INCH-POUND

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MILITARY SPECIFICATION

CONNECTORS, FIBER OPTIC, SINGLE TERMINUS, 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 terminus fiber optic connectors. The connectors described herein cover families of both bulkhead and cable termination configurations. The connectors must have consistent optical performance. The connectors are supplied under a MIL-STD-790 reliability assurance program. Statistical process control (SPC) techniques are required in the manufacturing process to minimize variation in production of connectors supplied to the requirements of this specification. See 6.1 for restrictions on intended use and applications.

1.2 Classification. Plug and receptacle styles shall permit in-line, wall-mounted, panel and rack, right angle, and other configurations. Individual connector requirements shall be as specified herein and in accordance with the applicable specification sheets (see 3.1).

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

a. Type I - Multimode (MM).

b. Type II - Single mode (SM).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 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 listed in the issue of the Department of Defense Index of Specifications and standards (DODISS) and supplement thereto, cited in the solicitation.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use use in improving this document should be addressed to: Electronic Support Division AFLC, 2750 ABW/ES, Gentile AF Station, Dayton, OH 45444-4500 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 6060

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SPECIFICATIONS

FEDERAL

QQ-A-225/6	-	Aluminum Alloy 2024, Bar, Rod, and Wire; Rolled, Drawn or Cold Finished.
QQ-B-613	-	Brass, Leaded and Non-Leaded: Flat Products (Plate, Bar, Sheet, and Strip).
QQ-B-626	-	Brass, Leaded and Non-Leaded Rod, Shapes, Forgings, and Flat Products With Finished Edges (Bar and Strip).
QQ-C-576	-	Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed, or Machine Edges (Plate, Bar, Sheet, and Strip).
QQ-P-35	-	Passivation Treatments for Corrosion-Resistant Steel.
QQ-S-763	-	Steel Bars, Wire, Shapes, and Forgings, Corrosion-Resisting.
QQ-Z-363	-	Zinc-Base Alloy; Die Castings.
TT-I-735	-	Isopropyl Alcohol.
ZZ-R-765	-	Rubber, Silicone.

MILITARY

MIL-S-901	-	Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment & Systems, requirements For.
MIL-G-3056	-	Gasoline, Automotive, Combat.
MIL-H-5606	-	Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance.
MIL-T-5624	-	Turbine Fuel, Aviation, Grades JP-4 and JP-5.
MIL-F-16884	-	Fuel, Naval Distillate.
MIL-L-17331	-	Lubricating Oil, Steam Turbine and Gear, Moderate Service.
MIL-L-23699	-	Lubricating Oil, Aircraft Turbine Engines, Synthetic
DOD-F-49291	-	Fiber, Optical (Metric).
MIL-C-55330	-	Connectors, Electrical and Fiber Optic, Packaging of.
DOD-C-85045	-	Cable, Fiber Optics, General Specification for (Metric).

STANDARDS

MILITARY

MIL-STD-105	-	Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129	-	Marking for Shipment and Storage.
MIL-STD-202	-	Test Methods for Electronic and Electrical Component Parts.
MIL-STD-454	-	Standard General Requirements for Electronic Equipment.
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-1344	-	Test Methods for Electrical Connectors.
MIL-STD-1678	-	Fiber Optic Test Methods & Instrumentation.
MIL-STD-45662	-	Calibration Systems Requirements.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

NATIONAL AERONAUTICAL AND SPACE ADMINISTRATION (NASA)

NHB 8060.1	-	Flammability, Odor, and Offgassing and Compatibility Requirements and test Procedures For Materials in Environments That Support Combustion.

(Application for copies should be addressed to Office of Safety and Mission Quality, (Code QR), NASA Headquarters, Washington, DC 20546)

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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 the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-A-484 - General Requirements for Stainless and Heat-Resisting Wrought Steel Products (Except Wire).

ASTM-A-582 - Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished.
ASTM-E-595 - Total Mass Loss and Collected Volatile Condensable Materials From Outgassing in a Vacuum Environment.
ASTM-D-1141 - Standard Specification for Substitute Ocean Water.
ASTM-D-1430 - Standard Specification for Polychlorotrifluro-Ethylene (PCTFE) Plastics.
ASTM-D-2116 - Standard specification for FEP Fluorocarbon Molding and Extrusion Materials.
ASTM-D-4181 - Standard specification for Acetal (POM) Molding and Extrusion Materials.

(Application for copies of ASTM publications should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103).

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA-455 - Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices, Test Procedures For.
*EIA-455-14 - Fiber Optic Shock Test (Specified Pulse).
*EIA-455-20 - Measurement of Change in Optical Transmittance.
*EIA-455-21 - Mating Durability for Fiber Optic Connecting.
*EIA-455-22 - Ambient Light Susceptibility.
*EIA-455-32 - Discontinuities.
*EIA-455-34 - Interconnection Device Insertion Loss Test.
EIA-455-49 - Procedure for Measuring Gamma Irradiation Effects in Optical Fibers and Optical Cables.
*EIA-455-36 - Twist Test for Fiber Optic Connecting Devices.
EIA-455-107 - Return Loss for Fiber Optic Components.
*EIA-557 - Statistical Process Control System.

* Has been adopted by DOD.

NOTE: EIA-455-20 and -34 are applicable to EIA-455-107.

(Application for copies should be addressed to Electronic Industrial Association (EIA) 2001 Eye Street, NW, Washington, DC 20006.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document take 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 requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Connectors furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.5 and 6.3).

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

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3.2.1.1 Statistical process control. The contractor shall implement and use statistical process control techniques in the manufacturing process for parts covered by this specification. The SPC program shall be developed and maintained in accordance with EIA-557. The SPC program shall be documented and maintained as part of the overall reliability assurance program as specified in MIL-STD-790.

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 herein, all metals used in the construction of the connectors shall be corrosion-resistant types (300 series CRES recommended), or shall be suitably plated or otherwise finished to prevent corrosion during service life under any of the environmental conditions specified in this document. 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.

3.3.3.3 Radioactive materials. Radioactive materials shall not be used in the construction of the connectors specified herein.

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.

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3.3.5 Fungus. Finishes and materials shall be certified that they meet the requirements of MIL-STD-454, requirement 4. Connectors that are not in accordance with MIL-STD-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.

3.3.7 Overall finish. The resultant finish on all parts covered by the individual specification sheets shall be stainless steel passivate in accordance with QQ-P-35.

3.4 Design and construction. The connectors, backshells, protective covers, etc., 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 Configuration 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 shall be provided for the following minimum classes of connectors:

a. Receptacles.

b. Plugs.

c. 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 DOD-C-85045 unless otherwise specified in the individual specification sheets (see 3.1).

3.4.5 Fiber optic termini. The specification sheets (see 3.1) shall define the technology employed to provide the optical termini. Issues to be specified shall include, but are not limited to, the following:

a. Method of optical alignment, i.e., tube, straight sleeve, grooved plate, etc.

b. Coating requirements, as applicable.

3.4.5.1 Fiber attachment. Fiber attachment shall be provided by crimping and/or adhesive bonding.

3.4.6 Special handling. The connectors specified herein shall be designed for use in 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 attenuation performance limits specified in 3.5.1.1 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 and 3.5.1.2.

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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. Cleaning operations shall not degrade the specified performance of the connector. To facilitate cleaning, the connector design shall allow easy accessibility to the optical faces. Cleaning materials may include clean water (not distilled water), a dry cloth or a small brush. Compressed air or nonfluorocarbon aerosol liquid may be used for cleaning. Disassembly of optical connectors is not acceptable for field operations. No special equipment shall be required to clean the optical connectors (see 3.1).

3.4.8.1 Cleaning procedures. The specification sheets (see 3.1) for the connectors specified herein shall include the procedures for cleaning the optical mating surfaces of the connectors. Attention shall be given to the criteria for inspection and test of the connector to determine if the cleaning procedure has been successful.

3.4.9 Dust cover. All optical connectors (plugs 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 1.0 dB, or as specified (see 3.1). The maximum insertion loss at any time shall not exceed 1.5 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 during and after any tests as specified in this document (see 4.7.7). Unless otherwise specified the periodicity of the measurement 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 tested as specified in 4.7.9, there shall be no signal discontinuity when the connector is subjected to the shock and vibration levels specified herein. A signal discontinuity is defined as a change in the attenuation in the optical path of the connector in excess of 0.5 dB for single and multimode for a duration of 50 microsecond or more. For tests of extended durations, measurements may be made at discrete times by use of a triggering circuit which constantly monitors the optical signal, as approved by the qualifying activity.

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).

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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 newtons applied to the cable behind the back end of the plug without evidence of physical damage to the connector or 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 and 3.5.1.1 after, and 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, and shall meet the requirements of 3.5.1.1 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 torque. 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 3.5.1.1, 3.5.1.2 and 3.5.1.5. 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 nonoptical 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).

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.

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.

3.5.2.6 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 exposure to the operating pressure (sea level to 70,000 feet), and after exposure to the nonoperating pressure (sea level to 70,000 feet). There shall be no evidence of physical damage to the connector.

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3.5.3.2 Temperature. When tested as specified in 4.8.2, the connectors 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. Normal temperature range:

1. Operating: -46°C to +85°C.

2. Nonoperating: -62°C to +85°C.

b. High temperature range:

1. Operating: -55°C to +125°C.

2. Nonoperating: -65°C to +200°C.

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 in a signal discontinuity as specified in 3.5.1.4 when the connector is vibrated.

3.5.3.5 Shock. When tested as specified in 4.8.6, the connectors shall show no evidence of broken, loose, deformed or displaced parts, cracks, chips, or other damage which would result in a signal discontinuity as specified in 3.5.1.4 when the connector is subjected to the shock levels specified herein.

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. The requirements of 3.5.1.1 shall be met after temperature humidity cycling test.

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 Nonoperating. 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.

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).

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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 3.5.1.1 and 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. QUALITY ASSURANCE PROVISIONS

4.1 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.

4.1.1 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.

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4.1.2 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 MIL-STD-45662.

4.1.3 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.

4.1.4 Statistical process control. A SPC program shall be established and maintained in accordance with EIA-557. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.

4.2 Classification of inspections. The inspections 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).

TABLE I. Materials inspection.

Component material	Requirement	Applicable specification paragraph
Metals	3.3.2	---
Zinc	---	QQ-Z-363
Brass	---	QQ-B-613 or QQ-B-626
Aluminum	---	QQ-1-225/6
Steel corrosion-resistant	---	QQ-S-763, ASTM A484 or ASTM A582
Dissimilar metals	3.3.2.1	MIL-STD-454
Bronze (alloy 425)	---	---
Nonmetallic materials	3.3.3	---
TFE fluorocarbon	---	---
FEP fluorocarbon	---	ASTM D1430
Silicon rubber	---	ZZ-R-765
Acetal	---	ASTM D4181
Epoxies	3.3.3.1	---
Sealing compounds	3.3.3.2	---
Radioactive materials	3.3.3.3	---
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.

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4.5.1 Sample size. Fourteen connectors of the same PIN with its mating connector 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. Twelve mated connector pairs shall be subjected to the 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 tests within one of groups II, III and IV of table II. Two additional mated connector pairs shall be subjected to the flammability test in group V of table II. 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. The first report for groups A, B, and C is required at 12 months. Thereafter, groups A and B require a report at 12-month intervals, and group C requires a report at 36-month intervals. The qualifying activity shall establish the initial reporting date. Initial retention of qualification shall be at an 18-month interval; subsequent retention of qualification at a 36-month 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 12- or 36-month 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 12- or 36-month 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 12- or 36-month 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 III, 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 and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots and shall be clearly identified as reinspected lots.

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4.6.1.1.2 Group B inspection. Group B inspection shall consist of the inspections specified in table IV 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 shall be in accordance with MIL-STD-105 for special inspection level S-4. The sample size shall be based on the inspection lot size from which the sample was selected for group A inspection. The AQL shall be 1.5 percent defective.

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 reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected 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 1 year after initial qualification and within each 3 year period thereafter. Six sample units shall be selected from the first lot produced. Six sample units shall also be selected after 200,000 connectors have been produced. 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 reinspection, 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-C-55330.

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TABLE II. Qualification inspection.

Inspection	Optical tests 1/			Requirement paragraph	Test method paragraph
	Insertion loss	Signal discontinuities	Change in optical transmittance		
Group I (12 mated pairs)					
Visual and mechanical inspection				3.4, 3.4.1 3.4.4 through 3.4.10 3.6 and 3.7	4.7.2 4.7.2.1
Weight				3.4.2	4.7.3
Size				3.4.3	4.7.4
Insertion loss				3.5.1.1	4.7.6
Ambient light Susceptibility				3.5.1.3	4.7.8
Return loss (S) 2/				3.5.1.5	4.7.10
Group II (4 mated pairs)					
Temperature			X	3.5.3.2	4.8.2
Temperature/humidity cycling	X		X	3.5.3.6	4.8.7
Water submersion			X	3.5.3.7	4.8.8
Marking				3.6	4.7.2
Group III (4 mated pairs)					
Tensile loading			X	3.5.2.1.1	4.7.11.1
Cable strain relief				3.5.2.1.2	4.7.11.2
Flex life	X		X	3.5.2.1.3	4.7.11.3
Twist	X		X	3.5.2.1.4	4.7.11.4
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
Mating durability	X		X	3.5.2.5.1	4.7.15
Impact			X	3.5.2.6	4.7.16
Thermal shock			X	3.5.3.3	4.8.3
Vibration		X		3.5.3.4	4.8.5
Shock		X		3.5.3.5	4.8.6
Ozone exposure				3.5.3.10	4.8.11
Temperature life	X		X	3.5.3.12	4.8.4
Marking				3.6	4.7.2
Group IV (4 mated pairs)					
Mating durability	X		X	3.5.2.5.1	4.7.15
Pressure altitude			X	3.5.3.1	4.8.1
Thermal shock			X	3.5.3.3	4.8.3
Temperature/humidity cycling	X		X	3.5.3.6	4.8.7
Salt Spray				3.5.3.8	4.8.9
Dust (fine sand)			X	3.5.3.9	4.8.10
Fluid immersion			X	3.5.3.11	4.8.12
Temperature cycling	X		X	3.5.3.15	4.8.16
Nuclear radiation resistance			X	3.5.3.14	4.8.15
Marking				3.6	4.7.2
Group V (see 4.5.2)					
Flammability			X	3.5.3.13	4.8.13
Fungus				3.3.5	4.8.14

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TABLE II. Qualification inspection. - Continued.

Inspection	Optical tests 1/			Requirement paragraph	Test method paragraph
	Insertion loss	Signal discontinuities	Change in optical transmittance		
Group VI 3/ (2 mated pairs)					
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

1/ X - Indicates that this test applies. See appropriate test paragraph for details.
2/ Applies only to single mode connectors (SM).
3/ NASA will perform these tests.
NASA Parts project Office
CODE 310
Goddard Space Flight Center
Greenbelt, MD 20771

TABLE III. Group A inspection. 1/

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 4.7.2.1
Weight 2/	3.4.2	4.7.3
Size 2/	3.4.3	4.7.4

1/ AQL is 4 percent minor and no major failures.
2/ The contractor may use in-process controls for this requirement.

TABLE IV. 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 fail

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 PA.

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

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TABLE V. Group C inspection.

Inspection	Optical tests 1/			Requirement paragraph	Test method paragraph
	Insertion loss	Signal discontinuities (see 4.7.5)	Change in optical transmittance		
Group I (4 mated pairs)					
Temperature			X	3.5.3.2	4.8.2
Temperature/humidity cycling	X		X	3.5.3.6	4.8.7
Submersion			X	3.5.3.7	4.8.8
Group II (4 mated pairs)					
Tensile loading			X	3.5.2.1.1	4.7.11.1
Flex life	X		X	3.5.2.1.3	4.7.11.3
Twist	X		X	3.5.2.1.4	4.7.11.4
Impact			X	3.5.2.6	4.7.16
Thermal shock			X	3.5.3.3	4.8.3
Vibration		X		3.5.3.4	4.8.5
Shock		X		3.5.3.5	4.8.6
Ozone exposure	X			3.5.3.10	4.8.11
Temperature life	X		X	3.5.3.12	4.8.4
Group III (4 mated pairs)					
Mating durability	X		X	3.5.2.5.1	4.7.15
Pressure altitude			X	3.5.3.1	4.8.1
Salt spray				3.5.3.8	4.8.9
Dust (fine sand)			X	3.5.3.9	4.8.10
Fluid immersion			X	3.5.3.11	4.8.12
Temperature cycling	X		X	3.5.3.15	4.8.16
Nuclear radiation			X	3.5.3.14	4.8.15
Marking				3.6	4.7.2
Group IV (2 mated pairs)					
Flammability			X	3.5.3.13	4.8.13
Group V 2/ (2 mated pairs)					
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 (Offgassing)				3.5.4.4	4.9.4

1/ X - Indicates that this test applies. 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.

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4.7.2 Visual and mechanical inspection. Connectors and associated fittings 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 by mating the connector with its applicable mating gauges or other suitable means acceptable to the Government.

4.7.3 Weight (see 3.4.2). Connector plugs 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 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. Unless otherwise specified, the optical properties inspection methods shall be performed at a wavelength of 1300 nm. The connectors should be attached to lengths of cable in accordance with DOD-C-85045. The cable lengths shall not be greater than 30 meters. For multimode fiber, a noncoherent light source shall be used. Light launch conditions shall be as specified in table VI or equivalent. Initial launch conditions may be interrupted between tests.

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.

TABLE VI. Light launch conditions.

Single mode	30 mm diameter mandrel
Multimode	70/70 restricted or equivalent mandrel wrap

4.7.6 Insertion loss (see 3.5.1.1). The initial insertion loss shall be measured in accordance with method A of EIA-455-34. Subsequent insertion loss shall be measured as approved by qualification activity.

4.7.7 Change in optical transmittance (see 3.5.1.2). The change in optical transmittance shall be measured in accordance with EIA-455-20 or by an equivalent method.

4.7.8 Ambient light susceptibility (see 3.5.1.3). The ambient light susceptibility shall be measured in accordance with EIA-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.

4.7.9 Signal discontinuities (see 3.5.1.4). Signal discontinuities shall be measured in accordance with EIA-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.

4.7.10 Return loss (SM) (see 3.5.1.5). Samples shall be tested for return loss in accordance with EIA-455-107. The insertion loss measurements shall be performed in accordance with EIA-455-34. Upon completion of each test, samples shall be examined for compliance to 3.5.1.5.

4.7.11 Cable retention (see 3.5.2.1).

4.7.11.1 Tensile loading (see 3.5.2.1.1). Tensile loading shall be measured in accordance with method 2009 of MIL-STD-1344, maximum tensile load shall be held for 1 minute, unless otherwise specified (see 3.1). The change in optical transmittance shall be measured during and after the test.

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.

4.7.11.3 Flex life (see 3.5.2.1.3). The plug specimen shall be tested for flex life in accordance with method 2017 of MIL-STD-1344. 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. Insertion loss shall be measured at the completion of the flex test.

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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 test and every 500 cycles during the test.

4.7.11.4 Twist (see 3.5.2.1.4). Mated cable-connector assemblies shall be tested in accordance with EIA-455-36 (FOTP-36). The cable shall then 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. Insertion loss shall be measured after the completion of the twist test.

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).

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 pairs (plug to adapter to plug) shall be tested for mating durability in accordance with EIA-455-21 for a total of 500 mating cycles. The optical performance tests (see 3.5.1) shall be performed after the test. The change in optical transmittance (3.5.1.2) shall be measured every 100 cycles during the durability test.

4.7.16 Impact (see 3.5.2.6). Unmated connector assemblies with protective covers 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 minimum thickness, as shown on figure 1.

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 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).

4.8 Environmental requirements (see 3.5.3).

4.8.1 Pressure altitude (see 3.5.3.1). With mated pairs of connectors assembled to specimen cables as specified in 4.7.4, the connectors 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 2,000 feet per minute.

c. Operating and nonoperating: 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.

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4.8.2 Temperature (see 3.5.3.2). With mated pairs of connectors assembled to specimen cables, the connectors shall be tested at high and low temperature as specified herein.

Step	Ramp time
1. Room temperature	1 hour
2. Ramp to high operating temperature	2 hours maximum
3. High operating temperature	Hold for 24 hours
4. Do change in optical transmittance	
5. Ramp to room ambient (25°C ±2°C)	2 hours maximum
6. Room ambient	Hold for 1 hour
7. Do change in optical transmittance	
8. Ramp to low operating temperature	2 hours maximum
9. Low operating temperature	Hold for 24 hours
10. Do change in optical transmittance	
11. Ramp to room ambient (25°C ±2°C)	2 hours maximum
12. Room ambient	Hold for 1 hour
13. Do change in optical transmittance	

4.8.3 Thermal shock (see 3.5.3.3). Cable-connector assemblies (at least one mated and one unmated) shall be tested in accordance with test method 4020 of DOD-STD-1678 with the exception that the low test temperature in table I, step 1, test condition A, method 107 of MIL-STD-202 shall be -62°C. The mated and unmated cable-connector assemblies shall be examined for degradations of any sort after testing in accordance with 3.5.3.3.

a. High test temperature: +85°C.

b. Examination during test: Verify that the optical performance is within the limits specified in 3.5.1.2 at the end of each temperature cycle.

c. Examination after test: Examine for compliance to 3.5.3.3.

4.8.4 Temperature life (see 3.5.3.12). Mated and unmated cable connector assemblies shall be tested in accordance with method 108 of MIL-STD-202. The exposure time shall be 240 hours. The exposure temperature shall be 110°C. The change in optical transmittance (see 3.5.1.2) and the connector insertion loss (see 3.5.1.1) shall be measured after the connector assemblies have returned to ambient temperature conditions.

4.8.5 Vibration (see 3.5.3.4). A complete connector assembly shall be mounted as shown on figure 2 or suitable test fixture and vibrated in accordance with test conditions III and VI, condition C for 1.5 hours, except III at 10 G's, method 2005, MIL-STD-1344. Specimen cable, using the normal connecting devices of the connector and clamped as shown on figure 2, shall be used. The connector shall be mounted by its normal mounting device and engaged by its normal coupling device. No safety wire shall be used. Cable to cable connectors may be held to the jig of figure 2 by a suitable clamp on one half of the connector assembly. The following conditions shall apply:

a. Test condition letter if other than above (see 3.1).

b. Signal discontinuity as specified in 4.7.9, shall be monitored during vibration.

c. Upon completion of test, the connectors shall be examined for compliance to 3.5.3.4.

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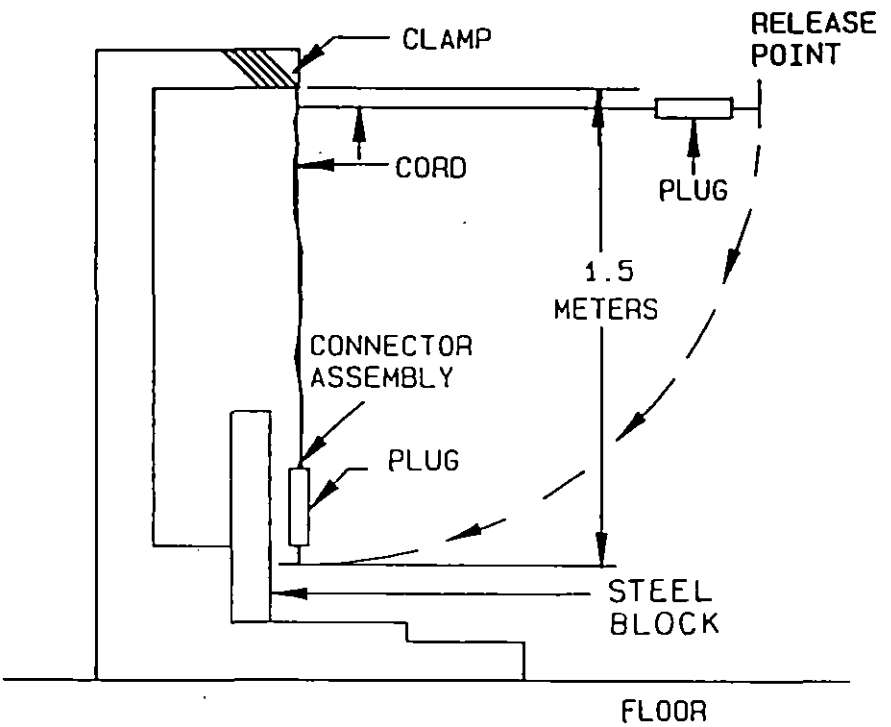

FIGURE 1. Impact test facility.

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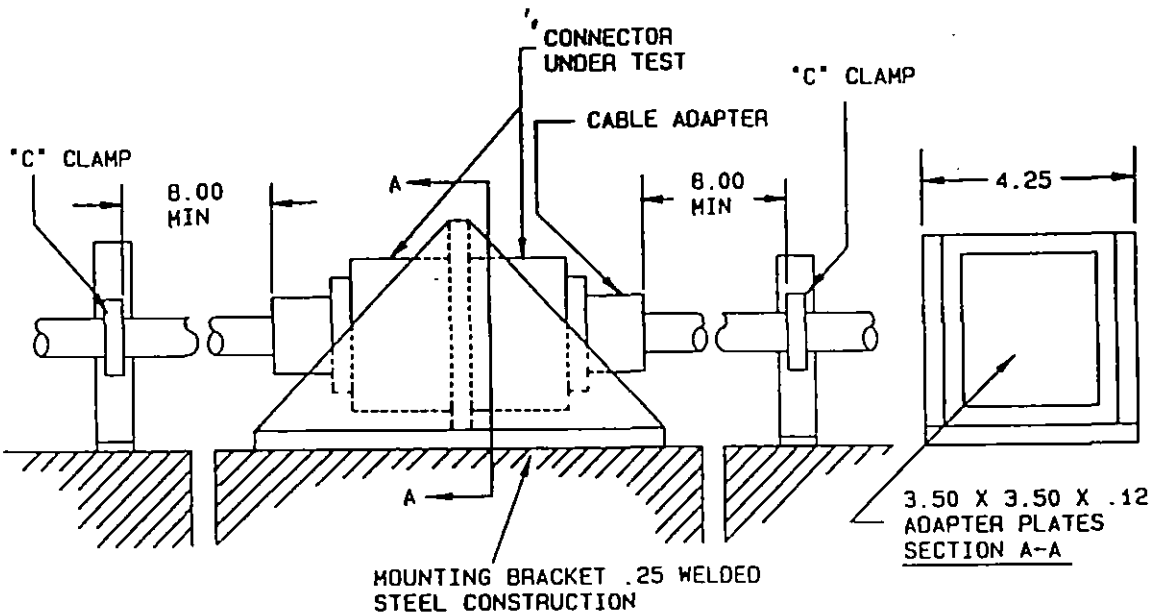

Inches	mm
.12	3.1
.25	6.4
3.50	88.9
4.25	107.9
8.00	203.2

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

FIGURE 2. Vibration testing setup.

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4.8.6 Shock (see 3.5.3.5). Connector plugs and receptacles, with specimen cables attached, shall be shock tested in accordance with EIA-455-14. When specified (see 3.1), the shock test shall be in accordance with MIL-S-901, grade A, type A, class I. Signal discontinuity as specified in 4.7.9 shall be monitored during the test. The following details and exceptions shall apply:

a. 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.

b. Test condition I.

c. Three blows in each of three mutually perpendicular planes; one of which shall be parallel to the axis of the connector.

d. Signal discontinuity as specified in 4.7.9, shall be monitored during shock.

e. Upon completion of test, the connectors shall be examined for compliance to 3.5.3.5.

f. A dummy mass may be included as part of the test fixture, however the total mass requirements of MIL-S-901 shall be met.

4.8.7 Temperature/humidity cycling (see 3.5.3.6). Cable-connector assemblies (at least one mated and one unmated), shall be tested in accordance with method 4030 of DOD-STD-1678. The subcycle shall be included in the testing. The change in optical transmittance shall be measured before, during, and after testing (see 3.5.1.2).

a. Measurements shall be made at high humidity when specified (see 3.1).

b. Examination during test: Verify that the optical performance of each connector is within the limits specified in 3.5.1.2 at the end of each 24-hour cycle.

c. Examination after test: Examine for compliance to 3.5.3.15, 3.5.1.1 and 3.5.1.2.

4.8.8 Water Submersion (see 3.5.3.7). Mated cable-connector assemblies shall be tested for water pressure susceptibility as follows. The assemblies 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 nonoperating 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).

4.8.9 Salt spray (see 3.5.3.8). Half the samples mated and half the samples unmated shall be tested in accordance with method 1001 of MIL-STD-1344. The following details and exceptions shall apply:

a. Test condition letter: A.

b. The samples shall not be mounted but shall be suspended from the top of the chamber using waxed twine or string, glass rods, or glass cord.

c. Fiber ends must be protected to prevent salt migration.

d. After test exposure, the samples shall be externally cleaned and examined under five-power magnification for salt penetration and damage to external parts.

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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.

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 method 1007 of MIL-STD-1344.

4.8.12 Fluid immersion (see 3.5.3.11). Connector samples (one mated and one unmated pair), shall be subjected to the test specified in method 1016 of MIL-STD-1344. All samples shall be subjected to the all of the fluids, temperatures, and immersion times specified below. Each assembly shall be completely dried after each immersion. Following the test, samples shall be examined for compliance to 3.5.3.11. Additional fluids will be tested when specified.

a. Sample preconditioning shall be under ambient conditions.

b. Perform only one immersion cycle.

Fluid	Temperature (°C)	Immersion time (hours)
Isopropyl alcohol TT-I-735	20 - 25	168
Automobile gas MIL-G-3056	20 - 25	168
Hydraulic fluid MIL-H-5606	48 - 50	24
Turbine fuel MIL-T-5624	20 - 25	168
Lubricating oil MIL-L-23699	73 - 77	24
Lubricating oil MIL-L-17331	73 - 77	24
Fuel oil MIL-F-16884	33 - 37	24
Coolant, Monsanto Coolanol or equivalent	20 - 25	24
Ocean water ASTM-D-1141	20 - 25	24

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4.8.13 Flammability (see 3.5.3.13). Mated and unmated connector assemblies shall be tested in accordance with method 1012 of MIL-STD-1344. The mated assemblies shall be exposed to a 0.75 inch flame height applied for ten seconds (Test Condition C) 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 assemblies shall be demated. Two unmated connector assemblies shall be exposed to a 1.5 inch flame height applied for 60 seconds (test condition A) to the connector/strain relief interface region.

4.8.14 Fungus resistance (see 3.3.6). Connector components shall be tested for exposure to fungus in accordance with method 508 of MIL-STD-810.

4.8.15 Nuclear radiation resistance (see 3.5.3.14). When specified (see 3.1), mated cable-connector assemblies shall be tested in accordance with EIA-455-49. The tests shall be performed at a wavelength of 1300 ±.20 nm at the low operating temperature, at room temperature, and at the high operating temperature. The change in optical transmittance shall be measured during and after the test.

4.8.16 Temperature cycling (see 3.5.3.15). The connector shall be tested in accordance with DOD-STD-1678, method 4010. The following is a list of test steps, test temperatures, and test times. Change in optical transmittance (3.5.1.2) shall be measured at the end of steps 3, 5, 7, and 9.

Step	Temperature (°C)	Duration (hours)
1.	Room ambient	24
2.	Ramp to -46°C ±2°C	2
3.	Low operating temperature	8
4.	Ramp to +25°C ±2°C	2
5.	+25°C ±2°C	6
6.	Ramp to +71°C ±2°C	1
7.	High operating temperature	6
8.	Ramp to +25°C ±2°C	1
9.	+25°C ±2°C	6

10. Repeat steps 2 through 9 four times for a total of five cycles.

The change in optical transmittance (see 3.5.1.2) shall be monitored during and after the test. The samples shall be examined for compliance with 3.5.3.15 after the test. The insertion loss (see 3.5.1.1) shall be measured 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 E-595.

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.

4.9.3 Odor. Material samples shall meet the requirements of 3.5.4.3 when tested in accordance with NHB 8060.1, test 6.

4.9.4 Toxicity (Offgassing). Material samples shall meet the requirements of 3.5.4.4, when tested in accordance with NHB 8060.1, test 7.

5. PACKAGING

5.1 Packaging requirements. The requirements for packaging shall be in accordance with MIL-C-55330.

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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 nonvehicular 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 mobile marine environment (on board or in tow).

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, nonwatertight.

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 demating 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.

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6.1.3 Material safety data sheets (MSDS). MSDS sheets shall be available upon request.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and if required, 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).

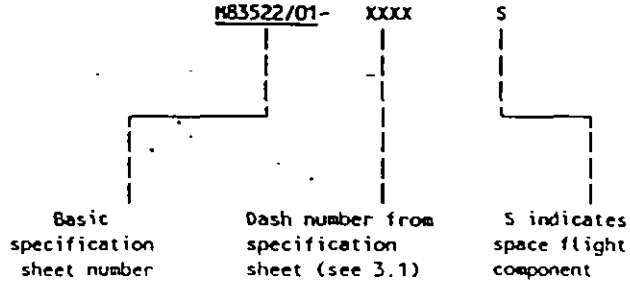
6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in the applicable Qualified Products List QPL No. 83522 whether or not such products have actually been so listed by that date. 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 purchase orders for the products covered by this specification. The activity responsible for the QPL is Electronic Support Division AFLC, 2750 ABW/ES, Gentile AF Station, Dayton, Ohio 45444; however information pertaining to qualification of products may be obtained from Defense Electronics Supply Center (DESC-E), 1507 Wilmington Pike, Dayton, Ohio 45444.

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 PIN. The PIN shall consist of the letter "M" followed by the basic specification sheet number, and a sequentially assigned dash number (see 3.1).

Example:



6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

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CONCLUDING MATERIAL

Custodians:
Army - CR
Navy - EC
Air Force - 85
NASA - NA

Review activities:
Army - MI
Navy - AS, SH
NASA - LRC, MSF
Air Force - 13, 14, 17, 19, 70, 71, 80, 82, 84, 90, 99
DLA - ES

User activities:
Navy - MC, OS, YD
Air Force - 80

Preparing activity:
Air Force - 85

Agent:
DLA - ES

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INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-C-83522D	92-06-25

3. DOCUMENT TITLE
CONNECTORS, FIBER OPTIC, SINGLE TERMINUS, GENERAL SPECIFICATION FOR

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial	(2) AUTOVON
2750 LOG/ES GENTILE AFS	(513) 296-5517	986-5517
c. ADDRESS (Include Zip Code) 1060 HAMILTON STREET DAYTON, OH 45444-5400	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	

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