SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Pathways.
   2. UTP cable.
   3. Outside Plant Campus Cable
   5. Multi-mode laser optimized 50/125-micrometer, optical fiber cabling.
   6. Cable connecting hardware, protection blocks, patch panels, and cross-connects.
   7. Cabling identification products.

1.2 PERFORMANCE REQUIREMENTS


B. Quality Standards:
   1. For Telecommunications Pathways and Spaces: TIA-569-D.
   2. Grounding: TIA-607-C.

1.3 DEFINITIONS


C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

D. EMI: Electromagnetic interference.

E. IDC: Insulation displacement connector.

F. LAN: Local area network.


H. OSP: Outside Plant

I. RCDD: Registered Communications Distribution Designer.
1.4 BACKBONE CABLING DESCRIPTION

A. Backbone cabling system shall provide interconnections between telecommunications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.

B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.5 PERFORMANCE REQUIREMENTS

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

1.6 ACTION SUBMITTALS

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

1. For coaxial cable, include the following installation data for each type used:

   a. Nominal OD.
   b. Minimum bending radius.
   c. Maximum pulling tension.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by the Government.
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:

   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.

6. 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.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

D. Maintenance Data: For splices and connectors to include in maintenance manuals.

E. All test results shall be a required submittal to the Government.

F. Contractor shall submit qualifications of any required Independent Testing and Inspection Agent in advance for Government approval.

1.8 CLOSEOUT SUBMITTALS

A. Software and Firmware Operational Documentation:
   1. Software operating and upgrade manuals.
   2. Program Software Backup: On magnetic media or compact disk, complete with data files.
   3. Device address list.
   4. Printout of software application and graphic screens.

1.9 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.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
   1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, and field testing program development by an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, 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.

B. Testing Agency Qualifications: An NRTL.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

C. 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: 25 or less.
2. Smoke-Developed Index: 450 or less.

D. 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.

E. Telecommunications Pathways and Spaces: Comply with TIA-569-D.

F. Grounding: Comply with TIA-607-C.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cable to determine the continuity of the strand end to end. Use optical loss test set.
2. Test optical fiber cable while on reels. Use an optical time domain reflectometer to verify the cable length and locate cable defects, splices, and connector, including the loss value of each. Retain test data and include the record in maintenance data.
3. Test each pair of UTP cable for open and short circuits.

1.12 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.

1.13 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with the Government’s telecommunications and LAN equipment and service suppliers.
PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA-569-D.

B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
   1. Support brackets with cable tie slots for fastening cable ties to brackets.
   2. Lacing bars, spools, J-hooks, and D-rings.
   3. Straps and other devices.

C. Cable Trays: Comply with requirements in Section 27 05 36 “Cable Trays for Communications Systems.”

D. Conduit and Boxes: Comply with requirements in Section 26 05 33 “Raceway and Boxes for Electrical Systems.” Flexible metal conduit shall not be used.

2.2 BACKBONE CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. General Cable Technologies Corporation.
   2. CommScope, Inc.
   3. Mohawk; a division of Belden CDT.
   4. Superior Essex Inc.

B. Description: (Indoor) 100-ohm, multi-pair Category 5e UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket and overall metallic shield.
   1. Comply with ICEA S-90-661 for mechanical properties.
   2. Comply with TIA-568-C.1 for performance specifications.
   3. Comply with TIA-568-C.2, Category 5e.
   4. 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, General Purpose: Type CM or CMG; or MPP, CMP, MPR.
      b. Communications, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
      c. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
      d. Communications, Limited Purpose: Type CMX; or MPP, CMP, MPR, CMR, MP, MPG, CM, or CMG.
      e. Multipurpose: Type MP or MPG; or MPP or MPR.
      f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
      g. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.
C. Description: (Outside Plant Cable): Multi-pair shielded, 24 AWG, RUS/REA PE-89 type cable with 25-pair binder groups. 100-ohm, UTP, as indicated on drawings. Solid annealed bare copper conductors with foamed polyolfin insulation. Cable core filled with dry block cable waterproofing compound. Flooding compound applied over the core and to all surfaces of the shield/armor. Black polyethylene jacket imprinted with footage marker at regular intervals.

1. Comply with ICEA 7CFR 390 for mechanical properties.

2.3 UTP BACKBONE CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Emerson Network Power.
3. Hubbell Premise Wiring.
4. Leviton Voice & Data Division.
5. Panduit Corp.
7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.

B. General Requirements for Cable Connecting Hardware: Comply with TIA-568-C.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. Building Entrance Protection Blocks (BEPB): RUS approved, UL497 listed with 110- style IDC output connectors. Provide blocks for the number of cables terminated on the block, as indicated on drawings. Provide integral with connector bodies, including plugs and jacks where indicated.

D. Protection Modules: Gas tube 380 V DC, 5-pin protector modules with heat coils.

E. Connecting Blocks: 110-style IDC for Category 5e. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

F. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

G. 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.

1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to suit specified expansion criteria.

H. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
I. Patch Cords: Factory-made, 4-pair cables in 48-inch lengths; terminated with 8-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
2. Patch cords shall have color-coded boots for circuit identification.

2.4 OPTICAL FIBER CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berk-Tek; a Nexans company.
2. CommScope, Inc.
3. Corning Cable Systems.
4. General Cable Technologies Corporation.
5. Mohawk; a division of Belden CDT.
6. Superior Essex Inc.

B. Description: (Indoor) Single-mode, 8.3-micrometer, nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492CAAA 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. General Purpose, Nonconductive: Type OFN or OFNG.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG.
   e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Conductive cable shall be steel armored type.
6. Maximum Attenuation: 0.4 dB/km at 1310 nm; .3 dB/km at 1550 nm.

C. Jacket:

1. Jacket Color: Yellow for 8.3 micron single mode cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

D. Description: (Indoor) Multimode, 50/125-micrometer, nonconductive, tight buffer, optical fiber cable.

1. Comply with ICEA S-83-596 for mechanical properties.
2. Comply with TIA-568-C.3 for performance specifications.
3. Comply with TIA-492AAAA-B 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. General Purpose, Nonconductive: Type OFN or OFNG.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG.
   e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.
5. Conductive cable shall be steel armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 1500 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

E. Jacket:
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-C.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

F. Description: (Outside plant campus cable): Single-mode, 8.3-micron, loose tube, optical fiber cable.
1. Comply with ICEA S-87-640 Fiber Optic Outside Plant Communications Cable.
2. Comply with TIA-568-C.3 for performance specifications.
4. Jelly filled core.
6. Cable cordage jacket, fiber, unit, and group color shall be according to TIA-598-B.
7. Maximum Attenuation: .4dB/km at 1310 nm; .3 dB/km at 1550 nm.
8. 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 of the following:
1. Ortronics
2. Berk-Tek; a Nexans company.
3. Corning Cable Systems.
4. Hubbell Premise Wiring.
5. Nordex/CDT; a subsidiary of Belden.
6. Panduit
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. Cable Connecting Hardware:
   1. Multimode cable terminations shall be Ultra Physical Contact (UPC) connectors and Singlemode cable terminations shall be Angled Physical Contact (APC) connectors.
   3. Fusion splice cables with factory polished duplex, Type SC-LC connectors. Insertion loss not more than 0.3 dB.
   4. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.6 GROUNDING
A. Comply with requirements in Section 27 05 26 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
B. Comply with TIA-607-C.

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

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

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

3.2 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 Section 26 05 33 "Raceway and Boxes for Electrical Systems."
B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
C. Wiring within Enclosures: Bundle, lace, and train cables within enclosures. Connect to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 INSTALLATION OF PATHWAYS
A. Cable Trays: Comply with NEMA VE 2 and TIA-569-D.
B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 27 11 00 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
C. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
D. Comply with requirements in Section 26 05 33 "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 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 4 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.4 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:
   1. Comply with TIA-568-C.1 and TIA-568-C.3.
   2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
   3. Install 110-style IDC termination hardware unless otherwise indicated.
   4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
   5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
   6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
   7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Use lacing bars and distribution spools.
   8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
  11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:
   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:
   2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.

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

F. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-D recommendations 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:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 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:
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 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.

3.5 FIRESTOPPING

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter and Section 27 05 26 “Grounding and Bonding for Communications Systems.

B. Comply with TIA-607-C.

C. Bond metallic equipment, conduit, cable tray, ladder rack, structural steel, entrance conduits, cable shields, primary and secondary surge protectors to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
3.7 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-C. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

1. Administration Class: 2.
   2. Color-code cross-connect fields and apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA-606-C for Class 2 level of administration including optional identification requirements of this standard.

C. Comply with requirements in Section 27 15 00 "Communications Horizontal Cabling" for cable and asset management software.

D. Cable Schedule: Install in a prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

E. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, and entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors.

F. 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 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.
G. 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 606-C, for the following:

1. Cables use flexible vinyl or polyester that flexes as cables are bent.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Visually inspect UTP and optical fiber jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test UTP 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-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.

4. Optical Fiber Cable Tests:

   a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

   b. Tests for Single Mode Cabling:

      1) OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 66 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in
accordance with TIA-526-7 for single-mode fiber. Splice losses shall not exceed 0.3 db.

2) Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using 1310 and 1550 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with TIA-526-7 for single-mode fiber optic cables. The measurement method shall be in accordance with TIA-455-78-B. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber.

D. Data for each measurement shall be documented. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

E. Remove and replace cabling where test results indicate that they do not comply with specified requirements.

F. End-to-end cabling will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

END OF SECTION 27 13 00