RTP Co.
Imagineering Plastics®

Very Long Fiber Compounds

Strong, Stiff, and Impact Resistant Solutions Using Long Glass Fiber Technology

LGF versus SGF Pellets: What's the Difference?

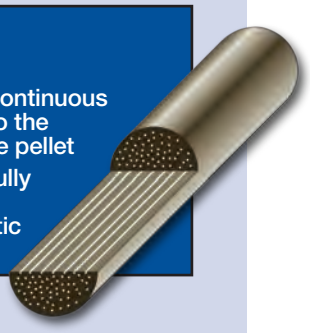
Long Glass Fiber (LGF) pellets are longer in length than Short Glass Fiber (SGF) pellets, with long, continuous fibers that extend the entire length of the pellet (see Figure 1). When LGF pellets are processed via injection molding, the long fibers inside will entangle, creating an internal skeletal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

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

Very Long Fiber (VLF) Compounds

Strong, Stiff, and Impact Resistant Solutions Using Long Glass Fiber Technology

RTP Company has been a pioneer in developing Long Glass Fiber (LGF) pellets since the 1980s. Our VLF Compounds are LGF thermoplastic pellets that encapsulate long fibers the same length as the pellets themselves. We manufacture these materials using a proprietary pultrusion process built on years of experience.

VLF 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 VLF Compounds provide significantly improved impact resistance without sacrificing strength and stiffness, even at extreme temperatures.

Like many RTP Company compounds, VLF 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 VLF 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 VLF Compounds from RTP Company. To get your project started, contact us, scan our code, or visit www.rtpcompany.com today!

Impact Resistance

Due to their high strength-to-weight ratio, VLF 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.

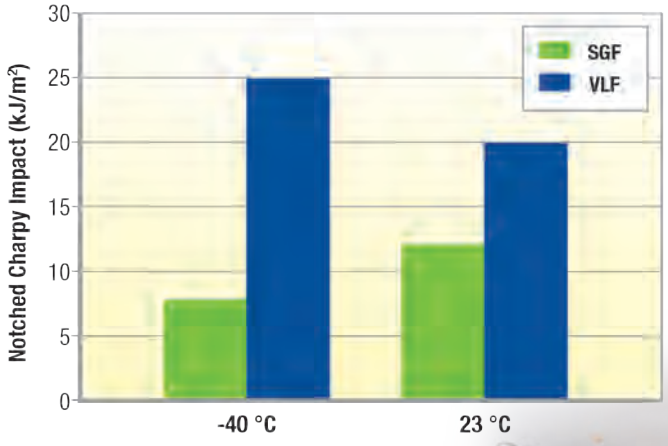
Our VLF Compound formulations display a high degree of impact performance while also providing good strength and stiffness. This combination of properties provides protection from breakage, even in extreme temperatures.

When compared to SGF reinforced Polypropylene (PP) and Nylon (PA), VLF 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. VLF Compound Impact Comparison 30% Glass Reinforced PP



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

Dimensional Stability

Parts molded with our VLF 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 VLF 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 VLF50 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*

** VLF 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 VLF Compounds form a skeletal network during molding to provide dimensional stability for large structures such as an automotive trunk or "frunk".

Our VLF 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.

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, VLF Compounds maintain functional strength and stiffness.

Figure 4: ***Tensile Stress-Strain PP VLF40***

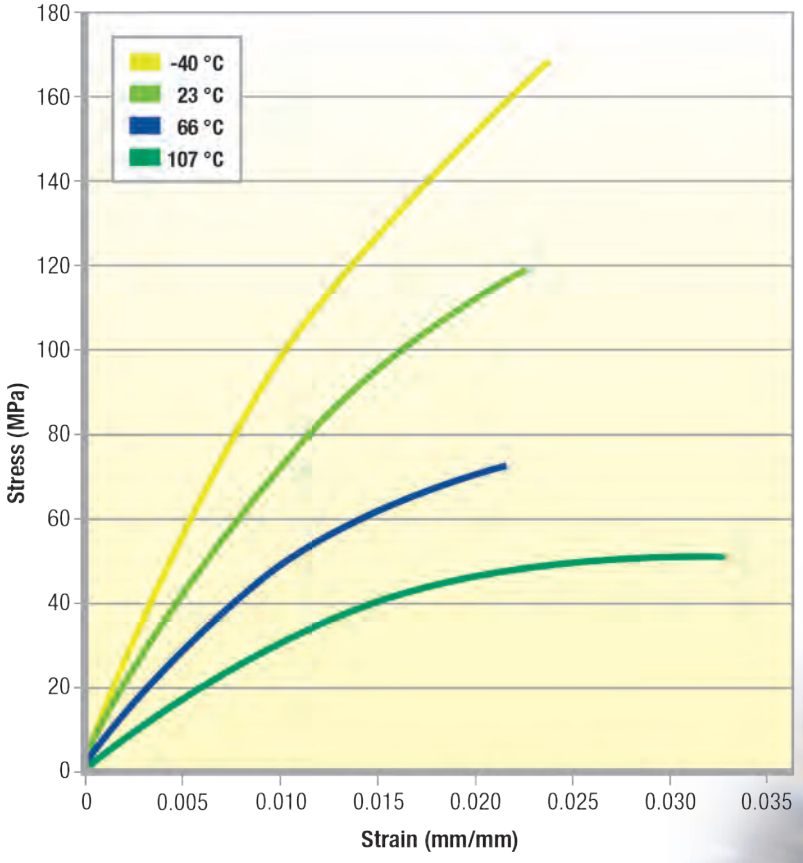
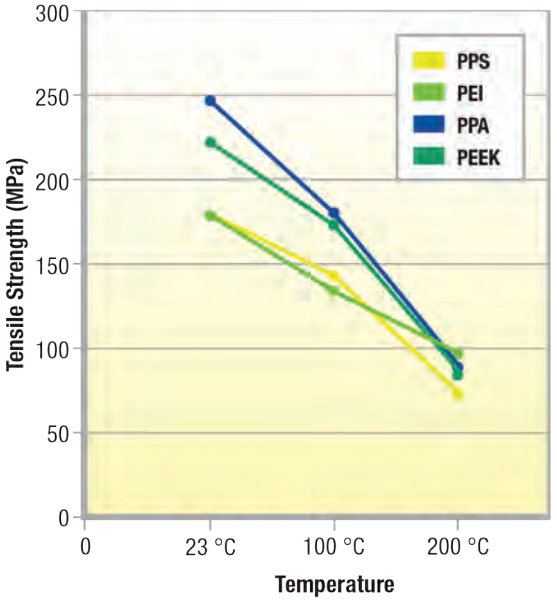


Figure 5: ***Tensile Strength vs. Temperature VLF40***

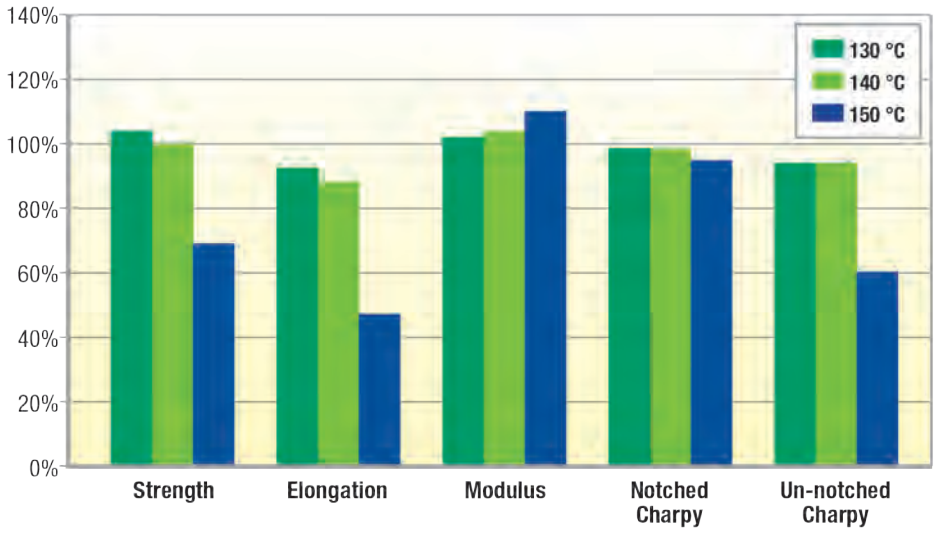


Critical components like those used in oil drilling operations benefit from the durability of VLF Compounds, which maintain their physical properties under high pressure and extreme temperatures.

Long-term Heat Aging Resistance

Some high temperature-resistant VLF Compounds offer excellent heat aging performance based on the inherent properties of the base polymer. Other VLF 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 VLF 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 VLF 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 VLF40***

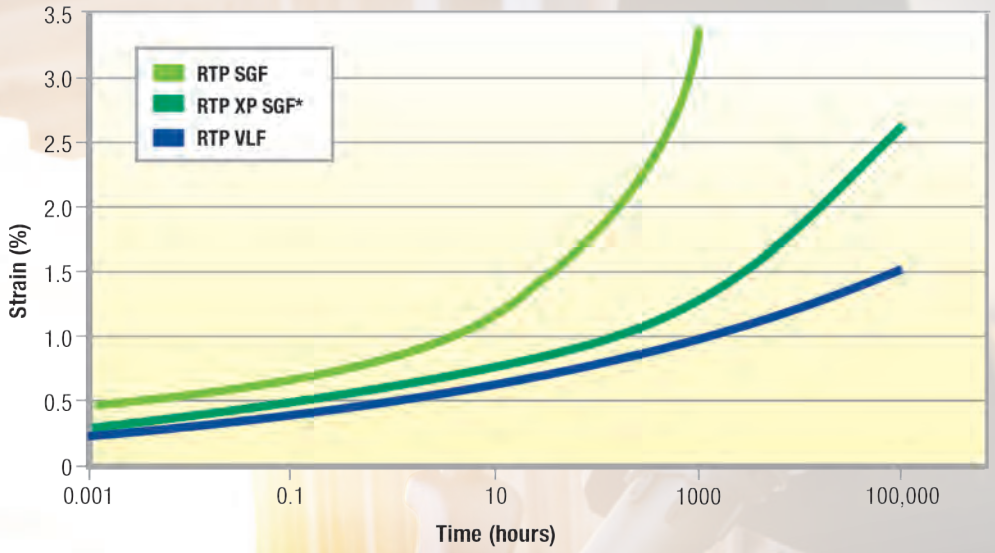


Under-the-hood parts benefit from the long-term heat aging resistance provided by VLF Compounds.

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 VLF 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 VLF Compounds resist creep over time.

EXTERIOR

Applications:

- Roof Systems
- Underbody
- Structural Trim

INTERIOR

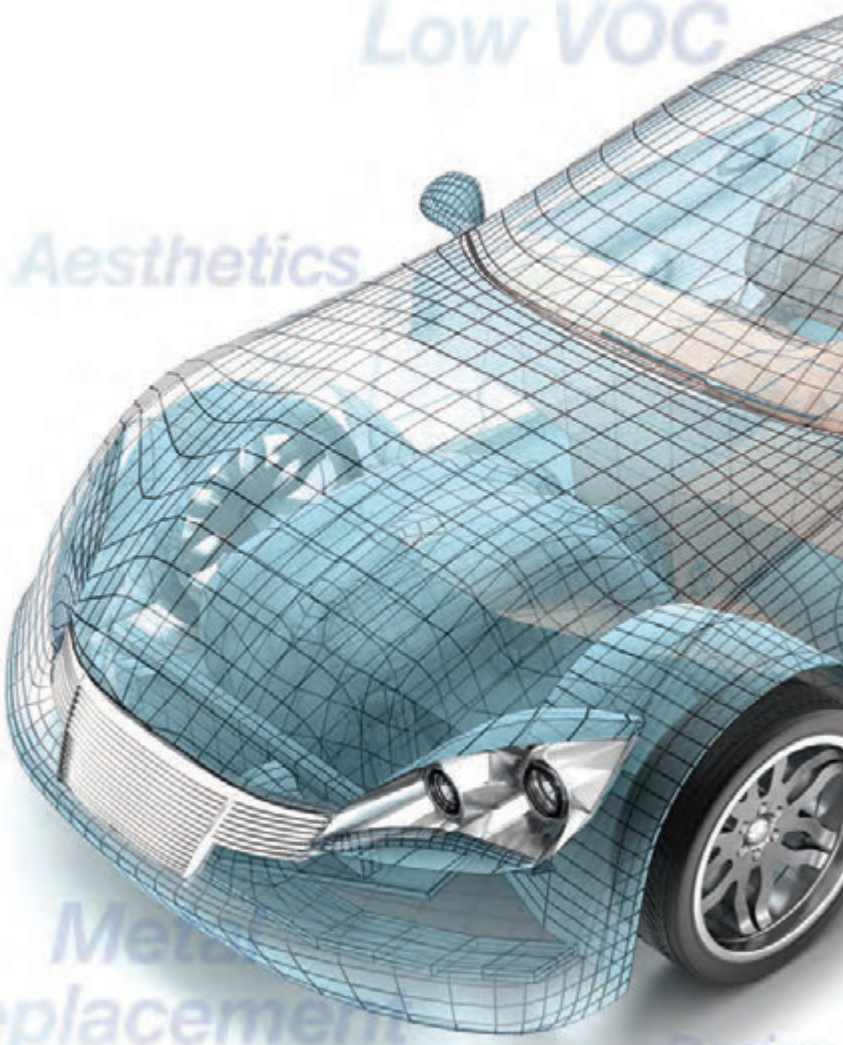
Applications:

- Instrument Panel
- Consoles
- Seating

UNDER-THE-HOOD

Applications:

- Front End Modules
- Fan Shrouds

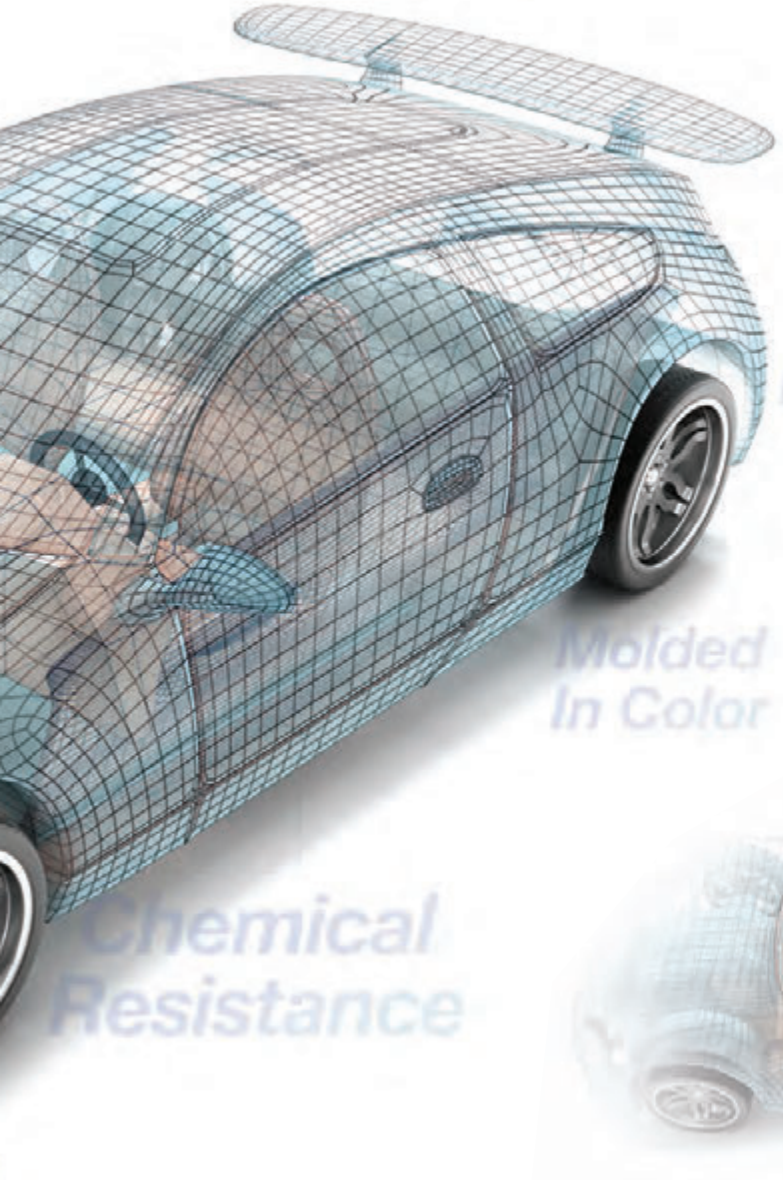


VLF Compounds for Automotive

DOOR SYSTEMS

Applications:

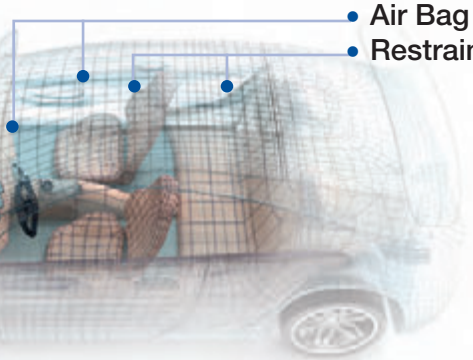
- Lift Gates
- Door Modules



PASSENGER SAFETY

Applications:

- Air Bag Housings
- Restraint Systems

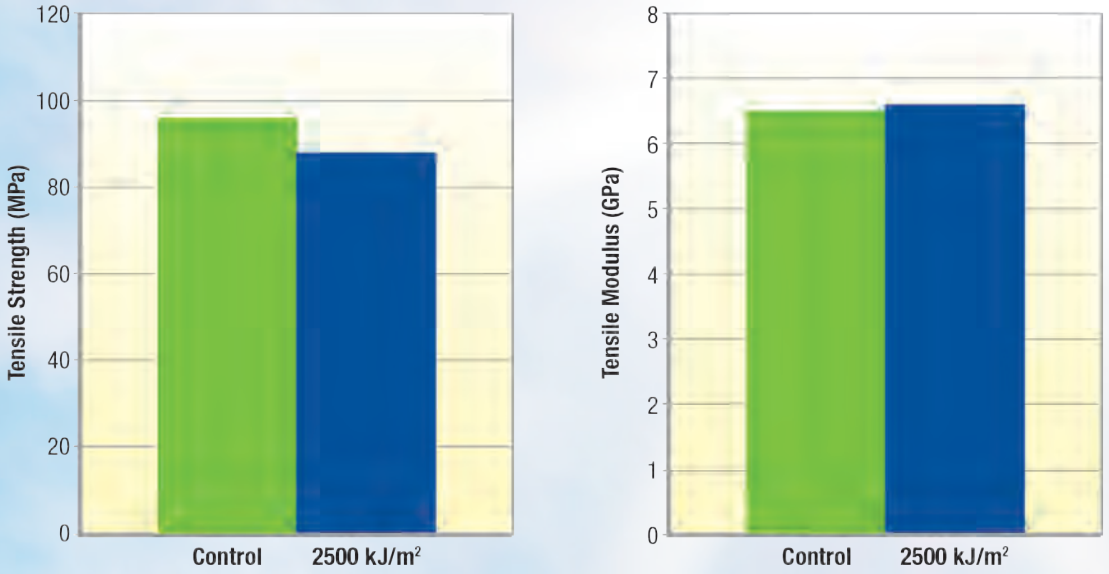


UV Protection

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

Figure 8:

Physical Property Performance of PP VLF30 after 2500 kJ/m² UV Exposure



We can formulate VLF 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 VLF Compounds to modify a variety of plastics. As shown in Figure 8, the tensile strength and tensile modulus of a PP VLF Compound are maintained, even after UV exposure.

The plastic housing of this rooftop heat exchanger required a VLF 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 VLF products designed to meet automotive interior VOC requirements.

These low emission PP VLF 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 VLF 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 VLF Compounds***

PP VLF Low Emission Performance, North American OEM Requirements		VDA 278	
Formula PP	Description	VOC µg/g	SVOC µg/g
RTP 199 X 108595	*PP VLF20, Automotive*	*≤ 300*	*≤ 500*
RTP 199 X 70815	*PP VLF30, Automotive*	*≤ 300*	*≤ 500*
RTP 199 X 70836 A	*PP VLF40, Automotive*	*≤ 300*	*≤ 500*
RTP 199 X 70836 B	*PP VLF50, Automotive*	*≤ 300*	*≤ 500*

Compliant with requirements from GM, Stellantis, Tesla, Ford

PP VLF 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 VLF30, EU Low Emission Automotive*	*≤ 2*	*≤ 3*	*≤ 3*	*≤ 20*	*≤ 50*	*≤ 100*
RTP 199 X 123150 B	*PP VLF40, EU Low Emission Automotive*	*≤ 2*	*≤ 3*	*≤ 4*	*≤ 20*	*≤ 50*	*≤ 100*
RTP 199 X 123150 C	*PP VLF50, 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 a 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, Biocompatability)
- 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

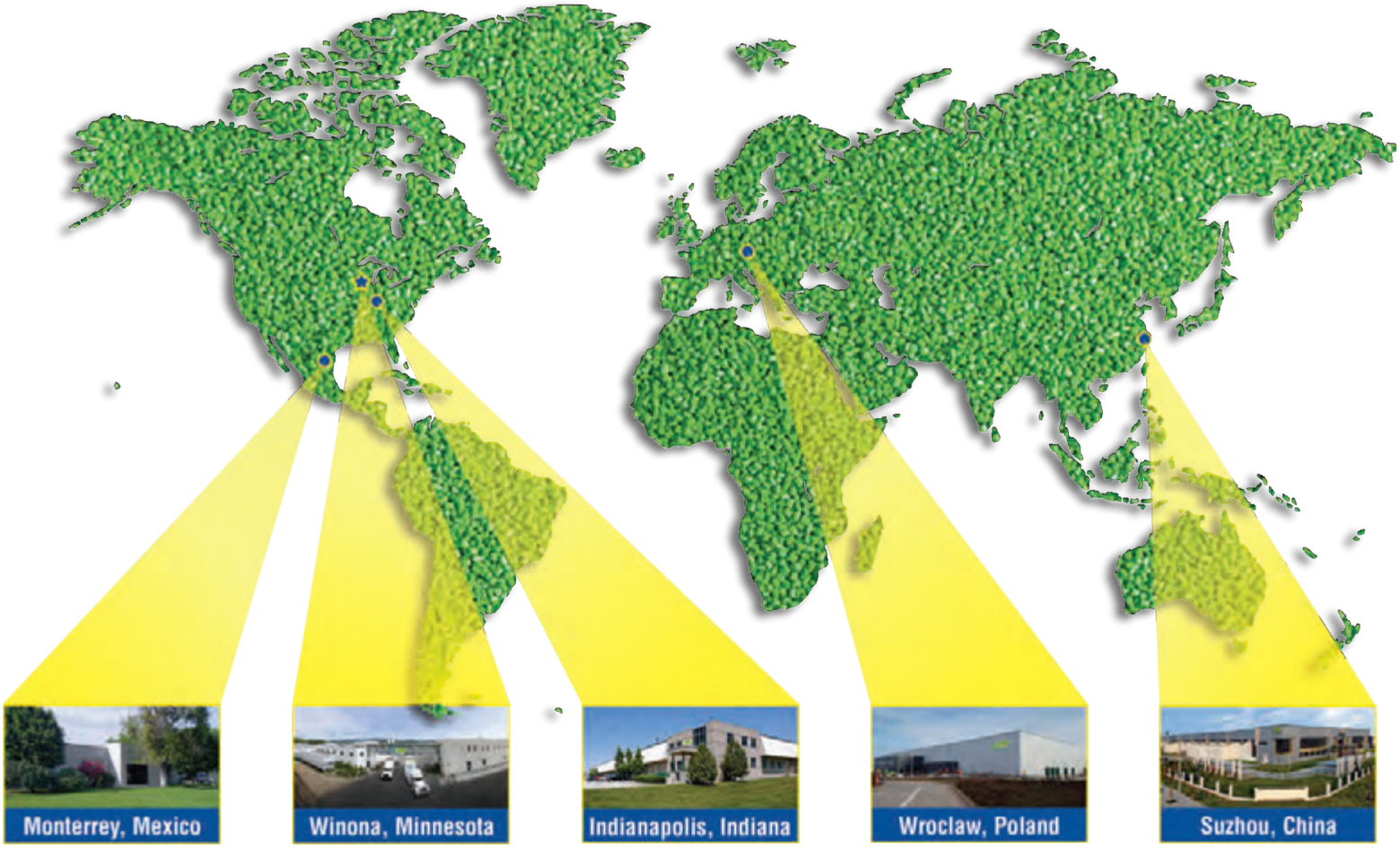
RTP Company CAE Engineers can provide assistance with injection molding analysis or structural FEA analysis on complex parts like this automotive door carrier module.

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 VLF 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 material known as VLF Compounds around the world that meet global specifications in markets such as: Automotive, Industrial, Healthcare, Consumer Goods, and more.



We manufacture VLF 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/m²)	IZOD Unnotched Impact (kJ/m²)
Polypropylene (PP)								
RTP 199 X 108595	PP VLF20, General Purpose, Automotive	1.05	90	4800	125	4100	16	48
RTP 199 X 70815	PP VLF30, General Purpose, Automotive	1.13	110	7100	170	6500	21	60
RTP 199 X 70836 A	PP VLF40, General Purpose, Automotive	1.20	130	8500	200	8500	25	63
RTP 199 X 70836 B	PP VLF50, General Purpose, Automotive	1.33	140	11900	220	10500	23	75
RTP 199 X 118048	VLF60 Concentrate, General Purpose, Automotive	1.49	*	*	*	*	*	*
RTP 199 X 146911	PP VLF20, General Purpose UV	1.05	90	4800	125	4100	16	48
RTP 199 X 82416	PP VLF30, General Purpose UV	1.13	110	7100	170	6500	21	60
RTP 199 X 70821 A	PP VLF40, General Purpose UV	1.20	130	8500	200	8500	25	63
RTP 199 X 70821 B	PP VLF50, General Purpose UV	1.33	140	11900	220	10500	23	75
RTP 199 X 123127 A	PP VLF30, Automotive UV	1.13	110	7100	170	6500	21	60
RTP 199 X 123127 B	PP VLF40, Automotive UV	1.20	130	8500	200	8500	25	63
RTP 199 X 123127 C	PP VLF50, Automotive UV	1.33	140	11900	220	10500	23	75
Nylon 6 (PA 6)								
VLF 80207 A	PA 6 VLF40	1.45	210	12900	320	12300	25	80
VLF 80209 A	PA 6 VLF50	1.56	230	17900	330	16500	30	94
Nylon 6/6 (PA 6/6)								
VLF 80207 EM HS	PA 6/6 VLF40	1.46	225	13500	345	12000	27	90
VLF 80209 EM HS	PA 6/6 VLF50	1.57	250	16000	370	15200	29	100
VLF 80211 EM HS	PA 6/6 VLF60	1.71	250	21500	400	18500	32	250
Polyphenylene Sulfide (PPS)								
RTP 1399 X 68907 A	PPS VLF40	1.69	165	15500	235	15000	23	40
RTP 1399 X 68907 B	PPS VLF50	1.73	185	17500	275	17900	25	42
Polyetheretherketone (PEEK)								
RTP 2299 X 108578 A	PEEK VLF30	1.52	185	11700	275	11000	17	60
RTP 2299 X 108578 B	PEEK VLF40	1.61	205	13800	310	15200	18	80
Rigid Thermoplastic Polyurethane (RTPU)								
VLF 82307 A	RTPU VLF40	1.51	230	10000	325	10000	30	120
VLF 82309 A	RTPU VLF50	1.60	235	12400	345	12400	40	140
Polyphthalamide (PPA)								
VLF 84007	PPA VLF40	1.57	230	15200	325	14500	22	75
VLF 84009	PPA VLF50	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 VLF 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.

RTP Co.
Imagineering Plastics®

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 long glass fiber materials, we've perfected the manufacturing of our Very Long Fiber (VLF) Compounds. These pellets encapsulate long fibers for superior strength, stiffness and impact resistance.

STRUCTURAL
Our reinforced structural compounds can increase strength, stiffness, and provide resistance to impact, creep, and fatigue. Ideal for metal or other material replacement, our formulas can be customized to meet cost and performance targets.

TPE
Our thermoplastic elastomers provide rubber-like performance with the processing benefits of thermoplastic resin. We offer a wide range of options, 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.

Please contact your local RTP Company Sales Engineer by calling 1-507-454-6900 or 1-800-433-4787 (U.S. only), by Email at rtp@rtpcompany.com, or visit www.rtpcompany.com

RTP Company Corporate Headquarters • 580 East Front Street • Winona, Minnesota 55987 USA **website:** www.rtpcompany.com • **email:** rtp@rtpcompany.com

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TELEPHONE:	U.S.A.	SOUTH AMERICA	MEXICO	EUROPE	SINGAPORE	CHINA	WIMAN CORPORATION	ENGINEERED SHEET
	+1 507-454-6900	*+55 11 4193-8772*	*+52 81 8134-0403*	*+33 380-253-000*	*+65 6863-6580*	*+86 512-6283-8383*	*+1 320-259-2554*	*+1 800-432-2386*