SECTION 27 13 00 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 and Division 27 Specification Sections, apply to this Section.

B. Refer to appendices at the following hyperlink: https://www.pdx.edu/technology/telecom-infrastructure-wiring-standards

1.2 SUMMARY

A. Section Includes:
1. Pathways.
2. UTP cable.
3. Single-Mode optical fiber cabling.
4. Cable connecting hardware, patch panels, and cross-connects.
5. Cabling identification products.

1.3 DEFINITIONS

A. See 270500, Common Work Results for Communications.

1.4 BACKBONE CABLING DESCRIPTION

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

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

1.5 PERFORMANCE REQUIREMENTS

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

1.6 ACTION SUBMITTALS

A. Comply with submittal requirements in Section 270500, Common Work Results for Communications.

B. Shop Drawings. comply with 270500, Common Work Results for Communications and in addition:
1. Wiring diagrams to show typical wiring schematics including the following:
   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.
2. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
3. 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 CLOSEOUT SUBMITTALS

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

B. Software and Firmware Operational Documentation per Closeout Submittals in Section 270500, Common Work Results for Communications.

1.8 QUALITY ASSURANCE

A. Comply with requirements of Quality Assurance in 270500.

B. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

C. Grounding: Comply with ANSI-J-STD-607-A.

1.9 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.

PART 2 - PRODUCTS

2.1 UTP CABLE

A. Copy this article and re-edit for each product.

B. Products: Subject to compliance with requirements, provide the following:
1. Legrand, LLC.

C. Description: 100-ohm, multi-pair UTP, formed into 25-pair binder groups covered with a gray thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-C.1 for performance specifications.
3. Comply with TIA/EIA-568-C.2, for Category 3, Category 5e, Category 6, and Category 6A performance.
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, Plenum Rated: Type CMP or MPP, complying with NFPA 262.
b. Communications, Riser Rated: Type CMR; or MPP, CMP, or MPR, complying with UL 1666.
c. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
d. Multipurpose, Riser Rated: Type MPR or MPP, complying with UL 1666.

2.2 UTP CABLE HARDWARE

A. Products: Subject to compliance with requirements, provide the following:
1. Legrand, LLC

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-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. 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. Contractor shall contact PSU Telecom before ordering and terminating connector blocks. There may be variation in needs specific to each project.

D. 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.

E. Multi-pair 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. General specifications: Construct patch panel of high strength steel with black powder finish and design for wall or 19-inch rack mounting. Panels shall be available in 24-port and 48-port configurations, with height of 1 RU of 44.5 millimeters (1.75 inches) for each group of 24 ports. Patch panel shall be UL listed and ULC certified. Unit shall accommodate vertical and horizontal cord organizers available to facilitate patch cord management.
      a. Provide 8-pin RJ-45 modular patch jacks on the front of the panel and 50-pin female patch connections on the back.
      b. Optional - Provide 8- RJ-45 pin modular patch jacks on the front of the panel and 50-pin female patch connections on the back, with 2 pairs terminated on each 8-pin patch outlet. Pair 1 is terminated on pins 1 and 2; pair 2 is terminated on pins 3 and 6, which provides one 50-pin connector serving 12 patch outlets.
   2. Comply with following standards:
      a. ISO/IEC 11801
      b. CENELEC EN-50173
      c. UL, ULC, and ACMA
   3. Application standards: Support application standards specified for related cabling.
   4. Jacks: Comply with jack requirements specified for related cable category.
   5. BAS applications: Comply with specifications for related cabling.
   6. Performance specifications: Comply with specifications for related cabling.

F. Category 3 Multipair Connectors and Cable Assemblies:
   1. General specifications: Category 3 multipair connectors and cable assemblies consist of 25-pair category 3 multipair cables connectorized with either one or two category 3 multipair connectors. Category 5 multipair connectors shall be compatible with industry standard 25-pair Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals. connectors while providing keyed category 3 connections with equipment using this feature. In addition, the connector design using crosstalk reduction techniques shall provide a 6 decibel margin to assure category 3 performance throughout systems that use multiple connectors. See following component requirements:
      a. Category 3 multipair cables: Comply with specifications in Category 3 Multipair Solutions.
      b. Category 3 multipair connectors:
         1) Comply with specifications above in Category 3 Multipair Solutions.

2.3 OPTICAL FIBER CABLE

A. Products: Subject to compliance with requirements, provide the following:
   1. Corning, Inc.

B. Description: Single mode 8.3/125-mircrometer, optical fiber cable.
   1. Comply with ICEA S-83-596 for mechanical properties.
   2. General Single mode Specifications: Cables shall be designed for point-to-point applications as well as mid-span access, and shall provide a high-level of protection for optical fiber installed in building environment and OSP applications:
      a. Higher optical fiber count cables shall utilize a sub-unitized design with color-coded subunits for easy identification.
      b. Single-mode optical fibers shall be 8.3 micrometers and use standard colored tight-buffered construction.
      c. The single-mode optical fiber shall be dispersion-unshifted optical fiber that meets ITU-T G.652c requirements.
      d. Cable shall provide optimum performance over entire wavelength range from 1260 to 1625 nanometers.
      e. Cable shall also support existing and legacy single mode applications that traditionally operate in 1310 and 1550 nanometer regions.

f. Cable shall deliver a cost-effective upgrade path by expanding available wavelengths by 50 percent supporting 16 channels of coarse wave division multiplexing (CWDM) on a single optical fiber and up to 400 channels of dense wave division multiplexing (DWDM) on a single cable.

3. Basis of Design Specification for Single mode: Legrand, LLCsingle mode optical fiber.

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, or OFNR, OFNP.
   b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
   c. Riser Rated, Nonconductive: Type OFNR or OFNP, complying with UL 1666.
   d. General Purpose, Conductive: Type OFC or OFCG; or OFNG, OFN, OFCR, OFNR, OFCP, or OFNP.
   e. Plenum Rated, Conductive: Type OFCP or OFNP, complying with NFPA 262.
   f. Riser Rated, Conductive: Type OFCR; or OFNR, OFCP, or OFNP, complying with UL 1666.

5. Conductive cable shall be steel armored type for OSP loose tube metallic sheath and aluminum armored type for indoor armored type optical fiber cables.

6. Performance:
   a. Multimode Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
   b. Multimode Minimum Modal Bandwidth: 2000 MHz-km at 850 nm; 500 MHz-km at 1300 nm.
   c. Single mode

7. Comply with following cable construction specifications by cable type:
   a. Indoor armored:
      1) Interlocking armor spiraling around premises distribution cable, with an overall sheath jacket to provide additional protection and security
      2) Available with Riser or Plenum-rated outer jacket
   b. OSP loose tube dielectric:
      1) Design: Dielectric design with MDPE sheath jacket and no metallic elements to provide environmental protection.
      2) Buffer tubes and optical fibers:
         a) Industry standard buffer tubes stranded around a central strength member and compatible with standard hardware, cable routing, and fan-out kits
         b) Optical fibers shall be industry-standard color coded and separated into 12-fiber color-coded binder groups surrounded by plastic core tubes
      3) Water blocking: Dry water-blocking compound suitable for underground conduit, direct burial, and aerial applications
   c. OSP loose tube metallic sheath:
      1) Design:
         a) Metallic sheath design with MDPE sheath jacket to provide environmental protection
         b) Metallic armor of corrugated polymer coated steel tape to provide added crush protection
         c) Armor shall meet Telcordia requirements for superior armored cable.
      2) Buffer tubes and optical fibers:
         a) Industry standard buffer tubes stranded around a central strength member and compatible with standard hardware, cable routing, and fan-out kits.
         b) Optical fibers shall be industry-standard color coded and separated into 12-fiber color-coded binder groups surrounded by plastic core tubes.
      3) Water blocking: Dry water-blocking compound suitable for underground conduit, direct burial, and aerial applications.
   d. Indoor/outdoor tight-buffered:
      1) Design: Dielectric design with fluoropolymer thermoplastic outer sheath jacket and no metallic elements to provide petrochemical resistance, flame propagation, and reduced smoke generation properties
      2) Optical fiber identification:
         a) Optical fibers shall be industry-standard color coded
         b) Water blocking: Dry water-blocking compound shall be suitable for underground conduit, direct burial, and aerial applications. Cable shall not contain gel, filling or flooding compound, grease or other flammable water blocking fluids. The aramid yarns shall be specially prepared with an agent that shall provide waterproof attribute of cable.
   e. Indoor/outdoor loose tube:
      1) Design: Dielectric design with fluoropolymer thermoplastic outer sheath jacket and no metallic elements to provide petrochemical resistance, flame propagation, and reduced smoke generation properties
      2) Buffer tubes and optical fibers:

a) Industry standard buffer tubes stranded around a central strength member for protection against thermal expansion and contraction at operational temperature extremes
b) Compatible with standard hardware, cable routing, and fan-out kits
c) Optical fibers shall be industry-standard color coded and separated into 12-fiber color-coded binder groups surrounded by plastic core tubes.

3) Water blocking: Dry water-blocking compound shall be suitable for underground conduit, direct burial, and aerial applications.

f. OSP central tube dielectric:
1) Design: Dielectric design with medium-density polyethylene (MDPE) sheath jacket with longitudinal polyester ripcords and no metallic elements to provide environmental protection.
2) Buffer tubes and optical fibers:
a) Central tube of polybutylene terephthalate (PBT) material, containing all optical fibers, with 2 dielectric longitudinal outer strength members extending length of cable and industry-standard color coding.
3) Water blocking: Water-blocking compound shall be suitable for underground conduit, direct burial, and aerial applications.

g. OSP central tube metallic sheath:
1) Design:
a) Metallic sheath design with MDPE sheath jacket to provide environmental protection
b) Metallic armor of corrugated polymer coated steel tape to provide added crush protection

h. Buffer tubes and optical fibers: Central tube of PBT material, containing all optical fibers, with 2 metallic longitudinal outer strength members extending length of cable and industry-standard color coding.

i. Water blocking: Water-blocking compound shall be suitable for underground conduit, direct burial, and aerial applications.

C. Jacket:
1. Jacket Color: Aqua for 50/125-micrometer Listed cables installed within buildings.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.4 OPTICAL FIBER CABLE HARDWARE

A. Products: Subject to compliance with requirements, provide the following:
1. Legrand, LLC

B. Cross-Connects and Patch Panels/Internal Sliding Shelf: Modular panels housing multiple-numbered, duplex cable connectors for multimode and single mode optical fiber cable.
1. General specifications: Panel shelves shall be used for combination of splicing and termination of optical fiber building cable or OSP cables. Shelf shall be designed for use as termination shelf only (direct connector termination) or as splice and termination shelf. Fiber splice and termination capacities shall be as specified in this section.
2. Optical fiber connector panel specifications: Provide connector types in simplex or duplex configurations. Panels shall accommodate 50 micrometer multimode, 62.5 micrometer multimode, and single mode optical fiber cabling. Comply with following specifications:
a. Pre-populated panels with factory-installed adapters:
1) Duplex: 6 or 12 adapters accommodating LC
2) Simplex: 6 or 12 adapters accommodating LC
b. Pre-terminated modules with pigtails: 12 LC adapters for all optical fiber cable types:
1) LC modules shall contain 12 pigtails with colorized 0.9 millimeters tight-buffered cordages, following color sequence as defined by TIA standard.
3. Optical fiber termination module specifications: Modules shall support LC connectors and accommodate 50 micrometer multimode, 62.5 micrometer multimode, and single mode optical fiber cabling. Modules shall be either unterminated or equipped with pigtails ready for splicing. Provide interchangeable multimedia outlet bezels where specified to accommodate 4 outlets for M-series jacks for multimedia applications. Configurations shall be as follows:
a. Unterminated modules: 12 LC adapters for all optical fiber cable types
b. Pre-terminated modules with pigtails: 12 LC adapters for all optical fiber cable types:
1) LC modules shall contain 12 pigtails with colorized 0.9 millimeters tight-buffered cordages, following color sequence as defined by TIA standard.

2) SC and ST modules shall contain 6 pigtails with colorized 0.9 millimeters tight-buffered cordages, with following color sequence:
   a) Type A: blue, orange, green, brown, slate, and white
   b) Type B: red, black, yellow, violet, rose, and aqua
3) Physical specifications:
   a) Ready™ 1U Internal Sliding Shelf, black 1U, 2U and 4U Configurations.

C. Optical Fiber Patch Cords: Factory-made, duplex-fiber cables.
1. General Specifications: To maintain channel integrity, optical fiber patch cords and pigtails shall be fabricated to meet the performance parameters corresponding to the optical fiber cable approved product type specified below. Patch cord and pigtail plug connectors shall be equipped with boots, and shall have same colors as related optical fiber backbone cables, unless specified or indicated otherwise. Optical fiber patch cords and pigtails shall be available with the following options as specified or indicated:
   a) Termination types: LC.
   b) Connector/cable configuration: duplex.
   c) Listing rating: Riser, unless traveling through a plenum air space, then Plenum.
   d) Patch cord outside diameters: 1.6 millimeters (0.063 inches) and 3.0 millimeters (0.118 inches).
   e) Pigtails: Ruggedized and tight-buffered optical fiber—0.9 millimeters (0.035 inches) outside diameter.
   f) Lengths: As specified or indicated. Assume 3 meter if not specified otherwise.

D. Cable Connecting Hardware: Optical fiber connector types shall be provided in patch panels, patch cords, and workstation outlets for termination of optical fiber cables. Connectors shall be compatible with 50 micrometer multimode and single mode optical fiber cables. Connector colors shall be specified or selected by PSU's Representative from manufacturer's standard colors.:
1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-C.3.
2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.5 GROUNDING

A. Comply with requirements in Section 270526 "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.

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

2.6 IDENTIFICATION PRODUCTS

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

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 and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
1. Install plenum cable in environmental air spaces, including plenum ceilings.

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

H. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A 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:
   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 270500, Common Work Results for Communications.

B. Comply with TIA/EIA-569-A, 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 ANSI-J-STD-607-A.

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. Distances over 66-feet required a 3/0 conductor.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.6 IDENTIFICATION

A. Comply with requirements in specification 270500, Common Work Results for Communication.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. 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/EIA-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/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.
4. Optical Fiber Cable Tests:
5. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-C.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

a. 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/EIA-526-14-A, Method B, One Reference Jumper.
   2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-C.1.

C. 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.

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

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

F. Prepare test and inspection reports.

END OF SECTION 271300