SECTION 33 82 23

OPTICAL FIBER COMMUNICATIONS TRANSMISSION AND DISTRIBUTION CABLING

[Specifier Notes] – This document uses hidden text to guide the specifier through various options while editing the document. Hidden text may be turned on two ways: with the “Show/Hide” symbol “¶” in the ribbon; or selecting “File” above the ribbon at the top left, then “Options” at the very lower left, then “Display” on the left side of the menu pop-up, and then check the box next to “Hidden Text.”

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1. GENERAL
	1. SECTION INCLUDES
		1. Optical Fiber for Composite, Loose Tube, Ribbon, and Tight Buffered Cables.
		2. Outdoor Loose Tube Optical Fiber Cables.
		3. Outdoor Loose Tube Optical Fiber Cables with Embedded Sheath Tear Features.
	2. RELATED SECTIONS

[Specifier Notes]: Remove sections not required under project scope of work.

* + 1. Section 27 11 16 - Communications Cabinets, Racks, Frames and Enclosures.
		2. Section 27 13 23 - Communications Optical Fiber Backbone Cabling.
		3. Section 27 13 23 13 - Communications Optical Fiber Splicing and Terminations.
		4. Section 33 82 23 - Optical Fiber Communications Distribution Cabling.
	1. SUBMITTALS
		1. Submit in accordance with requirements of Section 01 30 00 - Administrative Requirements.
		2. Submittals for Initial Selection:
			1. Product Data: Manufacturer's technical data sheets, specifications, performance data and installation instructions for all products referenced in the scope of work defined in this section.
			2. Shop Drawings: Submit shop drawings required to depict the requirements for fabrication and installation. Include the following drawings as applicable:
				1. Proposed riser and horizontal cabling diagram.
				2. Overlay of system components on floor plans.
			3. Sample Warranty Information:
				1. Submit confirmation and details of manufacturer’s warranty, extended warranty, and replacement policies.
		3. Closeout submittals
			1. Maintenance Contracts.
			2. Operation and Maintenance Data.
			3. Preventative Maintenance Instructions.
			4. Final Site Survey.
			5. Warranties for all manufactured components specified in this section.
	2. QUALITY ASSURANCE
		1. Manufacturer Qualifications: Minimum 25 years in business manufactured at a facility in the United States.
		2. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of optical fiber.
	3. DELIVERY STORAGE AND HANDLING
		1. Deliver, store and handle materials and products in accordance with the manufacturer's instructions and recommendations and industry standards.
		2. Store all materials in the manufacturer’s original packaging until ready for installation. Protect all products from damage or exposure to adverse environmental conditions, including weather, humidity, and dust.
	4. Project Conditions
		1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.
	5. Warranty
		1. Manufacturer’s Warranty: Manufacturer agrees to replace or refund the purchase price of products that fail from defects in material and workmanship within the specified warranty period.
			1. Warranty Period: One (1) year from date of Substantial Completion.
		2. Manufacturer’s Extended Warranty: Manufacturer agrees to replace or refund the purchase price of products that are installed by a manufacturer-certified installer that fail from defects in material and workmanship within the specified warranty period.
			1. Warranty Period: Twenty-five (25) years from date of Substantial Completion.
1. PRODUCTS
	1. MANUFACTURERS

[Specifier Notes] – Retain the following Paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + 1. Basis of Design Manufacturer: Corning Optical Communications LLC.
			1. Address: 4200 Corning Place; Charlotte, NC 28216.
			2. Toll Free Phone: (800)743-2675.
			3. Phone: (828)901-5000.
			4. Fax: (828)325-5060.
			5. Website: [www.corning.com/opcomm](https://www.corning.com/opcomm)
			6. Email: ccsamericas@corning.com.

[Specifier Notes] – Retain the following Paragraph if this document is written as a PERFORMANCE specification, without listing a manufacturer as a basis of design. Insert manufacturers that sell products comparable to those specified in this section. Delete if not required.

* + 1. Manufacturer List:
			1. Manufacturer:
		2. Substitution Limitations:
			1. Submit substitution requests in accordance with provisions of Section 01 60 00.
			2. Single manufacturer will provide, from a single source, optical fiber and accessories.
	1. PERFORMANCE REQUIREMENTS
		1. Cabling System Requirements:
			1. General Requirements: Provide cabling system able to support interconnections to active telecommunications equipment for voice and data applications in a multi-vendor, multi product environment.
			2. Structured cabling system should adhere to the following:
				1. General: Provide cabling system in compliance with ANSI/TIA-568-D.
				2. Pathways: Provide cabling system for pathways and spaces in compliance with ANSI/TIA-569-C.
				3. Labelling: Provide cabling system labelled in compliance with ANSI/TIA-606-B.
				4. Grounding and Bonding: Provide cabling system grounded and bonded in accordance with ANSI/TIA-607-C.
				5. Color Coding: Provide cabling system color coded in compliance with ANSI/TIA-598-C.
				6. Data Centers: Provide cabling system in compliance with ANSI/TIA-942-B.
	2. Optical Fiber for Composite, Loose Tube, Ribbon, and Tight Buffered cables
		1. General Requirements: Provide optical fiber consisting of germania-doped silica core surrounded by a concentric glass cladding in accordance with the following requirements and compatible with the cable types specified below.
			1. Surface Imperfections: None.
			2. Protective Coating: Manufacturer’s standard dual layer acrylate in contact with the cladding surface.
			3. Proof Test: Minimum 100 kpsi (0.7 GN/m2).

[Specifier Notes] – Retain one or more of the following Paragraphs to suit project requirements.

* + 1. Single Mode (Dispersion Un-shifted).
			1. Specifications:
				1. TIA/EIA 492-CAAB.
				2. ITU G.652 (Categories A, B, C, and D).
				3. IEC 60793-2-50, Type B1.3.
				4. Telecordia GR-20-CORE.
			2. Geometry Requirements:
				1. Cladding:

Diameter: 125.0±0.7 µm.

Non-Circularity: No more than 0.7 percent.

* + - * 1. Mode Field Diameter:

9.2±0.4 µm at 1310 nm.

10.4±0.5 µm at 1550 nm.

* + - * 1. Core-to-Cladding Concentricity: No more than 0.5 µm.
				2. Coating Diameter: 245±5 µm.
				3. Fiber Curl: Radius of curvature no less than 4.0 m.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

Between .35 and 0.40 dB/km at 1310 nm.

Between .35 and 0.40 dB/km at 1383 nm.

Between .22 and 0.30 dB/km at 1550 nm.

* + - * 1. Point Discontinuity: No more than 0.05 dB at 1310 nm and 1550 nm.
				2. IEEE 802.3z GbE Distance: Up to 5000 m at 1300 nm.
		1. Single Mode Non-Zero Dispersion-Shifted Fiber for Long-haul Telecommunications Applications
			1. Specifications:
				1. TIA/EIA 492-EA00.
				2. ITU G.655 Tables A, B, C, and D.
				3. IEC 60793-2-50, Type B4.
				4. Telecordia GR-20.
			2. Geometry Requirements:
				1. Cladding:

Diameter: 125.0±0.7 µm.

Non-Circularity: No more than 0.7 percent.

* + - * 1. Mode Field Diameter: 9.6±0.4 µm at 1550 nm.
				2. Core-to-Cladding Concentricity: No more than 0.5 µm.
				3. Coating Diameter: 245±5 µm.
				4. Fiber Curl: Radius of curvature no less than 4.0 m.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation: Less than .25 dB/km at 1550 nm.
				2. Point Discontinuity: No more than 0.05 dB at 1310 nm and 1550 nm.
		1. Single-Mode (Dispersion Un-shifted) Bend Improved Optical Fiber.
			1. Specifications:
				1. TIA/EIA-492CAAB.
				2. ITU-T G.652, Table D
				3. ITU-T G.657, Table A.
				4. IEC 60793-2-50, Type B1.3.
				5. Telcordia GR-20-CORE.
			2. Geometry Requirements:
				1. Cladding:

Diameter: Between 125.0±0.7 µm.

Non-Circularity: No more than 0.7 percent.

* + - * 1. Mode Field Diameter:

8.6±0.4 µm at 1310 nm.

9.8±0.5 µm at 1550 nm.

* + - * 1. Core-to-Cladding Concentricity: No more than 0.5 µm.
				2. Coating Diameter: 245±5 µm.
				3. Fiber Curl: Radius of curvature no less than 4.0 m.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 0.65 dB/km at 1310 nm.

No more than 0.65 dB/km at 1383±3 nm.

No more than 0.50 dB/km at 1550 nm.

* + - * 1. Point Discontinuity: No more than 0.05 dB at 1310 nm and 1550 nm.
				2. IEEE 802.3z GbE Distance: Up to 5000 m at 1300 nm.
		1. Single-Mode (Dispersion Un-shifted) Bend-Tolerant Optical Fiber.
			1. Specifications:
				1. ITU-T G.652, Table D.
				2. ITU-T G.657, Tables A2 and B2.
				3. IEC 60793-2-50, Type B1.3 and B6\_b.
				4. Telecordia GR-20-CORE.
			2. Geometry Requirements:
				1. Cladding:

Diameter: Between 125.0±0.7 µm.

Non-Circularity: No more than 0.7 percent.

* + - * 1. Mode Field Diameter:

8.6±0.4 µm at 1310 nm.

9.65±0.5 µm at 1550 nm.

* + - * 1. Core-to-Cladding Concentricity: No more than 0.5 µm.
				2. Coating Diameter: 245±5 µm.
				3. Fiber Curl: Radius of curvature no less than 4.0 m.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 0.65 dB/km at 1310 nm.

No more than 0.65 dB/km at 1383±3 nm.

No more than 0.50 dB/km at 1550 nm.

* + - * 1. Point Discontinuity: No more than 0.05 dB at 1310 nm and 1550 nm.
				2. IEEE 802.3z GbE Distance: Up to 5000 m at 1300 nm.
		1. Single-Mode (Dispersion Un-shifted) Bend Insensitive Optical Fiber.
			1. Specifications:
				1. ITU-T G.652, Table D.
				2. ITU-T G.657, Table B3.
			2. Geometry Requirements:
				1. Cladding:

Diameter: Between 125.0±0.7 µm.

Non-Circularity: No more than 0.7 percent.

* + - * 1. Mode Field Diameter:

8.6±0.4 µm at 1310 nm.

9.65±0.5 µm at 1550 nm.

* + - * 1. Core-to-Cladding Concentricity: No more than 0.5 µm.
				2. Coating Diameter: 245±5 µm.
				3. Fiber Curl: Radius of curvature no less than 4.0 m.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 0.65 dB/km at 1310 nm.

No more than 0.50 dB/km at 1550 nm.

* + - * 1. Point Discontinuity: No more than 0.05 dB at 1310 nm and 1550 nm.
		1. Single-Mode (Dispersion Un-shifted) Low Loss Optical Fiber.
			1. Specifications:
				1. ITU-T G.652, Tables A and B.
			2. Geometry Requirements:
				1. Cladding:

Diameter: Between 125.0±0.7 µm.

Non-Circularity: No more than 0.7 percent.

* + - * 1. Mode Field Diameter:

9.2±0.4 µm at 1310 nm.

10.5±0.5 µm at 1550 nm.

* + - * 1. Core-to-Cladding Concentricity: No more than 0.5 µm.
				2. Coating Diameter: 245±5 µm.
				3. Fiber Curl: Radius of curvature no less than 4.0 m.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

Between 0.32 and 0.34 dB/km at 1310 nm.

Between 0.18 and 0.20 dB/km at 1550 nm.

* + - * 1. Point Discontinuity: No more than 0.05 dB at 1310 nm and 1550 nm.
		1. Single-Mode (Dispersion Un-shifted) Low Loss and Bend Improved Optical Fiber.
			1. Specifications:
				1. ITU-T G.652, Tables A, B, C, and D.
				2. ITU-T G.657, Table A1
			2. Geometry Requirements:
				1. Cladding:

Diameter: Between 125.0±0.7 µm.

Non-Circularity: No more than 0.7 percent.

* + - * 1. Mode Field Diameter:

9.2±0.4 µm at 1310 nm.

10.4±0.5 µm at 1550 nm.

* + - * 1. Core-to-Cladding Concentricity: No more than 0.5 µm.
				2. Coating Diameter: 245±5 µm.
				3. Fiber Curl: Radius of curvature no less than 4.0 m.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

Between 0.33 and 0.35 dB/km at 1310 nm.

Between 0.19 and 0.25 dB/km at 1550 nm.

* + - * 1. Point Discontinuity: No more than 0.05 dB at 1310 nm and 1550 nm.
		1. Multimode Standard 62.5/125 μm Fiber (OM1).
			1. Specifications:
				1. TIA/EIA-492AAAA-A-1997.
				2. IEC 60793-2-10.
			2. Geometry Requirements:
				1. Core:

Diameter: 62.5±2.5 µm.

Non-Circularity: No more than 5 percent.

* + - * 1. Cladding:

Diameter: 125±2 µm.

Non-Circularity: No more than 1 percent.

* + - * 1. Core-to-Cladding Concentricity: No more than 1.5 µm.
				2. Coating Diameter: Primary, Uncolored; 242±5 µm.
				3. Colored Fiber Nominal Diameter: Between 253 and 259 µm.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 2.8 dB/km at 850 nm.

No more than 1.0 dB/km at 1300 nm.

* + - * 1. Point Discontinuity: No more than 0.2 dB at 850 nm and 1300 nm.
				2. Cabled Effective Modal Bandwidth: No less than 220 MHz·km at 850 nm.
				3. IEEE 802.3z GbE Distance:

Up to 300 m at 850 nm.

Up to 550 m at 1300 nm.

* + - * 1. OFL Bandwidth:

No less than 200 MHz·km at 850 nm.

No less than 500 MHz·km at 1300 nm.

* + - * 1. Numerical Aperture: 0.275±0.015.
		1. Multimode Standard 50/125 μm Fiber – 150 (OM2).
			1. Specifications:
				1. TIA/EIA-492AAAB.
				2. IEC 60793-2-10.
			2. Geometry Requirements:
				1. Core:

Diameter: 50.0±2.5 µm.

Non-Circularity: No more than 5 percent.

* + - * 1. Cladding:

Diameter: 125±1 µm.

Non-Circularity: No more than 1 percent.

* + - * 1. Core-to-Cladding Concentricity: No more than 1.5 µm.
				2. Coating Diameter: Primary, Uncolored; 242±5 µm.
				3. Colored Fiber Nominal Diameter: Between 253 and 259 µm.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 3.4 dB/km at 850 nm.

No more than 1.0 dB/km at 1300 nm.

* + - * 1. Point Discontinuity: No more than 0.2 dB at 850 nm and 1300 nm.
				2. Cabled Effective Modal Bandwidth: No less than 950 MHz·km at 850 nm.
				3. IEEE 802.3z GbE Distance:

Up to 750 m at 850 nm.

Up to 600 m at 1300 nm.

* + - * 1. IEEE 802.3ae 10 GbE Distance: Up to 150 m at 850 nm.
				2. OFL Bandwidth:

No less than 700 MHz·km at 850 nm.

No less than 500 MHz·km at 1300 nm.

* + - * 1. Numerical Aperture: 0.200±0.015.
		1. Multimode Laser-optimized 50/125 μm Fiber – 300 (OM3).
			1. Specifications:
				1. TIA/EIA-492AAAC.
				2. IEC 60793-2-10.
			2. Geometry Requirements:
				1. Core:

Diameter: 50.0±2.5 µm.

Non-Circularity: No more than 5 percent.

* + - * 1. Cladding:

Diameter: 125±1 µm.

Non-Circularity: No more than 1 percent.

* + - * 1. Core-to-Cladding Concentricity: No more than 1.5 µm.
				2. Coating Diameter: Primary, Uncolored; 242±5 µm.
				3. Colored Fiber Nominal Diameter: Between 253 and 259 µm.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 2.8 dB/km at 850 nm.

No more than 1.0 dB/km at 1300 nm.

* + - * 1. Point Discontinuity: No more than 0.2 dB at 850 nm and 1300 nm.
				2. Cabled Effective Modal Bandwidth: No less than 2000 MHz·km at 850 nm.
				3. IEEE 802.3z GbE Distance:

Up to 1000 m at 850 nm.

Up to 600 m at 1300 nm.

* + - * 1. IEEE 802.3ae 10 GbE Distance: Up to 300 m at 850 nm.
				2. OFL Bandwidth:

No less than 1500 MHz·km at 850 nm.

No less than 500 MHz·km at 1300 nm.

* + - * 1. Numerical Aperture: 0.200±0.015.
		1. Multimode Laser-optimized 50/125 μm Fiber – 550 (OM4).
			1. Specifications:
				1. TIA/EIA-492AAAD.
			2. Geometry Requirements:
				1. Core:

Diameter: 50.0±2.5 µm.

Non-Circularity: No more than 5 percent.

* + - * 1. Cladding:

Diameter: 125±1 µm.

Non-Circularity: No more than 1 percent.

* + - * 1. Core-to-Cladding Concentricity: No more than 1.5 µm.
				2. Coating Diameter: Primary, Uncolored; 242±5 µm.
				3. Colored Fiber Nominal Diameter: Between 253 and 259 µm.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 2.8 dB/km at 850 nm.

No more than 1.0 dB/km at 1300 nm.

* + - * 1. Point Discontinuity: No more than 0.2 dB at 850 nm and 1300 nm.
				2. Cabled Effective Modal Bandwidth: No less than 4700 MHz·km at 850 nm.
				3. IEEE 802.3z GbE Distance:

Up to 1100 m at 850 nm.

Up to 600 m at 1300 nm.

* + - * 1. IEEE 802.3ae 10 GbE Distance: Up to 550 m at 850 nm.
				2. OFL Bandwidth:

No less than 3500 MHz·km at 850 nm.

No less than 500 MHz·km at 1300 nm.

* + - * 1. Numerical Aperture: 0.200±0.015.
		1. Multimode Laser-optimized 50/125 μm Fiber – 600 (OM4).
			1. Specifications:
				1. TIA/EIA-492AAAD.
			2. Geometry Requirements:
				1. Core:

Diameter: 50.0±2.5 µm.

Non-Circularity: No more than 5 percent.

* + - * 1. Cladding:

Diameter: 125±1 µm.

Non-Circularity: No more than 1 percent.

* + - * 1. Core-to-Cladding Concentricity: No more than 1.5 µm.
				2. Coating Diameter: Primary, Uncolored; 242±5 µm.
				3. Colored Fiber Nominal Diameter: Between 253 and 259 µm.
			1. Optical Requirements:
				1. Cabled Fiber Attenuation:

No more than 2.8 dB/km at 850 nm.

No more than 1.0 dB/km at 1300 nm.

* + - * 1. Point Discontinuity: No more than 0.2 dB at 850 nm and 1300 nm.
				2. Cabled Effective Modal Bandwidth: No less than 5350 MHz·km at 850 nm.
				3. IEEE 802.3z GbE Distance:

Up to 1100 m at 850 nm.

Up to 600 m at 1300 nm.

* + - * 1. IEEE 802.3ae 10 GbE Distance: Up to 600 m at 850 nm.
				2. OFL Bandwidth:

No less than 3500 MHz·km at 850 nm.

No less than 500 MHz·km at 1300 nm.

* + - * 1. Numerical Aperture: 0.200±0.015.
	1. OUtdoor Loose Tube Optical Fiber Cables.
		1. General Requirements: Provide fiber optic cables that meet the following requirements when tested in accordance with the testing requirements in this section.
			1. Attenuation: Fiber optic cables shall not exceed the following change in attenuation:
				1. Single mode: 0.15 dB at 1550 nm.
				2. Multimode: 0.30 dB at 1300 nm.
			2. Ribbon shall not crack, split, or tear, or show separation of individual fibers.
			3. No mechanical damage to fibers.
		2. Testing Requirements:
			1. Temperature Cycling for Tight Buffered and Hybrid Fiber Optic Cables: FOTP-3.
				1. Storage: -40 °C to 70 °C (-40 °F to 158 °F).
				2. Installation: -30 °C to 60 °C (-22 °F to 140 °F).
				3. Operation: -40 °C to 70 °C (-40 °F to 158 °F).
			2. Crush Resistance: FOTP-41.
				1. Force: 220 N/cm (125 lbf/in).
			3. Cyclic Flexing: FOTP-104.
			4. Bending: FOTP-37.
			5. Impact Resistance: FOTP-25.
				1. Impact Energy: 4.4 N⋅m (38.94 in⋅lbf).
			6. Twisting: FOTP-85.
			7. Tensile and Fiber Strain: FOTP-33; Rated load .
				1. Rated Load: 2670 N (601 lbf).
			8. Water Penetration: Pass, when tested in accordance with FOTP-82.
			9. Compound Flow: Pass, when tested in accordance with FOTP-81.
			10. Lightning Damage: No loss of continuity when tested in accordance with FOTP-181.
		3. Outdoor Loose Tube Gel-Free Optical Fiber Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: ALTOS All-Dielectric Gel-Free Cables, 6-432 Fibers, by Corning Optical.
			2. Construction: All-dielectric cable construction requires no grounding or bonding.
			3. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element surrounded by water-swellable tape, with a flame-retardant, and UV-resistant jacket in compliance with NEC 770.

[Specifier Notes] – Retain one of the following six paragraphs to meet project requirements.

* + - * 1. Fiber Count: 6 - 72 fibers in up to 6 tubes.
				2. Fiber Count: 84 - 96 fibers in up to 8 tubes.
				3. Fiber Count: 108 - 144 fibers in up to 12 tubes.
				4. Fiber Count: 156 – 216 fibers in up to 18 tubes.
				5. Fiber Count: 228 - 288 fibers in up to 24 tubes.
				6. Fiber Count: 360 – 432 fibers in up to 36 tubes.
		1. Outdoor Single-Armored Loose Tube Gel-Free Single-Jacket Fibers Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: Altos Lite Loose Tube, Gel-Free, Single-Jacket, Single-Armored, by Corning Optical.
			2. Core Protection: Flexible, spirally wrapped, corrugated steel armor.
			3. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element surrounded by water-swellable tape, with a single flame-retardant, and UV-resistant jacket in compliance with NEC 770.

[Specifier Notes] – Retain one of the following six paragraphs to meet project requirements.

* + - * 1. Fiber Count: 6 - 72 fibers in up to 6 tubes.
				2. Fiber Count: 84 - 96 fibers in up to 8 tubes.
				3. Fiber Count: 108 - 144 fibers in up to 12 tubes.
				4. Fiber Count: 156 – 216 fibers in up to 18 tubes.
				5. Fiber Count: 228 - 288 fibers in up to 24 tubes.
				6. Fiber Count: 360 – 432 fibers in up to 36 tubes.
		1. Outdoor Loose Tube Gel-Free Double-Jacket Fiber Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: ALTOS Gel-Free Double-Jacket, Dielectric Cables, 12-288 Fibers, by Corning Optical.
			2. Construction: All-dielectric cable construction requires no grounding or bonding.
			3. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element surrounded by water-swellable tape, with a double flame-retardant, and UV-resistant jacket in compliance with NEC 770.

[Specifier Notes] – Retain one of the following five paragraphs to meet project requirements.

* + - * 1. Fiber Count: 12 - 72 fibers in up to 6 tubes.
				2. Fiber Count: 84 - 96 fibers in up to 8 tubes.
				3. Fiber Count: 108 - 144 fibers in up to 12 tubes.
				4. Fiber Count: 156 – 216 fibers in up to 18 tubes.
				5. Fiber Count: 228 - 288 fibers in up to 24 tubes.
		1. Outdoor Single-Armored Loose Tube Gel-Free Double-Jacket Fiber Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: ALTOS Gel-Free, Double-Jacket, Single Armored Cables, 12-288 Fibers.
			2. Core Protection: Flexible, spirally wrapped, corrugated steel armor.
			3. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element surrounded by water-swellable tape, with a double flame-retardant, and UV-resistant jacket in compliance with NEC 770.

[Specifier Notes] – Retain one of the following five paragraphs to meet project requirements.

* + - * 1. Fiber Count: 12 - 72 fibers in up to 6 tubes.
				2. Fiber Count: 84 - 96 fibers in up to 8 tubes.
				3. Fiber Count: 108 - 144 fibers in up to 12 tubes.
				4. Fiber Count: 156 – 216 fibers in up to 18 tubes.
				5. Fiber Count: 228 - 288 fibers in up to 24 tubes.
		1. Outdoor Single-Armored Loose Tube Gel-Free Single-Jacket Low Temperature Fiber Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: ALTOS Gel-Free, Low-Temperature, Single-Jacket/Single-Armored, 12-288 Fibers, by Corning Optical.
			2. Core Protection: Flexible, spirally wrapped, corrugated steel armor.
			3. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element surrounded by water-swellable tape, with a single flame-retardant, and UV-resistant jacket in compliance with NEC 770.

[Specifier Notes] – Retain one of the following five paragraphs to meet project requirements.

* + - * 1. Fiber Count: 12 - 72 fibers in up to 6 tubes.
				2. Fiber Count: 84 - 96 fibers in up to 8 tubes.
				3. Fiber Count: 108 - 144 fibers in up to 12 tubes.
				4. Fiber Count: 156 – 216 fibers in up to 18 tubes.
				5. Fiber Count: 228 - 288 fibers in up to 24 tubes.
	1. Outdoor Loose Tube Optical Fiber Cables with Embedded Sheath Tear Features.
		1. General Requirements: Provide fiber optic cables that meet the following requirements when tested in accordance with the testing requirements in this section.
			1. Attenuation: Fiber optic cables shall not exceed the following change in attenuation:
				1. Single mode: 0.15 dB at 1550 nm.
				2. Multimode: 0.30 dB at 1300 nm.
			2. Ribbon shall not crack, split, or tear, or show separation of individual fibers.
			3. No mechanical damage to fibers.
		2. Testing Requirements:
			1. Temperature Cycling for Tight Buffered and Hybrid Fiber Optic Cables: FOTP-3.
				1. Storage: -40 °C to 70 °C (-40 °F to 158 °F).
				2. Installation: -30 °C to 60 °C (-22 °F to 140 °F).
				3. Operation: -40 °C to 70 °C (-40 °F to 158 °F).
			2. Crush Resistance: FOTP-41.
				1. Force: 220 N/cm (125 lbf/in).
			3. Cyclic Flexing: FOTP-104.
			4. Bending: FOTP-37.
			5. Impact Resistance: FOTP-25.
				1. Impact Energy: 4.4 N⋅m (38.94 in⋅lbf).
			6. Twisting: FOTP-85.
			7. Tensile and Fiber Strain: FOTP-33; Rated load .
				1. Rated Load: 2670 N (601 lbf).
			8. Water Penetration: Pass, when tested in accordance with FOTP-82.
			9. Compound Flow: Pass, when tested in accordance with FOTP-81.
			10. Lightning Damage: No loss of continuity when tested in accordance with FOTP-181.
		3. Outdoor Loose Tube Gel-Free Dielectric 2- to 288-Fibers Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: Altos Loose Tube, Gel-Free, Dielectric w/ FastAccess Technology, by Corning Optical.
			2. Construction: All-dielectric cable construction requires no grounding or bonding.
			3. Cable Jacket: Manufacturer’s standard jacket with embedded sheath tear features.
			4. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element surrounded by water-swellable tape, with a single flame-retardant, and UV-resistant jacket in compliance with NEC 770.

[Specifier Notes] – Retain one of the following five paragraphs to meet project requirements.

* + - * 1. Fiber Count: 12 - 72 fibers in up to 6 tubes.
				2. Fiber Count: 84 - 96 fibers in up to 8 tubes.
				3. Fiber Count: 108 - 144 fibers in up to 12 tubes.
				4. Fiber Count: 156 – 216 fibers in up to 18 tubes.
				5. Fiber Count: 228 - 288 fibers in up to 24 tubes.
		1. Outdoor Loose Tube Gel-Free Dielectric 12- to 72-Fibers Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: ALTOS Loose Tube, Gel-Free, All-Dielectric Cables with Binderless FastAccess Technology, by Corning Optical.
			2. Construction: All-dielectric cable construction requires no grounding or bonding.
			3. Cable Jacket: Manufacturer’s standard jacket with embedded sheath tear features with no binder yarn or waterblocking tapes.
			4. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element, with a single flame-retardant, and UV-resistant jacket in compliance with NEC 770.
				1. Fiber Count: 12 - 72 fibers in up to 6 tubes.
		1. Outdoor Single-Armored Loose Tube Gel-Free Dielectric 12- to 72-Fibers Cables.

[Specifier Notes] – Retain the following paragraph if this document is a PROPRIETARY Specification, with Corning Optical products listed as the Basis of Design. Delete if not required.

* + - 1. Basis of Design Product: ALTOS Loose Tube, Gel-Free, All-Dielectric Cables with Binderless FastAccess Technology, by Corning Optical.
			2. Core Protection: Flexible, spirally wrapped, corrugated steel armor.
			3. Cable Jacket: Manufacturer’s standard jacket with embedded sheath tear features.
			4. Physical Performance: Provide cable with fiber in buffer tubes around a dielectric central element surrounded by water-swellable tape, with a single flame-retardant, and UV-resistant jacket in compliance with NEC 770.
				1. Fiber Count: 12 - 72 fibers in up to 6 tubes.
1. EXECUTION
	1. EXAMINATION
		1. Verification of Conditions: Do not begin installation until substrates have been properly prepared.
		2. Evaluation and Assessment: If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
	2. PREPARATION
		1. Surface Preparation: Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
	3. INSTALLATION
		1. Install all products in this section following the product manufacturer’s published installation and application manuals and guidelines.
	4. FIELD QUALITY CONTROL
		1. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.
			1. Inspections: Fiber optic cables, accessories, and installation are subject to inspection for compliance with requirements and photograph documentation of conditions to be concealed by subsequent Work.
		2. Tests: As determined by Owner's testing agency from among the following tests:
			1. Optical Fiber Cabling Components: Test in accordance with ANSI/TIA 568.3-D.
			2. Optical Power Loss: Test in accordance with ANSI/TIA-526-14-C.
			3. <<INSERT REQUIRED FIELD TESTS>>
		3. Fiber optic cable will be considered defective if it does not pass tests and inspections.
	5. PROTECTION
		1. Protect installed products until substantial completion, replace damaged materials and retest.

End of Section