

# Automotive: Applications, Processes and products

## -- Fiberglass for PA Reinforcement



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# Overview



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**Fiberglass Reinforced Thermoplastic Composites**

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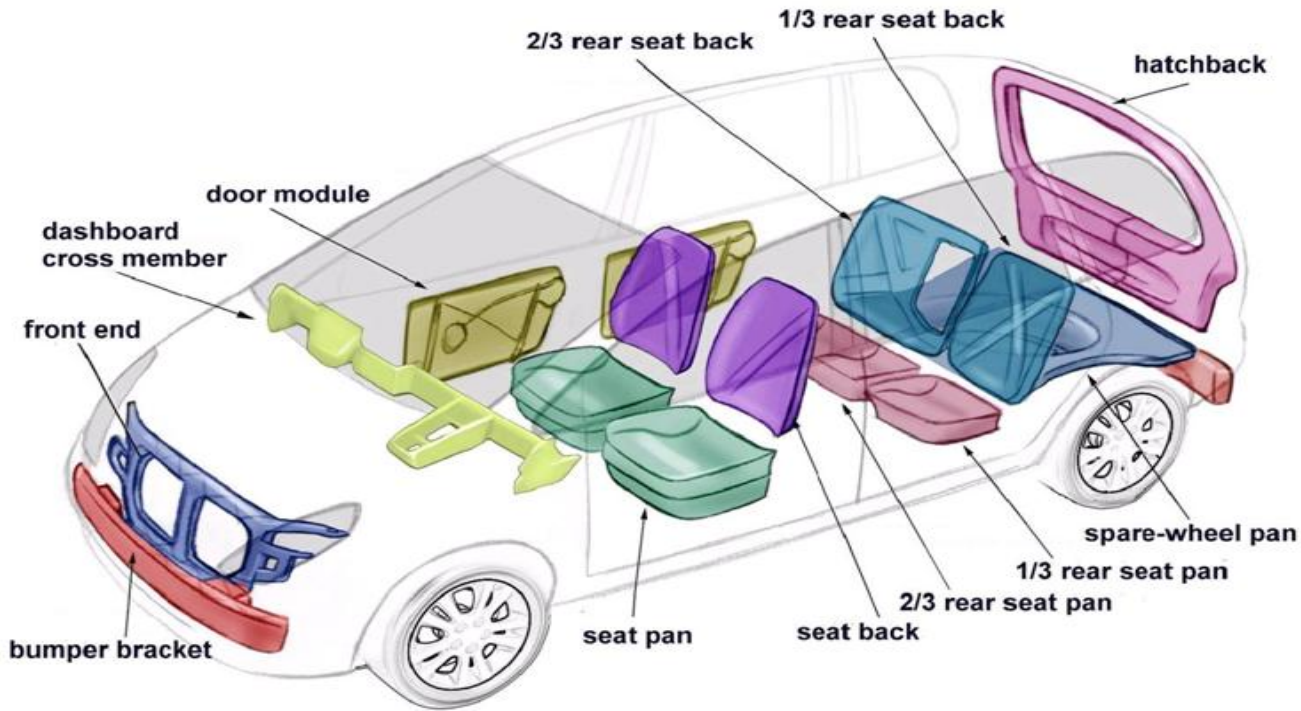
**PA & Fiberglass Reinforced PA**

3

**SFT-PA**

4

**LFT-PA**



## Traditional materials

- ❖ Metal & Alloy
- ❖ Wood
- ❖ Glass
- ❖ Rubber
- ❖ ... ..

## New requirements of materials

- ❖ Light weight, energy-saving
- ❖ High performance
- ❖ Environment friendly, recyclable
- ❖ Easy for processing
- ❖ ... ..

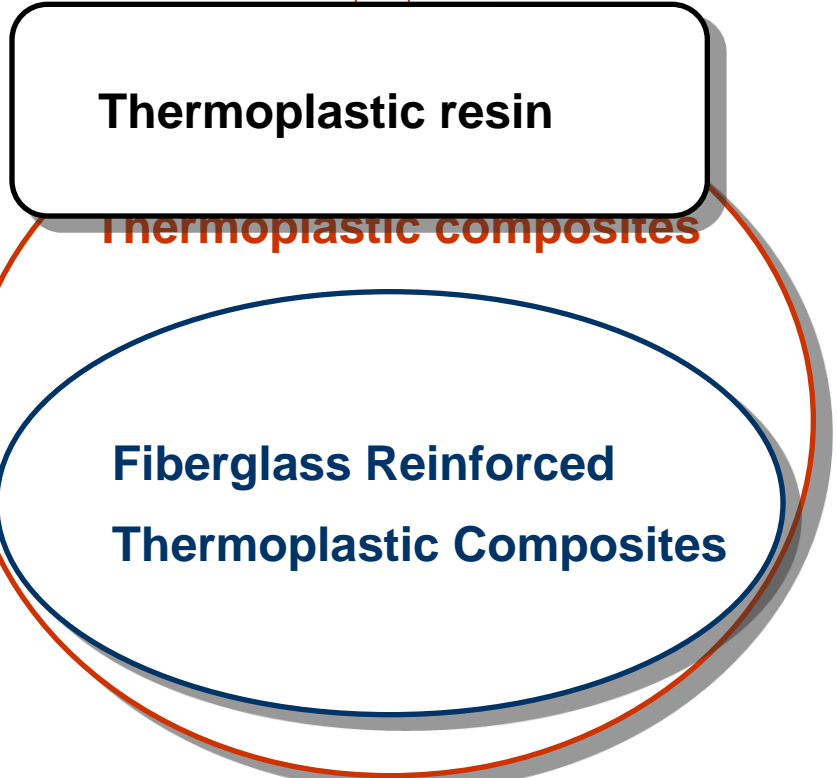


# Fiberglass Reinforced Thermoplastic Composites



## Polymer Vs. Metal, Ceramics

- *Meltable upon heating, molded after cooling*
- *Can be recycled and molded again*
- *Low-density, high specific strength, and high specific modulus*



- *Thermoplastic resin & other additives*
- *Fiberglass: high length-diameter ratio, high strength and modulus*
- *Light weight and high performance*
- *Meet the new requirements of materials for automotive*



# Classification

## SFT

**Short Fiberglass reinforced Thermoplastic composites**

## LFT

**Long Fiberglass reinforced Thermoplastic composites**

## CFRT

**Continuous Fiberglass Reinforced Thermoplastic composites**

	Remain length of fiberglass in the composites ( $L_r$ )
<b>SFT</b>	$L_r < 1\text{mm}$
<b>LFT</b>	$1\text{mm} < L_r < 25\text{mm}$
<b>CFRT</b>	$L_r = \text{the length of the part}$



# PA & Fiberglass Reinforced PA

PA

- *Good mechanical properties, heat resistance, and processability*
- *One of the most widely applied engineering plastic*

*Global annual production > 2,000,000 ton.*

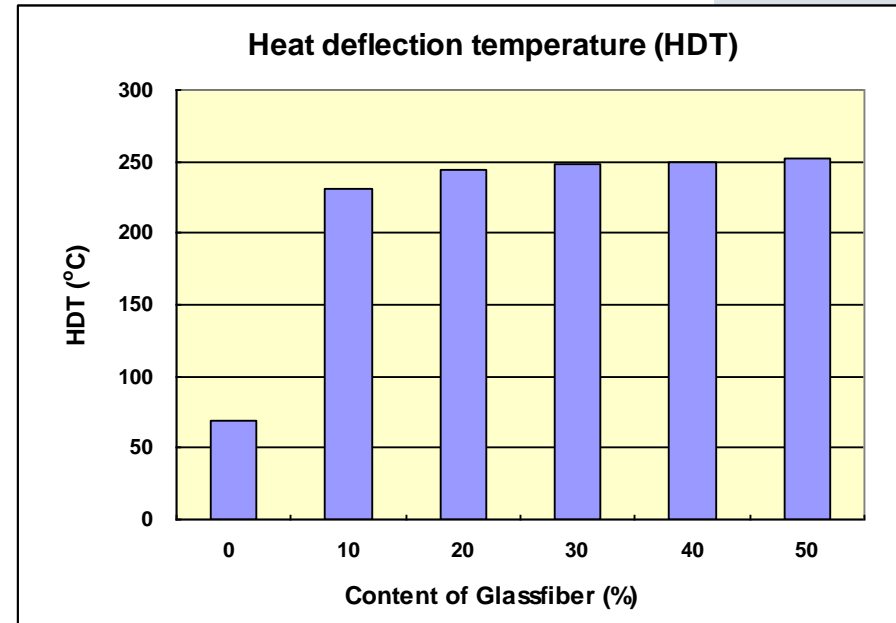
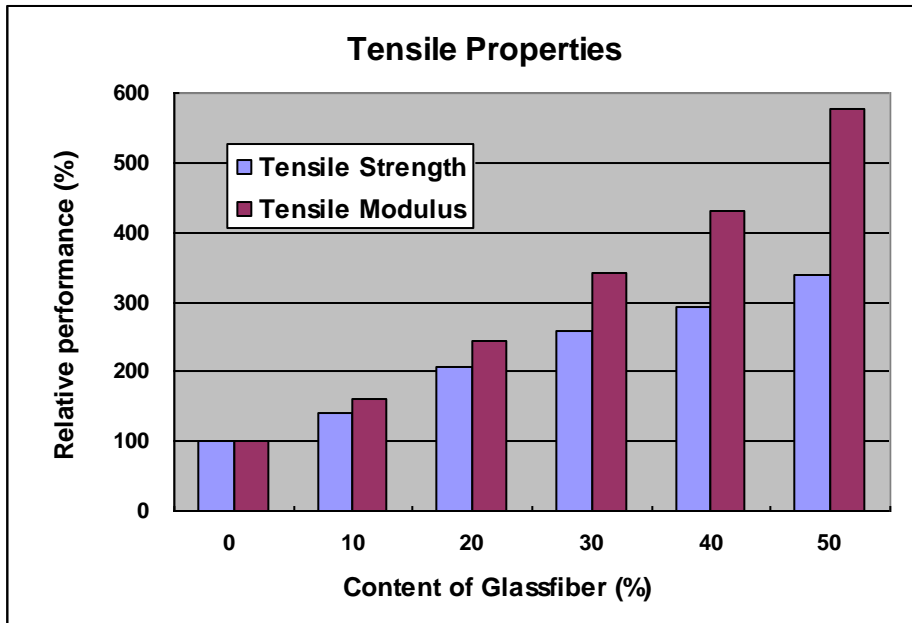
Fiberglass

Fiberglass Reinforced PA

# Fiberglass Reinforced PA

## PA66 with different content of fiberglass

### JUSHI 560A



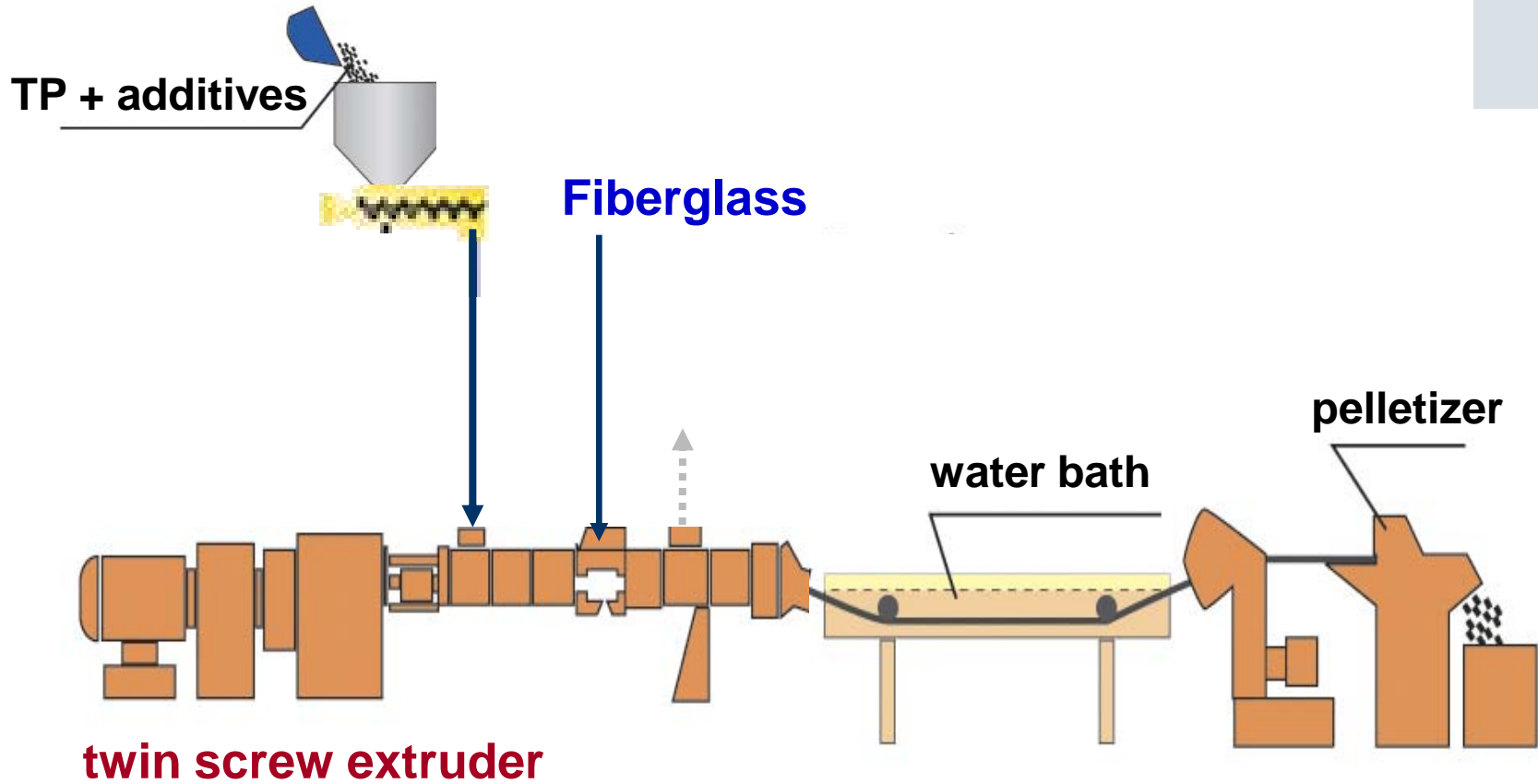
- Remarkably improved mechanical properties and heat resistance
- Lower the cost
- > 40% in fiberglass reinforced thermoplastics



❖ **SFT-PA**

❖ **LFT-PA**





*twin screw extruder → injection moulding*

Three hexagonal images arranged in a cluster. The top-left shows a car wheel, the top-right shows a wind turbine, and the bottom shows a boat.

## Advantages of SFT

- ✓ *Easy processing and mold to parts with various sizes and shapes*
- ✓ *Mature technology, well dispersion of GF, standard & adjustable*
- ✓ *Wide range of GF content (3-60%), various formulation and performance*
- ✓ *Simple molding process, short processing cycle, mass production*
- ✓ *Taking account of both the high productivity and good performance.*
- ✓ *Clean production environment, recyclability.*

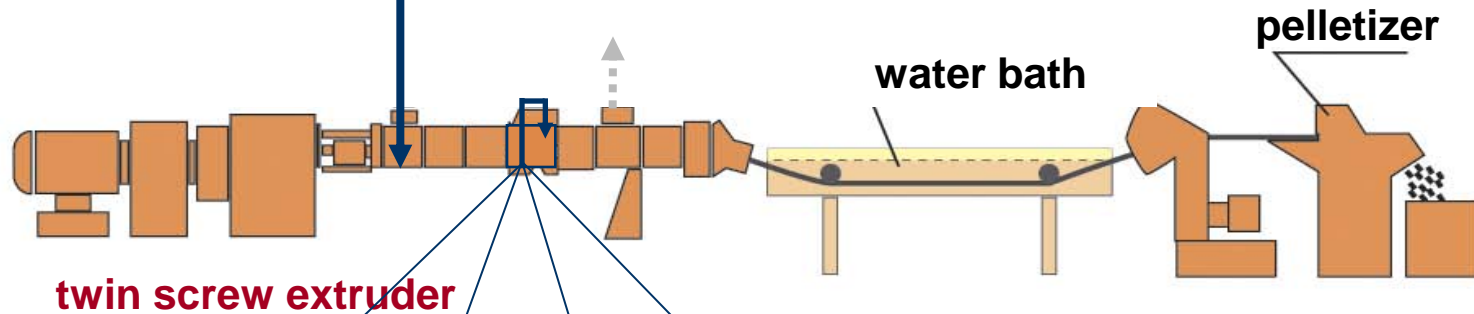
**>90% GF reinforced TP composite are SFT**

## 1. Roving



Direct roving: EDR

Assembled roving: ER

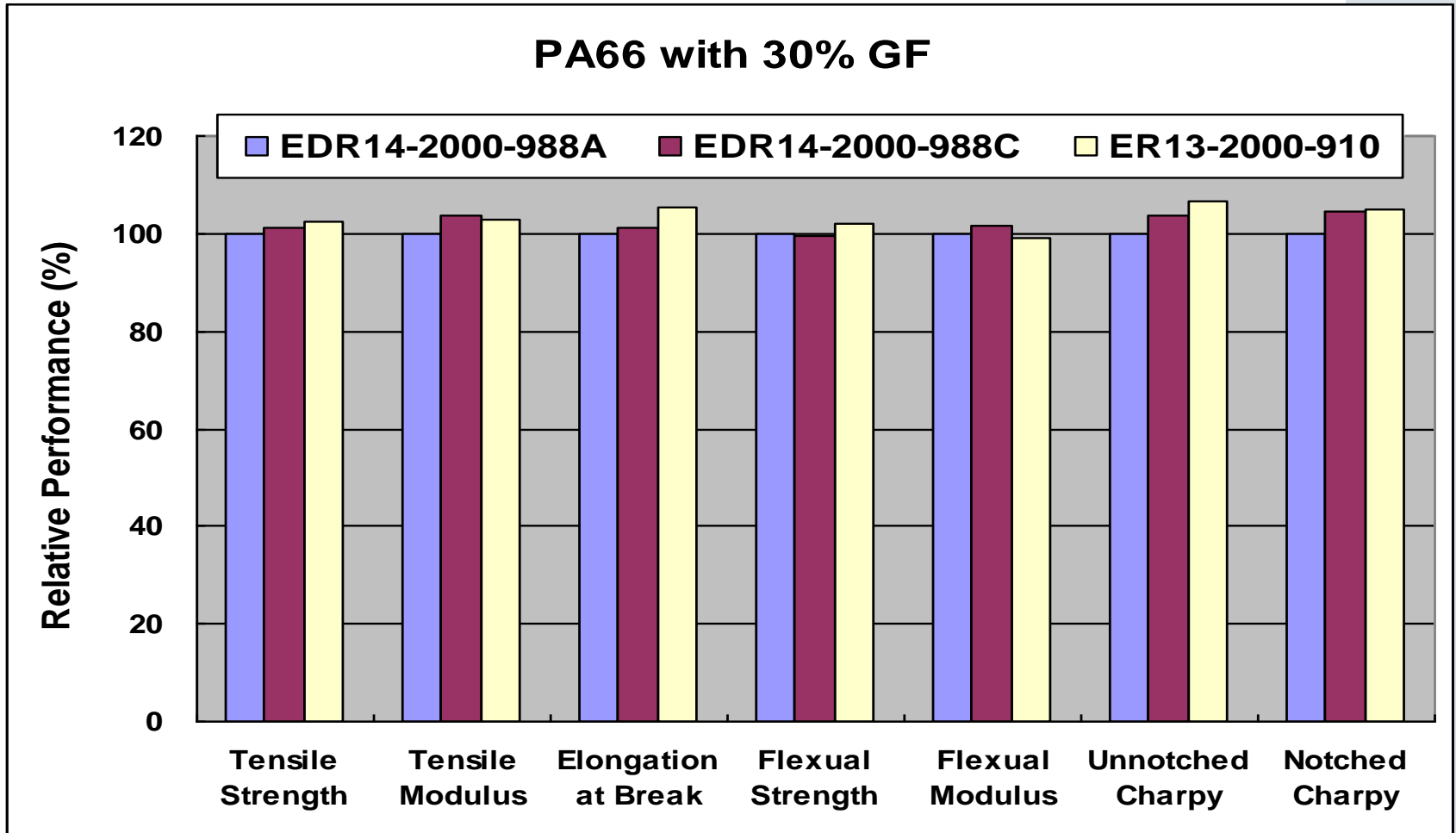




# Rovings

<b>Code</b>	<b>Main specification</b>	<b>Feature</b>
<b>988A</b>	<b>EDR14-1000-988A EDR14-2000-988A</b>	<b>General product</b>
<b>988C</b>	<b>EDR14-1000-988C EDR14-2000-988C</b>	<b>General product, upgraded product of 988A Better shearing and dispersion Solve the problem of yellow yarn in 988A, better color</b>
<b>910</b>	<b>ER13-2000-910</b>	<b>Specially designed for PA Better hydrolysis/glycol resistance</b>

## DAM Properties

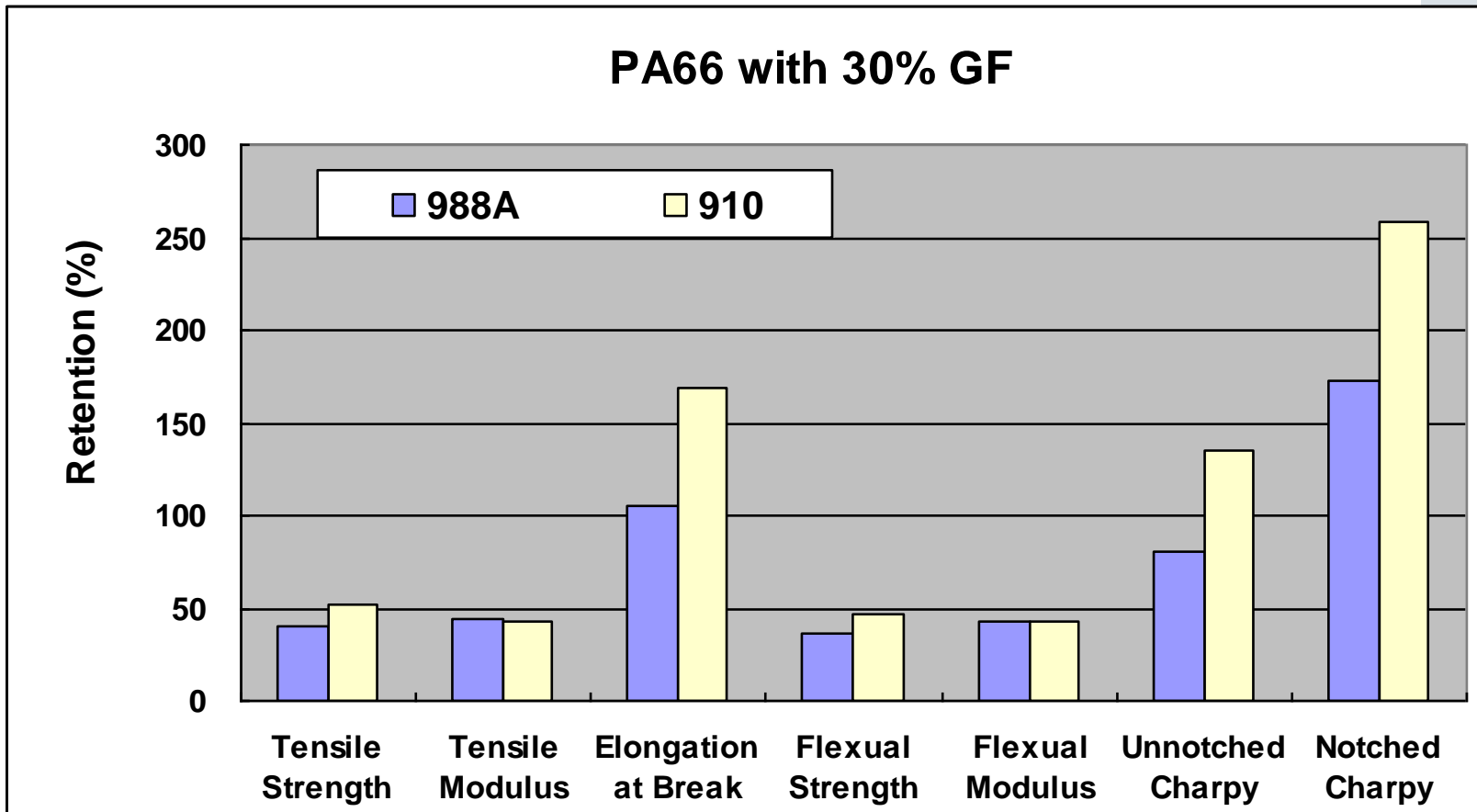


## Color

### PA66 with 30% GF

Samples	988A	988C
L (light)	56.93	57.08
a (+red/-green)	-6.75	-6.56
b (+yellow/-blue)	5.04	3.56

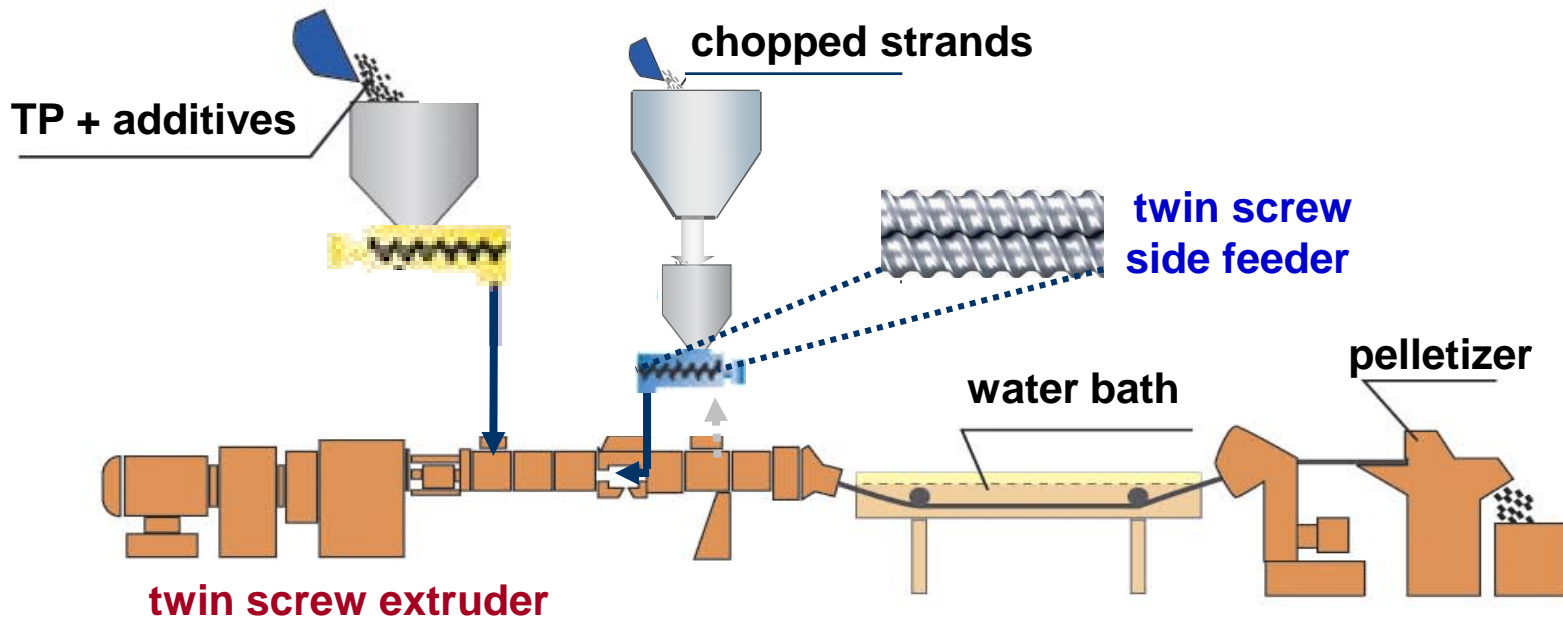
## Glycol Resistance (135°C / 48h)



## 2. Chopped Strands



- Measured by loss-in-weight feeding system  
*Automated*  
*Easier to change GF content*  
*Higher stability in quality of product*
- Chopped in advance  
*Lower requirements of shearing*  
*Less wear*





# Chopped Strands

Code	Feature	TP compatibility
560A	Standard product general reinforcement for PA	PA6/PA66
568H	Excellent hydrolysis/glycol resistance	PA6/PA66 PA46/HTN/PPA/PA9T/PA10T ...
568D	Excellent fatigue resistance	PA6/PA66 PA46/HTN/PPA/PA9T/PA10T ...
568FR	Designed for halogen-free flame retardant GFPA ↓FR amounts	PA6/PA66 PA9T/PA10T ...

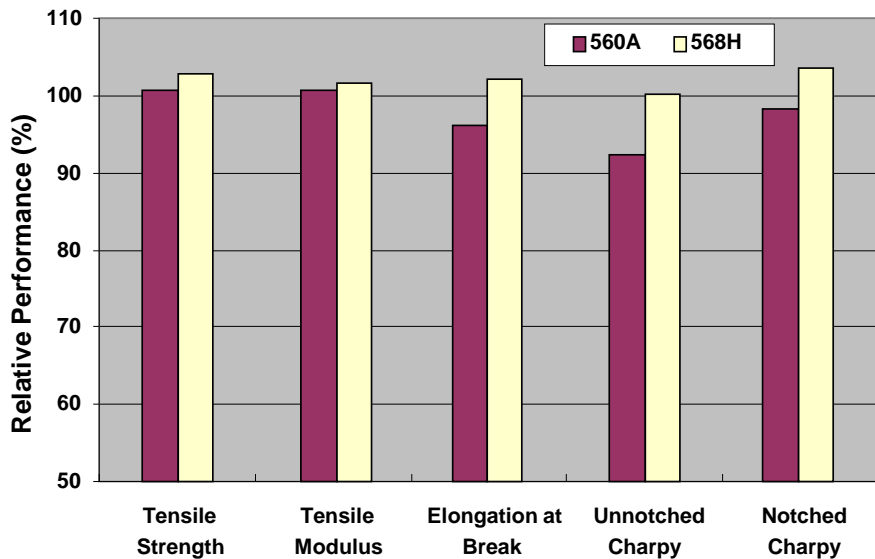
# 568H: Hydrolysis/glycol resistant



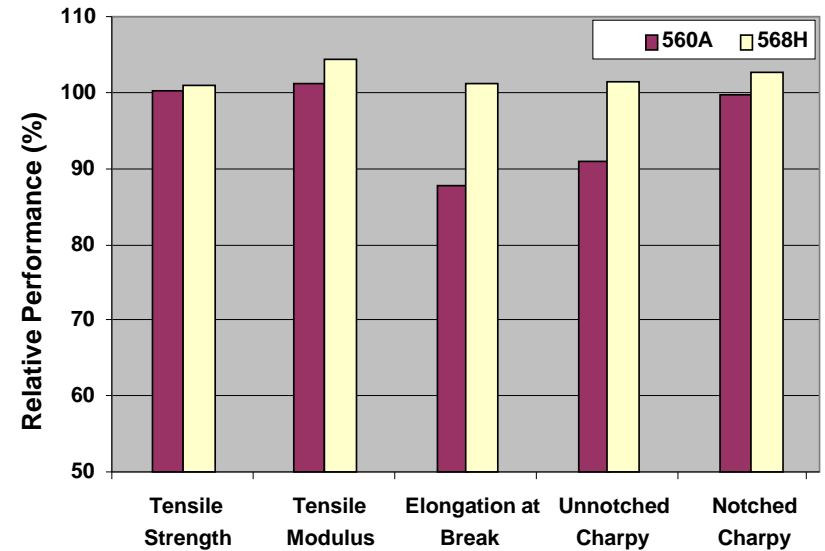
## ❖ PA6 and PA66

✓ *Good DAM physical properties*

### PA6 with 30% Glass



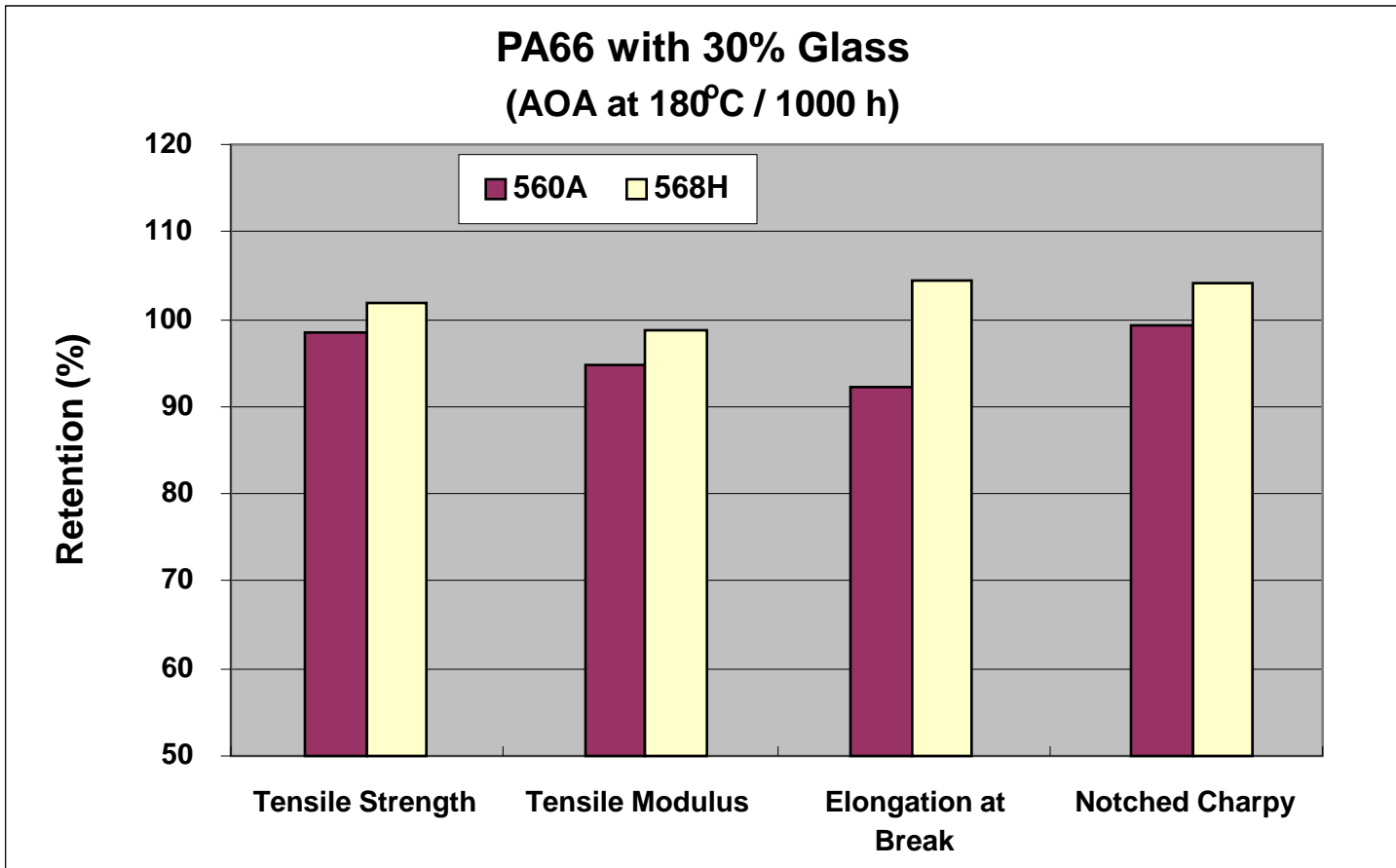
### PA66 with 30% Glass



# 568H: Hydrolysis/glycol resistant



**AOA at 180°C / 1000 h**

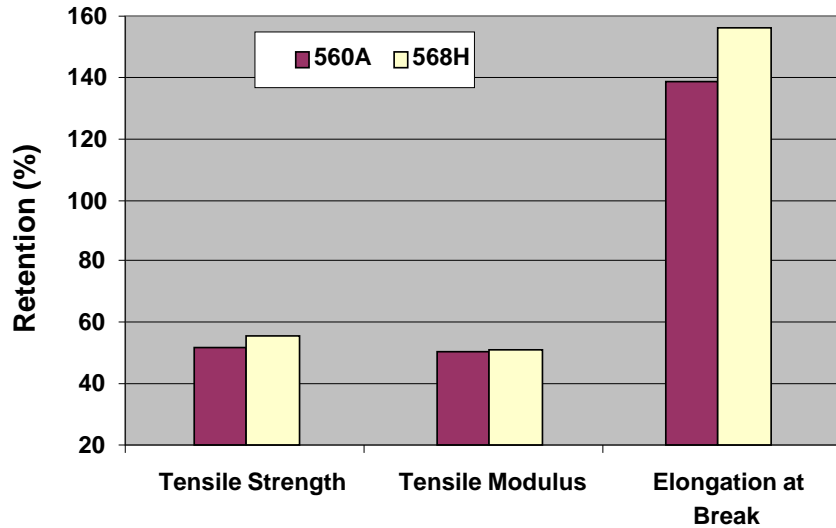


# 568H: Hydrolysis/glycol resistant

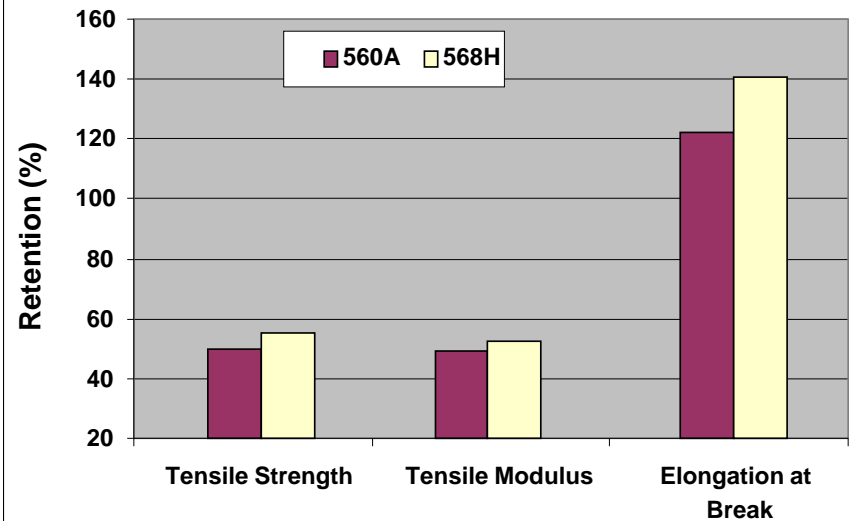


✓ *Excellent hydrolysis/glycol resistance -- Tensile*

**PA66 with 30% Glass**  
(LLC at 135°C / 255 h - Tensile Properties)



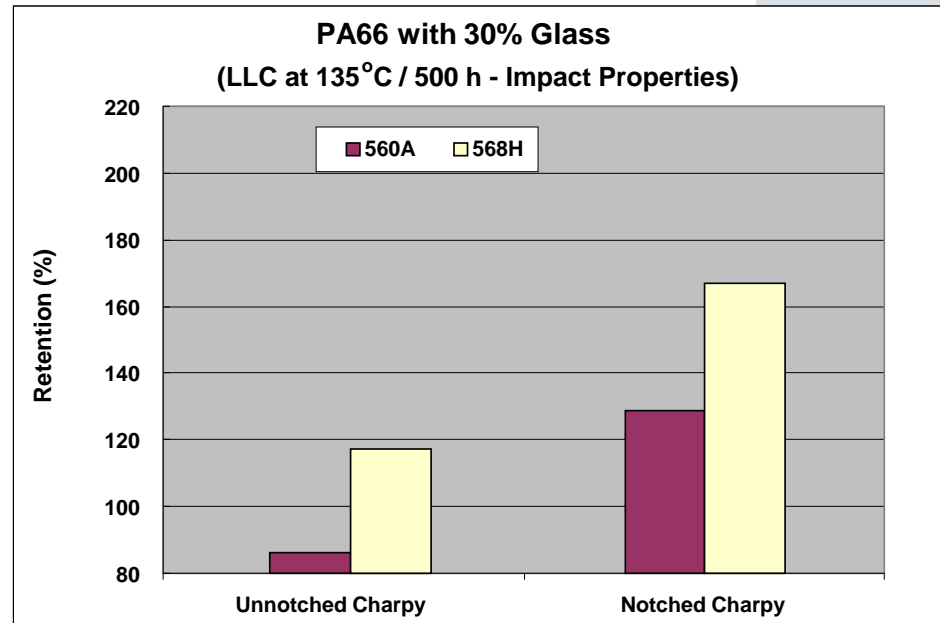
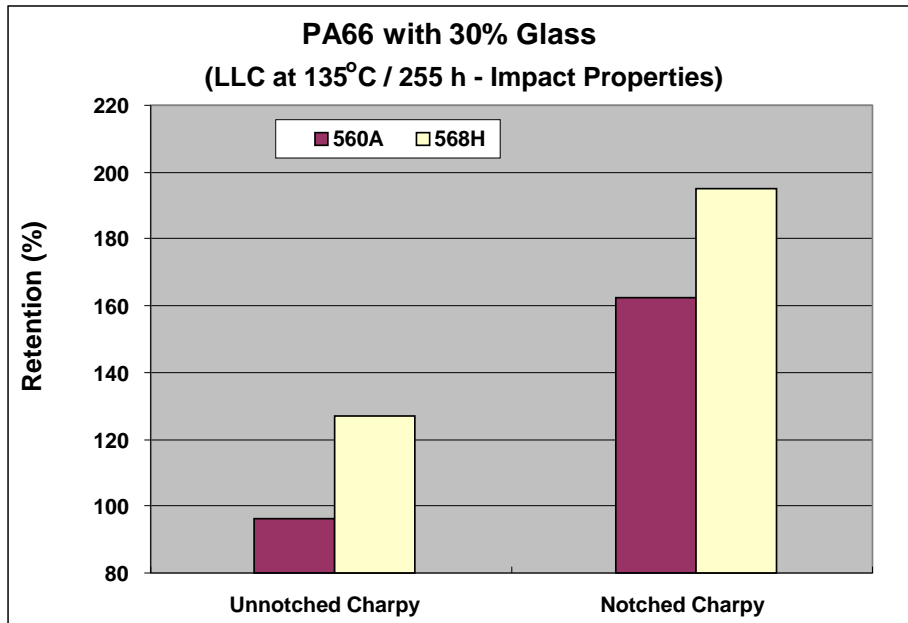
**PA66 with 30% Glass**  
(LLC at 135°C / 500 h - Tensile Properties)



# 568H: Hydrolysis/glycol resistant



✓ *Excellent hydrolysis/glycol resistance -- Impact*

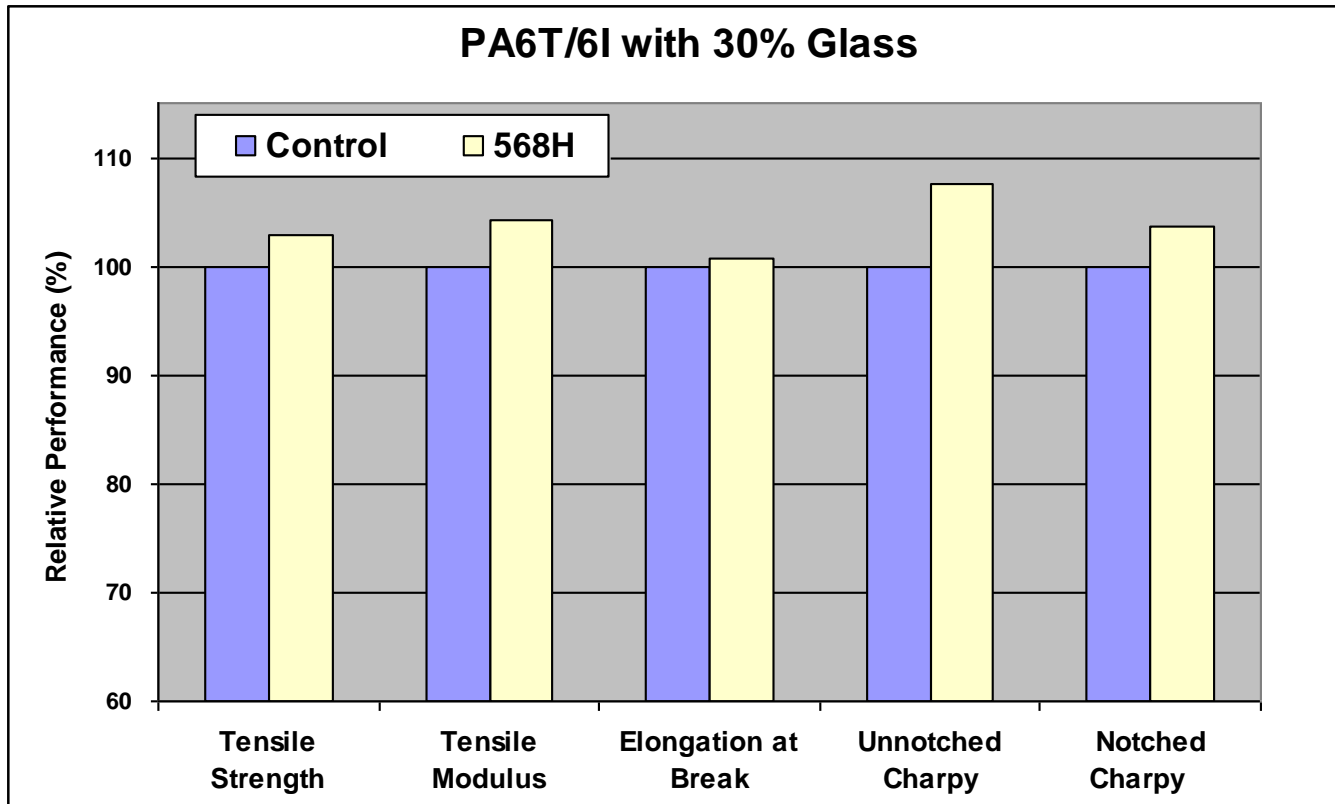


# 568H: Hydrolysis/glycol resistant



❖ *High temperature PA*

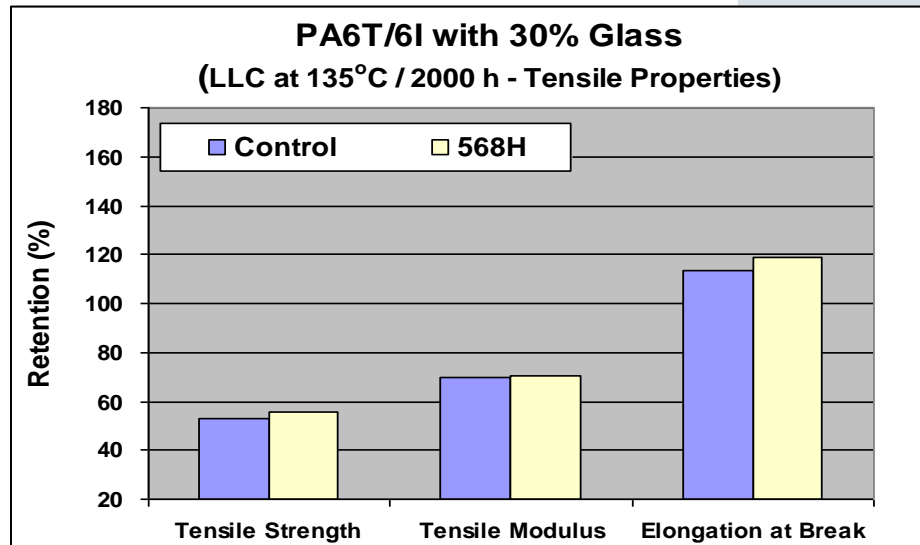
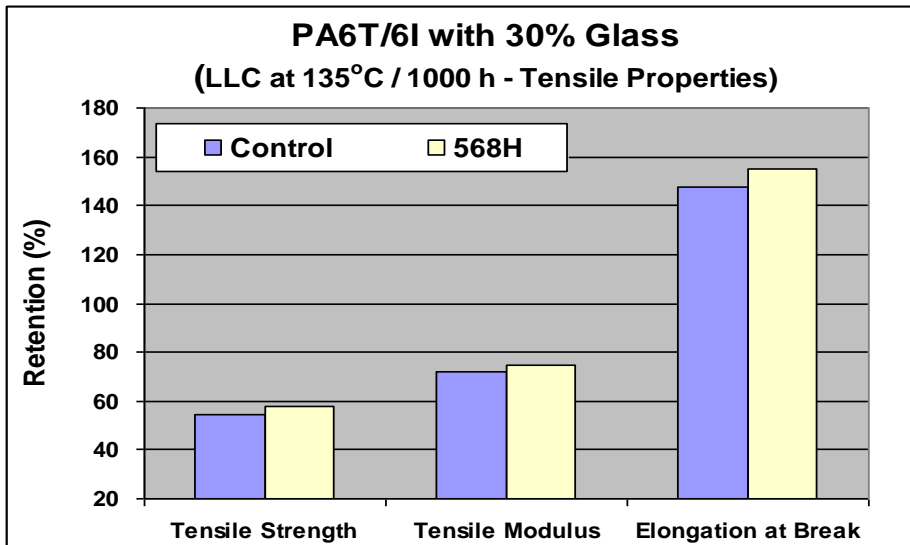
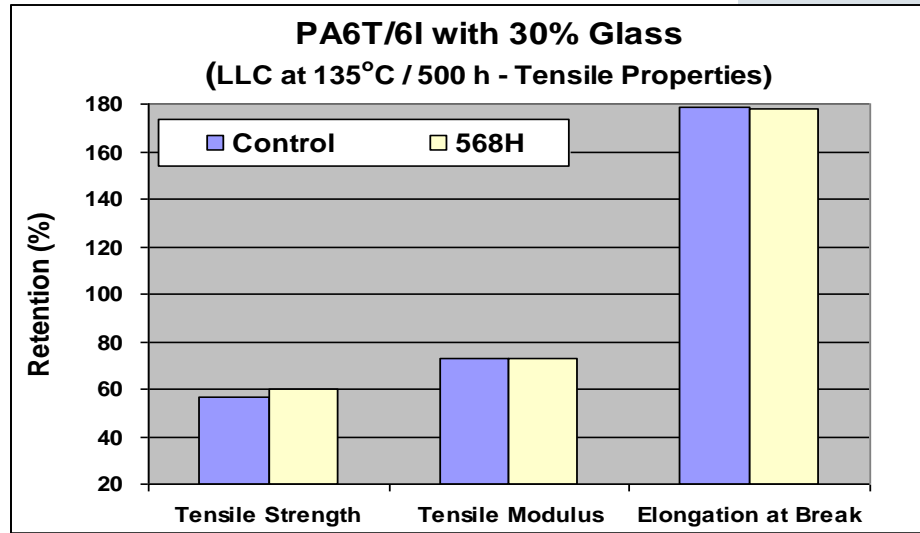
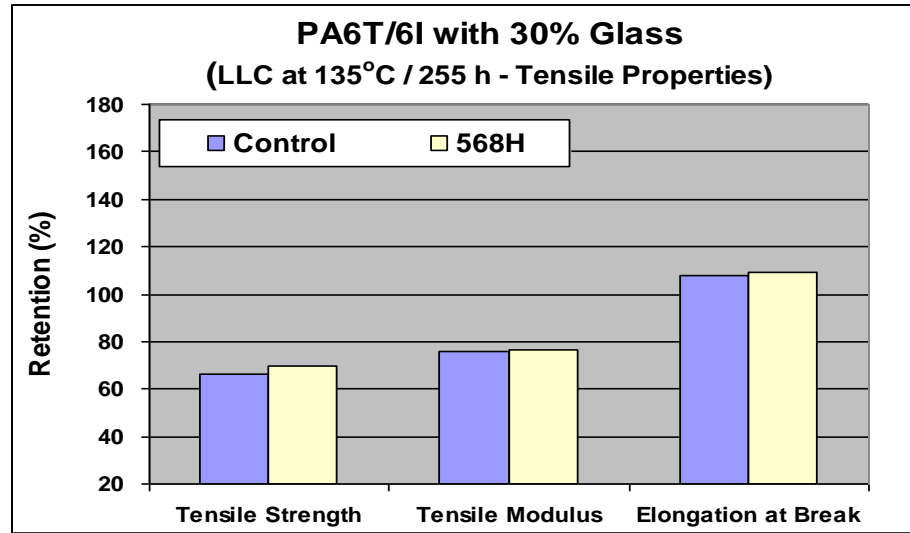
✓ *Good DAM physical properties*



# 568H: Hydrolysis/glycol resistant



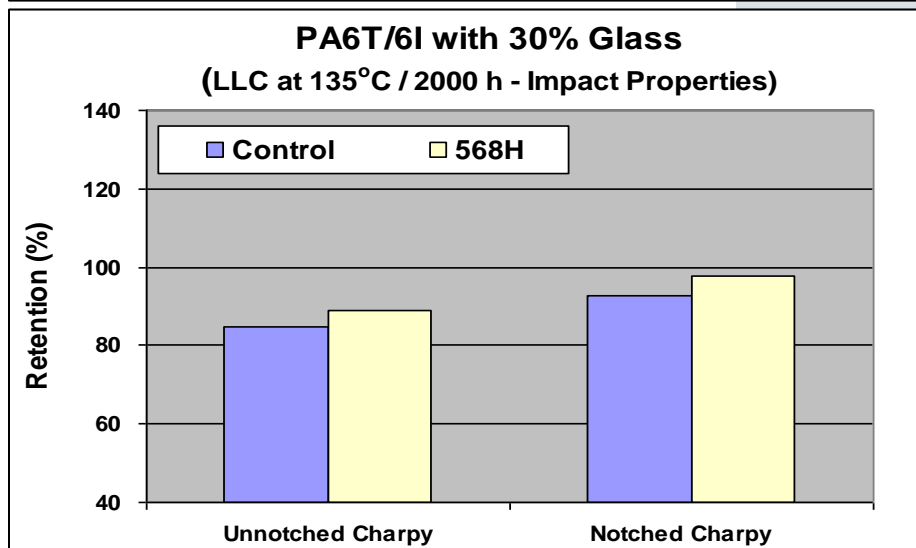
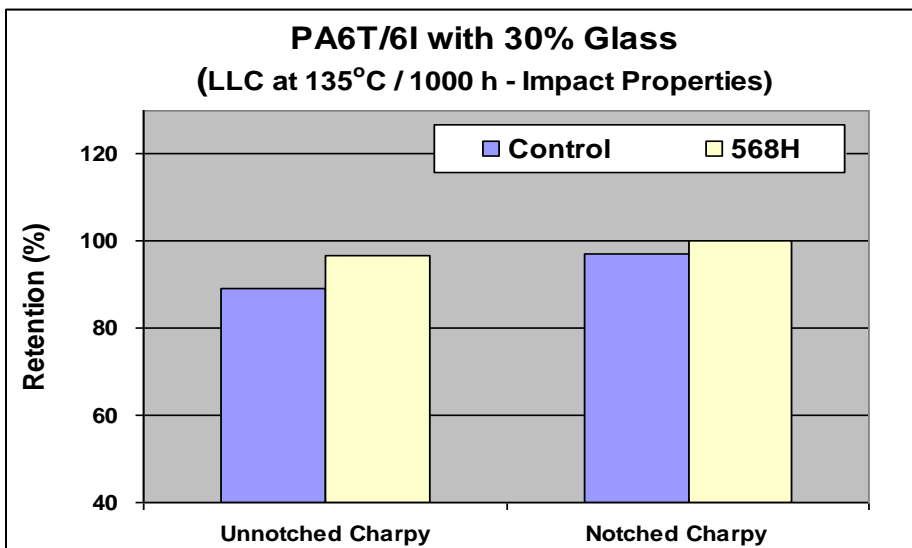
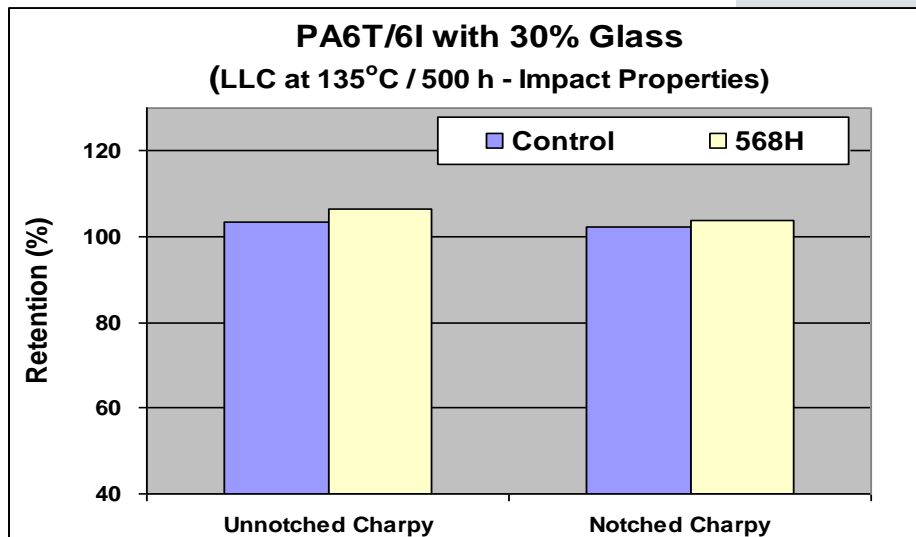
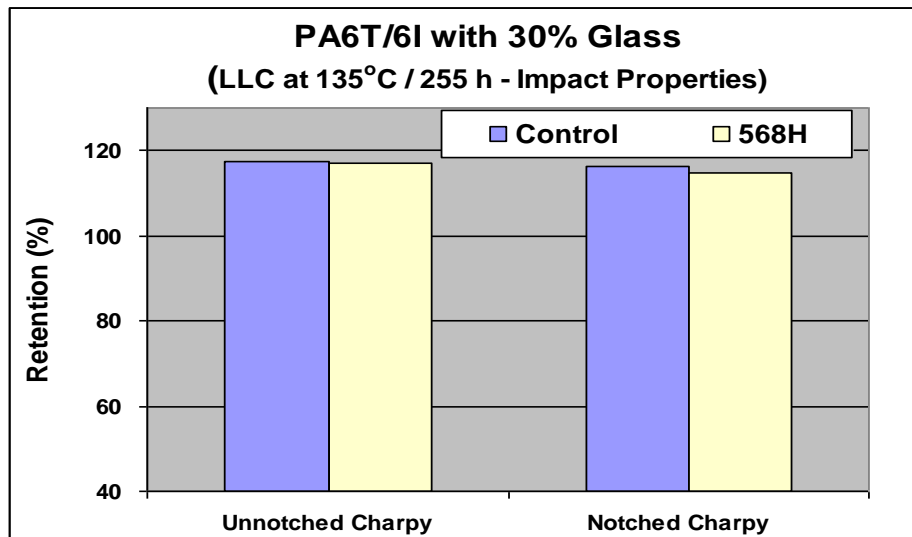
✓ *Excellent hydrolysis/glycol resistance -- Tensile*



# 568H: Hydrolysis/glycol resistant



✓ *Excellent hydrolysis/glycol resistance -- Impact*





# 568H: Hydrolysis/glycol resistant

## Applications

- Hydrolysis/glycol resistance
- Heat resistance

- *Heat-resistant parts surrounding Engine*
- *High-pressured clearer appendix*

• *Cooling system*



• *Water chamber of radiator*



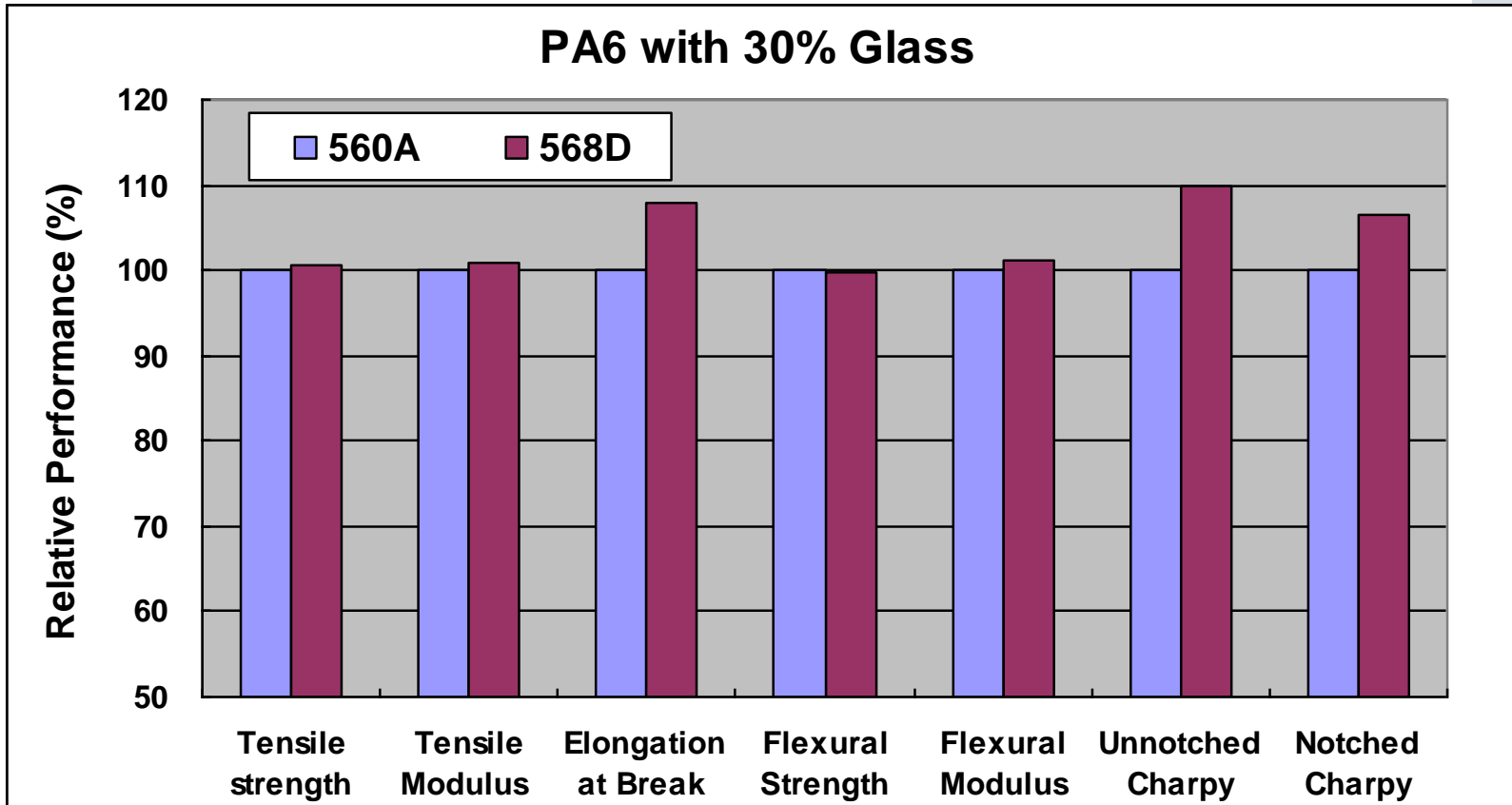
• *Engine intake manifold*



# 568D: Fatigue resistant



✓ *Good static physical properties*



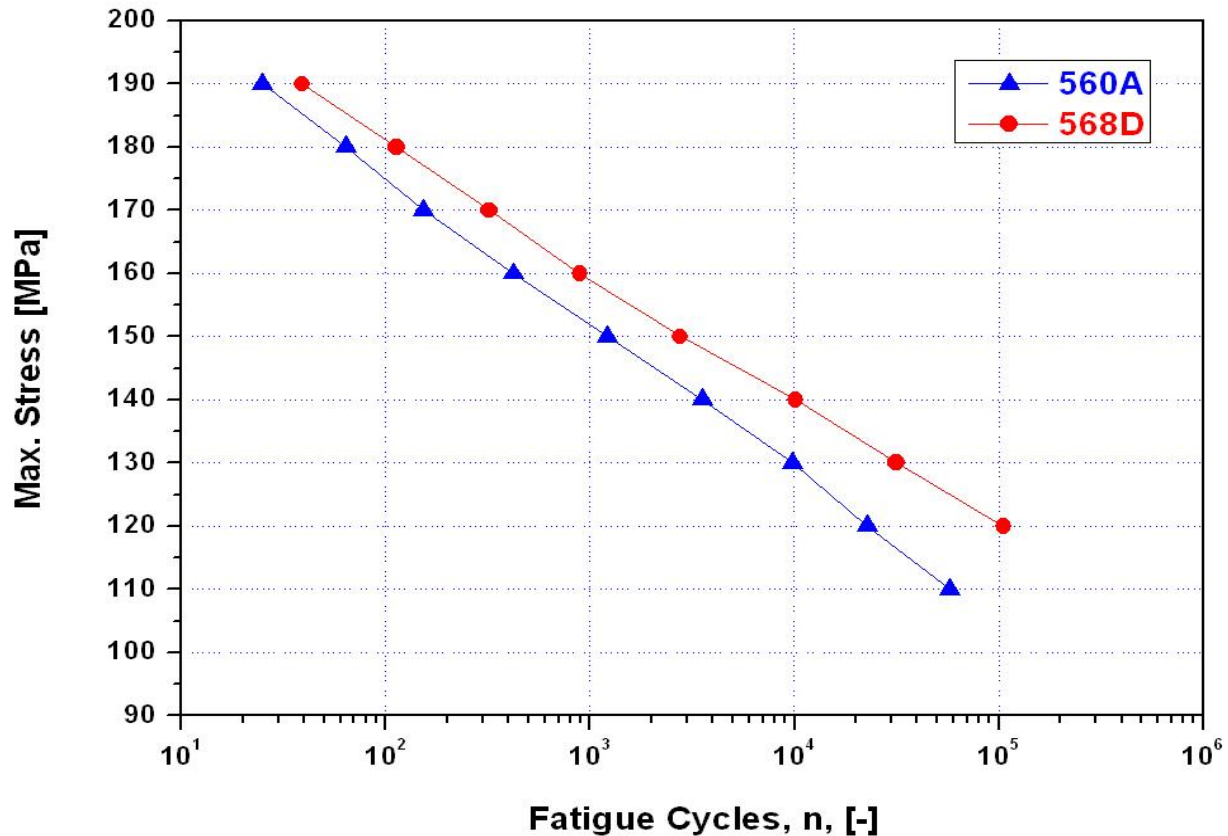
# 568D: Fatigue resistant

✓ *Outstanding fatigue resistance*

## Fatigue properties (tensile – tensile)

S-N Curves

1Hz



# 568D: Fatigue resistant

## Applications

- *Automobile structure*

- *Airway*



- *Gear*



- *Chain*





## 568FR: Flame retardant

- **Some application (e.g., EEE) demanded the use of halogen-free flame retardant materials, to reduce fire hazard and environmental harm.**



**Halogen-free FR GFPA is high cost, because of the high price and high additive amount of halogen-free flame retardant (e.g., Exolit<sup>®</sup> OP).**

- ✓ ***Specially designed for OP flame retardant GFPA materials***
- ✓ ***↓ the loading level of flame retardant***
- ✓ ***↓ the cost of product will be reduced***



**Short-board effect**



**Flame retardant glass fiber reinforced PA through traditional method: an overdose of flame retardant**

**Glass fiber reinforced PA: poor flame retardancy, application is restricted in some fields.**

**Using 568FR, the “short-board” of flame retardant PA composites can be effectively repaired, and therefore reduce the loading level of flame retardant.**

# FR fiberglass reinforced common PA



## Flame Retardant Fiberglass Reinforced PA6 (with OP1312/OP1314 under different conditions)

Flame Retardant			OP1312			OP1314		
Fiber Glass			560A	568FR	568FR	560A	568FR	568FR
Flame Retardant Content	wt%	/	17	13	13	16	13	13
Glass Content	wt%	/	30					
Compounding Conditions	A-1100		0	0	0.3wt%	0	0	0.3wt%
Property	Unit	Standard	Test Data					
Tensile Strength	MPa	ISO527	124	103	132	128	110	133
Tensile Modulus	GPa	ISO527	10.6	10.5	10.6	10.5	10.4	10.4
Flexural Strength	MPa	ISO178	192	152	201	206	169	220
Flexural Modulus	GPa	ISO178	9.7	9.5	9.7	9.8	9.8	9.9
Unnotched Charpy Impact	kJ/m <sup>2</sup>	ISO179	38	22	44	41	25	42
Notched Charpy Impact	kJ/m <sup>2</sup>	ISO179	8.6	6.1	7.9	9.1	6.5	8.1
Flame Retardancy	3.2 mm	UL 94	V-0	V-0	V-0	V-0	V-0	V-0
	1.6 mm	UL 94	V-0	V-0	V-0	V-0	V-0	V-0

# FR fiberglass reinforced high temperature resistant PA



## Flame Retardant Fiberglass Reinforced PA9T (with OP1230)

Resin			PA9T		
Fiber Glass			568H		568FR
Flame Retardant Content	wt%	/	16	18	14
Glass Content	wt%	/	30		
Property	Unit	Standard	Test Data		
Tensile Strength	MPa	ISO527	148	143	141
Tensile Modulus	GPa	ISO527	10.4	10.7	10.2
Flexural Strength	MPa	ISO178	232	223	222
Flexural Modulus	GPa	ISO178	10.6	10.8	10.6
Unnotched Charpy Impact	kJ/m <sup>2</sup>	ISO179	47	45	39
Notched Charpy Impact	kJ/m <sup>2</sup>	ISO179	8.8	8.5	6.9
Flame Retardancy	3.2 mm	UL 94	V-0	V-0	V-0
	1.6 mm	UL 94	V-1	V-0	V-0

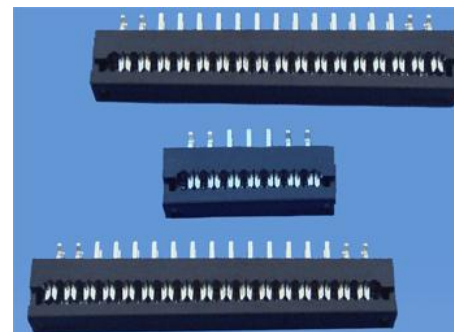


# 568FR: Flame retardant

## Applications



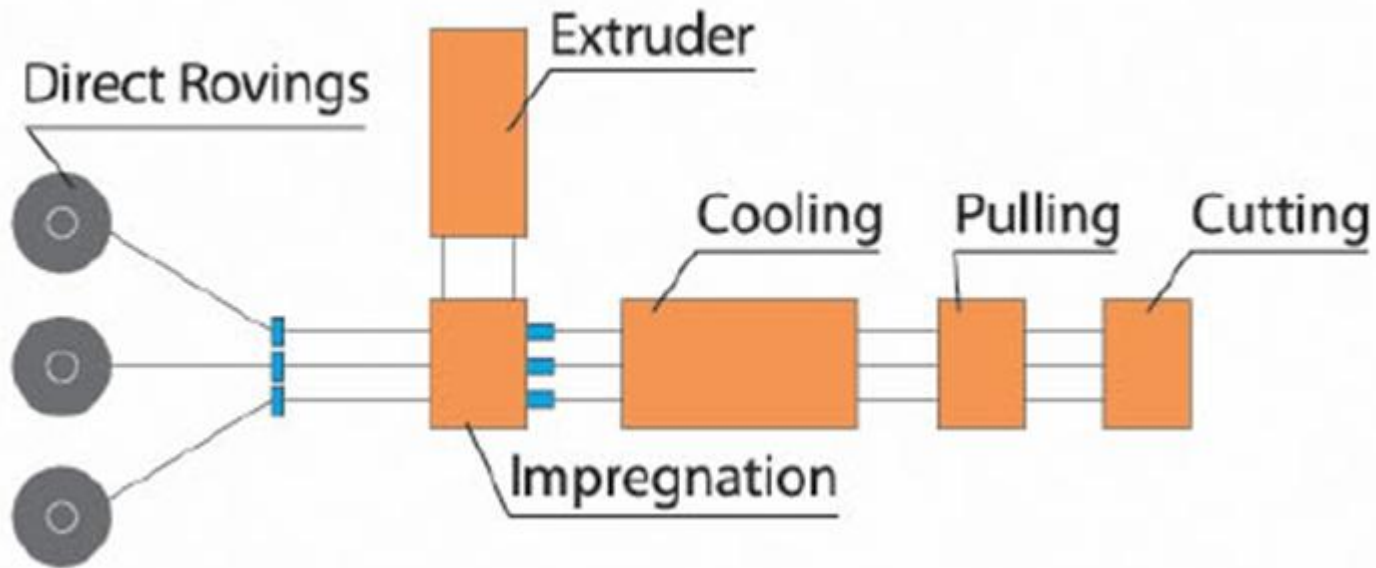
- *Electronic devices and electrical appliances*
- *Connectors*





❖ **SFT-PA**

❖ **LFT-PA**



**LFT-G**

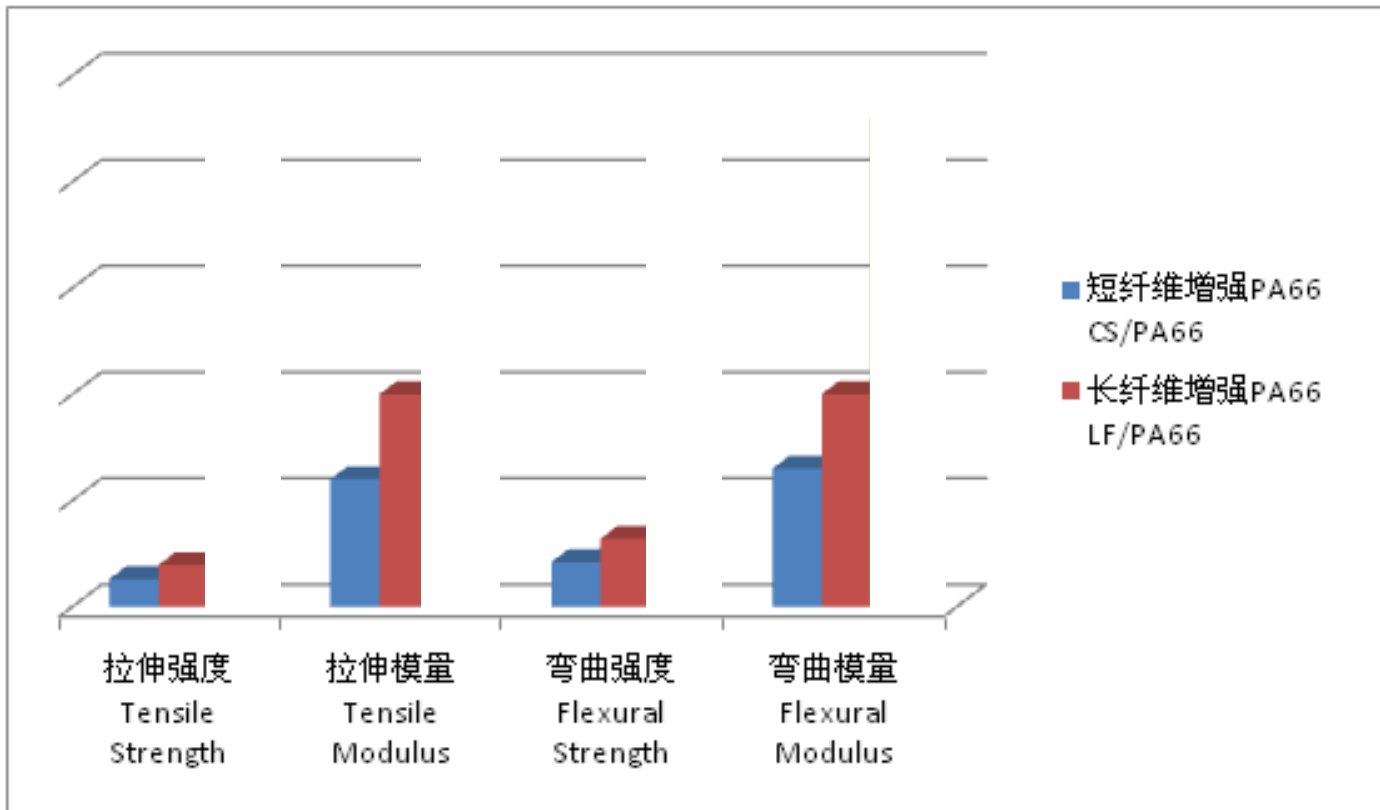
- *Wire coating process*
- *Long fiber pultrusion*

**LFT-D**

- *Extrusion compression*
- *Injection moulding*

# Advantages of LFT

- ✓ *Clean production environment, recyclability*
- ✓ *High content of fiberglass (40-60 wt%)*
- ✓ *Longer fiber, higher performance*



# JUSHI fiberglass for LFT-PA



Code	Diameter ( $\mu\text{m}$ )	Linear density (tex)	Resin	Application
<b>352B</b>	<b>17</b>	<b>2400, 2206</b>	<b>PA/TPU</b>	<b>LFT-D&amp;LFT-G</b>

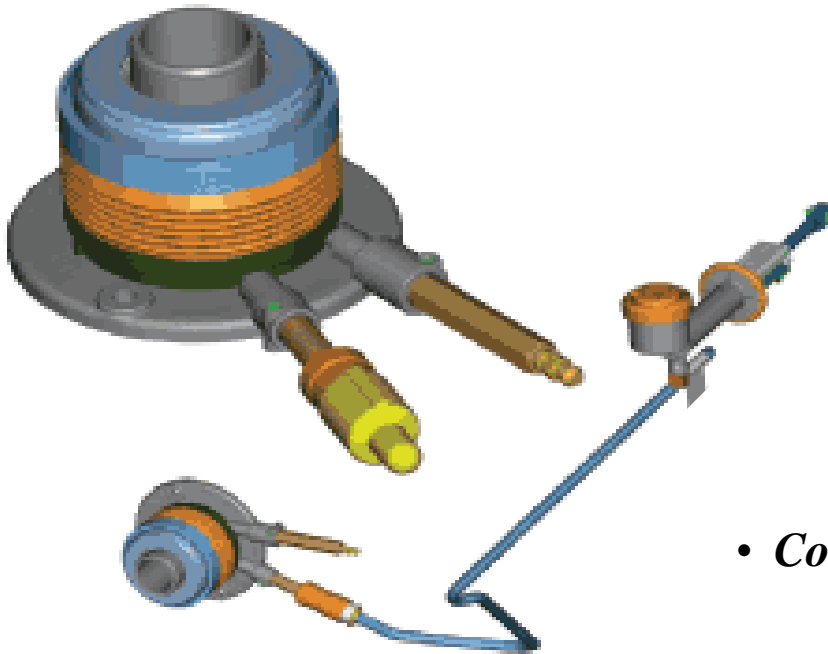
*Other products available upon request*

## PA6 with 40% GF

Samples	Relative performance (%)	
	SFT-PA (40% 560A)	LFT-PA (40% 352B)
Tensile strength	100	119.8
Tensile modulus	100	121.3
Flexural strength	100	115.6
Flexural modulus	100	119.1
Notched charpy impact	100	147.9

## Applications

- *Automobile structure*
- *Heat-resistant parts surrounding Engine*



- *Concentric slave cylinder*

# Contact information



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