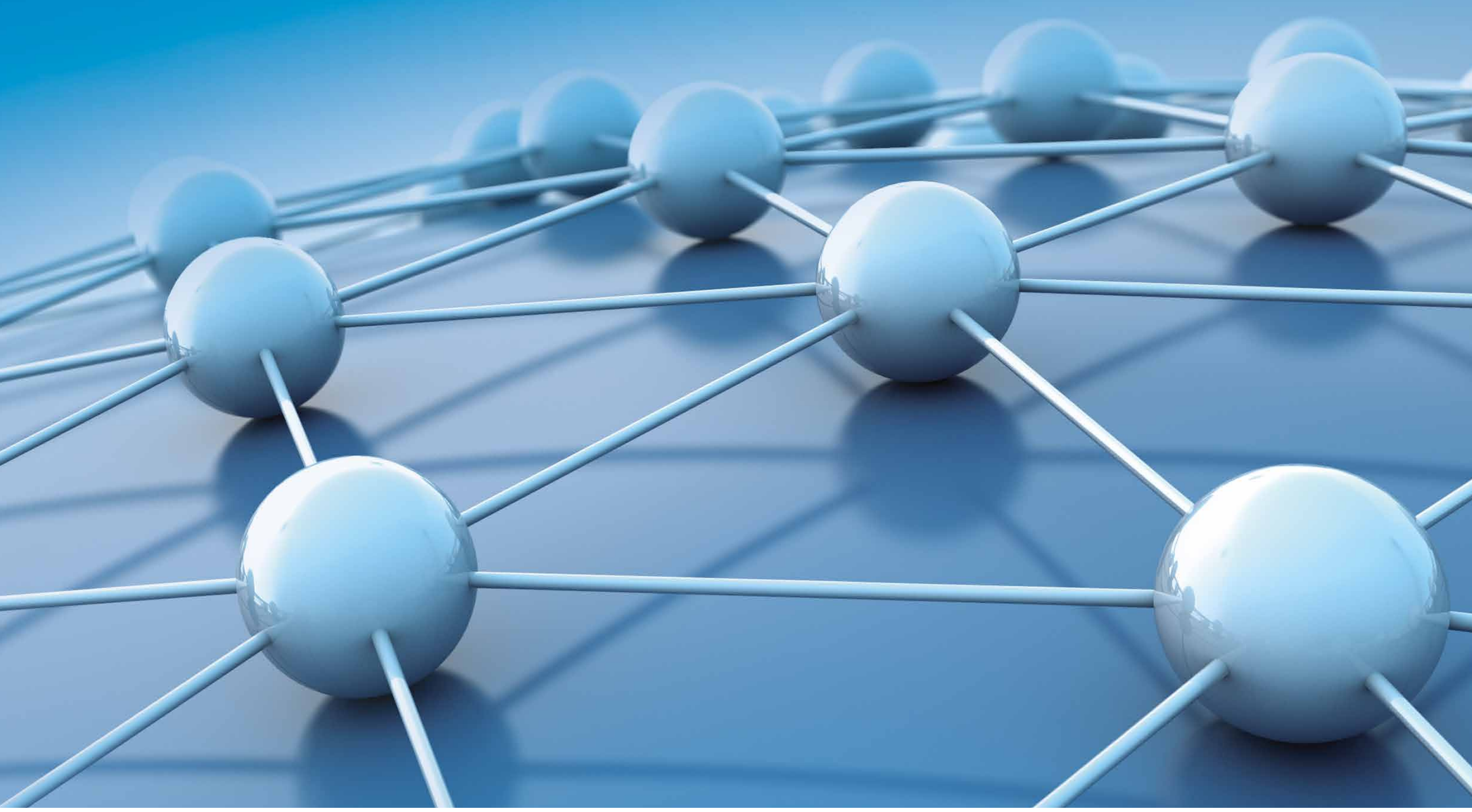
PRODUCT INFORMATION BASIC PROGRAM

AKROMID® A (PA 6.6)
AKROMID® B (PA 6)
AKROMID® C (PA 6.6/PA 6 Blend)



AKRO-PLASTIC
Think Polyamide

AKRO-PLASTIC GmbH
Member of the Feddersen Group

Dear AKRO-PLASTIC customers,

with our brochure AKROMID® Basic Program we would like to give you a compact overview of our range of products AKROMID® A, B and C and associated application information. Since this information represents only partial aspects of our production possibilities and special demands are often made on compounds, you should always consult our application engineering department for questions or individual needs. Our engineers are able to offer competent advice on specific subjects, questions and problem solutions.

At AKRO-PLASTIC GmbH, we see ourselves not only as a producer, but also as a service provider. We constantly refine existing successful products, continually adapting them to the growing demands of the market. We set new standards with our certified quality management and our inhouse accredited test lab. In this endeavour, you the customer are an important interface. It is your needs, questions and demands that drive our efforts to continue this successful development.

And this joint effort should continue into the future.

AKROMID® A3 (PA 6.6)

Typical values for natural color material at 23 °C	Test specification	Test method	Unit	A3[1] (2414)		A3 GF 15 (2418)		A3 GF 25 (2420)		A28 GF 30 9 (4915)		A3 GF 35 (2421)		A3 GF 40 (1258)		A28 GF 50 9 (5030)		A3 GF 60 (2424)		A 28 GF 30 1 GIT (4619)		A3 GM 20/10 4 WIT (4529)	
Mechanical properties				d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	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	3,200	1,100	6,400	3,700	8,500	6,000	9,600	7,000	11,600	8,400	13,100	9,800	16,000	12,000	20,500	15,800	9,200		8,200	5,200
Yield stress[1]/Tensile stress at break	5 mm/min	ISO 527-1/2	MPa	85/	50/	/140	/80	/185	/115	/200	/130	/215	/145	/225	/160	/250	/180	/260	/190	190		175	100
Elongation at break	5 mm/min	ISO 527-1/2	%	>20	>50	3.5	12	3.6	6.5	3	>6	3	5	3	4	2.5	3.5	2	2.5	3.5		3.7	11.5
Flexural modulus	2 mm/min	ISO 178	MPa	2,800		6,100		7,600	6,200	8,800	7,200	10,000	8,000	12,000		15,200	13,600	19,800		8,700		7,600	5,200
Flexural stress	2 mm/min	ISO 178	MPa	110		200		260	200	285	220	300	245	360		380	310	400		300		260	170
Charpy impact strength	23 °C	ISO 179-1/1eU	kJ/m^2	n.b.	n.b.	45	88	70	90	70	80	92	102	100	105	100	105	102	105	90		65	80
Charpy impact strength	-30 °C	ISO 179-1/1eU	kJ/m^2	n.b.		43		64		70		90		95		80		97		70		50	48
Charpy notched impact strength	23 °C	ISO 179-1/1eA	kJ/m^2	5	13	7	10	10	13	12	16	15	19	17	20	19	23	19	22	15		9	9.5
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	kJ/m^2	2		6		9		11		13		15		16		19		13		7	6.5
Ball indentation hardness	HB 961/30	ISO 2039-1	MPa			200		225		240		255		270		290		330					
Electrical properties																							
Volume resistivity		IEC 60093	Ohm x m	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10
Surface resistivity		IEC 60093	Ohm	1.0E+13	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10
Comparative tracking index, CTI	Test solution A	IEC 60112		600		600		600		600		600		600		600		600					
Thermal properties				d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.	
Melting point	DSC, 10 K/min	ISO 11357-1/3	°C	262		262		262		262		262		262		262		262		255		262	
Heat distortion temperature, HDT/A	1.8 MPa	ISO 75-2	°C	75		245		255		255		255		260		260		260				240	
Heat distortion temperature, HDT/B	0.45 MPa	ISO 75-2	°C	215		260		260		260		260		260		260		260				260	
Heat distortion temperature, HDT/C	8 MPa	ISO 75-2	°C							210		220		225		235		235		180			
CLTE, flow	23°C - 80°C	ISO 11359-1/2	1.0E-4/K	0.71		0.34				0.19						0.17							
CLTE, transverse	23°C - 80°C	ISO 11359-1/2	1.0E-4/K	1.1		1.11				0.95						0.88							
Temperature index for 50 % loss of tensile strength[2]	5,000 h	IEC 216	°C	115 – 145		160 – 175		160 – 175		160 – 175		160 – 175		160 – 175		160 – 175		160 – 175					
Temperature index for 50 % loss of tensile strength[2]	20,000 h	IEC 216	°C	100 – 120		130 – 150		130 – 150		130 – 150		130 – 150		130 – 150		130 – 150		130 – 150					
Flammability																							
Flammability acc. UL 94	1.6 mm	UL 94	Class	V–2		HB		HB		HB		HB		HB		HB		HB		HB		HB	
Rate acc. FMVSS 302 (<100 mm/min)	>1 mm thickness	FMVSS 302	mm/min	+		+		+		+		+		+		+		+		+		+	
GWFI	1.6 mm	IEC 60695-12	°C	750		650		650		650		650		650		650		650					
General properties																							
Density	23 °C	ISO 1183	g/cm^3	1.14		1.24		1.32		1.36		1.40		1.46		1.57		1.71		1.36		1.36	
Content minerals/reinforcement		ISO 1172	%	–		15		25		30		35		40		50		60		30		30	
Moisture absorption	70 °C/62 % r. h.	ISO 1110	%	2.9 – 3.1		2.5 – 2.7		2 – 2.2		1.9 – 2.1		1.8 – 2		1.7 – 1.9		1.3 – 1.5		1 – 1.2				2	
Water absorption	23 °C/satur.	ISO 62	%	8 – 9		6.7 – 7.3		5.7 – 6.3		5.2 – 5.8		4.7 – 5.3		4.3 – 4.7		3.7 – 4.3		3.2 – 3.7					
Processing																							
Flowability	Flowspiral[3]	AKRO	mm	1,040		990		890		950		770		720		700		530		1,100			
Processing shrinkage, flow		ISO 294-4	%	1.9		0.4		0.2		0.2		0.2		0.2		0.3		0.4				0.4	
Processing shrinkage, transverse		ISO 294-4	%	2.3		1.4		1.3		1.3		1.3		1.2		1.2		0.8				0.8	

Despite identical nomenclature the AKROMID® materials produced by AKRO in China are identified by differential batch numbering.

"cond." test values = conditioned, measured on test specimens stored according to DIN EN ISO 1110
"d.a.m." = dry as moulded test values = residual moisture content <0.10 %
n.b. = not broken + = passed

[1] = yield stress and elongation at break: test speed 50 mm/min for non-reinforced compounds
[2] = depending on selected stabilisation, see application examples
[3] = mould temperature: 100 °C, melt temperature: 320 °C, injection pressure: 750 bar, cross section of flow spiral: 7 mm x 3.5 mm

AKROMID® B3 (PA 6)

Typical values for natural color material at 23 °C	Test specification	Test method	Unit	B3[1] (2500)		B3 GF 15 (2469)		B3 GF 20 (2470)		B3 GF 25 (2471)		B3 GF 30 (2472)		B3 GF 35 (2473)		B3 GF 40 (2474)		B3 GF 50 (2475)		B28 GF 60 9 (4662)		B3 GF 30 2 GIT (4618)	
Mechanical properties				d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	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	3,600	1,200	6,100	3,300	6,800	4,200	8,500	5,100	10,300	6,200	11,500	7,300	12,800	8,200	17,000	11,000	21,000	13,500	9,100	5,500
Yield stress[1]/Tensile stress at break	5 mm/min	ISO 527-1/2	MPa	85/	45/	/120	/75	/150	/85	/160	/100	/185	/110	/195	/120	/205	/130	/230	/145	250	150	175	110
Elongation at break	5 mm/min	ISO 527-1/2	%	>20	>50	3	10	3.5	7.5	3.5	6.5	3	6.1	3	5	3	5	2.5	4.5	2.5	3.5	3	5
Flexural modulus	2 mm/min	ISO 178	MPa	3,100		5,200		6,100		7,000		8,500		10,000		10,300		14,900		19,000			
Flexural stress	2 mm/min	ISO 178	MPa	120		180		230		245		270		285		300		340		370			
Charpy impact strength	23 °C	ISO 179-1/1eU	kJ/m²	n.b.	n.b.	52	95	73	88	85	90	95	105	100	110	100	110	100	110	90	95	75	80
Charpy impact strength	-30 °C	ISO 179-1/1eU	kJ/m²	n.b.		43		65		80		85		90		90		90		88			
Charpy notched impact strength	23 °C	ISO 179-1/1eA	kJ/m²	5	16	7	11	9	14	12	16	13	18	15	21	17	23	20	26	20	25	12	17
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	kJ/m²	2		6		8		10		12		13		14		16		19			
Ball indentation hardness	HB 961/30	ISO 2039-1	MPa			180		200		215		230		240		250		270		290			
Electrical properties																							
Volume resistivity		IEC 60093	Ohm x m	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10
Surface resistivity		IEC 60093	Ohm	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10
Comparative tracking index, CTI	Test solution A	IEC 60112		600		600		600		600		600		600		600		600		600		600	
Thermal properties				d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.	
Melting point	DSC, 10 K/min	ISO 11357-1/3	°C	220		220		220		220		220		220		220		220		220		220	
Heat distortion temperature, HDT/A	1.8 MPa	ISO 75-2	°C	60		205		210		210		210		215		215		220		220			
Heat distortion temperature, HDT/B	0.45 MPa	ISO 75-2	°C	180		220		220		220		220		220		220		220		220			
Heat distortion temperature, HDT/C	8 MPa	ISO 75-2	°C									150		165		170		185		190			
CLTE, flow	23°C - 80°C	ISO 11359-1/2	1.0E-4/K									0,16						0.11					
CLTE, transverse	23°C - 80°C	ISO 11359-1/2	1.0E-4/K									0,95						0.94					
Temperature index for 50 % loss of tensile strength[2]	5,000 h	IEC 216	°C	100 – 140		160 – 175		160 – 175		160 – 175		160 – 175		160 – 175		160 – 175		160 – 175		160 – 175			
Temperature index for 50 % loss of tensile strength[2]	20,000 h	IEC 216	°C	90 – 120		130 – 150		130 – 150		130 – 150		130 – 150		130 – 150		130 – 150		130 – 150		130 – 150			
Flammability																							
Flammability acc. UL 94	1.6 mm	UL 94	Class	V – 2		HB		HB		HB		HB		HB		HB		HB		HB		HB	
Rate acc. FMVSS 302 (<100 mm/min)	>1 mm thickness	FMVSS 302	mm/min	+		+		+		+		+		+		+		+		+		+	
GWFI	1.6 mm	IEC 60695-12	°C	750		650		650		650		650		650		650		650		650			
General properties																							
Density	23 °C	ISO 1183	g/cm³	1.13		1.23		1.27		1.31		1.36		1.41		1.46		1.56		1.70		1.36	
Content minerals/reinforcement		ISO 1172	%	–		15		20		25		30		35		40		50		60		30	
Moisture absorption	70 °C/62 % r. h.	ISO 1110	%	2.6 – 3.4		2.6 – 2.9		2.4 – 2.7		2.2 – 2.5		2.1 – 2.3		1.8 – 2.1		1.5 – 1.8		1.3 – 1.6		0.9 – 1.2		2.2	
Water absorption	23 °C/satur.	ISO 62	%	9 – 10		7.7 – 8.3		7.4 – 7.7		6.8 – 7.4		6.3 – 6.9		5.9 – 6.5		5.2 – 5.7		4.5 – 5.1		3.9 – 4.4			
Processing																							
Flowability	Flowspiral[3]	AKRO	mm	1,070		870		800		720		660		610		540		430		470			
Processing shrinkage, flow		ISO 294-4	%	1.1		0.3		0.2		0.2		0.1		0.1		0.1		0.2		0.3			
Processing shrinkage, transverse		ISO 294-4	%	1		0.7		0.8		0.8		0.8		0.8		0.9		0.9		0.7			

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"cond." test values = conditioned, measured on test specimens stored according to DIN EN ISO 1110
"d.a.m." = dry as moulded test values = residual moisture content <0.10 %
n.b. = not broken + = passed

[1] = yield stress and elongation at break: test speed 50 mm/min for non-reinforced compounds
[2] = depending on selected stabilisation, see application examples
[3] = mould temperature: 80 °C, melt temperature: 270 °C, injection pressure: 750 bar, cross section of flow spiral: 7 mm x 3.5 mm

AKROMID® B3 (PA 6)

Typical values for natural color material at 23 °C	Test specification	Test method	Unit	B3 black (20004)		B3 GF 20 1 black (20001)		B3 GF 30 1 black (20000)		B3 GF 30 5 black (20009)		B3 GF 50 1 black (20008)	
Mechanical properties				d.a.m.	cond.	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	3,200	1,100	7,000	4,000	9,500	6,000	9,500	6,000	17,000	10,000
Yield stress[1]/Tensile stress at break	5 mm/min	ISO 527-1/2	MPa	80	40	145	80	175	100	175	100	210	120
Elongation at break	5 mm/min	ISO 527-1/2	%	>20	>40	3	7	3	5	3	5	3	5
Flexural modulus	2 mm/min	ISO 178	MPa										
Flexural stress	2 mm/min	ISO 178	MPa										
Charpy impact strength	23 °C	ISO 179-1/1eU	kJ/m^2	n.b.	n.b.	60	75	95	105	95	105	100	105
Charpy impact strength	-30 °C	ISO 179-1/1eU	kJ/m^2										
Charpy notched impact strength	23 °C	ISO 179-1/1eA	kJ/m^2			8	12	13	18	13	18	18	22
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	kJ/m^2										
Ball indentation hardness	HB 961/30	ISO 2039-1	MPa			200		230		230		270	
Electrical properties													
Volume resistivity		IEC 60093	Ohm x m	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10
Surface resistivity		IEC 60093	Ohm	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10
Comparative tracking index, CTI	Test solution A	IEC 60112		600		600		600		600		600	
Thermal properties				d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.	
Melting point	DSC, 10 K/min	ISO 11357-1/3	°C	220		220		220		220		220	
Heat distortion temperature, HDT/A	1.8 MPa	ISO 75-2	°C	60		210		210		210		220	
Heat distortion temperature, HDT/B	0.45 MPa	ISO 75-2	°C	180		220		220		220		220	
Heat distortion temperature, HDT/C	8 MPa	ISO 75-2	°C					150		150		185	
CLTE, flow	23°C - 80°C	ISO 11359-1/2	1.0E-4/K					0.16		0.16		0.11	
CLTE, transverse	23°C - 80°C	ISO 11359-1/2	1.0E-4/K					0.95		0.95		0.94	
Temperature index for 50 % loss of tensile strength[2]	5,000 h	IEC 216	°C									160 – 175	
Temperature index for 50 % loss of tensile strength[2]	20,000 h	IEC 216	°C									130 – 150	
Flammability													
Flammability acc. UL 94	1.6 mm	UL 94	Class	V-2		HB		HB		HB		HB	
Rate acc. FMVSS 302 (<100 mm/min)	>1 mm thickness	FMVSS 302	mm/min	+		+		+		+		+	
GWFI	1.6 mm	IEC 60695-12	°C	750		650		650		650		650	
General properties													
Density	23 °C	ISO 1183	g/cm^3	1.13		1.27		1.36		1.36		1.56	
Content minerals/reinforcement		ISO 1172	%			20		30		30		50	
Moisture absorption	70 °C/62 % r. h.	ISO 1110	%	2.6 – 3.4		2.4 – 2.7		2.1 – 2.3		2.1 – 2.3		1.3 – 1.6	
Water absorption	23 °C/satur.	ISO 62	%	9 – 10		7.4 – 7.7		6.3 – 6.9		6.3 – 6.9		4.5 – 5.1	
Processing													
Flowability	Flowspiral[3]	AKRO	mm			800		660		660		430	
Processing shrinkage, flow		ISO 294-4	%			0.2		0.1		0.1		0.2	
Processing shrinkage, transverse		ISO 294-4	%			0.8		0.8		0.8		0.9	

Despite identical nomenclature the AKROMID® materials produced by AKRO in China are identified by differential batch numbering.

"cond." test values = conditioned, measured on test specimens stored according to DIN EN ISO 1110
"d.a.m." = dry as moulded test values = residual moisture content <0.10 %
n.b. = not broken + = passed

AKROMID® C3 (PA 6.6/6 Blend)

Typical values for natural color material at 23 °C	C3 1[1] (4546)		C3 GF 50 XTC (4946)		C3 GF 50 1 (4401)		C3 GF 60 1 (4659)		C3 GF 30 5 XTC (4499)	
Mechanical properties	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.
Tensile modulus	3,100	1,100	17,500		16,000	11,000	21,300	13,200	9,900	6,000
Yield stress[1]/Tensile stress at break	80	45	/260		240	165	270	180	190	/115
Elongation at break	5	>50	3.2		2.5	4	2.3	4	3.7	6.5
Flexural modulus	3,000		17,000		16,200		22,500			6,200
Flexural stress	115		415		360		425			200
Charpy impact strength (23 °C)	n.b.	n.b.	125		95	100	96	103	95	90
Charpy impact strength (-30 °C)			125							
Charpy notched impact strength (23 °C)	3	13	25		20	20	19	24	13	13
Charpy notched impact strength (-30 °C)			25		20					
Ball indentation hardness										
Electrical properties										
Volume resistivity	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10
Surface resistivity	1.0E+13	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10
Comparative tracking index, CTI	600		600		600		600		600	
Thermal properties	d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.	
Melting point	260		255		260		260		255	
Heat distortion temperature, HDT/A			230		250				230	
Heat distortion temperature, HDT/B	185		190				255		250	
Heat distortion temperature, HDT/C					220		212			
CLTE, flow										
CLTE, transverse										
Temperature index for 50 % loss of tensile strength[2] (5,000 h)	100 – 140				160 – 175		160 – 175			
Temperature index for 50 % loss of tensile strength[2] (20,000 h)	90 – 120				130 – 150		130 – 150			
Flammability										
Flammability acc. UL 94	V-2		HB		HB		HB		HB	
Rate acc. FMVSS 302 (<100 mm/min)	+		+		+		+		+	
GWFI										
General properties										
Density	1.14				1.57		1.71		1.39	
Content minerals/reinforcement	–		50		50		60		30	
Moisture absorption	2.6				1.4		1.1			
Water absorption										
Processing										
Flowability	1,600				650		580			
Processing shrinkage, flow	1.2				0.3		0.4			
Processing shrinkage, transverse	1.9				1.2		0.8			

[1] = yield stress and elongation at break: test speed 50 mm/min for non-reinforced compounds
[2] = depending on selected stabilisation, see application examples
[3] = mould temperature: 90 °C, melt temperature: 300 °C, injection pressure: 750 bar, cross section of flow spiral: 7 mm x 3.5 mm

AKROMID® A/B (impact resistant)

Typical values for natural color material at 23 °C	Test specification	Test method	Unit	A3 1 S3[1] (1139)		A3 S1[1] (1071)		B3 GF 30 S1 (2091)		B3 GF 15 S1 (3228)		B3 S1 (3726)	
Mechanical properties				d.a.m.	cond.	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	2,700	1,300	2,000	900	7,500	4,200	6,000	3,100	2,000	550
Yield stress[1]/Tensile stress at break	5 mm/min	ISO 527-1/2	MPa	63	45	50	40	125	70	120	75	50/	45/
Elongation at break	5 mm/min	ISO 527-1/2	%	>35	>100	>50	>100	6	13	4	10	> 50	> 100
Flexural modulus	2 mm/min	ISO 178	MPa	2,500		1,950		6,400		5,300		1,500	
Flexural stress	2 mm/min	ISO 178	MPa	90				190		175		65	
Charpy impact strength	23 °C	ISO 179-1/1eU	kJ/m^2	n.b.	n.b.	n.b.	n.b.	110	135	70	95	n.b.	n.b.
Charpy impact strength	-30 °C	ISO 179-1/1eU	kJ/m^2	n.b.	n.b.	n.b.	n.b.	>100	>100	50	45	n.b.	n.b.
Charpy notched impact strength	23 °C	ISO 179-1/1eA	kJ/m^2	15	95	>80	>100	35	45	4	14	45	110
Charpy notched impact strength	-30 °C	ISO 179-1/1eA	kJ/m^2	10	13	35	35	25	22	6	5	55	40
Ball indentation hardness	HB 961/30	ISO 2039-1	MPa										
Electrical properties													
Volume resistivity		IEC 60093	Ohm x m	1.0E+15		1.0E+15						1.0E+13	
Surface resistivity		IEC 60093	Ohm	1.0E+14		1.0E+14						1.0E+12	
Comparative tracking index, CTI	Test solution A	IEC 60112		600		600							
Thermal properties				d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.	
Melting point	DSC, 10 K/min	ISO 11357-1/3	°C	262		262		220		220		220	
Heat distortion temperature, HDT/A	1.8 MPa	ISO 75-2	°C	70		70		200		200		50	
Heat distortion temperature, HDT/B	0.45 MPa	ISO 75-2	°C	213		152							
Heat distortion temperature, HDT/C	8 MPa	ISO 75-2	°C										
CLTE, flow	23°C - 80°C	ISO 11359-1/2	1.0E-4/K										
CLTE, transverse	23°C - 80°C	ISO 11359-1/2	1.0E-4/K										
Temperature index for 50 % loss of tensile strength[2]	5,000 h	IEC 216	°C									160 – 175	
Temperature index for 50 % loss of tensile strength[2]	20,000 h	IEC 216	°C									130 – 150	
Flammability													
Flammability acc. UL 94	1.6 mm	UL 94	Class	HB		HB		HB		HB		HB	
Rate acc. FMVSS 302 (<100 mm/min)	>1 mm thickness	FMVSS 302	mm/min	+		+		+		+		+	
GWFI	1.6 mm	IEC 60695-12	°C										
General properties													
Density	23 °C	ISO 1183	g/cm^3	1.10		1.07		1.28		1.22		1.07	
Content minerals/reinforcement		ISO 1172	%					30		15			
Moisture absorption	70 °C/62 % r. h.	ISO 1110	%	2.1		2		1.4		2.3			
Water absorption	23 °C/satur.	ISO 62	%										
Processing													
Flowability	Flowspiral[3]	AKRO	mm	800		770		530		730		600	
Processing shrinkage, flow		ISO 294-4	%	2.1		1.4		0.4		0.6		1.5	
Processing shrinkage, transverse		ISO 294-4	%	2.2		1.4		0.9		0.9		1.9	

Despite identical nomenclature the AKROMID® materials produced by AKRO in China are identified by differential batch numbering.

"cond." test values = conditioned, measured on test specimens stored according to DIN EN ISO 1110
"d.a.m." = dry as moulded test values = residual moisture content <0.10 %
n.b. = not broken + = passed

AKROMID® A EN (electrical neutral)

Typical values for natural color material at 23 °C	A4 5 EN natural (3162)		A3 GF 20 1 EN black (5935)		A3 GF 30 1 EN black (5646)		A3 GF 35 1 EN black (5300)		A3 GF 50 1 EN black (5737)	
Mechanical properties	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.	d.a.m.	cond.
Tensile modulus	3,500	1,400	7,200	4,600	10,000	7,100	11,600	8,400	16,700	12,600
Yield stress[1]/Tensile stress at break	/95	/55	/160	/100	/200	/130	/215	/145	/250	/180
Elongation at break	4.5	20	3.5	8	3	>6	3	5	2.5	3.5
Flexural modulus	2,900	1,500	7,000	5,000	8,800	7,200	10,000	8,000	15,200	13,600
Flexural stress	50	15	235	165	285	220	300	245	380	310
Charpy impact strength (23 °C)	n.b.	n.b.	60	86	85	95	92	102	105	110
Charpy impact strength (-30 °C)	n.b.	n.b.	48		80		90		105	
Charpy notched impact strength (23 °C)	5	15	9		12	16	15	19	19	23
Charpy notched impact strength (-30 °C)			8	11	11		13		16	
Ball indentation hardness					240		255		290	
Electrical properties										
Volume resistivity	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10	1.0E+13	1.0E+10
Surface resistivity	1.0E+13	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10	1.0E+12	1.0E+10
Comparative tracking index, CTI	600		600		600		600		601	
Thermal properties	d.a.m.		d.a.m.		d.a.m.		d.a.m.		d.a.m.	
Melting point	262		262		262		262		262	
Heat distortion temperature, HDT/A			250		255		255		260	
Heat distortion temperature, HDT/B			260		260		260		260	
Heat distortion temperature, HDT/C					210		220		235	
CLTE, flow					0.19				0.17	
CLTE, transverse					0.95				0.88	
Temperature index for 50 % loss of tensile strength[2] (5,000 h)			160 – 175		160 – 175		160 – 175		160 – 175	
Temperature index for 50 % loss of tensile strength[2] (20,000 h)			130 – 150		130 – 150		130 – 150		130 – 150	
Flammability										
Flammability acc. UL 94			HB		HB		HB		HB	
Rate acc. FMVSS 302 (<100 mm/min)			+		+		+		+	
GWFI			650		650		650		650	
General properties										
Density	1.14		1.28		1.36		1.40		1.57	
Content minerals/reinforcement			20		30		35		50	
Moisture absorption	2.4 – 2.8		2.3 – 2.5		1.9 – 2.1		1.8 – 2		1.3 – 1.5	
Water absorption			6.7 – 7.2		5.2 – 5.8		4.7 – 5.3		3.7 – 4.3	
Processing										
Flowability			950		830		770		600	
Processing shrinkage, flow			0.3		0.2		0.2		0.3	
Processing shrinkage, transverse			1.3		1.3		1.3		1.2	

[1] = yield stress and elongation at break: test speed 50 mm/min for non-reinforced compounds
[2] = depending on selected stabilisation, see application examples
[3] = mould temperature: 100 °C, melt temperature: 320 °C, injection pressure: 750 bar, cross section of flow spiral: 7 mm x 3.5 mm

Product characterisation

Stabilisation with shielding technology

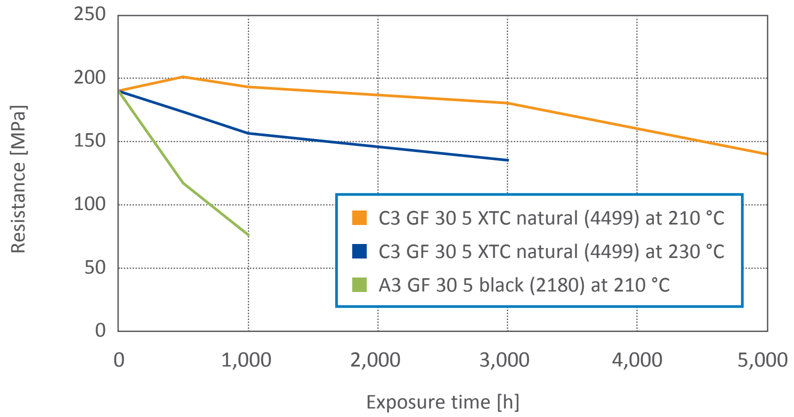
(Fig. 1)

Tensile bar made of C3 GF 30 5 XTC natural (4499) after 1,000 h at 210 °C

Rising to the challenge of meeting steadily increasing demands for cost-effective materials with greater heat resistance, AKRO-PLASTIC has developed AKROMID® C3 GF 30 5 XTC, a compound with an exceptional heat ageing resistance at temperatures of around 200 °C. Stabilisation in AKROMID® C3 GF 30 5 XTC is based on shielding technology (see Fig. 1) and is electrically neutral. Potential applications can be found primarily in the automotive industry, where alternatives to conventional thermoplastics are sought due to increasing temperatures in the engine compartment. Even after an ageing treatment lasting 5,000 h at 210 °C, hardly any decrease in tensile stress at break is observed (see Fig. 2). The strain following this conditioning is still significantly greater than 2 % (see Fig. 3). And AKROMID® C3 GF 30 5 XTC is just as easy to process as standard AKROMID® compounds. As with other polyamide compounds, the strengths are extremely dependent on the temperature (see Fig. 4).

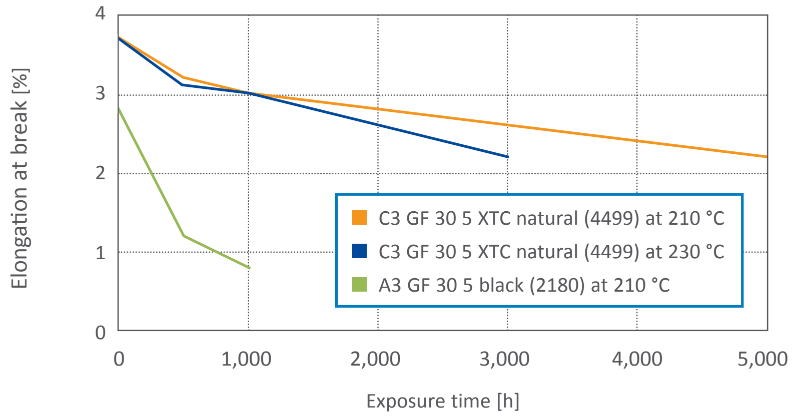
Resistance based on exposure time

(Fig. 2)



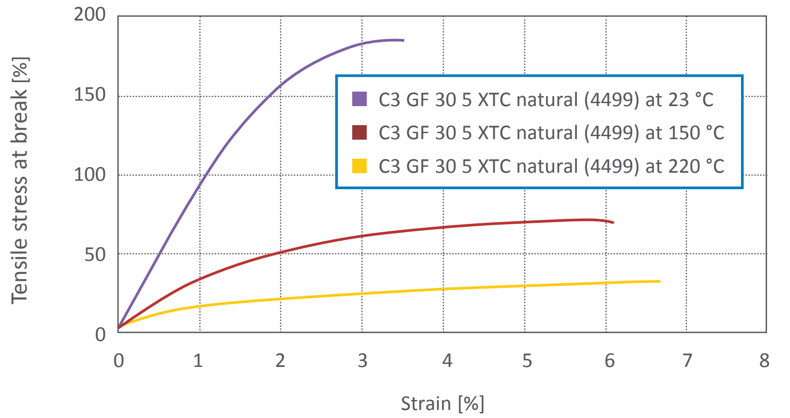
Elongation at break based on exposure time

(Fig. 3)



Stress-strain curves at temperature

(Fig. 4)



Electrically neutral compounds

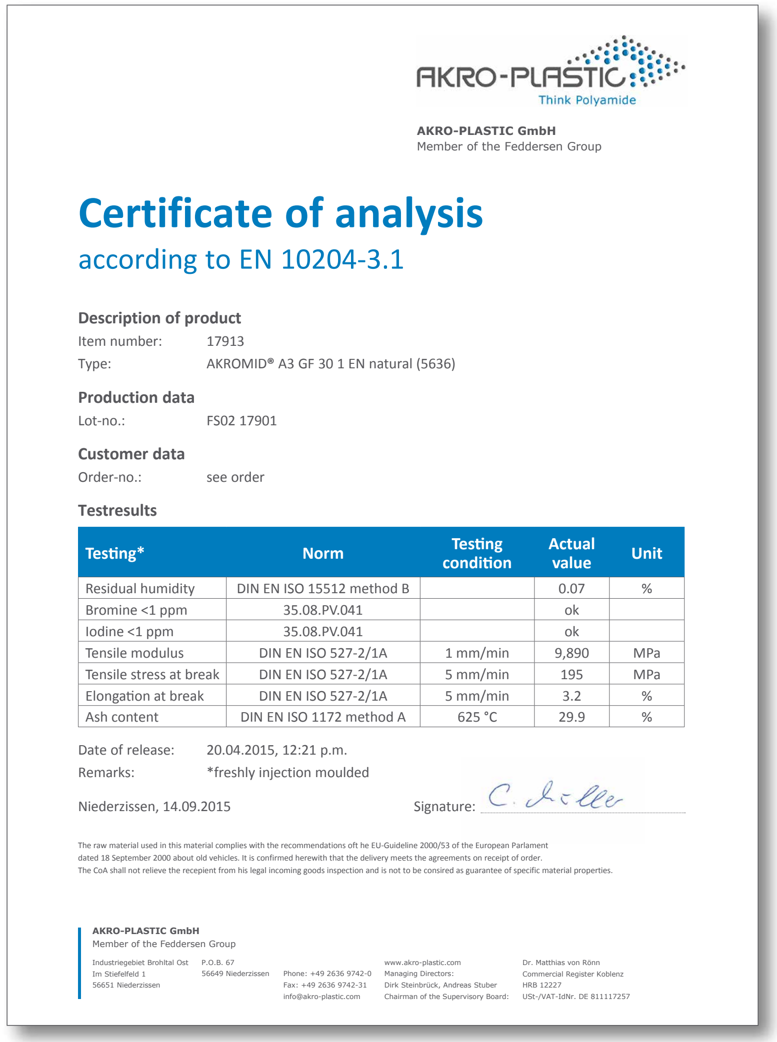
The growing use of electronics has made our lives easier and richer in many areas. Electronic components are not just used in smartphones and tablets; integrated circuits (IC) are also increasingly found in motor vehicles. In the automotive industry, it has been observed again and again that at increased temperatures, the service life of the elements and components used decreases. An analysis of prematurely failed components shows that corrosion on the contacts of the ICs is a major cause for the failure.

This causes a reaction in which iodine ions and bromine ions enter into a complex interaction with the intermetallic phases. These ions come from the stabilisation packages of the plastic and are specifically guided through the electrical fields to the locations where they can do their destructive work. One of the major tasks for the automotive industry is to ensure that such failures do not occur. AKRO-PLASTIC GmbH have risen to the challenge by developing a new product line of electrochemically neutral polyamide compounds with heat stabilisers and lubricants without halogens or metal soaps. This product line bears the extension "EN", for electrically neutral.

During acceptance testing on the production line, AKRO-PLASTIC state a bromine and iodine content of <1 ppm on all certificates of analysis for the EN product line (Fig. 5). We therefore provide what is likely the highest resolution analytics in day-to-day standard applications. Standard elemental analysis methods are typically only capable of identifying ranges of >10 ppm. This method is used in-house on our own production line.

Certificate of analysis

(Fig. 5)



AKRO-PLASTIC
Think Polyamide

AKRO-PLASTIC GmbH
Member of the Feddersen Group

Certificate of analysis

according to EN 10204-3.1

Description of product

Item number: 17913

Type: AKROMID® A3 GF 30 1 EN natural (5636)

Production data

Lot-no.: FS02 17901

Customer data

Order-no.: see order

Testresults

Testing*	Norm	Testing condition	Actual value	Unit
Residual humidity	DIN EN ISO 15512 method B		0.07	%
Bromine <1 ppm	35.08.PV.041		ok	
Iodine <1 ppm	35.08.PV.041		ok	
Tensile modulus	DIN EN ISO 527-2/1A	1 mm/min	9,890	MPa
Tensile stress at break	DIN EN ISO 527-2/1A	5 mm/min	195	MPa
Elongation at break	DIN EN ISO 527-2/1A	5 mm/min	3.2	%
Ash content	DIN EN ISO 1172 method A	625 °C	29.9	%

Date of release: 20.04.2015, 12:21 p.m.

Remarks: *freshly injection moulded

Niederzissen, 14.09.2015 Signature:

The raw material used in this material complies with the recommendations oft he EU-Guideline 2000/53 of the European Parlament dated 18 September 2000 about old vehicles. It is confirmed herewith that the delivery meets the agreements on receipt of order.
The CoA shall not relieve the recepient from his legal incoming goods inspection and is not to be consired as guarantee of specific material properties.

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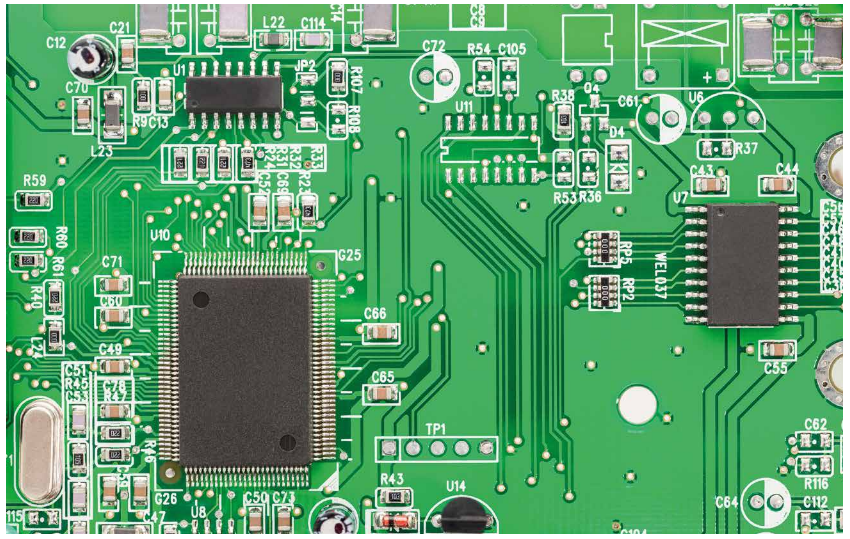
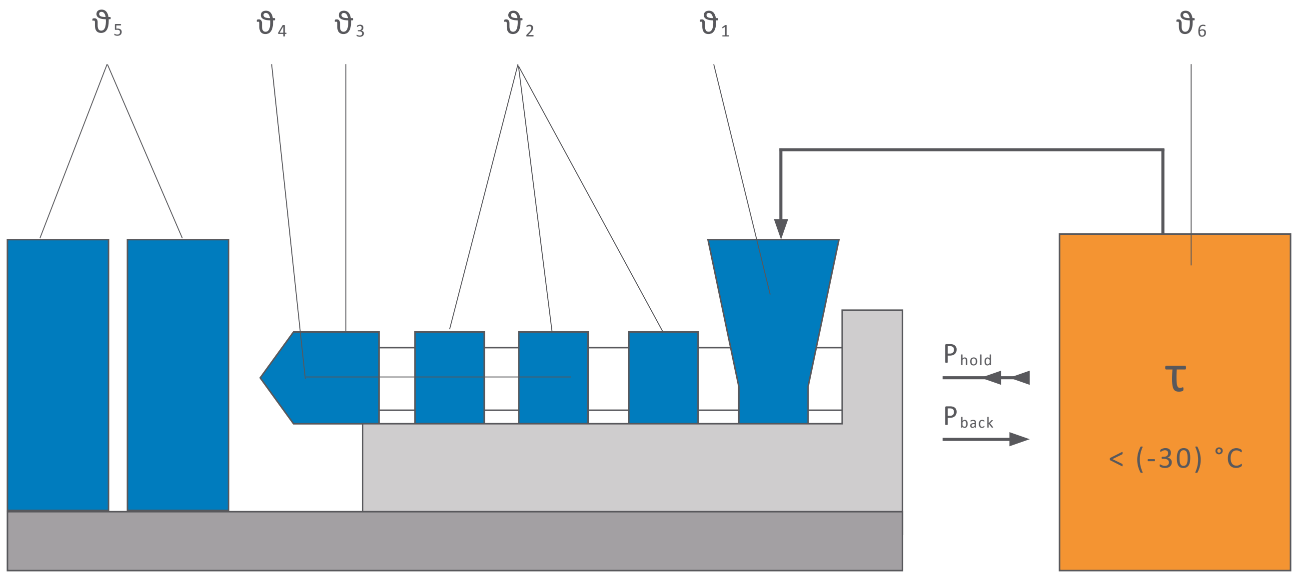
Chairman of the Supervisory Board: Dr. Matthias von Rönn
Commercial Register Koblenz HRB 12227
USt-/VAT-IdNr. DE 811117257



Application circuit board

Processing/Applications

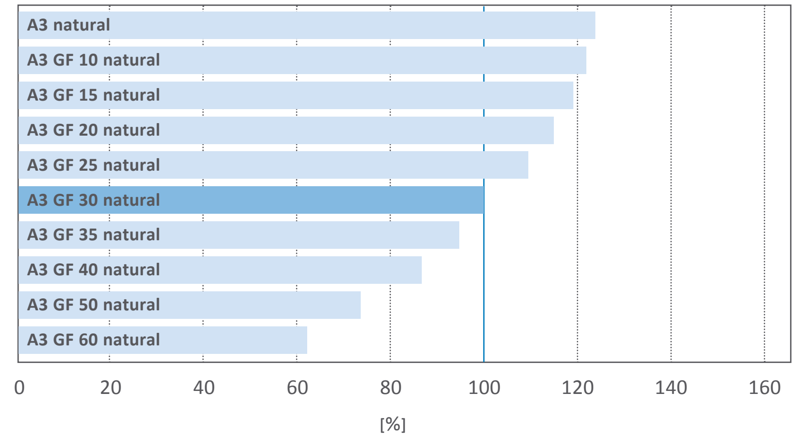
AKROMID® A, B and C can be processed on commercially available injection moulding machines with standard screws according to the recommendations of the machine manufacturer. Please refer to the tables below for our recommended machine, mould and dryer settings (see sketch):



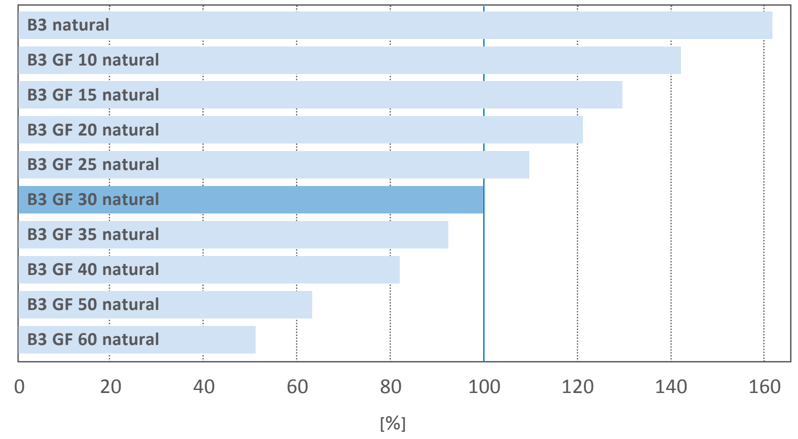
		AKROMID® A	AKROMID® B	AKROMID® C
Flange	ϑ_1	60 – 80 °C	60 – 80 °C	60 – 80 °C
Sector 1 – sector 4	ϑ_2	260 – 310 °C	220 – 300 °C	260 – 300 °C
Nozzle	ϑ_3	270 – 310 °C	230 – 300 °C	260 – 300 °C
Melt temperature	ϑ_4	280 – 310 °C	240 – 300 °C	270 – 300 °C
Mould temperature	ϑ_5	80 – 100 °C	80 – 100 °C	80 – 100 °C
Drying	ϑ_6	0 – 4 h	0 – 4 h	0 – 4 h
Holding pressure, spec.	P_{hold}	300 – 800 bar	300 – 800 bar	300 – 800 bar
Back pressure, spec.	P_{back}	50 – 150 bar	50 – 150 bar	50 – 150 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.
For AKROMID® delivered in bags, no predrying is required when properly stored. It is recommended to use opened bags completely.
Material processed from silo or boxes requires a minimum drying time of 4 h.

Flow length AKROMID® A

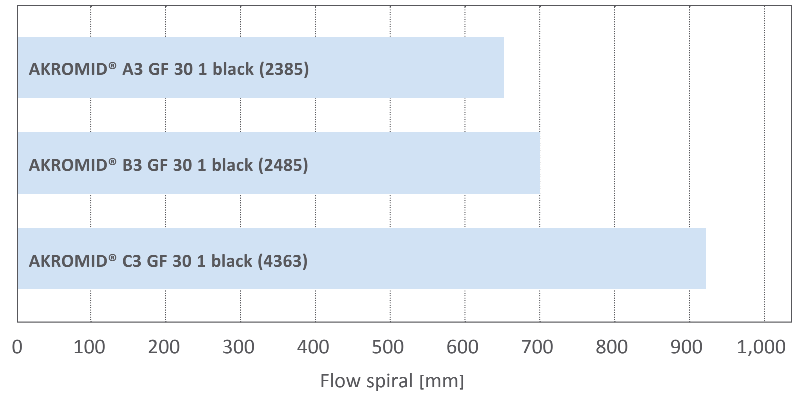


Flow length AKROMID® B



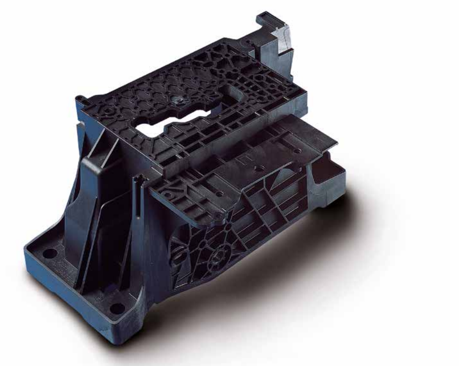
Comparison of AKROMID® C GF flow length

Melt temperature:	300 °C	Injection pressure:	750 bar
Mould temperature:	90 °C	Cross section:	7 x 3,5 [mm²]



Taking account of the processing conditions listed here, AKROMID® A, B and C can be used to make a number of sophisticated engineering parts, depending on the achievable flow paths. Here are a few examples which show that different industries are already successfully using this material in their innovative products.

Due to their excellent surface quality, AKROMID® B compounds (PA 6) are choice materials in the sports and leisure sector. Since the temperature level for many automotive applications (shift gates, for instance) requires materials with a higher heat distortion temperature, PA 6.6-based AKROMID® A compounds have become well-established here, unless lower loads allow the use of other AKROMID® compounds.



*Gear shift gate made from AKROMID® A3 GF 30 1 black (2385)**

* Thermal aging stabilisation 1 (long term stability up to 130 °C)
Thermal aging stabilisation 5 (long term stability up to 150 °C), subdued colors only

Lambda sensor holder made from AKROMID® B3 GF 30 black (2485)

Applications

In order to expand the range of possible applications with AKROMID® A, B and C to include specific production methods, materials have been developed which are specifically suited to fluid injection technology (FIT). This technology is used to manufacture components with relatively thick walls as well as components with hollow spaces. The fluid used can be either gas (GIT) or water (WIT). Materials designated as “WIT” are used when special attention is required for the formation of particularly high-quality surface finishes in the interior.

Thus components which are used in the engine cooling circuit of a number of different motor vehicles are made of our AKROMID® A3 GM 20/10 4 WIT black (4529). The advantages of this material lie in the extremely easy processability of our AKROMID®, which was optimised specifically for the water-injection process. The material is used in both the reverse-pressure mass process and the overflow cavity process.

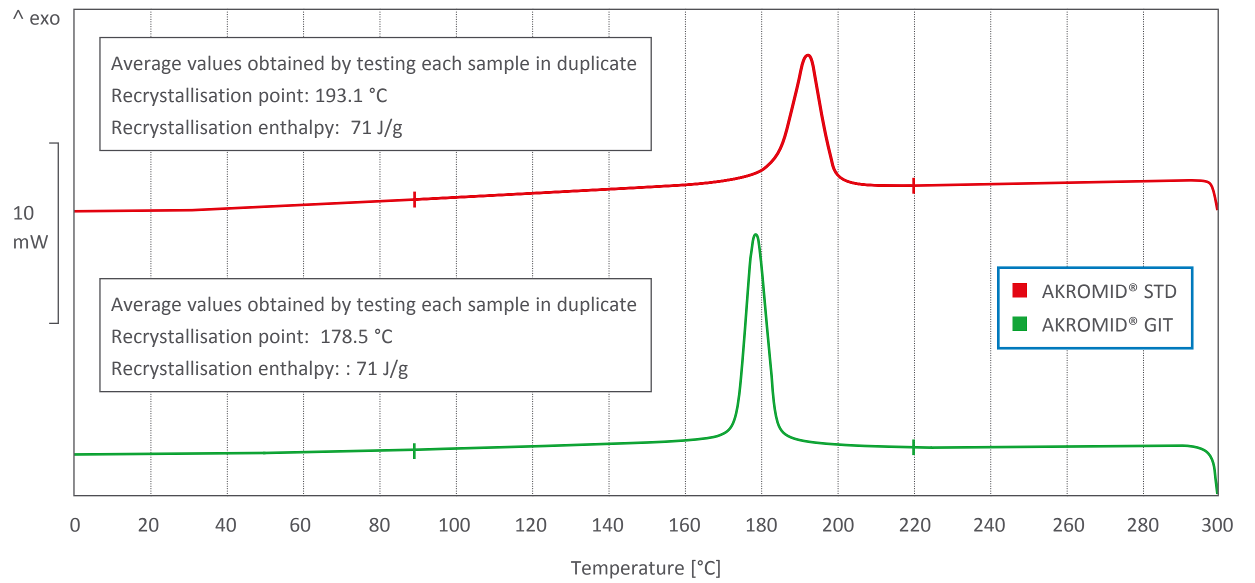
The most important step, irrespective of the selected method, remains the use an appropriate design of the component and, of course, the material. We are happy to assist you in choosing a process and material suitable for your application. Because one thing is certain when dealing with custom processes: the process complexity increases. Our materials are produced within such narrow production tolerances that our AKROMID® WIT and GIT blends guarantee a stable process. But it isn’t just the reproducibility which exceeds that of most of our competitors; so too does our process window. A sophisticated polymer technology enables us to lower the recystallisation point of the GIT and WIT blends without negatively impacting the crystallinity. In the DSC curve shown here, the AKROMID® GIT variant demonstrates a nearly 15 K lower recrystallisation temperature with the same recrystallisation enthalpy (see Fig. 1).

The result of this modification is useful not only for gas-injection applications but also for standard injection-moulding applications. The illustrated component section shows the high surface quality which can be achieved with AKROMID® A3 GF 15 1 GIT black (4620).

Valve seat with AKROMID® A3 GF 15 1 GIT modification

DSC – comparison of AKROMID® STD / GIT

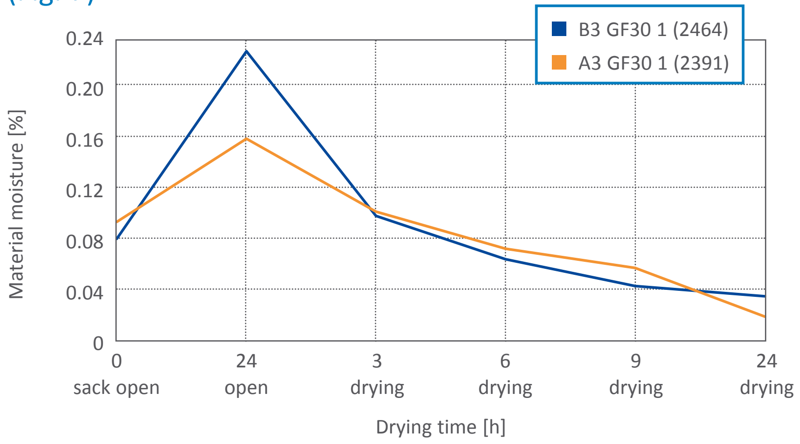
(Fig. 1)



Drying

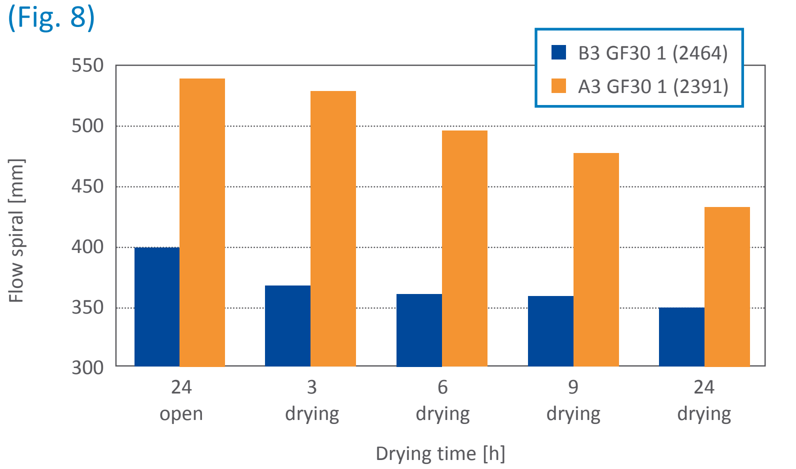
Drying as a function of material moisture

(Fig. 7)



Drying as a function of flow spiral

(Fig. 8)



Example of undesirable surface markings

(Fig. 9)

Most plastic pellets, and polyamide 6 and 6.6 in particular, absorb moisture from the air during storage. An excessive moisture content in the plastic pellet can lead to problems during injection moulding. Visible streaks or bubbles can appear on the component surface, for example. As further secondary effect, due to the presence of water, insufficiently dried pellets can break down hydrolytically during the plastification process.

One might therefore conclude that long drying times are favourable in every instance for the processing of polyamides. Yet this is not the case. During injection moulding, component defects can be caused not only by too much moisture; too little moisture in the pellet can also result in undesirable side effects. Thus for optimal processing, polyamides require a residual moisture content of at least 0.02 %, and up to 0.1 %, for example; quite often, however, the pellet is overly dried, resulting in decreased flowability of the melt (see Fig. 7). Problems with the filler performance are a possible consequence. Moreover, undesirable surface markings can also occur (see Fig. 9).

Drying of AKROMID® pellets made of foil-laminated PE sacks is not necessary, provided the pellet is removed from an undamaged container. It must be ensured that the container has reached ambient temperature prior to opening in order to prevent the formation of condensate. Dried pellets should be processed as quickly as possible and whilst still hot. If the containers are open, the required drying time can increase significantly due to moisture absorbed from the air.

Trouble shooting

For effective trouble shooting it is desirable to be able to clearly attribute a defect to a certain symptom. We have listed the most frequent cases alphabetically in the table below. Corrective actions are divided into the areas of processing and mould/finished part and listed in order of probability.

Symptom	Description	Process and processing optimisation	Mould and part optimisation
Flaking, scaling, lamination, delamination	Surface layers can be pulled off due to delamination	Check material for contamination, reduce or graduate injection speed, increase back pressure, increase mould and melt temperature	Smooth gate transitions with radius
Weld line	Line marks formed by the meeting of melting fronts	Increase mould and melt temperature, increase back and holding pressure, increase injection speed	Check mould ventilation, move gate, increase surface roughness
Diesel effect	Discoloration (burning) at the point of fill	Decrease injection speed and pressure, gradually towards the point of fill reduce or avoid screw retraction entirely	Check mould venting and, if required, increase
Sink marks	Surface recesses on the reverse side of ribs, domes or changes of wall thickness	If applicable, increase metering stroke, increase holding pressure and time, optimise injection speed	Enlarge or move gate, improve mould temperature control, optimise wall thickness or rib ratio, shorten flow paths
Color streaks (with use of masterbatch)	Locally limited color changes on the surface	Local surface color variations, increase back pressure and screw speed, change pigment size, if necessary use polymer specific masterbatch	Change gate size, use shear/mixing charge
Moisture streaks	Silvery streaks in the direction of flow	Dry material sufficiently, increase mould temperature, degas through the cylinder (vented)	

Symptom	Description	Process and processing optimisation	Mould and part optimisation
Jetting	Meandering surface pattern due to lack of wall adhesion of melt	Reduce injection speed in first stage significantly, increase mould temperature, decrease melting temperature	Change location or geometry of gate, inject against rebounding surface
Glass fibre streak	Rough surface, glass fibres visible on the surface, greying	Increase holding pressure and time, increase injection speed, increase mould and melt temperature, increase back pressure and screw speed	
Flash	Over-injection at the parting line and valves, inserts and ejectors	Increase mould clamping force, reduce dwell pressure and time, stage injection speed	Improve rigidity of mould, check for wear
Air streaks	Silvery streaks at ribs, domes and wall thickness changes	Reduce injection speed, increase back pressure and screw speed, reduce or avoid screw retraction entirely	Round off sharp edges, change location of gate, check contact of nozzle with mould and contact surface of nozzle in cylinder
Voids	Vacuum inclusions inside the part	Increase back pressure, increase holding pressure and time, reduce injection speed, increase metering distance and melt cushion	Enlarge gate, move closer to mass accumulation, reduce material accumulation
Matt areas	Dull surface in the gate area	Reduce injection speed, graduate quicker towards end of filling	Enlarge gate, round off sharp edges at gate
Burn streaks	Dark streaks due to thermally damaged material	Reduce injection speed, reduce back pressure and screw speed, reduce melt temperature (hot runner temperature)	Enlarge flow cross-section, optimise gates

Resistance to media

The information regarding chemical resistance are subjective ratings based on resistance experiments according to standards DIN EN ISO 175, DIN EN ISO 11403-3, DIN EN ISO 22088. The information is intended for an initial assessment only.

Medium	Temp. (°C)	Conc. (%)	pass	fail
Acetaldehyde	23	40		•
Acetone	23	100	•	
Acetonitrile	23	100	•	
Acrylonitrile	23	100	•	
Allyl alcohol	23	96		•
Formic acid	23	2		•
Ammonia, aqueous	23	10	•	
Amyl alcohol	23	100	•	
Benzine	23	100	•	
Benzine	40	100		•
Benzene	23	100	•	
Boric acid	23	10	•	
Boric acid	23	100		•
Brake fluid (DOT 4)	130	100		•
Brake fluid (DOT 4)	23	100	•	
Biodiesel	23	100	•	
Calcium chloride, aqueous	23	10	•	
Calcium chloride, alcoholic	23	10		•
Chlorine	23	100		•
Chloracetic acid	23	50		•
Hydrogen chloride, gas	23	100		•
Chlorine water	23	100		•
Chromic acid	23	10		•
Cyclohexane	23	100	•	
Cyclohexanol	23	100	•	
Dichloro-Acetic acid	23	50		•
Diesel fuel (DIN EN 590)	23	100	•	
Natural gas	23	100	•	
Acetic Acid	23	20	•	
Ethanol	23	96	•	
Ethyl acetate	23	100	•	
Ethylene glycol/water	120	50		•
Formaldehyde, aqueous	23	10	•	
Transmission oil (ATF m 1375.4)	150	100	•	
Glycerin	23	100	•	
Urea, aqueous	23	20	•	

Medium	Temp. (°C)	Conc. (%)	pass	fail
Hydraulic oil H and HL (DIN 51524)	100	100	•	
Iso-octanol	23	100	•	
Isopropanol	23	100	•	
Caustic potash solution, aqueous	23	50	•	
Potassium chloride, aqueous	23	10	•	
Potassium permanganate, aqueous	23	10		•
Carbonic acid	60	100	•	
Methanol	23	100	•	
Methylene chloride	23	100		•
Motor oil (SAE 10W-40)	130	100	•	
Motor oil (SAE 10W-40)	23	100	•	
Sodium chloride, aqueous	23	10	•	
Sodium hydroxide solution, aqueous	23	1	•	
Sodium hypochlorite, aqueous	23	10		•
Oleic acid	23	100	•	
Ozone	23	100		•
Phenol	23	100		•
Phosphoric acid	23	30		•
Nitric acid	23	40		•
Hydrochloric acid	23	36		•
Carbon disulphide	23	100	•	
Sulphuric acid	23	96		•
Sulphuric acid	23	5		•
Seawater	23	100	•	
Silcone fluid	23		•	
Super-grade petrol (DIN 51600)	23	100	•	
Carbon tetrachloride	23	100	•	
Toluol	23	100	•	
Water	up to 50	100	•	
Hydrogen peroxide	23			•
Xylol	23	100	•	
Zinc chloride, aqueous	23	50		•
Citric acid	23	10	•	

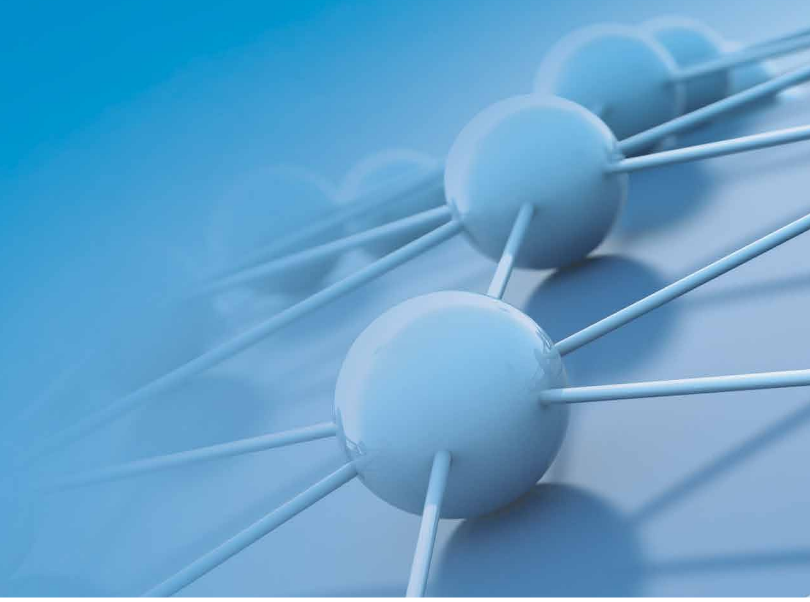
Resistant means:

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.

We will be pleased to meet you!



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