

SECTION 27 13 23
COMMUNICATIONS BACKBONE ISP FIBER OPTIC CABLING
Construction Specification

PART 1 GENERAL

1.1 Summary

- A. Section Includes: Backbone ISP (indoor) fiber optic cabling.
- B. Related Sections
 - 1. Comply with the Related Sections paragraph of Section 270000.
 - 2. 270821 Communication Fiber Optic Testing
 - 3. 272323 Communication Backbone OSP Fiber Optic Cabling

1.2 References

- A. Comply with References requirements of Section 270000.
- B. In addition to the codes and standards listed in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. National Fire Protection Agency (NFPA)
 - a. NFPA 262, "Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces", 2007
 - 2. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
 - a. UL 1569, "Metal-Clad Cables"
 - b. UL 1651, "Optical Fiber Cable"
 - c. UL 1666, "Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts"
 - 3. Insulated Cable Engineers Association (ICEA)
 - a. ANSI/ICEA S-83-596-1994, "Fiber Optic Premises Distribution Cable"
 - b. ANSI/ICEA S-87-640-1999, "Fiber Optic Outside Plant Communications Cable"
 - c. ANSI/ICEA S-104-696-2001, "Indoor-Outdoor Optical Cable"
 - 4. Telcordia
 - a. GR-409-CORE, Issue 2, "Generic Requirements for Indoor Fiber Optic Cable"

1.3 Definitions

- A. Refer to Section 270000 for Definitions.
- B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:

1. "MM": Multimode [fiber type]
2. "OFCP": Optical Fiber Conductive Plenum, plenum rating
3. "OFCR": Optical Fiber Conductive Riser, non-plenum riser rating
4. "OFNP": Optical Fiber Non-conductive Plenum, plenum rating
5. "OFNR": Optical Fiber Non-conductive Riser, non-plenum riser rating
6. "OFN": Optical Fiber Non-conductive, general purpose indoor rating
7. "PVC": PolyVinyl Chloride
8. "SM": Singlemode [fiber type]

1.4 System Description

A. Work Covered Under Other Sections

1. Pathways: The communications pathways (backbone conduits, riser sleeves, basketway, cable tray, etc.) work will be covered under another Section. Refer to the drawings for size/capacity and route information.
2. Rooms: Build out (e.g., backboards, overhead and vertical cable support, etc.) of the telecommunications rooms will be covered under another Section. Refer to the drawings for build out information.

B. Base Bid Work

1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications backbone fiber optic cabling system installation described in these specifications and shown on related drawings.
2. The drawings are diagrammatic in nature, and require shop drawings to complete the detailed design of the telecommunications infrastructure.
3. Consider Backbone cabling, as shown on drawings, as base bid work, unless otherwise noted, including terminations at both ends.
4. In general, the base bid work includes:
 - a. Submittals
 - b. Backbone inside plant (riser) fiber optic cables and terminations
 - c. Bonding (cable armor, termination apparatus, etc.)
 - d. Innerduct
 - e. Cable management
 - f. Crossconnections / patching
 - g. Cable identification tags and system labeling
 - h. Record Documents
 - i. Warranty

1.5 Submittals

- A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.
- B. Submittal Requirements Prior To Start Of Construction:
 - 1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.
 - 2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.
 - 3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations
- C. Submittal Requirements at Closeout:
 - 1. Copy of the manufacturer's printed reel documentation, including the following.
 - a. Manufacturer's reel number
 - b. Manufacturer's traceable batch number
 - c. Length of the fiber cable on the reel
 - d. Maximum attenuation
 - e. Minimum bandwidth
 - 2. As-Built Drawings
 - 3. Crossconnection records/cut sheets
 - 4. O&M Manuals
- D. Substitutions
 - 1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 Quality Assurance

- A. Comply with Quality Assurance requirements of Section 270000.
- B. Contractor Qualifications
 - 1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.7 Delivery, Storage, and Handling

- A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 Warranty

- A. The backbone fiber optic cabling system, as specified in this section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor

for the duration of the extended warranty. This extended warranty shall also cover optical performance of cabling system.

PART 2 PRODUCTS

2.1 Manufacturers

- A. Corning Cable Systems (no other substitutions allowed)

2.2 Fiber Optic Cable – Plenum Rated

A. Application:

1. Cable shall be suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in basketway, cable tray, conduit, and/or hangers).
2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.

B. Multimode OM4 fiber strands shall meet or exceed the following geometry criteria:

1. Core diameter = 50 μm , $\pm 3.0 \mu\text{m}$
2. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
3. Core/Cladding Concentricity = $\leq 3 \mu\text{m}$
4. Minimum Tensile Strength = 100,000 psi

C. Multimode OM4 fiber strands shall meet or exceed the following performance criteria:

1. Attenuation = 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm wavelengths, maximum
2. Overfilled Bandwidth = 1,500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
3. Effective Modal Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum

D. Singlemode fiber strands shall meet or exceed the following geometry criteria:

1. Core diameter = 8.3 μm
2. Mode field diameter = 8.8 μm , $\pm 0.5 \mu\text{m}$
3. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
4. Core/Cladding Concentricity = $\leq 0.8 \mu\text{m}$
5. Minimum Tensile Strength = 100,000 psi
6. The fiber shall meet the specifications of ITU-T G.652.D as classification for LWP singlemode fiber.

E. Singlemode fiber strands shall meet or exceed the following performance criteria:

1. Attenuation = 0.7 dB/km at 1310 nm and 0.7 dB/km at 1550 nm wavelengths, maximum

2. Cutoff wavelength = 1260 nm
3. Dispersion = 3.5 ps/nm•km at 1285-1330 nm and 18 ps/nm•km at 1550 nm
4. Singlemode fiber shall meet the specifications of the following:
 - a. International Telecommunication Union (ITU) ITU-T G.652.D classification for low water peak (LWP) singlemode fiber
 - b. International Electrotechnical Commission (IEC) 60793-2-50 "Sectional Specification for Class B single-mode fibers", Class B1.3

F. Primary Coating:

1. Each fiber shall be completely covered with a "primary coating" (acrylate material).
2. Coating diameter = 250 μm , $\pm 5 \mu\text{m}$

G. Buffering:

1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900 μm , $\pm 5 \mu\text{m}$. Material = PVC, or equivalent flame retardant thermoplastic.
2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)

H. Cable Sheath:

1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).
2. Outer Jacket: The cable shall have a seamless outer jacket (material = LS-PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).
3. Tensile Strength: The cable shall have a 150-lb, minimum, rated load.
4. Flame Rating: NEC (Article 770) rated as OFNP, and UL listed as such.

I. Manufacturers:

1. Corning Cable Systems

2.3 Fiber Optic Cable – Non-Plenum Rated

A. Application:

1. Cable shall be suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in basketway, cable tray, conduit, and/or hangers).
2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.

B. Multimode OM4 fiber strands shall meet or exceed the following geometry criteria:

1. Core diameter = 50 μm , $\pm 3.0 \mu\text{m}$

2. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
 3. Core/Cladding Concentricity = $\leq 3 \mu\text{m}$
 4. Minimum Tensile Strength = 100,000 psi
- C. Multimode OM4 fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm wavelengths, maximum
 2. Overfilled Bandwidth = 1,500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
 3. Effective Modal Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
- D. Singlemode fiber strands shall meet or exceed the following geometry criteria:
1. Core diameter = 8.3 μm
 2. Mode field diameter = 8.8 μm , $\pm 0.5 \mu\text{m}$
 3. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
 4. Core/Cladding Concentricity = $\leq 0.8 \mu\text{m}$
 5. Minimum Tensile Strength = 100,000 psi
- E. Singlemode fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 0.7 dB/km at 1310 nm and 0.7 dB/km at 1550 nm wavelengths, maximum
 2. Cutoff wavelength = 1260 nm
 3. Dispersion = 3.5 ps/nm•km at 1285-1330 nm and 18 ps/nm•km at 1550 nm
 4. Singlemode fiber shall meet the specifications of the following:
 - a. International Telecommunication Union (ITU) ITU-T G.652.D classification for low water peak (LWP) singlemode fiber
 - b. International Electrotechnical Commission (IEC) 60793-2-50 "Sectional Specification for Class B single-mode fibers", Class B1.3
- F. Primary Coating:
1. Each fiber shall be completely covered with a "primary coating" (acrylate material).
 2. Coating diameter = 250 μm , $\pm 5 \mu\text{m}$
- G. Buffering:
1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900 μm , $\pm 5 \mu\text{m}$. Material = PVC, or equivalent flame retardant thermoplastic.
 2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)

H. Cable Sheath:

1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).
2. Outer Jacket: The cable shall have a seamless outer jacket (material = PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).
3. Tensile Strength: The cable shall have a 150-lb, minimum, rated load.
4. Flame Rating: NEC (Article 770) rated as OFNR cable, and UL listed as such.

I. Manufacturers:

1. Corning Cable Systems

2.4 Fiber Optic Cable – Interlocked Armor Plenum Rated

A. Application:

1. Cable shall be suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in basketway, cable tray, conduit, and/or hangers).
2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.

B. Multimode OM4 fiber strands shall meet or exceed the following geometry criteria:

1. Core diameter = 50 μm , $\pm 3.0 \mu\text{m}$
2. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
3. Core/Cladding Concentricity = $\leq 3 \mu\text{m}$
4. Minimum Tensile Strength = 100,000 psi

C. Multimode OM4 fiber strands shall meet or exceed the following performance criteria:

1. Attenuation = 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm wavelengths, maximum
2. Overfilled Bandwidth = 1,500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
3. Effective Modal Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum

D. Singlemode fiber strands shall meet or exceed the following geometry criteria:

1. Core diameter = 8.3 μm
2. Mode field diameter = 8.8 μm , $\pm 0.5 \mu\text{m}$
3. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
4. Core/Cladding Concentricity = $\leq 0.8 \mu\text{m}$

5. Minimum Tensile Strength = 100,000 psi
- E. Singlemode fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 0.7 dB/km at 1310 nm and 0.7 dB/km at 1550 nm wavelengths, maximum
 2. Cutoff wavelength = 1260 nm
 3. Dispersion = 3.5 ps/nm•km at 1285-1330 nm and 18 ps/nm•km at 1550 nm
 4. Singlemode fiber shall meet the specifications of the following:
 - a. International Telecommunication Union (ITU) ITU-T G.652.D classification for low water peak (LWP) singlemode fiber
 - b. International Electrotechnical Commission (IEC) 60793-2-50 "Sectional Specification for Class B single-mode fibers", Class B1.3
- F. Primary Coating:
1. Each fiber shall be completely covered with a "primary coating" (acrylate material).
 2. Coating diameter = 250 μm , $\pm 5 \mu\text{m}$
- G. Buffering:
1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900 μm , $\pm 5 \mu\text{m}$. Material = PVC, or equivalent flame retardant thermoplastic.
 2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)
- H. Cable Sheath:
1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).
 2. Inner Jacket: The cable shall have a seamless inner jacket (material = PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).
 3. Armor: The cable shall have an interlocking metallic armor applied spirally and longitudinally to and completely covering the cable.
 4. Outer Jacket: The cable shall have a seamless outer jacket (material = PVC, or equivalent) applied to and completely covering the armor.
 5. Tensile Strength: The cable shall have a 150-lb, minimum, rated load.
 6. Flame Rating: NEC (Article 770) rated as OFCP, and UL listed as such.
- I. Manufacturer:
1. Corning Cable Systems
- 2.5 Fiber Optic Cable – Interlocked Armor Non-Plenum Rated
- A. Application:

1. Cable shall be suitable for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in basketway, cable tray, conduit, and/or hangers).
 2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.
 3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.
- B. Multimode OM4 fiber strands shall meet or exceed the following geometry criteria:
1. Core diameter = 50 μm , $\pm 3.0 \mu\text{m}$
 2. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
 3. Core/Cladding Concentricity = $\leq 3 \mu\text{m}$
 4. Minimum Tensile Strength = 100,000 psi
- C. Multimode OM4 fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm wavelengths, maximum
 2. Overfilled Bandwidth = 1,500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
 3. Effective Modal Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum
- D. Singlemode fiber strands shall meet or exceed the following geometry criteria:
1. Core diameter = 8.3 μm
 2. Mode field diameter = 8.8 μm , $\pm 0.5 \mu\text{m}$
 3. Cladding diameter = 125 μm , $\pm 1.0 \mu\text{m}$
 4. Core/Cladding Concentricity = $\leq 0.8 \mu\text{m}$
 5. Minimum Tensile Strength = 100,000 psi
- E. Singlemode fiber strands shall meet or exceed the following performance criteria:
1. Attenuation = 0.7 dB/km at 1310 nm and 0.7 dB/km at 1550 nm wavelengths, maximum
 2. Cutoff wavelength = 1260 nm
 3. Dispersion = 3.5 ps/nm•km at 1285-1330 nm and 18 ps/nm•km at 1550 nm
 4. Singlemode fiber shall meet the specifications of the following:
 - a. International Telecommunication Union (ITU) ITU-T G.652.D classification for low water peak (LWP) singlemode fiber
 - b. International Electrotechnical Commission (IEC) 60793-2-50 "Sectional Specification for Class B single-mode fibers", Class B1.3
- F. Primary Coating:

1. Each fiber shall be completely covered with a “primary coating” (acrylate material).
 2. Coating diameter = 250 μm , $\pm 5 \mu\text{m}$
- G. Buffering:
1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900 μm , $\pm 5 \mu\text{m}$. Material = PVC, or equivalent flame retardant thermoplastic.
 2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)
- H. Cable Sheath:
1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).
 2. Inner Jacket: The cable shall have a seamless inner jacket (material = PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).
 3. Armor: The cable shall have an interlocking metallic armor applied spirally and longitudinally to and completely covering the cable.
 4. Outer Jacket: The cable shall have a seamless outer jacket (material = PVC, or equivalent) applied to and completely covering the armor.
 5. Tensile Strength: The cable shall have a 150-lb, minimum, rated load.
 6. Flame Rating: NEC (Article 770) rated as OFCR, and UL listed as such.
- I. Manufacturer:
1. Corning Cable Systems
- 2.6 Fiber Optic Patch Cords
- A. Application
1. Fiber optic patch cords shall be suitable for indoor installation within a telecommunications room within and/or between fiber patch panels.
 2. Cord shall be assembled from a single, continuous length of cordage, homogenous in nature; Splices are not permitted.
- B. Cordage – Multimode OM4
1. Conductors: Two 50/125 μm multimode tight-buffered fibers.
 2. Strength Element: Aramid yarn (Kevlar).
 3. Jacket: Flame-retardant PVC, or equivalent, in a ‘zipcord’ configuration.
 4. NEC rated as OFN (or higher), and UL listed as such.
- C. Cordage – Singlemode
1. Conductors: Two singlemode tight-buffered fibers.
 2. Strength Element: Aramid yarn (Kevlar).

3. Jacket: Flame-retardant PVC, or equivalent, in a 'zipcord' configuration.
4. NEC rated as OFN (or higher), and UL listed as such.

D. Connectors

1. Multimode OM4 patch cords shall be either terminated via duplex LC connectors at both ends or terminated via duplex LC connectors to connect with the cable plant and via the connector type as required for connection to equipment.
2. Singlemode patch cords shall be either terminated via duplex LC Ultra PC connectors at both ends or terminated via duplex LC-UPC connectors to connect with the cable plant and via the connector type as required for connection to equipment

E. Connector Loss

1. Multimode: $\leq 0.5\text{dB}$ per mated pair at both 850nm and 1300nm.
2. Singlemode: 0.5dB per mated pair at both 1310nm and 1550nm.

F. Manufacturer:

1. Corning Cable Systems

2.7 Termination Apparatus – Fiber Optic Patch Panels

A. Application:

1. Fiber optic patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cable(s) and fiber strands, shall provide means to strain relieve and support of the specified cables, shall contain facilities to store fiber slack, and shall provide patch cord management.
2. Fiber optic patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting, and cross-connecting fiber optic cabling, shall possess a minimum fire resistant rating of UL94V-1, and shall conform to existing OSHA Health and Safety Laws.
3. Fiber optic patch panels shall be <rack-mountable><wall-mountable>.

B. Fiber optic patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.

C. Manufacturer:

1. Corning Cable Systems
 - a. #CCH-04U; "Connector Closet Housings" type patch panel, 4U, 12 adapter modules
 - b. #CCH-03U; "Connector Closet Housings" type patch panel, 3U, 6 adapter modules
 - c. #CCH-02U; "Connector Closet Housings" type patch panel, 2U, 4 adapter modules
 - d. #CCH-01U; "Connector Closet Housings" type patch panel, 1U, 2 adapter modules
 - e. #CCH-CP12-E4; Adapter Module e/w 6 duplex MM LC aqua adapters

- f. #CCH-CP12-A8; Adapter Module e/w 6 duplex MM LC beige adapters
- g. #CCH-CP12-A9; Adapter Module e/w 6 duplex SM LC blue adapters

2.8 Fiber Optic Connectors

A. Multimode Fiber Optic Connectors – LC Type

- 1. Materials:
 - a. Ferrule: ceramic (zirconia or alumina) with pre-radiused finish/face
 - b. Connector housing: plastic
- 2. Connector shall have an integral strain relief feature, including a bend limiting rear boot.
- 3. Connector shall be installable via either epoxy or anaerobic method.
- 4. Manufacturer:
 - a. Corning Cable Systems
- 5. # 95-051-98-SP-X; LC type connector, ceramic ferrule, for MM OM4, aqua boot

B. Singlemode Fiber Optic Connectors – LC Type

- 1. Materials:
 - a. Ferrule: ceramic (zirconia or alumina) with pre-radiused finish/face.
 - b. Connector housing: plastic.
- 2. Connector shall meet or exceed Ultra PC performance (LC-UPC).
- 3. Connector shall have an integral strain relief feature, including a bend limiting rear boot.
- 4. Connector shall be installable via either epoxy or anaerobic method.
- 5. Manufacturer:
 - a. Corning Cable Systems
- 6. # 95-200-99; LC type connector, SM, zirconia ceramic, blue boot, for 0.9 mm buffered fiber

2.9 Corning Cable Systems

- 1. #95-201-98-SP; LC type connector, ceramic ferrule, SM

2.10 Labels

- A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.
- B. Labels for Cables
 - 1. Labels shall be adhesive-backed and have a self-laminating feature
 - 2. Labels shall fit the backbone cables listed above (i.e., shall fully wrap around the cable's jacket).

3. Printable area should be 1-inch wide x 0.5 inch high, or larger
4. Printable area color shall be white
5. Manufacturer:
 - a. Panduit
 - 1) #S200X225YAJ; labels cables 0.24" (6.06mm) - 0.48" (12.13mm) dia.
 - 2) #S200X400YAJ; labels for cables 0.32" (8.09mm) - 0.95" (24.26mm) dia.
 - 3) #S200X650YAJ; labels for cables 0.48" (12.13mm) - 1.59" (40.43mm) dia.
 - b. Or equal

2.11 Miscellaneous

- A. Fiber Slack Storage Reel: Leviton #48900-OFR, or equal
- B. Velcro Cable Ties
 1. Width: .75".
 2. Color: Velcro cable ties the same color as the cable to which it is being applied.
 3. Manufacturers:
 - a. Panduit
 - 1) #HLS-15R-0 Black, 15' roll, cut to length.
 - b. Or equal

PART 3 EXECUTION

3.1 General

- A. Comply with Execution requirements of Section 270000.

3.2 Examination and Preparation

- A. Pathways: Prior to installation verify pathways (conduits, etc.) and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).
- B. Rooms: Prior to installation, verify equipment rooms are ready for cables and terminations.
- C. Prior to installation, verify cables and conductors are fully operational – both cable sheath and fiber strands. Pre-installation testing is the responsibility of the Contractor, though documentation of pre-installation testing is not a close out requirement.

3.3 Installation

- A. Backbone Cable Installation, Routing, and Termination
 1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.

2. Do not exceed 500 meters optical conductor length from the termination within the Entrance Facility to the termination in IDF.
3. Placement
 - a. Place cables within designated pathways. Place ISP cables in innerduct between points of termination throughout entire length (except at the fiber take up reel).
 - b. Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation.
 - c. Maintain pulling tension within manufacturer's limits.
 - d. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.
 - e. Do not use cable-pulling compounds for indoor installations.
 - f. Provide 20 to 30 feet of cable slack at each end within the Telecommunications Rooms; store slack in fiber slack storage reel mounted on the wall.
 - g. Place a pull rope along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull rope.
4. Routing
 - a. Within Telecommunications Rooms, neatly dress and organize cables on designated cable support apparatus (for example, overhead and vertical cable support), and fasten cables to cable support apparatus via tie wraps or Velcro-type straps.
5. Termination
 - a. Properly relieve strain from cables at termination points (at/within the fiber optic termination panels) per manufacturer's instructions.
 - b. Bond cable armor to grounding point (busbar) – refer to section 270526 for additional information.
 - c. Terminate fiber strands via direct connectorization at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Splicing type shall be fusion; mechanical splicing will not be accepted. Perform terminations in accordance with manufacturer's instructions.
 - d. Provide required accessories and consumables for the complete termination of fiber strands.
 - e. Provide 3 feet of unsheathed fiber (tight buffer) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the 'routing rings', per manufacturer's instructions.

B. Fiber Optic Cable Termination Panel

1. Provide fully assembled termination panel in designated equipment rack; locate per drawings (if not shown, locate at the top). "Fully assembled" includes installation and

mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.

2. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.
3. Bond termination apparatus to grounding point (busbar) – refer to section 270526 for additional information.

3.4 Labeling

A. General Requirements

1. Labeling, identifier assignment, and the label colors shall conform to the TIA/EIA-606-A Administration Standard and as approved by Owner or Owner's Representative before installation.
2. Provide permanent and machine generated labels; hand written labels will not be accepted.

B. Cable Labels

1. Label Format:
 - a. Label type shall be wrap-around self-laminating.
 - b. Label color shall be white background with clear laminating window.
 - c. Text color shall be black; text height shall be 1/8" high, minimum, or #12 font size.
2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

C. Termination Apparatus Labels

1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.
2. Label color shall be white for respective field type, per TIA/EIA-606-A.
3. Text color shall be black, 3/32" high, minimum, or #10 font size.

D. Identifier Assignment

1. General: Separate all label fields of the identifier with a hyphen.
2. Backbone ISP Fiber Optic Cables
 - a. First field shall identify the originating termination room identifier as shown on the plans; for example, "B01-TDA".
 - b. Second field shall identify the ending termination room identifier as shown on the plans; for example, "B01-TDB".
 - c. Third field shall identify the type and number of strands; for example, "Mxxx" where "M" stands for multimode or "S" for singlemode and xxx stands for the ending fiber strand sequential count.

d. Example: "B01-TDA– B01-TDB–M025-M036"

3. Termination Positions at the Termination Panels

a. First field of the identifier shall be the destination room; for example, "TO B01-TDB".

b. Second field of the identifier shall be the strand count range; for example, "M025-M036"

c. Identifier Example: "TO B01-TDB M025-M048".

3.5 Final Inspection and Certification

- A. Punch the Work of this Section compliant to the requirements of Section 270000.
- B. Remove and replace with new, at no additional cost, cables with conductors failing to meet the indicated standards and not passing the testing requirements of Section 270821. The Owner, or Owner's Representative, will not accept the installation until testing has indicated a 100% availability of cables and conductors or the Owner or Owner's Representative has approved in writing any deviation from this requirement.
- C. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION