INCH-POUND

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17 May 2013
SUPERSEDING
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DETAIL SPECIFICATION

CONNECTORS, FIBER OPTIC, SINGLE FERRULE, GENERAL SPECIFICATION FOR

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification defines the characteristics, performance and testing criteria for single ferrule fiber optic connectors. The connectors described herein cover families as listed in 1.2. The connectors are supplied under a MIL-STD-790 reliability assurance program. See 6.1 for restrictions on intended use and applications.

1.2 Classification. Styles for single ferrule plug – to – single ferrule plug, single ferrule plug t receptacle. And housing (both plug and receptacle) for a single fiber optic termini mated pair will permit in-line, wall mounted, panel and rack, right angle, and other configurations. Individual connector requirements will be as specified herein and in accordance with the applicable specification sheets (see 3.1).

1.2.1 Part or identifying number (PIN). The PIN will consist of the letter “M” followed by the basic specification sheet number, and a 3 to 5 character alpha-numeric (see 3.1).

Example:

M83522/01 -	XXXX	S
Basic specification sheet number	3 or 4 character alpha-numeric (see 3.1)	S indicates space flight component

1.3 Type. Connectors covered by this specification will be of the following types as specified (see 3.1).

a. Type I – Multimode (MM).

b. Type II – Single mode (SM).

2. APPLICABLE DOCUMENTS

Beneficial comments, recommendations, additions, deletions, clarifications, etc., and any data that may improve this document should be sent to: DLA Land and Maritime, Columbus, ATTN: VAT, P.O. Box 3990, Columbus OH 43218-3990, or email FiberOpticGroup@dla.mil. Since contact information can change you may want to verify the currency of the address information using the ASSIST Online database at https://assist.dla.mil.

AMSC N/A FSC 6060

2.1 Government documents.

2.1.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.1.1.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

COMMERCIAL ITEM DESCRIPTION

A-A-59588	-	Rubber, Silicone.

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-55330	Connectors, Electrical and Fiber Optic, Packaging of.
MIL-S-901	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment & Systems, Requirements For.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-129	Marking for Shipment and Storage.
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts.
MIL-STD-790	Product Assurance Program for Electronic and Fiber Optic Parts Specifications.
MIL-STD-810	Environmental Test methods and Engineering Guidelines.
MIL-STD-889	Dissimilar Metals.
MIL-STD-1285	Marking of Electrical and Electronic Parts.
MIL-STD-1678-1	Fiber Optic Cabling Systems Requirements and Measurements (Part 1: Design, Installation and Maintenance Requirements) (Part 1 of 6 Parts)
MIL-STD-1678-2	Fiber Optic Cabling Systems Requirements and Measurements (Part 2: Optical Measurements) (Part 2 of 6 Parts)
MIL-STD-1678-3	Fiber Optic Cabling Systems Requirements and Measurements Physical, Mechanical, Environmental and Material Measurements (Part 3 of 6 Parts)

DEPARTMENT OF DEFENSE HANDBOOK

MIL-HDBK-454	Standard General Requirements for Electronic Equipment.

(Copies of these documents are available online at http://quicksearch.dla.mil/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

NATIONAL AERONAUTICAL AND SPACE ADMINISTRATION (NASA)

NASA-STD-6001 - Flammability, Odor, Off-gassing, and Compatibility Requirements and Test Procedures for Materials in Environments That Support Combustion

(Copies of this document are available online at http://www.nasa.gov/centers/johnson/home/ or the NASA Johnson Space Center 2101 NASA Parkway Houston, Texas 77058.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM-A484/A484M	General Requirements for Stainless and Heat-Resisting Wrought Steel Products (Except Wire).
ASTM-A582/A582M	Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished.
ASTM B16/16M	Rod, Brass, Free-Cutting, Bar and Shapes for use in Screw Machines
ASTM B-36/36M	Plate, Brass, Sheet, Strip, and Rolled Bar
ASTM D1141	Standard Specification for Substitute Ocean Water.
ASTM D1430	Standard Specification for Polychlorotrifluro-ethylene (PCTFE) Plastics.
ASTM D2116	Standard Specification for FEP Fluorocarbon Molding and Extrusion Materials.
ASTM D6778	Polyoxymethylene (POM, Acetal) Molding and Extrusion Materials
ASTM E595	Total Mass Loss and Collected Volatile Condensable Materials From Outgassing in a Vacuum Environment.

(Copies of these documents are available online at http://www.astm.org or from ASTM International, P.O. Box C700, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECA EIA-364	Electrical Connector/Socket Test Procedures Including Environmental Classifications
ECA EIA-364-81	Combustion Characteristics Test Procedure for Electrical Connector Housings, Connector Assemblies and Sockets.

(Copies of these documents are available online at http://www.eciaonline.org or from ECIA, 1111 Alderman, Suite 400, Alpharetta, GA 30005.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 10012	Measurement Management Systems - Requirements for Measurement Processes and Measuring Equipment - First Edition

(Copies of this document are available online at www.ansi.org of from the ANSI Customer Service Department, 25 W. 43rd Street, 4th floor, New York, NY 10036.)

SAE INTERNATIONAL

SAE-AMS-QQ-A-225	Aluminum and Aluminum Alloy, Bar, Rod, Wire, or Special Shapes; Rolled,Drawn, or Cold Finished; General Specification For
SAE-AMS-QQ-S-763	Steel Bars, Wire, Shapes, and Forgings, Corrosion-Resisting.
SAE-AMS-2700	Passivation of Corrosion Resistant Steels.

(Copies of these documents are available online at http://www.sae.org or from the SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

TIA-455-3	FOTP-3 Procedure to Measure Temperature Cycling Effects on Optical Fiber Units, Optical Cable, and Other Passive Fiber Components
TIA/EIA-455-4	FOTP-4 Fiber Optic Component Temperature Life Test
TIA-455-5	FOTP-5 Humidity Test Procedure for Fiber Optic Components
TIA-455-6	FOTP-6 Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices
TIA-455-11	FOTP-11 Vibration Test Procedure for Fiber Optic Components and Cables
TIA-455-12	FOTP-12 Fluid Immersion Test for Fiber Optic Components
TIA-455-14	FOTP-14 Fiber Optic Shock Test (Specified Pulse)
TIA-455-16	FOTP-16 Salt Spray (Corrosion) Test for Fiber Optic Components
TIA-455-20	FOTP-20 IEC 60793-1-46: Optical Fibers- Part 1- 46: Measurement Methods and Test Procedures - Monitoring of Changes in Optical Transmittance
TIA-455-21	Mating Durability for Fiber Optic Connecting.
TIA-455-22	Ambient Light Susceptibility.
TIA-455-34	Interconnection Device Insertion Loss Test.
TIA-455-36	FOTP-36 Twist Test for Fiber Optic Connecting Devices.
TIA-455-56	Test Method for Evaluating Fungus Resistance of Optical Fiber and Cable.
TIA-455-64	FOTP-64 Procedure for Measuring Radiation-Induced Attenuation in Optical Fibers and Optical Cables.
TIA-455-71	FOTP-71 Procedure to Measure Temperature - Shock Effects on Fiber Optic Components
TIA-455-107	Return Loss for Fiber Optic Components.
TIA-455-189	FOTP-189 Ozone Exposure Test for Fiber Optic Components.

(Copies of this document are available from http://www.tiaonline.org or from Telecommunications Industry Association, Standards and Technology Department, 2500 Wilson Boulevard Arlington, VA 22201.)

2.3 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Connectors furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturers list before contract award (see 4.5 and 6.3).

3.2.1 Product assurance. The contractor's product assurance program for assembled connectors and assembly procedures shall meet the requirements of MIL-STD-790.

3.2.1.1 Test sample preparation. Fiber optic connector samples complying with the specified requirements (see 3.1) shall be submitted for qualification. For single ferrule connector plug qualification, the manufacturer shall provide the mating single ferrule connector receptacle, or provide the bulkhead adapter with another mating single ferrule connector plug. For bulkhead adapter qualification, the manufacturer shall provide two mating adapters with four mating single ferrule connector plugs. For single ferrule connector receptacle qualification, the manufacturer shall provide a mating single ferrule connector plug. All connectors (plug and receptacle) provided shall be fully assembled, terminated and attached to an appropriate length of the type of cable specified in the appropriate specification sheet. Opposite ends of the cable shall be terminated to an ST connector to facilitate optical testing. All ferrules on single ferrule connectors shall be optically finished (polished to specified process or end face geometry or both) as part of the termination process. Component quantities tested shall be as specified in the specific qualification table (see 3.1).

3.3 Material. Material shall be as specified herein (see table I). If materials other than those specified are used, the contractor shall certify to the qualifying activity that the substitute material enables the connectors to meet the requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the product. When a definite material is not specified, a material shall be used which will enable the connector to meet the requirements of this specification (see 4.4). Materials used in the connector construction shall not emit explosive fumes when exposed to high temperature or flame.

3.3.1 General. The connectors, caps, covers, storage receptacles, or other protective accessory hardware shall be constructed of material as specified herein or as specified in the detail specification sheets (see 3.1). Connectors shall be manufactured to good workmanship quality appropriate with the intended use of the equipment. Materials may be dielectric or conductive. Materials used in the connectors shall in no manner interfere with or degrade the optical performance of the fibers. When definite materials or finishes are specified, the materials or finishes used shall enable the connectors to meet all performance requirements of this specification.

3.3.2 Metals. Unless otherwise specified (see 3.1), all metals used in the construction of the connectors shall be corrosion-resistant types (300 series CRES), or shall be suitably plated or otherwise finished to prevent corrosion during any of the environmental

conditions specified. Surfaces which may be subjected to polishing or other abrasive operations during termination of the connector shall not be plated or coated in anyway.

3.3.2.1 Dissimilar metals. Dissimilar metals shall not be used in intimate contact with each other unless suitably finished to prevent electrolytic corrosion. The criteria for the selection and protection of dissimilar metal combinations shall be in accordance with MIL-STD-889.

3.3.3 Nonmetallic materials. All nonmetallic materials used in the construction of the connectors shall not be affected by the use of cleaning materials nor shall any substance used in the construction of the connectors be degraded when operating under the environmental conditions specified herein.

3.3.3.1 Adhesives (epoxies). Adhesives are not precluded from use in the construction of the connectors specified herein. However, the types of adhesives which may be used shall be specifically defined in the specification sheet (see 3.1). Adhesives shall not be used in the optical path of the connector.

3.3.3.2 Sealing compounds. Sealing compounds, which may flow at the maximum upper nonoperating temperature specified herein, or crack at the minimum lower storage temperature specified herein shall not be used.

3.3.3.4 Lubricants. Lubricants used in the construction of the connectors specified herein shall satisfy the following criteria:

a. Lubricants shall be permanent and shall not require replacement during the lifetime of the connector as defined in 3.5.2.5.1.

b. Lubricants shall not migrate to the optical interfaces resulting in degradation of the optical performance of the connector as specified in 3.5.1.

c. Lubricants shall be useful over the environmental conditions specified in 3.5.3.

d. Lubricants shall not be affected by cleaning solvents as defined in 3.4.8 which are required to maintain the optical performance of the connectors.

3.3.4 Liquid materials. Liquid materials shall not be used in the connector design.

3.3.5 Fungus. Finishes and materials shall be certified that they meet the requirements of MIL-HDBK-454, requirement 4. Connectors that are not in accordance with MIL-HDBK-454, requirement 4 for fungus-inert materials shall meet grade I classification of MIL-STD-810, method 508. If certification cannot be made, samples of all polymeric materials used in the construction of one mated connector pair shall be tested in accordance with 4.8.14.

3.3.6 Recovered materials. Unless otherwise specified herein, all material incorporated in the products covered by this specification shall be new. Products may be fabricated using raw materials produced from recovered bulk materials to the extent practicable if the intended use of the product is not jeopardized. The term “recovered materials” means materials which have been collected or recovered from solid waste and reprocessed to become part of a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of partially processed, assembled, used or rebuilt products are allowed under this specification. Reground polymers are acceptable materials.

3.3.6.1 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements and promotes economically advantageous life cycle costs.

3.3.7 Overall finish. Unless otherwise specified (see 3.1), the resultant finish on all items covered by the individual specification sheets shall be CRES passivated in accordance with SAE-AMS-2700.

3.4 Design and construction. The plugs, adapters, receptacles, as specified herein shall withstand normal handling, incident to operation, installation and in-service maintenance. Component parts shall be as specified on the individual specification sheets (see 3.1).

3.4.1 Styles and physical dimensions. The configuration and physical dimensions of the connectors specified herein shall be in accordance with the specification sheets (see 3.1). Specification sheets are provided for the following minimum styles:

a. Receptacles (Single ferrule connector receptacles).

b. Plugs (Single ferrule connector plugs).

c. Adapters (bulkhead adapters).

3.4.2 Weight. The weight shall be specified in the specification sheets (see 3.1). Verification shall be in accordance with 4.7.3.

3.4.3 Size. The size shall be specified in the specification sheets (see 3.1). Verification shall be in accordance with 4.7.4.

3.4.4 Fiber optic cable requirements. The connectors shall be designed for operation with fiber optic cables as specified in MIL-PRF-85045 unless otherwise specified in the individual specification sheets (see 3.1).

3.4.5 Fiber optic ferrule. The fiber optic ferrule shall be a non-removable integral part of the fiber optic connector that is affixed to the barrel mechanically or chemically or both. The specification sheets define the design and construction along with the method of performing the optical termination.

a. Method of optical alignment, such as tube, straight sleeve, or grooved plate.

b. Coating requirements, as applicable.

3.4.5.1 Fiber attachment. Unless otherwise specified (see 3.1), fiber attachment shall be provided by adhesive bonding.

3.4.5.2 Cable strength member attachment. Unless otherwise specified (see 3.1), cable strength member attachment shall be provided by crimping and adhesive bonding.

3.4.6 Special handling. The connectors specified herein shall be designed for use in protected field equipment and shall not require special handling with the exception of periodic cleaning as specified in 3.4.8.

3.4.7 Mating characteristics. The connectors specified herein shall satisfy the following operational and human factor requirements.

3.4.7.1 Optical performance degradation. The connectors specified herein shall remain within the optical performance limits specified in 3.5.1.2 during the lifetime of the connector as measured by mating cycles as specified in 3.5.2.5.1 or the lifetime requirements specified in 3.5.1.1.

3.4.8 Cleaning. Cleaning of the optical mating surfaces is not to be considered a repair action and is allowed to maintain the optical performance of the connector in the operational environment. To facilitate cleaning, the connector design shall allow easy accessibility to the optical faces. Disassembly of optical connectors is not acceptable for field operations. The ferrule end face of the connector plug shall be cleanable using fiber optic (lint free) wipes, with then without high (greater than 99 percent) purity isopropyl alcohol and of the connector receptacle. The optical interface surfaces of the connector receptacle and the optical interface of the adapter (such as the alignment sleeve) shall be cleaned using fiber optic (particulate free) swabs with then without high (greater than 99 percent) purity isopropyl alcohol.

3.4.9 Dust cover. All optical connectors (plugs, adapters and receptacles) shall be provided with a plastic throw-away protective cap or cover. The cover shall be free of mold release or any other lubricants.

3.4.10 Maintainability. The connectors specified herein shall be classified as field replaceable.

3.4.11 Sealing devices. Seals, grommets, o-rings, interfacial seals boots, gaskets, and other sealing devices as needed by the connector design, shall meet the performance requirements as specified herein.

3.4.11.1 Optical junction sealing. When specified, optical junctions shall be sealed against moisture and contamination as specified herein.

3.5 Performance requirements. The connectors specified herein shall meet the following performance requirements when the units are assembled to an appropriate optical cable as specified (see 3.1).

3.5.1 Optical requirements. The connectors specified herein shall meet the specific optical performance requirements as specified (see 3.1).

3.5.1.1 Insertion loss. The initial insertion loss shall be less than 0.75 dB, or as specified (see 3.1). The maximum insertion loss at any time during qualification or quality conformance testing after the initial insertion loss is performed (i.e., insertion loss verification) shall not exceed 1.25 dB (see 4.7.6), or as specified see (see 3.1).

3.5.1.2 Change in optical transmittance. The change in optical transmittance shall not be greater than 0.5 dB after any tests and when required during any tests, as specified in this document (see 4.7.7). Unless otherwise specified the periodicity of the measurement(s) taken during the test, when required, shall be appropriate for the test mentioned and as approved by the qualifying activity.

3.5.1.3 Ambient light susceptibility. When specified (see 3.1), the optical power of the light from the optical port shall not be greater than minus 50 dBm (see 4.7.8).

3.5.1.4 Signal discontinuities. When measured in accordance with 4.7.9, no discontinuity shall occur. A discontinuity is considered to be a reduction of optical transmittance of 0.5 dB or more for a duration of 50 microseconds or more.

3.5.1.5 Return loss (type II). The minimum return loss shall be 30 dB per mated pair, or as specified see 3.1.

3.5.2 Mechanical requirements. All connector assemblies specified herein and in the appropriate specification sheet (see 3.1) shall satisfy the mechanical requirements as specified herein.

3.5.2.1 Cable retention (see 4.7.11). The connector plug hardware shall have a secure mechanical retention of the cable strength members where cable has strength members, allowing the cable assembly to withstand the tensile and twist loads as specified herein. Variations of this mechanism to accommodate various cable configurations shall be identified in the specification sheets (see 3.1).

3.5.2.1.1 Tensile loading When tested as specified in 4.7.11.1, the connector plug (receptacle and adapter exempt) shall be capable of sustaining a static tensile load of at least 180 N (40 lb) applied to the cable behind the back end of the plug without evidence of physical damage to the connector of fiber optic cable. The optical performance of the connector shall remain within the limits specified in 3.5.1.2.

3.5.2.1.2 Cable strain relief. The design of the connector shall include a strain relief. When tested as specified in 4.7.11.2, the connector plug shall show no evidence of physical damage.

3.5.2.1.3 Flex life. When tested as specified in 4.7.11.3, the connector plug (receptacle and adapter exempt) shall show no evidence of physical damage and the optical performance of the connector shall remain within the limits specified in 3.5.1.2 during the test.

3.5.2.1.4 Twist. When tested as specified in 4.7.11.4, the connector plug shall show no evidence of physical damage and the optical performance of the connector shall remain within the limits specified in 3.5.1.2 after the test.

3.5.2.2 Force to engage/disengage. When tested as specified in 4.7.12, the torque necessary to completely couple or uncouple the connectors shall not exceed that specified (see 3.1). Also the longitudinal force necessary to initiate the engaging or disengaging cycle shall not exceed that specified (see 3.1).

3.5.2.3 Coupling proof tongue. When tested as specified in 4.7.13, the coupling mechanism (plug only) (threaded types) shall not be dislodged. The interface dimensions of the connector shall remain as specified (see 3.1).

3.5.2.4 Coupling mechanism retention force. When tested as specified in 4.7.14, the coupling mechanism (plug only) shall not be dislodged from the connector.

3.5.2.5 Engagement of connectors.

3.5.2.5.1 Mating durability. When tested as specified in 4.7.15, the connectors shall be capable of withstanding 500 mating cycles, unless otherwise specified (see 3.1), without evidence of mechanical damage or physical deterioration. The optical performance of the connectors shall remain within the limits specified in 3.5.1.2 after each 100 cycles during and after the test and within the limits specified in 3.5.1.5 after the test. Re-polishing the ferrule end face after the test to meet 3.5.1.5 is allowed. There shall be no evidence of mechanical damage to the coupling device or physical deterioration of controlling surfaces or component parts. Minor damages such as scratches or abraded finishes at non-optical surfaces or at surfaces not employed as part of optical contact guides shall not be cause for rejection.

3.5.2.5.2 Polarization. Connectors shall be keyed when specified (see 3.1). When specified, polarization of connector shells or connector-to-adapter shells shall be accomplished by means of integral key(s) and suitable matching keyway(s) on the counterpart (see 4.7.2.4). Polarization shall be accomplished before initial engagement of the coupling ring or other attachment device (such as bayonet). During axial engagement, mating ferrule end faces shall not touch until polarization has been achieved.

3.5.2.5.3 Interchangeability and intermateability. The connector material and hardware shall be specified (see 3.1) to ensure interchangeability and intermateability. All connectors, backshells, accessories and replaceable parts having the same part number shall be physically and functionally interchangeable without need for modification of such items or of the mating equipment (see 4.7.2.1).

3.5.2.5.4 Safety wires (when specified) (see 3.1). The connectors specified herein shall include the facility to use safety wires for high vibration environments (see 3.1). Safety wires shall not be required to satisfy the vibration requirements specified in 3.5.3.4.

3.5.2.5.5 Impact. When tested as specified in 4.7.16, connectors shall not be damaged or otherwise rendered unfit for operational use. The connector shall meet the optical requirements as specified in 3.5.1.2.

3.5.3 Environmental requirements. The connectors shall be capable of satisfactory operation and shall meet all performance requirements as specified herein and in the specification sheets (see 3.1), when exposed to the environmental conditions as stated herein. There shall be no evidence of mechanical damage, loosening of component parts, separation of bonded surfaces and the optical and mechanical performance shall be within the limits specified herein.

3.5.3.1 Pressure altitude. When tested as specified in 4.8.1, the connectors shall operate within the performance limits specified in 3.5.1.2 during and after exposure to the operating pressure (sea level to 70,000 feet), and after exposure to the non-operating pressure (sea level to 70,000 feet). There shall be no evidence of physical damage to the connector.

3.5.3.2 Temperature. When tested as specified in 4.8.2, the connector shall operate within the performance limits specified in 3.5.1.2 during exposure to the operating temperatures specified below, and there shall be no evidence of physical damage to the connector.

a. Temperature range 1:

1. Operating: -46°C to +85°C (-51°F to 185°F).

2. Non-operating: -62°C to +85°C (-80°F to 185°F).

3. Storage: -62°C to +85°C (-80°F to 185°F).

b. Temperature range 2:

1. Operating: -55°C to +165°C (-67°F to 329°F).

2. Non-operating: -40°C to +85°C (-40°F to 185°F).

3. Storage: -40°C to +85°C (-40°F to 185°F).

3.5.3.3 Thermal shock. When tested as specified in 4.8.3, the connectors shall show no evidence of mechanical damage, loosening of component parts, separation of bonded surfaces, or other damage and the optical performance shall be within the limits specified in 3.5.1.2.

3.5.3.4 Vibration. When tested as specified in 4.8.5, the connectors shall show no evidence of broken, loose, deformed or displaced parts, cracks, chips, or other damage which would result distortion or wear and may result in fatigue of the mechanical parts. The requirements for signal discontinuity as specified in 3.5.1.4 shall be met during the test when the connector is vibrated and for change in optical transmittance shall be met after the test. Mated connectors or connectors and adapters, as applicable, shall not disengage nor exhibit loosening (including the coupling mechanism).

3.5.3.5 Shock. When tested in accordance with 4.8.6, connectors shall not be damaged and there shall be no loosening of parts. The requirements of 3.5.1.4 shall be met during the test and 3.5.1.2 shall be met after the test.

3.5.3.6 Temperature humidity cycling. When tested as specified in 4.8.7, the connectors shall operate within the performance limits specified in 3.5.1.2 during and after exposure to the relative humidity of 95 percent at ambient temperatures up to +65°C. There shall be no visual evidence of deterioration of component parts or constituent materials, loosening of finishes, physical distortion, corrosion of metals, entrapment of moisture, separation of bonded surfaces or other damages.

3.5.3.7 Water submersion.

3.5.3.7.1 Operating. When tested in accordance with 4.8.8, visual inspection of the test connector shall reveal no penetration of water into the sealed region of the mated connector. The mated connector shall operate within the optical performance limits specified in 3.5.1.2 both during and after the test.

3.5.3.7.2 Non-operating. When specified (see 3.1), the unmated connector plug assemblies shall be submerged without caps or protective covers, and shall operate without degradation of optical performance beyond the limits specified in 3.5.1.2 after being externally cleaned (see 4.8.8).

3.5.3.8 Salt spray. When tested as specified in 4.8.9, the connectors shall show no visual evidence of deterioration such as flaking, pitting, blistering or loosening of finishes, corrosion of metal surfaces, or in the case of plated metals, corrosion which has passed through the plating and attacked the base metal.

3.5.3.9 Dust (fine sand). When tested as specified in 4.8.10, the connectors shall show no evidence of physical damage and shall be within the optical performance limits specified in 3.5.1.2.

3.5.3.10 Ozone exposure (when specified see 3.1). When tested as specified in 4.8.11, there shall be no evidence of cracking or other deterioration of plastic and rubber parts that could lead to degradation of the optical or environmental performance of the connector as specified herein.

3.5.3.11 Fluid immersion. When tested as specified in 4.8.12, the optical performance shall remain within the limits specified in 3.5.1.2. Visual examination of the test connector shall reveal no swelling or softening or material, no loss of sealing capability or identification marking, and no discoloration or other effects detrimental to the intended use of these connectors, such as corrosion, distortion, blistering, or delamination of plating as a result of fluid immersion.

3.5.3.12 Temperature life. Connectors shall show no visual evidence of dimensional change, opening of seals, cracking or other physical damage. After the test, connectors shall meet the maximum insertion loss and change in optical transmittance as specified in 3.5.1.2 and 3.5.1.1 (see 4.8.4).

3.5.3.13 Flammability. When tested in accordance with 4.8.13, the mated connector assembly shall meet the optical requirements of 3.5.1.2. The unmated connector shall not exceed a combined flame and afterglow extinguishing time of 30 seconds (condition C) after removal of applied flame. There shall be no dripping which will cause the flammable material to ignite and there shall be no violent burning or explosive type fire.

3.5.3.14 Nuclear radiation resistance. When specified (see 3.1), the connector shall meet the optical requirements as specified in 3.5.1.2 (see 4.8.15).

3.5.3.15 Temperature cycling. When tested as specified in 4.8.16, the connectors shall show no evidence of mechanical damage, loosening of component parts, separation of bonded surfaces, or other damage and the optical performance shall be within the limits specified in 3.5.1.2.

3.5.4 Space flight requirements.

3.5.4.1 Thermal vacuum outgassing. All non-metal materials shall not emit greater than 1.0% total mass loss and greater than 0.1 percent collected volatile condensable materials when test in accordance with 4.9.1.

3.5.4.2 Residual magnetism. When tested in accordance with 4.9.2, the residual magnetism for fully assembled connectors shall meet gamma levels as specified in the specification sheet (see 3.1).

3.5.4.3 Odor. Non-metal materials shall rate less than 2.5 when tested in accordance with 4.9.3.

3.5.4.4 Toxicity (offgassing). When tested in accordance with 4.9.4, all non-metals shall have a total hazard index less than 0.5.

3.6 Marking.

3.6.1 Component marking. Connectors and associated fittings shall be permanently and legibly marked in accordance with the general requirements of MIL-STD-1285. Marking shall be located on the connector body or on the boot. Marking shall include the following:

a. Military Part or Identifying Number (PIN).

b. Manufacturer's CAGE code or name or logo.

3.6.2 Package marking. Package marking shall be in accordance with MIL-STD-129.

3.7 Workmanship. Connectors and associated fittings shall be processed in such a manner as to be uniform in quality and shall be free from sharp edges, burrs and other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Materials inspection (see 4.4).

b. Qualification inspection (see 4.5).

c. Quality conformance inspection (see 4.6).

4.2 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.2.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspections, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ISO 10012.

4.2.3 Reliability assurance program. A reliability assurance program shall be established and maintained in accordance with MIL-STD-790. Evidence of such compliance shall be verified by the qualifying activity of this specification as a prerequisite for qualification and continued qualification.

TABLE I. Materials inspection.

Component material	Requirement	Applicable specification paragraph
Metals	3.3.2	--
Zinc	--	ASTM - B86
Brass	--	ASTM-B36/B36M, ASTM-B121/B121M, ASTM-B16/B16M, ASTM-B124/B124
Aluminum	--	SAE-AMS-QQ-A-225
Steel corrosion-resistant	--	SAE-AMS-QQ-S-763, ASTM-A582/A582M
Dissimilar metals	3.3.2.1	MIL-HDBK-454
Bronze	--	--
Nonmetallic materials	3.3.3	--
TFE fluorocarbon	--	
FEP fluorocarbon	--	ASTM D1430
Silicon rubber	--	A-A-59588
Acetal	--	ASTM6778
Adhesives (epoxies)	3.3.3.1	--
Sealing compounds	3.3.3.2	--
Lubricants	3.3.3.4	--
Liquid materials	3.3.4	

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of MIL-STD-202. For each test of threaded coupling connectors where the test is performed on mated pairs, the pair shall be torqued to the specified value (see 3.1).

4.4 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table I, used in fabricating the connectors are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production.

4.5.1 Sample size. Fourteen connector pairs of the same PIN with their appropriate adapters shall be subjected to qualification inspection. Samples of all polymeric materials used in the construction of one mated connector pair is also required when applicable.

4.5.2 Inspection routine. The qualification table in this base specification, MIL-DTL-83522, lists the inspections cited in the base specification with the sequence in with the inspections are to be performed. Inspections for qualification are tailored for each component in the individual specification sheet (see 3.1). From the applicable qualification table (see 3.1), twelve mated connector pairs shall be subjected to the specified inspections of test group I in table II. The twelve mated connector pairs shall then be divided into three sets of four. Each set shall be subjected to the specified tests within one of groups II, III and IV of table II. Two additional mated connector pairs shall be subjected to the flammability tests in group V of table II, when applicable. Samples of all polymeric materials used in the construction of one mated connector pair shall be subjected to the fungus test of group V in table II, when applicable.

4.5.3 Failures. One or more failures shall be cause for refusal to grant qualification approval.

4.5.4 Retention of qualification. To retain qualification, the contractor shall forward a report to the qualifying activity. Groups A and B require a report at 2 year intervals, and group C requires a report at 5 year intervals. The qualifying activity shall establish the initial reporting date. Retention of qualification shall be at a 5-year interval. The report shall consist of:

a. A summary of the results of the tests performed for inspection of product for delivery (groups A and B), indicating as a minimum the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.

b. A summary of the results of tests performed for periodic inspection (group C), including the number and mode of failures. The summary shall include results of all periodic inspection tests performed and completed during the 2 year or 5 year period. If the summary of the test results indicates nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list. Failure to submit the report within 60 days after the end of each 2 year or 5 year period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 2 or 5 year period that the inspection data indicates failure of the qualified product to meet the requirements of this specification. In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has the capabilities and facilities necessary to produce the item. If during 3 consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit a representative product from each group, as defined in 4.5.2 to testing in accordance with the qualification inspection requirements.

4.5.5 Qualification by similarity. The extent of qualification testing by similarity shall be determined by the qualified products list evaluating activity.

4.6 Quality conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections.

4.6.1.1 Inspection lot. An inspection lot shall consist of all the connectors and associated fittings comprised of identical piece parts produced under essentially the same conditions and offered for inspection at one time.

4.6.1.1.1 Group A inspection. Group A inspection shall consist of the inspections specified in table IV, and shall be made on the same set of sample units, in the order shown.

4.6.1.1.1.1 Sampling plan. All products for delivery shall be subjected to group A inspections.

4.6.1.1.1.2 Rejected lots. If an inspection lot is rejected, the manufacturer may rework it to correct the defects, or screen out the defective units ad resubmit for re-inspection. The manufacturer is not required to notify the qualifying activity of defective units screened out during the group A inspections. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots and shall be clearly identified as re-inspected lots.

4.6.1.1.2 Group B inspection. Group B inspection shall consist of the inspections specified in table V in the order shown, and shall be made on sample units which have been subjected to and passed the group A inspection. Connectors having identical piece parts may be combined for lot purposes and shall be in proportion to the quantity of each part-numbered connector produced.

4.6.1.1.2.1 Sampling plan. The sampling plan for group B shall be in accordance with table II.

TABLE II. Group B sampling plan.

Lot size	Sample size
1-5	All
6-150	5
151-1,200	20
1201-10,000	32
10001-35000	50
35001-500000	80
500001 and over	125

4.6.1.1.2.2 Rejected lots. If an inspection lot is rejected, the manufacturer may rework it to correct the defects, or screen out the defective units and resubmit for re-inspection. The manufacturer is not required to notify the qualifying activity of defective units screened out during the group A inspections. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots and shall be clearly identified as re-inspected lots.

4.6.1.1.2.3 Disposition of sample units. Sample units which have passed all the group B inspection may be delivered on the contract or purchase order, if the lot is accepted. Any connector or connector part deformed or otherwise damaged during testing shall not be delivered on the contract or order.

4.6.1.2 Periodic inspection. Periodic inspection shall consist of group C inspection. Except where the results of these inspections show noncompliance with the applicable test requirements (see 4.6.1.2.1.4), delivery of products which have passed groups A and B shall not be delayed pending the results of these qualification verification inspections.

4.6.1.2.1 Group C inspection. Group C inspection shall consist of the inspections specified in table V, in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed the groups A and B inspections.

4.6.1.2.1.1 Sampling plan. Group C inspection shall be performed on connectors of the same part number with their mating connectors 3 years after initial qualification and within each 3 year period thereafter. Six sample units shall be selected form the first lot produced. Six sample units shall also be selected 2 years after qualification or after 200,000 connectors have been produced, whichever occurs first. The sample units shall be subjected to all tests.

4.6.1.2.1.2 Failures. If one or more sample units fail to pass group C inspection, the sample shall be considered to have failed.

4.6.1.2.1.3 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract or order.

4.6.1.2.1.4 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, on all units of product which can be corrected and which are manufactured under essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all tests and examinations, or the test which the original sample failed, at the option of the qualifying activity). Groups A and B inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the group C inspection has shown that the corrective action was successful. In the event of failure after re-inspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.6.2 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of MIL-DTL-55330.

TABLE III. Qualification inspection.

Test performed	Requirements paragraph	Inspection (test methods) paragraph	Optical tests performed as part of the inspection 1/			
			Change in optical transmittance (see 4.7.7)	Optical signal discontinuity (see 4.7.9)	Insertion loss (see 4.7.6)	Return loss (see 4.7.10)
Group 1 (10 mated pair) 9/, 10/						
Visual & mechanical	3.4, 3.4.1, 3.4.4 through 3.4.10, 3.6 and 3.7	4.7.2 and 4.7.2.1				
Size	3.4.3	4.7.4				
Weight	3.4.2	4.7.3				
Identification marking	3.6	4.7.2.2				
Workmanship	3.7	4.7.2.3				
Functional						
Cable strain relief	3.5.2.1.2	4.7.11.2				
Force to engage/disengage	3.5.2.2	4.7.12				
Coupling proof torque	3.5.2.3	4.7.13				
Coupling mechanical retention force	3.5.2.4	4.7.14				
Optical-8SM & 4MM mated pair						
Insertion loss	3.5.1.1	4.7.6			X	
Return loss-SM only	3.5.1.5	4.7.10				X
Ambient light susceptability	3.5.1.3	4.7.8				
Group 2 (4 mated pair)						
Tensile loading	3.5.2.1.1	4.7.11.1	X 3/ d&a			
Cable strain relief	3.5.2.1.2	4.7.11.2				
Flex life	3.5.2.1.3	4.7.11.3	X 3/			
Twist	3.5.2.1.4	4.7.11.4	X 4/			
Mating durability	3.5.2.5.1	4.7.15	X 3/			
Return loss (SM only)	3.5.1.5	4.7.10				X
Impact	3.5.2.6	4.7.16	X 4/			
Insertion loss verification	3.5.1.1	4.7.6			X	
Vibration	3.5.3.4	4.8.5	X 4/	X		
Mechanical shock-4SM & 4MM 11/	3.5.3.5	4.8.6	X 3/	X		
Water submersion	3.5.3.7	4.8.8	X 3/			
Group 3 (4 mated pair)						
Thermal shock	3.5.3.3	4.8.3	X 4/			
Temperature humidity cycling	3.5.3.6	4.8.7	X 3/			
Temperature cycling	3.5.3.15	4.8.16	X 3/			
Temperature 5/	3.5.3.2	4.8.2	X 3/			
Temperature life	3.5.3.12	4.8.4				
Return loss (SM only)	3.5.1.5	4.7.10	X 4/			X
Pressure altitude	3.5.3.1	4.8.1	X 3/			
Insertion loss verification	3.5.1.1	4.7.6			X	
Sand and dust	3.5.3.9	4.8.10	X 3/			
Force to engage/disengage	3.5.2.2	4.7.12				
Identification marking	3.6	4.7.2.2				
Group 4 (2 mated pair & parts)						
Nuclear radiation resistance 6/	3.5.3.14	4.8.15	X 3/			
Fluid immersion (2 mated pair)	3.5.3.11	4.8.12				
Salt spray (2 mated pair)	3.5.3.8	4.8.9	X 4			
Flammability (1 mated pair)	3.5.3.13	4.8.13				
Fungus resistance 7/	3.3.6	4.8.14				
Ozone exposure 7/	3.5.3.10	4.8.11				
Group 5 – 2/, 8/						
Thermal vacuum outgassing	3.5.4.1	4.9.1				
Residual magnetism	3.5.4.2	4.9.2				
Odor	3.5.4.3	4.9.3				
Toxicity	3.5.4.4	4.9.4				

NOTES:
1/ An "X" indicates that this optical measurement applies for the inspection. See appropriate test paragraph for details.
2/ Group V tests are for parts intended for space flight. Group V tests will be performed by NASA.
3/ Perform the change in optical transmittance measurement both during and after the test (with the baseline measurement performed before the test).
4/ Perform the change in optical transmittance measurement after the test (with the baseline measurement performed before the test).
5/ Perform temperature in lieu of temperature cycling when specified. The soak duration at the low and high temperature cycling tests are performed at both low and high temperature limits for one cycle and 10 cycles, respectively.
6/ Either an additional four mated pair can be fabricated for this test of the Group 3 samples may be used after completion of Group 3 test.
7/ Polymeric parts from 1 mated pair.
8/ Two mated pair from Group 2.
9/ Initial qualification and re-qualification are performed on connectors with both single mode (SM) and multimode (MM) mated pair. The number of mated pair listed in table is for one fiber type.
10/ Group 1 mated pair are to be used for Groups 2, 3 and 4.
11/ When performing initial qualification or re-qualification with both singe mode (SM) and for multimode (MM) and when specified, four MM mated pairs may undergo Group 1 and shock testing only. Single mode mated pair shall undergo specified the cited inspections/tests. This multimode reduction in tests required is applicable if the only differences, between SM and MM, are ferrule diameter dimension, ferrule hole diameter dimension, boot color (optional) and markings.

TABLE IV. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph
Visual and mechanical examination 2/	3.4, 3.4.1, 3.4.4, through 3.4.10,3.6 and 3.7	4.7.2 and 4.7.2.1
Weight 1/	3.4.2	4.7.3
Size 1/	3.4.3	4.7.4

1/ The contractor may use in-process controls for this requirement.

TABLE V. Group B inspection.

Inspection	Requirement paragraph	Test method paragraph
Insertion loss 1/	3.5.1.1	4.7.6
Cable strain relief	3.5.2.1.2	4.7.11.2
Force to engage/disengage	3.5.2.2	4.7.12
Coupling proof torque	3.5.2.3	4.7.13
Coupling mechanism retention force	3.5.2.4	4.7.14

1/ If sample fails this test, then the lot fails.

4.7 Inspection methods.

4.7.1 Equivalent test methods. The use of equivalent test methods is allowed subject to the following conditions:

a. The allowance of an equivalent method is specified in this specification.

b. The manufacturer has conducted both test methods and has submitted complete test data to the preparing activity (PA).

c. The preparing activity has approved the use of that method by that manufacturer.

TABLE VI. Group C inspection.

Test performed	Requirements paragraph	Inspection (test methods) paragraph	Change in optical transmittance (see 4.7.7)	Optical tests performed as part of the inspection 1/		
				Optical signal discontinuity (see 4.7.9)	Insertion loss (see 4.7.6)	Return loss (see 4.7.10)
Group 1 (10 mated pair) 9/, 10/						
Optical – 8SM & 4MM mated pair						
Insertion loss	3.5.1.1	4.7.6			X	
Return loss- SM only	3.5.1.5	4.7.10				X
Group 2 (4 mated pair)						
Tensile loading	3.5.2.1.1	4.7.11.1	X 3/ d&a			
Flex life	3.5.2.1.3	4.7.11.3	X 3/			
Twist	3.5.2.1.4	4.7.11.4	X 4/			
Mating durability	3.5.2.5.1	4.7.15	X 3/			
Return loss (SM only)	3.5.1.5	4.7.10				X
Impact	3.5.2.6	4.7.16	X 4/			
Insertion loss verification	3.5.1.1	4.7.6			X	
Vibration	3.5.3.4	4.8.5	X 4/	X		
Mechanical shock – 4SM & 4 MM 11/	3.5.3.5	4.8.6	X 3/	X		
Water submersion	3.5.3.7	4.8.8	X 3/			
Group 3 (4 mated pair)						
Thermal shock	3.5.3.3	4.8.3	X 4/			
Temperature humidity cycling	3.5.3.6	4.8.7	X 3/			
Temperature cycling	3.5.3.15	4.8.16	X 3/			
Temperature 5/	3.5.3.2	4.8.2	X 3/			
Temperature life	3.5.3.12	4.8.4	X 4/			
Return loss (SM only)	3.5.1.5	4.7.10				X
Pressure altitude	3.5.3.1	4.8.1	X 3/			
Insertion loss verification	3.5.1.1	4.7.6			X	
Sand and dust	3.5.3.9	4.8.10	X 3/			
Force to engage/disengage	3.5.2.2	4.7.12				
Identification marking	3.6	4.7.2.2				
Group 4 (2 mated pair & parts)						
Nuclear radiation resistance 6/	3.5.3.14	4.8.15	X 3/			
Fluid immersion (2 mated pair)	3.5.3.11	4.8.12				
Salt spray (2 mated pair)	3.5.3.8	4.8.9				
Flammability (1 mated pair)	3.5.3.13	4.8.13	X 4/			
Ozone exposure 7/	3.5.3.10	4.8.11				
Group 5 – 2/, 8/						
Thermal vacuum outgassing	3.5.4.1	4.9.1				
Residual magnetism	3.5.4.2	4.9.2				
Odor	3.5.4.3	4.9.3				
Toxicity	3.5.4.4	4.9.4				

NOTES:
1/ An "X" – indicates that this optical measurement applies for the inspection. See appropriate test paragraph for details.
2/ Group V tests are for parts intended for space flight. Group V tests will be performed by NASA.
3/ Perform the change in optical transmittance measurement both during and after the test (with the baseline measurement performed before the test).
4/ Perform the change in optical transmittance measurements after the test (with the baseline measurement performed before the test).
5/ Perform temperature in lieu of temperature cycling when specified. The soak duration at the low and high temperature plateaus are longer and the temperature limits vary depending if performing at temperature range 1 or 2 for the temperature test. The temperature and temperature cycling tests are performed at both low and high temperature limits for one cycle and 10 cycles, respectively.
6/ Either an additional four mated pair can be fabricated for this test of the Group E samples may be used after completion of Group 3 tests.
7/ Polymeric parts from 1 mated pair.
8/ Two mated pair from Group 2.
9/ Initial qualification and re-qualification are performed on connectors with both single mode (SM) and multimode (MM) and when specified, four MM mated pair listed in table is for one fiber type.
10/ Group 1 mated pair are to be used for Groups 2, 3, and 4.
11/ When performing initial qualification or re-qualification with both single mode (SM) and multimode (MM) and when specified, four MM mated pairs may undergo Group 1 and shock testing only. Single mode mated pair shall undergo specified the cited inspections/tests. This multimode reduction in tests required is applicable if the only differences, between SM and MM, are ferrule diameter dimension, ferrule hole diameter dimension, boot color (optional) and markings.

4.7.2 Visual and mechanical inspection. Connectors, plugs adapters, and receptacles shall be examined to verify that the design, construction, physical dimensions, assembly instructions, marking and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.6 and 3.7).

4.7.2.1 Dimensional inspection. Mating dimensions shall be examined for conformance to the requirements in 3.4.1 through 3.4.5.2 by mating the connector with its applicable mating gauges or other suitable means acceptable to the Government.

4.7.2.2 Identification markings. Identification marking on connectors (including adapters) shall be visually examined and measured for conformance with the requirements of 3.6. Inspection for legible markings shall be performed from a distance of at least 6 inches (15 cm) with normal room lighting and without the aid of magnification. Markings shall be legible to the extent that none are missing, in whole or in part, faded, blurred, smeared, or shifted (dislodged) and shall be readily readable. Markings shall be permanent to the extent of withstanding cleaning procedures and of withstanding environmental and mechanical performance tests conducted.

4.7.2.3 Workmanship. The connectors (including adapters) shall be visually examined to verify that they meet the workmanship requirements of 3.7.

4.7.2.4 Polarization. For the connectors (including adapters) with polarization, during the mating of the connector shells or connector-to-adapter shells a visual examination shall be performed to verify that polarization is achieved within the requirements of 3.5.2.5.2.

4.7.3 Weight (see 3.4.2). Connector plugs, adapters and receptacles and receptacles shall be weighed using scales with an accuracy of ±5 percent to verify conformance to the requirements specified in 3.4.2, connectors shall not be assembled to cables for this test.

4.7.4 Size (see 3.4.3). Connector plugs, adapters and receptacles shall be measured, using instruments with accuracies appropriate to the tolerances defined in the specification sheet for the unit, to verify compliance to 3.4.3.

4.7.5 Optical test methods. The optical measurements in 4.7.6 through 4.7.10 shall be performed per the applicable TIA-455 series standards with the exception for adhering strictly to the setup and test procedure specified in the applicable 2100 series in MIL-STD-1678-2. Multiple fibers may not be concatenated during the measurement of change in optical transmittance or optical discontinuity. The center wavelength of test shall be 1300 ± -20nm. Light launch conditions shall be as specified in MIL-STD-1678-2. Cable length for test samples shall conform to MIL-STD-1678-2. Test sample fabrication of the optical interfaces shall conform as specified (see 3.1).

4.7.5.1 Non keyed connectors. For subsequent measurements of change in optical transmittance, it is recommended the sample (connector plugs and adapter) be mated in the same azimuthal orientation as established for the initial insertion loss measurement.

4.7.6 Insertion loss (see 3.5.1.1). The initial insertion loss of multimode connectors shall be measures in accordance with method A of TIA-455-34 using both 70/70 and overfill launch conditions. For subsequent insertion loss tests (insertion loss verifications), 70/70 launch conditions or equivalent shall be used. The insertion loss of single mode connectors shall be measured in accordance with method B of TIA-455-34. Setup and test procedure shall conform to 4.7.5.

4.7.7 Change in optical transmittance (see 3.5.1.2). This test shall evaluation the change of optical power (transmittance) level of the fibers due to exposure to each specified inspection (mechanical or environmental test) either after the test or during and after the

test (from a baseline obtained before each test) per TIA-455-20 for transmitted power. The periodicity of the measurement shall be appropriate for the test method (see applicable measurement in MIL-STD-1678-3) and as approved by the qualifying activity. Setup and test procedure shall conform to 4.7.5. The use of a reference fiber (as defined in MIL-STD-1678-1) to evaluate the change in optical transmittance due to exposure of the cable to the environmental tests is optional.

4.7.8 Ambient light susceptibility (see 3.5.1.3). The ambient light susceptibility shall be measured in accordance with TIA-455-22, with the exception that the output power in the "on" state shall be referenced to 1 milliwatt. The test temperature shall be +25°C±5°C.

4.7.9 Signal discontinuities (see 3.5.1.4). Signal discontinuities shall be measured in accordance with TIA-455-32. A signal discontinuity is considered to be a reduction in signal strength of .5 dB or more for a duration of 50 µs or more. Setup and test procedure shall conform to 4.7.5. Signal discontinuity shall be monitored with equipment in compliance with Measurement 2104 of MIL-STD-1678-2 and having a time resolution sufficient to resolve discontinuities of 50 microseconds duration.

4.7.10 Return loss (SM) (see 3.5.1.5). Samples shall be tested for return loss in accordance with TIA-455-107. Upon completion of each test, samples shall be examined for compliance to 3.5.1.5. Setup and test procedure shall conform to 4.7.5.

4.7.11 Cable retention. Specified inspections (see 3.1) from 4.7.11.1 through 4.7.11.4 shall be performed to verify conformance to 3.5.2.1.

4.7.11.1 Tensile loading (see 3.5.2.1.1). Mated connector pairs shall be tested in accordance with Method 1 of TIA-455-6. The axial tensile load shall be applied up to the load specified and shall be maintained for 1 minute unless otherwise specified (see 3.1). The change in optical transmittance shall be measured during and after the test (see 4.7.7). After the completion of the test, the connector shall be visually examined in accordance with 4.7.2.

4.7.11.2 Cable strain relief (see 3.5.2.1.2). A visual inspection of the connector designs (plugs) and the specification sheet of the unit shall be used to verify compliance to this requirement. Cable exiting a horizontal connector then placed in a vertical drip shall exhibit a gradual versus a sharp bend (i.e., a cable bend within the long term bend diameter of the cable).

4.7.11.3 Flex life (see 3.5.2.1.3). The plug specimen of the connector mated pairs shall be tested for flex life in accordance with TIA-455-1 except the cable interface or strain relief shall be flexed (versus the cable) using the setup as illustrated in figure 1 and parameters specified in 4.7.11.3.1 with the cycling rate not exceeding 14 cycles per minute if the test is performed manually. The specimen shall suffer no degradation in optical loss beyond the specified limits stated in 3.5.1.2, either during or after the test. At the completion of the test, the connector shall be visually examined in accordance with 4.7.2.

4.7.11.3.1 Room temperature tests. The plug specimens shall be flexed for 2,000 cycles at a temperature of 23°C ± 5°C. Flexing shall be in two planes, each mutually perpendicular to each other and to the face of the connector. The line of intersection of the two planes shall pass through the center of the connector. Half the number of flexes shall be in one plane and half in the other plane. Change in optical transmittance shall be measured after the completion of every five hundredth cycle during the test and after the test.

4.7.11.4 Twist (see 3.5.2.1.4). Connector mated pairs shall be tested in accordance with TIA-455-36. The cable shall be subjected to 1,000 twist cycles. (One cycle shall consist of a 180 degree twist ±90 degrees about the neutral axis.) The change in optical transmittance (see 3.5.1.2) shall be measured at 250 cycle intervals. The optical performance shall not degrade beyond the limits stated in 3.5.1.2 either during the test or subsequent to the test due to the twist cycling. At the completion of the test, the connector shall be visually examined in accordance with 4.7.2.

4.7.12 Force to engage/disengage (see 3.5.2.2). The connector shall be engaged with its mating standard part (see 3.1). During the entire coupling/uncoupling cycle (until the connector is fully engaged/disengaged), the forces or torques necessary shall not exceed those specified (see 3.1). For a threaded connection, the unmated connectors shall be tested as follows: The two mating parts shall be brought to a position where mechanical mating begins and the torque gauge is at zero indication. The parts shall then be fully mated or coupled and the torque required for mating shall be recorded. The torque gauge shall then be reset to zero indication. The mated parts shall be fully unmated and the torque required to un-mate shall be recorded.

4.7.13 Coupling proof torque (see 3.5.2.3). The connector under test shall be engaged with its mating standard part (gauge) and the coupling nut tightened to the torque value specified (see 3.1). After 1 minute the connector under test and its mating standard part shall be disengaged.

4.7.14 Coupling mechanism retention forces (see 3.5.2.4). The connector body and coupling mechanism shall be respectively secured to the lower and upper jaws of a tensile tester in an appropriate manner. A tensile load shall be applied at a rate of approximately 100 pounds/minute up to the force as specified and held at that value for 1 minute (see 3.1). During the one minute of steadily applied force, the coupling mechanism shall be rotated with respect to the connector body, two full revolutions in each direction.

4.7.15 Mating durability (see 3.5.2.5.1). Connector mated pairs (including the plug to adapter to plug configuration) shall be tested for mating durability in accordance with TIA-455-21 for a total of 500 mating cycles. The change in optical transmittance (3.5.1.2) shall be measured after the completion of every one hundredth cycle. Cleaning of the ferrule end face is permitted during and after

completion of the test in order to meet the requirements of 3.5.1.2. At the completion of the test, the connector shall be visually examined with 4.7.2.

4.7.16 Impact (see 3.5.2.6). Unmated connector plugs with protective covers (i.e., dust cap over ferrules) installed shall be tested in accordance with the following or other suitable technique:

a. The impact test facility shall consist of a clamp for securing a single jumper cable and a steel block, 1/2 inch (1.2 cm) minimum thickness, as shown on figure I.

b. The impact test shall be conducted as follows: The cable is clamped so that, with the connector plug hanging under its own weight, the end of the plug extends 59 inches (1.5 meters) below the cable clamp to the center of the steel block. The plug is then raised to the height of the clamp, and with the cable extended, released so as to strike the block. The unmated plug shall be dropped 8 times.

c. The change in optical transmittance shall be measured after the test (see 3.5.1.2).

d. At the completion of the test, the connector shall be visually examined in accordance with 4.7.2.

4.8 Environmental requirements. The environmental tests in 4.8.2 through 4.8.16 shall be performed per the applicable TIA-455 series standards with the exception for adhering strictly to the setup and test procedure specified in the applicable 3200, 3300 and 3400 series measurements in MIL-STD-1678-3. Connectors with a composite body shall be unmated and re-mated after each environmental test. Post exposure optical transmittance measurements may be taken up to 24 hours after completion fo the environmental exposure.

4.8.1 Pressure altitude (see 3.5.3.1). Connector mated pairs shall be tested for susceptibility to low pressure (altitude) in accordance with method 500 of MIL-STD-810. The following conditions shall apply:

a. Specimens shall be mounted in a manner simulating that in actual service.

b. Pressure shall be increased or decreased, as applicable, at a rate not to exceed 2,500 feet per minute.

c. Operating and non-operating: Specimens shall be subjected to a simulated altitude of 70,000 feet above sea level for a minimum of 2 hours. Change in optical transmittance measurements shall be performed at 15 minute intervals during and immediately following the test and there shall be no degradation of optical performance beyond the limits specified in 3.5.1.2. Following the test, specimens shall be examined for compliance to 3.5.3.1.

d. At the completion of the test, the connector shall be visually examined in accordance with 4.7.2.

4.8.2 Temperature (see 3.5.3.2). Connector mated pair shall be subjected to the specified operating temperature extremes as indicated. The change in optical transmittance (see 4.7.7) shall be measured at the end of each temperature plateau and at the end of the test. At the completion of the test, the connector shall be visually examined in accordance with 4.7.2.

Step	Duration
1. Maintain +25°C ± 2°C	1 hour minimum
2. Optical transmittance measurement	
3. Ramp to operating temperature	2 hours maximum
4. Maintain high operating temperature	24 hours minimum
5. Optical transmittance measurement	
6. Ramp to +25°C ± 2°C	2 hours maximum
7. Maintain +25°C ± 2°C	1 hr. minimum
8. Optical transmittance measurement	
9. Ramp to low operating temperature	2 hours maximum
10. Maintain low operating temperature	24 hours minimum
11. Optical transmittance measurement	
12. Ramp to +25°C ± 2°C	2 hours maximum
13. Maintain +25°C ± 2°C	1 hr. minimum
14. Optical transmittance measurement	

4.8.3 Thermal shock (see 3.5.3.3). Connector mated pairs shall be tested in accordance with test schedule C of TIA-EIA-455-71 for five cycles. When testing to temperature range 1, the temperature extremes shall be the specified non-operational temperature extremes for temperature range 1 (see 3.5.3.2). When testing to temperature range 3, the temperature extremes shall be the specified operational temperature extremes for temperature range 2 (see 3.5.3.2). Change in optical transmittance measurements shall be measured after the test for temperature range 1 and measured during (towards the end of each temperature plateau) and after the test for temperature range 2. The connectors shall be visually examined in accordance with 4.2 after the test. The connector mated pair shall be examined for degradations of any sort after testing in accordance with 3.5.3.3.

4.8.4 Temperature life. Connector mated pairs shall be tested in accordance with TIA/EIA-455-4 and as specified herein. The specimens shall be exposed to dry air at a temperature and duration specified in table VII. The change in optical transmittance shall be monitored after the test in accordance with 4.7.7. The connectors shall be visually examined in accordance with 4.7.2 after the test.

TABLE VII. Temperature life test conditions.

Temperature range	Temperature (+5/-0°C)	Duration (hours)
1	110	240
2	165	1,000

4.8.5 Vibration. Connector mated pairs shall be tested in accordance with TIA/EIA-455-11 using the setup and procedure specified in measurement 3201 of MIL-STD-1678-3. Optical discontinuities shall be measured during each test (see 4.7.9). The change in optical transmittance shall be measured ager each test (see 4.7.7). The connector shall be visually examined in accordance with 4.7.2 after the test. Lockwires (safety wire) shall not be utilized during this test. For connectors with a threaded coupling nut (ring) but no ratchet mechanism, retightening of the connector after each axis and test condition is permitted. For a mating connector containing a coupling ring ratchet mechanism, do not tighten the coupling ring during testing. Cable to cable connectors may be held to the jig of figure 2 by a suitable clamp on one half of the connector assembly.

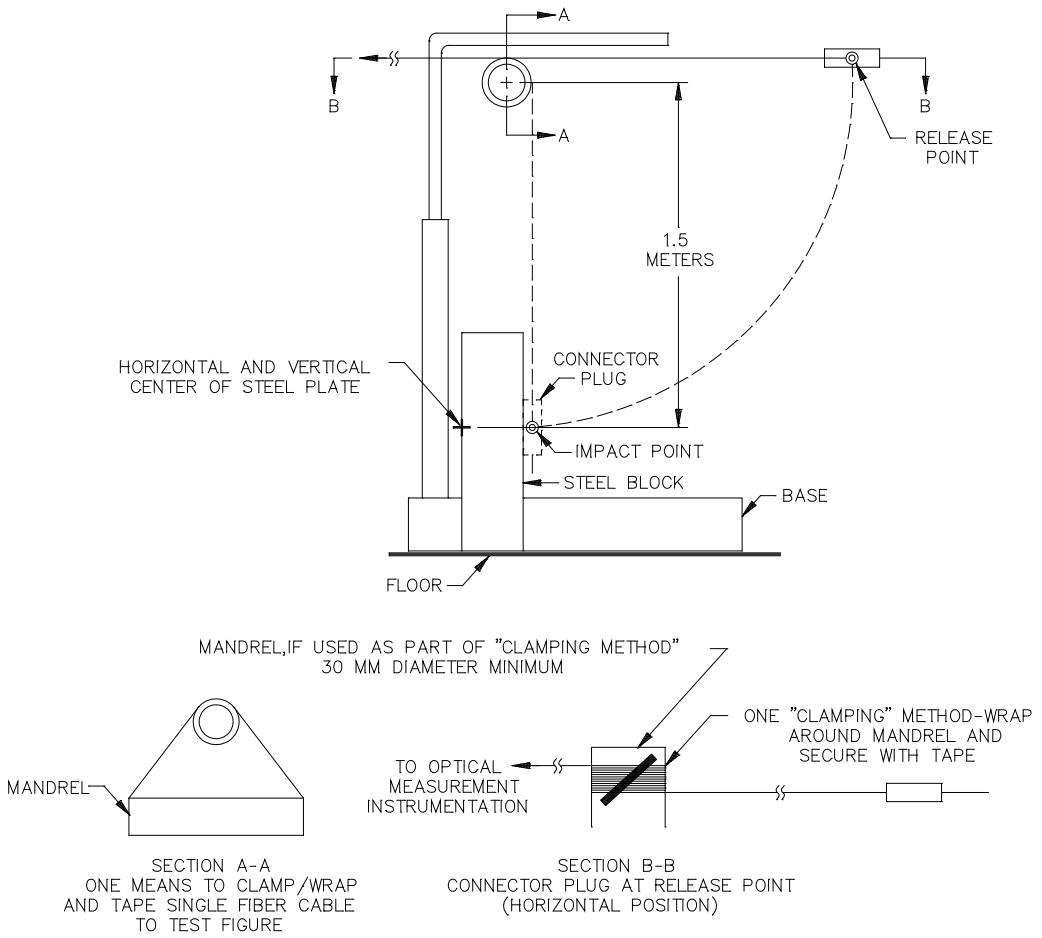
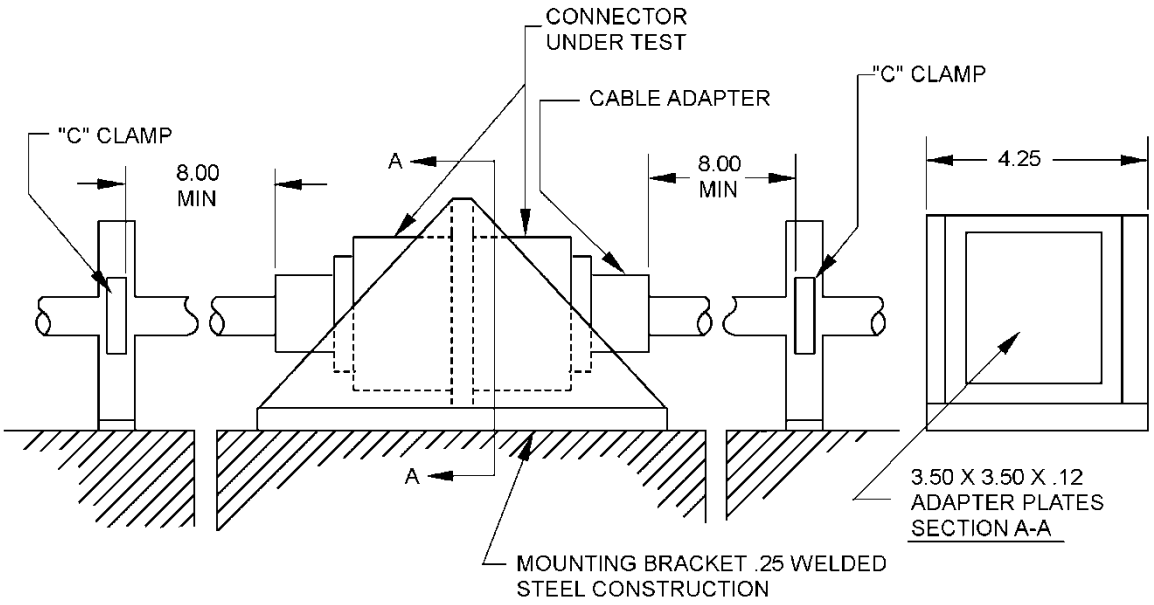


FIGURE I. Impact test fixture and test setup.



Inches	mm
.12	3.1
.25	6.4
3.50	88.9
4.25	107.9
8.00	203.2

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.

FIGURE 2. Vibration testing setup.

4.8.6 Shock. Optical discontinuities shall be measured during the test (see 4.7.9). The change in optical transmittance shall be measured after the test (see 4.7.7). The connector shall be visually examined in accordance with 4.7.2 after the test. For temperature range 1 testing, retightening of the connector after each blow is permitted. For temperature range 2 testing, initially mate the connector assemblies and apply the specified torque value. Mark the position after the torque has been applied and check/record position after each impact. For a mating connector containing a coupling ring ratchet mechanism, do not tighten the coupling ring after each impact if the connector is being tested in addition to the terminus. Otherwise, retighten after each impact.

4.8.6.1 Temperature ranges 1 and 2. Connector mated pair shall be tested in accordance with MIL-S-901, grade A, class I. Three blows (impacts) in each of three mutually perpendicular planes (axes) shall be performed (nine blows or impacts total), one plane (axis) of which shall be parallel to the longitudinal axis of the connector. Standard shock fixture 4A for bulkhead mounting shall be used. Measurement 3202 of MIL-STD-1678-3 shall be used to supplement setup and test procedure as appropriate for particular fiber optic component configuration tested. Supplemental test fixture with mounting that is applicable shall be used as specified in Measurement 3202 of MIL-STD-1678-3.

4.8.6.2 Temperature range 2 only. Connector mated pair shall be tested in accordance with TIA-455-14, test condition D. Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test sample (18 shocks). Receptacles and panel or bulkhead mounted connectors and adapters shall be mounted by normal means. All other connectors and adapters shall be rigidly clamped to the shock table.

4.8.7 Temperature/humidity cycling. Connector mated pairs shall be tested in accordance with method B of TIA-455-5 with refinements specified in measurement 3302 of MIL-STD-1678-3 (such as the sub-cycle shall be included in the testing). The change in

optical transmittance shall be measured during, and after testing (see 3.5.1.2) with optical performance being verified near the end of each plateau and after each 24 hour cycle. The connector shall be visually examined in accordance with 4.7.2 after the test.

4.8.8 Water submersion. Connector mated and unmated pair shall be tested for water pressure susceptibility as follows: The connectors shall be immersed in water to a minimum depth of 10.4 meters (34 ft.) or equivalent depth pressure for a period of not less than 48 hours. For the operating test (see 3.5.3.7.1), the change in optical transmittance shall be measured during the test. At the completion of the test, the connector assemblies shall be externally cleaned, unmated, and examined for water penetration into the connector. For the non-operating test (see 3.5.3.7.2), the unmated connector assemblies shall be cleaned and mated at the completion of the test. The change in optical transmittance shall then be measured (see 3.5.1.2). The connector shall be visually examined in accordance with 4.7.2 after the test.

4.8.9 Salt spray (corrosion) (see 3.5.3.8).

4.8.9.1 Temperature ranges 1 and 2. Connector mated pair shall be tested in accordance with test condition I of TIA/EIA-455-16 with particular attention to MIL-STD-1678-3 measurement 3402 refinements. The exposure time shall be 96 hours, and the exposure temperature 35° C. After test exposure, the assemblies shall be externally cleaned and examined under three-power magnification for salt penetration into the connector junction area and damage to external parts.

4.8.9.2 Temperature range 2 only. Connector halves of two unmated connector pair shall be tested to TIA-EIA-455-16, test condition C. Connector ferrule may be covered up to half way from the end face to the shoulder with plastic protective dust covers. After test exposure, the assemblies shall be externally cleaned and examined under three-power magnification for salt penetration inot the connector junction area and damage to external parts. An insertion loss verification test shall be performed to determine if the optical requirement is met. Insertion loss verification shall be performed prior to and after the salt spray test.

4.8.10 Dust (fine sand) (see 3.5.3.9). With mated pairs of connectors assembled to specimen cables as specified, the connectors shall be tested for effects of exposure to a dry dust (fine sand) laden atmosphere in accordance with method 110 of MIL-STD-202. The following details and exceptions shall apply:

a. Failure criteria: The connectors will be considered to have failed this test if, after exposure to the blowing dust (fine sand) and subsequent cleaning of the optical fiber surfaces (see 3.4.7), the optical performance of the connectors is degraded beyond the limits specified in 3.5.1.2.

b. Orientation during test: The connectors shall be oriented in the test chamber so that the blowing air stream intersects the longitudinal axis of the connector at the coupled (mated) faces. The connectors shall be rotated 90 degrees about the longitudinal axis of the connectors, at least two times during steps 1 and 3.

c. Operation during test: The change in optical transmittance of the connectors shall be monitored during this test.

d. Step 2 waiting period: The 16-hour holding period of step 2 is not required. Step 3 may proceed immediately after reaching temperature stabilization.

e. Examinations: The change in optical transmittance test shall be performed before dust test, before and after sample reorientation, during each 6 hour exposure period, and after dust test. Samples shall be examined for compliance to 3.5.3.9. If the change in optical transmittance measurements are within the limits specified during the dust test, the mated pairs of connectors shall not be de-mated until the completion of the temperature cycling test.

4.8.11 Ozone exposure (see 3.5.3.10). When specified (see 3.1), a pair of mated connectors and an unmated cable connector shall be tested in accordance with TIA-455-189 with the restrictions (and pretest and post test inspections) in Measurement 3404 of MIL-STD-1678-3. When only polymeric materials used on the connector are tested (see 3.1), then any induced stress on the material by the connector shall be simulated (see measurement 3404 of MIL-STD-1678-3).

4.8.12 Fluid immersion (see 3.5.3.11). Connector mated pair and separate polymeric samples shall be exposed to each of the fluids specified in MIL-STD-1678-3 measurement 3409 table 3409-AI when tested in accordance with TIA/EIA-455-12. Exceptions to the fluids in MIL-STD-1678-3 measurement 3409 table AI are that exposure shall include automotive gas for temperature range 1 and that automotive gas, turbine fuel, and isopropyl alcohol shall be immersed for 168 hours for temperature range 1. Sample preconditioning shall be done under ambient conditions for a minimum of 4 hours. Each connector mated pair and sample of each polymeric shall be completely dried after each immersion. Prior to and after testing, the connector mated pair shall be visually examined and the separate polymeric samples shall be visually and dimensionally examined (see MIL-STD-1678-3 measurement 3409).

4.8.13 Flammability (see 3.5.3.13). Connector mated pair and unmated connectors shall be tested in accordance with ECA EIA-364-81 and as specified herein. The mated pair shall be exposed to a 0.75 inch (19 mm) flame height applied for ten seconds to the region of the mated pair interface. The change in optical transmittance (see 3.5.1.2) shall be measured after the test sample has returned to ambient temperature. The mated pair shall be un-mated. Two unmated connector assemblies shall be exposed to a 1.5 inch (38.1 mm) flame height applied for 60 seconds to the connector/strain relief interface region.

4.8.14 Fungus resistance (see 3.3.6). Connector not listed as fungus inert in guideline 4 of MIL-HDBK-454 components shall be tested for exposure to fungus in accordance with TIA/EIA-455-56 for the duration of 28 days evaluated with the rating designations in measurement 3401 of MIL-STD-1678-3.

4.8.15 Nuclear radiation resistance (see 3.5.3.14). When specified (see 3.1), connector mated pair shall be tested in accordance with TIA-455-64 for steady state radiation with a high dose rate (as specified in 3.1), except that the test sample shall be the connected mated pair instead of an optical fiber or fiber optic cable. The test shall be performed at a wavelength of 1300±.20nm at the low operating temperature and at +25°C ± 5°C. The change in optical transmittance shall be measured during and after each test. If the change in optical transmittance at +25°C is greater than the change in optical transmittance at the low operating temperature, then a connector mated pair shall be tested at the high operating temperature.

4.8.16 Temperature cycling (see 3.5.3.15). The connector shall be tested in accordance with TIA-455-3 using the profile of test steps, test temperatures, and test times in MIL-STD-1678-3 measurement 3301 table 3301-I for temperature range 1 and MIL-STD-1678-3 measurement 3301 table 3301-II for temperature range 2. Change in optical transmittance (3.5.1.2) shall be measured at the end of steps 1, 3, 5, 7, and 9 for each cycle and at the completion of the test. The connector shall be visually examined in accordance with 4.7.2 after the test.

4.9 Space flight

4.9.1 Thermal vacuum outgassing. Non-metal materials shall meet the requirements of 3.5.4.1, when tested in accordance with ASTM-E595 (see 3.5.4.1).

4.9.2 Residual magnetism. The connector shall be fully assembled before testing. The residual magnetism test shall be performed in a magnetically quiet area i.e., where machines, electronic equipment, vehicles, and personnel traffic are restricted. Use a magnetometer to measure residual magnetism immediately after the connector is exposed to a 5000 gauss field strength of a magnet for at least 2 seconds. The connector shall not contact the magnet pole pieces. The residual magnetism shall be measured with a magnetometer the probe of the magnetometer shall be within .125 inch of the connector. One gamma is equivalent to 1×10^{-5} gauss. (see 3.5.4.2).

4.9.3 Odor. Material samples shall meet the requirements of 3.5.4.3 when tested in accordance with NASA-STD-6001, test 6 (see 3.5.4.3).

4.9.4 Toxicity (offgassing). Material samples shall meet the requirements of 3.5.4.4, when tested in accordance with NASA-STD-6001, test 7 (see 3.5.4.4).

5. PACKAGING

5.1 Packaging requirements. For acquisition purposes, the packaging requirements shall be as specified in the contract or order. When packaging of materiel is to be performed by DoD personnel or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The fiber optic connectors covered by this specification are intended for use in the following applications as specified (see 3.1) where their performance characteristics are required.

a. Fixed plant. Used in systems in fixed locations including indoor, outdoor aerial, direct burial, duct and undersea applications.

b. Tactical. Concerned with use in non-vehicular and mobile militarized systems.

c. Space. Which involves use in vehicles and/or systems deployed in outer space.

d. Avionics. Involving use in aircraft or missile systems.

e. Shipboard. Involving use in systems deployed in a sheltered uncontrolled mobile marine environment.

f. Ground vehicle. Involving use in land vehicular systems.

g. Other specialized military applications.

6.1.1 Special considerations for application categories. The following list is intended to serve as a reminder in generating a specification sheet. It is not all inclusive; however, it highlights some of the special considerations. Important to each application are specific requirements as follows:

a. Fixed plant.

(1) Inside (Plenum): Flame and toxicity, breakout.

(2) Aerial: Wide temperature range, solar radiation.

(3) Duct: Narrow temperature range, water immersion.

(4) Buried: Rodent protection, crush resistance.

(5) Submarine: High pressure tensile strength for recovery.

b. Tactical: Ruggedness, water freeze, zero bend radius, nuclear.

c. Space: Outgassing in vacuum (change in composition), low level radiation, extreme temperature range, and nuclear for military applications.

d. Avionics: High temperature, vibration, and altitude.

e. Shipboard: Watertight, non-watertight.

f. Vehicle ground: Flammability and toxicity.

6.1.2 Primary design considerations. The primary design considerations for this family of optical connectors are as follows:

a. Consistent and predictable optical performance.

b. Operational use in the field environment with a minimum of special handling procedures.

c. Suitable for operation, including mating and de-mating under the environmental conditions specified herein, without degradation of performance beyond the performance limits specified herein.

d. Simple design, having a maximum ease of repair and maintainability as specified herein.

e. A service life of 20 years consistent with the mating requirements specified herein.

6.1.3 Material Safety Data Sheets (MSDS). MSDS sheets will be available upon request.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. The specific issue of individual documents referenced (see 2.1).

c. Title, number and date of the applicable specification sheet.

d. The complete PIN of the connector or fitting ordered.

e. Specific finish when required (see 3.3.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in QPDSIS-83522 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from DLA Land and Maritime, ATTN: VQ, P.O. Box 3990 East Broad Street, Columbus, OH, 43218-3990 or by email to vqp.chief@dla.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at https://assist.dla.mil.

6.3.1 Requalification. Requalification will be performed every 5 years. Requalification tests will be performed on test samples selected from the first lot produced during the 5 year period and from a lot randomly selected from production later in the 5 year period (see 4.6.1.2.1.1).

6.4 Subject term (key word) listing.

Adapter
Bayonet
Cable, fiber optic
Connector
Covers, protective
Epoxy
Expanded beam lens
F.S.M.A. style
Lensless
Military specification
Optical performance requirements
Plug
Receptacle
Step-down nose interface
Straight nose interface
Terminus
Threaded

6.5 Definitions

6.6 Adapter (bulkhead, fiber optic). A fiber optic component used mechanically and optically connect with a connector plug. The adapter includes the shell. Alignment sleeve and alignment sleeve retainer. The shell has the interface for the connector plug coupling mechanism, the means to affix to a bulkhead or panel. And means to position and retain the alignment sleeve. For purposes of this specification, the adapter is included as one of the connector configurations.

6.6.1 Alignment sleeve. A cylindrical, split ceramic tube that provides the mechanical and optical alignment of two mating connector ferrules. Other alignment sleeve configurations are those with a solid (non split) ceramic tube and a split metal tube.

6.6.2 Barrel. The barrel is the part of the connector that provides the means of holding the ferrule within the connector on one end and may be used as the surface to affix the crimp sleeve (or provide other means of cable strain relief) on the other end.

6.6.3 Bend diameter, minimum. The minimum bend diameter is the diameter at which a cable or cable harness can be bent without degrading optical performance or the diameter at which a loose tube cable, convoluted tube or conduit can be bent without kinking (tube collapse causing fiber breakage). Two types of minimum bend diameters, short-term and long-term bend diameters, must be considered.

6.6.4 Blind mate. A situation in which personnel wishing to mate a connector can neither observe nor touch the mating connector and must rely on some mechanism to accomplish the mating.

6.6.5 Connector (fiber optic). A device that permits repeated mating and couples the optical power between two optical fibers (by using the end faces of the two mating ferrules to bring the tow fiber ends into contact). A fiber optic connector must maintain fiber alignment without significant loss of optical power. For purposes of this specification, the term connector is generalized to encompass connector plugs, connector receptacles and bulkhead adapters.

6.6.6 Connector mated pair. The connector is the entire cable assembly and is composed of the connector plug, either connector receptacle or adapter with other mating connector plug, cabling that is terminated to the connector plug/receptacle at one end, same cabling that is terminated for test equipment interface at the other end, and, if specified, other accessories.

6.6.7 Non pull proof connectors. This configuration connector is one in which the spring compresses as the cabling exiting the connector is pulled. This compression removes the ferrule from the mating connector end face. The result is a discontinuous optical path (optical discontinuity) for the duration of the pulled cable. The non pull proof connector is designed to be used with either loose tube or tight buffer cabling. The standard commercial configuration for the ST connector is the non pull proof one.

6.6.8 Plug (connector plug). A fiber optic connector configuration in which the connector shell has the coupling mechanism (such as a coupling nut or bayonet cap), the shell may have a means of cable strain relief at the cable entry end, and usually has the ferrule exposed.

6.6.9 Pull proof connectors. This configuration connector is one in which there is no optical discontinuity at the mating connector end faces when the cabling affixed to one of the connectors is pulled (see 6.6.5). A pull proof connector is designed to be used with a loose tube cable. The standard commercial configuration for the SC connector and the LC connector is the pull proof one.

6.6.10 Receptacle (connector receptacle). A fiber optic connector configuration in which the connector will has the interface for the connector plug coupling mechanism, the shell has a means to affix to a bulkhead or panel, and usually has the ferrule unexposed

(about half way within an alignment sleeve). For test purposed, the receptacle is considered to be the combination of the other connector plug – to –adapter when assembled as a connector plug – to- adapter – to – connector plug mated pair. Another configuration considered to be a receptacle is the equipment fiber optic interface connection (including at the bulkhead, panel or patch panel) or a printed circuit board mounting active device interface adapter/connection.

6.6.11 Scoop-proof. Scoop-proof means that because of the connector long shell design, it is impossible for the connector plug to inadvertently be cocked into the mating connector receptacle (potentially damaging the ferrule).

6.6.12 Shell. The shell (such as the bayonet cap) is the front portion of the connector which holds the connector barrel and contains the connector coupling mechanism, Shells are with of a plug or receptacle configuration. For an adapter, the shell is the portion which retains the alignment sleeve, contains the mating interface to the connector coupling mechanism, and contains the means to mount the adapter to a bulkhead or panel.

6.6.13 Space grade. Connectors that are classed as space grade are those connectors that comply with allowed plating material and meet the requirements of thermal vacuum outgassing, residual magnetism, odor and toxicity (see 4.9) in addition to the other specified requirements. Cadmium or tin finishes are not allowed for space applications whereas nickel is compliant.

6.6.14 Swab. A consumable used to clean the ferrule end face that is configured as an absorbent material placed on the end of a stick or dowel. Absorbent material of a lint free nature that must meet constraints for geometry (such as the cylindrical diameter be smaller than 1.25 mm), abrasion (non-abrasive to fiber end face), and cleaning efficacy (sufficient cleaning effectiveness for most common particles and file contaminants and for ability to absorb hydraulic oils, fuels and other aircraft and shipboard fluids).

6.6.15 Termination. The act of placing a fiber optic connector onto the end of a fiber optic cable.

6.6.16 Wipe. A consumable used to clean the ferrule end face that is configured as a sheet of absorbent material. Absorbent material of a lint free nature that must meet constraints for abrasion (non abrasive to fiber end face) and cleaning efficacy (sufficient cleaning effectiveness for most common particles and film contaminants and for ability to absorb hydraulic oils, fuels and other aircraft and shipboard fluids.

6.7 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. As of the dating of this document, the U.S. Environmental Protection Agency (EPA) is focusing efforts on reducing 31 priority chemicals. The list of chemicals and additional information is available on their website at http://www.epa.gov/osw/hazard/wastemin/priority.htm. Included in the list of 31 priority chemicals are cadmium, lead, and mercury. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see section 3).

6.8 Changes from previous issue. The margins of this specification are marked with vertical lines to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:
Army - CR
Navy – SH
Air Force – 85
NASA - NA
DLA – CC

Preparing activity:
DLA - CC

(Project 6060-2013-001)

Review activities:
Army – MI
Navy – EC, AS
Air Force – 03, 19, 33, 93, 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at https://assist.dla.mil.