



ANSI/EIA-710-A-2017
Approved: January 11, 2017

EIA-710-A

EIA SPECIFICATION

Requirements Guide for Space Grade Electrical Connectors

EIA-710-A
(Revision of EIA-710)

January 2017



Electronic Components Industry Association

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(From Standards Proposal No. 5341, formulated under the cognizance of the CE-2.0 Committee on EIA National Connector and Sockets Standards, and previously published in EIA-710).

Published by

©Electronic Components Industry Association 2017
EIA Standards & Technology Department
2214 Rock Hill Road, Suite 265
Herndon, VA 20170

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Foreword

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.

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Specification for Requirements Guide for Space Grade Electrical Connectors

(From EIA Standards Proposal No. 5341, formulated under the cognizance of the EIA CE-2.0 Committee on National Connector and Socket Standards, and previously published as EIA-710.)

1. Introduction

1.1 Scope

1.1.1 This requirements document is applicable to all types of single or multi contact electrical connectors including: circular, rectangular printed circuit, rectangular microminiature, rectangular D-subminiature, rectangular nanominiature, rectangular rack and panel, coaxial, and hermetic. This document will be used to determine 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, trans-atmospheric 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.

1.1.2 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 test 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 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 intended as 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 Applicable documents

NASA specifications and standards

- MSFC-STD-40M38277: Circular, miniature, high density, environment resisting, electrical connector
- MSFC-STD-40M38298: Circular, miniature, special, environment resisting, electrical connector

- MSFC-STD-40M39569: Circular, miniature, environmental resisting, 200 °C, electrical connector
- GSFC-S-311-P-4: Connectors, Electrical, Subminiature, Rack and Panel, General Specification for
- GSFC-S-311-P-10: Connectors, Electrical, Rectangular, Miniature, Polarized Shell, Rack and Panel, for Space Flight Use
- MSFC-SPEC-522: Design Criteria For Controlling Stress Corrosion Cracking
- NASA-STD-6001: Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials In Environments That Support Combustion
- NHB5300.4(1C): Inspection System Provisions
- NHB5300.4(3A-1): Requirements for Soldered Electrical Connections

Military specifications and standards

- MIL-STD-202-210: Test Method Standard Method 210, Resistance To Soldering Heat
- MIL-STD-202-301: Test Method Standard Method 301, Dielectric Withstanding Voltage
- MIL-STD-202-302: Test Method Standard Method 302, Insulation Resistance
- MIL-STD-889: Dissimilar Metals
- MIL-DTL-24308: Connectors, Electric, Rectangular, Non-environmental, Miniature, Polarized Shell, Rack And Panel, General Specification For
- MIL-DTL-26482: Connectors, Electrical, (Circular, Miniature, Quick Disconnect, Environment Resisting), Receptacles And Plugs, General Specification For
- MIL-DTL-32139: Connectors, Electrical, Rectangular, Nanominiature, Polarized Shell, General Specification For
- MIL-DTL-38999: Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, And Breech Coupling), Environment Resistant, Removable Crimp And Hermetic Solder Contacts, General Specification For
- MIL-PRF-39012: Connectors, Coaxial, Radio Frequency, General Specification For
- MIL-DTL-55302: Connectors, Printed Circuit Subassembly And Accessories
- MIL-DTL-83513: Connectors, Electrical, Rectangular, Microminiature, Polarized Shell, General Specification For

Industry specifications and standards

- SAE AS39029: Contacts, Electrical Connector, General Specification for
- SAE AS50151: Connectors, Electrical, Circular Threaded, AN Type, General Specification for
- ASTM-E595: Vacuum outgassing
- ASTM-D635: Flammability
- EIA/IPC/JEDEC J-STD-002: Solderability

- EIA-364: Electrical connectors test procedures
- EIA-364-02: (Air Leakage)
- EIA-364-05: (Contact Insert/Removal)
- 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 Resistance)
- EIA-364-24: (Maintenance Aging)
- EIA-364-26: (Salt Spray)
- EIA-364-27: (Mechanical Shock)
- EIA-364-28: (Vibration)
- EIA-364-29: (Contact Retention)
- EIA-364-31: (Humidity)
- EIA-364-32: (Thermal Shock)
- EIA-364-35: (Insert Retention)
- EIA-364-37: (Contact Engagement/Separation)
- EIA-364-38: (Cable Retention)
- EIA-364-42: (Impact)
- EIA-364-43: (Bending Moment)
- EIA-364-44: (Corona)
- EIA-364-45: (Firewall Flame)
- EIA-364-49: (Ultraviolet Radiation)
- EIA-364-54: (Magnetic Permeability)
- EIA-364-56: (Solder Heat Resistance)
- EIA-364-66: (EMI Shielding)
- EIA-364-83: (Shell-To-Shell and Shell-To Bulkhead Resistance)
- EIA-364-104: (Flammability)

2.2 Electrical connector categories

- Circular, power: C (MIL-DTL-26482, MIL-DTL-38999, SAE-AS50151)
- D-subminiature rectangular: D (MIL-DTL-24308)
- Microminiature rectangular: M (MIL-DTL-83513)
- Nanominiature rectangular: N (MIL-DTL-32139)
- Printed circuit, rectangular: P (MIL-DTL-55302)
- Coaxial: RF (MIL-PRF-39012)
- Rack and panel, rectangular: A (GSFC-S-311-P-4)
- Hermetic: H
- Contacts: T (SAE-AS39029)



2.3 NASA approved parts listing:

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), +200 °C

Specification number: 40M39569, circular, C: Miniature, environment resistant, (backshells and contacts available with connector), +200 °C

Specification number: AS50151, 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-DTL-26482, circular, C: series 2, miniature, quick disconnect, environment resistant. MS3470, MS3472, MS3474-76, MS3449.

Specification number: MIL-DTL-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-PRF-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-DTL-55302, printed circuit, P, Printed circuit, subassembly and accessories, non-environment resistant: M55302/55- M55302/66.

Specification number: MIL-DTL-24308, rectangular, D

— Rectangular, miniature, rack and panel:

— Nickel Finished Polarized Shell, Gold Plated Non-Removable Solder Contacts: M24308/1-34 to M24308/1-38, M24308/3-23 to M24308/3-27

— Gold Finish Polarized Shell, High-Density, Gold Plated Removable Crimp Contacts: M24308/6-512 to M24308/6-517, M24308/6-526 to M24308/6-531, M24308/8-335 to M24308/8-339, M24308/8-345 to M24308/8-350.

— Nickel Finished Polarized Shell, Gold Plated Removable Solder Contacts: M24308/2-516 to M24308/2-520, M24308/4-335 to M24308/4-339

— Gold Finish Polarized Shell, High-Density, Gold Plated Non-Removable Solder Contacts: M24308/5-34 to M24308/5-38, M24308/7-23 to M24308/7-27

— 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