

INCH-POUND

MIL-DTL-32139

16 December 2003

## DETAIL SPECIFICATION

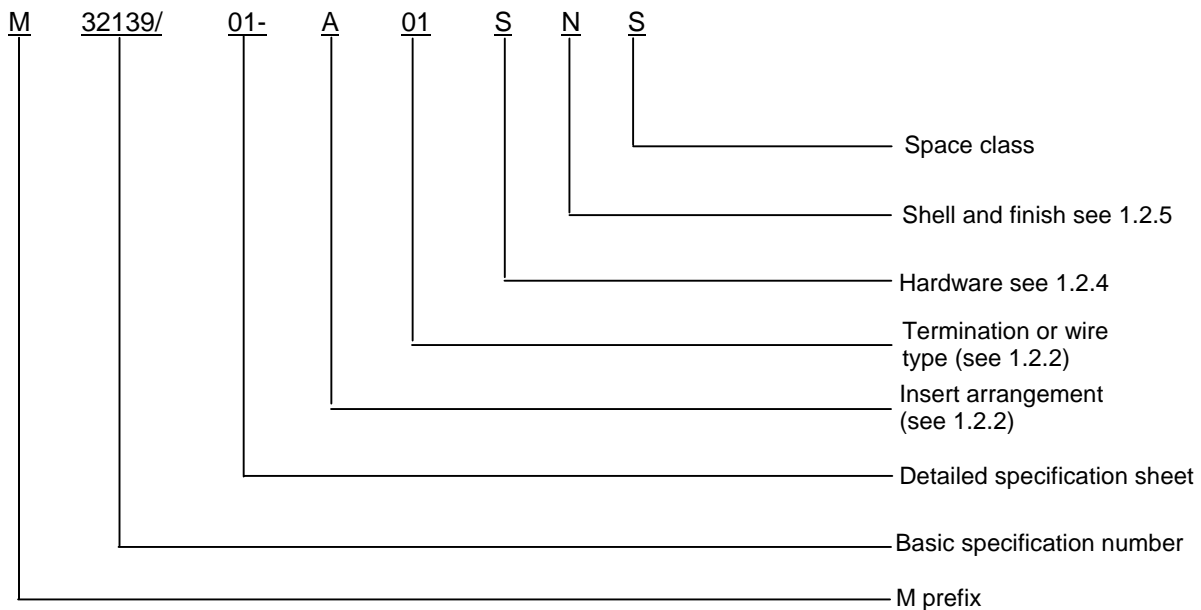
CONNECTORS, ELECTRICAL, RECTANGULAR,  
NANOMINIATURE, POLARIZED SHELL,  
GENERAL SPECIFICATION FOR

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

## 1. SCOPE

1.1 Scope. This specification covers the detail requirements for nanominiature connectors terminated on printed circuit boards or attached to cable assemblies. The connector contacts are densely packed with .025 (.064 mm) inch spacing between contact centers in the same row. These connectors are intended for use in assemblies requiring very densely packaged electronic components, and are commonly used in digital applications.

1.2.1 Part or Identifying Number (PIN). The PIN consists of the letter M (see 3.8), the basic specification number, a forward slash, a detail specification number, a dash, a letter for the insert arrangement, a number for the termination type, a letter for the hardware designator, a letter for the shell finish, and a letter for space class when applicable (see 3.1) shown in the following example:



Comments, suggestions, or questions on this document should be addressed to: Commander, Defense Supply Center Columbus, Attn: VAI, 3990 East Broad Street, Columbus, Ohio, 43216-5000 or emailed to [RectangularConnector@dsccl.dla.mil](mailto:RectangularConnector@dsccl.dla.mil). Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at [www.dodssp.daps.mil](http://www.dodssp.daps.mil).

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### 1.2.2 Insert arrangement.

A letter assigned in a specific specification sheet.

### 1.2.3 Termination or wire type.

A number assigned in a specific specification sheet.

### 1.2.4 Hardware.

A letter assigned in a specific specification sheet.

### 1.2.5 Shell and finish.

A letter assigned in a specific specification sheet.

### 1.2.6 Space class.

S for space class and a blank for non-space applications.

1.3 Classification. For the purpose of clarification in this document and the references cited herein the connector's class and mounting types are defined as follows.

#### 1.3.1 Class.

M - Metal shell.

#### 1.3.2 Mounting type.

- I - Printed wiring board mounting
- II - Surface mount solder contacts
- III - Pigtail wiring

## 2. APPLICABLE DOCUMENTS

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

### 2.2 Government documents.

2.2.1 Specifications standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

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FEDERAL STANDARDS

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

COMMERCIAL ITEM DESCRIPTIONS

- A-A-59551 - Wire, Electrical, Copper (Uninsulated)

DEPARTMENT OF DEFENSE SPECIFICATIONS

- MIL-C-81021 - Copper-Beryllium Alloy (Copper Alloy Numbers C17500 and C17510), Strip.
- MIL-PRF-7808 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
- MIL-PRF-87252 - Coolant Fluid, Hydrolytically Stable, Dielectric
- MIL-T-81556 - Titanium and Titanium Alloys, Extruded Bars and Shapes Aircraft Quality
- MIL-M-24519 - Molding Plastics, Electrical, Thermoplastic
- MIL-W-22759 - Wire, Electrical, Fluoropolymer-Insulated Copper or Copper Alloy
- MIL-W-22759/33 - Wire, Electrical, Fluoropolymer-Insulated, Crosslinked Modified ETFE, Lightweight, Silver-Coated, High-Strength Copper Alloy, 200 Deg. C, 600-Volt

(See supplement 1 for list of specification sheets)

DEPARTMENT OF DEFENSE STANDARDS

- MIL-STD-202 - Electronic and Electrical Component Parts
- MIL-STD-681 - Identification Coding and Application of Hookup and Lead Wire
- MIL-STD-790 - Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specifications
- MIL-STD-889 - Dissimilar Metals
- MIL-STD-1285 - Marking of Electrical and Electronic Parts

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

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (AMSE)

- ASME-Y-14.5M - Dimensioning and Tolerancing

(Copies of these documents are available from [www.asme.org](http://www.asme.org) or American Society of Mechanical Engineers Three Park Avenue, New York, NY 10016-5990).

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## ASTM INTERNATIONAL

ASTM A342	-	Materials, Feebly Magnetic, Permeability of
ASTM A693	-	Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A582	-	Free Machining Stainless and Heat Resisting Steel Bars
ASTM B3	-	Copper Wire, Soft or Annealed
ASTM B16	-	Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
ASTM B85	-	Aluminum-Alloy Die Castings
ASTM B122	-	Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B135	-	Tube, Seamless Brass
ASTM B194	-	Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar
ASTM B196	-	Rod and Bar, Copper-Beryllium Alloy
ASTM B197	-	Wire, Alloy, Copper-Beryllium
ASTM B209	-	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	-	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B453	-	Copper Zinc Lead Alloy (Leaded Brass) Rod, Bar and Shapes
ASTM B477	-	Alloy, Electrical Contact, Gold-Silver-Nickel
ASTM B488	-	Gold for Engineering Uses, Electrodeposited Coatings of
ASTM B541	-	Alloy, Electrical Contact, Gold
ASTM B562	-	Refined Gold
ASTM B733	-	Metal Autocatalytic Electroless Nickel-Phosphorus Coatings on
ASTM B768	-	Copper-Cobalt-Beryllium Alloy and Copper-Nickel-Beryllium Alloy Strip and Sheet
ASTM D570	-	Water Absorption of Plastics
ASTM D4376	-	Vapor-Degreasing Grade Perchloroethylene
ASTM D5138	-	Liquid Crystal Polymers.
ASTM D5948	-	Compounds, Molding, Thermosetting.
ASTM E595	-	Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment
ASTM F29	-	Dumet Wire for Glass-to Metal Seal Applications
ASTM G21	-	Materials to Fungi, Synthetic Polymeric, Determining Resistance of

(Copies of these documents are available from [www.astm.org](http://www.astm.org) or ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania, USA 19428-2959.)

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA-364	-	Electrical Connector/Socket Test Procedures Including Environmental Classifications
EIA-557	-	Statistical Process Control Systems

(Copies of these documents are available from <http://global.ihs.com> or Global Engineering Documents, 15 Inverness Way East, Englewood, CO 80112).

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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

- ISO-10012-1 - Equipment, Quality Assurance Requirements for Measuring - Part 1: Metrological Confirmation System for Measuring Equipment

(Copies of these documents are available from [www.iso.ch](http://www.iso.ch) or International Organization for Standardization American National Standards Institute 11 West 42<sup>nd</sup> Street, 13<sup>th</sup> Floor New York, NY 10036.)

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES

- J-STD-004 - Solder Fluxes Requirements for
- J-STD-005 - Solder Paste Requirements for
- J-STD-006 - Electronic Grade Solder Alloys and Fluxed and Non-Fluxed Solid Solders for Electronic Soldering Applications Requirements for

(Copies of these documents are available from [www.ipc.org](http://www.ipc.org) or IPC - Association Connecting Electronics Industries 2215 Sanders Road Northbrook, IL 60062-6135).

NATIONAL CONFERENCE OF STANDARDS LABORATORIES (NCSL)

- NCSL Z540.1 - Laboratories Calibration and Measuring and Test Equipment

(Copies of these documents are available from National Conference of Standards Laboratories (NCSL), 2995 Wilderness Place Suite 107, Boulder, CO 80301-5404).

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA HP3 - Electrical and Electronic PTFE (Polytetrafluoroethylene) Insulated High Temperature Hook-Up Wire; Types ET (250 Volts), E (600 Volts) and EE (100 Volts)

(Copies of these documents are available from [www.nema.org](http://www.nema.org) or National Electrical Manufacturers Association, 1300 North 17<sup>th</sup> Street, Suite 1847, Rosslyn, VA 22209).

SAE INTERNATIONAL

- SAE-AMS-QQ-A-200/8 - Aluminum Alloy 6061, Bar, Rod, Shapes, Tube, and Wire, Extruded.
- SAE-AMS-QQ-A-250/11 - Aluminum Alloy 6061, Plate and Sheet
- SAE-AMS-C-26074 - Coatings, Electroless Nickel Requirements for
- SAE-AMS-QQ-P-35 - Passivation Treatments for Corrosion-Resistant Steel
- SAE-AMS-QQ-P-416 - Plating, Cadmium (Electrodeposited)
- SAE-AMS 2404 - Nickel, Electroless, Plating,

(Copies of these documents are available from [www.sae.org](http://www.sae.org) or SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001).

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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## 3. REQUIREMENTS

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

3.2 Qualification. Connector assemblies furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable Qualified Products List (QPL) before contract award (see 4.3 and 6.3).

3.2.1 Quality.

3.2.1.1 Statistical process control (SPC). The contractor shall implement and use statistical process control (SPC) techniques, when possible, in the manufacturing of parts covered by this specification. The SPC program shall be developed and maintained in accordance with EIA-557 or MIL-STD-790. Where SPC cannot be utilized because of non-continuous production, a lot sampling plan for inspection with  $C = 0$  (accept on zero defects) may be utilized. The SPC and  $C = 0$  programs shall be documented and maintained as part of the overall reliability assurance program, as specified in EIA-557, MIL-STD-790, or equivalent. Evidence of such compliance shall be verified by the qualifying activity as a prerequisite for qualification, effective 24 months after the date of this document. Dimensioning and tolerancing shall be in accordance with ASME Y-14.5M.

3.3 Materials. Materials shall be as identified herein or as approved by the qualifying activity. However, when a definite material is not specified, a material shall be used which will enable the connectors to meet the requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of acceptance of the finished product.

3.3.1 Reference critical interface, materials, platings and processes. The interface, materials, platings, and processes identified in this specification are intended to assure electrical and mechanical compatibility, eliminate problems of electrochemical contamination of critical electrical and mechanical interfaces, and minimize interface surface wear. Manufacturers of connectors supplied to this specification may use alternate industry recognized standards for materials, platings, and processes, provided prior approval is granted by the qualifying activity. The use of such alternatives shall not result in connectors with inferior short or long-term performance or reliability.

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

3.3.3 Dissimilar metals. When dissimilar metals are used in intimate contact with each other, protection against electrolysis and corrosion shall be provided. Dissimilar metals such as brass, copper or steel (except corrosion-resisting steel passivated in accordance with SAE-AMS-QQ-P-35) (see 3.3.1) shall not be used in intimate contact with aluminum or aluminum alloy. Protective measures for dissimilar metals shall be in accordance with MIL-STD-889.

3.3.4 Materials permeability. When tested as specified in 4.7.3, all materials used in the construction of connectors and associated hardware shall be of low magnetic permeability, enabling connector pairs to meet the permeability requirement of less than  $2\mu$  in accordance with ASTM A342.

3.3.5 Pure tin. The use of pure tin is prohibited. Tin content used in connector materials shall not exceed 97 percent, and an alloy material shall be chosen to inhibit the growth of tin whiskers (see 6.4).

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### 3.3.6 Contact material.

3.3.6.1 Pin contact material. Pin contacts shall be copper in accordance with A-A-59551 or ASTM B3; beryllium copper in accordance with ASTM B197; or beryllium copper strip in accordance with ASTM B194. Pin contact wire bundle strands consisting of precious metal alloy shall be in accordance with ASTM B477, ASTM B541, or ASTM B562.

3.3.6.2 Socket contact material. Socket contacts or contact sleeves shall be beryllium copper as specified in ASTM B194, ASTM B196, MIL-C-81021 (UNS No. C17500) or ASTM B768 (UNS No. C17410) mill hardened to TH02; brass in accordance with ASTM B453 or ASTM B16; nickel-silver shall be in accordance with ASTM B122; or precious metal alloy shall be in accordance with ASTM B477, ASTM B541, or ASTM B562.

### 3.3.6.3 Contact finish.

3.3.6.3.1 Pin contact finish. Contacts shall be gold plated in accordance with ASTM B488, type II, code C, class 1.27, 50 microinches minimum thickness, over a suitable underplate. Silver underplating shall not be used. Pin contact wire bundle strands consisting of precious metal alloy contact pins do not require additional plating.

3.3.6.3.2 Socket contact finish. Socket contacts or contact sleeves shall be gold plated in accordance with ASTM B488, type II, code C, class 1.27, 50 microinches minimum thickness, over a suitable underplate. Silver underplating shall not be used. Precious metal alloy sockets do not require additional plating.

### 3.3.7 Dielectric materials.

3.3.7.1 Insert material. Insert material for connectors shall be in accordance with MIL-M-24519, type GST-40F or GLCP-30F, or GDI-30F in accordance with ASTM D5948 (color optional) or ASTM D5138.

3.3.8 Material fungus resistance. Materials used in the construction of these connectors shall be fungus inert in accordance with ASTM G21.

3.3.9 Flux. When flux is used, it shall be rosin mildly activated (RMA), paste or liquid, in accordance with J-STD-004, J-STD-005, or J-STD-006.

### 3.3.10 Shells. Shells shall be:

- a. Aluminum:
  - (1) Die cast or extruded aluminum A380 in accordance with ASTM B85 or SAE-AMS-QQ-A-200/8.
  - (2) Bar stock aluminum in accordance with ASTM B221 or aluminum alloy 6061 in accordance with SAE-AMS-QQ-A-250/8.
  - (3) Plate and sheet aluminum alloy 6061 in accordance with SAE-AMS-QQ-A-250/11 or aluminum alloy 6061, 2024, or 7075 in accordance with ASTM B209.
- b. Stainless steel (300 series) in accordance with ASTM A693.
- c. Titanium in accordance with MIL-T-81556.

3.3.10.1 Shell finish (aluminum). Aluminum shells shall be cadmium plated in accordance with SAE-AMS-QQ-P-416, type II, class 1. A suitable underplate is permissible for shells when cadmium plating is used.

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3.3.10.2 Shell finish (aluminum) (space applications only). For space applications utilizing aluminum shells, the shell finish shall be electroless nickel plated in accordance with SAE-AMS-C-26074, class 3 or 4, grade B (see 6.1.2).

3.3.10.3 Shell finish (stainless steel). Passivated in accordance with SAE-AMS-QQ-P-35.

3.4 Design, construction, and physical dimensions. Connectors shall be of the design, construction and physical dimensions specified (see 3.1). Connectors shall be designed so pins and sockets will not be damaged during normal mating. Contacts shall be reverse gender type. The live pin shall be installed in a protective insulator with the static socket protruding from a suitably shrouded insulator.

3.4.1 Contact termination design. For contact termination see applicable specification sheet.

3.4.1.1 Contact termination for surface mounting. Contacts intended for surface mounting shall be profiled with the mounting pad geometry specified in the applicable specification sheets.

3.4.2 Crimp contacts. Crimp contacts shall not be removable from the insert.

3.4.3 Contact interface schemes. Contacts shall be designed to provide multiple contact points (2 or more) at all possible interconnect positions of the connector halves (within limits of engagement design parameters), or hertzian (see 6.5) type single point contacts rated at 100,000 psi (690 MPa) or greater. Hertzian stress requirement is a design goal and should be used for reference only.

3.4.3.1 Contact wipe. All contacts shall have a contact wipe of .015 inch (0.38 mm) minimum prior to the connector halves arriving at their fully mated position. The requirements of contact wipe may be satisfied by tolerance analysis only and with no need for direct measurement.

3.4.4. Contact current capability. Contacts shall be capable of carrying 1.0 ampere in continuous duty operation. See EIA 364 test procedure 70 for guidance.

3.4.5 Encapsulate potting material. When specified in an individual specification sheet, encapsulate potting material shall be used which will enable the connector to pass the required environmental testing.

3.4.6 Insert design and construction. Inserts shall be designed with suitable sections and radii such that they will not readily chip, crack, or break in assembly or in normal service. Connectors shall be designed so neither the pins nor the sockets will be damaged during normal mating of connectors. Pin inserts shall provide adequate protection against a socket contacting a pin before the mating connector pair has been polarized. The contact retention system shall provide positive retention.

3.4.6.1 Insert heat deflection. Insert materials shall be molded or machined from high strength, high heat deflection materials capable of withstanding high temperature soldering techniques such as vapor phase or infrared (see 3.3.1).

3.4.6.2 Insulator durability. The connector insulator shall be molded or machined from a highly durable insulator material capable of withstanding vibration and shock as specified in 3.7.7 and 3.7.8 without evidence of deterioration such as chipping, cracking, or warping.

3.4.7 Insert arrangement. The contact arrangement shall be as specified by the connector PIN (see 3.1).

3.4.8 Hydrolytic stability. All nonmetallic material shall be selected to meet the hydrolytic immersion requirements in accordance with ASTM D570.

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3.4.9 Contact identification. Do to the size and space constraints marking is not required to identify contact positions.

3.4.10 Contact alignment and stability. With all contacts in place, the alignment of pin and socket contacts shall permit engagement irrespective of buildup of allowable tolerances on hole locations, distortion of contacts due to crimping, and insulator location in the shell.

3.5. Alignment feature.

3.5.1 Ancillary hardware material. Mating hardware shall be fabricated from corrosion resistant steel in accordance with ASTM A582, type 303. Threads shall be accordance with FED-STD-H28, and surface treatment in accordance with SAE-AMS-QQ-P-35. Mating hardware, when supplied, shall be captive. Cadmium plating shall not be used.

3.5.2 Interchangeability and intermateability.

3.5.2.1 Intermateability. Plugs and receptacles having the same shell size, keying and contact arrangement shall be intermateable.

3.5.2.2 Interchangeability. All connectors and accessories having the same PIN shall be completely interchangeable electrically and physically (see 3.1).

3.6 Wire types.

3.6.1 Pigtail wire. Insulated wire shall be in accordance with either MIL-W-22759/33 for American Wire Gauge (AWG) size 30 stranded or NEMA HP3 for size 30 AWG stranded, and 30 AWG solid. (Note: Corrosion of connectors, which are prewired with MIL-W-22759/33 and stored in a sealed environment, could be experienced. This should be considered when using, packaging and storing connectors using this wire.)

3.6.2 Bare solid wire. Bare solid wire shall be in accordance with ASTM B194, ASTM F29, or A-A-59551-H30S2S or A-A-59551-H30S1B tin-plated alloy as specified in 3.3.5.

3.6.3 Integral tail. Integral tail shall be beryllium copper strip in accordance with ASTM B194, ASTM F29, A-A-59551-H30S2S, brass in accordance with ASTM B16 or nickel silver in accordance with ASTM B122.

3.7 Performance. Connectors shall be designed to meet the requirements specified herein.

3.7.1 Porosity (nitric acid vapor). When tested as specified in 4.7.4, plated pin and socket contacts shall meet the acceptance criteria in accordance with EIA-364 test procedure 53.

3.7.2 Contact engagement and separation forces. Pin contacts shall meet the engagement and separation forces specified in table I when tested in accordance with 4.7.5.

TABLE I. Contact engagement and separation forces.

Contact size 30		
Maximum individual engagement force	5.0 oz (1.39 Newtons)	Use minimum diameter test sleeve
Minimum individual separation force	0.4 oz (0.11 Newtons)	Use maximum diameter test sleeve

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3.7.3 Connector mating and unmating forces. Connector mating and unmating forces, when tested as specified in 4.7.6, shall not exceed 7 ounces (1.95 Newtons) per contact (maximum average installed).

3.7.4 Insulation resistance. The insulation resistance of mated connectors shall meet the requirements in table II when tested in accordance with 4.7.7.

TABLE II. Insulation resistance.

Humidity conditioned in accordance with EIA-364 test procedure 31 (see 4.7.14)	Minimum insulation resistance (Megohms)
After step 6	1
After 24 hours of conditioning	1,000
All other conditions	5,000

3.7.5 Withstanding voltage. Mated or unmated connectors, when tested in accordance with 4.7.8.1 and 4.7.8.2, shall show no evidence of breakdown or flashover when subjected to the voltages and altitudes shown in table III.

TABLE III. Test voltage (60 Hz). 1/

Altitude	Test voltage before humidity testing	Test voltage after humidity testing (see 3.7.11) (Class M, type I and II connectors)
Sea level	250 V	100 V
70,000 feet	100 V	---

1/ These are not working voltages.

3.7.6 Contact resistance. Contact resistance for mated pin and socket contact pairs, with wires attached, shall meet the requirements in table IV when tested in accordance with 4.7.9. A test current of less than 1 ampere is permitted for group B testing only, with corresponding corrections for voltage drop.

TABLE IV. Contact resistance.

Contact size AWG	Wire size AWG	Test current (amperes)	Maximum voltage drop (millivolts)		Wire type
			Initial	After salt spray	
30	30	1	71	75	NEMA HP3-ETXBBG* (stranded) <u>1/</u> M22759/33-30-* (stranded) <u>1/</u>
30	30	1	76	80	A-A-59551-H30S2S (solid) <u>2/</u>
30	30	1	TBD	TBD	Flat wire lead (ASTM B194)

1/ Asterisks refer to color designators 0 through 9. Color-coding shall be in accordance with MIL-STD-681, system 1, except using ten solid colors only, repeating in sequence. For connectors with more than 10 contacts the wire color shall repeat every 10 wires.

2/ Sleeving is permitted for testing purposes only.

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3.7.7 Vibration. Mated connectors when tested as specified in 4.7.10 shall not be damaged and there shall be no loosening of parts due to vibration. There shall be no change of resistance greater than 10 ohms, which lasts longer than 10 nanoseconds.

3.7.8 Shock. When tested for mechanical shock as specified in 4.7.11, mated connectors shall not be damaged, and there shall be no loosening of parts. There shall be no change of resistance greater than 10 ohms, which lasts longer than 10 nanoseconds.

3.7.9 Durability. When tested as specified in 4.7.12, connectors shall show no mechanical or electrical defects detrimental to the operation of the connector, and shall subsequently pass all tests shown in table VIII, subgroup I, in sequence.

3.7.10 Temperature cycling. When tested as specified in 4.7.13, there shall be no damage detrimental to the operation of the connector after being subjected to the operating temperatures in table V.

TABLE V. Operating temperatures.

Class	Extremes	°C
M	Low High	-55°, +0°, -3° +125°, -0°, +3°

3.7.11 Humidity. When tested as specified in 4.7.14, connectors shall meet the applicable withstanding voltage (see 3.7.5) and insulation resistance requirements (see 3.7.4).

3.7.12 Salt spray (corrosion). When tested as specified in 4.7.15, mated connectors shall show no exposure of base metal due to corrosion which will affect performance, and shall meet the specified requirements for low-signal level contact resistance (3.7.13) and connector mating and unmating forces (3.7.3).

3.7.13 Low-signal level contact resistance. When tested as specified 4.7.16, the low-level signal contact resistance of mated contacts shall meet the requirements specified in table VI.

TABLE VI. Allowable low signal contact resistance.

Contact size	Wire type	Wire size	Maximum resistance (milliohms)
30	NEMA HP3-ETXBBG (stranded) MIL-W-22759/33-30 (stranded)	30	71
30	A-A-59551-H30S2S (solid)	30	76
30	Flat wire lead (ASTM B194)	30	TBD

3.7.14 Fluid immersion. When tested as specified in 4.7.17, there shall be no degradation of the plastic, bonding adhesives, or elastomers.

3.7.15 Contact retention. When tested in accordance with 4.7.18, connector contacts shall be retained in their insulators when subjected to a minimum force of 2 pounds (8.89 Newtons).

3.7.16 Solderability. When tested as specified in 4.7.19, the solder termination area on the wire leads or pigtail shall be solderable.

3.7.17 Crimp tensile strength. When tested as specified in 4.7.20, the wire shall not break or pull out of the crimp with an applied force of less than 1.0 pound (0.44 kg) for 30 AWG wire. Wire breakage other than at the crimp shall not constitute failure.

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3.7.18 Thermal vacuum outgassing (space classes only). When tested in accordance with 4.7.21, the connector assembly shall have maximum total mass loss (TML) of 1.0 percent of the original specimen mass, and shall have a maximum volatile condensable material (VCM) content of 0.1 percent of the original specimen mass.

3.7.19 Resistance to solder heat. When tested as specified in 4.7.22, there shall be no degradation of the plastic, bonding adhesives, or sealing elastomers. Connector insulators shall also be capable of withstanding solder heat without evidence of deteriorating, deforming, or change of physical dimensions (see 3.3). The connector shall meet the requirements for mating and unmating forces (3.7.3) and contact retention (see 3.7.15).

3.8 Marking. The PIN shall be marked on the package, or if size permits, on the connector. Marking shall be in accordance with method I of MIL-STD-1285, and shall include the PIN (see 3.1), the manufacturer's name or CAGE code, and date code. Connector marking shall remain permanent and legible when tested in accordance with 4.7.23.

3.8.1 JAN and J marking. The United States Government has adopted and is exercising legitimate control over the certification marks "JAN" and "J", respectively, to indicate that items so marked or identified are manufactured to, and meet all the requirements of specifications. Accordingly, items acquired to, and meeting all of the criteria specified herein and in the applicable specifications shall bear the certification mark "JAN" except that items too small to bear the certification mark "JAN" shall bear the letter "J". The "JAN" or "J" shall be placed immediately before the part number except that if such location would place a hardship on the manufacturer in connection with such marking, the "JAN" or "J" may be located on the first line above or below the part number. Items furnished under contracts or orders which either permit or require deviation from the conditions or requirements specified herein or in the applicable specifications shall not bear "JAN" or "J". In the event an item fails to meet the requirements of this specification and the applicable specification sheets, the manufacturer shall remove completely the military part number and the "JAN" or "J" from the sample tested and also from all items represented by the sample. The "JAN" or "J" certification mark shall not be used on products acquired to contractor drawings or specifications. The United States Government has obtained Certificate of Registration Number 504,860 for the certification mark "JAN" and Registration Number 1,586,261 for the certification mark "J".

3.9 Workmanship. Connectors and accessories shall be processed in such a manner as to be uniform in quality and shall be free from burrs, crazing, cracks, voids, pimples, chips, blisters, pinholes, sharp cutting edges, and other defects that will adversely affect life, serviceability, or appearance (see 4.7.2).

#### 4. VERIFICATION

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

- a. Qualification inspection (see 4.3).
- b. Conformance inspection (see 4.4).
- c. Verification of qualification (see 4.6).

4.2 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in (applicable test method document, or applicable paragraph(s) in the specification).

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4.2.1 Verification testing. The following tests and test methods assure connector integrity within typical operating conditions and applications. Alternate methods are allowed with prior approval by the qualifying activity. The test methods described herein are the preferred methods, and shall take precedence when alternate test methods result in differing or conflicting results.

4.2.2 Test equipment and inspection facilities. Test and measuring equipment and inspection facilities of sufficient accuracy, qualify and quality to permit performance of the required inspection shall be established and maintained by the contractor. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment (i.e. NCSL Z540.1, ISO 10012-1, or equivalent) shall be required.

4.3 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production. Use of alternate materials, plating, and processes shall be identified in the product test documentation (see 3.3.1).

4.3.1 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the "GENERAL REQUIREMENTS" of EIA-364 and MIL-STD-202.

4.3.1.2 Materials inspection. Materials inspection shall consist of verification that the materials shown in table VII are used in fabricating the connectors and accessories described in this specification.

4.3.2 Preparation of samples. Connectors shall be mounted by their normal means. When required, connectors shall be wired with the appropriate wire specified in table VI.

4.3.3 Sample size.

4.3.3.1 Connectors. Samples of the connectors with the largest number of contacts for the class and type for which qualification is desired shall be inspected.

4.3.3.2 Contacts. Individual contacts to be used in the connectors proposed for qualification shall be subject to crimp tensile strength testing as specified in 3.7.17 and shown in table VIII. Contact mating pairs for each wire type shall be tested for qualification purposes, and contact-mating pairs for each design shall be tested for retention of qualification.

4.3.4 Inspection routine. The samples shall be subjected to the inspections specified in table VIII in the order shown.

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TABLE VII. Materials.

Component Material	Requirement paragraph	Applicable specifications <u>1/</u>
Aluminum	3.3.10	ASTM B85 ASTM B209 ASTM B221 SAE-AMS-QQ-A-250/8 SAE-AMS-QQ-A-250/11
Beryllium copper	3.3.6.1 and 3.3.6.2	ASTM B194 ASTM B196 ASTM B197 ASTM B768 MIL-C-81021
Brass	3.3.6.2	ASTM B453
Copper	3.3.6.1	A-A-59551 ASTM B3
Corrosion resistant steel	3.5.1	ASTM B582
Gold (electroplate)	3.3.6.3.1 and 3.3.6.3.2	ASTM B488
Nickel (electroplate)	3.3.10.2	AMS 2404 ASTM B733
Nickel silver	3.3.6.2 and 3.6.3	ASTM B122
Plastic molded material	3.3.7.1	MIL-M-24516 ASTM D5138 ASTM D5948
Precious metal alloy	3.3.6.1 3.3.6.2	ASTM B477 ASTMB541 ASTM B562
Stainless steel	3.3.10	ASTM A693
Titanium	3.3.10	MIL-T-81556

1/ See applicable paragraph for specific material used.

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TABLE VIII. Qualification and verification of qualification inspection.

Inspection	Requirement paragraph	Test method paragraph
<u>Major group (all sample units)</u>		
Visual and mechanical inspection <u>1/</u>	3.1, 3.3, 3.4, 3.8, and 3.9	4.7.2
Magnetic permeability <u>2/</u>	3.3.4	4.7.3
Withstanding voltage <u>2/</u>		
At sea level <u>2/</u>	3.7.5	4.7.8.1
At altitude <u>2/</u>	3.7.5	4.7.8.2
Insulation resistance	3.7.4	4.7.7
Mateability <u>3/</u>	3.5.2.1	---
Low signal level contact resistance	3.7.13	4.7.16
Contact resistance	3.7.6	4.7.9
Contact engagement and separation forces	3.7.2	4.7.5
Crimp tensile strength <u>4/</u>	3.7.17	4.7.20
Porosity (5 samples each pin and socket contacts) <u>4/</u>	3.7.1	4.7.4
<u>Subgroup I (4 pair)</u>		
Durability	3.7.9	4.7.12
Low signal level contact resistance	3.7.13	4.7.16
Shock (specified pulse)	3.7.8	4.7.11
Vibration	3.7.7	4.7.10
Low signal level contact resistance	3.7.13	4.7.16
Withstanding voltage (sea level)	3.7.5	4.7.8.1
<u>Subgroup IIa (2 pair mated)</u>		
Temperature cycle	3.7.10	4.7.13
Low signal level contact resistance	3.7.13	4.7.16
Humidity	3.7.11	4.7.14
Low signal level contact resistance	3.7.13	4.7.16
Withstanding voltage (sea level)	3.7.5	4.7.8.1
Insulation resistance	3.7.4	4.7.7
<u>Subgroup IIb (3 pair of connectors unmated)</u>		
Connector mating and unmating forces	3.7.3	4.7.6
Fluid immersion	3.7.14	4.7.17
Connector mating and unmating forces	3.7.3	4.7.6
<u>Subgroup III (2 pairs) <u>2/</u></u>		
Contact retention <u>5/</u>	3.7.15	4.7.18
Durability	3.7.9	4.7.12
Contact engagement and separation forces	3.7.2	4.7.5
Low signal level contact resistance	3.7.13	4.7.16
Salt spray (corrosion)	3.7.12	4.7.15
Low signal level contact resistance	3.7.13	4.7.16

See footnotes at end of table.

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TABLE VIII. Qualification and verification of qualification inspection. - Continued.

Inspection	Requirement paragraph	Test method paragraph
<u>Group IVa (4 sample units of type III connectors only)</u>	3.7.16	4.7.19
Solderability	3.8	4.7.23
Marking performance (3 connectors) <u>6/</u>		
<u>Group IVb (4 sample units of each, type I and type II connectors only)</u>	3.7.16	4.7.19
Solderability	3.7.19	4.7.22
Resistance to soldering heat	3.7.3	4.7.6
Connector mating and unmating forces	3.7.15	4.7.18
Contact retention	3.8	4.7.23
Marking performance (3 connectors) <u>6/</u>		
<u>Subgroup V (3 samples minimum)</u>		
Thermal vacuum outgassing (space applications only) <u>7/</u>	3.7.18	4.7.21

1/ All sample units, except groups IV and V.

2/ For connectors with metal shells. Not required for retention of qualification.

3/ Connectors shall be mated to verify intermateability with appropriate mating connector and hardware.

4/ Loose contacts only (see 4.3.3.2).

5/ Preconditioning is not required.

6/ If applicable (see 3.8) samples may be taken from virgin samples or from other subgroups (manufacturers discretion).

7/ Space class connectors only.

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

4.4 Conformance inspection. Conformance inspection shall consist of group A inspections.

4.4.1 Inspection lot. An inspection lot shall consist of all connectors produced under essentially the same conditions, and offered for inspection at one time.

4.4.2 Group A inspection. Group A inspection shall consist of the inspections specified in table IX, in the order shown. 100 percent of completed connector assemblies (leads attached and contacts installed) shall be tested for insulation resistance (3.7.4) and withstanding voltage (3.7.5).

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TABLE IX. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.8, and 3.9	4.7.2
Mateability <sup>1/</sup>	3.5.2.1	---
Contact resistance	3.7.6	4.7.9
Insulation resistance	3.7.4	4.7.7
Withstanding voltage (at sea level)	3.7.5	4.7.8.1

<sup>1/</sup> Connectors shall be mated prior to contact resistance test to verify intermateability with appropriate mating connector and hardware.

4.4.2.1 Sampling plan (group A). Table IX tests shall be performed on a production lot basis. Samples shall be selected in accordance with table X. If one or more defects are found, the lot shall be screened for that particular defect and defective parts removed. A new sample of parts shall be selected in accordance with table X and all Group A tests again performed. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE X. Lot and sample size.

Lot size	Sample size
2 to 5	100 percent
6 to 150	5
151 to 1,200	20
1,201 to 10,000	32
10,001 to 35,000	50
35,001 to 500,000	80
500,001 and over	125

4.5 Periodic inspection. Periodic inspection shall consist of group B inspection. Except where the results of these inspections show noncompliance with the applicable requirements (see 4.5.4), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of these inspections.

4.5.1 Group B inspection. Group B inspection shall consist of the inspections specified in table XI in the order shown. Group B inspection shall be made on sample units selected from inspection lots that have passed group A inspections.

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TABLE XI. Group B inspection.

Inspections	Requirement paragraph	Test method paragraph
<u>Group I (2 sample units each type) 1/</u>		
Salt spray (corrosion)	3.7.12	4.7.15
Connector mating and unmating forces	3.7.3	4.7.6
Contact resistance	3.7.6	4.7.9
<u>Group II (2 sample units each type)</u>		
Solderability	3.7.16	4.7.19
Crimp tensile strength (contact lead assembly) 2/	3.7.17	4.7.20
<u>Group III (2 sample units each type)</u>		
Resistance to soldering heat	3.7.19	4.7.22
Withstanding voltage (sea level)	3.7.5	4.7.8.1
Connector mating and unmating forces	3.7.3	4.7.6
Contact retention	3.7.15	4.7.18

1/ Type see 1.2.2.

2/ Loose contacts only (see 4.3.3.2).

4.5.1.1 Sampling plan. Group B inspection shall be performed every 36 months on samples from units produced during that period. Sampling shall be in accordance with table X. The connectors shall have their full complement of contacts. The samples shall be subjected to the inspections of group I, table XI. The samples shall then be subjected to group II and group III inspections.

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

4.5.3 Disposition of sample units. Sample units, which have been subjected to group B inspection, shall not be delivered on a contract or purchase order.

4.5.4 Noncompliance. If a sample fails to pass group B inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure, and take corrective action on the materials, processes, and all units of product, which can be corrected and were manufactured under essentially the same conditions, and are considered subject to the same failure. Acceptance of the product shall be discontinued until corrective action acceptable to the qualifying activity has been taken. After the corrective action has been taken, group B inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Group A inspections may be reinstated. However, final acceptance and shipment shall be withheld until the group B inspection shows that the corrective action was successful. In the event of failure after reinspection, information concerning the failure and corrective action shall be made available to the cognizant inspection activity and the qualifying activity.

4.6 Verification of qualification. To retain qualification, the contractor shall verify to the qualifying activity that it is capable of manufacturing products, which meet the requirements of this specification. The qualifying activity shall be notified whenever inspection data indicates failure of the qualified product to meet the requirements of this specification.

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4.7 Methods of inspection.

4.7.1 Test methods. The following tests and test methods assure connector integrity within typical operating conditions and applications. Alternate test methods are allowed with prior approval by the qualifying activity. The test methods described herein are the preferred methods and take precedence when alternate test methods give differing or conflicting results.

4.7.2 Visual and mechanical inspection. Contacts and connectors shall be examined to ensure conformance with this specification and associated specification sheets. Continuous examination shall be performed to assure compliance with the following requirements:

- a. Specification sheets (3.1).
- b. Materials (3.3, 3.3.1, and 4.3.1.2).
- c. Design, construction and physical dimensions (3.4).
- d. Marking (3.8).
- e. Workmanship (3.9).

Where feasible, in-process controls may be used in lieu of specific inspections required by this paragraph provided such controls assure conformance to all requirements.

4.7.3 Magnetic permeability (see 3.3.4). Magnetic permeability shall be measured on connectors with an instrument conforming to the requirements of ASTM A342. The connectors may be wired or unwired, but shall not be carrying current. Requirements shall be as specified in 3.3.4.

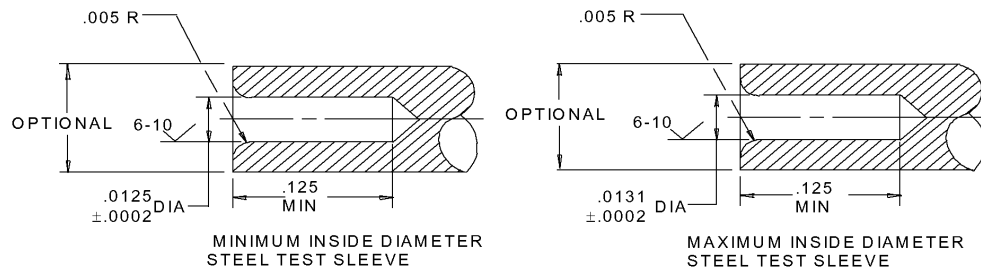
4.7.4 Porosity (nitric acid vapor) (see 3.7.1). The requirements specified in 3.7.1 shall be met when tested in accordance with EIA-364 test procedure 53. The following details shall apply:

- a. Optical microscope capable of 25X magnification.
- b. Seven samples of each pin and socket contact.
- c. Measurement area on pin contacts shall be .020 inch (0.51 mm) minimum from mating end to .040 inch (1.02 mm). Reference applicable figures in EIA-364 test procedure 53.
- d. Measurement area on socket contacts shall be .020 inch (0.51 mm) minimum from mating end to .040 inch (1.02 mm).

4.7.5 Contact engagement and separation forces (see 3.7.2).

- a. Pin contacts (minimum of 14) shall be divided equally.
- b. Select one group of 7 pin contacts and insert in a socket contact with a minimum diameter test sleeve (see figure 1).
- c. Repeatedly, insert and remove the pin contact into a minimum diameter test sleeve.
- d. During the third cycle, the engagement force shall be in accordance with 3.7.2.
- e. Insert and separate the remaining 7 pin contacts in a maximum diameter test sleeve (see figure 1) three times. During the third cycle the separation force shall be in accordance with 3.7.2.

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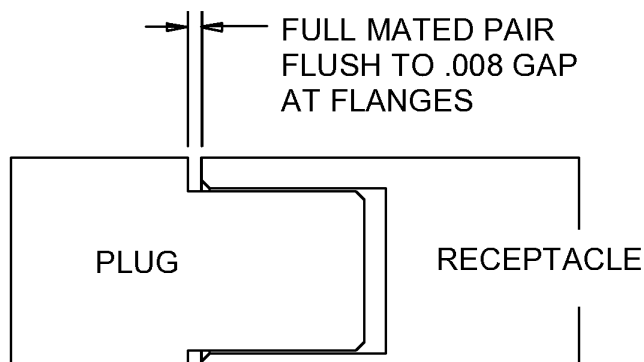
Inches	mm	Inches	mm
.0002	0.005	.0125	0.317
.005	0.13	.0131	0.332
		.125	3.17

## NOTES:

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

FIGURE 1. Test sleeve.4.7.6 Connector mating and unmating forces (see 3.7.3).

- a. The associated mating test connector shall not have the applicable hardware installed.
- b. Plugs and receptacles shall be rigidly mounted in a manner permitting mating and unmating of counterpart connectors, and with instrumentation capable of measuring the specified forces.
- c. Gradually increasing axial loads shall be applied until plugs and receptacles are fully mated (see figure 2).
- d. The connectors shall then be disengaged.
- e. Connector pairs shall undergo three mate and unmate cycles before initial measurements are taken.
- f. The forces shall be measured in both directions and shall be in accordance with the requirements specified in 3.7.3. No individual plug or receptacle may be used for more than 500 cycles of mating and unmating.

FIGURE 2. Connectors, fully mated.

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4.7.7 Insulation resistance (see 3.7.4). The requirements specified in 3.7.4 shall be met for mated connectors tested in accordance with EIA-364 test procedure 21. The following details and exceptions apply:

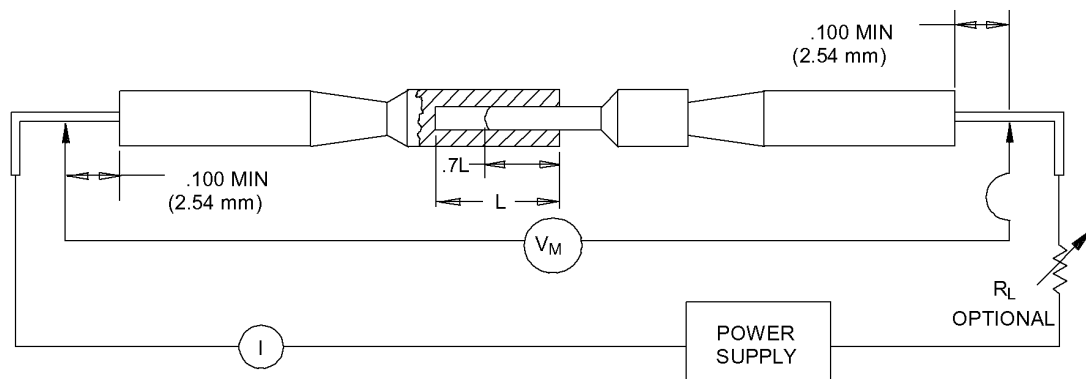
- a. Unless otherwise specified, twenty percent, but not less than 9 contacts shall be tested. Contact test positions shall be evenly distributed in each row of multi-row connectors, at each end, and in the middle of each row.
- b. Test voltage: 100 V dc  $\pm 5\%$ .
- c. The connectors shall meet the insulation resistance requirements specified in 3.7.4.

4.7.8 Withstanding voltage (see 3.7.5).

4.7.8.1 Withstanding voltage (sea level) (see 3.7.5). The requirements specified in 3.7.5 shall be met with mated connectors tested in accordance with EIA-364 test procedure 20 test condition I. Unless otherwise specified, not less than 9 contacts shall be tested. Contact test positions shall be evenly distributed in each row of multi-row connectors, at each end, and in the middle. Contact to shell withstanding voltage shall be tested. The voltage shall be 250 VAC, 60 Hz.

4.7.8.2 Withstanding voltage (altitude) (see 3.7.5). The requirements specified in 3.7.5 shall be met with mated connectors when tested in accordance with EIA-364 test procedure 20, test condition IV. Unless otherwise specified, not less than 9 contacts shall be tested. Contact test positions shall be evenly distributed in each row of multi-row connectors, at each end, and in the middle. Contact to shell withstanding voltage shall be tested. The test voltage shall be 100 VAC, 60 Hz.

4.7.9 Contact resistance (see 3.7.6). The requirements specified in 3.7.6 shall be met when tested in accordance with EIA-364 test procedure 06. A test current of 1 ampere shall be used. Wire length shall be 6 inches (15.24 cm). Twenty percent, but not less than 9 mated connector pairs shall be tested. The applicable test circuit shall be as shown on figure 3, and contacts shall be fully mated (see figure 2).



NOTES:

1. Voltage drop measurement connection points shall be permanent connections and may be protected by potting or equivalent means.
2. Total resistance equals the wire resistance plus the mated contact resistance.

FIGURE 3. Test circuit for measurement of contact resistance.

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4.7.10 Vibration (see 3.7.7). The connector assembly shall be mounted as specified herein and vibrated in accordance with EIA-364 test procedure 28, test condition IV. All contacts shall be wired in series with at least 100 ma of current flow. A suitable sensor shall monitor the vibration of the receptacles at a point on or near the receptacle. A counterpart plug shall be engaged with the receptacle and shall be held by normal locking means. A suitable instrument shall be employed to monitor the current flow and to indicate any discontinuity of current flow. The following details shall apply:

- a. The connector plug and receptacle under test shall be mounted to the vibration test fixture using mounting hardware that most closely simulates intended design usage. Care must be taken to eliminate any effect of mounting fixture hardware on vibration test results. Special mounting means may be used upon agreement between the manufacturer, customer and the government.
- b. The wire bundles attached to the receptacle shall be clamped to non-vibrating points  $2 \pm .5$  inches ( $51 \pm 13$  mm) minimum from the rear of the receptacle. The clamping length shall be chosen to avoid resonance of the wire bundles.
- c. A suitable monitoring circuit shall be provided to detect any interruption greater than 10 nanoseconds. Two contacts per detector channel shall be used (reference EIA 364 test procedure 87).
- d. Test current shall be 100 milliampere maximum.
- e. Test condition IV or as specified on individual specification sheets.
- f. At the conclusion of this test, contact leads and plastic materials shall be examined at 25X magnification for signs of cracking or other signs of damage. The connector mating hardware shall be visually examined for loosening, fracture, or other degradation.

4.7.11 Shock (specified pulse) (see 3.7.8). Mated connectors shall meet the requirements specified in 3.7.8 when tested in accordance with EIA-364 test procedure 27. The following details shall apply:

- a. Mounting and accessories: Shall be similar to 4.7.10a, with a suitable monitoring circuit to detect any interruptions of current greater than 10 nanoseconds. Special mounting means may be utilized upon agreement between the manufacturer, customer and the government.
- b. Test condition G.
- c. A suitable monitoring circuit shall be provided to detect any interruption greater than 10 nanoseconds. Two contacts per detector channel shall be used (reference EIA 364 test procedure 87).
- d. Test current shall be 100 milliampere maximum.
- e. For pigtailed wired connectors, a minimum of 4 inches of wire shall be unsupported behind the rear of the receptacle, and  $2 \pm .5$  inches ( $51 \pm 13$  mm) of wire shall be unsupported behind the rear of the plug.
- f. A suitable instrument shall be employed to indicate any discontinuity or interruption of current flow.
- g. Connector performance shall be monitored as required by 3.7.8.
- h. Following completion of shocks on each axis, solder joints and contacts shall be examined at 25X magnification for signs of cracks or other degradation. The remainder of the connectors shall be inspected for damage and evidence of unusual wear.

4.7.12 Durability (see 3.7.9). The requirements specified in 3.7.9 shall be met when connector pairs are tested in accordance with EIA-364 test procedure 09. The following details shall apply:

- a. The test equipment and test sample requirements of EIA 364 test procedure 09 shall be followed.
- b. When tested in a mate-unmate cycle fixture, the fixture shall simulate normal utilization of the connector while maintaining proper alignment of the two connector housings.
- c. Connectors, less mating hardware, shall be mated and unmated 200 times at a rate of  $100 \pm 50$  cycles per hour to simulate actual service.
- d. Following the durability test, the connectors shall meet the requirements specified in table VIII, subgroup I.

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4.7.13 Temperature cycling (see 3.7.10). The requirements specified in 3.7.10 shall be met for mated connectors tested in accordance with EIA-364 test procedure 32, test condition I (5 cycles). The following conditions shall apply:

- a. A mated connector shall be weighed and the weight recorded.
- b. The dwell time shall be determined by EIA 364 test procedure 32.
- c. Temperature extremes for high temp (class M) connectors shall be as follows:
  - (1) Low temperature shall be  $-55^{\circ}\text{C}$ ,  $+0^{\circ}\text{C}$ ,  $-5^{\circ}\text{C}$ .
  - (2) High temperature shall be  $+125^{\circ}\text{C}$ ,  $+3^{\circ}\text{C}$ ,  $-5^{\circ}\text{C}$ .
- d. At the completion of the last cycle, the connectors shall be returned to room temperature and shall meet the requirements specified in 3.7.10.
- e. Connectors shall exhibit no visual evidence of physical degradation and shall pass succeeding tests of table VIII in sequence.

4.7.14 Humidity (see 3.7.11). The requirements in 3.7.11 shall be met with connectors fully wired and mated, when tested in accordance with EIA-364 test procedure 31 test condition A (except steps 7a and 7b shall not be required). The following exceptions and details shall apply:

- a. Upon completion of step 6 of the final cycle, the connectors shall be removed from the chamber, unmated, and surface moisture shall be removed from the inserts.
- b. The following tests shall be performed for all classes of connectors:
  - (1) Immediately following removal of surface moisture, the withstanding voltage test of 4.7.8.1 (sea level) shall be performed.
  - (2) Within 1 to 2 hours after removal of surface moisture, the insulation resistance test of 4.7.7 shall be performed.
- c. After the 24-hour conditioning period, the insulation resistance specified in 3.7.4 shall again be measured.

4.7.15 Salt spray (corrosion) (see 3.7.12). The requirements specified in 3.7.12 shall be met for mated connectors subjected to a salt spray test in accordance with EIA-364 test procedure 26, condition B. Connectors shall then be examined as specified in EIA-364 test procedure 26 for evidence of corrosion. Connectors shall then meet the specified requirements for mating and unmating forces (3.7.3), and low signal level contact resistance (3.7.13).

4.7.16 Low-signal level contact resistance (see 3.7.13). The requirements specified in 3.7.13 shall be met for low signal level contact resistance accordance with EIA-364 test procedure 23. The following details shall apply:

- a. Test samples shall consist of mated connector pairs. Unless otherwise specified, twenty percent, but not less than 9 contacts shall be tested. Contact test positions shall be evenly distributed in each row of multi-row connectors, at each end, and in the middle.
- b. Test current: 10 milliamperes maximum.
- c. Environmental conditioning not required.
- d. Voltmeter placement: see figure 3.
- e. Maximum allowable contact resistance: see table VI.

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4.7.17 Fluid immersion (see 3.7.14). The requirements specified in 3.7.14 shall be met. Unmated connector pairs shall be immersed fully in the fluids specified in table XII for the required periods. The following details shall apply:

- a. At least one connector shall be immersed in each fluid.
- b. After removal from the fluid, each connector shall remain in free air at ambient room conditions for 1 hour.
- c. Subsequent testing shall be performed on the same-mated connector pairs used previously.
- d. The connector mating and unmating forces shall meet the requirements specified in 3.7.3 when mated as shown on figure 2.

TABLE XII. Test fluids.

Test fluid	Description	Time
ASTM D4376	Perchloroethylene, US practical grade (Cleaning solvents)	2 hours
MIL-PRF-7808	Lubricating oil, aircraft turbine engine, synthetic base	20 hours
MIL-PRF-87252	Coolant Fluid, Hydrolytically Stable, Dielectric	1 hour $\pm$ 1 minute

4.7.18 Contact retention (see 3.7.15). The requirements specified in 3.7.15 shall be met for connectors tested in accordance with EIA-364 test procedure 29. The following details and exceptions shall apply:

- a. Number of samples: Twenty percent, but not less than 9 contacts shall be tested.
- b. Applied axial load: .5 pound per second (2.22 Newton's) until the load specified in 3.7.15 has been reached. Maintain load for 5 seconds minimum.
- c. Maximum allowable contact displacement during application of specified force and after removal of specified force: None.
- d. When a pin or socket contact is tested, the load shall be applied by pulling on the pigtail. Wire breakage outside of the connector is not a failure.
- e. There shall be no damage to the connector or degradation in connector performance after this test.

4.7.19 Solderability (see 3.7.16). Connectors with wire printed wiring board terminations shall meet the requirements for solderability specified in MIL-STD-202 method 208. The following details shall apply:

- a. Test samples shall not be cleaned prior to soldering.
- b. Twenty percent, but not less than 7 leads of test specimens shall be tested.
- c. Examination at 25X magnification.

4.7.20 Crimp tensile strength (see 3.7.17). Contacts crimped to wires shall be placed in a tensile-testing machine and an axial load shall be applied. The holding surfaces or clamps of the tensile testing machine may be serrated to provide sufficient gripping or holding strength. The following details shall apply:

- a. Twenty contacts/wire size/wire type.
- b. The rate of travel of the head of the testing machine shall be 1.00 inch (25.4 mm) per minute minimum.
- c. The crimp tensile strength shall meet the requirements specified in 3.7.17.

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4.7.21 Thermal vacuum outgassing (space classes only) (see 3.7.18). The requirements specified in 3.7.18 shall be met. All nonmetallic materials, including lubricants, used in the manufacture of these connectors shall be tested in accordance with ASTM E595 to determine the maximum TML of the original specimen mass and the VCM content of the original specimen mass. For the purpose of determining TML and VCM of connectors, the original specimen mass shall be the assembled connector excluding metallic parts. The TMC and VCM for the connectors may be determined by testing the specific materials of the connector and calculating the loss.

4.7.22 Resistance to solder heat (see 3.7.19). All solder type connectors shall be tested in accordance with EIA-364 test procedure 56. The following details shall apply:

- a. The connector shall show no evidence of distortion or damage to any area of the housing or show evidence of contact misalignment.
- b. The contacts shall meet the contact retention requirements (3.7.15).
- c. The contacts shall meet requirements for connector mating and unmating force requirements (3.7.3).

4.7.28 Marking performance. The marking shall meet the requirements specified in 3.8 when tested in accordance with MIL-STD-202, method 215.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Controls Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

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

6.1 Intended use. These connectors are intended for use for interconnections on printed wiring board, printed wiring board to cable, cable to panel, or cable to cable on miniaturized equipment sub-assemblies with low power requirements. The connectors covered by this specification are militarily unique because of requirements to operate satisfactorily under sinusoidal vibrations of 10 to 2000 Hz at up to 20 g's; withstand 48 hours of salt spray without exposure of base metals which will affect performance, or cause pitting or porosity of the finish; withstand 100 g's of shock with no electrical discontinuity; and operate at temperatures of minus 55 to plus 125 degrees Celsius. Commercial electronic components are not designed to withstand these extreme conditions or sudden environmental changes, and would experience catastrophic failure.

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6.1.2 Space applications using aluminum shells. Aluminum shells with electroless nickel is intended for use in space applications only. Cadmium plating is prohibited on electrical, electronic and electromechanical (EEE) parts and associated hardware. In some applications use of cadmium plating may be acceptable via a project approved waiver process that includes review and approval by both Materials and Parts Engineering Activities.

- a. Cadmium is known to sublime in a hard vacuum environment (especially at temperatures above 75°C). The sublimation products, which are conductive, can redeposit resulting in short circuits. The sublimation products may also interfere with sensitive optics.
- b. Cadmium is a toxic material that should not be used in manned spaceflight applications.
- c. Cadmium is subject to the spontaneous growth of cadmium whiskers.

Cadmium plating is commonly used on connectors, connector hardware and mechanical hardware such as fasteners. It provides excellent resistance to salt corrosion and is therefore offered in many military specifications predominantly for use in naval applications. However, most NASA applications are not concerned with salt corrosion and the risks associated with use of cadmium plating noted above outweigh the benefits of its use in space applications.

6.1.3 Caution note. Corrosion has been experienced on connectors prewired with MIL-W-22759/33 wires and stored in a sealed environment. CAUTION SHOULD BE EXERCISED WHEN USING THIS WIRE.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Title, number, and date of the applicable specification sheet and the complete PIN (see 3.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products that, at the time of award, are qualified for inclusion in QPL No. 32139 whether or not such products have actually been listed by that date. The attention of contractors is called to this requirement. In order to be eligible for contracts or orders for products covered by this specification, manufacturers are should arrange for qualification testing of products they propose to offer the Federal Government. The activity responsible for the QPL is DSCC-VQ, which may be contacted at the Defense Supply Center Columbus, P.O. Box 3990, ATTN: DSCC-VQ, Columbus, Ohio 43216-5001 or emailed to vqp.chief@dla.mil. Application procedures should be in accordance with the "Provisions Governing Qualification" (see 6.3.1).

6.3.1 Provisions governing qualification. Copies of "Provisions Governing Qualification" may be obtained upon application to Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6.4 Tin whisker growth. The use of alloys with tin content greater than 97 percent may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture, and can develop under typical operating conditions on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead have shown to inhibit the growth of tin whiskers.

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6.5 Definitions

- Captive hardware - Hardware that is held in place by some mechanical means.  
 Herzian - Weight distributed over a cross sectional area (point of contact) in psi or Mpa.  
 Mating hardware - Hardware that fastens mating connector halves together.  
 Mounting hardware - Hardware that mounts connector assemblies to another piece of equipment.  
 Precious metal alloy - Metals that contain high composition weights of gold, silver, platinum or combinations of the three.

6.6 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs. Table XIII lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. If any of these hazardous materials are required, it is recommended that they be used only when other materials cannot meet performance requirements.

TABLE XIII. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and compounds	Lead and compounds	Toluene
Carbon Tetrachloride	Mercury and compounds	1,1,1 - Trichloroethane
Chloroform	Methyl Ethyl compounds	Trichloroethylene
Chromium and compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and compounds	Nickel and compounds	

6.7 Subject term (key word) listing.

Arrangement  
 Beryllium copper  
 Contacts  
 Engagement  
 Force  
 Gold  
 Inserts  
 Lead  
 Nickel  
 Perchloroethylene  
 Plug  
 Polarization  
 Receptacle

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CONCLUDING MATERIAL

Custodians:  
Army - CR  
Navy - EC  
Air Force - 11  
DLA - CC

Preparing activity:  
DLA - CC  
  
(Project 5935-4618-000)

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at [www.dodssp.daps.mil](http://www.dodssp.daps.mil).