Series 80 Connectors for Space Flight

1 Material Selection: What materials are approved for space flight? What materials are restricted? How to choose the right materials for Series 80 connectors.

What materials are approved for space flight?

Section C2 “Connectors and Contacts” of NASA EEE-INST-002 provides guidelines for materials used in connectors for space flight applications. Aluminum is a preferred material for connector components, and electroless nickel is the preferred finish. Beryllium copper is a preferred material for contacts. 50 microinch minimum gold plating is the preferred contact finish. LCP is a preferred material for dielectric insulating materials.

What materials are prohibited?

100% tin plating shall not be used. Pure tin can grow “whiskers” which can lead to catastrophic electrical short circuits. Silver plating is prohibited because of corrosion concerns. Cadmium is prohibited because it is unstable in vacuum environments.

Specifying Series 80 connectors for space flight

Standard Series 80 connectors meet NASA guidelines for material selection. Specify “M” for aluminum shells with electroless nickel finish. The table below lists the Series 80 materials.

SERIES 80 CONNECTOR MATERIALS APPROVED FOR SPACE FLIGHT

Component	Material	Notes
Shells, Coupling Nuts, Jam Nuts	Aluminum alloy 6061 per ASTM B211, electroless nickel plated	Approved for Space Flight
Rigid Insulators	Glass-filled liquid crystal polymer (LCP) in accordance with MIL-M-24519, Type GLP-30F	Approved for Space Flight
Contact Retention Clip	Beryllium copper, heat-treated, unplated	Approved for Space Flight
Grommet, Peripheral Seal, Interfacial Seal, O-ring	Blended fluorosilicone/silicone elastomer, 30% silicone per ZZ-R-765, 70% fluorosilicone per MIL-R-25988	Requires outgassing processing
Hermetic Insert	Vitreous glass	Approved for Space Flight
Pin Contact	Beryllium copper alloy per ASTM B197, 50 microinches gold plated per ASTM B488 Type 3 Code C Class 1,27 over nickel plate per QQ-N-290 Class 2, 50-100 microinches	Approved for Space Flight
Pin Contact, Hermetic	Nickel-iron alloy per ASTM F30 (Alloy 52),50 microinches gold plated per ASTM B488 Type 3 Code C Class 1,27 over nickel plate per QQ-N-290 Class 2, 50-100 microinches	Ferromagnetic material.
Socket Contact	Beryllium copper alloy per ASTM B197, 50 microinches gold plated per ASTM B488 Type 3 Code C Class 1,27 over nickel plate per QQ-N-290 Class 2, 50-100 microinches.	Approved for Space Flight
Socket Contact Hood	Stainless steel, passivated per AMS-QQ-P-35	Approved for Space Flight
Adhesives	RTV and epoxies (see following table for outgassing info)	Requires outgassing processing
Potting Compound, PCB and Solder Cup Versions	Environmental and Hermetic Connectors: Stycast 2651/Catalyst 9 epoxy encapsulant. Filter Connectors: Stycast 2850FT/Catalyst 11 thermally conductive epoxy encapsulant.	Approved for Space Flight
Filter Element	Multilayer Ceramic Planar Array, ferrite inductors	Approved for Space Flight

Dimensions in inches (millimeters) and are subject to change without notice.

Glenair®

Series 80 Connectors
Guidelines for Space-Grade Applications

Series 80 Connectors for Space Flight

2 Outgassing: What is outgassing and how does it affect connector selection? Is special processing required to meet outgassing requirements?

What is outgassing?

Plastic and rubber materials give off gaseous molecules. For example, the smell inside a new car is caused by polymer outgassing. Heat and vacuum increase the rate of diffusion. In a spacecraft the gases coming off polymers can contaminate optical surfaces and instruments. The result is degraded performance.

How is outgassing measured?

The space industry has adopted a standardized test procedure, ***ASTM E 595***, to evaluate out-gassing properties of polymers. Small samples of material are heated to 125° C. at a vacuum of 5 X 10^{-5} torr for 24 hours.

Then the sample is weighed to calculate the ***Total Mass Loss*** (TML). The TML cannot exceed 1.00% of the total initial mass. During the test, outgassed matter condenses on a cooled collector plate. The quantity of outgassed matter is caluclated to determine the ***Collected Volatile Condensable Material*** (CVCM). The CVCM cannot exceed 0.10% of the original specimen mass.

Is special outgassing processing necessary on Series 80 connectors?

NASA states "A bakeout for outgassing control is driven by the application and may be required where tight contamination control must be maintained." NASA generally recommends that military circular connectors undergo outgassing processing. This processing can be performed by Glenair; however, some customers prefer to fabricate higher level subassemblies before outgassing processing.

Outgassing At-a-Glance

1 Fluorosilicone rubber components and encapsulants exceed NASA outgassing limits.

2 NASA recommends outgassing processing to reduce outgassing to acceptable levels.

3 An inexpensive oven bakeout has better results than the more costly thermal vacuum outgassing. The higher temperature of the oven bakeout is more effective at removing volatile materials. However, both methods assure compliance with outgassing limits.

4 Glenair Mod 429 codes provide an easy ordering solution, whatever the outgassing option.

OUTGASSING PROPERTIES OF MATERIALS USED IN SERIES 80 CONNECTORS

Component	Material	TML %	TCVML %	Test Reference
Front and Rear Insulator	Liquid Crystal Polymer Vectra C130	0.03	0.0	NASA Test # GSC17478
Rear Grommet Interfacial Seal Peripheral Seal	Blended flourosilicone/silicone elastomer, 30% silicone per ZZ-R-765, 70% flourosilicone per MIL-R-25988	0.48	0.14	Glenair testing conducted at NuSil Technology 02/27/2001
Front-To-Rear Insulator Bonding Material	Eccobond 104 A/B	0.52	0.08	Emerson & Cuming Data Sheet
Insulator-to-Rubber Bonding Material	DC3145 RTV, per MIL-A-46146	2.52	0.58	NASA Test GSC28621
Coupling Nut Retainer	Torlon® 4203L	1.88	0.01	Glenair Test at NuSil Technology 03-12-2003
Coupling Nut Epoxy	Hysol C9-4215	0.48	0.01	Glenair Test
O-Ring	Flourosilicone Rubber	0.32	0.03	NASA Test GSFC8687
White Epoxy Ink for Silkscreening	Markem 7224 White	0.49	0.03	NASA Test #GSC19899
Black Ink for Part Number Identification	Videojet #16-5600Q	TBD	TBD	
Potting Compound, Solder Cup and PC Tail Connectors	Hysol C9-4215	0.48	0.01	Glenair Test
Potting Compound, Solder Cup and PC Tail Connectors	DC3145 RTV, per MIL-A-46146	2.52	0.58	NASA Test GSC28621
Potting Compound, Filter Receptacles	Stycast epoxy, 2850FT/Catalyst 11	0.29	0.02	Mfgr Data Sheet

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3 **Screening**: What is NASA screening and what level of screening is required?

What is NASA screening?

NASA specification EEE-INST-002 provides instructions on selecting, screening and qualifying parts for use on NASA GSFC space flight projects. Table 2A in the NASA specification contains inspection instructions for circular connectors including MIL-DTL-38999. Series 80 connectors are not mentioned in the NASA spec but are similar to D38999 connectors, so Table 2A applies by similarity to Series 80 connectors.

What screening level is required?

NASA defines three levels of screening: level 1 for highest reliability, level 2 for high reliability, and level 3 for standard reliability. Level 3 equates to standard lot acceptance inspection. Levels 1 and 2 call for additional testing.

What about qualification requirements?

Projects using connectors covered by military specifications are typically able to waive qualification testing. The Series 80 connector has been rigorously tested by Glenair but is not covered by a military specification. Projects considering using the Series 80 for space flight should obtain guidance from the overseeing space agency regarding the suitability of existing Glenair Series 80 test data, available on request.

NASA EEE-INST-002 SCREENING REQUIREMENTS

Inspection/ Test	NASA Level 1	NASA Level 2
Visual Inspection	100%	100%
Mechanical	2 pcs.	2 pcs.
Voltage (DWV)	2 pcs.	2 pcs.
Insulation Resistance	2 pcs.	2 pcs.
Contact Engagement and Separation Force (socket contacts)	2 pcs.	N/A
Coupling Force	2 pcs.	N/A
Air leakage (Hermetic connectors only)	100%	100%
Solderability/Resistance to Soldering Heat	2 pcs.	N/A

1. NASA screening requirements from Table 2A of EEE-INST-002 “Screening Requirements for Circular Connectors...”

4 **Magnetic permeability**: Are nonmagnetic connectors required?

Spacecraft designers generally avoid the use of ferromagnetic materials, which can become magnetized and can interfere with sensitive instruments. Series 80 aluminum shell connectors have a maximum permeability of 2 mu. Hermetic Series 80 connector pins are iron alloy, a highly magnetic material.

5 **Cryogenic exposure**: Space programs sometimes need cryogenic connectors capable of withstanding temperatures as low as -270° C. Can Series 80 connectors operate satisfactorily at this temperature?

Series 80 connectors are rated to -65° C. Glenair does not have data to validate these connectors for cryogenic applications. EEE-INST-002 states “...experience has proven it is possible for (non-certified) connector types to be used successfully at cryogenic temperatures. It is recommended that connector samples should be subjected to five cycles of cryogenic temperature...(followed by examination for cracks and DWV)”.