

## **SECTION 270528 - PATHWAYS FOR COMMUNICATIONS**

### **PART 1 - GENERAL**

#### **1.1 SUBMITTALS**

A. Product Data:

1. Raceway.
2. Innerduct.
3. Spillways/waterfalls.
4. Floor boxes.
5. Device boxes.
6. Cable spillways.
7. Discrete cable supports.

B. Shop Drawings:

1. Coordinated floor plan drawings depicting the size(s), locations, and dimensions of the following:
  - a. Primary pathways.
  - b. Conduit sleeves (e.g., thru-the-wall, thru-the-floor, and thru-the-bulkhead).
  - c. Roof penetrations.
  - d. Conduits: Trade-size 2 inches and larger.
  - e. Raceway: Featuring a cross-sectional area of  $\geq 4$  square inches.
  - f. Vertical and horizontal working clearances around tray and ladder rack.
2. Conduit Interconnect Diagrams: for each totally-enclosed pathway system.

C. Closeout Submittals:

1. Accurate up-to-date as-built versions of shop drawings.

#### **1.2 REFERENCES**

A. Definitions:

1. Hybrid Pathway System: A pathway system built from a varied mixture of boxes, raceway, cable tray and discrete cable supports. Fundamentally a pathway system that is not a totally-closed pathway system. A hybrid pathway system supports cables in the horizontal at increments not exceeding 60 inches.
2. Pathway: A collection of products that when used together achieve a complete means for the conveyance of cable(s) from one location to another. A pathway system protects and supports cables to various degrees depending upon the application and products used. The pathway system most frequently terminates

- into an enclosure, boxes or other apparatus where cables are terminated and associated devices are mounted.
3. Primary Pathway: A cabling pathway typically located in a corridor, public area, or dedicated vertical cable chase and used to enclose and/or support large quantities of compatible-signal cables from one or more systems to the general vicinity of where cables are terminated. Cables carried by a primary pathway transfer to secondary pathways.
  4. Raceway: An enclosed pathway component used for the routing of cables. The raceway envelops the cables that pass through it to protect them from physical damage, and at times from heat, humidity, corrosion and water intrusion. A raceway may feature a continuous outer shell, or in select cases (such as surface raceway) may feature a removable outer shell that facilitates installation and removal of cables. Raceway frequently terminates directly into boxes or enclosures used for the purpose of mounting devices and termination of the cables.
  5. Secondary Pathways: Pathways typically branching from a primary pathway and routing to a space(s) where a cable is terminated. A secondary pathway typically accommodates sixteen (16) cables or less. A secondary pathway carries cables from a single system that together can be run in tight parallel proximity to one another without any negative impact on adjacent cables or cause distortion or induce consequential interference on the signals they carry.
  6. Totally Enclosed Pathway System: A pathway system that is built from a mixture of boxes and raceway that when assembled are closed on all sides. Fundamentally it is a pathway system where the cables within the system are not visible and not accessible except when a component of the system, or a device mounted to it is removed. A totally enclosed pathway system supports cables run horizontally and continuously.

### **1.3 SPECIAL REQUIREMENTS**

- A. Contract Division of Work and issuance of separate contracts notwithstanding, the entity(s) performing work of this Section shall have the responsibility to provide complete, working and code compliant pathway systems for the systems specified in this Division and for the additional systems so specified in the Contract Documents. Such systems shall be constructed in compliance with the Contract Documents.
- B. Provide complete, working and code compliant pathway systems for Division 27 and Division 28 Systems (where applicable), and as otherwise identified in the Contract Documents. Note that the Drawings may not fully detail the required complete pathway system and components.
- C. Should Work of this Section be performed by a party that is different from the party responsible for providing components (e.g., cabling) that utilize the pathway systems, the pathway provider shall:

1. Review specifications of this Division and Division 28 Systems (where applicable) and the related Drawings to gain a complete understanding of the specific systems that will utilize the pathways.

#### **1.4 SYSTEM DESCRIPTION**

##### **A. General:**

1. Each communications pathway system shall consist of products to support, protect, enclose, manage and secure the cables that are part of the communication system they serve.
2. Pathway systems shall be supplied and installed to meet the unique requirements of individual communications systems.
3. Separate pathway systems shall be provided for individual communication systems. Individual communication systems shall have unique and dedicated conveyances. Cables from individual communication systems shall be run in separate conveyances (e.g., data system cables shall be run in separate conveyances from sound system cables).
4. Separate pathway conveyances shall be provided for cables that carry incompatible signal types (e.g., analog microphone level and speaker level cables shall be run in separate conveyances).
5. Pathway systems shall include penetrations through walls, floors, ceilings, roofs, bulkheads and other physical barriers that are necessary to route cable between adjacent spaces.
6. Pathway penetrations shall be prepped, installed, sealed and fire stopped in a code-compliant manner.
7. Pathways through expansion joints shall include expansion and deflection joint fittings with bonding straps.
8. Pathways shall be assembled from components that are listed by a recognized safety testing laboratory.
9. The cable fill capacity of each pathway segment shall meet or exceed the capacity necessary to accommodate cables initially installed. Additional capacity shall be provided as identified in the Contract Documents. The sizes and quantities of conveyances shown on the Drawings shall be interpreted as minimums. Larger sizes, or additional quantities, shall be provided as required or further identified herein.
10. Pathway systems shall be provided with sufficient support to carry the weight of the system, plus a full capacity of cables, with a safety factor of greater than or equal to 5. In addition, each individual above-the-floor vertical hanging support shall feature an installed static weight support capacity of not less than 200 lbs. (e.g., hanging all-thread, multi-anchor mounting flange and support cable).
11. Pathway systems shall include matching cover plates over junction and pull boxes.

##### **B. Pathway Systems for Horizontal Copper, Coaxial and Fiber Cabling:**

1. Hybrid pathway system .

2. Minimum permissible conduit size: ¾-inch.
- C. Pathway Systems for Voice Paging, Background Music, Foreground Music Systems:
1. Hybrid pathway system.
  2. Minimum permissible conduit size: ¾-inch.
- D. Pathway Systems for Audio and Video Systems:
1. Hybrid pathway system.
  2. Minimum permissible conduit size: ¾-inch.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Products furnished of each Type shall be manufactured by a single manufacturer, bear the same brand name, be the same finish color and texture, and be from the same product model series, except where otherwise indicated.

### **2.2 RACEWAY**

- A. Conduit:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hubbell-Raco (Raco).
    - b. Allied Tube & Conduit / Atkore (Allied).
    - c. Republic Conduit (Republic).
    - d. CalConduit (CalConduit).
  2. Rigid Steel Conduit (RMC):
    - a. NEC Type RMC recognized.
    - b. Threaded rigid steel conduit shall be manufactured from mild steel, zinc galvanized both inside and outside including threads.
    - c. Constructed in accordance with ANSI C80.1, Underwriters Laboratories Safety Standard UL6.
  3. Intermediate Metallic Conduit (IMC):
    - a. NEC Type IMC recognized.
    - b. Threaded intermediate metallic conduit shall be manufactured from mild steel, zinc galvanized both inside and outside including threads.
    - c. Constructed in accordance with ANSI C80.6, Underwriters Laboratories Safety Standard UL6.

4. Electric Metallic Tubing (EMT):
    - a. NEC Type EMT recognized.
    - b. Electric metallic tubing shall be manufactured from mild steel, zinc galvanized both inside and outside.
    - c. Constructed in accordance with ANSI C80.2, Underwriters Laboratories Safety Standard UL6.
  5. Flexible metallic conduit (FMC):
    - a. NEC Type FMC recognized.
    - b. Spirally wound double sized zinc galvanized steel.
    - c. Unjacketed.
    - d. Integral ground conductor.
    - e. Color: Natural zinc.
  6. Liquid-Tight Flexible Metal Conduit (LFMC):
    - a. NEC Type LFMC recognized.
    - b. Spirally wound double sized zinc galvanized steel.
    - c. Overall liquid-tight outer jacket.
    - d. Integral ground conductor.
    - e. Color: Gray.
  7. Polyvinylchloride (PVC-A, PVC-B):
    - a. Constructed of Type C300 virgin polyvinylchloride.
    - b. Schedule 40 or Schedule 80 rated to 90°C.
    - c. Constructed in accordance with NEMA TC2 and Federal Specifications W-C-1094A.
  8. Conduit LB
    - a. Built in bend radius to protect cabling
    - b. Madison Electric Products Smart LB
- B. Wireway:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hubbell-Raco.
    - b. Allied Electrical.
    - c. Hoffman.
    - d. Cooper.
    - e. Square-D.

2. Product Requirements:
  - a. 6 inches or smaller: 16 gauge steel, minimum.
  - b. Larger than 6 inches: 14 gauge steel, minimum.
  - c. Finish: Epoxy coated.
  - d. Color: Gray.
  - e. Covers: Hinged on one side, secured on the other side with screws.
  - f. Knockouts: Field installed to suit the application.
  - g. No manufacturer-installed knockouts or knockouts that are not used.
  - h. Provided with manufacturer accessories including: tees, connectors, elbow, crosses, partitions, and telescoping sections.

### 2.3 DISCRETE CABLE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into work include:
  1. Erico CableCat™ Series.
  2. Panduit J-Pro™ Series.
  3. Cooper/B-Line BCH Series.
- B. Product Requirements:
  1. UL 2043 Listed and NEC compliant for use in plenum air returns.
  2. J-Hook style design.
  3. No sharp edges that could come in contact with supported cables during or after installation.
  4. Linear bearing surface for cable:
    - a. For use with backbone cables: Greater than or equal to 1-3/4 inches.
    - b. For use in primary pathways: Greater than or equal to 1-3/4 inches.
    - c. For use in secondary pathway: Greater than or equal to 1-3/8 inches.
    - d. For use with individual cables less than 0.400 inch diameter: Greater than or equal to 7/8 inch.

### 2.4 FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Hubbell-Raco (Raco).
  2. Allied Tube & Conduit / Atkore (Allied).
  3. Republic Conduit (Republic).
  4. CalConduit (CalConduit).
  5. Cooper Crouse Hinds.
- B. Rigid Steel or Intermediate Metallic Conduit:

1. Threaded to NEMA standards for conduit.
2. Integral non-conductive plastic throat liner to minimize/eliminate risk of cable abrasion during installation.
3. Zinc galvanized steel.
4. Conductive.

C. Electric Metallic Tubing:

1. Compression type.
2. Integral non-conductive plastic throat liner to minimize/eliminate risk of cable abrasion during installation.
3. Attachment: 100-percent concentric compression.
4. Zinc galvanized steel.
5. Conductive.

D. Flexible Metallic Conduit:

1. Fittings shall be manufactured by the same manufacturer as the raceway(s) it connects.
2. Integral non-conductive plastic throat liners to minimize/eliminate risk of cable abrasion during installation.

E. Polyvinylchloride (PVC-A, PVC-B):

1. Fittings shall be manufactured by the same manufacturer as the raceway(s) it connects.
2. Seal connections using PVC cement.

F. Conduit Sealing Bushings:

1. Factory-fabricated watertight conduit sealing bushing assemblies.
2. Suitable for sealing around conduit or tubing passing through concrete floors and walls.
3. Constructed of steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

G. Insulating Bushings:

1. Designed to protect cables from damage caused by sharp edges on the exposed end(s) of conduit and associated fittings, fully insulating the exposed end.
2. Rated for use in the environment where the product is installed.
3. Sized to match the conduit or conduit fitting to which it is applied.
4. Soft radius non-conductive front edge to prevent damage to cables passing through the bushing.
5. Sized to hold firmly to the conduit or fitting to which it attaches with sufficient strength that the bushing cannot and will not come free during the installation of cable.
6. Non-conductive version:

- a. Threaded version: Provide threaded version for use on the threaded end of conduits or fittings.
  - b. Press-on version: Provide press-on version for use on non-threaded end of conduits and conduit fittings.
  - c. Internal diameter of one end equal to or slightly less than the internal diameter of the conduit or fitting to which it attaches. The opposite end sized to match the conduit or fitting to which it is applied.
  - d. Designed for installation before any cable is installed.
7. Conductive version:
- a. Conductive metal frame.
  - b. Integral grounding lug.
  - c. Separate non-conductive insulator to protect cable.
  - d. Designed for installation before any cable is installed.

H. Expansion/Deflection Fittings:

- 1. Shall provide 4" axial expansion/contraction
- 2. Shall allow 3/4" parallel misalignment
- 3. Shall allow up to 30 degree angular misalignment in any direction
- 4. Basis of Design shall be Cooper Crouse Hinds:
  - a. 2" Expansion/Deflection joint fitting XJGD64 (Galv. Rigid Conduit)
  - b. Tinned copper Braid Bonding Jumper 24" BJ64
  - c. 2.5" Expansion/Deflection joint fitting XJGD74 (Galv. Rigid Conduit)
  - d. Tinned copper Braid Bonding Jumper 24" BJ74
  - e. 3" Expansion/Deflection joint fitting XJGD84 (Galv. Rigid Conduit)
  - f. Tinned copper Braid Bonding Jumper 24" BJ84
  - g. 4" Expansion/Deflection joint fitting XJGD104 (Galv. Rigid Conduit)
  - h. Tinned copper Braid Bonding Jumper 36" BJ108

## 2.5 PENETRATIONS

- A. All penetrations through walls, floors, and ceilings shall be sleeved.
  - 1. Reference Firestopping for Communications specification for fire rated sleeve assemblies.
  - 2. All sleeves shall be metallic and shall have bushings at both ends.

## 2.6 BOXES

- A. Standard Wall and Ceiling Device Boxes:
  - 1. General:
    - a. Stamped steel, code-compliant gauge, zinc galvanized.
    - b. Available in various depths from 2-1/2 to 3-1/2 inches deep, minimum.



- c. Corrosion protection suitable for the atmosphere in which they are installed.
  - d. Non-modular sheet-steel construction.
  - e. Conduit knockouts of the size, quantity and locations required.
  - f. Threaded device-mounting screw holes.
  - g. Rated for installation in the space where the box is installed.
  - h. Equip boxes with code compliant accessory Class-1 and Class-2 service partitions when boxes are used in multi-service applications.
2. Boxes in Masonry or Tile Walls:
    - a. "Masonry" style box construction.
    - b. Available in standard gang sizes from 1 to 10.
    - c. Available in various depths from 2-1/2 inches to 3-1/2 inches.
    - d. Conduit knockouts to suit the application.
  3. Boxes used within interior framed walls (e.g., gypsum board walls):
    - a. 1 to 2 Gang Sizes, 2-1/2 inches box depth:
      - 1) 4 inches square or 4-11/16 inches square box, 2-1/8 inches deep.
      - 2) 3/4" deep device ring (single or double as required).
    - b. 3 to 10 Gang Sizes:
      - 1) Multi-gang style box construction (not gangable), 2-1/2" depth.
      - 2) 3/4" deep device ring.
      - 3) Conduit knockouts to suit the application.
- B. Exterior Surface Mount Outlet Style Boxes:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. Adalet / Scott Fetzer Company (Adalet).
  3. Appleton Electric (Appleton).
  4. Characteristics:
    - a. Hinged cover, sized to accommodate the devices being mounted to the box.
    - b. Cast aluminum construction.
    - c. Available in standard gang sizes from 1 to 3.
    - d. Threaded conduit hubs.
- C. Junction Boxes and Pull Boxes:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Hubbell-Raco (Raco).
    - b. Allied Tube & Conduit / Atkore (Allied).

- c. Republic Conduit (Republic).
  - d. CalConduit (CalConduit).
  - e. Hoffman.
2. Characteristics:
- a. Screw-cover type enclosure.
  - b. Covers fabricated of the same material and with the same finish as the box itself.
  - c. Boxes installed flush in wall shall be provided with oversize cover plates painted to match the surrounding building surface.
  - d. Boxes shall be NEMA rated for the atmospheric condition in which the box is installed.
  - e. Boxes in exterior or moist locations shall meet NEMA 3R (at minimum).

## 2.7 ACCESSORIES

### A. Pull Strings:

- 1. Construction: nylon.
- 2. Designed and rated by the manufacturer for use as a pull-rope.

### B. Fiber Optic Innerduct:

- 1. Manufacturers: Subject to compliance with requirements, provide the Basis of Design product listed, or Designer approved comparable product from:
  - a. Arnco.
  - b. Endot.
  - c. Opti-Com.
  - d. Pyramid.
- 2. NEMA TC 5, UL listed, corrugated, specifically designed for optical fiber cable pathways.
  - a. Color: Orange.
  - b. 1-inch minimum inside diameter.
  - c. 600 pounds minimum pulling strength.
  - d. Factory installed pull rope.
  - e. UL Listed and NEC approved for the environment in which it is installed.
  - f. Basis of Design:
    - 1) Riser Rated Environments: Carlon DF4X1C-\*\*\*\*.
    - 2) Plenum Rated Environments: Carlon CF4X1C-\*\*\*\*.

### C. Cable Waterfalls (Spillways) – for Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufactures offering products that may be incorporated into Work include, but are not limited to, the following:
    - a. Bejed, Inc.
    - b. LincTek, Inc.
    - c. Cooper/B-Line.
    - d. Chatsworth.
    - e. Cable Management Corp.
    - f. Panduit
  2. Product Requirements:
    - a. Available in 2 inches and 4 inches diameter for direct attachment to conduit stubs and sleeves.
    - b. Integral clamp for securing to EMT conduit.
    - c. Maintains proper bending radii for cabling entering the conduit served.
    - d. Self-fastening tie down system.
    - e. UL Listed and NEC approved for the environment in which it is installed.
- D. Supports:
1. General:
    - a. Supports, support hardware, and fasteners shall be manufacturer protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.
    - b. Products used outdoors shall be hot-dip galvanized.
  2. Material Types:
    - a. Raceway Supports:
      - 1) Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
    - b. Fasteners:
      - 1) Types, materials, and construction features as follows:
        - a) Expansion anchors: Carbon steel wedge or sleeve type.
        - b) Toggle bolts: All-steel springhead type.
        - c) Powder-driven threaded studs anchors: Heat-treated steel, designed specifically for the intended service.
        - d) Solid concrete anchors: Drop-in zinc plated steel tubular expansion shield with solid, cone-shaped expander plug.
    - c. Cable supports for vertical conduit:

- 1) Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits.
  - 2) Provide with plugs with the number and size of conductor gripping holes as required to suit each individual application.
  - 3) Body construction: Malleable-iron casting with hot-dip galvanized finish.
- d. Threaded Rod Stock (All-Thread Rod):
- 1) Available in 1/4-inch, 3/8-inch, 1/2-inch, and 5/8-inch sizes.
  - 2) Utilize 1/2 " for ladder/tray installations under 24" and 5/8" for 24" or larger.
    - a) Rod lengths over 6' will require a "Rod Stiffener" installation for 1/2" and 5/8" rods.
- e. Slotted Metal Angle and U-channel Systems:
- 1) 16-gauge steel U-shaped channel;
  - 2) Available in a variety of sizes including: 1-5/8 inches square, 1-1/4 inches square and 13/16 inch square.
  - 3) Available with pre-punched and un-punched versions.
  - 4) Available with holes on top or sides of channel.
  - 5) Available with a wide-variety of fittings for field construction of structural support assemblies.
- E. Bushing, Knockout Closures and Locknuts:
1. Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.
- F. Pipe Curb Assemblies:
1. Manufacturers: Subject to compliance with requirements, available manufactures offering products that may be incorporated into the Work include, but are not limited to:
    - a. The Pate Company, PCC-series.
  2. Product Requirements:
    - a. Designed to seal around pipes penetrating through conventional or metal roofs.
    - b. Prevents the ingress of water into the building under all weather conditions.
    - c. Models available to accommodate all standard sizes or pipe from 1/2 inch to 10 inches O.D.
    - d. Stainless steel pipe fasteners.
    - e. Provide with manufacturer recommended accessories and options necessary to seal and prevent water infiltration.

## **PART 3 - EXECUTION**

### **3.1 COORDINATION**

- A. Review and coordinate the size requirements of pathways with the suppliers and installers of cabling and devices. Pathway segments shall accommodate the quantity and type of cables that will be installed. Upsize pathway segments from any default and minimum size(s) identified so as to accommodate the cables that will be installed, including any future expansion capacities, as identified in the Contract Documents.
- B. Review the specific routes and composite length of planned pathway routes with parties responsible for supplying or installing cables as distance limitations will apply differently for different cables and applications.
- C. Coordinate the location and routing of pathways with work of this Division, the work of other trades, the work of the Owner, and existing site conditions (where applicable) to ensure adequate headroom, post installation access to and working clearances around the pathways. Review and verify HVAC, Fire Suppression, Electrical Power, Lighting and other Drawings for design coordination. Provide routes accordingly.
- D. Proactively participate with other trades in the creation of coordination drawings that depict primary and major secondary pathways. Emphasis shall be placed on ensuring that pathways are accessible for initial cable installation and readily accessible for reuse in accommodating future cable moves, additions and changes.
- E. Coordinate the colors and types of surface raceway with the color of surface raceway provided as work of both Division 26 and Division 28. Colors of raceways shall match, except where expressly reviewed and approved by the Architect/Designer.
- F. Ensure that pathways, as installed, are adequately sized for the cables to be installed and any future expansion capacities as identified in the Contract Documents.

### **3.2 GENERAL**

- A. Provide specified pull wires in all cabling pathways.
- B. Ground and bond all systems in accordance with the NEC and ANSI/TIA/EIA 607.
- C. All installation material and practices shall fully comply with NFPA 70 “National Electrical Code” and ANSI/TIA/EIA 569A Commercial Building Standard for Telecommunications Pathways and Spaces.
- D. Coordinate work with the building structural systems and electrical installation.
- E. All work shall fully comply with these Specifications and related Drawings and all manufacturers’ recommended installation practices.

### 3.3 PATHWAY SIZING

- A. Raceways shall be sized so that they are the larger of the following:
  - 1. Minimum size indicated within the Contract Documents.
  - 2. In accordance with the National Electric Code.
  - 3. As recommended by the product manufacturer.
  
- B. Discrete cable supports shall be sized so that they are the larger of the following:
  - 1. Minimum size indicated within the Contract Documents.
  - 2. In accordance with the National Electric Code.
  - 3. As recommended by the product manufacturer.

### 3.4 RACEWAY USAGE

- A. Rigid Steel (GRC) Conduit:
  - 1. Above grade, outside the building envelope, in exposed areas.
  - 2. Above grade, inside the building envelope, within high moisture areas.
  - 3. As a transitional component of a below grade conduit path where the conduit needs to pass through a poured-in-place concrete slab.
  - 4. As a sleeve through poured-in-place concrete slabs.
  - 5. Where specifically indicated on the Drawings.
  
- B. Intermediate Metallic Tubing (IMC) Conduit:
  - 1. Where specifically indicated on the Drawings.
  
- C. Electric Metallic Tubing (EMT) Conduit:
  - 1. Within the building envelope concealed within walls and ceilings.
  - 2. Above grade, inside the building envelope, where no other type of raceway is identified to be used.
  - 3. Where specifically indicated on the Drawings.
  
- D. Flexible Metal Conduit (FMC):
  - 1. Inside the building envelope as a component of a secondary pathway system where flexibility is necessary for constructability to meet specified objectives and where length of the segment does not exceed 6 feet.
  - 2. Inside the building envelope as the transitional segment of a raceway system and interconnection to permanently-cabled systems-furniture is necessary and where the length of the FMC segment does not exceed 12 feet.
  - 3. Where specifically indicated on the Drawings.
  
- E. Liquid-Tight Flexible Metal Conduit (LFMC):

1. Above grade, outside the building envelope, between junction (or pull) boxes and connected devices (e.g., cameras) and where cables to/from the devices would otherwise be visually exposed or exposed to the elements.
2. Above grade, outside the building envelope, between junction (or pull) boxes and connected devices requiring regular movement where cables to/from the device would otherwise be visually exposed or exposed to the elements.
3. Above grade, inside the building envelope, between junction (or pull) boxes and connected devices (e.g., cameras) and where cables to/from the connected devices would otherwise be exposed to water or sustained periods of high moisture.
4. Above grade, outside the building envelope, between junction (or pull) boxes and connected devices requiring regular movement where cables to/from the device would otherwise be exposed to water or sustained periods of high moisture.
5. Where specifically indicated on the Drawings.

F. Polyvinylchloride (PVC) Conduit:

1. Below grade, where conductive conduit is not otherwise required.
2. Where specifically indicated on the Drawings.

G. Electrical Nonmetallic Tubing:

1. Where specifically indicated on the Drawings.

H. Non-metallic:

1. Non-metallic raceway shall be used only where specifically indicated to be used in the Contract Documents.
2. Non-metallic raceway shall only be used where specifically approved for use by the Designer.

I. Conduit Sleeves:

1. In accessible but concealed ceiling cavities, wherever a cable needs to pass through a wall, floor, ceiling, bulkhead (or similar building obstruction) to get from one space to another.
2. In unfinished areas, high to the ceiling, where a cable not installed in raceway, needs to pass through a wall, floor, ceiling, bulkhead (or similar building obstruction) to get from one space to another.
3. Wherever one or more conduits must pass through a poured-in-place formed concrete structure.

J. Wireway:

1. Where specifically indicated on the Drawings.

K. Communications Poles:

1. Where specifically indicated on the Drawings.

### **3.5 DISCRETE CABLE SUPPORT USAGE**

- A. Discrete cable supports shall be used to support cable that is not installed within raceway, cable tray or ladder rack.
- B. Discrete cable supports shall be supported from the building structure, in a manner that is code compliant.
- C. Discrete cable supports shall be anchored using accessories and hardware that is manufactured or recommended by the support manufacturer.
- D. Discrete cable supports shall be spaced at horizontal increments not exceeding 60 inches on center. Additional supports shall be installed to limit cable sag to less than 9 vertical inches.

### **3.6 BOX USAGE**

- A. Boxes:
  - 1. Boxes shall be used at device and equipment locations. Raceway shall terminate into an approved box, except where indicated.
  - 2. Standard wall and ceiling boxes shall be used in walls and ceilings except where specialty boxes are indicated.
  - 3. Boxes designed expressly for use within floors shall be used within floors. The type of box used shall be appropriate for the floor construction.
  - 4. The size and type of boxes used shall accommodate the quantity and type of cable, raceway and devices the box must accommodate.
  - 5. Junction boxes and pull boxes shall be sized to comply with the NEC, but not less than the sizes indicated in the Contract Documents.
  - 6. Custom size and special order boxes shall be provided where custom sizes and special order boxes are required to meet the project requirements.

### **3.7 INSTALLATION**

- A. General:
  - 1. Install in accordance with local codes. Adhere to clearance and fire protection regulations.
  - 2. Install above-grade pathways parallel to and perpendicular to building elements.
  - 3. Install pathways plumb and level except where changes in elevation are specifically necessary for constructability.
  - 4. Document the exact routing of concealed pathways on as-built drawings.
- B. Bonding and Grounding:
  - 1. Conductive components of the pathway systems shall be bonded to ground in accordance with the NFPA and the NEC.



2. Additional grounding and bonding shall be provided as set forth in the Contract Documents.

C. Rustproof Fasteners and Hardware:

1. Install pathway components and associated mounted devices with stainless steel nuts, bolts, screws and washers when installed on the exterior of the building, when installed within unconditioned building spaces, and when the pathway serves exterior devices or devices in areas prone to sustained humidity levels in excess of 60-percent.

D. Conduit:

1. Install conduit in a concealed manner except where approved by the Designer in advance.
2. Install conduit terminations into boxes and enclosures using fittings featuring locknuts and insulating throat liners.
3. Install insulating bushings on the exposed ends of conduit stubs and sleeves.
4. Install insulating bushings on the exposed threaded portion of conduits and conduit fittings that terminate conduit to a box or equipment enclosure.
5. Support conduits by using pipe straps or trapeze hangers. Space supports not more than 8 feet on center. Secure supports by means of toggle bolts, inserts or expansion bolts.
6. Space wall brackets supporting conduits not more than 4 feet 6 inches on center. Secure supports by means of toggle bolts, inserts or expansion bolts.
7. Support raceway components directly from structural building systems, not from ceiling suspensions systems. Provide supplemental supports for junction or pull boxes.
8. Conceal conduit raceways under floors, in walls, above ceilings and in furred spaces within finished building areas.
9. Support single conduits 1-1/2 inches and larger by means of rod and cast ring hangers. Support multiple runs in similar manner or use a common trapeze hanger system.
10. Provide two-hole sheet metal pipe straps for surface mounted conduit supports on walls up to a height of 8 feet above the finished floor.
11. Pinch type hangers similar to minerallac shall only be used at heights greater than 8 feet.
12. Protect conduits during construction with temporary plugs or caps. Securely cap conduits until pull string, or cable is installed.
13. Do not install conduit horizontally in concrete slabs on grade.
14. Provide expansion/deflection fittings where raceway crosses the building expansion joints.
  - a. Utilize manufacturer recommendations for installation
  - b. Provide external bonding jumpers to bond metallic conduits across joint.

15. Conduit Routing:

- a. If specific routing information appears on the Drawings, route and maintain conduits as shown. Should interference or a conflict arise, consult the Designer before proceeding with the Work.
  - b. If specific routing information does not appear on the Drawings, Determine the best route for the conduit in accordance with code, accessibility and other project guidelines.
16. Conduit bends:
- a. Bends shall be made so that the conduit will not be flattened or kinked and so that the internal diameter of the conduit is not reduced.
  - b. The radius of the curve of the inner edge of any bend shall not be less than indicated by the National Electrical Code and TIA/EIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces.
  - c. All conduit bends or fabricated elbows shall have a bend radius equal or greater than 4 times the trade size.
  - d. When it is necessary to make field bends, use tools manufactured for conduit bending.
    - 1) Heating of metallic conduit to facilitate bending is not permitted.
  - e. Constructing an outside entrance to a building from buried conduit to penetrate above the ceiling line will allow an exception for a 4 inches LB fitting at one end to allow placement of the conduit flat to the building outside wall.
17. Do not cut, burn, or drill any structural member to pass through or mount any pathway product without first obtaining approval in writing from the building architect and structural engineer.
18. Install above-ceiling conduits a minimum of 7 inches above ceiling tiles to permit ceiling tile removal.
19. Install conduits at least 6 inches away from insulated pipes, steam lines or any other hot pipes which they pass. Where the lines are not insulated, the clearances shall be increased until the temperature of the conduit, with no live conductors enclosed, does not rise above the ambient temperature of the installation area.
20. Install flashing and counter flashing or pitch pockets for waterproofing of raceways, outlets and fittings that must penetrate the roof.
21. Install oversized sleeves in forms for new concrete walls, floor slabs, and partitions to allow for the passage of raceways.
22. Waterproof sleeved raceways shall be provided below grade and in areas prone to high moisture and condensation.
23. Outside Plant Conduits
- a. All conduits shall drain into open bottom hand holes.
  - b. Minimum depth is 24-30"
  - c. Conduits may slope from middle of run

E. Pull Boxes:

1. Install each pull box indicated on the Drawings.
  - a. As additionally required by Code.
2. Install additional pull boxes outside the building envelope:
  - a. Every 500 running feet of below-grade raceway.
  - b. Every 180 degrees of raceway bend.
  - c. Every 100 feet of above-grade raceway. (less than 2")
  - d. Every 200 feet of above-grade raceway (2" and larger)
  - e. As additionally required by Code.
3. Install pull boxes in areas that will be accessible after installation. Accessible areas include spaces above removable tile ceilings and behind access doors that are installed expressly for this purpose. Do not install pull-boxes in locations that will not be accessible after construction is complete and is not accessible after permanently installed furniture or fixtures are installed.
4. Size boxes in accordance with the NEC. Use larger boxes where so specified.
5. Support boxes rigidly.
6. Land conduits on the boxes such that conduits enter and exit across from each other on opposite sides of the box so as to facilitate straight line pulling of cable through the box.
7. Do not use pull boxes in lieu of conduit bends, except as necessary by design or to meet constructability constraints.
8. When directional transition of the cables is necessary through a box, land conduits on the box so that they permit the largest possible bending radius for those cables that will pass through the box.

F. Pull Stings:

1. Install a usable pull string in every pathway prior to the installation of cables. The string shall be installed after pathway installation and prior to such time as the cable installer desires to install cable within the pathway. The string shall be used as an aid to the installation of cables.
2. Install a replacement pull string in each pathway as part of the cable installation process to facilitate installation of additional cable(s). Tie the pull-string off and tag for "Future Use."

G. Innerduct:

1. Install innerduct within and along pathways that will be used to accommodate fiber optic cables.
  - a. Plenum rated innerduct shall be used in pathways that are not 100-percent conduit.
  - b. Exception: Innerduct is not required in those pathways that will contain exclusively armored-type fiber optic cables.

#### H. Spillways:

1. Install cable spillways where cable(s) will exit a conduit sleeve, cable tray, or wireway and where they would otherwise be unsupported for more than 6 inches.

#### I. Telecommunication Poles:

1. Mount straight and anchor to building structure above the ceiling line.
2. Provide mounting hardware, entrance end fitting, and ceiling trim plate.
3. Utilize cutouts or add-on compartments for jack frames.
4. Isolated pathway from electrical circuits with separate internal raceway.

#### J. Discrete Cable Supports:

1. Install supports in areas that will be readily accessible after installation (e.g., above accessible suspended ceilings; up within the building structure in unfinished areas).
2. Do not install supports in any location that is not readily accessible and cannot be reached by the hand of an individual standing flat footed on the ground, a ladder or scaffolding. Do not install in areas where an individual has to strain to reach or where a pole will be required to access.
3. Install separate discrete cable support pathways for cables from each system. Where the allowed capacity of an individual support will be exceeded, install multiple parallel pathways.
4. Install separate discrete cable support pathways for cables from the same system that carry signals that could negatively interfere with one another. Array supports vertically using an appropriate spacing not less than 6 inches for every 6 dB of nominal voltage differential between the cables.
5. Attach supports directly to vertical building surfaces, or from overhead structural members using threaded rod and other approved attachment methods. Support of cables by use of suspended ceiling wires shall not be permitted.
6. Install supports plumb and square.
7. Install horizontal runs of cables supports level. Change elevation only where necessary for coordination with other trades and pathways of other systems.
8. Mount the bottom of supports approximately 12 inches above the top of suspended ceilings.
9. Install cable supports at intervals not exceeding 5 cable feet.
10. Install supports so that they will not interfere with the removal or installation of ceiling tiles.
11. Provide support in close proximity of device conduit pathway termination for service loop.

#### K. Device Boxes:

1. New-work and old-work device boxes shall be installed flush with or slightly recessed below the finished surface. Do not recess boxes more than is permitted by code, nor more than .078 inches (2mm). Old-work boxes require advanced

- craftsmanship and construction techniques to achieve specification compliance for communications Work.
2. The installed elevation of boxes shall generally be as indicated on the drawings. Elevations shall be adjusted in the field to ensure a clean appearance resulting from coordination of the new box elevations to match the existing box elevations. Where the specified box elevations and existing condition box elevations differ by more than 4 inches, seek the direction of the Designer prior to installation.
  3. Device boxes and associated cover plates shall not span different types of wall finishes either vertically or horizontally. Horizontal and vertical position of boxes shall be adjusted at time of installation to ensure that this condition does not exist after finish is completed.
  4. Boxes in masonry shall be installed so that the specified over plates will cover the mortar joints and cut openings completely.
  5. Device boxes shall be installed so that they are securely and rigidly attached to structure. Gypsum board and similar non-structural board shall not be used for box support.
  6. Devices boxes shall not rely on raceway as a means of support. Boxes shall be fully supported by surrounding building structure.
    - a. Provide sufficient support for ceiling device boxes to support weight of installed products.
    - b. Provide tile support bridge for device box in accessible ceiling.
  7. Device boxes shall be installed plumb and level to within the following limits:
    - a. Maximum one-tenth (1/10) of one degree from plumb and from level, and;
    - b. Maximum difference from level of .078 inch (2mm) at one end of the box relative to the other end of the box, and;
    - c. Maximum difference from plumb of .078 inch (2mm) at the top of the box relative to the bottom of the box.
  8. Boxes shall be shimmed as necessary to insure level and plumb installation.
  9. Install gaskets on boxes installed outside and in wet or damp locations (e.g., tunnels, crawlspaces, pits).
  10. Device boxes shall be protected from plaster, drywall mud, mortar, and other construction debris.
  11. Floor boxes shall be installed flush and true with the finished floor, or otherwise in accordance with the manufacturer's instructions.
  12. Boxes shall be cleaned of debris after installation.
  13. Boxes shall be cleaned of debris thoroughly prior to installation of cover plates;
  14. Install blank cover plates on each unused device box.
  15. Knock out requirements exceeding manufacturers standard sizes shall be accommodated with punch of correct size.

L. Sleeves and Penetrations:

1. Sleeves through poured-in-place concrete surfaces shall be set in place prior to the concrete pour and protected from concrete ingress.
2. Sleeves through floors shall be installed to prevent the passage of water between the sleeve and the floor.
3. Install cable-protecting insulating bushings on the each end of each sleeve.
4. Extend through-the-wall sleeves a minimum of 2 inches beyond the wall surface. Extend the sleeve a greater distance where necessary to permit proper installation of cable-protecting bushings and any associated cable waterfalls.
5. Extend through-the-floor sleeves to a consistent elevation of 4 inches to 6 inches above finished floors, except where otherwise noted on the Drawings.
6. Fill the voids between sleeve and building surface with approved fire stop material sufficient to maintain the fire-rating of the building surface.
7. Firestop or plug all penetrations, conduits and sleeves to prevent the movement of air between spaces.

M. Conduit Stubs:

1. Install cable-protecting insulating bushings on each conduit stub.

N. Supports:

1. Fabricated Support Devices:

- a. Conform to the manufacturer's recommendations for selection and installation of supports.
- b. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
- c. Support parallel runs of horizontal raceways together on trapeze-type hangers.
- d. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners shall be used in lieu of hangers for 1-1/2 inches and smaller raceways above suspended ceilings only.
- e. For hanger rods with spring steel fasteners, use 1/4 inch diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
- f. Support exposed and concealed raceway within 1 foot of box and access fittings. In horizontal runs, support at the box and access fittings shall be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
- g. In vertical runs, arrange supports so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on the ends of the raceway.

2. Miscellaneous supports:

- a. Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, pull boxes, junction boxes, and other devices.
  - b. Support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.
3. Fastening:
- a. Fasten pathway products and its supporting hardware securely to the building structure in accordance with the following:
    - 1) Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts shall be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
    - 2) When installing fasteners in concrete or CMU structures, do not cut reinforcing bars.
    - 3) Ensure that the load applied to any fasteners does not exceed 25-percent of the proof test load. Use vibration-and shock-resistant fasteners for attachments to concrete slabs.
  - b. Raceway supports: Hanger spacing shall be as required for adequate support of the raceway, but in no case shall there be less than one hanger per 5 feet of raceway length.
- O. Pathway Evacuation:
1. Prior to the installation of cable:
    - a. Clean and vacuum boxes, raceway, cable tray, and discrete cable supports.
    - b. Remove solids or other hindrances that could impede its full utilization or that could damage cable during or after installation.
    - c. Remove liquids. Blow out until raceway is dry, sufficiently that the installed cables will not be subjected to contact with them.
  2. Where existing raceways are reused, remove liquid from the raceway.
- P. Water Proofing:
1. Protect raceways from moisture infiltration in areas where moisture penetration is probable (e.g., outdoors, natatoriums, wash bays).

2. Provide watertight fittings where one or more cables exit the pathway in areas where moisture penetration is probable.
3. Seal below-grade conduit joints to prevent moisture infiltration.
4. Seal joints of conduits in high-moisture areas to prevent moisture infiltration.
5. Pressure or vacuum test below-grade conduits before and after concealing the conduits to ensure resistance to moisture ingress.

Q. Repair and Patching:

1. Holes and other penetrations into building surfaces or structure that are created to facilitate pathway installation but that are not ultimately used shall be filled, repaired, and restored to their original strength, appearance and integrity.
2. Damage to building or property that occurs during the course of pathway installation shall be repaired and restored to its original condition prior to damage.

R. Cover Plates

1. Provide cover plates over the openings of junction boxes, pull boxes and cast boxes.

**END OF SECTION 270528**