

## SECTION 260529 - HANGERS AND SUPPORTS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

#### 1.2 LISTINGS

- ##### A.
- Provide and install products to the project that are labeled and/or listed for the intended location and use per manufacturer's guidelines and the California Electric Code.

#### 1.3 SUBMITTALS

- ##### A.
- Refer to the Standard General Conditions and Supplementary Conditions.
- ##### B.
- Product Data: For each type of product.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- ##### A.
- All products within this section shall be manufactured by one of the following:
1. ABB.
  2. Unistrut.
  3. Or Equal.

#### 2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- ##### A.
- Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches one center in at least one surface.
1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  2. Material for Channel, Fittings, and Accessories: Stainless steel, Type 304 Stainless steel.
  3. Channel Width: Selected for applicable load criteria.

4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  5. Comply with 2019 CBC Chapter 16A and ASCE 7-16 Mechanical Equipment Anchorage Requirements.
- B. Conduit and Cable Support Devices: Galvanized Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened Portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  2. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
  3. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
  4. Hanger Rods: Threaded galvanized steel.
  5. Raceway spring steel clamps.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
1. NECA 1 (Good Workmanship Standards).
  2. NECA 101 (Metallic Raceway Standards).
  3. NECA 111 (Nonmetallic Raceway Standards).
  4. California Electric Code 300.19 and Table 300.19 (A) for vertical cable supports.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, and RMC as required by CEC. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT IMC and RMC may be supported by openings through structure members, according to CEC.
- C. Strength of Support Assemblies: Where indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  - 6. To Light Steel: Sheet metal screws.
  - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

### 3.4 CEILING FIXTURES, TERMINALS AND DEVICES

- A. All fixtures, terminals and other devices shall be mounted in a manner that will not compromise ceiling performance in accordance with Section 13.5.6.2.2 Item 5 of ASCE 7 as amended by CBC Section 1616A.1.20 (1616.10.16\*) and ASTM E580 Sections 5.3 and 5.4.
- B. Ceiling panels shall not support any light fixtures or devices.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Specification Division 09 and Architectural plan sheets for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Conduit and fittings
  - 2. Smoke and acoustical pathways.
  - 3. Boxes, enclosures and cabinets.

#### 1.2 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. Concealed: Rendered inaccessible by the structure or finish of the building. Raceways and cables supported or located within hollow frames or permanently enclosed by the finish of buildings are considered concealed.
- C. Exposed: On or attached to the surface or behind panels designed to allow access. Raceways and cables in unfinished basements in accessible underfloor areas or attics; or behind, above, or below
- D. Enclosure: a space within an above ground box to which raceways terminate and wire space is given to redirect, splice, or terminate to power distribution blocks (CEC 314.28). Cabinets and enclosures are typically equipped with hinged doors that may be lockable, or gasketed.

#### 1.3 SUBMITTALS

- A. Refer to the Standard General Conditions and Supplementary Conditions.
- B. Product Data: For all products.

#### 1.4 LISTINGS

- A. Provide and install products to the project that are labeled and/or listed for the intended location and use per manufacturer's guidelines and the California Electric Code.

### PART 2 - PRODUCTS

#### 2.1 CONDUITS AND FITTINGS

- A. EMT:

1. Indoor: Setscrew or Compression with insulated throats.
2. Outdoor: Compression raintight.
3. Comply with ANSI C80.3 and UL 797

B. LFMC:

1. Liquid tight steel or iron.
2. Flexible steel conduit with PVC jacket and complying with UL 360.

## 2.2 SMOKE AND ACOUSTICAL PATHWAYS

- A. Description: Smoke & Acoustical Pathway is a device designed to allow cables to penetrate non-fire-rated walls and floors without the need for smoke sealing. This device features a built-in smoke sealing system that automatically adjusts to the amount of cables installed. Once installed in a barrier, cables can be easily added or removed at any time without the need to remove or reinstall caulking materials.

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. STI Firestop
- b. Or equal: Refer to the Standard General Conditions and Supplementary Conditions.
- c. Substitutions: Refer to the Standard General Conditions and Supplementary Conditions.

- B. The pathway shall provide an achievable STC rating of greater than or equal to the STC rating of the specific underlying construction per ASTM E90-04/ASTM C919.

## 2.3 BOXES, ENCLOSURES, AND CABINETS

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

1. Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

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

- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

- D. Device Box Dimensions:

1. General: 4 inches square by 2-1/8 inches deep.

## PART 3 - EXECUTION

### 3.1 COMPLIANCE STANDARDS

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with CEC limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Wireways shall be installed per CEC Article 376.
- C. Raceways shall be installed in compliance with the manufacturer installation instructions, this Specification Section and relevant CEC Articles listed below:
  - 1. EMT: CEC Article 358.
  - 2. LFMC: CEC Article 350.
- D. For metallic and nonmetallic surface mounted raceways, comply with CEC Articles 386 through 388.

### 3.2 INSTALLATION OF ABOVE GROUND RACEWAY

- A. Do not fasten conduits onto the bottom side of a metal deck roof.
- B. Complete raceway installation before starting conductor installation.
- C. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- D. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- E. Make bends in raceway using large-radius preformed ells. Field bending shall be according to CEC minimum radii requirements. Use only equipment specifically designed for material and size involved.
- F. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- G. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- H. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated throat metal grounding bushings on service conduits.
- I. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- J. 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.

- K. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- M. 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.
- N. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.
- O. Locate boxes so that cover or plate will not span different building finishes.
- P. 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.
- Q. Fasten junction and pullboxes to or support from building structure. Do not support boxes by conduits.

### 3.3 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit not Subject to Damage: EMT.
  - 2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  - 3. Boxes, Wireways and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit not Subject to Damage: EMT.
  - 2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 3. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. All data, video, and communications cable bundles shall utilize an enclosed smoke and acoustical pathway device wherever cables penetrate non-fire-rated walls and floors.

END OF SECTION 260533



## SECTION 260560 - PENETRATION FIRESTOPPING (ELECTRICAL)

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.

#### 1.2 SUBMITTALS

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

#### 1.3 PROJECT CONDITIONS

- A. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

#### 1.4 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

### PART 2 - PRODUCTS

#### 2.1 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
  - 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. 3M Fire Protection Products.
    - b. Hilti, Inc.
    - c. Or Equal.<http://www.specagent.com/Lookup?uid=123457006178>

- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
  - 2. Fire rated pathway designed to allow cables to penetrate fire rated walls and floors without the need for firestopping. Built in fire and smoke sealing system that automatically adjusts to the amount of cables installed. System allows for cables to be easily added or removed at any time without the need to remove or reinstall firestopping materials.
- C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.
  - 1. Permanent forming/damming/backing materials.
  - 2. Substrate primers.
  - 3. Collars.
  - 4. Steel sleeves.

## 2.2 FILL MATERIALS

- A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture. See details on drawings.
- C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
- D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers. See details on drawings.
- E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

1. Installations shall be clean, without wiping putty or other sealants on adjacent walls or other materials.

### 3.2 FIELD QUALITY CONTROL

- A. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- B. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 260560

## SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 QUALITY ASSURANCE

- ##### A.
- Installation shall comply with TIA/EIA-569-A standards. At the Architect's request, the Engineer of Record shall perform a walkthrough/checklist to ascertain whether installation complies with minimum TIA/EIA-569-A standards.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- ##### A.
- Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- ##### B.
- Comply with UL 467 for grounding and bonding materials and equipment.
- ##### C.
- Comply with TIA-607-B.

#### 2.2 CONDUCTORS

- ##### A.
- Comply with UL 486A-486B.
- ##### B.
- Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
  2. Cable Tray Equipment Grounding Wire: No. 6 AWG.

C. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

- A. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with CEC for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- B. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
1. Electroplated tinned copper, C and H shaped.
- C. Busbar Connectors: Cast silicon bronze, solderless compression or exothermic-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Bonding all metallic conduits.
- B. Comply with NECA 1.

- C. Comply with TIA-607-B.

### 3.3 APPLICATION

- A. Conductors: Install solid stranded conductors for No. AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.
- C. Conductor Support:
  - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- D. Grounding and Bonding Conductors:
  - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
  - 2. Install without splices.
  - 3. Support at not more than 36-inch intervals.
  - 4. Install grounding and bonding conductors in 3/4-inch EMT.
    - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

### 3.4 CONNECTIONS

- A. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- B. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  - 1. Use crimping tool and the die specific to the connector.
  - 2. Pretwist the conductor.
  - 3. Apply an antioxidant compound to all bolted and compression connections.
- C. Primary Protector: Bond to the TMGB with insulated bonding conductor.

- D. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond the TMGB to the vertical steel of the building frame.
- E. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each ground bar of the panelboard.

### 3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 270526

## SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. See Specification Section 260533, "RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS" for low voltage raceways and boxes. Where installation instructions within this specification section deviate from section 260533, this specification section shall supersede division section 260533.
- B. See Specification Section 260544, "SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING" for low voltage sleeves and sleeve seals.

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Optical-fiber-cable pathways and fittings.
  - 2. Smoke and acoustical pathways.
  - 3. Hooks.
  - 4. Velcro one-hole straps.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For all products.

#### 1.4 LISTINGS

- A. Provide and install products to the project that are labeled and/or listed for the intended location and use per manufacturer's guidelines and the California Electric Code.

### PART 2 - PRODUCTS

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

- A. Description: Pathways as indicated on plans.
- B. Listed and labeled as defined in CEC, by an NRTL, and marked for intended location and application.
- C. Comply with TIA-569-D.



## 2.2 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. 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. Panduit Corp.
  - 2. Wiremold / Legrand.
  - 3. Arlington.
- C. Listed and labeled as defined in CEC, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.
- E. J shape.

## 2.3 VELCRO ONE-HOLE STRAP

- A. Description: Velcro bundle support device with one hole strap for securing smaller cable runs to the building structure.
- B. 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. <http://www.specagent.com/Lookup?uid=123457087511> Rip Tie.

# PART 3 - EXECUTION

## 3.1 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-D.
  - 4. NECA 101
  - 5. NECA 102.
  - 6. NECA 105.
  - 7. NECA 111.
- B. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
  - 1. 2-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
  - 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.

3. Utilize long radius ells for all optical-fiber cables.

C. 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 or structural steel. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches 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 o.c.
5. Provide a hook at each change in direction.
6. Separate communications, fire alarm, data and other systems by minimum spacing of 6 inches.

- D. Install Velcro one-hole straps for smaller cable runs (5 or less). Space no more than 5 ft on center.

END OF SECTION 270528

## SECTION 270553 - IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Color and legend requirements for labels and signs.
2. Labels.

#### 1.2 ACTION SUBMITTALS

- A. Refer to the Standard General Conditions and Supplementary Conditions.
- B. Product Data: For each type of product

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with CEC and TIA 606-B.
- B. Comply with ANSI Z535.4 for safety signs and labels.
- C. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

#### 2.2 COLOR AND LEGEND REQUIREMENTS

A. Equipment Identification Labels:

1. Black letters on a white field.
2. Comply with TIA-606-A and UL969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
3. The size, color, and contrast of all labels should be selected to ensure that the identifiers are easily read. Labels should be visible during normal maintenance of the infrastructure.
4. Labels should be resistant to the environmental conditions at the point of installation (such as moisture, heat, or ultraviolet light), and should have a design life equal to or greater than that of the labeled component.

5. The text on labels shall be machine generated.

## 2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters of raceway or cable they identify, that stay in place by gripping action.
- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, polyester or vinyl flexible labels with acrylic pressure-sensitive adhesive.
  1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating protective shields over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
  2. Marker for Labels: Permanent, waterproof black ink marker recommended by tag manufacturer.
  3. Marker for Labels: Machine-printed, permanent, waterproof black ink recommended by printer manufacturer.

## 2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

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

# PART 3 - EXECUTION

## 3.1 PREPARATION

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

## 3.2 INSTALLATION

- A. Install identifying devices before installing acoustical ceilings and similar concealment.
- B. Verify identity of each item before installing identification products.
- C. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- F. Vinyl Wraparound Labels:
  - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
  - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
  - 3. Provide label 6 inches from cable end.
- G. Snap-Around Labels:
  - 1. Secure tight to surface at a location with high visibility and accessibility.
  - 2. Provide label 6 inches from cable end.
- H. Self-Adhesive Wraparound Labels:
  - 1. Secure tight to surface at a location with high visibility and accessibility.
  - 2. Provide label 6 inches from cable end.

### 3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations with high visibility. Identify by system and circuit designation.
- C. Faceplates: Label individual faceplates with self-adhesive labels. Place label at top of faceplate. Each faceplate shall be labeled with its individual, sequential designation, numbered clockwise when entering room from primary egress, composed of the following, in the order listed on plans.
- D. Equipment Room Labeling:
  - 1. Racks, Frames, and Enclosures: Identify front and rear of each with self-adhesive labels.
  - 2. Patch Panels: Label individual rows and outlets, starting at top left and working down, with self-adhesive labels.
  - 3. Data Outlets: Label each outlet with a self-adhesive label indicating the following, in the order listed on plans.
- E. Backbone Cables: Label each cable with a vinyl-wraparound, label snap-around or label self-adhesive wraparound label indicating the location of the far or other end of the backbone cable. Patch panel or punch down block where cable is terminated should be labeled identically.
- F. Horizontal Cables: Label each cable with a vinyl-wraparound label, snap-around label or self-adhesive wraparound label indicating the following, in the order listed on plans.

G. Instructional Signs: Self-adhesive labels.

H. Equipment Identification Labels:

1. Indoor Equipment: Laminated-acrylic or melamine-plastic sign.
2. Outdoor Equipment: Laminated-acrylic or melamine-plastic sign.
3. Equipment to Be Labeled:
  - a. Communications cabinets.

END OF SECTION 270553

## SECTION 271300 - COMMUNICATIONS BACKBONE CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Pathways.
2. Single mode 9/125-micrometer, optical fiber cabling.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Cabling identification products.

#### 1.2 DEFINITIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- C. EMI: Electromagnetic interference.
- D. IDC: Insulation displacement connector.
- E. LAN: Local area network.
- F. LIU: Light interface unit.
- G. RCDD: Registered Communications Distribution Designer.
- H. UTP: Unshielded twisted pair.

#### 1.3 BACKBONE CABLING DESCRIPTION

- A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
- B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. General Performance: Backbone cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For coaxial cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.

#### 1.6 QUALITY ASSURANCE

- A. Installation shall comply with TIA/EIA-569-A standards. At the Owners' request, the Engineer of Record shall perform a walkthrough/checklist to ascertain whether installation complies with minimum TIA/EIA-569-A standards.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in CEC, by a qualified testing agency, and marked for intended location and application.
- D. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
- E. Grounding: Comply with ANSI-J-STD-607-A.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

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

#### 1.8 PROJECT CONDITIONS

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



## 1.9 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

## PART 2 - PRODUCTS

### 2.1 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Belden CDT Networking Division/NORDX.
  - 2. Berk-Tek Leviton; a Nexans/Leviton alliance.
  - 3. General Cable; General Cable Corporation.
- B. Description:
  - 1. Type: Single Mode OS-1:9/125 micrometer.
  - 2. Strands: strands as indicated in the Drawings.
  - 3. Comply with ICEA S-83-596 for mechanical properties.
  - 4. Maximum Attenuation: per EIA/TIA 568 standards.
  - 5. Comply with TIA/EIA-568-B.3 for performance specifications.
  - 6. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and CEC for the following types:
    - a. General Purpose, Nonconductive, Non-Plenum: Type OFNG.
- C. Jacket:
  - 1. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
  - 2. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.
  - 3. Color as indicated on plans.

### 2.2 OPTICAL FIBER CABLE HARDWARE

- 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. Belden CDT Networking Division/NORDX.
  - 2. Berk-Tek Leviton; a Nexans/Leviton alliance.
  - 3. Corning Cable Systems.
- B. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.
- C. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
  2. Type SFF connectors may be used in termination racks, panels, and equipment packages.
- D. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus 25 percent spares and blank positions adequate to suit specified expansion criteria.

## 2.3 GROUNDING

- A. Comply with ANSI-J-STD-607-A.

## 2.4 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

## 2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Cabling may be routed in conduit except within IT equipment rooms.
- B. Wiring within Enclosures: Comb, bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

### 3.2 INSTALLATION OF PATHWAYS

- A. Provide LIU's appropriate for the application where required to terminate fiber as equipment racks and/or cabinets.
- B. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Communications Equipment Rooms:
  - 1. Install cable trays to route cables if conduits cannot be located in these positions.
  - 2. Secure conduits to backboard when entering room from overhead.
  - 3. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

### 3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
  - 1. Comply with TIA/EIA-568-B.1.
  - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
  - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
  - 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
  - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 9. Splicing at LIU's shall be accomplished via fusion splicing.
  - 10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
  - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. Optical Fiber Cable Installation:

1. Comply with TIA/EIA-568-B.3.
2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
3. Cabling shall not touch materials foreign to the low voltage system.

E. Group connecting hardware for cables into separate logical fields.

### 3.4 FIRESTOPPING

- A. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 270553, "IDENTIFICATION FOR COMMUNICATIONS SYSTEMS".

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  1. Visually inspect optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments and inspect cabling connections for compliance with TIA/EIA-568-B.1.
  2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  3. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Horizontal backbone link measurements: Test at 850 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.

- 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.
- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION 271300

## SECTION 271513 - COMMUNICATIONS COPPER HORIZONTAL CABLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Category 6A twisted pair cable.
2. Twisted pair cable hardware, including plugs and jacks.
3. Cable management system.
4. Cabling identification products.
5. Grounding provisions for twisted pair cable.
6. Source quality control requirements for twisted pair cable.

#### 1.2 DEFINITIONS

- A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- B. EMI: Electromagnetic interference.
- C. FTP: Shielded twisted pair.
- D. F/FTP: Overall foil screened cable with foil screened twisted pair.
- E. F/UTP: Overall foil screened cable with unscreened twisted pair.
- F. IDC: Insulation displacement connector.
- G. LAN: Local area network.
- H. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- I. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- J. RCDD: Registered Communications Distribution Designer.
- K. Screen: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- L. Shield: A metallic layer, either a foil or braid, placed around a pair or group of conductors.
- M. S/FTP: Overall braid screened cable with foil screened twisted pair.
- N. S/UTP: Overall braid screened cable with unscreened twisted pairs.
- O. UTP: Unscreened (unshielded) twisted pair.

### 1.3 COPPER HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable cabling system shall provide interconnections between Distributor A, Distributor B, or Distributor C, and the equipment outlet, otherwise known as "Cabling Subsystem 1," in the telecommunications cabling system structure. Cabling system consists of horizontal cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for horizontal-to-horizontal cross-connection.
  - 1. TIA-568-C.1 requires that a minimum of two equipment outlets be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications equipment outlet.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. A work area is approximately 100 sq. ft. and includes the components that extend from the equipment outlets to the station equipment.
- C. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length includes an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

### 1.4 ACTION SUBMITTALS

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

### 1.5 QUALITY ASSURANCE

- A. Installation shall comply with TIA/EIA-569-A standards. At the Architect's request, the Engineer of Record shall perform a walkthrough/checklist to ascertain whether installation complies with minimum TIA/EIA-569-A standards.

### 1.6 PROJECT CONDITIONS

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

### 1.7 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

### 1.8 WARRANTY

- A. The horizontal communications cabling system installed shall be eligible for coverage by a Limited Lifetime Warranty to the end user.

1. Horizontal channels shall be completed with applicable to the cable manufacturer's qualifications for warranty with channel performance guarantees.
- B. Optimized Installer/Optimized Integrator shall provide labor, materials, and documentation in accordance with cable manufacturer requirements necessary to ensure that the Owner will be furnished with a Limited Lifetime Warranty.
- C. The installed structured cabling system shall provide a warranty guaranteeing installed channel performance above the ANSI/TIA 568-C requirements for Cat 6A cabling systems or ISO 11801 requirements for Class D, Class E, and/or Class E<sub>a</sub>.
  1. Standards-compliant channel or permanent link performance tests shall be performed in the field with an approved cable manufacturer certification tester.
- D. Installer shall ensure that the Owner receives the manufacturer issued project warranty certificate within 60 calendar days of warranty registration.
- E. Workmanship: The installer shall issue the Owner a 20-year workmanship warranty on all installed products.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA-568-C.1, when tested according to test procedures of this standard.
- B. Telecommunications Pathways and Spaces: Comply with TIA-569-D.
- C. Grounding: Comply with TIA-607-B.

### 2.2 GENERAL CABLE CHARACTERISTICS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with the applicable standard and CEC for the following types:
  1. Communications, Plenum Rated: Type CMP complying with UL 1685.
  2. Communications, Non-plenum: Type CMR complying with UL 1666.
- B. RoHS compliant.

### 2.3 CATEGORY 6A TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6A cable at frequencies up to 250MHz.
- B. 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. Belden Inc.
  2. Berk-Tek Leviton; a Nexans/Leviton alliance.
  3. General Cable; General Cable Corporation.
- C. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.
- D. Shielding/Screening: Unshielded twisted pairs (UTP).
- E. Jacket:
1. Data: White thermoplastic.

#### 2.4 TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate twisted pair copper communications cable.
- B. Manufacturer shall match cabling manufacturer. Obtain twisted pair cable hardware from same manufacturer as twisted pair cable, from single source.
- C. General Requirements for Twisted Pair Cable Hardware:
1. Comply with the performance requirements of specified cabling.
  2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
  3. Cables shall be terminated with connecting hardware of same category or higher.
- D. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.
1. Features:
    - a. Universal T568A and T568B wiring labels.
    - b. Labeling areas adjacent to conductors.
    - c. Replaceable connectors.
    - d. 24 or 48 ports.
  2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
  3. Number of Jacks per Field: One for each four-pair cable indicated, plus 25 percent spare.
- E. Plugs and Plug Assemblies:
1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
  2. Standard: Comply with TIA-568-C.2.
  3. Marked to indicate transmission performance.
- F. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair, 100-ohm, unshielded or shielded twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standard: Comply with TIA-568-C.2.
4. Marked to indicate transmission performance.

G. Faceplate:

1. Plastic Faceplate: High-impact plastic.
2. Metal Faceplate: Stainless steel in areas where the plate is susceptible to damage.
3. For use with snap-in jacks accommodating any combination of twisted pair, optical fiber, and coaxial work area cords.
  - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

H. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

## 2.5 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606-B and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. See specification section 270553, IDENTIFICATION FOR COMMUNICATIONS SYSTEMS” for further information.

## 2.6 GROUNDING

- A. Comply with TIA-607-B.

## 2.7 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test cables on reels according to TIA-568-C.1.
- C. Factory test twisted pair cables according to TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports and submit a digital copy in PDF format to the engineer of record upon completion.

## PART 3 - EXECUTION

### 3.1 WIRING METHODS

- A. Wiring Method: Cabling may be routed as exposed above ceilings but shall be in raceways through inaccessible locations.
- B. Wiring within Enclosures: Comb, bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools. Install conductors parallel with or at right angles to sides and back of enclosure.

### 3.2 INSTALLATION OF TWISTED-PAIR HORIZONTAL CABLES

- A. Comply with NECA 1 and NECA/BICSI 568.
- B. General Requirements for Cabling:
  - 1. Comply with TIA-568-C.0, TIA-568-C.1, and TIA-568-C.2.
  - 2. Comply with BICSI's "Information Transport Systems Installation Methods Manual (ITSIMM), Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section.
  - 3. Do not untwist twisted pair cables more than 1/2 inch from the point of termination to maintain cable geometry.
  - 4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
  - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
  - 6. Install lacing bars to restrain cables, prevent straining connections, and prevent bending cables to smaller radii than minimums recommended by manufacturer.
  - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI Information Transport Systems Installation Methods Manual , Ch. 5, "Copper Structured Cabling Systems," "Cable Termination Practices" Section. Use lacing bars and distribution spools.
  - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation, and replace it with new cable.
  - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
  - 11. Pulling Cable: Comply with BICSI Information Transport Systems Installation Methods Manual, Ch. 5, "Copper Structured Cabling Systems," "Pulling and Installing Cable" Section. Monitor cable pull tensions.
- C. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  2. Suspend twisted pair cabling, not in a wireway or pathway, a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
  3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- D. Group connecting hardware for cables into separate logical fields.
- E. Separation from EMI Sources:
1. Comply with recommendations from BICSI's "Telecommunications Distribution Methods Manual" and TIA-569-D for separating unshielded copper communication cable from potential EMI sources, including electrical power lines and equipment.
  2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
  3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
  4. Separation between communications cables in grounded metallic raceways, power lines, and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
  5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
  6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.3 GROUNDING

- A. Install grounding according to the "Grounding, Bonding, and Electrical Protection" chapter in BICSI's "Telecommunications Distribution Methods Manual."
- B. Comply with TIA-607-B and NECA/BICSI-607.

- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall, allowing at least a 2-inch clearance behind the grounding bus bar. Connect grounding bus bar to suitable electrical building ground, using a minimum No. 6 AWG conductor.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than a No. 6 AWG equipment grounding conductor.

### 3.4 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Paint and label colors for equipment identification shall comply with TIA-606-B.
- C. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
  - 1. Visually inspect jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test twisted pair cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similarly to Table 10.1 in BICSI's "Telecommunications Distribution Methods Manual," or shall be transferred from the instrument to the computer, saved as text files, printed, and submitted.

- E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION 271513