THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS



VALUE THROUGH TRUSTED PERFORMANCE

www.thegundcompany.com | World HQ 314.492.4800

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WHO IS TGC / OUR PHILOSOPHY

- We Are The Gund Company
- We are Thermoset Composite Materials Manufacturers and Fabricators
- Why You Should Replace Metals with Plastics and Composites in Space

OUTGASSING SELECTING SPACECRAFT MATERIALS BY THE GUND CO

COMPOSITES & THERMOSET MATERIALS

- Cryo G-10 Data Sheet
- NEMA FR4 Data Sheet
- NEMA G-11 Data Sheet
- NEMA G-11R (Roving Reinforced)
- NEMA G-15 Data Sheet
- NEMA G-7 Data Sheet
- NEMA FR5 Data Sheet
- MICA M Data Sheet
- MICA P Data Sheet
- Vetronite EGS 619 HTC Data Sheet

HIGH PERFORMANCE THERMOPLASTICS

- Thermoplastic selection guide
- Delrin® Data Sheet
- Acetal Data Sheet
- Vespel® Data Sheet
- Torlon® Data Sheet
- Ultem™ Data Sheet
- PEEK™ Data Sheet
- Teflon® Data Sheet
- Kapton® Data Sheet
- Rulon® (PTFE) Data Sheet

QUALITY/INSPECTION

CORPORATE INFORMATION

THE GUND COMPANY

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We Are The Gund Company

The Gund Company is a leading manufacturer and fabricator of thermoplastic and composite material solutions for the space industry. Leveraging more than 75 years of experience of being a vertically integrated manufacturer, The Gund Company specializes in precision machined thermoplastics and composite components designed for mission critical space applications. The company offers a broad portfolio of plastics, composites, elastomeric, and flexible materials solutions engineered to meet the rigorous performance, reliability, and environmental demands of spaceflight. The company is AS9100D certified, ISO 9001:2015 certified, ITAR compliant, and NADCAP accredited, making it a trusted supplier for space programs.

OUR PHILOSOPHY

The Gund Company bases our business philosophy on providing value to the customer. To better define what constitutes value to the customer, The Gund Company uses the formula below to guide our daily actions.

$$\frac{\text{QUALITY} \times \text{SERVICE}}{\text{COST} \times \text{CYCLE TIME}} \text{ (TRUST)} = \text{VALUE}$$

While the value formula cannot produce a specific, meaningful number, it shows us the mathematical relationship between value and its critical components.
As Quality improves, Value increases.

- As Customer Service improves, Value increases.
- As Cost decreases, Value increases.
- As Cycle Time decreases, Value increases.
- Trust in our Character and Competence is a multiplier increasing the Value received by the customer.

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We are Thermoset Composite Materials Manufacturers and Fabricators

Thermoset rigid laminates are composite materials. By definition, composite materials consist of two or more materials. In most thermoset rigid laminates, the primary materials include a substrate or base material such as paper, cotton cloth, or glass cloth, along with a resin or adhesive such as epoxy, melamine, or silicone. For thermoset laminate production, the base material is coated with an adhesive so that layers of material can be pressed into sheet form under heat and pressure.

Thermosetting materials are strong materials consisting of resin and a substrate. They do not melt at high temperatures and cannot be reformed. They are rigid by nature, so they are easily machinable.

The Gund Company is one of North America's largest filament wound-tube and pultrusion manufacturers, with competence in multiple facilities. In addition, we can supply compression and resin transfer molded parts, convoluted wound tubes, autoclaves, and large layup and spray products. We have the resources and capabilities to manufacture products and processes rapidly.

TYPES OF THERMOSET RIGID COMPOSITE PRODUCTS

- High-Pressure Laminates
- Filament & Convolute Wound Tubing
- Low-Pressure Laminates
- Pultruded Shapes (Rod, Tube, Angle, & Channel)
- Compression Molded BMC
- Vacuum Infusion Molding
- Autoclave Composite Molding

TYPICAL PRODUCT NAMES

- Glass Epoxy, NEMA Grades FR4, G-10, G-11
- Glass Silicone, NEMA Grade G-7
- Glass Polyimide, NEMA Grade G-15
- Silicone Bonded Mica Paper Laminate
- Filament Wound Glass Epoxy Tubing
- Glass Polyester, NEMA Grade GPO-3
- Stand-Off Insulators
- Custom Composite Molded Components



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Why You Should Replace Metals with Plastics and Composites in Space

As spacecraft and satellite systems demand higher performance at lower mass, engineers are replacing traditional metallic components with advanced plastics and composite materials. In the extreme environment of space, characterized by launch loads, thermal cycling, vacuum conditions, and radiation exposure—engineered polymers and composites offer material advantages that metals cannot provide alone. When properly selected, space-grade plastics and composites enable lighter structures, improved dimensional stability, and enhanced functional performance critical to modern space missions.

- **SIGNIFICANT WEIGHT REDUCTION**
  Advanced polymer composites provide exceptional strength to weight ratios compared to aluminum and steel, enabling mass reductions that directly translate into increased payload capacity or reduced launch costs. Lightweight composite structures are now widely used in spacecraft panels, antenna booms, and structural supports.
- **SUPERIOR THERMAL STABILITY AND LOW CTE**
  Many composite and thermoplastic materials exhibit low coefficients of thermal expansion (CTE), maintaining dimensional stability across the extreme temperature swings experienced in space. This is critical for precision aligned systems.
- **CORROSION AND VACUUM RESISTANCE**
  Unlike metals, plastics and composites do not corrode and are inherently resistant to moisture, atomic oxygen, and chemical degradation. When formulated for low outgassing, these materials remain stable in high vacuum environments and help protect sensitive optics and electronics from contamination.
- **ELECTRICAL INSULATION AND EMI CONTROL**
  Engineered polymers provide inherent electrical insulation, eliminating the need for additional isolation layers often required with metals. Composite systems can also be tailored for electromagnetic interference (EMI) control, supporting reliable operation of spacecraft electronics and communication systems.
- **DESIGN FLEXIBILITY AND FUNCTIONAL INTEGRATION**
  Plastics and composites enable complex geometries, integrated features, and multifunctional designs that are difficult or costly to achieve with metal machining. This flexibility supports part consolidation, reduced assembly complexity, and optimized system performance.
- **RADIATION PERFORMANCE**
  Certain polymer based composites offer effective radiation attenuation while remaining significantly lighter than metallic shielding solutions. These materials are increasingly evaluated for both structural and protective roles in space systems.

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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 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 1,250°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 (CVCM) 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 (CVCM). Additionally, the water vapor regained (WVR) can be evaluated to understand how much moisture can be 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.

LAMINATES

MATERIAL	Standards	Resin/Substrate	Data Reference	TML %	CVCM%	WVR%	Cost	Add. Properties
G-7	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	$$$$	Tech. Data Sheet
G-10	NEMA LI-1 (IM 60000) MIL-I-24768/2 GEE IIEC 60893: EP GC 201 (sheet), IEC 61212: EP GC 21 (tube)	Epoxy/Glass	GSFC06614	0.52	0.00	0.16	$$	Tech. 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	$$$	Tech. Data Sheet
G-11	NEMA LI-1 (IM 60000) MIL-I-24768/3 GEB EP GC 203, 22	Epoxy/Glass	GSFC8999	0.59	0.00	0.20	$$$	Tech. Data Sheet
G-30	NEMA LI-1 (IM 60000) IEC 60893-3-7 PI GC 301	Polyimide/Glass	GSFC09476	0.71	0.00	0.40	$$$$$	Tech. Data Sheet

The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application. A variety of dimensions and diameter sizes are available. Product colors vary according to material type.

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Outgassing (cont.)

THERMOPLASTICS

MATERIAL	Standards	Resin/Substrate	Data Reference	TML %	CVCM%	WVR%	Cost	Add. Properties
PEEK™	MIL-P-46183 Type 2 Class 1 & 3 (other grades available)	Polyetheretherketone	GSFC30151	0.14	0.00	0.05	$$$$$	Tech. Data Sheet
Delrin® Acetal	ASTM D4181	Polyoxymethylene (POM)	GSFC17976	0.28	0.02	0.13	$$$	Tech. Data Sheet
Rulon®		Reinforced PTFE	GSFC6826	0.00	0.00	0.01	$$$$	Tech. Data Sheet
Ryton®		Polyphenylene Sulfide (PPS)	GSC21579	0.09	0.00	0.01	$$$$	Tech. Data Sheet
Teflon®	MIL-I-19161A	Polytetrafluoroethylene (PTFE/FEP)	GSFC10661	0.01	0.00	0.02	$$$	Tech. Data Sheet
UHMW		Ultra High Molecular Weight Polyethylene	GSFC28162	0.06	0.00	0.00	$$	Tech. Data Sheet
Ultem®		Polyetherimide (PEI)	GSFC3286	0.40	0.00	0.32	$$$$	Tech. Data Sheet

FILMS

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

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Cryo G-10 Maintains Electrical, Mechanical, and Physical Properties in Space

Cryogenic environments where temperatures can reach extremely frigid temperatures of -200°C or lower often pose significant problems for typical composite materials. When exposed to cryogenic environments, materials tend to become hard and brittle, increasing their susceptibility to damage. High-performance specialized materials are essential for maintaining critical electrical, mechanical, and physical properties in these harsh environments. **The Gund Company is a renowned composites manufacturer and a leading industry expert in engineered high-pressure laminate composites for extreme subzero environments, such as Cryo G-10.**

Cryo G-10 is a specialized continuous filament woven fiberglass sheet bonded with low-temperature epoxy resin. The non-brominated material can maintain excellent electrical, mechanical, and physical properties in cryogenic environments ranging from -270°C to 135°C.

The Gund Company works directly with engineers to design customized solutions for a wide range of critical applications, from next-gen composite materials to specialty machined components for extreme cryogenic conditions, to meet the needs of the space exploration industry.

STANDARDS: NEMA LI-1 (IM 60000): Grade G-10 | MIL-I-24768/2 GEE

		ASTM/ISO		TYPICAL VALUES
	PROPERTIES (HPL from B Stage)	**Test Method**	**Units**	**CRYO G-10**
PHYSICAL	Glass Content from LOI		%	70.5
	Density		gm/c.c.	2.00
	Outgassing: TML	ASTM E595	%	0.29
	Outgassing: CVCM	ASTM E595	%	0.01
	Outgassing: WVR	ASTM E595	%	0.10
THERMAL	Coefficient of Thermal Expansion: Perpendicular @ Room Temperature	ISO 11359-2	/°C·10^{-6}	26.04
	Coefficient of Thermal Expansion: Parallel @ -196°C	ISO 11359-2	/°C·10^{-6}	8.08
	Thermal Conductivity: Room Temperature	ISO 8302	W/m°C	0.235
	Thermal Conductivity: -196°C	ISO 8302	W/m°C	0.28
MECHANICAL	IZOD Impact Strength: Room Temperature	ISO 180	KJ/m^2	139
	Charpy Impact Strength: Room Temp	ISO 179	KJ/m^2	131
	Charpy Impact Strength: -196°C	ISO 179	KJ/m^2	148
	In-Plane Shear Strength: Room Temperature	ASTM D3846	KSI (MPa)	10.5 (73)
	In-Plane Shear Strength: -100°C	ASTM D3846	KSI (MPa)	20.5 (142)
	In-Plane Shear Strength: -196°C	ASTM D3846	KSI (MPa)	21 (148)
	Compressive Strength: Room Temperature	ASTM D695	KSI (MPa)	84 (583)
	Compressive Strength: -100°C	ASTM D695	KSI (MPa)	120 (826)
	Compressive Strength: -196°C	ASTM D695	KSI (MPa)	141 (974)
	Parallel Shear: Room Temp.	ASTM D3846	MPa	73.5
	Parallel Shear: -100°C	ASTM D3846	MPa	141.5
	Parallel Shear: -196°C	ASTM D3846	MPa	148
	Tensile Strength: Room Temperature	ISO 527-4	KSI (MPa)	78 (537)
	Tensile Strength: -100°C	ISO 527-4	KSI (MPa)	102 (708)
	Tensile Strength: -196°C	ISO 527-4	KSI (MPa)	109 (754)
	Flexural Strength: Room Temperature	ISO 178	KSI (MPa)	82 (567)
	Flexural Strength: -100°C	ISO 178	KSI (MPa)	126 (870)
	Flexural Strength: -196°C	ISO 178	KSI (MPa)	156 (1,076)

LAMINATE SHEET AVAILABILITY

SHEET SIZE
- 30" x 48" or 60" x 48" or 48" x 120"

THICKNESS
- 0.006" to 5.000"

LAMINATE SHEET AVAILABILITY (SI)

SHEET SIZE
- 76 cm x 122 cm or 122 cm x 152 cm or 122 cm x 305 cm

THICKNESS
- 0.15 mm to 127 mm

The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application. A variety of dimensions and diameter sizes are available. Product colors vary according to material type.

CRYO G-10

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NEMA FR4

Glass Epoxy Laminate

NEMA Grade FR4 materials are glass fabric reinforced laminates bonded with flame-resistant epoxy resin. This material can maintain excellent mechanical, electrical, and physical properties at elevated temperatures of up to 130°C. FR4 from The Gund Company is UL, RoHS, and REACH certified, ensuring reliability, safety, and consistency (UL File No. E339275). The Gund Company offers FR4 convolute tubes in virtually any custom size for both inside and outside diameters, based on customer specifications.

STANDARDS: NEMA LI-1: GRADE FR4 | MIL-I-24768/27 GEE-F | IEC 60893: EP GC 202

The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application. The standard color is green. Custom colors are available upon request.

	PROPERTIES	ASTM/IEC Test Method	Units - English (SI)	NEMA Required*	IEC Required**	Typical Values
PHYSICAL	Density		lb/in^3 (g/cc)			0.067 (1.85)
	Moisture Absorption (0.125")	ASTM D570	%	0.15 max		0.10
	Moisture Absorption (1.5 mm)		mg		19 max	13
THERMAL	Flammability Rating	UL94	Class	V-I	V-0	V-0
	Coefficient of Thermal Expansion	ASTM E228	"/"°C·10^{-6}			15
	Temperature Index	ASTM D2304	°C			130
	Glow Wire Flame Index & Ignition Temperature	IEC 60695-2-12	°C			960
	Hot Wire Ignition	UL 746A	Sec			120
MECHANICAL	IZOD impact: Notched, LW (0.062")	ASTM D229	ft·lbs/in	7.0 min		13
	IZOD impact: Notched, CW (0.062")	ASTM D229	ft·lbs/in	5.5 min		12
	Flexural Strength: LW (0.062")	ASTM D790	ksi (MPa)	60.0 (414) min		80 (552)
	Flexural Strength: CW (0.062")	ASTM D790	ksi (MPa)	50.0 (345) min		70 (483)
	Flexural Strength	ISO 178	MPa		340 min	560
	Bonding Strength: LW (0.500")	ASTM D229	lb (kg)	2,000 (907) min		2,500 (1,133)
	Bonding Strength: CW (0.500")	ASTM D229	lb (kg)	1,600 (725) min		1,900 (862)
	Charpy Impact Strength	ISO 179	kJ/m^2		33 min	49
	Tensile Strength: LW (0.125")	ASTM D638	ksi (MPa)			62 (430)
	Compressive Strength: Flatwise (0.500")	ASTM D695	ksi (MPa)			66 (455)
	Flexural Modulus: LW (0.062")		ksi (GPa)			2,900 (20)
	Flexural Modulus: CW (0.062")		ksi (GPa)			2,600 (18)
	Shear Strength: Punch Type (0.062")	ASTM D732	PSI (MPa)			21,500 (148)
ELECTRICAL	Breakdown Voltage: Cond. A (0.062")	ASTM D149	kV	45 min		66
	Breakdown Voltage: Cond. D-48/50 (0.062")	ASTM D149	kV	40 min		65
	Permittivity: Cond. A @ 1 MHz (0.062")	ASTM D150		5.2 max		4.4
	Permittivity: Cond. D-24/23 @ 1 MHz (0.062")	ASTM D150		5.4 max		4.5
	Dissipation Factor: Cond. A @ 1 MHz (0.062")	ASTM D150		0.025 max		0.014
	Dissipation Factor: Cond. D-24/23 @ 1 MHz (0.062")	ASTM D150		0.035 max		0.015
	Perpendicular Electrical Strength: 90°C in Oil (1.5 mm)	IEC 60243-1	kV/mm		13 min	25
	Parallel Breakdown Voltage: Stepped @ 90°C in Oil (3 mm)	IEC 60243-1	kV		35 min	>45
	Insulation Resistance: After Water Immersion		MΩ		5·10^4	>10^7
	High Current Arc Ignition (3 mm)	UL 746A	Arcs			120
	Arc Resistance (0.125")	ASTM D495	Sec			140
	Comparative Tracking Index (0.125")	ASTM D3638***	V			230
	Dielectric Strength: Cond. A	ASTM D149	V/mil			635
	Volume Resistivity (0.062")	ASTM D257	Ω - cm			3·10^{15}
	High Voltage Arc Resistance	UL 746A	Sec			300
	High Voltage Arc Tracking Rate	UL 746A	mm/min			0

*NEMA LI-1 FR4 Required Properties | **IEC 60893-3-2 EPGC 202 Required Properties | ***ASTM D3638 & IEC 112 are the same test method - IEC 60112 is slightly different, but the results are similar.

LAMINATE SHEET AVAILABILITY

THICKNESS
0.010 - 5.000 in.

SHEET SIZE
48 x 120 in.

LAMINATE SHEET AVAILABILITY (SI)

THICKNESS
0.125 - 127 mm

SHEET SIZE (SI)
• 122 x 305 cm

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NEMA G-11

Fiberglass Composite Sheets & Tubes

NEMA Grade G-11 materials are continuous filament woven fiberglass sheets bonded with high-temperature epoxy resin. This material maintains excellent mechanical, electrical, and physical properties at elevated temperatures, with a maximum continuous operational temperature of 155°C. Our NEMA G-11 is RoHS and REACH-compliant to ensure reliability, safety, and consistency.

STANDARDS: NEMA IM 60000: GRADE G-11 | IEC 60893: EP GC 203 (sheet) **| IEC 61212: HIgh Temperature EP GC 22** (tube)

NEMA G-11 can be manufactured into convolute tubes and fabricated to multiple interior and exterior diameters. The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application. The standard color is green but, custom colors available upon request.

		ISO/IEC 60893				ASTM			
	PROPERTIES	Test Method	Units	IEC Req.	G-11	Test Method	Units	NEMA Req.	G-11
PHYSICAL	Density		g/cc		1.9		lbs/in^3		0.069
	Water Absorption: 4 mm	ISO 62	mg	23**	4.2				
	Water Absorption: 0.062"					ASTM D570	%	0.25**	0.01
THERMAL	Coefficient of Thermal Expansion						/°C·10^{-6}		10
	Thermal Endurance	IEC 60216	°C		155				
	Flammability (0.250")					UL94	Class	HB	HB
MECHANICAL	Tensile Strength: Perp., LW (0.125")					ASTM D638	KSI (MPa)		41 (283)
	Compressive Strength (0.500")					ASTM D695	KSI (MPa)		70 (483)
	Flexural Strength: Cond. A, LW (0.062")					ASTM D790	KSI (MPa)	60 (414)*	80 (552)
	Flexural Strength: Cond. A, CW (0.062")					ASTM D790	KSI (MPa)	50 (345)*	70 (486)
	Flexural Strength: Cond. E-150/T150, LW (0.062")					ASTM D790	KSI (MPa)	30 (207)*	40 (276)
	Flexural Strength: Cond. A, LW	ISO 178	MPa	340*	486				
	Flexural Strength: Cond. E-150/T150, LW	ISO 178	MPa	170*	276				
	Flexural Modulus: LW (0.062")					ASTM D790	KSI (GPa)		4,200 (29.0)
	Flexural Modulus: CW (0.062")					ASTM D790	KSI (GPa)		4,000 (27.6)
	Bonding Strength: Cond. A (0.5")					ASTM D229	lb (kg)	1,600*	2,200 (998)
	Bonding Strength: Cond. D-48/50 (0.5")					ASTM D229	lb (kg)	1,500*	2,000 (907)
	Charpy Impact Strength	ISO 179	kJ/m^2	33*	45				
	IZOD Impact Strength: Cond. E-48/50, LW (0.125")					ASTM D256	ft-lb/in, Notched	7.0*	11
	IZOD Impact Strength: Cond. E-48/50, CW (0.125")					ASTM D256	ft-lb/in, Notched	5.5*	10
ELECTRICAL	Dielectric Strength: Cond. A in Oil (0.062")					ASTM D149	V/mil		485
	Comparative Track Index (0.125")					ASTM D3638	V		180
	Breakdown Voltage: Par., COND A (0.062")					ASTM D149	kV	45*	>50
	Breakdown Voltage: Par., COND D-48/50 (0.062")					ASTM D149	kV	40*	>50
	Breakdown Voltage: Par., Stepped (90°C) in Oil (3 mm)	IEC 60243-1	kV	35*	>45				
	Permittivity: Cond. A at 1 MHz (0.125")					ASTM D150		5.2	4.7
	Permittivity: Cond. D-24/30 at 1 MHz (0.125")					ASTM D150		5.4	4.8
	Dissipation Factor: Cond. A at 1 MHz (0.187")					ASTM D150		0.025**	0.014
	Dissipation Factor: Cond. D-24/30 at 1 MHz (0.187")					ASTM D150		0.035**	0.017
	Electric Strength: Perp. (90°C) in Oil (1.5 mm)	IEC 60243-1	kV/mm	13*	15				
	Insulation Resistance: After Water Immersion	IEC 60167	MΩ	5·10^4*	>10^7				

Cond. = Condition | Par. = Parallel | Perp. = Perpendicular | LW = Lengthwise | CW = Crosswise

*Minimum | **Maximum

LAMINATE SHEET AVAILABILITY

THICKNESS
0.010 - 5.000 in.

SHEET SIZE
• 48 x 96 in. • 48 x 110 in. • 48 x 125 in.

LAMINATE SHEET AVAILABILITY (SI)

THICKNESS
0.25 - 127 mm

SHEET SIZE (SI)
• 122 x 244 cm • 122 x 280 cm • 122 x 317 cm

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

NEMA G-11R (Roving Reinforced)

Filament-Woven Fiberglass Laminate

Roving reinforced NEMA G-11 material is continuous filament woven fiberglass sheets bonded with high-temperature epoxy resin.
The material maintains excellent mechanical, electrical, and physical properties at an elevated temperature of 180°C.
The Gund Company is RoHS compliant to ensure reliability, safety, and consistency.

STANDARDS: NEMA LI-1: Grade G-11 | IEC 60893-3-2 EPGC205

The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application.
A variety of dimensions and diameter sizes are available. The standard color is green but, custom colors available upon request.

		ASTM/IEC			
PROPERTIES		**Test Method**	**Units**	**IEC Requirement**	**Typical Values**
PHYSICAL	Density		lbs/in³ (g/cc)	-	0.068 (1.89)
	Water Absorption	ISO 1183-1	%	-	0.02
THERMAL	Thermal Endurance	IEC 60216	°C	180	190
	Flammability: >3 mm	UL94	Class	-	V1
MECHANICAL	Flexural Strength: 23°C	ISO 178	MPa	340	558
	Flexural Strength: 150°C	ISO 178	MPa	150	238
	Flexural Strength: 180°C	ISO 178	MPa	-	170.3
	Compressive Strength: Perpendicular	ISO 604	MPa	-	492.1
	Compressive Strength: Parallel	ISO 604	MPa	-	374.3
	Tensile Strength	ISO 527-4	MPa	-	439.5
	IZOD Impact Strength	ISO 180	kJ/m²	34	310
ELECTRICAL	Electrical Strength: Perpendicular to Laminates @ 90°C in Oil	IEC 60243	kV/mm	9	21
	Breakdown Voltage: Parallel to Laminates @ 90°C in Oil	IEC 60243	kV	35	>50
	Insulation Resistance	IEC 60167	Ω		$2.6 \cdot 10^{15}$
	Insulation Resistance: After Water Immersion	IEC 60167	Ω	$5 \cdot 10^{4}$	$1.4 \cdot 10^{12}$
	Proof Tracking Index	IEC 60112	V		CTI200

LAMINATE SHEET AVAILABILITY

THICKNESS	SHEET SIZE
0.010 - 5.000 (in.)	48 x 96 • 48 x 120 (in.)

LAMINATE SHEET AVAILABILITY (SI)

THICKNESS	SHEET SIZE
0.25 - 127 (mm)	122 x 244 • 122 x 305 (cm)

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

G-15

NEMA Thermoset Composite

NEMA G-15 is a new thermoset composite comprised of woven fiberglass and a unique blend of high-temperature resin binders designed for applications that demand superior performance at elevated temperatures. It is a cost-effective alternative to engineered thermoplastics. NEMA G-15 has outstanding flexural and impact strength and maintains a high percentage of mechanical and insulating properties up to 240°C. NEMA G-15 offers excellent dimensional stability and creep resistance and has good resistance to moisture, chemicals, alkalis, and acids. It does not melt or soften at elevated temperatures and offers extended application capability beyond typical NEMA grades. IEC equivalent is PIGC 301.

		ASTM/IEC		TYPICAL VALUES
PROPERTIES		Test Method	Units	NEMA G-15
PHYSICAL	Color			Orange/Amber
	Specific Gravity	ASTM D229		1.81
	Water Absorption: 0.35"	ASTM D570	%	<0.16
	Outgassing: TML	ASTM E595	%	0.93
	Outgassing: CVCM	ASTM E595	%	<0.01
	Outgassing: WVR	ASTM E595	%	0.10
MECHANICAL	Rockwell Hardness	ASTM D785	M Scale	117
	Bond Strength	ASTM D229	lb (kg)	>1,450 (658)
	Flexural Strength: Lengthwise (0.35")	ASTM D790	PSI (MPa)	>78,000 (538)
	Flexural Strength: Crosswise (0.35")	ASTM D790	PSI (MPa)	>73,000 (503)
	Flexural Strength: LW & CW @ 150°C/302°F for 1 hour	ASTM D790	PSI (MPa)	>59,000 (407)
	Flexural Strength: LW & CW @ 220°C/428°F for 1 hour	ASTM D790	PSI (MPa)	>36,100 (249)
	Flexural Strength: LW & CW @ 260°C/500F for 1 hour	ASTM D790	PSI (MPa)	>17,400 (120)
	IZOD Impact Strength: Lengthwise	ASTM D256	ft-lb/in	>17
	IZOD Impact Strength: Crosswise	ASTM D256	ft-lb/in	>14
	Compressive Strength: Flatwise	ASTM D695	PSI (MPa)	>60,000 (414)
	Shear Strength: Category A (0.125")	ASTM D732	PSI (MPa)	>20,000 (138)
ELECTRICAL	Dielectric Breakdown: 0.125"	ASTM D149	V	>50,000
	Dielectric Strength: Step by Step	ASTM D149	VPM	>450
	Arc Resistance	ASTM D495	Seconds	>180
	Comparative Tracking Index	IEC 60112		375
	Flammability	UL94		V1 <5 mm / V0 >6 mm
THERMAL	Tg-DMA Method: 0.35"	ASTM E1640	°C (°F)	240 (464)

SHEET AVAILABILITY

SHEET SIZE	THICKNESS
• 48" x 48" or 48" x 96"	• 0.016" to 3.500"

SHEET AVAILABILITY (SI)

SHEET SIZE	THICKNESS
• 122 cm x 122 cm or 122 cm x 244 cm	• 0.41 mm to 88.90 mm

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

G-15

NEMA Thermoset Composite

	PROPERTIES	ASTM Test Method	Units	TYPICAL VALUES NEMA GPO-3	NEMA G-10/FR	NEMA G-11	NEMA G-15	Mica XM	Mica XP	Mica XFP
PHYSICAL	Specific Gravity			1.80	1.85	1.90	1.81	2.21	2.13	1.90
	Water Absorption (0.125")	ASTM D570	%	0.20	0.10	0.01	<0.16	0.065	< 1	< 1
MECHANICAL	Flexural Strength: Lengthwise	ASTM D790	KSI (Mpa)	23 (159)	80 (552)	70 (486)	>78 (538)	24 (166)	18 (125)	-
	Flexural Strength: Crosswise	ASTM D790	KSI (Mpa)	20 (138)	70 (483)	62 (425)	>73 (503)	24 (166)	18 (125)	-
	IZOD Impact Strength: Lengthwise	ASTM D229	ft-lb/in	9.3	13	11	>17	-	-	-
	IZOD Impact Strength: Crosswise	ASTM D229	ft-lb/in	9.5	12	10	>14	-	-	-
	Compressive Strength: Flatwise	ASTM D695	KSI (Mpa)	33 (228)	66 (455)	70 (483)	>60 (414)	58 (397)	48 (330)	-
	Shear Strength: Cat. A (0.125")	ASTM D732	KSI (Mpa)	13 (90)	22 (148)	-	>20 (138)	-	-	-
	Compressibility	ASTM F36 J	%	-	-	-	-	-	-	20
	Elastic Recovery	ASTM F36 J	%	-	-	-	-	-	-	37
ELECTRICAL	Dielectric Breakdown	ASTM D149	kV	45	66	50	50	-	-	-
	Dielectric Strength	ASTM D149	V/mil	550	635	485	>450	629	625	508
	Arc Resistance	ASTM D495	Seconds	192	140	-	>180	>420	>420	>420
	Thermal Conductivity: 23°C	ASTM E1461	W/m°C	0.32	-	-	0.32	0.23	0.23	0.23
	Thermal Conductivity: 250°C	ASTM E1461	W/m°C	-	-	-	-	0.21	0.21	0.21
	Thermal Expansion: 110°C	ASTM E228	10^{-6}/°C	-	15	10	-	10	10	10
	Thermal Expansion: 250°C	ASTM E228	10^{-6}/°C	-	-	-	-	28	28	28
THERMAL	Operating Temperature	UL 746B	°C (°F)	130 (266)	130 (266)	180 (356)	225 (437)	500 (932)	700 (1,292)	700 (1,292)
	Peak Temperature	UL 746B	°C (°F)	-	-	-	280 (536)	700 (1,292)	1000 (1,832)	900 (1,652)
	Flame Rating	UL 94	Class	V-0	V-0	HB	V-0	V-0	V-0	V-0
	Specific Heat: 23°C	ASTM E1269	J/kg°C	-	-	-	-	822	0.21	0.21
	Specific Heat: 250°C	ASTM E1269	J/kg°C	-	-	-	-	1,081	1,081	1,081

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

NEMA G-7

Glass Silicone Laminate

NEMA Grade G-7 materials are glass fabric-reinforced laminates with a silicone resin binder. Glass silicone insulating materials offer excellent thermal resistance (up to 250°C) and arc resistance. Applications for these grades include electric furnace insulation, circuit breaker parts, switchboard panels, and arc barriers.

NEMA Grade G-7 convolute tubes are available from The Gund Company in nearly any custom size of inside and outside diameter, per customer requirements.

STANDARDS: NEMA IM 60000: Grade G-7 | IEC 60893: SI GC 201 / SI GC 202 (sheet & tube) **| MIL-I-24768:17** (Type GSG)

The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application.
The standard color is white. Custom colors are available upon request.

	NEMA LI-1 G-7 REQUIRED PROPERTIES	ASTM Test Method	Units - English (SI)	Typical Values
PHYSICAL	Density		lbs/in³ (g/cc)	0.068 (1.9)
	Moisture Absorption: 0.062"	ASTM D570	%	0.19
THERMAL	Flammability Rating	UL94	Class	V-0
MECHANICAL	Compressive Strength: Cond. A, Flatwise	ASTM D695	PSI (MPa)	45,000 (310)
	Flexural Strength: Cond. A, LW (0.25")	ASTM D790	PSI (MPa)	18,000 (124)
	Flexural Strength: Cond. A, CW (0.25")	ASTM D790	PSI (MPa)	15,000 (103)
	IZOD Impact Strength: LW	ASTM D256	ft-lbs/in	17.0
	IZOD Impact Strength: CW	ASTM D256	ft-lbs/in	8.5
ELECTRICAL	Dielectric Strength: Cond. A	ASTM D149	V/mil	350
	Arc Resistance: Cond. A (0.125")	ASTM D495	Seconds	200
	Breakdown Voltage: Par., Cond. A (0.062")	ASTM D149	kV	55
	Breakdown Voltage: Par., Cond. D-48/50 (0.062")	ASTM D149	kV	34
	Permittivity: Cond. D-24/23 (0.062")	ASTM D150		4.34
	Dissipation Factor: Cond. D-24/23 (0.062")	ASTM D150		0.017

LAMINATE SHEET AVAILABILITY

THICKNESS
0.125 - 1.250 in.

SHEET SIZE
• 48 x 96 in. • 48 x 120 in.

LAMINATE SHEET AVAILABILITY (SI)

THICKNESS
3.18 - 31.75 mm

SHEET SIZE (SI)
• 122 x 244 cm • 122 x 305 cm

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Laminate

VETRONITE FR-5 HF CTI 600M

- **High pressure laminate for high mechanical and electrical requirements at elevated temperature**
- **Low smoke emission and toxicity in case of fire acc. to EN 45545-2: 2020-02, R22/R23**
- **Defined burning rate acc. to UL94, class V-0. UL file: E47629**
- **Special tracking resistance CTI 600M**
- **Temperature class H**

Description
Vetronite FR5 HF CTI 600M is special laminate made of fine weave glass fabric bonded with halogen free and temperature resistant epoxy resin. The product provides a unique combination of excellent properties and approvals.

Specifications

IEC/DIN EN 60893	EP GC 204/311
DIN 7735	HGW 2372.2 (*)
BS 3953	EP-6 (*)
NFC 26-151	Vt-EM 2-e (*)
NEMA LI-1	FR-5

(*) no longer valid

RoHS Directive
Hazardous products listed in the EU-directive 2011/65/EU (RoHS-directive), annex II and amendment 2015/863/EU are not used as ingredients in this material.

Applications
Railway and traffic engineering
Transformers
Low smoke parts in trains, ships and aircraft

Color
Dark red

	Unit	Value	Test norm
Mechanical properties			
Flexural strength	MPa	450	ISO 178
E-modulus	MPa	24000	ISO 178
Flexural strength at 150°C / 1h	MPa	300	ISO 178
Notched impact strength (Charpy) //	kJ/m²	60	ISO 179
Compressive strength // at 23°C	MPa	300	ISO 604
Compressive strength ⊥ at 23°C	MPa	550	ISO 604
Tensile strength	MPa	330	ISO 527
Electrical properties			
Insulation resistance after immersion in water	Ohm	1.00E+11	IEC 62631-3-3
Breakdown voltage // 90°C in oil	kV	75	IEC 60243-1
Electric strength ⊥ 90°C in oil	kV/mm	15	IEC 60243-1
Relative permittivity at 1 MHz		5.5	IEC 62631-2-1
Dissipation factor at 1 MHz		0.02	IEC 62631-2-1
Comparative tracking index CTI		600M	IEC 60112
Thermal properties			
Temperature index (TI)	°C	180	IEC 60216
Physical properties			
Density	g/cm³	1.99	ISO 1183
Flammability		V-0 > 3 mm	UL 94
Water absorption	mg/%	10/0.05	ISO 62

Form of delivery
Sheet formats:
1170 x 1070 mm
2070 x 1070 mm (up to 40 mm thick)
4300 x 1300 mm (untrimmed)
Size tolerance 0 / - 30 mm

Thickness range 0,2 to 100 mm
Thickness tol. acc. to DIN EN 60893-3-2

Also available as panels or machined parts.
Other dimensions and thicknesses on request.

Machining
Machining with carbide or diamond tools.
For water jet cutting we recommend adding silica sand to the water and drill through-holes prior to machine.

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VRI Composites custom fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application. A variety of dimensions and diameter sizes are available. Product colors vary according to material type.

VRIR 03/2026

VRI Composites Deutschland GmbH
www.vri-composites.com

VRI COMPOSITES IS A DIVISION OF THE GUND COMPANY

THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Mica M

Silicone Bonded Mica Paper Laminate

Silicone-bonded Muscovite Mica is an alumino-silicate with exceptional physical, electrical, mechanical, and thermal characteristics. Mica M is primarily used in high-voltage and high-temperature electrical insulation. It is extremely applicable as an asbestos replacement in high-temperature applications.

The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application. A variety of dimensions and diameter sizes are available. Product colors vary according to material type.

		ASTM	TYPICAL VALUES		
PROPERTIES		Test Method	Units	Thickness as Tested	MICA M (Muscovite)
PHYSICAL	Density	ASTM D792	lb/in^3 (g/cc)	0.06"	0.08 (2.22)
	Water Absorption	ASTM D570 D-24/23	%	0.06"	0.65
	Thermal Expansion: along Plane @ 110°C	ASTM E228	10^{-6}/°C	0.25"	10
	Thermal Expansion: along Plane @ 250°C	ASTM E228	10^{-6}/°C	0.25"	28
	Thermal Conductivity: 23°C	ASTM E1461	W/m·°C	0.25"	0.23
	Thermal Conductivity: 250°C	ASTM E1461	W/m·°C	0.25"	0.21
MECHANICAL	Tensile Strength	ASTM D638	KSI (MPa)	0.06"	28.3 (195)
	Flexural Strength	ASTM D790	KSI (MPa)	0.06"	24.1 (166)
	Compressive Strength: Room Temperature	ASTM D695	KSI (MPa)	1.00"	57.5 (397)
	Compressive Strength: 150°C	ASTM D695	KSI (MPa)	1.00"	44.0 (304)
	Compressive Strength: 200°C	ASTM D695	KSI (MPa)	1.00"	40.4 (279)
	Compressive Strength: 288°C	ASTM D695	KSI (MPa)	1.00"	43.3 (299)
ELECTRICAL	Dielectric Strength: Room Temperature in Oil	ASTM D149	V/mil (kV/mm)	0.04"	629 (24.53)
	Dielectric Strength: 1 hour @ 400°C in Oil	ASTM D149	V/mil (kV/mm)	0.04"	631 (24.61)
	Dielectric Strength: 1 hour @ 600°C in OIl	ASTM D149	V/mil (kV/mm)	0.04"	593 (23.13)
THERMAL	Flammability Test	UL 94	Class	0.02"	V-0
	Heat Resistance			Continuous @ 500°C / Peak @ 700°C	
	Specific Heat: 23°C	ASTM E1269	J/kg·°C	0.25"	822
	Specific Heat: 250°C	ASTM E1269	J/kg·°C	0.25"	1081

SHEET AVAILABILITY

SHEET SIZES
- 39.370" x 47.244"
- 41.340" x 98.430"
- 39.370" x 94.490"

THICKNESS
- 0.010" to 4.000"

SHEET AVAILABILITY (SI)

SHEET SIZES
- 100 cm x 120 cm
- 105 cm x 250 cm
- 100 cm x 240 cm

THICKNESS
- 0.25 mm to 101.60 mm

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Mica P

Silicone Bonded Mica Paper Laminate

Mica is an alumino-silicate with exceptional physical, electrical, mechanical, and thermal characteristics.
Its primary application is high-voltage and high-temperature electrical insulation.

MICA P is commonly used as a replacement for asbestos-based sheets in the construction and maintenance of high-temperature applications.

		ASTM/IEC		TYPICAL VALUES
PROPERTIES		**Test Method**	**Units**	**MICA P (Phlogopite)**
PHYSICAL	Density	IEC 371-2	lb/in³ (g/cc)	0.077 (2.13)
	Water Absorption: 0.125"	ASTM D570	%	<1
MECHANICAL	Tensile Strength	ISO 527	PSI (MPa)	15,955 (110)
	Compressive Strength: 20°C	ISO 604	PSI (MPa)	47,862 (330)
	Compressive Strength: 200°C	ISO 604	PSI (MPa)	34,809 (240)
ELECTRICAL	Arc Resistance	ASTM D495	Seconds	≥420
	Dielectric Strength: 20°C	IEC 243	V/mil (kV/mm)	625 (24.38)
	Dielectric Strength: 1 hour @ 400°C	IEC 243	V/mil (kV/mm)	325 (12.68)
	Dielectric Strength: 1 hour @ 600°C	IEC 243	V/mil (kV/mm)	250 (9.75)
	Track Resistance	IEC 112	V	525
THERMAL	Flame Resistance	UL 94		94 V-0
	Temperature Resistance: Continuous		°C	700
	Temperature Resistance: Peak		°C	1,000

SHEET AVAILABILITY

SHEET SIZE	THICKNESS
• 48" x 120"	• 0.004" to 3.000"

SHEET AVAILABILITY (SI)

SHEET SIZE	THICKNESS
• 122 cm x 305 cm	• 0.1 mm to 76.0 mm

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Mica P - Flexible

Silicone Bonded Mica Paper Laminate

Flexible Mica P is a high-temperature insulation material, offering superior sealing performance in extreme temperature applications. Mica P also provides good chemical resistance to solvents, acids, bases, and oils, making it the gasket material of choice for gas turbines, heat exchangers, and other burner applications.

STANDARDS: NEMA FI1 Grade 6 | IEC Grade 371-3-9

		ASTM/IEC		TYPICAL VALUES
PROPERTIES		**Test Method**	**Units**	**Flexible Mica P**
PHYSICAL	Phlogopite Mica Content	IEC 371-2	%	Min. 90
	Silicone Binder Content	IEC 371-2	%	Max. 10
	Density	IEC 371-2	g/cm³ (lb/in³)	1.9 (0.068)
	Weight Loss	ASTM D3850	%	<4%
MECHANICAL	Tensile Strength	ASTM D638	MPa (PSI)	74 (10,700)
	Compressibility	ASTM F36 J	%	20
	Elastic Recovery	ASTM F36 J	%	30-37
ELECTRICAL	Dielectric Strength: 23°C	ASTM D149	kV/mm (V/mil)	20 (508)
THERMAL	Flammability	UL 94		V-0
	Thermal Expansion: 250°C	ASTM E228	cm/cm (in/in)	2.8 (10^{-3})
	Thermal Conductivity: Perp. at 50°C	ASTM E1461	W/m·K	0.23
	Thermal Conductivity: Hor. at 250°C	ASTM E1461	W/m·K	0.21
	Max. Continuous Temperature		°C (°F)	700 (1,300)
	Max. Intermittent Temperature		°C (°F)	900 (1,650)

SHEET AVAILABILITY

SHEET SIZE	THICKNESS
• 40" x 48"	• 0.005" to 0.125"

SHEET AVAILABILITY (SI)

SHEET SIZE	THICKNESS
• 1,016 mm x 1,219 mm	• 0.013 mm to 3.175 mm

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Laminate

VETRONITE EGS 619 HTC

- **High pressure laminate showing outstanding thermal conductivity**
- **High CTI value**
- **Defined burning rate acc. to UL 94, class V-0. UL file: E47629**

	Unit	Value	Test norm
Mechanical properties			
Flexural strength	MPa	450	ISO 178
E-modulus	MPa	24000	ISO 178
Notched impact strength (Charpy), //	kJ/m²	55	ISO 179
Compressive strength // at 23°C	MPa	250	ISO 604
Compressive strength ⊥ at 23°C	MPa	420	ISO 604
Tensile strength	MPa	300	ISO 527
Electrical properties			
Insulation resistance after immersion in water	Ohm	1.00E+12	IEC 62631-3-3
Breakdown voltage // 90°C in oil	kV	65	IEC 60243-1
Electric strength ⊥ 90°C in oil	kV/mm	15	IEC 60243-1
Relative permittivity at 1 MHz		5.3	IEC 62631-2-1
Dissipation factor at 1 MHz		0.01	IEC 62631-2-1
Comparative tracking index CTI		500	IEC 60112
Thermal properties			
Temperature index (TI)	TI	130	IEC 60216
Thermal conductivity	W/m·K	0.86	ISO 8301
Physical properties			
Density	g/cm³	2.05	ISO 1183
Flammability		V0	UL 94
Water absorption	mg/%	10/0.05	ISO 62

Description
Vetronite EGS 619 HTC is an insulating laminate made of fine weave glass fabric bonded with special epoxy resin to achieve high thermal conductivity.
Suitable for applications where waste heat removal is necessary.

Specifications
Similar to IEC/DIN EN 60893 EP GC 202

RoHS Directive
Hazardous products listed in the EU-directive 2011/65/EU (RoHS-directive), annex II and amendment 2015/863/EU are not used as ingredients in this material.

Color
White

Applications
Electrical insulation, heat dissipating
Medical equipment

Form of delivery
Sheet formats 1170 x 1070 mm; 2070 x 1070 mm
Tolerance 0 / - 30 mm

Thickness range 0.2 to 50 mm
Thickness tol. acc. to DIN EN 60893-3-2

Also available as panels or machined parts.
Other dimensions and thicknesses on request.

Machining
Machining with carbide or diamond tools.
For water jet cutting we recommend adding silica sand to the water and drill through-holes prior to machine.

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VRI Composites custom fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application. A variety of dimensions and diameter sizes are available. Product colors vary according to material type.

VRIR 03/2026

VRI Composites Deutschland GmbH
www.vri-composites.com

VRI COMPOSITES IS A DIVISION OF THE GUND COMPANY

THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Thermoplastic Material Selection Guide

Amorphous and Semi-Crystalline

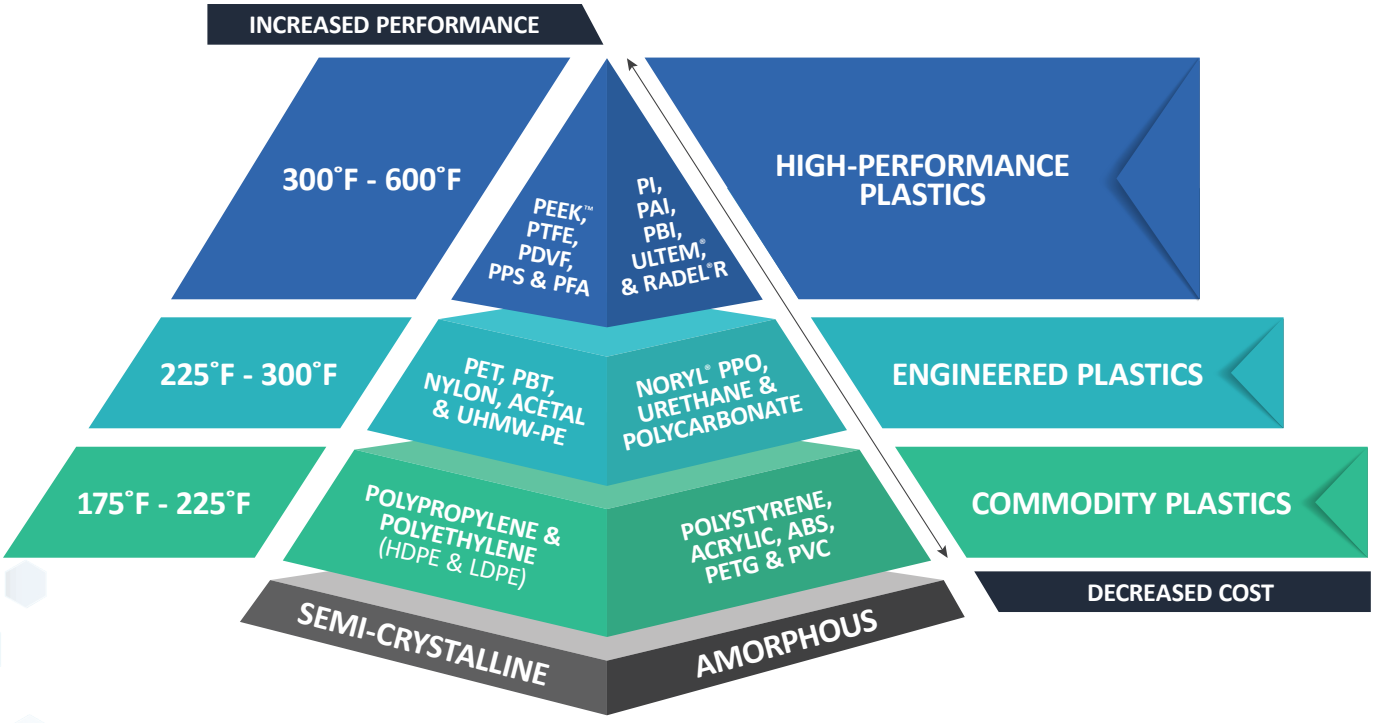
Thermoplastic materials are suitable for a wide range of applications across various industries, including aerospace, defense, medical, satellite communications, food service, and electronics. However, with so many options available, selecting the best thermoplastic based on price, performance, and manufacturability can be challenging.

PYRAMID OF PLASTICS

The pyramid of plastics (Figure 1) helps to narrow down material options by illustrating which materials are suitable for specific application requirements. It's essential to avoid using an expensive material when a more economical alternative could fulfill the needs of the application. Often, as operating temperatures and performance requirements increase, so does the cost.

Thermoplastics can be categorized into two groups based on their composition: **AMORPHOUS** and **SEMI-CRYSTALLINE** thermoplastics. In an amorphous polymer, the molecules are oriented randomly, while in a semi-crystalline polymer, the molecules are packed together in an organized manner.

FIGURE 1



FOR ADDITIONAL INFORMATION ON THERMOPLASTIC MATERIALS

thegundcompany.com/materials/thermoplastic-materials

THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Thermoplastic Material Selection Guide (cont.)

SEMI-CRYSTALLINE THERMOPLASTICS

Semi-crystalline thermoplastics are ideal for wear and structural applications. When compared to amorphous thermoplastics, these materials generally offer better chemical resistance, electrical properties, and a lower coefficient of friction. However, semi-crystalline plastics are challenging to thermoform, difficult to bond, have a sharp melting point, and exhibit lower impact strength.

SEMI-CRYSTALLINE PROPERTIES

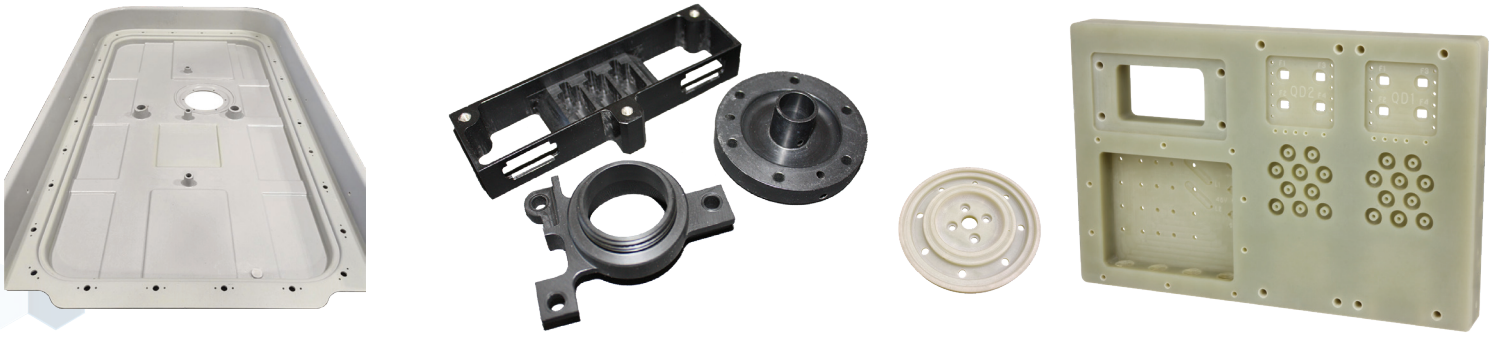
- Challenging to Thermoform
- Typically Opaque
- Sharp Melting Point
- Difficult to Bond
- Good for Structural Applications
- Good Fatigue Resistance
- Good for Wear & Bearing Applications
- Good Resistance to Cracking from Stress

AMORPHOUS THERMOPLASTICS

Amorphous thermoplastics are more conducive to thermoforming; they soften over a range of temperatures and have better bonding ability with adhesives. Compared to semi-crystalline thermoplastics of a similar grade, amorphous plastics typically exhibit better dimensional stability and impact resistance. However, they are more susceptible to fatigue and cracking due to stress.

AMORPHOUS PROPERTIES

- Easy to Thermoform
- Typically Translucent
- Softens Over a Range of Temperatures
- Bonds Well Using Adhesives
- Good for Structural Applications
- Poor Fatigue Resistance
- Not Ideal for Wear Applications
- Subject to Cracking Under Stress



TGC Composite Manufacturing & Fabrication Samples

SEMI-CRYSTALLINE MOLDING

- Good to High-Volume Production
- Efficient Material Use
- Fast Run Time
- Capable of Making Complex Parts
- High Tooling Costs
- Slow to Start Production
- Low Part Price

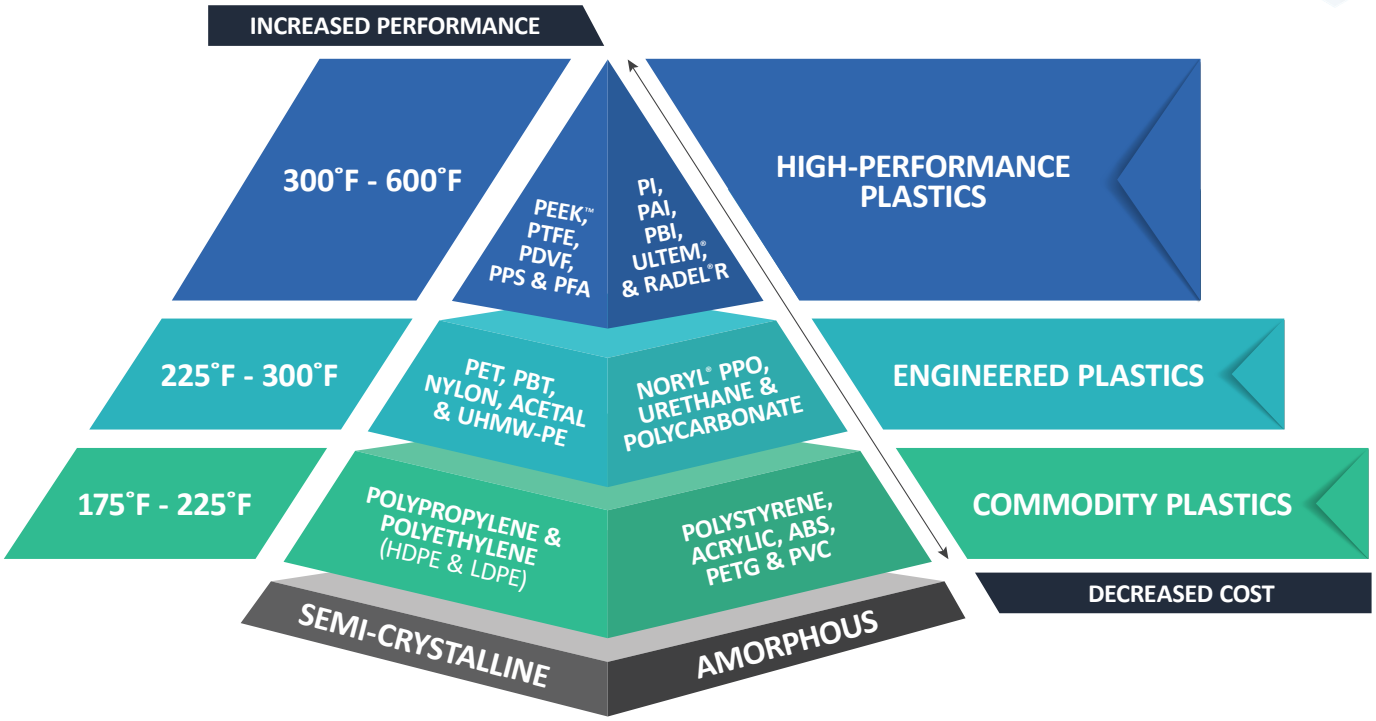
AMORPHOUS MACHINING

- Good for Short Runs
- More Material Availability
- Little to no Tooling Cost
- Quick to Start Production
- Slow Run Time
- High Part Price
- Limitations in Part Complexity

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Thermoplastic Material Selection Guide (cont.)



PLASTIC FAMILIES

At the base of the pyramid, we find cost-effective commodity plastics like ABS, PVC, PET, PP, and PE polymers, available in both semi-crystalline and amorphous forms. While these materials typically have lower operating temperatures and strength compared to higher-performing plastics, they still provide good chemical resistance and machinability, although there can be variability among commodity plastics.

Moving up the pyramid, you'll encounter engineering plastics such as polycarbonate, nylon (PA), acetal (POM), and UHMW-PE. These materials generally offer higher temperature resistance and strength than commodity plastics. Engineering plastics are higher-performing and more expensive but still relatively low-cost compared to specialty materials. They are typically easy to machine, mold, or form and exhibit good electrical, mechanical, and physical properties for various applications. If one of these materials meets your requirements, it is often a better option than high-performance or imidized plastics.

For more demanding or specialized applications, high-performance plastics and imidized plastics may be necessary. High-performance plastics like PEEK™, PTFE, and PSS can withstand very high temperatures and offer excellent chemical resistance. Imidized plastics, such as polyamide-imide (PAI), polybenzimidazole (PBI), and polyimide (PI), are often better suited for aerospace applications but can also be used for thermal insulators, high-performance bearings, and electrical connectors in extreme environments. These materials offer the highest temperature resistance and load-bearing capabilities, among other properties.

Switchgear



Electronics



Electric Vehicles



Military



Medical



Aerospace



A few of the Thermoplastic-Specific Markets TGC Currently Services

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MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Thermoplastic Material Selection Guide (cont.)

SELECTING A MATERIAL

Selecting the appropriate thermoplastic material is a critical step in the design process, as material choice directly influences performance, manufacturability, reliability, and cost. Because thermoplastics exhibit a wide range of thermal, mechanical, electrical, and chemical properties, engineers must evaluate application requirements holistically rather than focusing on any single attribute. This section outlines a structured approach to material selection, beginning with operating temperature and moving through key performance, production, and economic considerations to help narrow suitable material options efficiently.

1. UNDERSTAND THE APPLICATION'S OPERATING TEMPERATURE

Determining the operating temperature is crucial, as thermoplastic properties can change dramatically with heat. Mechanical properties such as elasticity and stiffness can significantly alter as a thermoplastic crosses the glass transition temperature (Tg). The pyramid is organized by operating temperature, making it easy to narrow material options to those that can operate at temperatures above the maximum application's operating temperature.

2. PERFORMANCE REQUIREMENTS

After establishing the operating temperature, other performance characteristics will guide material selection. Every application is unique and typically has one or two key performance criteria. Engineers should consider the following questions when narrowing down options:

- Are there any forces acting on the part? What are they?
- Will the part be used outdoors or exposed to UV light?
- Will the part come into contact with any chemicals? If so, which ones?
- What kind of electrical stresses will the part experience?

3. UNDERSTAND PRODUCT VOLUME

Each material can be manufactured or processed in various ways. Machining and molding are common methods for transforming thermoplastics into finished parts, but the required product volume is a significant factor in determining the most economical manufacturing method.

Machining parts from sheets or blocks is a good option for low-volume requirements. The tooling costs are minimal, the material is readily available, and lead times are typically shorter. However, machining tends to be slower than other operations, and there may be production limitations based on the complexity of the object.

Molding, on the other hand, is an excellent choice for high-volume parts. While tooling costs can be substantial depending on the part, the production speeds are considerably faster compared to machining. Additionally, material is utilized more efficiently, and the complexity of the part is less of a concern. That said, tooling lead times and material availability can be common drawbacks to molding, but these may represent a small expense for a long-term project. There are other options as well, such as 3D printing, thermoforming, die-cutting, and punching, each with its own pros and cons. Not all thermoplastics can be manufactured using every method, so it is crucial to understand the volume requirements to narrow down the materials to those that can be produced most economically.

4. ESTABLISH A BUDGET

With so many options available, establishing a budget can be challenging. However, understanding the application’s operating temperature and production volumes can help set clear expectations. Once the first two steps are complete, it’s best to select a material that meets all property requirements and can be manufactured as efficiently as possible.

Considering performance, manufacturing, and cost requirements can make it difficult to identify the right material among thousands of options. The Gund Company is here to help.

If you need assistance finding a solution, The Gund Company has material specialists and application engineers who are available by email, phone, or through our website to help you find the appropriate material for your application. We offer a wide selection at competitive prices and can produce your part using one of our many manufacturing and fabrication capabilities at any of our 12 locations worldwide.

FOR ADDITIONAL INFORMATION ON THERMOPLASTIC MATERIALS

thegundcompany.com/materials/thermoplastic-materials

or call: 314-492-4837

THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Delrin® Series

Acetal Homopolymer Semi-Crystalline Plastic

Delrin® is a high-performance acetal homopolymer that bridges the gap between plastics and metals. Delrin® combines low friction and high-wear resistance with high strength and stiffness at a wide operating temperature. Because of its extreme low water absorption and chemical resistance to hydrocarbons, solvents and natural chemicals, Delrin® is ideal for industrial applications. Delrin® is used for high-load mechanical applications such as gears, safety restraints, door systems, conveyor belts, and healthcare delivery devices.

511

- Good electrical insulation properties and machinability
- Very good wear abrasion resistance
- High stiffness, fatigue strength, and creep resistance

APPLICATIONS

- Automotive, construction, mechanical engineering, conveyor technology, electronics, and gear manufacturing

150

- Good mac
- High stiffn and creep
- Very good

APPLICATI

- Automotiv conveyor gear manu

		ISO/IEC		TYPICAL VALUES			
	PROPERTIES	Test Method	Units	511	150 (Black)	500 AF (Brown)	527 AF (Black)
PHYSICAL	Density		g/cm³	1.42	1.41	1.50	1.41
	Moisture Absorption: 24 hrs. at 73°F						
	Moisture Absorption Saturation at 73°F						
						175	
THERMAL	Melting Temperature	DIN EN ISO 11357	°C	178	-	-	178
	Heat Deflection Temperature at 66 PSI	ISO-R 75 Method B	°C	163	-	-	-
	Heat Deflection Temperature at 264 PSI	ISO-R 75 Method A	°C	107	-	149	-
	Intermittent Service Temperature		°C	149	149	85	-
	Long Term Service Temperature		°C	85	85	-	85
	Coefficient of Linear Thermal Expansion						
	Specific Heat						
	Flammability	UL 94		-	HB		HB
MECHANICAL	Tensile Modulus						
	Tensile Yield Strength						
	Elongation at Yield at 73°F						
	Elongation at Break at 73°F						
	Flexural Strength at 73°F						
	Flexural Modulus at 73°F						
	Compression Strength at 73°F: 1% strain						
	Compression Strength at 73°F: 10% strain						
	Compression Modulus						
	IZOD Impact Strength at 73°F						
	Rockwell Hardness: M Scale						
	Rockwell Hardness: R Scale						
	Shore Hardness: D Scale						
	Coefficient of Friction: Static, 40 PSI						
	Coefficient of Friction: Dynamic, 40 PSI, 50 FPM						
	Wear Rate: 40 PSI, 50 FPM						
ELECTRICAL	Volume Resistivity						
	Surface Resistivity						
	Dielectric Strength at 73°F						
	Dissipation Factor at 60 Hz, 73°F						
	Dielectric Constant at 60 Hz, 73°F, 50% RH						
	Dielectric Constant at 100 MHz, 73°F						

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chinability and wear properties
ess, fatigue strength,
resistance
wear abrasion resistance

ONS

ve, construction, food processing,
technology, electronics, and
ufacturing

500

- Excellent Wear Properties
- Good machinability
- Low static friction
- High mechanical load capacity

APPLICATIONS

- Business industries, heavy duty Industry, printing machines, packaging and paper machinery

527

- Improved surface hardness
- Good machinability
- Very good UV and weather resistance
- Very good mechanical strength

APPLICATIONS

- Automotive, construction, agricultural machinery, and solar systems

570

- Very good UV and weather resistance
- Excellent strength and stiffness
- Good machinability
- Very high creep resistant

APPLICATIONS

- Automotive, construction, fixture construction, and gear manufacturing

		ASTM		TYPICAL VALUES				
	570	Test Method	Units	511	150 (Black)	500 AF (Brown)	527 AF (Black)	570
	1.56		lb/in³	0.05130	0.05093	0.05419	0.05093	0.05636
		ASTM D570	%	0.2	0.25	0.18	0.14	0.15
		ASTM D955	%	0.90	0.90	-	-	-
	175	ASTM D2133	°F	-	347	347	352	347
	-	ASTM D648	°F	-	336	-	325	329
	-	ASTM D648	°F	-	257	-	198	311
	-		°F	300	300	300	-	300
	-		°F	185	185	185	185	185
		ASTM D696	µin/in·°F	68	68	-	61	47.20
			BTU/lb·°F	0.35	0.35	-	-	-
	HB	UL 94		-	HB	-	HB	HB
		ASTM D638	KSI	450	350	475	420	350
		ASTM D638	PSI	10,000	11,000	7,200	10,300	7,700
		ASTM D638	%	18	-	4	-	-
		ASTM D638	%	25	25	-	15	10
		ASTM D790	PSI	16,000	14,000	13,000	13,500	14,500
		ASTM D790	KSI	520	470	495	490	650
		ASTM D695	PSI	2,100	3,600	1,500	-	1,500
		ASTM D695	PSI	16,500	15,500	14,000	-	14,500
		ASTM D695	KSI	-	325	200	-	-
		ASTM D256	ft-lb/in	1.25	1.50	0.80	1.25	0.90
		ASTM D785		95	94	87	89	87
		ASTM D785		-	120	-	120	-
		ASTM D2240		-	84	-	-	-
		ASTM D3702	%	0.20	-	-	-	-
		ASTM D3702		0.35	0.20	-	-	-
		ASTM D3702	in³·min/ft·lbs·hr	$55 \cdot 10^{-10}$	$55 \cdot 10^{-10}$	-	-	-
		ASTM D257	Ohm-cm	10^{15}	10^{15}	-	-	-
		ASTM D257	Ohms	-	-	-	-	$200 \cdot 10^{15}$
		ASTM D149	V/mil	-	500	-	-	452
		ASTM D150		-	0.005	-	-	-
		ASTM D150		-	3.70	-	-	-
		ASTM D150		-	-	-	-	3.80

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

ACETAL

Polyoxymethylene Molding and Extrusion Materials

ACETAL (POM) is an engineering plastic often used in wet environments. It has a near-zero level of moisture absorption, excellent dimensional stability, and low friction. Ease of machinability is a key characteristic of Acetal. Therefore, it is an ideal choice for applications that require complex machining to tight tolerances. Acetal maintains performance and form during precise machining. Applications include bearings, bushings, wear pads, and pump/valve parts. Our expertise lies in CNC plastic machining (CNC turning, CNC milling, CNC cutting and sawing, and CNC multiple-axis machining) for rigid materials such as Acetal (ASTM D6778).

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		ASTM		TYPICAL VALUES	
PROPERTIES		**Test Method**	**Units**	**Homopolymer Acetal**	**Copolymer Acetal**
PHYSICAL	Water Absorption: 24 hrs. in Water	ASTM D570	%	0.25	0.20
	Density	ASTM D792	lb/in³	0.051	0.051
	Density	ASTM D792	g/cm³	1.41	1.41
	Coefficient of Friction: Dynamic			0.20	0.21
THERMAL	Heat Deflection Temperature (264 PSI)	ASTM D648	°F	257	230
	Max. Continuous Service Temperature in Air	ASTM D648	°F	185	195
	Coefficient of Linear Thermal Expansion	ASTM D696	µin/in·°F	6.80	6.10
MECHANICAL	Tensile Strength	ASTM D638	PSI	10,000	9,800
	Flexural Modulus	ASTM D790	PSI	420	370,000
	IZOD Impact Strength: Notched	ASTM D256	ft-lbs/in	1.50	1

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MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Vespel®

Polyimide

Vespel® is a high-performance polyimide material known for its combination of properties, including heat resistance, lubricity, dimensional stability, chemical resistance, and creep resistance. It is particularly suitable for use in harsh and extreme environmental conditions. The Gund Company specializes in machining Vespel® to precise tolerances, ensuring that you receive the exact machined parts you need. Several grades of Vespel® are available. Contact your local TGC representative for more information about Vespel.® Vespel® is a product of DuPont.

COMMON APPLICATIONS: WEAR STRIPS | BUSHINGS | THERMAL & ELECTRICAL INSULATORS

KEY CHARACTERISTICS: DIMENSIONALLY STABLE | HIGH WEAR RESISTANCE | RADIATION RESISTANCE

MEETS MILITARY SPECIFICATIONS: GE A50 TF146 CLASS A | ASTM D6456-99 TYPE 1 | AMS 3644 CLASS 1 | MIL-R-46198 TYPE 1

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		ASTM		TYPICAL VALUES				
	PROPERTIES	Test Method	Units	Vespel® (Unfilled)	Vespel® (15% graphite)	Vespel® (40% graphite)	Vespel® (10% PTFE, 15% graphite)	Vespel® (15% Moly)
PHYSICAL	Specific Gravity	ASTM D792	lb/in³	0.051	0.055	0.060	0.056	0.058
	Water Absorption: 24 hrs. @ 73°F	ASTM D570	%	0.24	0.19	0.14	0.21	0.23
	Water Absorption: 24 hrs. @ 122°F	ASTM D570	%	0.72	0.57	0.42	0.49	0.65
THERMAL	Flammability Rating	UL 94	Class	V-0	V-0	V-0	V-0	V-0
	Coefficient of Linear Thermal Expansion	ASTM D696	x10^{-5} in/in/°F	3.0	2.7	2.1	3.0	2.9
MECHANICAL	Tensile Strength @ 73°F	ASTM D638	PSI	12,500	9,500	7,500	6,500	8,200
	Tensile Strength @ 500°F	ASTM D638	PSI	6,000	5,500	3,400	3,500	-
	Tensile Modulus	ASTM D638	PSI	-	-	-	-	-
	IZOD impact: Notched	ASTM D256	ft·lbs/in	0.8	0.8	-	-	0.4
ELECTRICAL	Dielectric Strength: Short Time (0.125")	ASTM D149	V/mil	560	250	-	-	-

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Torlon®

Polyamide-imide

Torlon® is a premium engineered thermoplastic with a range of impressive properties, including high thermal endurance, excellent dimensional stability, minimal creep, outstanding high-heat resistance, and broad chemical resistance across a wide temperature range.

It can operate continuously at temperatures up to 500°F, making it ideal for applications involving bearings, seals, and electrical components that require heat resistance. The Gund Company offers precise machining of Torlon® to close tolerances and maintains a comprehensive stock of Torlon® rods, sheets, and tubes, which are readily available for custom fabrication.

COMMON APPLICATIONS: ELECTRICAL INSULATORS | SEALS | VALVE PLATES

KEY CHARACTERISTICS: HIGH IMPACT RESISTANCE | HIGH CREEP RESISTANCE | EXCELLENT DIMENSIONAL STABILITY

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		ASTM	TYPICAL VALUES			
	PROPERTIES	Test Method	Units	Torlon® 4203 (Electrical Grade)	Torlon® 4301 (Bearing Grade)	Torlon® 5530 (Glass Filled)
PHYSICAL	Specific Gravity	ASTM D792	lb/in³	0.051	0.052	0.059
	Water Absorption: 24 hrs.	ASTM D229	%	0.4	0.4	0.3
THERMAL	Flammability Rating	UL 94	Class	V-0	V-0	V-0
	Coefficient of Linear Thermal Expansion	ASTM D638	x10⁻⁵ in/in/°F	1.7	1.4	2.6
	Glass Transition Temp.	ASTM D3418	°F (°C)	527˚ (275˚)	527˚ (275˚)	527˚ (275˚)
	Max Operating Temp.	ASTM D3418	°F (°C)	500˚ (260˚)	500˚ (260˚)	500˚ (260˚)
MECHANICAL	Tensile Strength	ASTM D638	PSI	18,000	12,000	15,000
	Tensile Modulus	ASTM D638	PSI	600,000	800,000	900,000
	IZOD impact: Notched	ASTM D256	ft·lbs/in	2.0	0.8	0.7
	Rockwell Hardness	ASTM D785		E80 (M120)	E70 (M106)	E85 (M125)
ELECTRICAL	Dielectric Strength: Short Time (0.125")	ASTM D149	V/mil	580	-	700

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Ultem™ 1000

Amorphous High Performance Plastic (PEI - Unreinforced)

PEI (Polyetherimide) is a thermoplastic and a member of the imide family (containing the O=C-N-C=O group). Ultem™ 1000 is a commercial grade of PEI. It is excellent for applications that require consistent dielectric properties over a wide frequency range, including reusable medical devices, analytical instruments, semiconductors, and electrical insulation. Though Ultem offers identical properties as generic PEI, it exceeds with exceptional resistance to environmental forces and high dielectric strength and stability. Applicable industries include medical, electronic, microwave, automotive, and aircraft. Ultem is FDA, USP Class VI and NSF compliant.

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A variety of dimensions and diameter sizes are available. Product colors vary according to material type.

		ASTM		TYPICAL VALUES		
PROPERTIES		**Test Method**	**Units**	**Ultem 1000**		
PHYSICAL	Specific Gravity	ASTM D792	g/cm^3	1.27		
	Water Absorption: 24 hrs. at 73°F	ASTM D570	%	0.25		
	Water Absorption: Saturation at 73°F	ASTM D570	%	1.25		
THERMAL	Coefficient of Linear Thermal Expansion	ASTM 696	µin/in·°F	31		
	Thermal Conductivity	ASTM D2214	$BTU \cdot in/ft^2 \cdot hr \cdot °F$	1.50		
	Heat Deflection Temperature (66 PSI)	ASTM D648	°F	410		
	Heat Deflection Temperature (264 PSI)	ASTM D648	°F	394		
	Vicat Softening Point	ASTM D1525	°F	426		
	Flammability: UL94 (3.2 mm)			V-0		
MECHANICAL	Rockwell Hardness: M Scale	ASTM D785		109		
	Ultimate Tensile Strength at 73°F	ASTM D638	PSI	15,200		
	Elongation at Break at 73°F	ASTM D638		40 / 7.50		
	Elongation at Yield	ASTM D638		40 / 7.50		
	Tensile Modulus of Elasticity at 73°F	ASTM D638	KSI	430		
	Flexural Strength at 73°F	ASTM D790	PSI	22,000		
	Flexural Modulus at 73°F	ASTM D790	KSI	480		
	Compressive Strength	ASTM D695	PSI	21,900		
	Compressive Modulus	ASTM D695	KSI	480		
	Shear Strength	Ultimate	PSI	15,000		
	IZOD Impact Strength: Notched	ASTM D256	ft-lb/in	1		
ELECTRICAL	Volume Resistivity (1/16")	ASTM D257	Ohm-cm	10^{17}		
	Dielectric Constant at 1000 Hz	ASTM D150		3.15		
	Dielectric Strength (Perp. in Oil / Air)	ASTM D149	V/mil	710 / 830		
	Dissipation Factor at 1000 Hz	ASTM D150		0.0013		

The data supplied are typical values. They are not to be considered specification values. All of the information, suggestions, and recommendations about these properties and uses of the products herein are based on tests and data believed to be accurate; however, the final determination regarding the 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, warranties of merchantability or fitness for a particular purpose. Under no circumstances shall we be liable for incidental or consequential loss or damage.

THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

PEEK™ Series

Semi-Crystalline High Performance Plastic

PEEK™ (Polyether ether ketone) is a high-performance thermoplastic. It is not part of the PI family. It has similar heat and hostile environment resistance as the PI family at a similar cost premium. PEEK™ is frequently used in injection molding thanks to a blend of strength, resistance, and workability. It is exceptionally resistant to high temperatures, chemicals, fatigue, and creep. PEEK's strength-to-weight profile rivals metals like aluminum, and it will not degrade in chemically or physically harsh environments as metals do. It also has unique properties like total bio-compatibility, UV resistance, pure radiolucency, gamma-ray resistance, and low/no toxicity in all forms.

The Gund Company fabricates insulation materials to the exact specifications and drawings specified by our customers. We offer our customers the proper product for their specific application.
A variety of dimensions and diameter sizes are available. Product colors vary according to material type.

		ISO/IEC		TYPICAL VALUES		ASTM		TYPICAL VALUES	
	PROPERTIES	Test Method	Units	Unfilled	30% Glass Filled	Test Method	Units	Unfilled	30% Glass Filled
PHYSICAL	Density	ISO 1183-1	g/cm³	1.31	1.51				
	Specific Gravity					ASTM D792		1.31	1.51
	Water Absorption: 24 hrs. in water at 73°F	ISO 62	%	0.06	0.05	ASTM D570	%	0.10	0.10
	Water Absorption: Saturation in water at 73°F		%	0.45	0.35	ASTM D570	%	0.50	0.30
	Wear Rate	ISO 7148-2	µm/km	28	7	QTM 55010	in^3·min/ft·lbs·hr·10^{-10}	375	-
	Coefficient of Friction: Dynamic	ISO 7148-2		0.30 - 0.50	0.30 - 0.45	QTM 55007		0.32	-
	Limiting PV at 100 FPM		MPa·m/s	-	-	QTM 55007	ft·lbs/in^2·min	8,500	-
	Limiting PV at 0.1 / 1 (m/s)		MPa·m/s	0.33 / 0.21	-				
THERMAL	Melting Temperature: DSC, 10°C(50°F)/min	ISO 11357-1/-3	°C	340	340	ASTM D3418	°F	644	644
	Glass Transition Temperature (DMA- Tanδ)								
	Thermal Conductivity at 23°C (73°F)		W/m·K	0.25	0.43		BTU·in/ft^2·hr·°F	1.75	2.98
	CLTE (-40 to 150°C) (-40 to 300°F)					ASTM E831 (TMA)	µin/in·°F	26	12
	CLTE (23 to 100°C) (73 to 210°F)		µm/m·°K	50	30				
	CLTE (23 to 150°C) (73 to 300°F)		µm/m·°K	55	30				
	CLTE (>150°C) (>300°F)		µm/m·°K	130	65				
	Heat Deflection Temperature (264 PSI)	ISO 75-1/-2	°C	160	230	ASTM D648	°F	320	450
	Continuous Service Temperature in Air: 20 hrs.		°C	250	250		°F	480	480
	Min. Service Temperature		°C	-50	-20		°F	-	-
	Flammability: UL94 (3 mm (1/8 in.))			V-0	V-0			V-0	V-0
	Flammability: Oxygen Index	ISO 4589-1/-2	%	35	40				
MECHANICAL	Ultimate Tensile Strength	ISO 527-1/-2	MPa	115	80	ASTM D638	PSI	16,000	14,000
	Tensile Strain at Yield	ISO 527-1/-2	%	5	4	ASTM D638	%	5	-
	Tensile Strain at Break	ISO 527-1/-2	%	17	4.50	ASTM D638	%	40	2
	Tensile Modulus of Elasticity	ISO 527-1/-2	MPa	4,300	7,000	ASTM D638	KSI	630	1,000
	Shear Strength			55	97	ASTM D732	PSI	8,000	14,000
	Compressive Stress: 1 / 2 / 5% nominal strain	ISO 604	MPa	38 / 75 / 140	54 / 103 / 155				
	Compressive Strength					ASTM D695	PSI	20,000	22,000
	Charpy Impact Strength: Unnotched	ISO 179-1/1eU	kJ/m²	NB	25				
	Charpy Impact Strength: Notched	ISO 179-1/1eA	kJ/m²	3.50	3.00				
	IZOD ImpactStrength: Notched					ASTM D256	ft-lb/in	0.60	0.80
	Flexural Strength	ISO 178	MPa	170	155	ASTM D790	PSI	25,000	23,000
	Flexural Modulus	ISO 178	GPa	-	-	ASTM D790	KSI	600	1,000
	Rockwell Hardness: M Scale	ISO 2039-2		105	100	ASTM D785		100	103
	Rockwell Hardness: R Scale					ASTM 2240		126	126
ELECTRICAL	Dielectric Strength	IEC 60243-1	kV/mm	24	24	ASTM D149	V/mil	480	500
	Volume Resistivity	IEC 62631-3-1	Ohm-cm	10^{13}	10^{13}				
	Surface Resistivity					ANSI/ESDSTM 11.11	Ohms/sq	10^{12}	10^{12}
	Dielectric Constant at 1 MHz	IEC 62631-2-1		3.20	3.60	ASTM D150		3.30	-
	Dissipation Factor at 1 MHz	IEC 62631-2-1		0	0	ASTM D150		0	-

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Teflon®

Polytetrafluoroethylene

Polytetrafluoroethylene, commonly known as PTFE or Teflon®, is a synthetic fluoropolymer made from tetrafluoroethylene and is suitable for a wide range of applications. The Gund Company specializes in machining various grades of Teflon® to very precise tolerances. With our extensive expertise in thermoplastics, we ensure that our PTFE and FEP machined parts meet your exact customer specifications.

COMMON APPLICATIONS: ELECTRICAL INSULATORS | SEALS | VALVE PLATES

KEY CHARACTERISTICS: HIGH-IMPACT RESISTANCE | HIGH-CREEP RESISTANCE | EXCELLENT DIMENSIONAL STABILITY

TGC PTFE/FEP PRODUCTS COMPLY WITH MILITARY SPECIFICATION: MIL-I-19161A

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		ASTM	TYPICAL VALUES		
PROPERTIES		**Test Method**	**Units**	**Teflon® (Unfilled)**	**Teflon® (25% Glass-Filled)**
PHYSICAL	Specific Gravity	ASTM D792	lb/in^3	0.078	0.081
	Water Absorption: 24 hrs.	ASTM D229	%	<0.01	0.02
THERMAL	Melting temperature	ASTM D3418	°F (°C)	635˚ (335˚)	635˚ (335˚)
	Flammability Rating	UL94	Class	V-0	V-0
	Coefficient of Linear Thermal Expansion	ASTM D696	$x10^{-5}$ in/in/°F	7.5	6.4
MECHANICAL	Tensile Strength	ASTM D638	PSI	3,900	2,100
	Tensile Elongation at Break	ASTM D638	%	300	270
	Flexural Strength	ASTM D790	PSI	no break	1,950
	Tensile Modulus	ASTM D638	PSI	80,000	-
	Flexural Modulus	ASTM D790	PSI	72,000	190,000
	IZOD impact: Notched	ASTM D256	ft·lbs/in	3.5	-
ELECTRICAL	Dielectric Strength: Short Time (0.125")	ASTM D149	V/mil	285	-

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Kapton®

Polyimide Film

Kapton® Polyimide Film possesses a unique combination of properties previously unavailable among polymeric film materials. The ability of Kapton to maintain its excellent physical, electrical, and mechanical properties over a wide temperature range has opened new design and application areas to plastic films. It has proven especially useful in applications involving high operating temperatures.

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			Typical HN Film Thickness (mils)						**Typical VN Film Thickness** (mils)					
PROPERTIES		**Units**	**0.30**	**0.50**	**1.00**	**2.00**	**3.00**	**5.00**	**0.30**	**0.50**	**1.00**	**2.00**	**3.00**	**5.00**
PHYSICAL	Moisture Absorption	%	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
MECHANICAL	Tensile Strength: 23°C	PSA	16,000	20,000	20,000	24,000	24,000	24,000	20,000	20,000	20,000	20,000	20,000	20,000
	Tensile Strength: 23°C	MPa	110	138	138	165	165	165	138	138	138	138	138	138
	Elongation	%	25	35	40	45	50	50	35	35	45	50	60	60
	Shrinkage	%	4.0	4.0	2.5	2.5	2.5	2.5	0.1	0.1	0.1	0.05	0.05	0.05
ELECTRICAL	Dielectric Strength	V/mil	3,000	3,000	6,000	5,000	5,400	3,000	3,000	3,000	3,000	3,000	3,000	3,000
	Dielectric Strength	kV/mm	117	117	234	195	211	117	117	117	117	117	117	117
	Dielectric Constant: 1 kHz		4.0	4.0	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9
	Dissipation Factor: 1 kHz		0.007	0.005	0.0036	0.0036	0.0036	0.0036	0.005	0.005	0.0036	0.0036	0.0036	0.0036
	Volume Resistivity	Ohm-cm	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}	10^{12}

LAMINATE SHEETS: GAUGES

KAPTON TYPE HN

• 30 • 50 • 100 • 200 • 300 • 500

KAPTON TYPE VN

• 50 • 75 • 100 • 200 • 300 • 500

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

Rulon® Grades

Semi-Crystalline High Performance Plastic (PTFE)

PTFE (Polytetrafluoroethylene) is commonly known as Teflon. It is one of the greatest thermoplastics invented in the 20th Century. Its high-temperature resistance (up to 300°C) and corrosion resistance rival and exceed that of the high-performance thermoplastics of the PI family, PEEK, and PES. Its low coefficient of friction and water repellence is unmatched. Mechanical properties, however, are weaker than other high-performance thermoplastics. Reinforcing substrates can improve those deficiencies. PTFE and molded grades (FEP and PFA) are affordable (considering their superior properties). They are used in most electrical and commercial applications where low-friction, long-wear, non-stick, and water resistance are necessary. Teflon, Flourosint, and Rulon® are commercial names.

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		ISO/IEC		TYPICAL VALUES				ASTM		TYPICAL VALUES			
	PROPERTIES	Test Method	Units	Rulon® J	Rulon® 641	Rulon® AR	Rulon® LR	Test Method	Units	Rulon® J	Rulon® 641	Rulon® AR	Rulon® LR
PHYSICAL	Density		g/cm^3	1.95	2.20	2.22	2.25	ASTM D792	lb/in^3	0.0704	0.0795	0.0802	0.0813
	Water Absorption: 24 hrs.		%	0	0	0	0	ASTM D570	%	0	0	0	0
	Water Absorption at Saturation		%	-	-	0	3		%	-	-	0	3
	Deformation at 10.3 MPa (1,500 PSI)		%	-	4	-	-	ASTM D621	%	-	4	-	-
THERMAL	CTE, Linear, Parallel to Flow at 37.8°C (100°F)	Length	µm/m·°C	100	103	-	99.40	Length	µin/in·°F	55.70	57.20	-	55.20
	CTE, Linear, Parallel to Flow at 149°C (300°F)	Length	µm/m·°C	120	139	-	149	Length	µin/in·°F	66.50	77.20	-	83
	CTE, Linear, Transverse to Flow at 37.8°C (100°F)	Diameter	µm/m·°C	90	76.90	-	61.90	Diameter	µin/in·°F	50	42.70	-	34.40
	CTE, Linear, Transverse to Flow at 149°C (300°F)	Diameter	µm/m·°C	105	102	-	81.50	Diameter	µin/in·°F	58.60	56.70	-	45.30
	Thermal Conductivity		W/m·K	0.0346	0.375	0.331	0.331	ASTM D2214	BTU·in/hr·ft²·°F	0.24	2.60	2.30	2.30
	Maximum Service Temperature in Air		°C	288	288	288	288		°F	550	550	550	550
	Minimum Service Temperature in Air		°C	-268	-240	-240	-240		°F	-450	-400	-400	-400
MECHANICAL	Hardness: Brinell			≥64	-	-	-			≥64	-	-	-
	Hardness: Rockwell B			≥25	-	-	-			≥25	-	-	-
	Hardness: Shore D			60 - 70	60 - 70	75	60 - 70	ASTM D2240		60 - 70	60 - 70	75	60 - 70
	Tensile Strength		MPa	18.80	21.40	13.80	18.60	ASTM D4894	PSI	2,730	3,100	2,000	2,700
	Elongation at Break		%	235	350	175	235	ASTM D4894	%	235	350	175	235
	Flexural Yield Strength: Strain 1%		MPa	3.40	4.20	-	3.80	ASTM D790	PSI	493	609	-	551
	Flexural Modulus		GPa	0.36	0.41	-	0.40	ASTM D790	KSI	52.20	59.50	-	59.50
	Compressive Yield Strength: Strain 1%		MPa	5.50	4.60	6.89	5.20	ASTM D695	PSI	798	667	1,000	754
	Compressive Modulus		GPa	0.56	0.48	-	0.55	ASTM D695	KSI	81.20	69.60	-	79.80
	Coefficient of Friction: Dynamic				0.10 - 0.30	0.15 - 0.25	-			-	0.10 - 0.30	0.15 - 0.25	-
	Coefficient of Friction: Static				-	0.15 - 0.25	-			-	-	0.15 - 0.25	-
	Limiting Pressure Velocity		MPa·m/sec	0.263	0.35	0.35	0.35		PSI-ft/min	7,500	10,000	9,990	9,990
	IZOD Impact: Notched		J/cm	-	-	3.20	-		ft-lb/in	-	-	6	-
ELECTRICAL	Volume Resistivity				-	-	10^{15}	ASTM D257	Ohm-cm	$8.2 \cdot 10^{18}$	-	-	10^{15}
	Surface Resistance		Ohm	$6.3 \cdot 10^{18}$	-	-	$2 \cdot 10^{13}$	ASTM D257	Ohm	$6.3 \cdot 10^{18}$	-	-	$2 \cdot 10^{13}$
	Dielectric Constant at 1 MHz			2.40	-	-	2.50	ASTM D150		2.40	-	-	2.50
	Dielectric Strength		kV/mm	7.87	-	-	35.40	ASTM D149	kV/in	200	-	-	900
	Dissipation Factor at 1 MHz			0.0015	-	-	0.001 - 0.004	ASTM D149		0.0015	-	-	0.001 - 0.004

RULON® J

- The lowest coefficient of friction of all Rulons
- Good wear and abrasion resistance (even against aluminum and soft mating surfaces)

APPLICATIONS

- Used in dry or vacuum type environments
- Agriculture, Appliance, Automotive, Industrial, and Transportation

RULON® 641

- Designed to run dry without external lubrication
- Compatible with 303 / 316 stainless steel mating surfaces
- FDA compliant

APPLICATIONS

- Used in steam, wet, dry, vacuum, or FDA type environments
- Appliances, Automotive, Dairy/Food/Beverage, Industrial, Medical, and Transportation

RULON® AR

- More flexible than Rulon® LR
- Reliability in continuous non-lubricated service
- Universal chemical inertness
- Working Temperature Range between -240° to +288°C (-400° to +550°F)

APPLICATIONS

- Suitable for seals and bonded coating of slide surfaces

RULON® LR

- High wear resistance and low friction
- Good electrical properties and chemical inertness
- Can also be bonded to nearly any surface to provide wear resistance and reduce friction

APPLICATIONS

- Used in steam, wet, dry, and vacuum environments
- Agriculture, Appliance, Automotive, Industrial, and Transportation

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS



Our Commitment to Quality

Excellence at Every Step

At The Gund Company, quality is built into every stage of our process—from material sourcing and engineering support to fabrication, inspection, and delivery. Our quality management system is designed to ensure product conformity, traceability, and continuous improvement while meeting the stringent requirements of the aerospace industry. With multiple manufacturing facilities and decades of experience, we partner with customers to reduce risk, improve reliability, and consistently deliver solutions that perform in the most demanding applications.

CERTIFICATIONS & ACCREDITATIONS

ISO 9001:2015 Certified

AS9100D Certified

ITAR Registered Facilities

NADCAP Accredited for Composites

Certifications and accreditations may vary by facility and process. Visit our website for the most current information.

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THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

OUR EXPERTISE IS OUR COMPETITIVE ADVANTAGE

At The Gund Company, we're not just about materials; we're about empowering our clients innovations with a diverse array of solutions, from resilient glass epoxy composites to high-performance silicone sponges. Our consultative approach ensures that we dive deep into their unique needs, collaborating closely with your engineers and buyers to identify the perfect materials that match your projects.

We understand that selecting the right material can be a daunting task, which is why our experienced Application Engineering Teams are here to help navigate these challenges. By focusing on the key material properties, we often uncover valuable opportunities for cost reduction, enhancing the overall success of your project.

Our Material Specialists are dedicated to reviewing customer specifications and providing insightful recommendations that could save you money while still meeting all your requirements. Together, we're not just solving problems; we're innovating for the future.

We believe that asking the right questions is the first step towards delivering tailored solutions. At The Gund Company, continuous improvement is at the core of our ethos. We are committed to optimizing production for material yield and fabrication efficiency, constantly adapting our capabilities based on what our customers need.

Today, we proudly stand as an industry-leading manufacturer and fabricator of engineered material solutions, and we're excited to evolve alongside our employees. Let's embark on this journey together and redefine what's possible for tomorrow!

WE LISTEN, LEARN, RESPOND, AND SERVE.

OUR CURRENT FABRICATION FACILITIES



LOS ANGELES - CA
- 80 employees
- 46,480 square feet



CEDAR LAKE - IN
- 30 employees
- 30,000 square feet



MILWAUKEE - WI
- 50 employees
- 75,000 square feet



ST. LOUIS - MO
- 120 employees
- 62,000 square feet



ALBANY - NY
- 150 employees
- 100,000 square feet



DALLAS - TX
- 30 employees
- 54,000 square feet



TORONTO - CANADA
- 45 employees
- 55,000 square feet



QUERETARO - MEXICO
- 200 employees
- 55,000 square feet



XIAMEN - CHINA
- 70 employees
- 60,000 square feet



HUZHOU - CHINA
- 100 employees
- 52,000 square feet



AUGSBURG - GERMANY
- 180 employees
- 320,000 square feet



BRADFORD - UK
- 39 employees
- 32,000 square feet

1,200+
TEAM MEMBERS

17
MANUFACTURING LOCATIONS*

8
COUNTRIES WITH OFFICES

*12 of the 17 shown above

GLOBALLY-KNOWN AND GROWING

Established in 1951 | Fourth-generation family business | **One of the largest insulation component fabricators in North America**
Unique supplier of thermoset composites specializing in rigid and flexible laminates | Vertical integration on key materials
Partners with many major Electrical/Electronic OEMs

THE GUND COMPANY

MANUFACTURERS & FABRICATORS OF ENGINEERED MATERIAL SOLUTIONS

MARKETS


Switchgear


Electronics


Power Generators


Motor Applications


Transformers


Metals Processing


Electric Vehicles


Military/Aerospace


Oil & Gas


Medical


Space

OUR EXPERTISE IS YOUR COMPETITIVE ADVANTAGE

We manufacture and fabricate a complete line of components for market-specific applications (left column). As TGC better understands these markets – we can expand into other applications for our products.

As an employer, we are one family, acting in accordance with our Core Values: respect, trust, growth, passion, connection, teamwork, integrity, and performance. Collectively, we recognize and serve others so that lives are transformed!

Material Families:

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

Engineering Capabilities:

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

Manufacturing Capabilities:

- Compression Molding
- Autoclave & Light RTM Molding
- Pultrusion / Extrusion of Rods & Shapes
- Filament, Convolute & Wet Winding Tubes
- Additive & Injection Molding
- Infusion & B-Stage Composites Lay-Up
- Hand Lay-Up & Spray-Up Molding

Conversion Capabilities:

- Die, Laser & Knife Cutting
- Waterjet Cutting
- Rotary Die Cutting
- Slitting
- Thermoforming

Fabrication Capabilities:

- 5-Axis Machining
- CNC Milling
- Routing
- Turning & Lathe Cutting
- Punching
- Bending

THE GUND COMPANY GLOBAL FOOTPRINT

