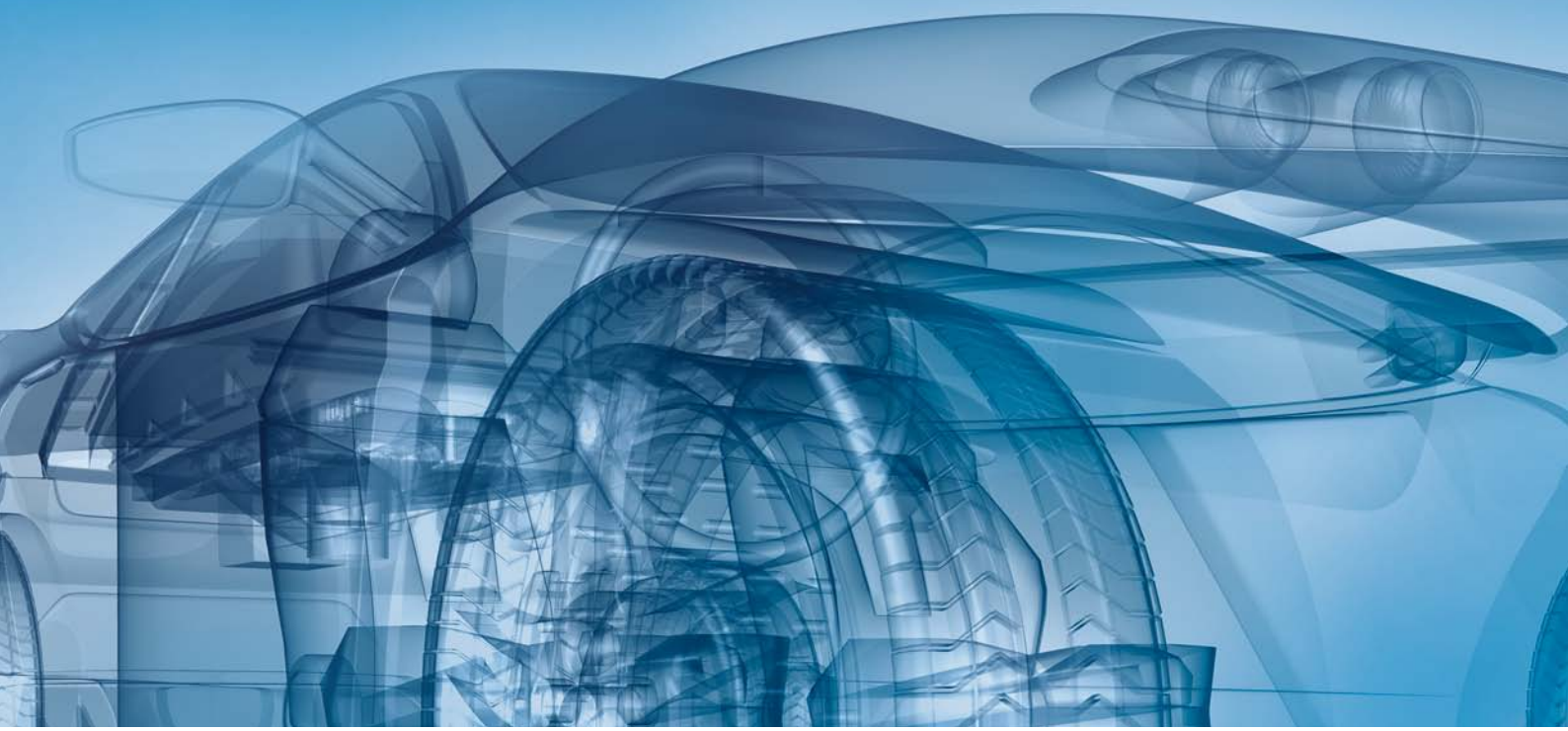
AKROMID® Lite and AKROMID® XtraLite – Lower-Density Polyamide Compounds



AKRO-PLASTIC
Think Polyamide

AKRO-PLASTIC GmbH
Member of the Feddersen Group

For the last 25 years **AKRO-PLASTIC GmbH** has been a developer and manufacturer of high-quality technical compounds specialising in the field of polyamides. The constant demand for weight reduction has resulted in an increase in use of plastics with a lower density, for example polypropylenes. The automotive sector in particular focuses on low-density plastics in its attempt to reduce fleet consumption and carbon dioxide emissions. The properties of polypropylene alone are inadequate which is why technical thermoplastics, e.g. polyamides are used. This is why AKRO-PLASTIC has developed **AKROMID® Lite** and **AKROMID® XtraLite**, a range of compounds with similar properties such as polyamide but with a lower density.

AKROMID® Lite and AKROMID® XtraLite bridge the gap between polypropylene and polyamide. In comparison to polypropylene, **AKROMID® Lite and AKROMID® XtraLite** display a superior surface quality, enhanced mechanical properties and higher heat resistance. In comparison to PA6 compounds, **AKROMID® Lite and AKROMID® XtraLite** score higher in terms of lower density, lower volume price, superior flowability, reduced moisture absorption and enhanced notched impact strength. The objective of the AKROPLASTIC developers was to create a technical polyamide compound with a lower density while maintaining the typical properties of polyamide.

Typical values for black colour material at 23° C	Test Specification	Test Method
Mechanical Properties		
Tensile modulus	1 mm/min	ISO 527-2
Yield stress[1]/Tensile stress at break	5 mm/min	ISO 527-2
Elongation at break	5 mm/min	ISO 527-2
Charpy impact strength	23 °C	ISO 179-1/1eU
Charpy impact strength	-30 °C	ISO 179-1/1eU
Charpy notched impact strength	23 °C	ISO 179-1/1eA
Charpy notched impact strength	-30 °C	ISO 179-1/1eA
Thermal Properties		
Melting point	DSC, 10 K/min	DIN EN 11357-1
Heat distortion temperature, HDT/A	1.8 MPa	ISO 75
Heat distortion temperature, HDT/B	0.45 MPa	ISO 75
Flammability		
Flammability acc.UL 94	0.8 mm	UL 94
Rate acc. FMVSS 302 (< 100 mm/min)	> 1 mm thickness	FMVSS 302
General Properties		
Density	23 °C	ISO 1183
Content reinforcement		ISO 1172
Moisture absorption	70 °C/62 % r.h.	ISO 1110
Processing		
Flowability	Flowspiral[2]	AKRO
Processing shrinkage, flow		ISO 294-4
Processing shrinkage, transverse		ISO 294-4

AKROMID® Lite and AKROMID® Xtra

Unit	B3[1] 1 L black (4525)		B3 GF 15 1 L black (4670)		B3 GF 25 1 L black (4637)		B3 GF 30 1 L black (4365)	
	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.
MPa	2,300	1,200	5,200	3,700	7,500	5,600	8,800	6,800
MPa	55	40	105	65	135	88	140	105
%	45	>50	3.3	5.3	3.3	4.5	3	4.5
kJ/m²	o.B.	o.B.	60	54	68	58	70	67
kJ/m²	o.B.	o.B.	60	60	67	54	56	55
kJ/m²	6	18	10	12	15	15	15	16
kJ/m²	5	4	6	6	13	10	15	13
°C	220		220		220		220	
°C	60		193		198		200	
°C	140		215		217		217	
Class	HB		HB		HB		HB	
mm/min	+		+		+		+	
g/cm³	1.04		1.14		1.22		1.26	
%	0		15		25		30	
%	1.9		1.7		1.5		1.4	
mm	860		1,000		860		715	
%	1.3		0.5		0.3		0.3	
%	1.9		0.9		0.8		0.9	

[1] = yield stress and elongation at break: test speed 50 mm/min
[2] = mould temperature: 80 °C, melt temperature: 270 °C
injection pressure: 750 bar, cross section of flow spiral: 7 mm x 3,5 mm

Lite

B3 GF 40 1 L black (4581)		B3 GK 30 1 L black (4674)		B3 GM 10/20 1 L black (4646)		B3 GF 30 1 XL black (4366)	
d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.
11,000	8,400	3,000	1,600	5,100	3,300	8,200	6,800
160	115	45	28	88	55	115	100
3.2	4.2	6.5	37	3.4	6	3	3.5
70	66	37	74	46	44	48	48
55	55	34	31	43	42	45	42
16	18	3.5	6	7	9	12	13
15	15	2.7	2.3	4	4	13	13
220		220		220		220	
201		66		165		160	
217		145		208		186	
HB		HB		HB		HB	
+		+		+		+	
1.36		1.25		1.26		1.22	
40		30		30		30	
1.2		1.4		1.4		1.0	
650		650		730		785	
0.4		0.7		0.5		0.4	
0.9		1.5		1.2		0.9	

+ = passed
“cond.” test values = conditioned, measured on test specimens stored according to ISO 1110
“d.a.m.” = dry as moulded test values = residual moisture content < 0.10 %

AKROMID® Lite

Unit	A3[1] 1 L black (4652)		A3 GF 15 1 L black (4673)		A3 GF 25 1 L black (4672)		A3 GF 30 1 L black (4436)	
	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.
MPa	2,300	1,300	5,300	4,000	7,500	5,800	8,400	6,700
MPa	54	40	110	75	140	100	150	110
%	30	>50	3.4	5.3	3.1	4.2	3	4.4
kJ/m²	o.B.	o.B.	68	56	75	67	77	70
kJ/m²	o.B.	o.B.	61	61	78	66	68	
kJ/m²	6.5	12	10	11	13	14	15	16
kJ/m²	5.0	4.0	7	7	11	11	12	
°C	262		262		262		262	
°C	65		240		245		246	
°C	150		258		260		260	
Class	HB		HB		HB		HB	
mm/min	+		+		+		+	
g/cm³	1.04		1.14		1.22		1.26	
%	0		15		25		30	
%	1.7		1.5		1.3		1.2	
mm	1,050		1,170		1,150		1,010	
%	2.5		1.0		0.8		0.7	
%	1.8		1.0		1.0		1.0	

[1] = yield stress and elongation at break: test speed 50 mm/min
[2] = mould temperature: 80 °C, melt temperature: 270 °C
injection pressure: 750 bar, cross section of flow spiral: 7 mm x 3,5 mm

A3 GF 40 1 L black (4671)		A3 GF 30 4 L black (4678)		S3 GF 30 1 L black (4657)		B3 GFM 10/20 1 L black (4679)	
d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.
11,800	8,600	8,600		8,200	6,700	5,000	
170	130	150		130	106	80	
2.9	3.8	2.8		3.1	3.8	3.5	
80	73	70		60	56	40	
73	68	63				37	
17	17	16		15	14	15	
17	16	14				15	
262		262		220		220	
246		246		182		156	
260		260		NA		210	
HB		HB		HB		HB	
+		+		+		+	
1.36		1.26		1.23		1.27	
40		30		30		30	
1				0.7			
910							
0.5							
1.0							

+ = passed
“cond.” test values = conditioned, measured on test specimens stored according to ISO 1110
“d.a.m.” = dry as moulded test values = residual moisture content < 0.10 %

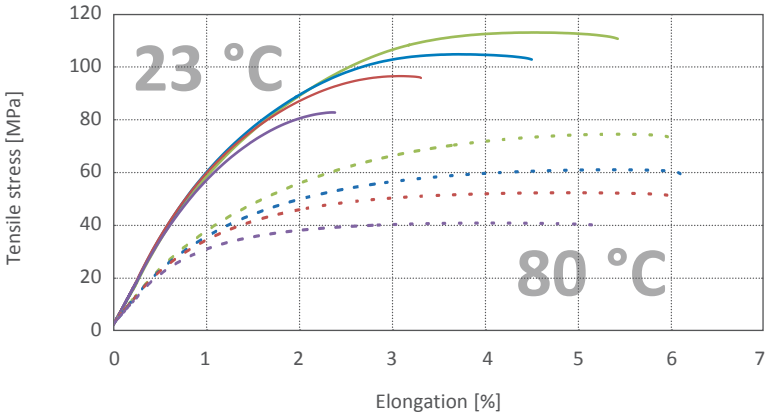
Product characterisation

- B3 GF 30 1 black
- B3 GF 30 1 L black (4365)
- B3 GF 30 1 XL black (4366)
- PP GF 30 black

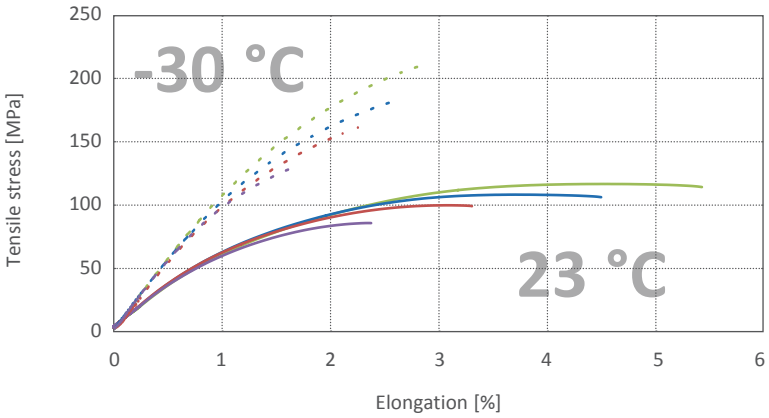
Ageing conditions:	
Temperature:	70 °C
Rel. humidity:	62 %
Ageing period:	500 h

Under a practice-related conditioned state, the resistance of **AKROMID® Lite** and **XtraLite** compounds is within the range of a standard polyamide compound and above a similar PP compound at room temperatures as well as at -30 °C. At average vehicle interior temperatures of +80 °C, the polyamide products are significantly more resistant than a PP-GF30. For use in the engine compartment, an **AKROMID® B3 GF 30 1 L** black (4365) is superior to a B3 GF 30 1 black (PA 6/GF 30) with approx. 2/3 resistance and density reduction of approx. 7 % (Fig. 5) and more constant properties due to the reduced moisture absorption. (Fig. 1 - 3)

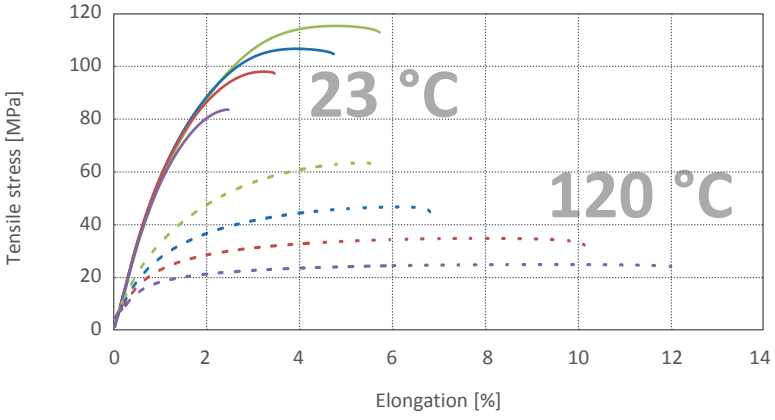
Tensile test at 23 °C and 80 °C – conditioned (Fig. 1)



Tensile test at 23 °C and -30 °C – conditioned (Fig. 2)

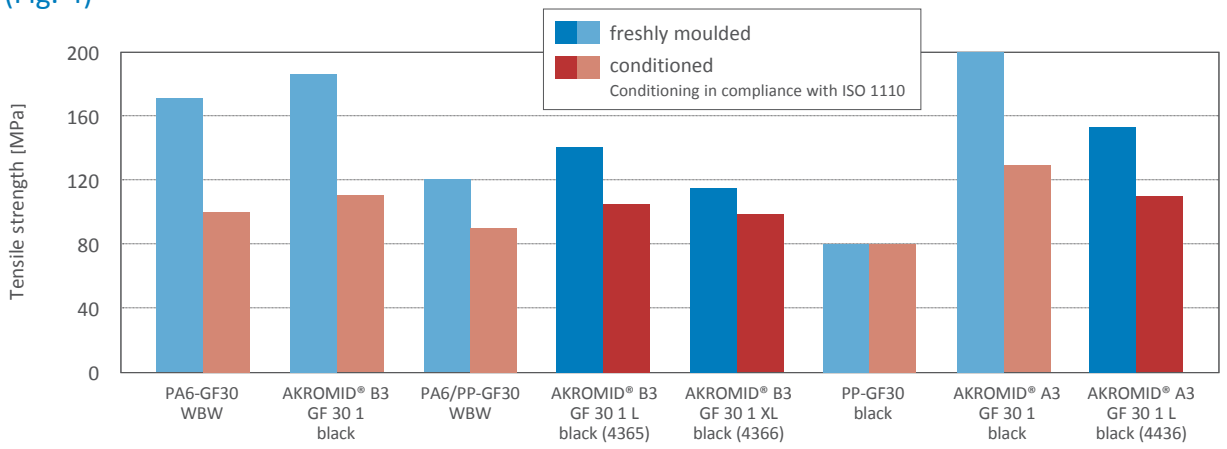


Tensile test at 23 °C and 120 °C – conditioned (Fig. 3)



Resistance comparison [MPa]

(Fig. 4)



Even though a PP-GF30 exhibits the lowest density in the comparative test, its property profile is inadequate for many applications. In such cases, engineers usually use a PP-GF40 which actually exhibits a similar density to **AKROMID® B3 GF 30 1 L** black (4365). Above all, this material is more stable and rigid at room temperature (see Fig. 4).

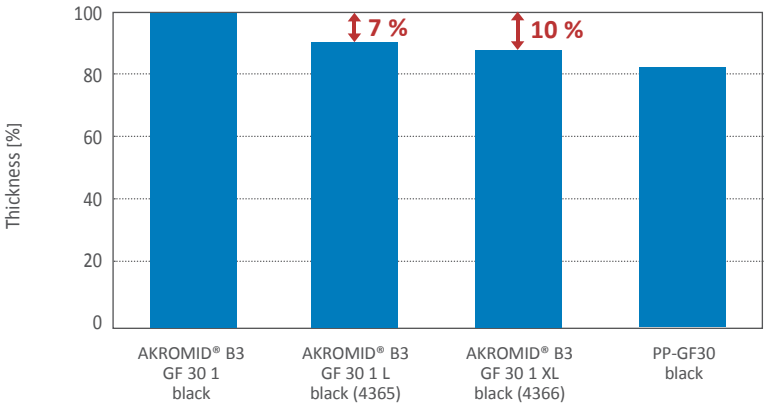
The differences become significantly more evident at higher temperatures where the polyamide-based AKROMID® compounds produce superior results to the PP compounds as shown in the tensile strength-elongation curves (Fig. 1, 2 and 3). In comparison to compounds from PP-based counterparts, a far wider spectrum of use is available for **AKROMID® Lite** and **AKROMID® XtraLite**.

In conditions extremely similar to the practical environment, the resistance of **AKROMID® B3 GF 30 1 L** black (4365) is almost at the same level of an AKROMID® B3 GF 30 1 black and above the average values of PA6-GF30 compounds from the competition (see Fig. 4). The tensile strength of an **AKROMID® B3 GF 30 1 XL** black (4366) is almost the same as that of a competitor PA6-GF30 (abbreviated to „WBW") and is considerably above the tensile strength of another competitor PA/PP blend. The superiority of AKROMID® compound properties in comparison to competitor products lies in the special, sensitive compound technology applied by AKRO-PLASTIC GmbH.

By producing a glass-fibre reinforced PA6/PP, and PA 6.6/PP blend, this not only reduces the density of the material-based compound, the impact of conditioning on the mechanical properties is minimised significantly (see Fig. 4). This results in a more constant property profile and offers engineers enhanced product design safety.

Density benefit of AKROMID® Lite and XtraLite

(Fig. 5)



Product characterisation

The chemical resistance of **AKROMID® B3 GF 30 1 L** black (4365) and **AKROMID® B3 GF 30 1 XL** black (4366) is particularly superior to calcium chloride ($CaCl_2$) and likewise **AKROMID® A3 GF 30 1 L** black (4436) exhibits better chemical resistance than zinc chloride ($ZnCl_2$). Among other uses, $CaCl_2$ is used in road salt to lower the freezing point and as a dust-binding agent. The chemical reaction between zinc parts and salt can form $ZnCl_2$. Polyamide 6 and 6.6 compounds are aggressively corroded by the materials listed above which, in extreme cases, can severely impair a part's functioning.

Although AKROMID® B3 GF 30 1 black test specimens exhibit significant damage after immersion in $CaCl_2$ solution (in accordance with DBL 5416), the tension rods made of **AKROMID® B3 GF 30 1 L** black (4365) successfully pass the test. No noticeable change is witnessed with **AKROMID® B3 GF 30 1 XL** black (4366) (see Fig. 6).

Fig. 6: Tension rods made from various AKROMID® compounds after immersion in $CaCl_2$ (in accordance with DBL 5416).

Fig. 7: Significant damage to test specimens made from standard PA6.6-GF30 after just 2 hours immersed in $ZnCl_2$ solution

The results of the $ZnCl_2$ resistance comparison are even more alarming. The state of a standard PA6.6-GF30 deteriorates drastically after just a few hours contact with $ZnCl_2$ solution (see Fig. 7). In contrast, **AKROMID® A3 GF 30 1 L** black (4436) test specimens exhibit no damage even after 200 hrs of exposure to the mechanical load of $ZnCl_2$ in compliance with the SAE standard J2044 (see Fig. 8).

Fig. 8: No material damage of **AKROMID® A3 GF 30 1 L** black (4436) even after 200 hours immersed in $ZnCl_2$ solution

A special hydrolysis-stabilised **AKROMID® A3 GF 30 4 L** black (4678) passed the requirements of the VW TL 52682 with distinction (status: May 2011). This test stipulates a bending strength of at least 25 MPa after immersion in coolant G12++ for between 500 and 1000 hours in compliance with TL 774-G. The values achieved by **AKROMID® A3 GF 30 4 L** black (4678) are considerably higher than this brand (see Fig. 9).

The reasons for the excellent ratings in terms of chemical resistance of **AKROMID® B3 GF 30 1 L** black (4365), **AKROMID® B3 GF 30 1 XL** black (4366) and **AKROMID® A3 GF 30 1 L** black (4436) are the special combination of compounds as well as the sensitive compounding process.

The user can thus profit from the following key benefits:

- **Higher resistance in comparison to PP compounds**
- **Approx. 7 – 10 % weight reduction in comparison to PA compounds**
- **Outstanding chemical resistance in comparison to:**
  - $ZnCl_2$
  - $CaCl_2$
  - Coolants (hydrolysis)

These and other benefits open up a wide range of applications for **AKROMID® Lite** and **AKROMID® XtraLite**: not only for the automotive industry (cable ducts, fan shrouds, fan wheels, radiator tanks, toothed belt covers, controls, cup holders, handles etc.) but also for industrial applications (casings and covers, sleeves, guide rails etc.) or for the electrical and electronic sector (controls, switches, sensor housings etc.).

Resistance against coolant G12++ (Fig. 9)

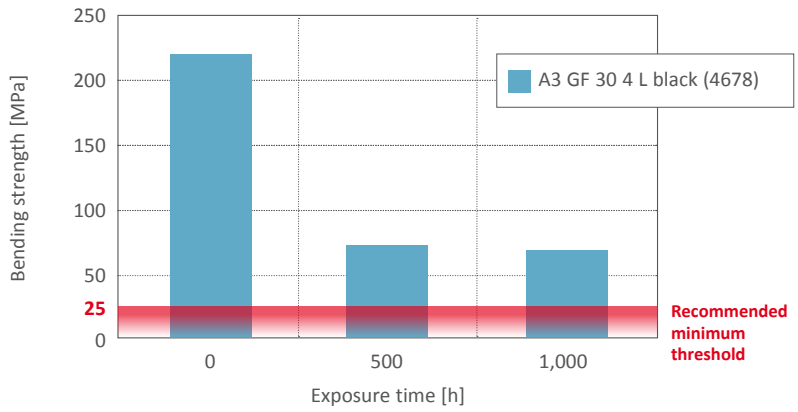
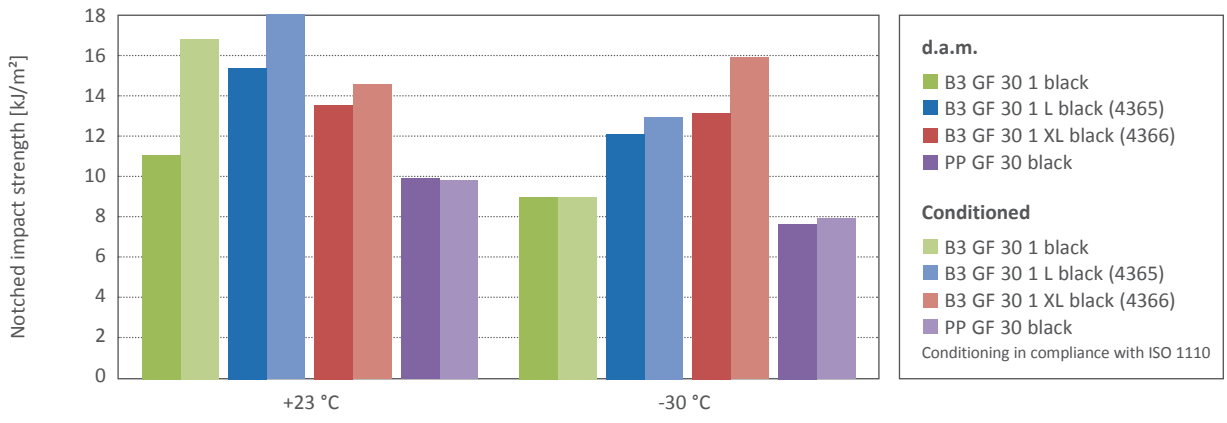


Fig. 9: Resistance against coolant G12++ in accordance with VW TL 52682. The amount is far above the recommended minimum threshold.

Notched impact strength (Fig. 10)

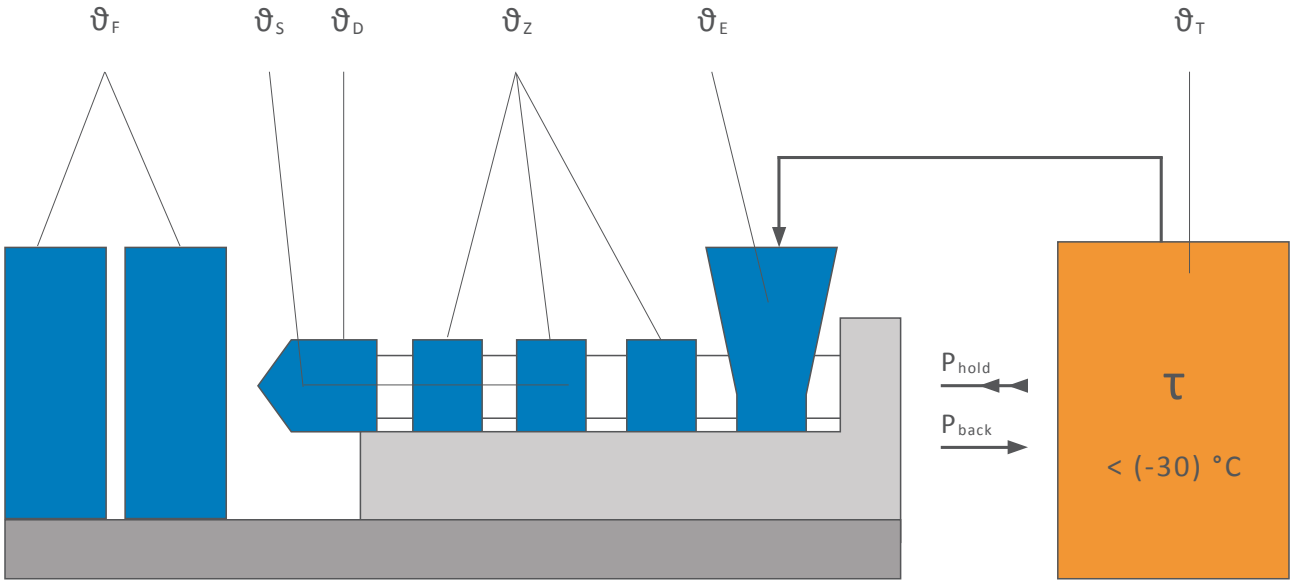


In terms of notched impact strength, an important property for part design, **AKROMID® B3 GF 30 1 L** black (4365) exceeds the values of a B3 GF 30 1 black (PA 6 GF 30) not just in a dry state but also when conditioned.

The B3 GF 30 1 XL black (4366) exhibits its strengths especially at low temperatures (see Fig. 10).

Processing recommendations

AKROMID® B3 GF XX* 1 L, **AKROMID® B3 GF XX* 1 XL** and **AKROMID® A3 GF XX* 1 L** can be processed on commercially available injection moulding machines with standard screws according to the recommendations of the machine manufacturer. Please refer to the tables below for our recommended machine, tool and dryer settings (see diagram):



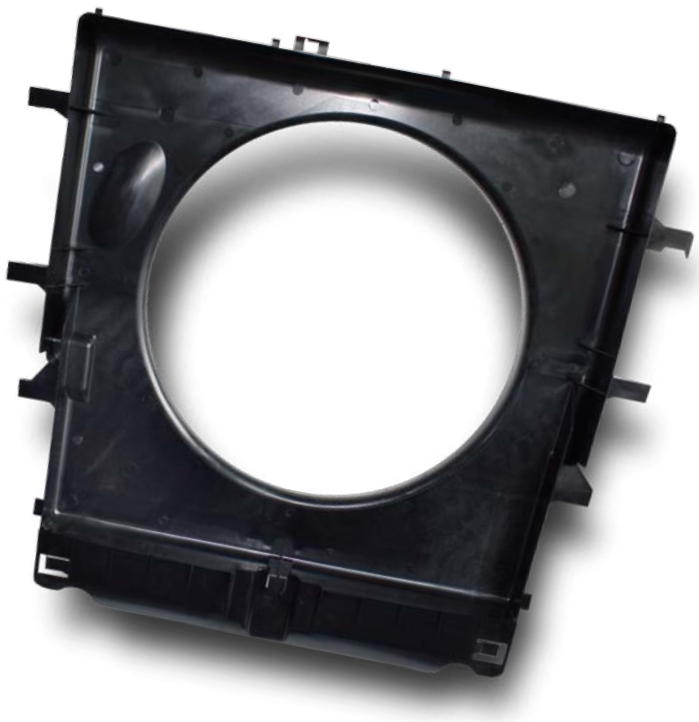
		AKROMID® B3 GF XX* 1 L + XL	AKROMID® A3 GF XX* 1 L
Feed section	ϑ_E	60 – 80 °C	60 – 80 °C
Sector 1 – Sector 4	ϑ_Z	220 – 280 °C	230 – 295 °C
Nozzle	ϑ_D	260 – 275 °C	270 – 290 °C
Melt temperature	ϑ_S	260 – 280 °C	270 – 295 °C
Mould surface	ϑ_F	70 – 100 °C	70 – 100 °C
Drying	ϑ_τ	80 °C, up to 2 h	80 °C, up to 2 h
Holding pressure, spec.	P_{hold}	300 – 800 bar	300 – 800 bar
Back pressure, spec.	P_{back}	50 bar	50 bar

The specified values are for reference values. For increasing filling contents the higher values should be used.
For drying, we recommend using only dry air or a vacuum dryer. Processing moisture levels between 0.02 and 0.1 % are recommended.
The drying time of freshly-opened bags is up to 4 h. It is recommended to use opened bags completely.
Material processed from silo or boxes requires a minimum drying time of 4 h.

XX* = 0 – 40 %

Applications

Based on the characteristic features and technical properties, the scope of applications can include the following:



Automotive applications:

Engine compartment
- Cable ducts
- Cable brackets
- Fan shrouds
- Fan wheels
- Engine covers
- Intake manifolds
- Toothed belt covers

Exterior
- Rear window release handles
- Door handles
- Side mirror casings

Interior
- Airbag components
- Controls
- Cup holders
- Glove compartment handles
- Air duct holders
- Multifunction switches
- Switch housings
- Seat adjustment lever
- Sun visor axles
- Handle brackets
- Transmission housings

Industrial applications:

Universal
- Guide rails
- Casings and covers
- Handles and levers
- Sleeves
- Furniture fittings
- Hubs for lawnmowers
- Energy chains

Electrics/electronics
- Controls
- Switches
- Sensor housings
- Coil bodies
- Connectors
- Multipoint connectors

Property	PA6 or PA6.6	AKROMID® Lite	AKROMID® XtraLite	PP
Density	0	+	+ +	+++
Volume price	+	++	++	+++
Flowability	+	++	+++	+++
Notched impact strength	+	++	++	++
Cold impact strength	++	++	+	0
Surface quality (sink marks)	++	++	+	0
Warpage	++	+	+	0
Stability	+	+	+	0
Heat resistance	++	+	0	-
Resistance to moisture absorption	0	+	++	+++
Chemical resistance	+	++	++	+++
Processing	++	++	++	++

We will be pleased to meet you!

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