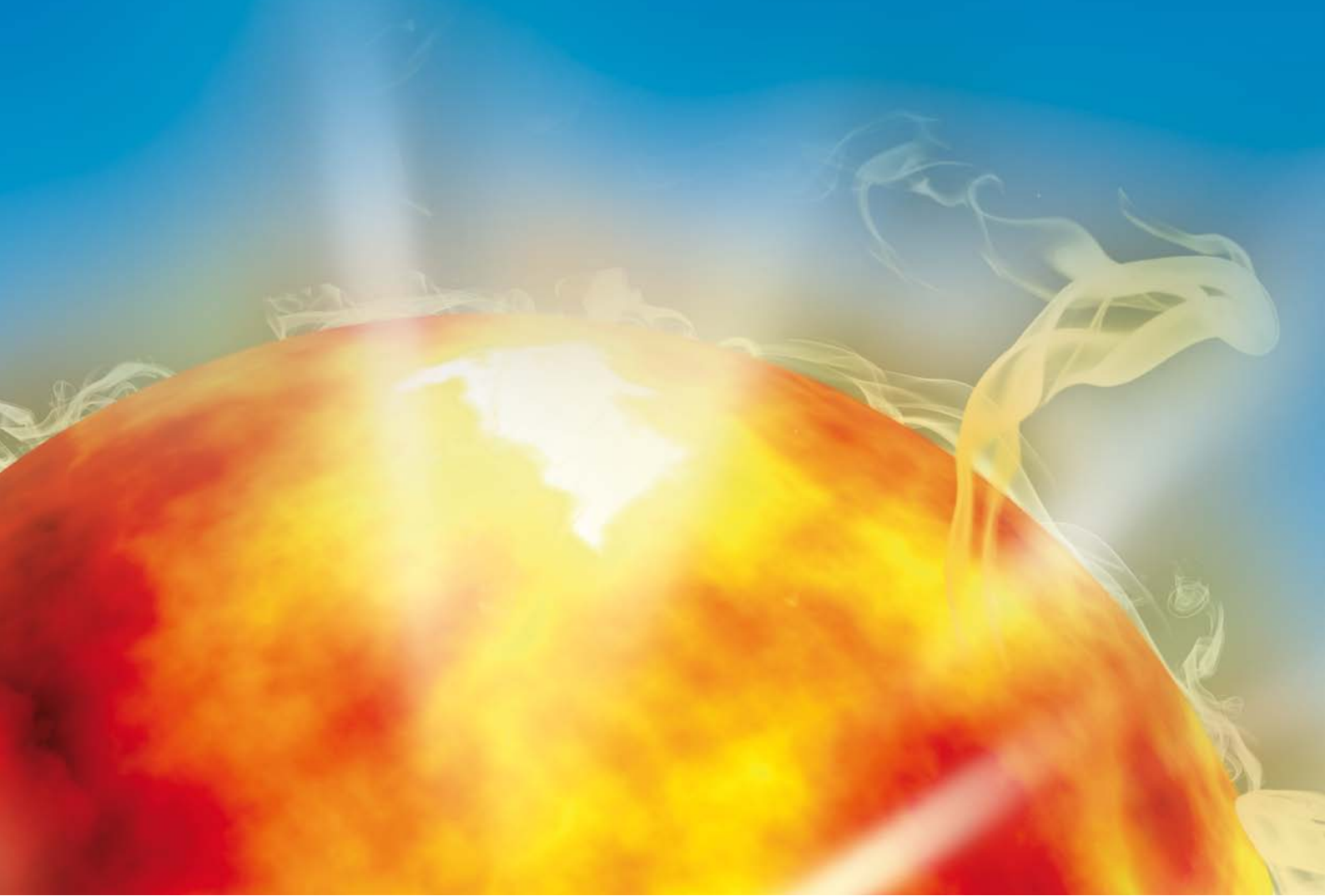


AKROMID® T – New high-temperature materials based on PPA



AKRO-PLASTIC 
Think Polyamide

AKRO-PLASTIC GmbH
Member of the Feddersen Group

Ever higher demands for cost and weight reductions have made metal substitution a much-discussed topic for years in many industries. In the automotive industry, it has already become standard practice to substitute engineering plastics for die casting; now, in sanitary installations and general mechanical engineering, this has begun to emerge as a feasible solution as well. The key benefit: the moulded part is formed in only one step and immediately undergoes further processing, resulting in significantly lower production costs per component.

At AKRO-PLASTIC GmbH, we are fully committed to keeping pace with these increasing requirements. That is why we have developed AKROMID® T, a new high temperature-resistant, polyphthalamide (PPA)-based material used specifically in applications where metal was traditionally used. From the very outset, one of our primary objectives was to modify polyamides for higher performance.

In the overview at right and on the following pages, you will find technical data and possibilities for a whole host of technically innovative applications.

Typical values for black colored products at 23 °C	Test Specification	Test Method
Mechanical Properties		
Tensile modulus	1 mm/min	ISO 527-1/2
Tensile stress at break	5 mm/min	ISO 527-1/2
Elongation at break	5 mm/min	ISO 527-1/2
Flexural modulus	2 mm/min	ISO 178
Flexural strength	2 mm/min	ISO 178
Flexural strain at break	2 mm/min	ISO 178
Charpy impact strength	23 °C	ISO 179/1eU
Charpy impact strength	-30 °C	ISO 179/1eU
Ball indentation hardness	HB 961/30	ISO 2039-1
Electrical Properties		
Comparative Tracking Index, CTI	Test solution A	IEC 60112
Thermal Properties		
Melting point	DSC, 10 K/min	ISO 11357-1
Heat distortion temp., HDT/A	1.8 MPa	ISO 75-1/2
Heat distortion temp., HDT/B	0.45 MPa	ISO 75-1/2
Heat distortion temp., HDT/C	8 MPa	ISO 75-1/2
Temp. index for 50 % loss of tensile strength	5,000 h	IEC 216
Temp. index for 50 % loss of tensile strength	20,000 h	IEC 216
Flammability		
Flammability acc. to UL 94	0.8 mm	UL 94
Burning rate acc. to (< 100 mm/min)	> 1 mm thickness	FMVSS 302
General Properties		
Density	23 °C	ISO 1183
Reinforcement content		ISO 1172
Moisture absorption	70 °C/62 % r.h.	ISO 1110
Processing		
Processing shrinkage, flow		ISO 294-4
Processing shrinkage, transverse		ISO 294-4



AKROMID® T Series (Polyphthalamide)

Unit	T1 GF 30 (3466)		T1 GF 40 (3464)		T1 GF 50 (3101)		T1 GF 30 9 (3498)		T1 GF 40
	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.
MPa	12,500	12,000	15,500	15,500	20,000	20,000	12,000	12,000	15,000
MPa	215	200	260	230	270	255	210	190	250
%	2.2	2.2	2.4	2.1	2	2	2.4	2.3	2.4
MPa	11,000		14,500		18,000		11,000		14,500
MPa	300		345		380		300		360
%	3		2.7		2.4		3		2.9
kJ/m ²	60		75		90	85	50		70
kJ/m ²	45		60		70		45		55
MPa	290		330		360		270		310
	d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.
	600		600		600		600		600
°C	313		313		313		308		308
°C	285		285		285		275		275
°C	310		310		310				
°C	165		205		230		165		195
°C	170 - 180		170 - 180		170 - 180		150 - 160		150 - 160
°C	150 - 160		150 - 160		150 - 160		130 - 140		130 - 140
Classification	HB		HB		HB		HB		HB
mm/min	+		+		+		+		+
g/cm ³	1.40		1.50		1.62		1.42		1.52
%	30		40		50		30		40
%	1.25		1.10		0.85		1.30		1.10
%	0.4		0.2		0.3				0.3
%	0.9		0.8		0.7				0.8

+ = passed

"cond." test values = conditioned, measured on test specimens stored according to ISO 1110



9 (3499)		T1 GF 50 9 (3257)		T6 GF 30 (3501)		T6 GF 40 (3500)		T6 GF 50 (3106)	
cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.
15,000	19,500	18,500	11,000	10,500	13,000	13,000	17,000	17,000	
220	290	250	200	180	240	205	270	230	
2.1	2.1	2.1	2.2	2.5	2.5	2.4	2.5	2.2	
	17,000		10,500				17,000		
	390		285				390		
	2.6		3.0				2.7		
	90		50		70		85		
	80		45		60		75		
	340								
d.a.m.	d.a.m.		d.a.m.		d.a.m.		d.a.m.		
600	600		600		600		600		
308	308		304		304		304		
275	275		290		290		290		
195	205		225		240		250		
150 - 160	150 - 160		150 - 160		150 - 160		150 - 160		
130 - 140	130 - 140		130 - 140		130 - 140		130 - 140		
HB	HB		HB		HB		HB		
+	+		+		+		+		
1.52	1.62		1.50		1.51		1.65		
40	50		30		40		50		
1.10	0.95		1.35		1.15		0.95		
0.3	0.2						0.3		
0.8	0.7						0.7		

"d.a.m." = dry as moulded test values = residual moisture content < 0.10 %

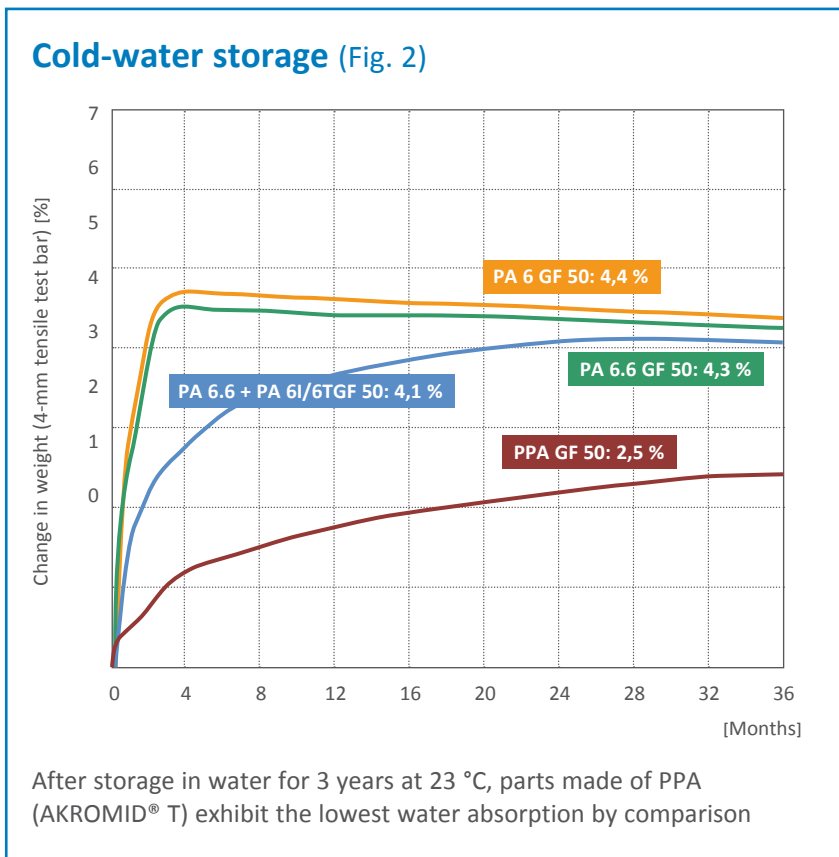
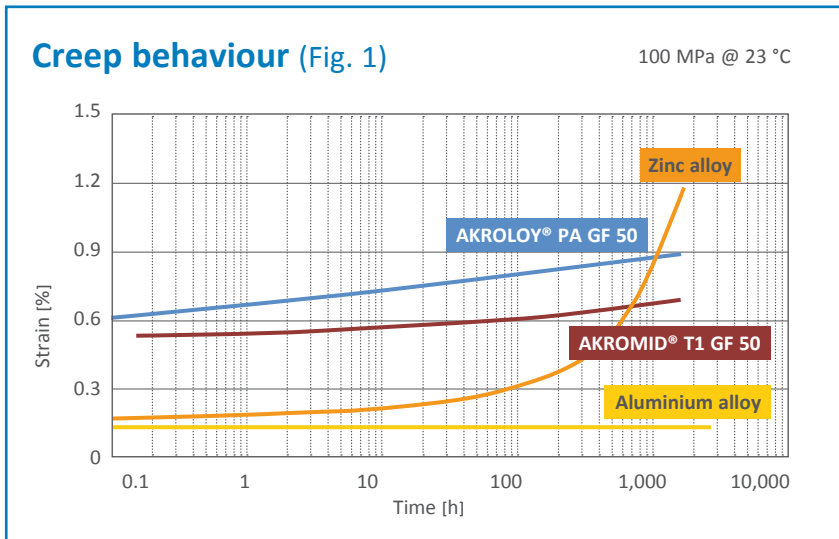
Product Characterisation

The new AKROMID® T is characterised primarily by high heat resistance and the lowest moisture absorption of the three PA grades (PA 6, PA 6.6, PPA). This makes it particularly well-suited in the automotive sector for high-temperature applications in the engine compartment and in machine building for components subjected to high mechanical loads. It easily maintains its high initial stability even at temperatures of up to 140 °C and also exhibits minimal creep, which is further enhanced by extremely low moisture absorption.

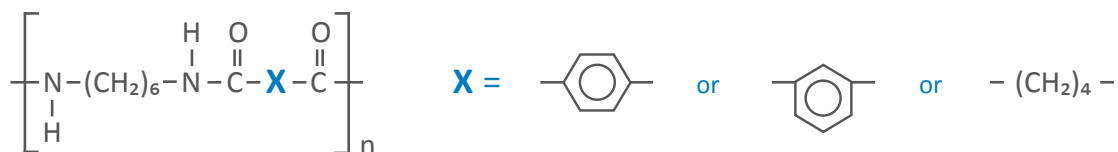
(Fig. 1, Fig. 2)

With AKROMID® T, AKRO-PLASTIC has developed a product line of different PPA compounds (polyphthalamides) to meet a wide range of technical requirements, including easy processability. PPA means that a partially aromatic polyamide block such as a PA 6T is found in the polymer chain. The chemical structure is based on a reaction between aliphatic diamines, e.g. hexamethylenediamine, usually with aromatic dicarboxylic acids such as terephthalic or isophthalic acid, but also aliphatic dicarboxylic acids such as adipic acid.

(Fig. 3)



AKROMID® T – Chemical structure (Fig. 3)



**AKROMID® T1:**

Maximum stiffness and high heat resistance,

$T_g = 130^\circ\text{C}$

AKROMID® T6:

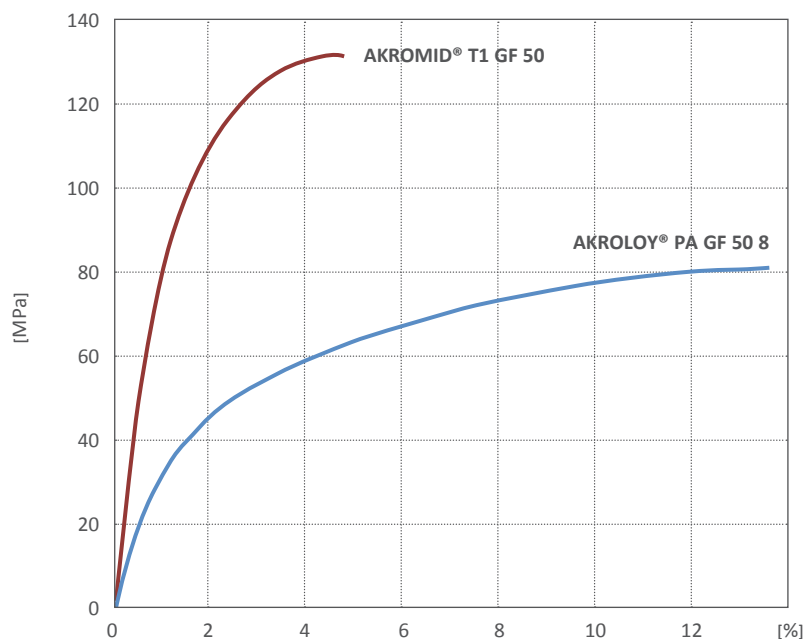
Maximum heat distortion temperature with easy processability, lowest creep behaviour at 150°C ,

$T_g = 95^\circ\text{C}$

AKROMID® T1 “9”:

Process-optimized PPA compounds,

$T_g = 100^\circ\text{C}$

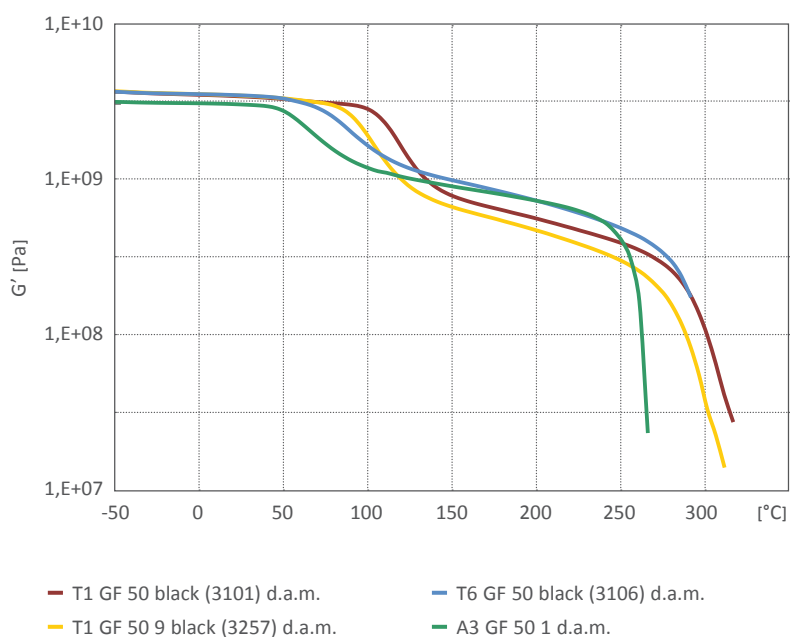
Stress-strain curves at 120°C (Fig. 4)

The partially aromatic component ensures increased heat and chemical resistance in particular, as well as reduced moisture absorption. (Fig. 2, Fig. 4)

The material can be combined with other PPA and PA blocks to produce a range of technical properties, resulting in differences in the glass transition T_g and shear modulus (Fig. 5).

Under specific ambient conditions (short-term stress), AKROMID® T6 in particular can also be used in applications above 150°C , as is evident from the shear modulus (Fig. 5).

Modification of the base grades has also made the material suitable for applications requiring a high-quality surface finish.

Shear modulus characteristics (Fig. 5)

A further key advantage over PA 6 or PA 6.6 is demonstrated in the significantly improved chemical and hydrolytic resistance. In combination with the aforementioned mechanical properties, the material becomes an ideal solution for difficult applications in industrial pumps and fluid filters. Its low water absorption over extended periods is yet another advantage in this regard (Fig. 2).

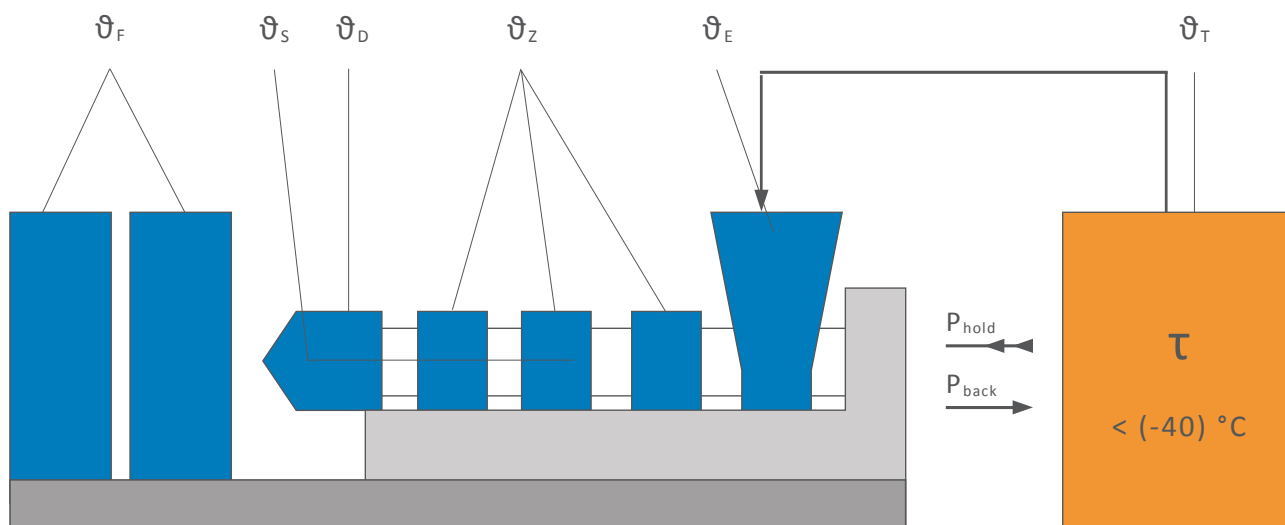


Processing Recommendations

AKROMID® T1, T1 “9” and T6 can be processed on commercially available injection moulding machines with standard screws according to the recommendations of the machine manufacturer. Please refer to the diagram below for our recommended machine, mould and dryer settings:

Bagged-product processing: Undamaged bags with the original seals intact can generally be processed without pre-drying.

Excessive drying can result in filling and surface problems; processing below a residual moisture content of 0.02 % is therefore not recommended.



		AKROMID® T1	AKROMID® T6	AKROMID® T1 “9”
Feed section	ϑ_E	80 – 95 °C	80 – 95 °C	80 – 95 °C
Sector 1	ϑ_Z	315 – 325 °C	310 – 320 °C	310 – 320 °C
Sector 2	ϑ_Z	320 – 330 °C	315 – 325 °C	315 – 325 °C
Sector 3 /4	ϑ_Z	325 – 340 °C	320 – 335 °C	320 – 335 °C
Nozzle	ϑ_D	325 – 335 °C	320 – 330 °C	320 – 330 °C
Melt temperature	ϑ_S	330 – 340 °C	325 – 340 °C	325 – 340 °C
Mould surface	ϑ_F	135 – 160 °C	95 – 140 °C	100 – 130 °C
Drying, temperature	ϑ_τ	90 °C	90 °C	90 °C
Drying, time	ϑ_τ	2 – 16 h	2 – 16 h	2 – 16 h
Drying, moisture	ϑ_τ	< 0.1 %	< 0,1 %	< 0,1 %
Holding pressure, spec.	P_{hold}	300 – 800 bar	300 – 800 bar	300 – 800 bar
Back pressure, hydr.	P_{back}	2.0 – 6,5 bar	2.0 – 6.5 bar	2.0 – 6.5 bar

The specified values are reference values. For increasing filling contents the higher values should be used. For drying, we recommend using only drying air or a vacuum dryer.



Applications

Based on the characteristic features and technical properties shown, the following applications are possible:

Automotive sector

- Cooling system (thermostat housing, connectors, etc.)
- Parts in the oil circuit (tensioner bases, etc.)
- Parts in the brake system (valve bodies, etc.)
- Clutch components (central clutch release bearing, etc.)
- Air ducting parts (side pieces for charge-air coolers, control shafts, etc.)
- Parts subjected to high loads in the interior (centre armrest, etc.)



Resistance to Media

The information on chemical resistance are subjective ratings based on resistance experiments according to standards ISO 175, ISO 11403-3, ISO 4599, ISO 4600, ISO 6252 etc. The information is intended for an initial assessment only.

Resistant means:

Unrestricted resistance under the specified conditions.

Not resistant means:

In spite of short-term resistance the material may be damaged, in case of prolonged contact there will be quickly visible chemical degradation.

In any case, AKROMID® intended for use with one of the listed media may only be used after practical testing.

Medium	Temp. (°C)	Conc. (%)
Acetone	23	100
Formic acid	23	100
Petrol	23	100
Diesel fuel (DIN 51601)	23	100
Acetic acid	23	100
Ethylene glycol/water	120	50
Ethanol	23	96
Urea, aqueous	23	20
Hydraulic oil	23	100
Isopropanol	23	100
Kerosene	23	100
Cresol	23	100
Methanol	23	100
Engine oil	23	100
Phenol	23	100
Sulphuric acid	23	96
Silicone oil	23	
Toluene	23	100
Water	23	100
Xylene	23	100
Zinc chloride, aqueous	23	50

Disclaimer: All specifications and information given in this brochure are based on our current knowledge and experience. A legally binding promise of certain characteristics or suitability for a concrete individual case cannot be derived from this information. The information supplied here is not intended to release processors and users from the responsibility of carrying out their own tests and inspections in each concrete individual case. AKRO®, AKROMID®, AKROLEN®, AKROLOY® and AKROTEK® are registered trademarks of the Feddersen Group.

Electrical engineering

- Mobile telephone parts (chip carrier, etc.)
- Coil formers
- Motor parts (brush holders, etc.)
- Plugs and connectors
- Bulb and LED sockets

Industry and household

- Heating systems (fan housings, etc.)
- Components for coffee machines (grades compliant with KTW – German recommendation for polymers in drinking-water systems)
- Water meters and water filters (KTW-compliant, hot water)
- Pump systems (misc. functional parts)

pass	fail
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Summary:

T1	
Chemical resistance	+++
Creep behaviour at 80 °C	+++
Creep behaviour at 120 °C	+++
Creep behaviour at 150 °C	+
Water absorption rate	+++
Stiffness and strength, conditioned	+++
Stiffness and strength at 80 °C	+++
Stiffness and strength at 120 °C	+++
Stiffness and strength at 150 °C	+ to ++
Heat ageing behaviour	+++
Surface quality	+ to ++
Processing behaviour	+
Impact strength/toughness	+ to ++
T6	
Chemical resistance	++
Creep behaviour at 80 °C	++
Creep behaviour at 120 °C	++
Creep behaviour at 150 °C	+++
Water absorption rate	++ to +++
Stiffness and strength, conditioned	+++
Stiffness and strength at 80 °C	++
Stiffness and strength at 120 °C	++
Stiffness and strength at 150 °C	+++
Heat ageing behaviour	+++
Surface quality	+
Processing behaviour	+ to ++
Impact strength/toughness	+ to ++
T1 "9"	
Chemical resistance	++
Creep behaviour at 80 °C	++ to +++
Creep behaviour at 120 °C	+
Creep behaviour at 150 °C	+
Water absorption rate	++ to +++
Stiffness and strength, conditioned	++ to +++
Stiffness and strength at 80 °C	++ to +++
Stiffness and strength at 120 °C	+
Stiffness and strength at 150 °C	+
Heat ageing behaviour	++
Surface quality	++
Processing behaviour	++
Impact strength/toughness	+ to ++

We will be pleased to meet you!

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