

SECTION 27 15 00

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 REFERENCES & STANDARDS

- A. Refer to Section 27 00 00 "Common Work Results for Communications", which identifies pertinent References & Standards

1.3 SUMMARY

- A. Section Includes:
 - 1. UTP cabling.
 - 2. Cable connecting hardware, patch panels, and cross-connects.
 - 3. Telecommunications outlet/connectors.
 - 4. Cabling system identification products.
 - 5. Cable management system.
- B. Related Requirements:
 - 1. Section 27 13 00 "Communications Backbone Cabling" for voice and data cabling associated with system panels and devices.
 - 2. Section 28 05 13 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.4 DEFINITIONS

- A. Refer to Section 27 00 00 "Common Work Results for Communications", which provides information on Definitions and Abbreviations used in this and related sections.
- B. BICSI: Building Industry Consulting Service International.
- C. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.

- D. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- E. EMI: Electromagnetic interference.
- F. IDC: Insulation displacement connector.
- G. Jack: Also commonly called an "outlet," it is the fixed, female connector.
- H. LAN: Local area network.
- I. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- J. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- K. Plug: Also commonly called a "connector," it is the removable, male telecommunications connector.
- L. RCDD: Registered Communications Distribution Designer.
- M. UTP: Unshielded twisted pair.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.6 ACTION SUBMITTALS

- A. Refer to Section 27 00 00 "Common Work Results for Communications" which provides general guidelines for product and/or installation information to be submitted by the contractor.
- B. Product Data: For each type of product.
 - 1. For coaxial cable, include the following installation data for each type used:
 - a. Nominal OD.
 - b. Minimum bending radius.
 - c. Maximum pulling tension.
- C. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
3. Cabling administration drawings and printouts.
4. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
5. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

1.7 INFORMATIONAL SUBMITTALS

- A. Refer to Section 27 00 00 "Common Work Results for Communications", which provides general guidelines for product and/or installation information to be submitted by the contractor.
- B. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Patch-Panel Units: One of each type.
 2. Connecting Blocks: One of each type.
 3. Device Plates: One of each type.
 4. Multiuser Telecommunications Outlet Assemblies: One of each type.

1.9 QUALITY ASSURANCE

- A. Refer to Section 27 00 00 "Common Work Results for Communications", which identifies general quality assurance requirements for the project.
- B. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings, Cabling Administration Drawings, and field testing program development by an RCDD.
 2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Testing Agency Qualifications: An NRTL.
1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight or optical loss test set.
 2. Test optical fiber cables 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.
 3. Test each pair of UTP cable for open and short circuits.

1.11 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.

1.12 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 GENERAL

- A. Refer to Project Drawings for quantities and location of Communications Outlets.

- B. All Cables and Termination hardware shall be technically compliant with and installed in accordance with referenced TIA documents.
- C. All cables shall be suitable for installation in the environment defined and shall meet a Plenum (CMP) rating (or permitted substitute as defined by the NEC).
- D. Cables shall be Underwriters Laboratory (UL) listed, comply with Article 800 (Communications Circuits) of the National Electrical Code and shall meet the specifications of NEMA (low loss), UL 444, and ICEA (where applicable).
- E. Horizontal (Station) Cable and Termination Components (Jack, Patch Panel) are specified to function as a System.
 - 1. Where required for warranty purposes, the manufacturers of cabling and termination components used (if more than one) shall recognize each other in their Certification Programs.
- F. No distinction between "Voice" and "Data" is made in the Horizontal Cabling subsystem.
- G. Station Cable types include:
 - 1. 4-pair Unshielded Twisted Pair (UTP)
- H. Station Cable types not applicable to this project include:
 - 1. Fiber Optic to the Desktop
- I. Acceptable Manufacturer(s) of connecting components: Ortronics / Superior Essex
 - 1. Includes Modular Jacks, Communications Outlets, Modular Patch Panels.
 - 2. Components by same manufacturer shall be used throughout project.
 - 3. All components of which the structured cabling system is comprised shall be fully certifiable by one of the acceptable manufacturers identified above.

2.2 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
 - 1. TIA/EIA-568-d.1 requires that a minimum of two telecommunications outlet/connectors 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 outlet/connector.

3. Bridged taps and splices shall not be installed in the horizontal cabling.
 4. Splitters shall not be installed as part of the optical fiber cabling.
- B. A work area is approximately 100 sq. ft. and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
- C. The maximum allowable horizontal cable length is 295 ft. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment or in the horizontal cross-connect.

2.3 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-D.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 50 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with TIA-607-C.

2.4 4-PAIR UTP CABLE

- A. Manufacturers Subject to compliance with requirements, provide the following:
- B. Superior Essex;
- a. 10Gain® XP Category 6A CMP 6H-272-2B
- C. The 4-pair UTP cables shall be constructed of four (4) unshielded twisted pairs with 23-AWG insulated solid copper conductors.
- D. The cable shall not incorporate an overall shield.
- E. Cable shall meet or exceed TIA Category 6A performance criteria as defined by the referenced TIA documents.
- F. Outer jacket shall be as required to meet flammability requirements for cable type.
- G. Cable outside diameter for any 4-pair UTP Cable shall not exceed 0.265 in.

- H. Maximum Pulling Load should not be rated for less than 25 lbs.
- I. Pairs of all 4-pair cables shall be identified by a banded color code in which conductor insulation is marked with a dominant color and banded with a contrasting color. By pair number, the pair colors or dominant bands are:
 - Pair 1: Tip - White/Blue; Ring - Blue (or Blue/White)
 - Pair 2: Tip - White/Orange; Ring - Orange (or Orange/White)
 - Pair 3: Tip - White/Green; Ring - Green (or Green/White)
 - Pair 4: Tip - White/Brown; Ring - Brown (or Brown/White)
- J. The jacket color shall be as follows:
 - 1. Horizontal Cable designated for Voice/Data – BLUE.
 - 2. Horizontal Cable designated for Nurse Call – BLACK
 - 3. Horizontal Cable designated for Phillip Monitoring – ORANGE

2.5 UTP CABLE HARDWARE

- A. Manufacturer: Subject to compliance with requirements, provide the following:
 - 1. Ortronics
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-D.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Patch Panel: Non-Modular panels with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- D. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Manufacturer: Subject to compliance with requirements, provide the following:
 - 1. Ortronics.
- B. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-C.1.
- C. Verify and confirm finish and colors of items specified in this section with architect and owner prior to purchase. In some locations, there may be a requirement for faceplates designed for furniture system modular cut outs.

- D. Standard faceplate: accommodates (2) inserts. Attaches to standard NEMA single-gang or double-gang flush-mount junction box or plaster reducing ring. Plastic. Please confirm with architect and owner. Bulk pack specified
 - 1. Part no.:
 - a. TracJack Faceplate, two-port (single gang), plastic, Fog White Part# OR-40300548 (2-port)
 - b. TracJack Faceplate, six-port (dual gang), plastic, Fog White Part# OR-40300555 (6-port) (white blank inserts is required)
- E. Color-coded tabs for port designations.
 - 1. Part no.:
 - a. OR-40326200 (blue data)
 - b. OR-40325200 (green data)
 - c. OR-40309200 (white data)
- F. Blank insert for unused faceplate ports. Plastic.
 - 1. Color to match faceplate.
 - 2. Part no.: OR-42100002
- G. Single jack/wall telephone faceplate with stand-off studs to accommodate wall phone. Attaches to standard single gang flush-mounted outlet box. Stainless steel.
 - 1. Part no.: OR-403STJ1WP
- H. Two port surface mount box. Accommodates (2) inserts. Plastic. Provide blank for unused port.
 - 1. Part no.: OR-404TJ2
- I. Outlet frame for surface-mounted raceway. Fits in GFCI opening. Accommodates (3) inserts. Plastic. (as needed)
 - 1. Part no.: OR-41900017

2.7 MODULAR JACKS

- A. Manufacturer: Subject to compliance with requirements, provide the following:
 - 1. Ortronics; OR-TJ6A-88
 - 2. See Article 2.1 "General" above.
- B. Jacks shall be 8 position, 8-conductor (8P8C) non-keyed.
- C. Jacks shall be designed for 100-Ohm UTP cable termination.
- D. Jacks shall meet or exceed the transmission requirements of TIA Category 6A.
- E. Jacks shall be manufactured by an ISO 9001:2000 registered manufacture.

- F. Jacks shall be:
 - CENELEC EN 50173 compliant.
 - Nationally Registered Testing Laboratory (NRTL) VERIFIED for performance.
 - UL LISTED 1863 and CSA certified.
- G. Each jack shall be an individually constructed unit and shall snap-mount in an industry standard keystone opening (.760" x 580").
- H. Jack housings shall be high impact 94 V0 rated thermoplastic.
- I. Modular jack contacts shall be constructed of Beryllium copper for maximum spring force and resilience.
 - 1. Contact Plating shall be a minimum of 50-micro-inches of gold in the contact area over 50-micro-inches of nickel.
- J. Jacks shall terminate 22-26 AWG stranded or solid conductors.
- K. The interface between jack and station cable shall be insulation displacement type contact.
 - 1. Cable pairs shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
 - 2. Jacks shall be compatible with standard single conductor impact termination tools.
 - 3. Jacks shall be supplied with wire retention caps.
- L. Jacks shall have an operating temperature range of -10°C (14°F) to 60°C (140 °F).
- M. Jacks shall be pinned per TIA T568B pinning as follows:
 - Pair 1 - Pins 5 & 4
 - Pair 2 - Pins 1 & 2
 - Pair 3 - Pins 3 & 6
 - Pair 4 - Pins 7 & 8
- N. Jacks shall have an attached color-coded wiring instruction label as an aid to the installer.
- O. Jacks shall be available in a variety of colors for identification or designation of applications at the workstation or closet.
 - 1. Default Jack color shall be WHITE unless specified otherwise.
- P. Jacks shall have a designation indicating performance (e.g. "Category 6A", "Cat 6A" or "C6A") either on the front or rear of the connector, which may be visible from the front of the faceplate.
- Q. Jacks shall be compatible with TIA/EIA-606-B color code labeling and accept snap on icons for identification or designation of applications.

- R. Jacks shall be supplied with installed dust covers to protect the jack opening and internal elements during installation until the jack is in use.
 - 1. No damage to the Jack pinning shall result from insertion or removal of these covers.

2.8 NON-MODULAR PATCH PANEL – CATEGORY 6A

- A. Manufacturer: Subject to compliance with requirements, provide the following:
 - 1. Ortronics;
 - a. Category 6A (2U Patch Panel): OR-PHA6AU48
 - b. Category 6A (1U Patch Panel): OR-PHA6AU24
 - 2. See Article 2.1 "General" above.
- B. The Panels shall be designed for 100-Ohm UTP cable termination.
- C. The Panels shall meet or exceed the transmission requirements of TIA Category 6A.
- D. Jacks shall be manufactured by an ISO 9001:2000 registered manufacture.
- E. The Panels shall be:
 - Cenelec EN 50173 compliant.
 - UL VERIFIED for performance.
 - UL LISTED 1863 and CSA certified.
- F. Panels shall be rack mountable in standard CEA-310-E 19" equipment racks.
- G. Panels shall be made of black anodized aluminum.
 - 1. Panels shall be manufactured with a rolled-edge at the top and bottom for stiffness.
 - 2. Contact plating shall be a minimum 50-micro-inch gold plating on contact surfaces over 50-100 micro-inch of nickel compliant with FCC part 68.
- H. Panels shall be terminated in T568B wiring scheme.
- I. Panels shall be equipped with an IDC-type termination made of fire retardant UL 94V0 rated thermoplastic and tin, lead solder plated IDC.
 - 1. Panels shall terminate 22-26 AWG solid conductors, maximum insulated conductors.
 - 2. Panels shall provide wiring identification & color code and maintain a paired punch down sequence that does not require the overlapping of cable pairs.
- J. Panel circuit boards shall be fully enclosed front and rear for physical protection.

- K. Panels shall have port identification numbers on both the front and rear of the panel.
- L. Panels shall have rear cable support bar for strain relief, which shall clip to the rear of the patch panel.
 - 1. As an option, an external cable support bar may be used.
 - 2. The Panel and cable support hardware shall insure that the minimum bend radius requirements of the horizontal cabling are satisfied.
- M. The port identification numbers on the panel front shall be located so as to minimize obstruction by patch cords.
- N. The panel front shall have two raised panel identification label fields to accept 1/2' label inserts.
- O. Panels shall have self-adhesive, clear label holders and white designation labels provided with the panel for each 8-port adapter.

2.9 GROUNDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with TIA-607-C.

2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-B and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

2.11 HORIZONTAL CABLE MANAGEMENT SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Manufacturer: Ortronics
 - 2. Part No.:
 - a. OR-60400054 (4U Horizontal Cable Management)
 - b. OR-60400057 (2U Horizontal Cable Management)

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.

- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-C.1.
- C. Factory test UTP cables according to TIA/EIA-568-D.2.
- D. Factory test multimode optical fiber cables according to TIA-526-14-C and TIA/EIA-568-D.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

2.13 WIRELESS ACCESS POINT ENCLOSURE

- A. Confirm requirement for wall and/or ceiling-mounted WAP Enclosures with NYU IT, Enclosures or brackets shall satisfy mounting requirements for Cisco 3800 series WAPs.
- B. Intended by manufacturer to accommodate most standard wireless access point sizes.
- C. Wall- and Ceiling-mounted Enclosures. Refer to Project Drawings for requirements.
 - 1. Contractor shall make adjustments as necessary during construction to accommodate installation environment.
- D. Construction:
 - 1. Wall-mount – Steel; Ceiling-mount – Aluminum or Steel
 - 2. Vented
 - 3. Finish: durable powder coat; Color - Office White
 - 4. Continuous hinged door.
- E. Lockable door; keyed.
- F. Two 1" antenna openings 5" apart.
- G. Cable entry/exit:
 - 1. (4) 7/8" round knock-out openings on sides, top and bottom.
 - 2. (1) 1-3/8" knock-out on back.
- H. UL listed.
- I. Ceiling-mounted unit shall be rated for installation in a return-air plenum.

- J. Ceiling-mount unit shall mount above standard 24"x24" drop ceiling panel space.
- K. Manufacture(s) / Model(s): Enclosure for Wireless Access Points:
 - 1. Ceiling-mounted: Oberon. Check manufacturer for current model
 - a. CADDY 512HD Above-Ceiling WAP Mount Wireless AP
 - b. Oberon Recessed Ceiling WAP Install Kit 1043-CCOAP3800
 - c. Oberon Right-Angle WAP Mount with Universal T-bar Bracket and Locking Cover 1012-00 (in mechanical spaces)

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.2 WIRING METHODS

- A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters. Conceal pathways and cables except in unfinished spaces.
 - 1. Comply with requirements in Section 27 05 28 "Pathways for Communications Systems."
 - 2. Comply with requirements in Section 27 05 36 "Cable Trays for Communications Systems."
- B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures:
 - 1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
 - 2. Install lacing bars and distribution spools.
 - 3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-C.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Install 110-style IDC termination hardware unless otherwise indicated.
 4. MUTOA shall not be used as a cross-connect point.
 5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
 - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
 - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
 6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 7. 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.
 8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 9. 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. Install lacing bars and distribution spools.
 10. 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.
 11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 12. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
 13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:
1. Comply with TIA/EIA-568-C.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-C.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable 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.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.
- G. Outdoor Coaxial Cable Installation:
1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
 2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-D for separating unshielded copper voice and data 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 and 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.

3.4 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with TIA-607-C.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-C. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 1. Administration Class: 2
 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

- B. Using cable management system software specified in Part 2, develop Cabling Administration Drawings for system identification, testing, and management. Use unique, alphanumeric designation for each cable and label cable, jacks, connectors, and terminals to which it connects with same designation. At completion, cable and asset management software shall reflect as-built conditions.
- C. Comply with requirements in Section 099123 "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- D. Paint and label colors for equipment identification shall comply with TIA/EIA-606-C for Class 2 level of administration.
- E. Cable Schedule: Post in 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.
- F. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-C. Furnish electronic record of all drawings, in software and format selected by Owner.
- G. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- H. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-C.
 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 1. Visually inspect UTP and optical fiber cable 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-D.1.
 2. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper 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/EIA-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.
 5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-D.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 and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA-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-C.1.

6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-D.1 and TIA/EIA-568-C.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-C.1 and TIA/EIA-568-C.3.
8. Coaxial Cable Tests: Conduct tests according to Section 274133 "Master Antenna Television System."
9. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- B. Document data for each measurement. 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.
- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.8 WARRANTY

- A. Contractor shall provide a Manufacturer's Warranty covering all Copper and Fiber Optic Cabling and Connecting Components.
 1. Materials shall be covered for no-less than twenty (20) years from date of substantial completion of this work.

2. Labor and workmanship shall be covered for no-less than twenty (20) years from date of substantial completion of this work.
3. The Warranty on the Station Cabling and Components shall be a System Warranty and cover the Permanent Link (Communications Outlet to Patch Panel or Block) as defined by the referenced EIA/TIA documents.
4. This Warranty shall be direct from the manufacturer(s) of the cabling and connecting components to the Owner.

3.9 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets. Include training in cabling administration software.

END OF SECTION