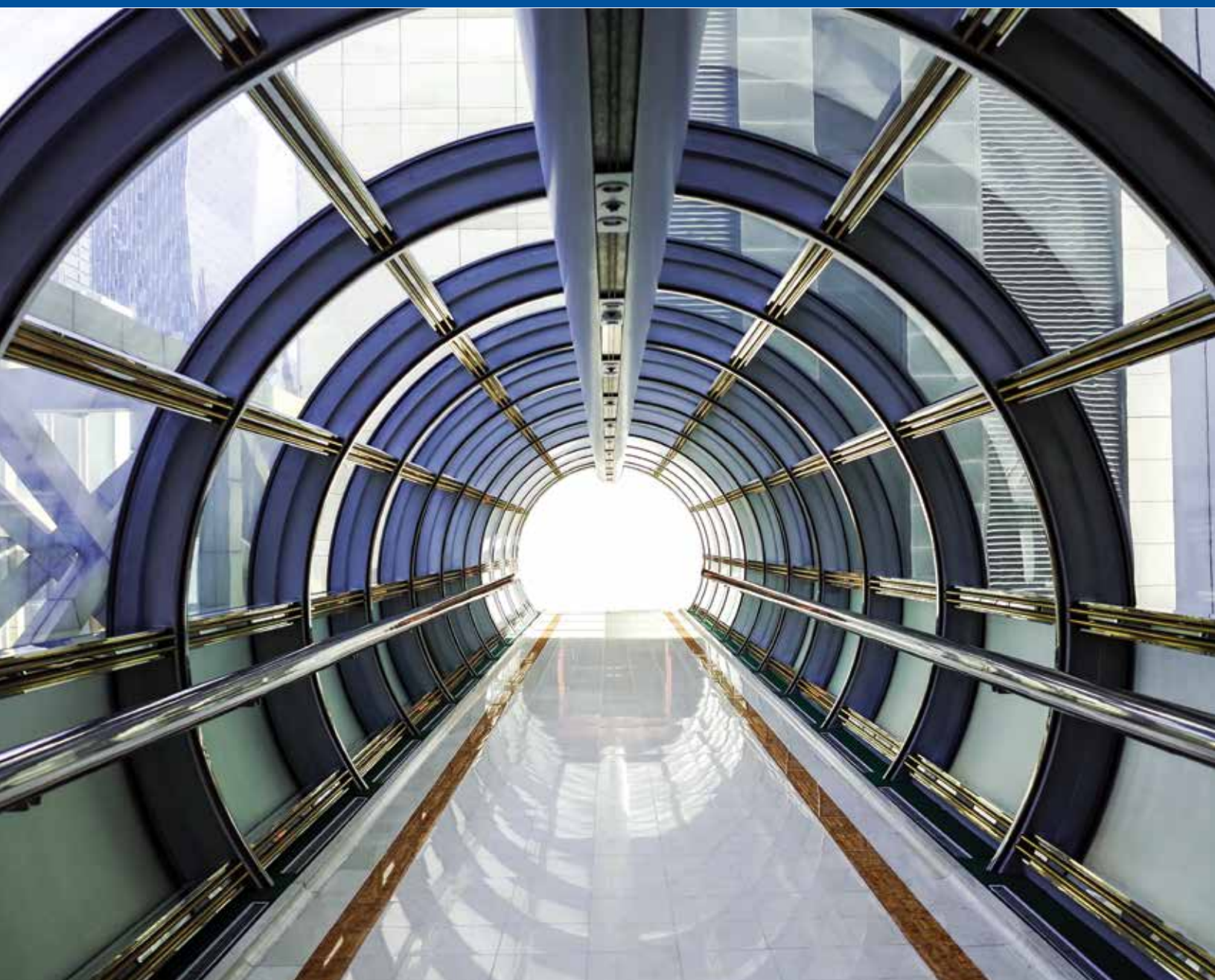




Long Glass Fiber Thermoplastics

Strong, Impact Resistant Solutions
for Replacing Metal and Reducing Part Weight



LGF versus SGF Pellets: What's the Difference?

Long Glass Fiber (LGF) pellets have long, continuous fibers that extend the entire length of the pellet, and are longer in length than Short Glass Fiber pellets (see Figure 1). When LGF pellets are processed via injection molding, the long fibers inside will entangle, creating an internal skeletal network of reinforcement; this increases mechanical properties and can improve dimensional stability of the molded part. Our LGF Compounds consist of a base resin, long glass fibers, and additives that can be processed in standard injection molding equipment with easy material flow. We also offer both Technical and Computer Aided Engineering (CAE) Services to assist you with any processing questions.

Figure 1:

LGF vs. SGF Pellet Comparison

LGF pellets:

- 11mm long
- Fibers are continuous and equal to the length of the pellet
- Fibers are fully wetted with thermoplastic resin



SGF pellets:

- 3mm long
- Random fibers vary in length and orientation through the pellet



Long Glass Fiber (LGF) Compounds

Exceptionally Strong, Stiff, and Impact Resistant Solutions

RTP Company has been a pioneer in developing Long Glass Fiber (LGF) pellets since the 1980s. We manufacture these compounds using a proprietary pultrusion process built on years of experience. The fibers are fully wetted, encapsulated, and the resulting LGF pellets have fibers the same length as the pellets themselves.



Our LGF Compounds are the go-to technology for replacement of welded metal assemblies, machined parts, or die castings because they are a lightweight and functional alternative to steel assemblies or die cast aluminum, magnesium, and zinc. Compared to Short Glass Fiber (SGF) Compounds, our LGF Compounds provide significantly improved impact resistance without sacrificing strength and stiffness, even at extreme temperatures.

Like many RTP Company compounds, LGF Compounds can be further enhanced and customized with additives that provide:

- long-term heat aging resistance
- low VOC/odor release
- UV protection
- and more!

Our LGF Compounds are available in a number of resin systems and can be efficiently injection molded into complex shapes without expensive finishing costs. We welcome the opportunity to collaborate with you and discuss the benefits of LGF Compounds from RTP Company. To get your project started, contact us, scan our code, or visit www.rtpcompany.com today!





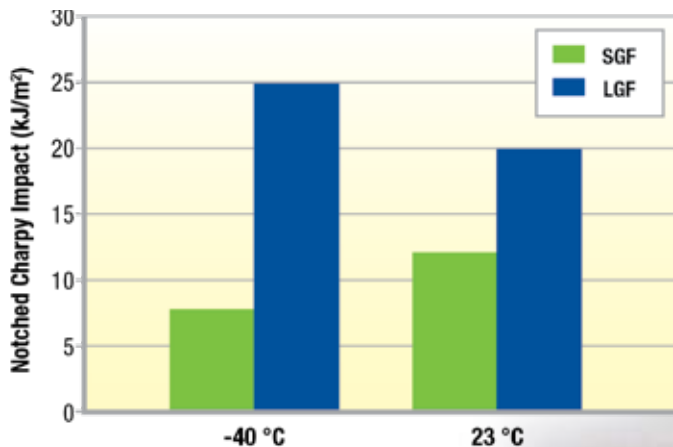
Due to their high strength-to-weight ratio, our LGF Compounds are an excellent material choice for applications such as wheelchair wheels, which must stand up to extreme stress at a wide range of temperatures.

Our LGF Compound formulations display a high degree of impact performance while also providing good strength and stiffness. This combination of properties provides protection from breakage, even in extreme temperatures.

When compared to SGF reinforced Polypropylene (PP) and Nylon (PA), LGF Compounds provide far better impact resistance at both ambient and extremely low temperatures (see Figure 2).

This is particularly useful for parts that must withstand impact in diverse environments – for example, recreational vehicle components that must operate safely in the heat of the desert or the extreme cold of the north.

Figure 2: **SGF vs. LGF Compound Impact Comparison**
30% Glass Reinforced PP



These ATV beadlock rings are made from LGF Compounds, which can withstand extreme environments and be colored to eliminate secondary processing and enhance aesthetics.



Dimensional Stability

Parts molded with our LGF Compounds are able to hold their dimensional accuracy, due, in part, to the length of the long fibers, which promote the creation of an internal skeletal structure to support the part. This structure reduces part shrinkage after molding, thus maintaining part size as intended.

We offer LGF Compounds in a variety of base resins with glass fiber content ranging from 20 - 60% wt. For reference purposes, the table (Figure 3) shows the mold shrinkage percentages of a variety of polymers with 50% glass content.

Figure 3: *Mold Shrinkage of Various LGF50 Compounds*

Polymer*	Mold Shrinkage (%)**
Polypropylene (PP)	0.20
Nylon 6/6 (PA 6/6)	0.18
Rigid Thermoplastic Polyurethane (RTPU)	0.15
Polyphthalamide (PPA)	0.20
Polyphenylene Sulfide (PPS)	0.15
Polyetherimide (PEI)	0.15
Polyetheretherketone (PEEK)	0.20

* LGF Compounds with fiber content ranging from 20-60% are available to meet your specific requirements

** shrinkage measured in direction of flow after conditioning 48 hours at 23 °C

The long fibers in our LGF Compounds form a skeletal network during molding to provide dimensional stability for large structures such as an automotive trunk or “frunk”.



Our LGF Compounds offer structural integrity and high flowability for thin walls, which benefits complex parts like automotive door modules.

RTP Company provides shrinkage data to our customers for informational purposes only. RTP Company does not guarantee the shrinkage of a material. Any shrinkage values communicated by RTP Company should be used as a guideline only and further testing and verification of communicated data on a part configuration similar to the final product is recommended.

Temperature Performance

Regardless of polymer type, the introduction of long fibers will result in a compound with increased modulus and strength; this increase extends to elevated temperatures. Figures 4 and 5 show that even at significantly elevated temperatures, LGF Compounds maintain functional strength and stiffness.

Figure 4:

**Tensile Stress-Strain
PP LGF40**

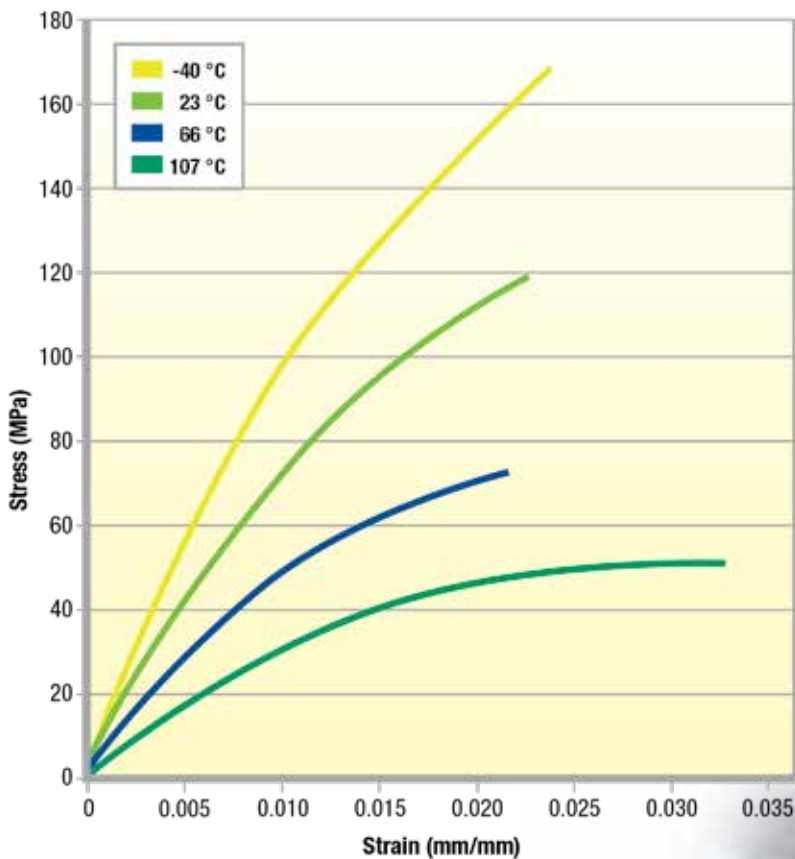
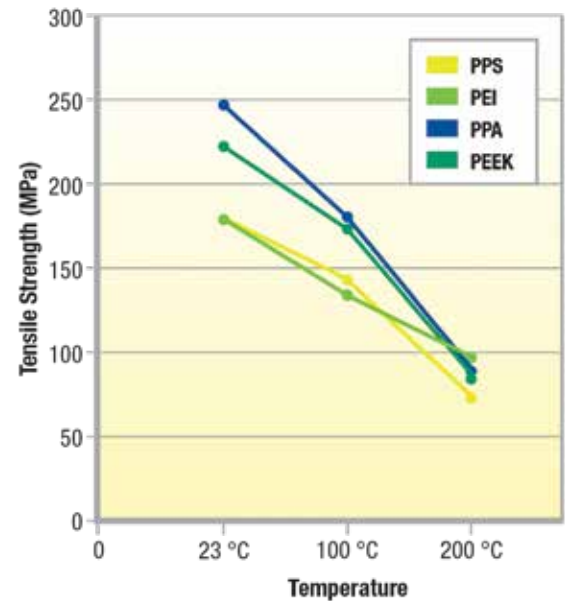


Figure 5: **Tensile Strength vs. Temperature
LGF40**



Critical components like those used in oil drilling operations benefit from the durability of LGF Compounds, which maintain their physical properties under high pressure and extreme temperatures.

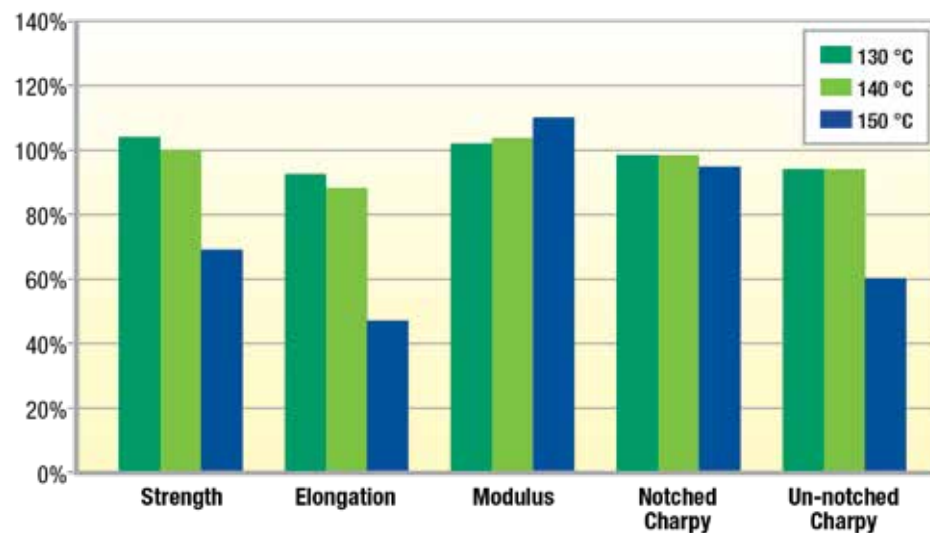


Long-term Heat Aging Resistance

Some high temperature-resistant LGF Compounds offer excellent heat aging performance based on the inherent properties of the base polymer. Other LGF Compounds such as PA and PP benefit from the addition of stabilizer packages. When exposed to high temperatures over a significant amount of time, compounds with heat stabilization packages maintain performance better than standard compounds. In fact, heat stabilized PP LGF Compounds from RTP Company can maintain more than 90% of its strength, elongation, and impact properties at 140 °C after 1,000 hours of exposure (Figure 6). This makes heat stabilized LGF Compounds an excellent choice for extending the service life of parts that are exposed to high heat during operation.

Figure 6:

**1000 Hour Heat Aging Property Retention
PP LGF40**

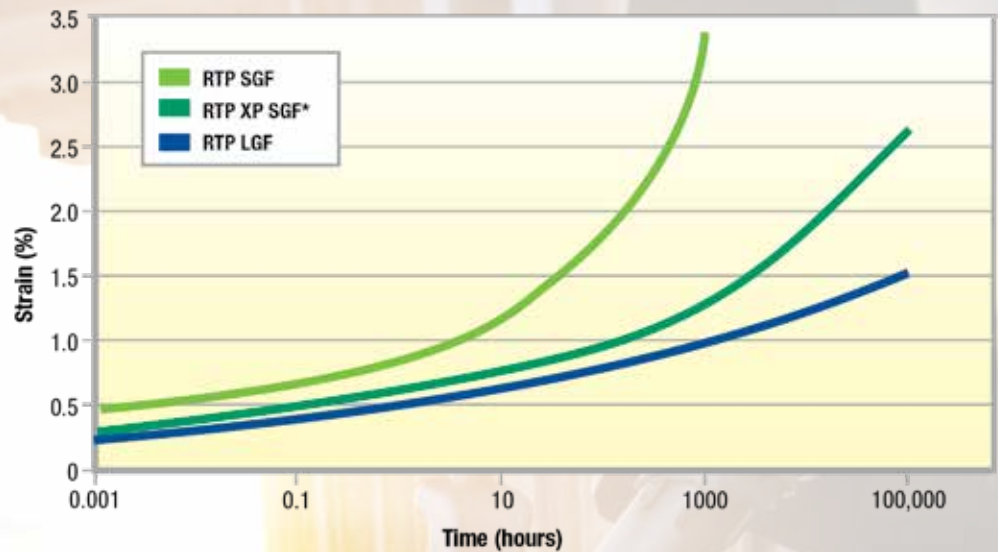


Under-the-hood parts benefit from the long-term heat aging resistance provided by LGF Compounds.

In some situations, a part will deform from stress over a period of time, which is known as “creep”. Long fiber solutions are an excellent material choice when deflection over time is a concern for parts that are under constant load. The increased stiffness provided by LGF Compounds also results in improved creep resistance compared to unfilled or SGF Compounds (Figure 7).

Figure 7:

Flexural Creep Strain vs. Time
33 MPa, 23 °C
30% Glass Reinforced PP



** RTP XP materials are high performance SGF Reinforced Compounds*

Load bearing parts like snowmobile skis require rigidity to function properly and consistently. Unlike parts made from unfilled or SGF Compounds, components made from LGF Compounds resist creep over time.

EXTERIOR

Applications:

- Roof Systems
- Underbody
- Structural Trim

INTERIOR

Applications:

- Instrument Panel
- Consoles
- Seating

UNDER-THE-HOOD

Applications:

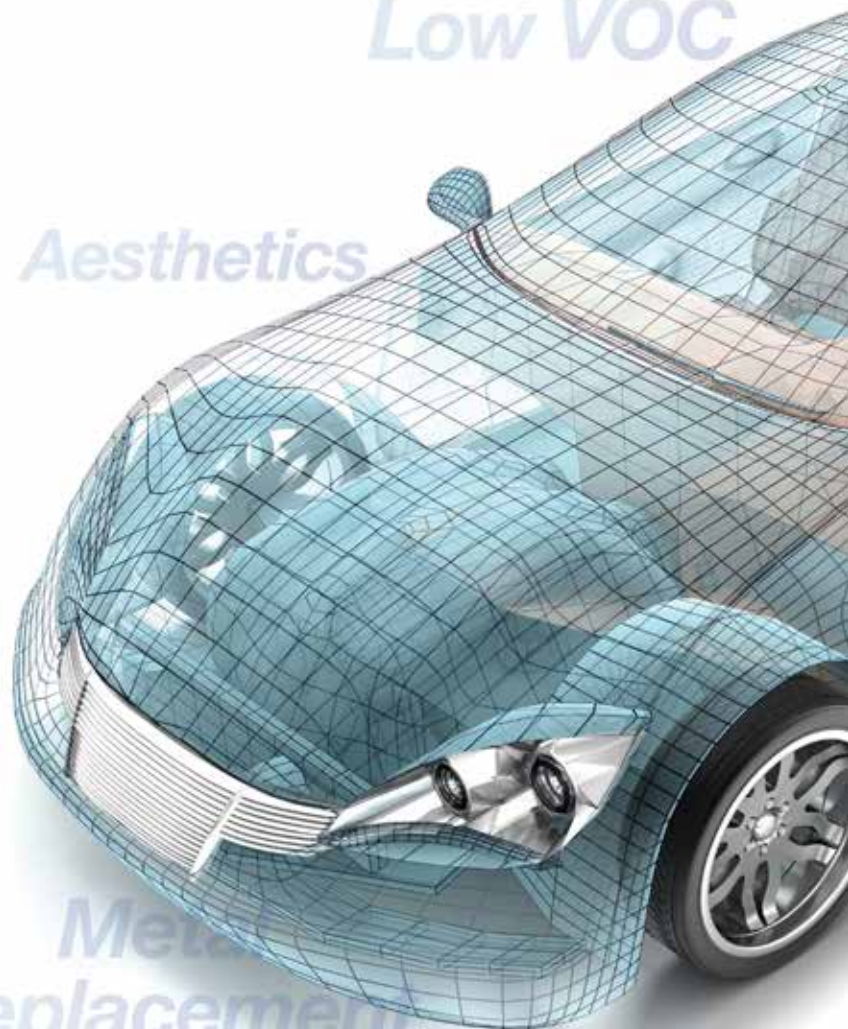
- Front End Modules
- Fan Shrouds

Low VOC

Aesthetics

Metal Replacement

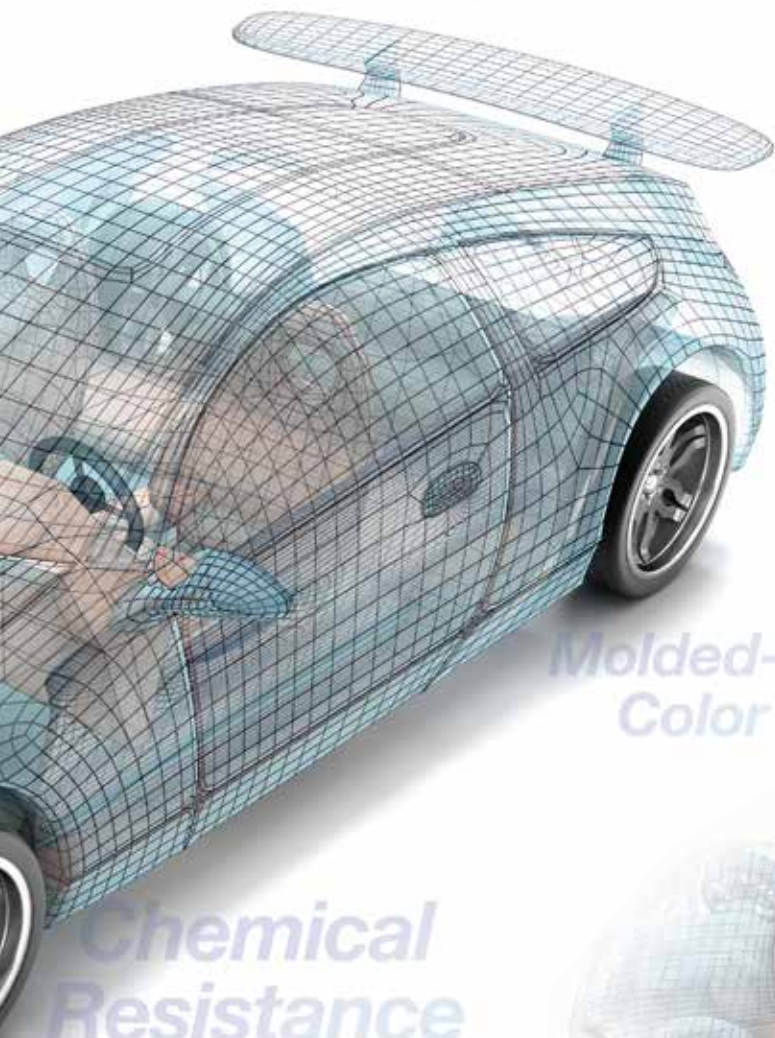
Design Consolidation



LGF Compounds for Automotive



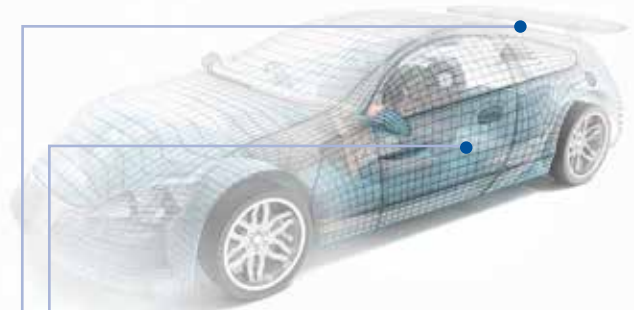
Durable



High Flow

*Molded-In
Color*

*Chemical
Resistance*



DOOR SYSTEMS

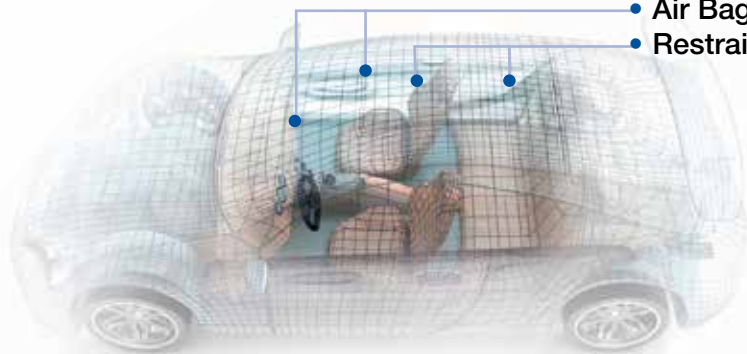
Applications:

- Lift Gates
- Door Modules

PASSENGER SAFETY

Applications:

- Air Bag Housings
- Restraint Systems

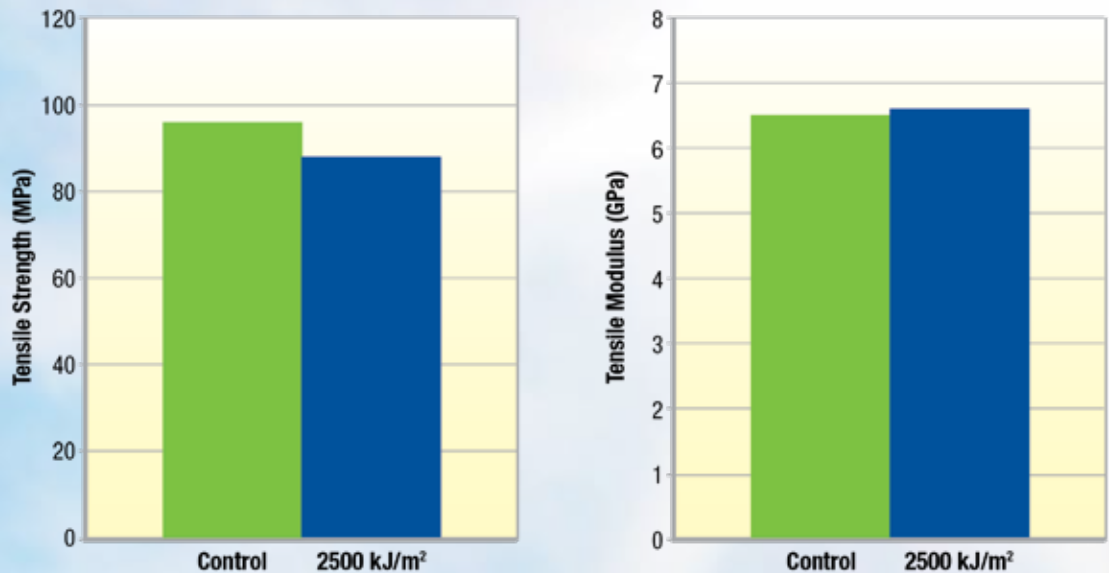


With RTP Company's engineering expertise, LGF Compounds can be formulated for UV protection and weatherability. Our long history with LGF Compounds and color formulation allows us to maintain the balance between preserving physical properties and color.

We can formulate LGF Compounds specifically for standards such as SAE J2527, the standard for accelerated exposure of Automotive Exterior Materials, and test them accordingly. Our UV protection technology can be used in conjunction with LGF Compounds to modify a variety of plastics. As shown in Figure 8, the tensile strength and tensile modulus of a PP LGF Compound are maintained, even after UV exposure.

Figure 8:

Physical Property Performance of PP LGF30 after 2500 kJ/m² UV Exposure



The plastic housing of this rooftop heat exchanger required an LGF Compound containing a UV stabilizer package to reduce damage from the sun's rays and extreme weather conditions.

International legislation and automotive OEMs have identified the need to reduce odor, fogging, and total Volatile Organic Compounds (VOCs) to improve air quality and the safety of vehicle interiors. We offer a selection of PP LGF products designed to meet automotive interior VOC requirements.

These low emission PP LGF Compounds are designed for structural use and help OEMs meet strict interior cabin air quality standards. With reinforcement levels of 20 – 50 wt%, these compounds have been tested and authenticated by approved outside laboratories according to German Automotive Industry (VDA) test methods; results show that PP LGF products from RTP Company meet or exceed the OEM requirements in all three categories (see Figure 9).



Figure 9: VDA Test Results: RTP Company PP LGF Compounds

PP LGF Low Emission Performance, North American OEM Requirements		VDA 278	
Formula PP	Description	VOC µg/g	SVOC µg/g
RTP 199 X 108595	PP LGF20, Automotive	≤ 300	≤ 500
RTP 199 X 70815	PP LGF30, Automotive	≤ 300	≤ 500
RTP 199 X 70836 A	PP LGF40, Automotive	≤ 300	≤ 500
RTP 199 X 70836 B	PP LGF50, Automotive	≤ 300	≤ 500

Compliant with requirements from GM, Stellantis, Tesla, Ford

PP LGF Low Emission Performance, European OEM Requirements		VDA 270			VDA 277	VDA 278	
Formula PP	Description	A1 (23 °C/24h)	A2 (40 °C/24h)	A3 (80 °C/2h)	Total Carbon µgC/g	VOC µg/g	SVOC µg/g
RTP 199 X 123150 A	PP LGF30, EU Low Emission Automotive	≤ 2	≤ 3	≤ 3	≤ 20	≤ 50	≤ 100
RTP 199 X 123150 B	PP LGF40, EU Low Emission Automotive	≤ 2	≤ 3	≤ 4	≤ 20	≤ 50	≤ 100
RTP 199 X 123150 C	PP LGF50, EU Low Emission Automotive	≤ 2	≤ 3	≤ 5	≤ 20	≤ 50	≤ 100

Compliant with requirements from VW, Daimler, BMW

Metal-to-Plastic Conversion

Metal-to-plastic conversion doesn't have to be difficult or lengthy. We have extensive experience in guiding companies and teams through the process. Our experts can answer your questions, and develop a plan that will work for you. Here are 7 steps to make the metal-to-plastic conversion process as seamless and effortless as possible:

1. IDENTIFY PARTS

What makes a part a good candidate for metal replacement?

- High volume production parts
- Parts with complex geometries, assemblies, or secondary operations that can be eliminated or reduced

2. DEFINE PART REQUIREMENTS

Reduce risks by determining requirements up front such as:

- Part environment: temperatures, Ultra Violet (UV), chemical and moisture exposure
- Structural performance: strength, stiffness, and impacts

3. SPECIAL CONSIDERATIONS

Are there any special requirements or attributes that the part must meet, such as:

- Regulatory requirements (UL, FDA, NSF, EU, Biocompatibility)
- Unique characteristics (wear, conductivity, color, flame retardancy)

4. COST ANALYSIS

Plastics can provide a significant system cost decrease versus metals when all aspects are considered, such as the reduction of:

- Raw material costs and density
- Tooling and processing
- Cycle times
- Assembly steps and labor
- Secondary operations

5. PROJECT DESIGN REVIEW AND SUPPORT

Understanding the feasibility of a metal-to-plastic conversion is an important step in making it a reality. We offer additional services to ensure your metal-to-plastic conversion is a success, including:

- Part, tooling, process, and design reviews
- CAE support such as Autodesk Moldflow® and FEA

6. PROTOTYPE MOLDING AND PART VALIDATION

We can assist in material molding trials and final part testing to ensure that you are ready for production.

7. TRANSITION TO PLASTIC PRODUCTION

We will also help optimize your production molding processes to ensure a smooth transition while maximizing benefits.

Services include:

- Production molding process
- Material release specifications
- Supply chain support



Computer Aided Engineering (CAE) Services

RTP Company CAE Engineers can provide assistance with injection molding analysis or structural FEA analysis on complex parts like this automotive door carrier module.



Our team of experienced CAE analysts provide assistance with structural analyses to predict how an actual molded part might perform, or with flow simulation filling and warpage analyses to anticipate the injection molding cycle and ultimate part shape. Because fiber orientation impacts how a material will behave under different conditions, analyses performed by our CAE team can be instrumental in successful plastic part or component development. We offer product design review and consultation of the following:

- Injection molding analysis
- Structural analysis (FEA)
- Structural failure consultation
- Quick mechanical structural design review
- Mold design assistance
- Product testing recommendation

Worldwide Manufacturing of LGF Compounds

Supporting today's global economy with products worldwide is an important facet of the thermoplastic materials industry. RTP Company is committed to offering LGF Compounds around the world that meet global specifications in markets such as: Automotive, Industrial, Healthcare, Consumer Goods, and more.



We manufacture LGF Compounds in Asia, Europe, and multiple sites in North America to provide our customers with custom solutions and support wherever they are located. When combined with support from Product Development Engineers in each region that understand the process and formulations, your application will be well positioned for success.

To learn more, contact us, scan our code, or visit www.rtpcompany.com to get your project started today!



Property Comparison

Formula	Description	Specific Gravity	Tensile Strength (MPa)	Tensile Modulus (MPa)	Flexural Strength (MPa)	Flexural Modulus (MPa)	IZOD Notched Impact (kJ/m ²)	IZOD Unnotched Impact (kJ/m ²)
Polypropylene (PP)								
RTP 199 X 108595	PP LGF20, General Purpose, Automotive	1.05	90	4800	125	4100	16	48
RTP 199 X 70815	PP LGF30, General Purpose, Automotive	1.13	110	7100	170	6500	21	60
RTP 199 X 70836 A	PP LGF40, General Purpose, Automotive	1.20	130	8500	200	8500	25	63
RTP 199 X 70836 B	PP LGF50, General Purpose, Automotive	1.33	140	11900	220	10500	23	75
RTP 199 X 118048	LGF60 Concentrate, General Purpose, Automotive	1.49	*	*	*	*	*	*
RTP 199 X 146911	PP LGF20, General Purpose UV	1.05	90	4800	125	4100	16	48
RTP 199 X 82416	PP LGF30, General Purpose UV	1.13	110	7100	170	6500	21	60
RTP 199 X 70821 A	PP LGF40, General Purpose UV	1.20	130	8500	200	8500	25	63
RTP 199 X 70821 B	PP LGF50, General Purpose UV	1.33	140	11900	220	10500	23	75
RTP 199 X 123127 A	PP LGF30, Automotive UV	1.13	110	7100	170	6500	21	60
RTP 199 X 123127 B	PP LGF40, Automotive UV	1.20	130	8500	200	8500	25	63
RTP 199 X 123127 C	PP LGF50, Automotive UV	1.33	140	11900	220	10500	23	75
Nylon 6 (PA 6)								
VLF 80207 A	PA 6 LGF40	1.45	210	12900	320	12300	25	80
VLF 80209 A	PA 6 LGF50	1.56	230	17900	330	16500	30	94
Nylon 6/6 (PA 6/6)								
VLF 80207 EM HS	PA 6/6 LGF40	1.46	225	13500	345	12000	27	90
VLF 80209 EM HS	PA 6/6 LGF50	1.57	250	16000	370	15200	29	100
VLF 80211 EM HS	PA 6/6 LGF60	1.71	250	21500	400	18500	32	250
Polyphenylene Sulfide (PPS)								
RTP 1399 X 68907 A	PPS LGF40	1.69	165	15500	235	15000	23	40
RTP 1399 X 68907 B	PPS LGF50	1.73	185	17500	275	17900	25	42
Polyetheretherketone (PEEK)								
RTP 2299 X 108578 A	PEEK LGF30	1.52	185	11700	275	11000	17	60
RTP 2299 X 108578 B	PEEK LGF40	1.61	205	13800	310	15200	18	80
Rigid Thermoplastic Polyurethane (RTPU)								
VLF 82307 A	RTPU LGF40	1.51	230	10000	325	10000	30	120
VLF 82309 A	RTPU LGF50	1.60	235	12400	345	12400	40	140
Polyphthalamide (PPA)								
VLF 84007	PPA LGF40	1.57	230	15200	325	14500	22	75
VLF 84009	PPA LGF50	1.64	265	18300	400	18000	25	85

* Concentrate grade is formulated to be blended with various types and levels of PP or PE.

The materials listed here are a small selection of our LGF compounds; for a listing of our complete portfolio, visit www.rtpcompany.com.

For additional data, such as temperature, flow, and crossflow, or to learn how other technologies can be incorporated, contact your local RTP Company representative.



**Your Global Compounder of
Custom Engineered Thermoplastics**

RTP COMPANY THERMOPLASTIC TECHNOLOGIES



COLOR

Color inspires, energizes, and builds brand recognition, and choosing the right supplier is as important as selecting the right color. We offer color technology options in standard precolored resins or custom compounds, UniColor®, Masterbatches, or cube blends.



CONDUCTIVE

We offer compounds for electrostatic discharge (ESD) protection, EMI shielding, or PermaStat® permanent anti-static protection. Available in particulate and all polymeric-based materials, these compounds can be colored as well.



FLAME RETARDANT

Whether you are developing a new product or need to reformulate due to ever-changing regulations, we can custom engineer a flame retardant material with the exact properties you require.



HIGH TEMPERATURE

We formulate our high temperature compounds precisely to retain their performance properties, provide better dimensional stability, and offer excellent electrical characteristics in continuous-use high temperatures.



ENGINEERED SHEET

If you need engineered sheet material for your plastic part, we can extrude custom thermoplastic formulations into cut sheet in various sizes and thicknesses.



LONG GLASS FIBER

As pioneers in developing a proprietary pultrusion process, we've perfected the manufacturing of our Long Glass Fiber (LGF) Compounds. These pellets encapsulate long fibers for superior strength, stiffness and impact resistance, making them ideal for metal replacement.



STRUCTURAL

Our reinforced Structural Compounds are formulated to increase strength and stiffness, and provide resistance to impact, creep, and/or fatigue. These materials can be customized to meet cost and performance targets.



TPE

Our thermoplastic elastomers provide rubber-like performance with the processing benefits of thermoplastic resin. Our portfolio ranges from standard, in-stock resins to custom compounds designed to meet your specifications.



WEAR RESISTANT

Our wear resistant thermoplastic compounds can incorporate internal lubricants to reduce wear and friction, thereby lengthening the service life of your application and reducing your processing costs.



FILM – WIMAN

Through our sister company, Wiman Corporation, we can provide you with polymer film in a variety of resins, and customized with additives to provide specific properties.

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