CORNING OPTICAL COMMUNICATIONS GENERIC SPECIFICATION FOR DIELECTRIC OR TONEABLE PRECONNECTORIZED LOW PROFILE OPTICAL FIBER CABLES WITH THE OPTITAP (HFOC) CONNECTOR FOR OUTDOOR SINGLE-FIBER DROP APPLICATIONS

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

Master Format 27 16 13 Communication Custom Cable Assemblies

1.0 General Considerations

The Hardened Outdoor Drop Cable Assembly shall be robust in design with factory terminated connectors for superior optical performance and durability and ease of installation in all outdoor applications (aerial, duct, and direct-buried). These advantages directly translate into cost savings via a reduced installation time and a longer life-span (20 years) resulting in less repairs. The cable assembly itself shall be pulled without issue through a 1.25 inch conduit and shall have a pulling cap designed to withstand a 100 lbf maximum pulling . The cable assembly shall be made with either an SC UPC or an SC APC style environmentally hardened connector. The Hardened Outdoor Drop Cable Assembly shall be compatible with Terminals supplied with flush-mounted environmentally hardened bulkhead adapters.

Prior to the cable assembly being made, individual tests shall be done on both the drop cable and the connectors. The drop cable itself shall be designed to and undergoe Telcordia GR-20 testing, and the environmentally hardend connector shall be designed to and undergoe Telcordia GR-3120 testing. The completed cable assembly shall be designed to and undergoe Telcordia GR-326 testing. The assembly shall also be RDUP (formerly RUS) listed.
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2.0 Fiber Characteristics

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.”

Dispersion Un-shifted and Non-zero Dispersion Shifted Single-mode Fiber: Generic Specification F3, “Generic Specification for Single-mode Optical Fiber in Tight Buffer Cables.”

50/125 µm and 62.5/125 µm Multimode Fiber: Generic Specification F4, “Generic Specification for Multimode Optical Fiber in Tight Buffer Cable.”

3.0 Specifications for Single-fiber Optitap Outdoor Cable Assembly

3.1 The cable shall be totally gel-free in design and shall not contain a buffer tube.

3.2 The cable shall contain one blue-colored 250 µm fiber or one natural-colored 900 µm fiber embedded in the cable jacket.

3.3 Tensile strength shall be provided by two dielectric strength members situated on either side of the cavity and shall be extruded into the cable jacket.

3.4 Cables shall be sheathed with medium density polyethylene applied over the dielectric strength members.

3.5 The MDPE jacket material shall be as defined by ASTM D1248, Type II, Class C, Category 4, Grade J4.

3.6 The jacket or sheath shall be free of holes, splits, and blisters.

3.7 The cable shall be primarily oval in shape with a slight depression along the top and bottom of the center of the major axis between the dielectric strength members.

3.7.1 Dielectric drop cable construction

3.7.1.1 Dielectric drop cable shall have nominal major and minor axis lengths of 5.4 mm and 3.0 mm, respectively.

3.7.1.2 Dielectric drop cable pigtails shall have a tear feature located between each strength member. Tear feature shall allow easy access of the center cavity and fiber when the strength rods are pulled apart from one another on the bare cable end.

3.7.2 Tonable drop cable construction

Tonable drop cable shall have a 24 AWG copper or copper-clad steel wire in a lobe that can separated by hand. Tonable drop cable shall have nominal major and minor axis lengths of 6.6 by 3.0 mm, respectively.

3.8 The cable jacket shall be marked with the manufacturer's name, sequential meter or two foot markings, month and year of manufacture, a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®), fiber count, and fiber type. The actual length of the cable shall be within -0/+1% of the length markings. The marking shall be in contrasting color to the cable sheath.

3.9 If the initial marking fails to meet the specified requirements (i.e., improper text statement, color, legibility, or print interval), the cable may be remarked using a contrasting alternate color. The numbering sequence will differ from the previous numbering sequence, and a tag will be attached to both the outside end of the cable and to the reel to indicate the sequence of remarking. The preferred remarking color will be yellow, with the secondary choice being blue.

3.10 The maximum pulling tension shall be 445 N (100 lbf) during installation.

3.11 The shipping, storage, and operating temperature range of the assembly shall be -40°C to +70°C. The installation temperature range of the cable shall be -30°C to +70°C.

3.12 The connector shall be of a SC APC or SC UPC connector type or make.

3.13 The connector housing shall environmentally sealed and hardened to increase lifespan and robustness of the cable assembly and connector.

3.14 The connector shall have a dust cap with a pulling eye that will allow for the maximum pulling tension of 445N(100 lbf)

3.15 The connector dust cap shall be of threaded screw design to maintain the environmental seal.

3.16 The connector shall have arrows and/or markings for alignment purposes when installing into a terminal. Once it is aligned, the connector will also be threaded into the bulkhead adapter, similar to the dust cap.

3.17 The cable shall be capable of self-support applications at up to 350 feet in NESC Light and 150 feet in NESC Heavy at 1% installation sag when supported by 2-pair telephone drop wire clamps.

4.0 General Cable Performance Specifications

4.1 When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components," the change in attenuation at extreme operational temperatures (-40°C and +70°C) will not exceed 0.15 dB/km at 1550 nm for single-mode fiber and 0.3 dB/km at 1300 nm for multimode fiber.

4.2 When tested in accordance with FOTP-82, "Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable," a 1 m length of un-aged cable will withstand a 1m static head or equivalent continuous pressure of water for 1 hour without leakage through the open cable end.

4.3 When tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables," the cable will withstand a minimum compressive load of 220 N/cm applied uniformly over the length of the sample. The 220 N/cm load will be applied at a rate of 2.5 mm per minute. The load will be maintained for a period of 1 minute. The load will then be decreased to 110 N/cm. Alternatively, it is acceptable to remove the 220 N/cm load entirely and apply the 110 N/cm load within five minutes at a rate of 2.5 mm per minute. The 110 N/cm load will be maintained for a period of 10 minutes. Attenuation measurements will be performed before release of the 110 N/cm load. The change in attenuation will not exceed 0.15 dB at 1550 nm for single-mode fibers and 0.3 dB at 1300 nm for multimode fiber.

4.4 When tested in accordance with FOTP-104, "Fiber Optic Cable Cyclic Flexing Test," the cable will withstand 25 mechanical flexing cycles around a sheave diameter $\leq$ 20 times the cable diameter. The change in attenuation will not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.3 dB at 1300 nm for multimode fiber.

4.5 When tested in accordance with FOTP-25, "Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies," except that the number of impacts will be two at three locations along a one-meter cable length and the impact energy will be at least 4.4 Nm (in accordance with ICEA S-87-640), the change in attenuation will not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.3 dB at 1300 nm for multimode fiber.

4.6 When tested in accordance with FOTP-33, "Fiber Optic Cable Tensile Loading and Bending Test," using a maximum mandrel and sheave diameter of 560 mm, the cable will withstand a rated tensile load of 1333 N (300 lbf) and residual load of 30% of the rated installation load. The axial fiber strain shall be $\leq$ 60% of the fiber proof level after completion of 60 minute conditioning and while the cable is under the rated installation load. The axial fiber strain shall be $\leq$ 20% of the fiber proof level after completion of 10 minute conditioning and while the cable is under the residual load. The change in attenuation at residual load and after load removal shall not exceed 0.15 dB at 1550 nm for single mode fiber and 0.3 dB at 1300 nm for multimode fiber.

4.7 When tested in accordance with FOTP-85, "Fiber Optic Cable Twist Test," a length of cable no greater than 2 m will withstand 10 cycles of mechanical twisting. The change in attenuation will not exceed 0.15 dB at 1550 nm for single-mode fiber and 0.3 dB at 1300 nm for multimode fiber.

4.8 When tested in accordance with FOTP-181, "Lightning Damage Susceptibility Test for Optic Cables with Metallic Components," the cable will withstand a

simulated lightning strike with a peak value of the current pulse equal to 105 kA without loss of fiber continuity. A damped oscillatory test current will be used with a maximum time-to-peak value of 15 μs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz. The time to half-value of the waveform envelope will be from 40 - 70 μs.

4.9 When tested in accordance with FOTP-37, "Low or High Temperature Bend Test for Fiber Optic Cable," the cable will withstand four full turns around a mandrel of ≤ 20 times the cable diameter after conditioning for four hours at test temperatures of -30°C and +60°C. Neither the inner or outer surfaces of the jacket will exhibit visible cracks, splits, tears, or other openings. The change in attenuation will not exceed 0.3 dB at 1550 nm for single-mode fiber and 0.5 dB at 1300 nm for multimode fiber.

4.10 When locating tonable drop cable, the toning wire shall be detected at distances of up to a mile when buried 2 ft. underground.

5.0 General Hardened Fiber Optic Connector Performance Specifications

5.1 The connector will be free of any defects such as burrs that may present a hazard safety or otherwise to the user.

5.2 When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components", the connector shall be put through 21 cycles (168hrs) with a temperature range -40 ^{o}C to 75 ^{o}C for each cycle. At the end of the temperature cycling the connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB. The loss measurements are done before and after every cycle and at each temperature plateau.

5.3 When tested in accordance with FOTP-4, "Fiber Optic Component Temperature Life Test" ", the connector shall be placed in an 85 ^{o}C environment with uncontrolled humidity for 168hrs. At the end of the temperature life test the connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB. The measurement is done before and after the test.

5.4 When tested in accordance with FOTP-5, "Humidity Test Procedure for Fiber Optic Components", each connector undergoes two tests: a Humidity Aging Test and a Humidity/Condensation test. For the Humidity Aging test each connector is subjected to test conditions of 75 °C and 95% relative humidity for 7 days. Measurements of loss and reflectance are made at the beginning of the test, at a minimum of six-hour intervals during the test, and at the end of the test. For the Humidity/ Condensation test each connector is subjected to the temperature cycle of –10oC to 65oC, with relative humidity of 90 to 100%, for a

period of 7 days. Measurements of loss and reflectance are made at every temperature plateau, and at 23°C at the end of the test, at least thirty minutes after the start of each plateau interval. At the end of either test the connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB. The loss measurements are done at the beginning and end of the test and every six hours during the test.

5.5 When tested in accordance with FOTP-12, "Fluid Immersion Test for Fiber Optic Components" , the connector shall be submersed in groundwater for 168 hrs. At the end of the groundwater submersion test the connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB. The loss measurements are done at the beginning and end of the test.

5.6 When tested in accordance with FOTP-12, the connectors shall be submerged in the following chemicals: Kerosene, IGEPAL 10%, Sodium Hydroxide, and Sulfuric Acid. The connectors shall only be smeared with the following chemicals: WD-40, Wasp & Hornet Spray, Isopropyl Alcohol, Cable-filling compound, Splice Encapsulating compound, and IGEPAL 10%. After being submerged or smeared for the required time, the connectors will be cleaned with water then checked for cracks or any other physical deformations.

6.0 General Cable Assembly Performance Specifications

6.1 When tested in accordance with FOTP-1, "Cable Flexing for Fiber Optic Connectors", the assembly shall be mounted to a cable tension test device with a weight of 0.9kg. Each assembly is rotated through the angles of +90 to –90 degrees for a total of 100 cycles. Measurements of loss and reflectance are made at the beginning and at the end of the test. At the end of the test each connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB.

6.2 When tested in accordance with FOTP-2, "Impact Test Measurements for Fiber Optic Devices", each assembly is subjected to eight impact cycles by being dropped from a height of 1.5 m. Each connector was cleaned after the test and re-mated. Measurements of maximum loss and reflectance were measured before and after the impacts. At the end of the test each connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB.

6.3 When tested in accordance with FOTP-3, "Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components", each assembly is subjected to test conditions ranging from 23 °C

to 75 °C to -40 °C for 7 days and a total of 21 cycles. Measurements of loss and reflectance were made at the beginning, at each temperature plateau and at the end of the test. At the end of the temperature cycling each connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB.

6.4 When tested in accordance with FOTP-4, "Fiber Optic Component Temperature Life Test", each assembly is subjected to test conditions of 85 °C for 7 days. Measurements of loss and reflectance are made at the beginning of the test and at the end of the test. At the end of the temperature life test each connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB.

6.5 When tested in accordance with FOTP-5 "Humidity Test Procedure for Fiber Optic Components", each cable assembly undergoes two tests: a Humidity Aging Test and a Humidity/Condensation test. For the Humidity Aging test each connector assembly is subjected to test conditions of 75 °C and 95% relative humidity for 7 days. Measurements of loss and reflectance are made at the beginning of the test, at a minimum of six-hour intervals during the test, and at the end of the test. For the Humidity/ Condensation test each assembly is subjected to the temperature cycle of –10oC to 65oC, with relative humidity of 90 to 100%, for a period of 7 days. Measurements of loss and reflectance are made at every temperature plateau, and at 23°C at the end of the test, at least thirty minutes after the start of each plateau interval. At the end of either test each connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB. The loss measurements are done at the beginning and end of the test and every six hours during the test.

6.6 When tested in accordance with FOTP-6, “Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices," each assembly is mounted onto a text fixture device, and tension is then applied at 0^{o} and 90^{o} offset from the boot of the connector. The tension applied starts at 0.25 and is gradually increased to 0.7kg, 1.5kg, and finally 2.0kg. At the end of the test each connector shall maintain an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB. The loss measurements are made while the tensile load is applied.

6.7 When tested in accordance with FOTP-11, "Vibration Test Procedures for Fiber Optic Components and Cables", each connector assemblies is tested with a vibration amplitude of 1.5 mm (peak-to-peak), with a frequency range sweeping from 10 to 55 Hz at a rate of 45 Hz per minute. The test is conducted for 2 hours in each of three planes. Measurements of loss and reflectance are made at the beginning of the test and after vibration in each of the three planes. At the end of the vibration test each connector shall maintain a maximum

insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB.

6.8 When tested in accordance with FOTP-21, " Mating Durability for Fiber Optic Interconnecting Devices", each assembly is disconnected and then reconnected 200 times. The assemblies are cleaned after every 25th mating. Measurements of loss and reflectance are made before and after each cleaning cycle. At the end of the durability test each connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB.

6.9 When tested in accordance with FOTP-36, " Twist Test for Fiber Optic Connecting Devices", each assembly is mounted to a cable tension test device with a weight of 1.35 kg. The assembly is then twisted +2.5 revolutions to –2.5 revolutions (from the starting point) about the axis of the cable (10 cycles in total). After that, it was rotated + 5Y revolutions in one direction, then was reversed direction and rotated another + 5Y revolutions, for a total of 10 cycles. Measurements of loss and reflectance are made at the beginning and at the end of the test. At the end of the twist test each connector shall maintain a maximum insertion loss of ≤ 0.50 dB, a mean insertion loss of ≤ 0.30 dB, an insertion loss increase of ≤ 0.30 dB, a maximum reflectance of ≤ -40 dB, and a reflectance change of ≤ 5 dB.

7.0 Quality Assurance Provisions

7.1 All cable assemblies of any length shall be 100% attenuation tested.

7.2 The cable manufacturer shall be TL 9000 registered.

8.0 Packing and Shipping

8.1 The completed cable shall be packaged for shipment in non-returnable cardboard boxes or on a waterproof corrugated plastic reel for lengths above 300ft.

8.2 The cable assembly shall be provided with two packaging options; a single packed option and a bulk packed option.

9.0 Miscellaneous

9.1 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 PGS109 Revision History

Revision #	Date	Reason for Change
0	4/30/10	New document
1	5/24/12	Added info for Fast Access ROC dielectric and self-support
2	10/25/12	Added info for FAR 900um
3	10/25/17	Reformatted and added Master Format number