SECTION 27 13 24
COMMUNICATIONS BACKBONE OSP FIBER OPTIC CABLING
Construction Specification

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Backbone outside plant (OSP) fiber optic cabling
2. Outside plant innerduct
3. Conduit and innerduct plugs

B. Related Sections

1. Comply with the Related Sections paragraph of Section 270000
2. 270821 Communication Fiber Optic Testing
3. 271323 Communication Backbone ISP 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. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:
   a. UL 1651, “Optical Fiber Cable”
2. Insulated Cable Engineers Association (ICEA)
   a. ANSI/ICEA S-87-640-1999, “Fiber Optic Outside Plant Communications Cable”
3. Telcordia
   a. GR-20-CORE, Issue 3, “Generic Requirements for Optical Fiber and Optical Fiber 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. “HDPE”: High Density Polyethylene
2. “LDPE”: Light Density Polyethylene

3. “MDPE”: Medium Density Polyethylene
4. “MM”: Multimode [fiber type]
5. “OSP”: Outside Plant [cabling]
6. “PE”: Polyethylene
7. “SM”: Singlemode [fiber type]

1.4 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections

1. Pathways: The communications pathways (underground conduits, maintenance holes, pull boxes, innerducts, pull ropes, 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 rooms (MDF, BDFs, IDFs) 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 this Section 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 outside plant (OSP) fiber optic cables and terminations
    c. Innerduct
    d. Cable management
    e. Crossconnections / patching.
    f. Cable identification tags and system labeling
    g. Record Documents
    h. 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. Sample Submittal, consisting of the following components:

a. Cable label

3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.

4. 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

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 communications 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 OUTSIDE PLANT INNERDUCT – “CORRUGATED”

A. Description: Continuous thermoplastic corrugated pipe with a low-friction internal surface

B. Application: Outside plant innerduct shall be suitable for outdoor installations within an underground pathways system (conduits, maintenance holes, etc.) for the purpose of sub-ducting the pathways and to support communications cables.

C. Material and Fabrication: Innerduct shall be continuous extruded (no welds or joints) HDPE (thermoplastic polymer conforming to PE334470E/C as defined in ASTM D3350), containing stabilization additives for protection against thermal and UV degradation throughout the projected lifespan of the finished product. Innerduct shall be packed coiled on a reel.

D. Standards: Innerduct shall be manufactured to meet (or exceed) the requirements of ASTM F2160, ASTM D2239, ASTM D3035, NEMA TC-7, and UL 651B.

E. Innerduct shall contain a pre-installed pulling tape or rope; minimum pull tension rating of 1,000 pounds.

F. Colors: orange, black, blue, and yellow.

G. Manufacturers:

1. A-D Technologies
2. Carlon (including Pyramid)
3. Endot
4. Or equal

2.3 FIBER OPTIC CABLE – UNDERGROUND DIELECTRIC

A. Application:

1. Cable shall be suitable for outdoor installations within underground pathways system and/or within innerduct/sub-ducting.
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 μm.
2. Cladding diameter = 125 μm, $\pm$1.0 μm.
3. Core/Cladding Concentricity = $\leq$ 3 μm.

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 = 500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum.

3. Laser 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, ±0.5 μm.

3. Cladding diameter = 125 μm, ±1.0 μm.

4. Core/Cladding Concentricity = ≤ 0.8 μm.

5. Minimum Tensile Strength = 100,000 psi.

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

1. Attenuation = 0.4 dB/km at 1310 nm and 0.3 dB/km at 1550 nm wavelengths, maximum.

2. Cutoff wavelength = 1260 nm.

3. Dispersion = 3.5 ps/nm•km at 1285-1330 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. Buffering:

1. Fibers shall be loosely buffered, either in a core tube or in multiple tubes around a central member.

2. Buffer tube/tubes shall be filled with compound to protect against moisture penetration. Filling compound: “FLEXGEL”, or equivalent.

3. Each buffer tube shall be color-coded for identification, and shall meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, reference ANSI/ICEA Publication S-80-576, and EIA-230).

G. Sheath:

1. Sheath shall consist of a strength member and an outer jacket, with non-metallic component dielectric sheath.

2. Strength Member: Aramid yarn (e.g., Kevlar®), or reinforced fiberglass rods.

3. Jacket: PE (MDPE or HDPE).

4. Rated tensile load: 600 lb. maximum rated load.

5. Operating Temperature Range: -40 to 158°F (-40 to 70°C)

H. Manufacturer:

1. Corning Cable Systems

2.4 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 Housing” type patch panel, 4U, holds 12 adapter modules

b. #CCH-03U; “Connector Closet Housing” type patch panel, 3U, holds 6 adapter modules

c. #CCH-02U; “Connector Closet Housing” type patch panel, 2U, holds 4 adapter modules

d. #CCH-01U; “Connector Closet Housing” type patch panel, 1U, holds 2 adapter modules

e. #WCH-02P; “Wall-Mount Closet Housing” type patch panel, holds 2 adapter modules

f. #WCH-04P; “Wall-Mount Closet Housing” type patch panel, holds 2 adapter modules

g. #CCH-CP12-E4; Adapter Module e/w 6 duplex MM LC aqua adapters

h. #CCH-CP12-A8; Adapter Module e/w 6 duplex MM LC beige adapters

i. #CCH-CP12-A9; Adapter Module e/w 6 duplex SM LC blue adapters

2.5 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

1. #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 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

1. #95-200-99; LC type connector, ceramic ferrule, SM

2.6 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

2.7 DUCT PLUGS

A. Application: Duct plugs suitable for installation into duct ends within underground structures (vaults, manholes, pull boxes, maintenance holes) for sealing ducts against water ingress and for securing innerducts and cables against recoil.

B. Manufacturers:

1. Carlon

a. #MAEPG2; blank plug for 1-inch duct (0.96”-1.16”)

b. #MAEPG4; blank plug for 1-1/4-inch duct (1.14”-1.48”)

c. #MAEPG3; blank plug for 1-1/2-inch duct (1.149”-1.83”)

d. #MAEPG5; blank plug for 2-inch duct (1.83”-2.36”)

e. #MAEPG55; blank plug for 3-inch duct (2.99”-3.46”)

f. #MAEPG7; blank plug for 4-inch duct (3.94”-4.33”)

g. #MATPG2; “triplex” duct plug for 4-inch conduit (3.92”-4.21”), with 3 ports (1.31”-1.42”)

h. #MATPG3; “triplex” duct plug for 4-inch conduit (3.92”-4.21”), with 3 ports (1.53”-1.67”)

i. #MAQPG2; “quadplex” duct plug for 4-inch conduit (3.92”-4.21”), with 4 ports (1.19”-1.36”)

j. #MAQPG4; “quadplex” duct plug for 4-inch conduit (4.16”-4.34”), with 4 ports (1.19”-1.36”)

k. #MAFPG2; cable duct plug for 1-inch conduit (1.00”-1.10”), 1 cable (0.35”-0.57”)

l. #MAFPG21; cable duct plug for 1-inch conduit (1.00”-1.10”), 1 cable (0.43”-0.57”)

m. #MAFPG22; cable duct plug for 1-inch conduit (1.00”-1.10”), 1 cable (0.57”-0.70”)

n. #MAFPG3; cable duct plug for 1-1/4-inch conduit (1.22”-1.36”), 1 cable (0.35”-0.57”)

o. #MAFPG4; cable duct plug for 1-1/4-inch conduit (1.22”-1.36”), 1 cable (0.57”-0.70”)

p. #MAFPG41; cable duct plug for 1-1/4-inch conduit (1.22”-1.34”), 1 cable (0.70”-0.90”)

q. #MAFPG5; cable duct plug for 1-1/2-inch conduit (1.50”-1.65”), 1 cable (0.35”-0.57”)

r. #MAFPG6; cable duct plug for 1-1/2-inch conduit (1.50”-1.65”), 1 cable (0.50”-0.70”)

s. #MAFPG9; cable duct plug for 2-inch conduit (1.98”-2.15”), 1 cable (0.35”-0.57”)

2. Tyco

a. #542288 (JM-BLA-07D100U); blank plug for 0.7-inch duct (0.71”-0.83”)

b. #298182 (JM-BLA-10D104U); blank plug for 1-inch duct (0.96”-1.16”)

c. #187308 (JM-BLA-12D148U); blank plug for 1-1/4-inch duct (1.14”-1.48”)

d. #036620 (JM-BLA-15D183U); blank plug for 1-1/2-inch duct (1.49”-1.83”)

e. #923104 (JM-BLA-20D236U); blank plug for 2-inch duct (1.83”-2.36”)

f. #162754 (JM-BLA-30D346U); blank plug for 3-inch duct (2.99”-3.46”)

g. #377850 (JM-BLA-40D402U); blank plug for 4-inch duct (3.94”-4.17”)

h. #40B167S; “triplex” duct plug for 4-inch conduit with 3 ports

i. #40Q136S; “quadplex’ duct plug for 4-inch conduit with 4 ports

j. #187308 (JM-BLA-12D148U); blank plug for 1.25-inch duct (1.14”-1.48”)

k. #10S035S; simplex/port plug for 1 cable in 1-inch (ID) port

l. #11S057SB; “simplex” duct plug for 1¼-inch (ID) port

3. Condux International, Inc

4. Or equal

2.8 MISCELLANEOUS

A. Breakout Kits

1. Application: for loose buffer cables, kit to furcate coated fibers from buffer tube in preparation for “direct connectorization” type termination.

2. Manufacturer:

a. Corning Cable Systems

1. #FAN-BT25-06; “Buffer Tube Fan-Out Kit”, for 6 fibers/tube, 25” tubing

2. #FAN-BT36-06; “Buffer Tube Fan-Out Kit”, for 6 fibers/tube, 36” tubing
3. #FAN-BT47-06; “Buffer Tube Fan-Out Kit”, for 6 fibers/tube, 47” tubing
4. #FAN-BT25-12; “Buffer Tube Fan-Out Kit”, for 12 fibers/tube, 25” tubing
5. #FAN-BT36-12; “Buffer Tube Fan-Out Kit”, for 12 fibers/tube, 36” tubing
6. #FAN-BT47-12; “Buffer Tube Fan-Out Kit”, for 12 fibers/tube, 47” tubing

b. SYSTIMAX

1. #760 018 820; breakout kit for 6 strands per tube
2. #760 018 838; breakout kit for 12 strands per tube

c. Or equal

B. Fiber Slack Storage Reel: Leviton #48900-OFR, or equal

C. Velcro Cable Ties

1. Width: .75”.
2. Color: Velcro cable ties, 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 the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Pathways: Prior to installation verify that duct banks, ducts, maintenance holes, pullboxes, 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. Innerduct

1. Place innerducts per duct simultaneously (all at the same time).
2. Place innerducts using a pulling harness with a pulling swivel.
3. Leave approximately 24 inches of innerduct slack at each end.

B. Backbone Cable Installation and Routing

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere, unless expressly shown on the Drawings or approved in writing by the Engineer prior to installation.
2. Do not exceed 1,500 meters optical conductor length from the termination from the MDF to the termination in IDF.
3. Placement
    a. Install cables within designated pathways. Place OSP 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. Use a pulling tension meter when using mechanical assistance during installation. Record maximum pulling tension for each cable run, and submit to the Engineer for review if requested. Replace runs when manufacturer’s maximum pulling tension is exceeded.
    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. Only use UL approved cable-pulling compounds when necessary to reduce pulling tensions.
    f. Provide 20 to 30 feet (minimum) cable slack at each end within the Telecommunications Rooms; store slack in the overhead cable support.
    g. Place a pull rope along with cables where run in pathways (e.g., conduit) and spare capacity in the pathway remains. Tie off ends of the pull rope.
4. Routing
    a. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via tie wraps or Velcro-type straps.
    b. Within Telecommunications Rooms, neatly dress and organize cables on designated cable support apparatus (for example, overhead cable tray or vertical cable runway), 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. Provide breakout kits to furcate fibers from buffer tubes.

c. Terminate/connectorize fiber strands at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Perform terminations in accordance with manufacturer's instructions.

d. Provide required accessories and consumables for complete termination of fiber strands.

e. Provide 3 feet of unsheathed fiber (including buffer tube and broken out from the buffer tube) 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.

C. 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.

D. Duct Plugs

1. Provide duct plugs at each duct end and each innerduct end. Duct plug type shall match application (blank, quadplex, etc.).

2. In ducts, provide blank duct plugs in each unused duct and triplex/quadplex duct plugs in each duct with innerduct.

3. In corrugated innerducts, provide blank plugs in each unused.

4. Provide simplex plugs in each innerduct containing a cable to seal innerducts around cables.

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 brown 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 OSP 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, “B02-TDA”.

c. Third field shall identify the type and number of strands; for example, “Sxxx” where “S” stands for singlemode and xxx stands for the ending fiber strand sequential count.

d. Example: “B01-TDA– B01-TDB–S025-S036”

3. Termination Positions at the Termination Panels

a. The first field of the identifier shall be the fiber strand count; e.g., “0025-0048”.

b. The second field of the identifier shall be cable’s other end room; e.g., “FROM B01-TDA”.

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 cost to the Owner, cables or 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 all cables and conductors or the Owner or Owner’s Representative has approved any deviation from this requirement.

C. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION