



Delivery programme

Semi-finished products made of thermoplastics

We are producer of semi-finished plastics.

Our service for you:

- Sheets, Rods, Tubes
- Pre-cut pieces
- Machined parts

We are certified according to
DIN EN ISO 9001:2015

Please note that all weights provided in this catalog are theoretical values. Invoicing is based on the measured effective weight.

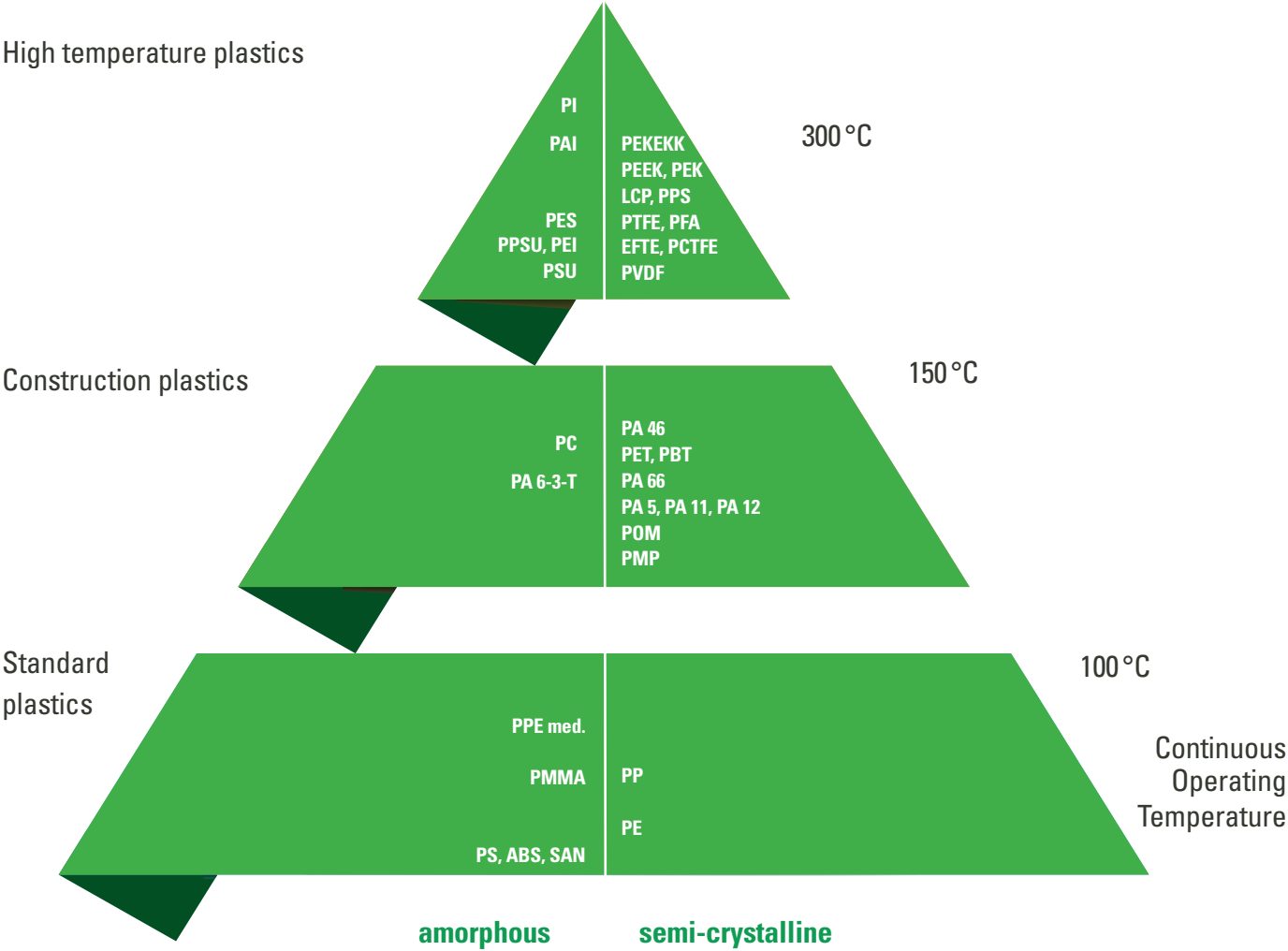
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Thermoplastics for construction parts

POM, PA, PET, PE, PP

Classification of plastics



Rods POM-C

1,000 + 3,000 mm standard length | tolerances according to DIN EN 15860

Ø	Tolerance in mm	ca. Weight in kg/m	natural	black	blue
5	+0.1/+0.6	0.03	o	o	o
6		0.05	+	+	o
8	+0.1/+0.7	0.08	+	+	o
10		0.12	+	+	o
12	+0.2/+0.8	0.18	+	+	o
14		0.24	o	o	o
15		0.27	o	o	o
16		0.31	+	+	o
18		0.39	+	+	o
20		0.48	+	+	o
22	+0.2/+1.0	0.57	o	o	o
25		0.74	+	+	o
28		0.92	+	+	o
30		1.06	+	+	o
32	+0.2/+1.2	1.22	o	o	o
35		1.49	o	o	o
36		1.54	+	+	o
40		1.94	+	+	o
45	+0.3/+1.3	2.42	+	+	o
50		2.94	+	+	o
55		3.70	o	o	o
56		3.73	+	+	o
60	+0.3/+1.6	4.23	+	+	o
65		5.01	o	o	o
70		5.80	+	+	o
75	+0.4/+2.0	6.63	o	o	o
80		7.57	+	+	o
85	+0.5/+2.2	8.43	o	o	o
90		9.60	+	+	o
95	+0.6/+2.5	10.60	o	o	o
100		11.83	+	+	o
110	+0.7/+3.0	14.30	+	+	o
115	+0.8/+3.5	15.50	o	o	o
120		17.20	+	+	o
125		18.53	+	+	o
130	+0.9/+3.8	20.08	+	+	o
140		23.30	+	+	o
150	+1.0/+4.2	26.40	+	+	o
160	+1.1/+4.5	30.10	+	+	o
170	+1.2/+5.0	33.80	+	o	o
180		37.90	+	+	o
200	+1.3/+5.5	46.80	+	+	o
210	+1.3/+5.8	51.70	o	o	o
220		57.50	o	o	o
250	+1.5/+6.2	73.10	o	o	o
280	+1.5/+6.6	92.50	o	o	o
300	+1.5/+7.5	104.00	o	o	o

+ Standard article

o Production on request

Delivery programme

Tubes POM-C

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø mm	AD Tol. in mm	ID Tol. in mm	ca. kg/m	natural	black
20 / 10	+0.4/+1.1	-0.4/-1.1	0.39	+	o
25 / 12			0.62	o	o
25 / 15			0.54	+	o
30 / 15			0.92	o	o
30 / 20			0.70	+	+
36 / 15	+0.6/+2.0	-0.6/-2.0	1.39	o	o
36 / 20			1.20	o	o
36 / 25			0.99	+	+
40 / 20			1.54	+	+
40 / 25			1.26	o	o
40 / 30			1.00	+	+
45 / 30			1.55	+	o
50 / 20			2.59	+	o
50 / 25			2.40	o	o
50 / 30			2.07	o	o
50 / 40			1.30	o	o
56 / 25	+0.8/+2.5	-0.8/-2.5	3.10	o	o
56 / 30			2.80	o	o
56 / 40			2.10	o	o
60 / 30			3.42	+	+
60 / 40			2.73	o	o
60 / 50			1.64	o	o
65 / 30	+0.8/+3.0	-0.8/-3.0	4.10	+	o
65 / 40			3.34	o	o
65 / 50			2.55	+	o
70 / 30			4.96	+	o
70 / 40			4.10	o	o
70 / 50			3.30	+	+
75 / 50			4.20	o	o
80 / 40			6.05	+	+
80 / 50			5.20	+	+
80 / 60			3.90	+	o
85 / 40	+1.2/+3.6	-1.6/-5.0	7.10	o	o
90 / 50			7.23	+	+
90 / 60			6.10	+	o
90 / 70			4.78	+	o
100 / 50			9.30	+	o
100 / 60			8.20	+	o
100 / 70			6.90	+	o
100 / 80			5.50	+	o
110 / 50			11.50	o	o

+ Standard article

o Production on request

Tubes POM-C

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø mm	AD Tol. mm	ID Tol. mm	ca. kg/m	natural	black
110 / 60			12.00	o	o
110 / 80			7.60	+	o
110 / 90			5.70	+	o
115 / 90	+1.5/+4.5	-2.0/-6.5	7.10	o	o
120 / 60			13.40	+	o
120 / 80			10.50	+	o
120 / 100			6.50	+	o
125 / 50			15.80	o	o
125 / 90			10.10	+	o
130 / 100			9.60	+	o
130 / 110			7.10	+	o
140 / 110			10.70	+	o
140 / 120			7.90	+	o
150 / 80			19.80	+	o
150 / 100			16.30	+	o
150 / 120			11.30	+	o
160 / 100	+1.8/+5.4	-2.2/-7.5	19.40	+	+
160 / 120			15.40	+	o
160 / 130			12.30	+	o
160 / 140			9.60	+	o
180 / 120			23.20	+	+
180 / 140			17.80	+	o
180 / 150			14.60	+	o
180 / 160			11.20	+	o
200 / 100	+2.0/+6.0	-2.5/-8.5	36.20	+	o
200 / 150			23.60	+	+
200 / 160			20.10	+	o
200 / 170			16.50	+	o
200 / 180			12.60	o	o
210 / 170			20.90	o	o
210 / 180			17.70	+	o
220 / 180			23.00	+	o
230 / 170	+3.0/+9.0	-3.0/-10	32.70	+	o
230 / 190			24.60	+	o
230 / 200			20.60	+	o
230 / 210			16.60	+	o
250 / 120			58.80	+	o
250 / 200			31.40	o	o
250 / 210			27.50	+	o
250 / 230			17.80	+	o
280 / 240	+3.0/+10.0	-3.5/-13	32.10	+	o

+ Standard article

o Production on request

Sheets POM-C

2,000 + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black
8	+0.2/+1.1	7.7	+	+
10		9.7	+	+
12	+0.3/+1.5	11.8	+	+
16		15.3	+	+
20		18.8	+	+
25		23.3	+	+
30	+0.5/+2.5	28.1	+	+
36		33.7	+	+
40		37.1	+	+
45		43.0	+	o
50		46.0	+	+
60	+0.5/+3.5	55.8	+	+
70	+0.5/+5.0	65.6	+	+
80		74.0	+	+
90		82.0	o	o
100		93.6	+	+

600 mm width

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black
8	+0.2/+1.1	13.1	+	+
10		16.2	+	+
12	+0.3/+1.5	19.3	+	+
15		24.3	o	o
16		25.4	+	+
20		30.9	+	+
25		38.7	+	+
30	+0.5/+2.5	46.7	+	+
36		55.7	+	+
40		61.7	+	+
45		68.7	+	o
50		75.8	+	+
60	+0.5/+3.5	92.2	o	o
70	+0.5/+5.0	107.6	o	o
80		123.0	o	o
90		137.8	o	o
100		152.0	o	o

1,000 mm width

+ Standard article

o Production on request

Sheets POM-C

2,000 + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	
8	+0.2/+1.1	15.5	+	+	1,200 mm width
10		20.1	+	+	
12	+0.3/+1.5	23.4	+	+	
16		30.7	+	+	
20		37.6	+	+	
25		46.5	+	+	
30	+0.5/+2.5	56.2	+	+	
36		67.4	+	+	
40		71.4	+	+	
45		80.7	+	+	
50		91.2	+	+	
60	+0.5/+3.5	111.3	o	o	
70	+0.5/+5.0	129.3	o	o	
80		148.8	o	o	
90		170.5	o	o	
100		186.7	o	o	
110		205.0	o	o	

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	
150	+0.5/+10	123.0	o	o	Block 500mm width

Calander Sheets POM-C

2000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	
0.5	-0.50/+0.08	0.8	+	-	1,000 mm width
0.8		1.2	o	-	
1	-0.10/+0.10	1.5	+	-	
1.5	-0.15/+0.15	2.2	+	-	
2		3.0	+	+	
2.5		3.7	+	-	
3	-0.20/+0.20	4.5	+	+	
4		5.9	+	+	
5	-0.25/+0.25	7.4	+	+	
6		8.9	+	+	

+ Standard article

o Production on request

Delivery programme

Rods PA 6 cast

1,000 mm standard length

Ø	Tolerance in mm	ca. kg/m	natural	black	with oil
30	+0.2/+1.4	0.85	o	o	o
40		1.5	o	o	o
45	+0.3/+1.9	1.9	o	o	o
50		2.4	+	+	o
55		2.8	+	+	o
60	+0.3/+2.5	3.4	+	+	o
65		4.0	+	+	o
70		4.8	+	+	o
75	+0.4/+2.8	5.6	+	+	o
80		6.2	+	+	o
85	+0.5/+3.2	6.9	+	+	o
90		7.8	+	+	o
95	+0.6/+3.5	8.7	o	o	o
100		9.6	+	+	o
110	+0.7/+3.9	11.6	+	+	o
120		13.7	+	+	o
125		15.3	+	+	o
130	+0.8/+5.0	16.4	+	+	o
140		18.4	+	+	o
150	+0.8/+5.3	21.6	+	+	o
160		24.6	+	+	o
170	+1.0/+6.5	27.0	+	+	o
180		30.6	+	+	o
190	+1.0/+7.5	34.5	+	+	o
200		38.0	+	+	o
210	+1.0/+8.5	42.2	+	+	o
220		46.4	+	+	o
230	+1.0/+9.5	50.2	+	+	o
240		55.0	o	o	o
250		60.4	+	+	o
260	+1.0/+11.0	65.2	+	+	o
270		70.0	o	o	o
280		76.2	+	+	o
290	+1.5/+12.0	80.7	o	o	o
300		86.5	+	+	o
310		92.0	o	o	o
320		97.7	+	+	o
340	+1.5/+13.5	113.0	o	o	o
350		117.5	+	+	o
360		124.0	o	o	o
370	+1.5/+15.0	131.0	+	o	o
380		140.0	o	o	o
400		153.0	+	+	o
420	+1.5/+16.5	173.8	o	o	o
450		195.0	+	+	o
500	+1.5/+18.0	238.0	+	+	o

+ Standard article

o Production on request

Tubes PA 6 cast

Several length possible up to 3,000 mm | Ø100 – 1,000 mm AD,

Several in-between sizes possible

Ø mm	AD Tol. mm	ID Tol. mm	natural	black
120 / xx	+2.0/+7.0	-2.0/-7.0	o	o
125 / xx			o	o
130 / xx			o	o
140 / xx			o	o
150 / xx			o	o
160 / xx	+2.0/+8.0	-2.0/-8.0	o	o
170 / xx			o	o
180 / xx			o	o
190 / xx	+2.0/+9.0	-2.0/-9.0	o	o
200 / xx			o	o
210 / xx			o	o
220 / xx			o	o
230 / xx	+3.0/+10	-3.0/-10	o	o
240 / xx			o	o
250 / xx			o	o
260 / xx	+3.0/+12	-3.0/-12	o	o
270 / xx			o	o
280 / xx			o	o
290 / xx			o	o
300 / xx			o	o
310 / xx	+3.0/+14	-3.0/-14	o	o
320 / xx			o	o
350 / xx			o	o
370 / xx			o	o
400 / xx			o	o
420 / xx	+3.0/+16	-3.0/-16	o	o
450 / xx			o	o
475 / xx			o	o
500 / xx			o	o

+ Standard article

o Production on request

Sheets PA 6 cast

2,000 mm und 1,000 mm lang

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	with oil
8	+0.5/+1.7	11.0	o	o	o
10		13.4	+	+	o
12		15.9	+	+	o
15	+0.5/+2.5	19.8	+	+	o
16		21.0	+	+	o
20		26.0	+	+	o
25		32.1	+	+	o
30	+0.5/+3.5	38.5	+	+	o
35		45.3	+	+	o
40		51.0	+	+	o
45	+1.0/+5.0	57.1	o	o	o
50		63.5	+	+	o
55		70.0	o	o	o
60		76.0	+	+	o
65		82.5	o	o	o
70		88.4	+	+	o
75	+1.0/+6.0	96.5	o	o	o
80		101.0	+	+	o
85		107.0	o	o	o
90		113.4	+	+	o
100		126.0	+	+	o
110		138.5	+	+	o
120		152.0	+	+	o
130		164.0	+	+	o
140		175.0	+	+	o
150		187.0	+	+	o

+ Standard article

o Production on request

Rods PA 6 xt

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø	Tolerance in mm	ca. kg/m	natural	black
5	+0.1/+0.4	0.03	-	-
6		0.04	+	-
8	+0.1/+0.7	0.06	+	o
10		0.10	+	+
12	+0.2/+0.8	0.14	+	+
14		0.19	o	o
15		0.22	+	o
16		0.24	+	o
18		0.30	o	o
20		0.39	+	+
22	+0.2/+1.0	0.46	o	o
25		0.60	+	+
28		0.75	o	o
30		0.86	+	+
32	+0.2/+1.2	1.00	o	o
36		1.25	o	o
40		1.50	+	+
45	+0.3/+1.3	2.00	o	o
50		2.40	+	+
56		3.00	o	o
60	+0.3/+1.6	3.40	+	+
65		4.00	o	o
70		4.60	+	+
75	+0.4/+2.0	5.30	o	o
80		6.00	+	+
85	+0.5/+2.2	6.80	o	o
90		7.70	+	+
95	+0.6/+2.5	8.50	o	o
100		9.40	+	+
110	+0.7/+3.0	11.40	+	+
115	+0.8/+3.5	12.30	o	o
120		13.50	+	+
125		14.70	o	o
130	+0.9/+3.8	16.00	+	+
140		18.50	+	o
150	+1.0/+4.2	21.20	+	+
160	+1.1/+4.5	24.10	o	o
170		27.30	o	o
180		30.50	o	o
200	+1.3/+5.5	38.00	o	o

+ Standard article

o Production on request

Tubes PA 6 xt

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø mm	AD Tol. mm	ID Tol. mm	ca. kg/m	natural	black
16 / 10	+0.4/+1.1	-0.4/-1.1	0.18	+	o
20 / 10			0.32	+	o
25 / 12			0.50	+	o
25 / 15			0.44	o	o
30 / 15			0.71	+	o
30 / 20			0.56	o	o
36 / 15	+0.6/+2.0	-0.6/-2.0	1.10	o	o
36 / 20			0.94	o	o
36 / 25			0.75	+	o
40 / 20			1.20	+	o
40 / 25			1.10	o	+
40 / 30			0.86	+	o
45 / 20			1.6	o	o
45 / 25			1.5	o	o
45 / 30			1.2	o	o
50 / 20			2.1	+	o
50 / 25			1.9	+	o
50 / 30			1.7	+	+
50 / 40			1.1	o	o
56 / 25	+0.8/+2.5	-0.8/-2.5	2.5	o	o
56 / 30			2.2	o	o
56 / 40			1.7	o	o
60 / 20			3.1	+	o
60 / 30			2.7	+	o
60 / 40			2.2	+	+
60 / 50			1.4	o	o
65 / 30	+0.8/+3.0	-0.8/-3.0	3.4	o	o
65 / 35			3.1	o	o
65 / 40			2.8	o	o
65 / 45			2.3	o	o
65 / 50			2.0	o	o
70 / 30			3.9	o	o
70 / 40			3.3	+	o
70 / 50			2.6	+	+
70 / 60			1.6	o	o
75 / 40			4.1	o	o
75 / 50			3.3	o	o
75 / 60			2.4	o	o
80 / 30			5.4	o	o
80 / 40			4.8	+	o
80 / 50			3.9	+	o
80 / 60			3.0	o	o
85 / 30	+1.2/+3.6	-1.6/-5.0	6.3	o	o
85 / 40			5.7	o	o
90 / 40			6.4	+	o
90 / 50			5.7	o	o
90 / 60			4.8	+	o

+ Standard article

o Production on request

Tubes PA 6 xt

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø mm	AD Tol. mm	ID Tol. mm	ca. kg/m	natural	black
90 / 70			3.8	o	o
100 / 40			8.3	o	o
100 / 50			7.5	+	o
100 / 60	+1.2/+3.6	-1.6/-5.0	6.6	+	o
100 / 70			5.4	+	o
100 / 80			4.3	+	o
110 / 50			9.6	o	o
110 / 60			8.8	o	o
110 / 90			4.9	o	o
115 / 80	+1.5/+4.5	-2.0/-6.5	7.2	o	o
120 / 60			10.9	o	o
120 / 70			9.6	o	o
120 / 80			8.4	o	o
120 / 100			5.4	o	o
125 / 50			12.7	o	o
125 / 60			11.8	o	o
125 / 90			8.2	o	o
125 / 100			6.5	o	o
130 / 80			10.9	o	o
140 / 70			14.7	o	o
140 / 80			13.4	o	o
140 / 100			10.4	o	o
180 / 140	+1.8/+5.4	-2.2/-7.5	14.0	o	o

+ Standard article

o Production on request

Sheets PA 6 xt

2,000 + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black
8	+0.2/+1.1	6.2	o	o
10		8.0	o	o
12	+0.3/+1.5	9.7	+	+
16		12.6	+	+
20		15.4	+	+
25		19.0	+	+
30	+0.5/+2.5	23.0	+	+
36		27.1	+	o
40		30.2	+	+
45		33.8	+	o
50		38.0	+	+
60	+0.5/+3.5	45.4	+	o
70	+0.5/+5.0	51.7	o	-
80		59.4	o	-
90		66.5	o	-
100		74.6	o	-

600 mm width

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black
8	+0.2/+1.10	10.6	+	+
10		13.5	+	+
12	+0.3/+1.5	16.3	+	+
15		18.8	+	+
16		21.1	+	+
20		25.9	+	+
25		31.3	+	+
30	+0.5/+2.5	38.2	+	+
35		43.4	+	o
36		46.3	+	o
40		50.6	+	+
45		57.3	+	o
50		61.5	+	+
60	+0.5/+3.5	75.5	+	o
70	+0.5/+3.50	90.5	+	-
80		102.0	o	-
90		112.5	o	-
100		126.0	o	-

1,000 mm width

+ Standard article

o Production on request

Sheets PA 6 xt

2,000 + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	1,200 mm width
8	+0.2/+1.1	12.9	o	o	
10		16.5	o	o	
12	+0.3/+1.5	19.9	o	o	
16		25.7	o	o	
20		31.6	o	o	
25		38.2	o	o	
30	+0.5/+2.5	46.6	o	o	
36		56.5	o	o	
40		61.7	o	o	
45		69.9	o	o	
50		75.0	o	o	
60	+0.5/+3.5	92.1	o	o	
70	+0.5/+5.0	110.4	o	-	
80		124.4	-	-	
90		137.3	-	-	
100		153.7	-	-	

Calander Sheets PA 6

2,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	1,000 mm width
0.5	-0.02/+0.08	0.61	+	-	
0.8	-0.05/+0.10	0.97	+	-	
1	-0.10/+0.10	1.20	+	-	
1.5	-0.15/+0.15	1.80	+	-	
2		2.35	+	-	
2.5		3.0	+	-	
3	-0.20/+0.20	3.5	+	o	
4		4.7	+	+	
5	-0.25/+0.25	5.9	+	+	
6		7.0	+	+	

+ Standard article

o Production on request

Rods PA 6 Glasfiber

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø	Tolerance in mm	ca. kg/m	black
20	+0.2/+0.9	0.46	+
25	+0.2/+1.2	0.72	+
30		1.03	+
40	+0.2/+1.6	1.82	+
50	+0.3/+2.0	2.85	+
60	+0.3/+2.5	4.11	+
70		5.55	+
80	+0.4/+3.0	7.27	+
100	+0.6/+3.8	11.38	+
125	+0.8/+4.6	17.77	o
150	+1.0/+5.8	25.6	o
180	+1.2/+7.4	36.2	o
200	+1.3/+8.5	44.7	o

Sheets PA 6 Glasfiber

2,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness	Tolerance in mm	ca. kg/m	black
8	+0.2/+1.1	6.1	-
10		7.5	o
16		12.0	o
20	+0.3/+1.5	4.8	o
25		18.4	o
30	+0.5/+2.5	22.3	o
40		29.4	o
50		36.5	o
60	+0.5/+3.5	44.0	o

600 mm
width

+ Standard article

o Production on request

Rods PA 66

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø	Tolerance in mm	ca. kg/m	natural	black
5	+0.1/+0.6	0.03	o	o
6		0.04	o	o
8	+0.1/+0.7	0.06	o	o
10		0.10	+	o
12	+0.2/+0.8	0.14	o	o
14		0.19	o	o
15		0.22	o	o
16		0.24	o	o
18		0.30	o	o
20		0.39	+	o
22	+0.2/+1.0	0.46	o	o
25		0.60	+	o
28		0.75	o	o
30		0.86	+	o
32	+0.2/+1.2	1.00	o	o
36		1.25	+	o
40		1.5	+	o
45	+0.3/+1.3	2.0	+	o
50		2.4	+	o
56		3.0	+	o
60	+0.3/+1.6	3.4	+	o
65		4.0	+	o
70		4.7	+	o
75	+0.4/+2.0	5.3	o	o
80		6.1	+	o
85	+0.5/+2.2	6.8	o	o
90		7.7	+	o
100	+0.6/+2.5	9.4	+	o
110	+0.7/+3.0	11.4	o	-
120	+0.8/+3.5	13.8	+	-
125		14.7	o	-
130	+0.9/+3.8	16.0	o	-
140		18.5	o	-
150	+1.0/+4.2	21.2	+	-
160	+1.1/+4.5	24.1	o	-
165	+1.2/+5.0	25.8	o	-
170		27.3	o	-
180		30.5	o	-
200	+1.3/+5.5	37.8	o	-

+ Standard article

o Production on request

Tubes PA 66

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø mm	AD Tol. mm	ID Tol. mm	ca. kg/m	natural	black
25 / 12	+0.4/+1.1	-1.1/+0.4	0.50	o	o
33 / 25			0.40	o	o
30 / 20			0.56	o	o
36 / 20	+0.6/+2.0	-2.0/-0.6	0.94	o	o
36 / 25			0.75	o	o
40 / 20			1.20	o	o
40 / 25			1.10	o	o
40 / 30			0.86	o	o
45 / 20			1.60	o	o
45 / 25			1.50	o	o
45 / 30			1.20	o	o
50 / 25			1.90	o	o
50 / 30			1.70	o	o
50 / 40			1.10	o	o
56 / 30	+0.8/+2.5	-2.5/-0.8	2.2	o	o
56 / 40			1.7	o	o
60 / 30			2.7	o	o
60 / 40			2.2	o	o
60 / 50			1.4	o	o
75 / 50	+0.8/+3.0	-3.0/-0.8	3.3	o	o
80 / 40			4.8	o	o
80 / 60			3.0	o	o
90 / 60			4.8	o	o
90 / 70	+1.2/+3.6	-1.6/-5.0	3.8	o	o
100 / 60			6.5	o	o
100 / 80			4.3	o	o
110 / 60			8.5	o	o
110 / 90			4.7	o	o
120 / 90			7.1	o	o
120 / 60			10.8	o	o
125 / 80	+1.5/+4.5	-2.0/-6.5	9.4	o	o
125 / 90			7.7	o	o
140 / 110			8.6	o	o
140 / 120			6.4	o	o
150 / 130			6.9	o	o
180 / 150			11.5	o	o
200 / 150	+2.0/+6.0	-2.5/-8.5	18.8	o	o
230 / 200			15.4	o	o
250 / 230	+3.0/+9.0	-3.0/-10	14.7	o	o

+ Standard article

o Production on request

Sheets PA 66

1,000 + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	1,000 mm width
8	+0.2/+1.1	10.6	o	o	
10		13.5	+	o	
12	+0.3/+1.5	16.3	o	o	
16		21.1	o	o	
20		25.9	+	o	
25		31.3	o	o	
30	+0.5/+2.5	38.2	+	o	
36		46.3	o	o	
40		50.6	+	o	
45		57.3	o	o	
50		61.5	+	o	
60	+0.5/+3.5	75.5	o	o	

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	600 mm width
8	+0.2/+1.1	6.2	o	o	
10		8.0	+	o	
12	+0.3/+1.5	9.7	o	o	
16		12.6	o	o	
20		15.4	+	o	
25		19.0	+	o	
30	+0.5/+2.5	23.0	+	o	
36		27.1	o	o	
40		30.2	+	o	
45		33.8	o	o	
50		38.0	+	o	
60	+0.5/+3.5	45.4	+	o	

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black	500 mm width
8	+0.2/+1.1	5.1	o	o	
10		6.3	o	o	
12	+0.3/+1.5	7.7	o	o	
16		10.1	o	o	
20		12.5	o	o	
25		15.5	o	o	
30	+0.5/+2.5	18.9	o	o	
40		24.9	o	o	
50		30.8	o	o	
60	+0.5/+3.5	37.1	o	o	

+ Standard article

o Production on request

Rods PA 66 Glasfiber GF 30

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø	Tolerance in mm	ca. kg/m	black
10	+0.1/+0.8	0.12	+
16	+0.2/+0.9	0.29	o
20		0.46	+
25	+0.2/+1.2	0.71	+
30		1.00	+
36	+0.2/+1.6	1.45	o
40		1.81	+
50	+0.3/+2.0	2.80	+
60	+0.3/+2.5	4.10	+
70		5.50	+
80	+0.4/+3.0	7.20	+
90	+0.5/+3.4	9.00	+
100	+0.6/+3.8	11.20	+
125		17.80	+
150	+1.0/+5.8	25.20	o

Sheets PA 6 Glasfiber GF30

2,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	black
8	+0.2/+1.1	6.1	o
10		7.5	+
16		12.0	o
20	+0.3/+1.5	4.8	+
25		18.4	o
30	+0.5/+2.5	22.3	+
40		29.4	+
50		36.5	+
60	+0.5/+3.5	44.0	o

600 mm
width

+ Standard article

o Production on request

Rods PET

1,000 mm + 3,000 mm standard length | Tolerance according to DIN EN 15860

Ø	Tolerance in mm	ca. kg/m	natural	black
10	+0.1/+0.7	0.12	o	o
16	+0.2/+0.8	0.30	o	o
20		0.46	+	o
25	+0.2/+1.0	0.72	o	o
30		1.05	+	o
36		1.50	o	o
40		1.80	+	o
45	+0.3/+1.3	2.29	o	o
50		2.81	+	o
56		3.52	o	o
60	+0.3/+1.6	4.05	+	o
70		5.50	o	o
80	+0.4/+2.0	7.18	+	o
90	+0.4/+2.2	9.09	o	o
100	+0.6/+2.5	11.24	+	o
110	+0.7/+3.0	13.63	o	o
120	+0.8/+3.5	16.26	o	o
125		17.61	o	o
130	+0.9/+3.8	19.10	o	o
140		22.08	o	o
150	+1.0/+4.2	25.40	o	o
160	+1.1/+4.5	28.90	o	o
170	+1.2/+5.0	33.50	o	o
180	+1.2/+5.0	36.50	o	o
200	+1.3/+5.5	45.10	o	o

+ Standard article

o Production on request

Sheets PET

2,000 + 3,000 mm standard length | Tolerance according to DIN EN 15860

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black
8	+0.2/+1.1	7.5	–	on request
10		9.5	o	
12	+0.3/+1.5	11.4	o	
16		14.6	o	
20		18.5	o	
25		22.9	o	
30	+0.5/+2.5	27.7	o	
36		33.3	o	
40		36.8	o	
45		40.5	o	
50		45.5	o	
60	+0.5/+3.5	54.5	o	
70	+0.5/+5.0	63.5	o	
80		72.5	o	
100		91.0	o	

600 mm width

Thickness in mm	Tolerance in mm	ca. kg/m	natural	black
8	+0.2/+1.10	12.9	o	on request
10		15.8	o	
12	+0.3/+1.5	19.5	o	
16		25.0	o	
20		31.0	o	
25		38.3	o	
30	+0.5/+2.5	45.5	o	
35		54.1	o	
40		61.3	o	
50		75.8	o	
60	+0.5/+3.5	91.6	o	

1,000 mm width

+ Standard article

o Production on request

Rods PE-HD (PE-300)

2,000 mm standard length

Ø	Tolerance in mm	ca. kg/m	natural	black
10	+0.1/+0.6	0.08	o	o
12	+0.2/+0.7	0.12	o	o
15	+0.2/+0.8	0.18	o	o
16		0.20	o	o
20	+0.2/+1.2	0.33	o	o
25		0.51	o	o
30		0.72	o	o
35		1.00	o	o
40	+0.2/+1.5	1.30	o	o
50	+0.3/+2.0	2.00	o	o
60	+0.3/+2.3	2.90	o	o
70	+0.3/+2.5	3.90	o	o
80	+0.4/+3.0	5.10	o	o
90	+0.5/+3.4	6.50	o	o
100		8.00	o	o
110	+0.7/+4.2	9.60	o	o
120		11.40	o	o
130	+0.8/+4.6	13.30	o	o
140		15.60	o	o
150	+1.0/+5.8	17.90	o	o
160	+1.1/+6.3	20.40	o	o
180	+1.2/+7.4	25.70	o	o
200	+1.3/+8.5	32.20	o	o
250		50.00	o	o
300	+1.3/+10.9	71.80	o	o

+ Standard article

o Production on request

Rods PE-UHMW (PE-1000)

2,000 mm standard length

Ø	Tolerance in mm	ca. kg/m	natural	black	green
20	+0.2/+1.2	0.38	o	o	o
25		0.50	o	o	o
30		0.70	o	o	o
35	+0.2/+1.3	0.90	o	o	o
40	+0.2/+1.5	1.30	o	o	o
45	+0.3/+2.0	1.6	o	o	o
50		2.0	o	o	o
60	+0.3/+2.3	2.9	o	o	o
70	+0.3/+2.5	3.9	o	o	o
80	+0.4/+3.0	5.0	o	o	o
90	+0.5/+3.4	6.4	o	o	o
100	+0.6/+3.8	8.0	o	o	o
110	+0.7/+4.2	10.0	o	o	o
120		11.3	o	o	o
130	+0.8/+4.6	13.4	o	o	o
140	+0.9/+5.4	15.5	o	o	o
150	+1.0/+5.8	17.4	o	o	o
160	+1.1/+6.3	20.5	o	o	o
180	+1.2/+7.4	25.0	o	o	o
200	+1.3/+8.5	31.5	o	o	o
160	+1.1/+6.3	20.40	o	o	o
180	+1.2/+7.4	25.70	o	o	o
200	+1.3/+8.5	32.20	o	o	o
250		50.00	o	o	o
300	+1.3/+10.9	71.80	o	o	o

+ Standard article

o Production on request

Rods PP

2,000 mm standard length

Ø	Tolerance in mm	ca. kg/m	natural	grey
10	+0.1/+0.6	0.08	o	o
12	+0.2/+0.7	0.11	o	o
15	+0.2/+0.8	0.18	o	o
16		0.20	o	o
20	+0.2/+1.2	0.31	o	o
25		0.49	o	o
30		0.69	o	o
35		0.95	o	o
40	+0.2/+1.5	1.23	o	o
45	+0.3/+2.0	1.6	o	o
50		1.9	o	o
55		2.3	o	o
60	+0.3/+2.3	2.8	o	o
65		3.3	o	o
70	+0.3/+2.5	3.8	o	o
80	+0.4/+3.0	4.9	o	o
90	+0.5/+3.4	6.2	o	o
100	+0.6/+3.8	7.6	o	o
110	+0.7/+4.2	9.3	o	o
120	+0.8/+4.6	10.9	o	o
130	+0.9/+5.4	12.8	o	o
140		15.0	o	o
150	+1.0/+5.8	17.1	o	o
160	+1.1/+6.3	19.5	o	o
170	+1.2/+7.4	21.1	o	o
180		24.7	o	o
200	+1.3/+8.5	30.9	o	o
250	+1.3/+9.0	47.9	o	o
300	+1.3/+10.0	68.7	o	o

+ Standard article

o Production on request

Polyoxymethylene (Polyacetal) POM-C

Material Datasheet

Our POM products are characterized by a high mechanical strength, good dimensional stability and outstanding machinability (short chips facilitate processing on CNC machines).

These factors have qualified POM as a technical polymer which can often be used instead of metals, resulting not only in technical improvements but also enabling considerable cost reductions.

The outstanding properties of semi-finished products made of POM are:

- high strength
- good toughness, even at low temperatures
- good elasticity
- good dimensional stability
- low water absorption
- good machinability
- good sliding friction properties
- good chemical resistance (particularly against strongly basic media)
- good recyclability

Mechanical properties				POM
Yield stress / stress at break	DIN	EN ISO 527-2	MPa	70
Elongation at break	DIN	EN ISO 527-2	%	35
Tensile modulus of elasticity	DIN	EN ISO 527-2	MPa	3,000
Charpy impact strength	DIN	EN ISO 179	kJ/m ²	>140

Thermal properties				POM
Coefficient of thermal expansion			1/K*106	120
Upper service temperature, short term			°C	140
Upper service temperature, continuous			°C	100
Flammability according to UL94		3 mm		HB

Electrical properties				POM
dielectric strength	DIN	EN IEC 60243	kV/mm	20
Volume resistivity	DIN	DIN EN 62631	Ω*cm	>10 ¹⁴
Surface resistivity	DIN	DIN EN 62631	Ω	>10 ¹³

General properties				POM
Density	DIN	1183	g/cm ³	1,41
Waterabsorption, saturation in water at 23°C	DIN	EN ISO 62	%	0,8

Polyamid 6 extruded (PA 6 E)

Material Datasheet

Our semi-crystalline polyamide products (PA 6, PA 6 cast, PA 66) have achieved a key role among the technical polymers. Thanks to its combination of high strength and high impact resistance, even at low temperatures, polyamide has become a very versatile material.

All polyamide semi-finished products offer the following properties::

- good impact resistance
- high dynamic load capacity
- high strength and stiffness
- improved toughness by water absorption
- virtually no stress cracking
- good chemical resistance
- good gas barrier properties
- high abrasion and wear resistance
- good sliding and emergency running properties
- good sound and vibration damping properties
- good recyclability

In comparison to the other polyamides polyamide 6 extruded shows:

- slightly higher impact strength
- higher water absorption

Mechanical properties				PA 6 E		PA 6 GV 30	
				dry	moist	dry	moist
Yield stress / stress at break	DIN	EN ISO 527-2	MPa	75	50	175 (B)	100 (B)
Elongation at break	DIN	EN ISO 527-2	%	60	110	3	6
Tensile Modulus of elasticity	DIN	EN ISO 527-2	MPa	3,300	1,500	8,400	5,500
Charpy impact strenght	DIN	EN ISO 179	kJ/m ²	OB			

Thermal properties				PA 6 E		PA 6 GV 30	
				dry	moist	dry	moist
Coefficient of thermal expansion			1/K*106	90		25	
Upper service temperature, short term			°C	160		180	
Upper service temperature, continuous			°C	90		120	
Flammability according to UL94		3mm		HB		HB	

Electrical properties				PA 6 E		PA 6 GV 30	
				dry	moist	dry	moist
Dielectric strength	DIN	EN IEC 60243	kV/mm	25	18	17	12
Volume resitivity	DIN	DIN EN 62631	Ω*cm	>10 ¹⁴	>10 ¹²	>10 ¹⁴	>10 ¹²
Surface resitivity	DIN	DIN EN 62631	Ω	>10 ¹³	>10 ¹²	>10 ¹²	>10 ¹⁰

General properties				PA 6 E		PA 6 GV 30	
				dry	moist	dry	moist
Density	DIN	1183	g/cm ³	1.14		1.35	
Waterabsorption, saturation in water at 23°C	DIN	EN ISO 62	%	9		6.4	

Cast Nylon (PA 6 C) Material Datasheet

Our semi-crystalline polyamide products (PA 6, PA 6 cast, PA 66) have achieved a key role among the technical polymers. Thanks to its combination of high strength and high impact resistance, even at low temperatures, polyamide has become a very versatile material.

All polyamide semi-finished products offer the following properties

- good impact resistance
- high dynamic load capacity
- high strength and stiffness
- improved toughness by water absorption
- virtually no stress cracking
- good chemical resistance
- good gas barrier properties
- high abrasion and wear resistance
- good sliding and emergency running properties
- good sound and vibration damping properties
- good recyclability

In comparison polyamide 6 cast has:

- a slightly higher hardness than PA 6 E and PA 66
- a slightly higher strength than PA 6 E
- a high toughness, even at low temperatures

Mechanical properties					PA 6 Cast		PA 6 Cast with oil	
					dry	moist	dry	moist
Yield stress / stress at break	DIN	EN ISO 527-2	MPa	80	50	70	45	
Elongation at break	DIN	EN ISO 527-2	%	25	>50	23	>50	
Tensile modulus of elasticity	DIN	EN ISO 527-2	MPa	3,450	1,650	3,150	1,500	
Charpy impact strenght	DIN	EN ISO 179	kJ/m ²	OB		OB		

Thermal properties					PA 6 Cast		PA 6 Cast with oil	
					dry	moist	dry	moist
Coefficient of thermal expansion			1/K*106	85		85		
Upper service temperature, short term			°C	170		170		
Upper service temperature, continuous			°C	100		100		
Flammability according to UL94		3mm		HB		HB		

Electrical properties					PA 6 Cast		PA 6 Cast with oil	
					dry	moist	dry	moist
Dielectric strength	DIN	EN IEC 60243	kV/mm	25	16	26	16	
Volume resitivity	DIN	DIN EN 62631	Ω*cm	>10 ¹⁴	>10 ¹²	>10 ¹⁴	>10 ¹²	
Surface resitivity	DIN	DIN EN 62631	Ω	>10 ¹³	>10 ¹²	>10 ¹³	>10 ¹²	

General properties					PA 6 Cast		PA 6 Cast with oil	
					dry	moist	dry	moist
Density	DIN	1183	g/cm ³	1.14		1.14		
Waterabsorption, saturation in water at 23°C	DIN	EN ISO 62	%	6.6		6.6		

Polyamide 66 (PA 66)

Material Datasheet

Our semi-crystalline polyamide products (PA 6, PA 6 cast, PA 66) have achieved a key role among the technical polymers. Thanks to its combination of high strength and high impact resistance, even at low temperatures, polyamide has become a very versatile material

All polyamide semi-finished products offer the following properties:

- good impact resistance
- high dynamic load capacity
- high strength and stiffness
- improved toughness by water absorption
- virtually no stress cracking
- good chemical resistance
- good gas barrier properties
- high abrasion and wear resistance
- good sliding and emergency running properties
- good sound and vibration damping properties
- good recyclability

In comparison to the other polyamides polyamide 66 has:

- the highest strength
- the highest melting point
- a water absorption lower than PA 6 E

Mechanical properties				PA 66		PA 66 GV 30	
				dry	moist	dry	moist
Yield stress / stress at break	DIN	EN ISO 527-2	MPa	90	50	100 (B)	75(B)
Elongation at break	DIN	EN ISO 527-2	%	>35	>95	4	7
Tensile modulus of elasticity	DIN	EN ISO 527-2	MPa	3,300	1,600	5,800	3,100
Charpy impact strenght	DIN	EN ISO 179	kJ/m ²	OB		>45	

Thermal properties				PA 66		PA 66 GV 30	
				dry	moist	dry	moist
Coefficient of thermal expansion			1/K*106	90		55	
Upper service temperature, short term			°C	175		240	
Upper service temperature, continuous			°C	100		110	
Flammability according to UL94		3mm		V-2		V-2	

Electrical properties				PA 66		PA 66 GV 30	
				dry	moist	dry	moist
Dielectric strength	DIN	EN IEC 60243	kV/mm	28	18	28	
Volume resitivity	DIN	DIN EN 62631	Ω*cm	>10 ¹⁴	>10 ¹²	>10 ¹⁴	>10 ¹³
Surface resitivity	DIN	DIN EN 62631	Ω	>10 ¹³	>10 ¹²	>10 ¹³	>10 ¹²

General properties				PA 66		PA 66 GV 30	
				dry	moist	dry	moist
Density	DIN	1183	g/cm ³	1.14		1.14	
Waterabsorption, saturation in water at 23°C	DIN	EN ISO 62	%	6.6		6.6	

Polyethylene Terephthalate (PET)

Material Datasheet

PET is a thermoplastic polyester featuring a very high strength and hardness as well as a very low friction coefficient.

These excellent properties make it an ideal substitute for metallic materials in a variety of applications. Like POM, it produces short chips when being machined, enabling cost-efficient processing on CNC machines. The low coefficient of thermal expansion in comparison to other thermoplastic polymers ensures a good dimensional stability, critical when tight tolerances are required.

Key characteristics of PET semi-finished products are:

- good sliding and wear properties
- very high strength
- high stiffness and hardness
- good dimensional stability
- low water absorption
- good machinability
- good chemical resistance
- good recyclability
- not resistant against hot water (60 °C, continuous subjection)

Mechanical properties				PET
Yield stress / stress at break	DIN	EN ISO 527-2	MPa	90
Elongation at break	DIN	EN ISO 527-2	%	15
Tensile modulus of elasticity	DIN	EN ISO 527-2	MPa	3600
Charpy impact strenght	DIN	EN ISO 179	kJ/m ²	>40

Thermal properties				PET
Coefficient of thermal expansion			1/K*106	70
Upper service temperature, short term			°C	160
Upper service temperature, continuous			°C	105
Flammability according to UL94		3 mm		HB

Electrical properties				PET
Dielectric strength	DIN	EN IEC 60243	kV/mm	22
Volume resitivity	DIN	DIN EN 62631	Ω*cm	>10 ¹⁵
Surface resitivity	DIN	DIN EN 62631	Ω	>10 ¹⁴

General properties				PET
Density	DIN	1183	g/cm ³	1.39
Waterabsorption, saturation in water at 23°C	DIN	EN ISO 62	%	0.5

Polyethylene (PE)

Material Datasheet

Polyethylene has gained an outstanding position among the technical polymers due to its high impact strength, even at low temperatures, its good electrical insulating properties and its low friction coefficient. In addition, its chemical resistance against acids, bases, saline solutions, etc. has made it the material of choice in many areas.

General characteristics of PE are:

- high toughness, elongation and tear, even at low temperatures
- good chemical resistance
- low sliding coefficient of friction
- very low water absorption
- restricted mechanical properties
- poor glueability

Special characteristics of PE-HD are:

- weldable
- good damping properties

Special characteristics of PE-1000 are:

- comparatively high wear resistance
- lower service temperature, down to -150 °C

Mechanical properties				HD-PE	PE-1000
Yield stress / stress at break	DIN	EN ISO 527-2	MPa	22	20
Elongation at break	DIN	EN ISO 527-2	%	>50	>50
Tensile modulus of elasticity	DIN	EN ISO 527-2	MPa	800	700
Charpy impact strenght	DIN	EN ISO 179	kJ/m ²	OB	OB

Thermal properties				HD-PE	PE-1000
Coefficient of thermal expansion			1/K*106	200	200
Upper service temperature, short term			°C	120	120
Upper service temperature, continuous			°C	80	80
Flammability according to UL94		3mm		HB	HB

Electrical properties				HD-PE	PE-1000
Dielectric strength	DIN	EN IEC 60243	kV/mm	<40	<50
Volume resitivity	DIN	DIN EN 62631	Ω*cm	>10 ¹⁵	>10 ¹⁵
Surface resitivity	DIN	DIN EN 62631	Ω	>10 ¹³	>10 ¹³

General properties				HD-PE	PE-1000
Density	DIN	1183	g/cm ³	0.95	0.93
Waterabsorption, saturation in water at 23°C	DIN	EN ISO 62	%	0.02	0.01

Polypropylene (PP)

Material Datasheet

Polypropylene resembles PE in many ways. But due to its higher stiffness and higher service temperature when compared to PE it has captured its own area of applications.

Special characteristics of PP are:

- very low density
- high hardness, stiffness, and strength in the polyolefines area
- relatively high dimensional stability under heat
- low toughness at low temperatures up to approx. 0 °C
- good chemical resistance
- very low water absorption

Mechanical properties				PP
Yield stress / stress at break	DIN	EN ISO 527-2	MPa	30
Elongation at break	DIN	EN ISO 527-2	%	>500
Tensile modulus of elasticity	DIN	EN ISO 527-2	MPa	1,200
Charpy impact strenght	DIN	EN ISO 179	kJ/m ²	OB

Thermal properties				PP
Coefficient of thermal expansion			1/K*106	110
Upper service temperature, short term			°C	130
Upper service temperature, continuous			°C	100
Flammability according to UL94		3 mm		HB

Electrical properties				PP
Dielectric strength	DIN	EN IEC 60243	kV/mm	>90
Volume resitivity	DIN	DIN EN 62631	Ω*cm	>10 ¹⁶
Surface resitivity	DIN	DIN EN 62631	Ω	>10 ¹⁴

General properties				PP
Density	DIN	1183	g/cm ³	0,91
Waterabsorption, saturation in water at 23°C	DIN	EN ISO 62	%	0,03



Mechanical properties				PA 6 E		PA 6 GV 30		PA 6 G	
				tr	If	tr	If	tr	If
Yield stress / tensile strength	DIN	EN ISO 572-2	MPa	75	50	175 (B)	100 (B)	80	50
Elongation to break	DIN	EN ISO 572-2	%	60	110	3	6	25	>50
Tensile modulus of elasticity	DIN	EN ISO 572-2	MPa	3,300	1,500	8,400	5,500	3,450	1,500
Compressive strength at 1% compression	DIN	EN ISO 604	MPa	22				25	
Compressive strength at 2% compression	DIN	EN ISO 604	MPa	45				50	
Compressive strength at 5% compression	DIN	EN ISO 604	MPa	78				90	
Charpy impact strength	DIN	EN ISO 179	kJ/m ²	OB				OB	
Charpy notched impact strength	DIN	EN ISO 179	kJ/m ²	5				4	
Ball indentation hardness	DIN	EN ISO 2039	N/mm ²	150		200		165	
Sliding abrasion	•		µm/km	0.23					

Thermal properties				PA 6 E		PA 6 GV 30		PA 6 G	
				tr	If	tr	If	tr	If
Melting temperature		11357	°C	220		220		220	
Thermal conductivity			W/(K*m)	0.25		0.8		0.29	
Coefficient of linear expansion			1/K*10 ⁶	90		25		85	
Upper service temperature, short term			°C	160		180		170	
Upper service temperature, long term			°C	90		120		100	
Lower service temperature			°C	-40		-30		-30	
Flammability according to UL94		3mm		HB		HB		HB	

Electrical properties				PA 6 E		PA 6 GV 30		PA 6 G	
				tr	If	tr	If	tr	If
Dielectric strength	DIN	EN IEC 60243	kV/mm	25	18	17	12	25	16
Specific volume resistivity	DIN	EN 62631	Ω*cm	>10 ¹⁴	>10 ¹²	>10 ¹⁴	>10 ¹²	>10 ¹⁴	>10 ¹²
Specific surface resistivity	DIN	EN 62631	Ω	>10 ¹³	>10 ¹²	>10 ¹²	>10 ¹⁰	>10 ¹³	>10 ¹²
Dielectric constant at 1 MHz	DIN	53483		3.3	4	3.5	6	3.2	3.8
Dielectric dissipation factor at 1 MHz	DIN	53483		0.025	0.06	0.02	0.2	0.018	0.052

General properties				PA 6 E		PA 6 GV 30		PA 6 G	
				tr	If	tr	If	tr	If
Density	DIN	1183	g/cm ³	1.14		1.35		1.14	
Waterabsorption at standard climate 50% RM	DIN	EN ISO 62	%	2.5		2		2.1	
Waterabsorption in water at 23°C	DIN	EN ISO 62	%	9		6.4		6.6	

PA 6 G ÖI		PA 66		PA 66 GV 30		PA 12	POM	PET	PP	HD-PE	PE-1000	PVDF
tr	lf	tr	lf	tr	lf							
70	45	90	50	100 (B)	75 (B)	35	70	90	30	22	20	50
23	>50	>35	>95	4	7	230	35	15	>500	>50	>50	>20
3,150	1,500	3,300	1,600	5,800	3,100	1,700	3,000	3,600	1,200	800	700	2,200
23		26		27			20	25		4.5	4	17
45		50		53			30	50		7.5	7	32
85		90		85			65	100		14.5	12	
OB		OB		>45		OB	>140	>40	OB	OB	OB	OB
3.5		4.8		6			6.5	2				10
160		160		165		95	140	170	80	35	35	110
		0.9				0.8	9	0.4	11			

PA 6 G ÖI		PA 66		PA 66 GV 30		PA 12	POM	PET	PP	HD-PE	PE-1000	PVDF
tr	lf	tr	lf	tr	lf							
220		255		255		180	165	250	165	130	135	175
0.3		0.27		0.3		0.22	0.3	0.3	0.22	0.4	0.4	0.19
85		90		55		100	120	70	110	200	200	140
170		175		240		140	140	160	130	120	120	160
100		100		110		80	100	105	100	80	80	150
-30		-25		-20			-50	-20		-50	-150	
HB		V-2		V-2		V2	HB	HB	HB	HB	HB	V-0

PA 6 G ÖI		PA 66		PA 66 GV 30		PA 12	POM	PET	PP	HD-PE	PE-1000	PVDF
tr	lf	tr	lf	tr	lf							
26	16	28	18	28		30	20	22	>90	<40	<50	18
>10 ¹⁴	>10 ¹²	>10 ¹⁴	>10 ¹²	>10 ¹⁴	>10 ¹³	>10 ¹⁵	>10 ¹⁴	>10 ¹⁵	>10 ¹⁶	>10 ¹⁵	>10 ¹⁵	>10 ¹⁵
>10 ¹³	>10 ¹²	>10 ¹³	>10 ¹²	>10 ¹³	>10 ¹²	>10 ¹⁴	>10 ¹³	>10 ¹⁴	>10 ¹⁴	>10 ¹³	>10 ¹³	>10 ¹⁶
3.1	3.6	3.2	3.7	3.8	6.8	3.5	3.8	3.6	2.3	3	3	5.8
0.02	0.06	0.019	0.058	0.014	0.04	0.04	0.01	0.008	0.0002	0.0003	4E-05	0.165

PA 6 G ÖI		PA 66		PA 66 GV 30		PA 12	POM	PET	PP	HD-PE	PE-1000	PVDF
tr	lf	tr	lf	tr	lf							
1.14		1.14		1.3		1.02	1.41	1.39	0.91	0.93	0.93	1.79
2		2.3		1.7		0.7	0.2	0.3				0.05
6.5		8		5.5		1.6	0.8	0.5	0.03	0.02	0.01	0.05

General Technical Information

Mechanische Eigenschaften

When considering the mechanical strength of plastic materials, the speed at which the load is applied or, respectively, the duration of the loading must be taken into account. At the same time it should be noted that the mechanical properties of plastics strongly depend on the temperature and that these temperatures are considerably lower than the relevant temperatures for metals. For most metals, temperatures of 100 °C represent no

problem and do not lead to any significant change in their mechanical properties, whereas for many plastics temperatures around 100 °C would rule out any practical application. Even at low loads, plastic materials tend to give way to these forces, i.e. they start to "yield". Some plastics absorb water from the air moisture making them mechanically softer.

The following table shows an overview of relevant technical terms with regard to mechanical loads:

Term	Unit	Definition
Tensile stress	N/mm ² MPa	The ratio between the force currently applied and the smallest initial cross-section of the specimen
Elongation		The ratio between the elongation of the specimen and the original length of the deformed area
Modulus of elasticity	N/mm ² MPa	The E-Modulus of elasticity is comparable to the elasticity of a spring. It is the ratio between the force applied and the resulting extension in the linear section of the stress-strain curve.
Yield stress	N/mm ² MPa	The stress at which the specimen starts to deform further without having to increase the force. The stress acting on the specimen does not have to be the stress at which it breaks. The plastic may further deform after this force has been exceeded without the force actually being increased. This condition is referred to as yield.
Tear strength	N/mm ² MPa	The stress occurring at fracture of the specimen
Compressive strength at a given deformation	N/mm ² MPa	The force required to uniaxially compress a specimen by a certain percentage. In this context it should be noted that only short-term stresses occur during these tests. Long-term stresses with the same force would cause considerably greater deformation.
Charpy impact strength	kJ/m ²	The energy per square metre of fracture surface required to break a (notched) specimen by impact.

Usually, the tensile test according to DIN is used to assess the mechanical behaviour of plastics subjected to short-term uniaxial loading. The test basically determines the deformation of the material, i.e. the change in length and cross-section of a sample rod under a given mechanical load. Bending tests are normally only used for long-fibre filled

materials in order to examine the delamination of the fibres. In case of unfilled plastics, the information gained from such tests is only of limited use. Another type of load particularly important for plastics is impact load. The respective tests for this type of load usually either determine the energy required to fracture the specimen under a defined

impact load or establish whether the sample fractures at a certain impact load. Usually, a distinction is made between a notched and an unnotched specimen and the way in which the specimen is held. In the Charpy test, for example, the specimen is lying horizontally on special supports, whereas in the Izod test the specimen is held by clamps in a vertical position. The energy is determined from the weight of the pendulum hammer and the height from which it is dropped.

Sliding and Frictional Behaviour

Some literature contains values for the sliding and frictional behaviour of plastic materials. These values are never pure material values but are always specifically determined for the respective combination of materials, their surface properties and the forces between the partners. The results obtained from a combination of parameters cannot be directly transferred to others so that these literature values are only of limited use in the choice of materials.

Additives are often incorporated into plastic materials to optimize their sliding/frictional behaviour. These partly change the structure of the materials (e. g. MoS₂), or low-molecular additives (PE wax, low-molecular PTFE, oil, etc.) are added as lubricants whose structure allows them to diffuse towards the sliding surface to continuously lubricate it.

Thermal Properties

At this point it should be emphasized again that the mechanical properties of plastics depend much stronger on the temperature than those of metals or ceramic materials.

There are two different approaches or criteria for examining the thermal properties of a plastic material. The first is the temperature range in which a thermally initiated chemical degradation, i.e. a chemical decomposition of the material, occurs. This is specified by the so-called continuous service temperature.

The second quantity is the temperature determining the dimensional stability of the material. The

dimensional stability under heat, for example, is specified by the temperature at which a bending load of 1.8 N/mm² results in a 0.2 % elongation of the extreme fibres of a specimen. This temperature is often used synonymously with the so-called short-term service temperature.

Fire Behaviour

There is a number of standards for the fire behaviour of plastic materials. Usually, these standards refer to finished products. For semi-finished products, the UL 94 standard has become widely accepted.

The UL 94 specifies the following classifications:

- | | |
|-----|---|
| V-0 | Burning stops within 10 seconds, glowing stops within 30 seconds, no flaming drips, no complete combustion of the specimen, specimen supported in a vertical position |
| V-1 | Same criteria as for V-0, but burning stops within 30 seconds |
| V-2 | Same criteria as for V-1, but the underlying cotton may be ignited by flaming drips |
| HB | The combustion of a horizontally supported specimen with a given thickness stops after 25,4 mm after having been exposed to the flame for 30 seconds |

In some cases, the oxygen index (ASTM D 2863), i.e. the concentration of oxygen in an oxygen/nitrogen mixture at which the material burns, is also determined.

Commonly used terms such as "self-extinguishing" or "flame-resistant" should be used with great care as these criteria only apply under laboratory conditions.

Tolerances and Terms

A general rule for semi-finished products is that the nominal size of the semi-finished product should be obtained as finished size when being properly processed. The applicable tolerances for semi-finished products can be found in our catalogue. The basic properties of the raw materials used are defined by the respective underlying standards quoted in the corresponding semi-finished product standard.

Mechanically processed parts are – if not indicated otherwise on the drawing or the order – produced in accordance with the DIN ISO 2768-1 tolerance class “medium”.

Please state if you require tolerances other than those mentioned above. In most cases we should be able to meet your requirements, provided that the tolerances are “plastics-compatible”.

With “plastics-compatible” we refer to a tolerance zone for semi-finished products of at least 0.1 mm, depending on the absolute dimensions, due to the much stronger tendency of plastics to change in

dimension under external influences in comparison to metals. Of course, tighter tolerances can be realized, but this always represents only an “instantaneous image” during production, which can easily lead to complaints due to the problems mentioned.

Therefore, if the dimensions according to a drawing supplied by the customer show a tighter tolerance, we will apply the aforementioned minimum tolerance of 0.1 mm in the desired direction (+ or - or +/-). If this proves to be impossible due to the absolute dimensions, we will have to take exception to this tolerance.

For pre-cut sheets and rods we generally distinguish the following types of finish:

Terms					
Thickness	unmachined			planed	
Width	Rough sawed*	sawed*	planed*	sawed*	planed*
Pre-cut, length	Rough sawed**	sawed**	sawed**	sawed**	sawed**
	▼ „rough sawed“	▼ „sawed“	▼ „width-planed“	▼ „thickness-planed“	▼ „planed allround“

* when standard width: 600, 1.000 bzw. 1.200, not sawed to exact width

** when standard length: 1.000, 2.000 bzw. 3.000, not sawed to exact length

Pre-Cut Sheets

Pre-Cut Sheets				
Thickness	unmachined	The applicable tolerances for semi-finished products can be found in our catalogue		
	planed	> 8 to 30mm	-0.2/+0.2mm	
		> 30 to 120mm	-0.3/+0.3mm	
		> 120 to 230mm	-0.5/+0.5mm	
Width	standard width*	600mm	+0/+35mm	
		1,000mm	+0/+40mm	
		1,200mm	+0/+50mm	
	rough sawed	Thickness ≤ 80mm	+0.5/+2.0mm	
		Thickness > 80mm	+0.5/+3.0mm	
	sawed	Thickness ≤ 80mm	according to customer specifications or +0.0/+1.0 mm	
		Thickness > 80mm	according to customer tolerances or +0.0/+2.0 mm	
	planed	> 8 to 30mm	-0.2/+0.2mm	
		> 30 to 120mm	-0.3/+0.3mm	
		> 120 to 230mm	-0.5/+0.5mm	
Length	standard length**	1,000mm	+0/+30mm	
		2,000mm	+0/+60mm	
		3,000mm	+0/+90mm	
	rough sawed	Thickness ≤ 80mm	+0.5/+2.0mm	
		Thickness > 80mm	L < 1.000	+0.5/+2.0mm
			L > 1.000	+0.5/+5.0mm
	sawed	Thickness ≤ 80mm	according to customer specifications or +0.0/+1.0 mm	
		Thickness > 80mm	according to customer tolerances or +0.0/+2.0 mm	

Pre-Cut rods and tubes

Length	standard length**	1,000mm	+0/+30mm
		2,000mm	+0/+60mm
		3,000mm	+0/+90mm
	rough sawed	∅ ≤ 80mm	+1.5/+7.0mm
		∅ > 80mm	+1.0/+5.0mm

* when standard width: 600, 1.000 bzw. 1.200, not sawed to exact width

** when standard length: 1.000, 2.000 bzw. 3.000, not sawed to exact length

Processing information

1 General

When working with thermoplastic polymers, their special properties must be taken into account. Their viscoelastic properties impose special requirements on tooling. The use of tools made of HSS-steels has proved advantageous. In general, the tools must be kept very sharp, and the part to be machined must be fixed in such a way to prevent it from vibrating during processing.

In contrast to metals, polymers exhibit very low thermal conductivity, i.e. heat is not conducted away from the surface into the workpiece as it is the case with metals. Therefore, heat must be actively removed from the surface, which is preferably done by means of the chips. Additional air cooling can also be very effective.

**Basic requirements for clean mechanical processing of plastic parts are:
very sharp tools
and
very good cooling**

2 Processing temperature

Semi-finished plastic parts are usually produced either by extrusion or by casting. In both cases, internal stresses are generated in the material, which are reduced by subsequent thermal treatment. However, a small amount of stress remains in the material, which can result in dimensional inaccuracies or possibly crack formation in the finished part if the material is not treated properly. Therefore, processing of semi-finished plastic products in cold condition (i.e. at temperatures well below room temperature) should be avoided. If the material is delivered, for example by lorry during the winter, it should not be processed immediately. Experience has shown that it is sufficient to store the material at room temperature for 24 to 48 hours prior to processing.

3 Dimensions and stress within the material

Often the design of plastic parts poses requirements on tolerances that cannot be met by the materials. The following example serves to illustrate this:

A shaft with a diameter of 150 mm is to be made of POM (coefficient of thermal linear expansion $10 \cdot 10^{-4} \text{ K}^{-1}$) with a tolerance of $\pm 0.05 \text{ mm}$. Assuming a turner manages to meet the required dimensions and to adhere to the measuring temperature of 20°C , delivering a shaft with an actual diameter of 150.0 mm. If the shaft is later installed outdoors in bright sunlight, raising the temperature of the shaft to 28°C , the shaft will no longer fit into its bearing because the higher temperature has increased the diameter to 150.12 mm. In comparison, a steel shaft (with a coefficient of thermal linear expansion of $1.2 \cdot 10^{-5} \text{ K}^{-1}$) would have expanded by only approx. 0.014 mm.

The same considerations apply to machining. If the temperature of the workpiece is not observed, this can result in inaccurate dimensions of the finished product.

Although all our semi-finished products are tempered to relieve as much internal stress as possible, there is still the possibility of residual stresses being relieved after processing, which can affect the dimensions of the product. An example of such relaxation is the bending of a thick plastic sheet that has only been machined on one side. This can be minimized by symmetrical machining.

To ensure accurate dimensions, the following rules should be observed:

- Ensure cool working conditions to avoid relief of further stresses.
- Use very sharp tools.
- Avoid the workpiece vibrating.
- Do not measure the dimensions before the workpiece has completely cooled down.
- Avoid asymmetric machining.

4 Bonding

Bonding thermoplastic polymers is always problematic. In general, we distinguish three different types of joints: interdiffusion, ionic interaction and chemical bonding.

Direct chemical bonds between components can very rarely be achieved as this requires manipulating the chemistry of the components. Interdiffusion is possible with components made of the same material. With extruded PA 6, this can be achieved relatively simply by slightly dissolving the surfaces with formic acid. With all other materials, this gluing technique is rarely feasible as the required solvents are difficult to handle.

Caution: Formic acid is very caustic and harmful if inhaled!

Available adhesives can be generally divided into four groups:

- Cyan-acrylate systems
- Acrylate systems
- Polyurethane systems
- Epoxy systems

These systems differ in both their application and their properties. Commercially available cyan-acrylate systems are relatively easy to apply and produce very strong joints. However, their disadvantage is that these joints are very brittle and relatively vulnerable to impact and tensile stress. Therefore, cyan-acrylate systems should only be used in cases where sufficient strength is provided by the design of the finished part. Hence, this type of joint mainly serves to secure the parts in position.

Acrylate systems provide a more elastic joint. We distinguish between single-component systems, which need to be hardened by UV light, ready-mixed two-component systems, and two-component systems which need to be mixed on site. Polyurethane systems are also relatively inexpensive, but their chemical stability is often insufficient.

The variety of epoxy systems is similar to that of acrylate and polyurethane systems with cold- and hot-hardening systems being available. The standard systems are relatively brittle, but there are also special systems available that are more elastic.

When choosing an adhesive, the entire system should be taken into account, i.e. the adhesive must not only suit the materials to be joined, but also the mechanical and chemical (environmental) conditions under which it is applied. Hence, it is impossible to give clear recommendations for the most suitable type of adhesive for any given type of thermoplastic polymer. If in doubt, we recommend contacting the manufacturer of the adhesive for advice. The following book contains suggestions for various gluing problems. It is written in such a way that the basics can be understood by non-German speakers:

Marktspiegel Kunststoffkleben
Michaeli/Netze/Freitag
Verlag TÜV Rheinland/1991
ISBN 3-88585-965-2

There are, however, some simple rules for gluing thermoplastic polymers which should be observed:

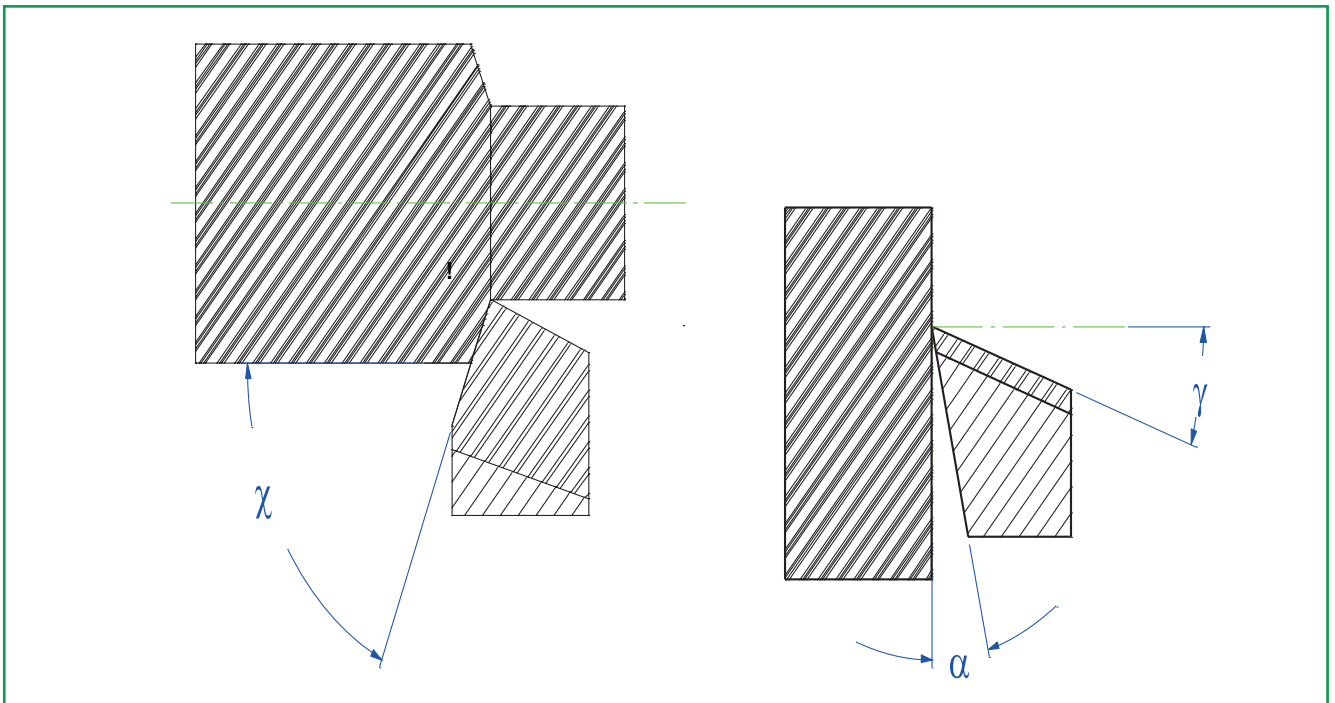
- The surfaces must be clean and free of grease.
- If possible, the surfaces should be roughened.
- If the construction allows, the joint should be fixed by additional means.
- The best joint is achieved with a chemical bond between the parts.
- If this is not possible, interdiffusion of the long molecular polymer chains of both parts is the second choice.
- Only if chemical or interdiffusion methods are not possible should a purely adhesive joint be considered.

4 Turning

In case of low-vibration parts (massive rods and short clamping lengths) the surface quality can be considerably improved by using a wide smoothing tool. This method cannot be used with thin-walled parts or parts that tend to vibrate within the lathe.

Recommended values for cutting geometry and machining parameters							
Turning			Polyamide	Polyacetal	Polyester	Polyolefins	Glass fibre reinforced plastics
Clearance angle	α	°	6–10	6–8	5–10	6–10	6–8
Rake angle	γ	°	0–5	0–5	0–5	0–5	2–8
Tool cutting edge angle	χ	m/min	45–60	45–60	45–60	45–60	45–60
Cutting speed	v	mm/U	250–500	300–600	300–400	250–500	150–200
Feed rate	s	mm/rev	0.1–0.5	0.1–0.4	0.2–0.4	0.1–0.5	0.1–0.5

The tip radius should be 0.5mm if possible.



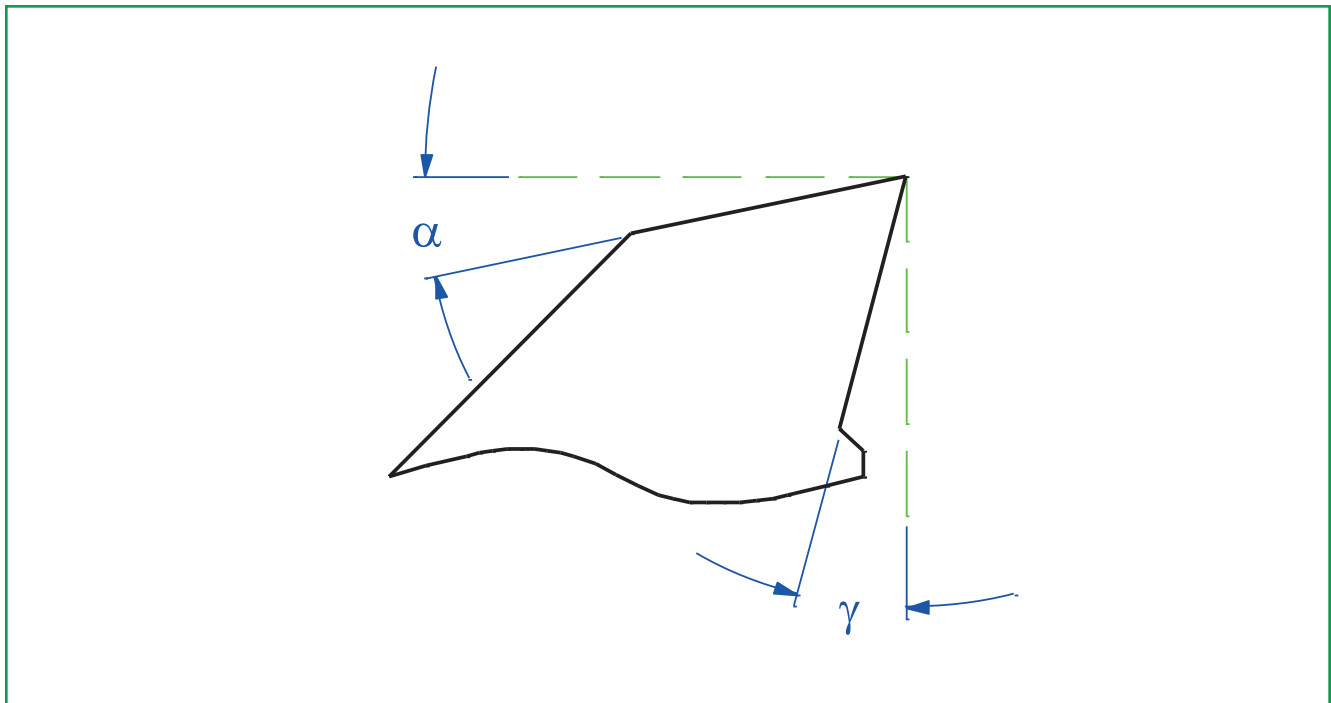
5 Milling

Any vibration of the workpiece during milling must be avoided. This can be achieved by using a one-edged tool. The space for the chips should generally be kept as large as possible.

Recommended values for cutting geometry and machining parameters

Milling			Polyamide	Polyacetal	Polyester	Polyolefins	Glass fibre reinforced plastics
Clearance angle	α	°	10–20	5–15	5–15	10–20	15–30
Rake angle	γ	°	5–15	5–15	5–15	5–15	6–10
Cutting speed	v	m/min	250–500	250–500	300	250–500	80–100

The feed rate can be up to 0.5mm/tooth.



6 Drilling

The twist angle β of the drill bit should be 12 to 16°. For pilot-drilling, the feed rate can be much higher, i.e. up to 1 mm/rev.

The values given are standard values supported by our own experience. It has proved sensible to modify the drill bit in such a way that the drill is not drawn into the material. This can be achieved by adding a negative rake angle (see picture). For thick-walled parts, it is possible to leave the point angle at the value of commercial drills.

Round rods with a large diameter may need to be heated prior to drilling. Doing so, it must be ensured that the part is thoroughly heated, which may take several hours. In practice, the following rule has proved useful:

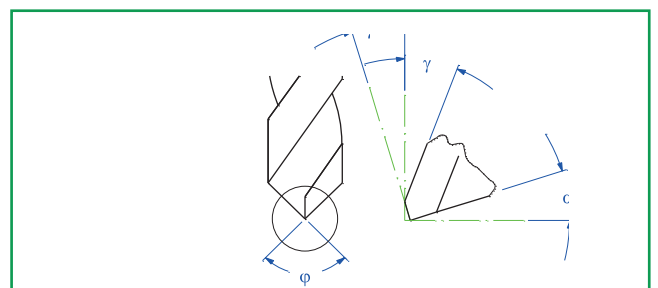
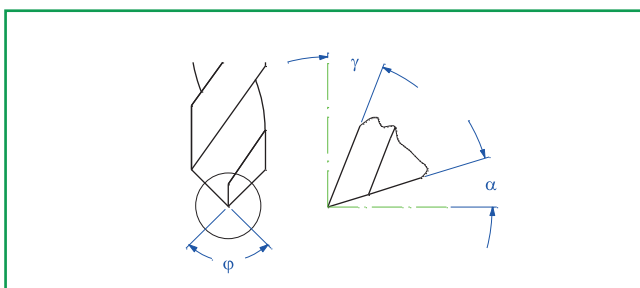
Furnace temperature: 100–120°C
Heating time: 2 hours per 10 mm material at the recommended temperature

Example:

A round rod with a diameter of 200 mm is to be heated thoroughly. According to the above rule, the rod has to remain in the furnace for 20 hours.

This process only serves to heat the component for subsequent machining and has nothing to do with the aforementioned tempering.

Recommended values for cutting geometry and machining parameters							
Drilling			Polyamide	Polyacetal	Polyester	Polyolefins	Glass fibre reinforced plastics
Clearance angle	α	°	5–15	5–10	5–10	5–15	6
Rake angle	γ	°	10–20	15–30	10–20	10–20	5–10
Point angle	φ	°	90	90	90	90	120
Cutting speed	v	mm/U	50–150	50–200	50–100	50–150	80–100
Feed rate	s	mm/rev	0.1–0.3	0.1–0.3	0.2–0.3	0.1–0.3	0.1–0.3

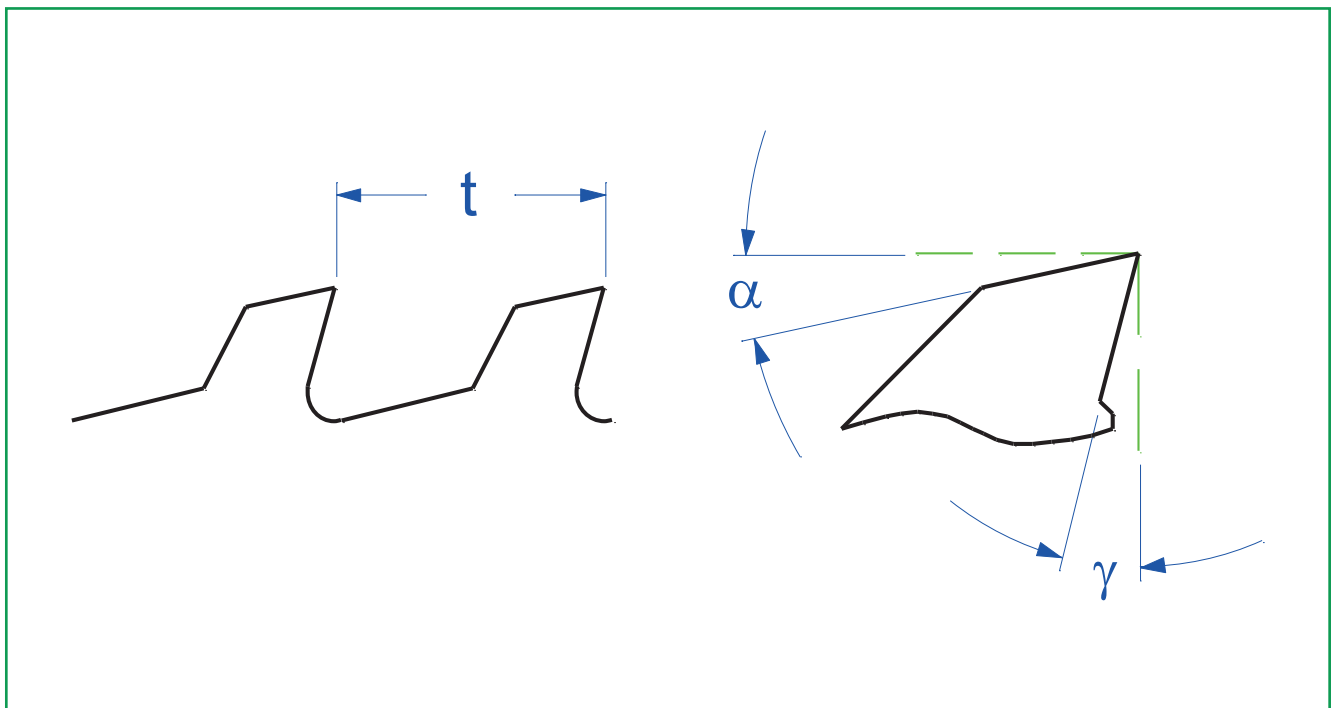


7 Sawing

Generally, the generation of heat should be kept to a minimum when processing plastic material. This can, for example, be achieved by using very sharp saw blades with a low tooth count

Recommended values for cutting geometry and machining parameters

Sawing			Polyamide	Polyacetal	Polyester	Polyolefins	Glass fibre reinforced plastics
Clearance angle	α	°	20–30	20–30	15–30	20–30	15–30
Rake angle	γ	°	2–5	0–5	5–8	2–5	10–15
Cutting speed	v	m/min	500	500–800	300	500	200–300
Pitch	t	mm/rev	3–8	2–5	3–8	3–8	3–5



8 Threads

The same general recommendations that apply for the processing of plastic materials also apply to thread-cutting. Within our company, thread formers have proved very effective tools. When using taps, the elastic behaviour of the plastic should be taken into account as this may require a certain amount of overmeasure.

Standards and Permissions for Special Purposes

Most application-related standards refer to special parts, which means that they are only partially applicable to semi-finished products. For this reason, many plastic materials are not tested in accordance with these standards.

The Download section of our website (www.globus-thermoplast.de) contains a number of declarations to frequently requested standards.

RoHS

REACH

EU Standard

ISO 9001:2015 certificate

Food admission, KTW, WRAS (on request)



Terms of delivery

1. General

- 1.1. Our Terms of Delivery and Payment are valid as of the given latest Version and apply to all current and future Orders from home and foreign ordering parties, unless we have explicitly accepted deviations in writing. Only our written confirmation relating to subsidiary agreements and subsequent changes is binding for us. This also applies to a revocation of the written form clause. The acceptance of our deliveries and Services is considered to be an acceptance of our Terms of Delivery and Payment.
- 1.2. Possible purchasing terms of the contractual partner are only binding for us following our explicit written acceptance of these terms. The same applies to other general business terms of the contractual partner.
- 1.3. Agreements of the contractual partner with our salesmen, representatives and authorised persons are only binding for us after our written confirmation. Our visiting and authorised personnel, as well as our representatives, are only entitled to accept cash payments and cheques upon presentation of an authority to collect.
- 1.4. We are entitled to process data of ordering parties that are related to the given business relations according to the Federal Data Protection Law (Bundesdatenschutz Gesetz-BDSG).

2. Offers and the conclusion of contracts

- 2.1. Our offers are subject to their confirmation. A delivery agreement, or any other contract, is only effective when we have confirmed the client's Order, or any other order, in writing or when we have delivered the merchandise.
- 2.2. We reserve the right to change the production process and product composition provided that this does not adversely affect the type and quality of the product.
- 2.3. In so far as no alternative has been confirmed, details in text or pictorial form (e.g. descriptions, illustrations or drawings) published in catalogues, brochures and other publications define the nature, condition and use of the

merchandise that we ultimately supply. The details are approximate values that are customary in the given line of business, unless they have been explicitly defined as binding in the order conformation. Other details of the manufacturer are not binding.

- 2.4. Excess and Short deliveries within the customary extent are considered as agreed.

3. Prices

- 3.1. Invoicing will be based on the prices applicable on the delivery day if a fixed price has not been explicitly stipulated in writing.
- 3.2. In so far as no alternative provisions have been explicitly made, all prices are net prices without value-added tax which the contractual partner has to pay in the given statutory amount, and they are applicable ex our production location without packaging. If no alternative details are furnished, prices are in the European currency (EURO).
- 3.3. We reserve the right to change prices if the basis for our calculations changes.
- 3.4. Granted discounts are cancelled in the event of default of payment of the contractual partner, if insolvency proceedings are filed for the assets of the contractual partner or if proceedings are rejected due to insufficiency of assets.

4. Delivery

- 4.1. Delivery times commence as from the date of our order confirmation, but not before all technical and commercial details have been unequivocally clarified. The delivery time is considered to have been fulfilled when the object has left our plant or warehouse prior to its expiry or if notification of dispatch readiness has been given if the merchandise cannot be dispatched in due time through no fault of ours.
- 4.2. In the event that we exceed deadlines and delivery times that are not explicitly defined as „fixed“ or „fix“ in the order confirmation, then the contractual partner may grant us a reasonable period of grace for the given

delivery/service. Only with the expiry of this grace period will we be in default.

- 4.3. Notwithstanding our rights resulting from a default of payment by the contractual partner, periods of time and deadlines are extended by the same amount of time as the contractual partner fails to fulfil their obligations vis-à-vis us.
- 4.4. We are absolved of all obligations incurred in the given contract in the event of unforeseeable and exceptional circumstances which we do not have to justify, such as industrial disputes, operating disruptions, any impediments imposed by any government or subdivision thereof, transport disruptions and other cases of force majeure, irrespective of whether they arose with us or our suppliers. Obstacles of a temporary nature only prevail for the actual duration of the restriction, plus a reasonable initial period. In the event that such events subsequently make the delivery impossible or unreasonable for one of the parties, both parties will be entitled to withdraw from the contract.
- 4.5. Our liability for culpable delay attributable to slight negligence in breach of duty is herewith excluded other than the breach of duty results in injury to life, body or health. This Provision is not associated with a change of the burden of proof to the detriment of the contractual partner.
- 4.6. We are entitled to effect partial deliveries provided that this can be reasonably expected of the contractual partner. Partial deliveries can be separately invoiced.

5. Information and consultation

Information and consultation relating to our products are based on our past experiences and findings. The specified values are established average values. Information and consultation do not dispense with the need to test the suitability of the supplied merchandise and to observe processing instructions. Verbal details are not binding. Clause 10 of these Terms is applicable in the event of possible liability.

6. Dispatch and passing of risk

- 6.1. If not specified otherwise, deliveries are effected ex works. In the event that an Incoterm has been agreed on as a delivery term, the Version valid at the time the agreement was concluded is applicable.
- 6.2. If, at the request of the contractual partner, the merchandise is dispatched to a location other than the place of fulfilment, the contractual partner will bear all arising costs. After due assessment of the circumstances, we are free to decide the transport route and the transport Company. Upon receipt of the merchandise, the contractual partner must immediately notify us in writing of the nature and extent of any transport damage. The merchandise will only be insured for transport damage, transport loss or breakage at the explicit request and expense of the contractual partner.
- 6.3. Dispatch and transport of ex works deliveries are always effected at the risk of the contractual partner. This is also the case if deliveries are effected from a third party warehouse (drop-off shipment) and for the return of merchandise and empties (transport of re-usable packaging). The risk, also with partial deliveries, passes to the contractual partner as soon as the consignment has been handed over to the person
- 6.4. executing the transport Operation or when, for the purpose of dispatch, the consignment has left our warehouse or, in the case of ex works deliveries, the consignment has left our plant. In the event that dispatch of merchandise is delayed for reasons which the contractual partner has to justify, or when the contractual partner is responsible for the transportation of the merchandise, then the passing of risk becomes effective when the contractual partner is given notification of dispatch readiness. The contractual partner shall bear the storage costs amounting to 0.5% of the invoiced total per month if the merchandise is stored in our works or store. We reserve the right to furnish proof of higher storage costs. Following the expiry of a reasonable period of grace without results, we shall be entitled to dispose of the

- merchandise in an alternative manner and supply the contractual partner again within a reasonably extended period of grace.
- 6.5. The risk for carriage paid deliveries to the customer's premises/warehouse and also partial deliveries passes to the contractual partner as soon as the merchandise has arrived at their business premises/warehouse ready for unloading. Unloading must be immediately carried out by the contractual partner who is obliged to provide an adequate number of workers and unloading facilities. We will charge for waiting times as is customary in this line of business. If transport to the destination fails for reasons which lie within the contractual partner's scope of risk, the risk associated with this transport shall then pass to the contractual partner. This also applies to any unjustified refusal of acceptance by the contractual partner. Clause 6.4 shall apply accordingly.

7. Payment

- 7.1. Payments must be effected in EURO (€) free of postage and expenses. Payments must only be made into the place of payment specified by us. Bills of exchange and cheques will only be considered to have been accepted as payment after they have been honoured and without the Obligation for timely presentation and submitting an objection.
- 7.2. If not specifically agreed otherwise, payments must be effected within 30 days of the invoice date without any deductions. In the event that this payment period is exceeded, we shall be entitled to Charge interest in the amount of 8 per cent above the basic interest rate p.a. (Section 247 BGB- German Civil Code).
- 7.3. The contractual partner can only offset counterclaims if these counterclaims are undisputed or legally binding. In the event of a defect, the contractual partner can withhold the three-fold of the post-performance amount. In exercising the retention right, the contractual partner must give us, according to our preference, security for the unpaid amount either by way of a bank guarantee or a deposit with a notary of their choosing.
- 7.4. If payment is not effected in due time we can:
- 7.4.1 Immediately assert from the ordering party all Claims arising from the given or other business, even if they are not yet due;
- 7.4.2. Retain our deliveries and other Services associated with the order in hand or other Orders until the ordering party has completely fulfilled all our Claims that are still open as a result of the order in hand or other Orders;
- 7.4.3. Demand the Provision of adequate security;
- 7.4.4. Demand the return of the merchandise supplied by us and that is subject to our reservation of title. If, as a result of lapse of time, the merchandise is no longer usable, or only usable to a limited extent, we will then be entitled to demand value equalization.
- 7.5. If, after a contract has been concluded, we become aware of facts relating to a significant deterioration of the financial Status of the contractual partner which, after due commercial assessment of the circumstances, could endanger our claim to counter-performance – especially if insolvency proceedings are filed – until the moment of Performance we can demand the Provision of an appropriate security within a reasonable period of time, or demand Performance upon tender of counter-performance. We can withdraw from the contract or demand compensation if the contractual partner does not fulfil our justified demand in due time. In such a Situation all amounts – also deferred amounts – shall become immediately due.

8. Reservation of title and industrial property rights

- 8.1. All delivered merchandise remains our property until all owed remunerations, including „all subsidiary Claims, have been

fully paid. If bills of exchange or cheques are accepted, then payment is only considered to have been effected after they have been finally honoured. Subsidiary Claims include the cost of packaging, freight and insurance, banking fees, dunning costs, the cost of legal advice and representation, court fees and other costs.

- 8.2. The contractual partner accepts the merchandise subject to reservation of title for safekeeping in conformity with commercial practice. The contractual partner is obliged to store the merchandise separately and identify it as belonging to us. We are entitled to check the separate storage and Identification of the merchandise at Short notice. If insolvency proceedings are filed for the assets of the contractual partner, we shall be entitled to immediately identify the reserved merchandise as our own property and/or repossess the merchandise. The contractual partner is liable for the loss of our merchandise. The contractual partner must insure the merchandise against fire, water and theft at their expense and for our benefit. Insurance Claims are herewith assigned to us in advance. We must be immediately notified of all arising damage.
- 8.3. Transformation and processing of the reserved merchandise are carried out on our behalf as manufacturer in accordance with Section 950 BGB (German Civil Code) without placing us under Obligation. The processed merchandise is considered to be reserved property with the meaning of Clause 8.1. In the event that the customer processes, combines and mixes the reserved merchandise with other goods, then we are entitled to co-ownership of the new object in the same ratio as the invoiced amount of the reserved merchandise in relation to the invoiced value of the other used goods. If our ownership ceases to exist due to combination or mixing, the customer hereby transfers their ownership rights already now to the new stock of objects to the same extent as the invoiced value of the reserved merchandise and will store it free of Charge on our behalf. The co-ownership rights existing hereafter are deemed as reserved merchandise as defined in Clause 8.1.
- 8.4. The reserved merchandise can be sold, processed or combined with other objects, or extended in any other form (hereinafter referred to as „resell“) by the contractual party only within the orderly course of business and provided that the contractual partner is not in default. Any other disposition of the reserved merchandise is inadmissible. We must be immediately notified of third-party attachments or seizures of the reserved merchandise. All Intervention costs, e.g. the cost of a third-party action in Opposition to proceedings in conformity with Section 771 ZPO (German Code of Civil Procedure must be borne by the contractual party in so far as they are not retracted by the third party {party opposing the proceedings) following the first request, and if Intervention was justified. If the contractual party grants their buyer deferment of payment, he must reserve ownership to the reserved merchandise under the same conditions as we have reserved ownership to the delivered reserved merchandise. However, the contractual partner is not obliged to reserve ownership vis-à-vis the buyer regarding the ownership to future arising demands. Otherwise, the contractual partner is not entitled to resell.
- 8.5. The Claims of the contractual partner resulting from the resale of the reserved merchandise are herewith assigned to us to the same extent as is needed to secure the reserved merchandise. The contractual partner is only entitled to resell if the resulting Claims entitlement is assigned to us.
- 8.6. If the contractual partner sells the reserved merchandise together with other goods not supplied by us for a total price, the Claims for the sale will be assigned to us to the same extent as the invoice value of our sold reserved merchandise.
- 8.7. If the assigned Claim is included in a running invoice, the contractual partner herewith assigns a part of the balance already to us, including the final balance from the current account that equals this Claim.

- 8.8. The contractual partner is entitled, until revocation, to collect the Claims assigned to us. We are entitled to revocation if the contractual party does not fulfil their payment obligations resulting from the business relations with us in an orderly manner or if we become aware of circumstances that could significantly diminish the credit worthiness of the contractual partner. If the preconditions exist to exercise the revocation right, then the contractual partner must, at our request, immediately disclose the assigned Claims and their debtor, declare all the details that are necessary to collect the Claims, hand over all the requisite documents to us and notify the debtor of this assignment. We are also entitled to notify the debtor of this assignment ourselves.
- 8.9. If the nominal value {invoice amount for the merchandise or the nominal amount of the Claim rights) of the securities existing for us exceeds the secured Claims by more than 20%, we will then be obliged to release securities of our choice at the request of the contractual partner.
- 8.10. If we assert our reservation of title, then this will only represent a withdrawal of the contract if we specifically declare this in writing. The right of the contractual partner to possess the reserved merchandise shall cease to exist if the contractual partner does not fulfil their obligations resulting from this agreement or other contracts.
- 8.11. We reserve the ownership and Copyright to the illustrations, drawings, specimens and other documents. They must not be duplicated in any form, nor made available to others, without our written approval. They must be immediately returned to us at our request or if an order is not placed.
- 8.12. If the object we have delivered includes Software, we shall retain all rights to this Software, especially the Copyright and other commercial property rights. We merely grant a non-exclusive utilisation licence related to the intended purpose of use. The actions, especially duplication, processing or distribution, specified in Section 69 c of the Copyright Law, require our written approval.
- 8.13. If third-party rights are infringed when products are produced according to specimens or other details of the contractual party, then the contractual party will immediately exempt us of all Claims.
- 8.14. If we are not awarded the order, we will then be entitled to demand reasonable reimbursement for the specimen products that we have produced.
- 9. Molds, models, jigs and fixtures**
- The following is applicable if the production of the contractual object requires the manufacturing of molds, models and fixtures (hereinafter referred to as „production devices*“):
- 9.1. If not stipulated otherwise, the production devices must be separately remunerated in addition to the price agreed for the contractual objects.
- 9.2. The remuneration payable for the production devices becomes immediately due when the order is confirmed. We are entitled to discontinue the manufacture of the production devices until we have received the payable remuneration.
- 9.3. If not stipulated otherwise, we remain the owners of the production devices. Notwithstanding the provisions in Clause 9.4, we undertake to use the production devices solely for the Orders of the contractual partner, provided that the contractual partner fulfils the payment and purchase obligations.
- 9.4. We can freely dispose of the production devices if the contractual partner releases the production devices. The same applies two years after the last partial delivery involving the use of the production devices, provided we have notified the contractual partner of the disposal or destruction of the production devices and this has not been opposed in writing by the contractual partner. We can dispose of the production devices under all circumstances if three years have passed since the last partial delivery involving the use of the production devices.
- 10. Warranty**
- 10.1. We are not liable for the incorrect or inappropriate use of the products.

- 10.2. The contractual partner is obliged to immediately carefully inspect the supplied merchandise upon receipt for completeness and conformity, even if specimens or samples have been previously supplied. The delivery is considered to be approved if notice of any defects is not given in writing, by fax or email within 3 working days of arrival of the merchandise at the point of destination or, if the defect was not immediately apparent in the course of an orderly inspection, within 3 working days of its discovery. If notice of a defect in relation to an additional delivery is not given within 3 days of receipt of the merchandise at the point of destination, it will be considered to have been approved. Our field staff is not entitled to accept notices of defect or incorrect quantities.
- 10.3. In the event that a notice of defect is justified, then the contractual partner will initially only be entitled to post-performance, which at our discretion can be the delivery of products that are free of defects (against return of the objected merchandise) or by remedying the defect. In the event that post-performance fails or is unreasonable for the contractual partner (Section 440 BGB – German Civil Code) or superfluous because
- a. We subsequently reject post-performance;
 - b. We cannot complete post-performance within the contractually stipulated time or a stipulated grace period and the continuation of Performance interest of the contractual partner is linked to timely rendition of Performance;
 - c. When special circumstances exist which, when mutual interests are taken into account, justify immediate withdrawal (Section 232, Sub-Section 2, BGB – German Civil Code), the contractual partner will immediately have the right to reduce the purchase price or, according to their preference, withdraw from the contract and demand compensation in place of the Performance, or demand replacement of futile expenditures in conformity with Clause 10.
- 10.4. The expenditures required for post-performance, especially transport, travel, work and material costs, will be borne by us. This does not apply if the expenditures increase if the product has been relocated after delivery to a different location than the domicile or commercial residence of the contract partner, except if this relocation is in keeping with the intended purpose of use of the given object.
- 10.5. If the contractual partner accepts defective merchandise even though he has recognised the defect, then he can only be entitled to the Claims and rights associated with defects if he has reserved these Claims and rights when accepting the defective merchandise.
- 10.6. The assignment of Claims of the contractual partner to third parties due to defects is excluded. Payments of the contractual partner in connection with notices of defect can only be retained to an extent that is reasonable with the asserted defect.
- 11. Liability for damages**
- 11.1. We are liable for damages resulting from injury to life, body or health in conformity with the corresponding legal provisions.
- 11.2. Otherwise our liability is limited to breach of duty and our non-contractual liability for damage caused intentionally or by gross negligence. The liability for the gross negligence of our employees, collaborators and simple agents is excluded in this context.
- 11.3. Exempt from Clause 11.2 is the breach of contractual duties (cardinal duties). In this case we are also liable in the event of slight negligence that is our own fault as well as that of the fault of our employees, collaborators and simple agents.
- 11.4. Liability is limited to contract-typical damage that we could have expected when the contract was concluded on account of the circumstances known to us at the given time.
- 11.5. Further damage, irrespective of the legal reason, is excluded. We are not liable for lack of commercial success, lost profit, indirect damage, consequential damage caused

by a defect and damage resulting from third-party Claims.

- 11.6. The above liability limitations apply equally to Claims for compensation on account of futile expenditures (Section 284 BGB – German Civil Code).
- 11.7. Irrespective of the legal reason, compensation Claims directed against us shall expire within two years of the legally stipulated commencement of the period of limitation, but at the latest after the surrender of the subject.
- 11.8. The above provisions are not associated with a reversal of the burden of proof to the disadvantage of the contractual partner.
- 11.9. Compensation Claims according to the Product Liability Law remain unaffected.

12. **Place of fulfilment and jurisdiction, applicable law**

- 12.1. Place of fulfilment for all mutual obligations is the domicile of GLOBUS Thermoplast GmbH.
- 12.2. If the contractual partner is a trader or a legal entity under public law as defined in Section 29 a), Sub-Section 2 ZPO (Code of Civil Procedure), the sole place of jurisdiction for all disputes is the seat of our commercial register. We are also entitled to take legal proceedings against the contractual partner at their legal place of jurisdiction.
- 12.3. The relations between us and the contractual partner are subject to German law under the exclusion of the United Nations Convention on Contracts for the International Sale of Goods (CISG) and the Rules of International Private Law. INCOTERMS apply to the interpretation of the contract.
- 12.4. In the event that individual provisions should prove to be ineffective or become ineffective due to subsequent circumstances, this will not affect the effectiveness of the remaining provisions.

Effective as from August 1st 2019
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