

# AKROLOY® PA – New opportunities for design in plastics



AKROMID® A AKROLEN® AF-Color® AKROMID® S AKROLOY®  
AKROMID® S AF-Color® AKROLOY® AKROMID® T AF-Carbon® AKROMID® B AF-Complex® AKROLEN® AKROMID® A AF-

# AKROLOY® PA Series (PA 6.6 + PA 6I/6T reinforced)

## AKROLOY® PA – the alternative for innovative products made from engineering plastics

The subject of metal substitution, based on the demand for cost and weight reductions, has been discussed for many years in many sectors of the industry. In the last 10 years special synthetic materials have begun to emerge as a feasible solution as a substitute for metal die-casting, particularly in the automotive industry, but also in sanitary installations and general machine building.

In order to fulfill those requirements AKRO PLASTIC GmbH has developed the new innovative product AKROLOY PA® – a special blend – based on PA 6.6.

The table at right and the information on the following pages demonstrate the technical data and possibilities for many innovative applications that in the future may be implemented in designs using engineering plastics instead of metal.

<sup>1</sup> = mould temperature: 100 °C  
melt temperature: 320 °C  
injection pressure: 750 bar  
cross section of flow spiral: 7 mm x 3.5 mm

+ = passed

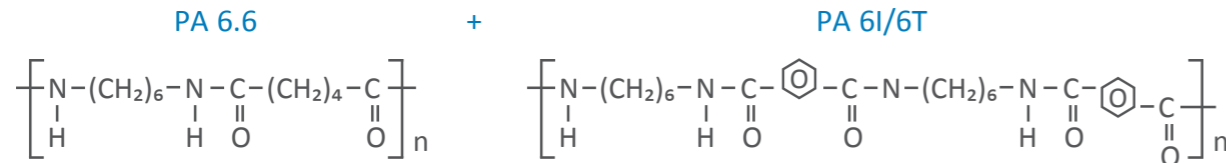
"cond." test values = conditioned, measured on test specimens stored according to ISO 1110

"dry as moulded" test values = residual moisture content < 0.10 %

Typical values for black colored products at 23 °C	Test Specification	Test Method	Unit	PA GF 30 (2718)	PA GF 40 (2845)	PA GF 50 (2706)	PA GF 60 (2844)				
<b>Mechanical Properties</b>				d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.
Tensile modulus	1 mm/min	ISO 527-1/2	MPa	10,500	10,000	13,000	12,000	17,500	16,500	21,000	20,000
Tensile stress at break	5 mm/min	ISO 527-1/2	MPa	210	180	230	200	250	220	275	245
Elongation at break	5 mm/min	ISO 527-1/2	%	3	3	3	3	3	3	2.5	2.5
Flexural modulus	2 mm/min	ISO 178	MPa	9,300		12,000		16,400		20,000	
Flexural stress	2 mm/min	ISO 178	MPa	265		325		380		405	
Charpy impact strength	23 °C	ISO 179/1eU	kJ/m <sup>2</sup>	80	80	95	90	105	100	100	95
Charpy impact strength	-30 °C	ISO 179/1eU	kJ/m <sup>2</sup>	65		80		95		90	
Charpy notched impact strength	23 °C	ISO 179/1eA	kJ/m <sup>2</sup>	11	10	14	14	17	17	16	16
Charpy notched impact strength	-30 °C	ISO 179/1eA	kJ/m <sup>2</sup>	10		13		15		14	
Ball indentation hardness	HB 961/30	ISO 2039-1	MPa	240		265		290		330	
<b>Electrical Properties</b>											
Volume resistivity		IEC 60093	Ohm x cm					9.1 E13			
Surface resistivity		IEC 60093	Ohm					1.5 E17			
Comparative tracking index, CTI	Test solution A	IEC 60112		600		600		600		600	
Permittivity	1 MHz	IEC 60250						4.42			
<b>Thermal Properties</b>				d.a.m.		d.a.m.		d.a.m.		d.a.m.	
Melting point	DSC, 10 K/min	ISO 11357-1	°C	255		255		255		255	
Heat distortion temperature, HDT/A	1.8 MPa	ISO 75-1/2	°C	215		220		225		225	
Heat distortion temperature, HDT/B	0.45 MPa	ISO 75-1/2	°C	245		245		245		245	
CLTE, flow	23 °C – 80 °C	ISO 11359-1/2	10 <sup>-4</sup> /K	0.20		0.15		0.15		0.15	
CLTE, transverse	23 °C – 80 °C	ISO 11359-1/2	10 <sup>-4</sup> /K	0.75		0.70		0.65		0.55	
Temp.index for 50 % loss of tens.strength	5,000 h	IEC 216	°C	140 – 150		140 – 150		140 – 150		140 – 150	
Temp.index for 50 % loss of tens.strength	20,000 h	IEC 216	°C	110 – 130		110 – 130		110 – 130		110 – 130	
<b>Flammability</b>											
Flammability acc.UL 94	0.8 mm	UL 94	Classification	HB		HB		HB		HB	
Rate acc. FMVSS 302 (<100 mm/min)	> 1 mm thickness	FMVSS 302	mm/min	+		+		+		+	
<b>General Properties</b>											
Density	23 °C	ISO 1183	g/cm <sup>3</sup>	1.38		1.48		1.59		1.72	
Reinforcement content		ISO 1172	%	30		40		50		60	
Moisture absorption	23 °C/50 % r.F.	ISO 1110	%	1.55		1.30		1.05		0,80	
Water absorption	23 °C/satur.	ISO 62	%	4.5 – 5		4 – 4.5		3.5 – 4		3 – 3.5	
<b>Processing</b>											
Flowability	Flow spiral <sup>1</sup>	AKRO	mm	757		664		536		468	
Processing shrinkage, flow		ISO 294-4	%	< 0.1		< 0.1		< 0.3		< 0.3	
Processing shrinkage, transverse		ISO 294-4	%	0.6		0.6		0.5		0.5	

# Product Characterisation

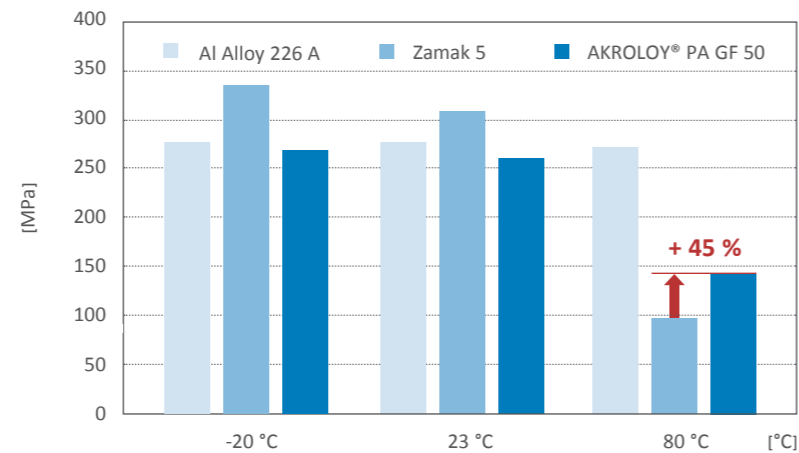
## AKROLOY® PA



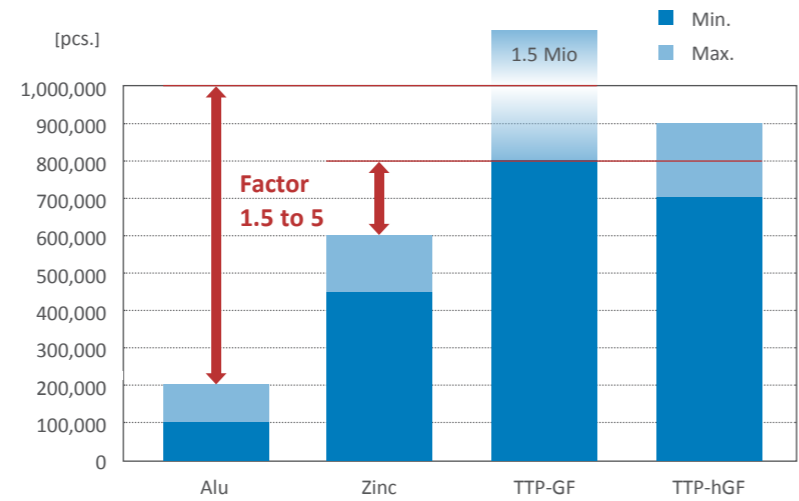
One of the most characteristic properties of polyamide (PA 6.6) is the absorption of moisture. This essentially leads to increased toughness and elongation at break, to name the most important parameters. On the other side, there are important diminished design properties, such as rigidity, strength and creep modulus. It is also clear that the water molecules diffused into the polymer require a certain space, so that the dimensional stability suffers, as well.

Applications that up to now have been manufactured of die-cast metals, usually involve extremely high demands on synthetic materials, running contrary to the above mentioned disadvantages. Even high levels of reinforcement in standard polyamides on the basis of PA 6 or PA 6.6 with, for example, 50 % or 60 % glass fibres, still exhibit drastic changes in mechanical characteristics.

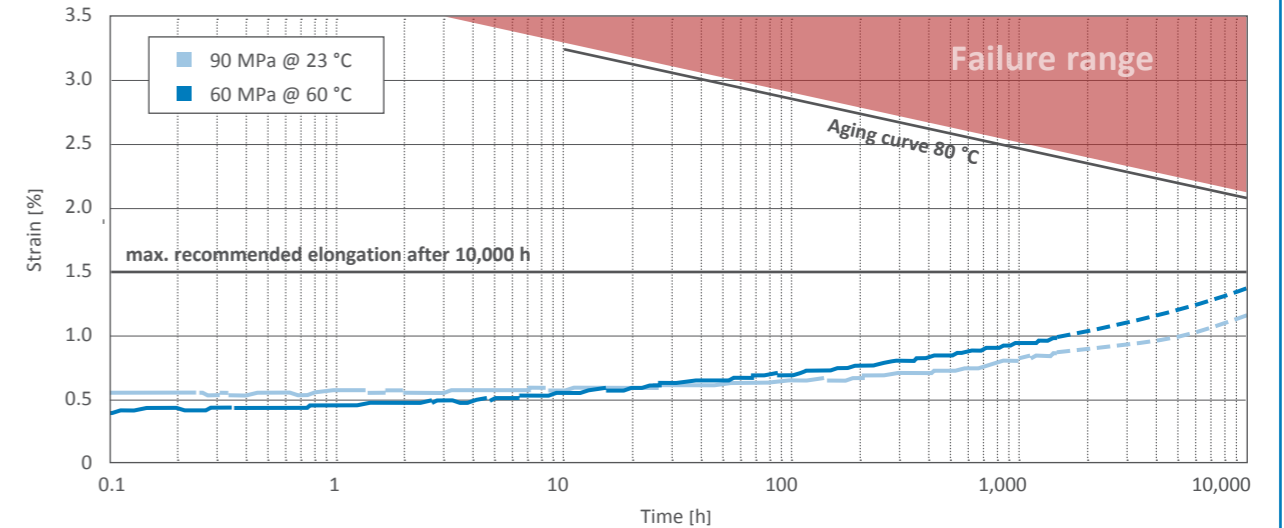
### Comparison of tensile strength with metal alloys



### Comparison of mould output with metal alloys

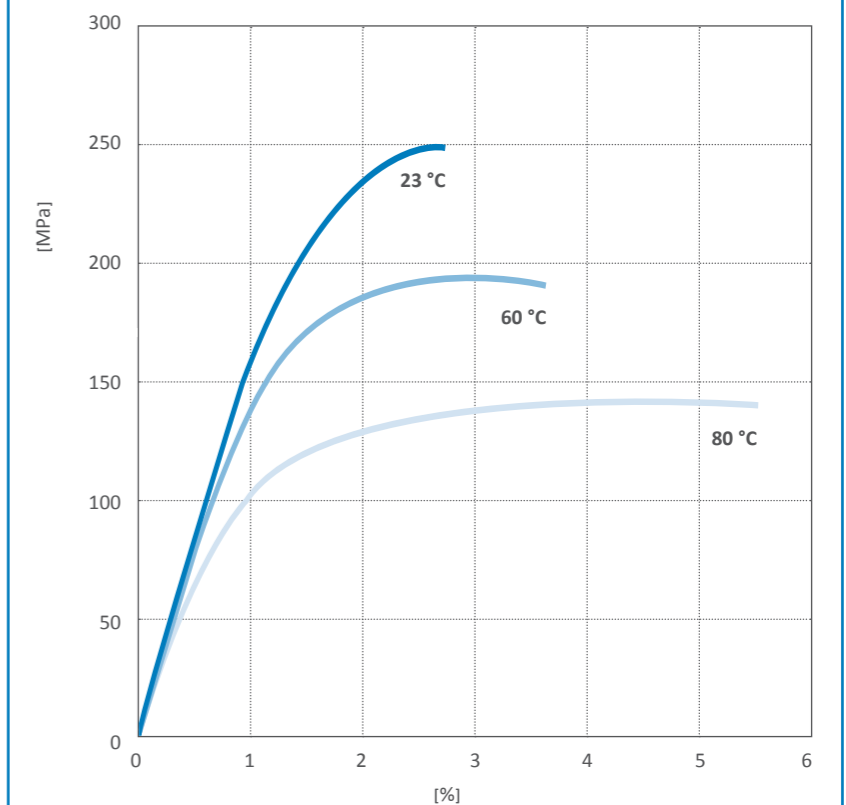


### Creep behaviour depending on load



By blending of PA 6.6 with a partially aromatic CoPA (PA 6I/6T), it is possible to significantly reduce the influence of moisture on the product characteristics. While the drop in rigidity and strength of PA 6.6 GF 50 in a standard climate is still at approx. 25 %, a partially aromatic blend nevertheless exhibits a drop of less than 10 %. Furthermore, it becomes apparent that the toughness remains virtually unaffected. As a result of these findings, the swelling behaviour is improved, as well, which is favourable for dimensional stability. At the same time, this material mix also increases the glass transition temperature range. All in all, partly aromatic PA 6.6-Blends offer exactly the characteristics that are demanded by designers and users.

### Stress-strain diagram

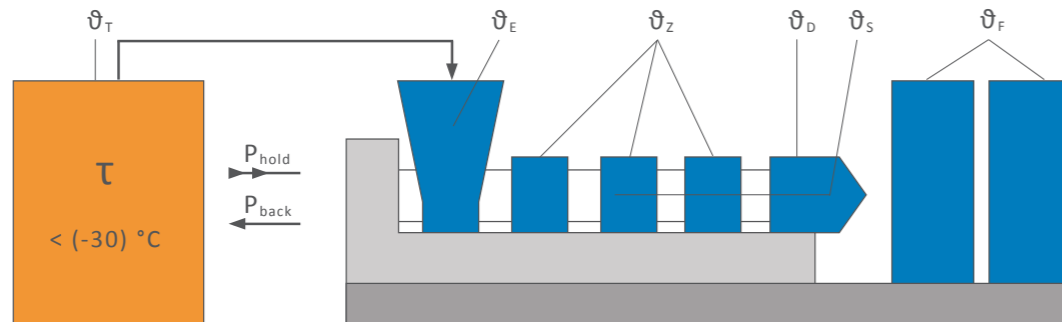


The measuring values shown in all diagrams apply to the material AKROLOY® PA GF 50 (2706)

# Processing Recommendations

# Applications

AKROLOY® AKROMID® B AF-Carbon® AKROMID® T AF-Complex® AKROMID® A AKROLEN® AF-Color® AKROMID® S AKROLOY® AKROMID® T AF-Color® AKROMID® S AKROLEN® AKROLOY® AF-Complex® AKROMID® A AF-Carbon® AKROMID® S AF-Color® AKROLOY® AKROMID® T AF-Carbon® AKROMID® B AF-Complex® AKROLEN® AKROMID® A

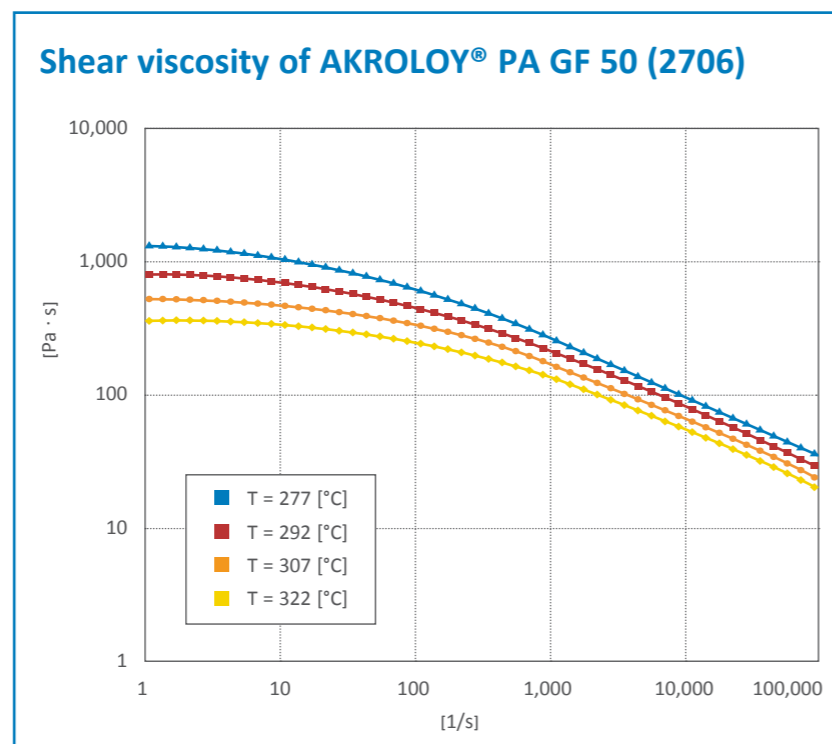


AKROLOY® PA can be processed on any commercially available injection moulding machine with standard screws according to the recommendations of the machine manufacturer. Please refer to the sketch and table beside for our recommended machine, mould and dryer settings.

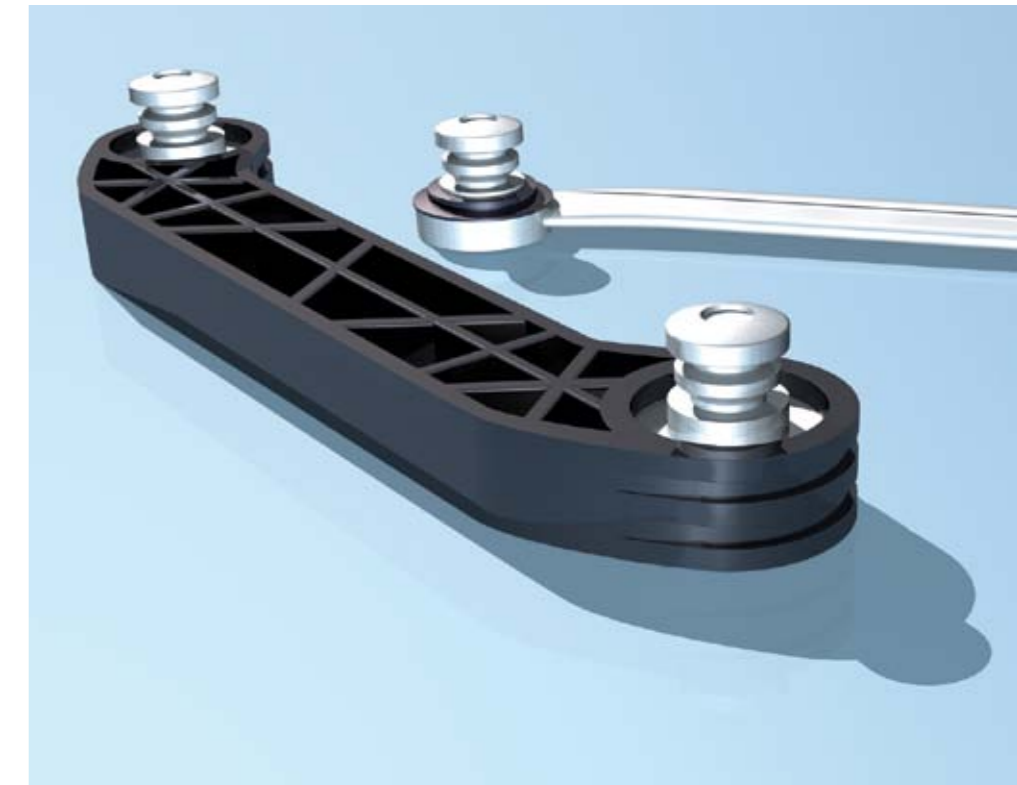
AKROLOY® PA		
Feed section	$\vartheta_E$	80 °C
Sector 1 – Sector 4	$\vartheta_Z$	275 – 305 °C
Nozzle	$\vartheta_D$	290 – 310 °C
Melt temperature	$\vartheta_S$	290 – 310 °C
Mould surface	$\vartheta_F$	80 – 120 °C
Drying	$\vartheta_t$	80 °C, ca. 4 – 8 h
Holding pressure, spec.	$P_{\text{hold}}$	300 – 800 bar
Back pressure, spec.	$P_{\text{back}}$	50 – 150 bar

The specified values are reference values. Higher values should be aimed for with increasing filling contents. For drying we recommend the use of drying air or vacuum dryer exclusively.

AKROLOY® PA is based on a semi-crystalline PA 6.6 and an amorphous CoPA. This essentially determines the processing conditions. Accordingly, the melting point of AKROLOY® PA is at approx. 255 °C and is not influenced by the CoPA. With increasing temperatures, the amorphous contents provide a disproportionately low viscosity. The result is a very good reproduction of mould surfaces and a mass temperature that is up to 30 °C lower than required by comparable products. This results, aside from high quality surface finishes, frequently in reductions of cycle times, as well. Owing to production conditions, this must be verified in each individual case. Overall, AKROLOY® PA represents a step towards energy savings, in particular, when energy costs are compared to those in metal production and processing.



Due to increasing cost pressure in many industrial sectors, AKROLOY® PA will become a very interesting alternative material in the area of substitutes for metal diecasting. Aside from already mentioned advantages in the service life of the mould, the omission of post processing allows an average cost reduction of up to 50 % – and more. The following list comprises imaginable and suitable areas of application, grouped by segments. Naturally, there is a multitude of further feasible applications, which we would be glad to discuss with you.



Draft for the automotive industry:  
CAD-Model „Control Arm“ made in AKROLOY® PA GF 60

## Automotive Industry

- ignition key switch housing
- door handle components
- door lock components
- instrument panels (centre console)
- arm rests
- electric motor housings
- wiper components
- carriers for wood decor strips
- seat sliding mechanisms, etc.

## Sanitary Installation

- single lever taps
- water filter housings
- housing for bath tap
- chrome-plated shower heads, levels, etc.

## Construction

- window locks
- door lock components
- expanding nails for insulating plugs
- corner connectors for lighting systems
- shelving support elements, etc.

## Household

- handles
- coffee maker components
- juice extractor components
- knives and handles
- bottle openers
- nutcrackers, etc.

## Electronic Industry

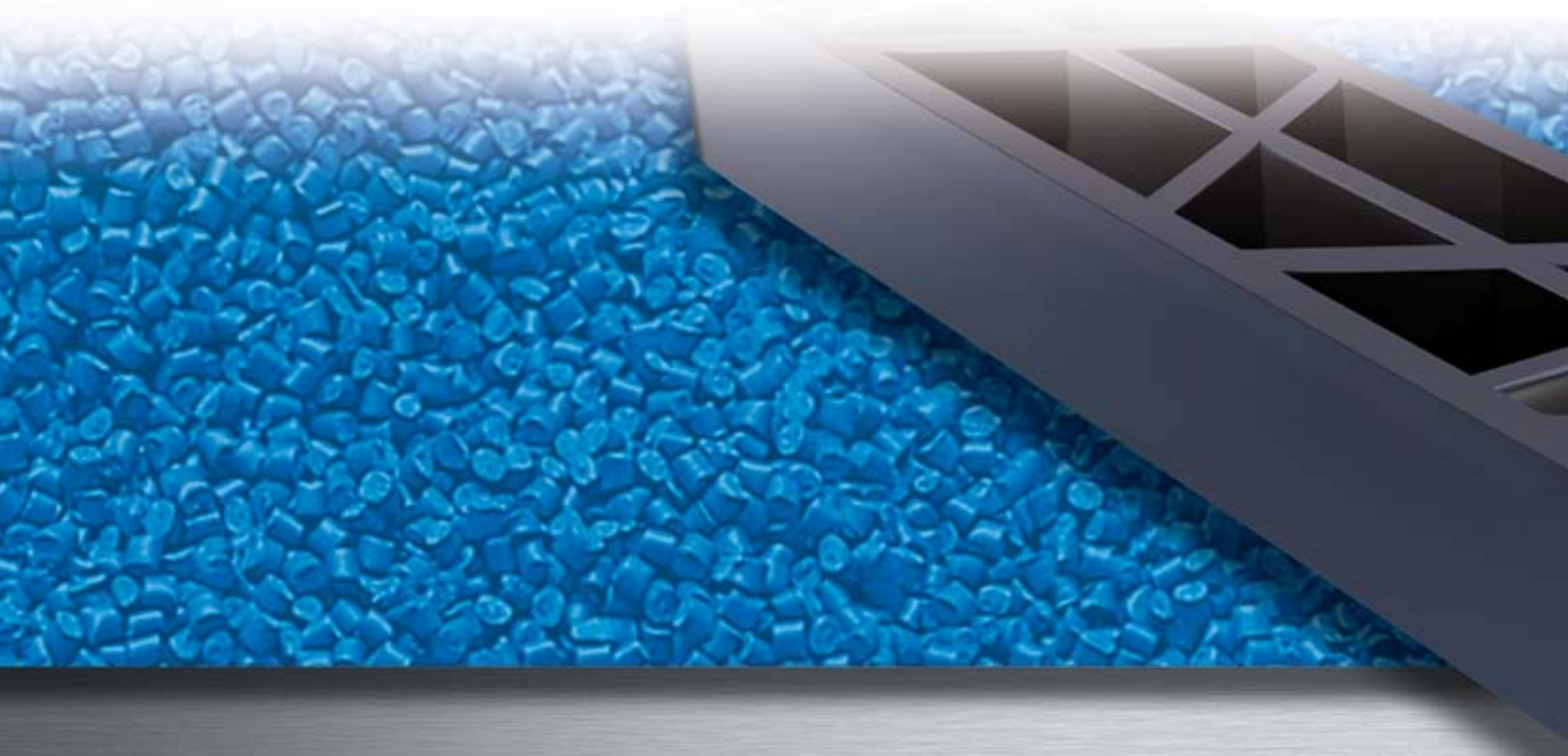
- Momobile phone housings
- plastic tongs
- housings for measuring units
- carrier plates, etc.

## Machine Building

- plastic screws
- calipers
- screw clamps, etc.

**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® and AKROLOY® are registered or pending trademarks of the Feddersen Group.

**We will be  
pleased to meet you!**



AKRO-PLASTIC AKROMID<sup>®</sup> B AF-Carbon<sup>®</sup> AKROMID<sup>®</sup> T AF-Complex<sup>®</sup>  
AKROMID<sup>®</sup> T AF-Color<sup>®</sup> AKROMID<sup>®</sup> S AKROLEN<sup>®</sup> AKROLOY<sup>®</sup> AF-Complex<sup>®</sup> AKROMID<sup>®</sup> A AF-Carbon<sup>®</sup> AKROMID<sup>®</sup>

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