



THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

OUTGASSING Selecting Spacecraft Materials

Outgassing is the release of by-products such as water vapor, gases, oil, or additives from materials that are subject to the vacuum of space or elevated temperatures. When selecting materials for space applications, outgassing is one of the most critical properties to consider. Outgassing can cause significant problems to satellites or spacecraft by impacting critical components such as electronics, optics, and sensors. Furthermore, outgassing can even pose health hazards. Often, these by-products are captured in materials during the manufacturing process. This is why it's crucial to produce top-notch materials using cutting-edge manufacturing techniques, similar to those provided by The Gund Company.

Industry Standard Testing

Testing for material outgassing typically follows the industry Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment, ASTM E595.

The ASTM E595 tests materials under vacuum at 125°C for 24 hours. During this condition, the material outgassing vapor passes through a chamber, where the outgassing will be contained on a collector plate. After the 24-hour testing parameter, the samples are weighed in order to determine the Total Mass Lost (TML) and Collected Volatile Condensable Material (CVCN) percentage.



One critical aspect of testing, initially developed by NASA and widely adopted by industry leaders, is the acceptable limit for outgassing. These limits are stringent, with the acceptable levels being less than 1% for Total Mass Loss (TML), and less than 0.10% for Collected Volatile Condensable Material (CVCN). Additionally, the water vapor regained (WVR) can be evaluated to understand how much moisture is regained at room temperature for 24 hours.

Check out The Gund Company's extensive list of acceptable laminates, thermoplastics and films that offer low outgassing values.



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Laminates

Material	Standards	Resin/Substrate	Data Reference	TML %	CVCM%	WVR%	Cost	Additional Properties
G7	NEMA LI-1 (IM 60000) MIL-I-24768/17 GSG IEC 60893: SI GC 201 / SI GC 202 (sheet & tube)	Silicone/Glass	GSC11521	0.09	0.02	0.01	\$\$\$\$	Material Data Sheet
G10	NEMA LI-1 (IM 60000) MIL-I-24768/2 GEE IIEC 60893: EP GC 201 (sheet), IEC 61212: EPGC21 (tube)	Epoxy/Glass	GSFC06614	0.52	0.00	0.16	\$\$	Material Data Sheet
FR4	NEMA LI-1 (IM 60000) MIL-I-24768/27 GEE-F IIEC 60893: EP GC 202 (sheet)	Epoxy/Glass	GSC23727	0.22	0.00	0.09	\$\$\$	Material Data Sheet
G11	NEMA LI-1 (IM 60000) MIL-I-24768/3 GEB EPGC 203, 22	Epoxy/Glass	GSFC8999	0.59	0.00	0.20	\$\$\$	Material Data Sheet
G30	NEMA LI-1 (IM 60000) IEC 60893-3-7 PI GC 301	Polyimide/Glass	GSFC09476	0.71	0.00	0.40	\$\$\$\$\$	Material Data Sheet



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Thermoplastics

Material	Standards	Compound	Data Reference	TML %	CVCM%	WVR%	Cost	Additional Properties
PEEK	MIL-P-46183 Type 2 Class 1 & 3 (other grades available)	Polyetheretherketone	GSFC30151	0.14	0.00	0.05	\$\$\$\$\$	Material Data Sheet
Delrin Acetal	ASTM D 4181	Polyoxymethylene (POM)	GSFC17976	0.28	0.02	0.13	\$\$\$	Material Data Sheet
Rulon	--	Reinforced PTFE	GSC21579	0.00	0.00	0.01	\$\$\$	Material Data Sheet
Ryton	--	Polyphenylene Sulfide (PPS)	GSFC6826	0.09	0.00	0.01	\$\$\$\$	Material Data Sheet
Teflon	MIL-I-19161A	Polytetrafluoroethylene (PTFE/FEP)	GSFC10661	0.01	0.00	0.02	\$\$\$	Material Data Sheet
UHMW	--	Ultra High Molecular Weight Polyethylene	GSFC28162	0.06	0.00	0.00	\$\$	Material Data Sheet
Ultem®	--	Polyetherimide(PEI)	GSFC3286	0.40	0.00	0.32	\$\$\$\$	Material Data Sheet

Films

Material	Standards	Compound	Data Reference	TML %	CVCM%	WVR%	Cost	Additional Properties
Kapton®	--	Polyimide	GSC10365	0.97	0.00	0.80	\$\$\$\$\$	Material Data Sheet
Mylar®	--	Polyester	GSFC31726	0.24	0.01	0.18	\$\$	Material Data Sheet
Dacron	MIL-I-22834 MIL-E-917 D	Polyester	GSFC12706	0.16	0.02	0.04	\$\$	--
Teflon	MIL-I-19161A	Polytetrafluoroethylene (PTFE/FEP)	GSFC10661	0.01	0.00	0.02	\$\$\$	Material Data Sheet

*Values obtained from NASA Reference Publication GSFC data references.

Data supplied above are typical values and are not to be considered specification values. All of the information, suggestions and recommendations pertaining to the properties and uses of the products herein are based upon tests and data believed to be accurate; however, the final determination regarding suitability of any material described herein for the contemplated application, the manner of such use, and whether the use infringes any patents is the sole responsibility of the user. There is no warranty, expressed or implied, including, without limitation warranty of merchantability or fitness for a particular purpose. Under no circumstances shall we be liable for incidental or consequential loss or damage.



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Markets



Electric Vehicles



Electric Motors



Power Generators



Transformers



Switchgear



Electronics



Military/Aerospace



Communications/5G



Medical

Our Expertise Is Your Competitive Advantage

We provide a wide range of material solutions from rigid, glass epoxy composites to high-temperature, silicone sponge.

We take a consultative approach to understanding your application and work with your engineers and buyers to find the material that fits your application. By understanding the most important material properties, we can work to find cost reduction opportunities. Our Application Engineering Teams have decades of material experience and look forward to working with you on your upcoming project.

Material Families:

- Thermoset Rigid Laminates and Composites
- Flexible Laminates, Papers, Films, and Felts
- Thermoplastic Materials
- Elastomeric Materials

Our Engineering Capabilities Include:

- Custom Material Development
- Resin Formulation
- Laboratory Testing
- Comparative Materials Evaluation

Our Manufacturing Capabilities Include:

- Compression Molding
- Pultrusion
- Filament & Convoluted Wound Tube
- Infusion & B-Stage Composites Lay-up and Molding
- Injection Molding
- Extrusion of Thermoplastics



Global Footprint – Local Service

