

SECTION 271500 - COMMUNICATIONS HORIZONTAL CABLING

Latest Update: 05-22-2024 See underlined text for Edits.

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

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 and all other sections of Division 27.

1.2 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. 50/125 multimode and single-mode optical fiber cabling.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Telecommunications outlet/connectors.
6. Cabling system identification products.
7. Cable management system.

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.

- G. IDC: Insulation displacement connector.
- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.
- J. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- K. RCDD: Registered Communications Distribution Designer.
- L. Solid-Bottom or Non-ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
- M. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- N. UTP: Unshielded twisted pair.

1.4 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 "permanent link," a term that is used in the testing protocols.
 - 1. ANSI/TIA-568-C requires that a minimum of two (2) telecommunications outlet/connectors be installed for each work area.
 - 2. Transition points or consolidation points are not allowed 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 one hundred (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 two hundred ninety five (295) feet. This maximum allowable length does not include an allowance for patch cords at the workstation, and patch cords at the equipment room. System designer should plan for a combined cable length (horizontal cable length plus patch cord length) not to exceed three hundred twenty eight (328) feet.

1.5 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in ANSI/TIA-568-C, when tested according to test procedures of this standard.

1.6 SUBMITTALS

- A. Product Data: For each type of product specified in this section.
- B. Shop Drawings:
 - 1. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - 2. Cabling administration drawings and printouts.
 - 3. Wiring diagrams to show typical wiring schematics, including the following:
 - a. Cross-connects.
 - b. Patch panels.
 - c. Patch cords.
 - 4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - 5. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - a. Vertical and horizontal offsets and transitions.
 - b. Clearances for access above and to side of cable trays.
 - c. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - d. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 - 6. Provide layout drawings coordinated with receptacle locations shown.
 - 7. Provide test reports with corrective measures documented.
- C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector, and RCDD
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Maintenance Data: For splices and connectors to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff. RCDD, testers, and installers shall be certified by the manufacturer of the product being installed.
 - 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 RCDD, who shall be available at all times when Work of this Section is performed at Project site. A Level 2 Installer must 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.
- 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.
 - 1. Flame-Spread Index: Twenty five (25) or less.
 - 2. Smoke-Developed Index: Four hundred fifty (450) 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. Telecommunications Pathways and Spaces: Comply with latest version of TIA-569.
- E. Grounding: Comply with J-STD-607-A-2002 and all applicable sections of NFPA 70, NEC.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
 - 1. 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.
 - 2. Test each pair of UTP cable for open and short circuits.

1.9 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.

- B. Drywall, sanding, and all painting of all surfaces shall be completed before installing cable in equipment rooms.

1.10 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and cabling with UMB's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area, unless otherwise noted on telecommunications drawings to meet ADA requirements.

1.11 EXTRA MATERIALS

- 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 (1) of each type.
 - 2. Connecting Blocks: One (1) of each type.

1.12 WARRANTY/GUARANTEE

- A. See Division 26 Specification Section "Basic Electrical Requirements" for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with ANSI/EIA/TIA-569-B.
- B. Support of Open Cabling: NRTL labeled for support of Category 6a cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
 - 1. Velcro straps.
 - 2. J-hooks.
- C. Cable Trays:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Cable Management Solutions, Inc.
 - b. Chatsworth Products Inc.
 - c. Cablofil Inc.
 - d. Cooper B-Line, Inc.
 - e. Cope - Tyco/Allied Tube & Conduit.
 2. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by hot-dip galvanizing, complying with ASTM A 123/A 123M, Grade 0.55, not less than 0.002165 inch thick steel, steel wire mesh or aluminum.
 - a. Basket Cable Trays: [Six (6) inches wide and two (2) inches deep] <Insert dimensions>. Wire mesh spacing shall not exceed two (2) inches by four (4) inches.
 - b. Ladder Cable Trays: [nominally eighteen (18) inches] <Insert dimension> wide, and a rung spacing of nine (9) inches.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems.
1. Outlet boxes shall be no smaller than two (2) inches wide, four (4) inches high and two and one half (2-1/2) inches deep.
- ## 2.2 UTP CABLE
- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
1. Berk-Tek; a Nexans company.
 2. CommScope, Inc.
 3. Mohawk; a division of Belden CDT.
 4. Superior Essex Inc.
 5. General Cable Company.
 6. Siemon
- B. Description: 16-20 AWG, solid copper conductors, 100-ohm, 4-pair UTP, nominal impedance +/- 15%, green CMP Plenum jacket and complies with EIA/TIA 568-C Category 6a standard.
1. Comply with ICEA S-116-732 for mechanical properties.
 2. Comply with ANSI/TIA-568-C.2, Category 6a.
 3. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

- a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 1. Siemon Co.
 2. Ortronics Corp.
- B. General Requirements for Cable Connecting Hardware: Comply with ANSI/TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same manufacturer and of same category or higher.
- C. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 1. Number of Terminals per Field: One (1) for each conductor in assigned cables.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
- E. Number of Jacks per Field: One (1) for each two-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in [thirty six (36) inch] [eighty four (84) inch] lengths <Insert length>; terminated with eight-position modular plug at each end.
 1. Patch cords shall have bend-relief-compliant boots to ensure Category 6a performance. Patch cords shall have latch guards to protect against snagging.

2.4 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 1. Corning
 2. SYSTIMAX Solutions; a CommScope, Inc. brand.
 3. Optical Cable Corporation
 4. Mohawk

- B. Description: Multimode, 50/125-micrometer, 12-fiber, nonconductive, tight buffer, OM4, optical fiber cable. Single mode, 9/125-micrometer, 12-fiber, plenum-rated, optical fiber cable.
1. Comply with ICEA S-83-596 for mechanical properties.
 2. Comply with ANSI/TIA-568-C.3 for performance specifications.
 3. Comply with TIA/EIA-492AAAA-A for detailed specifications.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 5. Maximum Attenuation: 3.0dB/km at 850 nm; 1.0dB/km at 1300 nm for OM3 multimode, 1.0 dB/km at 1310 nm; 1.0 dB/km at 1550 nm for single mode.
 6. Minimum Modal Bandwidth: 3500 MHz-km at 850 nm; 4700 MHz-km at 1300 nm for OM4 multimode.
- C. Jacket:
1. Jacket Color: Aqua or violet for multimode and yellow for single mode.
 2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-C.
 3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.5 OPTICAL FIBER CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
1. Corning Cable Systems.
- B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.
1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.
- C. Patch Cords: Factory-made, dual-fiber cables in thirty six (36) inch lengths.
- D. Cable Connecting Hardware:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-10. Comply with ANSI/TIA-568-C.3
 2. Connectors: Quick-connect, duplex, Type LC, as manufactured for each cable type with insertion loss not more than 0.5 dB.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with ANSI/TIA-568-C.2 Category 6a.
- B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.
 - 1. Metal Faceplate: Stainless steel, complying with requirements in Division 26 Section "Wiring Devices."
 - 2. For use with snap-in jacks accommodating any combination of UTP, LC optical fiber, and work area patch cords.
 - a. Flush mounting jacks, positioning the cord (downward) at a 45-degree angle.
 - b. Flush mounting jacks, positioning the cord at a 90-degree angle for wall phones only.
 - 3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.7 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Comply with requirements of NFPA 70, NEC, National Electrical Code.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with ANSI/TIA/EIA-606-B and ANSI/UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.9 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to ANSI/TIA-568-C.2.
- B. Factory test UTP cables according to ANSI/TIA-568-C.2.
- C. Factory test multimode and single mode optical fiber cables according to and ANSI/TIA-568-C.2.
- D. Cable will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including all deficiencies and corrective measures.

PART 3 - EXECUTION

3.1 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools to comply with manufacturer's recommendations.

3.2 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and ANSI/TIA/EIA-569-B.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with ANSI/TIA/EIA-569-B for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install vertical and horizontal cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits three (3) inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with ninety six (96) inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CABLES

- A. Comply with NECA 1-2010, The Standard Practice of Good Workmanship in Electrical Construction, and BICSI TDMM.
- B. General Requirements for Cabling:
1. Comply with ANSI/TIA-568-C.2.
 2. Comply with BICSI ITSIMM, Ch 5 “Cable Installation”
 3. Install 110-style IDC termination hardware unless otherwise indicated. Terminate conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 4. Cables may not be spliced.
 5. Secure and support cables at intervals not exceeding thirty (30) inches and not more than six (6) inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 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 ITSIMM, "Cable Installation" Chapter. Install distribution spools.
 7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Do not allow un-terminated cable to lay on floor, prior to installation. Remove and discard cable if damaged prior to and/or during installation and replace it in its entirety with new cable.
 8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating. In the communications equipment room, install a ten (10) foot long service loop in the cable tray, on the backboard or on each end of cable.
 9. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Cable Installation." Monitor cable pull tensions and ensure manufacturer's specified tension limits are not exceeded.
- C. UTP Cable Installation:
1. Comply with ANSI/TIA-568-C.2.
 2. Do not untwist UTP cables more than one half (1/2) inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with ANSI/TIA-568-C.3.
 2. Cable must be terminated on connecting hardware that is rack 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 eight (8) inches above ceilings by cable supports not more than forty eight (48) inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, equipment, or other potentially damaging items.
- F. Conduit Installation:
1. Install conduit bushings at each end of conduit to avoid disturbing cable jacket. Provide pull string in spare conduits and label at both ends.
- G. 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 six (6) feet long not less than twelve (12) inches in diameter below each feed point.
- H. Group connecting hardware for cables into separate logical fields.
- I. Separation from EMI Sources:
1. Comply with BICSI TDMM and ANSI/TIA/EIA-569-B 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 five (5) inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of twelve (12) inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of thirty six (36) 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 two and one half (2-1/2) inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of six (6) inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of eighteen (18) inches.
 4. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

5. Separation between Communications Cables and Fluorescent Fixtures: A minimum of twelve (12) inches.

3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with ANSI/TIA/EIA-569-B, "Firestops."
- C. Comply with BICSI TDMM, "Firestop Systems" Chapter.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. Comply with J-STD-607-A-2002.
- C. Comply with NFPA 70-NEC.
- D. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least two (2) inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG green THHN/THWN insulated grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- E. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG green THHN/THWN insulated equipment grounding conductor.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with ANSI/TIA-606-B. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
 1. Administration Class: 3.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards.
- C. 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.

- D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of ANSI/TIA-606-B. Furnish electronic record of all drawings, in software and format selected by Owner.
- E. Cable and Wire Identification:
1. Label each cable within two (2) 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 required to be numbered at device and numbered within panel or cabinet.
 3. Label each terminal strip and screw terminal in each outlet jack, cabinet, rack, and 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. Identify with one label.
 - b. Label each unit and field within distribution racks and frames.
 - c. Each outlet shall have an identification code consisting of five (5) digits (six (6) if "LL" is used instead of "B"). The first digit shall indicate the floor of the building where the outlet is located. The letter "G" shall be used for the ground floor. One (1) for the first floor, etc. The letter "B" shall be used for basements, "S" for subbasement, "LL" for lower level, and "M" for mezzanine.
 - d. The second digit shall be the closet identifier. The letter "N" shall be used to indicate the north closet, the letter "S" shall be used to indicate the south closet, the letter "E" shall be used to indicate the east closet, and the letter "W" shall be used to indicate the west closet. If there is only one closet per floor, we use the letter "N."
 - e. The last three digits shall denote the number of the outlet. Outlet numbers one (1) through nine (9) shall be preceded with two zeros (e.g. 1N008). Outlet number ten (10) through ninety nine (99) shall be preceded with one zero (e.g. 1N028).
 - f. In the Telecommunications Room, data patch panels will be labeled with both the outlet # and the jack #. For instance for outlet # 1N028, the patch panel will read 1N028-D1, and 1N028-D2.
 - g. The color code for Communication Outlet Icons is as follows:
 - 1) Category 6a data jack "GREEN"
 - 2) 'LC' Fiber jack "RED"

4. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware.
- F. Labels shall be preprinted or computer-printed type with white printing area and black font color that complies with requirements in ANSI/TIA-606-B.
1. Labels on cables shall be flexible vinyl or polyester that flex as cables are bent.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

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 ANSI/TIA-568-C.2.
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 horizontal 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 and before cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in ANSI/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.
5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in ANSI/TIA-568-C. 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 horizontal link measurements: Test at 850 or 1300 nm in one (1) direction according to TIA/EIA-526-14-A, Method B, One (1) Reference Jumper.

- 2) Attenuation test results for horizontal links shall be less than 1.0 dB. Attenuation test results shall be less than that calculated according to equation in ANSI/TIA-568-C.
6. UTP Performance Tests:
 - a. Test for each outlet. Perform the following tests according to ANSI/TIA-568-C:
 - 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 ANSI/TIA-568-C.
 8. 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.
- C. 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.
 - D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports noting all deficiencies and corrective measures

END OF SECTION 271500