

PP GLASS FIBER COMPOUNDS FOR STRUCTURAL AUTOMOTIVE APPLICATIONS

The demand for lightweighting solutions has only increased as automotive manufacturers strive to achieve efficiency gains for their vehicle platforms. Even with the shift to electrified vehicles, lightweighting is a priority to help offset the weight of power systems and heavy battery components – improving overall efficiency and increasing range.

As a result, materials like thermoplastics continue to make inroads into new applications across the entire vehicle, allowing for meaningful weight savings and additional benefits.

For some time now, the automotive industry has turned to long glass fiber (LGF) and short glass fiber (SGF) polypropylene materials for use in structural and semi-structural applications. LGF-PP is now commonly used in components like instrument panel carriers, front end modules, door module assemblies, lift-gates (or tailgates) and center consoles; SGF-PP in parts like active grille shutter frames, air filter box assemblies, cooling fans, bumper brackets, fuse box assemblies and mirror brackets.

A critical consideration when choosing any material is recognizing that all individual part designs and their requirements are unique – a single material solution rarely meets all needs.

With SGF-PP more established in the automotive industry, manufacturers have a better understanding of processing techniques for this material. This, in addition to cost factors, can lead some to choose the material for an application. With only a slight price delta between SGF-PP and LGF-PP, however, one should perform a detailed engineering properties needs analysis before making a final selection.

INSTRUMENT PANELS AND INTERIOR TRIM COMPONENTS

With instrument panels, OEMs, with the support of their Tier 1 partners, have developed lighter and stiffer parts with a combination of foaming and proper long glass orientation.

Key considerations include:

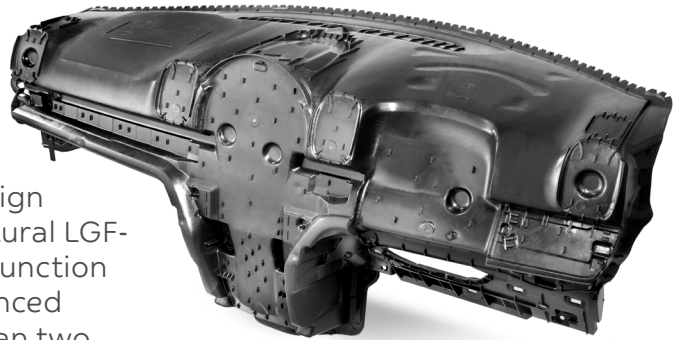
- **Mechanical behavior** – Material solutions must meet a range of impact performance requirements.

AUTOMOTIVE EXPERT SERIES

This series offers education, guidance and insights from our global team of automotive experts. We cover industry pain points, a diverse range of technical topics and frequently asked questions on the use of thermoplastics for automotive applications.

One should perform a detailed engineering properties needs analysis before choosing between SGF-PP and LGF-PP.

- **Environmental conditions** – LGF-PP materials are inherently robust but must be tuned to meet chemical resistance, especially in humid and elevated temperatures.
- **Cost-out** – Economical LGF-PP materials offer opportunities to reduce cost via component integration and relatively easy engineering conversion from metal to plastic composites when modeled effectively.
- **Weight-out** – Combined with the inherent design freedom injection molding offers, semi-structural LGF-PP solutions can further reduce weight in conjunction with established foaming technologies. Advanced foaming has enabled wall thickness of less than two millimeters in some cases.



LIGHTWEIGHT LIFTGATE (TAILGATE) SOLUTIONS

The inner structures of liftgates are increasing in size and need excellent strength-to-weight ratios and long-term creep fatigue resistance.

Key considerations include:

- **Mechanical behavior** – Structural solutions like LGF-PP are strong enough for tailgates to remain closed under severe conditions, as well as stay rigid after repetitive cycles like open and closure. They are resistant to deformation and creep.
- **Environmental conditions** – In humid conditions, designers must consider the “bondability” of their resin solutions in the backlite interface for both the assembly process and long-term use.



IMPORTANCE OF MODELING

Generally, LGF-PP has grown within the automotive industry because of its mechanical superiority and weight-saving potential, particularly when switching from metal solutions. When faced with a choice between plastic solutions, the correct path is less obvious.

Historically, part developers have selected overly-engineered plastics to mitigate risk. However, simpler material solutions can work just as effectively when designed and processed to their fullest potential using the right modeling tools.

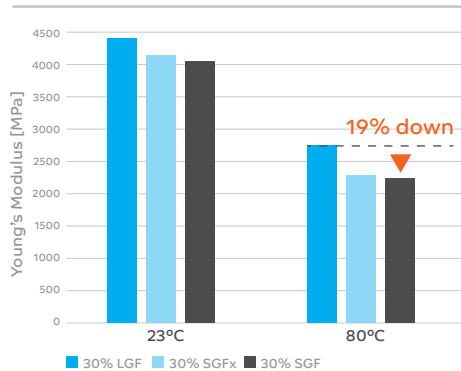
Today, instances exist where parts actually shrink in volume and increase in stiffness. When isotropic part modeling is employed to ensure glass fibers are oriented to the crucial sections identified in a dynamic modeling design loop process, part optimization can be achieved more reliably.

KEY GLASS REINFORCEMENT CONSIDERATIONS

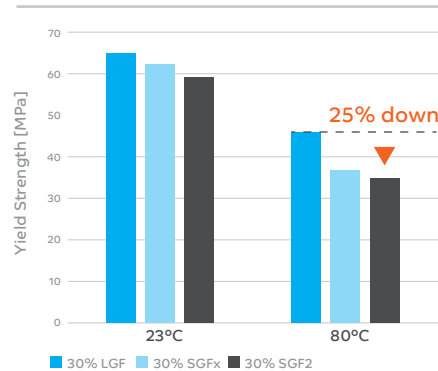
Glass reinforced PP includes both continuous and discontinuous fibers. The benefits that come from adding glass fibers to PP includes high stiffness, high modulus and thermal stability.

LGF-PP has each of the above-mentioned properties, and in addition, superior impact resistance, higher rigidity, creep resistance and modulus retention at typical automotive temperatures (-30°C to 80°C). LGF-PP also has less shrinkage and warpage than SGF-PP, for greater dimensional stability.

LGF-PP vs SGF-PP — Stiffness

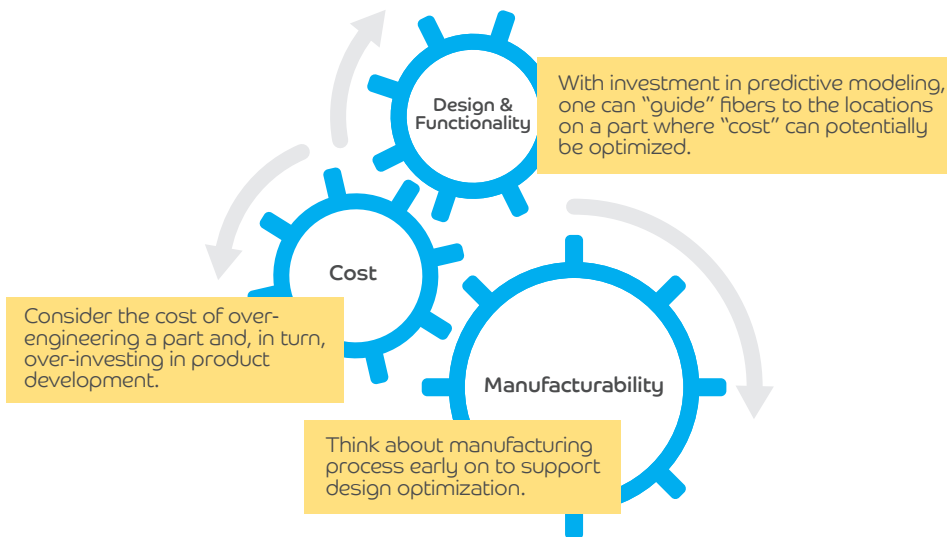


LGF-PP vs SGF-PP — Strength



LGFPP offers improved stiffness, strength and performance at elevated temperatures

Several key decision points are involved when developing a new application beyond selecting a material. The development team needs to consider factors like design and functionality, cost and manufacturability.

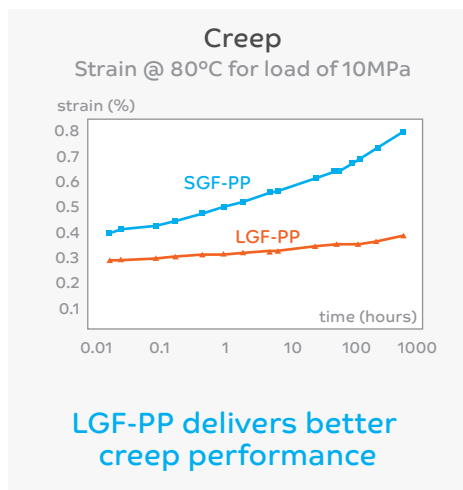
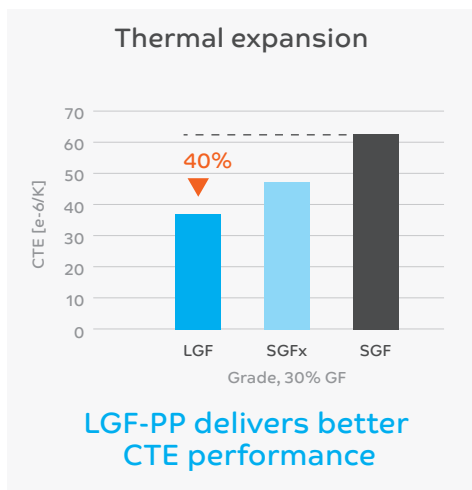


Each of these factors can affect the other areas. This can help explain why material selection is arguably the most complicated decision in application development.

When weighing the pros and cons of SGF-PP vs LGF-PP, the load and environmental conditions your application withstands during its service life are important considerations. This is especially true if considering creep and fatigue performance data where we see superior impact properties for LGF-PP.

Additionally, the higher creep performance and lower coefficient of thermal expansion of LGF-PP are critical considerations when low gap and flush requirements are important.

LGF-PP vs SGF-PP



Typically, part weight increases 10-15 percent when switching to SGF-PP from LGF-PP.

Although SGF-PP may perform satisfactorily for a given application, validation is critical, as is approaching materials substitution in an integrated way, where one considers part design, processing and cost simultaneously. Extensive engineering is required, especially with the significant structural complexity of glass fiber reinforced PP grades.

SABIC offers both SGF-PP and LGF-PP grades, and has extensive knowledge and expertise to aid in designing your application using these glass-filled materials.

STAMAX™ LGF-PP resin from our portfolio is available in a variety of concentrations (20-60 percent glass fiber), which makes it suitable for an extremely wide range of load bearing applications.

When considering one material over another, remember – reopening the choice of material involves a redesign, not a direct substitution. Part design and material selection is a continuous process.

SABIC can help assess the right design-material-process combination with our sophisticated set of predictive engineering and modeling capabilities.



RECAP

- Both SGF and LGF polypropylene materials deliver beneficial properties for a wide range of applications including high stiffness, high modulus and good thermal stability.
- In addition to those properties, LGF-PP imparts superior impact resistance, higher rigidity, good creep resistance and modulus retention at typical automotive temperatures. LGF-PP also has less shrinkage and warpage than SGF-PP, for greater dimensional stability.
- Extensive engineering is required for the design of applications with these glass-filled materials, especially with their structural complexity. SABIC can help with our extensive knowledge of both SGF-PP and LGF-PP materials and our sophisticated set of predictive engineering and modeling capabilities.

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