

## SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This section identifies common and general grounding and bonding requirements of communication installations and applies to all sections of Divisions 27 and 28.

## 1.2 SUBMITTALS

- A. Provide plan indicating location of system grounding electrode connections and routing of aboveground and underground grounding electrode conductors.
- B. Closeout Submittals: Provide the following:
  - 1. Certified test reports of ground resistance.
  - 2. Certifications: Two weeks prior to final inspection, submit following:
    - a. Certification materials and installation is in accordance with construction documents.
    - b. Certification complete installation has been installed and tested.

## PART 2 - PRODUCTS

## 2.1 COMPONENTS

- A. Grounding and Bonding Conductors:
  - 1. Provide UL 83 insulated stranded copper equipment grounding conductors, with the exception of solid copper conductors for sizes 6 mm<sup>2</sup> (10 AWG) and smaller. Identify all grounding conductors with continuous green insulation color, except identify wire sizes 25 mm<sup>2</sup> (4 AWG) and larger per NEC.
  - 2. Provide ASTM B8 bare stranded copper bonding conductors, with the exception of ASTM B1 solid bare copper for wire sizes 6 mm<sup>2</sup> (10 AWG) and smaller.
- B. Ground Rods:
  - 1. Copper clad steel, 19 mm (3/4-inch) diameter by 3000 mm (10 feet) long, conforming to UL 467.
  - 2. Provide quantity of rods required to obtain specified ground resistance.
- C. Splices and Termination Components: Provide components meeting or exceeding UL 467 and clearly marked with manufacturer's name, catalog number, and permitted conductor sizes.
- D. Telecommunication System Ground Bus-bars:
  - 1. Telecommunications Main Grounding Bus-bar (TMGB):
    - a. 6.4 mm (1/4 inch) thick solid copper bar.

- b. Minimum 100 mm (4 inches) high and length sized in accordance application requirements and future growth of minimum 510 mm (20 inches) long.
  - c. Minimum thirty predrilled attachment points (two rows of fifteen each) for attaching standard sized two-hole grounding lugs.
    - 1) 27 lugs with 15.8 mm (5/8 inch) hole centers.
    - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
  - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
  - e. Listed as grounding and bonding equipment.
2. Telecommunications Grounding Bus-bar (TGB):
    - a. 6.4 mm (1/4 inch) thick solid copper bar.
    - b. Minimum 50 mm (2 inches) high and length sized in accordance application requirements and future growth of minimum 300 mm long (12 inches) long.
    - c. Minimum nine predrilled attachment points (one row) for attaching standard sized two-hole grounding lugs.
      - 1) 6 lugs with 15.8 mm (5/8 inch) hole centers.
      - 2) 3 lugs with 25.4 mm (1 inch) hole centers.
    - d. Wall-mount stand-off brackets, assembly screws and insulators for 100 mm (4 inches) standoff from wall.
    - e. Listed as grounding and bonding equipment.
- E. Equipment Rack and Cabinet Ground Bars:
1. Solid copper ground bars designed for horizontal mounting to framework of open racks or enclosed equipment cabinets:
    - a. 4.7 mm (3/16 inch) thick by 19.1 mm (3/4 inch) high hard-drawn electrolytic tough pitch 110 alloy copper bar.
    - b. 482 mm (19 inches) or 584 mm (23 inches) EIA/ECA-310-E rack mounting width (as required) for mounting on racks or cabinets.
    - c. Eight 6-32 tapped ground mounting holes on 25.4 mm (1 inch) intervals.
    - d. Four 7.1 mm (0.281 inch) holes for attachment of two-hole grounding lugs.
    - e. Copper splice bar of same material to transition between adjoining racks.
    - f. Two each 12-24 x 19.1 mm (3/4 inch) copper-plated steel screws and flat washers for attachment to rack or cabinet.
    - g. Listed as grounding and bonding equipment.
  2. Solid copper ground bars designed for vertical mounting to framework of open racks or enclosed equipment cabinets:
    - a. 1.3 mm (0.05 inch) thick by 17 mm (0.68 inch) wide tinned copper strip.
    - b. 1997 mm (78 inches) high for mounting vertically on full height racks.
    - c. Holes punched on 15.875 mm-15.875 mm-12.7 mm (5/8"-5/8"-1/2") alternating vertical centers to match EIA/ECA-310-E Universal Hole Pattern for a 45 RMU rack.
    - d. Three #12-24 zinc-plated thread forming hex washer head installation screws, an abrasive pad and antioxidant joint compound.
    - e. NRTL listed as grounding and bonding equipment.
- F. Ground Terminal Blocks: Provide screw lug-type terminal blocks at equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted.

1. Electroplated tin aluminum extrusion.
  2. Accept conductors ranging from #14 AWG through 2/0.
  3. Hold conductors in place by two stainless steel set screws.
  4. Two 6 mm (1/4 inch) holes spaced on 15.8 mm (5/8 inch) centers to allow secure two-bolt attachment.
  5. Listed as a wire connector.
- G. Splice Case Ground Accessories: Provide splice case grounding and bonding accessories manufactured by splice case manufacturer when available. Otherwise, use 16 mm<sup>2</sup> (6 AWG) insulated ground wire with shield bonding connectors.
- H. Irreversible Compression Lugs:
1. Electroplated tinned copper.
  2. Two holes spaced on 15.8 mm (5/8 inch) or 25.4 mm (1 inch) centers.
  3. Sized to fit the specific size conductor.
  4. Listed as wire connectors.
- I. Antioxidant Joint Compound: Oxide inhibiting joint compound for copper-to-copper, aluminum-to-aluminum or aluminum-to-copper connections.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Exterior Equipment Grounding: Bond exterior metallic components (including masts and cabinets), antennas, satellite dishes, towers, raceways, primary telecommunications protector/arresters, secondary surge protection, waveguides, cable shields, down conductors and other conductive items to directly to Intersystem Bonding Termination.
- B. Install telecommunications bonding backbone conductor throughout building via telecommunications backbone pathways effectively bonding all interior telecommunications grounding bus-bars in telecommunications rooms and data center room to telecommunications main grounding bus-bar in the Demark room after testing bond to verify bonding conductor for telecommunications from grounding electrode conductor is installed per NEC. Size telecommunications bonding backbone conductor as specified in TIA-607-B.
- C. Inaccessible Grounding Connections: Utilize exothermic welding for bonding of buried or otherwise inaccessible connections with the exception of connections requiring periodic testing.
- D. Conduit Systems:
1. Bond ferrous metallic conduit to ground.
  2. Bond grounding conductors installed in ferrous metallic conduit at both ends of conduit using grounding bushing with #6 AWG conductor.
- E. Boxes, Cabinets, and Enclosures:
1. Bond each pull box, splice box, equipment cabinet, and other enclosures through which conductors pass (except for special grounding systems for intensive care units and other critical units shown) to ground.
- F. Corrosion Inhibitors: Apply corrosion inhibitor for protecting connection between metals used to contact surfaces, when making ground and ground bonding connections.

## G. Telecommunications Grounding System:

1. Bond telecommunications grounding systems and equipment to facility's electrical grounding electrode at Intersystem Bonding Termination.
2. Provide hardware as required to effectively bond metallic cable shields communications pathways, cable runway, and equipment chassis to ground.
3. Install bonding conductors without splices using shortest length of conductor possible to maintain clearances required by NEC.
4. Provide paths to ground that are permanent and continuous with a resistance of 1 ohm or less from each raceway, cable tray, and equipment connection to telecommunications grounding bus-bar.
5. Below-Grade Connections: When making exothermic welds, wire brush or file the point of contact to a bare metal surface. Use exothermic welding cartridges and molds in accordance with manufacturer's recommendations. After welds have been made and cooled, brush slag from weld area and thoroughly clean joint areas. Notify owner prior to backfilling at ground connections.
6. Above-Grade Bolted or Screwed Grounding Connections:
  - a. Remove paint to expose entire contact surface by grinding.
  - b. Clean all connector, plate and contact surfaces.
  - c. Apply corrosion inhibitor to surfaces before joining.
7. Bonding Jumpers:
  - a. Assemble bonding jumpers using insulated ground wire of size and type shown on drawings or use a minimum of 16 mm<sup>2</sup> (6 AWG) insulated copper wire terminated with compression connectors of proper size for conductors.
  - b. Use connector manufacturer's compression tool.
8. Bonding Jumper Fasteners:
  - a. Conduit: Connect bonding jumpers using lugs on grounding bushings or clamp pads on push-type conduit fasteners. Where appropriate, use zinc-plated external tooth lock washers or Belleville Washers.
  - b. Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lock washers or Belleville washers and nuts. Install protective cover, e.g., zinc-plated acorn nuts, on bolts extending into wireway or cable tray to prevent cable damage.
  - c. Grounding Bus-bars: Fasten bonding conductors using two-hole compression lugs. Use 300 series stainless steel bolts, Belleville Washers, and nuts.
  - d. Slotted Channel Framing and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and Belleville washers or external tooth lock washers.

## H. Telecommunications Room Bonding:

1. Telecommunications Grounding Bus-bars:
  - a. Install bus-bar hardware no less than 950 mm (18 inches) A.F.F.
  - b. Where other grounding bus-bars are located in same room, e.g. electrical panelboard for telecommunications equipment, bond bus-bars together as indicated on grounding riser diagrams.
  - c. Make conductor connections with two-hole compression lugs sized to fit bus-bar and conductors.

- d. Attach lugs with stainless steel hardware after preparing bond according to manufacturer recommendations and treating bonding surface on bus-bar with anti-oxidant to help prevent corrosion.
2. Telephone-Type Cable Rack Systems:
    - a. Aluminum pan installed on telephone-type cable rack serves as primary ground conductor within communications room.
    - b. Make ground connections by installing bonding jumpers:
      - 1) Install minimum 16 mm<sup>2</sup> (6 AWG) bonding between telecommunications ground bus-bars and the aluminum pan installed on cable rack.
      - 2) Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across aluminum pan junctions.
- I. Self-Supporting and Cabinet-Mounted Equipment Rack Ground Bars:
    1. Install rack-mount horizontal bus-bar or vertical bus-bar to provide multiple bonding points,
    2. At each rack or cabinet containing active equipment or shielded cable terminations:
      - a. Bond bus-bar to ground as part of overall telecommunications bonding and grounding system.
      - b. Bond copper ground bars together using solid copper splice plates manufactured by same ground bar manufacturer, when ground bars are provided at rear of lineup of bolted together equipment racks.
      - c. Bond non-adjacent ground bars on equipment racks and cabinets with 16 mm<sup>2</sup> (6 AWG) insulated copper wire bonding jumpers attached at each end with compression-type connectors and mounting bolts.
      - d. Provide 16 mm<sup>2</sup> (6 AWG) bonding jumpers between rack and cabinet ground bus-bars and overhead cable runway or raised floor stringers, as appropriate.
- J. Backboards: Provide a screw lug-type terminal block or drilled and tapped copper strip near top of backboards used for communications cross-connect systems. Connect backboard ground terminals to cable runway using an insulated 16 mm<sup>2</sup> (6 AWG) bonding jumper.
- K. Other Communication Room Ground Systems: Ground metallic conduit, wireways, and other metallic equipment located away from equipment racks or cabinets to cable tray or telecommunications ground bus-bar, whichever is closer, using insulated 16 mm<sup>2</sup> (6 AWG) ground wire bonding jumpers.
- L. Communications Cable Grounding:
    1. Bond all metallic cable sheaths in multi-pair communications cables together at each splicing or terminating location to provide 100 percent metallic sheath continuity throughout communications distribution system.
    2. Install a cable shield bonding connector with a screw stud connection for ground wire, at terminal points. Bond cable shield connector to ground.
    3. Bond all metallic cable shields together within splice closures using cable shield bonding connectors or splice case manufacturer's splice case grounding and bonding accessories. When an external ground connection is provided as part of splice closure, connect to an effective ground source and bond all other metallic components and equipment at that location.

## M. Communications Cable Tray Systems:

1. Bond metallic structures of cable tray to provide 100 percent electrical continuity throughout cable tray systems.
2. Where metallic cable tray systems are mechanically discontinuous:
  - a. Install splice plates provided by cable tray manufacturer between cable tray sections so resistance across a bolted connection is 0.010 ohms or less, as verified by measuring across splice plate connection.
  - b. Install 16 mm<sup>2</sup> (6 AWG) bonding jumpers across each cable tray splice or junction where splice plates cannot be used.
3. Bond cable tray installed in same room as telecommunications grounding bus-bar to bus-bar.

## N. Communications Raceway Grounding:

1. Conduit: Use insulated 16 mm<sup>2</sup> (6 AWG) bonding jumpers to bond metallic conduit at both ends and intermediate metallic enclosures to ground.
2. Cable Tray Systems: Use insulated 16 mm<sup>2</sup> (6 AWG) grounding jumpers to bond cable tray to column-mounted building ground plates (pads) at both ends and approximately 16 meters (50 feet) on centers.

## O. Ground Resistance:

1. Install telecommunications grounding system so resistance to grounding electrode system measures 5 ohms or less.
2. Measure grounding electrode system resistance using an earth test meter, clamp-on ground tester, or computer-based ground meter as defined in IEEE 81. Record ground resistance measurements before electrical distribution system is energized.
3. Backfill only after below-grade connection have been visually inspected by owner. Notify owner twenty-four hours before below-grade connections are ready for inspection.

## P. Ground Rod Installation:

1. Drive each rod vertically in earth minimum 3000 mm (10 feet) in depth.
2. Make connections by exothermic process to form solid metal joints, where permanently concealed ground connections are required. Make accessible ground connections with mechanical pressure type ground connectors.
3. Install angled ground rods or grounding electrodes in horizontal trenches to achieve specified resistance, where rock prevents driving of vertical ground rods.

## 3.2 FIELD QUALITY CONTROL

- A. Perform tests per BICSI's Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
- B. Perform two-point bond test using trained installers qualified to use test equipment.
- C. Conduct continuity test to verify that metallic pathways in telecommunications spaces are bonded to TGB or TMGB.
- D. Conduct electrical continuity test to verify that TMGB is effectively bonded to grounding electrode conductor.

- E. Visually inspect to verify that screened and shielded cables are bonded to TGB or TMGB.
- F. Perform a resistance test to ensure patch panel, rack and cabinet bonding connection resistance measures less than 5 Ohms to TGB or TMGB.

END OF SECTION 270526

## SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Nonmetallic conduits and fittings.
  - 3. Optical-fiber-cable pathways and fittings.
  - 4. Metal wire-ways and auxiliary gutters.
  - 5. Nonmetallic wire-ways and auxiliary gutters.
  - 6. Metallic surface pathways.
  - 7. Nonmetallic surface pathways.
  - 8. Hooks.
  - 9. Boxes, enclosures, and cabinets.
  - 10. Polymer-concrete hand-holes and boxes for exterior underground cabling.

## 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.

## 1.4 ACTION SUBMITTALS

- A. Product data for the following:
  - 1. Surface pathways
  - 2. Wireways and fittings.
  - 3. Tele-power poles.
  - 4. Boxes, enclosures, and cabinets.
  - 5. Underground hand-holes and boxes.
- B. Shop Drawings: For custom enclosures and cabinets and custom underground hand-holes and boxes. Include plans, elevations, sections, and attachment details.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
  - 3. Underground ducts, piping, and structures in location of underground enclosures and hand-holes.



## PART 2 - PRODUCTS

## 2.1 METAL CONDUITS AND FITTINGS

- A. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  - 2. Comply with TIA-569-C.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  - 2. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Set screw or compression.
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions were installed, and including flexible external bonding jumper.
- G. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. General Requirements for Nonmetallic Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Comply with TIA-569-C.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. Rigid HDPE: Comply with UL 651A.
- D. Continuous HDPE: Comply with UL 651A.
- E. RTRC: Comply with UL 2515A and NEMA TC 14.
  - 1. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

### 2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway, approved for location that it is installed unless otherwise indicated.
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Comply with TIA-569-C.

### 2.4 SURFACE METAL PATHWAYS

- A. Galvanized steel with snap-on covers, complying with UL 5.
- B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with TIA-569-C.

### 2.5 SURFACE NONMETALLIC PATHWAYS:

- A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- C. Comply with TIA-569-C.

### 2.6 HOOKS

- A. General Requirements for Hooks:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Comply with TIA-569-C.
  - 3. Galvanized steel.
  - 4. J shape.
  - 5. Minimum of one inch wide.

### 2.7 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Comply with TIA-569-C.
  - 2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
  - 3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  - 4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Metal Floor Boxes:
  - 1. Material: Cast metal or sheet metal.
  - 2. Type: Fully adjustable.

3. Shape: Rectangular.
  4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasket cover.
- G. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- H. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures:
    - a. Material: Plastic.
    - b. Finished inside with radio-frequency-resistant paint.
  3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- I. Cabinets:
1. NEMA 250, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  2. Hinged door in front cover with flush latch and concealed hinge.
  3. Key latch to match panelboards.
  4. Metal barriers to separate wiring of different systems and voltage.
  5. Accessory feet where required for freestanding equipment.
  6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.8 POLYMER-CONCRETE HAND-HOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.
1. Boxes and hand-holes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  3. Comply with TIA-569-C.
- B. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
- C. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  2. Cover Legend: Molded lettering, "COMMUNICATIONS".

- D. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- E. Hand-holes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

### PART 3 - EXECUTION

#### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: Type EPC-40-PVC.
  - 2. Concealed Conduit, Aboveground: Type EPC-40-PVC.
  - 3. Underground Conduit: Type EPC-40-PVC.
  - 4. Boxes and Enclosures, above ground: NEMA 25.
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Damp or Wet Locations: IMC.
  - 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway.
  - 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway.
  - 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable.
  - 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic units in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use set-screw fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.

- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg. F (49 deg. C).

### 3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA/BICSI 568.
  - 3. TIA-569-C.
  - 4. NECA 101
  - 5. NECA 102.
  - 6. NECA 105.
  - 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Fire-stopping" for fire-stopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270528.29 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Pathways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot (3-m) intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
  - 3. Arrange pathways to keep a minimum of 1 inch (25 mm) of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Some authorities having jurisdiction may not permit nonmetallic tubing in fire-rated slabs in subparagraph below. Change from nonmetallic conduit and fittings to IMC and fittings before rising above floor.

- M. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits of 2-inch (50-mm) trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- U. Surface Pathways:
1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
  2. Install surface pathway with a minimum 2-inch (50-mm) radius control at bend points.
  3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. 1-Inch (25-mm) Trade Size and Larger: Install pathways in maximum lengths of 75 feet (23 m).
  2. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- W. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.

- X. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
    - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    - 2. Where an underground service pathway enters a building or structure.
    - 3. Where otherwise required by NFPA 70.
  - Y. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
  - Z. Cable Hooks:
    - 1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
    - 2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
    - 3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
    - 4. Space hooks no more than 5 feet (1.5 m) o.c.
    - 5. Provide a hook at each change in direction.
    - 6. Hooks shall be a minimum of 1" wide.
  - AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
  - BB. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between boxes and cover plates or supported equipment and box.
  - CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
  - DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
  - EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
  - FF. Set metal floor boxes level and flush with finished floor surface.
  - GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- ### 3.3 INSTALLATION OF UNDERGROUND CONDUIT
- A. Direct-Buried Conduit:
    - 1. Excavate trench bottom to provide firm and uniform support for conduit.
    - 2. Provide marker tape 12" above conduit along its full buried length.

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete around conduit for a minimum of 12 inches (300 mm) on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning tape: Bury warning planks approximately 12 inches (300 mm) above direct-buried conduits, but a minimum of 6 inches (150 mm) below grade. Align tapes along centerline of conduit.

#### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install hand-holes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- E. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

#### 3.5 FIRESTOPPING

- A. Install fire-stopping at penetrations of fire-rated floor and wall assemblies.



3.6 PROTECTION

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

END OF SECTION 270528

SECTION 270544 - SLEEVES AND SLEEVE SEALS FOR COMMUNICATIONS PATHWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

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

B. Related Requirements:

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

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

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

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

- C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
  - 1. Material: Galvanized-steel sheet.
  - 2. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

## 2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and pathway or cable.
  - 1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Carbon steel.
  - 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

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

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

### PART 3 - EXECUTION

#### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
  - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pathway or cable unless sleeve seal is to be installed.
  - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
  - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
  - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
  - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between pathway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

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

3.3 SLEEVE-SEAL-FITTING INSTALLATION

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

END OF SECTION 270544

## SECTION 283111 – EXPANSION OF DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

## PART 1 - GENERAL:

## 1.1 SCOPE:

- A. Provide a fully functional, code compliant, commissioned and tested addition to the existing “Simplex” addressable fire alarm network which utilizes digital voice audible notification. Provide a new network node serving the new building “Zone” beyond the two hour wall separation.
- B. All new devices shall be 100% compatible with the existing system and shall be of the same manufacturer name/brand. Ensure that after the new devices are commissioned that the entire system has a minimum of 15 minutes of alarm back-up power after a 24 hour loss of primary AC power.
- C. All initiation devices shall be of the addressable type and fully compliant with the control panel being installed. Any system initiation devices that are not addressable such as high temp heat detectors shall be monitored by a supervised addressable input module.
- D. The notification devices shall be connected to a class “B” notification circuit.
- E. The system shall utilize speakers, strobes, and speaker/strobes for occupant notification of alarm conditions. Ensure that a minimum of 15db above ambient sounds levels is achieved in every space.
- F. Provide additional remote power supplies with battery back-up (24 hours of standby and 15 minutes of alarm) as needed for driving notification devices.
- G. Provide a ceiling mounted photoelectric smoke detector above each fire alarm panel, fire alarm power supply, and annunciator.
- H. Addressable monitor modules shall be utilized for monitoring all sprinkler tamper switches, flow switches, low air switches, and post indicator valves (Coordinate closely with the Fire Protection Contractor).
- I. Addressable relay modules will be incorporated for interfacing with elevator controllers, HVAC units, and other systems.
- J. Manual pull stations will be installed within 5'-0" of each exterior door. Pull stations shall be single action “push pull” style. Break glass style stations will not be allowed.
- K. Ceiling mounted smoke and/or heat detectors will be included to provide detection as required by code or by room hazard.
- L. Supply and return duct mounted smoke detectors shall be installed on any HVAC unit that meets or exceeds 2000cfm. Additionally, duct mounted smoke detectors shall be installed at each smoke damper and shall be configured to close the damper upon detection of smoke. Coordinate closely with the mechanical plans and the mechanical contractor.

## 1.2 SUMMARY

### A. Section Includes:

1. Fire-alarm control panel.
2. Addressable Manual fire-alarm boxes.
3. Addressable smoke detectors.
4. Addressable Heat detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable monitor device.
8. Addressable relay device
9. Digital alarm communicator transmitter (integral to the FACP).

## 1.3 ACTION SUBMITTALS

### A. Product Data: For each type of product, including furnished options and accessories.

### B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, clearances required, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include riser diagram indicating each device connected to the system in the order that they are installed.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this specification and in NFPA 72.
9. Include performance parameters and installation details for each device.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
  - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
  - b. Show field wiring required for HVAC unit shutdown on alarm.
  - c. Locate detectors according to manufacturer's written recommendations.
12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

### C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect. As part of the submittal supply the AHJ review notes and include the corrections/alteration on the system plans.

2. Shop Drawings shall be prepared by persons with the following qualifications:
  - a. Trained and certified by manufacturer in fire-alarm system design.
  - b. NICET-certified, fire-alarm technician; Level III minimum.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
  1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
    - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - c. Complete "as-built" wiring diagrams showing connections and circuit routes between all devices and equipment as installed.
    - d. Riser diagram indicating all devices connected to the system in the order that they appear on each circuit.
    - e. Record copy of site-specific software on a CD provided to the owner for archiving.
    - f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
      - 1) List of all equipment/devices tested.
      - 2) Frequency of testing of installed components.
      - 3) Frequency of inspection of installed components.
      - 4) Requirements and recommendations related to results of maintenance.
      - 5) Manufacturer's user training manuals.
    - g. Manufacturer's required maintenance related to system warranty requirements.
    - h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit. Instructions should be formatted on an 8.5x11 sheet.
- B. Software and Firmware Operational Documentation:
  1. Program Software Backup: On magnetic media or compact disk, complete with data files.
  2. Device address list.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Installation personnel shall be trained by the system manufacturer for installation of units required for this project.
- B. Technician/Programmer Qualifications: Programming and testing shall be by personnel certified by NICET as fire-alarm Level III technician.



## 1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two (2) years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Provide a fully functional, code compliant, commissioned and tested addition to the existing addressable fire alarm system which utilizes digital voice audible notification. All devices and panels shall be supplied by SimplexGrinnell.
- B. All new devices shall be 100% compatible with the existing system and shall be of the same manufacturer name/brand (Simplex). Ensure that after the new devices are commissioned that the entire system has a minimum of 15 minutes of alarm back-up power after a 24 hour loss of primary AC power.
- C. All components provided shall be listed for use with the selected system.
- D. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. This is an addition to an existing system, therefore, the sequence of operation for the addition shall match the AHJ approved and site standard sequence of operation for the existing site fire alarm system. The existing system is currently divided into building "Zones" with independent operational characteristics.
  - 1. Activation of only one alarm initiation device within a building zone will cause a general alarm condition within that zone only and for a trouble condition to be indicated on all other building zones.
  - 2. Upon receipt of two alarm initiation devices activated within a building zone a structure wide general alarm will be initiated.
  - 3. Verify exact building zone separation lines with the architectural drawings.

### 2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Panel (FACP):
  - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864. The control panel shall be supplied with all cards required for connection to the existing network as a new network node. Provide all programming required for integration into the network including graphical map updates.
  - 2. Provide addressable circuits or capacity for all initiating devices plus 25% spare.
  - 3. Provide notification circuits for all audible and visual notification devices plus 25% spare capacity on each circuit.
  - 4. Indicate which programmed devices have been disabled.

5. Allow silencing of the audible notification devices while leaving the visual notification devices operational.
  6. Provide secondary power source (battery back-up) of sufficient capacity to sustain the entire system for 24 hours of stand-by operation and 15 minutes of general alarm operation following a loss of primary AC power circuits.
  7. Provide standard digital fire alarm evacuation message, a severe weather warning message, a lockdown message, and a shelter in place message in addition to a microphone for live voice message override.
- B. Alphanumeric display and system controls: Arranged for interface between human operator at fire-alarm control panel or annunciator panel and system components including notification and supervision. Display alarm, supervisory, trouble, and component status messages and the programming and control menu.
1. FACP display and annunciator: Liquid-crystal type, 40 characters, minimum.
  2. FACP keypad: Arranged to permit entry and execution of programming, display, and control commands.
  3. Provide a dedicated labeled switch for activating each of the digital voice messages.
- C. Pathway Class Designations: Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
1. Signaling line Circuits: NFPA 72, style "4" minimum.
  2. Notification appliance Circuits: NFPA 72 class "B" minimum.
  3. Initiating device (monitor modules to contacts): NFPA 72 class "B" minimum
- D. Notification-Appliance Circuit:
1. Audible signals shall remain active until the silence switch is pressed or until the alarm condition is reset. Contractor to verify desired operation with the local authority having jurisdiction.
  2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72. Visual signals shall remain active until alarm conditions are reset. Contractor to verify desired operation with the local authority having jurisdiction.
- E. Elevator Recall:
1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
    - a. Smoke detectors in the elevator lobbies.
    - b. Smoke detector in elevator machine room.
    - c. Smoke detectors in elevator hoistway.
  2. Elevator controller shall be programmed to move the cars to the alternate recall floor (second floor) if lobby detectors located on the primary recall floor (first floor) is activated.
  3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay in addition to heat detectors in the hoistway or machine room.
- F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system. Release any electrically secured doors in the path of egress upon general alarm.

- G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system historical log.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals for each addressable point or monitored point on the system (point reporting) to an approved central station monitoring service. Include the first years monitoring service contract fees in the base bid. The system supplier shall coordinate with the owner for identification of contact names and numbers for the monitoring system contract.
- I. Primary Power: 24 VDC obtained from 120 VAC service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals supervisory and digital alarm communicator transmitters shall be powered by 24 VDC source. Primary 120 VAC feeds shall be dedicated 20 A circuits with a lockable breaker and labeled as "Fire Alarm System" in red text.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed eighty percent (80%) of the power-supply module rating.
- J. Secondary Power: 24 VDC supply system with batteries, automatic battery charger, and automatic transfer switch. Provide secondary power source (battery back-up) of sufficient capacity to sustain the entire system for 24 hours of stand-by operation and 15 minutes of general alarm operation following a loss of primary AC power circuits.

## 2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.
  - 1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
  - 2. Station Reset: Key operated switch.
  - 3. Provided within 5'-0" of each exterior door.

## 2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
  - 1. Comply with UL 268; operating at 24 VDC, nominal.
  - 2. Detectors shall be two wire types.
  - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to system wiring.
  - 5. Self-Restoring: Detectors do not require resetting or re-adjustment after actuation to restore them to normal operation.
  - 6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.

7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
  - a. Multiple levels of detection sensitivity for each sensor.
  - b. Sensitivity levels based on time of day.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts shall be used for any duct mounted smoke detector which is required to be external to the building.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Provide a fully programmable addressable relay for each HVAC unit requiring shutdown upon activation of a general alarm condition. The relay should be mounted within 3'-0" of the HVAC unit's controller.
7. Each duct mounted smoke detector shall be provided with a remote station including a status LED and a key test switch. The remote station shall be mounted near the detector but in a location that does not require a ladder or special equipment to access.

## 2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

- B. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.
  - 1. Mounting: Adapter plate for outlet box mounting or twist-lock base interchangeable with smoke-detector bases.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed set temperature.
  - 1. Mounting: Adapter plate for outlet box mounting or twist-lock base interchangeable with smoke-detector bases.
  - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, equipped for mounting as indicated, and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
  - 2. Special Note: Addressable notification devices shall not be utilized and will not be accepted on this project.
  
- B. Speakers: 24 VDC; with provision for housing the operating mechanism behind a grille. Comply with UL 464. All speakers shall be tapped at two watts and adjusted down as needed. Minimum output shall be 85db measured at 10 feet.
  
- C. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens or housing.
  - 1. Mounting: Wall mounted unless otherwise indicated.
  - 2. Flashing shall be synchronized with other units.
  - 3. Strobe Leads: Factory connected to screw terminals.
  - 4. Mounting Faceplate: Factory finished in red with white lettering.

## 2.8 REMOTE ANNUNCIATOR

- A. Description: Annunciator functions shall match those of fire-alarm control panel for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control panel, including acknowledging, silencing, resetting, and testing. Include a remote microphone matching the functions of the FACP.
  - 1. Mounting: Flush cabinet/box, NEMA 250, Type 1.

- B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control panel. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
  - 1. Provide standard digital fire alarm evacuation message, a severe weather warning message, a lockdown message, and a shelter in place message in addition to a microphone for live voice message override.
  - 2. Provide activation buttons for the standard digital fire alarm evacuation message, a severe weather warning message, a lockdown message, and a shelter in place message in addition to a microphone for live voice message override.

## 2.9 ADDRESSABLE INTERFACE DEVICES

- A. General:
  - 1. Include address-setting means on the module.
  - 2. Store an internal identifying code for control panel use to identify the module type.
- B. Addressable Monitor Module: Microelectronic module providing a system address for alarm initiating devices for wired applications with normally open contacts. Monitor modules shall supervise the conductors between itself and the monitored contact.
- C. Addressable Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall, to circuit-breaker shunt trip for power shutdown, for access control door interface, or for shutdown of HVAC units.
  - 1. Allow the control panel to switch the relay contacts on command.
  - 2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
  - 3. Be mounted within 3'-0" of the device that it is controlling.

## 2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

- A. Utilize the existing site fire alarm system's AHJ approved network monitoring system and standard operating procedure.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems." and NEC requirements
- B. Install wall-mounted panels, with tops of cabinets not more than 78 inches above the finished floor.

- C. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm pull station in the normal path of egress within 60 inches of the exit doorway.
  - 2. Mount manual fire-alarm pull station on a background of a contrasting color.
  - 3. The operable part of manual fire-alarm pull station shall be between 42 inches and 48 inches above floor level. All pull stations shall be mounted at the same height unless otherwise indicated.
- D. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
- F. Elevator Shafts: Coordinate heat detector temperature rating and location with sprinkler rating and location. Mount heat detectors within eighteen inches (18") of the sprinkler head. If multiple heads are mounted in the top of shaft, bottom of shaft, or elevator equipment room provide a heat detector adjacent to each.
- G. Remote Status and Alarm Indicators: Install in a visible location near each duct smoke detector.
- H. Audible Alarm-Indicating Devices: Install not less than six inches (6") below the ceiling. Install speakers on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated. As part of the base bid include ten (10) additional speaker units which shall be installed upon request of the fire marshal at the time of acceptance testing.
- I. Visible Alarm-Indicating Devices: Install so that lens is 80" AFF or at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated. . As part of the base bid include 5 additional strobe units which shall be installed upon request of the fire marshal at the time of acceptance testing.

### 3.2 PATHWAYS

- A. All fire alarm circuit pathways shall be in EMT conduit.
- B. Exposed EMT shall be red or painted red enamel.
- C. All fire alarm system related junction boxes shall have red covers.
- D. The minimum conduit size shall be  $\frac{3}{4}$ ". Conduit fill shall not exceed the requirements of NEC.

### 3.3 CONNECTIONS

- A. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Electronically locked doors.
  - 2. Alarm-initiating connection to elevator recall system and components.
  - 3. Supervisory connections at valve supervisory switches.
  - 4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

5. Supervisory connections at elevator shunt-trip breaker.
6. HVAC units that shutdown upon activation of a general alarm condition.

### 3.4 IDENTIFICATION

- A. Install framed instructions in a location visible from fire-alarm control panel and annunciator panel or update existing site maps. Coordinate with the owner or their representative for an acceptable mounting location.

### 3.5 GROUNDING

- A. Ground fire-alarm control panel and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control panel.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location and maintain shield continuity through each junction box or splice point.

### 3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by the owner's representative and the authorities having jurisdiction.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.
    - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.



3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide a minimum of two (2) classes lasting at least two (2) hours each for the Owner's representatives.

END OF SECTION 283111