

**SECTION 27 10 05
TELECOMMUNICATIONS CABLING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Communications system design requirements.
- B. Copper cable and terminations.
- C. Fiber optic cable and interconnecting devices.
- D. Communications identification.
- E. Telecommunications service entrance to building(s).
- F. Cabling and pathways inside building(s).
- G. Distribution frames, cross-connection equipment, enclosures, and outlets.
- H. Grounding and bonding the telecommunications distribution system.
- I. Cabling for IP Video Surveillance Equipment.

1.02 RELATED REQUIREMENTS

- A. Section 26 05 26 - Grounding and Bonding.
 - 1. Includes bonding jumpers for bonding of communications systems and electrical system grounding.
- B. Section 26 05 33.13 - Conduit.
- C. Section 26 05 36 - Cable Trays.
- D. Section 26 05 33.16 - Boxes.
- E. Section 26 27 26 - Wiring Devices.
- F. Section 27 10 10: Outside Plant Cabling.
- G. Section 28 13 00 - Access Control Systems.
- H. Section 28 23 00 - IP Video Surveillance.

1.03 DEFINITIONS

- A. Contractor/Owner Scope Definitions:
 - 1. Furnish
 - a. Supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.
 - 2. Install
 - a. Operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.
 - 3. Provide
 - a. To furnish and install, complete and ready for the intended operation.
- B. IDF: Intermediate Distribution Facility
 - 1. The IDF(s) is/are the consolidation and termination point(s) for the room cabling.
 - 2. The minimum size of an IDF is 120 square feet, with the minimum length of any side of the room being 10 feet.
- C. MDF: Main Distribution Facility
 - 1. Centrally located support structure for terminating the point of entry backbone conduit and cable from the campus network, and contains the backbone cables that extend to intermediate distribution frames (IDFs).
 - 2. The minimum size of an MDF shall be 150 square feet, with the minimum length of any side of the room being 10 feet.

3. Copper and fiber risers are to be installed between the MDF and each IDF. Topology of riser cabling shall use a star pattern, daisy chaining multiple IDFs is not allowed.
- D. MH: Manhole
 1. Utility/maintenance hole with an opening to a confined space often used as an access point for an underground public utility, allowing inspection, maintenance, and system upgrades.
 - E. MM (OM4) Multimode Fiber
 1. MM fiber cables enable multiple modes of light to propagate through; however, this limits the maximum of transmissions links possible due to modal dispersion. Thus, these fibers are used for short-distance transmissions of signals.
 - F. NDUS: North Dakota University System
 1. The North Dakota University System is a unified system of higher education governed by the State Board of Higher Education.
 - G. SM: Single Mode Fiber
 1. SM fiber is a cable designed to carry only a single mode of light that is the transverse mode. These are used for the long-distance transmission of signals.
 - H. UIT: University Information Technology — division of UND
 1. UND's technology support unit serving students, faculty, and staff.
 - I. UND: University of North Dakota
 1. UND is the state's oldest and largest university. UND offers 225+ highly accredited on-campus and online degrees.
 - J. WAP (or AP): Wireless Access Points
 1. Networking devices that allow Wi-Fi devices to connect to a wired network.
 2. Two (2) CAT6A cables shall be installed to each access point location.

1.04 REFERENCE STANDARDS

- A. ICEA S-83-596 - Indoor Optical Fiber Cable; 2021.
- B. TIA-568-C.3 - Optical Fiber Cabling Components Standard; 2016.
- C. TIA-598-D - Optical Fiber Cable Color Coding; 2014d.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. TIA-455-21 - FOTP-21 - Mating Durability of Fiber Optic Interconnecting Devices; 1988a (Reaffirmed 2012).
- F. TIA-492AAAD - Detail Specification for 850-nm Laser- Optimized, 50- μ m Core Diameter/125- μ m Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers Suitable for Manufacturing OM4 Cabled Optical Fiber; 2009.
- G. TIA-492AAAC-B - Detail Specification for 850-nm Laser-Optimized, 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers; 2009b.
- H. TIA-492AAAB-A - Detail Specification for 50-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers; 2009a.
- I. TIA-492AAAA-B - Detail Specification for 62.5-um Core Diameter/125-um Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers; 2009b.
- J. TIA-492CAAB - Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers with Low Water Peak; 2000 (Reaffirmed 2005).
- K. TIA-492CAAA - Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers; 1998 (Reaffirmed 2002).
- L. UL 1651 - Fiber Optic Cable; Current Edition, Including All Revisions.
- M. UL 444 - Communications Cables; Current Edition, Including All Revisions.

- N. EIA/ECA-310 - Cabinets, Racks, Panels, and Associated Equipment; Electronic Industries Alliance/Electrical Components Association; Revision E, 2005.
- O. ICEA S-83-596 - Indoor Optical Fiber Cables; Insulated Cable Engineers Association; 2011 (ANSI/ICEA S-83-596).
- P. CEA-310 - Cabinets, Racks, Panels, and Associated Equipment; Consumer Electronics Association; Revision E, 2005.
- Q. ICEA S-90-661 - Category 3, 5, & 5e Individually Unshielded Twisted Pair Indoor Cables (With or Without An Overall Shield) For Use in General Purpose and LAN Communications Wiring Systems Technical Requirements; Insulated Cable Engineers Association; 2012. (ANSI/ICEA S-90-661)
- R. NECA/BICSI 568 - Standard for Installing Building Telecommunications Cabling; National Electrical Contractors Association; 2006. (ANSI/NECA/BICSI 568)
- S. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- T. TIA-526-7 - OFSTP-7 - Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant; Telecommunications Industry Association; 2002.
- U. TIA-526-14 - OFSTP-14 - Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; Telecommunications Industry Association; Rev B, 2010.
- V. TIA-568 (SET) - Commercial Building Telecommunications Cabling Standard Set; 2015
- W. TIA-568-C.2 - Commercial Building Telecommunications Cabling Standard - Part 2: Balanced Twisted Pair Cabling Components; Telecommunications Industry Association; Rev C, 2009.
- X. TIA-568-C.3 - Optical Fiber Cabling Components Standard; Telecommunications Industry Association; 2008 (with Addenda; 2011).
- Y. TIA/EIA-568-B.3 - Commercial Building Telecommunications Cabling Standard - Part 3: Optical Fiber Cabling Components Standard, and Addendum 1 - Additional Transmission Performance Specifications for 50/125 um Optical Fiber Cables; Rev B, 2000; Addendum 1.
- Z. TIA-569-C - Telecommunications Pathways and Spaces; Telecommunications Industry Association; Rev C, 2012 (with Addenda; 2013).
- AA. TIA-598-C - Optical Fiber Cable Color Coding; Telecommunications Industry Association; Rev C, 2005.
- BB. TIA-606-B - Administration Standard for the Telecommunications Infrastructure; Telecommunications Industry Association; Rev B, 2012.
- CC. TIA-607-B - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises; Telecommunications Industry Association; Rev B, 2012 (with Addenda; 2013).
- DD. ANSI/J-STD-607 - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications; Rev A, 2002.
- EE. UL 497 - Standard for Protectors for Paired-Conductor Communications Circuits; Current Edition, Including All Revisions.
- FF. UL 1863 - Communications-Circuit Accessories; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 1. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for communications equipment.
 2. Coordinate arrangement of communications equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 3. Notify Architect/Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

- B. Preinstallation Meeting: Convene one week prior to commencing work of this section to review requirements and details with Owner.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Owner's approval shall be obtained for all equipment and material before delivery to the job site. Include adequate descriptive literature, catalog cuts, shop drawings, and other data necessary for the Owner to ascertain that the proposed equipment and materials comply with specification requirements.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product.
 - 1. Storage and handling requirements and recommendations.
 - 2. Installation methods.
- D. Submittals shall confirm compliance with contract requirements, to include the manufacturer's name, model or catalog numbers, catalog information, and technical data sheets.
- E. Shop Drawings: Show compliance with requirements on isometric schematic diagram of network layout, showing cable routings, telecommunication closets, rack and enclosure layouts and locations, service entrance, and grounding, prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
 - 1. Provide in writing as part of the Shop Drawing Submittal that the selected wiring and device Manufacturers system Warranty meets the warranty requirements of this specification.
 - 2. Provide floorplan drawings showing suggested routing of cabling to the furthest telecommunications jack from the assigned termination rack to confirm telecommunications outlets and associated devices with telecommunications cabling connections are within rated distances of the assigned MDF/IDF Rooms. If cabling distances exceed the recommended manufacturer distances the bidder shall provide written notice to the Engineer for clarification in the shop drawing submittals.
 - 3. Confirm drawings show sufficient quantity and size of cable pathways and cable tray. Note any required revisions to pathway sizes or routing in the shop drawing submittal floorplan drawings.
- F. Manufacturer Qualifications.
- G. Evidence of qualifications for installer(s).
- H. Field Test Reports.
- I. Project Record Documents: Prepared and approved by BICSI Registered Communications Distribution Designer (RCDD).
 - 1. Record actual locations of outlet boxes and distribution frames.
 - 2. Identify distribution frames and equipment rooms by room number on contract drawings.
- J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of project record documents.

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least 5 years experience manufacturing products of the type specified.
- B. Installer Qualifications: A company having at least 5 years experience in the installation and testing of the type of system specified, and:
 - 1. Employing a BICSI Registered Communications Distribution Designer (RCDD).
 - 2. Supervisors and installers factory certified by manufacturers of products to be installed.
 - 3. On site Foreman shall possess a current BICSI Installer 2 Certification.
 - 4. Employing experienced technicians for all work; show at least 3 years experience in the installation of the type of system specified, with evidence from at least 2 projects that have

been in use for at least 18 months; submit project name, address, and written certification by user.

5. The entire installation of the telecommunications system as specified in this section of the specifications shall be completed by an acceptable systems installer. The acceptable systems installers shall meet the following criteria.
 - a. The following installers have been reviewed for their performance and are acceptable installers for this project:
 - 1) ABT Data Technologies, Inc.
 - 2) All State Communications
 - 3) Archkey Technologies, Inc.
 - 4) Network Cabling Services, Inc.
 - 5) RBB Electric and Communications, Inc.
 - b. All other installers requesting approval to bid this project must submit the following information for evaluation in accordance with Section 26 50 00 and the General Conditions:
 - 1) General Company Information.
 - 2) RCDD Certificate for person preparing and approving the installation. The RCDD is required to be employed by the installing contractor.
 - 3) List of projects, with description of work performed in the last five years. Project list shall include cost of communications system, Owner's representative, address and telephone number.
 - c. Final approval of acceptable installers will be at the discretion of the Architect/Engineer and the Owner.

C. Products: Listed, classified, and labeled as suitable for the purpose intended.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep stored products clean and dry.

1.09 WARRANTY

- A. Correct defective Work within a 1 year period after Date of Substantial Completion.
- B. Manufacturer shall warranty and provide maintenance service for 15 years minimum on the network system and a lifetime for products used in the system.

PART 2 PRODUCTS

2.01 SYSTEM DESIGN

- A. Provide a complete permanent system of cabling and pathways for voice and data communications, including cables, conduits and wireways, pull wires, support structures, enclosures and cabinets, and outlets.
 1. Comply with TIA-568 (cabling) and TIA-569 (pathways), latest editions (commercial standards).
 2. Provide fixed cables and pathways that comply with NFPA 70 and TIA-607 and are UL listed or third party independent testing laboratory certified.
 3. Provide connection devices that are rated for operation under conditions of 32 to 140 degrees F at relative humidity of 0 to 95 percent, noncondensing.
 4. In this project, the term plenum is defined as return air spaces above ceilings, inside ducts, under raised floors, and other air-handling spaces.

2.02 SPEC WRITER: EDIT *SYSTEM DESCRIPTION* BELOW FOR EACH ITEM TO CORRELATE WITH THE PROJECT

- A. System Description:
 1. Building Entrance Fiber Cabling: ### strands fiber.
 2. Building Entrance Copper Cabling: ### pairs of copper.
 3. Building Entrance Conduit: (3) 4" Schedule 40 PVC.

4. Copper Backbone: ### Pairs.
 5. Fiber Backbone: ### strands of single mode fiber.
 6. Fiber Backbone; ### strands of multimode fiber.
 7. Horizontal cabling: Category 6A.
- B. Main Distribution Facility (MDF): Centrally located support structure for terminating the point of entry backbone conduit and cable from the campus network, and contains the backbone cables that extend to intermediate distribution facilities (IDFs).
1. For each building there is a single MDF, typically on the lowest floor. Location is as indicated on the drawings.
 2. Capacity: As required to terminate all cables required by design criteria plus minimum 25 percent spare space.
- C. Intermediate Distribution Facility (IDF): Support structures for terminating horizontal cables that extend to telecommunications outlets.
1. Locate intermediate distribution frames as indicated on the drawings.
- D. Backbone Cabling: Cabling, pathways, and terminal hardware connecting intermediate distribution frames (IDF's) with main distribution frame (MDF), wired in star topology with main distribution frame at center hub of star.
- E. Cabling to Outlets: Specified horizontal cabling, wired in star topology to distribution frame located at center hub of star; also referred to as "links".

2.03 PATHWAYS

- A. Conduit: As specified in **Section 26 05 33.13**; provide pull cords in all conduit.
- B. Cable Trays: As specified in **Section 26 05 36**.
- C. Outlets
1. As specified in Section **26 0533.16 - Boxes**.
 2. Sheetrock walls and ceiling installations: Four inch square box, 2 1/8 inch deep with single gang plaster ring.
 3. Masonry Walls: Single gang, 3 1/2 inch deep masonry box.
- D. Underground Service Entrance: Rigid polyvinyl chloride (PVC) conduit, Schedule 40.

2.04 COPPER CABLE AND TERMINATIONS

- A. Copper Backbone Cable: TIA/EIA-568 Category 6A solid conductor unshielded twisted pair (UTP), 23 AWG, 100 ohm; 4 individually twisted pairs; covered with green jacket and complying with all relevant parts of and addenda to latest edition of TIA/EIA-568 and UL 444.
1. Manufacturer:
 - a. Commscope 2091 Series.
 - b. Leviton SST Series
 - c. Approved Equal.
 2. Plenum rated cable, NFPA 70 type CMP.
 3. Quantity : Provide minimum of (6) Category 6A backbone cables, or as indicated on the drawings.
- B. Copper Backbone Cable: TIA/EIA-568 Category 3 solid conductor unshielded twisted pair (UTP), 24 AWG, 100 ohm; pairs as indicated on the drawings, formed into 25-pair binder groups; covered with gray thermoplastic jacket and complying with all relevant parts of and addenda to latest editions of TIA/EIA-568 and ICEA S-90-661, and UL 444.
1. NFPA 70 type CMP plenum-rated cable.
 2. Provide cable having conductors twisted at minimum rate of two per foot; actual length and frequency of twists at manufacturer's option.
 3. Color code conductors in accordance with ICEA S-90-661.
 4. For all underground conduits the following will be used:
 - a. Superior Essex Group SEALPIC-F (RUS PE39) water resistant with aluminum shield.
 - b. 24 AWG, non-shielded, copper conductors.

- c. ETPR compound filling with polyethylene jacket.
 - d. Pairs as indicated on the drawings.
 - e. Color Code: Standard telephone industry specifications.
- C. Copper Horizontal Cable: TIA/EIA-568 Category 6A solid conductor unshielded twisted pair (UTP), 23 AWG, 100 ohm; 4 individually twisted pairs; covered with green jacket and complying with all relevant parts of and addenda to latest edition of TIA/EIA-568 and UL 444.
- 1. Manufacturer:
 - a. Commscope 2091 Series.
 - b. Leviton SST Series
 - c. Approved Equal.
 - 2. Plenum rated cable, NFPA 70 type CMP.
- D. Copper Cable Terminations: Insulation displacement connection (IDC) type using appropriate tool.
- E. Jacks and Connectors: Category 6A, 8 position, 8 wire, Modular RJ-45, non-keyed, terminated with 110-style insulation displacement connectors (IDC); high impact thermoplastic housing; suitable for and complying with same standard as specified horizontal cable; UL 1863 listed.
- 1. Manufacturer: Systimax MGS600 Gigaspeed X10D Series
 - 2. Voice and Data Jacks: 4-pair, pre-wired to T568B configuration.
 - 3. Jack Colors:
 - a. Wireless Access Point: Green
 - b. Voice/Data: Match color of faceplate.
 - 4. Provide the following minimum number of Category 6A data cables for each device type.
 - a. (2) for each WAP location
 - b. (2) for each office data jack location
 - c. (6) for each lecture podium location
 - d. (2) for each printer location
 - e. (1) for each ceiling microphone location
 - f. (1) for each room scheduler touch panel
 - g. (2) for each video monitor
 - h. (2) for each digital signage monitor
 - i. (1) for each security camera
 - j. (2) for each building automation panel
 - k. (1) for each lighting control panel
 - l. (1) for each card access control panel
- F. Copper Patch Cords:
- 1. Description: Factory-fabricated 4-pair cable assemblies with 8-position modular connectors terminated at each end.
 - 2. Manufacturer: Ortronics RDC Series reduced diameter patch cables or Approved Equal.
 - 3. Provide Patch Cords in the following lengths and quantities:
 - a. 3' equal to the number of wireless access points + 20%.
 - b. 5' equal to 45% of total jack count.
 - c. 7' equal to 45% of total jack count.
 - d. 9' equal to 10% of total jack count.
 - e. Blue in color.
- G. Faceplates:
- 1. Systimax M Series modular faceplates.
 - a. Two port: M12L Series.
 - b. Three port: M13L Series.
 - c. Four port: M14L Series.
 - 2. Plastic plates with label ID windows.
 - 3. Color: to match devices as specified in Section 26 2726 Wiring Devices.
 - 4. See drawings for quantity of connector modules required at each location.

5. Provide with proper ID label utilizing UND labeling standards.
6. Provide blank inserts for unused ports.

2.05 FIBER OPTIC CABLE AND INTERCONNECTING DEVICES

- A. Fiber Optic Backbone Cable:
 1. Description: Tight buffered, indoor rated, fiber optic cable complying with TIA-568-C.3, TIA-598-D, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
 2. Cable Type: Singlemode, 9/125 um (OS1), complying with TIA-492-CAAA.
 3. Cable Capacity: a minimum of 12 strands or as indicated on the drawings.
 4. Cable Applications: Use listed NFPA 70 Type OFNP plenum cable unless otherwise indicated.
 5. Cable Construction:
 - a. Interlocked armor with plenum rated non-conductive jacket.
 - b. Aramid strength member.
 - c. Bend Radius: 15X outside diameter (installation), 10X (long term).
 - d. Flex resistance: minimum 25 cycles.
 6. Cable Jacket Color:
 - a. Single-Mode Fiber (OS1/OS2): Yellow.
 7. Manufacturer:
 - a. Commscope TeraSPEED.
 - b. Approved Equal.
- B. Fiber Optic Backbone Cable:
 1. Description: Tight buffered, indoor rated, fiber optic cable complying with TIA-568-C.3, TIA-598-D, ICEA S-83-596 and listed as complying with UL 444 and UL 1651.
 2. Cable Type: Multimode, laser-optimized 50/125 um (OM4) complying with TIA-492AAAD.
 3. Cable Capacity: Minimum of 12 Strands or as indicated on the drawings. .
 4. Cable Applications: Use listed NFPA 70 Type OFNP plenum cable unless otherwise indicated.
 5. Cable Construction:
 - a. Interlocked armor with plenum rated non-conductive jacket.
 - b. Aramid strength member.
 - c. Bend Radius: 15X outside diameter (installation), 10X (long term).
 - d. Flex resistance: minimum 25 cycles.
 6. Cable Jacket Color:
 - a. Laser-Optimized Multimode Fiber (OM3/OM4): Aqua.
 7. Manufacturer:
 - a. Commscope LazrSPEED.
 - b. Approved Equal.
- C. Fiber Optic Pigtails and Connectors : Duplex LC pigtails for fusion splicing to cables to match installed fiber with zirconia ceramic alignment sleeves; complying with relevant parts and addenda to latest edition of TIA/EIA-568 and with maximum attenuation of 0.15 dB at 1300 nm with less than 0.2 dB change after 500 mating cycles when tested in accordance with TIA-455-21.
- D. Fiber Optic Patch Cords:
 1. Description: Factory-fabricated 2-fiber cable assemblies with suitable connectors at each end.
 2. Patch Cords for Patch Panels:
 - a. Quantity: One for each pair of fiber patch panel ports.
 - b. Length: 7 feet.

2.06 GROUNDING AND BONDING COMPONENTS

- A. Comply with TIA-607.
- B. Comply with Section 26 0526 Grounding and Bonding for Electrical Systems

2.07 IDENTIFICATION PRODUCTS

- A. Comply with TIA-606.
- B. Comply with Section 26 0553 Electrical Identification.

2.08 SOURCE QUALITY CONTROL

- A. Factory test cables according to TIA-568.

2.09 CROSS-CONNECTION EQUIPMENT

- A. Wall mounted connector blocks for terminating telecommunications riser cables.
 - 1. Manufacturer: Siemens S110 Series or Equal.
 - 2. Type 110 IDC connectors; capacity sufficient for cables to be terminated plus 25 percent spare. Provide with clear ID strip holder, and required connecting kits and wall mounting brackets.
- B. Rack Mounted Connector Blocks for terminating telecommunications riser cables.
 - 1. Manufacturer: Systimax 360 Gigaspeed 360-1100GS3-24 Series or Approved Equal.
 - 2. Type: Single piece, rack mounted, 24 port preterminated style patch panel with Type 110 IDC connectors.
 - 3. Mounting: For mounting in standard 19 inch rack.
- C. Patch Panels for Copper Cabling: Sized to fit EIA standard 19 inch wide equipment racks; thermoplastic and powder coated steel construction, with modular jack openings.
 - 1. Jacks: RJ-45 modular jacks, suitable for and complying with same standard as cable to be terminated and with same manufacturer as used at the data outlet; maximum 48 ports per standard width panel.
 - 2. Capacity: Provide ports sufficient for cables to be terminated plus 25 percent spare.
 - 3. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA/EIA-606 using encoded identifiers.
 - 4. Provide incoming cable strain relief and routing guides on back of panel.
 - 5. Manufacturers:
 - a. Commscope CPP-UDDM Series.
 - b. No Substitutions.
- D. Patch Panels for Fiber Optic Cabling:
 - 1. 16 gauge steel construction, powder coated with black finish.
 - 2. Size: for termination of fiber quantities as indicated on the drawings, plus 25% spare capacity.
 - 3. Adaptors: As specified above under FIBER OPTIC CONNECTORS.
 - 4. Labels: Factory installed laminated plastic nameplates above each port, numbered consecutively; comply with TIA/EIA-606 using encoded identifiers.
 - 5. Provide with incoming cable strain relief, bend radius control, and routing guides.
 - 6. Provide rear cable management tray at least 8 inches deep with removable cover for rack mounted enclosures.
 - 7. Provide dust covers for unused adaptors.
 - 8. Rack Mounted: Sized to fit EIA standard 19 inch wide equipment racks:
 - a. Panduit FRME Series.
 - b. Approved Equal.
 - 9. Wall Mounted.
 - a. Panduit FWME Series.
 - b. Approved Equal.

2.10 ENCLOSURES

- A. Backboards: Interior grade plywood without voids, 3/4 inch thick; UL-labeled fire-retardant.
 - 1. Size: 48 inches wide by 96 inches high or as noted on the drawings.
 - 2. Do not paint over UL label.

3. Install on all walls in MDF and IDF Rooms from floor to 8'AFF unless noted otherwise on the drawings.
- B. Equipment Racks and Cabinets: CEA-310 standard 19 inch wide component racks.
1. Floor Mounted Racks: Standard 19" rack meeting EIA-310-D standards. Two post, open frame, aluminum construction, black in color, 3 inch column depth. 45 rack spaces minimum.
 - a. Manufacturer
 - 1) Chatworth 55053-703 Series.
 - 2) Hoffman EDR Series.
 - 3) Panduit R2P Series.
 - 4) Newton 004010 Series.
 - 5) Approved Equal.
 2. Mounting: Secure to floor and adjacent wall structure and to cable tray systems.
 3. Wire Management: Provide cable management for each rack as follows:
 - a. Vertical Wire Management: 8 inch wide, dual sided, aluminum construction with powdercoat finish, metal hinged cover, installed on each side of each rack. Side-by-side racks may share a single vertical wire manager between them.
 - 1) Manufacturer: Hoffman DV10D7 Series.
 - 2) Approved Equal.
 - b. Horizontal Wire Management - Provide one for each patch panel installed.
 - 1) Manufacturer: Hoffman DCHS2 Series, single sided, 2 RU.
 - 2) Approved Equal.
 - c. Ladder Tray: Minimum 12" wide, welded stringers on 9 inch spacing, black in color. Provide ladder tray from each rack to adjacent wall for securing each rack to wall, and ladder tray in quantities as required to run the length of the entire MDF or IDF room, centered above the data rack lineup.
 - d. Provide cable drop out (waterfalls) or cable exit accessories for connecting overhead trays to the rack.
 - e. Route Ladder trays down walls to floor penetrations where tray is routed up walls to overhead systems in MDF/IDF Rooms.
 - f. Grounding and bonding: Provide vertically mounted, rack grounding strip in each rack. Bond each rack to local telecom grounding bar.
 4. **SPEC WRITER: OMIT WALL MOUNTED CABINETS IF NOT REQUIRED ON PROJECT.**
 5. Wall Mounted Cabinets: Swing out cabinet body, adjustable 19" EIA threaded equipment rails, vented cabinet body, steel locking front door, 200 lb load rating, steel construction.
 - a. Manufacturer:
 - 1) Chatsworth 13265 Series.
 - 2) Hoffman EWMW Series
 - 3) Panduit Panzone Series.
 - 4) Approved Equal
 - b. Usable depth: 18" minimum.
 - c. Height: 36" minimum. Size according to required space for cabling terminations, cable management, and owner furnished equipment, with 25% spare capacity.
 - d. Door: ventilated front door with key lock.
 6. Power Distribution Unit:
 - a. Manufacturer: Vertiv Geist NI30203 Series PDU
 - b. UL listed, L5-30P plug, (8) NEMA 5-20R outlets,
 - c. Network monitoring port with Kilowatt Hours, wattage, VA, power factor, voltage, and amperage monitoring. 10/100/1000 Mbps Ethernet network connection.
 - d. ANSI C12.1 and IEC62503-21 at 1% accuracy class requirements.
 - e. Rack mounted, steel with black powder coat finish.
 - f. Quantity: Provide (2) for each rack.

- C. Outlet Boxes: For flush mounting in walls; depth as required to accommodate cable manufacturer's recommended minimum conductor bend radius. See section 26 0533.16 Boxes for additional information and installation requirements.
 - 1. Size, Unless Otherwise Indicated: 4-11/16 inches square by 2-1/8 inches deep.
 - 2. Wall-Mounted Telephones: 4 inches high by 2 inches wide by 2-1/8 inches deep.
 - 3. Labels: Comply with TIA/EIA-606 using encoded identifiers; label each jack on the face plate as to its function with a unique numerical identifier.

2.11 PENETRATIONS

- A. Cable Sleeves
 - 1. For fire or smoke wall penetrations provide Hilti CP 653 Speed Sleeve or approved Equal
 - 2. Provide cable sleeves at all up to 2 hour fire rated wall penetrations.
 - 3. Provide quantity and size (either 2 inch or 4 inch) of sleeves as required for 60% maximum fill of the quantity of cables being installed.
 - 4. For non-fire rated partitions, provide conduit sleeves through the partitions providing quantity and size of conduits as required for 60% maximum fill of the quantity of cables being installed.

2.12 COMMUNICATIONS SYSTEM CONDUITS

- A. The Electrical Contractor shall provide a complete communication raceway system as shown on the drawings and in accordance with the requirements described herein.
- B. Conduit color shall be as specified in Section 26 05 53 Electrical Identification.
- C. Minimum conduit size shall be 3/4 inch or as indicated on the drawings. Conduit runs for communications systems shall be run in the most direct path, with the minimum number of bends possible.
- D. Install conduit from outlet to a location adjacent to the cable tray above the nearest accessible ceiling.
- E. All conduit runs shall be provided with insulated bushings and a pull wire indicating the location of the opposite end.
- F. Install conduits with the following minimum clearances:
- G. 48 inches from motors, generators, frequency converters, transformers, x-ray equipment, and uninterruptible power systems.
- H. 12 inches from power conduits and cables and panelboards.
- I. 5 inches from fluorescent and high frequency lighting fixtures.
- J. 6 inches from flues, hot water pipes, and steam pipes.
- K. Conceal conduit under floor slabs and within finished walls, ceilings, and floors except where specifically indicated that exposed conduit is allowed.
- L. Conduit may remain exposed to view in mechanical rooms, electrical rooms, and telecommunications rooms.
- M. Treat conduit in crawl spaces and under floor slabs as if exposed to view.
- N. Where exposed to view, install parallel with or at right angles to ceilings, walls, and structural members.
- O. Under floor slabs, locate conduit at 12 inches, minimum, below vapor retarder; seal penetrations of vapor retarder around conduit.
- P. Conduit bends shall be smooth, even, and free of kinks or other discontinuities that may have detrimental effects on pulling tension or cable integrity. Observe the following bend radii guidelines:
- Q. For conduits with 2" or less internal diameter, the bend radius shall be at least 6 times the internal diameter.

- R. For conduits with greater than 2" internal diameter, the bend radius shall be at least 10 times the internal diameter.
- S. Conduit Fittings:
 - 1. Provide conduit fittings that maintain the bend radius requirements of the cables within. Utilize products similar to Madison Electric Products, Smart LB conduit bodies to meet the bend radius requirements for fiber optic and other communications cables.
- T. Pullboxes shall be installed in a convenient and accessible location and shall be shown on the Contractor's record drawings. Pull boxes shall be supported independently of the associated conduits. Size pullboxes per the NEC. Pullboxes for communications conduits shall be placed in sections of conduit that:
 - 1. Are 100 feet or more in length.
 - 2. Contain more than two 90 degree bends: Provide pullbox between sections with two bends or less.
 - 3. Contain reverse bends (between 100 and 180 degrees): Insert a pull point or pull box at each bend having an angle from 100 degrees to 180 degrees.
- U. A third bend in a conduit is acceptable in a pull section if the conduit capacity is derated by 15% or if one of the following is true:
 - 1. The total run is no longer than 33 feet.
 - 2. The conduit size is increased to the next trade size.
 - 3. One of the bends is within 12 inches of the cable feed end where cable is pushed around the first bend.
- V. Vertical riser conduits and sleeves shall terminate not less than 3 inches above and below the floor that they penetrate. Riser conduits and sleeves shall be reamed and bushed.
- W. Where drilling is necessary for vertical conduits, locate holes so as not to affect structural sections such as ribs or beams.
- X. Service entrance conduits and outside plant conduits shall be cut and installed as flush to the wall as possible and extend a minimum of 4 inches above the finished floor. Provide with a pull rope rated at a minimum of 200 lbs.
- Y. Underground Service Entrance: Install conduit at least 24 inches below finish grade; encase in at least 3 inches thick concrete for at least 60 inches out from the building line.
- Z. All empty conduits located in communication closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- AA. Conduit shall be sized per BICSI standards and shall maintain requirements for pulling tension on all data cabling. Use the following minimum conduit sizes for Category 6 data cabling:
 - 1. 1-3 cables: ¾" conduit.
 - 2. 4-5 cables: 1" conduit.
 - 3. 6-9 cables: 1 ¼" conduit.

2.13 CABLE SUPPORT HANGERS

- A. See **Section 26 0536** for cable tray requirements.
- B. Manufacturers:
 - 1. Panduit J-Pro Series J-hook.
 - 2. CADDY CAT HP Series J-hook.
 - 3. CADDY CAT 425 Series adjustable strap hanger.
 - 4. Approved Equal.
- C. Panduit JP2 Series j-hook shall be used for up to 46 Category 6 4-pair communications cables, 30 Category 6A cables.
- D. Panduit JP4 Series j-hook shall be used for up to 180 Category 6 cables or 115 Category 6A cables.

- E. Caddy CAT 425 Series adjustable cable support for up to 325 Category 6 cables, or 210 Category 6A cables.
- F. Manufacturer guidelines shall be used for supporting/mounting the cable supports. Provide wall mount, ceiling mount, threaded rod clip, beam clamp, etc. mounting option as appropriate for the installation
- G. Cable shall be supported at no greater than four-foot intervals for Category 6 cable. Provide a cable tie at each J-hook to retain and manage the cable bundle.
 - 1. J-hooks or adjustable cable supports. to be UL listed as suitable for air handling plenum spaces.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

- A. Comply with latest editions and addenda of TIA-568 (cabling), TIA-569 (pathways), TIA-607 (grounding and bonding), NECA/BICSI 568, NFPA 70, and SYSTEM DESIGN as specified in PART 2.
- B. Comply with Communication Service Provider requirements.
- C. Grounding and Bonding: Perform in accordance with TIA-607 and NFPA 70.
- D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section **07 84 00**.

3.02 INSTALLATION OF EQUIPMENT AND CABLING

- A. Cabling:
 - 1. Do not bend cable at radius less than manufacturer's recommended bend radius; for unshielded twisted pair use bend radius of not less than 4 times cable diameter.
 - 2. Do not over-cinch or crush cables.
 - 3. Do not exceed manufacturer's recommended cable pull tension.
 - 4. When installing in conduit, use only lubricants approved by cable manufacturer and do not chafe or damage outer jacket.
 - 5. Install cable support hooks a maximum of 4'-0" on center above ceiling.
 - 6. Where cable tray is installed, run telecommunications cabling in cable tray.
 - 7. Where telecommunication cables are installed exposed above accessible ceilings, support the cables to keep them from resting on ceiling tiles. Use properly sized Cable Caddies or J-Hooks on walls above the ceilings to neatly route cables between outlet and termination locations. Minimum distance between supports is 4 feet or in accordance with EAI/TIA standards, whichever is less.
- B. Service Loops (Slack or Excess Length): Provide the following minimum extra length of cable, looped neatly:
 - 1. At Distribution Frames: 120 inches.
 - 2. At Outlets - Copper: 12 inches.
 - 3. At Outlets - Optical Fiber: 39 inches.
- C. Copper Cabling:
 - 1. Category 6 and Above: Maintain cable geometry; do not untwist more than 1/2 inch from point of termination.
 - 2. For 4-pair cables in conduit, do not exceed 25 pounds pull tension.
 - 3. Bridged taps/splices are not allowed as part of the horizontal wiring system.
 - 4. Each workstation jack shall be provided with its own UTP cable continuous (without splice) from jack to rack.
 - 5. Avoid routing cables near EMI sources.
 - 6. All cabling shall consist of 4 pairs and 1 cable per jack. All pairs shall be terminated within the jack. Do not split pairs within a cable and terminate to multiple jacks.
 - 7. Install modular outlets at all locations shown on the Drawings. Terminate wiring at workstation jacks and rack.

8. Install cable from all workstation outlets to rack.
 9. Telecommunications wiring shall be used for both voice and data wiring.
 10. Where indicated, workstation jacks may be ganged under a common wall plate.
- D. Fiber Optic Cabling:
1. Prepare for pulling by cutting the outer jacket for 10 inches from end, leaving strength members exposed. Twist strength members together and attach to pulling eye.
 2. Support vertical cable at intervals as recommended by manufacturer.
- E. Floor-Mounted Racks and Enclosures: Permanently anchor to floor in accordance with manufacturer's recommendations.
- F. Wall-Mounted Racks and Enclosures:
1. Install to plywood backboards only, unless otherwise indicated.
 2. Mount so the height of topmost panel does not exceed 78 inches above floor.
- G. Identification:
1. Use wire and cable markers to identify cables at each end.
 2. Use manufacturer-furnished label inserts or identification labels to identify each jack at communications outlets with unique identifier.
- H. Field-Installed Labels: Comply with TIA/EIA-606 using encoded identifiers.
1. Cables: Install color coded labels on both ends.
 2. Outlets: Label each jack on its face plate as to its type and function, with a unique numerical identifier.
 3. Patch Panels: Label each jack as to its type and function, with a unique numerical identifier.
 4. All horizontal cabling shall be labeled with permanent tag indication from which jack the cable originated.
 5. Machine labels shall be installed on each workstation jack faceplate.
 6. All labels shall be machine printed labels in conformance with ANSI/EIA/TIA 606.
 7. Faceplates labeling shall follow this specific detail: Termination Location MDF/IDF - Rack # - Patch Panel # - Port #.
 - a. Example: 014-1-B-33 = MDF 014 - Rack 1 - Patch Panel B - Port 33.
 8. Final room numbers to be used for labeling, room numbers on plans are not to be used.

3.03 FIELD QUALITY CONTROL

- A. Comply with inspection and testing requirements of specified installation standards.
- B. Visual Inspection:
1. Inspect cable jackets for certification markings.
 2. Inspect cable terminations for color coded labels of proper type.
 3. Inspect outlet plates and patch panels for complete labels.
- C. Testing - Copper Cabling and Associated Equipment:
1. Test backbone cables after termination but before cross-connection.
 2. Test backbone cables for DC loop resistance, shorts, opens, intermittent faults, and polarity between connectors and between conductors and shield, if cable has overall shield.
 3. Test operation of shorting bars in connection blocks.
 4. Category 3 Backbone: Perform attenuation test.
 5. Category 3 Links: Test each pair for short circuit continuity, short to ground, crosses, reversed polarity, operational and ring-back, and dial tone.
 6. Category 6A Links: Perform tests for wire map, length, insertion loss, NEXT, PSNEXT, ELFNEXT, PSELFEXT, return loss, delay skew and propagation delay.
 - a. Utilize a Level III/Level IV rated tester compatible with the following test standards:
 - 1) TIA-1152 Level IIIe and ISO/IEC 61935-1 Level IV accuracy.
 - 2) TIA-58-C.2, TIA1152 Category 5, 5e, 6, 6A, and ISO/IEC 11801.

- b. The cabling tester shall be approved for use with the connectivity solution for both Channel and Permanent Link tests, and for the associated warranty provided by the connectivity Manufacturers.
 - c. The company/individual testing the cable shall be manufacturer certified for products provided.
 - d. Contractor shall perform and document all conductor tests per TIA-568-B and ANSI/TIA-606. Return one copy of testing report to the Engineer and one copy to the Owner. All copper station runs must be tested after final installation and termination. All cable runs shall be documented with a hard copy printout of the test results. This printout shall be bound and delivered to the Owner prior to final payment
- D. Testing - Fiber Optic Cabling:
- 1. Backbone: Perform optical fiber end-to-end attenuation test using an optical time domain reflectometer (OTDR) and manufacturer's recommended test procedures; perform verification acceptance tests and factory reel tests.
 - 2. Multimode Backbone: Perform tests in accordance with TIA-526-14 Method B.
 - 3. Single Mode Backbone: Perform tests in accordance with TIA-526-7 Method B.

END OF SECTION