SAE Aerospace
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AEROSPACE STANDARD

SAE AS5590 | REV. A

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Superseding AS5590

(R) Connectors, Fiber Optic, Advanced, Circular or Rectangular, Plug and Receptacle, Environment Resistant, Removable Termini/Contacts, General Specification For

RATIONALE

Users have identified a need for connectors with the capability to accommodate both fiber optic termini and electrical contacts, which requires the modification of this document to include the electrical requirements from MIL-DTL-38999. Some specification and paragraph references have been updated and all changes from Amendment A1 have been incorporated.

1. SCOPE

1.1 Scope

This specification covers the performance requirements for a plug and receptacle. The connector inserts may contain multiple termini or multiple termini and electrical contacts. The connectors use removable termini, or removable termini and electrical contacts, and are capable of operating within a temperature range of -65 to +200 °C (see 1.2.1.1). These connectors are supplied under AS9100 reliability assurance program.

1.2 Description

All series include removable termini or removable termini and removable electrical contacts. All series are designed to ensure proper orientation of the mating halves prior to mating. All connectors include EMI shielding capability, with conductive finishes, which provide electrical continuity between mated shells prior to terminus/contact engagement and have the termini/contacts so located as to be protected from handling damage. Connectors specified are designed for use with termini as specified in MIL-PRF-29504 or as listed in the individual slash sheet, and shall meet the clip-to-clip dimensions specified in the individual slash sheet. The test procedures and performance requirements of this specification are oriented toward circular connector designs. Appropriate test procedures and performance requirements for other shell configurations shall be addressed in the individual detail sheet requirements.

1.2.1 Design Considerations

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

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http://www.sae.org/technical/standards/AS5590A

1.2.1.1 Temperature

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

1.2.1.2 Vibration

See 3.18

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 3.11).

1.2.1.4 Shock

In accordance with EIA-364-27 (see 3.19).

1.2.1.5 Humidity

Humid conditions up to 98% relative humidity including condensation (see 3.26).

1.2.1.6 Corrosion

Exposure to salt-laden atmosphere (see 3.15).

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 3.30).

1.2.1.9 EMI Shielding

EMI shielding effectiveness: 100 MHz to 10 GHz (see 3.28).

1.3 Classification

1.3.1 Connectors

Connectors specified are designed for use with termini as specified in MIL-PRF-29504 or in the individual slash sheet and shall meet the clip-to-clip dimensions specified on the individual slash sheet.

Connectors fabricated to this specification are classified as follows:

a. Series:

Series 1 - AS5590/1, Connector, Fiber Optic, Circular, Environment Resistant, Removable Termini/Contacts Triple Start, Self-locking Threaded Coupling

Series 2 - AS5590/2, Connector, Fiber Optic, Circular, Environment Resistant, Removable Flush Termini with Guide Pins, Triple Start, Self-locking Threaded Coupling

b. Types:

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

01 - Receptacle, in-line

02 - Receptacle, square flange, box mounting

04 - Receptacle, jam nut

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

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

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

L - Nickel fluorocarbon polymer, conductive, composite material, -65 to +175 °C

M - Nickel fluorocarbon polymer, conductive, aluminum alloy, -65 to +175 °C

N - Pure dense electrodeposited aluminum, conductive, composite material, -65 to +175 °C

P - Pure dense electrodeposited aluminum, conductive, aluminum alloy, -65 to +175 °C

Z - Zinc nickel, black, conductive, aluminum alloy, -65 to +175 °C

2. REFERENCES

2.1 Applicable Documents

The following documents may or may not be applicable to all slash sheets and the body of this document. The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE International Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AS3582	Packing, Preformed - O-Ring Seal, AMS3304
AIR4567	Composite Electrical Connectors
AIR4789	Aerospace Information Report on Evaluating Corrosion Testing of Electrical Connectors and Accessories for the Purpose of Qualification
AS9100	Quality Management Systems - Requirements for Aviation, Space and Defense Organizations
AS39029	Contacts, Electrical Connector, General Specification For
AS85049	Connector Accessories, Electrical, General Specification For
AS85049/138	Connector Accessories, Electrical, Cap, Dust, Plastic, Category 9
AMS-QQ-P-416	Plating, Cadmium (Electrodeposited)
AMS-QQ-N-290	Nickel Plating (Electrodeposited)

2.1.2 U.S. Government Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, http://quicksearch.dla.mil/.

MIL-DTL-17	Cables, Radio Frequency, Flexible and Semi-rigid, General Specification 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-PRF-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-DTL-83488 Coating, Aluminum, High Purity

MIL-PRF-49291 Fiber, Optical

MIL-PRF-85045 Cables, Fiber Optic, (Metric), General Specification For

MIL-STD-202 Test Methods for Electronic and Electrical Component Parts

MIL-STD-810 Environmental Engineering Considerations and Laboratory Tests

MIL-STD-889 Dissimilar Metals

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

MS27488 Plug, End Seal, Electrical Connector

NASA Reference Publication 1124 Outgassing Data for Selecting Spacecraft Materials

2.1.2.1 Federal Standards

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6396, http://quicksearch.dla.mil/.

FED-STD-H28 Screw Thread Standards for Federal Services

2.1.3 Non-Government Publications

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

2.1.3.1 ECIA Publications

Available from Electronic Components Industry Association, 1111 Alderman Drive, Suite 400, Alpharetta, GA 30005, Tel: 678-393-9990, www.eciaonline.org.

EIA RS-359 Standard Colors for Color Identification and Coding (ANSI C-83.1-1973)

EIA364 Connector Test Method Standards

EIA 364-03 Altitude Immersion Test Procedure for Electrical Connectors

EIA 364-10 Fluid Immersion Test Procedure for Electrical Connectors

EIA 364-14 Ozone Exposure Test Procedure for Electrical Connectors

EIA 364-24 Maintenance Aging Test Procedure for Electrical Connectors

EIA 364-26 Salt Spray Test Procedure for Electrical Connectors, Contacts and Sockets

EIA 364-27 Mechanical Shock (Specified Pulse) Test Procedure for Electrical Connectors

EIA 364-28 Vibration Test Procedure for Electrical Connectors and Sockets

EIA 364-29 Contact Retention Test Procedure for Electrical Connectors

EIA 364-31 Humidity Test Procedure for Electrical Connectors and Sockets

EIA 364-32 Thermal Shock (Temperature Cycling) Test Procedure for Electrical Connectors and Sockets

EIA 364-35 Insert Retention Test Procedure for Electrical Connectors

EIA 364-42 Impact Test Procedure for Electrical Connectors

EIA 364-54 Magnetic Permeability Test Procedure for Electrical Connectors, Contacts and Sockets

EIA 364-66 EMI Shielding Effectiveness Test Procedure for Electrical Connectors

EIA 364-83 Shell-to-Shell and Shell-to-Bulkhead Resistance Test Procedure for Electrical Connectors

TIA/EIA 455-13 Visual and Mechanical Inspection of Fiber, Cable, Connectors and/or Other Fiber Optic Devices

TIA/EIA 455-20 Measurement of Change in Optical Transmittance

TIA/EIA 455-21 Mating Durability of Fiber Optic Interconnecting Devices

TIA/EIA 455-32 Fiber Optic Circuit Discontinuities

TIA/EIA 455-34 Interconnection Device Insertion Loss Test

TIAEIA 455-42 Optical Crosstalk in Fiber Optic Components

TIA/EIA 455-43 Output Near-Field Radiation Pattern Measurement of Optical Waveguide Fibers

TIA/EIA 455-47 Output Far Field Radiation Pattern Measurement

TIA/EIA 455-107 Return Loss for Fiber Optic Components

TIA/EIA 455-171 Attenuation by Substitution Measurement for Short-Length Multi-Mode Graded-Index and Single-Mode Optical Fiber Cable Assemblies

2.1.3.2 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

AFNOR NF ISO 68-1 ISO General Purpose Screw Threads, Basic Profile, Part 1: Metric Screw Threads.

AFNOR NF ISO 261 ISO General Purpose Metric Screw Threads, General Plan.

AFNOR NF ISO 262 ISO General Purpose Metric Screw Threads, Selected Sizes for Screws, Bolts and Nuts.

AFNOR NF ISO 965 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

2.1.3.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B733-90 Standard Specification for Autocatalytic (Electroless) Nickel-Phosphorus Coatings on Metal

ASTM B841-94 Electrodeposited Coatings of Zinc Nickel Alloy Deposits

ASTM D570-81 Plastic, Water Absorption

ASTM E595-84 Materials for Outgassing in a Vacuum Environment, Total Mass Loss and Collected Volatile Condensable, Standard Test Method for

2.1.3.4 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI Y14.5 Dimensioning and Tolerancing

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 AS9100 (see 4.1.3) with the exception that the failure reporting period shall be 12 months in lieu of 6 months.

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, J, L, and N (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 fluorosilicone 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 fluorosilicone elastomer.

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 dielectric 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 fluorosilicone elastomer.

3.3.3 Fungus Resistance (All Classes)

Materials used in the construction of these connectors shall be fungus inert (see 4.1.4).

3.3.4 Magnetic Permeability

The relative permeability of the terminated, assembled and fully mated connector assembly shall be less than 2.0 μ when measured in accordance with 4.6.33.

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 Fiber Optic Termini

Terminus shall be removable as specified.

3.4.1.1 Indirect Shipment of Fiber Optic Termini

Connectors are supplied less termini.

3.4.1.2 Removable Fiber Optic Termini

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

3.4.1.3 Fiber Optic Termini Arrangement

3.4.1.4 Terminus arrangements shall be in accordance with connector slash sheets. AS5590/1 inserts; 15-15, 15-97, 17-99, 19-28, 19-30, 21-39, 25-4, 25-20, 25-24, 25-43, 25-46, and 25-90 are intended for a combination of electrical contacts and fiber optic termini.

3.4.1.5 Fiber Optic Termini Insertion/Removal Tools

For proper terminus insertion and removal tools, reference MIL-PRF-29504 or appropriate terminus slash sheet.

3.4.2 Electrical Contacts

3.4.2.1 Indirect Shipment of Contacts

Connectors may be specified without electrical contacts.

3.4.2.2 Crimp Removable Contacts

Crimp removable contacts may be used with all environment resisting classes of connectors. Crimp contacts shall be qualified products in accordance with AS39029 (see 6.2). The quantity of crimp contacts to be supplied with each connector unit package shall consist of a full complement of contacts plus one spare contact for each size used in the arrangement utilizing 26 contacts or less. For arrangements utilizing more than 26 contacts, two spare contacts of each size used in the arrangement shall be supplied. Spare coax and twinax contacts are not required.

3.4.2.2.1 Contact Styles

1. Contact designators for connectors using standard contact arrangements as specified in MIL-STD-1560 are as follows:

   P - Pin - 500-cycle contact

   S - Socket - 500-cycle contact

   H - Pin - 1500-cycle contact

   J - Socket - 1500-cycle contact

   C - Pin - Feedthrough

   D - Socket - Feedthrough

   R - Pin - Rhodium plating

   M - Socket - Rhodium plating

   G - Pin - Heavy gold plating

   U - Socket - Heavy gold plating

   The P, S, H, J, X, Z, C, D R, M, G, and U designators are used to indicate that connectors will be supplied with a full complement of the applicable standard contacts as specified in MIL-STD-1560. These designators are part of the connector Part or Identifying Number (PIN) and shall be marked on the connectors. Contacts shall be obtained from a qualified AS39029 supplier.

2. Contact designators for connectors supplied without contacts that are for use with separately sourced military specification contacts or non-standard contact complements as specified in MIL-STD-1560 are as follows:

   A - Pin contact insert

   B - Socket contact insert

   The A and B designators are used to indicate that the connectors will be used with other than standard contacts as specified in MIL-STD-1560 (example: shielded, coaxial thermocouple, fiber optic). The A and B designators are part of the connector PIN and shall be marked on the connectors.

   When A and B designators are used, standard contacts shall not be supplied with the connectors. The contacts that will be used with the connectors must be specified separately (see 3.4.2.1, 3.36, and 6.1). Note: If contacts other than standard power contacts are used, then the connectors may not meet the requirements stated herein.

3.4.2.2.2 Contact Arrangement

Contact arrangements shall be in accordance with MIL-STD-1560 or the individual slash sheet. The engaging end of the pin contact in assembled connectors shall be located within 0.024 inch (0.61 mm) of true position and the engaging end of socket contacts in assembled connectors shall be located within 0.015 inch (0.38 mm) of true position. Test voltages for service ratings shall be as specified in Table 1.

TABLE 1 - TEST VOLTAGES, AC rms, 60 Hz

Altitude	Service Rating M		Service Rating N		Service Rating I		Service Rating II	
	Mated	Unmated	Mated	Unmated	Mated	Unmated	Mated	Unmated
Sea level	1300	1300	1000	1000	1800	1800	2300	2300
50 000 feet	800	550	600	400	1000	600	1000	800
70 000 feet	800	350	600	260	1000	400	1000	500
100 000 feet	800	200	600	200	1000	200	1000	200

3.4.2.2.3 Installing and Removal Tools

For connectors with electrical contacts, both MIL-I-81969/8 and MIL-I-81969/14 tools shall be utilized to properly assemble and disassemble the pin and socket contacts into their connector inserts. One MIL-I-81969/14 tool for each contact size shall be enclosed in the unit package. For indirect shipments, connectors may be specified without installation and removal tools (see 6.2).

3.4.3 Insert Design

3.4.3.1 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 so 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. Socket entry holes and pin “donut” rings shall conform to the requirements in the detail specification sheets.

3.4.4 Sealing

3.4.4.1 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 2. Connectors shall meet the requirements specified when:

a. A full complement of fiber optic cable of the applicable minimum or maximum diameter is installed.

b. Any combination of fiber optic cable diameters within the extremes of (a) above are used.

TABLE 2 - OUTER DIAMETER OF FIBER CABLE

Finished Fiber Cable Outside Diameter				
Terminus Size	Minimum		Maximum	
	Inches	mm	Inches	mm
16	0.065	1.65	0.109	2.77

3.4.4.2 Electrical Cable Sealing

Not applicable to box mount connectors. Environment resisting assemblies shall be designed to meet the environmental requirements of this specification using wire of outer diameter within the applicable range as shown in Table 3.

TABLE 3 - WIRE SIZES AND DIAMETERS

Contact Size	Wire Size (AWG)	Finished Wire Outside Dimensions			
		Minimum		Maximum	
		Inches	mm	Inches	mm
22D	28, 26, 24, 22	0.030	0.76	0.054	1.37
22M 1/	28, 26, 24	0.030	0.76	0.050	1.27
22 1/	26, 24, 22	0.034	0.86	0.060	1.52
20	24, 22, 20	0.040	1.02	0.083	2.11
16	20, 18, 16	0.065	1.65	0.109	2.77
12	14, 12	0.097	2.46	0.142	3.61
10	10	0.135	3.42	0.162	4.12
8 coax	M17/95-RG180 2/	0.135	3.43	0.155	3.94
8 twinax	M17/176-00002 3/	0.124	3.15	0.134	3.40

1/ Inactive for new design.
2/ MIL-DTL-17.
3/ The applicable insert arrangements are 19-18, 21-75, 9-1, 17-2, 25-7, 25-8, 25-20, 25-46, and 25-90.

NOTE: Connectors shall meet the requirements specified when:

a. A full complement of wire of the applicable minimum or maximum insulation diameter is installed.
b. Any combination of wire diameters within the extremes of (a), above are used.

3.4.4.3 Environment Resisting Classes

The entire insert and wire sealing or wire supporting member of the environment resisting assemblies shall be essentially one integral part, configured to provide suitable sealing and support (except box mount connectors) around the wires and to be non-removable. The rigid dielectric shall be one molded piece or no more than two pieces bonded so as to form essentially one integral piece. The configuration shall be such as to permit the removal and replacement of individual contacts into their connector inserts with AS81969 installation/removal tools per the detail specification sheet. The contact locking device shall be contained in the rigid dielectric insert and shall so retain the contacts as to meet the contact retention requirements of this specification. Inserts shall be secured to prevent rotation.

3.4.4.4 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/contacts are employed.

3.4.4.5 Mating Seal

Unless otherwise specified in the slash sheet (see 3.1), plugs and receptacles with pin inserts shall have a resilient face with individual pin barriers. 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/contact seals in the mated condition. The receptacles shall be provided with a peripheral seal.

3.4.4.6 Dust Caps

AS85049/138 dust caps shall be placed on the mating end of each connector. For connectors with spring fingers, dust caps must be assembled externally over the coupling ring.

3.4.5 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 (black for front release and blue for rear release) and one violet indicating “Fiber Optic” connector. Both color bands shall be located so that they are readily visible to any person servicing a mounted connector.

3.4.5.1 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.

3.4.5.2 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 AS3582.

3.4.6 Screw Threads

Screw threads shall conform to FED-STD-H28, MIL-S-7742, MIL-STD-1373, ISO R68-1973, AFNOR NF ISO 68-1, AFNOR NF ISO 261, AFNOR NF ISO 262, and AFNOR NF ISO 965 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.

3.4.7 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 color band indicating the terminus retention system (black for front release and blue for rear release) and one violet color band indicating "Fiber Optic” connector.

3.4.7.1 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.

3.4.7.2 Locking Circular Connectors

Complete coupling shall be accomplished by approximately 360 degree clockwise rotation of the coupling ring 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.

3.4.7.2.1 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/contacts shall not touch the opposing insert face until polarization has been achieved.

3.4.7.2.2 Alternates

Shells shall also be supplied with the keys or keyways rotated from normal position as indicated in figures in each slash sheet.

3.4.7.3 Lubrication

Lubricant is not recommended for connectors utilizing fiber optic termini.

3.4.7.4 Pin to Pin Mating Prevention

Connectors shall be designed such that pin-to-pin termini/contacts, physical mating, is not possible in the event that a plug with pin termini/contacts is inadvertently mated with a receptacle with pin termini/contacts.

3.4.8 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.

3.4.9 Plating

A - Olive drab cadmium plate, composite material, 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, composite material, to withstand 2000-hour salt spray test. Use of a suitable underplate is permissible.

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 B733-90, 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 B733-90, Sc4, Type I, Class 5, matte finish.

G - Electrodeposited nickel in accordance with AMS-QQ-N-290, Class 2, 0.0001 to 0.0002 inch (0.003 to 0.005 mm) thickness, 48 hour salt spray test.

H - Electrically conductive corrosion resistant steel, Passivated, 500 hour salt spray test.

J - Olive drab, cadmium free, zinc nickel plate, composite material, in accordance with ASTM B841-94 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, aluminum alloy, in accordance with ASTM B841-94 to withstand 500-hour salt spray test. Use of a suitable underplate is permissible. Resulting finish shall be electrically conductive.

L - Nickel fluorocarbon polymer, conductive, composite material, 1000 hour salt spray test. Use of a suitable underplate is permissible. Resulting finish shall be electrically conductive.

M - Nickel fluorocarbon polymer, conductive, aluminum alloy, 500 hour salt spray test. Use of a suitable underplate is permissible. Resulting finish shall be electrically conductive.

N - Pure dense electrodeposited aluminum in accordance with MIL-DTL-83488, Type II, composite material, 1000 hour salt spray test.

P - Pure dense electrodeposited aluminum in accordance with MIL-DTL-83488, Type II, aluminum alloy, 500 hour salt spray test.

Z - Zinc nickel in accordance with ASTM B841, type D (black), over a suitable underplate to withstand 500 hours of dynamic salt spray testing. Color shall be nonreflective.

3.4.9.1 Shell Spring Fingers

Shell spring fingers shall be suitably protected to prevent corrosion.

3.4.9.1.1 Coupling (Classes A, B, and J)

The coupling of Classes A, B, and J may be unplated.

3.4.9.1.2 Jam Nut

Jam nut of Classes A, B, and J may be unplated.

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/contact installation and removal forces shall not exceed the requirements of Tables 4 and 5.

TABLE 4 - MAINTENANCE AGING REQUIREMENTS

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

TABLE 5 - ELECTRICAL CONTACT INSTALLING AND REMOVAL FORCES.

Contact size	Installing and Removal Forces	
	Pounds	Newtons
22D	10	44
22M 1/	10	44
22 1/	10	44
20	20	89
16	20	89
12	30	133
10	35	156
8 Triax	35	156

1/ Inactive for new design.

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 6.

TABLE 6 - COUPLING TORQUE

Shell Size	Maximum Engagement and Disengagement		Minimum Disengagement	
	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 4.4.4).

3.10 Altitude Immersion

When tested as specified in 4.6.8, the mated connector pair shall be optically tested per 3.43.1.

3.11 Insulation Resistance for Electrical Contacts

When tested as specified in 4.6.9, the insulation resistance between any pair of contacts and between any contact and the shell shall be greater than 5000 MΩ. Insulation resistance after altitude immersion shall be 1000 MΩ minimum. Insulation resistance after humidity shall be 100 MΩ minimum.

3.12 Dielectric Withstanding Voltage for Electrical Contacts

When tested as specified in 4.6.10, the maximum leakage current shall be 2 mA, and there shall be no evidence of electric breakdown or flashover.

3.13 Insert Retention

When tested as specified in 4.6.11, 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.

3.14 Salt Spray (Corrosion)

When tested in 4.6.12, unmated connectors shall show no exposure of base material due to corrosion, which adversely affects performance (see AIR4789). For class A and J (initial qualification) after 500 hours of salt spray, inspect connector for plating wear (inspection method optional). No underplate or base material shall be exposed. Return to chamber for completion of the 2000 hours.

3.15 Electrical Engagement

When tested as specified in 4.6.13, wired, mated connectors with electrical contacts shall provide a minimum of 0.050 inch (1.27 mm) electrical engagement.

3.16 Accessory Thread Strength

When tested as specified in 4.6.19, the accessory threads and portion of the connector that accepts cable clamps and adapters shall be capable of withstanding the torque listed in Table 7.

TABLE 7 - 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

3.17 Vibration (Qualification Only)

When tested as specified in 4.6.20, there shall be no optical discontinuity per 3.43.2. 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.

3.18 Shock

When tested as specified in 4.6.21, there shall be no optical discontinuity per 3.43.2. Also there shall be no dis-engagement of the mated connectors, evidence of cracking, breaking, or loosening of parts.

3.19 Shell to Shell Conductivity

When tested as specified in 4.6.29, 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 mV initial, 5.0 mV after conditioning.

b. Class D and K - 2.5 mV.

c. Class E, F, and G - 1.0 mV.

d. Class H (or a connector having half of the mating part Class H) - 10 mV.

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

3.20 External Bending Moment

When tested as specified in 4.6.14, connectors shall show no evidence of damage detrimental to their normal operation nor shall there be any interruption of optical continuity.

3.21 Terminus Retention

When tested as specified in 4.6.15, the termini shall be retained in their inserts and the displacement shall not exceed 0.015 inches. No damage to the retention clip shall result.

3.22 Gauge Location for Electrical Contacts (Series 1 only)

Using test gauges conforming to the requirements in Figures 3, 4, and 5, the axial location of contacts shall be measured as specified in 4.6.16. Gauge location measurements shall fall within the range specified in Figures 3, 4, and 5.

3.23 Gauge Retention for Electrical Contacts (Series 1 only)

When tested as specified in 4.6.18, the test gauge conforming to Figures 3 and 6 shall be retained in the contact cavities of crimp contact connectors and the axial displacement of the test gauges while under load shall not exceed 0.012 inch (0.30 mm).

3.24 Contact Retention for Electrical Contacts (Series 1 only)

When tested as specified in 4.6.18, the axial displacement of the contact shall not exceed 0.012 inch (0.30 mm). No damage to contacts or inserts shall result.

3.25 Humidity

When tested as specified in 4.6.22, 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 3.43.1 must be met.

3.26 Shell Spring Finger Forces

When tested as specified in 4.6.23, the forces necessary to engage and separate EMI plugs with receptacle shells shall be within the values specified in Table 8.

TABLE 8 - 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

3.27 EMI Shielding

When tested as specified in 4.6.24, the EMI shielding capabilities of mated shells with spring fingers shall not be less than that specified in Table 9 at the specified frequencies.

TABLE 9 - EMI SHIELDING EFFECTIVENESS

Frequency MHz	Leakage Attenuation (dB) minimum		
	Class A, D, J, K & P	Class B, E, F, G, L, M & N	Class H
100	90	90	80
200	88	88	75
300	88	88	73
400	87	87	71
800	85	85	66
1000	85	85	65
1500	69	76	59
2000	65	70	55
3000	61	69	52
4000	58	68	50
6000	55	66	48
10000	50	65	45

3.28 Ozone Exposure

When tested as specified in 4.6.25, the connectors shall show no evidence of cracking of material or other damage due to ozone exposure that would adversely affect performance.

3.29 Fluid Immersion

When tested as specified in 4.6.26, the connectors shall meet the requirements for coupling torque.

3.29.1 Retention System Fluid Immersion

When tested as specified in 4.6.26.1, the insert assemblies shall meet the requirements of terminus/contact retention (see 3.23/3.25). Effects of the fluids on resilient sealing members shall not be a consideration of this test.

3.30 Installation/Removal Tool Abuse (Qualification Only)

When tested as specified in 4.6.27, there shall be no evidence of damage to the termini/contacts, the connector insert, or the terminus/contact retaining mechanism.

3.31 High Temperature Exposure

When tested as specified in 4.6.28 for 1000 hours, connectors shall perform satisfactorily and pass succeeding tests in the qualification test sequence.

3.32 Pin Contact Stability for Electrical Contacts (Series 1 only)

When tested as specified in 4.6.33, the total displacement of a reference point on the contact tip end shall not exceed the amount shown in Table 19.

3.33 Contact Walkout for Electrical Contacts (Series 1 only)

When tested as specified in 4.6.34, contacts shall not become dislodged from their normal position.

3.34 Cavity-to-Cavity Leakage Bonding Integrity for Electrical Contacts (Series 1 only)

When tested as specified in 4.6.35, there shall be no air leakage between contact cavities.

3.35 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

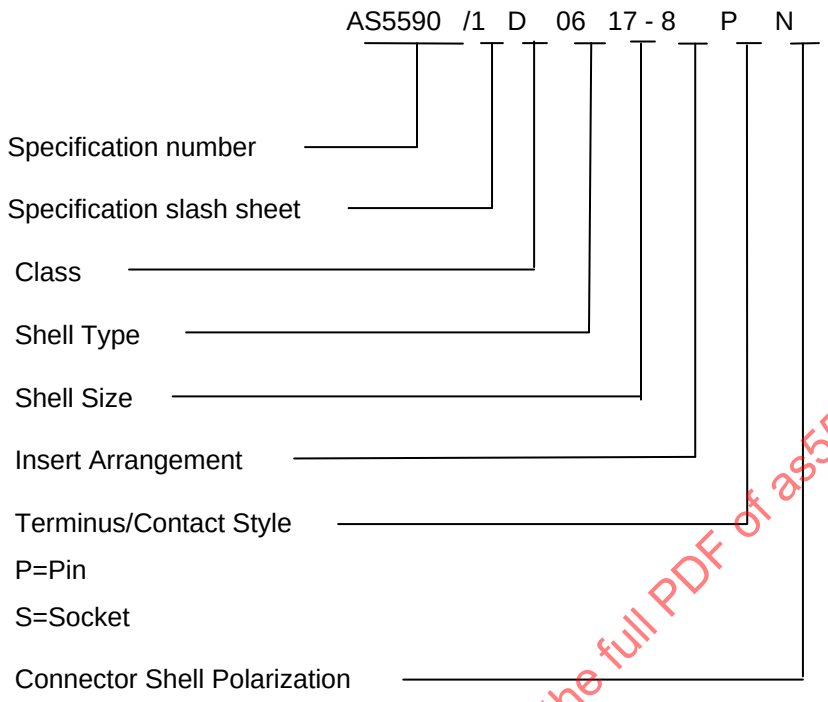


FIGURE 1 - IDENTIFICATION

b. Lot Number: (000010)

3.35.1 Terminus and Contact Location Identification

Terminus and contact locations shall be identified as indicated on the applicable AS5590 detail sheet 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 and contact 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 and contact 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.

3.36 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.

3.37 Ice Resistance

When tested as specified in 4.6.30, 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 6 by more than 25%.

3.38 Dust (Fine Sand)

When tested as specified in 4.6.31, 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 6 by more than 25%.

3.39 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 4.6.38. Data listed in NASA reference publication 1124 may be used in lieu of actual test data for applicable materials.

3.40 Hydrolytic Stability (Class A, B, J, L, and N)

When tested as specified in 4.6.38, 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 6, there shall be no evidence of cracking, breaking, or loosening of parts.

3.41 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 4.6.39. 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.

3.42 Impact (Classes A, B, and K)

When connector plugs with straight strain relief accessories are tested as specified in 4.6.40, there shall be no breaking or cracking of inserts or shells. There shall be no bending of termini or damage which would prevent the connector from mating or un-mating.

3.43 Optical Performance Requirements

Mated connectors using termini as specified shall meet the requirements of 4.7.1 and 4.7.1.1.

3.43.1 Insertion/Substitution Loss

When measured in accordance with 4.7.2, the initial insertion loss shall not exceed 1.0 dB maximum. When substitution loss verification is required, the loss shall not exceed 1.5 dB maximum after any specified mechanical or environmental testing.

3.43.2 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 50 µs or more for multi-mode terminus and a reduction of signal strength of 0.5 dB or more for a duration of 100 µs or more for single mode terminus.

3.43.3 Return Loss

When applicable and when measured in accordance with 4.7.4, the return loss of a multi-mode terminus shall not be less than -30 dB. The return loss of a single-mode terminus shall not be less than -37 dB.

3.43.4 Optical Crosstalk

When connectors with three or more channels are tested in accordance with 4.7.5, the signal power levels, or sum of levels of the passive channel or channels, shall be below the signal level of the active channel by at least 60 dB.

3.43.5 Change in Optical Transmittance

When measured in accordance with 4.7.6, 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 ensure 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 ensure 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 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 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

The manufacturer's reliability assurance program for connector accessories and assembly procedures shall comply with the AS9100 Aerospace Standard for Quality Management System requirements. Other established and industry recognized quality assurance standards that ensure all products produced conform to the contract requirements are acceptable. However, if used, it is the responsibility of the manufacturer to provide evidence of compliance to AS9100. The qualifying activity (QA) authority reserves the right to monitor, measure, and validate compliance at their discretion.

4.1.4 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 6.2) on sample units produced with equipment and procedures normally used in production, with the exception of Group 6 which shall be performed by the Qualifying Activity. Qualification approval may be granted upon successful completion of the inspections and tests of 4.4.4 of AS5590 conducted on samples of 4.4.2 of AS5590, 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.

4.4.1 Initial Qualification Inspection Routine and Test Report Submittal

The Qualifying Activity laboratory and supplier laboratory test methods shall be available to either party upon request. Where test measurements are required, the value shall be reported. The Qualifying Activity laboratory shall submit the test results for the Qualifying Activity required test groups in a data package to the supplier. The supplier shall maintain the data for two retention periods. The supplier shall provide a final test report to the Qualifying Activity. The report may contain the Qualifying Activity test results. If the test results indicate non-conformance with the specification requirements, and corrective action acceptable to the Qualifying Activity has not been taken, the product will not be approved.

4.4.2 Sample Size

The following test samples shall be provided for each connector class manufactured by normal production methods, unless otherwise specified by the detail specification sheet. 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 6.2).

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 ranges (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/contact arrangement. Half the samples shall have pin termini/contacts in the receptacle and sockets in the plug. The balance of samples will have socket termini/contacts 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 E595-84 for sample size for thermal vacuum testing.

4.4.3 Preparation of Samples

Suitable lengths of fiber optic cable per Table 10 and Table 2 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 manufacturer's recommended termination procedures. Perform initial insertion loss testing per TIA/EIA 455-34. The process used to build the cables, how the termini are attached, and the end face geometry shall be documented in the test report.

a. Samples provided under 4.4.2a, 2c, 2d, and 2e shall be terminated with fiber optic cable having a smooth extruded outer jacket of waterproof construction. See Table 10 and Table 2 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 4.4.2a shall be terminated with fiber optic cable having composition capable of surviving any exposure to fluids specified in EIA 364-10. Refer to Table 10 and Table 2 for dimensional data.

TABLE 10 - FIBER SIZES/INSERTION LOSS

Fiber Size (Micron)	Insertion Loss Maximum dB (Connectorized)	Jacket Diameter Simplex 1/
50/125 multi-mode	0.7	0.109/0.065 inch
100/140 multi-mode	0.66	0.109/0.065 inch
62.5/125 multi-mode	1.00	0.109/0.065 inch
5.8/9/125 single-mode	0.7	0.109/0.065 inch

1/ See Table 2.

Except as otherwise specified for shielded contacts, wiring of crimp-type contacts shall be accomplished using tools conforming to MIL-DTL-22520, class I. The length of stripped portion of conductor shall be at least long enough to reach the bottom of the crimp barrel, but shall not be so long that more than 0.031 inch (0.79 mm) of conductor is exposed at the end of the barrel when the conductor end touches the bottom of the barrel. An alternate sample preparation may be used with the approval of the qualifying activity.

c. Samples provided under 4.4.2a, 2c, 2d, and 2e shall be wired with wire having a smooth extruded outer jacket of waterproof construction. One sample of each shell size shall utilize maximum diameter wire and the remaining samples shall utilize minimum diameter wire. See Tables 3 and 11 for example of wires that can be used to accomplish the required minimum and maximum diameter. Two cavities of each sample provided shall contain unwired contacts and sealing plugs in accordance with MS27488, AS85049/80, or AS85049/81, as applicable. Connectors with less than four contacts of a given contact size will not have sealing plugs installed for that contact size. Box mount connectors may be potted at any convenient stage in the test prior to altitude immersion in group 1 and humidity in group 2.

TABLE 11 - TEST WIRE SIZES 1/

Contact Size	Example of Wire to Accomplish Maximum Diameter	Example of Wire to Accomplish Minimum Diameter
22 2/, 22D and 22M 2/	M22759/9 or /20 -24 M22759/10 or /21 -24	M22759/18, /19, /32, 33 -26 M22759/44, /45, /46 -26
20	M22759/7 -20 M22759/8 -20	M22759/18, /19, /32, 33 -22 M22759/44, /45, /46 -22 M2259/11, /12, /13, /14 -24 M22759/22, /23
16	M22759/3, /4 /7, or /8 -16	M22759/18, /19, /32 -16 M22759/44, /45
12	M22759/7 -12 M22759/8 -12	M81381/7 or /8 -12 M81381/11 or /12
10	M22759/7 -12 M22759/8 -12	M22759/11 -10
8 coax	M17/95-RG180	M17/95-RG180
8 twinax	M17/176-00002	M17/176-00002

1/ Heavy gold or rhodium contacts and high-strength wire are recommended for use with vibration samples.
2/ Inactive for new design.

4.4.4 Qualification Tests

a. Samples provided under 4.4.2a shall all go through Group 1 testing (Table 12). After Group 1, samples shall be divided into two groups. One group shall be subjected to the tests in Group 2 (Table 12) in the sequence indicated. The second group shall be subjected to the tests of Group 3 (Table 12) in the sequence indicated.

b. Samples provided under 4.4.2b shall be subjected to the tests of Group 4, Table 12, in the sequence indicated.

c. Samples provided under 4.4.2c shall be subjected to the tests of Group 5, Table 12, in the sequence indicated.

d. Samples provided under 4.4.2d shall be forwarded to the Qualifying Activity for performance of the tests of Group 6, Table 12, in the sequence indicated.

e. Samples provided under 4.4.2e shall be subjected to the tests of Group 7, Table 12, in the sequence indicated.

f. Samples provided under 4.4.2f shall be subjected to the tests of Group 8, Table 12, in the sequence indicated.

TABLE 12 - QUALIFICATION AND GROUP C PERIODIC TESTS

Inspection	Requirement Paragraph	Test Paragraph
Group 1 (All classes and finishes, 4.4.2a samples) Unless otherwise noted		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.35, 3.36	4.6.1, 4.6.2
Insert retention	3.13	4.6.11
Terminus retention	3.22	4.6.15
Coupling torque	3.8	4.6.5
Accessory thread strength	3.16	4.6.19
Gauge location 1/	3.22	4.6.18
Gauge retention 1/	3.23	4.6.17
Maintenance aging	3.6	4.6.3
Contact retention 1/	3.24	4.6.18
Shell to shell conductivity	3.20	4.6.29
Electrical engagement 1/	3.15	4.6.13
Insertion/Substitution loss	3.43.1	4.7.2
Post test examination	3.35, 3.36	4.6.36
Group 2 (All classes, 4.4.2a samples) Unless otherwise noted		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.36, 3.37	4.6.1, 4.6.2
Magnetic permeability	3.3.4	4.6.32
External bending moment	3.20	4.6.14
Durability	3.9	4.6.6
Vibration	3.17	4.6.20
Shock	3.18	4.6.21
Shell to shell conductivity	3.19	4.6.29
Coupling torque	3.8	4.6.5
Post test examination	3.35, 3.36	4.6.36
Group 3 (All classes and finishes, 4.4.2a samples) Unless otherwise noted		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.36, 3.37	4.6.1, 4.6.2
High temperature exposure	3.32	4.6.28
Humidity	3.25	4.6.22
Temperature cycling	3.7	4.6.4
Altitude immersion	3.10	4.6.8
Insulation resistance at ambient temperature 1/	3.11	4.6.9
Dielectric withstanding voltage at sea level 1/	3.12	4.6.10
Durability	3.9	4.6.6
Terminus retention	3.21	4.6.15
Contact retention 1/	3.24	4.6.18
Coupling torque	3.8	4.6.5
Post test examination	3.36, 3.37	4.6.36
Group 4 (Shells with spring fingers, 4.4.2b samples)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.36, 3.37	4.6.1, 4.6.2
Shell spring finger forces	3.26	4.6.23
Shell to shell conductivity	3.19	4.6.29
Salt spray (dynamic test) (Class A and B only)	3.14	4.6.12.2
EMI shielding	3.27	4.6.24
Post test examination	3.35, 3.36	4.6.36

TABLE 12 - QUALIFICATION AND GROUP C PERIODIC TESTS (CONTINUED)

Inspection	Requirement Paragraph	Test Paragraph
Group 5 (Dielectric, 4.4.2c samples)		
Ozone exposure	3.28	4.6.25
Fluid immersion	3.29	4.6.26
Coupling torque	3.8	4.6.5
Post test examination	3.35, 3.36	4.6.36
Group 6 (Retention system, 4.4.2d samples)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.35, 3.36	4.6.1, 4.6.2
Pin contact stability 1/	3.32	4.6.33
Contact walkout 1/	3.33	4.6.34
Installing/removal tool abuse	3.30	4.6.27
High temperature exposure	3.31	4.6.28
Insert retention	3.14	4.6.11
Retention system fluid immersion	3.29.1	4.6.26.1
Terminus retention	3.21	4.6.15
Contact retention 1/	3.24	4.6.18
Post test examination	3.35, 3.36	4.6.36
Group 7 (All classes, 4.4.2e samples)		
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.5, 3.35, 3.36	4.6.1, 4.6.2
Ice resistance	3.37	4.6.30
Dust (fine sand) connectors mated or with dust covers installed	3.38	4.6.31
Impact (Class A and B)	3.42	4.6.40
Coupling torque	3.8	4.6.5
Post test examination	3.35, 3.36	4.6.36
Group 8 (All classes, 4.4.2f samples)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.35, 3.36	4.6.1, 4.6.2
Cavity to cavity leakage bonding integrity	3.34	4.6.35
Insert grommet bonding	3.41	4.6.39
Thermal vacuum outgassing (Class F only)	3.30	4.6.37
Post test examination	3.35, 3.36	4.6.36
Group 9 (Class A, B, and J)		
Visual and mechanical examination	3.1, 3.3, 3.4, 3.5, 3.35, 3.36	4.6.1, 4.6.2
Hydrolytic stability	3.40	4.6.38
Fungus	3.3.3	4.1.4
Post test examination	3.35, 3.36	4.6.36

1/ Only applicable to inserts that contain electrical contacts.

4.4.4.1 Failures

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

4.4.5 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 13.

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 the cable termination end of the insert and the 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 13 - GROUP A INSPECTION[1]

Inspection	Requirement Paragraph	Test Paragraph
Visual Examination[1]	3.1, 3.3, 3.4, 3.5, 3.35, and 3.36	4.6.1, 4.6.2
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 14 in the order shown and shall be made on sample units which have been subjected to and passed the Group A inspection.

TABLE 14 - GROUP B INSPECTION

Inspection	Requirement Paragraph	Test Paragraph	Number of Samples
Visual and Mechanical Examination[1]	3.1, 3.3, 3.4, 3.5, 3.35, and 3.36	4.6.1, 4.6.2	As Specified in Table 15
Insertion/Substitution Loss (initial)	3.43.1	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]	3.26	4.6.23	

[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 15. 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 15 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 15 - 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 to1200	34 unit
1201 to 3200	42 units

4.5.1.2.2 Lot Definition (Group B Inspection)

The production lot definition is further defined as follows:

a. 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.

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, and shall be performed by the Qualifying Activity. Except where the results of this inspection show non-compliance with the applicable requirements (see 4.5.2.3.2), 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 Periodic Qualification Inspection Routine and Test Report Submittal

The Qualifying Activity laboratory and supplier laboratory test methods shall be available to either party upon request. Where test measurements are required, the value shall be reported. The Qualifying Activity laboratory shall submit the test results for the Qualifying Activity required test groups in a data package to the supplier. The supplier will maintain the data for two retention periods. The supplier test report shall be a summary of all Group A and B tests performed and completed during the retention qualification interval of 4.5.2.3.1, material certifications, and other details required by the Qualifying Activity. The report may contain the Qualifying Activity test results. If the retention of qualification test results indicate non-conformance with the 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.

4.5.2.2 Periodic Qualification Certification of No Production.

In the even that no production occurred during the reporting period (see 4.5.2.3.1), a certification report shall be submitted certifying that the supplier still has the capabilities and facilities necessary to produce the product. The form of the report shall be in accordance with the Qualifying Activity requirements. No more than one reporting period may be certified.

4.5.2.3 Group C Inspection (Periodic Tests)

Periodic tests shall be performed on a 36 month basis. Samples submitted to either of these periodic tests shall have passed Groups A and B inspections.

4.5.2.3.1 Thirty Six Month Periodic Tests

Every 36 months, mating connector sample units shall be selected and submitted to the Qualifying Activity 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 subjected to the applicable tests of Table 12, Group 1. The remaining samples shall be fully cabled with the applicable fiber optic cable listed in Table 10 and be subjected to the applicable tests of Table 12, Group 6.

b. One receptacle shell and plug barrel (with coupling nut) of any small and large shell size of each finish style qualified shall be provided. The salt spray test of 4.6.13 shall be conducted.

4.5.2.3.2 Failures

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

4.5.2.3.3 Disposition of Sample Units

Sample units which have been subjected to Group C inspection shall not be delivered on the contract or purchase order.

4.5.2.3.4 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 re-inspection has shown that the corrective action was successful. In the event of failure after re-inspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5.3 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 TIA/EIA 455-13, 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, 3.36, 3.37). 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 AS81969/8 and AS81969/14. A minimum of 20%, but not less than three termini and three contacts (if insert contains electrical contacts) of each connector shall be tested. 50% of the maintenance aging shall be performed with AS81969/8 tools and 50% with AS81969/14 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 °C +0 -5 °C, and the temperature of step 3 shall be 175 °C for Class A, D, J, K, and P, and 200 °C for all other classes. The following procedure is recommended. All channels to a maximum of 12 shall 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 (temperature cycling), the optical power in dBm shall be recorded for a maximum of 12 channels of the connector.

e. Connectors will meet the insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4 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, J, L, and N composites. 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 insertion/substitution loss requirement of 3.43.1, and the change in optical transmittance requirements of 3.43.4, 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 3.43.1 and 3.43.4. Reference TIA/EIA 455-21, 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 ten 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, shall have reference power measurements in dBm recorded at room temperature per 3.43.1, if not completed after the last test. After testing, repeat insertion/substitution loss testing per 3.43.1. The connectors shall meet the insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4.

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 Insulation Resistance at Ambient Temperature (see 3.11)

Unmated connectors shall be tested in accordance with test procedure EIA-364-21. The following details and exceptions apply:

a. For lot acceptance testing, where it is undesirable to install actual contacts in connectors, simulated contacts and special techniques may be used in performing this test.

b. The tolerance on the applied voltage shall be ±10%.

c. Connectors shall be mated when testing after altitude immersion, humidity and altitude low temperature.

4.6.10 Dielectric Withstanding Voltage at Sea Level (see 3.12).

Wired, unmated connectors shall be tested in accordance with test procedure EIA-364-20, method A. Connectors shall be mated when testing after altitude immersion, humidity, and altitude low temperature. The following details and exceptions apply:

a. The magnitude of the test voltage shall be as specified in Table 1 (see MIL-STD-1560 for service rating).

b. 50% of the contacts available shall be tested, but in no case shall less than six dielectric withstanding voltage readings be taken. If the number of contacts is three or less, all contacts shall be tested. The test voltage shall be applied between each wired contact, and each adjacent contact, and the shell.

c. The test voltage shall be maintained at the specified value for 2 seconds minimum.

d. For quality conformance, simulated contacts and special techniques may be used in performing this test.

4.6.11 Insert Retention (see 3.13)

Unmated connectors shall be tested in accordance with EIA 364-35 with the following details and exceptions:

a. Force to be applied: 10 pounds per square inch ± 5 pounds per square inch with a 25 pound minimum force.

b. Connectors may be terminated.

4.6.12 Salt Spray (Corrosion) (see 3.14)

4.6.12.1 Standard Test (Classes E, F, and G)

Unmated connectors shall be tested in accordance with EIA 364-26 and evaluated 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 shall 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 in order to meet the requirements of 3.43.1 and 3.43.4.

d. Samples shall be mated and optical power (dBm) shall be recorded for each of the channels.

e. A post test visual inspection of the connector and termini shall be performed. All hardware will be checked for pits, cracks, scratches, de-lamination, and removal of finish due to test environment. Connectors shall meet the insertion/substitution loss requirements of 3.43.1 and change in optical transmittance requirements of 3.43.4.

4.6.12.2 Dynamic Test (Classes A, B, D, H, J, K, L, M, N, and P)

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 EIA364-26. The following details and exceptions apply:

a. The connectors (Class D, H, K, M, and P) 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 initial qualification, the connectors (Classes L and N), shall be subjected to 50 cycles durability followed by 952 hours salt spray mated, then 48 hours salt spray un-mated followed by 1450 cycles durability. For periodic inspection, the connectors (Class A, B, J, L, and N) 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 shall have reference power measurements in dBm recorded at room temperature if not already completed after the last test.

b. Samples shall 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.

d. Optical power (dBm) shall be recorded for each of the channels. Connectors shall meet the insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4.

e. The mated samples shall 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.

g. Optical power (dBm) shall be recorded for each of the channels. Connectors shall meet the insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4.

h. Samples shall 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.

j. Samples shall be mated and optical power (dBm) shall be recorded for each of the channels. Connectors shall meet the insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4.

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. Connectors will meet the insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4.

The following procedure is recommended for periodic inspection:

a. All channels to a maximum of 12 shall have reference power measurements in dBm recorded at room temperature, if not already completed after the last test.

b. The mated samples shall be subjected to the 452 hour salt spray test.

c. After the test the connector shall be cleaned. Cleaning shall consist of a 5 minute water rinse for all connector parts.

d. Optical power (dBm) shall be recorded for each of the channels. Connectors will meet the insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4.

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.

g. Samples shall be mated and optical power (dBm) will be recorded for each of the channels. Connectors shall meet insertion/substitution loss requirements of 3.43.1 and the change in optical transmittance requirements of 3.43.4.

4.6.13 Electrical Engagement (see 3.16)

Counterpart plugs and receptacles shall be wired so as to provide a complete series circuit through all contacts of the mated connector. A suitable power source and indicator shall be provided such that the earliest point at which the circuit is completed, during normal connector mating, can be established. Connector halves shall be slowly mated by the normal mating means until first indication of a completed circuit is observed. Means shall be provided to ensure that electrical contact is made between the pin and the spring of the socket contact, rather than the hood of the socket contact. The mating operation shall be held at this point and the overall connector length shall be measured from solid reference points on the connector halves. The mating operation shall then be continued until the connector halves are in the completely mated position. A second overall length measurement shall then be taken from the same reference points. The difference of these two measurements shall be not less than that specified in 3.16. Both the outer shield and inner conductor circuits shall be included in the test of shielded contacts.

4.6.14 External Bending Moment (see 3.22)

The receptacle connector shall be mounted as in normal service to a rigid panel. Before mating the plug connector to the receptacle, an adapter or test torque arm shall be attached as shown in the detail specification sheet. After mating the plug and receptacle connectors, the distance ‘L’ from the point of load application ‘P’ to the mounting panel shall be determined. The load to be applied at point ‘P’ shall be determined as the bending moment listed in Table 16, divided by the lever arm ‘L’. This load shall be applied at a rate of approximately 10 pounds per second until the required load is achieved. The applied load shall be held for 1 minute, than the load shall be released. Continuity of the termini shall be monitored during the test per 3.43.2. The test circuit used to monitor shall be capable of detecting a discontinuity in excess of 50 µs for multi-mode termini and 100 µs for single mode termini. Connectors shall meet the discontinuity requirement of 3.43.2.

TABLE 16 - EXTERNAL BEND MOMENT

Shell Size	Inch Pounds	Newton Meters
A,8,9	51	5.8
B,10,11	155	17.5
C,12,13	206	23.3
D,14,15	258	29.2
E,16,17	310	35.0
F,18,19	361	40.8
G,20,21	413	46.7
H,22,23	464	52.4
J,24,24	516	58.3

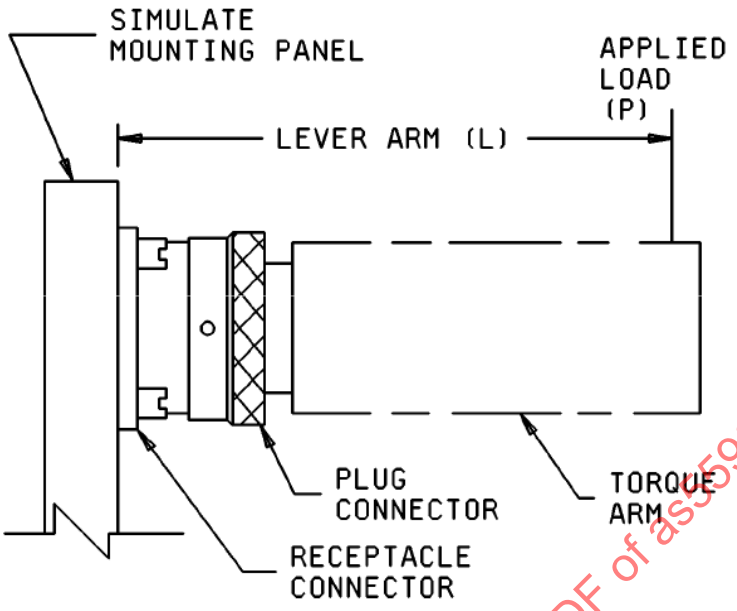


FIGURE 2 - EXTERNAL BENDING MOMENT TEST SETUP

4.6.15 Terminus Retention (see 3.21)

Unless otherwise specified, termini shall be tested as specified in EIA 364-29, method B. The following exceptions shall apply:

a. Number of samples - The test shall be performed on 20% of the terminus complement, but not less than three termini in each connector half.

b. Applied axial load - Pre-load to 3 pounds maximum (13.6 Newtons). Apply load as specified in Table 17.

c. Special requirements - Where the test sequence required maintenance aging prior to terminus retention, the termini that were subjected to maintenance aging shall also be selected for terminus retention.

d. Axial direction - The applicable forces shall be applied along the longitudinal axis of individual termini in the direction tending to displace the termini to the rear.

e. Only termini to be tested need be installed in the connector.

TABLE 17 - TERMINI RETENTION

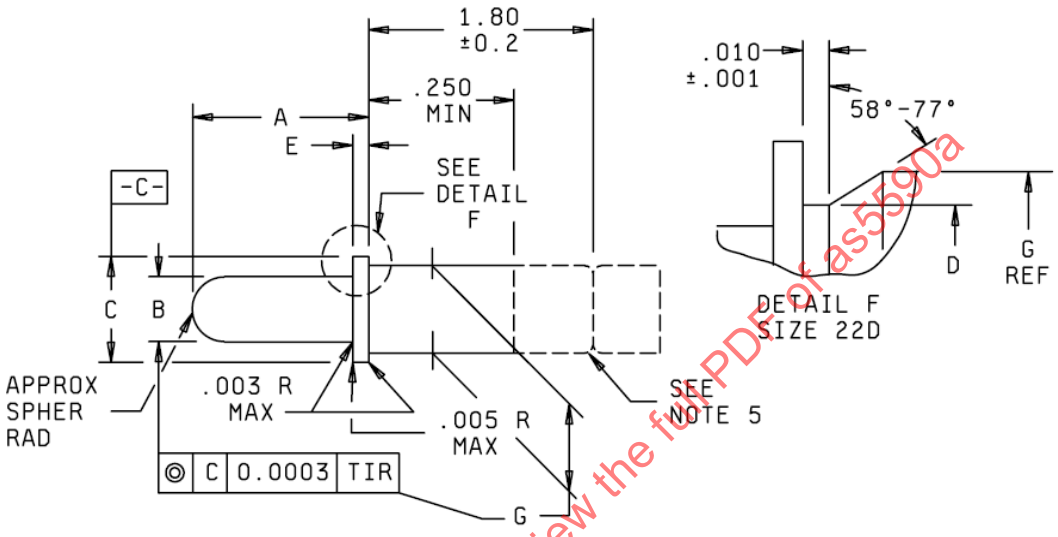
Termini Size	Load ±10%	
	Pounds	Newtons
16	25	111

4.6.16 Gauge Location (see 3.22, Series 1 only)

Applicable test gauges, as specified in Figures 3, 4, and 5, shall be installed in three randomly selected cavities in each connector, with the accessory rear hardware removed. With each test gauge fully seated back against its contact retention device, the axial location of the front end of each gauge shall be measured relative to the reference point specified on the detail specification, as applicable. The test shall be repeated on pin assemblies using gauges specified on Figure 3 and seating them forward in the contact cavity.

4.6.17 Gauge Retention (see 3.23, Series 1 only)

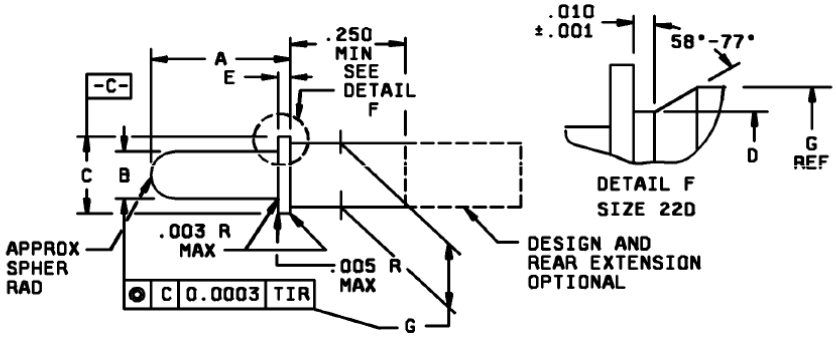
Applicable test gauges, as specified in Figures 3 and 6 shall be installed in three randomly selected cavities in each connector, with the accessory rear hardware removed. The axial load specified in Table 18 shall be applied to individual test gauges in both directions. The load shall be applied at a rate of approximately 1 pound per second until the specified load has been reached. Gauge displacement shall be measured with respect to the connector shell after an initial load of 2 pounds has been applied to ensure that all slack has been taken up.



Contact Size	A +0.0005 -0.0000	B DIA +0.0002 -0.0000	C DIA +0.0002 -0.0000	D DIA +0.0000 -0.0002	E +0.0000 -0.0002	G DIA +0.0000 -0.0002
22D	0.2950 (7.49)	0.0295 (0.749)	0.0600 (1.52)	0.0410 (1.04)	0.0330 (0.838)	0.0480 (1.22)
20	"	0.0390 (0.991)	0.0910 (2.31)	---	"	0.0700 (1.78)
16	"	0.0615 (1.56)	0.1270 (3.23)	---	"	0.1030 (2.62)
12	"	0.0930 (2.36)	0.1790 (4.55)	---	"	0.1510 (3.84)
10	"	0.1240 (3.15)	0.2380 (6.05)	---	"	0.2130 (5.41)
8 triax	"	0.2170 (5.51)	0.3110 (7.90)	---	"	0.2760 (7.01)

FIGURE 3 - TEST GAUGE, PIN, GAUGE LOCATION AND RETENTION

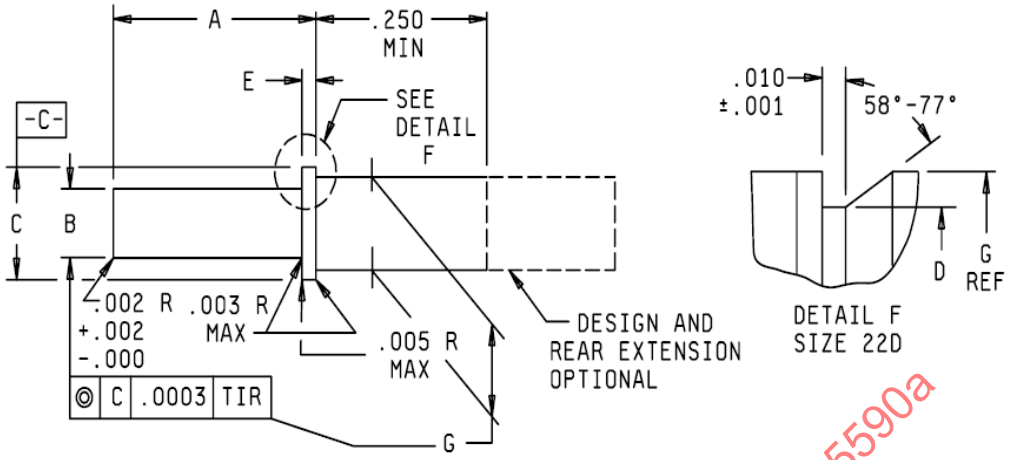
NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for information only.
3. Material: Hardened tool steel.
4. Finish: 32 micro-inches polished.
5. Design of rear extension is optional, but must have a groove provided as specified.



Contact Size	A +0.0005 -0.0000	B DIA +0.0002 -0.0000	C DIA +0.0002 -0.0000	D DIA +0.0000 -0.0002	E +0.0000 -0.0002	G DIA +0.0000 -0.0002
22D	0.3000 (7.62)	0.0295 (0.749)	0.0600 (1.52)	0.0410 (1.04)	0.0290 (7.37)	0.0480 (1.22)
20	"	0.0390 (0.991)	0.0910 (2.31)	---	"	0.0700 (1.78)
16	"	0.0615 (1.56)	0.1270 (3.23)	---	"	0.1030 (2.62)
12	"	0.0930 (2.36)	0.1790 (4.55)	---	"	0.1510 (3.84)
10	"	0.1240 (3.15)	0.2380 (6.05)	---	"	0.2130 (5.41)
8 triax	"	0.2170 (5.51)	0.3110 (7.90)	---	"	0.2760 (7.01)

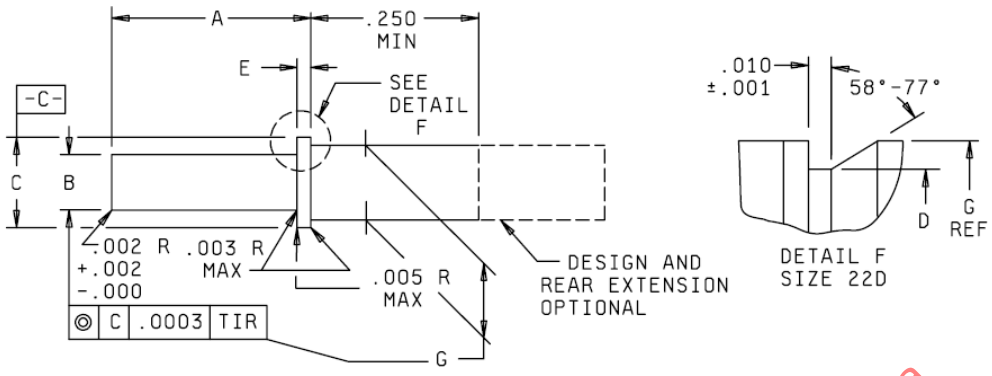
FIGURE 4 - TEST GAUGE, PIN, GAUGE LOCATION

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for information only.
3. Material: Hardened tool steel.
4. Finish: 32 micro-inches polished.



Contact Size	A +0.0005 -0.0000	B DIA +0.0002 -0.0000	C DIA +0.0002 -0.0000	D DIA +0.0000 -0.0002	E +0.0000 -0.0002	G DIA +0.0000 -0.0002
22D	0.5850 (14.86)	0.0600 (1.52)	0.0600 (1.52)	0.0410 (1.04)	---	0.0480 (1.22)
20	"	0.0770 (1.96)	0.0910 (1.55)	---	0.0330 (0.838)	0.0700 (1.78)
16	"	0.1120 (2.84)	0.1270 (3.23)	---	"	0.1030 (2.62)
12	"	0.1600 (4.06)	0.1790 (4.55)	---	"	0.1510 (3.84)
10	"	0.2190 (5.56)	0.2380 (6.05)	---	"	0.2130 (5.41)
8 triax	0.5900 (14.99)	0.2870 (7.29)	0.3110 (7.90)	---	"	0.2760 (7.01)

FIGURE 5 - TEST GAUGE, SOCKET, GAUGE LOCATION



Contact Size	A +0.0005 -0.0000	B DIA +0.0002 -0.0000	C DIA +0.0002 -0.0000	D DIA +0.0000 -0.0002	E +0.0000 -0.0002	G DIA +0.0000 -0.0002
22D	0.6260 (15.90)	0.0600 (1.52)	0.0600 (1.52)	0.0410 (1.04)	---	0.0480 (1.22)
20	"	0.0770 (1.96)	0.0910 (1.55)	---	0.0330 (0.838)	0.0700 (1.78)
16	"	0.1120 (2.84)	0.1270 (3.23)	---	"	0.1030 (2.62)
12	"	0.1600 (4.06)	0.1790 (4.55)	---	"	0.1510 (3.84)
10	"	0.2190 (5.56)	0.2380 (6.05)	---	"	0.2130 (5.41)
8 triax	0.6310 (16.03)	0.2870 (7.29)	0.3110 (7.90)	---	"	0.2760 (7.01)

FIGURE 6 - TEST GAUGE, SOCKET, RETENTION

4.6.18 Contact Retention for Electrical Contacts (see 3.24, Series 1 only)

Unless otherwise specified, contacts shall be tested to procedures I and II.

Procedure I. Contact retention shall be tested in accordance with test procedure EIA-364-29. The following details and exceptions shall apply:

a. Number of samples - The test shall be performed on 20% of the contact complement; but not less than three contacts in each connector half.

b. Applied axial load - Preload to 3 pounds maximum, (13.6 Newtons). Apply load as specified in Table 18.

c. Special requirements - Where the test sequence required maintenance aging prior to contact retention, the contacts which were subjected to maintenance aging shall also be selected for contact retention.

d. Axial direction - The applicable forces shall be applied along the longitudinal axis of individual contacts in the direction tending to displace the contacts to the rear.

e. Only the contacts to be tested need be installed in the connector.

TABLE 18 - CONTACT RETENTION.

Contact	Load ± 10%	
	Pounds	Newtons
22 1/ 22D 22M 1/	10	44
20	15	67
16	25	111
12	25	111
8	25	111
10	25	111
8 Triax	25	111

1/ Inactive for new design.

Procedure II. Contact retention shall be tested in accordance with test procedure EIA-364-29. The following details and exceptions shall apply:

a. 4.6.18a through 4.6.18c apply.

b. Axial direction - Same as 4.6.18d, except the direction shall tend to displace the contacts to the front.

c. Only the contacts to be tested need be installed in the connector.

4.6.19 Accessory Thread Strength (see 3.16)

The mated connector shall be mounted as in normal service to a rigid panel. The torque wrench shall be attached as shown in the detail specification sheet. After mating the plug and receptacle connectors, a torque shall be applied to the accessory end of the plug at a rate of approximately 10 inch pounds per second until the required torque is achieved (see Table 7). The applied load shall be held for 1 minute, than the load shall be released. The test shall then be repeated on the accessory end of the receptacle.

4.6.20 Vibration (Initial Qualification Only) (see 3.17)

All channels to a maximum of 12 shall have reference power measurements in dBm recorded at room temperature if not completed after the last test per 3.43.1. The sources and power meters shall remain connected to any termini not subjected to discontinuity monitoring, and optical power (dBm) shall be recorded during the test. Cabled and mated connectors shall be subjected to the applicable test specified. Connectors shall be mounted on the vibration table by normal means. A minimum of three termini shall be continuously monitored for discontinuities per 3.43.2 throughout the test. A detector capable of detecting any discontinuities in excess of 50 µs for multi-mode termini and 100 µs for single mode termini shall be used (see 4.7.3). After the test, optical power shall be recorded for each of the channels. Connectors shall meet the substitution loss requirements of 3.43.1, the discontinuity requirements of 3.43.2, and the change in optical transmittance requirements of 3.43.4. All plugs shall have an accessory load fixture in accordance with Figure 7.

4.6.20.1 Vibration Test Conditions

Connector samples shall be divided equally and subjected to vibration as follows:

a. Sine vibration per 4.6.21.1.1.

b. Random vibration per 4.6.21.1.2.

c. Random vibration per 4.6.21.1.3.

NOTE: One connector required for each test.

4.6.20.1.1 Sine Vibration

Connector samples shall be subjected to a simple harmonic motion from 10 to 2000 Hz in each of three mutually perpendicular axes. The level of vibration shall be a velocity 254 mm/s from 10 to 50 Hz; 1.5 mm double amplitude from 50 to 140 Hz, and 60 G from 140 to 2000 Hz. The entire frequency range from 10 to 2000 Hz and back shall be traversed in 20 minutes. The vibration shall be applied for a duration of 12 hours in each of the three mutually perpendicular axes for a total of 36 hours. Each axis of vibration shall be accomplished by vibrating for 4 hours at ambient room temperature, 4 hours at -55 °C ± 5 °C, and 4 hours at +175 °C ± 5 °C for Classes A, D, J, K, and P, and 200 °C ± 5 °C for Classes B, E, F, G, H, L, M, and N.

4.6.20.1.2 Random Vibration (Elevated temperature)

Connectors shall be subjected to the test specified in EIA 364-28. The following details shall apply:

a. Test condition VI, Letter ‘J’, at elevated temperature.

b. Vibration at the following temperatures: 175 °C ± 5 °C for Classes A, D, J, K, and P, and 200 °C ± 5 °C for Classes B, E, F, G, H, L, M, and N.

c. Duration shall be 8 hours in the longitudinal direction and 8 hours in a perpendicular direction for a total of 16 hours.

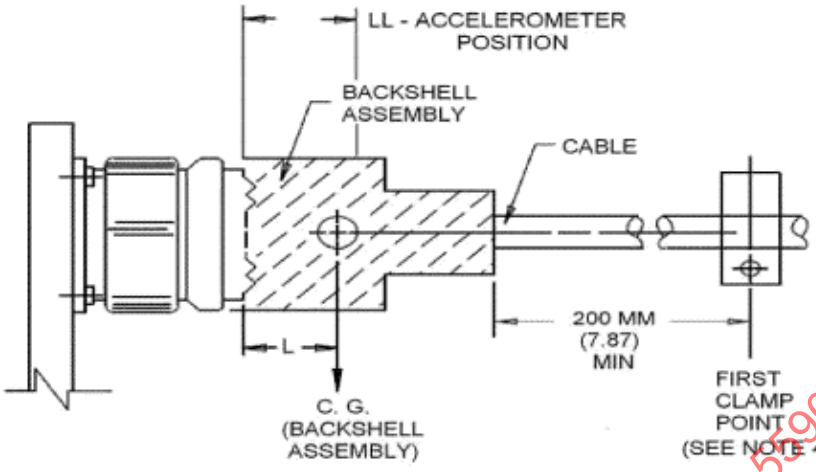
4.6.20.1.3 Random Vibration

Connectors shall be subjected to the test specified in EIA 364-28. The following shall apply:

a. Test condition V - Using the vibration envelope shown in Figure 8 (derived from zone 2, outlined in AIR1557).

b. Vibration to be conducted at ambient temperature.

c. Duration shall be 8 hours in the longitudinal direction and 8 hours in a perpendicular direction for a total of 16 hours. Test accessory shall not be required.



Shell Size	L (mm) Root to C.G. +10%/-0%	Weight (kg) Backshell Assembly +10%/-0%	LL (mm) ±1
9	15.24	0.05	10.2
11	17.78	0.06	10.2
13	19.05	0.07	17.8
15	19.05	0.09	25.4
17	19.05	0.11	25.4
19	22.86	0.18	30.5
21	22.86	0.22	30.5
23	23.37	0.25	35.6
25	23.37	0.31	35.6

FIGURE 7 - VIBRATION TEST ACCESSORY

NOTES:
1. Dimensions are in millimeters.
2. Shape of test accessory is optional.
3. The test accessory may include a strain relief clamp.
4. For series III, clamp point to be located on vibration table, and cable weight between rear of grommet and tie down clamp point to be considered a portion of the backshell assembly weight. Clamp point for series I and IV is to be on non-vibrating member.