



AEROSPACE STANDARD

AS29600™**REV. B**

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Superseding AS29600A

Connectors, Electrical, Circular, Miniature, Composite,
High Density, Quick Coupling, Environment Resistant, Removable
Crimp Contacts Associated Hardware, General Specification For

FSC 5935

RATIONALE

Revision is required to add AIR1351 to the marking requirements, to update installing/removal tool references, to replace MIL-HDBK-454 requirement reference with the applicable information and update all other document references.

1. SCOPE

1.1 Scope

This specification covers miniature, composite, high density, threaded coupling, self-locking, circular, environment resistant, electrical connectors utilizing removable crimp contacts, and associated hardware, which are capable of continuous operation within a temperature range of -65 to +175 °C. These connectors are supplied under an AS9100 reliability assurance program. See 6.1 for intended use and applications.

1.2 Description

The connectors employ rear release removable pin and socket contacts with crimp termination. The connectors are designed to assure proper orientation of the mating halves prior to electrical circuit closure. The connectors include EMI shielding capability. They also provide electrical continuity between mated shells prior to contact engagement and have the contacts so located as to be protected from handling damage and inadvertent electrical contact. The connectors consist of a composite material with light weight characteristics and, when used with backshells and contacts specified herein, provide high levels of corrosion resistance and durability.

1.2.1 Design Considerations

Connectors are designed to be used as a system with backshells and contacts specified herein. When so used, the connectors are capable of performance during or after, as applicable, under the following environmental conditions:

1.2.1.1 Temperature

-65 to +175 °C.

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1.2.1.2 Vibration

- a. Random: 41.7 G rms at rated high and low temperatures without backshell.
49.5 G rms at ambient temperature with backshell.
- b. Sine: 60 G at ambient temperature with backshell.

1.2.1.3 Altitude

Altitudes from sea level to 100000 feet (8 torr). Test voltage will vary with altitude (see Table 12).

1.2.1.4 Shock

Shock as represented by a 3 + 1 ms base half-sine wave peaking at 300 G (see 3.23).

1.2.1.4.1 High Impact Shock

Per MIL-S-901.

1.2.1.5 Humidity

Humidity conditions up to 98 percent relative humidity including condensation (see 3.25).

1.2.1.6 Corrosion

2000 hour exposure to salt-laden atmosphere (see 3.15).

1.2.1.7 Temperature Cycling

See 4.6.3.

1.2.1.8 Fluid Immersion

Immersion, in jet fuel, lubrication oil, liquid coolant, hydraulic fluid, gasoline, cleaning compound, defrosting fluid, and solvents (see 3.29).

1.2.1.9 EMI Shielding

EMI shielding effectiveness: 100 MHz to 10 GHz, minimum attenuation of 50 dB (see 3.27).

1.2.1.10 Electrolytic Erosion

Exposure of uncoupled connector to a salt moisture environment (see 3.34).

1.2.1.11 Durability

1500 matings and unmatings (see 3.4.1 and 3.10).

1.3 Classification

1.3.1 Connectors

Connectors fabricated to this specification are scoop-proof, self-locking, quick coupling and are as follows:

a. Series: The series A and B connectors are not intermateable.

A - Utilize MIL-DTL-38999 insert arrangements.

B - Utilize AS81511 insert arrangements.

b. Types:

(1) Plugs: Straight.

(2) Receptacles: Wall mounting, both front and rear panel mounting, jam nut mounting. Contains grounding member that makes shell contact prior to contact engagement.

c. Class: R - Environment resisting - conductive shell, EMI shielded.

E - Environment resisting - conductive or nonconductive shell, non-EMI shielded.

G - Environment resisting - conductive shell, EMI shielded, space grade.

1.3.2 Contacts

a. Styles:

(1) Connectors ordered with high performance contacts:

H - Pin

J - Socket

The H or J designators are used to indicate a full complement of applicable high performance contacts rated at 1500 cycles of durability, and shall appear in the part number marked on the connector.

(2) Connectors ordered with standard contacts:

P - Pin

S - Socket

The P or S designators are used to indicate a full complement of applicable standard contacts rated at 500 cycles of durability, and shall appear in the part number marked on the connector.

(3) Connectors ordered without contacts:

A - Less pin contacts. Application specifies 500 cycles of durability.

B - Less socket contacts.

K - Less pin contacts. Application specifies 1500 cycles of durability.

L - Less socket contacts.

The A, B, K, or L designators are used to indicate connectors ordered less contacts, and are intended to have other than all standard power contacts installed (example: shielded, coaxial and thermocouple contacts). The A, B, K, or L designator shall appear in the part number marked on the connector.

Connectors ordered less contacts, but intended for assembly with all high performance or all standard contacts, shall have the H or J designator, or the P or S designator, respectively in the part number marked on the connector the same as connectors ordered with a full complement of applicable contacts.

1.3.3 Associated Hardware

a. Types:

- (1) Backshells.
- (2) Protective covers.
- (3) Dummy stowage receptacles.
- (4) Sealing plugs.

2. APPLICABLE DOCUMENTS

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 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 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AIR1351	Manufacturer's Identification of Aerospace Electrical and Electronic Wiring Devices and Accessories
AIR1557	High and Extended Vibration Environment
AS3582	Packing, Preformed - O-ring Seal, AMS 3304
AS22520	Crimping Tools, Terminal, Hand or Power Actuated Wire Termination, and Tool Kits, General Specification for
AS22759	Wire, Electrical, Fluoropolymer-Insulated, Copper or Copper Alloy
AS39029	Contacts, Electrical Connector, General Specification For
AS81550	Insulating Compound, Electrical, Embedding, Reversion Resistant Silicone
AS85049	Connector Accessories, Electrical, General Specification For
AS29600/1	Connector, Electrical, Circular, Miniature, Composite, High Density, Quick Coupling, Environment Resistant, Removable Crimp Contacts, Sealing Plug, Size 8 (Series A)
AS29600/10	Connectors, Electrical, Circular, Miniature, Composite, High Density, Quick Coupling, Environment Resistant, Removable Crimp Contacts, Receptacle, Flanged (Series A)
AS29600/11	Connectors, Electrical, Circular, Miniature, Composite, High Density, Quick Coupling, Environment Resistant, Removable Crimp Contacts, Receptacle, Jam Nut (Series A)
AS29600/12	Connectors, Electrical, Circular, Miniature, Composite, High Density, Quick Coupling, Environment Resistant, Removable Crimp Contacts, Plug (Series A)
AS29600/20	Connectors, Electrical, Circular, Miniature, Composite, High Density, Quick Coupling, Environment Resistant, Removable Crimp Contacts, Receptacle, Flanged (Series B)

AS29600/21 Connectors, Electrical, Circular, Miniature, Composite, High Density, Quick Coupling, Environment Resistant, Removable Crimp Contacts, Receptacle, Jam Nut (Series B)

AS29600/22 Connectors, Electrical, Circular, Miniature, Composite, High Density, Quick Coupling, Environment Resistant, Removable Crimp Contacts, Plug (Series B)

AS81969 Installing and Removal Tools, Connector, Electrical Contact, General Specification for

2.1.1 Specifications, Standards, and Handbooks

Unless otherwise specified, the following specifications, standards and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

MIL-DTL-901 Shock Tests, H.I. (High Impact); Shipboard Machinery, Equipment and Systems, Requirements for

MIL-S-7742 Screw Threads, Standard, Optimum Selected Series: General Specification for

MIL-PRF-8516 Sealing Compound, Synthetic Rubber, Electric Connectors and Electric Systems, Chemically Cured

A-A-59877 Insulating Compound, Electrical, Embedding

MIL-PRF-23586 Sealing Compound (With Accelerator), Silicone Rubber, Electrical

MIL-M-24041 Molding and Potting Compound, Chemically Cured, Polyurethane

MIL-DTL-25038 Wire, Electrical, High Temperature and Fire Resistant, General Specification for

MIL-A-46146 Adhesive Sealants, Silicone, RTV, Non-Corrosive (For Use With Sensitive Metals And Equipment)

MIL-DTL-55330 Connectors, Electrical and Fiber Optic, Packaging of

MIL-DTL-81381 Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy

STANDARDS

FEDERAL

FED-STD-H28 Screw-Thread Standards for Federal Services

A-A-59569 Braid, Wire, (Copper, Tin Coated, Silver Coated or Nickel Coated, Tubular, or Flat)

MILITARY

MIL-STD-202	Test Methods for Electronic and Electrical Component Parts
MIL-STD-889	Dissimilar Metals
MIL-STD-1285	Marking of Electrical and Electronic Parts
MIL-STD-1560	Insert Arrangements for MIL-DTL-38999, MIL-DTL-27599 and AS29600 Series A Electrical Circular Connectors
MS3435	Test Gage, Contact Location and Retention Feature, MIL-C-81511 Series 3 and 4 Connectors
MS27488	Plug, Sealing, Electrical Connector

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

2.2 Other Publications

The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DODISS and the supplement thereto, if applicable.

2.2.1 ANSI Publications

Copies of these documents are available online at <http://webstore.ansi.org/>

ANSI - Z540.1 Laboratories, Calibration and Measuring and Test Equipment (DoD Adopted)

2.2.2 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada)) or +1-414-272-8575 (International), www.asq.org.

ASQC-Z1.4 Procedures, Sampling, and Tables for Inspection by Attributes (DoD adopted)

2.2.3 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 B488 Gold for Engineering Uses, Electrodeposited Coatings of (DoD adopted)

ASTM D570 Plastic, Water Absorption of

ASTM E595 Standard Test Method Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment

ASTM G85 Modified Salt Spray (Fog) Testing, Practice for

2.2.4 EIA Publications

Available from Electronic Industries Alliance, 2500 Wilson Boulevard, Arlington, VA 22201-3834, Tel: 703-907-7500, www.eia.org.

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

2.2.5 IPC - Association Connecting Electronics Industries Publications

Available from IPC, 3000 Lakeside Drive, Bannockburn, IL 60015, Tel: 847-597-2862, www.ipc.org.

J-STD-006 Requirements for Electronic Grade Soldering Alloys and Fluxed and Non-Fluxed Solders for Electrical Soldering Applications

2.2.6 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>

ISO/R 68-1973 ISO-Basic Profile for Triangular Screw Threads, .25 to 5 MM.

ISO/R 261-1973 ISO-Metric Screw Threads, General Plan, .25 to 300 MM.

ISO/R 262-1973 ISO-Metric Screw Threads for Screws, Bolts, and Nuts, 6 to 39 MM.

ISO/R 965-1973 Part 1 - ISO General Purpose Metric Screw Threads, Tolerances, Principles 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 39 MM
Part 3 - ISO General Purpose Metric Screw Threads, Tolerances, and Deviations for Constructional Threads 1.6 to 355 MM

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of Precedence

In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Specification Sheets

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

3.2 Qualification

Connectors furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.4 and 6.3).

3.2.1 Reliability

The supplier's quality management system program for assembled connector accessories and assembly procedures must be comparable to AS9100 subject to the approval of the qualifying activity. Certification and registration of conformance to the AS9100 standard shall be in accordance with AS9104.

3.3 Materials

Materials shall be as specified herein. However, when a definite material is not specified, a material shall be used which will enable the connectors and accessories to meet the performance requirements of this specification and shall be of the lightest practical weight. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

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 contact, 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 metal spraying on dissimilar-base metals to provide compatible couples for abutting surfaces is permitted per MIL-STD-889. The use of dissimilar metals separated by an appropriate insulating material is also permitted.

3.3.1.2 Hydrolytic Stability

Encapsulation and embedment materials shall be selected from the following specifications: MIL-PRF-8516, A-A-59877, MIL-PRF-23586, MIL-M-24041, and AS81550. The materials selected shall be capable of filling all voids and spaces around the items enclosed. For Air Force Applications use of materials other than transparent silicone in accordance with AS81550 requires procurement activity approval. When tested as specified in 4.6.36.2, the connector shells shall be without defects detrimental to performance. Connector weight shall not increase greater than 0.75 percent. When subjected to an over-torque at 150 percent of those values specified in Table 3, there shall be no evidence of breaking, loosening of parts, or cracking.

3.3.2 Components

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

- a. Shells, coupling rings, and associated hardware - Corrosion resistant, high performance resins, with or without filler materials, shall be defined by specifications listed in the DODISS or published by professional materials associations. Exceptions may be granted by the preparing activity. Use of regrind material requires the connector manufacturer to demonstrate to the qualifying activity that the regrind process does not jeopardize the intended use of the connector and the material meets the characteristics, properties, and capabilities of virgin material.
- b. Insert - Reinforced epoxy resin or other rigid dielectric material.
- c. Grounding members - Heat treated beryllium copper, corrosion resistant steel or conductive elastomer designed to provide electrical contact with the mating shell.
- d. Gaskets, grommet and interfacial seal - Silicone, fluorosilicone, or silicone/fluorosilicone blend elastomer.

3.3.3 Magnetic Permeability (Magnetic Materials)

The relative permeability of the wired, assembled and fully mated connector assembly shall be less than 2.0 μ when measured in accordance with 4.6.34.

3.3.4 Fungus Resistant

Materials used in the construction of these connectors shall be fungus inert (see 4.1.3).

3.3.5 Contact Materials

Contacts shall be made of conductive copper alloys as specified in AS39029.

3.3.6 Contact Plating

Contacts shall be plated to meet or exceed the performance requirements of AS39029 and withstand 1500 cycles of durability (see 4.6.5). Contact finish shall be 5 millionths minimum gold alloy over 45 millionths minimum palladium alloy, over a suitable underplate, and compatible with gold finish as defined in of AS39029.

3.3.7 Connectors and Accessories Finish

Conductive connector shells and backshells shall have a finish compatible with 500 millionths minimum tin or tin alloy, over a suitable surface preparation. Electrically conductive connector shells and backshells shall have an EMF range of -0.10 to -0.40 V as specified in MIL-STD-889. Coupling rings, jam nuts, dust caps, dummy receptacles, and associated hardware shall meet the requirements of this specification.

3.3.8 Dielectric Materials

3.3.8.1 Insert and Grommet

Insert and grommet materials shall have hardness, electrical, and mechanical characteristics for the purpose intended.

3.3.8.2 Insert Faces

The mating face of socket inserts shall be a hard non-resilient material. The mating face of pin inserts shall be a resilient material which shall provide sufficient sealing to meet the specification performance requirements.

3.4 Design and Construction

Connectors and accessories shall be designed and constructed to withstand normal handling incident to installation and maintenance in service. Connectors shall be designed such that neither the pins nor sockets will be damaged during normal mating of counterpart connectors. Connector intermateability control dimensions shall be as specified on Figures 1 through 4, 6 through 9, and 3.4.1.2. Connector accessory interface dimensions shall be as specified in Figures 5 and Figure 10.

3.4.1 Contacts

Contacts shall be designed for crimp termination and shall be as specified to AS29600/13, /14, /23, and /24. The connectors specified herein are also capable of operating with contacts specified in AS39029/17, /18, /56 and /58, as applicable. However, when AS39029 contacts are used, the durability level of the connector system shall be 500 cycles. The quantity of contacts to be supplied with each connector unit package shall consist of a full complement of contacts plus 1 spare contact for each size used in the arrangement utilizing 26 contacts or less. For arrangements utilizing more than 26 contacts, 2 spare contacts for each size used in the arrangement shall be used.

3.4.1.1 Indirect Shipment

Connectors may be ordered without contacts (see 1.3.1, 6.2, and 6.4).

3.4.1.2 Insert Arrangement

Insert arrangements for AS29600 Series A connectors shall be as specified in MIL-STD-1560, as applicable (pattern 25-11 is not applicable). Insert arrangements for AS29600 Series B connectors shall be as specified herein. The engaging end of the pin contact in assembled connectors shall be located within 0.024 inch (0.61 mm) diameter of true position and the engaging end of socket contacts in assembled connectors shall be located within 0.015 inch (0.38 mm) diameter of true position.

3.4.1.3 Installing and Removal Tools

Tools required for the assembly and disassembly of the pin and socket contacts into their connector inserts shall be qualified to MIL-I-81969/16 for series B connectors, or AS81969/8 and AS81969/14 for series A connectors. One qualified AS81969/16 or AS81969/14 tool shall be enclosed in the unit package, as applicable. For indirect shipments, connectors may be ordered without installing and removal tools (see 6.2 and 6.4).

3.4.2 Insert Design and Construction

The entire insert and wire sealing or wire supporting member of the assemblies shall be one integral part, designed to provide sealing and support around the wires and to be non-removable. The inserts shall be installed in the locations specified in Figures 1, 2, 6, 7 and 3.4.1.2. The rigid dielectric shall be one molded piece or no more than two pieces bonded so as to form essentially one integral piece. Inserts shall be of construction, eliminating all air paths between contacts. The design shall be such as to permit the removal and replacement of individual contacts into their connector inserts with specified installing/removal tools (see 3.4.1.3). The contact locking device shall be contained or located in the rigid dielectric insert and shall retain the contacts in accordance with the contact retention requirements specified herein (see 3.20).

The inserts shall be secured to prevent rotation or movement within the shell. All pin contact inserts shall have a resilient interface seal bonded to the front face in accordance with the applicable standards. Socket entry holes and pin barrier rings shall conform to Figures 4 and 9.

3.4.3 Sealing

3.4.3.1 Wire Sealing

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 1. Sealing to size 8 cavities of the wire sealing grommet may be accomplished by means of separate resilient bushings which shall be furnished with the connector. 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.

Table 1 - Wire sealing

Contact Size	Wire Size	Outer Diameter of Finished Wire			
		Series A		Series B	
		Inches	mm	Inches	mm
22D-23	28	0.030 minimum 0.054 maximum	0.76 minimum 1.37 maximum	0.030 minimum 0.054 maximum	0.76 minimum 1.37 maximum
	26				
	24				
	22				
20	24	0.040 minimum 0.083 maximum	1.02 minimum 2.11 maximum	0.040 minimum 0.074 maximum	1.02 minimum 1.88 maximum
	22				
	20				
16	20	0.065 minimum 0.109 maximum	1.65 minimum 2.77 maximum	0.060 minimum 0.103 maximum	1.52 minimum 2.62 maximum
	18				
	16				
12	14	0.097 minimum 0.142 maximum	2.46 minimum 3.61 maximum	0.097 minimum 0.135 maximum	2.46 minimum 3.43 maximum
	12				
8	Shielded Cable	0.120 minimum 0.155 maximum	3.05 minimum 3.94 maximum	N/A	N/A

3.4.3.2 Grommet Sealing Plugs

Unless otherwise specified (see 3.1), the grommets of environment resisting connectors shall be designed to accept sealing plugs in accordance with MS27488 and AS85049/80 in lieu of wire where unwired contacts are employed. Fifteen percent of the number of contacts, but not less than one, shall be enclosed in the unit package. For indirect shipments, connectors may be supplied without grommet sealing plugs (see 6.4).

3.4.3.3 Interfacial Seal

Plugs and receptacles with pin inserts shall have a resilient face with individual pin barriers (see Figures 4 and 9). The pin barrier projections shall seal in their respective lead-in chambers of the hard face socket insert. The resilient interfacial seal shall provide individual contact seals in the mated condition to ensure circuit isolation between each contact and contact to shell.

3.4.4 Shell

Shells, including mounting flanges, shall be of one-piece construction and shall be designed to retain their inserts 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. The shells of crimp contact connectors shall have a blue color band in accordance with EIA RS-359, indicating a rear release contact retention system. The blue color band shall be located so that it is readily visible to any person servicing a mounted connector. The shell shall be designed to accept and retain a cable support or other accessory (see Figures 5 and 10).

3.4.4.1 Grounding Members

Grounding members shall be designed to provide electrical contact with the mating shell prior to contact engagement.

3.4.4.2 Jam-Nut Mounting Receptacles

Jam-nut mounting receptacles shall be provided with mounting nut AS29600/7 all with provisions for locking and an SAE-AS3582 O-ring.

3.4.4.3 Screw Threads

Design of screw threads shall use FED-STD-H28 as a reference. Composite threads shall be checked with ring gages made to the worst case dimensions. Slight out-of-roundness beyond the specified tolerances is acceptable if threads can accept the go gages without forcing, and meet the minimum torque values of 3.39 for accessory thread strength.

3.4.5 Threaded Coupling

Unless otherwise specified (see 3.1), connectors shall be coupled to counterpart connectors by means of a triple start thread. An anti-decoupling mechanism shall be internal to the plug to maintain the mated connector in full engagement. The coupling ring shall be captivated and shall be knurled or fluted to facilitate coupling.

3.4.5.1 Ease of Coupling

Counterpart connectors of any arrangement shall be capable of being fully coupled and uncoupled in a normal and accessible location without the use of tools.

3.4.5.2 Locking

A complete coupling shall be accomplished by clockwise rotation of the coupling nut and shall provide shell to shell bottoming. A visual red color band shall be provided on the receptacle to determine complete coupling (see AS29600/10, /11, /20, and /21).

3.4.5.3 Polarization of Connector Shells

Polarization of connector shells shall be accomplished by means of five integral keys and suitable matching keyways on the counterpart. Polarization shall be accomplished before initial engagement of the coupling ring. During axial engagement, pins shall not touch sockets or the insert face until polarization has been achieved (see Figures 3 and 8).

3.4.5.3.1 Alternates

Shells shall also be supplied with the keys (or keyways) rotated from the normal as indicated on Figures 3 and 8.

3.4.5.4 Engagement Seal

Connectors shall contain sealing means so that engaged connectors comply with the requirements specified herein. A dynamic seal shall be provided to achieve a peripheral seal between the mated shells.

3.4.5.5 Pin to Pin Mating Prevention

The connector shall be designed such that pin to pin contact (electrical or physical) is not possible in the event that a plug with pin contacts is inadvertently mated with a receptacle with pin contacts.

3.4.5.6 Lubrication

Coupling threads may be coated with a lubricant. All lubricants shall meet the performance requirements specified herein. Lubricants shall be NASA approved for space flight parts.

3.4.6 Cavity Fill

If the rear grommet design does not allow for intimate contact between it and the complete inner perimeter of the shell, the resulting cavity between the insert and the shell shall be filled with RTV silicone conforming to MIL-A-46146, or equivalent. After filling, the grommet shall be in accordance with Figure 5 or 10.

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 4.6.2, the contact installation and removal forces shall not exceed the requirements of Table 2.

Table 2 - Installing and removal forces

Contact Size	Installing and Removal Forces (Maximum)	
	Pounds	Newtons
22D-23	10	44
20	20	89
16	20	89
12	30	133
8	35	156

3.7 Contact Protection, Connector Mating (Scoop-Proof)

Connectors designed to provide protection in receptacles or plugs equipped with pin contacts shall not permit the edge of the mating plug or receptacle shell to touch the pin contacts. The procedure described in 4.6.37 shall be used.

3.8 Temperature Cycling

When tested as specified in 4.6.3, there shall be no damage detrimental to the operation of the connector. There shall be no blistering, peeling, or other separation of the plating.

3.9 Coupling Torque

When tested as specified in 4.6.4, the coupling torque for mating and unmating of counterpart connectors shall meet the torque requirements of Table 3. The connectors used in this test shall have the complete set of contacts. Protective covers, when mated with their applicable connectors, shall also comply with the torque requirements of Table 3.

Table 3 - Coupling torque

Shell Size	Torque			
	Maximum Engagement and Disengagement		Minimum Disengagement	
	Inch-Pound	Newton Meters	Inch-Pound	Newton Meters
8-9	8	0.9	2	0.2
10-11	12	1.4	2	0.2
13	16	1.8	2	0.2
14-15	20	2.3	4	0.4
16-17	24	2.7	4	0.4
18-19	28	3.2	4	0.4
20-21	32	3.6	6	0.7
22-23	36	4.1	7	0.8
24-25	40	4.5	7	0.8

3.10 Durability

When tested as specified in 4.6.5, counterpart connectors shall show no damage detrimental to the operation of the connector and shall meet the subsequent requirements.

3.11 Altitude Immersion

Connectors shall have an insulation resistance greater than those values specified in Table 4, after being subjected to altitude immersion as specified in 4.6.6 and shall maintain a dielectric withstanding voltage at sea level as specified in 4.6.8.1.

Table 4 - Insulation resistance

Environmental Condition	Insulation Resistance (Megohms)	
	Series A	Series B
At ambient temperature	5000	5000
At elevated temperature	1000	2000
After altitude immersion	1000	5000
After humidity	100	500

3.12 Insulation Resistance

3.12.1 Insulation Resistance at Ambient Temperature

When tested as specified in 4.6.7.1, the insulation resistance between any pair of contacts and between any contact and the shell shall be greater than 5000 MΩ (see Table 4).

3.12.2 Insulation Resistance at Elevated Temperature

When tested as specified in 4.6.7.2, the insulation resistance between any pair of contacts and between any contact and the shell shall be greater than those values specified in Table 4.

3.13 Dielectric Withstanding Voltage

When tested as specified in 4.6.8.1 or 4.6.8.2, connectors shall show no evidence of flashover or dielectric breakdown.

3.14 Insert Retention

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

3.15 Salt Spray (Corrosion)

When tested as specified in 4.6.10, connectors shall be without defects detrimental to the mechanical and electrical performance.

3.16 Electrical Engagement

When tested as specified in 4.6.11, wired, mated connectors shall provide a minimum of 0.050 in (1.27 mm) electrical engagement for AS29600 Series A connectors, and 0.040 in (1.02 mm) electrical engagement for AS29600 Series B connectors. This requirement also applies to the outer shield and inner conductor of shielded contacts.

3.17 External Bending Moment

When tested as specified in 4.6.12, connectors shall be without defects detrimental to the mechanical and electrical performance.

3.18 Gage Location

When tested as specified in 4.6.13, gage locations shall fall within the range specified on Figures 1, 2, 6, and 7.

3.19 Gage Retention

When tested as specified in 4.6.14, the applicable test gages conforming to MS3435 and Figure 19, shall be retained in the contact cavities and the axial displacement of the test gages while under load shall not exceed 0.012 in (0.30 mm).

3.20 Contact Retention

When tested as specified in 4.6.15, the axial displacement of the contact shall not exceed 0.012 in (0.30 mm). No damage to the contacts or inserts shall result.

3.21 Altitude - Low Temperature

When tested as specified in 4.6.16 the connectors shall meet the requirements of dielectric withstanding voltage as specified in 3.13 and the insulation resistance as specified in 3.12.1.

3.22 Vibration (Qualification Only)

When tested as specified in 4.6.17, there shall be no electrical discontinuity greater than 1.0 μ s and there shall be no disengagement of the mated connectors, backing off of the coupling mechanism, evidence of cracking, breaking or loosening of parts.

3.23 Shock

When tested as specified in 4.6.18, there shall be no electrical discontinuity greater than 1.0 μ s and there shall be no disengagement of the mated connectors, evidence of cracking, breaking or loosening of parts.

3.24 Conductivity (Classes R and G Only)

3.24.1 Shell-to-Shell Conductivity

When tested as specified in 4.6.19.1 the maximum measured resistance between the two connectors shall be 6.0 mΩ for shell sizes 17 and larger and 10 mΩ for sizes 15 and smaller. The test probes shall not puncture or damage the connector finish.

3.24.2 Shield to Shell Conductivity (Accessories Only)

Unless otherwise specified (see 3.1), when tested as specified in 4.6.19.3, the maximum resistance measured between the shield terminated to the connector plug and the receptacle flange shall be 20 mΩ.

3.25 Humidity

When tested as specified in 4.6.20, wired, mated connectors shall be without defects detrimental to the mechanical and electrical performance. Following the test, and during the final cycle, insulation resistance shall be greater than those values specified in Table 4.

3.26 Grounding Member Forces

When tested as specified in 4.6.21, the axial force necessary to overcome the grounding member interference shall be greater than 0.25 lb but less than 15 lb.

3.27 EMI Shielding (Classes R and G Only)

When tested as specified in 4.6.22.1 and 4.6.22.2 the EMI shielding capabilities of mated shells shall be not less than that specified in Table 5 at the specified frequencies.

Table 5 - EMI shielding effectiveness

Leakage Attenuation (dB) Minimum	
Frequency (MHz)	Classes G and R
100	90
200	88
300	88
400	87
800	85
1000	85
1500	69
2000	65
3000	61
4000	58
6000	55
10000	50

3.28 Ozone Exposure (Unmated)

When tested as specified in 4.6.23, the connectors shall show no evidence of cracking of materials or other damage due to ozone exposure that will adversely affect subsequent performance.

3.29 Fluid Immersion

When tested as specified in 4.6.24, connectors shall meet the requirements for coupling torque (see 3.9) and dielectric withstanding voltage (see 3.13) when exposed to all fluids specified in EIA364-10 test method.

3.29.1 Retention System Fluid Immersion

When tested as specified in 4.6.24.1, the insert assemblies shall meet requirements of contact retention (see 3.20). Effects of the fluids on resilient sealing members shall not be a consideration of this test.

3.30 Pin Contact Stability

When tested as specified in 4.6.25, the total displacement of a reference point on the contact tip shall not exceed the amount shown in Table 6.

Table 6 - Pin contact stability

Total Displacement					Force			
Series A			Series B		Series A		Series B	
Contact Size	Inches (Maximum)	mm	Inches (Maximum)	mm	Pounds	Newtons	Pounds	Newtons
23	N/A	N/A	0.025	0.635	N/A	N/A	0.25	1.1
22D	0.030	0.762	N/A	N/A	0.28	1.2	N/A	N/A
20	0.054	1.372	0.030	0.762	0.56	2.5	0.50	2.2
16	0.075	1.905	0.048	1.219	1.1	4.9	1.0	4.4
12	0.075	1.905	0.062	1.575	1.1	4.9	1.0	4.4
8	0.100	2.540	N/A	N/A	2.2	9.8	N/A	N/A

3.31 Contact Walkout

When tested as specified in 4.6.26, the contacts shall not be dislodged from their normal position.

3.32 Insertion/removal Tool Abuse

When tested as specified in 4.6.27, there shall be no damage to the contacts, the connector insert, or the contact retaining mechanism. The connectors shall meet the requirements of subsequent testing.

3.33 High Temperature Exposure with Contact Retention

When tested as specified in 4.6.28, the contacts shall support an axial load equal to 50% of the values specified in Table 14. The contacts shall maintain their specified locations (see Figures 1, 2, 6, and 7). Electrical discontinuity shall not exceed 1 μ s. There shall be no visible leaching of the interfacial seal detrimental to connector performance.

3.33.1 High Temperature Exposure

When tested as specified in 4.6.28.1 for 1000 hour, connectors shall be without defects detrimental to the mechanical and electrical performance and shall pass succeeding tests in the qualification test sequence.

3.34 Electrolytic Erosion

When tested as specified in 4.6.29, pin contacts shall show no exposure of base metal due to electrolytic erosion. Corrosion products shall not be considered as defects.

3.35 Ice Resistance

When tested as specified in 4.6.30, connectors shall pass succeeding tests in the qualification table. Uncoupling and recoupling torque shall not exceed the values of Table 3 by more than 25 percent.

3.36 Dust (Fine Sand)

When tested as specified in 4.6.31, connectors shall pass succeeding tests in the qualification table. Uncoupling and recoupling torque shall not exceed the values listed in Table 3 by more than 25 percent.

3.37 Plating Adhesion

3.37.1 Plating Adhesion (Solder Pull)

The connectors shall be subjected to a solder pull test to determine the adhesion of the plating to the composite substrate. When tested as specified in 4.6.32.1, the plating shall adhere to the substrate with a shear strength greater than 750 psi.

3.37.2 Plating Adhesion (Thermal Shock)

The connector shells shall be subjected to a thermal shock test to determine the adhesion of the plating to the composite substrate. When tested as specified in 4.6.32.2, there shall be no blistering, peeling or other separation of plating.

3.38 Impact

When connectors are tested as specified in 4.6.33, there shall be no breaking or cracking of inserts or shells. Also, there shall be no bending of contacts nor any damage which would prevent the connectors from mating or unmating.

3.39 Accessory Thread Strength

When tested as specified in 4.6.35, mated connectors shall have an accessory thread strength of 50 in-lb minimum for shell sizes 8, 9, 10, 11, 13, 14, 15, 16, 17, 18 and 19, and 100 in-lb minimum for shell sizes 20, 21, 22, 23, 24 and 25. There shall be no detrimental damage to the connectors.

3.40 Thermal Vacuum Outgassing (Class G Only)

When tested as specified in 4.6.38, the total mass loss (TML) shall not be greater than 1.0 percent and collected volatile condensable materials (CVCM) shall not be greater than 0.10 percent.

3.41 Marking

Connectors and accessories shall be molded, etched or ink stamped with the manufacturer's name or trademark, date code, assembly plant code, and the following information, as applicable. Stamping shall be in accordance with MIL-STD-1285 where space permits. Suppliers' symbols or trademarks shall be listed in AIR1351. The following example is illustrative:

Identification

M29600/20	R	J	18	P	1
Specification sheet no.	Class (see 1.3.1)	Shell size (see Table 7)	Insert arrangement (see 3.4.1.2)	Contact style (see 1.3.2)	Polarization (a number is required for all positions) (see 3.4.5.3 and Figures 3 and 8)

Table 7 - Shell size code for part numbering

Shell Size	Code Letter
8	A
9	B
10	C
11	D
13	F
14	G
15	H
16	J
17	K
18	M
19	N
20	P
21	R
22	S
23	T
24	U
25	W

3.41.1 Contact Location Identification

Contact locations shall be identified as indicated on the applicable military standard. All positions shall be identified on the front and rear faces of the insert except where space limitations make this impracticable. Location of contact identifying characters shall be in close proximity to the holes but need not be placed exactly where indicated on the standard. Contact identifying characters shall be permanent and shall not be molded, raised characters on the connector interface.

3.42 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 marking parts, finish, molding and bonding. The connector shall be free from crazing, cracks, voids, pimples, chips, blisters, pinholes, sharp cutting edges, burrs and other defects that will adversely affect life, serviceability or appearance.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract or purchase order, the manufacturer is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the manufacturer may use his own or any other facilities for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements. Qualification by similarity may be granted. The acceptance and extent of qualification by similarity shall be determined by the Qualifying Activity. Similarity is established through a rationale that certain designs, materials, and/or processes are identical to those already approved through qualification of the components. Verification testing for the new product is not required for designs, materials, and/or processes already approved. When a Qualified Products List is being established the qualification by similarity rationale shall be approved by the qualifying activity prior to initiation of the remaining portions of the qualification inspection process.

4.1.1 Test Equipment and Inspection Facilities

Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the manufacturer. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with ANSI-Z540.1.

4.1.1.1 Assembly Plants

Assembly plants must be listed on or approved for listing on the applicable qualified products list. The qualified connector manufacturer shall certify that the assembly plant is approved for the distribution of the manufacturer's parts. The assembly plant shall use only piece parts supplied by the qualified connector manufacturer. No testing other than visual examination is required of certified piece parts obtained from the qualified connector manufacturer, except when there is a cause for rejection. Assemblies produced at the assembly plant shall be subjected to inspection to assure that the assembly process conforms with that established at the qualified manufacturing plant. Quality control requirements, including Government inspection surveillance, shall be the same as required for the qualified connector manufacturer.

4.1.2 Reliability Assurance Program

The supplier's quality management system program for assembled connector accessories and assembly procedures must be comparable to AS9100 subject to the approval of the qualifying activity. Certification and registration of conformance to the AS9100 standard shall be in accordance with AS9104.

4.1.3 Fungus Resistance Certification

All connectors shall be made of fungus-resistance material as listed in Table 5. Certification is required.

Table 5 – Fungus inert materials

Acrylics	Polycarbonate
Acrylonitrile-styrene	Polyester-glass fiber laminates
Acrylonitrile-vinyl-chloride copolymer	Polyethylene, high density (above 0.940)
Asbestos	Polyethylene terephthalate
Ceramics	Polyimide
Chlorinated polyester	Polymonochlorotrifluoroethylene
Fluorinated ethylenepropylene copolymer (FEP)	Polypropylene
Glass	Polystyrene
Metals	Polysulfone
Mica	Polytetrafluoroethylene
Plastic laminates: Silicone-glass fiber Phenolic-nylon fiber	Polyvinylidene chloride
Diallyl phthalate	Silicone resin
Polyacrylonitrile	Siloxane-polyolefin polymer
Polyamide <u>1</u> /	Siloxane polystyrene

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 the test conditions specified in the "GENERAL REQUIREMENTS" of EIA364. Performance of the inspection shall be the responsibility of the qualification applicant under authorization of the qualifying activity (NAVAIR). The qualifying activity shall authorize the applicant to begin qualification testing by written notice that describes the requirements of submission in accordance with this specification. The qualification applicant shall furnish test results, certifications, and tested product to the qualifying activity. Certifications shall be provided on government form DD Form 1718, "Certification of Qualified Products" or equivalent. The samples shall be taken from the same lot as tested by the supplier and plainly identified by attached durable tags marked with the information listed below. The tags must be stamped by the supplier and qualifying activities designated quality Assurance Representative (QAR) inspector as representative samples of the manufacturer's normal production capability. Samples submitted without the stamp will not be accepted.

4.4 Qualification Inspection

Initial qualification inspection shall be performed by the Qualifying Activity test laboratory (see 6.4) and the supplier in accordance with Table 8.

4.4.1 Initial Qualification

Test sample units shall be produced with equipment and procedures normally used in production. Inspection shall be performed on each connector type the supplier seeks to qualify, unless qualification by similarity is approved. The Qualifying Activity will perform test group 3 and the supplier is responsible for performing all other test groups in the applicable test tables.

4.4.1.1 Samples shall be subjected to qualification and Group C periodic tests in the sequence specified in Table 8.

- a. Connectors supplied for testing to Table 8, Group 1 shall consist of two small (sizes 8 through 13), two medium (sizes 14 through 19), and two large (sizes 20 through 25), shell sizes in the most dense contact arrangements. One small, one medium, and one large shell size connector shall be exposed to all of the Table 8, Group 1 tests except for plating adhesion (thermal shock). The other small, medium, and large size connectors shall be exposed to all Table 8, Group 1 tests except for plating adhesion (solder pull).
- b. Sample Group 2 in Table 8 shall consist of nine mated pairs of connectors, representative of each contact size and small, medium and large shell sizes. The samples shall be divided equally for testing to the three vibration levels.
- c. Sample Groups 3 through 7 in Table 8 shall consist of a small, a medium, and a large shell size in the most dense contact arrangements. Note: Group 5 samples may be provided less inserts.
- d. Connectors supplied for testing to Table 8, Group 8, shall consist of a sufficient quantity to subject 5 contact cavities of each size to the specified tests. Elastomeric O-rings may be supplied separate from the connectors.
- e. Connectors supplied for the tests of Table 8, Group 9, shall consist of twelve mating pairs, straight plugs, and wall mounting receptacles, of a medium shell size, in any representative insert and shell size arrangement. In addition, 12 elastomeric O-rings, separate from the connectors, shall be tested. One O-ring per test fluid.
- f. Connectors supplied for the tests of Table 8, Group 10, shall consist of a sufficient quantity to subject 20 contact cavities of each size to each immersion fluid specified.
- g. Unplated connectors supplied for the tests of Table 8, Group 11, shall consist of one small, one medium, and one large mated pair. No insert is required.

Table 8 - Qualification and Group C periodic tests

Inspection	Requirement Paragraph	Test Paragraph
Group 1		
Examination of product	3.1 thru 3.5, 3.41 and 3.42	4.6.1
Maintenance aging	3.6	4.6.2
Electrical engagement	3.16	4.6.11
Temperature cycling	3.8	4.6.3
Dielectric withstanding voltage (unmated at sea level)	3.13	4.6.8.1
Altitude immersion	3.11	4.6.6
Insulation resistance (ambient temperature)	3.12.1	4.6.7.1
Salt spray	3.15	4.6.10
Shell-to-shell conductivity	3.24.1	4.6.19.1
Coupling torque	3.9	4.6.4
Accessory thread strength	3.39	4.6.35
Insert retention	3.14	4.6.9
Dielectric withstanding voltage (unmated at sea level)	3.13	4.6.8.1
*Dielectric withstanding voltage (unmated at altitude)	3.13	4.6.8.2
Plating adhesion	3.37	4.6.32
Examination of product	3.1 thru 3.5, 3.41 and 3.42	4.6.1