CORNING OPTICAL COMMUNICATIONS GENERIC SPECIFICATION FOR GEL-FREE LOOSE TUBE OPTICAL FIBER CABLES FOR INDUSTRIAL LOW-SMOKE, ZERO HALOGEN APPLICATIONS

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PGS101
Revision 4

Corning Optical Communications reserves the right to update this specification without prior notification.

Master Format 27 13 23 Communications Optical Fiber Backbone Cabling

1.0 General Considerations

The cable must meet the requirements of the National Electrical Code® (NEC)® Section 770.

1.1 Industrial Ruggedness tested - Applicable Tests: UL 13; UL 444; UL 1277; CSA C22.2 No. 230 and No. 232. The cables shall be Tray Rated.

1.2 Low-Smoke Zero-Halogen – Applicable Flame-Smoke Test: UL 1685, *Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cable*. Cable shall be listed OFN-LS. Interlocking armored cables shall be listed OFC-LS. Corrugated armored cables shall be listed OFCR-LS and shall meet ANSI/UL 1666, *Test for Flame Propagation Height of Electrical and Optical Fiber Cables Installed Vertically in Shafts*

1.3 Finished cables shall conform to the applicable performance requirements of the Insulated Cable Engineers Association, Inc. (ICEA) *Standard for Indoor-Outdoor Optical Fiber Cable* (ICEA S-104-696).

1.4 Finished cables shall conform to the applicable performance requirements of the Institute of Electrical and Electronic Engineers (IEEE) Vertical Wire Flame Test (IEEE-383).

1.5 The cables shall be suitable for Direct Burial (DIR BUR) and shall be Sunlight Resistant (SUN-RES).

2.0 Fiber Specifications

2.1 Detailed information on the fiber types available for this cable design can be found in the following documents:

Dispersion Un-shifted and Non-zero Dispersion Shifted Single-mode Fiber: Generic Specification F1, “Generic Specification for Single-mode Optical Fiber in Loose Tube and Ribbon Cables.”

50/125 µm and 62.5/125 µm Multimode Fiber: Generic Specification F2, “Generic Specification for Multimode Optical Fiber in Loose Tube and Ribbon Cables.”

3.0 Cable Construction

3.1 Optical fibers shall be placed inside a loose buffer tube. The buffer tubes shall be made of polypropylene. The nominal outer diameter of the buffer tube shall be 2.5 mm.

3.2 Each buffer tube shall contain up to 12 fibers.

3.3 The fibers shall not adhere to the inside of the buffer tube.

3.4 Each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding."

3.5 The fibers shall be colored with ultraviolet (UV) curable inks. The UV curable ink shall be applied to the outside of the optical fiber protective coating layer and not be an integral component of the coating layer itself in order to produce more distinguishable colored fiber.

3.6 Buffer tubes containing fibers shall be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding."

3.6.1 Buffer tube colored stripes shall be inlaid in the tube by means of co-extrusion when required. The nominal stripe width shall be 1 mm.

3.7 For dual layer buffer tube construction cables, standard colors are used for tubes 1 through 12 and stripes are used to denote tubes 13 through 24. The color sequence applies to tubes containing fibers only, and shall begin with the first tube. If fillers are required, they shall be placed in the inner layer of the cable. The tube color sequence shall start from the inside layer and progress outward.

3.8 In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other. Colors shall not cause fibers to stick together.

3.9 The buffer tubes shall be resistant to kinking.

3.10 Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed. Fillers shall be placed so that they do not interrupt the consecutive positioning of the buffer tubes. In dual layer cables, any fillers shall be placed in the inner layer. Fillers shall be nominally 2.5 mm in outer diameter.

3.11 The central member shall consist of a dielectric, glass reinforced plastic (GRP) rod. The purpose of the central member is to prevent buckling of the cable. The GRP rod shall be overcoated with a thermoplastic, when required, to achieve dimensional sizing to accommodate buffer tubes/fillers.

3.12 Each buffer tube shall contain a water blocking element for water blocking protection. The water swellable element shall be non-nutritive to fungus, electrically non-conductive and homogeneous. They shall be free from dirt and foreign matter. The element will preclude the need for other water blocking material; the buffer tube shall be gel-free.

3.13 The optical fibers shall not require cleaning before placement into a splice tray or fan-out kit

3.14 Buffer tubes shall be stranded around the dielectric central member using the reverse oscillation, or "S-Z," stranding process. Water blocking yarn(s) shall be applied longitudinally along the central member during stranding.

3.15 Two polyester yarn binders shall be applied contrahelically and with sufficient tension to secure each buffer tube layer to the dielectric central member without crushing the buffer tubes. The binders shall be non-hygroscopic, non-wicking and dielectric with low shrinkage.

3.16 For single layer cables, a water blocking tape shall be applied longitudinally around the outside of the stranded tubes/fillers. The tape shall be held in place by a single polyester binder yarn. The water blocking tape shall be non-nutritive to fungus and electrically non-conductive. It shall also be free from dirt and foreign matter.

3.17 For dual layer cables, a second (outer) layer of buffer tubes shall be stranded over the original core to form a two-layer core. A water blocking tape shall be applied longitudinally over both the inner and outer layer with each being held in place with a single polyester binder yarn. The water blocking tape shall be non-nutritive to fungus and electrically non-conductive. It shall also be free from dirt and foreign matter.

3.18 Non-armored cables shall contain at least one ripcord under the sheath for easy sheath removal.

3.19 Flame-retardant tape may be applied to provide resistance to flame propagation.

3.20 A water blocking tape shall be applied longitudinally around the outside of the flame retardant tape.

3.21 The tensile strength shall be provided by the central member, and additional dielectric yarns as required. The dielectric yarns shall be helically stranded evenly around the cable core.

3.22 Cables shall be sheathed with a flame retardant low-smoke zero halogen jacket. Jacketing material shall be applied directly over the tensile strength members and water blocking tape. The flame retardant low-smoke zero halogen outer jacket shall contain carbon black or a UV stabilized colored compound to provide ultraviolet light protection and shall not promote the growth of fungus.

3.23 Cable jackets shall be capable of being colored any of the 12 colors identified in EIA/TIA-598, “Optical Fiber Cable Color Coding”, if requested to enhance cable identification. Colored jackets shall contain UV stabilizers to provide ultraviolet light protection.

3.24 The jacket shall be continuous, free from pinholes, splits, blisters, or other imperfections. The jacket shall have a consistent, uniform thickness; jackets extruded under high pressure are not acceptable. The jacket shall be smooth, as is consistent with the best commercial practice. The jacket shall provide the cable with a tough, flexible, protective coating, able to withstand the stresses expected in normal installation and service.

3.25 Cable jackets shall be marked with the manufacturer's name or file number, month and year of manufacture, sequential meter or foot markings, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type, flame rating and listing marking. The actual length of the cable shall be within -0/+1% of the length markings. The print color shall be white, with the exception that cable jackets containing one or more coextruded white stripes, which shall be printed in light blue. The height of the marking shall be approximately 2.5 mm.

3.26 The maximum pulling tension shall be 2700 N (600 lbf) during installation (short term) and 810 N (180 lbf) long term installed.

3.27 The cable specified herein shall be available in four sheath designs.

3.27.1 Un-armored, all-dielectric cables shall be listed OFN-LS and shall be as described previously in this section. These cables shall be available in fiber counts up to 288 fibers

3.27.2 Un-armored, double-dielectric cables shall be listed OFN-LS and shall be as described previously through paragraph 3.22. The maximum pulling tension shall be 4500 N (1000 lbf) during installation (short term) and 1500 N (333 lbf) long term installed.

3.27.3 Interlocking armored cables shall be as described previously in this section but shall also include an interlocking aluminum armor applied helically around the outside of the cable jacket. The interlocking armor may be left un-jacketed or may have a flame retardant low-smoke zero halogen outer jacket. The armor for these cables shall be comparable to liquid tight flexible metal conduit if jacketed, or flexible metal conduit

if not jacketed. Because of the interlocking metallic armor, this cable shall be listed OFC-LS. The interlocking armor and outer jacket options will be specified on the purchase order. Cables with interlocking armor shall be available in fiber counts up to 288 fibers.

3.27.4 Corrugated armored cables shall have an armor layer applied directly over at least one ripcord and a water blocking tape that shall be applied longitudinally around the inner flame retardant low-smoke zero halogen cable jacket. The tape shall be held in place by a single polyester binder yarn. The armor shall be a corrugated steel tape, plastic-coated on both sides for corrosion resistance, with an overlapping seam with the corrugations in register. A water swellable Mylar tape shall then be placed around the corrugated steel tape. The outer flame retardant low-smoke zero halogen jacket shall be applied over the water swellable Mylar tape. Because of the corrugated metallic armor, this cable shall be listed OFCR-LS. Any outer jacket options shall be specified on the purchase order. Cables with corrugated armor shall be available in fiber counts up to 288 fibers.

4.0 Cable Identification

4.1 The outer cable jacket shall be marked with the manufacturer's name or ETL file number, date of manufacture, shop order number, optional SOC code (SR##########), fiber count, fiber type, flame rating, listing symbol, and sequential length markings every two feet (e.g., “CORNING OPTICAL COMMUNICATIONS OPTICAL CABLE - MM/YY. XXXXX (feet or meters). The marking shall be in contrasting color to the cable jacket.

5.0 Cable Performance Specifications

5.1 Temperature Range

The storage temperature range for the cable on the original shipping reel shall be -50 °C to +75 °C. The installation temperature range for the cable shall be -30 °C to +60 °C. The operating temperature range for the cable shall be -50 °C to +75 °C. Testing shall be in accordance with FOTP-3.

5.2 Tensile Loading and Fiber Strain

When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," and FOTP-38, “Measurement of Fiber Strain in Cables Under Tensile Load,” a length of cable shall be tested to the rated tensile load. The rated tensile load shall be 2670 N (600 lbf). While under the rated tensile load, the fiber shall not experience a measured fiber strain greater than 60% of the fiber proof test level. After being held at the residual load (30% of the rated tensile load) the fiber shall not experience a measured fiber strain greater than 20% of the fiber proof test level nor an attenuation change greater than 0.40 dB at 1550 nm (single-mode) or greater than 0.60 dB at

1300 nm (multimode). After the tensile load is removed, the fibers shall not experience an attenuation change greater than 0.40 dB at 1550 nm (single-mode) or greater than 0.60 dB at 1300 nm (multimode).

5.3 Compressive Loading Test

When tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," the cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) applied uniformly over the length of the sample. The 220 N/cm (125 lbf/in) load shall be applied at a rate of 2.5 mm (0.1 in) per minute. The load shall be maintained for a period of 1 minute. The load shall then be decreased to 110 N/cm (63 lbf/in). Alternatively, it is acceptable to remove the 220 N/cm (125 lbf/in) load entirely and apply the 110 N/cm (63 lbf/in) load within five minutes at a rate of 2.5 mm (0.1 in) per minute. The 110 N/cm (63 lbf/in) load shall be maintained for a period of 10 minutes. Attenuation measurements shall be performed before release of the 110 N/cm (63 lbf/in) load. The change in attenuation shall not exceed 0.40 dB at 1550 nm for single-mode fibers and 0.60 dB at 1300 nm for multimode fiber.

5.4 Cyclic Flexing

When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable shall withstand 25 mechanical flexing cycles at a rate of 30 ± 1 cycles per minute. The flexing arc shall be $\pm$ 90 degrees from the reference position. The fiber shall not experience an attenuation change greater than 0.40 dB at 1550 nm (single-mode) or greater than 0.60 dB at 1300 nm (multimode). No cracks, splits, tears or other opening shall be present on the inner or outer surface of the jacket. No visible cracks greater than 5 mm in the armor, if present, shall be present.

5.5 Twist Test

When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 2 meters will withstand 10 cycles of mechanical twisting. The fiber shall not experience an attenuation change greater than 0.40 dB at 1550 nm (single-mode) or greater than 0.60 dB at 1300 nm (multimode).

5.6 High and Low Temperature Bend

When tested in accordance with FOTP-37, "Fiber Optic Cable Bend Test, Low and High Temperature," the cable shall withstand four full turns around a mandrel at test temperatures of -10 °C and +60 °C. The mandrel diameter shall be the larger of 20X cable diameter or 150 mm for general purpose and riser cables. The presence of visible cracks, splits, tears, or other openings on either the inner or outer surface of the jacket constitutes failure. None of the sheath components shall show visible cracking when removed successively and examined. For single-mode fibers, the increase in attenuation shall be $\leq$ 0.40 dB at 1550 nm. For multimode fibers, the increase in attenuation shall be $\leq$ 0.60 dB at 1300 nm.

5.7 Impact Resistance

When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," the cable shall withstand a minimum of 2 impact cycles at 3 locations spaced 150 mm. The impact energy shall be at least 4.4 N•m. The fibers shall not experience an attenuation change greater than 0.40 dB at 1550 nm (single-mode) or greater than 0.60 dB at 1300 nm (multimode). The presence of visible cracks, splits, tears, or other openings on the outer surface of the jacket constitute a failure. The presence of broken fibers within the specimen constitutes a failure.

5.8 Temperature Cycling

When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fiber, Optical Cable, and Other Passive Fiber Optic Components," the change in attenuation after 2 cycles at extreme operational temperatures (-40 °C to +70 °C) shall not exceed 0.40 dB/km at 1550 nm (single-mode) or 0.60 dB/km at 1300 nm (multimode). The change in attenuation is measured with respect to the baseline values measured at room temperature before temperature cycling and after the last low and last high temperature.

5.9 Water Penetration

When tested in accordance with FOTP-82, “Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable”, a one meter length of unaged cable shall withstand a one meter static head or equivalent continuous pressure of water for one hour without leakage through the open cable end.

5.10 Cold Impact Test

When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," the cable shall withstand a minimum of 2 impact cycles at 3 locations separated by 150 mm. The impact energy shall be at least 2.94 N•m. The cable shall be conditioned for at least 4 hours at the

minimum installation temperature (-10 °C). The presence of visible cracks on either the inner or outer surface of the jacket constitutes a failure. No optical measurements are required.

6.0 Packing and Shipping

6.1 The completed cable shall be packaged for shipment on non-returnable wooden reels. Required cable lengths shall be stated in the purchase order.

6.2 Top and bottom ends of the cable shall be available for testing.

6.3 Both ends of the cable shall be sealed to prevent the ingress of moisture.

6.4 The attenuation shall be measured at 850 nm and 1300 nm for multimode fiber. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fiber. The manufacturer shall store these values for a minimum of 5 years. These values are available upon request.

6.5 Reel Marking and Labeling. Every cable shall come with the following information:

6.5.1 Reel Label:

Part number
Reel number
Length (ft/m)
Marking (ft/m) top and bottom
Date of Manufacture
UL/ETL/CSA listing information

6.5.2 Bar Code Label:

Package ID
Reel number
Quantity
Customer ID
Package count
Factory order number
Release part number
Length (ft)
“Ship to:” Address
“Attention to:”

6.5.3 Stenciling:

Manufacturer's name and address
Direction of rotation
Reel Size
"DO NOT LAY REEL ON SIDE"

7.0 Quality Assurance Provisions

7.1 All optical fibers in cables lengths of 300 m or greater shall be 100 % attenuation tested. The attenuation shall be measured at 850 nm and 1300 nm for multimode fibers. The attenuation shall be measured at 1310 nm and 1550 nm for single-mode fibers. The manufacturer shall store these values for a minimum of 5 years. These values shall be available upon request.

7.2 The cable manufacturer shall be TL 9000 registered.

8.0 Miscellaneous

8.1 At the request of the customer, the cable manufacturer shall provide installation procedures and technical support concerning the items contained in this specification.

Gen Spec PGS101 Revision History

Revision #	Date	Reason for Change
0	6/8/09	New Gen Spec
1	7/8/09	Updated section 3.26.3 to reflect addition of water swellable Mylar tape surrounding corrugated tape and jacket then placed over the water swellable Mylar tape
2	8/26/2010	Updated
3	April 2012	Added information on colored jackets
4	Sept 2017	Reformatted, added Master Format number and added Identification section.