

GORE® Fiber Optic Cables, 1.8 mm Simplex

For Defense Aircraft

Proven higher levels of durability in 10-Gb+ avionics networks



Typical Applications

- Avionics networks (10 Gb+ up to 100)
- Digital video systems
- Ethernet backbone
- Flight management systems
- Radar systems
- Transceivers

Benefits

- Compact design exceeds EN4641-301 and JN1177 requirements for larger, more rugged designs
- Proven higher level of weight impact/crush resistance for longer service life
- Superior mechanical strength in wide temperatures, high vibration, shock, and more
- High-bandwidth signals with low loss for secure data/video transfer on 10-Gb+ and next-gen networks
- Easier connector termination due to dimensional stability, low jacket shrinkage, no thermal pre-conditioning
- Simpler/faster routing with highly flexible cable construction
- Less maintenance/downtime for lower total cost of ownership

With network data rates increasing to 10+ up to 100 gigabits per second (Gb/s), the aerospace industry is demanding higher-bandwidth fiber optic cables installed in avionics. The industry is also requiring aircraft cables to satisfy stricter requirements for more durability in extreme defense environments while meeting size, weight, and routing constraints.

Gore offers a fiber optic solution with proven higher levels of durability on today's 10-Gb+ and next-generation avionics networks. These compact cables exceed new stringent EN4641-301 and JN1177 industry standards intended initially for larger, more rugged cable designs.



Impressive Robustness in Compact Design

GORE® Fiber Optic Cables, 1.8 mm Simplex incorporates a balance of robust material properties for superior mechanical strength in the most demanding aircraft conditions (Figure 1). These cables resist high weight impact, crushing, kinking, abrasion, cut-through, repeated flexing, high-intensity vibration, mechanical shock, wide temperatures, and more. They reliably transmit high-bandwidth signals and transfer large amounts of data and video without interruption for a critical edge in defense operations (Table 1).

Also, the compact design of the 1.8 mm Simplex has a smaller diameter and lighter weight materials that allow for maximum flexibility and tight bending compared to rugged alternative cables constructed with a double jacket. Therefore, this version of Gore's fiber optic cables is ideal for routing in tight airframe spaces. Furthermore, these cables facilitate easier termination due to dimensional stability and low jacket shrinkage that does not require any thermal pre-conditioning.

Together, improving life



GORE® Fiber Optic Cables, 1.8 mm Simplex for Defense Aircraft

Figure 1: High-Strength Materials

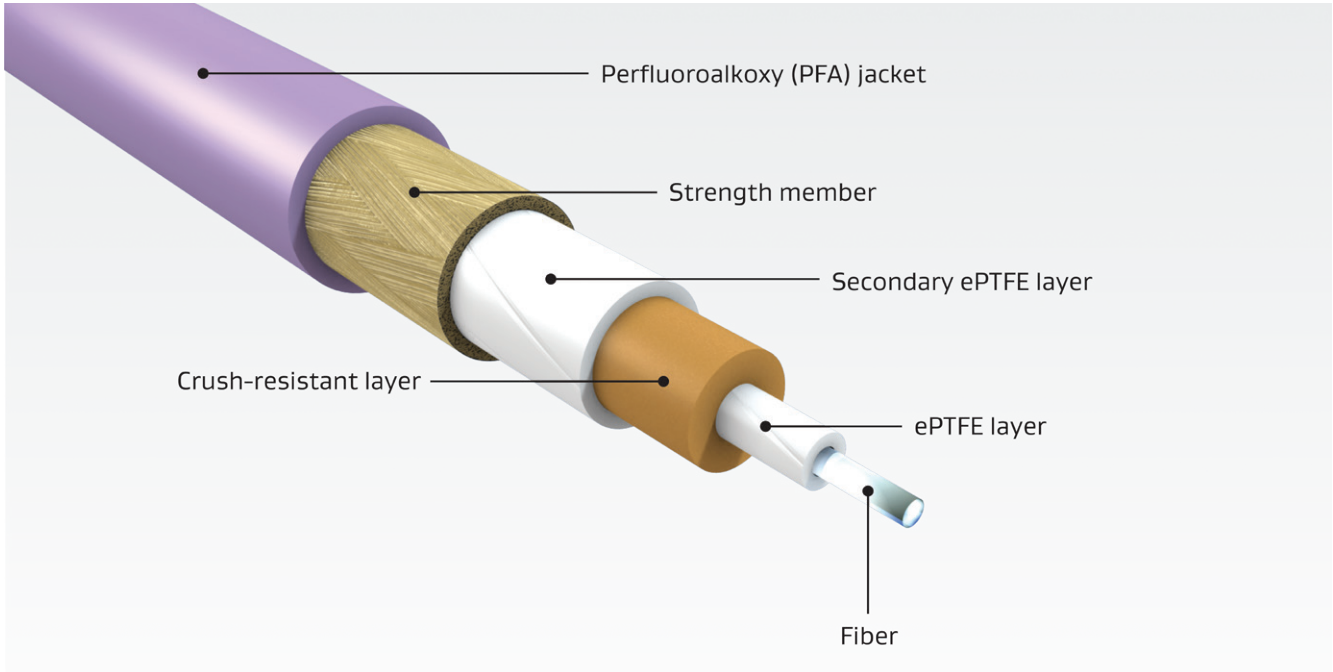


Table 1: Cable Properties

Optical

Property	Value
	GSC-13-84943-07 / GSC-13-84943-17*
Maximum Optical Loss (dB/km)	
at 850 nm	≤ 5.0
at 1300 nm	≤ 3.0

Mechanical / Environmental

Property	Value
Jacket Color	Violet
Jacket Material	PFA
Core Type	OM3 Multi-Mode, Graded Index
Coating Type	High-Temperature Acrylate
Core/Cladding/Coating	50/125/245
Buffering System	Expanded PTFE/Crush-Resistant Layer OD: 900 microns (Nominal)
Nominal Outer Diameter mm (in)	1.8 (0.07)
Minimum Bend Radius mm (in)	18.0 (0.71)
Nominal Weight (g/m)	4.0
Tensile Strength (N)	200
Temperature Range (°C)	-65 to +135

*Cable jacket material includes JN1177 marking.

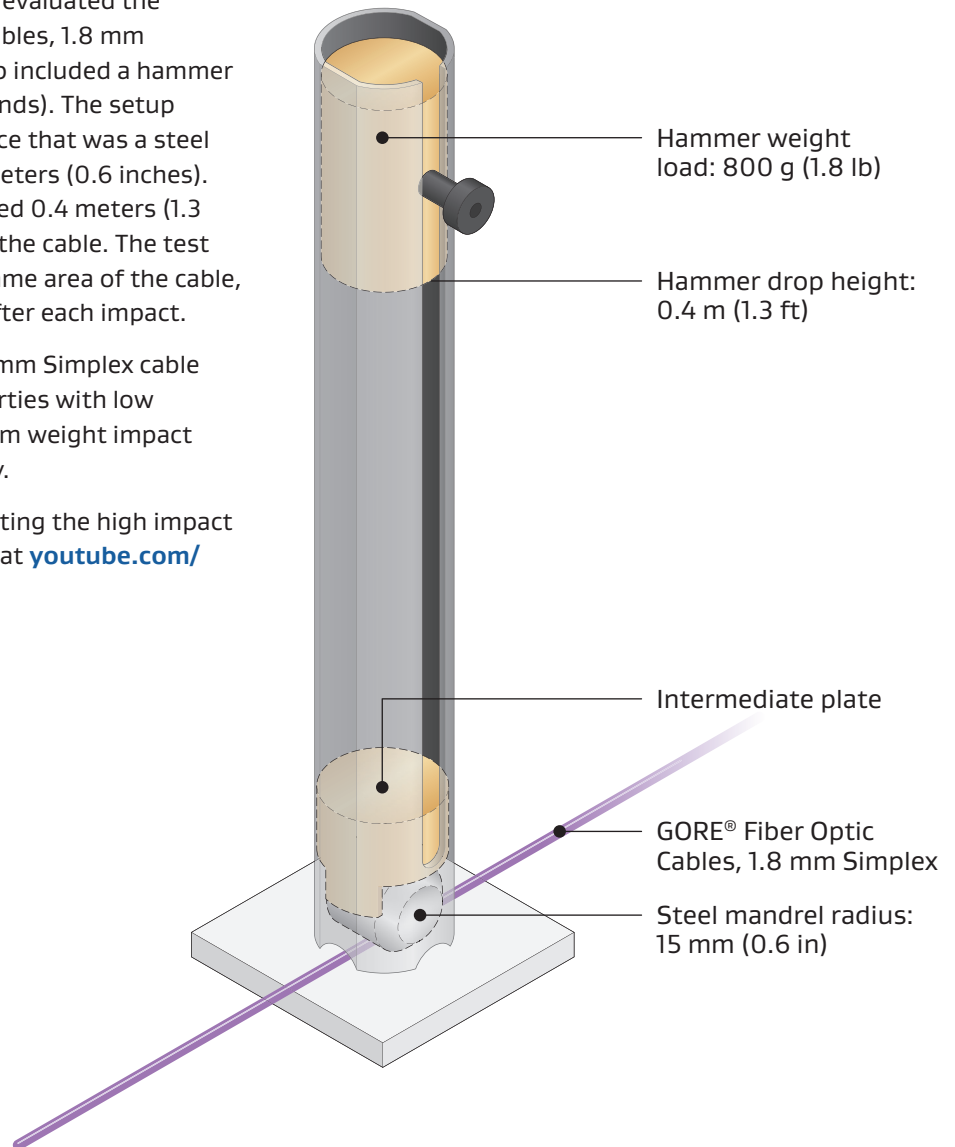
Higher Weight Impact Resistance

Using EN3745, method 506, Gore evaluated the durability of GORE® Fiber Optic Cables, 1.8 mm Simplex. Figure 2 shows the setup included a hammer that weighed 800 grams (1.8 pounds). The setup also included an intermediate piece that was a steel mandrel with a radius of 15 millimeters (0.6 inches). The hammer was manually released 0.4 meters (1.3 feet) in height and dropped onto the cable. The test was repeated five times on the same area of the cable, and performance was recorded after each impact.

Results indicated that Gore's 1.8 mm Simplex cable retained its original optical properties with low attenuation, meeting the minimum weight impact requirements for added durability.

Watch a video of Gore demonstrating the high impact resistance of the 1.8 mm Simplex at [youtube.com/watch?v=hSCYb1PQ6RU](https://www.youtube.com/watch?v=hSCYb1PQ6RU).

Figure 2: Test Setup



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High Vibration & Mechanical Shock Endurance

Gore also evaluated the vibration and mechanical shock performance of its fiber optic cable after exposure to extreme temperatures. The samples were tested on multiple axes at a total energy of 15_{geff} for vibration and acceleration at 50 g (0.1 lb) for mechanical shock. Results showed that GORE® Fiber Optic Cables, 1.8 mm Simplex endured high-intensity vibration and mechanical shock without degradation or optical loss in a wide range of temperatures for extended service life (Figures 3–6).

Figure 3: Vibration Endurance at -40°C (850 nm)

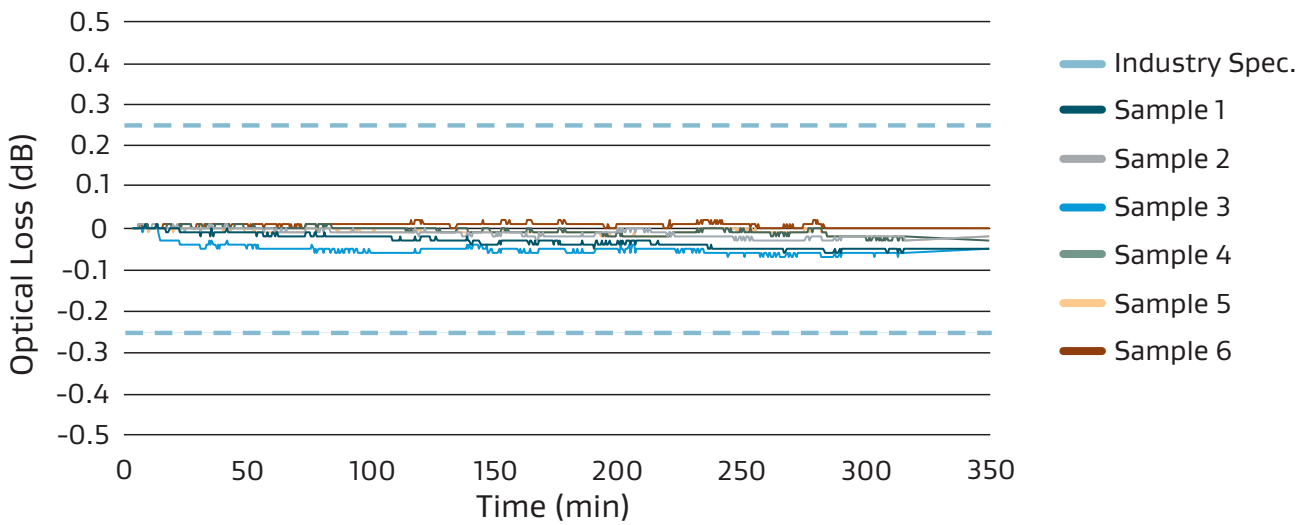


Figure 4: Vibration Endurance at +135°C (1300 nm)

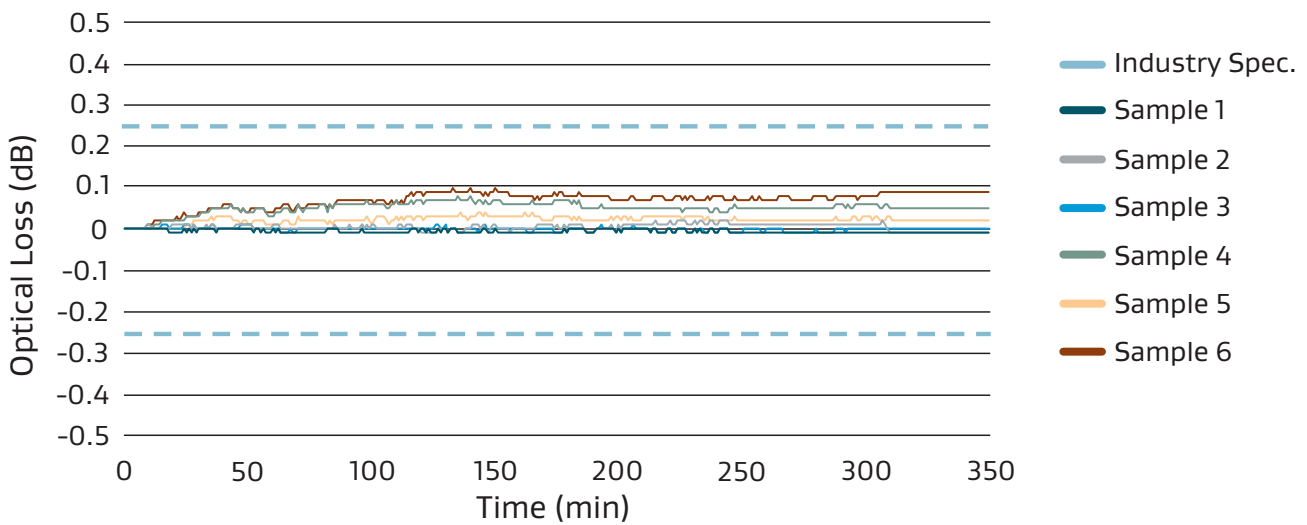


Figure 5: Mechanical Shock Endurance at -40°C (850 nm)

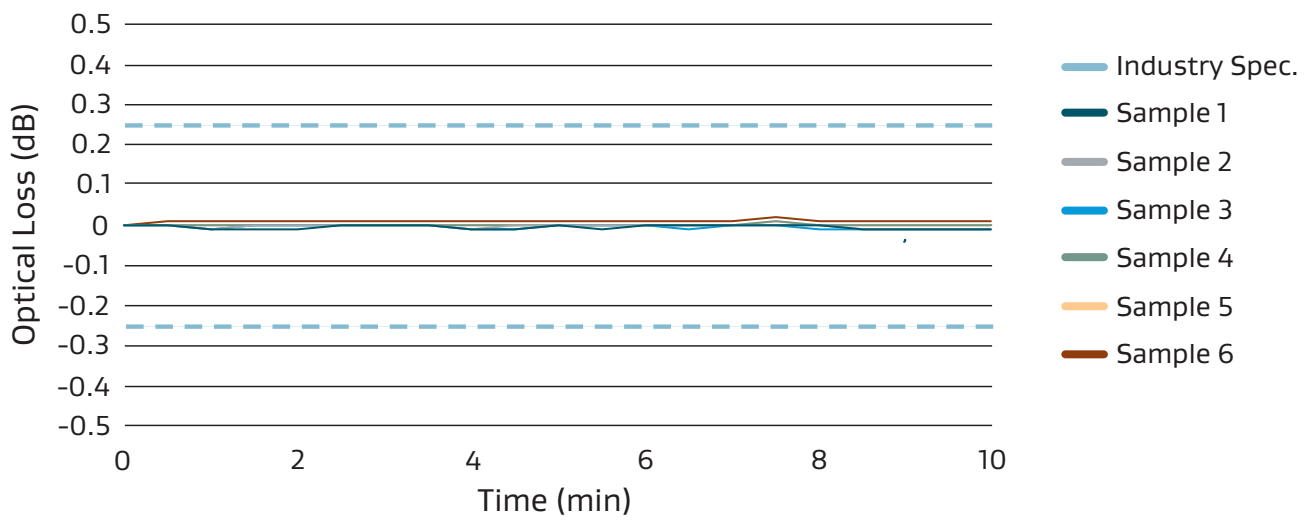
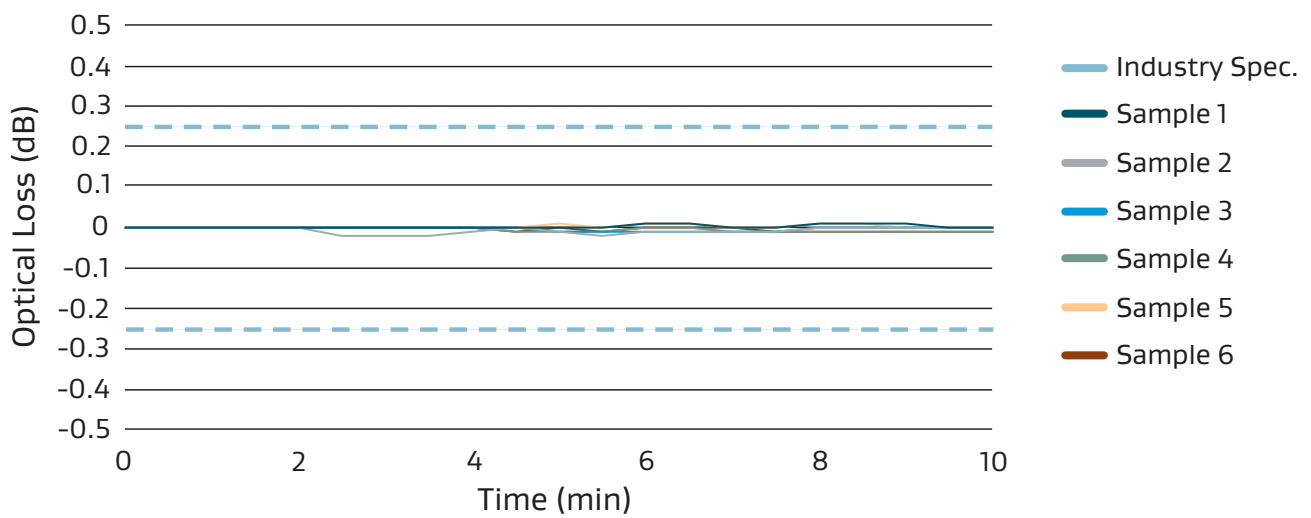


Figure 6: Mechanical Shock Endurance at +135°C (1300 nm)



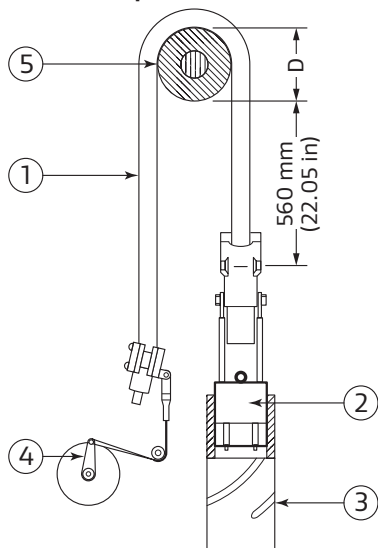
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Greater Torque Endurance

Gore tested the 1.8 mm Simplex using EN3745, method 514, to determine whether attenuation changed or remained stable after constant twisting and bending. Gore tested their 5 m (16.4 ft) cable with an applied load force of 150 N and room temperature set at 24°C. The cable was rotated clockwise at a 180-degree angle around a mandrel set to an 18 mm (0.7 in) radius and returned it to the starting position (Figure 7). Next, the cable was rotated counter-clockwise at 180 degrees around the mandrel and returned to the starting position. The test was repeated, and performance was recorded after each cycle.

Results showed that GORE® Fiber Optic Cables, 1.8 mm Simplex maintained reliable signal integrity after 2,000 cycles. Results also indicated no evidence of jacket degradation or softening, surface damage, cracking, splitting, or penetration, making this version ideal for complicated routing in new and existing aircraft.

Figure 7: Test Setup



1. Sample length: 5 m (16.4 ft)
2. Mass: (written in norm)
3. Vertical movement: 200 mm (15.75 in) ± 90° torsion from the center. Total torsion is 180°
4. Tension arm (tension branch/clamping arm) and working: 300 cycles per minute
5. Running role adjusted to 10 times the cable diameter plus maximum 0.1%

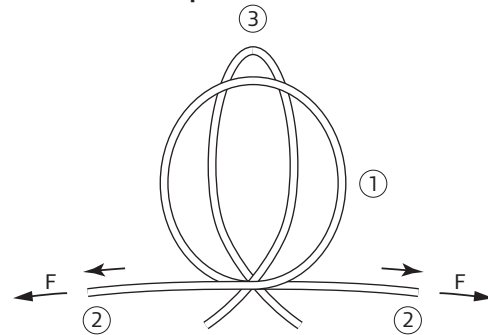
Better Kink Resistance

Using EN3745, method 509, Gore examined the 1.8 mm Simplex to determine the cable's resistance to severe kinking and over-bending. Gore looped a 2 m (6.6 ft)

cable at a minimum diameter of 10 mm (0.4 in), which is the requirement for the standard (Figure 8). The test was repeated on three samples, and performance was recorded after each test. Then, Gore looped the cable at a diameter of 6.5 mm (0.3 in) to test under harder conditions, and performance was recorded.

Results revealed that GORE® Fiber Optic Cables, 1.8 mm Simplex did not kink or break and maintained stable optical performance with low attenuation, exceeding the minimum requirements.

Figure 8: Test Setup



1. Original loop diameter
2. Direction of force applied
3. Loop diameter after force applied: 10 mm (0.4 in) and 6.5 mm (0.3 in)

Low Shrink Back

Gore tested the shrink-back resistance of the 1.8 mm Simplex according to EN3745-205, method A. Using a 5 m (16.4 ft) cable, they conducted the test in low-to-high temperatures ranging from -65°C to +135°C, soaked the cable for 0.5 hours, and applied heat while increasing and decreasing by 1°C per minute. The test was repeated for 25 cycles, and performance was recorded.

Results verified that GORE® Fiber Optic Cables, 1.8 mm Simplex met the qualification with dimensional stability, low jacket shrinkage with no thermal pre-conditioning required for easier and more reliable connector-cable termination (Table 2).

Table 2: Shrink-Back Resistance

Cable Material	Shrink End A (mm)	Shrink End B (mm)	Shrink Total (mm)	Shrink Total (%)
900 µm Buffer	4.0	2.5	6.5	0.13
1.8 mm Simplex Jacket	7.0	5.5	12.5	0.25

Qualification Testing

GORE® Fiber Optic Cables, 1.8 mm Simplex version has undergone substantial qualification testing to ensure it meets, even exceeds, new and current industry standards for high data rate cables in defense aircraft, such as the Eurofighter (Tables 3-6). Please contact a Gore representative to request the full test report.

Table 3: Cable Performance Requirements

Optical

Property	Value	Standard	Status
Optical Performance	—	—	Pass
Attenuation (dB/km)	850 nm: 2.54	EN3745-301, Method A	Pass
Attenuation with Temperature Cycling (dB/km)	850 nm: < +/- 0.25	EN3745-306 / EN3745-402	Pass
Attenuation with Bending (dB/km)	0.02	EN3745-406	Pass
Attenuation with Torque (Cable Twist Bend) (dB)	< 0.02	EN3745-514	Pass

Mechanical

Property	Value	Standard	Status
Number of Fibers	—	—	Pass
Sheath Color	—	—	Pass
Sheath Wall Thickness	—	—	Pass
Outside Diameter mm (in)	1.8395 to 1.8605 (0.0724 to 0.0732)	EN3745-203	Pass
Primary Buffer Diameter (µm)	240	—	Pass
Secondary Buffer Diameter (µm)	914 to 944	EN3745-203	Pass
Minimum Bend Radius at 20°C	—	—	Pass
Weight (g/m)	≤ 4	—	Pass
Tensile Strength (dB)	150 nm: 0.03 300 nm: 0.15 320 nm: Break Load	EN3745-505, Method B	Pass
Crush Resistance (dB)	850 nm: 0.18, 0.11, 0.18, 0.18, 0.16 1300 nm: 0.18, 0.10, 0.17, 0.18, 0.14	EN3745-513	Pass
Torque Endurance (Cable Twist Bend)	Visual Inspection	EN3745-514 / EN3745-201L	Pass
Cable Shrinkage or Elongation (%)	0.11, 0.14, 0.14, 0.03, 0.17, 0.06	J61.611 8.2.43	Pass

GORE® Fiber Optic Cables, 1.8 mm Simplex for Defense Aircraft

Table 4: Fiber Core Performance Requirements

Description	Results	Standard	Status
Refractive Index Difference of Core/Cladding (dB/km)	850 nm: 1.483 1300 nm: 1.478	IEC 60793-1-42	Pass
Numerical aperture	0.209	EN3745-302	Pass
Fiber Attenuation (dB/km)	850 nm: 2.36 1300 nm: 0.55	EN3745-301, Method A	Pass
Fiber Core Dimension (µm)	51.7	EN3745-202	Pass
Fiber Dimension Core Non-Circularity (%)	1.5	EN3745-202	Pass
Fiber Cladding Dimension (µm)	124.9	EN3745-202	Pass
Fiber Dimension Cladding Non-Circularity (%)	0.4	EN3745-202	Pass
Fiber Dimension Concentricity (µm)	0.7	EN3745-202	Pass
Optical Fiber Proof Test (N)	8.8	EN3745-501	Pass

Table 5: EN4641-301 Requirements

Description	Results	Standard	Status
Fiber Visual Inspection	—	EN3745-201	Pass
Fiber Core Diameter (µm)	51.7	EN3745-202, Method A	Pass
Fiber Proof Test (N)	8.8	EN3745-501	Pass
Fiber Cladding Diameter (µm)	124.9	EN3745-202, Method A or B	Pass
Non Circularity of Core (%)	1.5	EN3745-202	Pass
Non Circularity of Cladding (%)	0.4	EN3745-202	Pass
Concentricity Error of Fiber Core/Cladding (µm)	0.7	EN3745-202	Pass
Fiber Attenuation (dB/km)	850 nm: 2.36 1300 nm: 0.55	EN3745-301, Method A	Pass
Numerical Aperture	0.209	EN3745-302	Pass
Bandwidth (MHz*km)	850 nm: 2795 1300 nm: 584	EN3745-303	Pass
Cable Visual Inspection	—	EN3745-201	Pass
Secondary Buffer Diameter (µm)	914 to 944	EN3745-203	Pass
Cable Sheath Outside Diameter mm (in)	1.8395 to 1.8605 (0.0724 to 0.0732)	EN3745-203	Pass
Primary Buffer Diameter (µm)	240	EN3745-203	Pass

Table 5: EN4641-301 Requirements (continued)

Description	Results	Standard	Status
Longitudinal Stability (% Shrink)	Buffer: 0.13 Jacket: 0.25	EN3745-205, Method A	Pass
Cable Attenuation (dB/km)	850 nm: 2.54	EN3745-301, Method A	Pass
Susceptibility to Ambient Light Coupling (Optical Isolation of Cable Jacket) (dB/m)	-60	EN3745-305	Pass
Attenuation During Temp Cycling (dB)	< +/- 0.25	EN3745-306 / EN3745-402	Pass
Accelerated Aging (dB)	< +/- 0.1	EN3745-401	Pass
Thermal Shock (dB)	< +/- 0.25	EN3745-404	Pass
Cold Bend (dB)	0.23	EN3745-406	Pass
Humidity Resistance (dB)	0.11	EN3745-412	Pass
Bend (dB)	0.12 dB, -0.03	EN3745-510, Method A	Pass
Cable Repeated Bending (Cyclic Flexing) (dB)	0.1	EN3745-512	Pass
Scrape Abrasion (dB)	± 0.04	EN3745-503	Pass
Cable-to-Cable Abrasion	—	EN3745-511	Pass
Impact (dB)	0.03	EN3745-506	Pass
Cut-Through	No Fiber Breakage	EN3745-507	Pass
Torsion (dB)	≤ 0.17	EN3745-508	Pass
Kink (dB)	≤ 0.58	EN3745-509	Pass
Cable Tie Clamping (dB)	0.04	EN3745-517	Pass
Micro Bending (dB)	≤ 0.01	EN3745-504	Pass
Cable Crush Load (dB)	≤ 0.18	EN3745-513	Pass
Cable Tensile Strength (dB)	150 N: 0.03 300 N: 0.15 320 N: Break Load	EN3745-505, Method B	Pass
Flammability	—	EN3745-407	Pass
Smoke Density (dm)	25	EN3745-601	Pass
Cable Stripping	—	EN3745-701	Pass
Durability of Manufacturers Identity Marking	—	EN3745-703	Pass
Resistance to Contamination & Aircraft Fluids	—	EN3745-411, Method 2	Pass
Contrast Ratio (%)	≥ 75	EN3745-705	Pass

GORE® Fiber Optic Cables, 1.8 mm Simplex for Defense Aircraft

Table 6: JN1177 Additional Eurofighter Requirements

Description	Results	Standard	Status
Shrinkage or Elongation of Jacket (%)	0.11, 0.14, 0.14, 0.03, 0.17, 0.06	J61.611 8.2.43	Pass
Dimensional Stability (%)	≤ 0.06	J61.611 8.2.44	Pass
Dimensional Stability (%)	≤ 0.29	J61.611 8.2.45	Pass
Temperature Resistance (dB)	≤ 0.45	J61.611 8.2.46	Pass
Cable Twist Bend (dB)	Visual Inspection: EN3745-201 Attenuation: < 0.02	EN3745-514	Pass
Toxicity Index	—	EN3746-602	Pass
Cable Marking	—	EN3745-706	Pass
Biological and Chemical Requirements	—	Eurofighter specification SP-J-000-E-1028	Pass
Resistance to Contamination & Aircraft Fluids	—	EN3745-411, Method 2	Pass
Bandwidth (MHz*km)	850 nm: 2795	EN3745-303	Pass

Qualifications Summary

Table 7 provides an overview of the qualification testing for GORE® Fiber Optic Cables, 1.8 mm Simplex.

Table 7: Standards Compliance

Description	Standard	Status
Abrasion Resistance	EN3745-503; JN1177	Compliant
Accelerated Aging	EN3745-401; JN1177	Compliant
Chemical Resistance	EN3745-411; JN1177; SP-J-000-E-1028	Compliant
Cold Bend Resistance	EN3745-406; JN1177	Compliant
Cut-through Resistance	EN3745-507; JN1177	Compliant
Fiber Movement under Compression	ARINC-802-2	Compliant (GSC-13-84639, GSC-13-84640, GSC-13-84943)
Flammability	ABD0031 (AITM 2.0005); BSS7230; FAR Part 25, Appendix F, Part I	Compliant
Fluid Resistance	EN3475-411	Compliant
Flex Endurance	EN3745-512; JN1177	Compliant
Humidity Resistance	E3745-412; JN1177	Compliant
Impact/Crush Resistance	EN3745-513; JN1177	Compliant (GSC-13-84639)
Kink Resistance	EN3745-509; JN1177	Compliant
Smoke Density	ABD0031 (AITM 3.0008B); BSS7238; EN3745-601; FAR Part 25, Appendix F, Part V / JN1177	Compliant
Temperature Resistance	EN3745-402; JN1177	Compliant
Tensile Strength	EN 3745-505; JN1177	Compliant
Thermal Shock	EN3745-404; JN1177	Compliant
Torque Endurance	EN 3745-514; JN1177	Compliant
Toxicity	ABD0031 (AITM 3.0005); BSS7239; EN3745-602	Compliant

Ordering Information

The 1.8 mm Simplex version of GORE® Fiber Optic Cables is available in standard sizes (Table 8). Visit gore.com/cable-distributors for the list of distributors.

For more information or to discuss specific characteristic limits and application needs — including a bend-sensitive fiber option or particular fiberglass type, please contact a Gore representative.

Table 8: Cable Characteristics

Gore Part Number	Core Type	Core/Cladding/Coating	Jacket Color	Nominal Outer Diameter mm (in)	Minimum Bend Radius mm (in)	Nominal Weight g/m	Maximum Tensile Strength N
GSC-13-84689-04	SM (Single Mode)	9/125/245	Yellow	1.8 (0.07)	18.0 (0.71)	4.0	150
GSC-13-84689-07	SM (Single Mode)	9/125/245	Violet	1.8 (0.07)	18.0 (0.71)	4.0	150
GSC-13-84640-04	OM1 (Multi-Mode, Graded Index)	62.5/125/245	Yellow	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-84640-07	OM1 (Multi-Mode, Graded Index)	62.5/125/245	Violet	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-84639-04	OM2 (Multi-Mode, Graded Index)	50/125/245	Yellow	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-84639-07	OM2 (Multi-Mode, Graded Index)	50/125/245	Violet	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-84943-04	OM3 (Multi-Mode, Graded Index)	50/125/245	Yellow	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-84943-07 / GSC-13-84943-17*	OM3 (Multi-Mode, Graded Index)	50/125/245	Violet	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-85423-04	OM4 (Multi-Mode, Graded Index)	50/125/245	Yellow	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-85423-07	OM4 (Multi-Mode, Graded Index)	50/125/245	Violet	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-85868-04	OM5 (Multi-Mode, Graded Index)	50/125/245	Yellow	1.8 (0.07)	18.0 (0.71)	4.0	200
GSC-13-85868-07	OM5 (Multi-Mode, Graded Index)	50/125/245	Violet	1.8 (0.07)	18.0 (0.71)	4.0	200

* Cable jacket material includes JN1177 marking.

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