

Connectors, Fiber Optic, Advanced, Circular or
Rectangular, Plug and Receptacle,
Environment Resistant, Removable Termini, General Specification For

1. SCOPE:

1.1 Scope:

This specification covers the performance requirements for a plug and receptacle, multiple termini, fiber optic connector. Fiber optic connectors using removable termini, and are capable of operating within a temperature range of -65 to +200 °C (see 1.2.1.1). These connectors are supplied under 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.

1.2 Description:

All series include removable termini. All series are designed to assure proper orientation of the mating halves prior to mating. All connectors, except Class C, include EMI shielding capability, with conductive finishes, which provide electrical continuity between mated shells prior to terminus engagement and have the termini so located as to be protected from handling damage.

1.2.1 Design Considerations: Connectors are capable of satisfactory performance during and after, as applicable, when subjected to the following environmental conditions:

1.2.1.1 Temperature: Connectors are class dependent: -65 to +150 °C, 175 °C, or 200 °C (see 1.3.1c).

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1.2.1.2 Vibration: See 3.14

- a. Random of 41.7 G rms: At rated high temperature with simulated accessory load.
- b. Random of 49.5 G rms: At ambient temperature.
- c. Sine: 60 G rms: With temperature cycling and simulated accessory load.

1.2.1.3 Altitude: Altitudes from sea level to 100,000 feet (8 torr) (see 3.12).

1.2.1.4 Shock: Shock as represented by a 3 millisecond $\pm$ 1 millisecond base half-sine wave peaking at 300 G (see 3.15).

1.2.1.4.1 High Impact Shock: In accordance with MIL-S-901, with appropriate accessories (see 3.15).

1.2.1.5 Humidity: Humid conditions up to 98% relative humidity including condensation (see 3.19).

1.2.1.6 Corrosion: Exposure to salt-laden atmosphere (see 3.12).

1.2.1.7 Thermal Shock: Temperature cycling (see 3.7).

1.2.1.8 Immersion: Immersion in jet fuel, lubrication oil, liquid coolant, hydraulic fluid, gasoline, cleaning compound, defrosting fluid, and solvents (see 3.23).

1.2.1.9 EMI Shielding: EMI shielding effectiveness: 100 MHz to 10 GHz (see 3.21).

1.2.1.10 Electrolytic Erosion: Exposure of un-coupled connectors to a salt moisture environment (see 3.26).

1.3 Classification:

1.3.1 Connectors: Connectors fabricated to this specification are classified as follows:

a. Series:

AS5990/1 – Circular, Scoop Proof, Triple Start, Self-locking, Threaded Coupling

AS5990/2 – Circular Scoop Proof, Triple Start, Self-locking, Threaded Coupling, with Removable Socket Insert Front Face

1.3.1 (Continued):

b. Types:

00 – Receptacle, square flange, wall mounting, front and rear

01 – Receptacle, in-line

02 – Receptacle, square flange, box mounting

06 – Plug, straight, shell-to-shell bottoming with ground fingers for additional shielding

07 – Receptacle, jam nut

08 – Plug, straight, shell-to-shell bottoming

09 – Plug, straight, lanyard release

c. Classes and temperature ranges:

A – Olive drab cadmium plate, conductive, composite material, -65 to +175 °C

B – Electroless nickel plate, conductive, composite material, -65 to +200 °C

C – Unplated composite, non-conductive, -65 to +175 °C

D – Olive drab cadmium plate, conductive, aluminum alloy, -65 to +175 °C

E – Electroless nickel plate, conductive, aluminum alloy, -65 to +200 °C

F – Electroless nickel plate, space grade, conductive, aluminum alloy, -65 to +200 °C

G – Electrodeposited nickel, conductive, corrosion resistant steel, -65 to +200 °C

H – Passivated, conductive, corrosion resistant steel, -65 to +200 °C

J – Olive drab zinc nickel plate, cadmium free, conductive, composite material, -65 to +175 °C

K – Olive drab zinc nickel plate, cadmium free, conductive, aluminum alloy, -65 to +175 °C

Connectors specified are designed for use with termini as specified in MIL-T-29504.

2. APPLICABLE DOCUMENTS:

The following documents may or may not be applicable to all slash sheets and the body of this document.

2.1 Government Documents:

- 2.1.1 Specifications and Standards: The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

MILITARY SPECIFICATIONS

MIL-S-901	Shock Tests, High Impact, Shipboard, Machinery, Equipment and Systems, Requirements For
MIL-DTL-5624	Turbine Fuel, Aviation, Grades JP4 and JP5, JP8ST
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series, General Specification For
MIL-T-29504	Termini, Fiber Optic Connectors
MIL-DTL-38999	Connectors, Electrical, Circular
MIL-A-46146	Adhesive Sealants, Silicone, RTV, Non-Corrosive (for use with sensitive equipment)
MIL-DTL-55330	Connectors, Preparation for Delivery of
MIL-I-81969	Installation and Removal Tools, Connector, Electrical, General Specification For
MIL-DTL-83723	Connector, Electrical, Circular
MIL-F-49291	Optical Fiber
MIL-STD-1916	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-202	Test Methods for Electronic and Electrical Component Parts

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2.1.1 (Continued):

MIL-HDBK-454	Standard General Requirements for Electronic Equipment
MIL-STD-790	Reliability Assurance Program for Electronic Parts Specifications
MIL-STD-810	Environmental Considerations and Laboratory Tests
MIL-STD-1285	Marking of Electrical and Electronic Parts
MIL-STD-1373	Screw Thread, Modified, 60 Degree, Stub, Double
MIL-STD-1560	Insert Arrangement, MIL-DTL-38999
MIL-STD-1554	Insert Arrangement, MIL-DTL-83723
MS27488	Plug, End Seal, Electrical Connector

FEDERAL STANDARDS

FED-STD-H28	Screw Thread Standards for Federal Services
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(Copies of applicable specifications, standards and handbooks listed in the Department of Defense Index of Specifications and Standards (DODISS) and required by the contractor in connection with specific procurement functions may be obtained upon application to the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

- 2.1.2 Other Government Documents, Drawings and Publications: The following other Government documents, drawings and publications that form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

2.2 Non-Government Publications:

The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issue of the document, 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).

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

AS3582	Packing, Pre-Formed
AIR4567	Military Composite Electrical Connectors
AIR4789	Evaluating Corrosion Testing of Electrical Connectors and Accessories for the Purpose of Qualification
AS13441	Test Methods for Electrical Connectors
AS85049	Connector, Accessories, Electrical, General Specification For
AS90376	Caps, Dust, Plastic
AMS-C-26074	Coatings, Electroless Nickel, Requirements for

(Application for copies should be addressed to SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.)

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA RS-359	Standard Colors for Color Identification and Coding (ANSI C-83.1-1973) EIA 455-6 FOTP-6 Cable Retention Test Procedure for Fiber Optic Cable Interconnecting Devices
EIA364	Connector Test Method Standards
EIA 455-13 FOTP-13	Visual and Mechanical Inspection of Fiber, Cable, Connectors and/or Other Fiber Optic Devices
EIA 455-20 FOTP-20	Measurement of Change in Optical Transmittance
EIA 455-21 FOTP-21	Mating Durability of Fiber Optic Interconnecting Devices
EIA 455-22 FOTP-22	Ambient Light Susceptibility of Fiber Optic Components

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2.2 (Continued):

EIA 455-32 FOTP-32	Fiber Optic Circuit Discontinuities
EIA 455-34 FOTP-34	Interconnection Device Insertion Loss Test
EIA 455-36 FOTP-36	Twist Test for Fiber Optic Connecting Devices
EIA 455-42 FOTP-42	Optical Crosstalk in Fiber Optic Components
EIA 455-49 FOTP-49	Procedure for Measuring Gamma Irradiation Effects in Optical Fiber and Optical Cables
EIA 455-107 FOTP-107	Return Loss for Fiber Optic Components
EIA 557	Standard Implementation of Statistical Process Control (SPC) or Other Approved Statistical Method Analysis

(Application for copies should be addressed to EIA, 2500 Wilson Blvd., Arlington, VA 22201.)

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO/R68-1973	ISO Basic Profile for Triangular Screw Threads, .25 to 5mm
ISO/R261-1973	ISO Metric Screw Threads, General Plan, .25 to 300mm
ISO/R262-1973	ISO Metric Screw Threads for Screws, Bolts and Nuts, 6 to 39mm
ISO/R965-1973	Part 1 – ISO General Purpose Metric Screw Threads, Tolerances, Principals and Basic Data
	Part 2 – ISO General Purpose Metric Screw Threads, Tolerances, Limits of Sizes for Medium Quality Commercial Bolt and Nut threads 1.6 to 39mm
	Part 3 – ISO General Purpose Metric Screw Threads, Tolerances and Deviations for Constructional Threads 1.6 to 355mm
ISO 10012-1	Calibration System Requirements

2.2 (Continued):

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTM B 85	Aluminum Alloy Die Castings
ASTM B 209	Aluminum and Aluminum Alloy Plate and Sheet
ASTM B 211/B 221	Aluminum and Aluminum Alloy Bar, Rod, Wire, or shapes; Rolled, Drawn, Extruded or Cold Finished
ASTM B 841-94	Electrodeposited Coatings of Zinc Nickel Alloy Deposits
ASTM D 570-81	Plastic, Water Absorption
ASTM E 595-84	Materials for Outgassing in a Vacuum Environment, Total Mass Loss and Collected Volatile Condensable, Standard Test Method for

(Application for copies should be addressed to the American Society for Testing Materials, 100 Barr Harbor, West Conshohocken, PA 19428-2959.)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Y14.5	Dimensioning and Tolerancing
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(Application for copies should be addressed to the American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002.)

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 associated detail specifications, specification sheets or MS standards), the text of this document takes precedence. Nothing in this document, however, supercedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS:

3.1 Slash Sheet Form Specification Sheets:

The individual item requirements shall be as specified herein and in accordance with applicable slash sheet form or specification sheets and this specification. In the event of conflict, between this specification and the slash sheet, the slash sheet shall govern.

3.2 Qualification:

Fiber Optic Connectors and accessories furnished under this specification shall be products that are qualified for listing on the applicable qualified products list at the time for opening of bids.

3.2.1 Reliability: The contractors reliability program for assembled connectors and assembly procedures shall meet the requirements of MIL-STD-790 with the exception that the failure reporting period shall be 12 months in lieu of 6 months.

3.2.2 Quality:

3.2.2.1 Statistical Process Control (SPC): The contractor shall implement and use statistical process control techniques or approved statistical method analysis (SMA) in the manufacturing process for parts covered by this specification. The SPC or SMA program shall be developed and maintained IAW EIA577 or other approved plans.

3.3 Materials:

3.3.1 Metals: Metals shall be of a corrosion resistant type or shall be plated or treated to resist corrosion.

3.3.1.1 Dissimilar Metals and Compatible Couples: When dissimilar metals are used in intimate contact with each other, protection against galvanic corrosion shall be provided. The use of dissimilar metals in termini, which tend toward active galvanic corrosion (particularly brass, copper or steel used in contact with aluminum or aluminum alloy) is not acceptable. However, metal plating or dissimilar base metals to provide similar or suitable abutting surfaces is permitted. The use of dissimilar metals separated by a suitable insulating material is also permitted. Dissimilar metals and compatible couples are defined in requirement 16 of MIL-STD-889.

3.3.2 Components: Materials for specific components of the connector shall be as follows:

3.3.2.1 Class A, B, C and J (Composite Connectors):

- a. Shell, coupling and jam nut – Corrosion resistant, high performance resins with or without filler materials. The resins must be defined by specifications listed in the DODISS, published by professional materials associations or as described in AIR4567.
- b. Insert – Reinforced epoxy resin or other suitable rigid material.
- c. Spring fingers – Heat treated beryllium copper or corrosion resistant steel. Spring fingers are not required for unplated composite connectors.
- d. Filler compound – RTV silicone in accordance with MIL-A-46146, or equivalent.
- e. Gasket, grommet and interfacial seal – Silicone or flourosilicone elastomer.

3.3.2.2 Class D, E, F and K (Aluminum Connectors):

- a. Shell – Impact extruded or machined aluminum alloy.
- b. Coupling and jam nut – Machined aluminum alloy.
- c. Insert – Reinforced epoxy resin or other suitable rigid material.
- d. Spring fingers – Heat treated beryllium copper or corrosion resistant steel.
- e. Filler compound – RTV silicone in accordance with MIL-A-46146 or equivalent.
- f. Gaskets, grommet and interfacial seals – Silicone or fluoroelastomer.

3.3.2.3 Class G and H Environment Resisting (Stainless Steel Connectors):

- a. Shell – Corrosion resistant steel
- b. Coupling, jam nut – Corrosion resistant steel
- c. Insert – Reinforced epoxy resin or other suitable rigid material.
- d. Spring fingers – Heat treated beryllium copper or corrosion resistant steel.
- e. Filler compound – RTV silicone in accordance with MIL-A-46146 or equivalent.
- f. Gasket, grommet and interfacial seal – Silicone or fluoroelastomer.

3.3.3 Fungus Resistance (All Classes): Materials used in the construction of these connectors shall be fungus inert (see 4.1.5).

3.3.4 Magnetic Permeability: The relative permeability of the terminated, assembled and fully mated connector assembly shall be less than 2.0u when measured in accordance with 4.6.27.

3.4 Design and Construction:

Connectors and accessories shall be designed and constructed to withstand normal handling incident to installation and maintenance in service. Connector intermateability control dimensions shall be as specified on individual slash sheets. Connector accessory interface dimensions shall be as specified on individual slash sheets. Recommended panel cutout dimensions are shown on individual slash sheets. Dimensioning and tolerancing shall be in accordance with ANSI Y14.5M.

3.4.1 Terminus: Terminus shall be removable as specified.

3.4.1.1 Indirect Shipment of Termini: Connectors are supplied less termini.

3.4.1.2 Removable Termini: Removable termini may be used with all environment resisting classes of connectors. Termini shall be qualified to the detail specification sheets of MIL-T-29504, or as defined in slash sheets.

3.4.1.3 Terminus Arrangement: Terminus arrangement shall be in accordance with connector slash sheets.

3.4.1.4 Terminus Insertion/Removal Tools: For proper terminus insertion and removal tools, reference MIL-T-29504 or appropriate terminus slash sheet.

3.4.2 Insert Design:

3.4.2.1 Environment Resisting Classes: The entire fiber cable sealing or cable supporting member of the environment resisting assemblies shall be essentially one integral part, designed to provide suitable sealing and support (except box mounted connectors) around the fiber cable and to be non-removable. The insert may be one piece or no more than two pieces bonded as to form essentially one integral piece, or the insert may be of two-piece design where the front half of the insert is removable and captivates the terminus alignment sleeve. The design shall be such as to permit the removal and replacement of individual termini into their connector inserts with installation/removal tools. The termini locking device shall be contained in the rigid insert and shall so retain the terminus as to meet the termini retention requirements of this specification. Inserts shall be secured to prevent rotation. All pin termini inserts shall have a resilient interface seal bonded to the front face in accordance with the applicable standards. Unless otherwise specified on the detail specification sheets, socket entry holes and pin "donut" rings shall conform to figures in Appendix A.

3.4.3 Sealing:

3.4.3.1 Fiber Cable Sealing (Except Box Mount Connectors): Environment resisting assemblies shall be designed to meet the environmental requirements of this specification using fiber cable of outer diameter within the applicable range as shown in Table 1. Connectors shall meet the requirements specified when:

- a. A complement of fiber optic cable of the applicable minimum or maximum diameter is installed.
- b. Any combination of fiber optic cable diameter within the extremes of (a) above are used.

TABLE 1 - Outer Diameter of Fiber Cable

Finished Fiber Cable Outside Diameter				
Terminus Size	Minimum		Maximum	
	Inches	mm	Inches	mm
16	.065	1.65	.109	2.77

- 3.4.3.2 Grommet Sealing Plugs: Except for box mount receptacles and as otherwise specified (see 3.1), the grommet of environment resisting connectors shall be designed to accept sealing plugs in accordance with MS27488 in lieu of cable where un-terminated termini are employed.
- 3.4.3.3 Mating Seal: Unless otherwise specified in slash sheet (see 3.1), plugs and receptacles with pin inserts shall have a resilient face with individual pin barriers (see Appendix A). The pin barrier projections shall seal in their respective lead-in chamfers of the hard face socket insert. The resilient interfacial seal shall provide individual termini seals in the mated condition. The receptacles shall be provided with a peripheral seal.
- 3.4.4 Shell: Shells, including mounting flanges, shall be of one-piece construction and shall be designed to maintain their cavity locations in one position, both axially and with respect to rotation, by mechanical means. Adhesive may be used as a supplementary retention means for environment resisting connectors. Each plug and receptacle connector shall have at least two color bands in accordance with EIA RS-359. One indicating the terminus retention system (front or rear release) and one yellow indicating "Fiber Optic" connector. Both color bands shall be located so that they are readily visible to any person servicing a mounted connector.
- 3.4.4.1 Spring Fingers: Spring fingers shall be designed to make contact with the mating shell without interfering with proper engagement. The springs shall be retained about the shell periphery.
- 3.4.4.2 Jam Nut Mounting Receptacles: Jam nut mounting receptacles shall be provided with a mounting nut with provisions for locking and an o'ring in accordance with MS9068.
- 3.4.5 Screw Threads: Screw threads shall conform to FED-STD-H28, MIL-S-7742, MIL-STD-1373, ISO R68-1973, ISO R261-1973, ISO R262-1973 and ISO R965-1973, as applicable. MIL-STD-1373 should be used as reference for gauge design on triple start threads. Threads shall be checked using ring or plug gauges. Slight out-of-round condition, beyond the specified tolerance is acceptable if threads can accept the gauges without force.

- 3.4.6 Coupling: Connectors shall be coupled to counterpart connectors and the mechanism shall include a means of maintaining the mated connector in full engagement. For circular connectors, the coupling ring shall be knurled or fluted to facilitate coupling, and shall be captivated. The couplings of all circular connectors shall have two color bands in accordance with EIA RS-359. One indicating the terminus retention system (front or rear release) and one yellow indicating "Fiber Optic" connector.
- 3.4.6.1 Ease of Coupling: Counterpart connectors of any arrangement shall be capable of being fully mated and un-mated in a normal and accessible location without the use of tools.
- 3.4.6.2 Locking Circular Connectors: Complete coupling shall be accomplished by approximately 360 degree clockwise rotation of the coupling and shall provide shell-to-shell, metal-to-metal bottoming. An anti-decoupling device shall be provided to maintain complete coupling. A red band shall be located on the receptacle so as to be visible when unmated and fully covered when completely mated.
- 3.4.6.2.1 Polarization of Connector Shells: Polarization of circular connector shells shall be accomplished by means of integral keys and suitable matching keyways on the counterpart. Polarization shall be accomplished before initial engagement of the coupling ring. During axial engagement, termini shall not touch the insert face until polarization has been achieved.
- 3.4.6.2.2 Alternates: Shells shall also be supplied with the keys or keyways rotated from normal position as indicated in figures in each slash sheet.
- 3.4.6.3 Lubrication: Spring washers and the coupling threads may be coated with a suitable lubricant. Rear accessory threads of all connectors and receptacle coupling area shall not be lubricated.
- 3.4.6.4 Pin to Pin Mating Prevention: Connectors shall be designed such that pin-to-pin termini, physical mating, is not possible in the event that a plug with pin termini is inadvertently mated with a receptacle with pin termini.
- 3.4.7 Cavity Fill (Environment Resisting Classes): If the rear grommet design does not allow for intimate contact between it and the complete inner perimeter of the shell, any resulting cavity between the insert and the shell shall be filled with RTV silicone conforming to MIL-A-46146, or equivalent.

3.4.8 Plating:

- A – Olive drab cadmium plate in accordance with AMS-QQ-P-416 over a suitable underplate to withstand 2000-hour salt spray test. Resulting finish shall be conductive.
- B – Electrically conductive electroless nickel plating to withstand 2000-hour salt spray test. Use of a suitable underplate is permissible.
- C – Unplated composite material.
- D – Olive drab cadmium plate in accordance with AMS-QQ-P-416 over a suitable underplate to withstand 500-hour salt spray test. Resulting finish shall be conductive.
- E – Electrically conductive electroless nickel plating conforming to ASTM B 733-90, Sc2, Type I, Class 5. Finish shall withstand 48-hour salt spray test. Use of a suitable underplate is permissible.
- F – Same as 'E' except space grade conforming to ASTM B 733-90, Sc4, Type I, Class 5, matte finish.
- G – Electrodeposited nickel in accordance with AMS-QQ-N-290, Class 2, .0001 to .0002 inch (0.003 to 0.005 mm) thickness.
- H – Electrically conductive corrosion resistant steel, Passivated.
- J – Olive drab, cadmium free, zinc nickel plate, in accordance with ASTM B 841-94 to withstand 2000-hour salt spray test. Use of a suitable underplate is permissible. Resulting finish shall be electrically conductive.
- K – Olive drab, cadmium free, zinc nickel plate, in accordance with ASTM B 841-94 to withstand 1000-hour salt spray test. Use of a suitable underplate is permissible. Resulting finish shall be electrically conductive.

3.4.8.1 Shell Spring Fingers: Shell spring fingers shall be suitably protected to prevent corrosion.

3.4.8.1.1 Coupling (Classes A, B, C and J): The coupling of Classes A, B, C and J, may be unplated.

3.4.8.1.2 Jam Nut: Jam nut of Classes A, B, C and J, may be unplated.

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3.5 Interchangeability:

All connectors having the same part number shall be completely interchangeable with each other with respect to installation and performance.

3.6 Maintenance Aging:

When tested as specified in 4.6.3, the termini installation and removal forces shall not exceed the requirements of Table 2.

TABLE 2 - Maintenance Aging Requirements

Terminus Size	Maximum Installation and Removal Forces	
	Pounds	Newtons
16	20	89

3.7 Temperature Cycling:

When tested as specified in 4.6.4, there shall be no blistering, peeling or separation of plating or other damage detrimental to the operation of the connector.

3.8 Coupling Torque:

When tested as specified in 4.6.5, the coupling torque for mating and un-mating of the counterpart connectors and protective covers shall meet the requirements of Table 3.

TABLE 3 - Coupling Torque

Shell Size	Maximum Engagement and Dis-engagement		Minimum Dis-engagement	
	Inch Pound	Newton Meters	Inch Pound	Newton Meters
A,08,09	8	0.9	2	0.2
B,10,11	12	1.4	2	0.2
C,12,13	16	1.8	2	0.2
D,14,15	20	2.3	3	0.3
E,16,17	24	2.7	4	0.4
F,18,19	28	3.2	5	0.6
G,20,21	32	3.6	6	0.7
H,22,23	36	4.1	7	0.8
J,24,25	40	4.6	7	0.8

3.9 Durability:

When tested as specified in 4.6.6, the connectors shall show no defects detrimental to the operation of the connectors and shall meet the subsequent test requirements (see 4.4.3).

3.10 Altitude Immersion:

When tested as specified in 4.6.8, the mated connector pair shall be optically tested per 3.5.1.1.

3.11 Insert Retention:

When tested as specified in 4.6.9, unmated connectors shall retain their cavity locations in their proper shell location and there shall be no evidence of cracking, breaking, separation from the shell, or loosening of parts.

3.12 Salt Spray (Corrosion):

When tested in 4.6.10, unmated connectors shall show no exposure of base material due to corrosion, which adversely affects performance (see AIR4789). Class A and J (initial qualification) after 500 hours of salt spray, inspect connector for plating wear (inspection method optional). No underplate or basis material shall be exposed. Return to chamber for completion of the 2000 hours.

3.13 Accessory Thread Strength:

When tested as specified in 4.6.13, the accessory threads, the portion of the connector that accepts cable clamps and adapters shall be capable of withstanding the torque listed in Table 4.

TABLE 4 - Accessory Thread Strength

Shell Size	Accessory Thread Torque	
	Inch Pound	Newton Meters
A,08,09	45 / 55	5.1 / 6.2
B,10,11	45 / 55	5.1 / 6.2
C,12,13	45 / 55	5.1 / 6.2
D,14,15	45 / 55	5.1 / 6.2
E,16,17	45 / 55	5.1 / 6.2
F,18,19	45 / 55	5.1 / 6.2
G,20,21	95 / 105	10.7 / 11.9
H,22,23	95 / 105	10.7 / 11.9
J,24,25	95 / 105	10.7 / 11.9

3.14 Vibration (Qualification Only):

When tested as specified in 4.6.14, there shall be no optical discontinuity per 3.34.2. Also there shall be no dis-engagement of the mated connectors, backing off of the coupling mechanism, evidence of cracking, breaking or loosening of parts.

3.15 Shock:

When tested as specified in 4.6.15, there shall be no optical discontinuity per 3.34.2. Also there shall be no dis-engagement of the mated connectors, evidence of cracking, breaking or loosening of parts.

3.16 Shell to Shell Conductivity:

When tested as specified in 4.6.16, the probes shall not puncture or otherwise damage the connector finish. The maximum measured potential drop across assemblies shall be as follows:

- a. Class A, B and J – 3.0 millivolts initial, 5.0 millivolts after conditioning.
- b. Class D and K – 2.5 millivolts.
- c. Class E, F and G – 1.0 millivolts.
- d. Class H (or a connector having half of the mating part Class H) – 10 millivolts.

After conditioning (salt spray and coupling torque) the above values may increase 100%.

3.17 External Bending Moment:

When tested as specified in 4.6.11, connectors shall show no evidence of damage detrimental to their normal operation nor shall there be any interruption of optical continuity.

3.18 Terminus Retention:

When tested as specified in 4.6.12, no damage to the retention clip shall result.

3.19 Humidity:

When tested as specified in 4.6.16, wired, mated connectors shall show no deterioration which will adversely affect performance of the connectors. Following the test and during the final cycle, optical requirements of 3.34.1 must be met.

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3.20 Shell Spring Finger Forces:

When tested as specified in 4.6.17, the forces necessary to engage and separate EMI plugs with receptacle shells shall be within the value specified in Table 5.

TABLE 5 - Shell Spring Finger Forces

Shell Size	Axial Force Maximum		Axial Force Minimum	
	Pounds	Newtons	Pounds	Newtons
A,08,09	25	111	0.5	2
B,10,11	25	111	0.5	2
C,12,13	30	133	0.5	2
D,14,15	30	133	0.5	2
E,16,17	35	156	0.5	2
F,18,19	35	156	0.5	2
G,20,21	35	156	0.5	2
H,22,23	35	156	0.5	2
J,24,25	35	156	0.5	2

3.21 EMI Shielding:

When tested as specified in 4.6.18, the EMI shielding capabilities of mated shells with spring fingers shall not be less than that specified in Table 6 at the specified frequencies.

TABLE 6 - EMI Shielding Effectiveness

Frequency MHz	Leakage Attenuation (dB) minimum		
	Class A,D,J & K	Class B,E,F & G	Class H
100	90	90	80
200	88	88	75
300	88	88	73
400	87	87	71
800	85	85	66
1,000	85	85	65
1,500	69	76	59
2,000	65	70	55
3,000	61	69	52
4,000	58	68	50
6,000	55	66	48
10,000	50	65	45

3.22 Ozone Exposure:

When tested as specified in 4.6.19, the connectors shall show no evidence of cracking of material or other damage due to ozone exposure that would adversely affect performance.

3.23 Fluid Immersion:

When tested as specified in 4.6.20, the connectors shall meet the requirements for coupling torque.

3.23.1 Retention System Fluid Immersion: When tested as specified in 4.6.21, the insert assemblies shall meet the requirements of termini retention (see 3.18). Effects of the fluids on resilient sealing members shall not be a consideration of this test.

3.24 Installation/Removal Tool Abuse (Qualification Only):

When tested as specified in 4.6.22, there shall be no evidence of damage to the termini, the connector insert, or the terminus retaining mechanism.

3.25 High Temperature Exposure:

When tested as specified in 4.6.23 for 1000 hours, connectors shall perform satisfactorily and pass succeeding tests in the qualification test sequence.

3.26 Marking:

Connectors and accessories shall be permanently marked with the manufacturers name or trademark, date code, and the following information as applicable. Stamping shall be in accordance with MIL-STD-1285 where space permits. Metal stamping shall be accomplished before plating. The following example is illustrative.

a. Identification

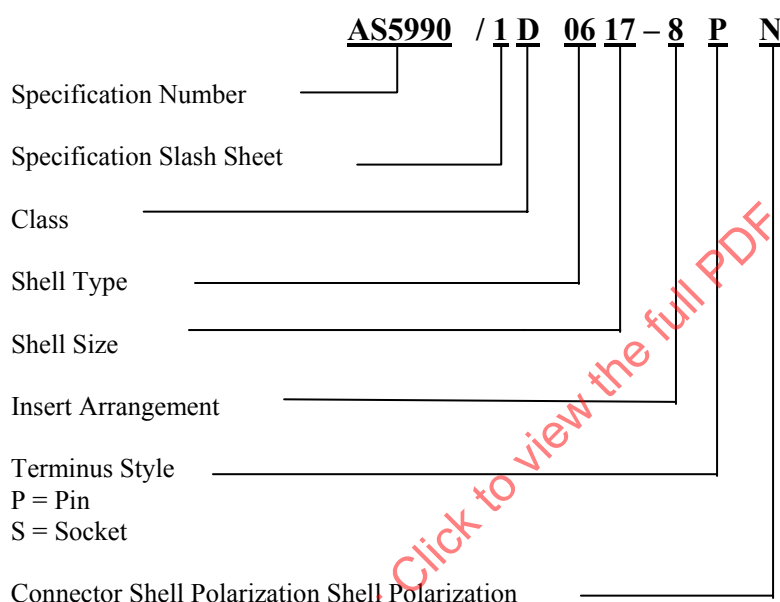


FIGURE 1

b. Lot Number: (000010)

- 3.26.1 Terminus Location Identification: Terminus locations shall be identified as indicated on the applicable standard. All positions shall be identified on the front and rear faces of the insert except where space limitations make this impracticable. Location of termini identifying characters shall be in close proximity to the holes but need not be placed exactly where indicated on the applicable standard. The preferred color of the termini identifying character is white. When the background is a color against which white is difficult to distinguish, a color shall be chosen for which the identifying character can be easily distinguished.

3.27 Workmanship:

The connector shall be fabricated in a manner such that the criteria for appearance, fit and adherence to specified tolerances are observed. Particular attention shall be given to neatness and thoroughness of part marking, plating, welding, soldering, riveting, staking and bonding. The visual examination under 3X magnification shall include examination of each retention cavity for molding discrepancies, retention features and excessive adhesive. The connectors shall be free from crazing, cracks, voids, pimples, blisters, pinholes, sharp cutting edges, burrs and other defects that will adversely affect life, serviceability or appearance.

3.28 Ice Resistance:

When tested as specified in 4.6.25, connectors shall pass succeeding tests in the qualification table. When tested in accordance with 4.6.5, uncoupling and re-coupling torque shall not exceed the values listed in Table 3 by more than 25%.

3.29 Dust (Fine Sand):

When tested as specified in 4.6.26, connectors shall pass succeeding tests in the qualification table. When tested in accordance with 4.6.5, uncoupling and re-coupling torque shall not exceed the values listed in Table 3 by more than 25%.

3.30 Thermal Vacuum Outgassing (Class F Qualification Only):

All non-metallic materials used in the finished connector shall not release greater than 1% total mass loss (TML) or 0.1% collected volatile condensable material (CVCM) when tested as specified in 4.6.29. Data listed in NASA reference publication 1124, may be used in lieu of actual test data for applicable materials.

3.31 Hydrolytic Stability (Class A, B C and J):

When tested as specified in 4.6.30, the connector shall be without defects detrimental to mechanical performance. There shall be no increase in the connector weight greater than 0.75%. When subjected to an over torque at 150% of those values specified in Table 3, there shall be no evidence of cracking, breaking or loosening of parts.

3.32 Insert Grommet Bonding:

Specimens of the insert grommet bonded assembly and the insert interfacial seal bonded assembly shall be subjected to the test specified in 4.6.31. There shall be evidence of cohesive failure of the insert face seal, grommet or insert material rather than complete adhesive failure of the bond. The test shall be conducted using only the complete insert assemblies in their final form prior to assembly into the connector shell.

3.33 Impact (Classes A, B, C and K):

When connector plugs with straight strain relief accessories are tested as specified in 4.6.32, there shall be no breaking or cracking of inserts or shells. There shall be no bending of termini nor damage, which would prevent the connector from mating or unmating.

3.34 Optical Performance Requirements:

Mated connectors using termini as specified shall meet the requirements of 4.7.1 and 4.7.2 when using the connectors covered by this specification.

3.34.1 Insertion/Substitution Loss: When measured in accordance with 4.7.2, the initial insertion loss shall not exceed 1.0 dB maximum. Unless otherwise specified the substitution loss shall not exceed 1.2 dB maximum during and after any specified mechanical or environmental connector testing.

3.34.2 Discontinuity: When measured in accordance with 4.7.3, no discontinuity shall occur. A discontinuity is considered to be a reduction of signal strength of 0.5 dB or more for a duration of 10 microseconds or more.

3.34.3 Return Loss: When applicable and when measured in accordance with 4.7.4, the return loss of a multimode terminus shall not be greater than -30 dB. The return loss of a singlemode terminus shall not be greater than -37 dB.

3.34.4 Change in Optical Transmittance: When measured in accordance with 4.7.5, the change in optical transmittance during or after any specified environmental or mechanical requirement shall not be greater than 0.5 dB.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Test Equipment and Inspection Facilities:

Test, measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to assure 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 10012-1.

4.1.1 Responsibility for Inspection: Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use their own, or any other facilities suitable for the performance of the inspection requirements herein, unless disapproved by the procuring activity. The procuring activity reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

- 4.1.2 Responsibility for Compliance: All items shall meet the requirements of Sections 3 and 5. The inspection set forth in this specification, shall become a part of the contractors 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 procuring activity for acceptance, comply with all the requirements of the contract. Sampling inspection 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 procuring activity to accept defective material.
- 4.1.3 Reliability Assurance Program: A reliable 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 (SPC): An SPC or approved statistical methods analysis (SMA) program shall be established and maintained. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification and retention of qualification.
- 4.1.5 Fungus Resistance Certification: Certification Method 508 of MIL-STD-810 is required (see 3.3.3).

4.2 Classification of Inspection:

The examination and testing of connectors shall be classified as follows:

- a. Qualification inspection (see 4.4).
- b. Quality conformance inspection (see 4.5).

4.3 Inspection Conditions:

Unless otherwise specified herein, all inspections shall be performed in accordance with test conditions specified in the "General Requirements" of EIA 364.

4.4 Qualification Inspection:

Qualification inspection shall be performed at a laboratory acceptable to the procuring activity (see 6.3) on sample units produced with equipment and procedures normally used in production. Qualification approval may be granted upon successful completion of the inspections and tests of 4.4.3 of AS5990 conducted on samples of 4.4.1 of AS5990, such approval to include classes, finishes, shell configurations, and insert arrangements other than those actually tested providing that the capability to manufacture these parts is demonstrated by providing exhibit samples. Qualification of Class H connectors also qualifies Class G connectors, providing Class G connectors satisfactorily pass salt spray and Group 4 tests. Qualification of Class E also qualifies Class F, and Class A also qualifies Class C.

- 4.4.1 Sample Size: The following test samples, for each connector class manufactured by normal production methods shall be provided. Tested and un-tested connectors, accessories and materials may be required, at no cost to the procuring activity, for qualification verification by the responsible qualification activity (see 6.3).
- a. For each slash sheet and each class (except as noted in 4.4) to qualify, two mating straight plugs and wall mounting receptacles from each of the following shell size range (if applicable) shall be provided. The three shell size ranges are small (C, 12 or 13), medium (F, 18 or 19), large (J, 24 or 25). Each arrangement in a given shell size shall be the densest terminus arrangement. Half the samples shall have pin termini in the receptacle and sockets in the plug. The balance of samples will have socket termini in the receptacle and pins in the plug. All samples shall be provided with an appropriate strain relief backshell.
 - b. One straight plug with spring fingers and counterpart receptacle of small, medium and large shell sizes with applicable EMI backshell. One wall mounting, mating receptacle with applicable conductive finish in a small, medium and large shell size, less inserts.
 - c. One mated pair of connectors, small, medium and large shell sizes.
 - d. One mated pair of plug and receptacle connectors, shell size J, 24 or 25.
 - e. One mated pair of plug and receptacle connectors, small, medium and large shell sizes.
 - f. Two bonded insert grommet assemblies and two bonded interfacial seal assemblies, which have not been assembled into the connector, shell shall be tested. The assemblies shall be medium shell size (F, 18 or 19). See ASTM E 595-84 for sample size for thermal vacuum testing.

4.4.2 Preparation of Samples: Suitable lengths of fiber optic cable per Table 7 and Table 1 shall be terminated at each end to an appropriate fiber optic connector, which mates to the fiber optic test set. These fiber optic connectors shall be terminated per the manufactures recommended termination procedures. Perform initial insertion loss testing per EIA 455-34 FOTP-34A.

- a. Samples provided under 4.4.1a, 1c, 1d and 1e shall be terminated with fiber optic cable having a smooth extruded outer jacket of waterproof construction. See Table 7 and Table 1 for examples of fiber optic cable that can be used. If possible, 2 cavities of each sample provided shall be tested with no fiber optic termini and with the appropriate size sealing plug.
- b. Samples provided under 4.4.1a, shall be terminated with fiber optic cable having composition capable of surviving any exposure to fluids specified in Method 1016 of EIA364-10. Reference Table 7 and Table 1 for dimensional data.

TABLE 7 - Fiber Sizes/Insertion Loss

Fiber Type MIL- F-49291	Fiber Size (Micron)	Insertion Loss Maximum dB	Jacket Diameter Simplex (a)
M49291/3	50/125 multimode	1.00	.109/.065 in.
M49291/4	100/140 multimode	0.80	.109/.065 in.
M49291/6	62.5/125 multimode	1.00	.109/.065in.
M49291/7	9/125 singlemode	1.00	.109/.065 in.
(a) See Table 1.			

4.4.3 Qualification Tests:

- a. Samples provided under 4.4.1a shall all go through Group 1 testing. After Group 1, samples shall be divided into two groups. One group shall be subjected to the tests in Group 2 (Table 8) in the sequence indicated. The second group shall be subjected to the tests of Group 3 (Table 8) in the sequence indicated.
- b. Samples provided under 4.4.1b shall be subjected to the test Group 4, Table 8, in the sequence indicated.
- c. Samples provided under 4.4.1c shall be subjected to the tests of Group 5, Table 8, in the sequence indicated.
- d. Samples provided under 4.4.1d shall be subjected to the tests of Group 6, Table 8, in the sequence indicated.

4.4.3 (Continued):

- e. Samples provided under 4.4.1c shall be subjected to the tests of Group 7, Table 8, in the sequence indicated.
- f. Samples provided under 4.4.1f shall be subjected to the tests of Group 8, Table 8, in the sequence indicated.

TABLE 8 - Qualification and Group C Periodic Tests

Inspection	Requirement Paragraph	Test Paragraph
Group 1 (All classes and finishes, 4.4.1a samples) Unless otherwise noted		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Insert retention	3.11	4.6.9
Termini retention	3.18	4.6.12
Coupling torque	3.8	4.6.5
Accessory thread strength	3.13	4.6.13
Maintenance aging	3.6	4.6.3
Shell to shell conductivity	3.16	4.6.24
Excluding Class C		
Optical insertion loss	3.34.1	4.7.2
Post test examination	3.26, 3.27	4.6.28
Group 2 (All classes, 4.4.1a samples) Unless otherwise noted		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Magnetic permeability	3.3.4	4.6.27
External bending moment	3.17	4.6.11
Durability	3.9	4.6.6
Vibration	3.14	4.6.14
High Impact Shock	3.15	4.6.15.1
Shell to shell conductivity	3.16	4.6.24
Excluding Class C		
Post test examination	3.26, 3.27	4.6.28

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Inspection	Requirement Paragraph	Test Paragraph
Group 3 (All classes and finishes, 4.4.1a samples) Unless otherwise noted		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
High temperature	3.25	4.6.23
Humidity	3.19	4.6.16
Temperature cycling	3.7	4.6.4
Altitude immersion	3.10	4.6.8
Durability	3.9	4.6.6
Terminus retention	3.18	4.6.12
Post test examination	3.26, 3.27	4.6.28
Group 4 (Shells with spring fingers, 4.4.1b samples)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Shell spring finger forces	3.20	4.6.17
Shell to shell conductivity (except Class C)	3.16	4.6.24
Salt spray (dynamic test) (Class A and B only)	3.12	4.6.10.2
EMI shielding (except Class C)	3.21	4.6.18
Post test examination	3.26, 3.27	4.6.28
Group 5 (Dielectric, 4.4.1c samples)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Ozone exposure	3.22	4.6.19
Fluid immersion	3.23	4.6.20
Coupling torque	3.8	4.6.5
Post test examination	3.26, 3.27	4.6.28
Group 6 (Retention system, 4.4.1d samples)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Installing/removal tool abuse	3.24	4.6.22
High temperature exposure	3.25	4.6.23
Insert retention	3.11	4.6.9
Retention system fluid immersion	3.23.1	4.6.21
Termini retention	3.18	4.6.16
Post test examination	3.26, 3.27	4.6.28

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Inspection	Requirement Paragraph	Test Paragraph
Group 7 (All classes, 4.4.1e samples)		
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Ice resistance	3.28	4.6.25
Dust (fine sand) connectors mated or with dust covers installed	3.29	4.6.26
Impact (Class A, B and C)	3.33	4.6.32
Post test examination	3.26, 3.27	4.6.28
Group 8 (All classes, 4.4.1f samples)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Insert grommet bonding	3.32	4.6.31
Thermal vacuum outgassing (Class F only)	3.30	4.6.29
Post test examination	3.26, 3.27	4.6.28
Group 9 (Class A, B, C and J)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.26, 3.27	4.6.1
Hydrolytic stability	3.3.1	4.6.30
Fungus	3.3.3	4.1.5
Post test examination	3.26, 3.27	4.6.28

4.4.3.1 Failures: One or more failures shall be cause for refusal to grant qualification.

4.4.4 Retention of Qualification: To retain qualification, the contractor shall verify in coordination with the qualifying activity the capabilities of manufacturing products that meet the performance requirements of this specification. Refer to the qualifying activity for the guidelines necessary to retain qualification to this particular specification. The contractor shall immediately notify the qualifying activity at any time that inspection data indicates failure of the qualified product to meet the performance requirements of this specification.

4.5 Quality Conformance Inspection:

4.5.1 Inspection of Product for Delivery: Inspection of product for delivery shall consist of Groups A and B inspections. The documentation requirements of the applicable military or industry test procedures do not apply.

4.5.1.1 Group A Inspection: Group A inspection shall consist of the inspections specified in Table 8.

4.5.1.1.1 Visual Examination (Group A Inspection): Each connector and accessory shall be visually examined for completeness. Attention shall be given to those assemblies that require a gasket to determine the condition of the gasket. Gaskets missing, twisted, buckled, kinked or damaged in any way shall be cause for rejection. Each connector shall be visually inspected for the presence of filler compound in the cavity between cable termination end of the insert and shell.

4.5.1.1.2 Critical Examinations (Group A Inspection): The following dimensions and features shown on the pertinent military or industry are considered critical.

- a. Mating diameters (maximum on plugs, minimum on receptacles).
- b. Key or keyway positions.
- c. Registration of grommet and insert markings (hole pattern between the grommet and the front face of the insert).

TABLE 9 - Group A Inspection¹

Inspection	Requirement Paragraph	Test Paragraph
Visual Inspection ¹	3.1,3.3,3.4,3.5, 3.26 and 3.27	4.6.1
Critical ² Examination	3.1	4.5.1.1.2
¹ 100% inspection.		
² The contractor may use in-process controls for this requirement.		

4.5.1.2 Group B Inspection: Group B inspection shall consist of the inspections specified in Table 10 in the order shown and shall be made on sample units which have been subjected to and passed the Group A inspection.

TABLE 10 - Group B Inspection

Inspection	Requirement Paragraph	Test Paragraph	Number of Samples
Visual and Mechanical Examination ¹	3.1, 3.3, 3.4, 3.5, 3.26 and 3.27	4.6.1	As Specified in Table 11
Substitution Loss (initial)	3.34.1	4.7.2	
Temperature Cycling (Class A, B and J) ^{1,2}	3.7	4.6.4	
Shell Spring Finger Forces (plug with spring fingers only) ^{1,2}	3.20	4.6.17	
¹ The contractor may use in-process controls for this requirement.			
² Test five pieces. No failures permitted.			

- 4.5.1.2.1 Sampling Plan (Group B Inspection): Every 24 months, a sample size shall be randomly selected in accordance with Table 11. If one or more defects are found the lot shall be re-screened and defects removed. If one or more defects were found a new sample in accordance with Table 11 shall be randomly selected. If one or more defects are found in the second sample the lot shall not be supplied to this specification.

TABLE 11 - Sampling Plan

Lot Size	Sample Size
1 to 13	100%
14 to 150	13 units
151 to 280	20 units
281 to 500	29 units
501 to 1,200	34 unit
1,201 to 3,200	42 units

- 4.5.1.2.2 Lot Definition (Group B Inspection): The production lot definition is further defined as follows:
- A production lot consists of all connectors covered under one specification or standard, manufactured from the specified raw materials, processed under the same specification and procedures, produced by the same type of equipment, and submitted for inspection at one time. Each production lot of assembled connectors shall be a group identified by a common manufacturing record through all significant assembly operations.

4.5.1.2.2 (Continued):

- b. Traceability of connectors to specific physical/chemical test reports of incoming raw material is not required.
- c. Common manufacturing records and traceability shall begin with the start of connector assembly.

4.5.1.2.3 Disposition of Sample Units: Sample units, which have passed all of Group B inspection, may be delivered on the contract or purchase order if the lot is accepted and the sample units are still within specified tolerances.

4.5.2 Periodic Inspection: Periodic inspection shall consist of Group C inspection. Except where the results of this inspection show non-compliance with the applicable requirements (see 4.5.2.1.5), delivery of products which have passed Groups A and B inspections shall not be delayed pending the results of this periodic inspection.

4.5.2.1 Group C Inspection (Periodic Tests): Periodic tests shall be performed on a 24 month and 48 month basis, beginning with the 12 month periodic test, which must be accomplished within this period after notification of qualification and alternating thereafter with the 24 month periodic test. Samples submitted to either of these periodic tests shall have passed Groups A and B inspections.

4.5.2.1.1 Twenty-four Month Periodic Test: The following tests shall be performed as follows (at the discretion of the qualifying agency an alternate test sequence may be performed).

- a. On two mating connectors with the highest density arrangement, of the largest shell size in regular production during that period. Humidity in accordance with 4.6.16.
- b. On one mating pair of connectors of any representative shell size for each terminus size qualified and arrangement. High temperature exposure with terminus loading in accordance with 4.6.23 except that the time period shall be 250 hours.
- c. On two mating connectors of any representative size and arrangement, one pair being subjected to each of the specific fluids. Fluid immersion in accordance with 4.6.20, except that the fluids shall be:
 - 1. MIL-DTL-5624, JP-5
 - 2. Hydraulic fluid (M2-V Chevron Oil or equivalent)
- d. On one receptacle shell and plug barrel (with coupling nut) of any small and large shell size of each finish style qualified, conduct the salt spray test of 4.6.10.

- 4.5.2.1.2 Forty-eight Month Periodic Tests: Every 48 months, mating connector sample units shall be selected and tested in accordance with the following (at the discretion of the qualifying agency an alternate test sequence may be performed).
- a. For each series qualified, two mating plugs and receptacles from each shell size range shall be provided. The three shell size ranges are small (size C, 12 or 13), medium (size F, 18 or 19), and large (size J, 24 or 25). One mating pair from each shell size range shall be fully cabled with the applicable fiber optic cable, listed in Table 10 and Appendix B, and subjected to the applicable tests of Table 1, Group 1. The remaining samples shall be fully cabled with the applicable fiber optic cable listed in Table 10 and Appendix B and be subjected to the applicable tests of Table 1, Group 2.
 - b. One receptacle shell and plug barrel (with coupling nut) of any small and large shell size of each finish style qualified, conduct the salt spray test of 4.6.10.
- 4.5.2.1.3 Failures: If one or more sample units fail to pass Group C inspection, the sample shall be considered to have failed
- 4.5.2.1.4 Disposition of Sample Units: Sample units which have been subjected to Group C inspection shall not be delivered on the contract or purchase order.
- 4.5.2.1.5 Noncompliance: If a sample fails to pass Group C inspection, the manufacturer shall take corrective action on the materials or processes or both, as warranted, and on all units of product which are to be corrected and which were manufactured with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall discontinue 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 the additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Groups A and B inspections may be reinstituted, however, final acceptance shall be withheld until the Group C reinspection 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.
- 4.5.3 Failures of Groups A, B or C: Lots which fail Groups A, B, or C and are not resubmitted for testing or failed resubmission shall not be shipped and the marking shall be removed within 30 days.
- 4.6 Methods of Inspection:
- 4.6.1 Visual and Mechanical Examination: Reference EIA 455-13A,. Visual and mechanical inspection of fiber optic components, devices and assemblies.

- 4.6.2 Connectors: The connectors, accessories and piece parts shall be visually and mechanically examined to ensure the conformance with the specification and the applicable standards (see 3.1, 3.3, 3.4, 3.5, 3.26, 3.27). The contractor may use in process controls to satisfy these requirements.
- 4.6.3 Maintenance Aging (see 3.6): Connectors shall be tested in accordance with EIA 364-24. The following detail shall apply; Installation/removal tool shall be in accordance with MIL-I-81969/8 and MIL-I-81969/14. A minimum of 20%, but not less than three termini of each connector shall be tested. 50% of the maintenance aging shall be performed with MIL-I-81969/8 tools and 50% with MIL-I-81969/14 tools. There shall be no lubricant used during this test.
- 4.6.4 Temperature Cycling (see 3.7): Mated connectors shall be subjected to the temperature cycling of EIA 364-32, test condition A, except that steps 2 and 4 shall be 2 minutes maximum duration. The temperature of step 1 shall be $-65^{\circ}\text{C} \pm 0 - 5^{\circ}\text{C}$, and the temperature of step 3 shall be 175°C for Class A, C, D, J and K, and 200°C for all other classes. The following procedure is recommended. All channels to a maximum of 12 will have reference power measurements in dBm recorded at room temperature.
- a. Samples will be placed inside an environmental chamber with the ends exiting through the chamber porthole.
 - b. Samples will be subjected to the above temperature profile.
 - c. A maximum of 12 termini shall be monitored during the test. Optical power measurements in dBm on a maximum of 12 channels of the connector and the chamber temperature shall be recorded within the last 4 minutes of each temperature extreme soak time.
 - d. After conditioning, the optical power in dBm shall be recorded for a maximum of 12 channels of the connector.
 - e. Connectors will meet the substitution loss requirements of 3.34.1 and the change in optical transmittance requirements of 3.34.4 both during and after the test.
- 4.6.5 Coupling Torque (see 3.8): For qualification testing, mating halves shall be coupled and un-coupled. The axial mating force and the torque which must be applied to facilitate full coupling and un-coupling shall be measured and recorded.

- 4.6.6 Durability (see 3.9): The cabled, assembled plugs and receptacles shall be mated and un-mated 250 cycles for classes with spring fingers and 1500 cycles for Classes A, B and J. Termini may be changed after 500 cycles when PC termini are used. 500 cycles for all other connectors at a rate of 300 cycles per hour maximum. The mating and un-mating shall be accomplished so that the plug and receptacle are completely separated during each cycle. The substitution loss requirement of 3.34.1, and the change in optical transmittance requirements of 3.34.4, shall be measured every 100 mating cycles, during and after the test. Cleaning of the termini is permitted during and after completion of the test in order to meet the requirements of 3.34.1 and 3.34.4. Reference EIA 455-21A, Mating Durability of Fiber Optic Devices.
- 4.6.7 Durability of Front Removable Inserts (If Applicable): Using the appropriate tool, install and remove the front removable insert a total of 10 times. There shall be no chipping or breaking of inserts or other damage detrimental to the operation of the connector. All channels, to a maximum of 12, will have reference power measurements in dBm recorded at room temperature per 3.34.1, if not completed after the last test. After testing, repeat substitution loss testing per 3.34.1. The connectors will meet the substitution loss requirements of 3.34.1 and the change in optical transmittance requirements of 3.34.4.
- 4.6.8 Altitude Immersion (see 3.10): Mated connectors shall be tested in accordance with EIA 364-03. The following details shall apply:
- a. All cable ends shall be located within the chamber and exposed to the chamber atmosphere, but not submerged or sealed.
 - b. At the end of the third cycle, while the connectors are still submerged in the solution, the return loss at ambient temperature shall be measured as specified in 4.7.2.
- 4.6.9 Insert Retention (see 3.11): Unmated connectors shall be tested in accordance with EIA 364-35 with the following details and exceptions:
- a. Force to be applied: 10 ± 5 pounds per square inch with a 25 pound minimum force.
 - b. Connectors may be terminated.

4.6.10 Salt Spray (Corrosion) (see 3.12):

4.6.10.1 Standard Test (Classes E, F and G): Unmated connectors shall be tested in accordance with EIA 364-26 and evaluate in accordance with AIR4789. The following details and exceptions shall apply:

- a. Test condition letter B.
- b. The samples shall not be mounted, but shall be suspended from the top of the chamber using waxed twine, string, glass rods or glass cord.
- c. Wire ends must be protected to prevent salt migration.

The following procedure is recommended:

- a. All channels to a maximum of 12, will have reference power measurements in dBm recorded at room temperature if not already completed after the last test.
- b. Samples will then be un-mated and subjected to the salt spray above.
- c. After the test, the connector and termini shall be cleaned. Cleaning shall consist of a 5 minute water rinse for all connector parts and isopropyl alcohol cleaning of terminus Ferrules using appropriate cleaning swab.
- d. Samples will be mated and optical power (dBm) will be recorded for each of the channels.
- e. A post test visual inspection of the connector and termini will be performed. All hardware will be checked for pits, cracks, scratches, delamination and removal removal of finish due to test environment. Connectors will meet the substitution loss requirements of 3.34.1 and change in optical transmittance requirements of 3.34.4.

4.6.10.2 Dynamic Test (Classes A, B, D, H, J and K): The terminated, assembled plugs and receptacles shall be mated and un-mated 50 cycles at a rate of 300 cycles per hour maximum. The mating and un-mating shall be accomplished so that the plug and receptacle are completely separated during each cycle. The connectors shall then be subjected to the salt spray test in accordance with method 1001 of MIL-STD-1344. The following details and exceptions apply:

- a. The connectors (Class D, H and K) shall be tested for 452 hours mated followed by 48 hours un-mated. For initial qualification, the connectors (Classes A, B and J), shall be subjected to 50 cycles durability followed by 1952 hours salt spray mated, then 48 hours salt spray un-mated followed by 1450 cycles durability. For periodic inspection, the connectors (Class A, B and J) shall be tested 452 hours mated followed by 48 hours un-mated.
- b. The connectors shall not be mounted, but shall be suspended from the top of the chamber using waxed twine, string, glass rods or glass cord.
- c. Wire ends must be protected to prevent salt migration. After the salt spray exposure, the remaining number of durability cycles specified in 4.6.6 shall be completed. Cleaning of the termini is permitted before continuing the durability testing of 4.6.6.

The following procedure is recommended for initial qualification:

- a. All channels to a maximum of 12, will have reference power measurements in dBm recorded at room temperature if not already completed after the last test.
- b. Samples will be mated and un-mated 50 cycles at a rate of 300 cycles per hour maximum.
- c. Cleaning of the ferrule interface shall be allowed after 50 cycles, to remove any debris that may form on the interface of the ferrule during mate/un-mate testing. Cleaning shall be limited to an isopropyl alcohol moistened cotton swab.
- d. Optical power (dBm) will be recorded for each of the channels. Connectors will meet the substitution loss requirements of 3.34.1 and the change in optical transmittance requirements of 3.34.4.
- e. The mated samples will be subjected to the 1952 hour salt spray test.
- f. After the test, the connectors shall be cleaned. Cleaning shall consist of a 5 minute water rinse for all connector parts.

4.6.10.2 (Continued):

- g. Optical power (dBm) will be recorded for each of the channels. Connectors will meet the substitution loss requirements of 3.34.1 and the change in optical transmittance requirements of 3.34.4.
- h. Samples will be mated and un-mated and subjected to the 48 hour salt spray test.
- i. After the test, the connector and termini shall be cleaned. Cleaning shall consist of a 5 minute water rinse for all connector parts and cotton swab cleaning with isopropyl alcohol on the ferrule interface.
- j. Samples will be mated and optical power (dBm) will be recorded for each of the channels. Connectors will meet the substitution loss requirements of 3.34.1 and the change in optical transmittance requirements of 3.34.4.
- k. Samples will be mated and un-mated 1450 cycles at a rate of 300 cycles per hour maximum. Optical power (dBm) shall be recorded during the mated state every 100 cycles. Cleaning of the ferrule interface shall be allowed before any testing to remove any debris that may form on the interface of the ferrule during mate/un-mate testing. Cleaning shall be limited to isopropyl alcohol moistened swab. Connectors will meet the substitution loss requirements of 3.34.1 and the change in optical transmittance requirements of 3.34.4.

The following procedure is recommended for periodic inspection:

- a. All channels to a maximum of 12 will have reference power measurements in dBm recorded at room temperature, if not already completed after the last test.
- b. The mated samples will be subjected to the 452 hour salt spray test.
- c. After the test the connector will be cleaned. Cleaning shall consist of a 5 minute water rinse for all connector parts.
- d. Optical power (dBm) will be recorded for each of the channels. Connectors will meet the substitution loss requirements of 3.34.1 and the change in optical transmittance requirements of 3.34.4.
- e. Samples will be un-mated and subjected to 48 hour salt spray test.
- f. After the test, the connector and termini shall be cleaned. Cleaning shall consist of a 5 minute water rinse for all connector parts and cotton swab and isopropyl alcohol cleaning on ferrule interface.