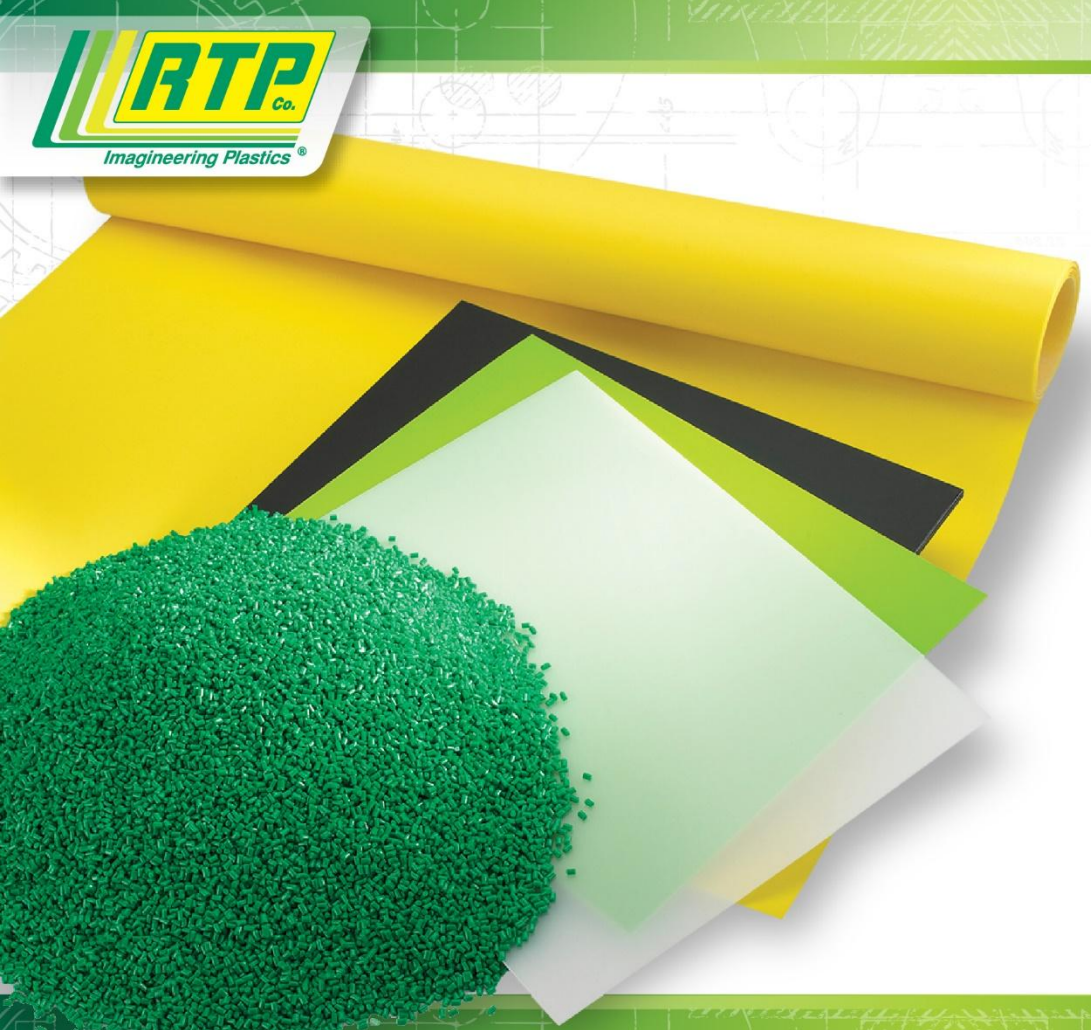


Built to Last: *Structural Thermoplastics for Hand and Power Tools*

Zach Halverson

Global Business Manager – Structural

March 28th, 2025

AGENDA

- RTP Company Intro
- Problems – Solutions
  - Brittleness
  - Strength and Rigidity
  - Environmental Exposures
  - Warp & Shrink
  - Density
  - Costs, Support, and Innovation
- Sustainability
- Summary

ABOUT RTP COMPANY

RTP Company is an independent, privately owned thermoplastics compounder with global manufacturing, engineering support, and sales representation.

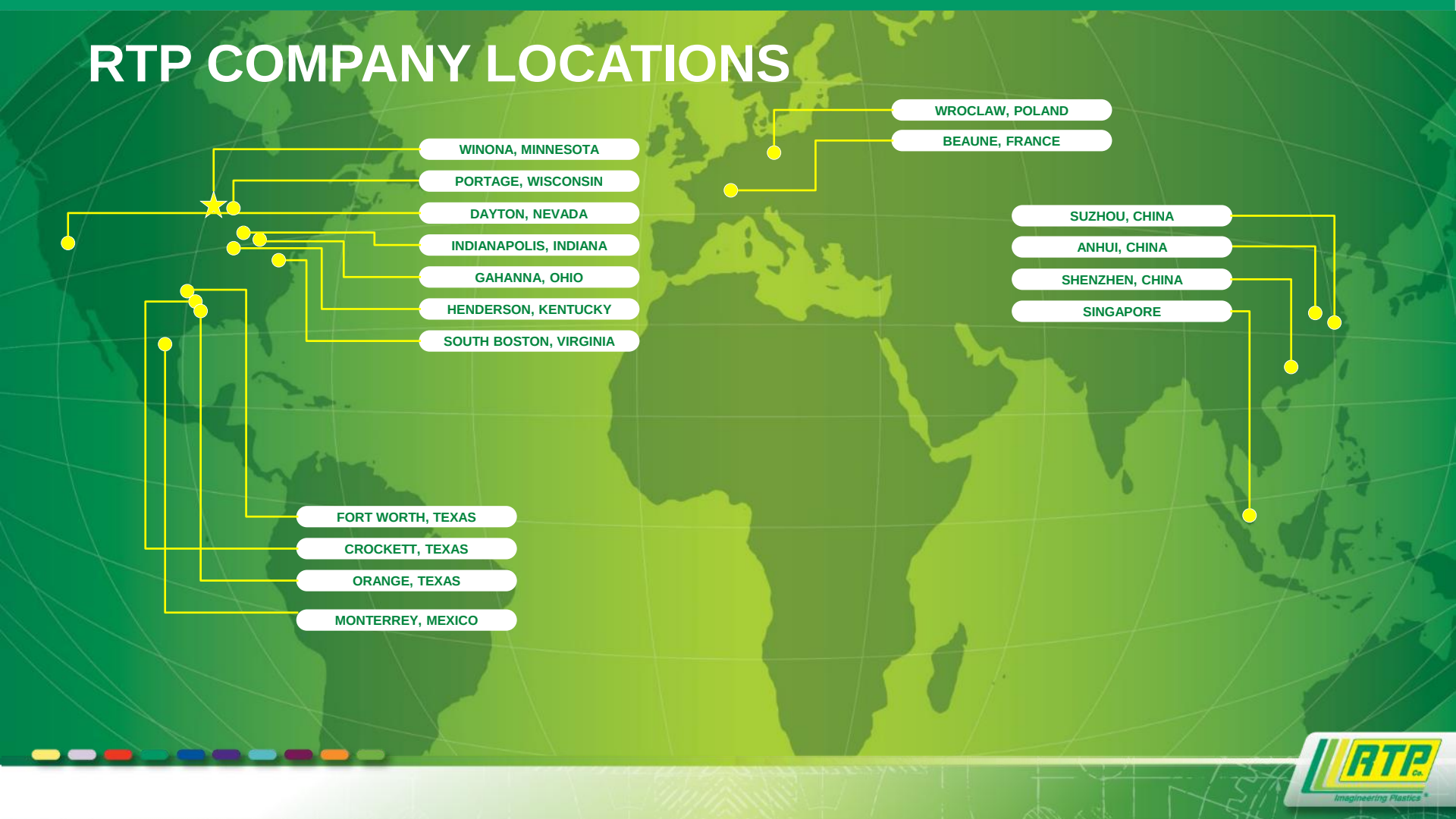
- ~1,800 employees
- ~$1 billion annual sales

CUSTOM SOLUTIONS

We offer High-Tech Compounds to Unfilled Resins in Pellet, Sheet, and Film format

- 60+ resins
- Hundreds of modifiers
- Broadest range of compounds, from talc PP to nanotube PEEK
- Annual production:
  - 9,000+ commercial products sold,
  - including 1,750 newly formulated compounds

RTP COMPANY LOCATIONS



OUR CULTURE

The culture at RTP Company can best be described as…

- Customer-centric
- Entrepreneurial
- “Bureaucracy-less”
- Generational, long-term perspective

MARKETS


Healthcare


Automotive


Industrial


Consumer Goods


Energy


Aerospace & Defense


Sports & Leisure


Agriculture & Off-Road Equipment


Electronic Packaging & Data Storage


Appliances

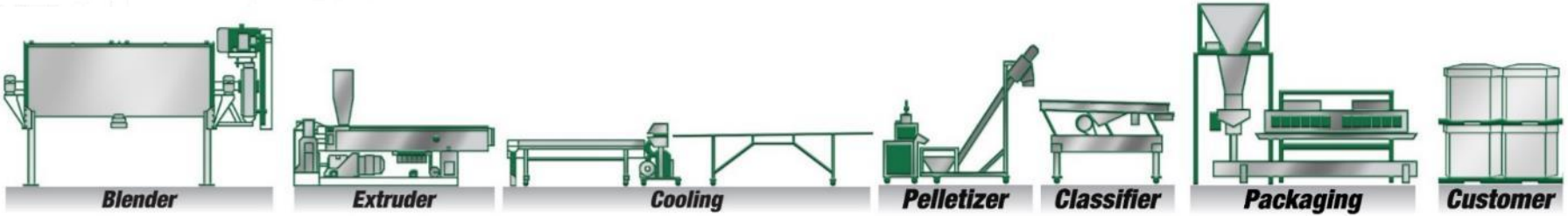

Infrastructure


Electronics

THE COMPOUNDING PROCESS

Base resin | Glass fiber | Blue pigment

Raw Materials → **Finished Product**



COMPOUNDING PROCESS

Polymers with Deficiencies

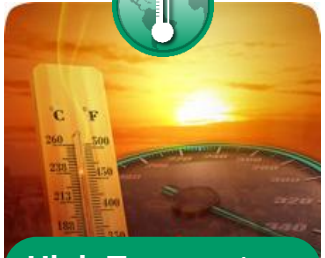
Compounds that Meet Product Requirements

PRODUCT FAMILIES


Color

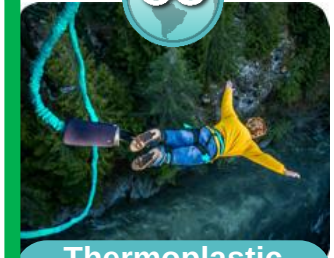

Conductive

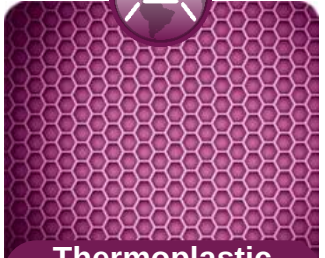

Flame Retardant


High Temperature


Long Glass Fiber


Structural


Thermoplastic Elastomers


Thermoplastic Polyolefins


Wear Resistant


Engineered Sheet

STRUCTURAL SOLUTIONS FOR TOOL APPLICATIONS

Solutions for common issues, including:

Brittleness

Improved ductility, reduced brittleness

Flexing

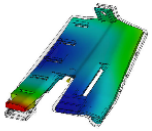
Increase rigidity

Low Strength

Enhance parts durability and resistance to loads

Warp & Shrink

Reduce warp, improve flatness, and control shrink



Environmental

Heat, UV, and chemical resistance

Comfort

Lightweighting or customized high gravity compounds

Costs

Product consolidation and optimization, metal-to-plastics

$$$

Innovation

Product development partners, educational support

STRUCTURAL ADDITIVES TOOLBOX

Modifiers

- Impact Modifiers
- Polymer Blends

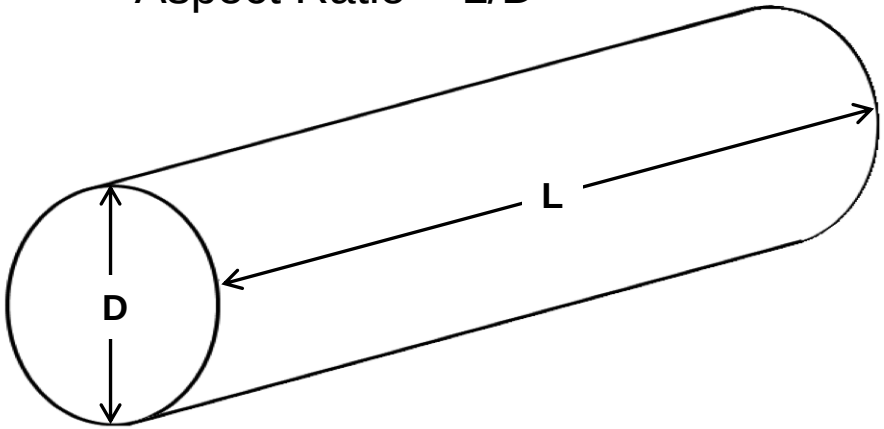
Fillers

- Mineral Fillers (low aspect ratio)
- Fiber Reinforcements (high aspect ratio)

FILLERS/REINFORCEMENT - ASPECT RATIO

Property change determined by:

Aspect Ratio = L/D



Aspect Ratio

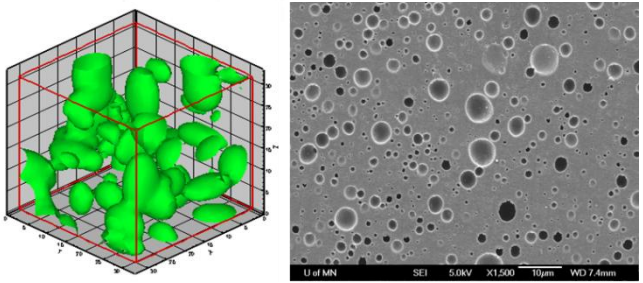
Reinforcing

BRITTLENESS/LOW IMPACT RESISTANCE

IMPACT MODIFIED COMPOUNDS

Primary Benefits of Impact Modified Compounds

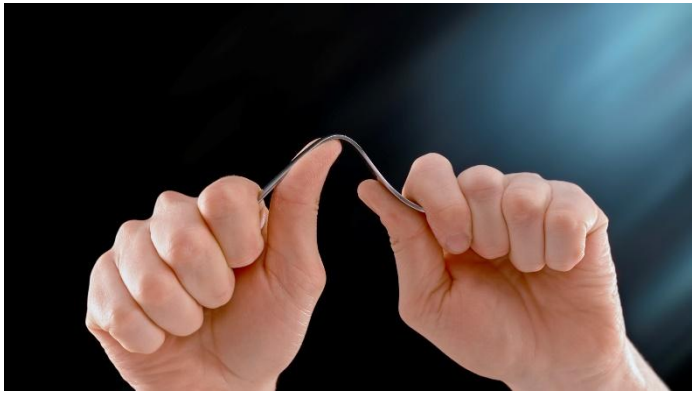
- Increased ductility across many polymers & technologies
  - Most popular in nylons, also do PBT, PP, PPA, PPS, some amorphous resins
- Improved impact performance at low temperatures
- Reduced specific gravity



Illustrations of an impact modified PA 66 matrix

ASTM DAM Conditions	**PA 6,6**	**RTP 200 H (IM PA6,6)**
Specific Gravity	1.14	1.08
Notched Izod Impact (J/m)	**53**	**961**
Tensile Strength (MPa)	83	50
Flexural Modulus (MPa)	2,760	1,800

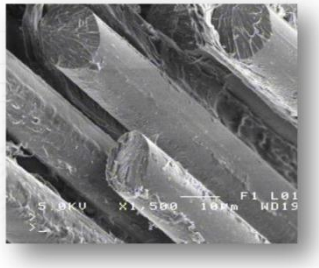
LOW STRENGTH AND STIFFNESS



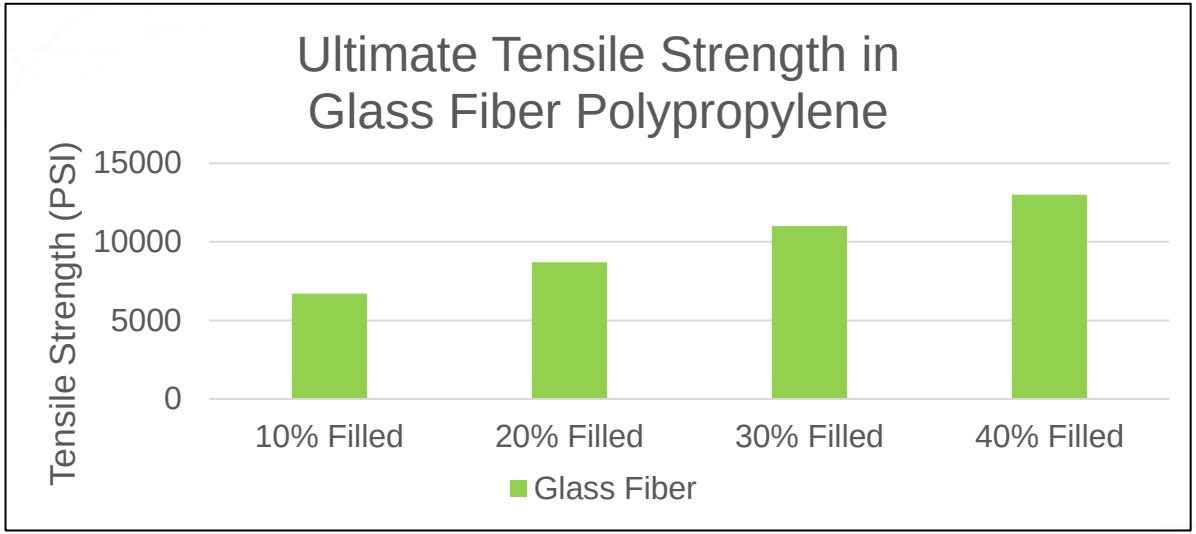
SHORT GLASS FIBER COMPOUNDS

Primary Benefits of Glass Fiber Compounds

- Increased strength and stiffness, sometimes impact resistance
- Improved creep and fatigue properties
- Improved performance across temperatures



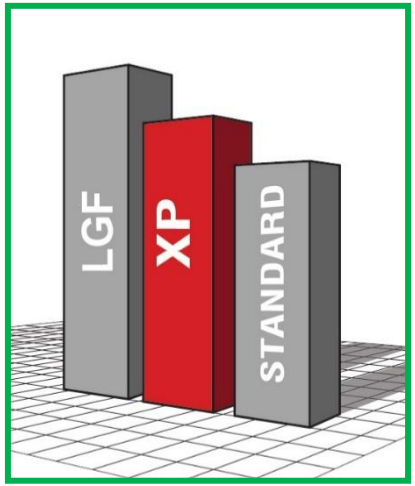
Glass Fiber



EXTRA PERFORMANCE COMPOUNDS

Features of Extra Performance (XP) technology

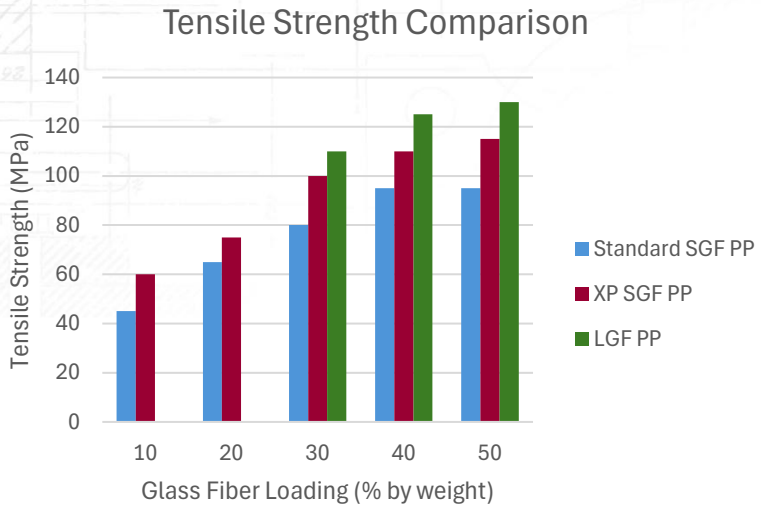
XP technology combines the best additives, glass fiber, and compounding techniques to create industry leading short glass fiber polypropylene compounds.

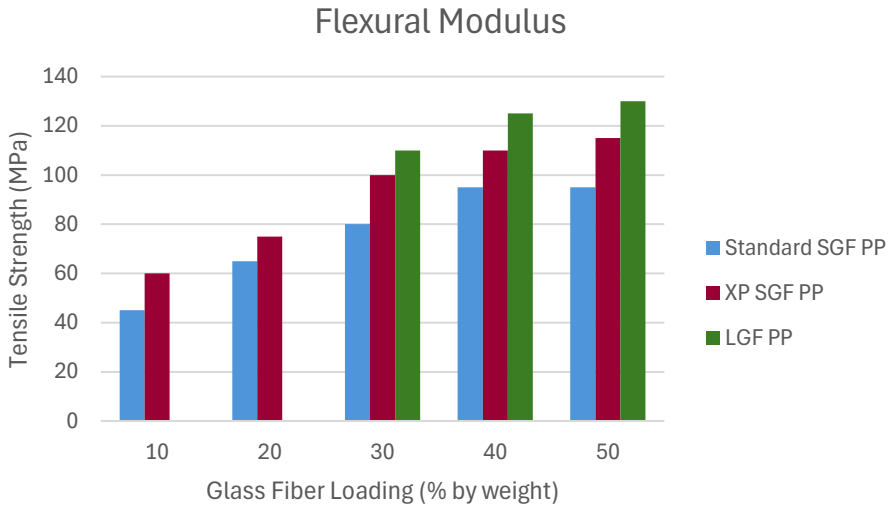


XP COMPOUNDS

Primary Benefits of XP Compounds

- Higher strength, stiffness, and impact properties than traditional SGF PP
- Strength and stiffness approaches extraordinary performance of LGF PP compounds
- Easy handling and processing of short glass fiber PP





ENVIRONMENTAL

Chemical Resistance

UV

Elevated Temperatures

POLYMER BLENDS (ALLOYS)

Polymer blends, aka alloys, use beneficial attributes of secondary polymer to modify characteristics of host polymer:

PC/PBT

PC brings

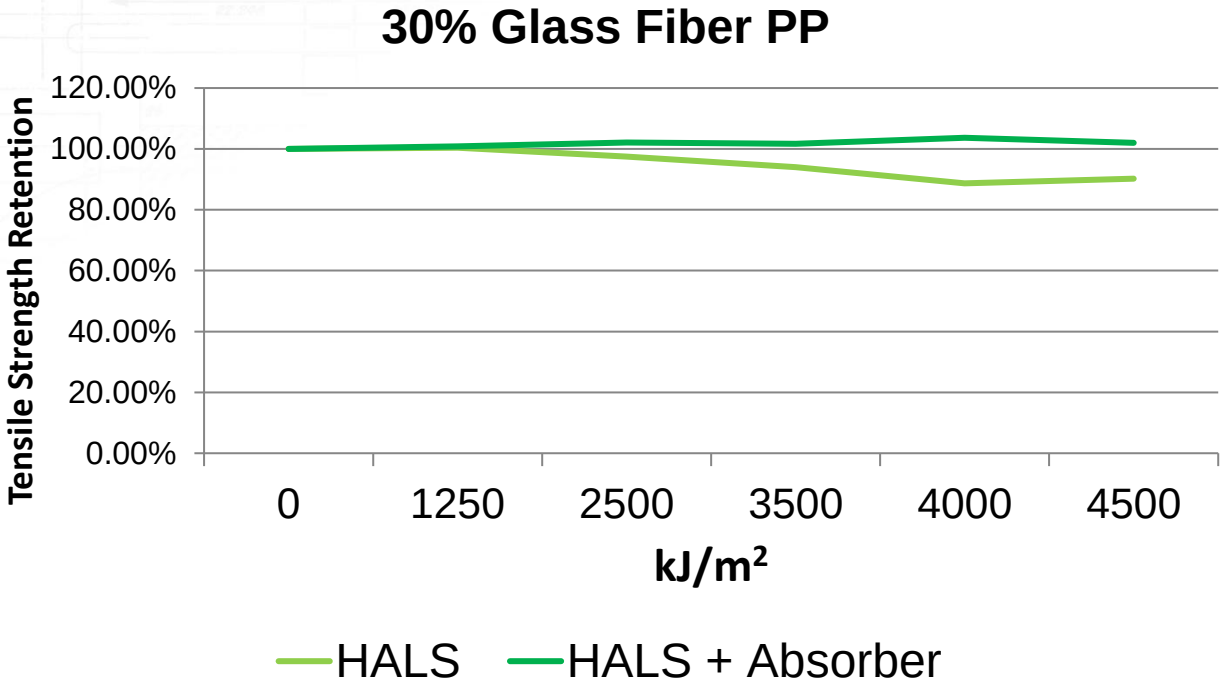
- Toughness
- Dimensional Stability

PBT brings

- Chemical resistance
- Improved flow

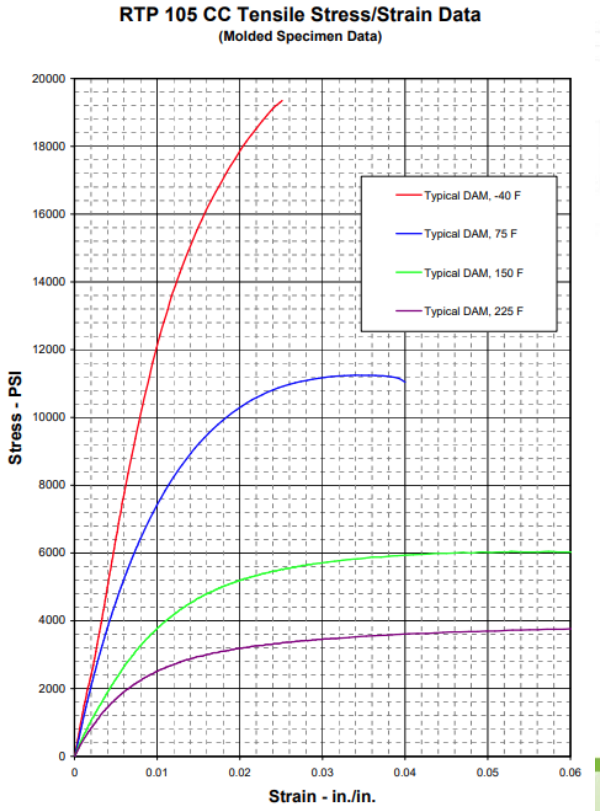
UV STABILIZATION

- UV Absorbers
  - Protects polymer by absorbing harmful UV light before the degradation reaction has started
- Hindered Amine Light Stabilizers (HALS)
  - Protects polymer by stopping degradation reactions once they have started



ELEVATED TEMPERATURES

Short-term



Long-term

GF PA6

1,000 hrs
@ 150°C

LONG-TERM HEAT STABILITY

40% GF PP

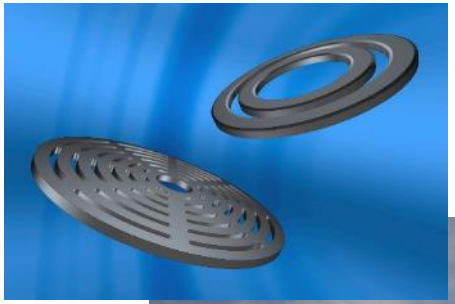
1000 Hour Heat Aging

Temperature	Tensile Retention	Izod Impact Retention
140 ºC	+5.7%	+9.9%
150 ºC	-4.7%	-11.3%

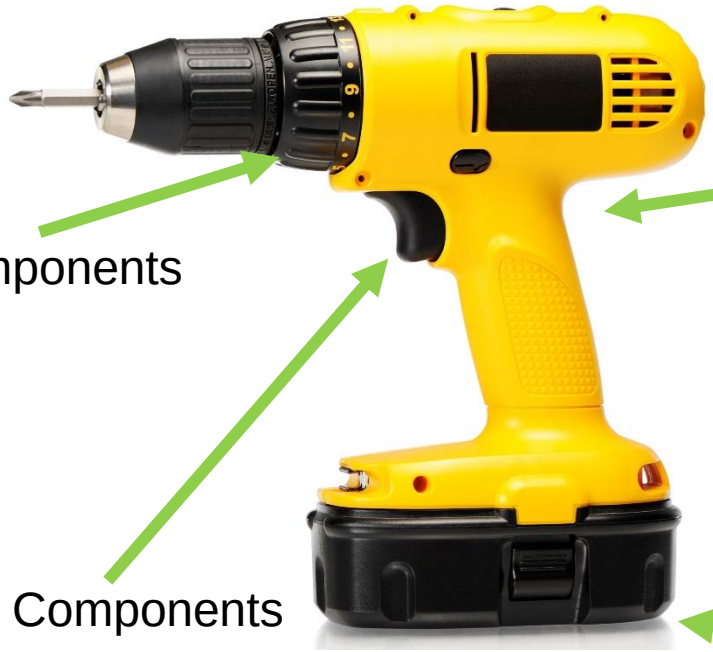
Typical Automotive requirements are ~+/- 25%

HIGH TEMPERATURE COMPOUNDS

- Based on high temperature polymers
- Retain physical performance properties at elevated temps
- Provide better dimensional stability
- Offer excellent electrical characteristics
- Improved chemical resistance
- Ideal for applications in continuous-use high temperature conditions



POWER DRILL



Main Case

Chuck/Internal Components

Trigger/External Components

Battery Case

MAIN CASE

- Good aesthetics: Branded, glossy precolors
- Durable material: strong, stiff, and impact resistant
- Scratch/scuff resistant
- Good chemical resistance
- Can be UV-stabilized

Impact-modified, 30% glass fiber reinforced PA6

POWER TOOL CASE MATERIALS

	RTP 205 A HB (30% GF PA6)	Impact-modified 33% GF PA6 with UV
Glass Fiber Loading, %	30	33
Specific Gravity, g/cm^3, ISO 1183	1.35	1.33
Tensile Strength, MPa, ISO 527	160	150
Flexural Modulus, MPa, ISO 178	8,200	7,500
Notched Izod Impact, kJ/m^2, ISO 180/1eA	9	25
Additional Benefits	UL94 HB and elevated RTI ratings	UV resistance, color-matching bright brand colors

CHUCK/INTERNAL COMPONENTS

- Very strong and stiff material
- Good wear resistance
- Low dimensional shift/water absorption
- High temperature performance

50% Glass fiber reinforced PPA

TRIGGER/EXTERNAL COMPONENTS

- Great price to performance balance
- Strong and stiff material
- Lower cost
- Easy processing

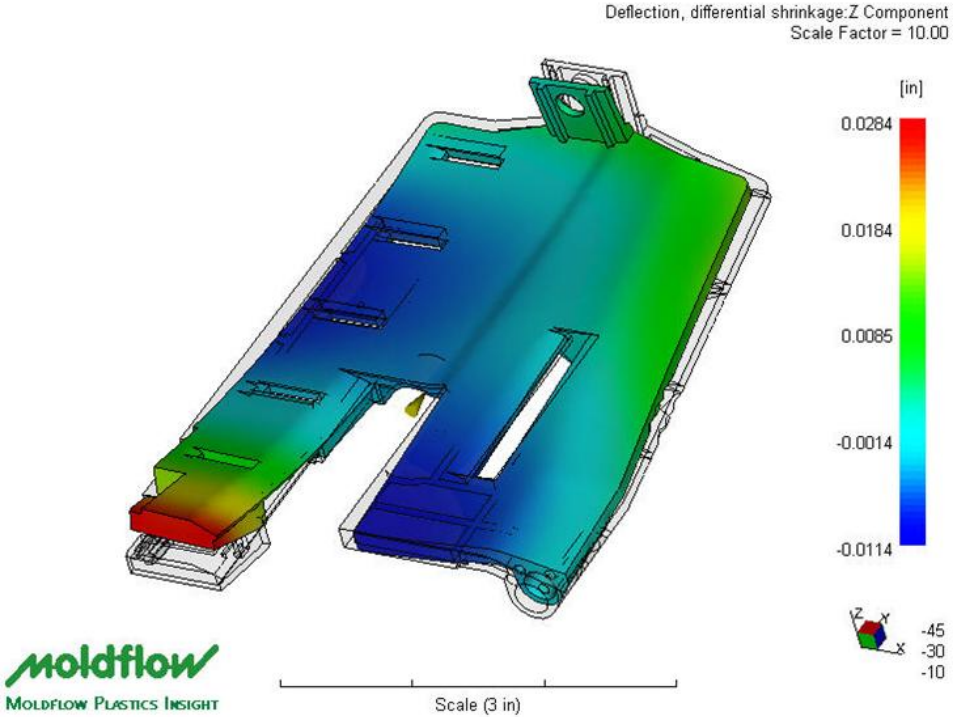
30% XP – High performance glass fiber reinforced PP

BATTERY CASE

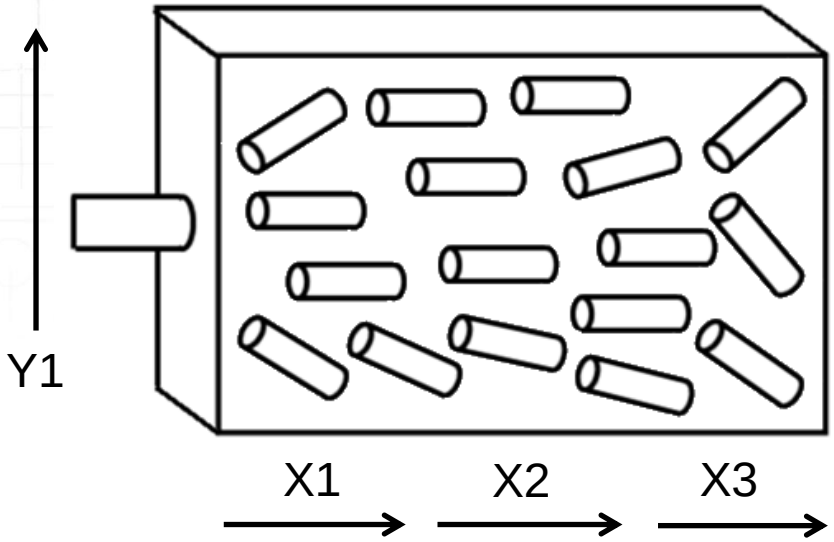
- High ductility/impact resistance, even at low temps
- Chemical resistance improved
- Low cost
- Good dimensional stability
- Easy moldability
- Glossy surface finish

PC/ABS Alloy

WARP/POOR DIMENSIONAL STABILITY



HIGH ASPECT RATIO - WARP



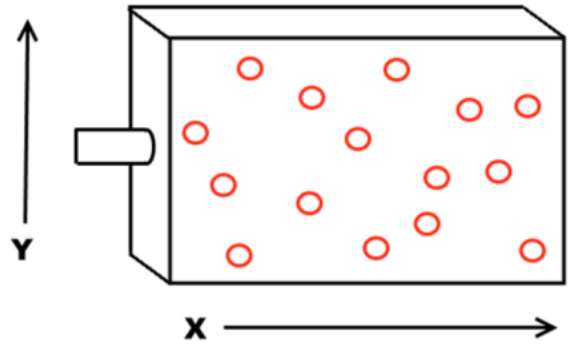
Shrinkage X1 & X2 ≠ X3 ⟹ Warp

MINERAL FILLED COMPOUNDS

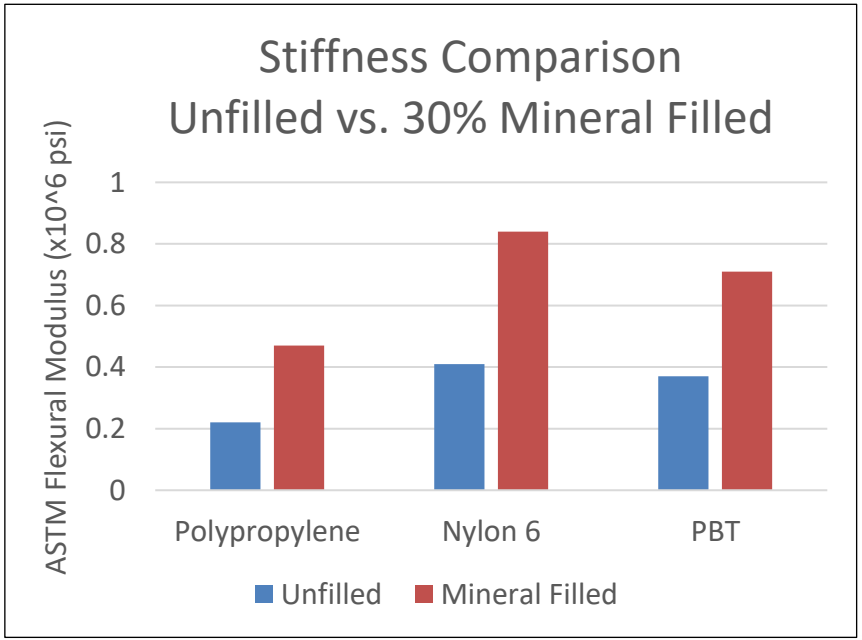
Primary Benefits of Mineral Filled Compounds

- Improved dimensional stability
- Reduced raw material costs
- Increased stiffness

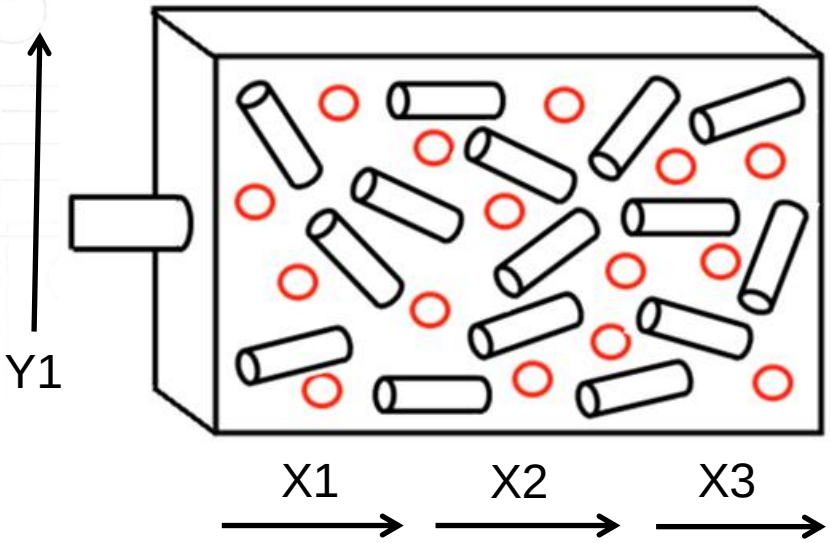
*Common Minerals: Calcium carbonate, talc, mica, wollastonite,*glass beads, milled glass fiber**



Shrink Rate X = Shrink Rate Y = Flat Part



HIGH + LOW ASPECT RATIO = IMPROVED FLATNESS

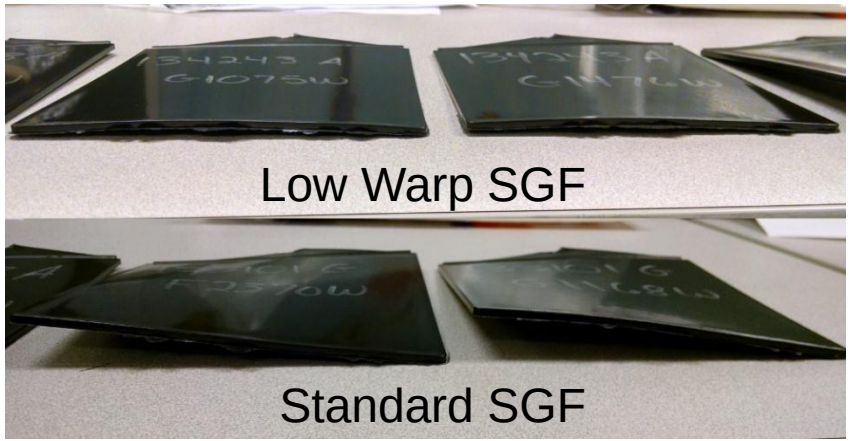


Shrinkage X1 & X2 = X3 ⟹ Flat Part

LOW WARP GLASS FIBER REINFORCEMENT

Low Warp GF in PA6

	Standard SGF	Low Warp SGF	SGF + Mineral
Filler Loading (%)	40	40	40
Tensile Strength (MPa)	179	172	100
NIZOD Impact (J/m)	160	130	65
Flexural Modulus (MPa)	11,700	11,000	8,400
Cost	$$	$$$	$



LOW WARP STRUCTURAL SOLUTIONS

- Amorphous base polymers and alloys are best but good dimensional stability is also possible with semi-crystalline
- Fillers: Low warp glass fiber technology and low aspect ratio fillers - glass beads, and minerals

Applications: Router bases, grinding surfaces, levels, and other parts requiring high performance and tight dimensions

DENSITY MODIFICATION

Lightweighting

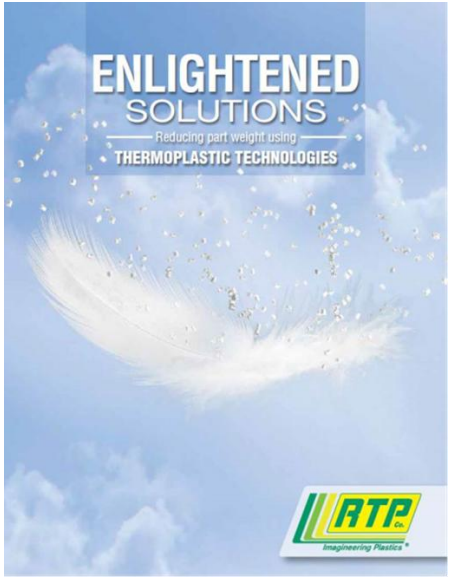
High Gravity

RTP COMPANY = LIGHTWEIGHTING COMPANY

Technical Lightweighting Solutions include:

- **Hollow Glass Bubble Compounds**
- **Light & Tough Compounds**
- **Carbon Fiber Compounds**

and comprehensive **Metal Replacement** Support!



GLASS BUBBLES – LIGHTWEIGHT PC/ABS

Benefits over CFAs:

- Not wall thickness dependent
- Easy processing
- Consistency

Hollow Glass Bubbles

	Standard PC/ABS	15% Glass Bubble PC/ABS
Specific Gravity, g/cm^3, ISO 1183	1.14	0.98
Tensile Strength, MPa, ISO 527	60	40
Tensile Modulus, MPa, ISO 527	2700	3200
Flexural Strength, MPa, ISO 178	90	95
Flexural Modulus, MPa, ISO 178	2700	3300
Notched Izod Impact, kJ/m^2, ISO 180/1eA	50.0	2.0

RTP Company's Low Density PC/ABS material offers potential of 14% weight reduction

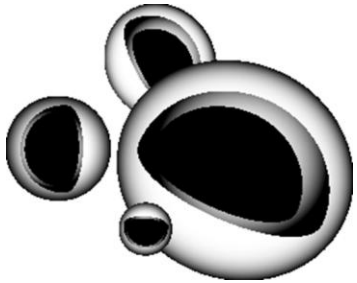
LT LOW DENSITY COMPOUNDS

Light and Tough Compounds – Quick and easy lightweighting solution!

- Similar mechanicals to traditional GF Compounds with reduced density
- Drop-in replacement to existing tools
- Not wall thickness dependent and good surface finish
- Available in most semi-crystalline polymers

Glass Fiber

+



Glass Bubbles

LT LOW DENSITY COMPOUNDS

	Standard 30% GF PA6	Light and Tough 30% GF PA6
Specific Gravity, g/cm^3, ISO 1183	1.35	1.22
Tensile Strength, MPa, ISO 527	160	167
Tensile Modulus, MPa, ISO 527	9,300	11,000
Flexural Strength, MPa, ISO 178	235	245
Flexural Modulus, MPa, ISO 178	8,200	10,000
Notched Izod Impact, kJ/m^2, ISO 180/1eA	9	10

CARBON FIBER COMPOUNDS

Carbon Fiber Compounds – Stronger, Stiffer, Lighter!

- Higher strength and stiffness than glass fiber reinforcement at reduced density
- Lightweighting through reduced density and reduced wall thicknesses
- Black color only

	30% Glass Fiber PA6	30% Carbon Fiber PA6
Specific Gravity, g/cm^3, ISO 1183	1.35	1.27
Tensile Strength, MPa, ISO 527	160	225
Tensile Modulus, MPa, ISO 527	9,300	22,000
Flexural Strength, MPa, ISO 178	235	330
Flexural Modulus, MPa, ISO 178	8,200	19,000
Notched Izod Impact, kJ/m^2, ISO 180/1eA	9	11

LIGHTWEIGHTING CASE STUDY

Backpack Blower

Backpack Frame
20% CF PP

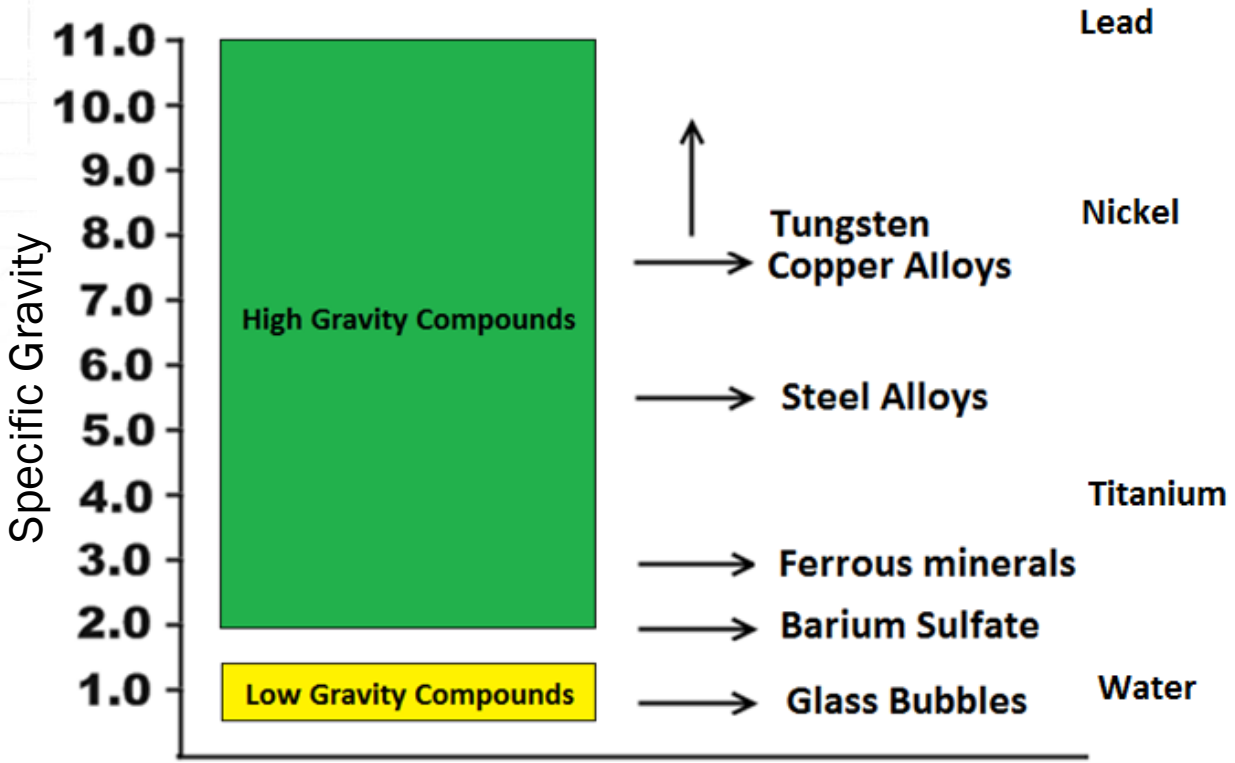
- Replaced 30% GF PP
- Over 10% weight savings and nearly 2x as stiff

Outer Case
20% GF Light and Tough PA6

- Achieved 8-9% density reduction vs standard grade
- Colorable to orange brand color
- Dropped-in on same tool

HIGH GRAVITY COMPOUNDS

- Vibration and sound damping
- Center of gravity adjustment
- “Expensive feel”



COSTS/INNOVATION/CONTINUOUS IMPROVEMENT

PRODUCT CONSOLIDATION

Huge product portfolio, globally available!

- Reduce suppliers and materials grades
  - Local production – *avoid tariffs*
  - Improved pricing through volume
  - Easier logistics
  - Better product support
  - Simplified material specification for technical teams
  - Less siloed communication, less mistakes

SALES AND SUPPORT

We have more than 80 sales and support employees worldwide, including:

Americas
Brazil, Canada, Mexico, USA

Europe
Austria, France, Germany, Netherlands, Poland, Turkey, UK

Asia/Pacific Rim
China, India, Japan, Korea, Singapore, Taiwan

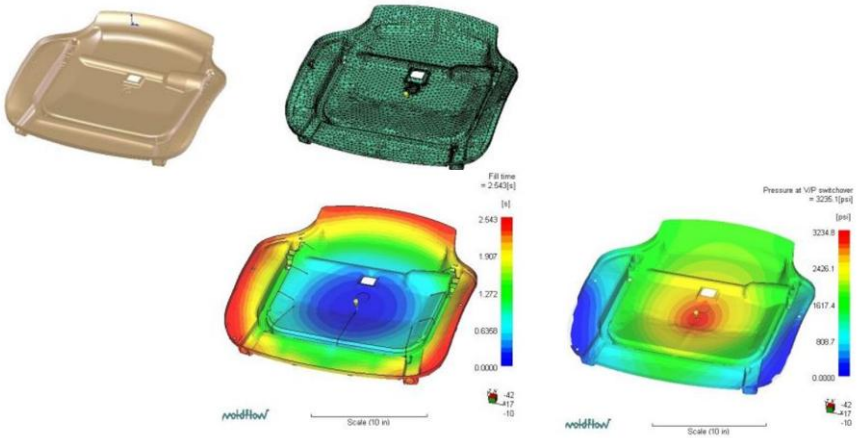
GLOBAL TECHNICAL SUPPORT

- 70+ Development Engineers, including regional engineers for local support

- Local and regional Technical Service Engineers
  - Plastic processing trial support
    - Injection molding
    - Extrusion
    - Compression molding
    - Cast and blown film
    - Blow molding
    - Rotational molding
  - Process optimization
  - Problem resolution

PART DESIGN SUPPORT

Metal-to-Plastics & VA/VE



CAE

EDUCATIONAL

SUSTAINABLE OPTIONS

Recycled Solutions

- Support zero-landfill initiatives with recycled streams
- Post-Consumer and Post-Industrial recycled options
- Closed-loop recycled options
- Solutions across multiple product groups

Plant-based Solutions

- Engineered bioplastic compounds based on Polyolefin, Polyamide, and Polyester chemistries

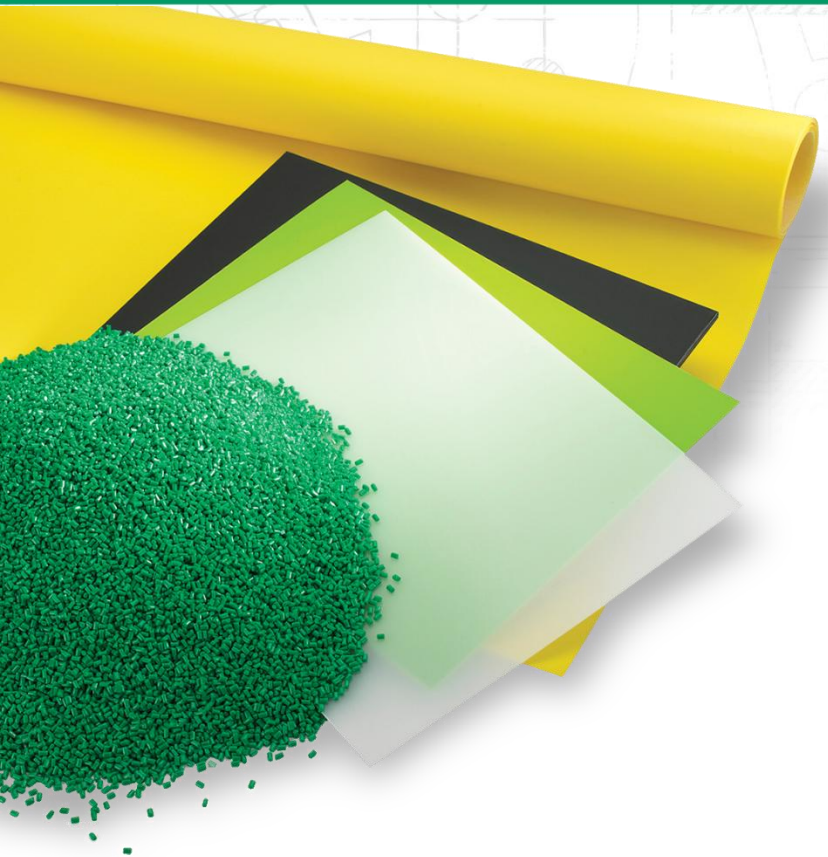
Carbon Footprint Reduction Solutions

- Turn-key lightweighting options

SUMMARY

Your material partner and solutions provider!

- Tool specific technologies and solutions
- Extremely diversified product portfolio
- Technical expertise
- Global production and support
- Competitive pricing from small to large volumes



THANK YOU!

Questions?

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zhalverson@rtpcompany.com