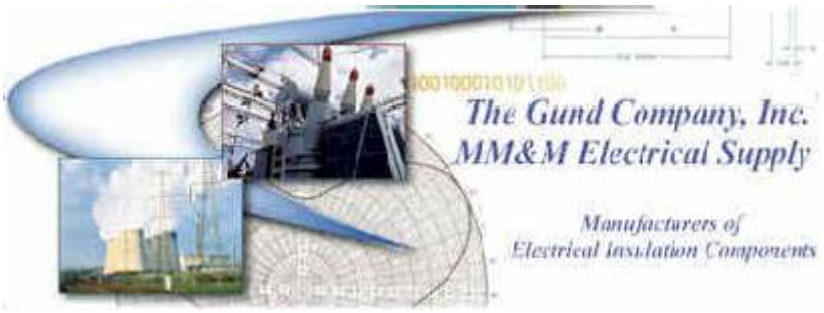

The Gund Company Introduces PolyPro FR Flame Retardant Polypropylene

The Gund Company proudly introduces PolyPro FR Flame Retardant Polypropylene with a complete range of thicknesses for electrical insulation applications in electrical and electronic equipment.

PolyPro FR offers the following characteristics:

- **UL 94 Rated V-O including the thinner thicknesses such .010", .017", and .031". UL 94 V-0 testing completed by Eltek Laboratories with test data available upon request.**
- **Extremely low water absorption (.01% after immersion for 24 hours) meeting UL requirements for use in outdoor equipment.**
- **Suitable for outdoor use with respect to exposure to Ultraviolet Light, Water Exposure and Immersion in accordance with UL 746C.**
- **UL Recognized under UL Card Number # E228440.**
- **Offers excellent fabrication and formability characteristics allowing the low cost production of insulation components.**
- **Offers temperature resistance to 110°C per UL testing satisfying the UL requirement for 105 °C temperature class applications.**
- **Provides a lower cost alternative for designs incorporating the use of materials such as Formex, Formex GK, Nomex 410, Valox, Mylar Polyester Film, Vulcanized Fibre, Duroid, and Quin-T products.**

The Gund Company recommends a complete insulation system design review in order to determine potential cost savings available from the incorporation of PolyPro FR. Because TGC can supply a full range of insulation materials, we can offer quotations for all insulation material options in order to present a complete picture of the design alternatives and potential cost savings.

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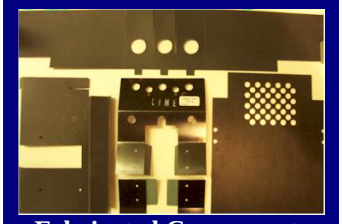
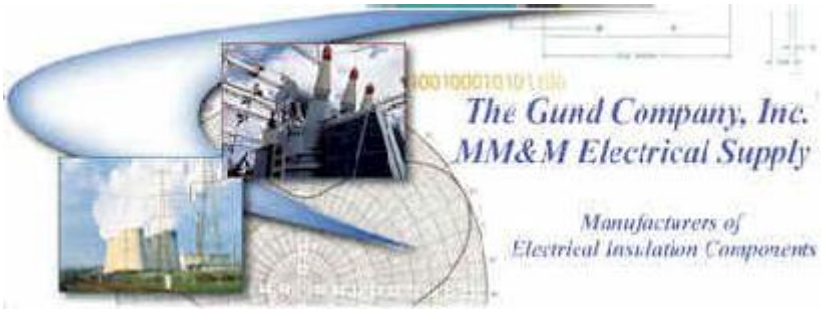
Insulation Materials
Insulation materials for electrical and electronic equipment.



Fabricated Components
TGC can assist with the most cost effective component design.

Switchgear Parts
PolyPro FR for barriers.

Fuse & Terminal Components
Flame Retardant Polypropylene replaces vulcanized fibre.



PolyPro FR As A Cost Effective Insulation Option

The Gund Company fabricates a complete range of electrical insulation materials for electrical and electronic equipment applications. For three generations, we have manufactured custom components from electrical insulation materials. As an overview of the properties of typical insulation materials used in electrical and electronic applications, please consult the following table.

	PolyPro FR	Formex	Vulcanized Fibre	Duroid D-100 FR	Mylar	Nomex	Valox
Flammability	UL 94 V-0	UL 94 V-0	UL 94 HB	UL 94 V-0	UL 94 HB	UL 94 V-0	UL 94 V-0
Dielectric Strength	1,000 VPM	500 VPM	215 VPM	200 VPM	1,400 VPM	700 VPM	400 VPM
Tensile Strength,	4,300 psi	4,800 psi	14,000 psi	12,000 psi	25,600 psi	NA	7,500 psi
Temperature Index	110 °C	110 °C	110 °C	90°C	130 °C	220 °C	140 °C
Water Absorption	0.01%	0.01%	66%	40%	0.01%	20%	.04%
Relative Cost	$ 2.00	$ 2.50	$ 2.20	$ 2.10	$ 2.00	$ 10.00	$ 3.50

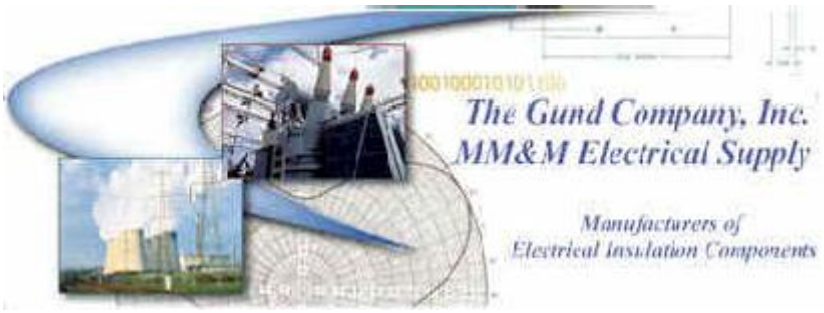
Note: All test data based on 1/8" test specimen, except Mylar which is based on .014" thickness, Valox which is based on .030" thickness, and Nomex which is based on .030" thickness.

As can be noted from the table above, PolyPro FR is a very cost effective option in comparison to other common insulation materials. Because The Gund Company fabricates all of the materials noted above, we have no vested interest in promoting one material over another. However, we do recognize the advantages of PolyPro FR over many other materials. By highlighting the advantages of PolyPro FR, we hope to be able to offer our customers a cost effective solution.

The key considerations in reviewing the use of PolyPro FR versus other materials in a particular design include:

Material	Design Considerations vs. PolyPro FR
Formex GK	Equivalent materials. PolyPro FR offers a typical savings of 5 – 15% depending on part design.
Vulcanized Fibre	Vulcanized Fibre has very high water absorption potentially making an insulation material into a conductive material in very high humidity applications. Vulcanized Fibre is not UL V-0 rated.
Duroid D-100FR	A fiber based material that also absorbs water quite readily. Has relatively low dielectric values and a relatively low thermal index. Many Duroid grades have been discontinued over the years.
Mylar	A very good electrical insulation material, but it is not available over .014" thick and is not UL94 V-0 rated. Also has very poor tear resistance if punctured.
Nomex	An excellent electrical insulation material for high temperature (220°C) applications. However, it is expensive and commonly used in non-220°C applications allowing for easy replacement with PolyPro FR for a significant cost savings.
Valox	A very good electrical insulating material with the UL V-0 rating, but it is relatively expensive versus PolyPro FR while offering very little design improvement if any. Valox users have experienced significant cost reduction benefits by switching to PolyPro FR.

It is absolutely critical that all material design decisions be made after a complete review of all technical data. The Gund Company can provide part samples in any or all potential material options for testing upon request. For more information, please contact John Sullivan at (314) 423-5200.



Challenge TGC to Engineer Lower Costs for Insulation Applications

Application Engineering from The Gund Company allows us to assist manufacturers of power supply equipment in designing the most cost effective insulation systems for their equipment.

Many manufacturers have partnered with The Gund Company to lower their cost structure for insulation components. With today's competitive marketplace and the tremendous impact of the economic slowdown, each company needs to remove cost from their products. TGC's Application Engineering and Partnership Agreement establish firm cost reduction initiatives that will lead to cost reductions, guaranteed! For a sample Partnership Agreement including examples of our cost reduction initiatives, please contact John Sullivan at (314) 423-5200.

As an example, for manufacturers of power supplies, The Gund Company has initiated three cost reduction initiatives specifically:

1) Engineering Review of All Insulation Materials
- Review material selection versus application for all materials.
- End practice of using Nomex Paper in non-220C applications.
- Review design dimensions for all NEMA GPO-3 Red Glass Polyester.
- Obtain savings of 10 – 15% by improved material selection.

2) Engineering Review of Nomex Aramid Paper
- Review all use of Nomex Paper in non-220C applications.
- Replace Nomex Paper with less costly alternatives.
- Obtain savings of 15 – 25% with alternate materials.

3) Introduction of Polypro FR 301 Flame Retardant Polypropylene
- Lower cost equivalent to Formex materials.
- Use to replace Formex for barriers, terminal insulation, and fuse clip insulation applications among others.
- Obtain savings of 10 – 15% versus Formex materials.

Backup Power Supplies With Dry Type Transformer.

Power Supplies for Telecommunications.

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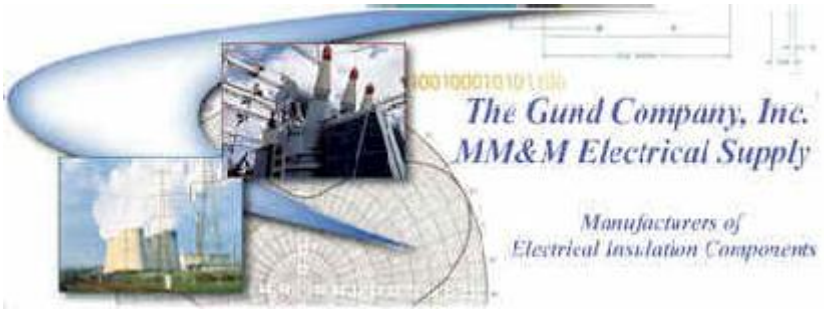

PolyPro FR Lowers Insulation System Costs by 10%

Custom Fabricated Parts from The Gund Company are manufactured according to our ISO 9002 certified quality system. TGC not only fabricates parts according to our customer's requirements, we help our customer's determine the best material options for their application.

We call it **Application Engineering**. Tell us about your part's operating parameters, its function, its environment, and we suggest material options for your consideration. In addition to helping with material selection, TGC can help adjust drawings to optimize the cost effectiveness of the design.

PolyPro FR was originally developed to solve a customer's design problem. Some years ago, UL changed their specifications causing manufacturers of outdoor electrical equipment such as watt hour meter bases to eliminate the use of vulcanized fiber insulation material due to its water absorption properties. Paul J. Gund, a chemical engineer by training, helped develop and introduce flame retardant polypropylene material to our customers to solve their design problem.

Today, PolyPro FR continues to solve design challenges for our customers. The Gund Company continues to offer our Application Engineering services to help our customers identify the most cost effective materials and designs for their application. For example, PolyPro FR offers the following to users of other common insulation materials:

Formex	PolyPro FR is an equivalent material to Formex at a lower cost. It has equivalent properties, appearance, and characteristics.
Nomex 410	PolyPro FR can replace Nomex in non-220°C applications common in electronics equipment and non-dry type transformer applications. Many electronic equipment and power supply applications have benefited from a change to PolyPro FR due to the lack of need for a 220°C material.
Valox	PolyPro FR is a much lower cost alternative to Valox for flame retardant electrical insulation applications requiring a formable material.
Mylar Polyester Film	PolyPro FR offers a better flame retardant rating and much better mechanical strength, particularly tear resistance, than Mylar or other polyester films.
Duroid FR 100	PolyPro FR is a lower cost alternative to flame retardant Duroid grades. It also offers better mechanical properties and much better formability.
Vulcanized Fibre	PolyPro FR does not absorb water like hydroscopic vulcanized fibre and fishpaper. PolyPro FR was originally developed as a replacement for, and meets UL requirements for use as an insulation barrier in outdoor equipment.

Programmable Power Supplies.

Power Inverters.

Telecommunications Power Supplies

PolyPro FR Flame Retardant Polypropylene Material Technical Data

	Test Method	PolyPro FR - .010"	Polypro FR - .017"	PolyPro FR - .030"
Color		Black	Black	Black
Thickness - Inches Thickness - Millimeters		.010" (+.004", -.001") *.25 (+.1, -.04)*	.017" (+.003", -.001") *.43 (+.08, -.4)*	.030" (+.004", -.004") *.79 (+.1, -.1)*
Physical Properties				
Density	ASTM D-792	1.035 gm/cc .037 lbs./in^3	1.035 gm/cc .037 lbs./in^3	1.035 gm/cc .037 lbs./in^3
Flammability	UL94	V-0	V-0	V-0
Oxygen Index	ASTM D-2863	28%	28%	28%
Water Absorption	ASTM D-570	0.01%	0.01%	0.01%
Relative Thermal Index	UL 746B			
Electrical		213°F / 100°C	213°F / 100°C	230°F / 110°C
Mechanical w/o Impact		213°F / 100°C	213°F / 100°C	230°F / 110°C
Heat Deflection Temperature @ 66 psi	ASTM D-648	223°F / 106°C	223°F / 106°C	223°F / 106°C
Mechanical Properties				
Tensile Strength, Yield	ASTM D-638 23°C, 0.125" specimen	4,400 psi 30.3 Mpa	4,400 psi 30.3 Mpa	4,400 psi 30.3 Mpa
Tensile Elongation, Yield	ASTM D-638 23°C, 0.125" specimen	> 100%	> 100%	> 100%
Flexural Modulus	ASTM D-790 23°C, 0.125" specimen	210 kpsi 1,448 Mpa	210 kpsi 1,448 Mpa	210 kpsi 1,448 Mpa
Flexural Strength	ASTM D-790 23°C, 0.125" specimen	5,900 psi 40.7 Mpa	5,900 psi 40.7 Mpa	5,900 psi 40.7 Mpa
Izod Impact Stength, Notched	ASTM D-256 23°C, 0.125" specimen	1.2 ft-lbs./inch 64 J/m	1.2 ft-lbs./inch 64 J/m	1.2 ft-lbs./inch 64 J/m
Electrical Properties				
Dielectric Breakdown - volts	ASTM D-149	22,000	28,700	30,000
Dielectric Strength – volt/mil	ASTM D-149	2,200	1,100	1,000
Volume Resistivity	ASTM D-257	1.5 x 10^{17} ohm-cm	1.5 x 10^{17} ohm-cm	1.5 x 10^{17} ohm-cm
Dielectric Constant	ASTM D-150	2.9	2.9	2.9
Dissipation Factor	ASTM D-150	0.002	0.002	0.002
High Current Arc Ignition	ASTM D-150	200+ Arcs to Ignite	200+ Arcs to Ignite	200+ Arcs to Ignite
High Voltage Arc Tracking	UL 746A	0.0 in/min	0.0 in/min	0.0 in/min
Hot Wire Ignition	UL 746A	8.90	10.90	12.30
Comparative Tracking Index	ASTM D-3638	600 +	600 +	600 +

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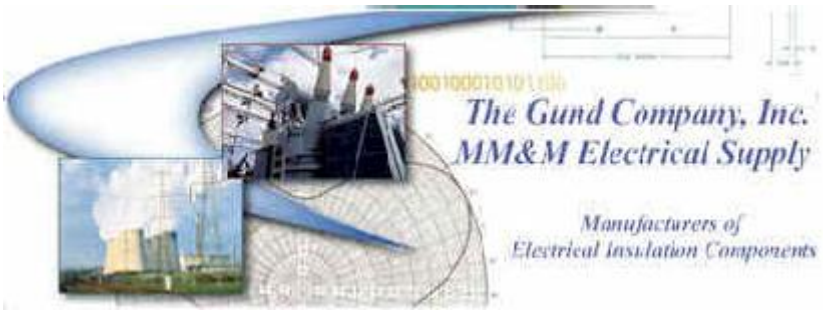

PolyPro FR Flame Retardant Polypropylene Material Technical Data

	Test Method	PolyPro FR - .040"	PolyPro FR - .062"	Polypro FR - .094"	PolyPro FR - .125"
Color		Black	Black	Black	Black
Thickness - Inches Thickness - Millimeters		.040" (+/- .004") *1.01 (+/- .1)*	.062" (+/- .004") *1.57 (+/- .1)*	.094" (+/- .004") *2.39 (+/- .1)*	.125" (+/- .007") *3.17 (+/- .17)*
Physical Properties					
Density	ASTM D-792	1.035 gm/cc .037 lbs./in^3	1.035 gm/cc .037 lbs./in^3	1.035 gm/cc .037 lbs./in^3	1.035 gm/cc .037 lbs./in^3
Flammability	UL94	V-0	V-0	V-0	V-0
Oxygen Index	ASTM D-2863	28%	28%	28%	28%
Water Absorption	ASTM D-570	0.01%	0.01%	0.01%	0.01%
Relative Thermal Index	UL 746B				
Electrical		230°F / 110°C	230°F / 110°C	230°F / 110°C	250°F / 120°C
Mechanical w/o Impact		230°F / 110°C	230°F / 110°C	230°F / 110°C	250°F / 120°C
Heat Deflection Temperature @ 66 psi	ASTM D-648	223°F / 106°C	223°F / 106°C	223°F / 106°C	223°F / 106°C
Mechanical Properties					
Tensile Strength, Yield	ASTM D-638 23°C, 0.125" specimen	4,400 psi 30.3 Mpa	4,400 psi 30.3 Mpa	4,400 psi 30.3 Mpa	4,400 psi 30.3 Mpa
Tensile Elongation, Yield	ASTM D-638 23°C, 0.125" specimen	> 100%	> 100%	> 100%	> 100%
Flexural Modulus	ASTM D-790 23°C, 0.125" specimen	210 kpsi 1,448 Mpa	210 kpsi 1,448 Mpa	210 kpsi 1,448 Mpa	210 kpsi 1,448 Mpa
Flexural Strength	ASTM D-790 23°C, 0.125" specimen	5,900 psi 40.7 Mpa	5,900 psi 40.7 Mpa	5,900 psi 40.7 Mpa	5,900 psi 40.7 Mpa
Izod Impact Stength, Notched	ASTM D-256 23°C, 0.125" specimen	1.2 ft-lbs./inch 64 J/m	1.2 ft-lbs./inch 64 J/m	1.2 ft-lbs./inch 64 J/m	1.2 ft-lbs./inch 64 J/m
Electrical Properties					
Dielectric Breakdown - volts	ASTM D-149	40,000	46,500	55,460	61,250
Dielectric Strength volts/mil	ASTM D-149	1,000	750	590	490
Volume Resistivity	ASTM D-257	1.5 x 10^{17} ohm-cm	1.5 x 10^{17} ohm-cm	1.5 x 10^{17} ohm-cm	1.5 x 10^{17} ohm-cm
Dielectric Constant	ASTM D-150	2.9	2.9	2.9	2.9
Dissipation Factor	ASTM D-150	0.002	0.002	0.002	0.002
High Current Arc Ignition	ASTM D-150	200+ Arcs to Ignite	200+ Arcs to Ignite	200+ Arcs to Ignite	200+ Arcs to Ignite
High Voltage Arc Tracking	UL 746A	0.0 in/min	0.0 in/min	0.0 in/min	0.0 in/min
Hot Wire Ignition	UL 746A	NA	20.2	21	35.7
Comparative Tracking Index	ASTM D-3638	600 +	600 +	600 +	600 +

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UL Yellow Card Information

QMFZ2 Component – Plastics | Thursday, August 15, 2002 | E228440

GUND CO INC
2121 WALTON RD ST LOUIS MO 63114

Material Designation: **PolyPro FR (f2)**

Product Description: Polypropylene (PP), flame retardant, furnished as sheets.

Color	**Min. Thick.** (mm)	**Flame Class**	**HWI**	**HAI**	**RTI Elec**	**RTI Imp**	**RTI Str**	**IEC GWIT**	**IEC GWFI**
BK	0.20	V-0	-	-	65	65	65	-	-
BK	0.41	V-0	4	3	100	90	100	-	-
ALL	0.75	V-0	3	0	110	105	110	-	-
	1.5	V-0	3	0	110	105	110	-	-
	2.4	V-0	2	0	110	105	110	-	-
	3.0	V-0	2	0	110	115	120	-	-

CTI: 0 **HVTR:** 0 **D495:** 6 **IEC BP:** -

(f2) Subjected to one or more of the following tests: Ultraviolet Light, Water Exposure or Immersion in accordance with UL 746C, where the acceptability for outdoor use is to be determined by UL Inc.

Report Date: 06/07/2002 | Underwriters Laboratories Inc® | 445020001

UL94 small-scale test data does not pertain to building materials, furnishings and related contents. UL 94 small-scale test data is intended solely for determining the flammability of plastic materials used in components and parts of end-product devices and appliances, where the acceptability of the combination is determined by ULI.

Note: Only the Flame Class of material 0.20mm was tested by UL. The RTI for 0.20mm material has not yet been tested and thus received the lowest RTI. If your application requires a 100 RTI with 0.20mm material, please contact us so that we may conduct the additional UL testing required to achieve this rating.