

MIL-DTL-38999 Connectors for Space Flight

Nonmetallic materials such as rubber, plastic, adhesives and potting compounds can give off gasses when subjected to a vacuum or high heat. The space industry has adopted a standardized test procedure, ASTM E 595, to evaluate outgassing properties of products that contain polymer materials. In the ASTM test, material samples are heated to 125° C at a vacuum of 5 X 10⁻⁵ torr for 24 hours. The test sample is then weighed to calculate the Total Mass Loss (TML), which may not exceed 1.00% of the total initial mass. Likewise the quantity of outgassed matter is weighed to determine the Collected Volatile Condensable Material (CVCM), which may not exceed 0.10% of the original specimen mass.

For space grade applications, Glenair is able to offer both an 8 hour 400° bakeout process as well as a 24 hour 125° thermal vacuum outgassing process on connector products that must conform to NASA screening or other

outgassing standards. Our experience has been that the simpler bakeout process is more than adequate to meet the ASTM E 595 benchmark of 1.00% TML and 0.10% CVCM.

Glenair is well versed in supplying connector products that are optimized for use in space grade applications, and we supply MIL-DTL-38999 type compliant to EEE-INST-002, Table 2G, the recognized standard for space grade connectors. 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. Specify “M” for aluminum shells with electroless nickel finish.

OUTGASSING PROPERTIES OF MATERIALS USED IN MIL-DTL-38999 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	1.74	0.90	NASA Test GSFC0191
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
White Epoxy Ink for Silk-screening	Markem 7224 White	0.49	0.03	NASA Test #GSC19899
Potting Compound, Solder Cup and PC Tail Connectors	Hysol C9-4215	0.48	0.01	Glenair Test
Potting Compound, Filter Receptacles	Stycast epoxy, 2850FT/Catalyst 11	0.29	0.02	Mfgr Data Sheet



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1. Fluorosilicone rubber components such as O-rings and grommets 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. Spacecraft designers generally avoid the use of ferromagnetic materials, which can become magnetized and can interfere with sensitive instruments. Aluminum shell connectors have a maximum permeability of 2 mu. Hermetic connector pins are iron alloy, a highly magnetic material.
5. Space programs sometimes need cryogenic connectors capable of withstanding temperatures as low as -270° C. D38999 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)".

MIL-DTL-38999 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