TEREZ LFT

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POLYMER GROUP

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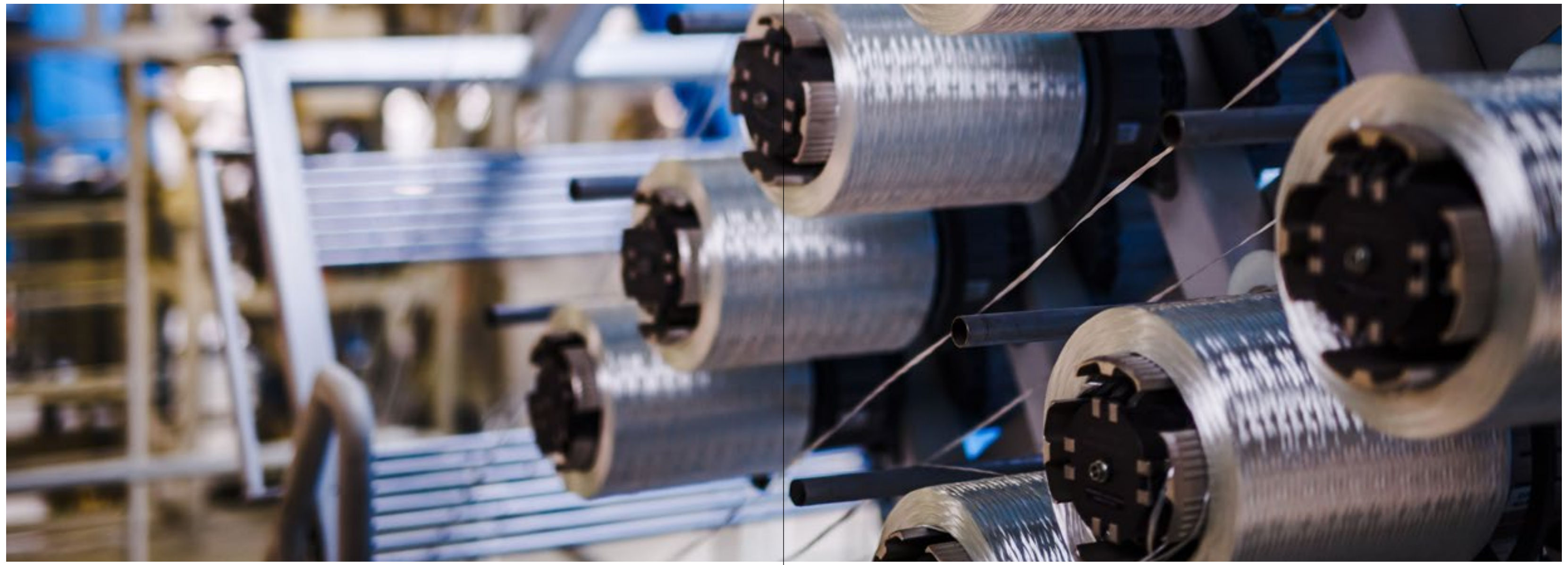
Content

Introduction



Long fiber production requires special know-how

Good products require optimal manufacturing processes. In the field of LFT technology, TER Plastics POLYMER GROUP together with its production subsidiary, TEREZ PERFORMANCE POLYMERS, has broken completely new ground and developed the technology further. The LFT technology combines conventional compounding know-how with state-of-the-art textile technology.

A good impregnation of the monofilaments is vital for achieving the excellent properties of the LFT compounds. This is done by means of an optimized spreading technique, which provides more singled-out monofilaments for individual impregnation – and more evenly than in previous processes.

The impregnation head has been completely redesigned. In the context of an R&D-cooperation with the Chemnitz Technical University – Institute for Structural Light Weight Design and Plastics Processing –, this new design has been verified with the experience gained there.

Thanks to this successful cooperation between science and business, it was possible to introduce the most state-of-the-art technical knowledge into this design.

For extreme demands in metal substitution

LFT products offer new possibilities for weight reduction in structural components in the automotive industry. Lightweight construction is also an issue in sports and leisure applications, where composite materials have long been used. The TEREZ LFT portfolio offers economical solutions where increasing quantities require a change to injection molding production.

The extensive product portfolio offers numerous solutions ranging from polyamide 6 to high-modulus materials with high stiffness and strength. Products for high operating temperatures have also been developed.

The long-fiber-reinforced TEREZ compounds thus offer the ideal basis for the automotive industry's change to lighter and more efficient vehicle concepts. The requirements in terms of emissions, crash behavior and recycling are at the forefront of development.

TEREZ LFT: long fiber contents up to 60 %

The TEREZ LFT portfolio consists of a wide range of different polyamide types and fiber contents. Due to a long fiber reinforcement of up to 60 %, the internal fiber skeleton offers unmatched high impact strength, better stiffness at elevated temperatures, as well as improved dimensional stability, fatigue and creep resistance.

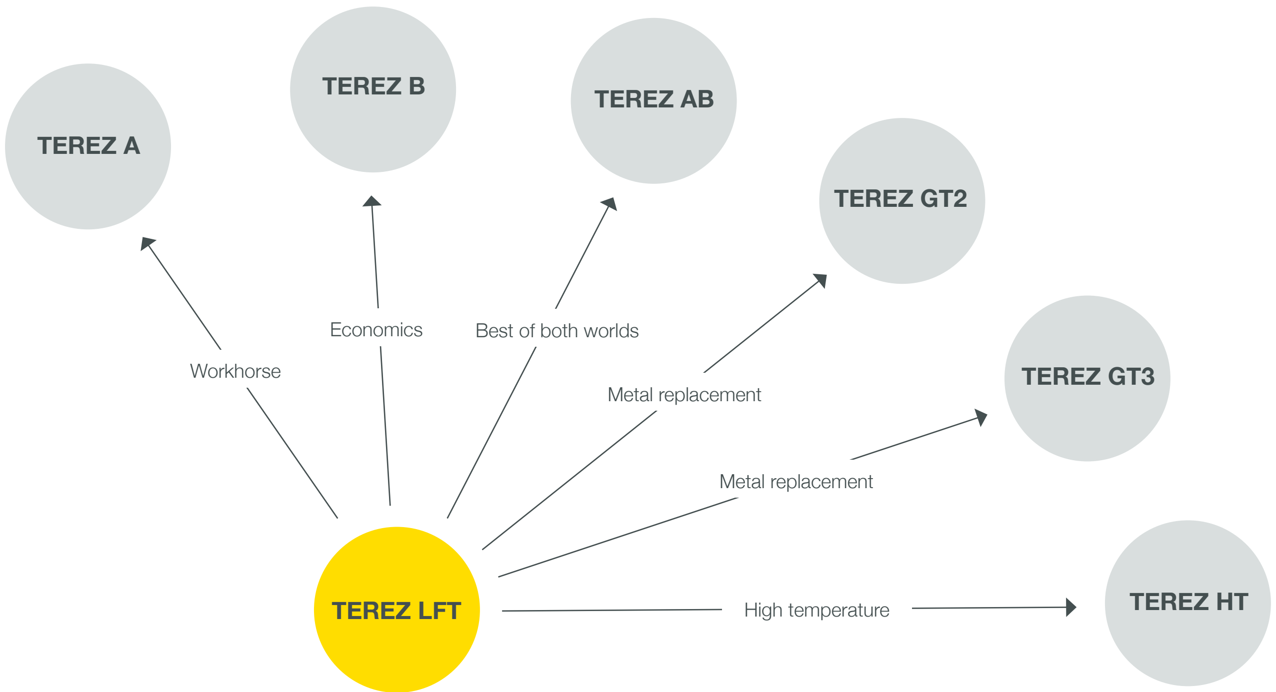
Long glass fiber pellets

Good glass fiber impregnation after coffee mill test

Poor glass fiber impregnation after coffee mill test

Portfolio overview

TEREZ LFT	Polymer	Profile
TEREZ A	Polyamide 66	PA66 long fiber-reinforced, heat stabilized for applications in harsh environments such as engine compartments
TEREZ B	Polyamide 6	PA6 long fiber-reinforced, heat stabilized for applications such as structural components in the seat area
TEREZ AB	Polyamide 66+6	PA66+PA6 long fiber reinforced, heat stabilized with the best properties of PA66 and PA6
TEREZ GT2	Polyamide MXD6	Polyarylamide long fiber reinforced, heat stabilized with highest stiffness and strength even in conditioned condition. Low shrinkage and excellent surfaces
TEREZ GT3	Polyamide 66+6I/6T	PA with partially aromatic components, long fiber-reinforced, heat stabilized with high stiffness and strength even in the conditioned state
TEREZ HT	Polyamide 6T/6I	High temperature polyamide long fiber reinforced, heat stabilized for applications with high mechanical requirements above 100 °C

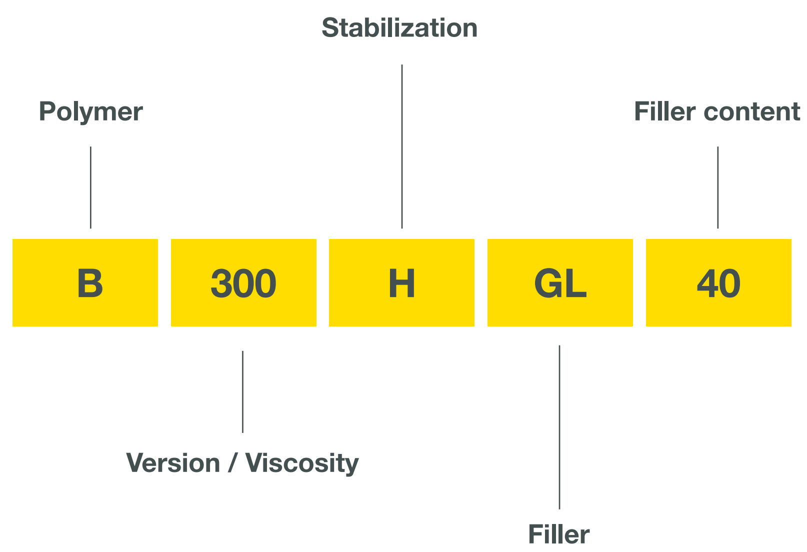


Nomenclature

Polymer	Version / Viscosity	Stabilization
TEREZ A = PA66 TEREZ B = PA6 TEREZ AB = PA66+PA6 TEREZ GT2 = PA MXD6 TEREZ GT3 = PA66+PA6I/6T TEREZ HT = PA6T/6I	300 = Standard 310 = Low viscosity 320 = High viscosity	H = Heat stabilization HO = Hot oil stabilization HY = Hydrolysis stabilization UV = UV stabilization

Filler	Filler content
GL = Long glass fiber	30 - 60 %

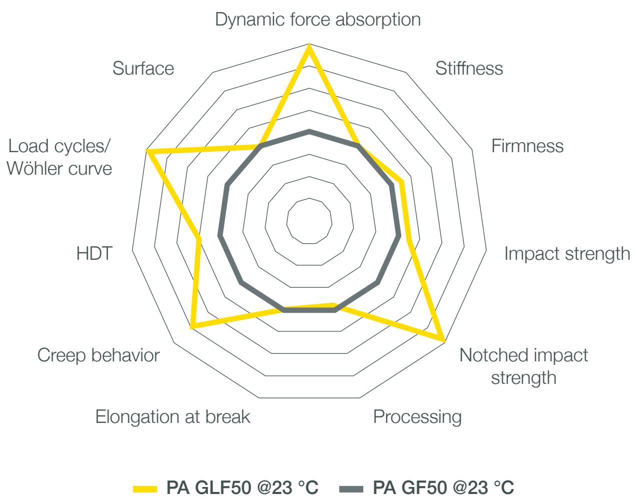
Example:

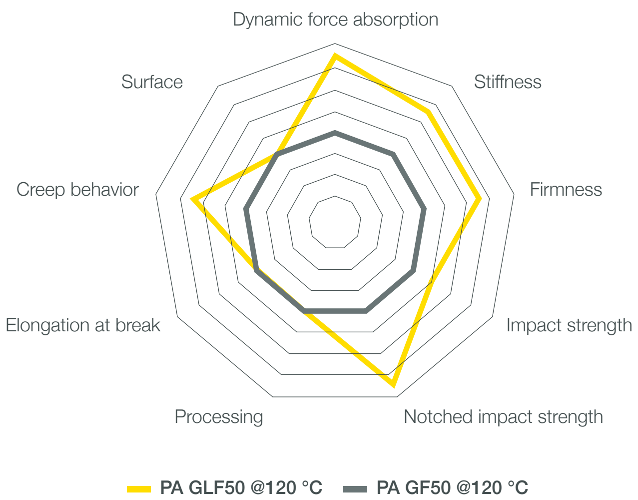


Properties at a glance

The TEREZ LFT product family has a unique property profile, making it the material of choice for challenging operating conditions.

- Strongly improved (notched) impact strength, especially at low temperatures
- Higher energy absorption in the event of impact or crash
- Better creep behavior
- Significantly improved fatigue behavior under dynamic load
- Improved stiffness and strength at higher temperatures





The greatly improved mechanical properties are supplemented by further advantages of the TEREZ LFT products:

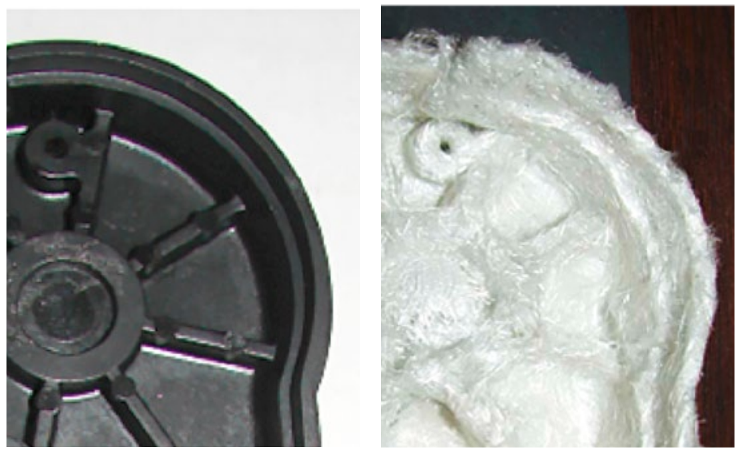
- Excellent surface quality even at high filling levels
- Less tendency to warpage
- Very good weldability

Three-dimensional fiber mesh

During the production and processing of TEREZ LFT, everything is all about the fiber. The correct exposure of the monofilaments of the continuous glass fiber rovings is decisive for the good properties of LFT compounds. The LFT technology developed by TER Plastics POLYMER GROUP enables an ideal impregnation of the fiber with polymer and thus creates the best starting point for the later processing and the resulting component properties.

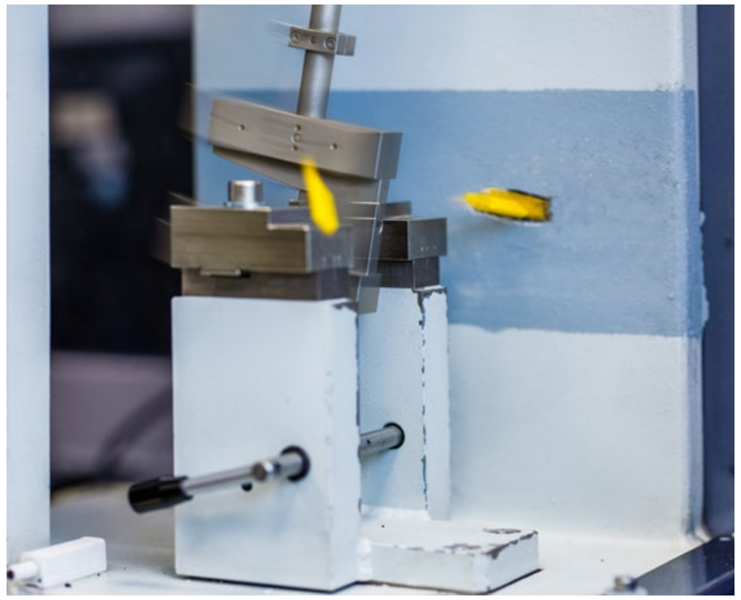
Pellet/fiber lengths of approx. 12 millimeters are the norm; shorter cutting lengths of down to 9 millimeters are available upon request.

Under ideal processing conditions at the injection moulding machine and the mold, fiber lengths in the component of up to 6 millimeters are achieved. The result is an inherently stable fiber skeleton that retains its structure even after the molded part has been pyrolyzed. This three-dimensional fiber mesh is the basis for the greatly improved properties of TEREZ LFT compounds.



Ashing-Test of LFT part

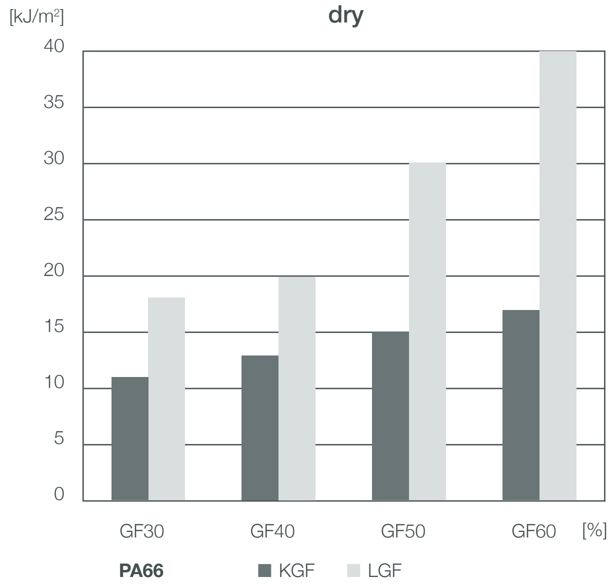
Energy absorption



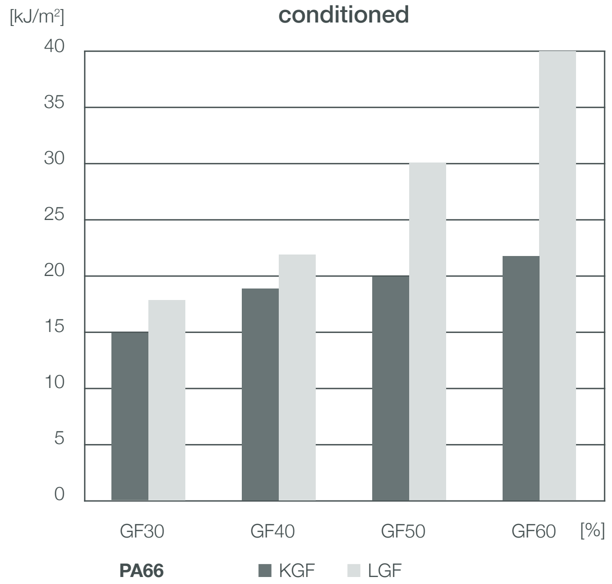
Impact strength

TEREZ LFT shows significantly improved toughness properties compared to conventional short fiber reinforced polymers. The introduced energy is taken up and absorbed by the fiber skeleton. Particularly at low temperatures, excellent notched impact strength is achieved while all other mechanical properties are retained.

Notched impact strength vs. glass fiber type/content dry

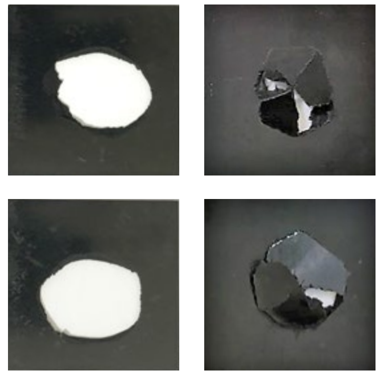


Notched impact strength vs. glass fiber type/content conditioned



Energy absorption/Crash performance

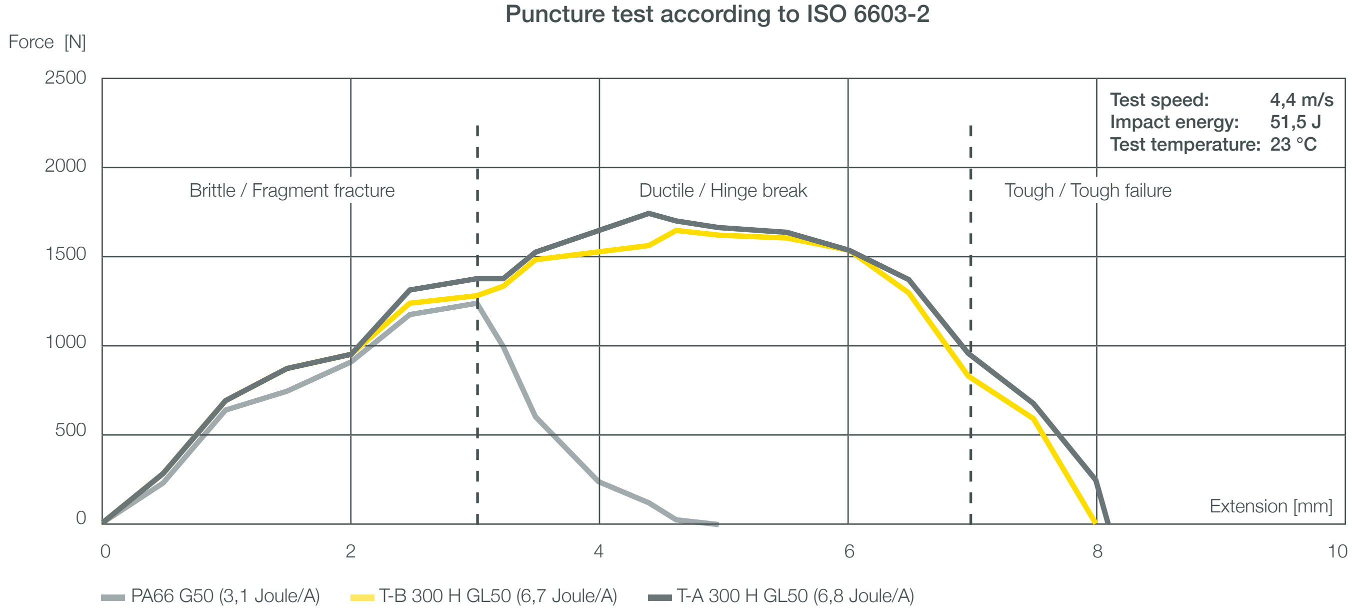
The puncture test shows the high energy absorption potential of TEREZ LFT compounds. An energy input occurring, for example, due to impact / crash is absorbed via the fiber skeleton in the polymer matrix. Thus, the TEREZ grades offer excellent properties for applications with high crash performance requirements. Results show ductile hinge fractures, while short-fiber-reinforced polymers show a rather brittle fracture pattern.



PA66 G50
Brittle fracture

PA66 GL50
Hinge fracture

Puncture test according to ISO 6603-2

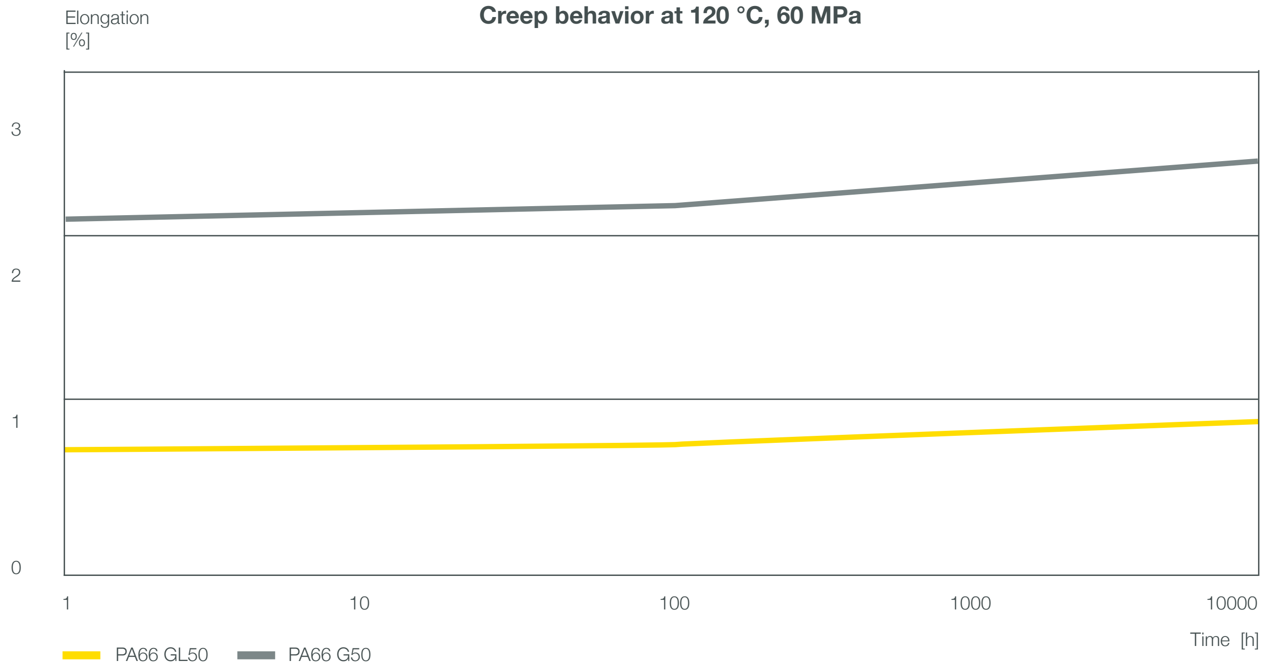


Creep behavior

Creep behavior

TEREZ LFT shows improved creep behavior. Applications with high static loads, e.g. suspensions, screw-on domes or durable pressure-loaded components, deform slowly and thus lose their residual stress in the long run. This is particularly evident at higher temperatures. Here, too, the skeleton of long fibers helps to maintain this stress better.

Creep behavior at 120 °C, 60 MPa

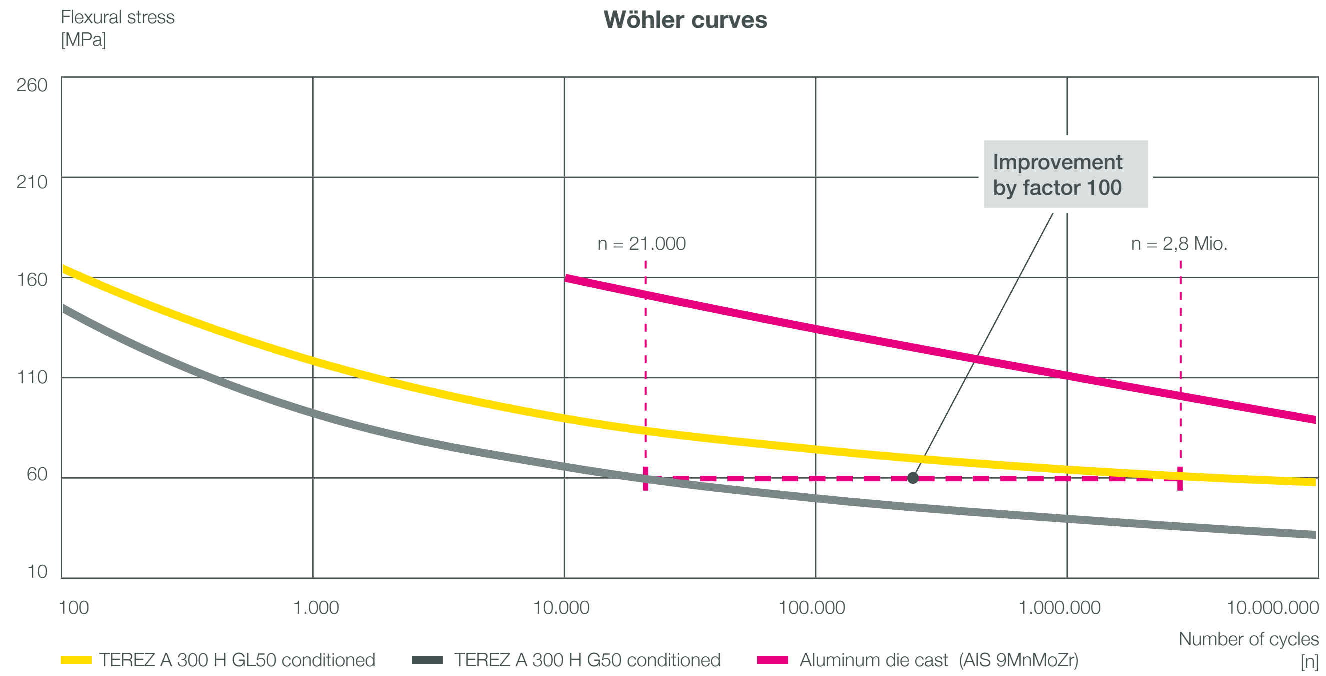


Fatigue behavior

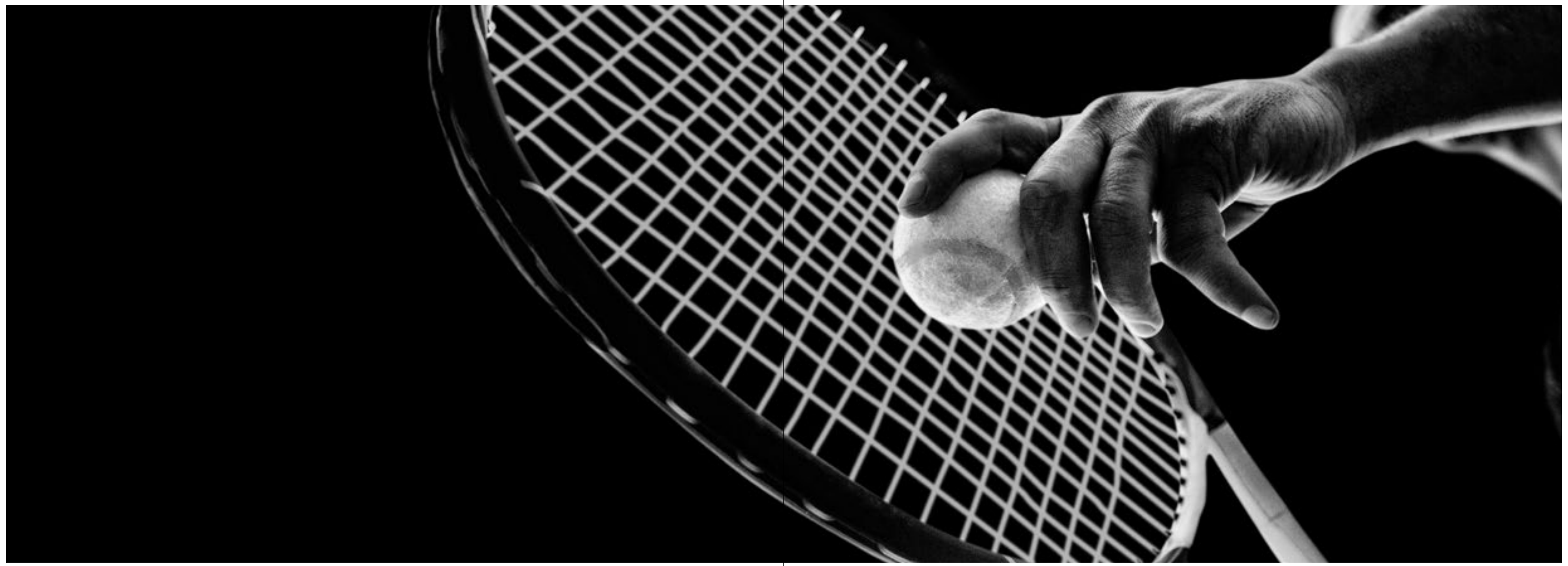
Dynamically resilient high-performance materials for metal replacement

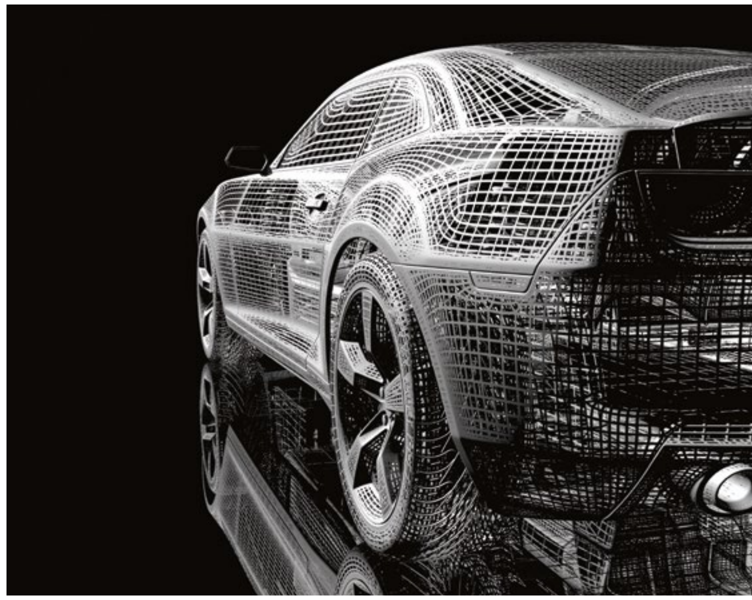
The use of TEREZ LFT results in a improved fatigue behavior by a factor of approx. 100. The load cycle test shows the potential of long fiber reinforced polymers in the area of metal substitution, especially at high numbers of load cycles. Highly dynamically stressed components are therefore no longer "metal matters", but can be designed economically and efficiently with engineering plastics.

Wöhler curves



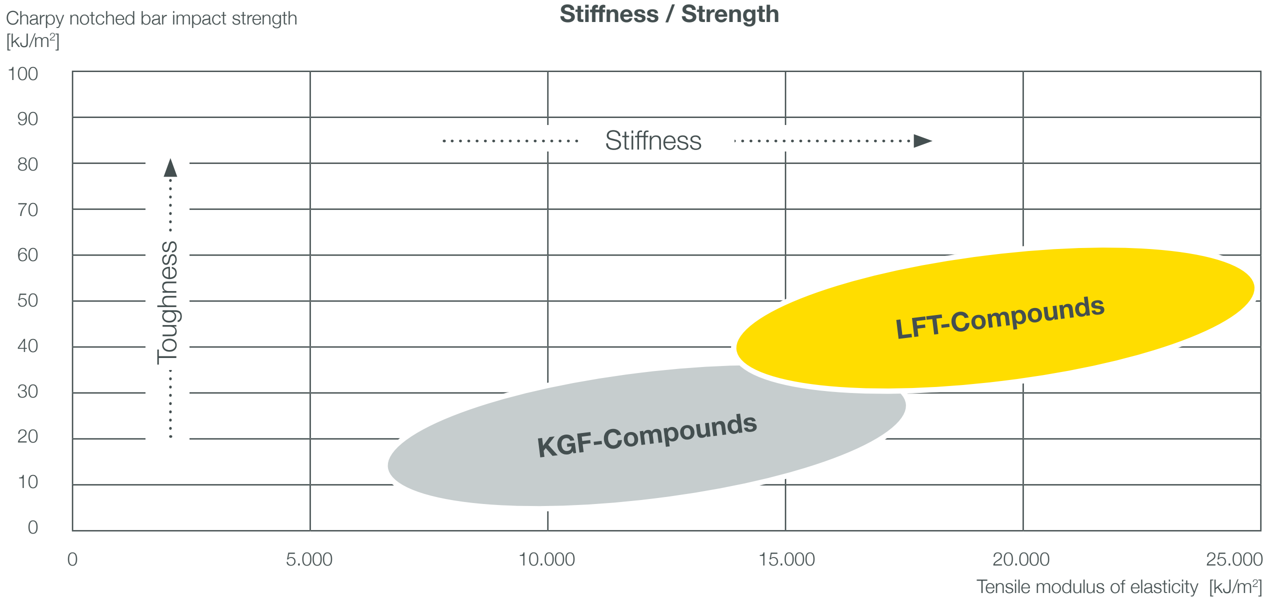
Mechanics





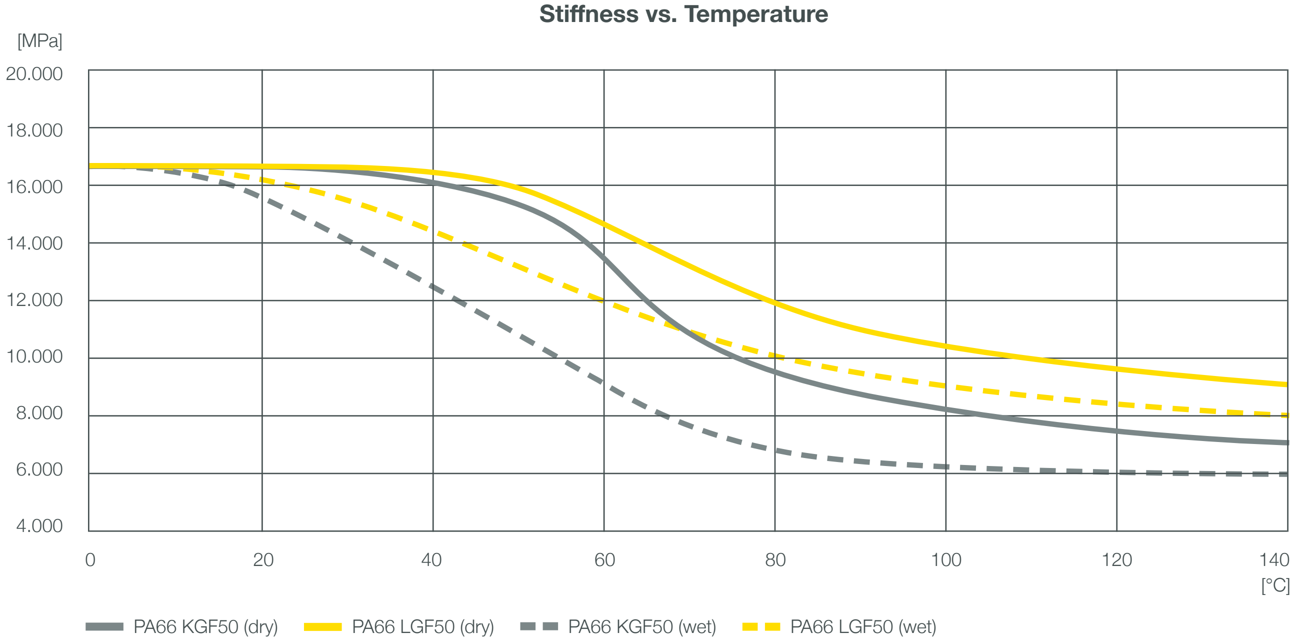
Stiffness / Strength

TEREZ LFT compounds achieve stiffnesses of up to 25 GPa as well as strengths of 280 MPa and thus offer a high potential for metal substitution. Compared to short fiber reinforced solutions, higher toughness is achieved.



Higher heat deflection temperature

If compared to the stiffness of short-fiber-reinforced grades at room temperature, long-fiber-reinforced compounds show hardly any difference. However, at temperatures above 50 °C, the clear advantage of long fiber reinforcement becomes evident. Beyond 80 °C, TEREZ LFT offers considerably more stiffness as shown with PA 66; the fiber mesh takes over the tasks which the polymer no longer covers at these temperatures. These improved properties can be transferred to other TEREZ LFT grades: In case of challenging requirements with respect to impact strength or energy absorption, a long fiber reinforced polymer can be the solution against decreasing stiffness at elevated temperatures before being forced to switch to more expensive polymer solutions.

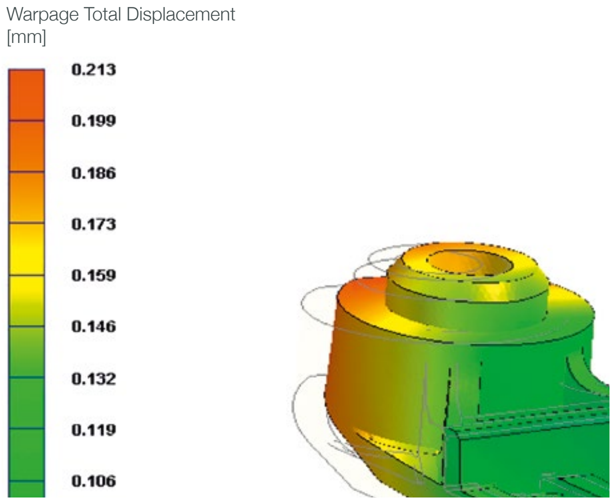


Warpage, surface, wear

The overall improved properties of TEREZ LFT focus on toughness, energy absorption, fatigue and creep behavior as well as higher heat resistance. In addition, the LFT technology provides other advantages.

Warpage

The tendency to warp is reduced by achieving an isotropic material appearance. Compared to short fiber reinforced solutions with a rather anisotropic character, the shrinkage across the flow direction is significantly lower. Thus, large-volume structural components are not only characterized by excellent mechanical properties, but also by corresponding dimensional accuracy.

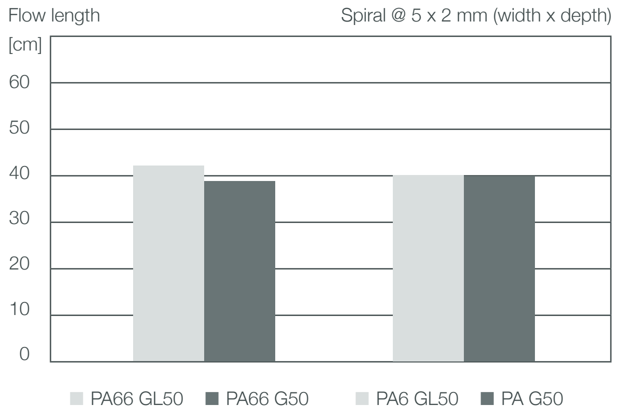


Injection moulding simulation: shrinkage and warpage

Flowability/Surface quality

If you imagine the long fibers in the polymer, or if you see an extruded melt cake of long fiber materials, you quickly get the impression that you have to process a viscous mass with little prospect of good surfaces. The opposite is the case. TEREZ LFT achieves the same flow path lengths as a short fiber reinforced compound. The surface qualities are equally very good and even better due to a smaller number of fiber ends.

Spiral flow test long glass fiber vs. short glass

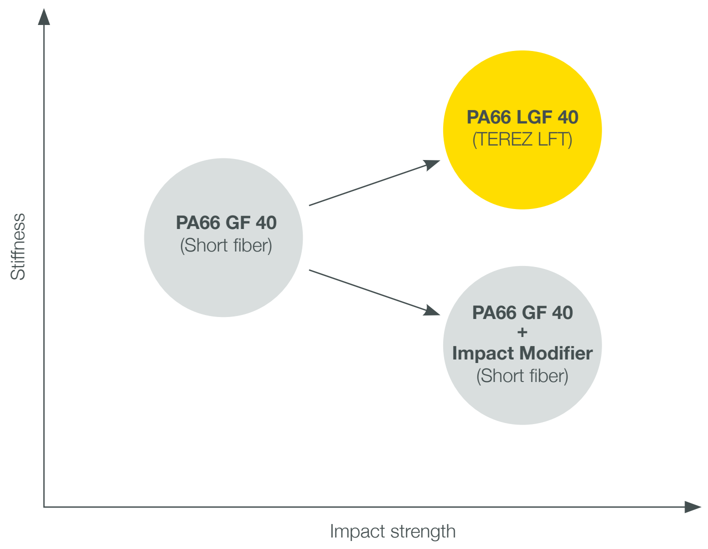


Wear

Due to a lower number of free fiber ends with abrasive break patterns and the same percentage of fiber weight, the resulting wear is also lower. Concerns about high wear on the injection cylinder, hot runner and mould are therefore unfounded.

TEREZ LFT A

Polyamide 66 is the most frequently used polyamide alongside polyamide 6 and is used in the automotive, electrical and mechanical engineering industries. Compared to polyamide 6, it has a higher melting point, slightly lower moisture absorption and impact strength.
Glass fiber-reinforced polyamide 66 grades have replaced a large number of metal applications in recent decades and are often highly filled. In case of long fibers compounds, even higher stiffness values can be achieved at temperatures above the glass transition temperature. High impact strength and a more balanced property profile in both dry and conditioned condition are also achieved.



Key facts

- Broad application potential
- Fatigue behavior like metal
- Excellent stiffness at temperatures above glass transition
- Excellent heat distortion temperature
- Short cycle times
- High notched impact strength while maintaining stiffness
- Low creep tendency

TEREZ LFT A | Long glass fiber reinforced

				A 300 H GL30		A 300 H GL40		A 300 H GL50		A 300 H GL60	
			Attributes	Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads	
			Abbreviation (ISO 1043)	PA66-GLF30		PA66-GLF40		PA66-GLF50		PA66-GLF60	
	Test conditions	Test method	Units	dry	conditioned	dry	conditioned	dry	conditioned	dry	conditioned
General properties											
Density	23 °C	ISO 1183	[g/cm³]	1,36		1,46		1,56		1,70	
Moisture absorption	70 °C/62 % r.F.	similar ISO 1110	[%]	2,0		1,5		1,4		1,2	
Water absorption	23 °C/saturated	similar ISO 62	[%]	6,0		5,0		4,0		3,5	
Color				Natural / Black		Natural / Black		Natural / Black		Natural / Black	
Colorability				On request		On request		On request		On request	
Mechanical properties											
Modulus of elasticity	1 mm/min	ISO 527-1/2	[MPa]	9700	6700	13000	10000	16500	13000	19500	15800
Stress at break	5 mm/min	ISO 527-1/2	[MPa]	170	155	235	165	250	175	250	190
Elongation at break	5 mm/min	ISO 527-1/2	[%]	2,5	2,5	2,4	2,4	2,0	2,0	1,8	2,0
Charpy impact strength	23 °C	ISO 179-1/1eU	[kJ/m²]	75	80	80	80	90	90	90	90
Charpy impact strength	-30 °C	ISO 179-1/1eU	[kJ/m²]	80	-	65	-	80	-	90	-
Charpy notched impact strength	23 °C	ISO 179-1/1eA	[kJ/m²]	19	20	23	23	35	35	40	36
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	[kJ/m²]	21	-	23	-	32	-	40	-
Thermal properties											
Melting point		similar to ISO 11357-3	[°C]	260		260		260		260	
Heat deflection temperature, HDT/A	1,8 MPa	ISO 75-2	[°C]	254		260		260		260	
Fire behavior Flammability UL 94	1,6 mm	test acc. to UL 94	[Class]	HB*		HB*		HB*		HB*	

* = UL listing on request

TEREZ LFT B

Having a long polymer history, polyamide 6 is one of the established polyamide types on the market. Invented in 1938 to circumvent the production patents of polyamide 66 “nylon”, it is now indispensable in the world of engineering plastics.

Thanks to its very balanced property profile, it is frequently used in automotive, construction and mechanical engineering. With an excellent impact strength, it is often used even under harsh conditions. Impact strength is achieved, among other things, by high moisture absorption, which in turn limits applications with high demands on dimensional stability. In lower temperature ranges, however, the absorbed water no longer acts as an impact modifier. With long fiber reinforcement, the fiber mesh absorbs energy even at low temperatures.

High glass fiber contents with simultaneously improved impact strength without loss of strength and stiffness make TEREZ B LFT a genuine super material for strongly dynamically stressed components when conventional short fibers do not offer sufficient reserves with.

Key facts

- Very good surface quality
- Wide processing window
- Economical solution
- High toughness
- Low deformation under static load
- Low creep tendency
- Significantly improved fatigue properties
- Higher heat deflection temperature

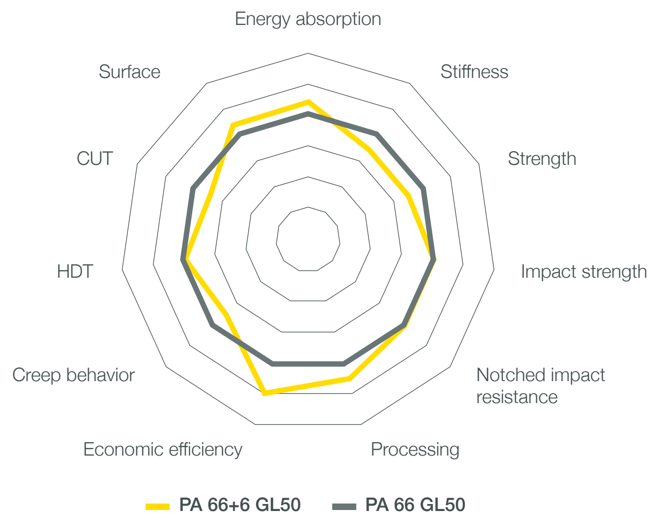
TEREZ LFT B | Long glass fiber reinforced

				B 300 H GL30		B 300 H GL40		B 300 H GL50		B 300 H GL60	
			Attributes	Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads	
			Abbreviation (ISO 1043)	PA6-GLF30		PA6-GLF40		PA6-GLF50		PA6-GLF60	
	Test conditions	Test method	Units	dry	conditioned	dry	conditioned	dry	conditioned	dry	conditioned
General properties											
Density	23 °C	ISO 1183	[g/cm³]	1,36		1,45		1,56		1,70	
Moisture absorption	70 °C/62 % r.F.	sim. to ISO 1110	[%]	1,9		1,6		1,4		1,2	
Water absorption	23 °C/saturated	sim. to ISO 62	[%]	6,2		6,0		4,5		3,5	
Color				Natural / Black		Natural / Black		Natural / Black		Natural / Black	
Colorability				On request		On request		On request		On request	
Mechanical properties											
Modulus of elasticity	1 mm/min	ISO 527-1/2	[MPa]	10500	7500	12400	8600	16000	10500	21500	17000
Stress at break	5 mm/min	ISO 527-1/2	[MPa]	170	105	220	140	250	162	263	215
Elongation at break	5 mm/min	ISO 527-1/2	[%]	2,5	2,7	2,3	2,5	2,2	2,5	1,9	2,1
Charpy impact strength	23 °C	ISO 179-1/1eU	[kJ/m²]	65	65	80	80	90	90	NB	NB
Charpy impact strength	-30 °C	ISO 179-1/1eU	[kJ/m²]	55	-	70	-	85	-	75	-
Charpy notched impact strength	23 °C	ISO 179-1/1eA	[kJ/m²]	20	20	25	25	30	30	37	37
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	[kJ/m²]	20	-	25	-	32	-	37	-
Thermal properties											
Melting point		similar ISO 11357-3	[°C]	220		220		220		220	
Heat deflection temperature, HDT/A	1,8 MPa	ISO 75-2	[°C]	215		220		220		220	
Fire behavior Flammability UL 94	1,6 mm	test acc. to UL94	[Class]	HB*		HB*		HB*		HB*	

* = UL listing on request NB = no break

TEREZ LFT AB

TEREZ LFT AB types are characterized by the combination of the best properties of polyamide 66 and polyamide 6.
With outstanding surface quality, good stiffness and toughness levels and a commercially attractive cost base, the combination of the best properties of polyamide 66 and polyamide 6 becomes evident. Equipped with long-fiber technology, even better surfaces can be achieved and, at the same time, a wider processing window can be utilized. This leads more quickly to the desired results in terms of component and process quality.



Key facts

- Combination of the best properties of PA6 and PA66
- Very good surface quality
- Wide processing window
- Very good heat distortion temperature
- Excellent energy absorption under dynamic loads
- Low creep tendency
- Significantly improved fatigue behavior

TEREZ LFT AB | Long glass fiber reinforced

				AB 300 H GL30		AB 300 H GL40		AB 300 H GL50		AB 300 H GL60	
			Attributes	Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads	
			Abbreviation (ISO 1043)	PA66+PA6-GLF30		PA66+PA6-GLF40		PA66+PA6-GLF50		PA66+PA6-GLF60	
	Test conditions	**Test method**	**Units**	dry	conditioned	dry	conditioned	dry	conditioned	dry	conditioned
General properties											
Density	23 °C	ISO 1183	[g/cm³]	1,36		1,45		1,55		1,68	
Moisture absorption	70 °C/62 % r.F.	ISO 1110	[%]	2,7		1,5		1,4		1,2	
Water absorption	23 °C/saturated	ISO 62	[%]	6,0		5,0		4,0		3,5	
Color				Natural / Black		Natural / Black		Natural / Black		Natural / Black	
Colorability				On request		On request		On request		On request	
Mechanical properties											
Modulus of elasticity	1 mm/min	ISO 527-1/2	[MPa]	10000	8000	12500	9800	16500	12500	21000	16000
Stress at break	5 mm/min	ISO 527-1/2	[MPa]	170	155	235	165	250	170	250	185
Elongation at break	5 mm/min	ISO 527-1/2	[%]	2,2	2,2	2,3	2,3	2,0	2,0	1,8	2,2
Charpy impact strength	23 °C	ISO 179-1/1eU	[kJ/m²]	75	80	80	80	90	90	90	90
Charpy impact strength	-30 °C	ISO 179-1/1eU	[kJ/m²]	-	-	-	-	-	-	-	-
Charpy notched impact strength	23 °C	ISO 179-1/1eA	[kJ/m²]	19	20	23	23	32	32	40	36
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	[kJ/m²]	21	-	23	-	30	-	40	-
Thermal properties											
Melting point		similar to ISO 11357-3	[°C]	260		260		260		260	
Heat deflection temperature, HDT/A	1,8 MPa	ISO 75-2	[°C]	250		255		255		255	
Fire behavior Flammability UL 94	1,6 mm	test acc. to UL 94	[Class]	HB*		HB*		HB*		HB*	

* = UL listing on request

TEREZ LFT GT2

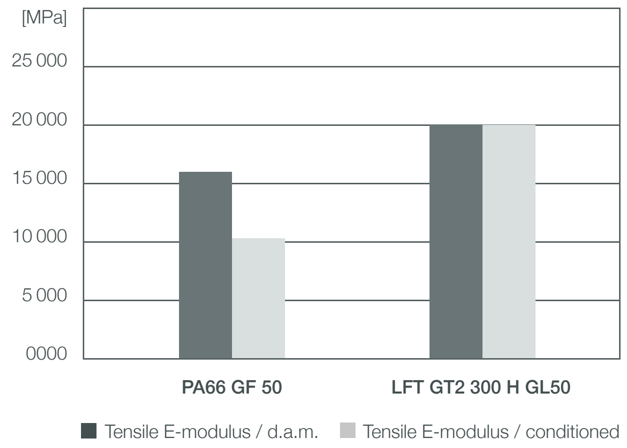
High strength and stiffness

Compared to conventional polyamides with the same degree of glass fiber reinforcement, the TEREZ GT2 line has an advantage in stiffness – immediately after being freshly injected. While PA 6 or PA 66 show a drop in stiffness of up to 40 % after conditioning, the characteristic data for the TEREZ GT2 remain constant – this applies also for the LFT grades. Therefore, the product is independent of the ambient climatic conditions and offers an additional reserve for high mechanical loads.

High dimensional stability

The water absorption of TEREZ GT2 is at a very low level. For the LFT grade TEREZ GT2 300 H GL50 with 50 % glass fiber reinforcement the water absorption is only 0.55 % when stored in water/ 23 °C. Under the same conditions, a PA 6 LGF 50 exhibits 8-times as much moisture absorption. The shrinkage of the TEREZ GT2 300 H GL50 is reduced by approx. 30 - 40 % in the direction of flow and transverse to the direction of flow.

Comparison Tensile E-modulus (ISO 527)



Key facts

- Minimal influence on mechanical properties after moisture absorption
- High dimensional stability
- Low warpage
- Excellent surfaces
- Wide processing window
- Very low creep tendency
- Significantly improved notched impact strength
- Higher heat deflection temperature
- High fatigue strength

TEREZ LFT GT2 | Long glass fiber reinforced

				GT2 400 H GL30		GT2 400 H GL40		GT2 400 H GL50		GT2 400 H GL60	
			Attributes	Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads	
			Abbreviation (ISO 1043)	PAMXD6 - GLF30		PAMXD6 - GLF40		PAMXD6 - GLF50		PAMXD6 - GLF60	
	Test conditions	Test method	Units	dry	conditioned	dry	conditioned	dry	conditioned	dry	conditioned
General properties											
Density	23 °C	ISO 1183	[g/cm³]	1,43		1,55		1,65		1,77	
Moisture absorption	23 °C/50 % r.F.	similar ISO 62	[%]	1,9		1,7		1,4		1,3	
Color				Natural / Black		Natural / Black		Natural / Black		Natural / Black	
Colorability				On request		On request		On request		On request	
Mechanical properties											
Modulus of elasticity	1 mm/min	ISO 527-1/2	[MPa]	12500	-	16000	-	21000	-	25000	-
Stress at break	5 mm/min	ISO 527-1/2	[MPa]	190	-	240	-	270	-	280	-
Elongation at break	5 mm/min	ISO 527-1/2	[%]	2	-	2	-	1,6	-	1,6	-
Charpy impact strength	23 °C	ISO 179-1/1eU	[kJ/m²]	45	-	65	-	70	-	70	-
Charpy impact strength	-30 °C	ISO 179-1/1eU	[kJ/m²]	-	-	-	-	-	-	-	-
Charpy notched impact strength	23 °C	ISO 179-1/1eA	[kJ/m²]	20	-	28	-	34	-	36	-
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	[kJ/m²]	-	-	-	-	-	-	-	-
Thermal properties											
Melting point		similar to ISO 11357-3	[°C]	240		240		240		240	
Heat deflection temperature, HDT/A	1,8 MPa	ISO 75-2	[°C]	235		235		240		240	
Fire behavior Flammability UL 94	1,6 mm	test acc. to UL 94	[Class]	HB*		HB*		HB*		HB*	

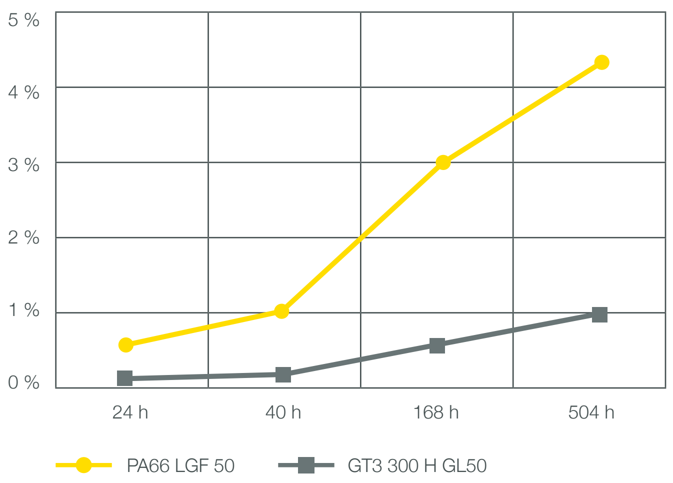
* = UL listing on request

TEREZ LFT GT3

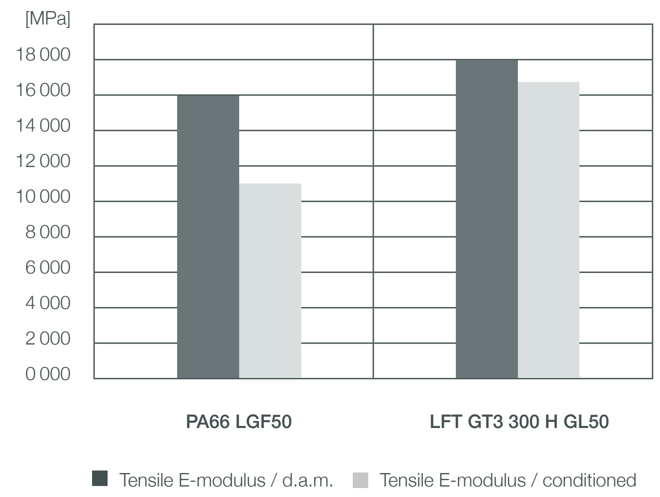
TEREZ LFT GT3
The classic in metal substitution

The TEREZ LFT GT3 series complements the long fiber reinforced PA6 and PA66 grades and is based on a PA66 + PA6I/6T with partially aromatic components. Due to long fiber contents of as high as 60 %, high stiffness and strength are achieved, which maintain their outstanding strength level even after moisture absorption. Dimensional stability also increases compared to conventional polyamides.

Moisture absorption during storage in water [23 °C / ISO 62]



Comparison Tensile E-modulus (ISO 527)



Key facts

- Low influence on mechanical properties after moisture absorption
- Good chemical resistance
- Low warpage
- Typical polyamide processing
- Balanced in stiffness and toughness
- Low creep tendency
- Excellent fatigue properties
- Improved heat deflection temperature

TEREZ LFT GT3 | Long glass fiber reinforced

				GT3 300 H GL30		GT3 300 H GL40		GT3 300 H GL50		GT3 300 H GL60	
			Attributes	Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads	
			Abbreviation (ISO 1043)	PA66 + PA6I/6T - GLF30		PA66 + PA6I/6T - GLF40		PA66 + PA6I/6T - GLF50		PA66 + PA6I/6T - GLF60	
	Test conditions	**Test method**	**Units**	dry	conditioned	dry	conditioned	dry	conditioned	dry	conditioned
General properties											
Density	23 °C	ISO 1183	[g/cm³]	1,34		1,46		1,55		1,68	
Moisture absorption	23 °C/50 % r.F.	similar ISO 62	[%]	1,5		1,3		1,2		1,1	
Water absorption	23 °C/saturated	similar ISO 62	[%]	4,5		4,4		3,9		3,4	
Color				Natural / Black		Natural / Black		Natural / Black		Natural / Black	
Colorability				On request		On request		On request		On request	
Mechanical properties											
Modulus of elasticity	1 mm/min	ISO 527-1/2	[MPa]	11000	10500	15000	14000	17500	16500	22000	21000
Stress at break	5 mm/min	ISO 527-1/2	[MPa]	210	-	235	-	260	-	290	-
Elongation at break	5 mm/min	ISO 527-1/2	[%]	3	-	2,4	-	2,2	-	2	-
Charpy impact strength	23 °C	ISO 179-1/1eU	[kJ/m²]	70	-	75	-	95	-	108	-
Charpy impact strength	-30 °C	ISO 179-1/1eU	[kJ/m²]	65	-	70	-	85	-	88	-
Charpy notched impact strength	23 °C	ISO 179-1/1eA	[kJ/m²]	20	22	25	-	32	-	40	-
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	[kJ/m²]	20	-	25	-	32	-	40	-
Thermal properties											
Melting point		similar to ISO 11357-3	[°C]	260		260		260		260	
Heat deflection temperature, HDT/A	1,8 MPa	ISO 75-2	[°C]	255		255		255		255	
Fire behavior Flammability UL 94	1,6 mm	test acc. to UL 94	[Class]	HB*		HB*		HB*		HB*	

* = UL listing on request

TEREZ LFT HT

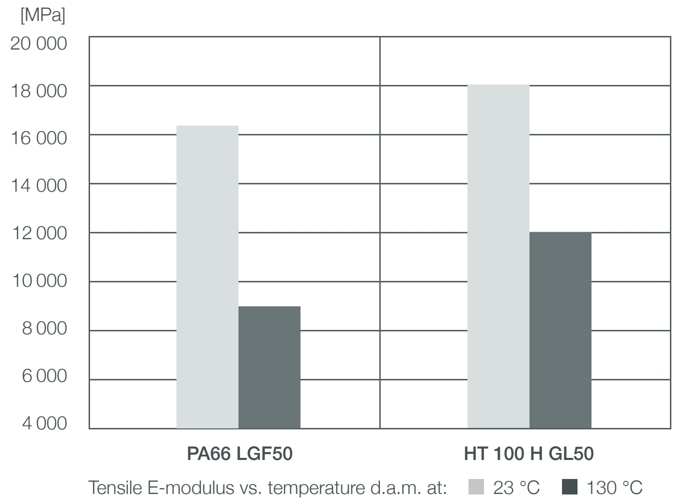
Metal replacement at high operating temperatures

The topic of metal replacement has occupied the plastics industry for many years, because the use of plastic instead of metal creates economical and ecological advantages. Plastics offer weight reduction, freedom of design, sustainability and last but not least even high stiffness and strength values. Operating temperatures of up to 230 °C can also be realized with plastics.

TEREZ LFT HT 100 for high-temperature applications

The TEREZ LFT HT product series has a melting point of 325 °C and is therefore the best Requirements for high-temperature use. Excellent creep resistance is achieved at ambient temperatures of 100 °C and above. TEREZ LFT HT long-fiber-reinforced compounds are used for applications with high demands on mechanical properties in the high-temperature range. The HT line shows its superiority at high temperatures especially in comparison to PA66 in terms of stiffness at 130°C.

Material comparison stiffness and temperature influence



Key facts

- High strength and stiffness even in conditioned condition
- Chemical resistance
- High strength and stiffness even at high operating temperatures
- Dimensional stability
- Low water absorption
- Very low creep tendency
- Improved notched impact strength
- High fatigue strength
- Increased heat distortion temperature

TEREZ LFT HT | Long glass fiber reinforced

				HT 100 H GL30		HT 100 H GL40		HT 100 H GL50		HT 100 H GL60	
			Attributes	Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads		Long glass fiber reinforced injection moulding grade for high dynamic loads	
			Abbreviation (ISO 1043)	PA6T/6I - GLF30		PA6T/6I - GLF40		PA6T/6I - GLF50		PA6T/6I - GLF60	
	Test conditions	Test method	Units	dry	conditioned	dry	conditioned	dry	conditioned	dry	conditioned
General properties											
Density	23 °C	ISO 1183	[g/cm³]	1,44		1,55		1,61		1,75	
Moisture absorption	23 °C/50 % r.F.	ISO 62	[%]	1,7		1,4		1,2		1,1	
Water absorption	23 °C/saturated	ISO 62	[%]	3,4		3,2		2,8		2,7	
Color				Natural / Black		Natural / Black		Natural / Black		Natural / Black	
Colorability				On request		On request		On request		On request	
Mechanical properties											
Modulus of elasticity	1 mm/min	ISO 527-1/2	[MPa]	11000	-	14000	-	18700	-	23500	-
Stress at break	5 mm/min	ISO 527-1/2	[MPa]	185	-	230	-	280	-	290	-
Elongation at break	5 mm/min	ISO 527-1/2	[%]	2,2	-	2	-	1,8	-	1,6	-
Charpy impact strength	23 °C	ISO 179-1/1eU	[kJ/m²]	50	-	70	-	82	-	95	-
Charpy impact strength	-30 °C	ISO 179-1/1eU	[kJ/m²]	-	-	-	-	-	-	-	-
Charpy notched impact strength	23 °C	ISO 179-1/1eA	[kJ/m²]	20	-	28	-	37	-	42	-
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	[kJ/m²]	-	-	-	-	-	-	-	-
Thermal properties											
Melting point		similar to ISO 11357-3	[°C]	330		330		330		330	
Heat deflection temperature, HDT/A	1,8 MPa	ISO 75-2	[°C]	285		285		285		285	
Fire behavior Flammability UL 94	1,6 mm	test acc. to UL 94	[Class]	HB*		HB*		HB*		HB*	

* = UL listing on request

Processing

In general, the glass fiber length is considerably shortened during the injection moulding process. To prevail most of the fiber length, extreme shear forces on the molding compound must be avoided. Compared to the processing of short fiber reinforced molding compounds, a reduction of the screw speed, the injection pressure, the injection speed and the holding pressure by approx. 40 % is recommended.

Recommended screw design

TEREZ LFT compounds can be processed on most conventional injection moulding machines. The standard 3-zone universal screws can be used. The L/D ratio should be 18 - 22 D and the compression ratio 2.1 - 2.5 : 1. The pellet feed should be cut as deep as possible for optimum pellet transport. Mixing elements on the screw should be avoided. The use of wear-protected screws and barrels is recommended for processing the long-fiber-reinforced TEREZ LFT.

Recommended temperature settings

Depending on the TEREZ LFT type selected, at least three separately controllable heating zones should be able to generate cylinder temperatures of up to 360 °C. A separate nozzle heater is required. The cylinder flange must be temperature-controlled. Processing can be carried out with an open nozzle, as it is very streamlined and durable due to its design. Valve gate nozzles on the cylinder are unfavorable. The melt temperatures are at the same level as with comparable short fiber compounds.

Mold wall temperatures

Higher mould temperatures result in lower-stress injection moulded parts, better surfaces, better embedding of the glass fibers, higher degrees of crystallisation and lower post-shrinkage. The hoses and fittings used for the mould temperature control must be designed for the required temperatures.

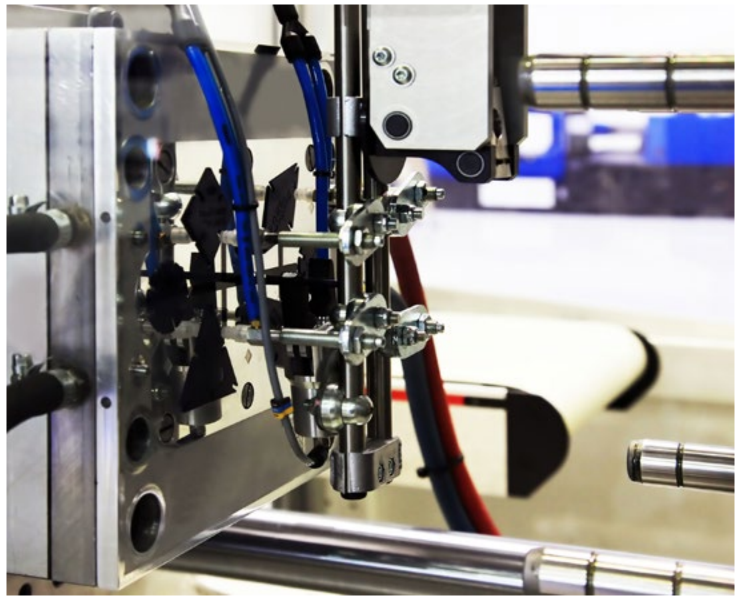
TEREZ LFT Type	Mould temperature
A, B, AB	60 - 120 °C
GT3	80 - 100 °C
GT2, HT	100 - 180 °C

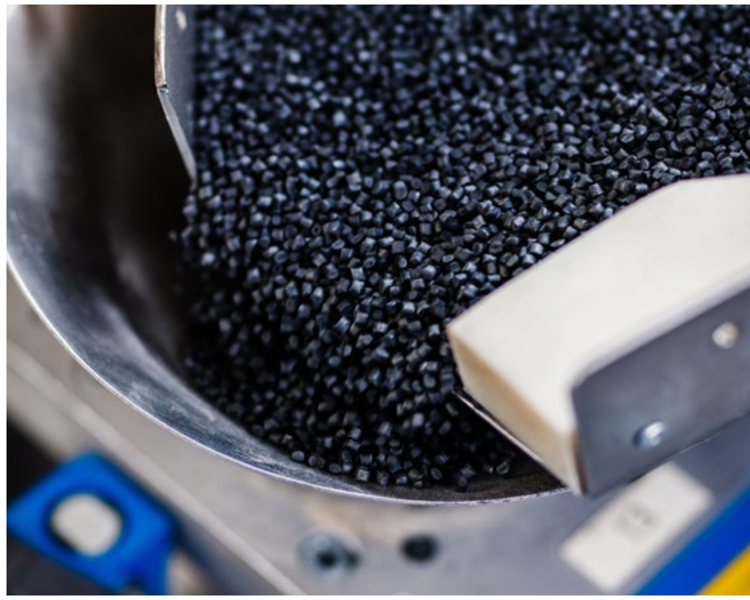
Pre-drying conditions

A dry air dryer should always be used. For moulded parts with a very demanding surface, a residual moisture content of ≤ 0.05 % is recommended. For the production of mechanically and optically perfect injection moulded parts we recommend pre-drying at 80 °C for 4 - 6 hours. When the container has been open (moist granulate), the pre-drying time can extend to 8 - 16 hours.

Notes on cleaning aggregates

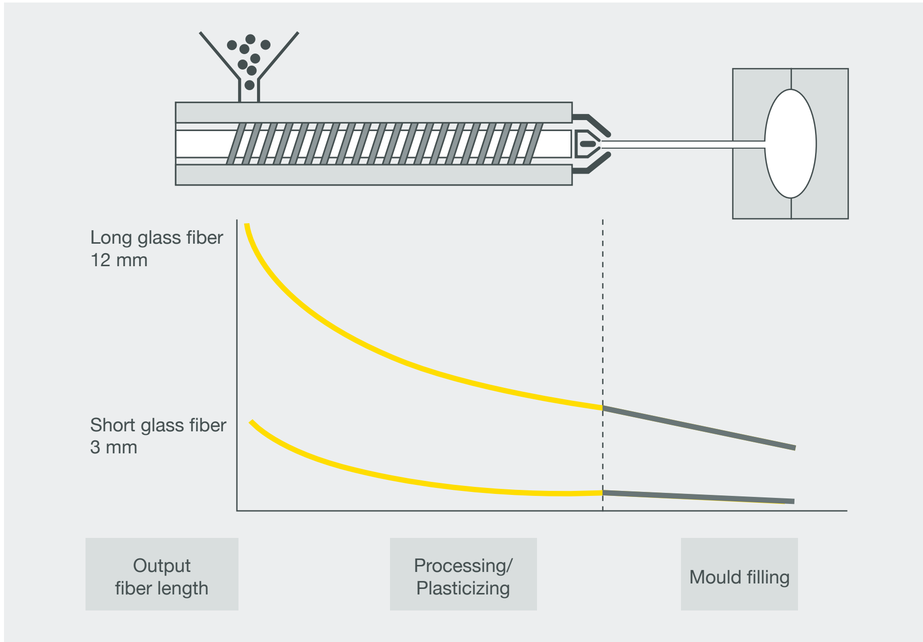
The unit can be rinsed with low MFI polypropylene for cleaning. Commercially available cleaning granules can also be used.



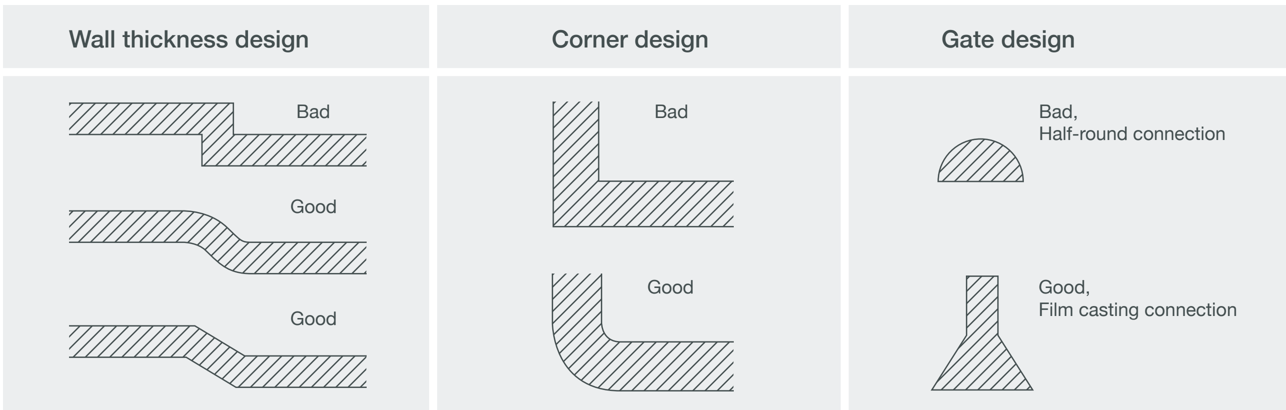


Special features / Influencing factors in long glass fiber processing

The processing results in a shortening of the initial fiber length. TEREZ LFT compounds have, depending on the processing parameters and component geometry, a much longer glass fiber length in the component in comparison to the short glass fiber and thus offer a significant improvement in component strength.



When processing long glass fiber compounds, it is crucial to maintain the highest possible average fiber length after completion of the injection molding process. A prerequisite for this is the aforementioned injection molding machine design and subsequent mold optimization:



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