



Modified Engineering Plastics

Engineering Polymers | 2017

PENTAMID



Modified Engineering Plastics

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PENTAMID

PENTAC since 1988



PENTAC Polymer GmbH, a mid-sized, independent and family owned company, is known for innovation, reliability and quality of their engineering plastics.

PENTAC develops and manufactures tailor made products for a wide range of applications. Especially the automotive industry has certified and approved our materials for high end use.

Our customers benefit from our longterm experience in high end compounds fulfilling all requirements of a challenging market.

Polyamide injection molding compounds form the core of our business model.

Significant growth of our business during the last years were the base for substantial investments in our production and logistics facilities. PENTAC's actual capacity adds up to about 30,000 tons of compounds annually.



Passion Mission Vision

PENTAC's vision is based on six pillars, that determine our processes, communication, focus and objectives.

- **Innovation**

Innovation begins in our minds. PENTAC's working culture is oriented to new ideas and developments. Together with our customers we create future solutions and answers to new requirements.

- **Performance**

Average quality was yesterday's standard. We are focussed on specialties with superior performance in nowadays markets. Our compounds are the result of long intense work.

- **Reliability**

A modern quality management system contributes significantly to our success. Process control and steady improvement allow consistent conformity with customers' requirements.

- **Satisfaction**

The customer stands in the focus of all our activities. Compliance with ambitious specifications and customer satisfaction are our ultimate aims. PENTAC always makes an additional effort to improve products and services.

- **Competence**

Finding the best individual solution for our customer is PENTAC's challenging business venture. Excellent education of our staff and many years of experience enable us to guarantee the best possible technical service and after sales support.

- **Improvement**

Stagnation means regression and does not fit into PENTAC's business model. Our philosophy demands continuous improvement process for products, processes, employees' expertise.

Polyamides are:

- semi-crystalline
- tough
- abrasion resistant
- moisture absorbing
- chemical resistant
- temperature resistant
- insulating

Polyamides

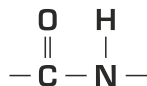


At the beginning there was the protein!

Polyamides – an engineering plastic family making history.

Already in the early 1930's the first polyamides have been used industrially by polycondensation of dicarbonic acid with diamine and hydrolytic polymerization of circular polylactame.

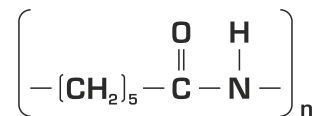
Despite many possible other molecules with a theoretical chance, the market was conquered by Polyamide 6 and Polyamide 6.6 with their well-balanced properties and their convenient feedstock and production costs. The replicated amide group is characteristic for all types of polyamides.



Properties of thermoplastic molding materials are affected by the used monomers. As for many other polymers mineral oil is the production base of the underlying raw materials.

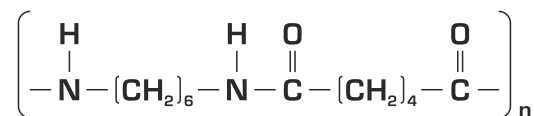
▪ Polyamide 6 = PENTAMID® B

is very tough, with an excellent damping behavior as well as a very good chemical resistance. It is the polyamide with best processing behavior for injection molding applications. Non-reinforced PA 6-compounds are already impact resistant immediately after molding. Impact strength (even for low temperature use) can be increased by adding appropriate impact modifiers. Reinforced PENTAMID®-grades stand out due to high stiffness and rigidity.



▪ Polyamide 6.6 = PENTAMID® A

is the polyamide with the highest values for hardness, stiffness, abrasion and heat resistance. Glass fiber reinforced grades are qualified for applications in the automotive sector due to their stiffness, their resistance against hot water and solvents.



Mineral oil → Benzene → Cyclohexanone →

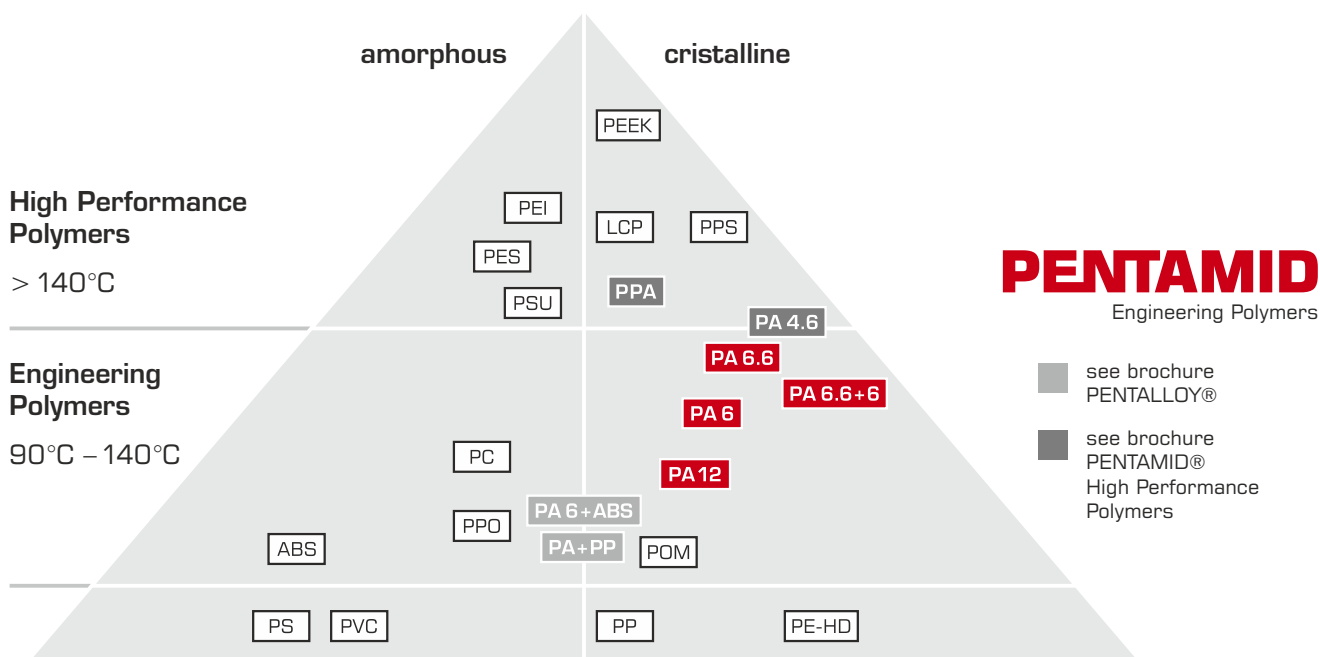
e-Caprolactame Polymerization → PA 6
Adipic acid + HMD Polycondensation → PA 6.6



Product positioning Engineering Polymers

- **Polyamide 6.6+6 = PENTAMID® AB**

Blending the two standard polymers PA 6 and PA 6.6 results in a material that combines the favorable properties of the components, thus providing excellent flowability and a wider processing window.



Nomenclature



	Modification		Modifier level	Stabilization	Additives	Colour
	B	S				
PENTAMID non-reinforced grades	A	SK	.	H	RC	natural
	AB	L	5	H1	UV	black
		E	10	H2	FR	coloured
			20	HYD2		
			10			
PENTAMID reinforced grades		GV	25	.	TF	natural
	B	GK	30	H	LS	black
	A	MK	35	H1	LT	coloured
	AB	MC	40	H2	RC	
		GVB	50	D	UV	
		CV	60	HYD2	FR	

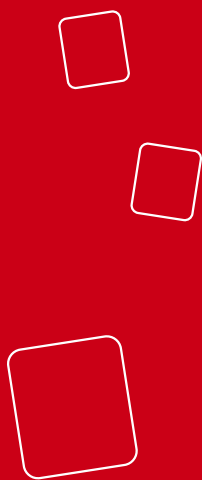
- Modification: **S** easy flowing | **SK** nucleated | **L** dry impact modified | **E** elastomere modified
- Modifier level: **5** slightly modified | **10** medium modified | **20** highly modified
- Type of reinforcement: **GV** glass fiber reinforced | **GK** glass bead reinforced | **MK** „classic“ mineral reinforced | **MC** „special“ mineral reinforced | **GVB** glass fiber / hollow glass spheres reinforced | **CV** carbon fiber reinforced
- Percentage: **10 - 60** amount of reinforcement from 10 up to 60 wt.-%
- Stabilization: **H** heat stabilized | **H1** hot oil resistant | **H2** highly heat resistant | **HYD2** highly hydrolysis resistant
- Additives: **TF** PTFE-additive | **MOS** Molybdenumdisulfide | **LS** laser sensitive | **LT** laser-transparent | **RC** recyclate | **UV** UV-stabilized | **FR** flame-retardant



Portfolio PENTAMID®

	B PA 6	A PA 6.6	AB PA 6.6 + 6	
Product family				page
non-reinforced	•	•		08
non-reinforced, impact modified	•	•	•	12
glass fiber reinforced, standard	•	•	•	16
glass fiber reinforced, easy flowing, highly loaded (Gv50+)	•		•	20
glass fiber reinforced, impact modified	•	•	•	24
glass bead-, mineral-, hybrid reinforced	•	•	•	28
lubricated	•	•		32
laser markable	•	•		36
weight reduced	•	•		40
flame retardant	•	•		44

- available



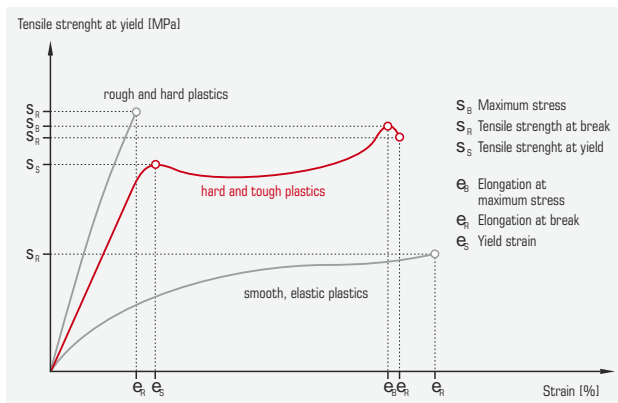
From
polymer to customized **PENTAMID®**
by modification



Applications

- Fixation parts
- Housings
- Mesh
- Covers

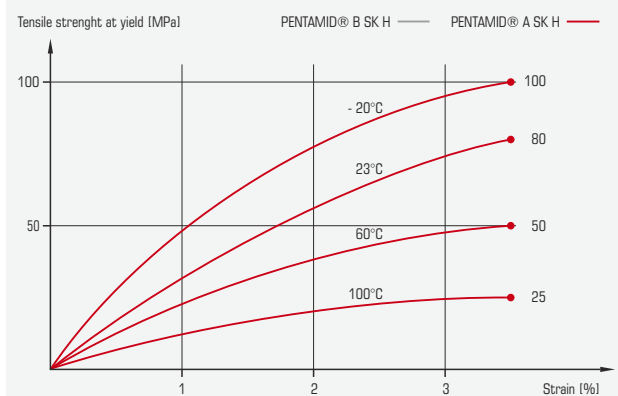
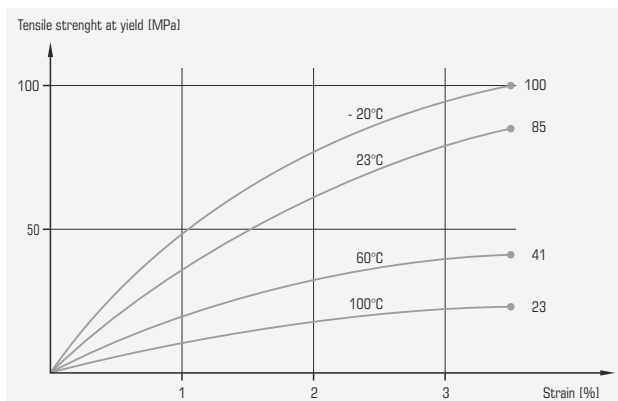
non-reinforced



Our non-reinforced grades contain standard viscosity resins that are modified by lubricants, crystallisation agents, UV and heat stabilisers.

Customized adaptations are our core activities.

Material properties of non-reinforced PENTAMID® are dependent on surrounding conditions such as moisture and temperature.



Stress-/ Strain-curves, PENTAMID® belongs to the material group of hard and tough plastics that is highlighted in red.

Stress-/ Strain-curves depending on temperature for PENTAMID® B SK H and A SK H in comparison.

	Standards	Unit	
Quality			
Color			
easy flowing			

Physical properties

Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.

Mechanical properties

Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.

Thermal and other properties

Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.



B SK H	A SK H	B SK H RC	A SK H RC
---------------	---------------	------------------	------------------

virgin	virgin	RC	RC
+	+	+++	+++

1.13	1.13	1.13	1.13
145	140	135	130
9	7.8	8.9	7.7
3.4	2.6	3.2	2.5
1.6	1.8	1.7	1.9
1.6	1.8	1.8	1.95

3200	3200	3200	3200
1100	1250	1150	1300
85	90	75	75
50	55	45	50
4	4	3	3.5
15	15	14	15

115	120	120	125
-----	-----	-----	-----

3100	3200	3100	3100
------	------	------	------

k.B.	k.B.	k.B.	k.B.
k.B.	k.B.	k.B.	k.B.
8	4	5	3
22	12	18	10

222	260	222	260
65	75	65	75
170	220	170	220
V-2	V-2	HB	HB



Impact modifiers
provide optimal **toughness**





Applications

- Cable channels
- Clips
- Plugs
- Fixation parts
- Holders
- Security parts | Safety parts

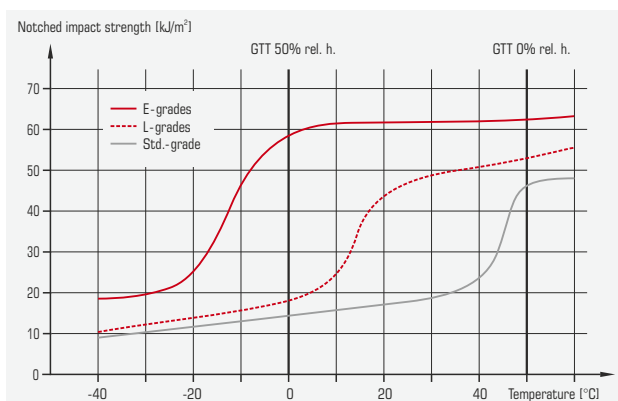
non-reinforced,
impact modified

PENTAMID®-grades are equipped with specific impact modification systems that provide perfect toughness for polyamides and parts made thereof.

These modifications provide excellent impact behaviour at low and ambient temperatures.

PENTAMID® non-reinforced systems are available in two variations:

- L – Modification for a well balanced, dry impact resistant performance
- E – Modification for applications requiring superior low temperature impact properties



Notched impact strength as a function of modification (GTT = glass transition temperature).



* **Processing recommendations**

- Mold temperature: 90°C
- Melt temperature: 270°C
- Injection pressure: 650 bar

	Standards	Unit	
Quality			
Color			
easy flowing			

Physical properties

Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.

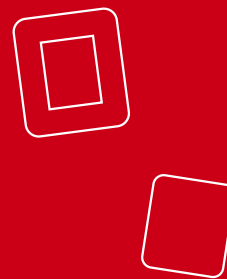
Mechanical properties

Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.

Thermal and other properties

Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.
MVR (5 kg 275°C d.a.m.)	ISO 1133	ml/10 min	d. a. m.
Flow length in PENTAC-flow-spiral (3 mm x 7 mm)*		mm	

	B L5 H	B L10 H	B E20 H	A L10 H	A E20 H	AB L5 H1	AB L5 H1 RC
	virgin	virgin	virgin	virgin	virgin	virgin	RC
	+	+	++	+	++	++	+++
	1.12	1.1	1.03	1.1	1.06	1.11	1.11
	145	145	145	140	140	140	130
	9	8.9	8.5	7.5	7.2	8.2	8.1
	2.6	2.5	2.3	1.9	2.4	2.6	2.5
	1.7	1.5	1.5	1.35	1.3	1.35	1.4
	2.1	1.9	1.7	1.75	1.5	1.35	1.4
	2800	2400	1700	2400	1700	2700	2700
	1100	1000	700	1100	900	1200	1200
	70	65	45	60	50	65	65
	45	45	30	50	35	45	40
	6	8	15	5.5	8	5	4.5
	20	25	35	25	40	20	17
				35	>40		
				100	>50		
	100	90	70	90	70	100	95
	2600	2200	2000	2200	1750	2550	2550
	k.B.	k.B.	k.B.	k.B.	k.B.	k.B.	k.B.
	k.B.	k.B.	k.B.	k.B.	k.B.	k.B.	k.B.
	15	20	k.B.	27	80	19	16
	30	60	k.B.	43	>100	24	22
	222	222	222	260	260	255	255
	60	60	50	65	60	60	60
	175	175	135	180	120	180	180
	HB	HB	HB	HB	HB	HB	HB



Glass fiber reinforced
PENTAMID® has
a wide range of applications

Applications

- Housings
- Fixation parts | Gears
- Air intake manifolds
- Impact plugs
- Cooling water parts
- Gearshift housings
- Fan wheels

glass fiber
reinforced, standard



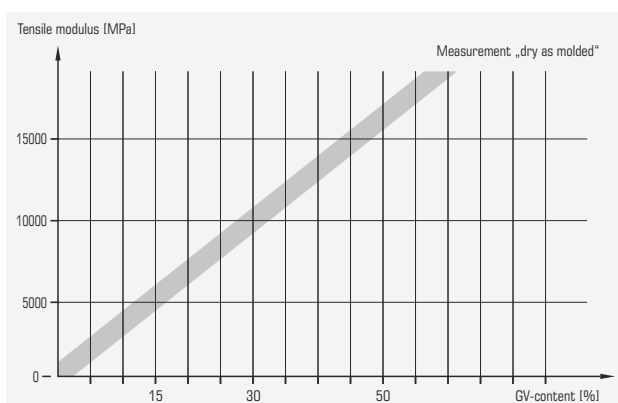
Measurement of length of glass fibers by a surface microscope.

Glass fiber reinforcement is the most common and widely used modification of polyamides. Standard PENTAMID®-grades are offered with GV reinforcements of 15% – 40%.

Component properties are always influenced by injection molding parameters.

Process parameters might improve dimensional stability and surface quality as well as mechanical strength and toughness.

With increasing glass fiber content stiffness increases at the expense of toughness. Glass fiber reinforced polyamides are highly recommended for applications of static and dynamic use because of their low creep tendency.



Stiffness as a function of GV-content [%]
for PA 6, PA 6.6 and PA 4.6.

The values for all polyamides are within the grey band – with a band width of 1.500 MPa.



	Standards	Unit	
Quality			
Color			
easy flowing			

Physical properties

Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.

Mechanical properties

Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.

Thermal and other properties

Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.

B GV15 H	B GV25 H	B GV30 H	B GV35 H	B GV40 H	A GV15 H	A GV25 H	A GV30 H	A GV30 HYD2	A GV35 H	AB GV15 H	AB GV30 H	B GV30 H RC	A GV30 H RC
virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	RC	RC
+	+	+	++	++	+	+	+	++	++	+	+	+++	+++
1.23	1.32	1.36	1.41	1.47	1.23	1.32	1.36	1.36	1.41	1.23	1.36	1.36	1.36
145	145	145	145	145	140	140	140	140	140	140	140	130	130
8	7.2	6.7	6.2	5.9	7	6.4	5.2	5	5	7.2	5.4	6.4	5.1
2.5	2.3	2.1	2	1.8	2.1	2.1	1.6	1.5	1.5	2.2	1.8	2	1.5
0.65	0.4	0.5	0.3	0.25	0.7	0.5	0.4	0.4	0.35	0.65	0.35	0.5	0.5
0.95	0.7	0.7	0.5	0.45	1	0.75	0.7	0.7	0.6	0.95	0.65	0.8	0.8
5600	8200	10000	10400	12550	6000	8500	10000	10300	11000	5900	9750	7800	7800
3200	5600	5500	6700	7100	3500	6300	7500	7500	8600	3400	7200	5300	6400
120	160	190	190	205	130	170	190	185	195	125	170	135	140
75	100	105	115	125	85	120	130	135	140	75	115	105	115
3.8	4.3	3.5	3	3	3	3.2	3.5	3.9	3	3.5	3.5	3	3.5
11	8	6.5	5	5	10	4.8	5	4.9	4	12	5	7	6
170	215	250		255	180	225			260	175	240		
5000	7100	8600		9800	5400	7300			9400	5300	8200		
45	80	95	95	95	50	60	85	80	90	60	90	60	60
70	90	100	100	100	65	75	95	90	95	75	95	80	75
7	14	16	17	19	7	10	13	13	14	10	14	8	7
11	15	21	20	22	9	12	15	16	19	13	16	12	9
222	222	222	222	222	260	260	260	260	260	255	255	222	260
195	205	210	210	215	210	245	240	245	250	200	235	190	225
210	215	220	215	215	250	250	255	255	255	240	250	215	240
HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB



Easy flowing and highly reinforced
PENTAMID® for
extreme engineering requirements

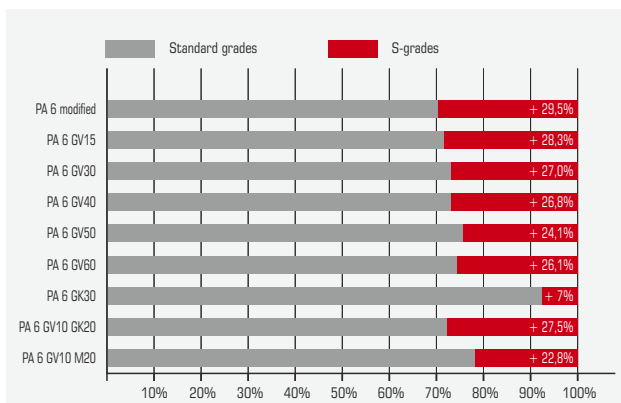




Applications

- Holders
- Gears | Handles
- Fixation parts
- Covers
- Sensors

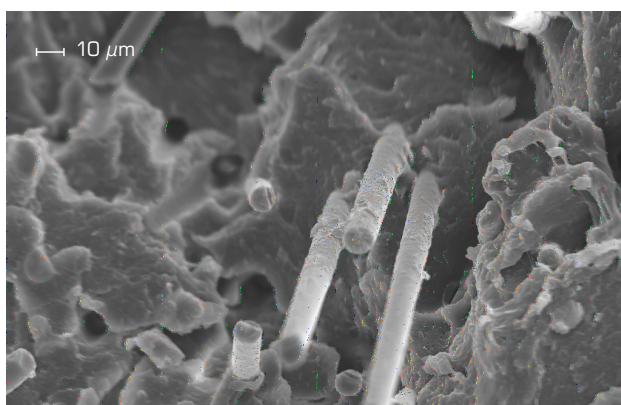
glass fiber reinforced,
easy flowing,
highly loaded (GV50+)



Improved easy flowing PA 6-grades, marked with the letter S in the brand name PENTAMID® B S GV... (glass fiber reinforcements of 15% – 60%) are adapted for the production of components that combine molds with extremely long flow paths at low wall-thicknesses and specified high mechanical properties in combination with good surface quality.

Shorter cycle times will effect cost savings.

Our highly glass fiber reinforced PENTAMID®-formulations (GV50+) can even be used as partial or total substitute of metal or for lightweight construction generally. Using PENTAMID® as metal replacement offers completely new design options without compromising physical properties.

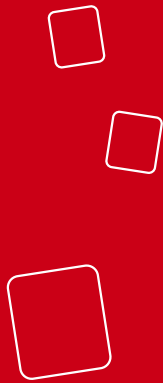


Comparison of flowing behaviour for various PA 6-grades with and without S-modification.

Comparison of the flow length for PENTAMID®-grades B GV30 H and B S GV30 H.

SEM-picture of glass fibers in the polymer matrix for highly loaded PENTAMID® with a reinforcement of GV50+.

glass fiber reinforced,
easy flowing,
highly loaded (GV50+)



* **Processing recommendations**

- Mold temperature: 90°C
- Melt temperature: 270°C
- Injection pressure: 650 bar

	Standards	Unit	
Quality			
Color			
easy flowing			

Physical properties

Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
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Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
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Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.

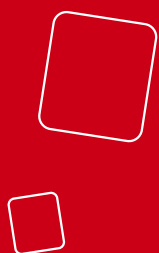
Thermal and other properties

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Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.
MVR (5 kg 275°C d.a.m.)	ISO 1133	ml/10 min	d. a. m.
Flow length in PENTAC-flow-spiral (3 mm x 7 mm)*		mm	

B S GV30 H**B S GV50 H****B S GV60 H****AB S GV50 H****AB S GV60 H**

virgin virgin virgin virgin virgin

+ + + + +
• • • • •1.35 1.56 1.68 1.56 1.64
125 120 120 125 130
6.7 4.8 4 4.8 3.6
2.1 1.5 1.2 1.5 1
0.5 0.25 0.2 0.2 0.2
0.7 0.4 0.35 0.4 0.559700 15400 19000 16500 17500
5500 11000 14700170 215 220 225 235
120 150 155
3.4 2.8 2 2.5 2.5
6 3.8 380 90 95 85 90
95 100 100
12 18 20 15 21
21 26 25222 222 222 255 255
210 210 215 250 250
215 220 220 255 255
HB HB HB HB HB
45 22 16 26 16
750 550 460 500 420



PENTAMID® with **balanced**
stiffness-toughness-characteristics
completes the product portfolio





Applications

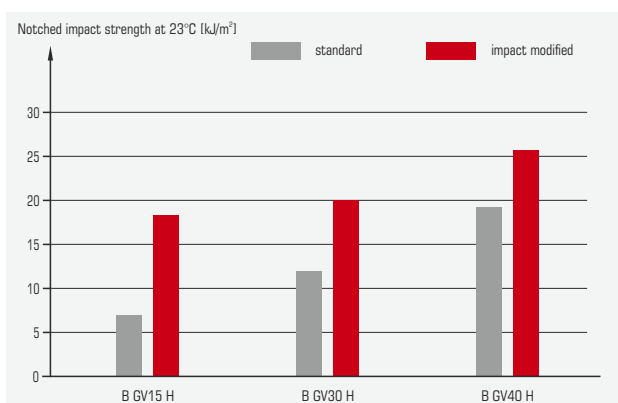
- Impact resistant housings
- Gears | Handles
- Holders | Fixation parts
- Sports equipment

glass fiber reinforced,
impact modified

Impact-modified, glass fiber reinforced PENTAMID® is ready to close the gap between brittle reinforced and tough non-reinforced polyamides. This always allows the right choice of products with appropriate performance.

Again this product group can be supplied with specific modifications for either dry impact resistance or low temperature impact strength.

Due to this impact modification a conditioning of the molded components should no longer be necessary. Based on our long-time experience and know-how additional tailor made product modifications can be developed.



Notched impact strength of various glass fiber reinforced PENTAMID®-B-grades with and without E-modification.

	Standards	Unit	
Quality			
Color			
easy flowing			
Physical properties			
Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.
Mechanical properties			
Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.
Thermal and other properties			
Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.

B GV15 E H**B GV30 E H****B GV50 E H****A GV15 E H****A GV30 E H****AB GV15 L H**

virgin	virgin	virgin	virgin	virgin	virgin
+	+	++	+	+	+

1.21	1.33	1.5	1.21	1.32	1.21
145	145	145	140	140	145
7.8	6.3	5.8	6.8	4.9	7.6
2.4	1.9	1.7	1.9	1.4	2.3
0.6	0.4	0.3	0.7	0.4	0.5
0.85	0.65	0.6	0.95	0.65	0.7

5250	9000	14800	5400	8600	5200
2700	5100	8000	2850	5600	2600

110	145	170	115	140	105
65	115	130	170	110	65
4	3.8	2.8	3.5	3.5	5
12	7.5	5.0	10	6	13

70	80	90	60	70	70
85	>100	>100	75	85	75
18	18	25	15	20	16
23	25	32	20	25	20

222	222	222	260	260	255
180	195	100	180	190	185
195	205	200	225	235	205
HB	HB	HB	HB	HB	HB



Special grades with an **isotropic**
shrinkage behaviour
open new dimensions

glass bead-, mineral-, hybrid reinforced



Applications

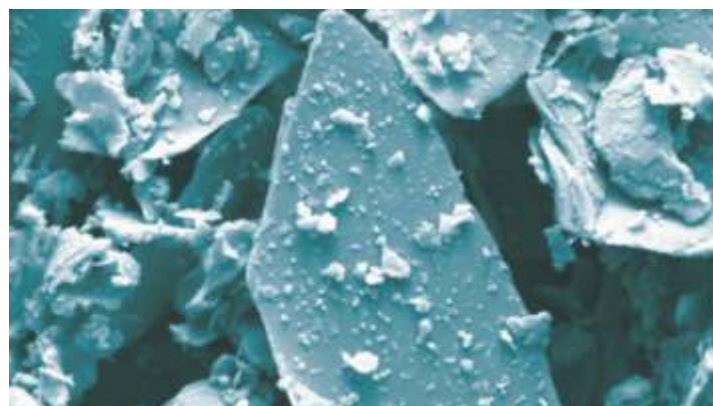
- Beauty covers
- Low-warpage housings
- Rotation symmetric parts
- Relay carriers
- Door handles

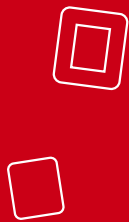
glass bead-,
mineral-,
hybrid reinforced

The possibility to work with non fibrous reinforcement such as glass beads, different kind of minerals and even combinations out of both, which show a isotropic shrinkage behavior on components, has opened new dimensions.

Our PENTAMID® portfolio allows the appropriate choice of polyamide compound for every thinkable specification. Even for challenging requirements as dimensional stability and surface finish.

SEM-pictures of different types of minerals.
Source: Aspanger Bergbau und Mineralwerke GmbH.





* **Processing recommendations**

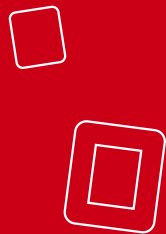
- Mold temperature: 90°C
- Melt temperature: 270°C
- Injection pressure: 650 bar

	Standards	Unit	
Quality			
Color			
easy flowing			
Physical properties			
Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.
Mechanical properties			
Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.
Thermal and other properties			
Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.
MVR (5 kg 275°C d.a.m.)	ISO 1133	ml/10 min	d. a. m.
Flow length in PENTAC-flow-spiral (3 mm x 7 mm)*		mm	

B GK30 H	B MK30 H	B MK40 H	B MK40 E H	A GK30 H	A MK15 H1	A MK30 H	B S GV10 GK20 H	B S GV10 MC20 H2	A GV20 GK10 E H	A GV15 MA15 H RC
virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin	RC
+	+	++	++	+	+++	+	+++	+++	++	+++
							.	.		
1.36	1.36	1.46	1.46	1.36	1.23	1.36	1.35	1.36	1.35	1.36
145	145	145	140	140	140	140	120	120	140	130
6.5	6.7	6.1	5.9	5.2	7	5.2	6.5	6.5	5.2	5.2
2.1	2.1	2.1	2	1.6	2.1	1.6	2.1	2.1	1.8	1.6
0.8	0.85	0.65	1	0.9	1.2	0.8	0.55	0.5	0.5	0.5
0.8	0.95	0.7	1.1	0.9	1.2	1	0.7	0.8	0.8	0.7
4300	5500	6300	6500	4500	3500	4600	5800	8700	7000	6400
2150	2200	2900	3250	2300	1800	2500	3600	5400	4800	4200
75	70	85	80	80	75	80	110	110	130	100
50	50	55	55	55	60	55	65	75	70	80
6	4.8	8	10	6	10	6	2.9	2.7	3.4	4
9	13	15	18	10	9	15	6.3	3.9	5.2	5
50	90	80	k.B.	45	10	80	43	44	70	50
>100	100	95	k.B.	85	15	k.B.	60	62		65
6	9	9	7	6	10	9	5	5	9	5.5
9	14	12	11	8	15	10	8	7	7.5	7
222	222	222	222	260	260	260	222	222	260	260
80	95	105	110	80	90	100	185	200	200	205
195	195	220	205	195	200	225	205	205	225	240
HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB
							55	60		
							760	725		



If it has to go slippery and greasy...





Applications

- Slide bushes
- Valves
- Sliding rails
- Levers | Transport slides

lubricated

Smooth and greasy - special PENTAMID® grades with solid lubricants such as PTFE, Molybdenumdisulfide, carbon fibers etc. make your life (gr)easier.

To use the right combination of lubricants inside our compounds opens up a wide range of possibilities in different applications.

Best tribological properties (sliding friction, dry run condition) of the compounds show even better performances than parts made from metal.

Weight reduction, higher shock- and vibration adsorption, no additional lubrication and the economical production are characteristic for our injection molding compounds.

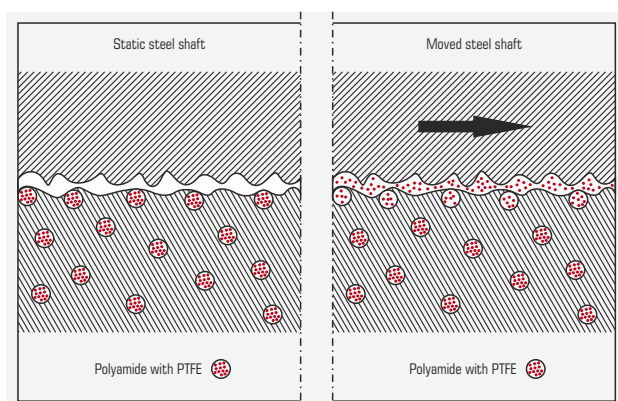


Diagramm shows lubricating scheme.

	Standards	Unit	
Quality			
Color			
easy flowing			
Physical properties			
Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.
Coefficient of friction – static			
Coefficient of friction – dynamic			
Mechanical properties			
Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.
Thermal and other properties			
Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.

B H TF25	A SK H MOS2	A H TF20	A GV30 H MOS	A GV30 H TF15
-----------------	--------------------	-----------------	---------------------	----------------------

virgin	virgin	virgin	virgin	virgin
+	+++	+	+++	+++

1.29	1.14	1.25	1.37	1.47
145	140	140	140	140
6.8	7.6	6.9	5.1	4.7
2.5	2.4	2.4	1.5	1.4
1.4	2.2	1.5	0.45	0.35
1.5	2.3	1.6	0.75	0.45
0.09	0.22	0.1	0.24	0.17
0.21	0.3	0.18	0.3	0.22

2850	3050	2900	10000	9000
1000	1150	1100	6700	6800
55	75	70		
40	45	45		
3	5	3.2		
10	15	12		

	170	155
	125	110
	3.3	3
	3.9	4

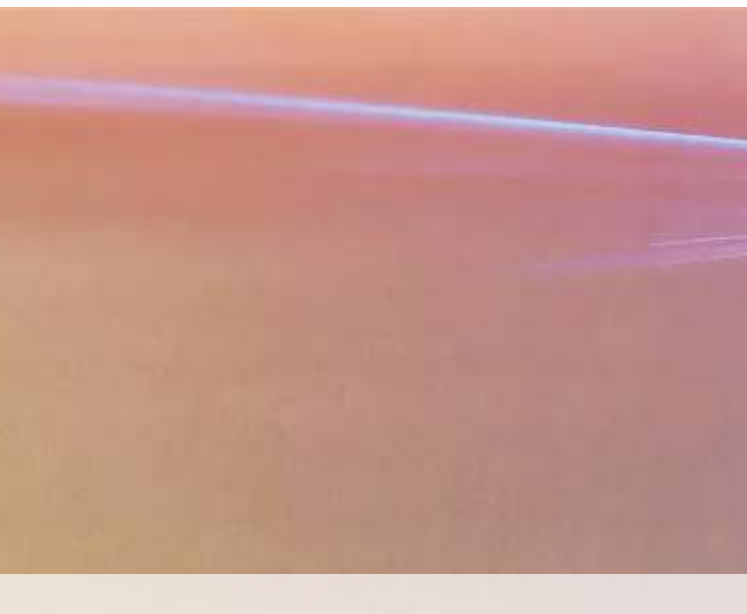
90	115	95	200
----	-----	----	-----

2600	3100	2800	9000
------	------	------	------

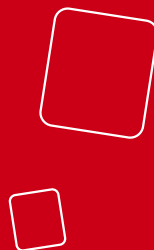
50	n.b.	65	85	60
65	n.b.	80	95	65
3.5	5	5	15	7
8	9	10	16	10

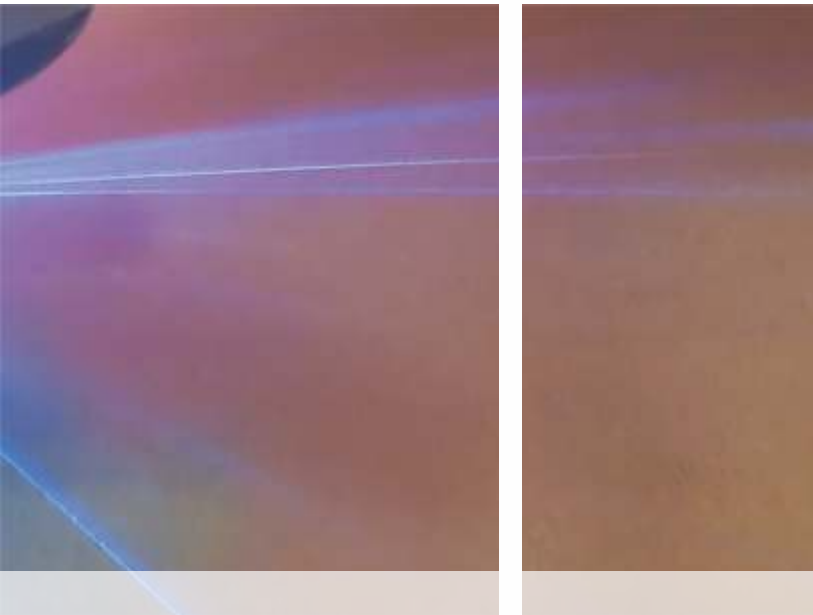
222	260	260	260	260
85	70	85	235	245
185	210	220	255	250
HB	HB	HB	HB	HB





Laser marking brings **information**
on to PENTAMID®

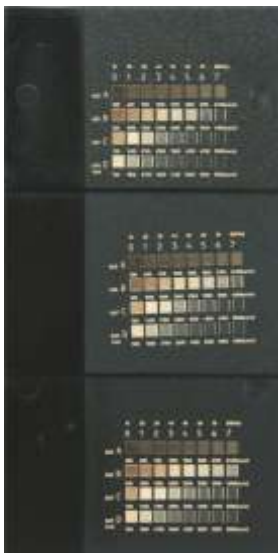




Applications

- Codifications (Data Matrix Code | QR-Code)
- Logos
- Other labeling

laser markable



Depending on focus, feedrate of the scanner mirror, pulse frequency and line spacing, laser marks can be brought on various rough surfaces in different colours.

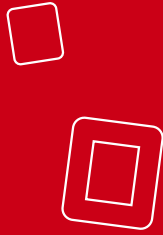
A really innovative possibility of identification: Labeling of technical construction parts made of modified polyamides by controlled laser marking.

- Product safety by a permanent and fraud-resistant label
- No negative influence on part properties by a contactless label
- Positive effect for the environment: solvent free technology and substitution of labels
- High speed labeling is possible during the molding process

Laser marking with high contrast is possible for black, natural, and coloured surfaces of reinforced PA 6 and PA 6.6.



Dark laser marks on natural coloured PENTAMID® LS and bright laser marks on black and natural coloured PENTAMID® LS.



	Standards	Unit	
Quality			
Color			
easy flowing			
Physical properties			
Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.
Mechanical properties			
Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.
Thermal and other properties			
Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.

B GV30 H LT	B GV30 H LS	B GK30 H LS	B S GV10 GK20 H LS	B S GV10 MC20 H2 LS	A GV30 H LS	A GK30 H LS	A SK H LT
virgin	virgin	virgin	virgin	virgin	virgin	virgin	virgin
+++	++	++	+++	+++	++	++	+++
			.	.			
1.35	1.36	1.36	1.36	1.36	1.36	1.36	1.13
145	145	145	145	145	140	140	
6.5	6.6	6.5	6.5	6.7	5.2	5.2	7.8
2.1	2.1	2.1	2.1	2.1	1.6	1.6	2.6
0.4	0.5	0.8	0.5	0.5	0.4	0.9	1.9
0.7	0.7	0.8	0.7	0.8	0.7	0.9	1.9
10000	9900	4300	6300	8200	10000	4500	3600
	5500	2150	3600	5700	7500	2300	
							90
							4
175	175	75	120	110	190	80	
	120	53	65	70	130	55	
3	4	8	4	3.5	3.5	6	
	8	9	10	4.5	5	10	
80	90	50	60	45	85	45	n.b.
	100	>100	80	65	95	85	
14	12	6	4.5	5	13	6	2
	21	9	15	8	15	8	
222	222	222	222	222	260	260	260
210	210	75	185	200	240	80	
215	215	190	210	220	255	195	
	HB	HB	HB	HB	HB	HB	



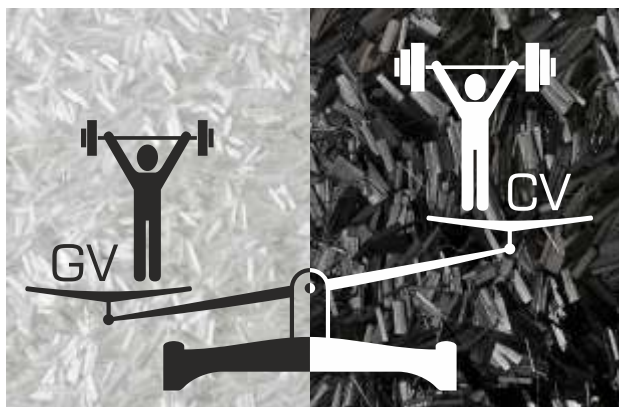
We prefer **lightweights:**
low density polyamide



Applications

- Housings
- Covers
- Fan shrouds
- Levers
- Rail tracks
- Spinning machines
- Bracket parts

weight reduced

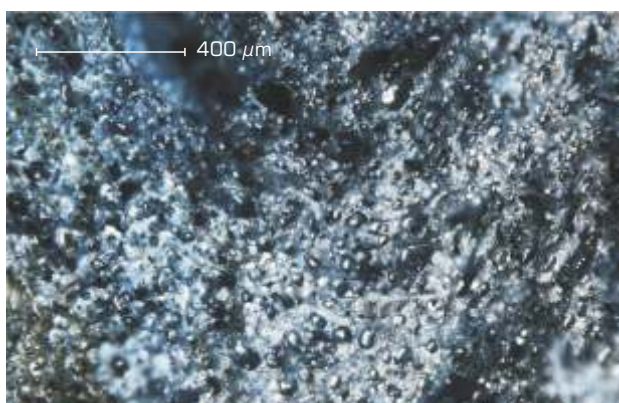
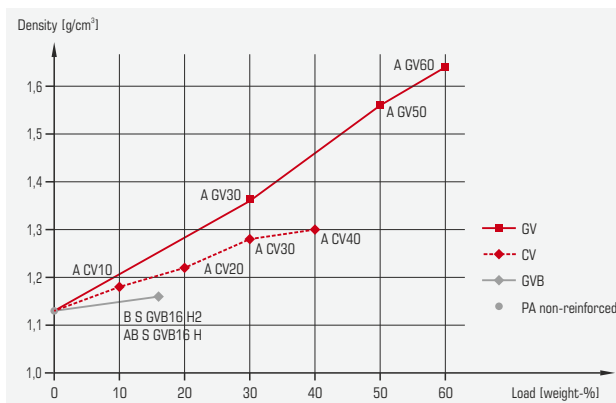


Increased environmental awareness and defined objectives of CO₂ reduction demand for weight reduced automotive parts. Some of PENTAC's new product groups bring these targets into reach

Carbon Fibers – use of the „Black Gold“ allows very high stiffness for highly strained structural components. Density reduction of 25 – 30% versus conventional glass fiber reinforced grades and possible thermal and electrical conductivity make this product group outstanding.

Glass Hollow Spheres – combined with other reinforcements polyamide parts can be produced in the same tools with comparable properties but at 20% reduced weight. Additionally cycle times can be reduced significantly.

Physical Foaming – Addition of an inert gas into the polymer melt provides material savings of up to 12%, reduced cycle times and thus commercial advantages. Decreased warpage, indentation and internal friction generate quality leads.



Demonstration of weight and stability advantages of carbon versus glass fiber reinforcements.

Density versus Load.

REM picture of a physically foamed element.



* Test wasn't done on standard test bar;
MuCell®-values are nevertheless comparable to each other.

** Quasi-density = mass test plate with sprue : mold volume

	Standards	Unit	
Quality			
Color			
Technical Data Sheet (TDS) MuCell®			
Weight saving			

Physical properties

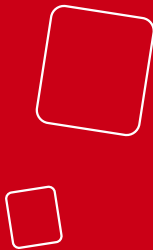
Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.
Optical characteristic		grade (1-6)	
Warpage		grade (1-6)	

Mechanical properties

Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.

Thermal and other properties

Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (1.6 mm)	Rating	d. a. m.



A CV10 H				A CV20 H				A CV30 H				A CV40 H				B S GVB16 H2				B S GV30 H				B S GV10 MC20 H2				A GV30 H											
virgin				virgin				virgin				virgin				virgin				virgin				virgin															
+++				+++				+++				+++				+++				+++				+++															
																TDB				MuCell®				TDB				MuCell®											
																0				0				8				0				0				8			
1.18	1.22	1.28	1.3					1.17										1.35	(1.25)	(1.15)	1.36	(1.28)	(1.18)	1.36	(1.28)	(1.18)	1.36	(1.28)	(1.18)	1.36	(1.28)	(1.18)							
140	140	140	140					121									125	129*		120	126*		140	139*		140	139*		140	139*									
7.8	6.7	5.2	4.7					7									6.7			6.5			5.2			5.2			5.2										
2.6	2.2	1.6	1.4					2.4									2.1			2.1			1.6			1.6			1.6										
0.35	0.25	0.15	0.1					0.6									0.5	0.33*	0.26*	0.5	0.66*	0.51*	0.4	0.46*	0.5*	0.4	0.46*	0.5*	0.4	0.46*	0.5*								
0.5	0.4	0.3	0.2					0.9									0.7	0.87*	0.74*	0.8	0.93*	0.75*	0.7	0.98*	0.9*	0.7	0.98*	0.9*	0.7	0.98*	0.9*								
																		1	3		1	2		1	3		1	3		1	3								
																		3	2		3	2		5	2		5	2		5	2								
8500	16500	20500	31500					5800									9600	6540*	4360*	8700	5800*	3690*	9800	5680*	4430*	9800	5680*	4430*	9800	5680*	4430*								
									5400									5400				7400																	
180	210	230	205					100									165	115*	76*	110	67*	43*	180	101*	67*	180	101*	67*	180	101*	67*								
																	115			75			125			125			125										
2.4	2.2	2	0.8					2.3									3.3	3.51*	3.58*	2.7	2.3*	2.19*	3.5	3.38*	2.26*	3.5	3.38*	2.26*	3.5	3.38*	2.26*								
																	7			3.9			4.5			4.5			4.5										
45	55	65	41					30									75	87*	68*	44	37*	26*	75	54*	55*	75	54*	55*	75	54*	55*								
																	90			62			85			85			85										
5	6.5	8	6.5					4									10	13.7*	14.6*	5	6.96*	6.93*	10	8.1*	8.4*	10	8.1*	8.4*	10	8.1*	8.4*								
																	20			7			12			12			12										
260	260	260	260					222									222			222			260			260			260										
245	250	255	255					190									210			200			240			240			240										
255	255	255	255					220									215			205			255			255			255										
HB	HB	HB	HB					HB																															



Cease fire:

Flame retardant PENTAMID® FR
for your safety!





Anwendungsgebiete

- Connectors | couplings
- Plugs | fuses | terminal blocks
- Switchgears | circuit breakers
- Lighting components
- Brown appliances
- White appliances
- Office equipment | telecommunication
- Power tools
- Motor parts | cable clamps & ties

flame retardant

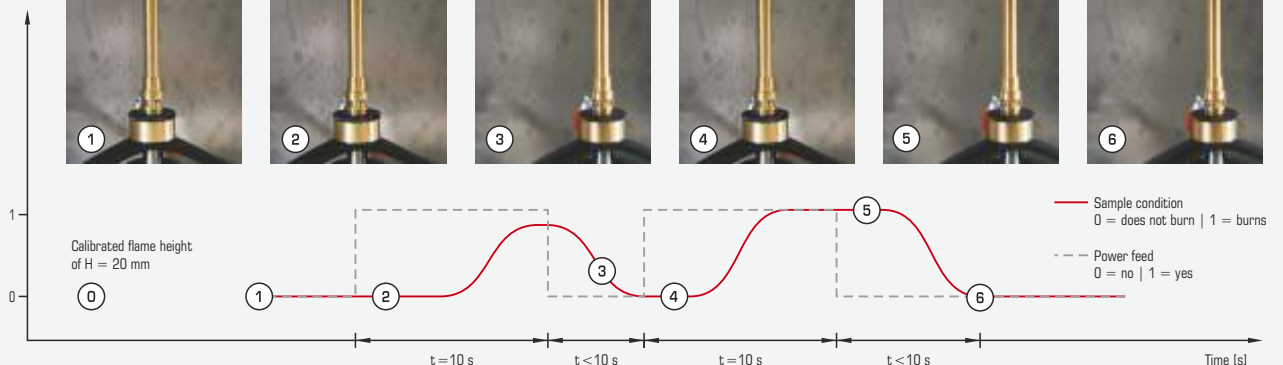
Fires cause significant property damage and human casualties every year. Therefore plastic parts used in electrical and electronic industry, transport and construction are subject to specific fire performance standards.

Our new PENTAMID®-FR-grades fulfill all requirements for mechanical and electrical properties and comply with current flame retardant standards, thus providing required application safety.

To protect our environment from unnecessary strain by harmful substances our FR compounds are halogen and red phosphorous free. In case of fire less smoke and toxic gases are released into the environment.

PENTAMID® FR – with the in-built fire brigade!

Determination of flammability according to UL 94 V:
Based on standard conditions PENTAMID® FR passes V-0.





	Standards	Unit	
Quality			
Color			
easy flowing			
Physical properties			
Density	ISO 1183	g/cm ³	d. a. m.
Viscosity number	ISO 307	ml/g	d. a. m.
Water absorption (saturation)	ISO 62	%	-
Moisture absorption (23°C 50% r.h.)	ISO 62	%	-
Molding shrinkage parallel	ISO 294-4	%	d. a. m.
Molding shrinkage normal	ISO 294-4	%	d. a. m.
Mechanical properties			
Tensile modulus	ISO 527-2 (1 mm/min)	MPa	d. a. m. cond.
Tensile strength at yield	ISO 527-2 (50 mm/min)	MPa	d. a. m. cond.
Elongation at yield	ISO 527-2 (50 mm/min)	%	d. a. m. cond.
Stress at break	ISO 527-2 (5 mm/min)	MPa	d. a. m. cond.
Strain at break	ISO 527-2 (5 mm/min)	%	d. a. m. cond.
Flexural strength at break	ISO 178	MPa	d. a. m. cond.
Flexural modulus	ISO 178	MPa	d. a. m. cond.
Impact strength (Charpy @ 23°C)	ISO 179/1eU	kJ/m ²	d. a. m. cond.
Notched impact strength (Charpy @ 23°C)	ISO 179/1eA	kJ/m ²	d. a. m. cond.
Thermal and other properties			
Melting point (DSC)	ISO 11357	°C	d. a. m.
Heat deflection temperature HDT/A	ISO 75 (1.80 MPa)	°C	d. a. m.
Heat deflection temperature HDT/B	ISO 75 (0.45 MPa)	°C	d. a. m.
Flammability class (UL 94)	ISO 1210 (0.8 mm)	Rating	d. a. m.
Comparative tracking index (CTI)	IEC 60112	-	
Glow Wire Flammability Index (GWFI)	IEC 60695-2-12 (0.8 mm)	°C	
Glow Wire Ignition Temperature (GWIT)	IEC 60695-2-13 (0.8 mm)	°C	
Burning rate	FMVSS 302		



B S GV25 H FR

B S GV30 H FR

A S GV25 H FR

A S GV30 H FR

A S MIK30 H FR

virgin virgin virgin virgin virgin

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1.39 1.44 1.39 1.44 1.44

5.8 4.9 5.8 4.9 4.9

1.9 1.6 1.9 1.6 1.6

0.4 0.4 0.4 0.4 1.5

0.9 0.9 1.1 1 1.5

9500 10300 9600 10400 7000

130 140 130 140 70

2.5 2.5 2.5 2.5 2

60 65 60 65 30

9 10 9 10 5

222 222 260 260 260

210 210 235 240 110

215 215 250 250 235

V-0 V-0 V-0 V-0 V-0

600 600 600 600 600

960 960 960 960 960

800 825 825 825 825

<100 <100 <100 <100 <100

Quality



Our customers expect the best quality from us. Therefore a complete and accurate analysis of the used raw materials is essential. Defined effective control procedures for incoming raw materials and production parameters secure high quality standards for our clients.

Compliance with European standards (ISO 9001, ISO 14001, ISO 50001) guarantee quality as well as responsible handling of environment and resources.

To cope with the high standards of our customers, we are using state of the art technologies in our plant. A very well equipped laboratory with fully automatic analysis devices and a continuous control system, as well as a quick and easy recording of all data by using high-tech communication devices provides the basis for an extensive and complete control and documentation system.

Certificates of analysis acc. EN 10204 3.1, permanent evaluation of suppliers and regular audits are part of our regular work.

Last but not least the longtime experience of our staff supports the consequent quality-, environment- and energy policy of PENTAC.





Processing Handling Service

Processing recommendations for PENTAMID®

■ Preparation | Drying

PENTAMID® will be delivered for immediate use. To avoid moisture condensation on the pellets you should store the product 24 hours before processing at ambient temperature. It is recommended to dry the pellets at a temperature of 80°C for 3 hours in a dry air dryer.

Please carefully attend to the recommended moisture level between 0.05% and 0.13%. Please find the influence of moisture with respect to the flowability on the charts below. In case of open or destroyed packaging a pre-drying is mandatory.

■ Plasticizing | Dosing

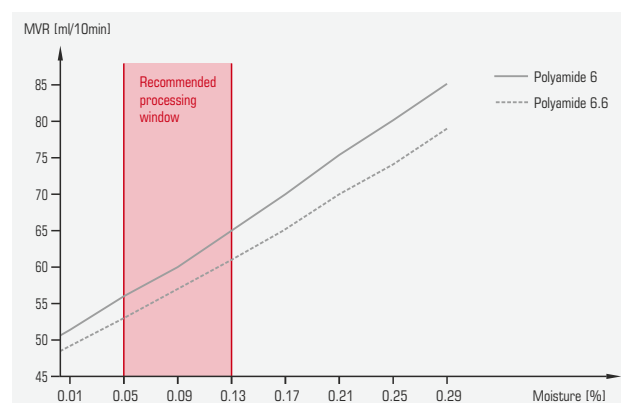
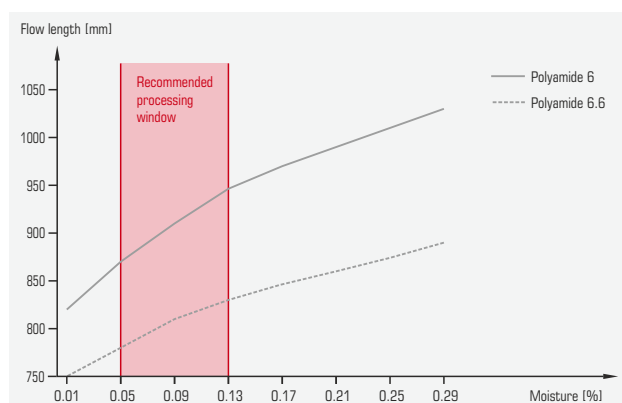
Polymers should always be plasticized as gently as possible. For this, adjust the screw speed at

such a level, that the available cooling time is used by about 80% to allow the polymer to be molten by the heaters.

For processing our engineering resins, we recommend dosing screws with a compression ratio of about 1:2.2 – 2.8. The feeding zone should be relatively long (50 – 60% L), compression zone rather short (20 – 25% L), to avoid excessive wear in the compression zone itself (L/D-ratio 20 ± 2).

We also recommend the use of high-alloy steels which are corrosion resistant. A regular maintenance of the check-valve is recommended.

PENTAC recommends the use of a filter nozzle when molding our ReCompounds – PENTAC is using a melt filtration system for the production of our RC-grades which removes any solid impurities >0.6 mm in order to avoid blockades of hot runner systems.





▪ **Recommended processing parameters**

Please find the recommended melt temperatures for our different grades in the following table:

PENTAMID®	Recommended processing temperatures					
	Zone 5	Zone 4	Zone 3	Zone 2	Zone 1	Feed zone
PA 6	275°C	280°C	275°C	270°C	260°C	80°C
PA 6.6	285°C	290°C	285°C	280°C	270°C	80°C
PA 6.6 + 6	280°C	285°C	280°C	275°C	265°C	80°C

PENTAMID® should be processed at a mold temperature of $80 \pm 20^\circ\text{C}$. The higher the temperature of the mold the higher the crystallinity and therefore the higher the dimension stability and smoother the surface quality.

Please find all relevant data for our process parameters on our recommendations at www.pentac.de.

Grade	Polyamide	Melting temperature	Chemical raw material composition
PENTAMID® B	6	222°C	ϵ -Caprolactame
PENTAMID® A	6.6	260°C	Hexamethyldiamine, Adipic acid
PENTAMID® AB	6.6 + 6	255°C	Alloy of PA 6.6 and PA 6



▪ Shrinkage

The shrinkage of polymer material is no constant value. Besides the formulation, the shrinkage depends on:

- Wall thickness of the part
- Holding pressure
- Cooling time
- Mold temperature
- Fiber orientation

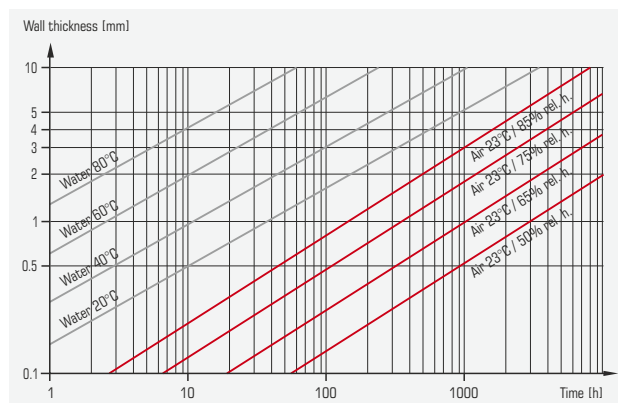
Therefore stated shrinkage data are only indicative.

Please find additional and individual information on our technical data sheets at www.pentac.de.

▪ Conditioning

Polyamides show their best properties after absorbing moisture. Conditioning of parts, which means the storing in water or warm and humid climatic chambers represent the most common procedures. The moisture absorption depends on the storage conditions, time and wall thickness.

The chart above shall give some base values about moisture absorption.



▪ Use of re-ground material

In general the use of 10 – 20% is possible, if the following aspects are respected:

- Residual moisture content should be not high
- Particle size of material must be homogenous
- Purity is to be ensured
- Change of mechanical properties is acceptable

For this purpose PENTAC recommends the use of our special ReCompounds (RC-grades), which consist of 2/3 virgin qualities and 1/3 second choice qualities (proofed sources of recycled material). These compounds possess very homogenous characteristics and guarantee highest standards of product safety.

Please find further information at www.pentac.de.



Post-processing recommendations for PENTAMID®

There are different possibilities to finish parts made of PENTAMID®. We want to give a basic recommendation for that:

▪ **Painting**

Polyamides are usable for painting due to their excellent resistance against most solvents. As usually the procedure of post-processing have to be adjusted to the respective PENTAMID®-grade.

Most PENTAMID®-grades cannot be powder coated; in those cases we recommend our conductive PENTAMID®-grades.

▪ **Printing**

Contrary to the painting process PENTAMID®-grades are easy to imprint with most common print technologies without any pretreatment. The molded parts must be free of any mold release agent.

▪ **Welding**

Parts made from PENTAMID® can be welded by all known and common methods, e.g. ultra-sonic-, diode-, friction-, and infrared-welding. The best method depends mainly on the geometry of the part, mechanical strength is excellent.

▪ **Plating**

Mineral reinforced PENTAMID® with their outstanding surface quality can be easily galvanized. Mechanical properties might be changed in the process.

▪ **Laser marking**

One of the smartest labeling procedures is the marking of our laser sensitive and markable polyamides. PENTAC offers a variety of PENTAMID®-LS-grades, which can be labeled permanently and fraud resistant by controlled laser beams. Due to the contactless labeling there is no negative influence on the mechanical properties.

It is our specialty to label bright surfaces as well as dark surfaces made of reinforced PA 6 and PA 6.6.

▪ **Bonding**

Because of their outstanding chemical resistance polyamides do not respond well to bonding. Special surface treatments can facilitate adhesion.

Reactive adhesives (e.g. multi-component systems) are preferred versus solvent adhesive glues due to their very aggressive and harmful ingredients.



Imprint

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Modified Engineering Plastics

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