



**Verizon NEBS™ Compliance: Test
Requirements for Multi-Mode Fiber**
Verizon Technical Purchasing Requirements
VZ.TPR.9460
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1.0 PURPOSE

The purpose of this Verizon Technical Purchasing Requirement document is to provide FOC testing requirements for Multi-Mode Fiber.

2.0 SCOPE

FOC Products

3.0 REFERENCES

GR-20-CORE, Issue 2, July 1998	Generic Requirements for Optical Fiber and Optical Fiber Cable
GR-20-CORE Issue 3, May 2008	
GR-409-CORE, Issue 3, September 1999	Generic Requirements for Premises Fiber Optic Cable
GR-409-CORE Issue 2, November 2008	

4.0 ACRONYMS

FOC	Fiber Optic Components
ITL	Independent Testing Laboratory

5.0 TEST REQUIREMENTS FOR MULTIMODE OPTICAL FIBER

The following table contains the test requirements for qualifying multimode fibers. All the testing must be completed by a Verizon approved ITL. All the samples shall be made using the tools designated by supplier.



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
	4.2.1	Attenuation Coefficient		
1.	R4-4	<p>[15] The cabled multimode fiber attenuation coefficient shall be less than 2.5 dB/km at 850 nm, and less than 0.6 dB/km at 1300 nm.</p> <p>Fiber: 50 micron fiber at 850 nm, 2.5 dB/km 50 micron fiber at 1300 nm, 0.6 dB/km</p> <p>62.5 micron fiber at 850 nm, 2.9 dB/km 62.5 micron fiber at 1300 nm, 0.6 dB/km</p> <p>Cable: 50 micron cable at 850 nm, 3.0 dB/km 50 micron cable at 1300 nm, 1.0 dB/km</p> <p>62.5 micron cable at 850 nm, 3.4 dB/km 62.5 micron cable at 1300 nm, 1.0 dB/km</p>	2@ 1000 M min	TIA-455-78-B
	4.2.2	Point Discontinuities		



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
2.	R4-5	[16] The cabled attenuation of the fiber shall be uniformly distributed throughout its length such that there are no discontinuities greater than 0.2 dB.	2@ 1000 M min	TIA-455-78-B
	4.2.3	Multimode Fiber Bandwidth		
3.	R4-6	[17] The minimum overfilled bandwidth for multimode cables are as follows: OM1 a cable containing 62.5/125 multimode fiber shall be 220 MHz-km at 850 nm and 500 MHz-km at 1300 nm.	2@ 2000 M min for overfilled measurement	TIA-455-204 Method A (Overfill)
4.	Req	OM2 50/125 multimode fiber shall be 500 MHz-km at 850 mm and 500 MHz-km at 1300 nm.	2@ 2000 M min	TIA-455-204 Method A (Overfill)



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
5.	Req	OM3 50/125 multimode fiber shall be 1500 MHz-km at 850 nm and 500 MHz-km at 1300 nm. In addition the EMB bandwidth as described in TIA shall be 2000 MHz*km at 850 nm validated using the method described in TIA 492AAAC-B Annex C.2 or Annex C.3 when used with transmitters defined in Annex C.1.	2@ 1000 M max	TIA 492AAAC-B appendix C.2
6.	Req	OM4 50/125 multimode fiber shall be 3500 MHz-km at 850 nm and 500 MHz-km at 1300 nm. In addition the EMB bandwidth shall be 4700 MHz*km at 850 nm validated using the method described in TIA 492AAAD Annex E.1 or E.2	2@ 1000 M max	TIA 492AAAD appendix E.1
	4.2.4	Geometrical Requirements for Multimode Fiber		
7.	R4-7	[18] The cladding outside diameter shall be 125.0 $\mu\text{m} \pm 1.0 \mu\text{m}$.	15 two-meter samples of fiber	TIA-455-176-A
8.	R4-8	[19] The nominal core diameter shall be either 50.0 μm or 62.5 μm , as appropriate.	15 two-meter samples of fiber	TIA-455-58-B



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method						
9.	R4-9	[20] The tolerance about the nominal core diameter shall not exceed $\pm 2.5 \mu\text{m}$.	15 two-meter samples of fiber	TIA-455-58-B						
10.	R4-10	[21] The cladding noncircularity shall not exceed 1.0 percent.	15 two-meter samples of fiber	TIA-455-176-A						
11.	R4-11	[22] The core noncircularity shall not exceed 5.0 percent.	15 two-meter samples of fiber	TIA-455-58-B						
12.	R4-12	[23] The offset between the center of the core and the center of the cladding shall not exceed $1.5 \mu\text{m}$.	15 two-meter samples of fiber	TIA-455-176-A						
13.	Req	The coating Cladding Concentricity shall be $< 12 \mu\text{m}$	15 two-meter samples of fiber							
14.	R4-13	<p>[24] The nominal value of numerical aperture, NA, shall be as follows:</p> <table border="1" data-bbox="596 1101 1486 1276"> <thead> <tr> <th>Fiber Type</th> <th>Numerical Aperture</th> </tr> </thead> <tbody> <tr> <td>50/125</td> <td>$0.185 \leq \text{NA} \leq 0.215$</td> </tr> <tr> <td>62.5/125</td> <td>$0.26 \leq \text{NA} \leq 0.29$</td> </tr> </tbody> </table>	Fiber Type	Numerical Aperture	50/125	$0.185 \leq \text{NA} \leq 0.215$	62.5/125	$0.26 \leq \text{NA} \leq 0.29$	15 two-meter samples of fiber	TIA-455-177-B
Fiber Type	Numerical Aperture									
50/125	$0.185 \leq \text{NA} \leq 0.215$									
62.5/125	$0.26 \leq \text{NA} \leq 0.29$									
		Fiber Coating								



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
15.	Req	The nominal outside diameter of the ‘uncolored” fiber coating shall be 242 or 245 um.	15 two-meter samples of buffered fiber	TIA-455-173-A
16.	Req	The deviation of the outside diameter of the fiber from nominal shall be ± 5 um	15 two-meter samples of buffered fiber	TIA-455-173-A
17.	R4-15	<p>[26] The colored fiber outside diameter requirements from GR-20, Section 4.3, <i>Geometrical Requirements</i> shall be met.</p> <p>[40] The allowable colored fiber diameter range, shall be $235 \mu\text{m} \leq \text{nominal OD} \leq 265 \mu\text{m}$.</p>	15 two-meter samples of buffered fiber	TIA-455-173-A
18.	R4-16	[27] The nominal outside diameter of buffered fiber shall be 900 μm .	15 two-meter samples of buffered fiber	



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
	R4-17	<p>[28] The tolerance about the nominal outside diameter shall not exceed $\pm 50 \mu\text{m}$.</p> <p>NOTE – Composite-buffered fibers are an emerging technology; hence, no outside diameter requirement has been established for this product. Please see the forthcoming Issues List for GR-409 for discussion of this topic.</p>	15 two-meter samples of buffered fiber	
	4.2.5	Fiber Macrobend		
	R4-18	<p>[29] For multimode fibers, the attenuation per 100 turns of fiber 75 mm in diameter shall not exceed 0.5 dB at 850 and 1300 nm, including the intrinsic attenuation of the 23.6 meters (77.4 feet) of fiber.</p>	Fifteen fiber samples of 25 meters each	
	Req	<p>Bend Insensitive Multimode fiber: R=15mm, Turns = 2, IL ≤ 0.1 @ 850 nm ≤ 0.3 @ 1300 nm</p>	Thirty samples of a minimum of 5 meters each	
	Req	<p>Bend Insensitive Multimode fiber: R=7.5 mm, Turns = 2, IL ≤ 0.2 @ 850 nm ≤ 0.5 @ 1300 nm</p>	Thirty samples of a minimum of 5 meters each	
	Req	Chromatic Dispersion λ (zero dispersion), Manufacturer's Specification	2@ 1000 M min	TIA-455-175-B



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
	Req	Chromatic Dispersion λ (zero dispersion) Slope, Manufacturer's Specification	2@ 1000 M min	TIA-455-175-B
	4.3	Mechanical Requirements for Single-Mode and Multimode Fiber		
	R4-19	[30] All requirements from GR-20, Section 4.4, <i>Mechanical Requirements</i> , shall be met with the exceptions, additions, and modifications described in the rest of Section 4.3 of this document.	Refer to TPR.9430	
	4.3.1	Coating Strip Force		
	R4-20	[31] The natural fiber used in products identified in this document shall meet the coating strip force requirements of GR-20.	10@ 12"-18" based on app.	
	R20-46 (4.4.2)	[46] The force required to remove 30 mm \pm 3 mm (1.2 in \pm 0.1 in) of the unaged fiber's protective coating at the fiber termination temperature extremes [0°C and 45°C (32°F and 113°F)] shall be \leq 5.0 N and shall be \geq 1.0 N.	10@ 12"-18" based on app.	



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
	R20-47 (4.4.2)	[47] The force required to remove 30 mm ± 3 mm (1.2 in ± 0.1 in) of the fiber's protective coating for the temperature/humidity-aged fibers shall be ≤ 5.0 N and shall be ≥1.0 N. .	10@ 12"-18" based on app.	
	R20-48 (4.4.2)	[48] The force required to remove 30 mm ± 3 mm (1.2 in ± 0.1 in) of the fiber's protective coating for the water-aged fibers shall be ≤ 5.0 N and shall be ≥1.0 N. .	10@ 12"-18" based on app.	
	R4-21	[32] The force required to "strip to the glass," remove 15 mm ± 1.5 mm (0.6 in ± 0.06 in) of the 900 μm coating composite structure in one stripping operation from the fiber samples shall not exceed 13.3 N (3.0 lbf) and shall be not less than 1.3 N (0.3 lbf).	10@ 12"-18" based on app.	
	O4-22	[33] The force required to "strip to the glass," remove 30 mm ± 1.5 mm (1.2 in ± 0.06 in) of the 900 μm coating composite structure in one stripping operation for the fiber samples should not exceed 13.3 N (3.0 lbf) and shall not be less than 1.3 N (0.3 lbf).	10@ 12"-18" based on app.	



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
	R4-23	[34] The force required to remove 15 mm ± 1.5 mm (0.6 in ± 0.06 in) of the 900 μm buffer material(s) (while leaving the fiber coating intact) from the fiber samples shall not exceed 13.3 N (3.0 lbf).	10@ 12"-18" based on app.	
	O4-24	[35] The force required to remove 30 mm ± 1.5 mm (1.2 in ± 0.06 in) of the 900μm buffer material(s) (while leaving the fiber coating intact) the fiber samples should not exceed 13.3 N (3.0 lbf).	10@ 12"-18" based on app.	
	R4-25	[36] The force required to remove 30 mm ± 1.5 mm (1.2 in ± 0.06 in) of the 900 μm buffer material(s) (while leaving the fiber coating intact) in one stripping operation for the fiber samples shall not exceed 13.3 N (3.0 lbf).	10@ 12"-18" based on app.	
	4.3.2	GR-20-CORE Section 4.4.1 Tensile Proof Strength		
	R20-45 (4.4.1)	[45] The full length of the fiber shall be proof tested to a minimum stress of 0.69 GPa (100 kpsi).	Certificate Verified during factory audit	TIA-455-31-C
	4.3.3	GR-20-CORE Section 4.4.3 Dynamic Tensile Strength		



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
	R20-49 (4.4.3)	<p>[49] The minimum tensile strength of unaged fiber shall be as listed below.</p> <p>3.8 (550) Gpa (kpsi) 50%</p> <p>3.14 (455) 15%</p>	Min 15	TIA-455-28-C
	R20-205 (4.4.3)	<p>[205] The minimum tensile strength of aged fiber shall be as listed below.</p> <p>3.03 (440) Gpa (kpsi) 50%</p> <p>2.76 (400) 15%</p>	Min 15	TIA-455-28-C
	4.3.4	GR-20-CORE Section 4.4.4 Stress Corrosion Parameter		
	R20-55 (4.4.4)	<p>[55] The dynamic stress corrosion parameter, n_d, of unaged and aged fibers shall be ≥ 18.</p>	Min of 15 per strain rate.	TIA-455-28-C
	4.4	GR-20-CORE Section 4.5 Fiber Cleavability and Fusibility		
	4.4.1	GR-20-CORE Section 4.5.1 Fiber Cleavability		



TPR Criteria	Section Reference (GR-409)	Requirements for Multi-Mode Optical Fiber	Samples	Test Method
	4.4.2	GR-20-CORE Section 4.5.2 Fiber Fusibility		
	R20-207 (4.5.2)	[207] Silica fibers shall be fusible with commercially available fusion splicer(s) with a mean splice loss of all splices not exceeding 0.10 dB using similar fibers which meet the nominal geometry criteria of this document.	5 three-meter samples of existing fiber and 5 three-meter samples of new fiber under test (25 tests)	