

Draft Specification for Optical Cable, Single, Multimode Fiber,  
Hermetic, Tight Buffer, Single Jacket, for Space Flight  
Part Number XXXXX-4

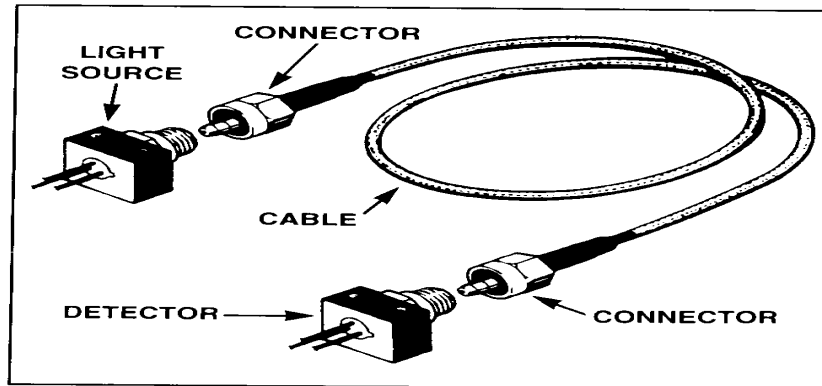
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## 1.0 Scope

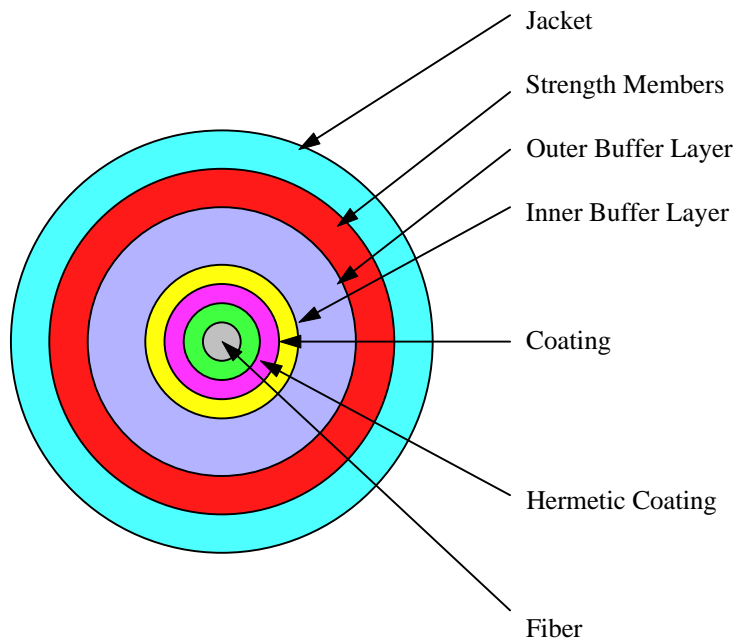
- 1.1 **Purpose:** This specification defines requirements for fiber optic cable for use in space flight applications. The cable types described here are intended for point-to-point applications which use connectors on each end of the cable, where exposure to mechanical stress will be moderate. These cables are limited to types using a 100/140  $\mu\text{m}$  size core/cladding with graded refractive index profile.



POINT TO POINT SPACECRAFT CABLE ASSEMBLY

Table 1.

<i>Element</i>	<i>Material</i>	<i>Dimensional Requirement</i>
Jacket	FEP Teflon	Outer diameter 0.046" +0.002"/-0.003" (1.168 mm +0.051/- 0.076 mm)
Strength Members	spiral (helical) or laterally wound Kevlar <sup>®</sup>	
Outer Buffer Layer	Fluoropolymer	Wall thickness 0.005" +0.001"/-0.002" (0.127 mm +0.025/- 0.051 mm) Outer diameter 0.024" +0.002"/-0.005" (0.610 +0.051/- 0.127 mm)
Inner Buffer Layer	GORE-TEX <sup>®</sup> Expanded PTFE	Helically wound tape
Coating	two layer acrylate (chemically strippable with MEK and Methylene chloride)	Outer diameter: 0.500 ± 25 mm Non-circularity: ≤ 10%
Hermetic coating	amorphous carbon	400 angstroms thickness maximum
Fiber Cladding	radiation hardened silica	140 micron +/- 2 micron
Fiber Core	radiation hardened silica	100 micron +/- 3 micron
Core/Cladding Offset		≤ 3 microns ( <i>test method?</i> )
Core Non-circularity		£5% ( <i>test method?</i> )



- 1.2 General Specification Unless otherwise specified in this detail specification, all cable provisions of GSFC specification S-311-339 apply.
- 1.3 Materials and Dimensions: Specifications for materials and dimensions which define this cable are shown in Table 1.
- 1.4 Part Number. The part number for this cable construction shall be XXXXX-4. The final digit in the part number is intended to differentiate between similar cables as additional designs emerge, which are appropriate for listing as part of this slash sheet.
- 1.5 Absolute Maximum Ratings. The absolute maximum ratings are as shown below and in Table 1 above.

Attenuation (over operating temperature range):

850 nm source: 5 dB/km

1300 nm source: 3 dB/km

Bandwidth: 100 MHz/km

Numerical Aperture:  $0.29 \pm 0.015$

Operating Temperature Range:  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

Storage Temperature Range:  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$

Short Term Temperature Exposure:  $-55^{\circ}\text{C}$  to  $+140^{\circ}$  for 1 hr

Bend Radius: 50 mm

## 2. APPLICABLE DOCUMENTS

- 2.1 Documents. The following documents, of the issue in effect on the date of invitation for bid or request for proposal, form a part of this specification to the extent specified herein. A later revision of a specification may be used, as long as, the later revision does not degrade the specification requirements.

## STANDARDS

### Military

DOD-STD-1678	Fiber Optics Test Methods and Instrumentation
MIL-STD-2223	Test Methods for Insulated Electric Wire

### Industry

EIA/TIA-455-3	FOTP-3, Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components
EIA/TIA-455-31	FOTP-31, Proof Testing Optical Fibers by Tension
EIA/TIA-455-55	FOTP-55, End-View Methods for Measuring Coating and Buffer Geometry of Optical Fibers
EIA/TIA-455-89	FOTP-89, Fiber Optic Cable Jacket Elongation and Tensile Strength
EIA/TIA-526-14	OFSTP-14, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

- 2.2 Order of Precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. However, nothing in this document supersedes applicable laws and regulations unless a specific exemption has been granted.

## 3. REQUIREMENTS

- 3.1 Design, Construction and Physical Dimensions. All cable dimensions, tolerances and limits defined in 1.3 above shall apply.

**3.1.1** Core/Cladding Offset. Core/Cladding offset shall be measured in accordance with paragraph 4.4 below as part of Group A testing on every lot. The offset shall meet the limit described in Table 1 above.

**3.1.2** Coating Geometry. Coating outer diameter and non-circularity shall be measured in accordance with paragraph 4.5 below and shall meet the limits shown in Table 1 above. The coating offset measurement shall be made in accordance with the referenced procedure however the limit shall be that the offset does not cause the coating wall to be thinner than 0.155 mm. The measurements shall consider the double layer coating as one layer. The

amorphous carbon layer shall be visibly present but is not required to be measured. Coating geometry measurements shall be performed as part of Group A testing on every lot.

- 3.2 Weight. The maximum weight by length shall be 4 g/m.
- 3.3 Attenuation. The attenuation shall not exceed the maximum rating stated in 1.5 above. The measurement shall be made using EIA/TIA-526-14 (OFSTP-14) Method B. The delta limit during and following qualification testing shall be 1 dB per 100 meters.
- 3.4 Bandwidth. The bandwidth shall not be less than that described in 1.5 above when tested in accordance with the general specification. Bandwidth shall be included in Group A testing following Attenuation.
- 3.5 Pull-Proof Connector Compatibility: The cable design and construction shall allow at least 1mm of free lateral movement of the coated fiber within a loose buffer or a tight buffered fiber within strength members or a primary jacket to allow use of this cable with a pull-proof connector.
- 3.6 Jacket and Buffer Shrinkage: Following preconditioning for 10 hours at 85°C, the cable jacket and buffer shall not shrink greater than 0.4% by length.
- 3.7 Ionizing Radiation. Performance stability in an ionizing radiation environment shall be established by test or by analysis to be  $\leq$  XXX dB loss per xxxx meter sample.
- 3.8 Material Outgassing. The outgassing requirements of the general specification shall apply to all the materials of the cable with the exception of the coatings
- 3.9 Numerical Aperture. The numerical aperture shall be  $0.29 \pm 0.015$  when measured in accordance with the general specification.
- 3.10 Strippability: The coating shall be strippable by chemical means. After chemical immersion for not more than 2 minutes in methylene chloride and wiped with a kim-wipe exposing the hermetic coating.
- 3.11 Tensile Load (Proof Test). The proof test shall be performed as part of Group A screening, on every sample lot. For qualification, this test shall be performed as part of Group I and removed from Group IV.
- 3.12 Tensile strength and elongation. The percent elongation shall be xxxxx and the tensile strength shall be xxxx when tested in accordance with paragraph 4.9 below. Tensile strength and elongation shall be testing as part of qualification in Group IB. (*← would like to specify this number for user's benefit and to establish minimum*

*performance for cables supplied to this spec. Establish these numbers based on qual testing).*

- 3.13 Flammability. When tested in accordance with paragraph 4.10 herein, the flame shall self-extinguish in less than or equal to 10 seconds and shall not travel more than 1 cm.
- 3.14 Impact. Testing shall be in accordance with the base specification and paragraph 4.11 herein. The change in attenuation shall be less than 0.4 dB and there shall be no damage to the jacket, following the test.
- 3.15 Crush (Compressive Strength). Compressive strength shall be verified as specified in paragraph herein. The change in attenuation shall be less than 0.4 dB and there shall be no physical damage to the jacket, following the test.
- 3.16 Certificate of Conformance. A certificate of conformance in accordance with the GSFC -S-311-339 paragraph 4.7 shall be provided with each lot of fiber optic cables delivered to this specification.
- 3.17 Verification and Review. GSFC retains the option to review the manufacturer's facility and applicable required documentation. Offshore documentation shall be made available onshore at the option of the reviewer. Pre-ship inspection is the option of GSFC and requires one week advance notice from the vendor for scheduling.
- 3.18 Qualification. Parts furnished to this specification shall be product which has been granted qualification approval by NASA/GSFC. Qualification approval shall be based on the following:
  - 3.18.1 Design and source approval. Prior to qualification, the manufacturer's facility shall be subjected to a survey, at the option of GSFC. The history and detailed engineering of the specific (part) design will be reviewed, as will the documented manufacturing and quality control procedures. Only those sources approved in the design and source phase shall be eligible for qualification or award of contract under this specification. Source approval and design approval are not substitutes for part qualification or an equivalent thereof.
  - 3.18.2 Part qualification. The cable shall be product which has passed the qualification inspection requirements of this specification. This requirement may be satisfied by passing the qualification inspection (see 4.2).
  - 3.18.3 Qualification by similarity. Qualification may be granted by GSFC based on existing qualification test data for product of similar design, manufactured by similar processes and controls. If qualification is to be based on generic qualification test data or on other conditions, the vendor shall supply the appropriate supporting documentation. GSFC will have the final decision on

which parts will require qualification testing and which may be qualified by other means.

- 3.19 Quality assurance provisions. Quality assurance requirements shall be as specified in GSFC S-311-339 and Section 4 herein. The product assurance program shall be subject to review and approval by GSFC.
- 3.20 Packaging. Packaging shall be in accordance with GSFC S-311-339 and Section 5 herein. Preparation for delivery shall meet specified requirements for identification, certification, and data package requirements.
- 3.21 Data requirements. The deliverable data package is described in section 6.3 herein.

#### 4. QUALITY ASSURANCE PROVISIONS

- 4.1 Conditions for optical measurements. Light launch conditions shall be in accordance with the referenced test method. ***Cladding mode stripping is not required.***
- 4.2 Qualification maintenance. At the discretion of GSFC but not less than every other year, the manufacturer will be requested to furnish a summary of qualification test results for product not older than six months, for retention of qualification status.
- 4.3 Serialization. Applicable.
- 4.4 Core/Cladding offset. The core/cladding offset shall be measured in accordance with EIA/TIA-455-?? at a minimum of xx places along the sample and shall meet the limit defined in Table 1 above.
- 4.5 Coating Geometry. Coating geometry shall meet the requirements of paragraph 3.1.2 above when measured in accordance with EIA/TIA-455-55 (FOTP-55), Method A. Two samples shall be measured; one from each end of the cable lot.
- 4.6 Attenuation. Attenuation shall be measured in accordance with EIA/TIA-526-14 (OFSTP-14) Method B.
- 4.7 Temperature Cycling. Temperature cycling shall be performed in accordance with EIA/TIA-455-3 (FOTP-3) over the rated temperature range. The rate of temperature change shall be in accordance with FOTP-3. Attenuation measurements shall be made during and after the cycling and visual examination performed after the test.

- 4.8 Tensile Load (Proof Test). The tensile load performance shall be measured in accordance with EIA/TIA-455-31 (FOTP-31). In-line testing is a suitable substitute for specimen based testing.
- 4.9 Tensile Strength and Elongation. Tensile strength and elongation shall be performed in accordance with EIA/TIA-455-89 (FOTP-89) and shall meet the requirements of 3.12.
- 4.10 Flammability. A 24 inch sample shall be tested in accordance with MIL-STD-2223, Method 1006.
- 4.11 Impact. Impact testing shall be performed in accordance with the base specification with the exception that the number of cycles shall be 10.
- 4.12 Crush (Compressive Strength). The cable shall meet the requirements of the base specification and paragraph 3.15 herein when testing in accordance with DOD-STD-1678, Method 2040, Procedure II. Optical measurements shall be performed in accordance with the methods described in the base specification and in paragraph 3.3 above. The tensile load shall be 90 kg (200 lb) and shall be applied for 1 minute.

## 5. PACKAGING

- 5.1 Packaging requirements. The requirements for packaging shall be in accordance with GSFC-S-311-339.

## 6. NOTES

- 6.1 Ordering data. Procurement documents shall specify the following:
- (a) Title, number and date of this and the applicable detail specification.
  - (b) Device part number (see 1.2)
- 6.2 Qualification provisions. With respect to products requiring qualification, awards will be made only for products which have been tested and approved by GSFC before the time for opening of bids. The attention of the suppliers is called to this requirement: manufacturers should arrange to have qualification tests made on products which they propose to offer to GSFC to become eligible for awards of contracts or orders for products covered by this specification. The manufacturer shall bear the cost of qualification inspection to this specification. Information pertaining to qualification of product may be obtained from the activity whose address is listed in 6.4.



6.2.1 NOTICE. When GSFC drawings, specifications, or other data are sent for any purpose other than connection with a definitely related GSFC procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever. The fact that GSFC may have formulated, furnished or in any way supplied said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any persons or corporations, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

6.3 Deliverable data package. The deliverable data package for each lot of each lot of each cable type shall include the following:

- A. Cover sheet with traceability information and serial number range.
- B. Certificate of processing and quality conformance.
- C. Group A variable and attributes data
- D. Radiation test certificate or analysis
- E. Waivers, if any.
- F. Generic data if applicable.
- G. Part numbers for non-proprietary materials (coated fiber, coating, buffer, strength members, jacket, etc.)