

**Verizon NEBSTM Compliance: Optical
Fiber and Optical Fiber Cable**
Verizon Technical Purchasing Requirements
VZ.TPR.9430
Issue 6, December 2016

CHANGE CONTROL RECORD:

Version	Date	Action*	Reason for Revision
1	11/2/2007	New	New Document.
2	4/3/2008	Change	Modified document from stating 3% seawater to stating 3% Salinity by volume
3	4/21/2008	Change	5.1.2 Ribbon Dimensions – changed to 5 samples 5.2.3 Ribbon Residual Twist – changed to 5 @ Pitch ≥ 400 mm 6.3.1 Filling Compound – changed to 1 sample 6.3.2 Water Blocking – changed to 1 sample 6.3.3 Filling Material Flow – changed to 70C for 24 hours 6.5.1 Optical Measurement – changed ref. to VZ.TPR.9413 6.5.4 Impact Resistance – removed 5X magnification 6.6.1 Optical Measurements – changed ref. to VZ.TPR.9413 6.6.4 Cable Aging – changed to measurements B/A
4	4/09/2010	Add	Added Rodent-resistant requirement
5		Change	Modify to refer to GR-20-CORE, Issue 4 Content of TPR now focuses on Verizon specific testing items Add 200 micron coated tensile requirement.
6	12/12/2016	Add	Proper (ground/sea) water penetration test procedures for Dry-Cable
* New, Add, Delete, Change, Reissue			

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1.0 PURPOSE

The purpose of this Verizon Technical Purchasing Requirement (VZ.TPR) document is to provide additional and/or overriding FOC testing requirements to those specified in GR-20-CORE, Issue 4: Generic Requirements for Optical Fiber and Optical Fiber Cable.

2.0 SCOPE

Optical Fiber and Optical Fiber Cables

3.0 REFERENCES

GR-20-CORE, Issue 4, July 2013	Generic Requirements for Optical Fiber and Optical Fiber Cable
VZ.TPR.9404	Factory Move Test Requirements
VZ.TPR.9445	Factory Audit Requirements
VZ.TPR.9453	Quality Audit Process
VZ.TPR.9455	Declaration of Readiness by FOC ITL for Factory Audit

4.0 ACRONYMS

A	After
B	Before
D	During
FOC	Fiber Optic Components
ITL	Independent Test Laboratory
TPR	Technical Purchasing Requirement

5.0 FACTORY AUDIT REQUIREMENTS

Manufacturing facilities for optical fiber and cable are subject to factory audits by Verizon. Guidelines regarding such audits are found in the following Verizon TPRs:

- VZ.TPR.9404: Factory Move Test Requirements
- VZ.TPR.9445: Factory Audit Requirements
- VZ.TPR.9453: Quality Audit Process
- VZ.TPR.9455: Declaration of Readiness by FOC ITL for Factory Audit

6.0 TEST REQUIREMENTS FOR OPTICAL FIBER AND OPTICAL FIBER CABLE

Verizon purchases Optical Fibers and Optical Fiber Cables as required for the network. The following are the test requirements for qualifying Optical Fiber and Optical Fiber Cables. All the testing must be completed by a Verizon approved ITL.

Note Verizon's position regarding external references to GR-20. This is recorded in Section 1.6. All references in place at the time of publication of GR-20, Issue 4 (July, 2013) are applicable for this TPR. Where external references have been updated since then, the revisions are not presumed applicable. These will be reviewed by Verizon and this TPR will be updated if necessary.

FOC Test Plan for Optical Fiber and Optical Fiber Cable (Based on GR-20)				
Task	Reference Spec.	Samples	Optical Monitor	Comments
3.0 Product Qualification Requirements				
The criteria of GR-20, Section 3 apply as presented in the GR				
4.0 Requirements for Single-Mode Optical Fibers				
All requirements of GR-20, Section 4 shall be met with the clarifications presented below: For 200 micron coated fiber the test program and requirements are the same as for 250 micron coated fiber with the exception noted for Section 4.5.3.				
4.5.2 Fiber Coating Strip Force				Pay attention to the note at the end of this section. Review with Verizon if the additional testing is required for the intended application.
4.5.3 Fiber Dynamic Tensile Strength	* For 250 micron coated fiber, test per GR. * For 200 micron coated fiber, Dynamic Tensile Strength of 3.14 GPa (455 kpsi) for unaged fiber and 2.76 GPa (400 kpsi) for aged fiber are acceptable for the 50% Weibull Probability level. These correlate to the 15% values for 250 micron coated fiber.			
Wavelength Dependent Loss		5 spools each from a separate preform (same samples as used for attenuation coefficient measurements)		Analysis of wavelength dependent loss is optional for all fibers, required for non-solid core solid cladding fibers
5.0 Requirements for Fiber Ribbons				
All requirements of GR-20, Section 5 shall be met with the clarifications presented below:				
5.2.2 Ribbon Dimensions	R5-5 R5-6	Test 5 samples 5@min 2 inches		
5.2 Mechanical Requirements				
5.2.1 Resistance to Twist (Robustness)	R5-3	20@2 meters (10 aged, 10 unaged)		No visible separation (5X magnification) for unaged and aged (per 6.3.4) ribbon - Per FOTP-141: Perform on 12-fiber ribbon and 4 fiber sub-ribbons as required.

**FOC Test Plan for Optical Fiber and Optical Fiber Cable
(Based on GR-20)**

Task	Reference Spec.	Samples	Optical Monitor	Comments
5.3.1 and 5.3.2 Ribbon Separation	R5-4	10@2 meters for mid-span; 10@560 mm for End Separation; 10@560mm for Individual Separation		
5.3.5 Ribbon Residual Twist	R5-8	At least 5 samples		
5.2.4 Ribbon Strippability	R5-9	30@6 inches; 10 per condition		Strip 25 mm of matrix material and fibers protective coating @ Unaged, Temp/Hum: 85°C 85% RH - 30 days, Water Aged: soaked in Di (or distilled) water - 23°C -14 days. No breakage, coating residue removable with 1 isopropyl alcohol wipe. Perform on 12-fiber ribbon and 4-fiber sub-ribbon.
6.0 Requirements for Optical Cables				
All requirements of GR-20, Section 6 shall be met with the clarifications presented below:				
Measurements: For single-mode fibers, in addition to the 1550 nm insertion loss measurements specified, measurements shall also be made at 1310 nm, 1490 nm, and 1625 nm. The only exception to this is for Section 6.5.6 where insertion loss measurements at 1550 nm are sufficient.				
6.4.6 Rodent Resistance				Provide a description of how rodent resistance of cable is assured. Provide evidence where possible.
6.5 Mechanical Requirements				
6.5.1 Optical Measurements	R6-36		Attenuation @ 1310, 1480, 1550 & 1625 nm	
6.5.6 Tensile Strength of Cable	R6-43 R6-44	1 @ FOTP specification	B/D/A 4 wavelength IL not required 1550 nm is sufficient	

FOC Test Plan for Optical Fiber and Optical Fiber Cable (Based on GR-20)				
Task	Reference Spec.	Samples	Optical Monitor	Comments
6.6 Environmental Requirements				
6.6.1 Optical Measurement Equipment	R6-51		at 4 wavelengths	Measurements to be performed at all four wavelengths; Equipment must meet VZ.TPR.9413
6.6.3 Temperature Cycling	CR6-64			Qualification to CR6-64 (extremely cold, -50°C, is generally not required). If cable is expected to be deployed in extremely cold environments, this may apply
6.6.5 Cable Freezing	R6-57			See Appendix A Cable Internal Freezing Test in this TPR after this Section. Verizon will also accept results per the alternate method proposed in GR-20, Section 6.6.5.5
6.6.7 Water Penetration	CO6-61 CO6-62			These criteria are applicable for Verizon. Where CO6-62 is not met, provide the additional information outlined in Section 6.6.7.3 of GR-20. For additional test details see Appendix B Water Penetration Test for Dry-Block Cables
6.6.9 Hydrogen in Cables	R6-69			This test is generally not required for Verizon
6.7 Electrical Protection Requirements				
6.7.1 Lightning Damage Susceptibility		3 samples (length as required by standard)	N/A	The old lightning test that has been removed from GR-20, should be performed Per FOTP -181, define Category passed
6.9 Additional Fiber Optic Cable Type Criteria				Where Verizon TPRs exist for the specified cable types, the TPR applies. In the absence of Verizon TPRs addressing these cable types, rely on the material in Section 6.9 of GR-20-CORE. Verizon

**FOC Test Plan for Optical Fiber and Optical Fiber Cable
(Based on GR-20)**

Task	Reference Spec.	Samples	Optical Monitor	Comments
				reserves the right to issue TPRs addressing these cable types in the future.

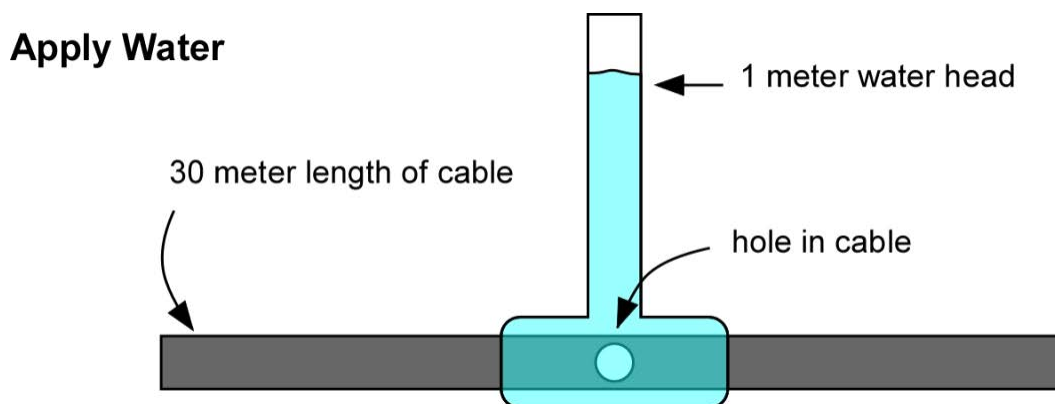
Appendix A Cable Internal Freezing Test

Cable Internal Freezing Test: the question was raised on what happens if water gets inside the central tube near the fibers, activates the water-blocking material, and subsequently freezes. A test was developed that forces water into the cable under pressure to fill a specified amount of the tube, specifies a freezing cycle, and checks for any attenuation impact. The test below is one example of an acceptable test method. Verizon will also accept results per the alternate method proposed in GR-20, Section 6.6.5.5

Freezing Water Inside of Buffer Tube Test Procedure:

1. Obtain the test cable, which must be at least 30 m long. Drill approximately a 10 mm diameter hole in the middle of the length of cable through the cable jacket and buffer tube to expose the fibers. It is recommended to use a blunt-ended drill bit or end mill bit to accomplish this task. The water-blocking materials should provide some separation between the fibers and drill bit.
2. Apply water into cable through hole using 1-meter head of saltwater (3% salinity by volume) * for 1 hour (Figure 1). The pressure and set-up requirements are the same as the requirements of Section 6.6.7 (Water Penetration) in GR-20 CORE Issue 2, R6-75.

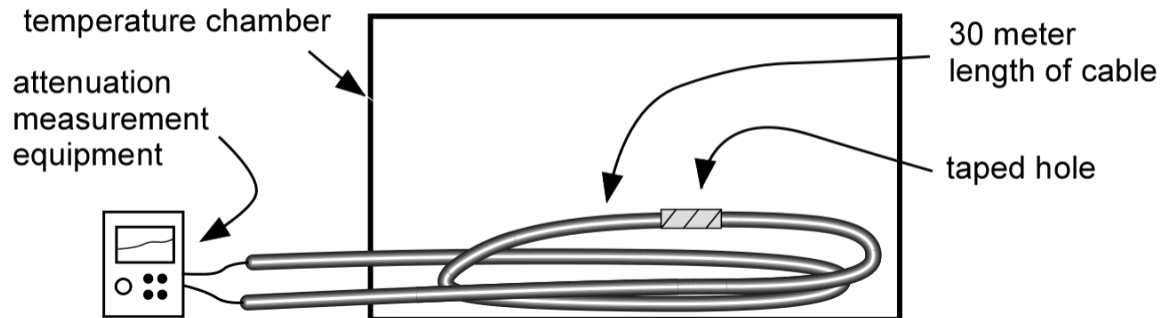
Figure 1 – Water Insertion



3. After applying the water, seal the hole in the cable with duct tape or equivalent. Coil at least 10 meters of cable in a temperature chamber ensuring there is at least 5 meters of cable length on each side of the hole inside the chamber (Figure 2).

Figure 2 – Test Setup

Freeze Cable and Measure Attenuation Change



4. Measure the attenuation of at least 24 fibers with the chamber at room temperature.
5. Transition the temperature chamber to -40°C within 12 hours and hold the chamber at -40°C for 4 hours. Measure the attenuation at -40°C . The allowable attenuation values shall be per the optical requirements of Section 6.6.5 (Cable Freezing) of GR-20 CORE Issue 2, requirement R6-71. The average attenuation increase shall not be greater than 0.05 dB and the maximum attenuation increase of an individual fiber shall not be greater than 0.15 dB.
6. Conduct 10 cycles.

Appendix B – Water Penetration Test for Dry Block Cable

- Test Basis: GR-20 Issue 4 Section 6.6.7, Water Penetration
 - 24 hours
 - 1 meter waterhead
 - Tap water
 - For pre-soak: 100 mm (+/- 10 mm) of the cable end that will be exposed may be pre-soaked. End of cable plugged.
 - The cable sample shall be a maximum of 3 m (10 feet) long.
- Additional Test Parameters requested by Verizon:
 - Cable length longer than 3 meters (at discretion of test laboratory to complete the test)
 - Time duration 168 hours (1 week)
 - Test solutions = diluted salt water as per ASTM D1141
 - 1 m and 3 m heads. For each test configuration, the waterhead is connected to the open cable end and the cable length is mounted horizontally.
 - At the end of the test cables a water detection spray such as Pinpoint Colormetric Developer WDP217 shall be used or an equivalent detection means to establish the water migration length and presence of water at end of cable sample.

Test Water Types:

- Type 1 = Dilution of 3% simulated ocean water in water.
- Type 2 = Dilution of 15% simulated ocean water in water.

The simulated ocean water used in the test mixtures is defined in ASTM D1141. Before testing, the supplier shall (a) verify the composition matches that described in ASTM D1141, and (b) describe preparation of the test solution. Note that ASTM D1141 uses 42 grams of hydrated salts to make a solution of 36 grams of salts in water.

Salinity is typically measured as a concentration of grams of salt per liter of water or grams per liter which is equivalent to grams per kilogram since one liter of pure water equals 1000 grams. The grams per liter units are used since it is simple to measure the weight of salts added to a volume of water. For example, the average concentration of salt in seawater is about 35 g/L. In other words, there are 35 grams of salt dissolved in 1 liter (or 1 kilogram) of typical seawater. This quantity is usually expressed as the measure of parts salt per thousand parts (ppt) of seawater. For example, 35 grams of salt dissolved in 1 kilogram of seawater is equal to 35 parts of salt dissolved in 1000 parts of seawater, or 35 ppt.

Type 1 Test Solution = 3% of ASTM D1141 salt water in water = $(3/100) \times 36$ grams of salt/Liter = 1.08 g/L = 0.11% salt solution. To make this 0.11% solution you would take $(0.03 \times 42) = 1.3$ grams of the ASTM D1141 hydrated salt mixture and mix in to 900-950 ml of tap water. After the salts have fully dissolved, the volume shall then be made up to 1 liter with tap water.

Type 2 Test Solution = 15% of ASTM D1141 salt water in water = $(15/100) \times 36$ grams of salt/Liter = 5.4 g/L = 0.54% salt solution. Therefore, to mix this solution you would take $(0.15 \times 42) = 6.3$ grams of the ASTM D1141 mixture and mix in to 900-950 ml of tap water. After the salts have fully dissolved, the solution volume shall then be made up to 1 liter with tap water. To make this 0.54% solution you would take $(0.15 \times 42) = 6.3$ grams of the ASTM D1141 hydrated salt mixture and mix in to 900-950 ml of tap water. After the salts have fully dissolved, the volume shall then be made up to 1 liter with tap water.

Note: Alternately, an equivalent means to preparing the test solutions can be achieved by added the weighed 1.3 or 6.3 grams of hydrated salts, to 998.7 or 993.6 grams respectively of water.

Waterhead - If a pressure vessel is used, set the pressure to the desired waterhead calculated at 1.42 psi in a meter of water head. The waterhead can be applied as described above with a column of the applicable height (1 or 3 meters) or attained with a calibrated pressurized system to simulate the full 1-meter or 3-meter height. A 1 meter waterhead is equivalent to a pressure of 1.42 psi; and a 3-meter waterhead is equivalent to a pressure of 4.3 psi.)

Sample Size - One (1) specimen of each unique cable type in the sample population shall be tested. Each unique cable type shall be tested under the following test conditions:

1. 1.0 meter waterhead with 3% sea water solution (Type 1)
2. 1.0 meter waterhead with 15% sea water solution (Type 2)
3. 3.0 meter waterhead with 3% sea water solution (Type 1)
4. 3.0 meter waterhead with 15% sea water solution (Type 2)

Note a cable that meets the requirements for the most severe Test Condition 4 will by interference meet the requirements for any of the other 3 test conditions.

When mutually agreed upon, manufacturers' measurement data may be used to establish compliance.

Water Migration Length – After 1 week the cable shall be dissected and the water migration length along the cable shall be measured and reported

Step 1- A 0.3 meter (1 foot) section shall be cut from the open end of the cable with cable cutters and the exposed end tested for the presence of water using the Pinpoint Colormetric Developer WDP217 or an equivalent detection means.

Step 2 - If no water is detected, the repeat Step 1 until water is detected.

Water migration lengths shall be reported for both smaller cables sizes (defined as less than 864 fiber count) and larger cable sizes (defined as 864 fiber count or greater). It is recommended that smaller cable sizes are tested first.

If water exits the open cable end before 1 week, then the migration length shall be reported as greater than length of the test cable.

Pass/Fail Criteria

- Water shall not migrate more than 3 m (10 feet) along the test cable.
- The water migration length shall be reported to enable evaluation of cables unable to meet the 3 meter (10 feet) criteria..
- The migration length for larger (≥ 864fiber count) cables shall be shorter than for smaller (< 864 fiber count) cables.