



Verizon NEBS™ Compliance: Test Requirements for Multi-Mode Fiber Optic Connectors

**Verizon Technical Purchasing Requirements
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1.0 PURPOSE

The purpose of this Verizon Technical Purchasing Requirement (VZTPR) document is to provide the FOC testing requirements for Multi-Mode Fiber Optical Connectors. These requirements are based on TIA-EIA 568 C.3 Optical Fiber Cabling Components Standard and GR-326 Generic Requirements for Singlemode Optical Connectors and Jumper Assemblies.

2.0 SCOPE

Multi-Mode Fiber Optical Connectors

3.0 REFERENCES

ASTM D2863	Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM G21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
GR-326-CORE, Issue 3, September 1999	Generic Requirements for Singlemode Optical Connectors and Jumper Assemblies
TIA-EIA 568 C.3	“Optical Fiber Cabling Components Standard”



4.0 ACRONYMS

A	After
B	Before
CIR	Change in Reflectance
CIT	Change in Transmittance
D	During
FOC	Fiber Optic Components
IL	Insertion Loss
ITL	Independent Test Laboratory
“O”	Requirement
“R”	Objective
RL	Return Loss
TPR	Technical Purchasing Requirement

5.0 TEST REQUIREMENTS FOR MULTI-MODE FIBER OPTICAL CONNECTORS

Multi-Mode Fiber Optical Connectors shall meet the requirements specified in the following tables, which are based on to the requirements specified in Telcordia document GR-326-CORE, “Generic Requirements for Singlemode Optical Connectors and Jumper Assemblies” and TIA-EIA 568 C.3, “**Optical Fiber Cabling Components Standard**”. All the testing must be completed by a Verizon approved ITL.



Technical Specifications for Multimode Optical Connectors and Jumper Assemblies					
Task	Test Group	Reference Spec.	Samples	Optical Monitor	Comments
3.0 General Requirements	----	----	----	----	All multimode connectors, adapters and cable assemblies shall meet the requirements of this document at both 850 nm and 1300 nm \pm 30 nm wavelengths. Qualification testing shall be conducted in accordance with the specified TIA Fiber Optic Test Procedure (FOTP) and in accordance with the details specified within this document.
3.1 Documentation	----	R-1	----	----	Documentation Shall be provided with the product.
3.2 Packaging and Shipping	----	R-2	----	----	Samples shall be packaged and shipped to the ITL as shipped to the field
3.3 Design Features					



Technical Specifications for Multimode Optical Connectors and Jumper Assemblies					
3.3.1 Materials					
Metallic Elements	----	R-3	----	----	Verified from Salt Fog and Thermal Cycling/Humidity results
Index Matching Fluid or Gel	----	R-4	----	----	Non-used
Fungus Resistance		R-5	5 plugs & adapters		ASTM-G21-70. Rating of 0
Flammability	----	R-6	<i>“A minimum of ten test specimens, 125+/-5mm long by 13+/-0.5mm wide, and provided in the minimum and maximum thickness for each type of polymeric material used in the DUT. The maximum thickness of the test samples is not to exceed 13mm. See UL 94 for additional sample preparation information.”</i>	----	V-1 or better / UL 94, Oxygen index of 28% or > per ASTM D-2863-87
Cable Media Type	----	R-7		----	GR-20 and/or GR-409 cable
3.4 Intermateability					
Intermateability	----	R-8	5 Plugs and 5 mating adapters	----	FOCIS-n (new product and after service live)
Glass Transition Housing Material	----	R-9	5 jumpers/5 mating adapters	----	Glass Transition > 100°C



Technical Specifications for Multimode Optical Connectors and Jumper Assemblies					
3.5 Product Marking and Packaging					
Product Marking		R-10	Inspect Two samples of Plugs and adapters		Supplier, model or series, vintage code (adapters - 6 months; plugs - 3 months)
Keying		R-11	-----		Connector plug should be keyed
3.6 Safety					
Radiation Hazard		R-13	-----		Documentation Review
Cleaning Materials		R-14	-----		Documentation Review
4.0 Connector Tests and Criteria (Service Life)					
4.1 Visual and Mechanical Inspection EIA/TIA 455-13	1-A	R-15	16 pigtailed pair, 5 hot swap pigtailed pair		Section 5.1 and 5.2.2
Performance of New Product	1-B	R-16	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL	IL/RL Per Tables 1 and 2 (New Product) Measurement must be taken against a mated pair (DUT mated to DUT)
Temp/Hum/Cond Test					



Technical Specifications for Multimode Optical Connectors and Jumper Assemblies					
Thermal Age Testing	1-C	R-17	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/A); CIT/CIR	85°C/168h (per GR-326)
Thermal Cycle Test	1-D	R-18	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/D/A); CIT/CIR	-40°C to +75°C; 7 days(per GR-326); Dwell Time: 1 hour
Humidity Aging Test	1-E	R-19	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/D/A); CIT/CIR	75° C / 95% RH, 7 days - Measurements every 6hrs min.
Humidity/Condensation Cycling Test	1-F	R-20	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/A); CIT/CIR	-10°C to +65°C, 90% - 100% RH; 7 days; (per GR-326, Figure 4-4) - See note ²
4.4.2.5 Dry-Out Step	1-G	R-21	16 pigtailed pair, 5 hot swap pigtailed pair		24 hrs @ 75°C, uncontrolled humidity
4.4.2.6 Post-Condensation Thermal Cycle Test	1-H	R-22	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/A); CIT/CIR	-40°C to +75°C; 7 days; Dwell Time:1 hour (per GR-325, Figure 4-3) . see note ¹
4.4.3 Mechanical Tests					
4.4.3.2 Flex Test	1-J	R-23	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/A); CIT/CIR	100 flex cycles @ 0°, 90°, 0°, 90°, 0°: Media Type 1 only - 2.0 lbf load, reduce load to 1.3 lbf for small form



Technical Specifications for Multimode Optical Connectors and Jumper Assemblies

					factor connectors. Product shall not uncouple during test.
Twist Test	1-K	R-24	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/A); CIT/CIR	Twist Cycles (per Table 4-8 of GR-326), Media Type 1: 3.0lbf, X= 2.5 turns, Y=5 turns Media Type 2: 1.65lbf X= 1.5 turns, Y=3 turns Media Type 3: 1.1lbf X= 1.5 turns, Y=3 turns Product shall not uncouple during test.
Proof Test	1-L	R-25	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/A); CIT/CIR	Media Type 1 Only: per GR-326, section 4.4.3.4
Cable Retention	1-M	R-26	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/D/A); CIT/CIR	Per TIA-EIA 568 C.3
Impact	1-N	R-27	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/A); CIT/CIR	Impacted @ 1.5 meter height - 8 impacts



Technical Specifications for Multimode Optical Connectors and Jumper Assemblies					
Durability	1-O	R-28	16 pigtailed pair, 5 hot swap pigtailed pair	IL/RL (B/D/A); CIT/CIR	200 cycles durability, per GR-326, section 4.4.3.8
Connector installation	1-P	R-29	5 pigtails	IL/RL (B/D/A); CIT/CIR	Perform testing per GR-326, section 4.4.6
End of Test Criteria	1-Q	R-30	16 pigtailed pair	IL/RL/CIT/CIR	Optical Measurements and Damage

Table 1 Loss Criteria

Test	Maximum Loss SC & LC, UPC mated connector	Loss Increase SC & LC, UPC mated connector
	(R)	(R)
New Product	0.5	---
During Test, Not Under Load	0.5	0.3
End of Test	0.5	---

Table 2 Return Loss Criteria

Test	Minimum Return Loss SC & LC, UPC mated connector	Minimum Return Loss SC & LC, UPC mated connector	Decrease in Return Loss SC & LC, UPC mated connector
	(R)	(O)	(R)
New Product	30	35	---
During Test, Not Under Load	30	35	10
During Test, Under Load	30	35	10
End of Test	30	35	---



Optical Measurements

- Loss (100% of channels to be monitored)
 - B – Before IL & RL Optical Testing @ (850, 1300 nm)
 - D – During IL & RL Optical Testing @ (850, 1300 nm)
 - A – After IL & RL Optical Testing @ (850, 1300 nm)
 - I initial (under load) IL & RL Optical Testing @ (850, 1300 nm)
 - E – End of test (under load) IL & RL Optical Testing @ (850, 1300 nm)
 - CIT (Change in Transmittance) Calculation - $CIT = A^{IL} - B^{IL}$
 - CIR (Change in Reflectance) Calculation - $CIR = A^{RL} - B^{RL}$

Geometry Criteria:

FOCIS document to be utilized for fiber geometry criteria. If requirement is not specified in either document, utilize the manufacturer's specifications.

Damage Criteria:

- At the completion of the respective test the connector plugs and adapters shall be inspected for damage that might impair the performance of the connector. This inspection shall include inspections for:
 - Distortion of housing parts, as indicated by difficulty in insertion, improper Snap-fits, etc.
 - Distortion of ferrules and sleeves, as indicated by change in mating force,
 - Changes in endface geometry, etc.
 - Cracks
 - Presence of debris, shavings, etc.
 - Corrosion or residue
 - Other potentially service-affecting damage
 - Permanent Loss Increase of more than 0.5 dB from the New Product Measurement
 - Permanent Reflectance Increase of more than 5 dB from the New Product Measurement.
- Permanent is defined as having the specified level of increase in loss or reflectance at the end of all tests performed on connector assemblies. The connector assemblies may be cleaned up to 2 times, using the specified Cleaning Procedure, at the supplier's option, in an attempt to bring their increases below the criteria level.
- Examination shall also include inspection of the polished end of the ferrule under a magnification of 100 power for cracks, chips, or scratches.



Testing Sequences:

The following table defines the test sequences.

Table 3 Test Sequence			
Sample Group	Test Sequence	Title	Section
1	a	Visual and Mechanical Inspection	4.4.5
1	b	New Product Measurement	4.4.1
1	c	Thermal Age Test	4.4.2.1
1	c	Thermal Cycling	4.4.2.2
1	e	Humidity Age	4.4.2.3
1	f	Humidity / Condensation Cycling Test	4.4.2.4
1	g	Dry-out Step	4.4.2.5
1	h	Post-Condensation Thermal Cycle	4.4.2.6
1	l	Vibration Test	4.4.3.1
1	j	Flex Test	4.4.3.2
1	k	Twist Test	4.4.3.3
1	l	Proof Test	4.4.3.4
1	m	Cable Retention	TIA-EIA 568 C.3
1	n	Impact Test	4.4.3.7
1	o	Durability	4.4.3.8
1	p	Connector Installation Test	4.4.6
1	q	End of Test Criteria (Optical, Ferrule Geometry and Damage)	4.4.3.9 & 4.4.5

Testing is to be performed sequentially as defined in the above table.



Notes:

Note 1: Measurement to be performed at every plateau - wait minimum of 30 minutes into cycle before starting. (Cycle may be modified by decreasing transition time and increasing hold times if need to complete measurements)

Note 2: Humidity is only controlled above freezing (0°C)

Note 3: (Service Life) The tensile test fixturing is to be designed with a bracket to hold the coupling adapter in angular increments of 45° about the axis of the connector. During testing, the sample of product is to be rotated as evenly as possible between the eight angular positions to ensure all angles are tested. (i.e.- sample 1@0°, sample 2@45°, sample 4@90°, etc.). Tensile Testing encompasses Flex, Twist, Proof and Cable Retention.

Note 4: Decrease in reflectance is not of concern. Note that the definition of “Reflectance” is that of a negative number, as opposed to Optical Return Loss, which is a positive number. The terms “greater than” and “less than” are applied to the numerical values of the Reflectance, and not the absolute values of these numbers. Thus, a -20 dB Reflectance is greater than a -30 dB Reflectance

Note 5: Optical readings - during are to be taken at the maximum sampling rate.

Note 6: The most stringent criteria is to be used as the pass/fail criteria i.e.: Verizon specifications, or supplier's specifications. The suppliers spec sheet is to be included in the test plan and report in the product description section of the document.