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PART 1 GENERAL

1.01 DESCRIPTION OF WORK

SEPTA’s 5th Street Station is a subway station owned and operated by Southeastern Pennsylvania Transportation Authority (SEPTA) that serves the Market-Frankford Line. This 51,000 SF station is located below the 5th and Market Street intersection in the historic Olde City section of Philadelphia. The station was originally opened to passenger service as part of the Market Street Subway in 1908 and substantially modified with the creation of Independence Mall in the 1950’s, rehabilitated in 1974 as part of the city’s preparations for the bicentennial, in 1997 for SEPTA’s Automatic Train Control System upgrade, and in 2010 for the installation of two (2) elevators and the construction of the National Museum of American Jewish History.

**Project Location:** 5th Street / Independence Hall Station  
SEPTA Market-Frankford Line (Blue Line)  
500 S. Market Street, Philadelphia PA 10106  
City of Philadelphia, Philadelphia County  
Tax Parcel: 884510110

The station is accessible by four (4) stairways located at each corner of the intersection. Two (2) elevators access the platform level, located on the northwest and southwest corners of 5th and Market streets. The station is approximately 350'-0" in length (east-west), 62'-0" in width (north-south), and is located one-story below street level. The platform is approximately 19'-0" below grade, and the track is located approximately 23'-0" below grade. There is one (1) eastbound track, toward Frankford; and one (1) westbound track, toward 69th Street.

The intent of this renovation is to create a station experience that is an appropriate gateway to Independence Mall and historic Philadelphia. Along with architectural enhancements this design we will be addressing the typical state of good repair items required within a station that is over 100 years old including: mitigating water infiltration, crack and spall repair.

**Project Scope**
The following project construction scope includes, but is not limited to:

1. Street level improvements:  
   a. Temporary maintenance and protection of pedestrian and vehicular traffic.  
   b. Temporary signage.  
   c. Temporary relocation and reinstallation of newsstands, bus shelters.  
   d. Selective demolition of existing sidewalks, curbs and street pavement.  
   e. Protection of underground utilities.  
   f. Replacing waterproofing layer of station roof.  
   g. Repairs to and/or replacement of existing street-to-mezzanine stairs and railings.  
   h. Construction of stair impact resistant barrier walls and ornamental fencing.  
   i. Construction of two (2) headhouses (west corners only). Provide new
LED lighting fixtures and control devices for the headhouses.

j. Installation of curb bumpouts at the western corners of 5th & Market streets.
k. Construction of sidewalk, curbs and street pavement.
l. Pavement markings and striping.

2. Stair corridor and mezzanine level improvements:
a. Temporary signage and barricades.
b. Selective demolition of existing walls, floors, finishes.
c. Selective demolition of existing stairs to platform level.
d. Demolition of existing light fixtures and related wiring, conduit, junction boxes, and lighting control devices.
e. Demolition of miscellaneous electrical equipment with associated conduits and wires.
f. Structural repairs and concrete restoration.
g. Waterproofing.
h. Construction or refurbishment of new stairs and handrails to platform level.
i. Finishes, including floors, column covers, walls, painted ceilings.
j. Prep for painting. Refer to G002 for locations of identified lead paint.
k. Provide new LED lighting fixtures.
l. Provide power supply and receptacles for information booths.
m. Security.
n. Signage.
o. Electrical Work.
p. Mechanical/Plumbing Work.

3. Platform level improvements:
a. Temporary signage and barricades.
b. Selective demolition of existing walls, floors, finishes.
c. Selective demolition of existing walls, floors, finishes, cashier's booths.
d. Demolition of existing light fixtures, and related wiring, conduit and junction boxes.
e. Demolition of receptacles for existing water boxes.
f. Demolition of associated conduits and wires for existing cashier booth and fare line.
g. Selective demolition of existing electrical panel boards.
h. Demolition of existing toilet rooms.
i. Structural repairs and concrete restoration.
j. Waterproofing.
k. Construction of new platform slab.
l. Construction of cashier's booth, fare line, security fencing and gates.
m. Provide new lighting fixtures and associated conduits, wires and control devices.
n. Provide new electrical panels.
o. Provide new motor starters and disconnect switches.
p. Provide new receptacles for water boxes.
q. Provide associated conduits and wires for new cashier booths and fare lines.
r. Security.
s. Signage.
t. Electrical Work.
u. Mechanical/Plumbing Work.
v. Art in Transit.

4. Track area improvements:
a. Demolish suspended ceiling.
b. Structural repairs and concrete restoration.
c. Waterproofing.
d. Prep for painting. Refer to G002 for locations of identified lead paint.
e. Paint ceiling and columns.
f. Install new electrical conduits across track area.

A detailed description of the Work for each Prime Contractor is included in subsequent Paragraphs of this Section.

The General Contractor (GC) is the Coordinating Contractor (CC) for the duration of the Project.

1.02 RELATED SECTIONS

Section 01010: Summary of Work
Section 01041: Project Coordination
Section 15010: Basic Mechanical Requirements
Section 16010: Basic Electrical Requirements

1.03 ADMINISTRATIVE AND PROCEDURAL SECTIONS
(applicable to all contractors)

Agreement and Exhibit III scheduling requirements.
Section 01025: Measurement and Payment
Section 01060: Regulatory Requirements and Related Safety
Section 01066: Subway/Elevated Safety Requirements
Section 01300: Submittals
Section 01400: Quality Requirements
Section 01600: Material and Equipment
Section 01700: Contract Close Out

1.04 TEMPORARY FACILITIES AND SERVICES

Section 01500: Construction Facilities and Temporary Controls
Section 01505: Mobilization
1.05 GENERAL CONTRACTOR (GC)

A. The GC is responsible for compliance with Division 1 of the Specifications and has specific responsibilities:

Section 01050: Field Engineering

Section 01500: Construction Facilities and Temporary Controls

Section 01510: Maintenance Support and Restoration of Existing Utility Facilities

Section 01530: Barriers and Enclosures

Section 01550: Site Access

Section 01570: Maintenance and Protection of Vehicles, Pedestrians, and Passengers

Section 01580: Project Signs

Section 01590: SEPTA Field Office

B. The General Construction Contract includes architectural, civil and structural construction and other construction operations traditionally recognized as General Construction. The Work under the GC includes, but is not limited to the following:

1. Temporary facilities and services
2. Site preparation and demolition
3. Sitework
4. Selective demolition
5. Interior and exterior architectural finishes and amenities
6. Waterproofing
7. Structural Repairs and concrete restoration

C. General Contractor Work Summary: It is the intent of the general specifications and the accompanying general drawings that the General Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools and equipment necessary to complete the work specified
herein. Work under the GC includes but is not limited to the following:

1. The GC is responsible for compliance with Division 1 of these specifications.

The General Construction contract also includes but not limited to:

2. The work described on the following drawings:
   a. G-Series, General Drawings.
   b. DC-Series, Civil Demolition Drawings.
   c. C-Series, Civil Drawings.
   d. DA-Series, Architectural Demolition Drawings.
   f. DS-Series, Structural Demolition Drawings.
   g. S-Series, Structural Drawings.

3. The work required by the following specifications:
   a. Division 2 – Site Work
   b. Division 3 – Concrete
   c. Division 4 – Masonry
   d. Division 5 – Metals
   e. Division 6 – Wood and Plastics
   f. Division 7 – Thermal & Moisture Protection
   g. Division 8 – Doors and Windows
   h. Division 9 – Finishes
   i. Division 10 – Specialties
   j. Division 12 – Furnishes

D. Repair of Damage

   1. Conduct a complete inspection of the project site, station utilities and equipment, system drainage and street drainage, prior to the start of the work and notify SEPTA in writing regarding prevailing conditions. Repair and patch all damaged areas or other unsatisfactory conditions that develop during the course of the work which were not reported in writing to the Project Manager prior to the start of the work and not included as work of other prime contractors on site. Repairs shall match adjacent surfaces according to the applicable sections of these Specifications.

E. Pest Control: Engage an experienced exterminator to provide monthly treatment until the project closeout to rid project site within the contract limit of rodents, insects and other pests.

F. Maintenance: Provide the required maintenance for all equipment and materials installed under this contract in "like-new" condition until date of final payment.

1.06 MECHANICAL CONTRACTOR (MC)

A. The MC is responsible for compliance with Division 1 of the Specifications.

B. The Mechanical Construction Contract includes heating, ventilating, air-conditioning, plumbing and other construction operations traditionally recognized as Mechanical Construction. The Work under the MC includes,
but is not limited to the following:
1. Selective demolition.
2. Mechanical Construction including:
   a. Plumbing
   b. HVAC work
   c. Testing, adjusting and balancing
   d. Fire Protection / Clean Agent Systems

Description of Work
1. Flush existing stormwater drainage system.
2. Remove all plumbing fixtures in the toilet rooms, including the unit heaters.
3. Selective demolition of existing drain, body, piping, sleeve, and typical supports.
4. Install all plumbing fixtures in the toilet rooms, including the unit heaters.
5. Install new drain, body, piping, sleeve, cleanouts, and typical supports for stormwater conveyance system.
6. Furnish and install supply/exhaust fans including the duct distribution system, and grilles. See architectural details for grille configuration.

C. Mechanical Contractor Work Summary: It is the intent of the general specifications and the accompanying general drawings that the Mechanical Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools and equipment necessary to complete the work specified herein. Work under the MC includes but is not limited to the following:

1. The MC is responsible for compliance with Division 1 of these specifications.

The Mechanical Construction contract also includes but not limited to:

2. The work described on the following drawings:
   a. G-Series, General Drawings.
   b. MP-Series, Mechanical/Plumbing Drawings.
   c. DM-Series, Mechanical Demolition Drawings.
   d. M-Series, Mechanical Drawings.
   e. DP-Series, Plumbing Demolition Drawings.
   f. P-Series, Plumbing Drawings.

3. The work required by the following specifications:
   a. Division 13 – Special Construction
   b. Division 15 – Mechanical
   c. All other associated specification sections pertaining to Work.

1.07 ELECTRICAL CONTRACTOR (EC)

A. The EC is responsible for compliance with Division 1 of the Specifications.

B. The Electrical Construction Contract includes lighting, power distribution, fire alarm system, communications, special systems, traffic signals, and other construction operations traditionally recognized as Electrical Construction. The Work under the EC includes, but is not limited to the following:
   1. Selective demolition.
   2. Electrical power distribution panels, disconnect switches and receptacles.
   3. Mechanical equipment power wiring and motor starters.
   4. Lighting system equipment, power and control wiring.
4. Telecommunication system equipment, power/signal distribution & wiring.
5. CCTV system equipment, power/data distribution and wiring.
6. AVPA system equipment, power/signal distribution & wiring.
7. Fiber Optic Multiplex Subsystem equipment, power/data distribution and wiring.
8. Fire alarm system equipment, power/signal distribution and wiring.
10. Technology systems equipment, power/signal distribution and wiring.
11. Pedestrian traffic signal relocation.
12. Street lighting.

C. Electrical Contractor Work Summary: It is the intent of the general specifications and the accompanying general drawings that the Electrical Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools and equipment necessary to complete the work specified herein. Work under the EC includes but is not limited to the following:

1. The EC is responsible for compliance with Division 1 of these specifications.

The Electrical Construction contract also includes but not limited to:

2. The work described on the following drawings:
   a. G-Series, General Drawings.
   b. C-Series, Street Level Plans.
   c. DE-Series, Electrical Demolition Drawings.
   d. E-Series, Electrical Drawings.
   e. DFA-Series, Fire Alarm Demolition Drawings.
   f. FA-Series, Fire Alarm Drawings.
   g. DES-Series, Electronic Safety and Security Demolition Drawings.
   h. ES-Series, Electronic Safety and Security Drawings.
   i. DET-Series, Technology Demolition Drawings.
   j. ET-Series, Technology Drawings.

3. The work required by the following specifications:
   a. Division 3 – Concrete
   b. Division 13 – Special Construction
   c. Division 16 – Electrical
   d. All other associated specification sections pertaining to Work.

1.08 WORK BY SEPTA

A. SEPTA will install turnstiles, both in temporary locations and final locations in the fare line and will do the final wiring connections at the turnstiles.

PART 2 – PRODUCTS

--Not Used--

PART 3 – EXECUTION

--Not Used--

END OF SECTION 01011
SECTION 08710

DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.

C. Related Sections:

1. 08130 – Stainless Steel Doors & Frames

D. Codes and References:

5. NFPA 105 - Installation of Smoke Door Assemblies, must current edition.
6. PA UCC Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:
   a. Type, style, function, size, label, hand, and finish of each door hardware item.
   b. Manufacturer of each item.
   c. Fastenings and other pertinent information.
   d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
   e. Explanation of abbreviations, symbols, and codes contained in schedule.
   f. Mounting locations for door hardware.
   g. Door and frame sizes and materials.
   h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
   a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
   b. Complete (risers, point-to-point) access control system block wiring diagrams.
   c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.

E. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols,
hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

F. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

G. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Integrated Wiegand, Wireless, and IP-Enabled Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the ASSA ABLOY "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors’ personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer’s instructions and recommendations and according to approved schedule.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.
C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
1. Twenty five years for manual surface door closer bodies.
2. Five years for motorized electric latch retraction exit devices.
3. Two years for electromechanical door hardware.
1.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

   a. Two Hinges: For doors with heights up to 60 inches.
   b. Three Hinges: For doors with heights 61 to 90 inches.
   c. Four Hinges: For doors with heights 91 to 120 inches.
   d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

   a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
   b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.
3. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
   a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

4. Acceptable Manufacturers:
   a. Bommer Industries (BO).
   b. Hager Companies (HA).
   c. McKinney Products (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

   1. Acceptable Manufacturers:
      a. Bommer Industries (BO).
      b. McKinney Products (MK).
      c. Pemko Manufacturing (PE).

C. Floor Closers: ANSI/BHMA A156.4 certified floor closers. Provide independent and adjustable valves for closing speed, latch speed, and backcheck with built-in dead stop and hold open features as specified. Provide finished cover plates or thresholds as indicated in door Hardware Sets.

   1. Acceptable Manufacturers:
      a. Rixson Door Controls (RF).

D. Pivots: ANSI/BHMA A156.4, Grade 1, certified. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

   1. Acceptable Manufacturers:
      a. Rixson Door Controls (RF).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets.
Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:
   a. McKinney Products (MK) - QC (# wires) Option.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:
   a. Pemko Manufacturing (PE) – EL-CEPT Series.
   b. Securitron (SU) - EL-CEPT Series.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:
   b. McKinney Products (MK) - Connector Hand Tool: QC-R003.

2. Acceptable Manufacturers:

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Acceptable Manufacturers:
   a. Burns Manufacturing (BU).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

2.5 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

   1. Acceptable Manufacturers:
      a. Yale Locks and Hardware (YA).

C. Cylinders: Original manufacturer cylinders complying with the following:

   1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
   2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
   3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
   4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

D. Keying System: Each type of lock and cylinders to be factory keyed.

   1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. New System: Key locks to a new key system as directed by the Owner.

E. Key Quantity: Provide the following minimum number of keys:

   1. Change Keys per Cylinder: Two (2) Three (3).
   2. Master Keys (per Master Key Level/Group): Five (5).

F. Construction Keying: Provide construction master keyed cylinders.
G. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner’s representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:
   a. Lund Equipment (LU).
   b. MMF Industries (MM).
   c. Telkee (TK).

I. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge. Provide factory key system formatted for importing into “Key Wizard” software.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Acceptable Manufacturers:
   b. Sargent Manufacturing (SA) – 8200 Series.
   c. Yale Locks and Hardware (YA) – 8800FL Series.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer’s standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.
B. Standards: Comply with the following:

2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.8 ELECTROMAGNETIC LOCKING DEVICES

A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 1 with minimum holding force strength of 1,200 pounds. Locks to be capable of either 12 or 24 voltage and be UL listed for use on fire rated door assemblies. Electronics are to be fully sealed against tampering and allow exterior weatherproof applications. As indicated in Hardware Sets, provide specified mounting brackets and housings. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Acceptable Manufacturers:

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when
conventional power supplies are not sufficient to provide the proper inrush current.

   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Fabricate latchbolts from cast stainless steel, Pullman type, incorporating a deadlocking feature.

1. Acceptable Manufacturers:
   a. Yale Locks and Hardware (YA) - 6000 Series.

2.10 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Acceptable Manufacturers:
   a. Corbin Russwin Hardware (RU) – DC6000 Series.
   b. Norton Door Controls (NO) - 7500 Series.
   c. Yale Locks and Hardware (YA) - 4400 Series.

C. Door Closers, Surface Mounted (Cam Action): ANSI/BHMA 156.4, Grade 1 certified surface mounted, high efficiency door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be of the cam and roller design, one piece cast aluminum silicon alloy body with adjustable backcheck and independently controlled valves for closing sweep and latch speed.

1. Acceptable Manufacturers:
   a. Corbin Russwin (RU) - DC5000 Series.
   b. Norton Door Controls (NO) - 2800ST Series.
   c. Sargent Manufacturing (SA) - 422 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16" above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:
   a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Acceptable Manufacturers:
   a. Hiawatha, Inc. (HI).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:
   a. Hiawatha, Inc. (HI).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
1. Acceptable Manufacturers:
   a. Rixson Door Controls (RF).
   b. Rockwood Manufacturing (RO).
   c. Sargent Manufacturing (SA).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

   1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

   1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:

   1. National Guard Products (NG).
   2. Pemko Manufacturing (PE).

2.14 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
1. Acceptable Manufacturers:
   a. Securitron (SU) - DPS Series.

   B. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:
   a. Securitron (SU) - BPS Series.

2.15 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.16 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer’s standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.
3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.


3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

Door Hardware

08710-17
3.5 adjusting

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 cleaning and protection

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 demonstration

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 door hardware sets

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. RF - Rixson
4. RO - Rockwood
5. YA - Yale
6. SA - Sargent
7. SU - Securitron
8. NO - Norton
Hardware Sets

Set: 1.0

Doors: 13B, 4B

<table>
<thead>
<tr>
<th>Item</th>
<th>Model</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Hinge (heavy weight)</td>
<td>T4A3386</td>
<td>US32D MK</td>
</tr>
<tr>
<td>1 Magnetic Lock</td>
<td>M62FGBD</td>
<td>SU</td>
</tr>
<tr>
<td>1 Rim Exit Device</td>
<td>6100 TE626F</td>
<td>YA</td>
</tr>
<tr>
<td>1 Cylinder</td>
<td>1109 CMK</td>
<td>YA</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>CLP7500</td>
<td>NO</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10&quot; 4BE CSK</td>
<td>US32D RO</td>
</tr>
<tr>
<td>3 Silencer</td>
<td>608 (or) 609</td>
<td>RO</td>
</tr>
<tr>
<td>1 Push Button</td>
<td>PB3ER</td>
<td>SU</td>
</tr>
<tr>
<td>1 Power Supply</td>
<td>BPS (type as required)</td>
<td>SU</td>
</tr>
<tr>
<td>1 Wiring Diagram</td>
<td>Elevation and Point to Point as Specified</td>
<td>WW</td>
</tr>
</tbody>
</table>

Notes: Connect power supply to fire alarm system. Electronic Operation: Remote push button momentarily releases magnetic lock. Free egress is not permitted, subject to approval from AHJ. In case of power loss or fire alarm, door remains locked, mag lock drops allowing free egress.

Set: 1.1

Doors: 13, 13C, 4, 4C

<table>
<thead>
<tr>
<th>Item</th>
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<th>Finish</th>
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<tbody>
<tr>
<td>3 Hinge (heavy weight)</td>
<td>T4A3386</td>
<td>US32D MK</td>
</tr>
<tr>
<td>1 Magnetic Lock</td>
<td>M62FGBD</td>
<td>SU</td>
</tr>
<tr>
<td>1 Rim Exit Device</td>
<td>6100 TE626F</td>
<td>YA</td>
</tr>
<tr>
<td>1 Cylinder</td>
<td>1109 CMK</td>
<td>YA</td>
</tr>
<tr>
<td>1 Cylinder</td>
<td>2153 CMK</td>
<td>YA</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>R (or) PR7500</td>
<td>NO</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10&quot; 4BE CSK</td>
<td>US32D RO</td>
</tr>
<tr>
<td>1 Door Stop</td>
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<td>US26D RO</td>
</tr>
<tr>
<td>1 Keyswitch</td>
<td>MKN</td>
<td>SU</td>
</tr>
<tr>
<td>1 Power Supply</td>
<td>BPS (type as required)</td>
<td>SU</td>
</tr>
<tr>
<td>1 Wiring Diagram</td>
<td>Elevation and Point to Point as Specified</td>
<td>WW</td>
</tr>
</tbody>
</table>

Notes: Connect power supply to fire alarm system. Electronic Operation: Keyswitch momentarily releases magnetic lock. Free egress is not permitted, subject to approval from AHJ. In case of power loss or fire alarm, door remains locked, mag lock drops allowing free egress.
permitted, subject to approval from AHJ. In case of power loss or fire alarm, door remains locked, mag lock drops allowing free egress.

**Set: 2.0**

Doors: 12A, 5A

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<tr>
<td>Mortise Lock (storeroom)</td>
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<td>TER3 8805RL CMK</td>
<td>YA</td>
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<tr>
<td>Surface Overhead Stop</td>
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<td>10-X36</td>
<td>RF</td>
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<td>Silencer</td>
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**Set: 3.0**

Doors: 1, 14, 16, 8, 9

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<tr>
<td>Dust Proof Strike</td>
<td>1</td>
<td>570</td>
<td>RO</td>
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<tr>
<td>Flush Bolt (manual)</td>
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<td>555 (or) 557</td>
<td>RO</td>
</tr>
<tr>
<td>Mortise Lock (storeroom)</td>
<td>1</td>
<td>TER3 8805RL CMK</td>
<td>YA</td>
</tr>
<tr>
<td>Door Closer</td>
<td>1</td>
<td>R (or) PR7500</td>
<td>NO</td>
</tr>
<tr>
<td>Kick Plate</td>
<td>2</td>
<td>K1050 10&quot; 4BE CSK</td>
<td>RO</td>
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<tr>
<td>Door Stop</td>
<td>2</td>
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<tr>
<td>Threshold</td>
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<td>Gasketing (head/jamb)</td>
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**Set: 4.0**

Doors: 10, 10A, 12, 15, 17, 19, 2, 20, 3, 5, 7

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<td>Hinge</td>
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<td>US32D</td>
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<td>Mortise Lock (storeroom)</td>
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<td>Door Closer</td>
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<td>Kick Plate</td>
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<tr>
<td>Door Stop</td>
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<tr>
<td>Threshold</td>
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<td>PE</td>
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<td>Gasketing (head/jamb)</td>
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Door Hardware 08710-20
### Set: 5.0

Doors: 11, 6

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<td>Hinge</td>
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<td>Mortise Lock (privacy lock)</td>
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<td>K1050 10&quot; 4BE CSK</td>
<td>US32D  RO</td>
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<tr>
<td>Door Stop</td>
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<td>US26D  RO</td>
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<tr>
<td>Threshold</td>
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<td>166A MSES10SS</td>
<td>PE</td>
</tr>
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<td>Gasketing (head/jamb)</td>
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<td>PE</td>
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<td>Sweep</td>
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### Set: 6.0

Doors: 1A

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<td>US32D  MK</td>
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<tr>
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<td>Kick Plate</td>
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<td>K1050 10&quot; 4BE CSK</td>
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### Set: 7.0

Doors: 13A, 4A

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<tr>
<td>Hinge</td>
<td>6</td>
<td>TA2314</td>
<td>US32D  MK</td>
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<tr>
<td>Dust Proof Strike</td>
<td>1</td>
<td>570</td>
<td>US26D  RO</td>
</tr>
<tr>
<td>Flush Bolt (manual)</td>
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<td>555 (or) 557</td>
<td>US26D  RO</td>
</tr>
<tr>
<td>Mortise Lock (store door)</td>
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<td>TER3 8860-2RL CMK</td>
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<td>US32D  RO</td>
</tr>
<tr>
<td>Door Stop</td>
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<td>US26D  RO</td>
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<tr>
<td>Silencer</td>
<td>2</td>
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Notes: Free egress is not permitted.

### Set: 8.0

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<th>Finish</th>
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<tbody>
<tr>
<td>Hinge</td>
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<td>TA2314</td>
<td>US32D  MK</td>
</tr>
<tr>
<td>Mortise Lock (storeroom)</td>
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<td>TER3 8805RL CMK</td>
<td>626    YA</td>
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<tr>
<td>Door Closer</td>
<td>1</td>
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Door Hardware 08710-21
<table>
<thead>
<tr>
<th>Item</th>
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<th>Model/Supplier Info</th>
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</tr>
<tr>
<td>Door Stop</td>
<td>403 (or) 441CU</td>
<td>US26D RO</td>
</tr>
<tr>
<td>Silencer</td>
<td>608 (or) 609</td>
<td>RO</td>
</tr>
<tr>
<td><strong>Set: 9.0</strong></td>
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<td>US32D MK</td>
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<tr>
<td>Mortise Lock (storeroom)</td>
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</tr>
<tr>
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Notes:

**Set: 10.0**

Doors: Glass Door

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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Floor Closer</td>
<td>SC 328N 95</td>
<td>626 RF</td>
</tr>
<tr>
<td>Top Pivot</td>
<td>By Patch Fitting supplier</td>
<td></td>
</tr>
<tr>
<td>Cylinder</td>
<td>2153 CMK</td>
<td>626 YA</td>
</tr>
</tbody>
</table>

Notes: Balance of hardware by door supplier.

END OF SECTION 087100
SECTION 09900
PAINTING AND COATING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Surface preparation and the application of paint systems on substrates indicated, including repainting at areas of renovation. Painting and coating Work includes, but is not necessarily limited to, the following:

1. Concrete.
2. Concrete masonry units (CMU).

B. Paint exposed exterior and interior substrates, except where schedules indicate that a surface or material is not to be painted or is to remain natural. If schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Do not paint prefinished items, integrally finished systems, finished metal surfaces, operating parts, and labels, unless otherwise indicated.
2. Prefinished items include the following shop- or factory-finished components:
   a. Finished mechanical and electrical equipment.
   b. Lighting fixtures.
3. Finished metal surfaces include the following:
   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper.
   e. Bronze and brass.

C. Related Requirements:

1. Section 01060 "Regulatory Requirements and Safety" for procedures related to removal of lead-based paint.
2. Section 05120 "Structural Steel" for shop priming of metal substrates with primers specified in this Section.
1.2 DEFINITIONS

A. Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 6 (Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat; cured not less than 7 days.

1. Submit Samples on rigid backing, 12 inches (300 mm) square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
b. Other Items: Architect will designate items or areas required.

2. Lighting: Do not apply mockups until a permanent level of lighting is provided on the surfaces to receive paint.

3. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.

2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Provide adequate ventilation, including mechanical ventilation, to remove paint odors and fumes from areas of the building where odors might migrate to occupied spaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product by The Sherwin-Williams Company listed in other Part 2 articles for the paint category indicated, or an approved equal product.
2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Quality: Unless otherwise indicated, provide manufacturer’s best-quality paint material for each coating type.

C. Material Compatibility:
   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
   2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

E. Colors: As selected by Architect from manufacturer’s full range.

2.3 MATERIALS FOR PREPARING EXISTING SUBSTRATES

A. Detergent Solution: Solution prepared by mixing 2 cups (0.5 L) of tetrasodium polyphosphate, 1/2 cup (125 mL) of laundry detergent that contains no ammonia, 5 quarts (5 L) of 5 percent sodium hypochlorite bleach, and 15 quarts (15 L) of warm water for each 5 gal. (20 L) of solution required.

B. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing 1/3 cup (80 mL) of household detergent that contains no ammonia, 1 quart (1 L) of 5 percent sodium hypochlorite bleach, and 3 quarts (3 L) of warm water.

C. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.

D. Paint Remover: Manufacturer’s standard water-rinsable formulation for removing paint and coatings from substrates indicated; and containing no methylene chloride.

E. Metal Patching Compound: Two-part, polyester-resin metal patching compound; formulation as recommended by manufacturer for type of metal repair indicated, for filling metal that has deteriorated due to corrosion; capable of filling deep holes and spreading to feather edge.
F. Cementitious Patching Compounds: Cementitious patching compounds and repair materials specifically manufactured for surface preparation and sanding of cementitious substrates prior to repainting; formulation as recommended by manufacturer for type of cementitious substrate indicated.

2.4 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
4. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
3.3 PREPARING EXISTING SUBSTRATES

A. Paint Removal, General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.

1. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and steel wool.
2. Paint Removal with Paint Remover:
   a. Remove loose and peeling paint using water, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
   b. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush.
   c. Allow paint remover to remain on surface for period recommended by manufacturer. Agitate periodically with stiff-fiber brush.
   d. If recommended by paint remover manufacturer, rinse with water applied by medium-pressure spray to remove chemicals and paint residue.
   e. Use mechanical methods recommended by manufacturer to remove chemicals and paint residue.
   f. Repeat process if necessary to remove all paint.

B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.

C. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.

D. Rust Removal:
   1. Remove rust with approved abrasives for ferrous metal cleaning. Clean to bright metal.
   2. Wipe off residue with mineral spirits and either steel wool or soft rags.
   3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
   4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

E. Substrate Repair, General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.
1. Cementitious Material Substrate:
   a. General: Repair defects including dents and chips more than 1/2 inch (13 mm) in size and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
   b. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.

2. Metal Substrate:
   a. General: Repair defects including dents and gouges more than 1/8 inch (3 mm) deep or 1/2 inch (13 mm) across and all holes and cracks by filling with metal patching compound and sanding smooth. Remove burrs and protruding fasteners.
   b. Prepare repair locations by wire-brushing and solvent cleaning. Use mechanical rust removal method to clean off rust, unless otherwise indicated or acceptable to Architect.
   c. Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that will be inaccessible after completion of the Work.

3.4 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
   3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
   4. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
   5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   6. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view on exterior:
   a. Uninsulated metal piping.
   b. Pipe hangers and supports.
   c. Metal conduit.

2. Paint the following work where exposed in occupied spaces:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

4. Per NFPA 13, fire suppression piping shall be shop painted prior to installation.

3.5 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
3.6  CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7  PAINTING AND COATING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:
   1. Epoxy-Modified Latex System:
      a. Prime Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6), MPI #115.
      b. Intermediate Coat: Epoxy-modified latex, interior, gloss (Gloss Level 6), MPI #115.
      c. Topcoat: Epoxy-modified latex, interior, gloss (Gloss Level 6), MPI #115.

B. CMU Substrates:
   1. Latex System:
      c. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.

C. Gypsum Board Substrates:
   1. Latex System:
      a. Prime Coat: Primer sealer, latex, interior, MPI #50.
      c. Topcoat: Latex, interior, eggshell (Gloss Level 3), MPI #52.

D. Insulation-Covering Substrates: Including pipe and duct coverings.
   1. Latex System:
a. Prime Coat: Primer sealer, latex, interior, MPI #50.
c. Topcoat: Latex, interior, eggshell (Gloss Level 3), MPI #52.

END OF SECTION 09900
SECTION 13852

FIRE DETECTION AND ALARM SYSTEMS

PART 1 – GENERAL

1.01 DESCRIPTION

A. This section details the Fire Detection and Alarm System requirements applicable to all Southeastern Pennsylvania Transportation Authority (SEPTA) stations requiring an addressable Fire Alarm Control Panel.

B. This section specifies the materials, equipment, performance and testing for a complete and functional Fire Detection and Alarm System in compliance with federal, Pennsylvania and Philadelphia codes and standards and the Authority Having Jurisdiction (AHJ) requirements.

C. The Fire Detection and Alarm System shall be a "turnkey" system to SEPTA and SEPTA’s service and monitoring Contractor of Record.

D. Contractor is responsible for all electrical Work related to the Fire Detection and Alarm Systems unless otherwise indicated.

E. Contractor is responsible to provide electrical power to FACPs and FAPSs as shown on the Contract Drawings.

F. Contractor is responsible for all electrical raceways and site Work for the Fire Detection and Alarm System as shown on the Contract Drawings.

G. Coordination is required between the Fire Protection and Systems Integration Contractors for fire protection system interface connections as shown on the Contract Drawings.

H. Contractor shall coordinate with the SEPTA Project Manager prior to performance of any Work that may affect the existing Fire Detection and Alarm System service.

I. Contractor shall perform demolition of existing Fire Detection and Alarm Systems at the station following Central Station monitoring of new Fire Detection and Alarm System and acceptance by SEPTA.

J. Contractor shall provide two telephone circuits from each DACT to an existing punch-down block within the Communications Room, as shown on the Contract Drawings.

K. Contractor shall utilize leased telephone circuits provided by SEPTA between the punch-down block and the Central Station to allow the Contractor to complete the installation of the Fire Detection and Alarm System. Contractor shall request telephone number assignments from the SEPTA Project Manager.
L. Contractor shall maintain the existing Fire Detection and Alarm Systems operational until the new Fire Detection and Alarm System is monitored by the Central Station and written approval is obtained from SEPTA.

M. SEPTA will provide the Contractor with point and room/area description listings for FACP programming. The point and room/area identification lists will include required abbreviations. The Contractor shall submit the final listing of information that will be transmitted to the Fire Alarm Monitoring Service to SEPTA for approval prior to programming the FACPs.

1.02 RELATED WORK

A. Division 1: General Requirements
B. Section 01720: Project As-Built Documents.
C. Section 01830: Operation and Maintenance Data
D. Section 02070: Selective Demolition
E. Section 16010: Basic Electrical Requirements
F. Section 16060: Grounding and Bonding
G. Section 16070: Hangers and Supports
H. Section 16075: Electrical Identification
I. Section 16120: Conductors and Cable
J. Section 16130: Raceways and Boxes
K. Section 16131: Conduit
L. Section 16700: Communications

1.03 SUBMITTALS

A. Submittals as described in Section 01300, Submittals.
B. Certifications and Licenses required for Quality Assurance in Article 1.04.
C. Bill of Materials for each Fire Detection and Alarm system.
D. Manufacturers’ catalog cut sheets including UL Listings, FM Approvals, compatibility listings and other descriptive information to provide sufficient detail in determining compliance with this Section including but not limited to the following:
   1. Fire Alarm Control Panel
   2. Fire Alarm Annunciator Panels
   3. Fire Alarm Annunciator Panel Cabinets
   4. Fire Alarm Power Supplies
   5. FACP Batteries
   6. FAPS Batteries
   7. Battery Cabinets
9. Smoke Detectors
10. Heat Detectors
11. Notification Appliances
12. NAC Synchronization modules
13. Monitor Modules
14. Isolation Modules
15. Surge Protection Modules
16. Relay Modules
17. Fire Alarm and Power Cables
18. Remote Circuit Testers
19. Smoke and Heat Detection Testers & Indicators
20. Electrical Materials per Electrical Sections (i.e. interior & weather proof conduit and pull boxes)

E. All submittals shall be approved by SEPTA prior to purchasing equipment.

F. Fire Detection and Alarm System Calculations
   1. Provide Primary and Supplemental Power Supply Calculations for each station’s Fire Detection and Alarm System.
   2. Provide Battery Supply Calculations for each station’s Fire Detection and Alarm System.
   3. Provide Voltage Drop Calculations for each station’s Fire Detection and Alarm System.

G. Shop Drawings
   1. Provide Shop Drawings for station Fire Detection and Alarm System meeting the requirements of NFPA 72.
   2. Shop Drawings shall include the property name and address, device legend, and date.
   3. Shop Drawings shall include floor plan drawings, riser diagrams, control panel wiring diagrams and point-to-point device wiring diagrams.
   4. Shop Drawings shall be drawn to scale and shall include the following information:
      a. Floor identification
      b. Point of Compass
      c. Graphic Scale
      d. All walls and doors
      e. All partitions extending to within 18 inches of the ceiling
f. Room and/or bay descriptions, use and door numbers

g. Fire Alarm controls, annunciators, device/component location

h. Show connections to suppression systems, HVAC, etc.

i. Location of Fire Detection and Alarm primary and secondary power connection(s)

j. Locations of monitor/control interfaces to other systems

k. Riser locations

l. Track crossover locations

5. Fire Detection and Alarm System riser diagrams shall include the following information:
   a. General arrangement of the system related to building cross section
   b. Number of risers
   c. Type and number of circuits in each riser
   d. Type and number of Fire Detection and Alarm System components/devices on each circuit, on each floor or level

6. Control panel wiring diagrams shall be provided for all control equipment (i.e. equipment listed as either a control unit or control unit accessory), power supplies, battery chargers and annunciators and shall include the following information:
   a. Identification of the control equipment depicted
   b. Location(s)
   c. All field wiring terminals and terminal identification
   d. All circuits connected to field wiring terminals and circuit identifications
   e. All indicators and manual controls, including the full text of all labels
   f. All field connections to supervising station signaling equipment
   g. Releasing equipment
   h. Fire safety control interfaces

7. Electrical schematic wiring diagrams shall be provided for the following:
   a. Initiating devices
   b. Notification appliances
   c. Primary Power Supply
   d. Battery Power Supply
   e. Power supervisory devices
   f. End-of-line resistors
   g. Remote test stations
H. Submit a preliminary version of a Fire Detection and Alarm System Manual for approval by SEPTA prior to acceptance of systems in accordance with Section 01830 and as specified herein. Following approval of the Fire Detection and Alarm System Manual, four (4) bound or hardback loose-leaf binder copies shall be provided.

1. The Manual shall be developed for SEPTA personnel and technicians (or 3rd Party Contractor) for Fire Detection and Alarm System operation, testing and maintenance activities specific to each station.

2. The Manual shall be a three ring binder that is labeled with the SEPTA Station name and make and model of the Fire Detection and Alarm System control panel.

3. Individual sheets of the Manual shall be typed and shall be protected by top-loading, heavyweight, clear sheet protectors.

4. The manual shall be indexed and include the following:
   a. Operator instructions for basic system operations and functions including alarm acknowledgements, system reset, interpretation of applicable system outputs (i.e. LEDs).
   b. Detailed narrative description of system inputs, evacuation signaling, ancillary functions, annunciation, intended sequence of operations, expansion capability, application considerations, and limitations.
   c. Listing of the individual system components that require periodic testing and maintenance.
   d. A testing and maintenance schedule shall be developed for each type of device as required by NFPA 72 and as recommended by the Manufacturer.
   e. Step-by-step instructions detailing maintenance and testing instructions for each type of device installed.
   f. Detailed troubleshooting instructions for each trouble condition generated from the monitored field wiring, including opens, grounds, shorts and loop failures and shall include the following:
      1) Flow chart indicating Fire Detection and Alarm System sequence of operations for every type of input,
      2) List of all trouble signals annunciated by the system,
      3) Description of the condition(s) that cause such trouble signals,
      4) Step-by-step instructions describing how to isolate such problems and correct them.
   g. The Manual shall focus on guiding technicians in identifying the sources of problems in specific subsystems and in locating, replacing, and testing specific modular components.
h. Test Plan detailing the method of testing the FACP including any system being monitored by the FACP.

i. FACP software program CDs for programming and data. SEPTA shall have the ability to modify the FACP program and data, as desired.

j. As-built FACP electronic upload program file on CD.

k. Hard copy of zone listing that describes every Fire Detection and Alarm device type and location.

l. As-Built Bill of Materials.

m. Manufacturer’s installation and operation manuals for the FACP and all connected devices.

n. Names, addresses and telephone numbers of suppliers of system.

o. As-Built Manufacturers' catalog cut sheets.

p. Manufacturer’s installation, testing, and maintenance instructions for each device.

q. Half-size As-Built Shop Drawings.
   1) Rated Horn dB levels shall be indicated on drawings.

r. As-Built Fire Detection and Alarm System Calculations.

s. Spare parts list for components of system.

t. Record of inspection, testing and certification including a complete record of horn dB levels.

u. A Record of Completion and Test Results.

v. Copies of letters, inspection reports and approvals of system.

1.04 REFER TO SECTION 01830, OPERATIONS AND MAINTENANCE DATA.

A. All applicable standards, codes and regulations shall be listed in the Shop Drawings with the current edition date. Codes and regulations involving Fire Detection and Alarm sub-systems, connections, etc. shall be similarly listed.

B. Final point and room/area identification and description lists for programming FACP.

1.05 QUALITY ASSURANCE

A. The following Certifications and Licenses shall be submitted to the SEPTA Project Manager:
   1. Commonwealth of Pennsylvania Electrical License
   2. City of Philadelphia Electrical License
   3. City of Philadelphia Fire Alarm License
   4. NICET Level III or IV Fire Alarm System Certification
5. **Fire Alarm System Manufacturer’s Authorized Installer Certification**

**B. Certification of Materials & Equipment**

1. Certification of Materials and Equipment which states that the Materials and Equipment complies with all requirements of this Contract.
2. Deviations from the Contract shall be approved in writing by the SEPTA Project Manager.
3. Materials and equipment supplied shall be new.
4. Materials and equipment shall meet or exceed the latest published specifications of the equipment.
5. Materials and equipment shall be listed for the specific Fire Detection and Alarm System application for which they are used.
6. Materials and equipment shall be listed by Underwriter’s Laboratories, Inc. and Factory Mutual Approved for its intended purpose and compatibility.
7. Materials and equipment are installed in accordance with manufacturer's instructions, requirements and recommendations.

### 1.06 APPLICABLE CODES AND STANDARDS

**A.** Systems shall be designed, installed and tested according to the most recent edition of the following codes and standards:

1. The Latest Philadelphia Building Code
3. Pennsylvania UCC Building Code
4. NFPA 13 - Installation of Sprinkler Systems
5. NFPA 14 - Installation of Standpipe, Private Hydrants and Hose Systems
6. NFPA 70 - National Electrical Code (NEC)
7. NFPA 72 - National Fire Alarm Code
8. NFPA 86 - Standard for Ovens and Furnaces
10. NFPA 130 - Standard for Fixed Guideway Transit and Passenger Rail Systems
11. NFPA 2001 - Clean Agent Fire Extinguishing Systems
12. NFPA Pub HLH 97 - Electrical Installations in Hazardous Locations
13. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
14. Americans with Disabilities Act (ADA) Accessibility Guidelines
15. UL 268 – Smoke Detectors for Fire Protective Signaling Systems
16. UL 268A – Smoke Detectors for Duct Applications
17. UL 464 - Standard for Audible Signal Appliances
18. UL 497B – Surge Suppression
19. UL 864 – Control Units for Fire Protective Signaling Systems
20. UL 1638 – Visual Signaling Appliances – Public Mode Emergency and General Utility Signaling
21. FM - Factory Mutual Global

1.07 REFER TO SECTION 01090, REFERENCES.
A. Where conflicts exist between codes, the Fire Detection and Alarm System shall be installed in accordance with the most rigid applicable code or regulation.

1.08 FIRE DETECTION AND ALARM SYSTEM PERFORMANCE
A. Signaling Line Circuits (SLC)
   1. SLCs shall be wired to meet the Style 4 performance.
   2. T-Tapping is only permitted at a device or in the FACP.
   3. The zoning of the Fire Detection and Alarm System shall be configured as shown on the Contract Drawings.
B. Notification Appliance Circuits
   1. Notification Appliance shall be wired to meet the Style Y performance.
   2. T-Tapping is not permitted.
   3. End of line resistor compatible with the FACP is required for supervision.
   4. The notification circuits of the Fire Detection and Alarm System shall be configured as shown on the Contract Drawings.
C. UL Central Station Monitoring Circuits
   1. UL Central Station Monitoring Circuits shall be wired to meet the Style C performance.
D. Sprinkler systems including limited area sprinkler systems and wet standpipe systems in stations shall be monitored by the main FACP for water flow, valve tamper and low air pressure if applicable.
E. Facilities with other types of active Fire Protection Systems (i.e. Clean Agent, Halon, Dry/Wet Chemical, etc.) shall be monitored for fire, trouble and supervisory alarms by the main FACP.
F. Control interface devices such as equipment shutdown, damper control, and fan shut down, etc. shall be shown on the “As-Built” to include a description of the action.
1.09 DELIVERY, STORAGE AND HANDLING
   A. Deliver material in Manufacturer's original, unopened, protective packaging.
   B. Store materials in a clean and dry space, protected from weather.
   C. Handle in a manner to prevent damage to finished surfaces.
   D. Smoke and heat detectors shall not be installed until after construction cleanup of all trades is complete and final.

1.10 ENVIRONMENTAL CONDITIONS
   A. The Fire Detection and Alarm System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:
      1. System components shall be rated for continuous operation in ambient temperatures of 32 to 120 degrees F and 20 to 90 percent relative humidity, non-condensing.
      2. System components installed in locations exposed to weather or installed on platform levels shall be rated for continuous operation in ambient temperatures of minus 30 to plus 122 degrees F and 20 to 100 percent relative humidity, condensing.
      3. Rated 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.
      4. System components shall function between 150 feet below and 250 feet above sea level.

1.11 HAZARDOUS ENVIRONMENTS
   A. System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, or combustible dust shall be rated, listed, and installed according to NFPA 70.
   B. Pump room wet wells are identified as Class 1, Division 2 Hazardous locations.

PART 2 – PRODUCTS

2.01 GENERAL
   A. The Fire Detection and Alarm System shall be Non-Proprietary as described herein.
   B. Equipment, replacement parts, system training and technical support shall be readily available to any licensed electrical contractor and SEPTA.
   C. Cabinets and devices shall be red unless otherwise approved by SEPTA.
   D. Cabinets shall be secured to walls using channel strut unless otherwise approved by SEPTA.
E. Partial supplements or replacements to the existing Fire Detection and Alarm System materials or equipment are not permitted without the specific written approval of SEPTA.

F. Field conditions may permit the use of existing embedded conduit that is not feasible to replace provided it does not interrupt existing Fire Detection and Alarm System service.

2.02 MANUFACTURERS

A. SEPTA Approved manufacturer for the fire alarm and detection system shall be the following:

1. SILENT KNIGHT or SEPTA approved equivalent.

2.03 FIRE ALARM CONTROL PANEL (FACP)

A. FACP shall be a Silent Knight Model 5820XL or SEPTA approved equivalent.

B. FACP shall be supplemented by Silent Knight Model 5815XL Loop Expanders for a maximum four (4) Style 4 SLCs or SEPTA approved equivalent.

C. Each SLC shall be capable of supporting 127 addressable points (508 points maximum).

D. FACP shall be non-proprietary, UL Listed and FM Approved.

E. FACP shall be an addressable panel utilizing addressable detection devices.

F. FACP shall be a commercial fire alarm-only panel that is not a combination fire/security panel.

G. FACP shall have six (6) notification appliance circuits (NAC)s.

H. Control panel shall be field programmable and remotely programmable with upload capability.

I. Provide a Silent Knight Model 5660 SKSS Software Suite or SEPTA approved equivalent.

J. Provide Silent Knight Model 5670 SKSS Silent Knight IntelliView Facility Management software or SEPTA approved equivalent.

K. Spare SLC device capacity of 25% of each addressable loop shall be provided unless written approval is obtained from SEPTA.

L. Cabinet shall be factory painted red.

M. Cabinet shall be equipped with a CAT 30 system lock and key.

N. FACP shall include an auxiliary alarm output that will allow a fire, trouble or supervisory signal to be transmitted to a secondary location in addition to the Central Station communications output requirements via a DACT. This secondary alarm output capability shall be available from the panel or through a separate alarm output module, and shall be included to allow a future communications interface by SEPTA to the Control Center.
2.04 **UNIVERSAL DIGITAL ALARM COMMUNICATOR (DACT)**
   A. DACT shall be UL Listed and FM Approved.
   B. FACP may have a built in DACT or have a separate cabinet.
   C. DACT shall be compatible with SEPTA’s UL Listed Central Station and SEPTA’s telephone system.
   D. DACT shall be capable of reporting all zones or points of alarm, supervisory and trouble as well as all system status information such as loss of AC, low battery, ground fault or loss of supervision to any remote device with individual and distinct messages to the Central Station.

2.05 **REMOTE FIRE ALARM ANNUNCIATOR PANEL (FAAP)**
   A. FAAP shall be a Silent Knight Model SK-5860 or SEPTA approved equivalent.
   B. FAAP shall be UL Listed and FM Approved with the main FACP.
   C. FAAP shall indicate FACP Fire, Trouble and Supervisory alarm status.
   D. FAAP shall control the FACP Acknowledge, Silence and Reset functions.
   E. FAAP shall be mounted on a 4-inch square weatherproof backbox within the FAAP cabinet.
   F. FAAP cabinet shall be a Hoffman Type 304 stainless steel NEMA 4X rated, vandalism-proof cabinet or SEPTA approved equivalent.
   G. FAAP cabinet shall be equipped with an ASSA system lock and key. Coordinate with SEPTA locksmith department before installing cabinets on wall.
   H. The FAAP cabinet shall be secured to the wall with shallow channel strut and not to exceed beyond cabinet width.

2.06 **FIRE ALARM PRIMARY POWER SUPPLY AND (FAPS) BOOSTER**
   A. The Fire Detection and Alarm System shall have a dedicated 120VAC, 20 amp circuit breaker. The circuit breaker shall be identified as FIRE ALARM SYSTEM in the electrical power panel.
   B. The dedicated branch circuit shall be protected within metallic raceway as shown on the Contract Drawings.
   C. A circuit breaker lock (that allows the breaker to trip, but does not allow tampering) that is listed for use with the circuit breaker for FACPs and FAPSs shall be provided.
   D. The Fire Detection and Alarm System shall be provided with a primary power supply comprised of FACP power and FAPS boosters to provide 20% expansion capacity.
   E. FAPS shall be Silent Knight Model Firepower 5495 or SEPTA approved equivalent.
F. The failure of either the primary or secondary power supply shall initiate a trouble signal at the FACP and the Central Station.

2.07 BATTERY BACKUP
A. The Fire Alarm System and supplemental power supplies shall be provided with backup battery power.
B. Battery back-up power supply shall be sized to be capable of operating the system under standby load for a period of at least twenty-four (24) hours immediately followed by a period of five (5) minutes in fire alarm condition.
C. Batteries shall be maintenance-free, gelled, sealed type that only requires annual charger and discharge tests as required by NFPA 72.
D. Batteries shall be marked with the month and year of manufacture.
E. Battery chargers shall be capable of fully recharging the batteries from fully discharged in a 24-hour period.
F. Batteries shall be located in a cabinet separate from the FACP and FAPS located as shown on the Contract Drawings.
G. The battery cabinet shall be factory painted red.
H. The battery cabinet shall be equipped with a CAT 30 system lock and key.

2.08 MANUAL FIRE ALARM PULL STATION
A. Fire alarm pull stations shall be Silent Knight Model SD500-PSDA or SEPTA approved equivalent.
B. Fire alarm pull stations shall be dual-action and ADA compliant.
C. Fire alarm pull stations shall be addressable.
D. Fire alarm pull stations shall be equipped with a CAT 30 system lock and key.
E. Fire alarm pull stations that require glass breakage or have crushable tubes to activate are not acceptable.
F. Fire alarm pull stations located in public areas shall be provided with a clear protective weatherproof vandal resistant removable cover. Protective covers shall be a Signal Communications Corp (SigCom) Sentry Station Cover (ST-series model) or SEPTA approved equivalent. The covers shall be fully compliant with all applicable ADA requirements (ADA; 28 CFR Part 36).
G. Protective cover shall not be equipped with a pre-alarm sounder that indicates cover removal.

2.09 SMOKE DETECTORS
A. Smoke detectors shall be Silent Knight Model SD505-APS or SEPTA approved equivalent.
B. Smoke detectors shall be UL Listed and FM Approved with the FACP.
C. Provide a removal tool for the smoke detector. Equipment shall be turned over to SEPTA.
D. Smoke detectors shall be provided with dust covers when initially installed.
E. Smoke detectors shall have a visual indicator to indicate the status of the detector.
F. Unless specifically designed and listed for the expected conditions, smoke detectors shall not be installed if any of the following ambient conditions exist:
   1. Temperature below 32 degrees F
   2. Temperature above 100 degrees F
   3. Relative humidity above 93 percent
   4. Air velocity greater than 300 ft/min
G. Smoke detectors shall not be installed in a manner that will cause false alarms.

2.10 DUCT SMOKE DETECTORS
A. Duct detector housings shall be Silent Knight Model SD505-ADHR or SEPTA approved equivalent.
B. Remote Test Switch shall be a Silent Knight Model SD505-DTS or SEPTA approved equivalent.
C. Duct detector housings shall be UL listed with the respective smoke detector.
D. Duct smoke detectors shall have an easily accessible (chest height) remote tester that indicates the status of the detector and provides a method of performing circuit testing.
E. Duct smoke detectors shall have remote test switches for each duct detector. Coordinate final mounting location with SEPTA project manager.
F. Smoke detector shall meet the requirements of Article 2.10.

2.11 HEAT DETECTORS
A. Heat detectors shall be Silent Knight Model SD505-AHS or SEPTA approved equivalent.
   Elevator Lobby Heat Detector shall be Chemetron WPB501 or SEPTA approved equivalent.
B. Heat detectors shall be UL Listed and FM Approved.
C. Heat detectors shall have an Ordinary temperature classification.
D. Heat detectors shall have a visual indicator to indicate the status of the detector.
E. Heat detectors located in probable high vandalism areas (e.g. station public restrooms) shall be protected by UL listed covers that protect the detector while allowing full operation and inspection.
F. Heat detectors shall not be installed in a manner that will cause false alarms.
2.12 NOTIFICATION APPLIANCES

A. Notification Appliances shall be manufactured by Wheelock, or approved equal as specified below:
   1. Horn/strobe wall unit shall be a Wheelock Model ASWP-2475W-FR with a Model WPBB-R and WP-KIT weatherproof back box or SEPTA approved equivalent.
   2. Strobe wall unit shall be a Wheelock Model RSSWP-2475W-FR with a Model WP SBB-R and WP-KIT weatherproof back box or SEPTA approved equivalent.

B. Notification appliances and their installation shall provide audible and visual signaling in compliance with the ADA Accessibility Guidelines.

C. Strobes shall be synchronized from the FACP power supply or supplemental fire alarm power supply.

D. Notification appliances and associated back boxes shall be painted red, weatherproof, and rated NEMA 3R.

2.13 MONITOR MODULES

A. Monitor modules shall be a Silent Knight Model SD500-AIM / SD500-MIM or SEPTA approved equivalent.

B. Monitor modules shall be used to monitor normally open dry contacts.

C. Monitor modules shall be installed in locations as shown on the Contract Drawings.

D. All sprinkler systems including limited area sprinkler systems and wet standpipe systems in stations shall be monitored by the main FACP for water flow, valve tamper, and low air pressure if applicable.

E. All modules associated with the sprinkler system shall be SD500-MIM and enclosed in a NEMA 4X latching - hinge cabinet adjacent the monitored devices.

F. Facilities with other types of active Fire Protection Systems (Clean Agent, Halon, Dry and Wet Chemical, etc.), shall be monitored for fire, trouble and supervisory alarms by the main FACP.

2.14 SURGE PROTECTION MODULES

A. Provide surge protection for all FACP and FABP line-voltage circuits and SLC and NAC circuits.

B. The surge protection shall be Ditek Model DTK-120SR or SEPTA approved equivalent for FACP and FABP line voltage circuits.

   The surge protection shall be a Ditek Model 2MHLP36B-WB module and base or equivalent for SLC’s and notification circuits.
C. Surge protector ground wires shall be run as straight as possible and have a minimum separation distance of 3 feet from FACPs and FSSCPs.
D. Surge protection shall be UL 497B Listed and be compatible with the FACP.
E. Surge protection shall be installed in accordance with Manufacturer's installation instructions.
F. Wire connections shall utilize screw terminal connections.

2.15 RELAY MODULE
A. Relay Module shall be Silent Knight Model SD500-ARM or SEPTA approved equivalent.
B. Relay Module shall be UL Listed and FM approved with the main FACP.
C. Relay Module shall be mounted in a 4-inch square box within three (3) feet of connected equipment.

2.16 CONDUIT RACEWAY AND WIRING
A. Conduit and Raceway
   1. Fire Detection and Alarm System conduit shall be type RGS.
   2. Fire Detection and Alarm System conduit shall be a minimum trade size diameter of 3/4-inch.
   3. Fire Detection and Alarm System conduit shall be appropriately sized to allow for 25 percent expansion.
   4. Fire Detection and Alarm System wiring including AC power supply shall be in dedicated conduits.
   5. The distance between junction or pull boxes for the Fire Detection and Alarm System shall not exceed 100 feet.
   6. Surface mounted, gasketed cast waterproof boxes and galvanized steel back boxes with "stand-offs" shall be utilized.
B. Wiring
   1. Power supply wiring shall be as shown on the Contract Drawings. Minimum conductor size shall be 12 AWG.
   2. The Fire Detection and Alarm System circuits shall be Type Fire Alarm Power Limited Riser, low smoke, zero halogen cables where installed entirely in conduit.
   3. Initiating circuits shall be as shown on the Contract Drawings. Minimum conductor size shall be 16 AWG.
   4. Notification circuits shall be as shown on the Contract Drawings. Minimum conductor size shall be 12 AWG.
   5. Accessory circuits (SBUS) shall be as shown on the Contract Drawings. Minimum conductor size shall be 16 AWG.
2.17 FIRE DETECTION AND ALARM SYSTEM LABELING

A. Labels shall be provided for the Fire Detection and Alarm System cabinets, including power supply cabinets, battery cabinets and conduit, pull boxes, and junction boxes as “FIRE ALARM SYSTEM” as shown on the Contract Drawings.

B. High-quality labels with adhesive backing (peel-off type) shall be waterproof.

C. A label shall be installed on the outside of the cabinet door containing the FAAP as shown on the Contract Drawings.

D. Junction box labels shall be octagon shaped and measure 3 inches across as shown on the Contract Drawings.

E. Conduit shall be labeled at a minimum of every 20 feet, with shorter lengths of conduit between connections boxes labeled at the midway point.

F. Conduit labels shall be rectangular shaped and measure 3/4 inches wide by 5-1/2 inches long as shown on the Contract Drawings.

G. Conduit shall be labeled at the following locations:
   1. At changes in direction.
   2. At each point of exit and entry where conduit passes through walls, floors or ceilings.
   3. Every 20 feet on a straight run.

H. Labels shall be provided above each pull station as shown on the Contract Drawings.

I. Addressable devices and notification appliances shall be identified by means of a waterproof self-adhering machine generated label (P-Touch style). The labels shall indicate device identifier as specified on plans.
   1. Addressable device identifier shall include SLC number and device address
   2. Notification appliance identifier shall include NAC or PSNAC number and the sequential device number on that circuit, beginning electrically nearest to the FACP or FAPS and continuing to the last device at the EOL.

J. Devices that contain End of Line Resistors shall also be labeled “EOL”.

K. Wires shall be tagged with permanent, factory-numbered wire markers which correspond to circuit number of device. Markers shall indicate both individual circuit number and device to which it is connected.

L. Wires shall be color-coded.

M. Wire tags shall be of high quality and equal to the 3M ScotchCode Wire Marking Tape.

N. Wires shall be tagged in disconnects, junction boxes, pull boxes, panels, terminal blocks and in general, wherever wire terminates or originates.
O. Wires shall be tagged with same number throughout its entire length.

P. All device labels must be placed in a visible location on the device and the device base that allows for easy visual inspection from the ground without the use of a personnel lifting device. If a label on the device back box is not visible from the ground without the use of a personnel lifting device, then install an additional device tag on the device and made visible from the ground without use of any personnel lifting device.

Q. Refer to Section 16075, Electrical Identification.

PART 3 – EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Contractor shall coordinate with the SEPTA Project Manager prior to performing any Work that may affect the existing Fire Detection and Alarm System.

B. Contractor shall protect the existing and new Fire Detection and Alarm devices from damage, dust and false alarms during Work. Any active devices covered to protect from dust shall be uncovered at the end of the workday.

C. Contractor shall cover manual pull stations with a protective canvas cover upon initial installation to prevent attempted activation to a non-active system. The Contractor shall remove and properly dispose of the covers upon system acceptance at each station.

D. Contractor shall be responsible for damages to existing and new Fire Detection and Alarm Systems caused by the Contractor or the Contractor’s representatives.

E. Contractor shall provide one NICET Level III Certified person that shall be responsible for the following:
   1. Examination of the design specifications and drawings to ensure specifications are met.
   2. Supervision of Electrical and Fire Alarm installation personnel.
   3. Final location of cabinets and devices and other Fire Alarm System equipment.
   4. As-Built Shop Drawings.
   5. Complete Fire Detection and Alarm System installation to ensure specifications are met.
   6. Programming of FACPs.

F. Mounting height of manual fire pull stations and horn/strobe units shall be ADA Compliant.
G. All device installations shall be readily accessible for periodic maintenance as defined in NFPA 70. A ladder may be used for access. Devices shall not be placed directly over electrical equipment. The Contractor shall ensure that other installed items (e.g. conduits, etc.) do not restrict accessibility. Final device locations shall be approved by SEPTA.

H. The fire, trouble, and supervisory signals from the FM-200 FSSCP shall be separate points for each type of signal from each suppression panel, as shown on the Contract Drawings.

3.02 SEQUENCE OF OPERATION

A. Upon the activation of the following devices the operations are required in the order listed within the time period permitted by code.

1. Smoke Detector, Heat Detector and Manual Fire Pull Station Activation
   a. Local station FACP shall indicate an audible/visual fire alarm condition.
   b. Remote FAAP shall indicate an audible/visual fire alarm condition.
   c. All notification appliances shall activate.
   d. Life safety functions activated by associated relays shall operate.
   e. Central Station shall receive alarm or trouble condition, station location, zone and description.
   f. SEPTA shall receive alarm or trouble condition, station location, zone and description by the Central Station.
   g. Upon silencing of system, visual notification shall continue until system is reset.

2. Sprinkler Flow Switch Activation
   a. Local station FACP shall indicate an audible/visual fire alarm condition.
   b. Remote FAAP shall indicate an audible/visual fire alarm condition.
   c. All notification appliances shall activate.
   d. Life safety functions activated by associated relays shall operate.
   e. Central Station shall receive alarm or trouble condition, station location, zone and description.
   f. SEPTA shall receive alarm or trouble condition, station location, zone and description by the Central Station.
   g. Upon silencing of system, visual notification shall continue until system is reset.

3. Sprinkler Tamper Switch Activation
   a. Local station FACP shall indicate an audible/visual supervisory alarm condition.
b. Remote FAAP shall indicate an audible/visual supervisory alarm condition.

c. Central Station shall receive a supervisory condition, station location, zone and description.

d. SEPTA shall receive supervisory condition, station location, zone and description by the Central Station.

3.03 FIRE DETECTION AND ALARM SYSTEM TESTS AND RESULTS

A. Upon completion of Fire Detection and Alarm System installation with the exception of Central Station monitoring, perform complete inspection and pretesting. Determine conformance to requirements of the Specification and the Owner's Requirements and correct deficiencies observed.

B. Replace malfunctioning or damaged devices with new and retest until specified performance and conditions are achieved.

C. Develop an Acceptance Test Plan in accordance with NFPA 72, Chapter 10, with steps that will record results and SEPTA personnel initials prior to the acceptance test. The Test Plan shall test the Fire Detection and Alarm System complete including, but not limited to, the following:

1. Fire Alarm Control Panel
   a. Measure and record resistance of each circuit. Verify that circuit resistance does not exceed Manufacturer's specified limits.
   b. Disconnect secondary power and test under maximum load for 5 minutes.
   c. Disconnect primary power supply and verify that trouble indication occurs.
   d. Measure and record standby current and calculate whether batteries are adequate to meet standby requirements.

2. Manual Fire Alarm Pull Station
   a. Pull stations shall be tested individually to ensure proper sequence of operation and location.

3. Smoke Detectors
   a. Individually test and record each detector to assure proper sequence of operations and correct location description.
   b. Individually test and record each detector’s sensitivity to insure it is at the factory setting.

4. Fire Sprinkler Flow Switches
   a. Test shall be conducted with water flow. Verify and record that flow switch activates FACP within 60 seconds of opening valve.

5. Supervisory Signal Initiating Devices
a. Operate valves and pressure switches and verify proper sequences.

6. Notification Appliances
   a. Put system into alarm and verify operation.
   b. Record ambient and alarm levels decibel level for each room or space of the facility.
   c. The reading levels shall be recorded on station plans.
   d. The reading levels shall also be recorded on the City Certificate of Inspection.

7. Fire/Smoke Damper
   a. Verify and record that each damper fully opens and fully closes via automatic and manual activation from FACP.

8. Air Handling Units
   a. Verify and record that each AHU shuts down upon the activation of a duct smoke detector.

9. Elevator Recall
   a. Verify and record that each elevator recalls to the egress level upon automatic and manual activation from the FACP.

D. Acceptance Testing
   1. Submit the Acceptance Test Plan to the SEPTA Project Manager for approval prior to Acceptance Testing.
   2. Notify the SEPTA Project Manager in writing with the date, time, and location of each Fire Detection and Alarm System testing at least two (2) weeks prior to each test, such that the SEPTA Project Manager or his authorized representative, SEPTA personnel and the SEPTA Fire Marshall may witness the test.

E. Within one week of test completion, submit completed NFPA 72 Record of Completion to the SEPTA Project Manager for approval.

3.04 TRAINING
   A. Contractor shall provide formal training to SEPTA personnel.
   B. Fire Detection and Alarm System Manual shall be used for training.

3.05 OVERVIEW BRIEFING
   A. At the time the Fire Detection and Alarm System is ready for acceptance, the Contractor shall provide an Overview Briefing to SEPTA management at a mutually agreed time.
   B. This briefing will include a “walk-through” of the system to physically view the system devices and an activation of the Fire Alarm.
C. The location of the initial part of this briefing shall be at SEPTA’s Headquarters located at 1234 Market Street.

D. The Contractor shall supply SEPTA the below items and documentation. All of the items shall be formally and professionally submitted to SEPTA. Further, all items requiring signature shall contain the printed or typed signature block of the signatory.

1. Record documents per Section 01720, Project As-Built Documents.

2. Installing Contractor’s Certificate of Completion stating that the system has been installed in accordance with approved plans and tested in accordance with the manufacturer’s specifications and the appropriate NFPA requirements.

3. A “Record of Completion” as defined in NFPA 72.

4. A “Record of Alarm Inspection, Testing, and Certification.” This record shall include all applicable items contained in Chapter 10 of NFPA 72 plus include an audibility record that provides a record of ambient and alarm level dBA for each section, room, etc. of the facility.

5. Four (4) sets of programmed zone descriptions per station approved by SEPTA.

6. A copy of the Fire Alarm permit submittal and approval.

7. Four (4) full-size sets of the marked up contractor’s “As-Builts.” These “As-Builts” shall contain the same information as the Shop Drawings in Article 1.03.

8. Four (4) sets of each key to the Fire Detection and Alarm System.


10. Two (2) copies of the site-specific software used to program the system and site data and require peripheral equipment used to upload program information.

11. Two (2) copies of the electronic files that programs the FACP.

12. A completed City Certificate of Inspection after the Contractor programs the system to the Central Station monitoring service, and the certificate has been accepted by the City.

13. A CD containing all documents included in the binder and ACAD & PDF of the Field-Changes and As-Built drawings.

E. Upon satisfactory completion of the overview briefing and approval of the above provided items and documentation, the Contractor shall coordinate with SEPTA the exact date monitoring will start (monitoring shall not be effected prior to the above overview briefing).

F. Perform Central Station monitoring testing.
3.06 DEMOLITION OF EXISTING FIRE DETECTION AND ALARM SYSTEMS
   A. Demolition of existing Fire Detection and Alarm Systems may be initiated upon Central Station monitoring.
   B. Inspect new Fire Detection and Alarm System following demolition of existing Fire Detection and Alarm System.
   C. SEPTA reserves the right to claim any salvaged equipment and devices prior to disposal by the Contractor. Confirm equipment and device list with EMC Contract Services.

3.07 FIRE ALARM MONITORING CUTOVER
   A. Contractor shall be responsible for all payments to SEPTA’s fire alarm monitoring company (currently TycoIS) for the final installation (cut over) of this fire alarm system to their database.
   B. The Contractor shall be solely responsible for coordinating with TycoIS and confirming that their monitoring practices and protocols are compliant with the fire alarm system design and final installation.
   C. SEPTA Project Manager shall be responsible for coordinating the installation with the current fire alarm monitoring company (TycoIS).

3.08 ACCEPTANCE
   A. Acceptance will not take place until the following:
      1. Fire Detection and Alarm System is completely installed.
      2. Training has been provided.
      3. Documentation as contained in this Section is submitted and approved.
      4. Demolition is completed for existing Fire Detection and Alarm Systems.
      5. FACP is in normal standby condition following Demolition.
      6. Fire Detection and Alarm System is free of dust and dirt.
      7. Detector dust covers are turned over to SEPTA.
   B. SEPTA acceptance of the Fire Detection and Alarm System shall include signoff from SEPTA and the Station Fire Marshall.
   C. The Contractor shall be responsible for maintenance and response to alarms until the newly installed Fire Detection and Alarm System responsibility is turned over to SEPTA.
   D. Once acceptance takes place, the Contractor is not allowed to perform any Fire Detection and Alarm System installation, service, connection, etc. without the specified approval of SEPTA.

END OF SECTION 13852
SECTION 13900

FIRE SUPPRESSION

PART 1 – GENERAL

1.01 DESCRIPTION
A. This Section includes fire-suppression sprinklers, piping, and equipment for the following building systems:
   1. All fire-suppression system in trash rooms, elevator machine rooms, and elevator pits, including piping, valves, specialties, and automatic sprinklers.
   2. Dry standpipe system at the platforms and concourse levels.

1.02 RELATED SECTIONS
A. Division 1 - General Requirements
B. Section 02200 - Earthwork
C. Section 13852 - Addressable Fire Alarm System
D. Section 15010 - Basic Mechanical Requirements
E. Section 15050 - Basic Mechanical Materials and Methods
F. Section 15060 - Hangers and Supports
G. Division 16 - Electrical

1.03 CODE REFERENCES
B. NFPA 70 (2017), or most current edition.

1.04 SUBMITTALS
A. Product Data: For the following:
   1. Pipe and fitting materials and methods of joining for sprinkler piping.
   2. Valves, including specialty valves, accessories, and devices.
   3. Alarm devices. Include electrical data.
   4. Fire department connections. Include type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
   5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
6. Wall hydrant connection: Include type, number, size and arrangement of outlet.


C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Include hydraulic calculations, if applicable.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

E. Maintenance Data: For each type of sprinkler specialty to include in maintenance manuals specified in Division 1.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.

B. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

C. Sprinkler Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to authorities having jurisdiction.

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.

E. NFPA Standards: Equipment, specialties, accessories, installation, and testing complying with the following:


1.06 DEFINITIONS

A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 for obtaining approval from authorities having jurisdiction.

1.07 SYSTEM PERFORMANCE REQUIREMENTS

A. Design sprinklers and obtain approval from authorities having jurisdiction.

B. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
1. Include losses through water-service piping, valves, and backflow preventers.

2. The following types of Sprinkler Occupancy Hazard Classifications are included. Classifications for specific areas are as shown on Contract Plans.
   a. Ordinary Hazard, Group 1.
   b. Ordinary Hazard, Group 2.

3. Minimum Density for Automatic-Sprinkler Piping Design: As follows:
   a. Ordinary Hazard, Group 1 Occupancy: 0.15 gpm/ft$^2$ over 1500 ft$^2$.
   b. Ordinary Hazard, Group 2 Occupancy: 0.20 gpm/ft$^2$ over 1500 ft$^2$.

C. Components and Installation: Capable of producing piping systems with 175 psi minimum working-pressure rating, unless otherwise indicated.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounting steel cabinet and hinged cover, with space for a minimum of six spare sprinklers plus sprinkler wrench. Include the number of sprinklers required by NFPA 13 and wrench for sprinklers. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

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

1. Specialty Valves and Devices:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.
   d. Or Approved Equal.

2. Water-Flow Indicators and Supervisory Switches:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.
d. Or Approved Equal.

3. Sprinkler, Drain and Alarm Test Fittings:
   a. Fire-End and Croker Corp.
   b. Grinnell Corp.
   c. Victaulic Co. of America.
   d. Or Approved Equal.

4. Sprinkler, Branch-Line Test Fittings:
   b. Fire-End and Croker Corp.
   d. Or Approved Equal.

5. Sprinkler, Inspector's Test Fittings:
   a. Fire-End and Croker Corp.
   b. G/J Innovations, Inc.
   c. Triple R Specialty of Ajax, Inc.
   d. Or Approved Equal.

6. Fire Department Connections:
   b. Fire-End and Croker Corp.
   c. Grinnell Corp.
   d. Or Approved Equal.

7. Wall Hydrant Connections:
   b. Badger-Powhatan, A Figgie International Co.
   c. Grinnell Corp.
   d. Or Approved Equal.

8. Sprinklers:
   a. Grinnell Corp.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Viking Corp.
   d. Or Approved Equal.

9. Indicator Posts and Indicator-Post, Gate Valves:
   a. Grinnell Corp.
   b. Nibco, Inc.
c. Stockham Valves & Fittings, Inc.

10. Indicator Valves:
   a. Grinnell Corp.
   b. Nibco, Inc.
   c. Victaulic Co. of America.
   d. Or Approved Equal.

11. Fire-Protection-Service Valves:
   a. Grinnell Corp.
   b. Stockham Valves & Fittings, Inc.
   c. Victaulic Co. of America.
   d. Or Approved Equal.

12. Keyed Couplings for Steel Piping:
   a. Grinnell Corp.
   b. Victaulic Co. of America.
   c. Or Approved Equal

2.02 PIPING MATERIALS
   A. Refer to Part 3 “Piping Applications” Article for applications of pipe, tube, fitting, and joining materials.

2.03 PIPES AND TUBES
   A. Standard-Weight Steel Pipe: ASTM A 53 or ASTM A 135; Schedule 40, galvanized for all pipe and drain pipe systems.

2.04 PIPE AND TUBE FITTINGS
   A. Steel, Threaded Couplings: ASTM A 865.
   B. Provide hot dipped ASTM A-123 galvanized fittings and couplings for all systems and drain systems.

2.05 JOINING MATERIALS
   A. Refer to Section 15050 - Basic Mechanical Materials and Methods, for pipe-flange gasket materials and welding filler metals.
   B. Transition Couplings: AWWA C219, sleeve type, or other manufactured fitting the same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.
2.06 FIRE-PROTECTION-SERVICE VALVES

A. General: UL listed and FM approved, with minimum 175 psi non-shock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.

B. Gate Valves, 2 in and smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.

C. Gate Valves, 2.5 in and larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

D. Indicating Valves, 2.5 in and smaller: UL 1091; butterfly or ball-type, bronze body with threaded ends; and integral indicating device.
   1. Indicator: Electrical 115-V ac, prewired, single-circuit, supervisory switch.

E. Indicator-Post, Gate Valves: UL 262, iron body, bronze mounted, solid-wedge disc, and nonrising stem with operating nut and flanged ends.

F. Indicator Posts: UL 789, horizontal, wall type, cast-iron body, with windows for target plates that indicate valve position, extension rod and coupling, locking device, and red enamel finish.

G. Swing Check Valves, 2 in and smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

H. Swing Check Valves, 2.5 in and larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

I. Split-Clapper Check Valves, 4 in and larger: UL 312, cast-iron body with rubber seal, bronze-alloy discs, and stainless-steel spring and hinge pin.

J. Backflow Preventer: Double check valve backflow preventer, Watts model 709 OS&Y or approved equal.

K. ALL valves must be capable of being chained and locked.

L. All valves associated with the installed sprinkler system must be chained and locked utilizing SEPTA padlock (ABUS No. 83AL/45) at the Contractor's expense.

2.07 SPECIALTY VALVES

A. Dry Pipe Valve: UL 193, 175 psi working pressure, designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, accelerator, and fill-line attachment with strainer.
   1. Option: Grooved-end connections for use with keyed couplings.
a. Drip Cup Assembly: Pipe drain without valves, and separate from main drain piping.

2.08 SPRINKLERS
A. Automatic Sprinklers: With heat-responsive element complying with the following:
   1. UL 199, for applications except residential.
B. Sprinkler Types and Categories: Nominal 0.5 in orifice for “Ordinary” temperature classification rating, unless otherwise indicated or required by application.
C. Sprinkler types, features, and options include the following:
   1. Pendent, dry-type sprinklers.
   2. Upright sprinklers.
D. Sprinkler Finishes: Chrome-plated, bronze, and painted.
E. Special Coatings: Wax, lead, and corrosion-resistant paint.
F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Chrome-plated steel, two piece, with 1 in. vertical adjustment.
   2. Sidewall Mounting: Plastic, white finish, one piece, flat.
G. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.09 SPECIALTY SPRINKLER FITTINGS
A. Specialty Fittings: UL listed and FM approved; made of steel, or other materials compatible with piping.
B. Dry Pipe System Fittings: UL listed for wet pipe service.
C. Sprinkler, Drain and Alarm Test Fittings: UL-listed, with threaded inlet and outlet, test valve, and orifice and sight glass.
D. Sprinkler, Branch-Line Test Fittings: UL-listed, with threaded inlet and capped drain outlet and threaded outlet for sprinkler.
E. Sprinkler, Inspector's Test Fittings: UL-listed, with threaded inlet and drain outlet and sight glass.

2.10 FIRE DEPARTMENT CONNECTIONS
A. Description: UL 405; cast-brass body with brass, wall, escutcheon plate; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads.
extension pipe nipples, check devices or clappers for inlets and escutcheon plate.

1. Type: Exposed, projecting mounting per City of Philadelphia Fire Department.
2. Fire Rated Valve Cabinet: Flush mount, 20 gage steel box, 20 gage steel door, 18 gage steel frame, fire insulation material; UL and ADA compliant; box dimension 24” x 24” x 10”.
3. Escutcheon Plate: Round with marking “FIRE SPRINKLER.”.

2.11 DRY STANDPIPE CONNECTION
A. Description: Cast brass body with brass, wall, escutcheon plates; brass, lugged caps with gaskets and brass chains; and brass, lugged swivel connections. Include outlets with threads according to NFPA 1963 and matching local fire department sizes and threads, inlet with pipe threads, extension pipe nipple, and valve control.
1. Type: Flush mounting.
2. Escutcheon Plate: Round with markings “DRY STANDPIPE”.

2.12 ALARM DEVICES
A. General: UL listed and FM approved. Types matching piping and equipment connections.
B. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
C. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
D. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw, with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

2.13 PRESSURE GAGES
A. Pressure Gages: UL 393, 3.5 in to 4.5 in diameter dial with dial range of 0 to 250 psig. Must be listed as FM approved.

2.14 HANGERS AND SUPPORTS
A. Provide hangers in accordance with the drawings and NFPA 13.
PART 3 – EXECUTION

3.01 PREPARATION
   A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in “Quality Assurance” Article in Part 1 of this Section.
   B. Report test results promptly and in writing.

3.02 EARTHWORK
   A. Refer to Section 02200 - Earthwork, for excavating, trenching and backfilling.

3.03 PIPING APPLICATIONS
   A. Do not use welded joints with galvanized steel pipe.
   B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
   C. Piping between Fire Department Connections and Check Valves: Use galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
   D. Underground Service-Entrance Piping: Use ductile-iron, grooved-end pipe and fittings; ductile-iron, keyed couplings; and grooved joints.
   E. Sprinkler Feed Mains and Risers: Use the following:
      1. Up to 6 in: Galvanized standard weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings, and grooved joints.

3.04 VALVE APPLICATIONS
   A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
      1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 13.
         a. Shutoff Duty: Use OS&Y gate valves with tamper switch or ball valves with integral tamper switch.
      2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13.
         a. Shutoff Duty: Use gate, ball, or butterfly valves.

3.05 JOINT CONSTRUCTION
   A. Refer to Section 15050 - Basic Mechanical Materials and Methods, for basic piping joint construction.
B. Steel-Piping, Grooved Joints: For piping 2 in. to 6 in. use galvanized Schedule 40 steel pipe with cut or roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer’s written instructions. Use gaskets listed for dry-pipe service for dry piping.

3.06 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping of size and in location indicated for service entrance to building. Refer to Section 02665 - Water Distribution System, for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories at connection to water service.

3.07 PIPING INSTALLATION

A. Refer to Section 15050 - Basic Mechanical Materials and Methods, for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install underground service-entrance piping according to NFPA 24 and with restrained joints.

D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes 2 in and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

F. Install flanges or flange adapters on valves, apparatus, and equipment having 2½ in and larger connections.

G. Install “Inspector's Test Connections” in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to sprinkler risers when sprinkler branch piping is connected to sprinkler risers.

J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

K. Install alarm devices in piping systems.

L. Hangers and Supports: Comply with NFPA 13 and Section 15060, Hangers and Supports for hanger materials and installation.
M. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.

N. Install pressure gages on riser or feed main and at each sprinkler test connection. Include pressure gages with connection not less than 8 mm and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

O. Test valves must be piped to a SEPTA approved working floor drain or track area.

3.08 SPECIALTY SPRINKLER FITTING INSTALLATION
A. Install specialty sprinkler fittings according to manufacturer's written instructions.

3.09 VALVE INSTALLATION
A. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
B. Install check valve in each water-supply connection.
C. Alarm Check Valves: Install valves in vertical position for proper direction of flow, including bypass check valve and retard chamber drain-line connection.

3.10 SPRINKLER APPLICATIONS
A. General: Use sprinklers according to the following applications:
   1. Trash Rooms without Ceilings: Pendant Dry-type sprinklers, as indicated.
   2. Rooms with Suspended Ceilings: Recessed sprinklers.
   4. Sprinkler Finishes: Use sprinklers with the following finishes:
      a. Upright and Pendent: Chrome-plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

3.11 SPRINKLER INSTALLATION
A. Install sprinklers in patterns indicated.
B. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical panels.
3.12 CONNECTIONS
   A. Connect water supplies to sprinklers.
   B. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
   C. Connect piping to specialty valves, specialties, fire department connections, and accessories.
   D. Electrical Connections: Power wiring is specified in Division 16.
   E. Connect alarm devices to fire alarm.

3.13 LABELING AND IDENTIFICATION
   A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Section 15050 - Basic Mechanical Materials and Methods.

3.14 FIELD QUALITY CONTROL
   A. Flush, test, and inspect sprinkler piping according to NFPA 13, “System Acceptance” Chapter.
   B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
   C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.15 CLEANING
   A. Clean dirt and debris from sprinklers.
   B. Remove and replace sprinklers having paint other than factory finish.

3.16 PROTECTION
   A. Protect sprinklers from damage until Substantial Completion.

3.17 COMMISSIONING
   A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
   B. Verify that specified tests of piping are complete.
   C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
   D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
   E. Verify that fire department connections have threads compatible with local fire department equipment.
F. Energize circuits to electrical equipment and devices.
G. Coordinate with fire alarm tests. Operate as required.

END OF SECTION 13900
SECTION 13967

CLEAN AGENT FIRE-EXTINGUISHING SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the City, Standard Contract Requirements, Supplements to the City Standard Contract Requirements, Special Provisions and other Division 1 through 16 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 13 Section 13852 – Fire Detection and Alarm System.

2. Division 13 Section 13900 - Fire Suppression.

1.02 SUMMARY

A. This Section includes clean-agent extinguishing systems and the following:

1. Piping and piping specialties.

2. Extinguishing-agent containers.

3. Extinguishing agent.


5. Control and alarm panels.

6. Air system dampers, controls and wiring

7. Accessories.

8. Connection devices for and wiring between system components.

9. Connection devices for power and integration into building's fire alarm system.
1.03 DEFINITIONS

A. HFC 227ea fire extinguishing clean agent. The trade names for this agent are FM-200 and FE-227.

1.04 SYSTEM DESCRIPTION

A. Description: Engineered system for discharge and total flooding of hazard areas with "HFC-227ea" known as “FM-200”, made by Great Lakes Chemical Corporation or FE-227 made by DuPont.

1.05 PERFORMANCE REQUIREMENTS

A. Design clean-agent extinguishing system and obtain approval from authorities having jurisdiction. Design system for Class A, B, or C fires as appropriate for areas being protected and include safety factor. Use clean agent indicated and in concentration suitable for normally occupied areas.

B. Performance Requirements: Discharge agent within 10 seconds and maintain 7.1 percent concentration by volume at 70 deg F for 10-minute holding time in hazard areas.

1. Agent concentration in hazard areas greater than 9.0 percent immediately after discharge or less than 7.0 percent throughout holding time will not be accepted without written authorization from Owner and authorities having jurisdiction.

2. System Capabilities: Minimum 620-psig calculated working pressure and 360-psig initial charging pressure.

C. Verified Detection: Include devices located in single zone. Sound alarm on activating single-detection device, and discharge extinguishing agent on actuating second-detection device.

D. System Operating Sequence: As follows:

1. Actuating First Detector: Give visual indication on annunciator panel, energize audible alarm, shut down air-conditioning and ventilating systems serving protected area, release and close doors in protected area, and send signal to fire alarm system.

2. Actuating Second Detector: Give visual indication on enunciator panel, energize audible alarm, shut down power to protected equipment, actuate time delay for extinguishing-agent discharge for 30 seconds, and release extinguishing agent.

3. Extinguishing-agent discharge will operate audible alarms and strobe lights.
E. Operating manual-release stations will discharge extinguishing agent when activated.

F. Operating abort switches will delay extinguishing-agent discharge while being activated, and switches must be reset to prevent agent discharge. Release of switch will discharge agent.

1.06 SUBMITTALS

A. Product Data: For the following:
   1. Extinguishing-agent containers.
   2. Extinguishing agent.
   3. Discharge nozzles.
   4. Control panel.
   5. Detection devices.
   7. Switches.
   8. Alarm devices.
   9. Air system dampers and controls.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include design calculations. Include the following for hazard-area enclosure, drawn to scale:
   1. Plans, elevations, sections, details, and attachments to other Work. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
   3. Design Calculations: For weight, volume, and concentration of extinguishing agent required for each hazard area.
   4. Reflected Ceiling Plans: Show ceiling-mounted items, and the following:
a. Extinguishing-agent containers, piping, discharge nozzles, detectors, and accessories.
b. Method of attaching hangers to building structure.
c. Other ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.

5. Occupied Work Area Plans: Show the following:
   a. Controls and alarms.
   b. Extinguishing-agent containers, piping and discharge nozzles if mounted in space, detectors, and accessories.
   c. Equipment and furnishings.

6. Access Floor Space Plans: Show the following:
   a. Extinguishing-agent containers, piping, discharge nozzles, detectors, and accessories.
   b. Method of supporting piping.

C. Permit Approved Drawings: Working plans, prepared according to NFPA 2001, 2012 Edition, that have been approved by authorities having jurisdiction. Include design calculations.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.07 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of clean-agent extinguishing systems that are similar to those indicated for this Project in material, design, and extent.

B. Source Limitations: Obtain extinguishing agent and equipment through one source.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of clean-agent extinguishing systems and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered. Contractor shall become responsible for submitting a new layout to the engineer for approval prior to purchasing any substitution equipment or accessories.

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. ASME Compliance: Fabricate piping to comply with ASME B31.1, "Power Piping."

F. FM Compliance
   1. Provide components that are FM approved and are listed in FM's "Fire Protection Approval Guide."
   2. Installation and testing of system shall comply with the latest edition of FM Global Property Loss Prevention Data Sheet 4-9. Contractor shall conduct an enclosure integrity procedure (i.e., door fan test) of the protected area in accordance with NFPA 2001. A discharge test using inert gas systems for final acceptance by FM Global will not be required.


H. UL Compliance: Provide equipment components complying with UL 1058, "Halogenated Agent Extinguishing System Units," and are UL listed for clean-agent extinguishing system units in UL's "Fire Protection Equipment Directory."

I. Contractor Qualifications: Contractor shall have not less than 3 years successful experience in installation and testing of FM-200 systems. Installers shall be skilled in their designated tasks, and under the supervision of a trained foreman.
   1. Contractor shall submit certification statement indicating compliance with above.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Clean agent extinguishing system control panel shall be a Fike SHP Pro control panel or SEPTA approved equivalent.

B. All fire alarm control panels shall be UL listed for releasing.

C. Clean-Agent Tanks shall be Fike Corp.; Fire Protection Systems Div or SEPTA approved equivalent.

2.02 PIPING MATERIALS

A. Refer to Part 3 piping applications Article retained for applications of pipe, tube, fitting, and joining materials.
B. Piping, Valves, and Discharge Nozzles: Comply with types and standards listed in NFPA 2001, Section "Distribution," and Appendix A, for charging pressure of system.

2.03 PIPES AND TUBES
A. Black Steel Pipe: ASTM A 53, Type S, Grade A or ASTM A 106, Grade A; Schedule 40.

2.04 PIPE AND TUBE FITTINGS
A. Steel Flanges and Flanged Fittings: ASME B16.5, Class 300.
B. Steel, Grooved-End Fittings: FM approved and UL listed ASTM A 536 ductile iron, with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.05 JOINING MATERIALS
A. Steel, Keyed Couplings: UL 213, AWWA C606, approved or listed for clean-agent service, and matching steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gasket, and steel bolts and nuts.

2.06 VALVES
A. General: Brass; suitable for intended operation.
B. Container Valves: With rupture disc or solenoid, capable of immediate and total agent discharge and suitable for intended flow capacity.
C. Valves in Sections of Closed Piping and Manifolds: Fabricate to prevent entrapment of liquid, or install valve and separate pressure-relief device.
D. Valves in Manifolds: Check valve; installed to prevent loss of extinguishing agent when container is removed from manifold.

2.07 EXTINGUISHING-AGENT CONTAINERS
A. Description: Steel tanks complying with ASME Boiler and Pressure Vessel Code: Section VIII, for unfired pressure vessels. Include minimum working-pressure rating that matches system charging pressure, valve, pressure switch, and pressure gage.
   1. Finish: Manufacturer's standard color, enamel or epoxy paint.
   2. Manifold: Fabricate with valves, pressure switches, selector switch, and connections for main-banks of multiple storage containers.
3. Storage-Tank Brackets: Factory fabricated retaining brackets consisting of steel straps and channels; suitable for container support, maintenance, and tank refilling or replacement.

2.08 FIRE-EXTINGUISHING CLEAN AGENT

A. Clean Agent: FM-200.

B. Clean Agent: FE-227.

2.09 DISCHARGE NOZZLES

A. Equipment manufacturer's standard one-piece brass or aluminum alloy of type, discharge pattern, and capacity required for application.

2.10 CONTROL PANELS

A. Description: UL listed/FM approved, including equipment and features required for testing, supervising, and operating fire-extinguishing system.

B. Power Requirements: 120V ac; with electrical contacts for connection to system components and fire alarm system, and transformer or rectifier as needed to produce power at voltage required for accessories and alarm devices.

C. Enclosure: NEMA ICS 6, Type 1, surface-mounted enameled-steel cabinet.

D. Supervised Circuits: Separate circuits for each independent hazard area.

1. Provide the following verified-detection applications:
   a. Detection circuit.
   c. Alarm circuit.
   d. Release circuit.

2. Provide the following control-panel features:
   a. Electrical contacts for shutting down fans, activating dampers, and operating system electrical devices. Contacts shall be properly rated for controlled devices; additional relays and wiring required to keep contacts within their rating shall be provided at no additional cost.
   b. Automatic switchover to standby power at loss of primary power.
   c. Storage container, low-pressure indicator.

3. Standby Power: Lead-acid or nickel-cadmium batteries with capacity to operate system for 72 hours and alarm for minimum of
15 minutes. Include automatic battery charger, with varying charging rate between trickle and high depending on battery voltage, that is capable of maintaining batteries fully charged. Include manual voltage control, dc voltmeter, dc ammeter, electrical contacts for connection to control panel, and suitable enclosure.

2.11 DETECTION DEVICES

A. Description: Comply with current edition of NFPA 2001 and NFPA 72, and include the following types:

1. Ionization Detectors: UL 268, dual-chamber type, having sampling and referencing chambers, with smoke-sensing element.

2. Photoelectric Detectors: UL 268, consisting of LED light source and silicon photodiode receiving element.

2.12 MANUAL-RELEASE STATIONS

A. Description: UL listed/FM approved with “PULL STATION” caption, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel. Unit can manually discharge extinguishing agent with operating device that remains engaged until unlocked

B. Stations shall be manufactured from high impact red Lexan. Lettering shall be raised and painted white.

C. The front of the station is to be hinged to a backplate assembly and must be opened with a key to reset the station. The key shall be common with the control panels. Stations that use allen wrenches or special tools to reset, will not be accepted.

D. Pull stations shall be installed a maximum height of 44 inches above finished floor in all areas and where the location is wheelchair side accessible. Areas only accessible to front facing wheelchairs shall have the manual pull stations located a maximum of 42 inches above finished floor. All dimensions shall be centerline of the pull station.

2.13 SWITCHES

A. Description: FM approved and UL listed, where available, 120-V ac or low voltage compatible with controls. Include contacts for connection to control panel.

1. Abort Switches: Dead-man type, requiring constant pressure, for delay of system discharge.
2.14 ALARM DEVICES

A. Description: FM approved and UL listed, low voltage, and surface mounting, unless otherwise indicated.

B. Bells: Minimum 6-inch diameter.

C. Horn/Stobes: UL listed/FM approved. Horn/strobe combination units shall be 65mA average at 24 VDC, 75 candela at 10 ft. 1 Hz flash rate conforming to ADA requirements and UL 1971 for strobes. Horn shall be 90 to 94 dBA.

2.15 ELECTRICAL POWER AND WIRING

D. Electrical power, wiring, and devices are specified in Division 16 Sections.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

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

3.02 PIPING APPLICATIONS FOR 360-PSIG CHARGING PRESSURE

A. Flanged pipe and fittings and flanged joints may be used to connect to specialties and accessories and where required for maintenance.


C. Flanged Joints: Class 300 minimum.

D. NPS 2 and Smaller: Black steel pipe, malleable-iron threaded fittings, and threaded joints.

E. NPS 2½ and larger: Black steel pipe; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

3.03 CLEAN-AGENT EXTINGUISHING PIPING INSTALLATION

A. Install clean-agent extinguishing piping and other components level and plumb and according to manufacturers' written instructions.
B. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.

C. Install extinguishing-agent containers against the wall of the space on the floor or near the ceiling.

D. Install pipe and fittings, valves, and discharge nozzles according to requirements listed in NFPA 2001, Section "Distribution," and related Appendix A paragraphs; and ASME B31.1.

1. Install valves designed to prevent entrapment of liquid or install pressure-relief devices in valved sections of piping systems.


3. Install control panels, detection system components, alarms, and accessories, complying with requirements of NFPA 2001, Section "Detection, Actuation, and Control Systems," as required for supervised system application.

3.04 CONNECTIONS

A. Drawings identify the areas to be served by the systems. The following are specific connection requirements:

B. Install piping adjacent to extinguishing-agent containers to allow service and maintenance.

C. Connect electrical devices to control panel and to buildings fire alarm system. Electrical power, wiring, and devices are specified in Division 16 Section 16820 "Fire Alarm Systems."

D. Ground electrical components.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
3.05 AIR SYSTEM DAMPERS AND EXISTING DUCT DISTRIBUTION SYSTEM

A. Modify existing ductwork as necessary to install new air system dampers and controls for shutdown of air distribution systems at locations indicated on drawing.

B. Insulate new sections of ductwork in accordance with manufacturer's written instructions.

C. Seal insulation joints and seams with vapor-retardant tape per manufacturer's recommendation.

3.06 LABELING


3.07 FIELD QUALITY CONTROL

A. Professional Engineer: Inspect installed clean-agent extinguishing systems, prepare installation report, and certify that installation complies with the Contract Documents and calculations, and comments of authorities having jurisdiction.

B. Comply with operating instructions and procedures of the latest edition of NFPA 2001, Section "Approval of Installations." Include the following inspections and tests to demonstrate compliance with requirements:

1. Check mechanical items.

2. Inspect extinguishing-agent containers and extinguishing agent, and check mountings for adequate anchoring to substrate.

3. Check electrical systems.


5. Perform functional pre-discharge test.


7. Check remote monitoring operations.

8. Check control-panel primary power source.
9. Pneumatically test open-ended piping in a closed circuit for a period of 10 minutes at 40 PSIG. At the end of 10 minutes, the pressure drop should not exceed 20 percent of the test pressure.

10. Perform "puff" test on piping system, using nitrogen.

C. Perform field-acceptance tests of each clean-agent extinguishing system when installation is complete. Perform system testing only after hazard-area enclosure construction has been completed and openings sealed. Comply with operating instructions and procedures of NFPA 2001, Section "Approval of Installations." Include the following to demonstrate compliance with requirements:
   1. Perform functional pre-discharge test.
   2. Perform system functional operational test.
   3. Check remote monitoring operations.
   4. Check control-panel primary power source.
   5. Perform "puff" test on piping system, using nitrogen.

D. Correct malfunctioning equipment, and then retest to demonstrate compliance. Replace equipment that cannot be corrected or does not perform as specified and indicated, then retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
   1. Report test results promptly and in writing to Engineer and authorities having jurisdiction.

E. Perform the following field quality-control testing:
   1. After installing clean-agent extinguishing piping system 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 ATS, Section 7, "Inspection and Test Procedures," and Section 8, "System Function Tests." Certify compliance with test parameters.

F. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment
installation, including piping and electrical connections. Report results in writing.

1. **Leak Test:** After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. **Operational Test:** After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.

3. **Test and adjust controls and safeties.** Replace damaged and malfunctioning controls and equipment.

### 3.08 COMMISSIONING

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that extinguishing system is installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with the Contract Documents.

D. Complete installation and startup checks according to manufacturer's written instructions and do the following:
   1. Verify that tests of piping system are complete.
   2. Check for complete enclosure integrity.
   3. Check operation of ventilation and exhaust systems.

E. **Startup Procedures:** Follow manufacturer's written procedures. If no procedures are prescribed by manufacturer, proceed as follows:
   1. Fill extinguishing-agent containers with extinguishing agent and pressurize to indicate charging pressure.
   2. Install filled extinguishing-agent containers.
   3. Energize circuits.
   4. Adjust operating controls.

### 3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain system.
1. Train Owner’s maintenance personnel on procedures and schedules for troubleshooting, servicing, and maintaining equipment and schedules.

2. Schedule training with Owner, through Engineer, with at least seven days' advance notice.

END OF SECTION 13967
SECTION 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes: General requirements for materials, equipment and installations necessary for complete and satisfactory performance of mechanical work specified in Sections of Division 15.

B. Related Sections:

1. The following sections prescribe items of related work:

   a. Section 01010: Summary of Project
   b. Section 01041: Project Coordination
   c. Section 01045: Cutting and Patching

1.02 REFERENCES

A. Philadelphia Plumbing Code

B. 2009 International Mechanical Code

C. American National Standards Institute:

1. ANSI B31.2, Building Service Piping.

D. American Society For Testing and Materials:


E. Steel Structures Painting Council:

1. Surface Preparation Specifications.

   a. SSPC-SP 2, Hand Tool Cleaning.
   b. SSPC-SP 6, Commercial Blast Cleaning.
   c. SSPC-SP 8, Pickling.

2. Paint Application Specifications: SSPC-PA 1, Shop, Field and Maintenance Painting.
1.03 SUBMITTALS

A. Submissions Required: Submit in accordance with Section 01300, Shop Drawings for the mechanical materials and equipment covered in each Section of Division 15, and such items as may be scheduled on the Contract Drawings.

B. Content of Submissions:

1. Include in shop drawings, manufacturer's descriptive literature and published details with performance/capacity rating schedules as applicable in submissions.
2. Indicate fabrication details and proposed layouts for shop or field fabrications of piping systems.

C. Operation and Maintenance Manuals: Furnish in accordance with Section 01830 Operations and Maintenance Data.

1.04 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies: The construction requirements of State, County, or other political subdivision specifications exceeding the requirements of the codes, standards, and approving bodies referenced herein shall be met and complied with.

1. Comply with requirements of the National Fire Protection Association Standards (NFPA) referenced in the various Specifications Sections, and as directly appropriate to work and workmanship of this Contract.

B. Certificates and Permits: Upon completion of work, and prior to final payment, furnish formal certification of final inspections to SEPTA from authorities having jurisdiction and secure required Permits, if any, from same. Additionally, prepare detailed diagrams and drawings which may be required by those authorities having jurisdiction.

C. Source Quality Control: Products used throughout these specifications are those of companies having established reputations in the manufacture of the particular materials, equipment or apparatus specified. Such products shall be of their own make, or products of others, for which the manufacturer assumes full responsibility for products used in said outfits which are not manufactured completely by them; and with replacement parts available.

D. Products of Manufacturers: The mechanical materials shall be essentially the standard products of manufacturers who have been regularly engaged in the successful production of high quality mechanical materials and equipment of this type for at least ten years, have supplied such mechanical materials and
equipment for at least five years of the ten year period, and have at least five installations in successful operation for at least five years.

E. Workmen’s Qualifications: In acceptance or rejection of completed work, no allowance will be made for lack of skill on the part of the Contractor's forces performing such work.

1. Provide certified pipe welder(s) capable of welding in accordance with ANSI B31.1, Power Piping (Pressure Piping). Show proof of certification when requested by SEPTA.

1.05 DELIVERY STORAGE AND HANDLING

A. Deliver, store and handle the mechanical materials and equipment in accordance with Section 01600, the manufacturer’s recommendations and as supplemented herein within each Section.

1.06 PROJECT CONDITIONS

A. Interferences:

1. Construct Mechanical Systems when and in a manner not to delay or interfere with other operations of work in the project.

2. Prior to making Mechanical installations, coordinate Mechanical Work locations with other operations of work, especially in congested areas, such as mechanical equipment rooms and above hung ceilings (if any).

3. In the event that interferences develop, SEPTA’s decision will be final and no additional compensation will be allowed for relocation of Mechanical products.

B. Basis of Design: The first named manufacturer’s product in the acceptable manufacturers list of each article of Section 15 is the basis of design.

1. Where the contractor proposes to use a product requiring a change in the contract drawings, the Contractor shall pay all costs for any modifications of the design including all re-engineering costs. Prior approval shall be obtained from SEPTA for any substitution.

2. Where a performance is specified and no manufacturer is listed, the Contractor shall submit through the shop drawing procedure the name of the manufacturer, the product proposed, and detailed information showing its characteristics. SEPTA shall determine acceptance.

3. Where a choice of color, pattern, or texture is available for a specified product or item of equipment, SEPTA will make a selection from the manufacturer’s highest or best standards.
1.07 WARRANTIES

A. Assigned Warranties: Assign directly to SEPTA such manufacturer's warranties on material and equipment (including internal components) as exceed the guarantee time period as stated in the Agreement.

1. Date such assigned warranties to begin on the date of the SEPTA's acceptance of the Work.
2. Submit warranties along with the Operation and Maintenance Manual submission.
3. Submit warranties along with submission of Shop Drawings and Product Data.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Material particulars and requirements as specified in the various Sections included under Division 15 - Mechanical.

PART 3 – EXECUTION

3.01 INSTALLATIONS

A. General Requirements: Installation particulars and requirements are as specified in the various Sections included under Division 15 - Mechanical.

1. Perform required interconnection of the differing mechanical systems to the various mechanical equipment, devices, or apparatus, regardless of where such Products are specified throughout Division 15 - Mechanical, in order to ensure the completeness of such mechanical systems.
2. Install mechanical equipment level, unless indicated or directed otherwise.
3. General, Mechanical, and Plumbing Contractors are responsible for furnishing disconnects, fuses, starters, and overloads for equipment furnished under their contract. Electrical contractor is responsible to install those items.

B. Factory Finishes and Field Painting: Painting factory-finished items will be required in the cases where the factory finish is damaged. Such painting will be performed by this Contract, and as specified herein

1. Surface Preparation: This Contractor is responsible for the quality of the repaint work insofar as proper surface preparation will affect the finished appearance. The quality of the repaint work will be subject to the Project Manager's approval.
Basic Mechanical Materials and Methods

a. Perform surface preparation of damaged areas in conformance with the latest edition of the Steel Structures Painting Council Standard SSPC-SP2, Hand Tool Cleaning.

b. Where a damaged area occurs on one surface of an item having several surfaces, that entire surface where the damage occurs shall require repainting. The surface preparation for outside the damaged area shall consist of a light sanding to profile the existing paint.

2. Paint Application: Apply paint in such a manner so that the finished appearance will match as nearly as possible the factory finish.

a. Use paint material matching the composition of the factory applied products.

b. Comply with the paint manufacturer's label instruction for mixing, thinning, proper spreading rate, drying time, and environmental limitations concerning application.

3.02 FIELD QUALITY CONTROL

A. General: Perform cleaning, flushing, and testing operations as specified in the various Sections included under Division 15 - Mechanical.

1. Provide instruments, testing equipment, and such other required materials to perform the Field Quality Control Work.

2. Correct all deficiencies to the satisfaction of SEPTA.

END OF SECTION 15010
SECTION 15080
MECHANICAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of Contract as shown in Sections A through SP apply to this Section.

1.02 SUMMARY
A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.

2. Insulating cements.
3. Adhesives.
5. Lagging adhesives.
7. Factory-applied jackets.
8. Field-applied jackets.

1.03 DEFINITIONS
A. ASJ: All-service jacket.
B. FSK: Foil, scrim, kraft paper.
C. FSP: Foil, scrim, polyethylene.
D. PVDC: Polyvinylidene chloride.
E. SSL: Self-sealing lap.
F. Piping, Exposed: Piping that is readily visible by public within the station.
G. Piping, Concealed: Piping that is not visible by public within the station.
1.04 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Insulation application at pipe expansion joints for each type of insulation.
3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
4. Removable insulation at piping specialties, equipment connections, and access panels.
5. Application of field-applied jackets.

C. Installer Certificates: Signed by Contractor certifying that installers comply with requirements.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control inspection reports.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
1.06 DELIVERY, STORAGE, AND HANDLING
A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION
A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.08 SCHEDULING
A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Products: Subject to compliance with requirements, provide one of the products specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 INSULATION MATERIALS
A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. Mineral-Fiber, Preformed Pipe Insulation:
   1. Products:
      a. Johns Manville; Micro-Lok.
      b. Knauf Insulation; 1000(Pipe Insulation.
      c. Owens Corning; Fiberglas Pipe Insulation.
   2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
   3. Type II, 1200 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ or with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products:
   a. Aeroflex USA Inc.; Aeroseal.
   b. Armacell LCC; 520 Adhesive.
   c. Foster Products Corporation, H. B. Fuller Company; 85-75.
   d. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products:
   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.


1. Products:
   a. Childers Products, Division of ITW; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products:
   a. Childers Products, Division of ITW; CP-35.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.
2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products:
   a. Childers Products, Division of ITW; CP-30.
   b. Foster Products Corporation, H. B. Fuller Company; 30-35.
   c. ITW TACC, Division of Illinois Tool Works; CB-25.
   e. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.

1. Products:
   a. Childers Products, Division of ITW; Encacel.
   b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
   c. Marathon Industries, Inc.; 570.
   d. Mon-Eco Industries, Inc.; 55-70.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products:
   a. Childers Products, Division of ITW; CP-10.
b. Foster Products Corporation, H. B. Fuller Company; 35-00.
c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
e. Mon-Eco Industries, Inc.; 55-50.
f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 200 deg F.

4. Solids Content: 63 percent by volume and 73 percent by weight.


2.05 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic-Foam, and Polyisocyanurate Products:

a. Childers Products, Division of ITW; CP-76.
b. Foster Products Corporation, H. B. Fuller Company; 30-45.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.
f. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Permanently flexible, elastomeric sealant.

4. Service Temperature Range: Minus 100 to plus 300 deg F.

5. Color: White or gray.

B. Metal Jacket Flashing Sealants:

1. Products:

a. Childers Products, Division of ITW; CP-76-8.
b. Foster Products Corporation, H. B. Fuller Company; 95-44.
c. Marathon Industries, Inc.; 405.
d. Mon-Eco Industries, Inc.; 44-05.
e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.
C. ASJ Flashing Sealants:
   1. Available Products:
      a. Childers Products, Division of ITW; CP-76.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.

2.06 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.07 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:
   1. Available Products:
      a. Childers Products, Division of ITW; Metal Jacketing Systems.
      b. PABCO Metals Corporation; Surefit.
      c. RPR Products, Inc.; Insul-Mate.
   2. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.
      a. Factory cut and rolled to size.
      b. Material, finish, and thickness are indicated in field-applied jacket schedules.
      d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
      e. Factory-Fabricated Fitting Covers:
         1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.08 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
   1. Available Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
   1. Available Products:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
      b. Compac Corp.; 120.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
      d. Venture Tape; 3520 CW.
   2. Width: 2 inches.
   3. Thickness: 3.7 mils.
   5. Elongation: 5 percent.
   6. Tensile Strength: 34 lbf/inch in width.
2.09 SECUREMENTS

A. Bands:

1. Available Products:
   a. Childers Products; Bands.
   b. PABCO Metals Corporation; Bands.
   c. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. **Carbon Steel:** Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.03 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
3.04 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
   1. Seal penetrations with flashing sealant.
   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Floor Penetrations:
   1. Pipe: Install insulation continuously through floor penetrations.

3.05 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this Article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.06 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.07 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.08 FIELD-APPLIED JACKET INSTALLATION

A. PVC jackets, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

B. Metal jackets install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.09 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Refer to Division 7 for requirements for the installation of fire rated stopping materials.

B. Install fire stopping at penetrations through fire-rated assemblies.

C. Fire rated materials for use in fire stopping are to be labeled FM approved and installed by trained and certified personnel.

3.10 FINISHES

A. Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Engineer. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent inspecting agency to perform field inspections and prepare inspection reports.

B. Perform the following field tests and inspections and prepare test reports:

1. Inspect field-insulated equipment, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

2. Inspect pipe, fittings, strainers, and valves, randomly selected by Engineer, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.

D. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
B. **Items Not Insulated:** Unless otherwise indicated, do not install insulation on the following:

1. Below-grade piping.

### 3.13 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be the following:
   
   a. Flexible Elastomeric: 1 inch thick.

   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1 inch thick.

   b. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

C. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1 inch thick.

D. Sanitary Pumped Discharge Piping:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 1 inch thick.

E. Domestic Cold Water Piping:

1. All Pipe Sizes: Insulation shall be the following:

   a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

### 3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:

   a. Flexible Elastomeric: 2 inches thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:
1. All Pipe Sizes: Insulation shall be the following:
   
a. Flexible Elastomeric: 2 inches thick.

3.15 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   
   1. None.

D. Piping, Exposed:
   
   1. Stainless Steel, Type 304 or 316, Corrugated: 0.010 inch thick.

3.16 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
   
   1. None.

D. Piping, Exposed:
   
   1. Stainless Steel, Type 304 or 316, Corrugated with Z-Shaped Locking Seam: 0.010 inch thick.

END OF SECTION 15080
SECTION 16120
CONDUCTORS AND CABLES

PART 1– GENERAL

1.01 DESCRIPTION
A. This specification section, along with the Contract Drawings, is intended to cover the complete furnishing and installing of wire for power and control circuits.

B. This section includes:
   1. Building wire.
   2. Wiring connections and terminations.
   3. Electrical connections to equipment specified under other Divisions or furnished by SEPTA.

1.02 RELATED SECTIONS
A. Provisions of the Contract Documents, including the requirements of Division 1 through 16 of these specifications and the Contract Drawings apply to all work if this Section. The related specification sections include, but are not limited to:
   1. Section 01300 – Submittals
   2. Section 01600 – Material and Equipment
   3. Section 01700 – Contract Closeout
   4. Section 01720 – Project As-Built Documents
   5. Section 16010 – Basic Electrical Requirements
   6. Section 16130 – Raceway and Boxes
   7. Section 16131 – Conduit
   8. Section 16140 – Wiring Devices

1.03 QUALITY ASSURANCE AND APPLICATION OF EQUIPMENT

B. Furnish products listed and classified by Underwriters Laboratories, Inc. As suitable for purpose specified and shown.

C. Provide products manufactured no more than six months prior to installation.

D. Perform work in accordance with NECA Standard of Installation.
1.04 SUBMITTALS

A. Submit separate wire shop drawing for each type of product in accordance with Section 01300 - SUBMITTALS.

B. Provide the following information with each shop drawing:
   1. Product Data: Provide wiring manufacturer’s catalog information showing ratings, dimensions, configurations, and materials.
   2. Intended Use: Indicate where each product is intended to be installed.
   3. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

C. Submit Test Report indicating procedures and values obtained.

1.05 PROJECT CONDITIONS

A. Wire and cable routing indicated is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

B. Where wire and cable routing is not shown, determine exact routing and lengths required for destination indicated.

1.06 COORDINATION

A. Obtain and review shop drawings, product data, manufacturer’s wiring diagrams, and manufacturer’s instructions for equipment furnished under other sections.

B. Determine required separation between wiring and other work.

C. Determine routing to avoid interference with other work.

D. Determine connection locations and requirements.

E. Sequence rough-in of electrical connections to coordinate with installation of equipment.

F. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 – PRODUCTS

2.01 CONDUCTORS AND CABLES

A. Available Manufactures: Provide products from one of the following:
   1. Southwire Company
   2. General Cable
   3. Alpha Wire Company
   4. Or approved equal
B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
C. Conductor Insulation:
   1. Indoor use: Type THHN/THWN-2.
   2. Outdoor and underground: Type XHHW-2 and Type USE

2.02 CONNECTORS AND SPICES
A. Available Manufacturers: Provide products from one of the following:
   1. 3M
   2. AFC Cable Systems.
   3. Tyco Electronics Corp.
   4. Or approved equal
B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.03 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

3.01 EXAMINATION
A. Verify that construction work likely to damage wire and cable has been completed.
B. Verify that raceway installation is complete and supported.
C. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 PREPARATION
A. Completely and thoroughly swab raceway before installing wire.
B. Review equipment submittals prior to installation and electrical rough-in. Verify location, size, and type of connections. Coordinate details of equipment connections with supplier and installer.
3.03 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.

3.04 CONDUCTOR INSULATION APPLICATIONS
   A. Outdoor and underground: Type XHHW-2, single conductors in raceway.
   B. Indoor exposed feeders: Type THHN/THWN-2, single conductors in raceway.
   C. Feeders and branch circuits concealed in ceilings, walls, partitions, and
      crawlspace: Type THHN/THWN-2, single conductors in raceway.

3.05 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 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 16070 "Hangers and Supports".
   G. Install cable in accordance with the NECA "Standard of Installation" and in
      accordance with manufacturer's instructions.
   H. Splices are NOT permitted in power cables, feeders, motor circuits, control
      circuits. Splices will be permitted in lighting and receptacle branch circuits.
   I. Connect heat producing equipment using wire and cable with insulation
      suitable for temperatures encountered.

3.06 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 and UL 486B.
   B. Make splices, terminations and taps that are compatible with conductor
      material.
C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.07 INTERFACE WITH OTHER PRODUCTS
A. Color code all wiring as follows:
   1. 120/208VAC Systems: Phase A, B, and C: Black, Red and Blue.
   4. Ground: Green or Bare
B. Identify each conductor with its circuit number under provisions of Section 16075 - ELECTRICAL IDENTIFICATION.
C. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.08 FIELD QUALITY CONTROL
A. Section 01400 - QUALITY REQUIREMENTS.
B. Perform inspections and tests listed in NETA ATS and provide documentation for the test performed.
C. Inspect wire for physical damage and proper connection.
D. Measure tightness of bolted connections and compare torque measurements with manufacturer’s recommended values.
E. Verify continuity of each feeder and branch circuit conductor.
F. Verify continuity of each equipment grounding conductor.

END OF SECTION 16120
SECTION 16131

CONDUIT

PART 1 – GENERAL

1.01 DESCRIPTION

A. This specification section, along with the Contract Drawings, is intended to cover the complete furnishing and installing of conduits for electrical conductors.

B. This section includes:
   1. Rigid Metal conduit.
   2. Liquid tight flexible metal conduit.
   3. Flexible Metal conduit.
   4. Rigid Nonmetallic conduit.
   5. Fittings and conduit bodies.

C. Provide materials, labor, tools, equipment, supervision, and all appurtenances as required for complete conduits installation.

1.02 RELATED SECTIONS

A. Provisions of the Contract Documents, including the requirements of Divisions 1 through 16 of these specifications and the Contract Drawings apply to all work of this Section. The related specification sections include, but are not limited to:
   1. Section 01300 – Submittals
   2. Section 01600 – Material and Equipment
   3. Section 01700 – Contract Closeout
   4. Section 01720 – Project As-Built Documents
   5. Section 09910 – Paints
   6. Section 16010 – Basic Electrical Requirements
   7. Section 16060 – Grounding and Bonding
   8. Section 16070 – Hangers and Supports
   9. Section 16130 – Raceway and Boxes
   10. Section 16150 – Wiring Connections
1.03 QUALITY ASSURANCE AND APPLICATION OF EQUIPMENT
   B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
   C. Perform Work in accordance with NECA Standard of Installation.

1.04 SUBMITTALS
   A. Submit conduit shop drawings in accordance with Section 01300 - SUBMITTALS. Submit separate shop drawings for each type of product intended to be provided.
   B. Provide the following information with each shop drawing:
      1. Product Data: Provide manufacturer's catalog information showing dimensions, knockout sizes and locations, materials, fabrication details, finishes, and accessories.
      2. Intended Use: Indicate where each product is intended to be installed.
      3. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 DELIVERY, STORAGE, AND PROTECTION
   A. Deliver, store, protect, and handle Products to site under provisions of Section 01600 – MATERIAL AND EQUIPMENT.
   B. Accept conduit on site. Inspect for damage.
   C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.06 PROJECT CONDITIONS
   A. Verify field measurements as shown on Drawings.
   B. Verify routing and termination locations of conduit prior to rough in.
   C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

1.07 PROJECT RECORD DOCUMENTS
   A. Submit under provisions of Section 01700 - CONTRACT CLOSEOUT.
   B. Accurately record actual sizes and routing of conduits for As-built Drawings.
PART 2 – PRODUCTS

2.01 RIGID METALLIC CONDUIT AND FITTINGS

A. Description: Threaded galvanized rigid steel. Hot dipped rigid galvanized steel (thick wall) conduit (RGS) and shall conform to UL 6 and IEEE C80.1

B. Minimum Size: 3/4”, unless otherwise specified.

C. Standard: ANSI C80.1.

D. Finish: Paint all conduit, fittings and bodies as specified under Section 09910 - PAINTS.

E. Manufacturers:
   1. Allied Tube and Conduit.
   2. Triangle Wire and Cable.
   3. Wheatland Tube Company.
   4. Or approved equal.

F. Fittings and Conduit Bodies
   1. Description: Threaded galvanized rigid steel.
   3. Manufacturers:
      a. Picoma Industries.
      b. O-Z Gedney.
      c. Crouse-Hinds.
      d. Or approved equal.

G. All preformed elbows shall be thoroughly compatible with the conduit and conform to UL 6.

2.02 LIQUID-TIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Description: Interlocked steel construction with low smoke/zero halogen jacket. Jacket material tested to comply with requirements for flame spread (ASTM E162) and smoke generation (ASTM E662). Liquid-tight flexible steel conduit shall conform to UL 360 and be suitable for transit tunnels.

B. Minimum Size: 3/4”, unless otherwise specified.

C. Manufacturers:
   1. Electri-flex Company.
   2. Alflex Corporation.
   3. International Metal Hose Company.
   4. Or approved equal.

2.03 FLEXIBLE METAL CONDUIT AND FITTINGS
   A. Flexible metal conduit and fittings shall comply with the following:
      1. FSC - Flexible steel conduit and fittings shall conform to UL 1.
      2. Fittings shall be of a type designed for use with the respective conduit
         and shall conform to UL 514B.

2.04 CONDUIT SUPPORTS
   A. Conduit clamps, straps and support shall be steel or malleable iron. These
      hardware items shall be galvanized to match conduit as required. Refer to
      Section 16070, Hangers and Supports.

2.05 CONDUIT ACCESSORIES
   A. When metal conduits are required to have a bituminous coating, use Koppers
      Bitumastic No. 50 compound, or approved equal.
   B. Conduit thread lubricant shall be Crouse Hinds Type STL or approved equal.
   C. Conduit sealing bushings shall be O.Z.Gedney Type CSB or approved equal.
   D. Expansion fittings shall be of a type recommended by the conduit
      Manufacturer to suit the application.

2.06 INSERTS
   A. Provide galvanized steel slotted type inserts to receive a machine-bold head
      or nut after installation.
   B. Inserts shall permit adjustment in one horizontal direction and shall, when
      installed in properly-cured concrete, develop the full strength of the bolt.

2.07 OPENINGS
   A. Firestop systems shall be provided for through penetrations of conduits.
      Where conduits penetrate wall or floor, fire stops with a fire rating equal or
      greater than the rating of the penetrated wall or floor shall be provided. All
      firestop systems shall conform to UL 1479.
   B. See Division 07 Specification for more details.

2.08 FASTENING DEVICES
   A. Provide clamps, bolts and washers, or any other type of fastening devices
      conforming to the requirements of Section 16070 - HANGERS AND
      SUPPORTS, required to secure conduits to walls or above hung ceilings.
      Unless otherwise shown on the Contract Drawings, all fasteners shall be hot-
      dipped galvanized and of sizes and types recommended by the equipment
      Manufacturer.
PART 3 – EXECUTION

3.01 INSTALLATION

A. General Requirements: All electrical installations shall conform to the National Electrical Code (NFPA 70) and local supplementary electrical codes, as applicable.

B. Wiring Methods: Wiring method shall be insulated conductors installed in conduit, except where specifically indicated or specified otherwise, or required by NFPA 70 to be installed otherwise. An insulated equipment grounding conductor shall be provided in all feeder and branch circuits.

C. Conduit Application

1. Rigid Galvanized Steel Conduit: Shall be provided:
   a. For all conduit runs, indoor and outdoor.

2. Flexible Liquid-Tight Metal Conduit: Shall be used:
   a. For connection of equipment subject to vibration, noise transmission or movement.

3. Rigid Galvanized Steel Conduit: Shall be provided:
   a. For installation below grade and concrete encased: Conduits installed below grade shall be connected to rigid steel conduit before rising through surface.

4. Rigid Galvanized Steel Conduit: Shall be provided:
   a. At track crossovers where indicated on the Contract Drawings.

D. Arrange supports to prevent misalignment during conduit installation.

E. Support conduit using coated steel or malleable iron straps, lay in adjustable hangers, clevis hangers, and split hangers.

F. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

G. Fasten conduit supports to building structure and surfaces under provisions of Section 16070 – HANGERS AND SUPPORTS.

H. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.

I. Arrange conduit to maintain headroom and present neat appearance.

J. Route conduit parallel and perpendicular to walls.

K. Maintain adequate clearance between conduit and piping.

L. Maintain 12 inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

M. Cut conduit square using saw or pipecutter.

N. Bring conduit to shoulder of fittings; fasten securely.
O. Use sealing locknuts and bushing to fasten conduit to sheet metal boxes and conduit hubs to fasten to cast boxes.

P. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows or hydraulic one-shot bender to fabricate elbows for bends in metal conduit larger than 2 inch in size.

Q. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

R. Provide suitable fittings to accommodate expansion and deflection where conduit crosses control and expansion joints.

S. Provide all empty conduits (including flexible metal conduits) with a 1/4-inch nylon pull cord.

T. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

U. Ground and bond conduit and raceway under provisions of Section 16060 – GROUNDING AND BONDING and NFPA 70 - National Electrical Code.

V. Do not use liquid tight flexible metal conduit lengths of longer than 24 inches.

W. Provide each run of liquid-tight flexible metal conduit with an appropriate length of ground wire.

X. Use flat head screws, clips, and straps to fasten raceway channel to surfaces. Mount plumb and level.

END OF SECTION 16131
SECTION 16150

WIRING CONNECTIONS

PART 1 – GENERAL

1.01 DESCRIPTION

A. This specification section, along with the Contract Drawings, is intended to cover the complete furnishing and installing of electrical connections to equipment specified under other Divisions or furnished by SEPTA.

B. Unless otherwise noted, provide all power and control wiring for all electrically operated apparatus installed on the project. Make all final connections, and leave apparatus in approved operating condition. It is the Contractor’s responsibility to examine detailed drawings, wiring diagrams, roughing-in drawings and other information pertaining to the apparatus in question to determine the extent of work to be provided and exact locations of service.

C. Provide materials, labor, tools, equipment, supervision, and all appurtenances as required for complete electrical connections to all equipment.

D. The watts of motors or wattage of equipment indicated on the plans is the estimated wattage requirement of equipment to be furnished. All feeders, conduit, wiring, motor starters, and circuit breakers shall be of the sizes and capacities to suit watts of motors or wattage of equipment actually furnished. However, all ratings as shown on the drawings or indicated in the specifications shall not be reduced without specific written approval from SEPTA.

1.02 RELATED SECTIONS

A. Provisions of the Contract Documents, including the requirements of Divisions 1 through 16 of these specifications and the Contract Drawings apply to all work of this Section. The related specification sections include, but are not limited to:

1. Section 01300 – Submittals
2. Section 01600 – Material and Equipment
3. Section 01700 – Contract Closeout
4. Section 01720 – Project As-Built Documents
5. Section 16010 – Basic Electrical Requirements
6. Section 16075 – Electrical Identification
7. Section 16120 – Conductors and Cables
8. Section 16130 – Raceways and Boxes
9. Section 16131 – Conduit

1.03 REFERENCES
C. National Electrical Manufacturers Association (NEMA).
D. Underwriters Laboratories Incorporated (UL).
F. National Electrical Contractors Association (NECA) - Standard of Installation.

1.04 QUALITY ASSURANCE AND APPLICATION OF EQUIPMENT
A. Conform to requirements of ANSI/NFPA 70.
B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.
C. Perform Work in accordance with NECA Standard of Installation.

1.05 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 01700 - CONTRACT CLOSEOUT.
B. Accurately record all equipment connections and routing.

PART 2 – PRODUCTS
This Part not used.

PART 3 – EXECUTION

3.01 COORDINATION
A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections prior to installation.
B. Determine connection locations, sizes, types and requirements. Coordinate details of equipment connections with supplier and installer.
C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
D. Sequence electrical connections to coordinate with start-up of equipment.

3.02 EXAMINATION
A. Verify that equipment is ready for electrical connection, wiring, and energization.
3.03 INSTALLATION

A. Make wiring connections in control panel or in wiring compartment of pre-wired equipment in accordance with equipment manufacturer's instructions. Provide interconnecting wiring where indicated or required.

B. Make conduit connections to vibrating equipment using liquid-tight flexible conduit with watertight connectors.

C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

D. Install disconnect switches and controllers as indicated. Connect with conduit and wiring as indicated or required.

END OF SECTION 16150
SECTION 16700

COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Specification Sections shall apply to this and all related Division 16 specification sections.

B. Related Specification Sections:

1. In addition to the above requirements the following Specification Sections shall also apply to this Section:

a. Division 07, Section “Through-penetration Firestop Systems”
b. Division 16, Section “Basic Electrical Requirements.”
c. Division 16, Section “Conductors and Cables.”
d. Division 16, Section “Grounding and Bonding.”
e. Division 16, Section “Hangers and Supports.”
f. Division 16, Section “Raceways and Boxes.”
g. Division 16, Section “Electrical Identification.”
h. Division 16, Section “Network Communications.”

C. Reference Symbols:

1. All device symbols are defined by the appropriate symbol schedule on the symbols and abbreviations sheet in the communications system drawing package. Not all device symbols as indicated may be required for the project.

2. Because of the scale of the drawings, symbols are shown on the drawings as close as possible to the mounting location. Contractor shall coordinate exact locations with architectural drawings and all affected trades prior to submittal of shop drawings.

D. Abbreviations:

1. ASIS  
   Formerly the American Society for Industrial Security, now known simply as ASIS International

2. A/V  
   Audio Visual Systems – For purposes of this specification section, A/V systems shall include all Media Management, Video Broadcasting, Intercommunications (Paging/Public
3. **AVI**
   Audio Visual Integrator: Shall be a qualified contractor experienced in the installation and certification of A/V systems. The AVI contractor shall be responsible for the design, testing, and certification of all audio/visual systems including, but not limited to: Intercommunications, TV Distribution, Audio/Visual, Master Antenna and Bi-Directional Antenna systems as well as all structured cabling systems supporting these technologies.

4. **BACnet**

5. **BAS**
   Building Automation System

6. **BICSI**
   Building Industry Consulting Services International - International organization whose primary objective is to enhance the reputation and skills of companies and individuals employed in the telecommunications and security industries by ensuring that current and developing standards are maintained.

7. **CP**
   Consolidation Point - Local Interconnection Point between horizontal cables from the building IDF/MDF rooms and horizontal cables for the furniture drops.

8. **CPU**
   Central Processing Unit

9. **DP**
   Demarcation Point - The point of interface between the Communications Networks, MATV, any Auxiliary Systems, and the associated Service Providers or Public Utilities. Also known as Entrance Facility. Shall also serve as the primary termination point for all incoming OSP cabling as well as the primary main grounding bus-bar for all communications systems. Refer to project documents for exact location and termination requirements.

10. **DDC**
    Direct Digital Controller

11. **DGP**
    Data Gathering Panel – A component of the Physical Access Control System (PACS) located at each door or portal location that communicates, stores and processes information received from readers, reader modules, input modules, and output modules with the Security Management System CPU and software.

12. **EMI**
    Electromagnetic interference.

13. **EMT**
    Electrical Metallic Tubing – Also known as thin-wall conduit.

14. **EVAC**
    UL Listed Emergency Voice Evacuation System. Not to be confused with the building Public Address/Intercom, Intercommunications and/or Mass Notification systems.

15. **FAA**
    Federal Aviation Administration

16. **FACP**
    Fire Alarm Control Panel
Common Work Results For 16700-3 Communications Systems

17. **FAAP** Remote Fire Alarm Annunciator Panel.

18. **FAS:** Fire Alarm System

19. **FASC:** Fire Alarm System Contractor – Shall be a NICET Level III certified contractor experienced in the installation, programming, testing, and certification of Rescue Assistance, Protected Premises, and Central Station Signaling Fire Alarm Systems as defined by NFPA 72.

20. **GFCl** Ground fault circuit interrupter.

21. **GUI** Graphic User Interface – A specialized program employing graphical display maps of a facility and/or site which, also provides a manual user interface for all system functions and operations by utilizing control and annunciation icons from dedicated human machine interface terminals.

22. **HMI** Human/Machine Interface – A Computer-operated, video control terminal complying with FCC Part 15 CFR Title 47, Subparts A and B, and shall utilize multiple dynamic GUI based displays for annunciation and control LCD flat panel computer monitor or display screen as defined by related specification sections.

23. **ICT:** Information Communications Technologies – For purposes of this specification section ITS shall include all data and telecommunications communications systems including but not limited to all Data, Telephone, Intercommunications (Paging/Public Address), TV Distribution Systems (MATV) and Audio Visual Systems (A/V) and IP based CCTV Surveillance Systems.

24. **ICTC:** Information Communications Technology System Contractor – Shall be a qualified contractor experienced in the installation and certification of all data, telecommunications, and A/V systems. The ICTC shall be responsible for the design, testing, and certification of Data, Telephone communications systems and all structured cabling systems supporting these technologies.

25. **IDF** Intermediate Distribution Frame – The room/space that shall serve as the local termination point for all horizontal and backbone cabling. Also shall be known as Equipment Room (ER), Horizontal Cross-Connect (HC) or Floor Distributor (FD).

26. **IO** Input/Output – Commonly associated with dry contact relay-based digital integration.

27. **IP** Internet Protocol

28. **LAN** Local Area Network

29. **LED** Light-Emitting Diode.

30. **LV** Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

31. **MATV** Master Antenna System – Shall include all TV and media systems.
management distribution cabling, termination jacks, head-end components, control, equipment racks, amplifiers, projection equipment, and video monitoring devices as defined by the project drawings and related specification sections.

32. MDF. The Main Distribution Frame – The room/space that shall serve as the primary termination point for all backbone cabling to each IDF locations and horizontal connection point for local communication drops. May also serve as a local IDF location as well as the cross-connection and interconnection of all entrance cables from the DP for all PSTN and WAN connections. Also shall be known as Main Cross Connect (MC), Telecommunications Room (TR) and/or Campus Distributor (CD)

33. M-JPEG Motion – Joint Photographic Experts Group

34. MPEG Moving picture experts group.

35. NEC National Electric Code

36. NEMA National Electrical Manufacturers Association

37. NFPA National Fire Protection Association

38. NTSC National Television System Committee.

39. NRTL Nationally Recognized Testing Laboratory

40. NVR Network Video Recorder

41. NVW Network Video Workstation

42. OTDR Optical Time Domain Reflectometer

43. OSP Outside Plant – All cabling associated with building services supporting the incoming service connections to Service Providers, Public Utilities, and Wide Area Networks.

44. PA Public Address or Building Intercommunications System.

45. POTS Plain Old Telephone Service – Analog Telephone Circuit used for the connection of fax machines, BAS and FAS communications devices and shall be wired upstream of the facility’s telephone switch.

46. PSP Physical Security Professional as registered by the American Society of Industrial Security-International (ASIS)

47. PSTN Public Switched Telephone Network – Connection to local telephone utility providing local telephony communications service.

48. RCDD BICSI-accredited Registered Communications Distribution Designer

49. RFI Radio-frequency interference. Request for Information – a method by which a formal query is proposed by a contractor/integrator to the design professional/team

50. RGS Rigid Galvanized Steel conduit: Galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
51. **RS-232** A TIA/EIA standard for asynchronous serial data communications protocol between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.

52. **RS-485** A TIA/EIA standard for multipoint communications protocol.

53. **SCADA** Supervisory Control and Data Acquisition – A system used in to monitor and control the operation and status of facility systems scattered over wide geographic areas.

54. **SMS** Security Management System – A system incorporating security alarms, door controls, emergency intercoms/paging, duress alarms, and surveillance systems all integrated through a single operating platform, providing centralized command and control capability for the various systems via dedicated human machine interface terminals.

55. **TCP/IP** A standard protocol stack on which the Internet and data communications networks operate.

56. **TGB** Telecommunications Grounding Busbar – Located in each IDF

57. **TMGB** Main Grounding Busbar – Located at the building DP/MDF

58. **TP** Transition Point – A location in the horizontal cabling where flat under carpet cable transitions to a horizontal cabling consolidation point (CP).

59. **TVSS** Transient voltage surge suppressor

60. **VLAN** Virtual LAN – A technique made possible by switching technologies that permits the logical grouping of any number of network devices into one or more sub-networks.

61. **UPS** Uninterruptible Power Supply

62. **UTP** Unshielded Twisted Pair

63. **VLAN** Virtual Local Area Network

64. **VoIP** Voice Over IP telephone Network

65. **WAN** Wide Area Network

66. **WAP** Wireless Access Point

67. **WLAN** Wireless Local Area Network

**E. Definitions:**

1. **Contract Documents:** The documents consisting of the Form of Agreement between Owner and Contractor, Conditions of the Contract, (General, Supplementary, and other Conditions), Drawings, Specifications and all Addenda issued prior to the execution of the Contract.

2. **Contract Drawings:** The drawings that form a part of the Contract Documents that provides the graphical representation of the project requirements intended design and/or performance criteria to be delivered by the Contractor.

3. **Reference Drawings:** A drawing and/or set of drawings produced by a proprietary supplier, manufacturer, subcontractor, or fabricator included in the Contract Documents for informational purposes, providing
specific information related to the installation of related appurtenances, components, devices, hardware, products, and/or systems. Reference Drawings shall also include any Contract Drawings from prior bid packages that may have pertinent information or require coordination of trades related to this contract.

4. Shop Drawings: A drawing and/or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator as a detailed representation of the proper installation of the related appurtenance, component, device, hardware, product, and/or system to be delivered in conformance to the requirements of the Contract Documents.

1.02 SUMMARY

A. This Section contains the overall requirements associated with all Division 16 Specification Sections, and includes the project design intent for installation of all equipment, electrical power, cabling, and raceways related to the installation of a new premises network infrastructure in accordance with all contract documents.

B. In addition, this section shall address all requirements for submittals, quality assurance, product handling, record documents, project conditions, installation, system performance, demonstrations, testing, and certifications for all scopes of work related to network communication cabling for this project scope of work. Refer to related Division 16 specification sections and related contract drawings for additional information.

1. The intent of this project is to award as a single prime contract. The successful Contractor shall act as the prime contractor for the project and who herein shall be known as the “Contractor.”

a. The ICTC shall be a sub-contractor to the Contractor and shall have overall responsibility for all designs, equipment and all technical support related to all Division 16 scopes of work and shall ensure full coordination of all work as required to provide the following fully operational communications network in accordance with all related specification sections and contract drawings.

1) The Division 16 Contactor shall be responsible for providing all equipment, devices, cabling, conduits, cable trays, components, final cable terminations (unless otherwise noted), electrical power, commissioning, and testing of all network communications systems in accordance with Division 16 specification sections.

2) The Contractor shall be responsible for integrating the new premises network infrastructure to the existing communications network. Coordinate with Owner and Owner’s Representative prior to commencement of any scopes of work associated with the integration of the new communications network.

3) The Contractor and/or sub-contractors shall meet the minimum
technical capabilities, certifications, and licensing requirements as defined by the “Quality Assurance” chapter.

C. It shall be the responsibility of the Contractor to furnish and install all necessary cabling, conduits/raceways, cable terminations, materials, devices, components, electrical power, equipment, as well as all appurtenances, programming, commissioning and testing necessary to deliver a complete and fully operational premises network infrastructure as indicated by the contract documents.

1. The installation, performance, and installation criteria as specified herein as well as all related Division 16 specification sections have been designed to offer the maximum system efficiency, ease of operation, occupant safety and the protection of equipment as recommended by the Owner’s Representative.

   a. Any deviations from the specified criteria shall be documented, reviewed, and agreed to in writing by Owner’s Representative prior to submission of bids. Refer to Division 1, and all related Division 16 specification sections for any substitutions and/or project deviation requests.

      1) The required information shall include, but not be limited to: reason for deviation, all differences in performance, operation, and function from the herein specified requirements, all benefits, and added features to the OWNER, including any additional incurred costs for maintenance and long term ownership.

      2) Failure to provide the Owner’s Representative with the required information shall result in any shop drawing submissions being returned for non-conformance with the contract requirements.

   b. The contractor and all sub-contractors for this work shall have read all provisions; of the Contract, including but not limited to: General, Supplementary, and Special Provisions to the Contract as well as all related specification sections in the execution of all work, and shall be bound by all of the conditions and requirements therein.

      1) Prior to the submission of the Bid, any discrepancies or inconsistencies noted within these specifications and/or the project drawings shall be brought to the immediate attention of the Owner’s Representative.

      2) Where ambiguity exists between the project specifications and the contract drawings, the superior in system performance regardless of cost shall prevail and shall be delivered by the Contractor at no additional expense to the project.

2. All device symbols are defined by the appropriate symbol schedules as indicated by the symbol and abbreviation drawing sheets for each
discipline. The Contractor shall coordinate exact locations with all architectural, mechanical, electrical, reflected ceiling, furniture drawings and door hardware specifications as well as all affected trades prior to submittal of bids.

a. All symbols are shown on the contract drawings as close as possible to their intended location. Contractor shall coordinate the installation of all equipment, devices, controls, components, cabling conduits/raceways, and integration of other systems with all affected trades and specified system contractors. The contractor shall document all coordination requirements at the time of shop drawing submission.

b. Drawings for this work are diagrammatic and intended to convey the extent, general arrangement, and locations of the work. Because of the scale of the drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, back-boxes and junction boxes may or may not be shown on the contract drawings. Include all items where required by code and related specification sections for proper installation of all work.

3. Project specifications and drawings may not deal individually with every part, control, device, component, or appurtenance, which may be required to produce the equipment performance for the specified system and/or as required for compliance with all specified systems integration.

a. Include such items and appurtenances, as required, for complete operational premises network infrastructure as defined by the project documents, whether or not specifically indicated. The contractor shall be responsible for providing conduits/raceways, cable terminations, equipment, materials, devices, components, electrical power, equipment racks/cabinets, commissioning, testing and the integration of any ancillary systems or Owner provided equipment/components/systems.

1) Where ambiguity exists between the project specifications and the contract drawings, the superior in system performance regardless of cost shall prevail and shall be delivered by the Contractor at no additional expense to the project.

b. Coordinate with other applicable trades in submittal of shop drawings and the installation of all cabling, conduits/raceways, cable trays, racks/cabinets, and equipment. All shop drawings shall detail space conditions in order to accommodate other concerned trades, all equipment locations are subject to final review by the Owner's Representative.

D. Use Of Premises

1. General: The Contractor shall have full use of premises for
construction operations as required to meet the scopes of work as delineated by the Contract Documents.

a. The contractor is reminded that this is, and will continue to be, an operating facility. The contractor shall become completely familiar with all existing conditions of the site, and review all proposed equipment and cable installation requirements, which shall have any impact to the daily operations of the facility with the Owner’s Representative.

2. The Contractor shall design, prepare, schedule, and coordinate all scopes of work without disruption of any existing premise network communications systems or the daily operation of the facility. Installation of all communications cabling, conduits/raceways, cable trays, racks/cabinets, and equipment shall be installed and tested prior to switch over and/or disconnecting of any existing premise networks.

a. Include any costs related to any phased construction methodologies having to do with the scope of work defined herein, including, but not limited to, all necessary temporary equipment, devices, components or systems as well as any labor costs associated with any installation, commissioning, testing demolition of any technology systems required to be performed after normal business hours of the facility.

b. Prior to the disabling, switchover and/or demolition of the existing premise network components and associated cabling, all new system components, equipment, conduits, cabling, shall be in place, tested and fully operational.

3. The Contractor shall plan, schedule and install all scopes of work in accordance with the requirements of the project construction schedule and shall be coordinated with all the Owner, Owner’s representative and all affected trades prior to commencement of any work. Refer to specification section 01100 “Special Project Procedures” for additional information related to project phasing and scheduling.

a. This Contractor shall have the responsibility to design, prepare, schedule, coordinate and execute a phasing methodology provide for the continuous operation of the existing data and telephone premise network communications systems with no operational downtime or zero communication system disruptions to the site.

b. Upon completion and full testing of the new premise network infrastructure, and prior to the demolition of any existing premise network communications systems, the contractor shall coordinate with the Owner, Owner’s Representative all proposed system conversions and/or switchover methodologies. This coordination shall include all affected systems, areas of change over, change over procedures, and duration of work to be performed.
1) The contractor shall coordinate all demolition activities so as not to disrupt the daily routine of the facility or negatively impact the integrality of the facility’s electronic security, premise networks, and life safety systems.

2) Contractor shall demolish all existing premise network, cabling, devices, components, and/or controls not integrated with the new premise network infrastructure at the completion of appropriate project phase and only after final acceptance by the Owner and Owner’s Representative. The removal or demolition of all existing devices and/or field wiring not incorporated into the new premise network infrastructure shall be performed in such a manner consistent with all requirements of NFPA 70.

a) Contractor shall submit a demolition plan for review by the Owner and Owner’s Representative outlining all procedures, means, methods and precautions to be employed in the demolition of any existing network communications systems prior to the commencement of any modification, disconnections, or demolition.

1.03 REFERENCES

A. References to industry and trade association standards as well as all building codes are minimum installation requirements. The codes, standards, and agencies listed below shall form a part of this specification section and all work shall comply with the latest adopted standards.

B. Where the contract drawings and specifications mandate a greater requirement or performance than those specified by, any of the below, referenced codes and standards, the Contract Documents shall then be the governing requirements for this project. The minimum codes and standards to be applied for this project shall be the following;

1. All applicable requirements of NFPA 70 "National Electrical Code" including, but not limited to:
   a. Article 250, Grounding
   b. Article 300, Part A. Wiring Method
   c. Article 310, Conductors for General Wiring
   d. Article 725, Remote Control, Signaling Circuits
   e. Article 770, Optical Fiber Cables and Raceways
   f. Article 800, Communication Systems

2. National Fire Protection Association, current edition:
   c. NFPA-99: Standard for Health Care Facilities

4. International Mechanical Code (IBC), 2009
5. ICC-ANSI A117.1 (2009), Standard for Accessible and Usable Buildings and Facilities

6. ANSI/TIA Compliance: Comply with the following Electronics Industries Association Standards:
   a. ANSI/TIA-568C.1: Commercial Building Telecommunications Cabling Standard
   b. ANSI/TIA-568C.2: Balanced Twisted-Pair Telecommunications Cabling and Components Standard
   c. ANSI/TIA-568C.3: Optical Fiber Cabling Components
   d. ANSI/TIA-569C: Commercial Building Standard for Telecommunications Pathways and Spaces
   e. ANSI/TIA-607A: Commercial Building Grounding and Bonding Requirements for Telecommunications
   f. ANSI/TIA-607B: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
   g. ANSI/TIA-862-A: Building Automation Systems Cabling Standard
   h. ANSI/TIA-492A: Detail Specification for 850-nm Laser Optimized 50-µm Core Diameter/125µm Cladding Diameter Class 1a Graded Index Multi-Mode Optical Fibers

7. Underwriters Laboratories, Inc.:
   a. UL 486A: “Wire connectors and soldering lugs for use with copper conductors”
   b. UL 1449: “Transient voltage surge suppressors”
   c. UL 1581: “Standard for Electrical Wires, Cables, and Flexible Cords”
   d. UL 478: “Standard for Electronic Data-Processing Units and Systems”
   e. UL 83: “Thermoplastic-Insulated Wires and Cables,”
   f. UL 910: Test Method for Fire and Smoke Characteristics of Cables Used in Air-Handling Spaces” Provide products which are UL-listed and labeled for the application.

8. Federal Communications Commission:
   a. FCC Regulations Part 15 Title 47.

9. Institute of Electrical and Electronic Engineers (IEEE)
   a. IEEE 802.3 - "Carrier Sense Multiple Access with Collision Detection,” and all applicable supplements a through af.”
   b. IEEE 802.3. u-100- “Base T/100-Base-TX, Fast Ethernet"
c. IEEE 802.3. z-“Gigabit Ethernet”
d. IEEE 802.3. ab-“1000 Base T”
e. IEEE 802.3. ae-“10 Gigabit Ethernet”
f. IEEE 802.3. af-“Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)”
g. IEEE 802.11. b/g/n-“Wireless Transmission Standard”

10. Internet Networking Standards: Network hardware and software shall be able to communicate with the Internet and provide for the creation of IP-based networks for the Agency. All supplied hardware shall comply with the following minimum standards and RFC’s as appropriate.

a. MIL-STD - 1777, RFC 971 - Internet Protocol
b. MIL-STD - 1778, RFC 793 - Transmission Control Protocol
c. MIL-STD - 1780, RFC 959 - File Transfer Protocol
d. MIL-STD - 1781, RFC 821 - Simple Mail Transfer Protocol
e. MIL-STD - 1782, RFC 854 - TELNET Protocol
f. RFC 950 - Internet Standard Sub-netting Procedure
g. RFC 1140 - Official Protocol Standards
h. RFC 1156 - MIB Base for IP Networks
i. RFC-1213 - MIB-II
j. RFC-1757 - Remote Monitoring (RMON)
k. RFC 1157 - Simple Network Management Protocol
l. RFC 1720 - TCP/IP, OSI Compliant
m. RFC 1918 - Address Allocation for Private Subnets
n. RFC 1583 - OSPF, Version II
o. RFC 1723 - RIP -II

11. ASTM Compliance: Comply with applicable requirements of D-2219 and D-2220. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).

12. Local Authority Having Jurisdiction

13. National Electrical Manufacturers Association (NEMA)

1.04 SUBMITTALS

A. In addition, to all submittal requirements as stipulated by Division 01 specifications sections, the Contractor shall provide all shop drawing submittals in accordance with the following:

1. The Owner’s Representative approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.

2. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Owner’s Representative to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

3. Submittals shall be provided as a complete submission; no partial
submissions will be accepted. Failure to provide a complete submission shall result in all submittals being returned for resubmission.

a. In addition to all paper submission requirements as stipulated by Division 01 the Contractor shall also submit one complete set of electronic submittals in a PDF format.

4. No substituted equipment shall be reviewed without prior approval in accordance with the requirements of "substitutions" under Division 1 specification section.

5. Mark the submittals, "SUBMITTED UNDER SECTION______________."  
   a. Submittals shall be marked to show specification reference including the section and paragraph numbers.

6. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination requirements refer to Division 01 Specification Sections, which outline basic submittal requirements and coordination. All Division 01 Specification Sections requirements shall be used in conjunction with this specification section.

7. Prior to any submission the contractor shall be responsible for performing the following quality control items to ensure compliance with all project requirements:
   a. Review all Shop Drawings and Product Data
   b. Review all field measurement criteria.
   c. Review all field construction criteria and methodologies.
   d. Review all catalog numbers and similar data.
   e. Review all coordination requirements of affected trades.
   f. Review conformance to all appropriate specification sections.

8. All shop drawings shall be prepared using latest version of AutoCAD, drawn accurately, and in accordance with all Owner's CAD Standards where applicable. The Contractor shall not reproduce the Contract Documents or copy standard information as the basis of the technical data, hand drawn mark-ups of the original project drawings shall not be acceptable. Failure to provide a complete set of “contractor prepared” installation drawings at the time of submittal shall result in all submittals being returned for resubmission.

9. Submission Packaging: The Contractor shall organize the submissions according to the following packaging requirements.
   a. Electronic Copy Submission: One complete set of electronic equipment data sheets and drawings submitted in PDF format and collated in two distinct files:
      1) Equipment Data Sheets, equipment schedules, alarm matrixes cable termination spread sheets, and all related pertinent
information.

2) Drawings including all site plans, floor plans, risers, point to point wiring, grounding, installation details and mounting elevations.

10. The Owner’s Representative review of the shop drawings and/or samples does not relieve the Contractor from compliance with the requirements of the project documents. Unless the Contractor has informed the Owner’s Representative in writing of such deviation at the time of submission, has noted the deviation on the shop drawings, and the Owner’s Representative has given written approval of the specific deviation to the project document, all project requirements shall stand. The Owner’s Representative’s review also does not relieve the Contractor from responsibility for any errors of omission in the submission of shop drawings and/or samples.

a. All project requirements shall stand. The Owner’s Representative review does not relieve the Contractor from responsibility for any errors of omission in the submission of shop drawings and/or samples.

11. Submit all system testing, commissioning and startup procedures to be employed. Include all estimated times for performance of all tests; all test equipment and manpower necessary for testing.

12. Submit all Contractor qualifications and certifications in accordance with the requirements as specified elsewhere in this specification section.

13. Submit project schedule outlining the time frames for all equipment with long lead times for equipment deliveries; include all system commissioning, testing, and training time expectations. Project schedule shall be submitted as CPM schedule and shall utilize a software based project management program.

14. Submit all system testing and startup procedures to be employed. Include all estimated times for performance of all tests, test equipment and manpower necessary for testing.

15. Submit all Contractor qualifications and certifications in accordance with the requirements as specified elsewhere in this specification section.

16. Submit project schedule outlining the time frames for all equipment with long lead times for equipment deliveries; include all system commissioning, testing, and training time expectations. Project schedule shall be submitted as CPM schedule and shall utilize a software based project management program.

B. Shop Drawings:

1. All shop drawings shall include sufficient information, clearly presented, to determine full compliance with all project drawings and specifications. Include the following information as applicable for review, failure to provide all information listed below shall result in all shop drawing submittals being returned for resubmission:

a. All Building Floor and Site Plans.
b. All equipment, devices and components with manufacturer’s name(s), model numbers,
c. All equipment, device and component electrical ratings and power requirements
d. All equipment, device, and component performance ratings.
e. All equipment/device battery calculations,
f. All equipment/device voltage drop calculations,
g. All equipment rack/cabinet layouts and rack/cabinet sizes.
h. All device-mounting elevations.
i. All device wiring details.
j. All grounding and bonding connections.
k. Complete point-to-point-wiring diagrams for all systems. Include all equipment and wiring termination schedules and/or matrices.

2. Provide a complete set of “contractor prepared” installation drawings. Drawings at the minimum shall consist of floor plans indicating all; passive and active electronic component locations, field devices, device identifications, distribution racks, patch panels, control panels, auxiliary control panels, power supplies, conduit and cable requirements as well as all 120 volt electrical circuit locations and designations.

a. Drawings shall include at the minimum the following;

1) Detailed equipment layouts for all communications rooms. Coordinate all room layouts with affected trades.
2) Floor plan drawings showing locations of all equipment, devices, equipment cabinets and/or rack locations. Identify type and sizes of all equipment cabinets and/or racks.
3) All cable tray layouts, and conduit routing of all conduits 2 inches in diameter or greater.
4) System riser diagrams and single line drawings
5) Equipment wattage for each location and estimated BTU production.
6) Detailed equipment layouts for all equipment consoles. Indicate all equipment locations, power connections, and installation details.
7) All equipment mounting hardware/brackets and installation details, identify type size, load capacities of all mounting hardware/brackets; include all mounting and installation details, all space requirements, any special architectural modifications required.
8) Outline drawings of all equipment cabinets/racks showing the relative position of all major components, all-wiring and grounding terminations. Include all panel, cabinet and/or rack dimensions.
9) Point-to-point wiring diagrams for all cabling. Include all cable drop identification at edge device and at termination equipment. Include
complete wiring termination schedules.
10) All grounding and bonding termination points
11) All electrical circuit numbers and distribution panel locations.

3. Provide a complete termination schedule of all communications device
drop/outlet locations; indicate on the installation drawings all device
drops/outlets’ unique identification which shall correspond with schedule
and drawings.

C. Equipment Submittals:

1. Sufficient information, clearly presented, shall be included to determine
compliance with drawings and specifications.
   a. Include all equipment data sheets pertinent to equipment provided. All
data sheets shall be highlighted indicating specific equipment
supplied. Failure to provide the proper annotation of all equipment
shall result in submittals being returned for resubmission.

2. Submit complete technical data necessary to evaluate the material and
equipment. Include a complete technical specification for the submitted
equipment, noting differences and adherence to this Section. Failure to
provide the required data will result in all submittals being returned for
resubmission.

3. Submit performance data, equipment ratings, cable requirements, control
sequences, GUI based control panels, programming matrixes, logic
diagrams and all other descriptive data necessary to describe the
installation and operations of the system being provided. Failure to provide
the required data will result in all submittals being returned for
resubmission.

4. Parts list which shall include those replacement parts recommended by the
equipment manufacturer, quantity of parts, current price, and availability of
each part.

D. Maintenance and Operation Manuals: Submit in accordance with all
requirements of Division 01 specification sections and as herein specified.

1. Maintenance and Operation Manuals: Submit as required for systems and
equipment specified in the technical sections. Furnish four copies, bound in
hardback binders, (manufacturer's standard binders) or an approved
equivalent. Furnish one complete manual as specified in the technical
section but in no case later than prior to performance of systems or
equipment test, and furnish the remaining manuals prior to contract
completion.

2. Inscribe the following identification on the cover: the words "Maintenance
and Operations Manual", include the name and location of the system,
equipment, building, name of Contractor, and contract number. Include in
the manual the names, addresses, and telephone numbers of each
subcontractor installing the system or equipment and the local
3. Provide a "Table of Contents" and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.

4. The manuals shall include:

   a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
   b. A control sequence describing start-up, operation, and shutdown.
   c. Description of the function of each principal item of equipment.
   d. Installation and maintenance instructions.
   e. Safety precautions.
   f. Diagrams and illustrations.
   g. Testing methods.
   h. Performance data.
   i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
   j. Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

5. Approvals will be based on complete submission of manuals together with shop drawings.

6. After approval and prior to installation, furnish the Owner’s Representative with one sample of each of the following:

   a. A 300 mm (12 inch) length of each type and size of wire and cable along with the tag from the coils of reels from which the samples were taken.
   b. Each type of conduit and pathway coupling, bushing and termination fitting.
   c. Raceway and pathway hangers, clamps, and supports.
   d. Duct sealing compound.

1.05 QUALITY ASSURANCE

A. Contractor Qualifications: The projects’ Information Communications Technology Contactor (ICTC) shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing and programming of all equipment being provided.

   1. The ICT contractor shall be capable of providing documented successful work experience of at least three (3) facilities of equivalent size and technical requirements utilizing the proposed equipment being provided. The system Contractor shall have on staff a minimum of one full time individual that holds a current RCDD registration.

   a. All information technology system work shall be certified in writing to
The Owner and the Design Professional by on staff RCDD professional asserting that all communications network system shop drawings and structured cabling is in conformance with all appropriate NEC requirements, EIA/TIA standards; BICSI recognized installation practices and all related specification sections.

2. Cable Installer Qualifications: The cable installation contractor shall demonstrate not less than three (3) years’ experience in the installation of structured cabling systems and shall have on staff a minimum of one full time member that holds a current BICSI level II installer credential.
   a. NOTE: The installation of all communications cabling shall be under the direct supervision of a current BICSI level II installer who shall be knowledgeable in the following technical applications:
      1) The Routing and installation of shielded, unshielded, twisted pair, coaxial and fiber optic cables.
      2) Bonding and grounding of cable tray and equipment racks.
      3) Fusion splicing of fiber optic cabling.
      4) Testing copper conductors for electrical continuity.
      5) Testing and Certifying of UTP structured cabling for attenuation and worst case near end cross talk.
      6) Testing and Certifying of ALL fiber optic cabling employing an Optical Time Domain Reflectometer (OTDR) in accordance with TIA/EIA protocols.
      8) Termination, connection, and testing of shielded and un- shielded twisted pair cable, coaxial cabling, and fiber optic cabling on all specified connectors, electrical protection blocks, termination blocks, and patch panels.
      9) Generally accepted industry standards, as well as manufacturers written installation instructions, will be used for in-process quality control and final acceptance of the work installation.

3. The Owner and Owner’s Representative reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval
   a. Experience shall be defined as the completion of the specific system being provided, with that system being successfully operated by the Owner for its intended purpose for at least three (3) years.
   b. In addition to the above “Experience” shall also be defined as the completion of modifications and renovations to any associated system being provided in any existing occupied facility of this size and magnitude.
   c. For each facility submit the following:
      1) Name and location of facility
      2) Date of Occupancy or beneficial use by Owner
      3) Owner’s representative to contact and telephone number
      4) Construction Manager or General Contractor
5) Project Architect or Engineer
6) Provide information on the installed locations with operational equipment
7) Registration number and expiration date of RCDD professional
8) Registration number and expiration date of Level II installer.

4. Service Qualifications: The ICTC shall be a permanent service organization maintained and/or trained by the product manufacturer on the products being provided for this project.
   a. The Contractor shall be (where required) properly licensed by the governing municipality to provide the services and work for the specific system being installed. In addition all Contractors shall be capable of providing full service for the entire warranty period within an 8-hour response time upon notification of a service emergency.

B. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and materials specified for this project, and shall have manufactured the items for at least three years.
   1. Product Qualification: The Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
      a. The manufacturers shall submit the appropriate documentation certifying that the project Contractor is a qualified service provider of all manufacturers’ products being provided for this project.

1.06 RECORD DOCUMENTS

A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections include the following project requirements;
   1. Provide complete set of finalized copies of record documents prior to final acceptance of the project by Owner’s Representative in accordance with all requirements of Division 01 specification sections. At the minimum the record documents shall contain all information, data, and drawings as described in Chapter 1.4 “Submittals” of this specification section.
      a. As-built documents shall be submitted in both paper and electronic media formats in the quantities as specified by Division 1 specification requirements.
         1) All electronic record drawings shall be prepared and submitted utilizing an AutoCAD based program as manufactured by Autodesk. Where electronic documents are prepared using other than an AutoCAD program manufactured by Autodesk, the contractor shall provide to the Owner’s Representative the necessary software to electronically view the submitted
documents.

2) All electronic data sheets, control sequences, programming matrixes and other descriptive data shall be provided in PDF formatted documents.

3) Copies of all current system programming and associated software shall be provided on downloadable media formatted for the use in restoration all system operations and functionality in the event of a catastrophic failure.

1.07 SOFTWARE AGREEMENT

A. Included as part of the scope of work for this project the Owner shall retain the ownership and access rights of ALL system programs and software associated with all systems installed and/or modified as part of this project.

1. The contractor shall provide to the Owner’s Representative complete copies of all current software programming and software licenses related to the operation of each system prior to final acceptance of the related Contract scopes of work.

a. All programming shall include but not be limited to all device identifications, device descriptions, Programming Logic Matrixes, all program access level passwords as well as all function and sub-function routines.

2. Programming and software copies shall be provided to the Owner’s Representative on CD or DVD digital formatted media. In addition, the contractor shall provide a complete hard copy printout of all system programming and shall be included as part of closeout documentation for review by the Owner’s Representative.

B. Software and firmware upgrade provisions shall be included as part of this specification requirement and shall include the automatic upgrades as required to maintain all software and firmware to the manufacturers most current revision on all system components installed and or modified as part of this project for duration of the warranty period. This upgrade policy shall require the contractor to install, test, and certify all software and firmware upgrades that become available from manufacturer for a period of one year from date of final acceptance to the expiration of the warranty.

1. Upgrading of software shall include all revised/new software, labor, testing certification as well as all licenses, software and all programming copies as described in this section associated with the installation of all revised software.

2. These updates shall be accomplished in a timely manner, fully coordinated with the system operators, and incorporated into the operations/maintenance and software documentation manuals.
a. One (1) scheduled final update shall be provided near the end of the warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer’s software and firmware for all systems installed and/or modified for this project.

b. All software changes shall be recorded in a log maintained in the unit control. An electronic copy of the most current software update shall be maintained within the log.

1) At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the cover marked “Software Change Log.”

3. Provide not less than thirty days’ notice to the Owner’s Representative to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.08 EXTRA MATERIAL

A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections refer to related specification sections “Extra Material” for specific requirements.

B. All Extra materials shall be provided at the time of final acceptance of the project and a signed packing list shall be obtained at the time of delivery. At no time is the contractor to use the extra materials provided for this project to replace malfunctioning or damaged equipment and or components.

PART 2 – PRODUCTS

2.1 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items that meet and/or exceed the specified performance and features of the equipment and/or systems and for which replacement parts shall be readily available to the system Contractor and/or using agency.

1. When more than one unit, device, or component of the same class of equipment is required, such units, devices, or components shall be the product of a single manufacturer.

2. Acceptable manufacturers for each system shall be as specified and shall be provided in full compliance with the requirements of this and all related specification sections and contract drawings.
a. Manufacturers listed as acceptable shall not negate the contractors’ responsibility for providing all equipment, devices, components, and/or systems, in accordance with all functions and performance requirements of the Contract Documents.

b. Where manufacturer and/or manufacturer model numbers reference specific system components in the related specification sections, it is to establish the performance requirements and quality of the systems and components only.

1) It is in no way an inference that the referenced model numbers are the manufacturer’s current product and are the only acceptable components for this project unless specifically referenced as “no substitutions.”

c. The Contractor shall provide the manufacturers’ most current product that meets and/or exceeds the specified performance and features of the equipment and/or systems.

d. Equivalent UL-listed equipment may be substituted for the approved manufacturers unless stipulated as “No Substitutions” or where approved equal is referenced after the specified system and/or component.

e. Where systems and/or components are referenced as “no substitutions” the specific system and/or component shall be provided.

1) All substitutions shall be submitted for approval by Owner’s Representative in accordance with all requirements of Division 01 and submitted for review in accordance with all requirements of Section 1.04 “Submittals” of this specification section.

2) All substitutions shall comply with all requirements as specified above and all system performance standards shall be maintained.

3) The contractor shall stipulate the following information impacted by such a substitution.

   a) Any and all extensions in time impacted by the substitution.

   b) Any changes to the architectural or structural elements to the project

   c) Differences in operation and/or performance from intended system criteria.

4) Failure to provide the required substitution information shall result in “without consideration” the immediate rejection of the substituted equipment and/or systems.

B. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same
Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.

a. Components shall be compatible with each other and with the total assembly for the intended service.

b. Constituent parts which are similar shall be the product of a single manufacturer.

d. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

C. Where Factory or Off-Premises Testing of any equipment, product or assembly is recommended by the product manufacturer or where specified as part of this section and/or any related specification section:

1. The Owner and/or Owner’s Representative shall have the option of witnessing all factory tests. The Contractor shall notify the Owner and Owner’s Representative at a minimum of thirty (30) working days prior to the performance of any factory or off-premises tests.

a. When factory assembly point for any off-premises testing is not within two (2) hours driving time from the project location, the system Contractor shall include as part of this project all per diem costs (travel, meals and lodging) for a minimum of two representatives from the using agency and the project Owner and/or Owner’s Representative to witness all testing.

2. Provide four (4) copies of certified test reports containing all preliminary test data and testing procedures shall be furnished to the Owner’s Representative prior to any final testing and not more than ninety (90) days after completion of any tests.

3. When equipment, product, or assembly fails to meet any factory or off-premises tests, retesting of equipment, product, or assembly shall be mandated, the manufacturer/contractor shall be liable for all additional expenses, including all expenses incurred by the Owner and Owner’s Representative for witnessing the retesting of any equipment, product, or assembly.

PART 3 – EXECUTION

3.01 EQUIPMENT PROTECTION

A. Protect all materials, equipment, devices, or components permanently installed and/or stored on the job site. Protect all materials, equipment, cabling, devices, or components during construction and after installation, provide appropriate protection of all materials, equipment, components and/or devices until time of
substantial completion. All materials, equipment, components and/or devices shall be protected during shipment and storage against any physical damage, dirt, moisture, cold, snow or rain:

1. During installation, enclosures, racks\cabinets, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of any foreign matter; and shall be vacuum cleaned both inside and outside before testing and operating and repainting if required.

2. Any materials, equipment, components and/or devices, stored on site which have been deemed by the Owner’s Representative to exhibit any indications of damage or exposure dust or moisture shall not be installed and shall returned to the source of supply for immediate replacement.

   a. The use of spare parts or the return of defective equipment for repair to mitigate the damage of defective materials, equipment, components, and/or devices shall not be acceptable. All materials, equipment, components, and/or devices shall be new and unused until final acceptance by the Owner’s Representative.

3. Provide and apply protective material immediately upon receiving the products and maintain throughout the construction process.

   a. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

   b. Any damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious or detectable.

4. Failure to properly protect all materials, equipment, components and/or devices prior to final acceptance shall constitute sufficient cause for rejection of materials, equipment, components and/or devices should any defects, damage or degradation in performance be observed.

B. Immediately replace all malfunctioning materials, equipment, components, and/or devices with new unused products up until the time the Owner’s Representative issues final acceptance of the system. The returning of any malfunctioning equipment, devices, and/or components to the manufacturer for repair and then reinstallation at the project site shall not be acceptable.

   1. All replacement materials, equipment, components, and/or devices shall be factory new and not scavenged from the Project’s spare parts inventory or factory recycled products unless expressly identified by contractor prior to replacement and approved beforehand by the Owner’s Representative.

3.02 WORK PERFORMANCE

A. Installation, final termination, testing, start-up and commissioning of all systems,
system components and cabling infrastructures shall be under the direct supervision of the appropriate system Contractor. The Contractor shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing, commissioning, and programming of all equipment, devices, components, and/or systems being provided as part of this project.

B. Job site safety and worker safety is the responsibility of the Contractor. Ensure that safe access and egress from all work areas is maintained during movement and installation of materials. Clean up all debris generated by installation activities. Keep all communications equipment rooms free of debris at all times.

C. Pre-installation Conferences: Include provisions to attend all pre-installation conferences at Project site in compliance with all requirements in Division 01 specification section and as herein specified. Review methods and procedures related to installation and operations of all communications systems, including, but not limited to, the following:

1. Inspect and discuss electrical and equipment roughing-in related to all communications systems as well as other preparatory work required to be performed by other trades.
2. Review and discuss all work, equipment deliveries, installation procedures, and related scopes as required to conform to the phased construction schedule.
3. Review sequence of operations for each type of system, control, cabling and/or integration to any systems and/or equipment provided by other trades.
4. Review and finalize construction schedule and verify availability of materials, installation personnel, equipment, and any preparatory work by other trades needed to make progress and avoid delays.
5. Review required start-up, testing, commissioning, and certifying procedures to be employed for each system and any impacts to other trades.

D. For work on existing facilities, arrange, phase, and perform work to assure the operation of all communications systems for other buildings and contiguous spaces at all times. Refer to Division 01 specification section for additional information.

E. All new work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Division 01 specification sections.

F. Coordinate the installation of all cabling, conduits/raceways, cable trays, racks/cabinets, and equipment with applicable trades to ensure proper operation and function of all integrated systems in accordance with all related specification sections. Refer to Division 01 specification section for additional project coordination requirements.
1. Coordinate with all trades at the time of shop drawing submission detailing all space and/or room conditions. The contractor shall coordinate with the appropriate trade all conditions impacting the installation of any system, conduit, or cable tray including but not limited to all equipment locations, site conditions, ceilings, lighting fixtures, fire protection piping, and ductwork layouts to the satisfaction of all concerned trades, subject to final review by the Owner’s Representative.

   a. Coordinate exact location of all desktop/counter/wall mounted equipment with the Owner and Owner’s Representative and all affected trades prior to the installation of any equipment and/or cabling.

   b. Coordinate exact location(s) of all cable, conduits, equipment and/or devices with all architectural plans, site plans, reflected ceiling plans and affected trades prior to installation.

   1) For equipment installations requiring coordination with other trades, the contractor shall provide all templates, back-boxes and equipment anchor bolts for mounting or flush mounting preparation, (e.g. pedestals or other devices requiring mounting on walls, concrete pads or other materials). Coordinate delivery of templates and equipment anchor bolts to preclude any delay in the construction schedule or the work of the affected trade.

   c. If installation of equipment, devices, cabling, raceways, cable trays and/or conduit is performed prior to coordination with other trades, which interferes with work of other trades or operation and maintenance of the facility, make necessary changes to correct the condition at no additional cost to the Owner.

   d. Prior to the final programming of any systems review with Owner and Owner’s Representative all system features, functions, system operations, network mapping, system integrated responses and all related programming as required for the proper operation of the respective communications systems.

G. The Contractor shall maintain a complete set of current and up to date set of shop drawings and equipment submissions at the job site at all times. The Shop drawings and all other submissions shall be marked up to reflect all as-built conditions and shall be made available for review by the Owner’s Representative upon request.

3.03 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. All system equipment installations shall be in accordance with good engineering practices, NEC, TIA/EIA Standards, local building codes, and all manufacturer’s requirements. Cable terminations at all equipment locations shall comply with all state and local electrical codes. All wiring shall test free from all grounds, shorts, stray
voltages, and EMI.

B. Follow manufacturers' instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the Owner’s Representative before installing any equipment. Provide an additional copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.

C. Equipment location shall be as close as practical to locations as indicated on the contract drawings.

1. Provide all equipment clearances in accordance with NEC requirements. Arrange equipment to facilitate unrestricted access for maintenance and service around all equipment, components, and/or cable terminations.

D. Inaccessible Equipment:

1. Where the Owner’s Representative determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the project.

   a. "Conveniently accessible” is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

3.04 COMMUNICATIONS CABLING REQUIREMENTS

A. General

1. Cabling shall be sized to support the appropriate communication system. All communications cable installations shall be in accordance with good engineering practices as established by the TIA/EIA, IEEE and the NEC. All cabling shall meet all state and local electrical codes. All cabling shall test free from all grounds, shorts, and EMI.

2. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between indicated terminations, taps, or junction points. Remove and discard cable where damaged during installation and replace it with new cable.

3. Ensure that all communications cabling supports (conduits, support grips, cable trays, and cable termination panels) are fully installed before proceeding with cable installation.

4. The Contractor shall not permit any communications cabling to lie unprotected on the floor at any time. If cables must be left on any floor,
protect the cables so that they may not be walked on or have any material or equipment placed or rolled on top. Replace all damaged cables from demarcation to termination point; no splicing of damaged cables shall be permitted.

a. At no times shall any cables be installed and left unsupported, nor shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports. Do not tie-wrap or permanently affix cable bundles to approved cable supports.

5. Maintain manufacturers recommended minimum bend radiuses of all cabling. Do not stretch, stress, tightly coil, bend, or crimp cables. The Contractor shall keep all cabling out of the way of other trades during staging of any work. The contractor at the contractor's expense will replace all severely stressed or damaged cables, equipment, and materials as determined by the Owner's Representative.

B. Premise Network Communications Cabling (UTP Structured Cable)

1. All premise network cabling is to be UTP Category-6 and concealed above suspended ceilings, bundled and independently supported to the building structure. All cabling bundles shall be plenum rated installed in dedicated conduits routed to cable trays, conduits shall not contain any AC carrying conductors or non-associated communications network cables.

a. All network cabling located above accessible suspended shall be installed in dedicated conduits, exposed cabling supported by the use of “J” hooks shall not be accepted.

b. All horizontal data drops shall be terminated on Category-6 patch panels installed on the 19” equipment racks\cabinets.

c. All data drops and backbone cabling installed above inaccessible ceiling spaces or areas containing no ceiling shall be installed in dedicated conduits. In no case shall cable be supported on ceiling tiles, T-bars, or tie- wrapped to any conduit or pipes.

1) Category-6 cables shall not be cinched too tightly; all cable bundles at patch panel locations and in the field shall be VELCRO type tie-wraps only. Plastic wire ties shall not be accepted on any Category-6 cabling.

2) Each network drop shall be a dedicated Category-6 cable and shall not exceed a maximum distance of 295 feet from the associated communications room termination panel to the furthermost data port for that network drop.

3) Cable Support: Mechanically secure to the permanent building structure where not installed in raceway. Provide “J” hooks at regular intervals no greater than 5’ apart depended appropriate to
Communications systems cabling supports (conduits, support grips, cable trays, and termination patch panels) are fully installed before proceeding with cable installation.

2. Fiber Optic Cabling
   a. All fiber optic cabling shall be provided to meet the communications requirements for all network communications systems. At the minimum, all fiber optic cabling shall be sized in accordance with the project documents. All fiber optic cabling shall be a minimum 8.3/125µm OS2 type cabling installed in accordance with all requirements of contract drawings and/or related specification sections.

   1) All fiber optic cabling shall be a continuous segment from demarcation to termination point and shall be installed above accessible ceilings wherever possible. All fiber optic cabling shall be supported to the building structure and shall be plenum rated armored type cabling installed on “J” hooks or in cable trays, or plenum rated non-armored type fiber optic cabling installed in dedicated conduits.

      a) Installation of all fiber optic cabling shall be in accordance with all guidelines established by the product manufacturer and all referenced industry standards.

      b) Special care shall be taken to avoid damage to the cable. While under pulling tension, the cable shall not be bent into a curve with a radius of less than twenty (20) times the
cable diameter, or no less than manufacturers minimum.

(1) Pulling tension shall not exceed manufacturer's recommended maximum tensile load. Contractor shall utilize a winch with tension control or a "break-away" link designed to break away at or below the recommended maximum pulling tension.

(2) Use methods and lubricating compounds on cables and wires to prevent damage to material and products during roughing-in. Provide compounds that are not injurious to the cable and wire jackets that do not harden or become adhesive.

2) "All exterior fiber optic cabling shall be rated for exterior outside plant (OSP) applications and installed in dedicated inner-duct conduit system, and routed in the exterior conduit ducts in accordance with the requirements of the contract documents. Outside plant cable shall not extend more than fifty (50) feet into a building interior before terminating and transitioning to indoor fiber optic cable.

3) Fiber optic cabling shall be provided as the primary media for any exterior network components installed remote to building, as well as all network communications links for all backbone communications.

   a) The contractor shall be responsible for the determination of actual segment lengths. Actual quantities will be calculated by the routing as indicated on the contract drawings and/or in the field based on existing conditions.

4) Conductive fiber optic cable shall be provided for all exterior system components requiring control and/or power capabilities in the support of their operation, include all necessary surge protection and grounding for conductive cabling.

5) Refer to related specification sections for additional information related to cabling types, sizes, and testing requirements.

C. Environmental Conditions

1. Systems, components, devices materials, and equipment shall be capable of withstanding the environmental conditions of the space without mechanical or electrical damage or degradation of operating capabilities or performance.

   a. Interior, Controlled Environment: System components, installed in temperature-controlled interior environments shall be rated for
continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 1 enclosures.

b. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 4X enclosures.

c. Exterior Environment: System components, conduits and backboxes installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rated for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick shall utilize NEMA 250, Type 4X enclosures.

d. Hazardous Environment: System components, conduits and backboxes 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.

e. Corrosive Environment: System components, conduits, and backboxes subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, shall utilize NEMA 250, Type 4X enclosures.

f. Submersible Environment: System components, conduits and backboxes subjected to prolonged submersion in water, shall utilize NEMA 250, Type 6P enclosures.

g. Areas where equipment and devices may be subject to damage by the general population shall be installed in vandal resistant enclosures, all fire alarm devices shall be provided with wire guards.

h. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

D. Conduits/Raceway/Cable Trays:

1. Provide conduit and raceway systems for all communications networks as indicated below. Refer to all related specification sections for additional conduit and raceway information.

a. Accessible suspended ceilings: Provide conduit stub-up from each outlet location to intestinal space above ceiling. Route all conduit stub-ups in dedicated conduits to cable tray.

b. Exposed structure: Provide conduit run from each drops to a height of 12 feet to cable tray where provided.
c. Use Vertical Wire runway to support riser cabling between floors in communications closets or accessible locations; in no case shall any riser cabling be unsupported.

d. Cables entering all communications equipment rooms shall be supported with Cable tray from entrance to rack/cabinet location as indicated on the contract drawings and/or herein specified.

e. Wire basket cable tray system shall be provided in all corridors as indicated on the contract drawings and installed as herein specified.

2. All conduits/raceways shall be concealed and shall be installed above accessible finished ceilings and/or in walls. Any conduits/raceways installed in areas requiring installation to be exposed, shall be installed as tight as possible to ceilings at right angles to walls, and shall not obstruct any access hatches, equipment service panels, lighting or other equipment and/or devices. No exposed conduits/raceways shall be installed without prior approval of the Owner’s Representative.

a. Where conduits cannot be concealed above ceilings or in walls and must be installed in finished or occupied areas of the building, all conduits shall be finished wire-mold type raceways or approved equal. Finished wire-mold type raceways shall not be installed without prior approval in writing by the Owner’s Representative.

b. Where any equipment and/or junction boxes are installed above non-accessible finished ceilings, the contractor shall provide access hatches listed for the intended application. Access hatches shall be located so that service access to the equipment and/or junction boxes are unimpeded. Refer to related specification section for additional information for access hatches.

1) Access hatches shall not obstruct any equipment, service panels, lighting equipment, devices, or any architectural elements of the ceiling. At the time of submittals the contractor shall submit all proposed access hatch locations for review by the Owner’s Representative.

c. All conduits/raceways shall be supported in accordance with NEC requirements and shall be affixed in such a manner that tampering and/or removal without the use of specialized tools shall be prevented.

d. All conduits/raceways shall be installed in a manner that prevents tampering or removal when installed in areas exposed to the general population.

1) Provide tamper-resistant installation utilizing “torx with peg” security-fastening devices for all conduits/raceways, equipment, devices and appurtenances in all areas accessible to the general population.
population and/or areas subjected to tampering or vandalism.

e. Interior raceways shall be a minimum 1 inch unless otherwise noted. Exterior raceways shall be a minimum 1 1/4-inch. Size all raceways and install conductors in accordance with NEC requirements. Fill ratio shall not exceed 40 percent for indoor raceways or exterior raceways.

1) EMT conduit with nylon shall be utilized in all inaccessible ceiling areas unless otherwise restricted by code.

2) Threaded Rigid metal conduit shall be used on all exterior applications, stub-ups and all interior areas where concealed conduit requirements cannot be met and are exposed to tampering or damage by the general population.

   a) All areas considered being of high risk due to the nature of the occupancy or the need to protect and maintain the integrity of the cabling shall be installed in rigid threaded conduits.

f. Outlet Boxes: shall be 4 x 4 x 2-1/8 inches deep for all data outlet locations and single gang for wall mounted telephone locations.

1) All outlet boxes shall be provided with single or dual gang device mud-rings flush to finished wall as required based on type and configuration of outlet and type of wall construction.

2) Use deep masonry boxes at masonry construction. T-Bar hangers or other appropriate mounting hardware shall be utilized to support boxes mounted in the ceiling.

g. Provide pull rope in all empty conduit runs with not less than 12 inches (30 cm) of slack both ends.

3. Cable Trays (Communications Rooms): Provide cable trays in all communications rooms and closets for routing horizontal distribution and backbone communications cables. All cable trays shall be constructed of aluminum with two side rails and 9" rung spacing. Cable tray shall be complete will all materials, miscellaneous hardware and all appurtenances required for a complete cable distribution and support system.

   a. All cable tray widths shall be sized according to the total number of cables to be supported within the various trays plus an additional 100% spare capacity for future expansion capability. At the minimum all cable trays installed in communications rooms and closets shall be a minimum of 24" wide by 4" deep.

   b. Install cable tray in a manner ensuring that all circuits fully comply with all ANSI/TIA/EIA standards.
1) Maintain a minimum clearance of 24” between top of cable tray and ceiling structure or other equipment or raceway.
2) Maintain a minimum clearance of 12” between bottom of cable tray and top ceiling grid or other equipment or raceway.
3) Maintain a minimum clearance of 24” from all conduits or cables used for electrical power distribution.
4) Maintain a minimum clearance of 12” between bottom of cable tray and top of equipment racks and/or cabinets.
5) Maintain a minimum clearance of 24” from fluorescent lighting. All Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.
6) Cable tray supports shall be attached to the structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray’s weight and required cable weight and volume.
7) Do not attach cable tray supports to ceiling support system or other mechanical support systems.
8) Load span criteria: Install tray supports in accordance with the load criteria of L/240.
9) Cable Trays shall be supported at 6-foot intervals and within two feet of a junction.
10) All Cable trays shall be installed without burrs, sharp edges, or projections, which may damage cable insulation.
11) All lengths or sections of cable tray shall be bonded and grounded in accordance with NEC, EIA/TIA, and IEEE.

c. Follow manufacturers' instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the Architect before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.

4. Cable Trays (Corridors and Open Areas) Provide basket type wire cable trays as indicated by the project drawings and/or as herein specified. Include all required connector assemblies, clamp assemblies, connector plates, splice plates, and splice bars. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features:

a. All cable tray widths shall be sized according to the total number of cables to be supported within the various trays plus an additional 100% spare capacity for future expansion capability. At the minimum all cable trays installed in corridors and open areas shall be a
minimum of 12" wide by 2" deep:

b. Install cable tray in a manner ensuring that material and cabling is fully compliant with all ANSI/TIA/EIA standards:

1) Maintain a minimum clearance of 8" between top of cable tray and ceiling structure or other equipment or raceway.
2) Maintain a minimum clearance of 6" between bottom of cable tray and ceiling grid or other equipment or raceway.
3) Maintain a minimum clearance of 48” from all motors or transformers.
4) Maintain a minimum clearance of 12" from all conduits or cables used for electrical power distribution.
5) Maintain a minimum clearance of 12" between bottom of cable tray and equipment racks and/or cabinets.
6) Maintain a minimum clearance of 24" from fluorescent lighting.

All Pathways shall cross perpendicular to fluorescent lighting and electrical power cables or conduits.

7) Cable tray supports shall be attached to the structural ceiling or walls with hardware or other installation and support aids specifically designed for the cable tray and designed to support the cable tray’s weight and required cable weight and volume.
8) Do not attach cable tray supports to ceiling support system or other mechanical support systems.
9) Load span criteria: Install tray supports in accordance with the load criteria of L/240.
10) Cable Trays shall be supported at 6-foot intervals and within two feet of a junction.
11) All Cable trays shall be installed without burrs, sharp edges, or projections, which may damage cable insulation.
12) All cable trays shall be bonded at each length and shall be properly grounded to the building steel.

c. Follow manufacturers' instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the Owner Representative before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.

E. Penetrations of Walls and Floors

1. All wall/floor penetrations are to be sleeved and fire stopped with approved fire stopping material or sealant as applicable for the type of penetration. Coordinate all cable and conduit penetrations of building with all affected trades. Refer to all related specification sections for additional wall/floor
penetration requirements.

a. All penetrations of rated walls and floors shall be fire stopped in accordance with the ASTM and NFPA standards. Refer to related specification sections for additional information.

b. Floor penetrations shall be sleeved with a minimum sleeve diameter of 4 inches. An additional penetration shall be provided for future use, sleeved, and capped and fire stopped as required.

c. Coordinate size of wall penetration with conduit size, number of conductors. Comply with all NEC requirements.

d. The fire rating of all penetrated walls, floors, and ceiling structures shall be strictly maintained. All penetrations shall be fire-stopped and sealed by the Contractor.

e. Install fire-stopping in open penetrations and in the annular space of penetrations for fire rated barriers.

f. Installation of fire-stops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer’s detailed installation procedures.

g. Installation of all fire-stopping shall be in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer’s recommendations, local fire and building authorities, and applicable codes and shall be installed in a manner acceptable to the authority having jurisdiction.

3.05 ELECTRICAL POWER DISTRIBUTION

A. All 120/208 emergency electrical power shall be provided by this Contractor from the nearest emergency distribution panel as required for the proper operation of all communications systems, devices and/or components. Coordinate with Owner's Representative prior to connections and/or modifications to the electrical distribution panels. Additional locations requiring electrical power by the specific products and/or Contractor selected equipment shall be the responsibility of this Contractor to include as part of this project.

1. Primary power for all premise network communications systems shall be configured to switch to emergency backup power sources automatically when primary power is interrupted without degradation of any critical system functions.

a. All electrical power shall be hardwired to the panel, system components or panels employing the use of plug-in transformers, extension cords or cheater cords for the connection to electrical power shall not be acceptable.

1) If no spare 20A/1P circuits are available for use, the contractor shall provide a new subpanel adjacent to the existing panel. Remove (3) 20A/1P breakers and replace with a 60A/3P breaker to feed the subpanel.

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2) Subpanel shall be 60A MLO with 18 circuits. Reconnect the (3) 20A/1P circuits to this new panel. Extend branch wiring as required. The Contractor shall size feeder to subpanel per the national electric code.

3.06 TRANSIENT VOLTAGE SUPPRESSION

A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade, except fiber optic cables, which serve as communications, control, or signaling circuits shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection.

1. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator.

2. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be acceptable for surge protection applications. All inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference at the minimum surge suppression test shall meet the following criteria.

   a. All system power supplies serving exterior system components or devices shall be provided with the appropriate transient surge suppression protection on both the line side as well as the load side.

      1) A 10-microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.

      2) An 8-microsecond rise time by 20-microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.

      3) Maximum series current: 2 AMPS. Provide units manufactured by Advanced Protection Technologies, model # TE/FA 10B or TE/FA 20B or approved equal.

      4) Operating Temperature and Humidity: -40 to 85 degrees C (-40 to 185 degrees) shall be the minimum performance requirements. Provide surge suppression in accordance with all manufacturers requirements.
3.07 GROUNDING AND BONDING

A. All electronic equipment, conduits, cable trays, racks/cabinets and cable shields shall be properly grounded and bonded in accordance with all requirements of EIA/TIA 607-A, NEC 250 and IEEE 1100. Where identified as applicable to the project, all equipment grounding and bonding shall be in accordance with all related specification sections and Motorola R56 Standards and Guidelines for Communications Sites.

1. A Telecommunications Grounding System shall be installed in all communications equipment rooms. Grounding system shall provide equalization of the grounding potentials between the building power system and the telecommunications main grounding bus-bar (TMGB) as well as all telecommunications grounding bus-bars (TGB). Grounding bus-bar shall provide the diversion of electrical transients from the telecommunications cables and to provide a safety ground for all equipment racks/cabinets, conduits, cable trays and cable shields as well as providing the required coupling to cancel and/or reduce transients.

   a. The TMGB and each TGB shall be provided where indicated on the drawings and shall provide an effective bonding connection to the nearest approved building grounding electrode (e.g., structural steel) as well as to the local power distribution panel grounding system (e.g., ac branch circuit panel board’s equipment grounding bus-bar).

      1) The minimum bonding shall be #6 AWG copper conductor connected to the TMGB and all TGB’s. Connections shall be 2-hole NEMA type compression or exothermic welded connections.

2. All grounding connections shall provide the equalization of all grounding potentials between the building power system and the grounding terminations at the communications equipment in order to provide the diversion of electrical transients as well as providing the necessary coupling in order to cancel and/or reduce any voltage transients.

   a. Equipment Grounding: Metallic structures, equipment racks, cabinets and enclosures as well as all raceways, cable trays, junction boxes, outlet boxes, machine frames, and other conductive items shall be bonded and grounded.

   b. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing any voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the grounding bus, to all manhole hardware and ground rods, to the cable shielding grounding provisions for all cable splices, terminations and equipment enclosures.

   c. Metallic Fences equipped with communications equipment: Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.

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Communications Systems
1) Drive ground rods until the top is 300 mm (12 inches) below grade. Attach a No. 4 AWG copper conductor, by exothermic weld to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 300 mm (12 inches) of fence mesh and fasten by two approved bronze compression fittings, one to bond wire to post and the other to bond wire to fence.

2) Each gate section shall be bonded to its gatepost by a 3 by 25 mm (1/8 by one inch) flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3. All connections of grounding conductors to ground rods, bus bars, rebar, structural members, pipes and fences, as well as splices of any ground conductors, shall be made by exothermic welds except where otherwise noted.

4. All connections to bar lugs shall be exothermic weld or compression type connections. Bolted type connection of ground conductors may only be made where terminal lugs or blocks have been furnished and installed in equipment by the manufacturer.

a. Equipment grounding conductors shall be insulated stranded copper, except for sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be permitted to be identified per the NEC.

1) At the minimum bonding connection shall be a #6 AWG copper conductor. All grounding shall provide an effective bonding connection between the protected equipment to the nearest approved building grounding electrode (structural steel) as well as to the local power distribution panel grounding system (e.g., ac branch circuit panel board’s equipment grounding busbar). All bonding and grounding connections shall be NEMA type compression or exothermic welded connections.

5. Refer to related Division 26 specification sections for any additional grounding and bonding requirements.

3.08 EQUIPMENT IDENTIFICATION

A. Identify all system controls, components and equipment cabinets using plastic laminate engraved ("lamicoid") labels, or approved equal. Firmly affix to the panel, device, and/or component. Refer to all related specification sections for additional information.

1. Nameplates shall be laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates
with screws. Nameplates that are furnished by manufacturer as a standard catalog item or where other method of identification is herein specified. Dymo or Kroy tap adhesive backed lettering shall not be acceptable.

2. Color-code all junction boxes and enclosures per NEC recommendations. At the minimum provide all communications junction boxes as follows:

   a. Color for Data circuits - Orange.
   b. Color for Telephone circuits - White.
   c. Letter all pull boxes and junction boxes located in service areas, tunnels, above accessible ceilings and pipe chases with laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws.

      1) Example: Telecommunications “TEL” Circuit Number TEL-126. Engraved laminated plastic tags shall be used for identification and securely fastened in accordance with all project requirements.

3. Permanently label all cabling at both ends with self-adhering plastic labels.

   a. Labeling: handwritten labels are not acceptable. All labels shall be machine printed on clear or opaque tape, stenciled onto adhesive labels, or type written onto adhesive labels. The font shall be at least one-eighth inch (1/8”) in height, block characters, and legible.

      1) The text shall be of a color contrasting with the label such that it may be easily read. If labeling tape is utilized, the width of the tape shall not exceed 3/8,” and the font color shall contrast with the background.

      2) All data patch panels shall exhibit data drop numbers, in sequential order, for all workstations served by the associated communications drops and/or equipment.

      3) Each fiber optic cable segment shall be labeled at each end with its respective communications network identifier.

      4) Warning Tags: At each location where the fiber cable is exposed to human intrusion, it shall be marked with warning tags. These tags shall be yellow or orange in color, and shall contain the warning: "CAUTION FIBER OPTIC CABLE." The text shall be permanent, black, block characters, and at least 3/16” high.

         (a) A warning tag shall be permanently affixed to each exposed cable or bundle of cables, at intervals of not more than five (5) feet. Any section of exposed cable which is less than five (5) feet in length shall have at least one warning tag affixed to it.

4. Provide typewritten circuit directories installed in 3-ring binders with
transparent page protectors in each control and sub control cabinet and/or equipment rack.

3.09 MAINTENANCE & SERVICE

A. General Requirements

1. The Contractor shall provide all services required and equipment necessary to maintain the all communications systems associated with this project in fully operational state as specified after formal written acceptance of the system.

   a. Provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. Refer to Division 1 specification section for additional information.

   b. The adjustment and repair of the communications systems shall include all software and firmware up-dates on all computers, CPU's, HMI terminals, devices, communications and data transmission medias’ (DTM), facility interface processors, signal transmission equipment and processors.

   c. Test, inspect, and service each system on a semi-annual basis at six month intervals during the warranty period from the time of final acceptance. The contractor shall compare each six month test results with the test results at the time of final acceptance.

      1) The contractor shall include as part of the semi-annual test the calibration and/or adjustment of any device, component, and/or system that has deviated from the original test results at the time of final acceptance.

   d. For each semi-annual maintenance period, provide written notification to the Owner’s Representative of the systems condition before and after service, the exact components that were tested and serviced, and overall status of the system.

B. Personnel

1. Service personnel shall be manufacturer certified in the maintenance, testing, and repair of the type of system and equipment provided for the project. Provide the Owner’s Representative the name of the designated service representative, and of any change in personnel.

   a. The Owner’s Representative shall be provided copies of system manufacturer certifications for all designated service representatives.

2. Schedule of all work to be performed during regular working hours, Monday through Friday, excluding federal holidays.

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C. Emergency Service

1. The Owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner’s Representative with an emergency service center telephone number. The emergency service center shall be staffed 24 hours a day 365 days a year. The Owner’s Representative shall have sole authority for determining catastrophic and non-catastrophic system failures.

   a. For catastrophic system failures, the Contractor shall provide same day eight (8) hour service response with a defect correction time not to exceed sixteen (16) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner’s Representative determines will place the facility(s) at increased risk.

   b. For non-catastrophic failures, the Contractor within 1 business day with a defect correction time not to exceed 48 hours from time of notification.

D. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

E. Work Request

1. The Contractor shall separately record each service call request, as received. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion.

2. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

F. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Owner’s Representative. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Owner’s Representative. Any modifications made to the system shall be incorporated into the operation and maintenance
3.10 WARRANTY

A. Warrant material and workmanship for a period as specified in Division 1 of the contract documents and all related specification sections. The warranty period shall commence from the date the Contractor received written notification of final acceptance from the Owner’s Representative. At the minimum the contractor shall provide warranty provisions:

1. Warrant the replacement of defective components/materials and/or correct defective work when given notice by the Owner’s Representative during the warranty period.

   a. At no time is the contractor to use the extra materials provided under the scope of this project to replace malfunctioning or damaged equipment and or components. The Contractor shall replace all malfunctioning or damaged equipment and or components with new. The repair and then reinstallation of malfunctioning or damaged equipment shall not be acceptable.

2. Warranty excludes liability for consequential incidental, or special damages due to vandalism, misuse, or acts of god.
3. Onsite warranty response time by qualified technician shall be within 8 hours upon receipt of request from Owner.
4. Warranty repairs shall be provided to the Owner at no cost. This shall include but not limited to replacement of all defective components/materials, all labor charges, all travel costs and all vehicle charges.
5. Response time shall be 7 days a week / 24 hours a day / 365 days a Year.
6. Provide test, inspection, and service of each system on a semi-annual basis at six month intervals.
7. Contractor must provide verification that they maintain their principle base of operation along with the personnel that will be responsible for providing service within 3 hours driving time to the project site. This tenet of the warranty shall remain in effect for the life of the warranty.
8. All TCP/IP based communications systems cabling and related appurtenances shall be provided with the manufacturers 25 year extended warranty in addition to all requirements above.

B. The Contractor shall, as a condition of final payment, execute a written warranty certifying all contract requirements have been completed according to all requirements of the Contract Documents.

1. All system testing, commissioning, demonstration and training shall be performed prior to final system acceptance. All defects or damages due to faulty materials or workmanship shall be replaced immediately without
delay, to the satisfaction of the Owner’s Representative, at the Contractor's expense.

a. The contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty.

b. The warranty period shall be extended until the last inspection and associated corrective actions are complete. Where any equipment and/or labor covered by Contractor’s or manufacturer's warranty, has been replaced, due to failure, the warranty period for any replaced equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work.

2. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

3.11 FIELD SERVICES

A. Notify the Owner’s Representative in writing, prior to the closing of any ceilings and ten (10) days advance of testing all system cabling to prevent delays in construction schedules.

1. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI and EMI conditions exist prior to start-up and commissioning of all components, devices, equipment and/or systems.

a. Before requesting a final inspection, the contractor shall perform a series of end to end installation performance tests. The contractor shall submit for approval by the Owner’s Representative all test procedures to be employed, test result forms, and timetable for testing all fiber optic and UTP structured copper wiring.

b. Acceptance of the simple test procedures discussed below is predicated on the contractor’s use of the recommended products including but not limited to, fiber optic cable, category structured cable, cross-connect blocks, patch panels, and outlet devices specified and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

B. UTP Cable Testing

1. Minimum Test Parameter requirements for Category-6 horizontal cabling.

a. Category-6: Each wire/pair shall be tested at both ends for the following utilizing Contractor generated test results forms:

   1) Wire Map.
2) Length.
3) Insertion Loss.
4) Near-end crosstalk (NEXT) loss.
5) Power sum near-end crosstalk (PSNEXT).
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.
11) Power Sum ACR.

b. All UT cable testing described herein shall exceed Category-6 transmission requirements of ANSI/TIA-568-C. In addition all cable and component transmission performance parameters shall meet or exceed the 1 GbE/s transmission requirements for connecting hardware, per the requirements of TSB-155.

1) Additionally, the installed channel system shall exceed IEEE 802.3 DTE Power specification to (4) times the rated current limits with no degradation of performance or materials and shall be error free Gigabit Ethernet performance to the referenced standard. (All performance requirements shall be verified and documented by a RCDD technician at the time of testing)

c. Channel system shall exceed 4 GbE/s data transmission capacity within the bandwidth of 1 – 250 MHz when configured in a 4-connector channel. The 4-connector channel test configuration shall utilize a Category-6 jack, patch panel, optional 6-110 block, and patch cords, all from the same manufacturer, with qualified Category-6 cable.

d. The 4-connector Category-6 channel performance margins in the table below shall be guaranteed provided the configuration satisfies above requirements.

<table>
<thead>
<tr>
<th>Electrical Parameter (1 - 250MHz)</th>
<th>Guaranteed Margins to Category-6 Channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insertion Loss</td>
<td>3 %</td>
</tr>
<tr>
<td>NEXT</td>
<td>dB</td>
</tr>
<tr>
<td>PSNEXT</td>
<td>dB</td>
</tr>
<tr>
<td>ELFEXT</td>
<td>dB</td>
</tr>
<tr>
<td>PSELFEXT</td>
<td>dB</td>
</tr>
<tr>
<td>Return Loss</td>
<td>dB</td>
</tr>
</tbody>
</table>

2. When errors are found, the source of each error shall be determined, corrected, and the cable re-tested. All defective components shall be replaced and retested. Defective components not corrected shall be reported to the Owner’s Representative with explanations of the corrective actions attempted.
3. Test records shall be maintained using the approved test result forms. The form shall record closet number, riser pair number or outlet ID, outcome of test, indication of errors found (e.g., a, b, c, d, or e) cable length, re-test results after problem resolution and signature of the technician completing the tests.

4. Test results for each 4 pair, Category 6, UTP cable must be submitted with identification to match labels on all patch panel ports and 8 position modular jacks, and identification to match as-built drawings associated with that cable.

5. Owner’s Representative shall observe and verify the accuracy of test results submitted.

6. Contractor shall submit both hardcopy printouts and electronic copy of all trace test results.

C. FIBER OPTIC TESTING

1. Contractor shall test each fiber strand. The Owner’s Representative reserve the right to have a representative present during all or a portion of the testing process. If the Owner’s Representative elect to be present during testing, test results will only be acceptable when conducted in the presence of the Owner’s Representative.

2. Fiber optic cable: each fiber strand shall undergo bi-directional testing for signal attenuation losses.
   a. Test Equipment
      1) Optical Power Meter OPM)(Single/Multimode Fiber)
      2) Optical Time-Domain Reflectometer (OTDR) (Single/Multimode Fiber)
   b. Tests:
      1) All fiber strands (Single and Multimode) shall be tested for attenuation using an Optical Power Meter and for optical link loss using the OTDR.
      2) Multi-mode: signal attenuation at 850 and 1300 nm.
      3) Single-mode: bi-directional signal attenuation at 1310 and 1550 nm.
      4) Test all fiber cable on the reel before installation, with an optical light meter, to ensure fiber continuity and no factory defects.
      5) Test criteria: signal loss of less than (3.6 db for 1000 base-sx @ 850nm for 50 um fiber) through entire passive fiber path, including cable, couplers and jumpers.

3. Fiber Optic Testing Specifications
   a. All testing shall be performed by factory trained and certified
personnel.
b. For all installed fiber optic cable EIA 455-171 Method D procedures will be adhered to (Bi-directionally).
c. Connector loss shall not exceed 0.75 dB per connector pair.
d. The Fiber Optic Cable shall not exceed 1.0 dB kilometer tested at 1310nm and 1550nm for single mode cable.
e. The contractor is responsible for obtaining minimum loss in fiber connections and polishing per manufacturer’s specifications.
f. Pre-installation tests of Inter-plant fiber-pre-test each reel:

1) Test each reel of fiber each strand for continuity with a light source.
2) Then test with an OTDR to determine the nature and location of the defect: Measure end-to-end attenuation and the distance to a high attenuation point.
3) If it is determined by Owner’s Representative that the fiber is defective the contractor shall contact the manufacturer and provide a completely new fiber reel.

g. Tests for installed Inter-plant and Intra-plant fiber optic cable:

1) Intra-plant and Inter-plant Single-mode: Bi-directional signal attenuation at 1310 and 1550 nm. power meter.
2) Interplant Single-mode: Bi-directional OTDR trace at 1310 and 1550 nm. OSP ONLY

NOTE: Obtain the actual index of refraction from the cable Manufacturer before testing.

4. Test Criteria.

a. Total signal loss must not exceed the maximum Attenuation Coefficient plus the maximum Connector Attenuation as listed in ANSI/TIA 568-C.
b. Maximum Link Attenuation shall be as calculated below:

1) Link attenuation is calculated as:
2) Link Attenuation = Cable Attn + Connector Attn + Splice Attn
3) Cable Attn (db) = Attenuation coefficient (db/km) Length(Km)
4) Attenuation Coefficient

   (c) 0.5 dB/km @ 1310 nm for single-mode outside plant cable
   (d) 0.5 dB/km @ 1550 nm for single-mode outside plant cable
   (e) 1.0 dB/km @ 1310 nm for single-mode inside plant cable
   (f) 1.0 dB/km @ 1550 nm for single-mode inside plant cable

5) Connector Attn (db) = number of connector pairs connector loss (dB)

   (a) =2 x 0.75 dB
   (b) =1.5 dB
6) Splice Attn (dB) = number of splices (S) splice loss (dB)
   (a) = 2 x 0.75 dB
   (b) = 1.5 dB

c. “Measured” Link Attenuation shall be compared to “Calculated” Link Attenuation to determine acceptance. The Contractor at no additional cost shall correct any Links that fail.
d. Single-mode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, using not more than one reference jumper.
e. Submit all test reports for approval; an OTDR signature report for every OS2 and OSP cables by strand and a fiber optic link attenuation record report for every cable by strand.

D. Notify the Owner’s Representative in writing, ten (10) days advance of testing of all equipment and/or components to prevent delays in construction schedules.

1. Perform all tests, as required, by authorities having jurisdiction throughout the facility.
2. Test system for grounds to demonstrate that the ground resistance does not exceed the requirements of the National Electric Codes (NEC).
3. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI, and EMI conditions exist prior to start-up and commissioning of all, components, devices, equipment, and/or systems.
4. Test all systems and components for proper function and operation; certify that all systems are in proper working operation in accordance with the Contract Documents prior to scheduling any system demonstrations.
5. Test all fiber optic cabling with Optical Time Domain Reflectometer (OTDR) in accordance with all TIA/EIA protocols.
6. Testing of all communications systems shall be in the presence of the Owner’s Representative as well as all appropriate representatives of the authorities having jurisdiction.

a. All completed communications systems shall be fully tested in accordance with all requirements of EIA\TIA. Upon completion of a successful testing, the contractor shall so certify in writing to the Owner’s Representative that all testing was completed, certified, and left in first class operational condition, include all completed copper and fiber testing read-outs, certifications and test reports.
b. The service of a competent, factory-trained engineer or technician authorized by the equipment manufacturer shall be provided to technically supervise installation and participate during initial system programming, start-up, final testing, assist in the final acceptance testing and Owner demonstrations.
c. At the minimum all acceptance testing, demonstrations and training shall include, but not be limited to the following:

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Communications Systems

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1) Communications Systems Network
2) Integration of all Owner’s Auxiliary Systems

7. In addition provide all testing, commissioning and certifications as specified by Division 01 specification sections and any manufacturer’s recommendations or requirements.

3.12 TRAINING

A. In addition to all demonstration and training as specified by Division 01 specification section and all related Division 16 specification sections, system demonstrations and training shall be provided in accordance with all requirements of this section.

1. Prior to acceptance of the work, the System Contractor shall demonstrate to the Owner’s Representative, all systems and sub-systems all features and functions of each system, and shall instruct the Owner Representatives in the proper operation, event sequences, programming, and maintenance of all systems and sub-systems.

2. The System Contractor shall furnish the necessary trained personnel to perform all demonstrations and instructions and arrange to have the manufacturer’s representatives present to assist with the demonstrations.

3. Training time shall include, as a minimum, the total time determined by the sum of the times per system as specified in this and related specification sections, for performing the prescribed demonstrations/training. Refer to related specification sections for additional training requirements.

a. Allow a minimum of 16 hours’ time for each system provided for performing the prescribed demonstrations/training.

1) Provide a minimum of (4) four 4-hour training classes performed at the project location and spaced over a three week interval. Training classes shall be scheduled not less than 48 hours apart to allow the Owner User\Operators to familiarize themselves with all system operations.

4. Provide operation, parts, and maintenance manuals defining operation and troubleshooting methods of all systems and review with Owner User\Operators as part of training demonstrations.

5. Provide detailed video recordings in high quality digitally formatted media of all demonstration and training of all systems and system operations.

a. Utilize remote microphones as may be required to ensure high quality audio of the recorded demonstrations.

b. Permanently and professionally label all recorded materials and provide self-sealing plastic cases.

B. Inspections
1. At the completion of the project and prior to final acceptance of the Work, provide evidence of final inspections and approvals to the, in accordance with all requirements of the Contract Documents as well as required by the authorities having jurisdiction.

END OF SECTION 16700
SECTION 16800

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PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Project drawings and general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections and stipulated Specification Sections shall apply to this and all related Division 16 specification sections.

B. Related Specification Sections:

1. In addition to the above requirements the following Specification Sections shall also apply to this Section:

   a. Division 16, Section “Basic Electrical Requirements.”
   b. Division 16, Section “Conductors and Cables.”
   c. Division 16, Section “Grounding and Bonding.”
   d. Division 16, Section “Hangers and Supports.”
   e. Division 16, Section “Raceways and Boxes.”
   f. Division 16, Section “Electrical Identification.”
   g. Division 13, Section “Fire Detection and Alarm Systems.”

C. Reference Symbols:

1. All device symbols are defined by the appropriate symbol schedule on the symbols and abbreviations sheet. Not all device symbols as indicated may be required for the project.

   a. Because of the scale of the drawings, symbols are shown on the drawings as close as possible to the mounting location. Contractor shall coordinate exact locations with related drawings and all affected trades prior to submittal of shop drawings.

D. Abbreviations:

1. ASIS: American Society Industrial Security (International)
2. AP: Wireless Access Point
4. BAS: Building Automation System
5. BICSI: Building Industry Consultant Services International – An organization whose primary objective is to enhance the reputation and skills of companies and individuals employed in the telecommunications and security industries by ensuring that current and developing standards are maintained.

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6. **CATV:** Community Antenna Television System – Cable TV Network
7. **CCD:** Charge-coupled device.
8. **CCTV:** Closed Circuit Television Surveillance System.
9. **CMOS:** Complementary metal–oxide–semiconductor
10. **CP:** Consolidation Point - Local Interconnection Point between horizontal cables from the building IDF/MDF rooms and horizontal cables for the furniture drops.
11. **CPU:** Central Processing Unit

12. **DP:** Demarcation Point - The point of interface between the Communications Networks, MATV, any Auxiliary Systems, and the associated Service Providers or Public Utilities. Also known as Entrance Facility. Shall also serve as the primary termination point for all incoming OSP cabling as well as the primary main grounding bus-bar for all communications systems. Refer to project documents for exact location and termination requirements.

13. **DVR:** Digital Video Recorder.
14. **DGP:** Data Gathering Panel – component of the Physical Access Control System (PACS) which provides the portal at the door location to communicate, store and process information received from readers, reader modules, input modules, output modules with the Security Management System CPU and software.

15. **DTS:** Digital Termination Service: A microwave-based, line-of-sight communications provided directly to the end user.

16. **DVT:** Remote digital viewing terminal which shall serve as the video surveillance systems' operator HMI terminal remote from the primary rack mounted HMI.

17. **EMI:** Electromagnetic interference.
18. **EMT:** Electric Metallic Tubing.
19. **EVAC:** UL Listed Emergency Voice Evacuation System. Not to be confused with the building; Public Address/Intercom, Intercommunications and/or Mass Notification systems.

20. **FAS:** Fire Alarm System
21. **FASI:** Fire Alarm System Integrator – Shall be a NICET Level III certified contractor experienced in the installation, programming, testing, and certification of Rescue Assistance, Protected Premises, and Central Station Signaling Fire Alarm Systems as defined by NFPA 72.

22. **GAP:** Graphic Annunciator Panel – A custom fabricated fixed display panel providing operational control and visual display of all alarm and system functions related to the operation of the FAS and/or ESSM as described in related specification sections.

23. **GFI:** Ground fault interrupter.
24. **GUI:** Graphic User Interface – A specialized program employing graphical display maps of a facility and/or site which, also provides a manual user interface for all system functions and operations by utilizing control and annunciation ICON’s from dedicated human machine interface terminals.

25. **HMI:** Human Machine Interface – A Computer-operated, video control terminal complying with FCC Part 15 CFR Title 47, Subparts A and B, and shall utilize multiple dynamic GUI based displays for annunciation and control LCD flat panel computer monitor or display screen as defined by the project plan.
26. ICS: Intercommunications system – Shall include but not limited to all intercoms, public address, clock, program, and auxiliary sound or emergency communications systems as defined by related specification sections.

27. IDF: Intermediate Distribution Frame – The room/space that shall serve as the local termination point for all horizontal and backbone cabling. Also shall be known as Equipment Room (ER), Horizontal Cross-Connect (HC) or Floor Distribution (FD).


30. ITS: Information Transport Systems – For purposes of this specification section ITS shall include all data and telecommunications communications systems including but not limited to all Data, Telephone, Intercommunications (Paging/Public Address), TV Distribution Systems (MATV) and Audio Visual Systems (A/V) and IP based CCTV Surveillance Systems.

31. ITSI: Information Technology System Integrator – Shall be a qualified contractor experienced in the installation and certification of all data, telecommunications, and A/V systems. The ITSI shall be responsible for the design, testing, and certification of Data, Telephone communications systems and all structured cabling systems supporting these technologies.

32. LAN: Local Area Network

33. LCD: Liquid-crystal display.

34. LED: Light Emitting Diode.

35. LV: Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

36. MATV: Master Antenna System – Shall include all TV and media management distribution cabling, termination jacks, head-end components, control, equipment racks, amplifiers, projection equipment, and video monitoring devices as defined by the project drawings and related specification sections.

37. MDF: The Main Distribution Frame – The room/space that shall serve as the primary termination point for all backbone cabling to each IDF locations and horizontal connection point for local communication drops. MDF may also serve as a local IDF location as well as the cross-connection and interconnection of all entrance cables from the DP for all PSTN and WAN connections. Also shall be known as Main Cross Connect (MC), Telecommunications Room (TR) and/or Campus Distributor (CD)


39. MPEG: Moving picture experts group.

40. NEC: National Electric Code

41. NEMA: National Electrical Manufacturers Association

42. NFPA: National Fire Protection Association

43. NTSC: National Television System Committee.

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44. NRTL: Nationally Recognized Testing Laboratory.
45. NVR: Network Video Recorder
46. NVS: Network Video Server
47. OTDR: Optical Time Domain Reflectometer
48. OSP: Outside Plant – All cabling associated with building services supporting the incoming service connections to Service Providers, Public Utilities, and Wide Area Networks.
49. PA: Public Address or Building Intercommunications System.
50. PACS: Physical Access Control System.
51. PIDS: Perimeter Intrusion Detection System
52. PIR: Passive Infrared
53. POTS: Plain Old Telephone Service – Analog Telephone Circuit used for the connection of FAX machines, BAS and FAS communications devices and shall be wired upstream of the facility's telephone switch.
54. PSTN: Public Switched Telephone Network – Connection to local telephone utility providing local telephony communications service.
55. RCDD: BICSI accredited Reregistered Communications Distribution Designer
56. RFI: Radio-frequency interference.
57. RMC: Rigid metal conduit (RMC) is a thick-walled threaded tubing, made of aluminum.
58. RGS: Rigid conduit is galvanized steel tubing, with a tubing wall that is thick enough to allow it to be threaded.
59. RS-232: A TIA/EIA standard for asynchronous serial data communications protocol between terminal devices. This standard defines a 25-pin connector and certain signal characteristics for interfacing computer equipment.
60. RS-485: A TIA/EIA standard for multipoint communications protocol.
61. SCADA: Supervisory Control and Data Acquisition – A system used to monitor and control plant status of facilities scattered over wide geographic areas.
62. SMS: Security Management System – A system incorporating security alarms, door controls, emergency intercoms/paging, duress alarms, and surveillance systems all integrated through a single operating platform, providing centralized command and control capability for the various systems via dedicated human machine interface terminals.
63. TCP/IP: The standard communications protocol that implement the protocol stack on which the Internet and data communications networks operate.
64. TGB: Telecommunications Grounding Busbar – Located in each IDF
65. TMGB: Main Grounding Busbar – Located at the building DP/MDF
66. TP: Transition Point – A location in the horizontal cabling where flat under-carpet cable transitions to a horizontal cabling consolidation point (CP).
67. TVSS: Transient voltage surge suppressor
68. VLAN: Virtual LAN – A technique made possible by switching technologies that permits the logical grouping of any number of network devices into one or more sub-networks.
69. UPS: Uninterruptible Power Supply
70. UTP: Unshielded Twisted Pair
71. VMS: Video Management Software which shall software that incorporates multiple security subsystems (e.g., physical access control, intrusion detection, closed circuit

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television, intercom) into a single platform and graphical user interface.

72. VoIP: Voice Over IP telephone Network
73. WAN: Wide Area Network
74. WLAN: Wireless Local Area Network

E. Definitions:

1. Contract Documents: The documents consisting of the Form of Agreement between Owner and Contractor, Conditions of the Contract, (General, Supplementary, and other Conditions), Drawings, Specifications and all Addenda issued prior to the execution of the Contract.

2. Contract Drawings: The drawings that form a part of the Contract Documents that provides the graphical representation of the project requirements intended design and/or performance criteria to be delivered by the Contractor.

3. Reference Drawings: A drawing and/or set of drawings produced by a proprietary supplier, manufacturer, subcontractor, or fabricator included in the Contract Documents for informational purposes, providing specific information related to the installation of related appurtenances, components, devices, hardware, products, and/or systems. Reference Drawings shall also include any Contract Drawings from prior bid packages that may have pertinent information or require coordination of trades related to this contract.

4. Shop Drawings: A drawing and/or set of drawings produced by the contractor, supplier, manufacturer, subcontractor, or fabricator as a detailed representation of the proper installation of the related, appurtenance, component, device, hardware, product, and/or system to be delivered in conformance to the requirements of the Contract Documents.

1.02 SUMMARY

A. This Section includes basic design requirements necessary to establish a standard of system quality; function and features for the proper installation of a point addressable fire alarm system and shall include all work and equipment as required to provide a fully operational system as indicated on the project drawings and/or herein specified. Refer to related Division 16 and Division 16 specification sections and drawings for additional information.

1. The Division 16 contractor shall act as the prime contractor for the project and who herein shall be known as the “Contractor”.

   a. The FSI shall be a sub-contractor to the Division 16 contractor. The Division 16 contractor shall have overall responsibility for all Division 13 scopes of work related to the installation of the fire alarm system.

B. It shall be the responsibility of the Contractor to furnish and install all necessary cabling, conduits/raceways, cable terminations, devices, and software modifications as well as all appurtenances, programming, commissioning and testing necessary to deliver complete and fully operational fire alarm system as
indicated by all Division 16 specification sections and related contract drawings.

a. The installation, performance, features, functions, software and programming criteria as specified herein as well as all related Division 16 specification sections have been designed to offer the maximum system efficiency, ease of operation, occupant safety and the protection of equipment as recommended by the Owner's Representative. Any deviations from the specified criteria shall be documented, reviewed, and agreed to in writing by Owner’s Representative prior to submission of bids. Refer to Division 1, and all related Division 16 specification sections for any substitutions and/or project deviation requests.

1) The required information shall include but not limited to: reason for deviation, all differences in performance, operation, and function from the herein specified requirements, all benefits, and added features to the Owner as a result of the deviations and any additional incurred costs to the Owner for maintenance and long term ownership.

2) Failure to provide the Owner’s Representative with the required information shall result in any shop drawing submissions being returned for non-conformance with the contract requirements.

b. The contractor and all sub-contractors for this work shall have read all of the General Conditions, Special Requirements, General Requirements, Division 1 and all related specification sections and in the execution of all work shall be bound by all of the conditions and requirements therein.

c. Prior to the submission of the Bid any discrepancies or inconsistencies noted within these specifications and/or the project drawings shall be brought to the immediate attention of the Owner's Representative.

2. All device symbols are defined by the appropriate symbol schedules as indicated by the symbol and abbreviation drawing sheets for each discipline. The Contractor shall coordinate exact locations with all architectural, mechanical, electrical, reflected ceiling, furniture drawings and door hardware specifications as well as all affected trades prior to submittal of bids.

3. All symbols are shown on the contract drawings as close as possible to their intended location. Contractor shall coordinate the installation of all equipment, devices, controls, components, cabling conduits/raceways and integration of other systems with all affected trades and specified system integrators. The contractor shall document all coordination requirements at the time of shop drawing submission.

a. Drawings for this work are diagrammatic and intended to convey the extent, general arrangement, and locations of the work. Because of the scale of the drawings, certain basic items such as access panels, conduits, cabinet sizes, penetration sleeves, pull boxes, back-boxes and junction boxes may or may not be shown on the contract drawings. Include all items where required by code and related
specification sections for proper installation of all work.

b. Where ambiguity exists between the project specifications and the contract drawings, the superior in system performance regardless of cost shall prevail and shall be delivered by the Contractor at no additional expense to the project.

4. Project specifications and drawings may not deal individually with every part, control, device, component, or appurtenance which may be required to produce the equipment performance for the specified system and/or as required for compliance with all specified systems integration.

a. Include such items and components, as required, for complete operational systems as defined by the project documents, whether or not specifically indicated. The contractor shall be responsible for providing conduits/raceways, cable terminations, controls, systems, equipment, materials, devices, components, electrical power, equipment racks/cabinets, software, programming, commissioning, testing and all appurtenances as well as the integration of any ancillary systems or SEPTA provided equipment/components/systems.

b. Coordinate with other applicable trades in submittal of shop drawings and the installation of all systems. All shop drawings shall detail space conditions in order to accommodate other concerned trades, all equipment locations are subject to final review by the Owner’s Representative.

C. Use Of Premises

1. General: The Contractor shall have full use of premises for construction operations as required to meet the scopes of work as delineated by the Contract Documents.

   a. The contractor is reminded that this is, and will continue to be, an operating facility. The contractor shall become completely familiar with all existing conditions of the site, and review all proposed equipment and cable installation requirements, which shall have any impact to the daily operations of the facility with the Owner’s Representative.

2. The Contractor shall design, prepare, schedule, and coordinate all scopes of work without disruption of the existing fire alarm system or the daily operation of the facility. Installation of all communications cabling, conduits/raceways, cable trays, racks/cabinets, and equipment shall be installed and tested prior to switch over and/or disconnecting of any existing fire alarm system or devices.

   a. Include any costs related to any phased construction methodologies having to do with the scope of work defined herein, including, but not limited to, all necessary temporary equipment, devices, components or systems as well as any labor costs associated with any installation, commissioning, testing demolition of the any fire alarm systems required to be performed after normal business hours of the facility.

   b. Prior to the disabling, switchover and/or demolition of the existing fire
alarm systems, components and associated cabling, all new system components, equipment, conduits, cabling, shall be in place, tested and fully operational.

3. The Contractor shall plan, schedule and install all scopes of work in accordance with the requirements of the project construction schedule and shall be coordinated with all the Owner, Owner’s representative and all affected trades prior to commencement of any work. Refer to specification section 01100 "Special Project Procedures" for additional information related to project phasing and scheduling.

   a. This Contractor shall have the responsibility to design, prepare, schedule, coordinate and execute a phasing methodology provide for the continuous operation of the existing fire alarm systems with no operational downtime or zero disruptions to the site.

   b. Upon completion and full testing of the new fire alarm system, and prior to the demolition of any existing fire alarm systems, the contractor shall coordinate with the Owner, Owner’s Representative all proposed system conversions and/or switchover methodologies. This coordination shall include all affected systems, areas of change over, change over procedures, and duration of work to be performed.

   1) The contractor shall coordinate all demolition activities so as not to disrupt the daily routine of the facility or negatively impact the integrality of the facility’s electronic security, premise networks, and life safety systems.

      a) Contractor shall submit a demolition plan for review by the Owner and Owner’s Representative outlining all procedures, means, methods and precautions to be employed in the demolition prior to the commencement of any modification, disconnections, or demolition.

1.03 REFERENCES

A. References to industry and trade association standards as well as all building codes are minimum installation requirements. The codes, standards, and agencies listed below shall form a part of this specification section and all work shall comply with the latest adopted standards.

B. The publications listed below (including amendments, addenda, revisions, supplement, and errata) form a part of this and all related Division 16 specification sections to the extent referenced. The publications are referenced in the text by the basic designation only.

C. Where the contract drawings and specifications mandate a greater requirement or performance than those specified by any of the below referenced codes and standards, the Contract Documents shall then be the governing requirements for this project. The minimum codes and standards to be applied for this project shall be the following:
1. American National Standards Institute (ANSI):
   a. ANSI S3.2-99 - Method for measuring the Intelligibility of Speech over Communications Systems

   b. B3-07 - Standard Specification for Soft or Annealed Copper Wire
   c. B8-04 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

3. Department of Justice: American Disability Act (ADA)
   a. 28 CFR Part 36-2010 - ADA Standards for Accessible Design

4. Institute of Electrical and Electronics Engineers (IEEE):
   c. C62.41-02 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
   d. C95.1-05 - Standards for Safety Levels with Respect to Human Exposure in Radio Frequency Electromagnetic Fields

5. International Building Code (IBC), 2009

6. International Mechanical Code (IBC), 2009


8. ANSI/TIA Compliance: Comply with the following Electronics Industries Association Standards:

   a. NFPA-70: National Electrical Code
   e. NFPA 92A: Standard for Smoke-Control Systems

10. Underwriters Laboratories, Inc. (UL):
    a. 1-05 – Flexible Metal Conduit
    b. 5-04 – Surface Metal Raceway and Fittings
    c. 6-07 – Rigid Metal Conduit
    d. 44-05 – Thermoset-Insulated Wires and Cables
    e. 50-07 – Enclosures for Electrical Equipment
    f. 83-08 – Thermoplastic-Insulated Wires and Cables
g. 294-99 – The Standard of Safety for Access Control System Units
h. 305-08 – Standard for Panic Hardware
i. 360-09 – Liquid-Tight Flexible Steel Conduit
j. 444-08 – Safety Communications Cables
k. 464-09 – Audible Signal Appliances
l. 467-07 – Electrical Grounding and Bonding Equipment
m. 486A-03 – Wire Connectors and Soldering Lugs for Use with Copper Conductors
n. 486C-04 – Splicing Wire Connectors
o. 486D-05 – Insulated Wire Connector Systems for Underground Use or in Damp or Wet Locations
p. 486E-00 – Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
q. 493-07 – Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
r. 514A-04 – Metallic Outlet Boxes
s. 514B-04 – Fittings for Cable and Conduit
t. 51-05 – Schedule 40 and 80 Rigid PVC Conduit
u. 651-05 – Schedule 40 and 80 Rigid PVC Conduit
v. 651A-07 – Type EB and A Rigid PVC Conduit and HDPE Conduit
w. 752-05 – Standard for Bullet-Resisting Equipment
x. 797-07 – Electrical Metallic Tubing
y. 827-08 – Central Station Alarm Services
z. 864-08 – Standard for Control Units and Accessories for Fire Alarm Systems
aa. 1242-06 – Intermediate Metal Conduit
bb. 1479-03 – Fire Tests of Through-Penetration Fire Stops
c. 1981-03 – Central Station Automation System

11. FM Global

1.04 SUBMITTALS

A. In addition, to all submittal requirements as stipulated by Division 01 specifications sections, the Contractor shall provide all shop drawing submittals in accordance with the following:

1. The Owner’s Representatives approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage, or installation of equipment or material which has not had prior approval will not be permitted at the job site.

2. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Owner’s Representative to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.

3. Submittals shall be provided as a complete submission; no partial submissions will be accepted. Failure to provide a complete submission shall result in all submittals being returned for resubmission.

4. No substituted equipment shall be reviewed without prior approval in accordance with the requirements of “substitutions” under Division 1 specification section.

5. Mark the submittals, "SUBMITTED UNDER SECTION_____________".
a. Submittals shall be marked to show specification reference including the section and paragraph numbers.

6. The Contractor shall schedule submittals in order to maintain the project schedule. For coordination requirements refer to Division 01 Specification Sections, which outline basic submittal requirements and coordination. All Division 01 Specification Sections requirements shall be used in conjunction with this specification section.

7. Prior to any submission the contractor shall be responsible for performing the following quality control items to ensure compliance with all project requirements:

   a. Review all Shop Drawings and Product Data
   b. Review all field measurement criteria.
   c. Review all field construction criteria and methodologies.
   d. Review all catalog numbers and similar data.
   e. Review all coordination requirements of affected trades.
   f. Review conformance to all appropriate specification sections.

8. All drawings shall be prepared using latest version of AutoCAD®. The Contractor shall not reproduce the Contract Documents or copy standard information as the basis of the technical data, hand drawn mark-ups of the original project drawings shall not be acceptable. Failure to provide a complete set of “contractor prepared” installation drawings at the time of submittal shall result in all submittals being returned for resubmission.

9. The FSI shall have a registered NICET Level IV review and seal all system designs, installations and testing certification for all fire alarm systems and associated structured cabling. Failure to provide NICET Level IV sealed shop drawings shall result in all shop drawings being returned for resubmission without any reviews taking place.

10. No deviations from the project requirements shall be accepted unless the Contractor has informed the Owners Representatives in writing of any such deviations prior to the submission of shop drawings, has noted all deviations on the shop drawing submission, and the Owners Representative has given written approval for the specific deviations, otherwise all project requirements shall stand.

   a. The Owner and Owners Representative review does not relieve the Contractor from any responsibility for delivering all criteria as stipulated by the contract documents because of errors, lack of clarity or omissions on the part of the Contractor in the review of shop drawings and/or samples by the Owners Representative.

11. Submit all system testing and startup procedures to be employed. Include all estimated times for performance of all tests, all test equipment and manpower necessary for testing.

12. Contractor shall submit a demolition plan for review outlining all procedures, means, methods, and precautions to be employed in the demolition of all existing systems.

13. Submit all integrator qualifications, certifications, and licenses in accordance with the requirements as specified elsewhere in this
specification section.

14. Submit project schedule outlining the time frames for all equipment with long lead times for equipment deliveries; include all system commissioning, testing, and training time expectations. Project schedule shall be submitted as CPM schedule and shall utilize a software based project management program.

B. Shop Drawings:

1. All shop drawings shall include sufficient information, clearly presented, to determine full compliance with all project drawings and specifications. Include the following information for review, failure to provide all information listed below shall result in all shop drawing submittals being returned for resubmission:

   a. All Building Floor and Site Plans
   b. All equipment with manufacturer's name(s), model numbers,
   c. All equipment/device electrical ratings and power requirements
   d. All equipment/device performance ratings.
   e. All standby battery and wiring voltage drop calculations
   f. All surge and/or transient protection devices and device locations
   g. All equipment rack, panels, and cabinet layouts, rack/cabinet sizes.
   h. All equipment and device-mounting elevations.
   i. All device wiring details.
   j. Complete point-to-point-wiring diagrams for all systems.
   k. Include all equipment and wiring termination schedules and programming matrixes.

2. Provide a complete set of “contractor prepared” installation drawings. All drawings at the minimum shall consist of floor plans indicating all device locations, device identifications, control panels, auxiliary control panels, power supplies, annunciator panels, conduit and cabling requirements as well as all 120 volt electrical circuit connections and the proper integration of all ancillary devices/systems.

   a. Drawings shall include at the minimum the following:

      1) Detailed equipment layouts for all equipment rooms. Coordinate all room layouts with affected trades.
      2) Floor plan drawings showing locations of all control panels, sub-panels, ancillary controls, equipment cabinets and/or racks, annunciator panels, HMI terminals, auxiliary power supplies, devices and sensors, electrical power and grounding terminations as well as all device/sensor identifications
      3) Conduit routing of all conduits 2 inches in diameter or greater.
      4) System riser diagrams and single line drawings representing interconnections of all system control panels, sub-panels, ancillary controls, equipment cabinets and/or racks, annunciator panels, HMI terminals, auxiliary power supplies, devices, sensors and components, include all cable types and sizes, electrical power connections and circuits, grounding
connections, surge and/or transient protection devices and all field device/sensor identifications.

5) Block diagrams and Logic flow charts representing all systems architecture and interconnection of any security systems (SMS) and fire management systems (FMS) all related integrated subsystems. Include detailed information on all system component integrations, data transmission and media conversions as well as logical functional data and performance criteria.

6) Equipment wattage for all equipment room locations and estimated BTU production.

7) Detailed equipment layouts for all equipment consoles. Indicate all equipment locations, power connections, and installation details.

8) All equipment mounting hardware/brackets and installation details, Identify type size, load capacities of all mounting hardware/brackets; include all mounting and installation details, all space requirements, any special architectural modifications required.

3. Failure to provide all required documentation in accordance with ALL related specification requirements at the time of shop drawing submission shall result in all submittals to be returned for non-compliance to the contract requirements.

C. Equipment Submittals and Data Sheets:

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

   a. Include all equipment data sheets pertinent to equipment provided. All data sheets shall be highlighted indicating specific equipment supplied. Failure to provide the proper annotation of all equipment shall result in submittals being returned for resubmission.

2. Submit complete technical data necessary to evaluate the material and equipment. Include a complete technical specification for the submitted equipment, noting differences and adherence to this Section. Failure to provide the required data will result in all submittals being returned for resubmission.

3. Submit performance data, equipment ratings, cable requirements, control sequences, GUI based control panels, programming matrixes, logic diagrams and all other descriptive data necessary to describe the installation and operations of the system being provided. Failure to provide the required data will result in all submittals being returned for resubmission.

4. Provide a complete termination schedule of all system devices, sensors, components, equipment, and controls, identify all locations as indicated on the installation drawings, include all unique identification numbers which correspond with shop drawing floor plans.

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a. Include point to point wiring terminations and programming matrixes for all control panels, sub-control-panels, and access control DGP’s and camera alarm input panels associated with the project. Include all input and output modules and all I/O termination points for all panels.

5. Provide a clear and concise sequence of operation that gives, in detail, all information required to properly operate all equipment and systems. Include detailed programming matrixes, indicating at the minimum all manual and automatic functions for all system, components, and devices comprising the system being provided.

6. Provide copies of all modifications to graphic screens for all HMI configurations for this project. Graphic maps shall indicate all site plans, floor plan maps, utility screens, camera/monitor interface screens all door control functions, intercom activation’s, alarm indications, door interlock functions and ancillary controls.

7. Provide a listing of all recommended time zone and alarm shunting functions.

8. Provide a preliminary list of all on screen emergency response instructions and help menus.

9. Provide system parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price, and availability of each part.

10. Failure to provide all required documentation in accordance with ALL related specification requirements at the time of shop drawing submission shall result in all submittals to be returned for non-compliance to the contract requirements.

D. Maintenance and Operation Manuals: Submit in accordance with all requirements of Division 01 specification sections and as herein specified.

1. Maintenance and Operation Manuals shall be submitted for all systems and equipment specified in the technical sections. Furnish the number of copies as specified by Division 1, all manuals shall be bound in hardback binders, (manufacturer’s standard binders) or an approved equivalent prior to the commissioning, testing and final acceptance of each system.

   a. The Contractor shall also furnish one complete set of manuals as specified herein at the time of shop drawing submission for Owner’s Representatives’ use in the review of all submittals.

2. Inscribe the following identification on the cover: "Maintenance and Operational Manual" include the name and location of the system, equipment, building, name of Contractor, and contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment.

   a. The Maintenance and Operation Manuals at the minimum shall include:
1) Copy of approved shop drawing and equipment submittals
2) Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of all equipment, components, devices, and servers.
3) A complete control sequence describing start-up, operation, and shutdown of all equipment, components, devices, and servers.
4) Description of the function of each principal item of equipment.
5) Installation and maintenance instructions
   a) Safety precautions
   b) Diagrams and illustrations.
   c) Testing methods.
   d) Performance data.
   e) Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
   f) Appendix; list qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

b. Failure to provide all required documentation in accordance with ALL related specification requirements at the time of shop drawing submission shall result in all submittals to be returned for non-compliance to the contract requirements.

1.05 QUALITY ASSURANCE

A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections include the following project requirements;

1. Cable Installer Qualifications: The cable installation contractor shall demonstrate not less than three (3) years’ experience in the installation of fire alarm systems.
   a. NOTE: The installation of all fire alarm system cabling and terminations shall be by a current NICET Level III fire alarm specialist who shall be knowledgeable in the following technical applications:
      1) The Routing and installation of shielded, unshielded, twisted pair, coaxial and fiber optic cables.
      2) Bonding and grounding of cabling, device, and equipment racks.
      3) Fusion splicing of fiber optic cabling.
      4) Testing copper conductors for electrical continuity.
      5) Termination, connection, and testing of shielded and unshielded twisted pair cable, coaxial cabling and fiber optic cabling on all specified connectors, electrical protection blocks, termination blocks and patch panels.
      6) Generally accepted industry standards, NFPA 72 as well as manufacturers written installation instructions, will be used for in-process quality control and final acceptance of the work installation.
b. Provide registration number and expiration date of NICET level III installer assigned to the project.

2. The Owner’s Representative reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval of shop drawings.
   
a. Experience shall be defined as the completion of the specific system being provided, with that system being successfully operated by the Owner for its intended purpose for at least three (3) years.
   
b. In addition to the above “Experience” shall also be defined as the completion of modifications and renovations to any associated system being provided in any existing occupied facility of this size and magnitude.
   
c. For each facility submit the following:

   1) Name and location of facility.
   2) Date of Occupancy or beneficial use by Owner.
   3) Owner’s representative to contact and telephone number.
   4) Construction Manager or General Contractor.
   5) Project Architect or Engineer.
   6) Provide detailed information on the installed locations with operational equipment.

3. The installing contractor shall be properly licensed by the governing municipality (where required) certified to provide the services and work of the specific system being provided.

1.06 RECORD DOCUMENTS

A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections include the following project requirements;

1. Provide complete set of finalized copies of record documents prior to final acceptance of the project by Owner’s Representative in accordance with all requirements of Division 01 specification sections. At the minimum the record documents shall contain all information, data, and drawings as described in Chapter 1.4 “Submittals” of this specification section.

   a. As-built documents shall be submitted in both paper and electronic media formats in the quantities as specified by Division 1 specification requirements.

   1) All electronic record drawings shall be prepared and submitted utilizing an AutoCAD based program as manufactured by Autodesk.
   2) All electronic data sheets, control sequences, programming matrixes and other descriptive data shall be provided in PDF formatted documents.
   3) Copies of all current system programming and associated software shall be provided on downloadable media formatted for the use in restoration all system operations and functionality.
1.07 SOFTWARE AGREEMENT

A. Included as part of the scope of work for this project SEPTA shall retain the ownership and access rights of ALL system programs and software associated with all systems installed and/or modified as part of this project.

1. The contractor shall provide to Owner’s Representative complete copies of all current software programming and software licenses related to the operation of each system prior to final acceptance of the related Contract scopes of work.

   a. All programming shall include but not be limited to all device identifications, device descriptions, Programming Logic Matrixes, all program access level passwords as well as all function and sub-function routines.

2. Programming and software copies shall be provided to the Owner’s Representative on CD or DVD digital formatted media. In addition, the contractor shall provide a complete hard copy printout of all system programming and shall be included as part of closeout documentation for review by the Owner’s Representative.

B. Software and firmware upgrade provisions shall be included as part of this specification requirement and shall include the automatic upgrades as required to maintain all software and firmware to the manufacturers most current revision on all system components installed and or modified as part of this project for duration of the warranty period. This upgrade policy shall require the contractor to install, test, and certify all software and firmware upgrades that become available from manufacturer for a period of one year from date of final acceptance to the expiration of the warranty.

1. Upgrading of software shall include all revised/new software, labor, testing certification as well as all licenses, software and all programming copies as described in Chapter 1.6 of this section associated with the installation of all revised software.

2. These updates shall be accomplished in a timely manner, fully coordinated with Owner’s Representative, and incorporated into the operations/maintenance and software documentation manuals.

   a. One (1) scheduled final update shall be provided near the end of the warranty period, at which time the Contractor shall install and validate the latest released version of the Manufacturer’s software and firmware for all systems installed and/or modified for this project.

   b. All software changes shall be recorded in a log maintained in the unit control. An electronic copy of the most current software update shall be maintained within the log.

   1) At a minimum, the contractor shall provide a description of the modification, when the modification occurred, and name and contact information of the individual performing the modification. The log shall be maintained in a white 3 ring binder and the
cover marked “Software Change Log.”

3. Provide not less than thirty days' notice to the Owner’s Representative to allow scheduling and access to system to allow the Owner to upgrade any computer equipment necessary for the installation of the system.

1.08 EXTRA MATERIAL

A. In addition to all general provisions of the Contract, including but not limited to all; General and Supplementary Conditions, Division 01 Specification Sections refer to related specification sections “Extra Material” for specific requirements.

1. All Extra materials shall be provided at the time of final acceptance of the project and a signed packing list shall be obtained at the time of delivery. At no time is the contractor to use the extra materials provided for this project to replace malfunctioning or damaged equipment and or components.

PART 2 – PRODUCTS

2.01 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, that meet and/or exceed the specified performance and features of the equipment and/or systems and for which replacement parts shall be readily available to the system integrator and/or using agency.

1. When more than one unit, device, or component of the same class of equipment is required, such units, devices, or components shall be the product of a single manufacturer.

2. Acceptable manufacturers for each system shall be as specified and shall be provided in full compliance with the requirements of this and all related specification sections and contract drawings.

   a. Manufacturers listed as acceptable shall not negate the contractors’ responsibility for providing all equipment, devices, components, and/or systems, in accordance with all functions and performance requirements of the Contract Documents.

   b. Where manufacturer and/or manufacturer model numbers reference specific system components in the related specification sections, it is to establish the performance requirements and quality of the systems and components only.

      1) It is in no way an inference that the referenced model numbers are the manufacturer’s current product and are the only acceptable components for this project unless specifically referenced as “no substitutions.”
c. The Contractor shall provide the manufacturers’ most current product that shall meet and/or exceed the specified performance and features of the equipment and/or systems.

d. Equivalent UL-listed equipment may be substituted for the approved manufacturers unless stipulated by other specification sections as “No Substitutions”. All substitutions shall be submitted for approval by Owner’s Representative in accordance with all requirements of Division 01 specification sections and Chapter 1.4 “Submittals” of this specification section.

1) Where systems and/or components are referenced as “no substitutions” the specific system and/or components shall be provided.

2) All substitutions shall comply with all requirements as specified above and all system performance standards shall be maintained.

3) The contractor shall stipulate the following information impacted by such a substitution.

   a) Any and all extensions in time impacted by the substitution.
   b) Any changes to the architectural or structural elements to the project.
   c) Differences in operation and/or performance from intended system criteria.

4) Failure to provide the required substitution information shall result in “without consideration” the immediate rejection of the substituted equipment and/or systems.

B. Equipment Assemblies and Components:

1. Components of an assembled unit need not be products of the same manufacturer.

   a. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
   b. Components shall be compatible with each other and with the total assembly for the intended service.
   c. Constituent parts which are similar shall be the product of a single manufacturer.
   d. Factory wiring shall be identified on the equipment being furnished and on all wiring diagrams.

C. Where Factory or Off-Premises Testing of any equipment, product or assembly is recommended by the product manufacturer or where specified as part of this section and/or any related specification section:

1. The Owner’s Representative shall have the option of witnessing all factory tests. The Contractor shall notify the Owner’s Representative at a minimum of thirty (30) working days prior to the performance of any factory or off-premises tests.
2. Where the factory or assembly point for all off-premises testing is not within two (2) hours driving time from the project location, the FSI shall include as part of this project all per diem costs (travel, meals and lodging) for a minimum of two representatives of the project Owner’s Representative to witness all testing.

3. Provide four (4) copies of certified test reports containing all preliminary test data and testing procedures shall be furnished to the Owner’s Representative prior to any final testing and not more than ninety (90) days after completion of any tests.

4. When equipment, product, or assembly fails to meet any factory or off-premises tests, retesting of equipment, product, or assembly shall be mandated, the manufacturer/integrator shall be liable for all additional expenses, including all expenses incurred by the Owner’s Representative for witnessing the retesting of any equipment, product, or assembly.

D. Compatibility and Interoperability of System Components and Devices

1. Where multiple components, devices, and/or systems are intended to be interconnected as part of a complete system in accordance with any related specification sections, it shall be the Contractor’s responsibility to verify the interoperability and compatibility of said components, devices, and/or systems is in full conformance to the specified performance criteria prior to the submission of shop drawings.

   a. Where specified devices are found to be incompatible or incapable of performing as specified in a seamless manner, the Contractor shall notify the Owner’s Representative in writing prior to submission of shop drawings. Failure to properly identify such functional discrepancies shall not relieve the Contractor from providing a complete and fully functional system in accordance with the requirements of all related specification section.

PART 3 – EXECUTION

3.01 EQUIPMENT PROTECTION

A. Protect all materials, equipment, devices, or components permanently installed and/or stored on the job site. Protect all materials, equipment, cabling, devices, or components during construction and after installation, provide appropriate protection of all materials, equipment, components and/or devices until time of substantial completion. All materials, equipment, components and/or devices shall be protected during shipment and storage against any physical damage, dirt, moisture, cold, snow or rain:

1. During installation, enclosures, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of
any foreign matter; and shall be vacuum cleaned both inside and outside before testing and operating and repainting if required.

2. Any materials, equipment, components and/or devices, stored on site which have been deemed by the Owner’s Representative to exhibit any indications of damage or exposure dust or moisture shall not be installed and shall returned to the source of supply for immediate replacement.

   a. The use of spare parts or the return of defective equipment for repair to mitigate the damage of defective materials, equipment, components, and/or devices shall not be acceptable. All materials, equipment, components, and/or devices shall be new and unused until final acceptance by the Owner’s Representative.

3. Provide and apply protective material immediately upon receiving the products and maintain throughout the construction process.

   a. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

   b. Any damaged paint on equipment and materials shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas is not obvious or detectable.

4. Failure to properly protect all materials, equipment, components and/or devices prior to final acceptance shall constitute sufficient cause for rejection of materials, equipment, components and/or devices should any defects, damage or degradation in performance is observed.

B. Immediately replace all malfunctioning materials, equipment, components, and/or devices with new unused products up until the time the Owner’s Representative issues final acceptance of the system. The returning of any malfunctioning equipment, devices, and/or components to the manufacturer for repair and then reinstallation at the project site shall not be acceptable.

   1. All replacement materials, equipment, components, and/or devices shall be factory new and not scavenged from the Project’s spare parts inventory or factory recycled products unless expressly identified by contractor prior to replacement and approved beforehand by the Owner’s Representative.

3.02 WORK PERFORMANCE

A. Installation, final termination, testing, start-up and commissioning of all systems, system components and cabling infrastructures shall be under the direct supervision of the appropriate system integrator. The integrator shall be an accredited and authorized distributor of the appropriate equipment manufacturer and shall be fully certified in the installation, testing, commissioning, and programming of all equipment, devices, components, and/or systems being provided as part of this project.

B. Job site safety and worker safety is the responsibility of the contractor. Ensure
that safe access and egress from all work areas is maintained during movement and installation of materials. Clean up all debris generated by installation activities. Keep all equipment rooms free of debris at all times.

C. Pre-installation Conferences: Include provisions to attend all pre-installation conferences at Project site in compliance with all requirements in Division 01 specification section and as herein specified. Review methods and procedures related to installation and operations of all systems, including, but not limited to, the following:

1. Inspect and discuss electrical and control system roughing-in related to all fire alarm and security systems as well as other preparatory work required to be performed by other trades.
2. Review sequence of operations for each type of system, controls and/or integration to any systems and/or equipment provided by other trades.
3. Review and finalize construction schedule and verify availability of materials, installation personnel, equipment, and any preparatory work by other trades needed to make progress and avoid delays.
4. Review required start-up, testing, commissioning, and certifying procedures to be employed for each system and any impacts to other trades.

D. For work on existing facilities, arrange, all construction phasing and/or demolition of existing systems, perform work in such a manner to assure the operation of all systems for other buildings and contiguous spaces at all times. Refer to Division 1 specification section for additional information.

E. All new work shall be installed and connected to existing work neatly and carefully. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Division 01 specification sections.

F. Coordinate the installation of all cabling, conduits/raceways and cable trays and equipment with applicable trades to ensure proper operation and function of all integrated systems in accordance with all related specification sections. Refer to Division 1 specification section for additional project coordination requirements.

1. Coordinate with all trades at the time of shop drawing submission detailing all space and/or room conditions. The contractor shall coordinate with the appropriate trade all conditions impacting the installation of any system or system device including but not limited to all equipment locations, ceilings, lighting fixtures, fire protection piping, and ductwork layouts to the satisfaction of all concerned trades, subject to final review by the Owner’s Representative.
   a. Coordinate exact location of all desktop/counter/wall mounted equipment with the Owner’s Representative and all affected trades prior to the installation of any equipment and/or cabling.
   b. Coordinate exact location(s) of all ceiling mounted cable, conduits, equipment, and/or devices with all architectural plans, reflected ceiling
c. Equipment installations requiring coordination with other trades the contractor shall provide all templates, back-boxes and equipment anchor bolts for mounting or flush mounting preparation, (e.g. pedestals or other devices requiring mounting on walls, concrete pads or other materials). Coordinate delivery of templates and equipment anchor bolts to preclude any delay in the construction schedule or the work of the affected trade.

d. If installation of equipment, devices, cabling, raceways, cable trays and/or conduit is performed prior to coordination with other trades, which interferes with work of other trades or operation and maintenance of the facility, make necessary changes to correct the condition at no additional cost to the project cost.

e. Prior to the final programming of any systems review with Owner’s Representative all system features, functions, system operations, network mapping, system integrated responses and all related programming as required for the proper operation of the respective fire alarm and security systems.

G. The Contractor shall maintain a complete set of current and up to date set of shop drawings and equipment submissions at the job site at all times. The Shop drawings and all other submissions shall be marked up to reflect all as-built conditions and shall be made available for review by the Owner’s Representative at request.

3.03 EQUIPMENT/CABLE INSTALLATION AND REQUIREMENTS

A. The contractor shall coordinate all installation and demolition activities so as not to disrupt the daily routines of the facility and shall include any costs related to a phased construction methodology. This construction methodology shall include but is not limited all necessary temporary equipment, devices, components or systems as well as any labor costs associated with any installation, commissioning, testing demolition of any systems required to be performed after normal business hours of the facility.

B. All system wiring and equipment installation shall be in accordance with good engineering practices and by all IEEE, EIA, NEC, and manufacturer’s requirements. Wiring shall comply with all state and local electrical codes. All wiring shall test free from all grounds, shorts, stray voltages, and EMI.

C. Follow manufacturers’ instructions for installing, components and adjusting all equipment and cabling. Submit two (2) copies of such instructions to the Owners Representative before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Where no instructions are included with the equipment, follow accepted industry practices and workmanlike installation standards.

D. Ensure that all cabling supports (conduits, support grips, cable trays, and/or J-hooks) are fully installed before proceeding with cable installation. At no times
shall any cables be installed and left unsupported. At no times shall cables be tie-wrapped to any other supporting structure in lieu of specified cable supports.

1. Do not leave any system cabling unprotected on floor at any time. If cables must be left on floor, the Contractor shall be responsible for protecting the cables so that they may not be walked on or have any material or equipment placed or rolled on top. Replace all damaged cables from demarcation to termination point; no splicing of damaged cables shall be permitted.

2. Maintain manufacturers recommended minimum bend radiuses of all cabling. Do not stretch, stress, tightly coil, bend, or crim any backbone, horizontal, patch, system, or workstation cables. The Contractor shall keep all cabling out of the way of other trades during staging of any work. The contractor at the contractor’s expense will replace all severely stressed or damaged cables, equipment, and materials as determined by the Owner’s Representative.

E. Equipment location shall be as close as practical to locations as indicated on the contract drawings.

1. Provide all equipment clearances in accordance with NEC requirements. Arrange equipment to facilitate unrestricted access for maintenance and service around all equipment, components, and/or cable terminations.

F. Inaccessible Equipment:

1. Where the Owner’s Representative determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the project.

   a. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

G. Cabling Requirements

1. Contractors shall have the option to combine all home runs and conductors of same type and voltage "class" in accordance with NEC requirements unless specified elsewhere. Size all conduits and install all conductors in accordance with NEC requirements and manufacturers recommendations.

   a. All TCP/IP based system cabling is to be Category-6 and concealed above suspended ceilings, bundled and supported to the building structure. All cabling bundles shall be plenum rated and shall not contain any AC carrying conductors or non-associated AC.
communications network cables. All TCP/IP based cabling located above accessible suspended ceilings may be installed without conduit and shall be supported by “J” hooks.

1) Cabling installed above inaccessible ceiling spaces shall be installed in dedicated conduits.
2) No exposed cabling will be acceptable in finished or occupied spaces of the facility without approval by the Owner’s Representative.
3) Any TCP/IP based system cabling installed exterior to the building and/or all cabling being routed from the facility to any remote location external to the project location shall utilize fiber optic cabling installed in dedicated conduits.
4) Refer to related specification sections for additional information for additional information related to cabling types, sizes, and testing requirements.

b. All analog or digital based system cabling is to be provided in accordance with manufacturers requirements and shall be concealed above suspended ceilings installed in dedicated conduits and supported above ceiling tiles to the building structure. All analog or digital based system conduits shall not contain any AC carrying conductors or non-associated fire alarm system cables.

1) All analog or digital based cabling shall be installed in dedicated conduits.
2) Conductors shall be twisted pair, shielded minimum 16 AWG unless otherwise noted.
3) All notification appliances, control wiring on electrically controlled interfaces unless otherwise noted shall utilize twisted pair, minimum 14 AWG wire, installed in dedicated conduits.
4) Refer to related specification sections for additional information for additional information related to cabling types, sizes, and testing requirements.

c. All fiber optic cabling shall be provided to meet the communications requirements for all network communications infrastructure at the minimum all fiber optic cabling shall be sized in accordance with the project documents. All fiber optic cabling shall be minimum 50/125 micron / 9/125 micron cables, hybrid cable configuration may be used with Owner’s Representative.

1) All fiber optic cabling shall be plenum rated armored type cabling installed above suspended ceilings and supported to the building structure or all fiber shall be standard fiber optic cable installed in dedicated conduits.
2) Fiber optic cabling shall be provided as the primary communications and control media for all exterior and remote building network communications links for all systems. Each fiber optic link shall be comprised of dedicated transmitter and receiver shall be capable of providing all communication transmissions at a
minimum of 1,280 feet. Refer to related specification sections for all additional Fiber optic-cabling requirements.

3) Conductive fiber optic cable shall be provided for all exterior system components requiring control and/or power capabilities in the support of their operation, include all necessary surge protection and grounding for conductive cabling.

4) Refer to related specification sections for additional information for additional information related to cabling types, sizes, and testing requirements.

H. Environmental Conditions

1. Systems, components, devices, materials, and equipment shall be capable of withstanding the environmental conditions of the space without mechanical or electrical damage or degradation of operating capabilities or performance.

a. Interior, Controlled Environment: System components, installed in temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of 2 to 50 deg C (36 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 1 enclosures.

b. Interior, Uncontrolled Environment: System components installed in non-temperature-controlled interior environments shall be rated for continuous operation in ambient conditions of -18 to 50 deg C (0 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, non-condensing and shall utilize NEMA 250, Type 4X enclosures.

c. Exterior Environment: System components, conduits and back-boxes installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of -34 to 50 deg C (-30 to 122 deg F) dry bulb and 20 to 90 percent relative humidity, condensing. Rated for continuous operation where exposed to rain as specified in NEMA 250, winds up to 137 km/h (85 mph) and snow cover up to 610 mm (24 in) thick shall utilize NEMA 250, Type 4X enclosures.

d. Hazardous Environment: System components, conduits and back-boxes 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.

e. Corrosive Environment: System components, conduits, and back-boxes subjected to corrosive fumes, vapors, and wind-driven salt spray in coastal zones, shall utilize NEMA 250, Type 4X enclosures.

f. Submersible Environment: System components, conduits and back-boxes subjected to prolonged submersion in water, shall utilize NEMA 250, Type 6P enclosures.
g. Areas where equipment and devices may be subject to damage by the general population shall be installed in vandal resistant enclosures.

h. Console: All console equipment shall, unless noted otherwise, be rated for continuous operation under ambient environmental conditions of 15.6 to 29.4 deg C (60 to 85 deg F) and a relative humidity of 20 to 80 percent.

I. Conduits/raceway/Cable Trays:

1. All conduits/raceways shall be concealed and shall be installed above accessible finished ceilings and/or in walls. Any conduits/raceways installed in areas requiring installation to be exposed, shall be installed tight to ceilings at right angles to walls, and shall not obstruct any access hatches, equipment service panels, lighting or other equipment and/or devices. No exposed conduits/raceways shall be installed without prior approval of the Owner’s Representative prior to installation.

   a. Where conduits cannot be concealed above ceilings or in walls and must be installed in finished or occupied areas of the building, all conduits shall be finished wire-mold type raceways or approved equal. No exposed conduits/raceways shall be installed without prior approval of the Owner’s Representative prior to installation.

   b. Where any equipment and/or junction boxes are installed above non-accessible finished ceilings, the contractor shall provide access hatches listed for the intended application. Access hatches shall be located so that service access to the equipment and/or junction boxes is unimpeded.

      1) Access hatches shall not obstruct any equipment, service panels, lighting equipment, devices, or any architectural elements of the ceiling. At the time of submittals the contractor shall submit all proposed access hatch locations for review by the Owners Representative.

   c. All raceways shall be supported in accordance with NEC requirements and shall be affixed in such a manner that tampering and/or removal without the use of specialized tools shall be prevented.

   d. All conduits/raceways shall be installed in a manner that prevents tampering or removal when installed in areas exposed to the general population.

      1) Provide tamper-resistant installation utilizing “torx with peg” security-fastening devices for all conduits/raceways, equipment, devices and appurtenances in all areas accessible to the general population and/or areas subjected to tampering or vandalism.
e. Interior raceways shall be a minimum 3/4 inches unless otherwise noted. Exterior raceways shall be a minimum 1-inch. Size all raceways and install conductors in accordance with NEC requirements. Fill ratio shall not exceed 40 percent for indoor raceways or exterior raceways.

1) EMT conduit with compression fittings and/or MC cabling may be utilized in all inaccessible ceiling areas unless otherwise restricted by code.

2) Threaded Rigid metal conduit shall be used on all exterior applications, stub-ups and all interior areas where concealed conduit requirements cannot be met and are exposed to tampering or damage by the general population.

   a) All areas considered being of high risk due to the nature of the occupancy or the need to protect and maintain the integrity of the cabling shall be installed in rigid threaded conduits.

3) RGS conduit shall be utilized in all underground applications. The conduit shall be buried at a minimum 36" below grade. Warning flagging tape shall be buried 12" below grade to indicate the conduit routing location.

   a) The Contractor shall have the option to utilize the same trench/routing location as other utilities. In no case shall any systems conduits or duct banks be combined with other electrical utilities.

f. All raceways shall be supported in accordance with NEC requirements and shall be affixed in such a manner that tampering and/or removal by the general population without the use of specialized tools shall be prevented.

g. Outlet Boxes: shall be 4 x 4 x 2-1/8 inches deep for all data jack locations and single gang for wall mounted telephone locations.

   1) All outlet boxes shall be provided with single or dual gang device mud-rings flush to finished wall as required based on type and configuration of outlet and type of wall construction.

   2) Use deep masonry boxes at masonry construction. T-Bar hangers or other appropriate mounting hardware shall be utilized to support boxes mounted in the ceiling.

J. Penetrations of Walls and Floors

1. All wall/floor penetrations are to be sleeved and fire stopped with approved fire stopping material. Coordinate all cable and conduit penetrations of the structure with all trades.
a. All penetrations of walls and floors shall be fire stopped in accordance with the ASTM and NFPA standards. Refer to related specification sections for additional information.

b. Floor penetrations shall be sleeved with a minimum sleeve diameter of 4 inches. An additional penetration shall be provided for future use, sleeved, and capped and fire stopped as required.

c. Coordinate size of wall penetration with conduit size, number of conductors. Comply with all NEC requirements.

d. The fire rating of all penetrated walls, floors, and ceiling structures shall be strictly maintained. All penetrations shall be fire-stopped and sealed by the Contractor.

e. Install fire-stopping in open penetrations and in the annular space of penetrations for fire rated barriers.

f. Installation of fire-stops shall be performed by an applicator/installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer’s detailed installation procedures.

g. Installation of all fire-stopping shall be in accordance with fire test reports, fire resistance requirements, acceptable sample installations, manufacturer’s recommendations, local fire and building authorities, and applicable codes and shall be installed in a manner acceptable to the authority having jurisdiction.

K. Existing System Demolition

1. The contractor shall at the completion of this project and only after final acceptance by the Owners’ Representatives of the new system, provide the complete and proper demolition of all existing systems not connected to the new systems or not required to remain operational unless otherwise noted.

   a. The contractor shall provide the complete demolition and removal of all existing systems, controls, devices, conduits and cabling associated with any systems included as part of this project.

   b. All cabling not associated with any systems included as part of this project shall be removed, all conduits shall be either removed and/or fire stopped in accordance with NFPA 70 requirements, the abandonment in place of any existing device, controls, cabling and/or conduits shall not be acceptable.

2. The contractor shall coordinate all demolition activities so as not to disrupt the daily routines of the facility and shall include any costs related to a phased construction methodology. This construction methodology shall include but is not limited all necessary temporary equipment, devices, components or systems as well as any labor costs associated with any installation, commissioning, testing demolition of any systems required to be performed after normal business hours of the facility.
a. Contractor shall plan, schedule and install all systems in accordance with all requirements of the project construction schedule. Refer to specification section, 01100 for additional information related to project scheduling and facility access.

3. Prior to the disabling, switchover and/or demolition of any existing systems, devices or wiring the contractor shall coordinate with Owner’s representatives all system conversions and/or switchovers. Coordination shall include all affected systems, areas of change over, change over procedures and duration of work to be performed.

1) The contractor shall coordinate all demolition activities so as not to disrupt the daily routine of the facility or negatively impact the integrity of the facility’s security and/or life safety measures.

2) Contractor shall demolish all, cabling, devices, components and/or controls not integrated with the new system at the completion of the project scopes of work. Demolition shall only commence after final acceptance by the Owners’ Representatives of the new system. The removal or demolition of any existing system, device, and/or field wiring not incorporated into the new systems shall be performed in such a manner consistent with all requirements of NFPA 70 and operational requirements of the Owner.

3) Contractor shall submit a demolition plan for review by the Owners’ Representatives outlining all procedures, means, methods, and precautions to be employed in the demolition of all existing systems. No demolition of any existing systems shall commence until all new and/or temporary systems are installed, tested, and accepted by the Owners' Representatives.

3.04 ELECTRICAL POWER DISTRIBUTION

A. Electrical power of 120 Volts (VAC) dedicated shall be provided by this Contractor. Coordinate with electrical drawings and Owner’s Representatives for nearest electrical distribution panels. Additional locations requiring primary electrical power as required by the specific products and/or integrator selected equipment shall be the responsibility of this Contractor to include as part of this project.

1. Primary power for all controls, sub-control panels, processors, amplifiers, and power supplies shall be configured to switch to emergency backup power sources automatically when primary power is interrupted without degradation of any critical system functions.

3.05 TRANSIENT VOLTAGE SUPPRESSION

A. Transient Voltage Surge Suppression: All cables and conductors extending beyond building façade (except nonconductive fiber optic cables) which serve
as communications, control, or signal lines shall be protected against Transient Voltage surges and have Transient Voltage Surge Suppression (TVSS) protection.

1. The TVSS device shall be UL listed in accordance with Standard TIA 497B installed at each end. Lighting and surge suppression shall be a multi-strike variety and include a fault indicator.
2. Protection shall be furnished at the equipment and additional triple solid state surge protectors rated for the application on each wire line circuit shall be installed within 914.4 mm (3 ft) of the building cable entrance. Fuses shall not be acceptable for surge protection applications. All inputs and outputs shall be tested in both normal mode and common mode to verify there is no interference.
3. All system power supplies serving exterior system components or devices shall be provided with the appropriate transient surge suppression protection on both the line side as well as the load side.
4. At the minimum, surge suppression devices shall meet or exceed the following criteria:
   a. Surge Current Rating: 15kA
   b. Rated Operating Current: 800mA – 1000mA
   c. Response Time: < 1ns
   d. Operating temperature range: -40 deg F to 185 deg F
   e. Thermal protection feature
   f. IEC Maximum Discharge Current I_{max} (8x20 microseconds): 15kA
   g. IEC Maximum Discharge Current I_{n} (8x20 microseconds): 10kA
   h. IEC Maximum Pulse Limp (10x350 microseconds): 2.5kA TE/FA 10B or TE/FA 20B or approved equal.

3.06 GROUNDING AND BONDING

A. All electronic equipment, conduits, cable trays, racks/cabinets and cable shields shall be properly grounded and bonded in accordance with all requirements of EIA/TIA 607-A, NEC 250 and IEEE 1100.

1. All grounding connections shall provide the equalization of all grounding potentials between the building power system and the grounding terminations at the fire alarm equipment in order to provide the diversion of electrical transients as well as providing the necessary coupling in order to cancel and/or reduce any voltage transients.
   a. Equipment Grounding: Metallic structures, equipment racks, cabinets and enclosures as well as all raceways, cable trays, junction boxes, outlet boxes, machine frames, and other conductive items shall be bonded and grounded sized per per NEC requirements.

2. All connections of grounding conductors to ground rods, bus bars, rebar, structural members, pipes and fences, as well as splices of any ground conductors, shall be made by exothermic welds except where otherwise noted. All connections to bar lugs shall be exothermic weld or compression type connections. Bolted type connection of ground conductors may only be made where terminal lugs or blocks have been furnished and installed in
equipment by the manufacturer.

a. Equipment grounding conductors shall be insulated stranded copper, except for sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be permitted to be identified per the NEC.

1) At the minimum bonding connection shall be a #6 AWG copper conductor. All grounding shall provide an effective bonding connection between the protected equipment to the nearest approved building grounding electrode (structural steel) as well as to the local power distribution panel grounding system (e.g., ac branch circuit panel board’s equipment grounding bus-bar). All bonding and grounding connections shall be NEMA type compression or exothermic welded connections.

3. Refer to related specification sections for any additional grounding and bonding requirements.

3.07 EQUIPMENT IDENTIFICATION

A. Identify all system controls, components and equipment cabinets using plastic laminate engraved labels, or approved equal. Firmly affix to the panel, device, and/or component.

1. Nameplates shall be laminated black phenolic resin with a white core with engraved (“lamicoid”) lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws. Nameplates that are furnished by manufacturer as a standard catalog item or where other method of identification is herein specified. Dymo or Kroy tap adhesive backed lettering shall not be acceptable.

2. Color-code all junction boxes and enclosures per NEC recommendations. At the minimum provide all junction boxes as follows:

   a. Letter all pull boxes and junction boxes located in service areas, tunnels, above accessible ceilings and pipe chases with laminated black phenolic resin with a white core with engraved lettering, a minimum of 6 mm (1/4 inch) high. Secure nameplates with screws.

3. Permanently label all wiring at both ends with self-adhering plastic labels.

4. Provide typewritten circuit directories installed in 3-ring binders with transparent page protectors in each control and sub control cabinet and/or equipment rack.

5. CCTV camera labeling: Place SEPTA approved label on each camera to uniquely identify the camera.

3.08 MAINTENANCE & SERVICE

A. General Requirements
1. The Contractor shall provide all services required and equipment necessary to maintain the electronic fire alarm systems in an operational state as specified after formal written acceptance of the system.

   a. Provide all necessary material required for performing scheduled adjustments or other non-scheduled work. Impacts on facility operations shall be minimized when performing scheduled adjustments or other non-scheduled work. Refer to Division 1 specification section for additional information.

   b. The adjustment and repair of the fire alarm systems shall include all software and firmware updates on all computers, CPU’s, HMI terminals, devices, communications and data transmission medias’ (DTM), facility interface processors, signal transmission equipment, management software and processors.

   c. Test, inspect, and service each system on a quarterly basis at three month intervals during the warranty period from the time of final acceptance. The contractor shall compare each three month test results with the test results at the time of final acceptance.

      1) The contractor shall include as part of the quarterly test the calibration and/or adjustment of any device, component, and/or system that has deviated from the original test results at the time of final acceptance.

   d. For each quarterly maintenance period, provide written notification to the Owner’s Representatives of the systems condition before and after service, the exact components that were tested and serviced, and overall status of the system.

B. Personnel

1. Service personnel shall be manufacturer certified in the maintenance, testing, and repair of the type of system and equipment provided for the project. Provide the Owner’s Representatives the name of the designated service representative, and of any change in personnel. The Owner’s Representatives shall be provided copies of system manufacturer certification for the designated service representative.

   a. Schedule of work to be performed during regular working hours, Monday through Friday, excluding federal holidays.

C. Emergency Service

1. The Owner shall initiate service calls whenever the system is not functioning properly. The Contractor shall provide the Owner’s Representatives with an emergency service center telephone number. The emergency service center shall be staffed.
24 hours a day 365 days a year. The Owner shall have sole authority for determining catastrophic and non-catastrophic system failures.

a. For catastrophic system failures, the Contractor shall provide same day eight (8) hour service response with a defect correction time not to exceed sixteen (16) hours from [notification] [arrival on site]. Catastrophic system failures are defined as any system failure that the Owner determines will place the facility(s) at increased risk.

b. For non-catastrophic failures, the Contractor within 1 business day with a defect correction time not to exceed 48 hours from time of notification.

D. Records & Logs

1. The Contractor shall maintain records and logs of each task and organize cumulative records for each component and for the complete system chronologically. A continuous log shall be submitted for all devices. The log shall contain all initial settings, calibration, repair, and programming data. Complete logs shall be maintained and available for inspection on site, demonstrating planned and systematic adjustments and repairs have been accomplished for the system.

E. Work Request

1. The Contractor shall separately record each service call request, as received.

a. The record shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing the action taken, the amount and nature of the materials used, and the date and time of commencement and completion.

b. The Contractor shall deliver a record of the work performed within five (5) working days after the work was completed.

F. System Modifications

1. The Contractor shall make any recommendations for system modification in writing to the Owners Representative. No system modifications, including operating parameters and control settings, shall be made without prior written approval from the Owners Representative. Any modifications made to the system shall be incorporated into the operation and maintenance manuals and all related documentation.

3.09 WARRANTY

A. Warrant material and workmanship for a period as specified in Division 1 of the contract documents and all related specification sections. The warranty period...
shall commence from the date the Contactor received written notification of final acceptance from the Owner's Representative. At the minimum the contractor shall provide warranty provisions:

1. Warrant the replacement of defective components/materials and/or correct defective work when given notice by the Owner’s Representative during the warranty period.
   
a) At no time is the contractor to use the extra materials provided under the scope of this project to replace malfunctioning or damaged equipment and or components. The Contractor shall replace all malfunctioning or damaged equipment and or components with new. The repair and then reinstallation of malfunctioning or damaged equipment shall not be acceptable.

2. Warranty excludes liability for consequential incidental, or special damages due to vandalism, misuse, or acts of god.

3. Onsite warranty response time by qualified technician shall be within 8 hours upon receipt of request from Owner.

4. Warranty repairs shall be provided to the Owner at no cost. This shall include but not limited to replacement of all defective components/materials, all labor charges, all travel costs and all vehicle charges.

5. Response time shall be 7 days a week / 24 hours a day / 365 days a Year.

6. Provide test, inspection, and service of each system on a semi-annual basis at six month intervals.

7. Contractor must provide verification that they maintain their principle base of operation along with the personnel that will be responsible for providing service within 3 hours driving time to the project site. This tenet of the warranty shall remain in effect for the life of the warranty.

B. The Contractor shall, as a condition of final payment, execute a written warranty certifying all contract requirements have been completed according to all requirements of the Contract Documents.

1. All system testing, commissioning, demonstration and training shall be performed prior to final system acceptance. All defects or damages due to faulty materials or workmanship shall be repaired or replaced without delay, to the satisfaction of the Owner’s Representatives at the Contractor’s expense.
   
a. The contractor shall provide written documentation of test results and stating what was done to correct any deficiencies. The first inspection shall occur 90 calendar days after the acceptance date. The last inspection shall occur 30 calendar days prior to the end of the warranty.
   
b. The warranty period shall be extended until the last inspection and
associated corrective actions are complete when equipment and labor covered by the Contractor's warranty, or by a manufacturer's warranty, has been replaced, or restored.

1) The warranty period for any replaced or repaired equipment or restored work shall be reinstated for a period equal to the original warranty period, and commencing with the date of completion of the replacement or restoration work.

2. In the event any manufacturer customarily provides a warranty period greater than one (1) year, the Contractor's warranty shall be for the same duration for that component.

3.10 FIELD SERVICES

A. General Testing Requirements

1. Notify Owner’s Representatives in writing, ten (10) days advance of testing of all system cabling to prevent delays in construction schedules.
2. Perform all tests, as required, by authorities having jurisdiction throughout the facility.
3. Test system for grounds to demonstrate that the ground resistance does not exceed the requirements of the National Electric Code (NEC).
4. Test all cabling to confirm that no grounds, shorts, sneak currents, RFI and EMI conditions exist prior to start-up and commissioning of all, components, devices, equipment and/or systems.

a. Before requesting a final inspection, the Contractor shall perform a series of end to end installation performance tests. The Contractor shall submit for approval by Owner’s Representatives all test procedures to be employed, test result forms, and timetable for testing all fiber optic and copper plant wiring.

b. Acceptance of the simple test procedures discussed below is predicated on the Contractor's use of the recommended products including but not limited to twisted pair cable, cross-connect blocks, and outlet devices specified and adherence to the inspection requirements and practices set forth. Acceptance of the completed installation will be evaluated in the context of each of these factors.

5. Test all systems and components for proper function and operation; certify that all systems are in proper working operation in accordance with the Contract Documents prior to scheduling any system demonstrations.

6. In addition, provide all testing, commissioning and certifications as specified by Division 01 specification sections and any manufacturer’s recommendations or requirements.

B. Fiber Optic Testing

1. Contractor shall test each fiber strand and each pair of each twisted-pair copper cable. The Owner and Owners Representative reserve the right to have a representative present during all or a portion of the testing process.
If the Owner and Owners Representative elect to be present during testing, test results will only be acceptable when conducted in the presence of the Owner and Owners Representative.

2. Each fiber strand shall undergo bi-directional testing for signal attenuation losses. Test equipment shall include:
   b. Single mode: Light Source and Power Meter.
   c. OTDR.

3. Tests shall include:
   a. Multi-mode: Signal attenuation at 850 and 1300 nm.
   b. Single-mode: Bi-directional signal attenuation at 1310 and 1550 nm.
   c. Test all Fiber cable on the reel before installation, with an optical light meter, to ensure fiber continuity and no factory defects.
   d. Test Criteria: Signal loss of less than (3.6 dB for 1000 Base-SX @ 850NM for 50 uM fiber) through entire passive fiber path, including cable, couplers and jumpers.

4. Fiber Optic Testing Specifications
   a. All testing shall be performed by factory trained and certified personnel.
   b. For all installed fiber optic cable EIA 455-171 Method D procedures will be adhered to (Bi-directionally).
   c. Connector loss shall not exceed 0.75 dB per connector pair.
   d. The Fiber Optic Cable shall not exceed 1.0 dB per kilometer tested at 1310nm and 1550nm for single mode cable.
   e. The Fiber Optic Cable shall not exceed 3.5dB per kilometer tested at 850 nm and 1.5dB per kilometer tested at 1300nm for multi-mode 50/125 fiber.
   f. The contractor is responsible for obtaining minimum loss in Fiber connections and polishing per manufacturer’s specifications.
   g. Pre-installation tests of Inter-plant fiber:
      1) Test each reel and each fiber strand on the reel for continuity with a light source. If continuity is not achieved:
      2) Then test with an OTDR to determine the nature and location of the defect: Measure end-to-end attenuation and the distance to a high attenuation point.
      3) If it is determined by Owners Representative that the fiber is defective the contractor shall contact the manufacturer and provide a completely new fiber reel.
   h. Tests for installed Inter-plant and Intra-plant fiber optic cable:
      1) Intra-plant and Inter-plant Multi-mode: Bi-directional signal
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attenuation at 850 and 1300 nm, power meter.
2) Intra-plant and Inter-plant Single-mode: Bi-directional signal attenuation at 1310 and 1550 nm, power meter.

3) Inter-plant Multi-mode: Bi-directional OTDR trace at 850 and 1300 nm. OSP ONLY
4) Interplant Single-mode: Bi-directional OTDR trace at 1310 and 1550 nm. OSP ONLY

NOTE: Obtain the actual index of refraction from the cable Manufacturer before testing.

i. Test Criteria.
j. Total signal loss must not exceed the maximum Attenuation Coefficient plus the maximum Connector Attenuation as listed in TIA/EIA 568-B.
k. Maximum Link Attenuation shall be as calculated below:

1) Link Attenuation = Cable Attn + Connector Attn + Splice Attn
2) Cable Attn (db) = Attenuation coefficient (db/km)*Length(Km)
3) Attenuation Coefficients are specified in items 4.a and 4.b above.
4) Connector Attn (db) = number of connector pairs * connector loss (dB)
5) Splice Attn (dB) = number of splices (S) * splice loss (dB)

l. "Measured" Link Attenuation shall be compared to "Calculated" Link Attenuation to determine acceptance. The Contractor at no additional cost shall correct any Links that fail.
m. Single-mode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, not more than One Reference Jumper. 50/125 um backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method A.1, One Reference Jumper.
n. Submit all test reports for approval; an OTDR trace report for every OSP cable by strand and a fiber optic link attenuation record report for every cable by strand.

C. Training

1. In addition to all demonstration and training as specified by Division 01 specification section and all related Division 16 specification sections, system demonstrations and training shall be provided in accordance with all requirements of this section.

2. Prior to acceptance of the work, the System Integrator shall demonstrate to the Owner's Representatives, all systems and sub-systems all features and functions of each system, and shall instruct the Owner's Representatives in the proper operation, event sequences, programming and maintenance of all systems and sub-systems.

3. The System Integrator shall furnish the necessary trained personnel to
perform all demonstrations and instructions and arrange to have the manufacturer's representatives present to assist with the demonstrations.

4. Training time shall include, as a minimum, the total time determined by the sum of the times per system as specified in this and related specification sections, for performing the prescribed demonstrations/training. Refer to related specification sections for additional training requirements.

   a. Allow a minimum of 16 hours’ time for each system provided for performing the prescribed demonstrations/training.

      1) Provide a minimum of (4) four 4-hour training classes performed at the project location and spaced over a three week interval. Training classes shall be scheduled not less than 48 hours apart to allow the Owner’s User\Operators to familiarize themselves with all system operations.

5. Provide operation, parts, and maintenance manuals defining operation and troubleshooting methods of all systems and review with Owner’s User\Operators as part of training demonstrations.

6. Provide detailed video recordings in high quality digitally formatted media of all demonstration and training of all systems and system operations.

   a. Utilize remote microphones as may be required to ensure high quality audio of the recorded demonstrations.
   b. Permanently and professionally label all recorded materials and provide self-sealing plastic cases.

D. Inspections

   1. At the completion of the project and prior to final acceptance of the Work, provide evidence of final inspections and approvals to the Owner’s Representatives, as required by the authorities having jurisdiction as well as all requirements of Division 01 specification sections.

END OF SECTION 16800