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**GUIDE OF SPACE GRADE REQUIREMENTS
FOR ELECTRICAL CONNECTORS**

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Introduction

This document is designed to be a reference guide and baseline in which minimum requirements are outlined for electrical connectors that will be used in any space environment. This document will be updated as necessary. There are six space environmental categories defined as a means of providing a standard knowledge of space environmental conditions and as a reference for screening and testing. All electrical connectors are included in the scope of this document, and several main categories are defined based on the current usage by the NASA community.

1 Scope and objective

1.1 Scope

This requirements document is applicable to all types of single or multicontact electrical connectors including: circular, rectangular printed circuit, rectangular microminiature, rectangular D-subminiature, rectangular rack and panel, coaxial, and hermetic. This document will be used in for determining the minimum requirements for space applications. This document is not a mandatory requirements document but is for the purpose of providing guidance. For purposes of standardization and reference, several space environments are defined and include: habitable pressurized modules, low earth orbit, geosynchronous earth orbit, transatmospheric vehicle, lunar surface, Martian surface. The environmental categories are designed to be used as a default when considering how to alter any test for a specific application. The environmental categories are meant for reference purposes. When performing any test or screening procedure the parameters of the operational environment can be used to govern the test conditions. All test EIA test procedures referenced are to be considered as the normative test procedures. All military test procedures are referenced for information purposes. Any reference to the military or industry environments is only as a reference to the space environmental categories significant to this document. For actual military and industry environment parameters please consult the appropriate military specifications or EIA documents.

There are several tables and charts designed for cross-referencing which types of connectors need to be tested for which space environments and for cross-referencing what types of tests are necessary for what type of connector when being used in any space environment.

1.2 Objective

The objective of this document is to provide the information concerning what the minimum requirements are for all electrical connectors being used in any space flight application. This document is meant for guidance purposes and is not a procurement document. Once screened by the requirements outlined in this document (and in accordance with project engineering documentation) with the appropriate results, a connector can be considered "space grade" for a given space environment category that governs all test conditions and requirements. If environmental parameters are not specified for any given application by project documentation the appropriate environmental category defined in this document can be used to govern all test conditions.

2 General information

2.1 Related documents

The following documents may or may not be referenced in the body of this requirements document and can be used as references to the material contained in this document.

NASA Specifications and Standards

NASA Approved Parts Listing (formally known as MIL-STD-975).

- **NHB8060.1 (Flammability, Odor, Offgassing, and Compatibility Requirements for Materials in Environments that Support Combustion)**
 -
- **40M38277, Circular, miniature, high density, environment resisting, electrical connector.**

- **40M38298, Circular, miniature, special, environment resisting, electrical connector.**
- **40M39569, Circular, miniature, environmental resisting, 200C, electrical connector.**
- **GSFC-S-311-P-4, Rectangular, space flight, electrical, connector.**
- **GSFC-S-311-P-10, Subminiature, electrical and coaxial contact, electrical, connector.**

Military Specifications and Standards

- **MIL-STD-1344 Test Methods for Electrical Connectors**
- **MIL-STD-202: Test Methods for Electronic and Electrical Component parts**
- **MIL-C-5015, Circular, threaded, AN type, electrical, connector.**
- **MIL-C-26482, Circular, miniature, quick disconnect, environment resisting, electrical, connectors, receptacles and plugs.**
- **MIL-C-38999, Circular, miniature, high density, quick disconnect, (bayonet, threaded and breech coupling), environment resisting, removable crimp and hermetic contacts, electrical, connectors.**
- **MIL-C-39012, Coaxial, radio frequency, electrical, connector.**
- **MIL-C-55302, Printed circuit, electrical, connector, subassembly and accessories.**
- **MIL-C-24308, Rectangular, miniature, polarized shell, crimp and solder contacts, electrical connector.**

- **MIL-C-39029, Electrical contacts.**
- **MIL-C-83513, Rectangular, microminiature, polarized shell, rack and panel, electrical connector.**

Industry Specifications and Standards

- **ASTM E595 Vacuum Outgassing**
- **ASTM D695 Flammability**
- **EIA-364-B**

Electrical Connectors Test Procedures

EIA-364-02 (Air Leakage)

EIA-364-05 (Contact Insert/Remove)

EIA-364-06 (Contact Resistance)

EIA-364-08 (Crimp Tensile Strength)

EIA-364-09 (Durability)

EIA-364-13 (Mating/Unmating Forces)

EIA-364-14 (Ozone)

EIA-364-18 (Visual Inspection)

EIA-364-20 (Withstanding Voltage)

EIA-364-21 (Insulation Resistance)

EIA-364-23 (Low-level Contact)

EIA-364-24 (Maintenance Aging)

EIA-364-26 (Salt Spray)

EIA-364-27 (Mechanical Shock)

EIA-364-28 (Vibration)

EIA-364-31 (Contact Retention)

EIA-364-32 (Thermal Shock)

EIA-364-35 (Insert Retention)

EIA-364-37 (Contact Engagement/Separation)

EIA-364-42 (Impact)

EIA-364-44 (Corona)

EIA-364-45 (Flame)

EIA-364-54 (Magnetic Permeability)

EIA-364-56 (Solder Heat Resistance)

EIA-364-66 (EMI Shielding)

2.2 Electrical connector categories

Circular, power: C

D-Subminiature Rectangular: D

Microminiature Rectangular: M

Printed circuit, Rectangular: P

Coaxial: RF

Rack and panel, rectangular: A

Hermetic: H

2.3 NASA approved parts listing (MIL-STD-975):

- **Specification number: 40M38277, Circular, C Miniature, High-Density, Environment Resistant, Low-Silhouette, (backshells and contacts available with connector)**
- **Specification number: 40M38298, Circular, C Miniature, Environment Resistant, Special, (backshells and contacts available with connector), + 200C.**
- **Specification number: 40M39569, Circular, C Miniature, Environment Resistant, (backshells and contacts available with connector), + 200C**
- **Specification number: MIL-C-5015, Circular, C Threaded Coupling, AN type, Circular Rear Release Crimp Contacts, Hermetic Solder contacts, Contact sizes 8 and larger only.: MS3450, MS3452, MS3454, MS3456, MS3459.**
- **Specification number: MIL-C-26482, Circular, C Series 2, , Miniature, Quick Disconnect, Environment Resistant MS3470, MS3472, MS3474-76, MS3449.**

- **Specification Number: MIL-C-38999, Circular, C Miniature, High Density, Quick Disconnect, Environment Resistant, Removable Crimp and Hermetic Solder Contacts:**
 - **Series 1, Bayonet Coupling, MS27466 - MS27468, MS27470, MS27471, MS27656, MS27662**
 - **Series 2, Bayonet Coupling, Low Silhouette:: MS27472, MS27474, MS27477, MS27478, MS27484, MS27497**
 - **Series 3, Scoop Proof, Threaded Coupling, Triple Start, Self-Locking: D38999/20, /21, /23 - /27.**
 - **Series 4, Scoop Proof, Breech Coupling: D38999/40 - /48.**
- **Specification number: MIL-C-39012, Coaxial, RF Radio Frequency: M39012/01-501,-503, M39012/03-501,-503, M39012/04-0001,-0002,-0003, M39012/26-101,-102,-018, M39012/28-101,-102, -018, M39012/34-0001, -0002, M39012/55-3006, -3007, --3009, -3010 M39012/57-3006, -3007, --3009, -3010 M39012/60-3001, -3002, M39012/61-3001, -3002**
- **Specification number: MIL-C-55302, Printed Circuit, P Printed Circuit, Subassembly and Accessories, Non Environment Resistant, M55302/55-M55302/66.**
- **Specification number: MIL-C-24308, Rectangular, D Rectangular, Miniature, Rack & Panel:**
 - **Nickel Finished Polarized Shell, Gold Plated Nonremovable Solder Contacts: M24308/1-34 - M24308/1-38, M24308/3-23 - M24308/3-27**
 - **Gold Finish Polarized Shell, High-Density, Gold Plated Removable Crimp Contacts, M24308/6-512 - M24308/6-517, M24308/6-526 - M24308/6-531, M24308/8-335 - M24308/8-339, M24308/8-345 - M24308/8-350,**

- **Nickel Finished Polarized Shell, Gold Plated Removable Solder Contacts: M24308/2-516 - M24308/2-520, M24308/4-335 - M24308/4-339.**
- **Gold Finish Polarized Shell, High-Density, Gold Plated Nonremovable Solder Contacts, M24308/5-34- M24308/5-38, M24308/7-23- M24308/7-27.**
- **Specification number: GSFC-S-311-P-4, Rectangular, A Subminiature, Rack & Panel, Non-Magnetic: 311P405, 311P407, 311P409, Contacts: Coaxial or High Voltage, S-311-P-4/06, S-311-P-4/08, S-311-P-4/10**
- **Specification number: GSFC-S-311-P-10, Rectangular, A Miniature, Rack & Panel, Non-Magnetic, Polarized Shell, Combination Solder, Coaxial and High Voltage Contacts: 311P10.**
- **Specification number: MIL-C-83513, Rectangular, M Rectangular, Microminiature, Polarized. Shell, Rack and Panel, Crimp & Solder Contacts: M83513/1-/4, M83513/6-/9.**
- **Specification number: MIL-C-39029, Contacts, T Crimp Removable:**
 - M39029/4-110, -111, -113**
 - M39029/5-115, -116, -118**
 - M39029/29-214, -215, -216**
 - M39029/30-220, -221, -222),**
 - M39029/56-348, -351, -352, -353,**
 - M39029/57-354,- 357, -358, -359,**
 - M39029/58-360, -363, -364, -365,**

M39029/106-(614 - 617),

M39029/107- (620-623),

M39029/63-368,

M39029/64-369.

3 Environmental category definitions

The following are definitions of special environments and the conditions that would affect the functional ability of components operating within that environment. These environments will be referred to by the appropriate abbreviations later in the document. The environmental categories of industry and the military are only provided as references in which to compare all space environments. For actual industry environments please consult EIA-364C Tables I and II. For actual military environments please consult military specifications. The information provided on military environments, military connectors or military references has no bearing on the military specifications from which they originated. Please consult actual military specification for proper usage of any military connector or contact mentioned in this document.

3.1 Industry environmental definitions

IND: Industry

Temperature: 15 C to 35 C

Atmospheric pressure: 86 kPa to 106 kPa

Relative humidity 20 % to 80 %

3.2 Military environmental definitions

MIL: Military aircraft

Temperature -65 C to 230 C.

Atmosphere: Earth.

Pressure: 7 kPa to 101 kPa (49 torr to 760 torr).

Gas/fluid compatibility: 25 % to 75 %, aerospace fluids.

Electromagnetic radiation: earth UV.

Particulate radiation: n/a.

Atomic oxygen: n/a.

Reduced gravity: n/a.

Charged plasma: n/a.

3.3 Space environmental definitions (SP1 - SP6)

3.3.1 Habitable environment, pressurized modules, SP1

Temperature 18.3 C to 26.7 C.

Atmosphere: Earth to 30 % oxygen.

Pressure: 69 kPa to 101 kPa (514 torr to 760 torr).

Gas/fluid compatibility: 25 % to 75 %, 100 % RH salt fog, space fluids.

Electromagnetic radiation: n/a.

Particulate radiation: n/a.

Atomic oxygen: n/a.

Reduced gravity: 10^{-5} m/s² to 10^{-2} m/s² (10^{-6} g_n to 10^{-3} g_n).

Charged plasma: n/a.

3.3.2 Low earth orbit (LEO), SP2:

Temperature cycles: 6000 cycles/y. @ - 65 C to 120 C (EIA-364 class number 3.0).

Atmosphere: Earth to very low oxygen.

Pressure: 10^{-4} Pa to (10^{-5} torr) to 10^{-9} Pa (10^{-10} torr).

Gas/fluid compatibility: 100 % RH salt fog, space fluids.

Electromagnetic radiation: 2220 ESH/y to 5800 ESH/y (altitude dependent).

Particulate radiation: protons, electrons, alpha-particles.

Atomic oxygen: 10^{20} to 10^{22} atoms/cm²-y (altitude dependent).

Reduced gravity: 10^{-5} m/s² to 10^{-2} m/s² (10^{-6} g_n to 10^{-3} g_n).

Charged plasma: 0.3 atoms/cm³ to 5×10^4 atoms/cm³, 0.1 eV to 0.2 eV.

Distance above the earth is in the range 600 km to 2000 km.

3.3.3 Geosynchronous earth orbit (GEO), SP3:

Temperature cycles: 90 cycles/y @ - 196 C to 128 C.

Atmosphere: Earth to very low oxygen.

Pressure: 10^{-11} Pa (7.5×10^{-14} torr).

Gas/fluid compatibility: 100 % RH salt fog, space fluids.

Electromagnetic radiation: 8760 ESH/y

Particulate radiation: protons, electrons, alpha-particles.

Atomic oxygen: n/a.

Reduced gravity: 10^{-5} m/s² (10^{-6} g_n) to 10^{-2} m/s² (10^{-3} g_n)

Charged plasma: 0.24 atoms/cm³ to 1.12 atoms/cm³, 120 keV to 295 keV.

Distance above the earth is approximately 37000 km with an orbit of approx. 24 hours.

3.3.4 Transatmospheric vehicle, SP4:

Temperature: cycles, altitude dependent @ -200 C to 260C.

Atmosphere: Earth to very low oxygen.

Pressure: 101 kPa (760 torr) to 10^{-11} kPa (7.5×10^{-14} torr)

Gas/fluid compatibility: 100 % RH salt fog, space fluids.

Electromagnetic radiation: 8760 ESH/y (altitude dependent).

Particulate radiation: protons, electrons, alpha-particles.

Atomic oxygen: 0 atoms/cm²-y to 10^{22} atoms/cm²-y (altitude dependent).

Reduced gravity: 10^{-5} m/s² (10^{-6} g_n) to 10 m/s² (1g_n)

Charged plasma: anywhere from LEO specified values to GEO values.

3.3.5 Lunar surface, SP5:

Temperature: 13 cycles/y, altitude dependent @ -171 C to 111C.

Atmosphere: Earth to very low oxygen.

Pressure: 10^{-6} Pa (10^{-8} torr) 10^{-10} Pa to (10^{-12} torr).

Gas/fluid compatibility: 100 % RH salt fog, space fluids.

Electromagnetic radiation: 8760 ESH/y

Particulate radiation: protons, electrons, alpha-particles.

Atomic oxygen: n/a

Reduced gravity: 0.165 g_n.

Charged plasma: n/a.

3.3.6 Martian surface, SP6:

Temperature: 356 cycles/y, altitude dependent @ -143 C to 27 C.

Atmosphere: Earth to 0.13 % oxygen, 95.3 % CO₂.

Pressure: 587 Pa (4.4 torr) to 1.5 kPa (11.4 torr)

Gas/Fluid Compatibility: 100 % RH salt fog, space fluids.

Electromagnetic radiation: 1656 ESH/y

Particulate radiation: n/a.

Atomic oxygen: n/a

Reduced gravity: 0.38 g_n.

Charged plasma: 10^3 to 10^5 atoms/cm³.

4 General requirements

4.1 Design and reliability requirements

The following requirements are necessary for all connector types:

- Gold contact plating shall be 1.27 m (50 in) over engagement area on a suitable underplating. Although 1.27 m (50 in) over the entire contact is optimum. Suitable underplating is copper or nickel, where copper is the optimum for applications where residual magnetism is a consideration.**
- Reliability Assurance Program: NHB 5300.4 (1C).**
- Storage temperature range shall be: -55 C to +85 C for use in inhabitable environments, SP1 and -55 C to +125 C for use in uninhabitable environments SP2 - SP6.**
- Interchangeability: with same part number.**
- There shall be adequate contact location identification.**
- There shall be lot traceability with adequate documentation. All screening tests completed per lot and shall be properly documented with corresponding date codes.**
- Molded inserts shall consist of two pieces or less.**

The following requirements are necessary for connector types: C, RF, D, A, M

- All plating on connector shells shall be conductive and noncorrosive.**
- Stress corrosion prevention in accordance with MSFC-SPC-522**

For connector types: C, D, A, M there shall be visual evidence of full mate and polarized shells.

All C and RF type connectors shall have resilient seals around each pin that seal the socket chamfer and have standard screw threads.

All C type connectors (only) shall have wire sealing grommets and low outgassing (dry or grease) lubricated coupling ring grooves.

All T types, or socket contacts shall be closed entry with chamfered entrance spring action. There shall be an inspection hole on crimp contacts.

4.2 General prohibitions

Cadmium Plating, due to sublimation regardless of underplate.

Zinc Plating, due to sublimation regardless of underplate.

Dissimilar Metals for All Connector Parts (refer to MIL-STD-889 for metal compatibility).

Recycled (Regrind) Dielectric Materials

Silver Underplate or Overplate, becomes nonconductive from atomic oxygen

Localized Contact Finish: Contacts must have uniform plating over engagement area.

Polyvinylchloride

Pure Tin

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5 Test conditions and screening requirements

Unless specifically stated otherwise for the project requirements, tests and examinations required by this document or any referenced document shall be conducted by the conditions of the test specified and adjusted to the parameters of the applicable operating environment.

5.1 Visual and dimensional inspection (all types)

The connectors and contacts shall be examined, in accordance with EIA-364-18 to determine compliance with the materials, dimensions, specifications, design and construction, finish and identification specified by project documentation. At a minimum magnification of 3X and using adequate lighting that clearly illuminates all connector details, visual inspection shall verify that the connectors/contacts are properly marked, free of defects, and fabricated with good workmanship.

5.2 Durability (all types):

The ability of the contacts or the connectors to meet the specified number of mating and unmating cycles shall be tested in accordance with EIA-364-09 or MIL-STD-1344 Method 2016. The number of cycles shall be 500 for all types of connectors and shall show no mechanical or electrical defects to the operation of the connector based on specifications in project engineering documentation.

5.3 Mating and unmating forces / coupling torque (all types)

The mating and unmating forces of the connector shall be determined in accordance with EIA-364-13 or MIL-STD-1344 Method 2013.

C and M Types: The mating and unmating forces shall be no more than 3 N (10 oz-f) times the number of contacts in the connector.

D Type: The mating and unmating forces are detailed in the chart below where all the units are in pounds.

Table 1

Unmating Minimum			Unmating Maximum		Mating Maximum	
ShellSize	Newtons (pounds)		Newtons (pounds)		Newtons (pounds)	
	Nonhermetics	Hermetics	Nonhermetics	Hermetics	Nonhermetics	Hermetics
1	3.34 (.75)	6.67 (1.50)	26.69 (6.0)	31.14 (7.00)	44.48 (10.0)	32.25 (7.25)
2	4.45 (1.00)	8.9 (2.00)	44.48 (10.0)	57.82 (13.00)	75.62 (17.0)	57.82 (13.00)
3	7.78 (1.75)	14.46 (3.25)	75.62 (17.0)	94.52 (21.25)	124.54 (28.0)	94.52 (21.25)

4	11.12 (2.50)	20.02 (4.50)	106.75 (24.0)	139 (31.25)	173.47 (39.0)	139 (31.25)
5	14.46 (3.25)	24.47 (5.50)	133.44 (30.0)	187.83 (42.25)	217.95 (49.0)	187.93 (42.25)
6	20.02 (4.50)	----	173.47 (39.0)	-----	289.12 (65.0)	----

P Type: After mating and unmating 3 times, the maximum mating force shall be 0.2 N (0.56 oz-f) times the number of contacts and .02 N (.08 oz-f) times the number of contacts minimum withdrawal force for standard size contacts. For low insertion force contacts the maximum mating force shall be 0.1 N (0.25 oz-f) times the number of contacts and minimum withdrawal force shall be 0.01 N (0.04 oz-f) times the number of contacts.

RF Type: Coupling torque shall be 0.2 Nm (2 lb-in-f) of torque max. for SMA and TNC types.

5.4 Contact insertion, release and removal force (types C and D, not for hermetics)

Contacts shall be tested in accordance with EIA-364-05 or MIL-STD-1344 Method 2012 whichever is appropriate given the conditions of the environment and the application of the connector. This test can be conducted on the nonhermetic removable contact connector types C and D.

C Type: The axial force necessary to remove a size 22 contact shall not exceed 45 N (10 lb-f) and the axial force necessary to insert a removable contact shall not exceed 67 N (15 lb-f).

D Type: The axial force necessary to remove a contact shall not exceed 18 N (4 lb-f) and the axial force necessary to insert a removable contact shall not exceed 18 N (4 lb-f).

5.5 Dielectric withstanding voltage (all types)

The ability of the connector to operate safely at its rated voltage and withstand momentary over voltages shall be determined by compliance with EIA-364-20 or MIL-STD-1344 Method 3001 test V or MIL-STD-202 Method 301 (for RF types). Under the specified voltages and time duration there shall be no evidence of breakdown. The test voltage is applied at a frequency of 60 Hz. The magnitude of the test voltage for screening and other test conditions, shall be as follows:

C Type: Use 800 Vrms ac on wired and unmated connectors. 2 milliamperes is the maximum allowable leakage current. Six readings minimum shall be taken. Tests shall be applied to all contact positions for 1 minute minimum on all connectors.

D Type: 1000 Vrms AC for 10 seconds applied from contact to contact, and then from contact to shell.

M Type: Under Condition 1 in MIL-STD-1344 Method 3001, mated or unmated use 600 Vrms AC for 10 seconds.

P Type: Use 1000 Vrms AC for 60 seconds between the closest contacts and between contacts and hardware. Connectors may be board mounted.

RF Type: AC Voltage applied between contact and body: SMA type apply 500 Vrms, 750 Vrms, or 1000 Vrms per cable size in reference specification. For TNC types apply 1500 Vrms.

5.6 Insulation resistance (all types)

The insulation resistance of the connector, unless otherwise stated or not required for a given environment, shall be determined in accordance with EIA-364-21 or MIL-STD-1344 Method 3003 for high temperature, 200 C and ambient temperature, 25 C. The magnitude of the voltage shall be 500 V DC. The ambient test is the minimum requirement for all types of connectors except the C type in which a high-temperature test shall be performed for environmental categories that specify high-temperatures.

C Type: For the ambient test MIL-STD-1344 Method 3003 use test condition B with connector wired and mated. Simulated contacts and special techniques may be used. The insulation resistance shall be no less than 5000 megaohms.

M and D Type: If using MIL-STD-1344 Method 3003 use test condition B with connectors mated. Measure between 50% (four minimum) adjacent pairs and between 50% (6 minimum) contacts adjacent to shell and shell. Resistance shall be no less than 5000 megaohms unconditioned. After step 6 of MIL-STD-1344 Method 1002 (Humidity) the resistance shall be no less than 1 megaohm. After 24 hours of humidity conditioning under the same test method the resistance shall be no less than 1000 megaohms.

P Type: Connector shall be mated and may be board mounted. Apply voltage from pin to pin and pin to hardware of plug half. Resistance shall be no less than 5000 megaohms.

RF Type: In accordance with MIL-STD-202 Method 302 Condition B measure between the center contact and the body. Resistance shall be no less than 5000 megaohms.

5.7 Contact retention (crimp removable connectors)

Two connectors of any given lot size shall be tested in accordance with EIA-364-35 or MIL-STD-1344 Method 2007. In the cases below where no displacement is mentioned for contacts after testing, all contact displacements shall continue to meet engineering part specification requirements. Test conditions and acceptance requirements of the contact retention for crimp removable contacts are as follows:

C Type: For crimp removable contacts. The applied axial load shall be: 45 N +/- 10 % (10 lb-f) for size 22 contacts, 67 N +/- 10 % (15 lb-f) for size 20 contacts, and 111 N +/- 10 % (25 lb-f) for size 16, 12, 10 and 8 contacts. For the given applied load the axial displacement shall be equal to or less than .30 mm (.011 inch).

D Type: For crimp removable contacts, apply a load of 9 pounds in both axial directions. Contact displacement shall be equal to or less than 0.30 mm (.011 inch).

M Type: For pre-wired crimp contacts, apply 5 pounds to individual wire pigtails for 6 seconds minimum. Load shall not cause any displacement of contact or pull the wire from the crimp contact.

P Type: Test 7 pairs of contacts minimum and use 22 N (5 lb-f) of load. Load shall not cause any displacement of contact.

RF Type: Determine the center contact retention on captivated center contact types only. Use a load of 27 N (6 lb-f) applied in both axial directions. Load shall not cause any displacement of contact.

5.8 Contact resistance (all types, hermetics only)

Two connectors of any given lot size shall be tested in accordance with EIA-364-06 or MIL-STD-1344 Method 3004 and pass all requirements. The test and acceptance criteria for resistance of connector contacts shall meet the following conditions and requirements:

C Type: For solder type contacts, apply conditions and requirements of Table IV in subclause 3.17 of MIL-C-38999.

D Type: For testing the non-removable solder socket contacts, 20 % of the contacts shall be tested for four minutes while mated. Test currents and acceptable contact resistances are listed in Table VI of MIL-C-24308.

M Type: 20 % of the mated contact pairs shall be tested (7 minimum). Measurements shall not exceed .03 ohms (75 millivolts per contact pair at 2.5 amps).

P Type: Seven mated pairs shall be tested as a minimum and shall not exceed 20 milliohms per mated pair.

5.9 Contact engagement and separation forces: (all types but RF)

For solder type nonremovable contacts (of which hermetics are a subset) the connector engagement and separation forces of all connectors shall be tested in accordance with EIA-364-37 or MIL-STD-1344 Method 2014. The test conditions and acceptance requirements are as follows:

C Type: This test is conducted during inspection prior to assembly and conducted on socket contacts. Measurements shall comply with MIL-C-39029.

D Type: For socket contacts only, insert and remove maximum diameter pin gage (MS3197). Insert minimum diameter pin gage and measure separation force during removal of pin. Insert and remove maximum diameter pin gage three times and measure engagement force during the third cycle. All measurements shall comply with table IX of MIL-C-39029.

M Type: Engagement force shall be 1.7 N (6 oz-f) per contact maximum and the separation force shall be 0.1 N (0.5 oz-f) per contact minimum.

P Type: Test shall be conducted on all sockets in the connector. Insert MS3197 test pins to a depth of (3.6 ± 0.5) mm [(0.140 ± 0.02) in]. Maximum engagement force shall be 3.4 N (12 oz-f) per contact for 22 size contacts and 1 N (4 oz-f) per contact for low insertion force contacts. Minimum separation force is 0.1 N (0.5 oz-f) per contact for each type.

5.10 Humidity cycling

This test is not crucial for space flight but is included for reference purposes when applicable. The ability of the connectors and their materials to withstand the effects of high humidity and heat shall be evaluated in accordance with EIA-364-31 or MIL-STD-1344 Method 1002 Condition II. Unless deemed necessary by special environmental considerations steps 7a and 7b will not be required. The conditions of humidity shall be altered accordingly to meet the requirements of any special environmental constraints. The default conditions of testing and acceptance requirements are as follows:

C Type: Shall be tested while mated and shall show no deterioration after cycling. Insulation resistance shall be no less than 100 megaohms.

D Type: Connectors shall be tested while wired but unmated. No vibration test is necessary as in 7B. After 24 hour conditioning period insulation resistance shall be measured (see insulation resistance requirement). At the completion of the test, moisture shall be removed and insulation resistance and DWV (see dielectric withstanding voltage requirements) shall be measured.

M Type: Connector shall be fully wired and mated. Steps 7a and 7b are not required. After 24 hour conditioning period insulation resistance shall be measured (see Insulation Resistance requirement) and DWV shall be measured (see dielectric withstanding voltage requirements).

P Type: Connectors tested while fully mated with a load voltage of 100 Vdc. At the completion of the test, moisture shall be removed and insulation resistance shall be tested.

RF Type: Connector shall be tested mated and cabled. At the completion of the test, moisture shall be removed and the dielectric withstanding voltage shall be tested.

5.11 Mechanical shock (specified pulse for all types)

The ability of the connectors to meet the mechanical shock requirement shall be evaluated in accordance with EIA-364-27 or MIL-STD-1344 Method 2004. If necessary the parameters of the test shall be adjusted to the constraints of the operational environment. The mated connectors shall have an applied test current for the series circuit contacts of 100 milliamperes. The circuit shall function adequately with no discontinuities larger than 1 microsecond or larger than what would be considered necessary for any given application. Other test conditions and acceptance requirements are as follows:

C Type: The Connectors shall be mated. The pulse shall be a half sine wave of 300 g_n magnitude with a duration of 3 milliseconds.

D and M Type: Use test condition E of MIL-STD-1344 Method 2004 (50 g_n sawtooth) with connectors mated. One shock shall be applied in each of the three major axes of the connector. The connectors shall be mated. A minimum of 203 mm (8 in) of wire or cable shall be unsupported behind the receptacle rear and 102 mm (4 in) behind the plug rear.>

P Type: Use test condition G of MIL-STD-1344 Method 2004 (100 g_n, sawtooth) with connectors mated. One shock in both directions along each of the three orthogonal connector axes (total of six).

RF Type: One shock shall be applied to each of the three orthogonal connector axes. Discontinuity duration, waveform, and intensity of shock shall be determined by the operational environment and the application of the connector.

5.12 Materials tests: flammability, odor, toxicity (nonmetal shell D, M and P types)

The materials in all non metal shell connectors of D, M, and P types shall be able to withstand these tests in accordance to the NASA handbook NHB 8060.1. The material tests are only necessary when the connectors are used in habitable compartments, environmental category SP1, during space flight. The requirement for flammability (Test 1) is that the materials, once exposed to a flame in an environment of 30 % oxygen do not propagate that flame and ignite adjacent materials.

5.13 Thermal vacuum outgassing, (all types)

All non metallic materials (including lubricants and adhesives) used in any type connector shall meet the requirements in accordance with ASTM-E595. This test is essential for any part being used in any of the space flight categories SP1-SP6. The material shall not exceed the 1% total mass loss (TML) or 0.1% collected volatile condensable materials (CVCVM) requirement when tested. NASA Publication 1124 "Outgassing Data for Selecting Spacecraft Materials" or the MSFC Handbook 527 "Materials Selection List for Space Hardware Systems" can be used as references for materials selection.

5.14 Vibration (all types)

The ability of the connectors to meet vibration requirements shall be evaluated in accordance with EIA-364-28 or MIL-STD-1344 Method 2005 Random Condition VI. The duration and intensity of the test shall be adjusted by the parameters of the application environment. Unless otherwise defined by the application environment use the detailed conditions provided below.

C Type: For bayonet coupling, breech coupling, and threaded coupling use Cond VI. Perform test for each of the three orthogonal axes for a minimum of 7 minutes per axis.

D Type: Use Condition IV or a range of 10 to 2000 Hz at 20 g_n peak and a total current of 100 microamperes.

M Type: Use test Condition III range of 10 to 2000 Hz at a peak of 15 g_n .

P Type: Use test Condition III.

RF Type: Environment and application shall determine which test will be used. Contact resistance shall be measured after test and comply with application parameter.

5.15 Thermal cycling (all types):

The ability of the connector to withstand the extremes of high and low temperatures shall be evaluated in accordance with EIA-364-32 or MIL-STD-1344 1003 condition A. The temperature extremes and duration of exposure shall be determined by the application environment: SP1 - SP6 for space flight. When the requirements of a given application environment are not specified the following conditions may be used as a default:

C Type: The temperature cycling shall be conducted with connectors mated, 5 times from the temperature extremes -65 C to +200 C or to the maximum temperature rating of the connector.

D and P Type: Unmated connectors shall be tested over 5 cycles from the temperature extremes -65 C to +125C.

M Type: Unmated connectors shall be tested over 5 cycles from the temperature extremes of -55 C to +125C.

RF Type: With connectors mated, use a temperature range of -65 C to +200 C or adjust to parameters of environment for 5 cycles. Measure contact resistance before and after test.

5.16 Salt spray corrosion (all nongold plated types)

This is not considered essential for space flight applications but is included for reference purposes when applicable. For any connectors containing non gold plated mechanical components, the ability to withstand a corrosive environment shall be tested in accordance with EIA-364-26 or MIL-STD-1344 Method 1001. If test is named necessary in project engineering documentation, the test conditions and acceptance requirements shall be determined by the environmental parameters governed by an extended pre-launch, location and ground time.

5.17 Magnetic permeability (type: D)

For D type connectors only, the magnetic permeability shall be tested in accordance with EIA-364-54 or MIL-STD-1344 Method 3006. Connectors shall have a relative permeability less than 2 μ .

5.18 Insert retention (types: C, D, and M)

When tested in accordance with EIA-364-35 or MIL-STD-1344 Method 2010 connectors shall retain their inserts in the proper location within the shell and there shall be no evidence of cracking, breaking or separation from the shell or loosening of parts.

C Type: Connectors shall be tested unmated but may be wired. The axial load shall be 517 kPa (75 psi).

D Type: For non-hermetic types, inserts shall not be dislocated from their original positions or damaged when an axial load of 414 kPa (60 psi) is applied. For hermetic types, inserts shall stay intact and undamaged with a load of 1400 kPa (200 psi inch).

M Type: The test shall be conducted on metal shell connectors only. The pressure of the load shall be increased gradually at a rate of 69 kPa (10 psi) per second until a load of 345 kPa (50 psi) is reached. The load shall be applied axially.

5.19 Air leakage (hermetic types C, D, and RF) Hermetic connectors shall be tested in accordance with EIA-364-02 or MIL-STD-1344 Method 1008.

C Type: The air leakage rate shall be no greater than 1.00×10^{-7} cm³/s for 101 kPa (1 atmosphere).

D Type: The air leakage shall be no greater 1.04×10^{-5} cm³/s at 101 kPa. The leakage rate does not apply to the flange to the mounting surface joint.

RF Type: The air leakage rate shall be no greater than 10^{-8} cm³/s.

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5.20 Low-level contact resistance (types M and P only)

The low level signal contact resistance shall be tested in accordance with EIA-364-23 or MIL-STD-1344 Method 3002. The contact resistance test shall meet the following conditions and requirements:

M Type: The contact resistance shall be 28 milliohms for contact size 24 and wire AWG 26, 25 milliohms for contact size 26 and wire AWG 25.

P Type: A minimum of seven mated contact pairs shall be tested. Using a test current of 0.001 amperes the contact resistance shall be as specified in table 2 subclause 3.18 of MIL-C-55302.

5.21 Crimp tensile strength (M and P type only)

The crimp tensile strength shall be tested in accordance with EIA-364-08 or MIL-STD-1344 Method 2003. The acceptance criteria is as follows:

M Type: The wire shall not break or pull out of the nonremovable crimp contacts at less than 22 N (5 lb-f) and wire breakage other than at the crimp shall not be considered a failure.

P Type The wire shall not break or pull out of the crimp contacts at less than 111 N (25 lb-f) for 20 AWG wire, 67 N (15 lb-f) for 22 AWG wire, 45 N (10 lb-f) for 24 AWG wire, 22 N (5 lb-f) for 26 AWG wire, 13 N (3 lb-f) for 28 AWG wire, 7 N (1.5 lb-f) for 30 AWG wire.

5.22 Maintenance aging (nonhermetic C and D types)

Connectors shall be tested in accordance with EIA-364-24 or MIL-STD-1344 Method 2002 when application requires such information on circular and D-subminiature types. This test may not be relevant to all applications of space flight.

C Type: The contact installing and removal forces shall not exceed the following: for contact size 22, 45 N (10 lb-f); for sizes 20 and 16, 89 N (20 lb-f); for size 12; 133 N (30 lb-f) for size 10 and 156 N (35 lb-f).

D Type: The mating/unmating forces as well as the contact insertion and removal forces shall meet the requirements listed in 5.1.3 and 5.1.4.

5.23 Resistance to solder heat (D and M types only)

This test is for solderable, non-removable contacts only on D-subminiature and micro-miniature connectors. The test shall be conducted in accordance with MIL-STD-202 Method 210 (or EIA-364-56).

D and M Type: Test 20% or seven contacts minimum. A solder iron rated for 25 watts shall be used. The solder iron shall be heated to 360 C. It shall be applied to the termination for a period necessary to hold the solder in a liquid state for a time duration of 4 s to 5 s. After the test a visual inspection shall be performed at a magnification of 10X. The contact shall meet the contact retention requirement and shall have no evidence of distortion or damage.

5.24 Solderability (D and M types)

The test for solderability shall be conducted in accordance with MIL-STD-202 Method 208 (or EIA-364-52). This test shall be conducted on D-subminiature and micro-miniature connectors.

5.25 Impact (special cases C composite type only)

The test for impact damage shall be conducted on circular type composite connectors that are considered environment resisting, have straight strain relief clamps and have either threaded coupling or breech coupling. This test is not for bayonet coupled connectors. The test for impact shall be performed in accordance with MIL-STD-1344 Method 2015 or EIA-364-42. The drop height shall be 1.2 m (4 ft). The number of drops shall be 8 total. The plate shall be indexed at 36 intervals. The plugs shall have no caps or covers installed. Connector should function adequately mechanically and electrically, within specified limits of project engineering documentation.

5.26 Shell-to-shell conductivity (C type only)

The test for shell to shell conductivity on circular connectors that have conductive plating only shall be performed in accordance with MIL-STD-1344 Method 3007. The maximum voltage potential drop across assemblies shall be:

C type connectors with spring fingers:
bayonet coupling

- 2.5 mV for silver plating
- 50 mV for stainless steel plating
- 1 mV for space grade electroless nickel plating or corrosion resistant steel with electrodeposited nickel plating threaded or breech:
- 2.5 mV for corrosive resistant plating
- 10 mV for hermetic or non hermetic connectors with corrosive resistant steel plating.
- 1 mV for any hermetic or nonhermetic types with electrodeposited nickel.

For corrosive resistant composite types, 3 mV initial and 6 mV after conditioning C type connectors without spring fingers, bayonet or breech coupling, 200 mV.

5.27 EMI shielding (C type only)

To measure the EMI shielding effectiveness, circular connectors with spring fingers, conductive plating and multiple contacts shall be tested in accordance with MIL-STD-1344 Method 3008 or EIA-364-66. The EMI shielding capabilities of mated shells shall not be less than what is specified below for a given connector coupling type and a given frequency.

Electroless nickel coated connectors:

- Bayonet, scoop-proof shall have a minimum leakage attenuation of 50 dB for the frequency range 100 MHz to 10000 MHz.

- Bayonet, non scoop proof, low silhouette, shall have a minimum leakage attenuation of 45 dB for the frequency range 100 MHz to 1000 MHz.
- Threaded or Breech (electroless nickel over composite) shall have a minimum leakage attenuation of 65 dB for the frequency range 100 MHz to 10000 Mhz.

Table 2 - Minimum allowable leakage attenuation vs. operating frequency.

Frequency (MHz)		Minimum allowable leakage attentuaton (dB)	
		Threaded or Breech, Steel or Steel plating	Threaded or Breech, Nickel plating *
100	80	90	
200	75	88	
300	73	88	
400	71	87	
800	66	85	
1000	65	85	
1500	59	76	
2000	55	70	
3000	52	69	
4000	50	68	
6000	48	68	
10000	45	65	

(* Nickel plating over steel connectors are included in this category)

The above is information extracted from MIL-C 389999

5.28 Firewall protection (C type only)

Circular connectors with a firewall barrier (and steel or nickel plating) shall be tested in accordance with MIL-STD-1344 Method 1009 or EIA-364-45. A mated connector pair shall prevent passing of a flame for 20 minutes. Current shall be applied for 5 minutes and in the 6th minute the connector shall draw no more than 2 A given that a potential of 100V to 125V at 60 Hz is being applied to adjacent contacts. Wire bundles shall be clamped to fixed points at least 20 cm behind the connector.

5.29 Ozone (C type only)

For circular connectors only, the wired, mated connectors shall be tested in accordance with MIL-STD-1344 Method 1007 or EIA-364-14. After ozone exposure the connectors shall show no evidence of dielectric cracking or any other type of degradation or damage.

5.30 Atomic oxygen (nonmetal shell D, M, P types)

All non metal shell connectors shall be tested for atomic oxygen degradation. Fluence levels shall be approximately 10^{21} atoms/cm² at an energy level of 5 eV and an exposure time of 40 hours. Atomic oxygen materials testing can be accomplished at Marshall Space Flight Center. Connectors shall show no signs of degradation or eroding.

5.31 Contact pin strength (D type only)

For D-subminiature connectors with non removable contacts, the contact pin strength shall be tested as follows. Contacts shall be mounted in a suitable fixture and a gradual force shall be applied to the pin at a maximum rate not faster than what it takes to move the head of the machine by 2.5 cm per min (1 inch/min). The maximum load shall be applied for no more than one minute. The maximum distance that the pin has moved permanently with respect to its initial position shall not exceed 0.13 mm (0.005 in) given a force of 9 N (2 lb-f). For more details refer to MIL-C-24308 subclause 4.7.24.

5.32 Cable retention (D type only)

For D-subminiature connectors attached to flat cables only, the unmated wired connector with strain relief shall be mounted by normal mounting means to a test fixture. An axial force of 2 N (8 oz-f) per contact shall be applied. The force shall be applied 15 cm (6 in) from the mating face of the connector to the cable and shall pull away from the connector in the direction that will put the maximum amount of stress on the contact-cable interface. The contact-cable interface shall withstand the force applied without mechanical damage.

5.33 Residual magnetism (D type only)

D-subminiature connectors without gold plating over copper shall be tested in accordance with NASA Goddard specification S-311-P-10 for residual magnetism. The connector shall be fully assembled prior to testing and tested in a magnetically quiet area in which machines, electronic equipment, vehicles and personnel traffic are restricted. The fluxmeter shall be warmed up for a minimum of fifteen minutes. The probe shall be mounted in a nonmagnetic stand and shall be in a horizontal position at full cable length from the meter. With the meter preset to the appropriate scale, align the probe in a magnetic east-west direction or orient to obtain a zero reading on the meter. Pass the connector three times at a rate of no more than (30 ± 10) cm [(12 ± 4) in] per second between the poles of a magnet with a field strength of approximately 5000 gauss. The connector shall not contact the pole pieces of the magnet. Immediately after, place the connector to within 3.18 mm (0.125 in) of the probe tip and orient the specimen for a maximum magnetism reading. The measurement unit shall be in gamma where one gamma is equivalent to 10^{-5} tesla (10^{-5} gauss).

5.34 RF insertion loss (RF type only)

When required by the project application, radio frequency (RF) coaxial connectors shall be tested in accordance with MIL-C-39012 subclause 3.27 for testing connector insertion loss using the testing apparatus and parameters specified. The insertion loss should meet the value stated in the product specification.

5.35 VSWR (RF type only)

When required by the project application, radio frequency (RF) coaxial connectors shall be tested in accordance with MIL-C-39012 subclause 3.14 for testing for the voltage standing wave ratio value using the testing apparatus and parameters specified. The VSWR should meet the value stated in the product specification.

5.36 Coupling proof torque (RF type only)

For radio frequency coaxial connectors only. The connector shall be engaged with its mating part and have the coupling nut tightened to the torque value quoted in the product specification sheet. After one minute the connector and its mating part shall be disengaged. The coupling mechanism for threaded types shall not be dislodged and dimensions of the connector shall remain as stated in the product specification.

5.37 Corona (C and RF type only)

Radio frequency connectors shall be tested in accordance with EIA-364-44 and show no signs of corona discharge at altitudes of 21336 m (70,000 ft).

5.38 Flammability (all nonmetal shell types) SP2-SP6

For all nonmetal shell connectors used in external environments SP2-SP6 a test for flammability shall be performed in accordance with ASTM D635. It is important to note that some materials may sustain more burn damage in a vacuum environment due to the lack of convection heat transfer. It may be necessary to conduct flammability tests under vacuum conditions. Note that subclause 5.12 is for flammability of materials in inhabitable environments and is a flammability test in a 30% oxygen environment.

5.39 UV weathering (all nonmetal shell types) SP2-SP6

This test is necessary for all non-metal shell connectors being used in any of the external environments SP2 - SP6. The connector shall be tested for total mass loss as a result of ultraviolet exposure in a vacuum environment or it shall be tested for degradation as a result of ultraviolet exposure only. The total sample exposure shall be adjusted by the operating environmental parameters stated under each environmental category. Testing of this nature can be conducted by Marshall Space Flight Center.

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Table 3 - Screen test requirement vs. environmental category

**X: indicates the appropriate test procedure,
A: indicates an alternative resource for information**

Test/screen	Test method	Requirement	Environmental category		
Electrical connectors (types: C, D, M, P, RF)			MIL	IND	SP1 - SP6
Mechanical tests and requirements:					
Visual/dimensional All types	Subclause 5.1.1 EIA-364-18	minimum magnification of 3X		X	X
Mating force/ coupling torque All types	MIL-STD-1344 Method 2013 EIA-364-13	2.5 N (10 oz -f) x # of contacts for C, M: D type use table 1 in 5.3 see Subclause 5.3 for RF and P.	X		A X
Durability All types	MIL-STD-1344 Method 2016 EIA-364-09	500 times subclause 5.2	X		A X
Impact Special cases, C type	MIL-STD-1344 Method 2015 EIA-364-42	8 x at 1.2 m (4 ft). Subclause 5.25	X		A X
Crimp tensile strength M & P types	MIL-STD-1344 Method 2003 EIA-364- 08	M Type: no breakage or pull out for 22 N (5 lb-f) or less. more specific for P, Subclause 5.21	X		A X
Insert retention C, D & M types	MIL-STD-1344 Method 2010 EIA-364-35	C: 517 kPa (75 psi), D: 414 kPa (60 psi), 1400 kPa (200 psi) for H(&D), M: 345 kPa (50 psi) max Subclause 5.18	X		A X
Contact Retention All types of crimp removable	MIL-STD-1344 Method 2007 EIA-364-29	45 N (10 lb-f) for size 22 contacts on C, 40 N (9 lb-f) for D, 22 N (5 lb-f) for P, M and 27 N (6 lb) for RF Subclause 5.7	X		A X
Cable retention D type only	MIL-STD-1344 Method 1006 EIA-364-38	2 N (8 oz-f) per contact Subclause 5.32	X		A X
Test/screen	Test method	requirement	Environmental category		
Electrical connectors (types: C, D, M, P, RF)			MIL	IND	SP1 - SP6
Mechanical tests and requirements:					
Contact engagement/ separation force C, D, M & P types	MIL-STD-1344 Method 2014 EIA-364-37	solder type contacts Subclause 5.9	X		A X

Contact insertion/ removal	MIL-STD-1344 Method 2012	C: less than 67 N (15 lb-f) (insert) less than 45 N (10 lb-f) (removal) for contact size 22. D: 18 N (4 lb-f) for intertion/ removal	X		A
(Not for hermetics) C & D types	EIA-364-05	Subclause 5.4		X	X
Maintenance aging	MIL-STD-1344 Method 2002		X		A
(Not for hermetics) C & D types	EIA-364-24	Subclause 5.22		X	X
* Vibration	MIL-STD-1344 Method 2005	Test cond. VI is default	X		A
All types	EIA-364-28	Subclause 5.14		X	X
Mechanical shock (specified pulse)	MIL-STD-1344 Method 2004	C: 300 Gs, D,M: 50 Gs, P: 100 Gs	X		A
All types	EIA-364-27	Subclause 5.11		X	X
External bending moment	EIA-364-43	Optional and not covered in detail in this document		X	X
Resistance to soldering heat	MIL-STD-202 Method 210	360 C for 4 to 5 s.	X		A
D and M types	EIA-364-56	Subclause 5.23		X	X
Solderability	MIL-STD-202 Method 208		X		A
D and M types	EIA-364-52	Subclause 5.24		X	X

Test/screen	Test method	Requirement	Environmental category		
Electrical connectors (types: C, D, M, P, RF)			MIL	IND	SP1 - SP6
Mechanical tests and requirements:					
Contact pin strength D type only	MIL-C-24308	Subclause 5.31	X		X
Coupling proof torque RF type only	Section 5.36				X
Electrical tests and requirements:					
Shell-to-shell conductivity C type only	MIL-STD-1344 Method 3007	Subclause 5.26 Maximum Potential depends on plating.	X		X
Dielectric withstanding voltage all types	MIL-STD-1344 Method 3001	Test condition I for sea level, Test condition IV for high-altitude 200 m (656 ft)	X		A
	EIA-364-20	Subclause 5.5		X	X

Magnetic permeability	MIL-STD-1344 Method 3006	relative permeability less than 2.0 mu	X		A
D type	EIA-364-54	Subclause 5.17		X	X
Insulation resistance (ambient and high temperature)	MIL-STD-1344 Method 3003	IR > 5000 M, at 500 Vdc, unconditioned. Default: Ambient = 25 C	X		A
all types	EIA-364-21	High temp = 200 C Subclause 5.6		X	X
Contact resistance	MIL-STD-1344 Method 3004	References MIL-C-38999, MIL-C-24308.	X		A
all hermetic types	EIA-364-06	Subclause 5.8		X	X
EMI shielding	MIL-STD-1344 Method 3008	Minimum leakage specified for different coupling types	X		A
C type only	EIA-364-66	Subclause 5.26		X	X

Test/screen	Test method	Requirement	Environmental category		
Electrical connectors (types: C, D, M, P, RF)			MIL	IND	SP1 - SP6
Electrical Tests and Requirements:					
VSWR	MIL-C-39012	Can also use EIA-364-67 for characteristic impedance.	X	X	X
RF type only					
RF Insertion Loss	MIL-C-39012		X	X	X
RF type only					
Low-level signal contact resistance	MIL-STD-1344 Method 3002	7 pairs of contacts	X		A
M and P types only	EIA-364-23			X	X
Environmental tests and special requirements:					
*Thermal cycling	MIL-STD-1344 Method 1003	In the range specified by environmental category conditions, 5 cycles, storage temp.range: -55 C to +85 C :	X		A
	EIA-364-32	SP1, -55 C to +125 C for SP2- SP6. Subclause 5.15		X	X
Salt spray (corrosion)	MIL-STD-1344 Method 1001.2	Not considered a minium requirement for space flight environments, depends on engineering documentation.	X		A
	EIA-364-26	For connectors without gold plated mechanical parts.		X	X
Ozone	MIL-STD-1344 Method 1007.1	Subclause 5.29	X		A
C type only	EIA-364-14			X	SP1 only, X
Humidity	MIL-STD-1344 Method 1002.2	Condition II. Not always necessary for space flight applications.	X		A
	EIA-364-31	Subclause 5.10		X	X
Flammablility	NHB 8060.1	30% oxygen materials test for non metal shell connectors. Essential for SP1 environment applications. Subclause 5.12			SP1 only
D, M & P					

Flammability	MIL-STD-1344 Method 1012	For military type environments.	X	
all types	ASTM D635	SP2-SP6 environments. Subclause 5.38		X SP2 - SP6 only

Test/screen	Test method	Requirement	Environmental category		
Electrical connectors (types: C, D, M, P, RF)			MIL	IND	SP1-SP6
Environmental tests and special requirements:					
Corona, RF only	EIA-364-44	Corona free at 70,000 ft		X	X
Outgassing (thermal vacuum) all types	ASTM 595E	Materials Test: 1% TML, 0.1% CVCM Subclause 5.13			X
Odor	NHB 8060.1	For nonmetal shell connectors. Subclause 5.12			SP1 only, X
Toxicity	NHB 8060.1	For nonmetal shell connectors. Subclause 5.12			SP1 only, X
Residual magnetism D type only	GSFC: S-311-P-4	Details of test in Subclause 5.33			X
UV weathering	TML test as a result of UV exposure.	Test procedure and testing can be conducted by Marshall Space Flight Center. Test is environment dependent. Subclause 5.39			X, SP2- SP6 only
Firewall protection C type only	MIL-STD-1344 Method 1009	Details in Subclause 5.28	X		A
Air leakage hermeticity	MIL-STD-1344 Method 1008	Hermetic Types Subclause 5.19	X		A
C, D and RF types	EIA-364-02			X	X
Atomic oxygen	Subclause 5.30	For nonmetal shell connectors. Testing available through Marshall Space Flight Center.			X

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Table 4 - Screen test vs. connector type

Test	Notes	Power circular	D-rectangular	Micromini rectangular	PC board	Coaxial
		C type	D type	M type	P type	RF type
Visual		X	X	X	X	X
Mating force/ coupling		X	X	X	X	X
Durability		X	X	X	X	X
*Impact	Special Cases	X				
Crimp tensile strength				X	X	
Insert retention		X	X	X		
Contact retention	Crimp Removable	X	X	X	X	X
Cable retention			X			
Contact eng/sep force	Solder Contacts	X	X	X	X	
Contact ins/rem force	Nonhermetics	X	X			
Maintenance aging	Nonhermetics	X	X			
Vibration		X	X	X	X	X
Mechanical shock		X	X	X	X	X
Resist. to sold. heat			X	X		
Solderability			X	X		
Contact pin strength			X			
Coupling proof torque						X
Shell-to-shell conduct.		X				
DWV		X	X	X	X	X
Magnetic permeability			X			
Insulation resistance	Ambient	X	X	X	X	X
Insulation resistance	High-temperature	X				
Contact resistance	Hermetics	X	X	X	X	X
EMI shielding		X				
Low-level signal				X	X	
RF insertion loss						X
VSWR						X
Thermal cycling		X	X	X	X	X
*Salt spray	Non-gold plating,	X	X	X	X	X
Ozone		X				
*Humidity	Non crucial for SP2 - SP6	X	X	X	X	X
**Flammability 30% O ₂	SP1, (NHB 8060.1)		X	X	X	
**Flammability	ASTM D635, SP2-SP6	X	X	X	X	X
Outgassing	SP1- SP6	X	X	X	X	X

**Toxicity	SP1, (NHB 8060.1)		X	X	X	
**Odor	SP1, (NHB 8060.1)		X	X	X	
Residual magnetism	SP1- SP6, Non Au over Cu		X			
**UV weathering	SP2- SP6		X	X	X	
Firewall protection		X				
**Atomic oxygen			X	X	X	
Air leakage (hermetics)		X	X			X
corona						X
* Test or screen is noncrucial for space flight environments.						
** Test or screen for nonmetal shell connectors only.						

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