Five things you should know about Series 80 connectors for space flight

1 Material Selection: What materials are approved for space-grade connectors? What materials are prohibited? Does the Series 80 connector contain space-approved materials?

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

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

4 Magnetic permeability: Are nonmagnetic connectors required?

5 Cryogenic exposure: Are these connectors suitable for -200° C. exposure?

Series 80 Connectors for Space Flight

The small size and reduced weight of the Series 80 connector make it an excellent choice for space instrumentation. Series 80 connectors are available with special screening and outgassing for satellites and space vehicles. This section explains NASA guideline for connector selection, screening and outgassing. This section also explains how to order connectors screened to meet NASA EEE-INST-002.

How To Order Space Grade Series 80 Connectors

Step 1: Find a Standard Part Number
Electroless nickel plated shells are preferred for space flight. Cadmium plating is prohibited.

Step 2: Select a NASA Screening Level
The term "Screening Level" refers to the final inspection procedure.
Level 1 for mission-critical highest reliability
Level 2 for high reliability
Level 3 for standard reliability

Step 3: Choose Outgassing
A detailed explanation of outgassing is on the following pages. The fluorosilicone rubber seals commonly used on aerospace-grade connectors such as MIL-DTL-38999 and Series 80 connectors, along with certain bonding agents and inks, do not meet NASA outgassing requirements unless the connector is specially processed. Glenair outgassing tests have shown oven baking or thermal vacuum outgassing processing are sufficient to reduce outgassing levels to NASA standards. Oven baking is more economical than thermal vacuum outgassing.

Step 4: Select the Mod Code that Matches the Desired Level of Screening and Outgassing
Use the following table to choose the right modification code. Add the mod code to the connector part number. Example: 801-007-16M6-7PA-***429j***

NASA Screening and Outgassing Modification Codes

NASA Screening Level	Special Screening Only	Special Screening Plus Outgassing	
		Thermal Outgassing	Thermal Vacuum Outgassing
Level 1 Highest Reliability	Mod 429B	Mod 429J 48 Hours at 175°C	Mod 429C 24 Hours at 125°C
Level 2 High Reliability	Mod 429	Mod 429K 48 Hours at 175°C	Mod 429A 24 Hours at 125°C
Level 3 Standard Reliability	(Use standard part number)	Mod 186S 48 Hours at 125°C	Mod 186M 24 Hours at 125°C

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

Series 80 Connectors for Space Flight

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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.

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 calculated 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.

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

Outgassing Properties of Materials used in Series 80 connectors				
Component	Material	TML %	TCVML %	Test Reference
Front and Rear Insulator	LCP	0.07	0.0	Glenair test at Pacific Testing Laboratories 07-25-2017
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

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)".

