



DELIVERY PROGRAMME

# SEMI-FINISHED PRODUCTS

LINNOTAM  
LiNNOTAMGLiDE  
LiNNOTAMHiPERFORMANCE  
LiNNOTAMDRiVE  
LiNNOTAMCuSTOM

PA6  
PA66  
POM  
PET  
PEEK

**Licharz**  
engineering plastics





## THE STRONG BRAND FOR CAST POLYAMIDE:

The engineering plastics PA, POM and PET are modern, versatile materials from which all kinds of components for industrial equipment can be made. Licharz develops especially wear resistant and lubricated cast polyamide and produces a wide range of semi-finished products which can be quickly machined.

The cast polyamides of **LiNNOTAM** are produced either as semi-finished products or near net shape parts. They can be easily machined and have almost no internal stresses. There is an enormous choice of shapes, weights and dimensions. **LiNNOTAM** is available in four further variations:

**LiNNOTAMGLIDE:** the best sliding properties over the entire product life.

**LiNNOTAMHiPERFORMANCE:** the high-performance triple: dimensionally stable, durable and with excellent damping properties. There are versions for special requirements, for example with low water absorption, good hydrolysis resistance or high impact strength.

**LiNNOTAMDRIVE:** perfectly suited for power and torque transmission.

**LiNNOTAMCUSTOM:** your requirements are specific to you. Talk to us. We have the technical means, the experience and the capability to develop a solution tailored to you.

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# Sheets of LINNOTAM | LINNOTAM MoS

$\rho = 1.15 \text{ g/cm}^3$

Thickness	Tolerance	3050 x 1220			2000 x 1220			2000 x 1000				1000 x 1000			+ MoS 2000 x 1000			
		kg/m			kg/m			kg/m					kg/m			kg/m		
in mm	in mm																	
8	+0.2/+1.5							11.5	+	+	○					11.5	○	
10					16.5	+	+	13.5	+	+	+					13.5	+	
12	+0.3/+2.5				19.4	+	+	16.0	+	+	+					16.0	○	
15		24.3	+	+	24.3	+	+	20.0	+	+	+					20.0	○	
16					25.0	+	+	21.5	+	+	○					21.5	○	
18								24.5	+	+	○					24.5	○	
20		31.0	+	+	31.0	+	+	26.0	+	+	+					26.0	+	
22								29.0	+	○	○					29.0	○	
25		39.0	+	+	39.0	+	+	32.0	+	+	+					32.0	○	
30	+0.5/+3.5	47.0	+	+	47.0	+	+	38.5	+	+	+					38.5	+	
35		55.8	+	+	55.8	○	+	45.3	+	+	○					45.3	○	
40		62.0	+	+	62.0	+	+	51.0	+	+	+					51.0	+	
45		68.0	+	○	68.0	○	○	57.0	+	+	○					57.0	○	
50		78.0	+	+	78.0	+	+	63.5	+	+	+					63.5	+	
55	+0.5/+5.0	84.0	○	○				70.0	+	+	○					70.0	○	
60		93.0	+	+	93.0	+	○	76.0	+	+	+					76.0	○	
65		100.0	○	○				82.5	+	+	○					82.5	○	
70		108.0	+	+	108.0	○	○	88.5	+	+	○					88.5	○	
75	+0.5/+7.0							94.5	○	○	○					94.5	○	
80		122.0	+	+	122.0	○	○	101.0	+	+	○					101.0	○	
85								108.0	○	○	○					108.0	○	
90		135.0	○	○	135.0	○	○	113.0	+	+	○					113.0	○	
95								120.5	○	○	○					120.5	○	
100		148.0	+	○	148.0	○	○	126.0	+	+	○					126.0	○	
110	+0.5/+9.0	161.0	+	+										137.7	+	+		
120		180.0	+	○										149.8	+	+		
130														161.8	+	+		
140	+0.5/+10.0													173.9	+	+		
150														186.0	+	+		
160														198.1	+	+		
165														202.9	○	○		

- + Stock item
- Make to order product

Length Tolerance: +0%/+3%  
Width Tolerance: +0.5%/+4%

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.



# Rods of LINNOTAM | LINNOTAM MoS

$\rho = 1.15 \text{ g/cm}^3$

Nominal size	Tolerance	2000			1000			Nominal size	Tolerance	+ MoS 1000*	
		kg/m			kg/m					kg/m	
ø in mm	in mm						ø in mm	in mm			
30	+0.2/+1.4	0.8	+	+	0.8	+	+	90	+0.5/+3.2	7.8	o
35					1.2	+	+	95	+0.6/+3.5	8.7	o
40		1.5	+	+	1.5	+	+	100		9.6	+
45	+0.3/+1.9				1.9	+	+	110	+0.7/+3.9	11.6	+
50		2.4	+	+	2.4	+	+	115	+0.8/+4.3	12.9	o
55		2.8	+	+	2.8	+	+	120		13.6	+
60	+0.3/+2.5	3.4	+	+	3.4	+	+	125		15.3	o
65		4.0	+	+	4.0	+	+	130	+0.8/+5.0	16.4	+
70		4.8	+	+	4.8	+	+	135		17.7	o
75	+0.4/+2.8	5.6	+	+	5.6	+	+	140		18.9	+
80		6.2	+	+	6.2	+	+	145	+0.8/+5.3	20.4	o
85	+0.5/+3.2	7.0	+	+	7.0	+	+	150		21.6	+
90		7.8	+	+	7.8	+	+	155	+0.8/+6.0	23.9	o
95	+0.6/+3.5	8.7	+	+	8.7	+	+	160		24.6	o
100		9.6	+	+	9.6	+	+	165	+1.0/+6.5	26.0	o
110	+0.7/+3.9	11.6	+	+	11.6	+	+	170		27.4	o
115	+0.8/+4.3	12.9	+	+	12.9	+	+	175		29.7	o
120		13.6	+	+	13.6	+	+	180		30.6	o
125		15.3	+	+	15.3	+	+	190	+1.0/+7.5	34.5	o
130	+0.8/+5.0	16.4	+	+	16.4	+	+	200		38.2	o
135		17.7	+	+	17.7	+	+	210	+1.0/+8.5	42.2	o
140		18.9	+	+	18.9	+	+	220		46.9	o
145	+0.8/+5.3				20.4	+	+	230	+1.0/+9.5	50.0	o
150		21.6	+	+	21.6	+	+	240		55.0	o
155	+0.8/+6.0				23.9	+	+	250		60.4	o
160		24.6	+	+	24.6	+	+				
165	+1.0/+6.5				26.0	+	+				
170		27.4	+	+	27.4	+	+				
175					29.7	+	+				
180		30.6	+	+	30.6	+	+				
190	+1.0/+7.5	34.5	+	+	34.5	+	+				
200		38.2	+	+	38.2	+	+				
210	+1.0/+8.5				42.2	+	+				
220					46.9	+	+				
230	+1.0/+9.5				50.0	+	+				
240					55.0	+	+				
250					60.4	+	+				
260	+1.0/+11.0				65.2	+	+				
270					70.0	+	+				
280					75.0	+	+				
290	+1.5/+12.0				80.7	+	+				
300					86.3	+	+				
310					92.0	+	+				
320					98.0	+	+				

+ Stock item  
o Make to order product  
Length Tolerance: +0%/+3%  
\* more diameters on request

For cut to size pieces, other colors or food grade quality, please contact us.  
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# Rods of LINNOTAM

$\rho = 1.15 \text{ g/cm}^3$



Nominal size	Tolerance	1000			Slices 50 - 200			
		kg/m			AD			
330	+1.5/+13.5	104.0	+	+	○	850	○	○
340		113.0	+	+		900	○	○
350		117.5	+	+	○	950	○	○
360		124.0	+	+	○	1000	○	○
370	+1.5/+15.0	131.0	+	+		1050	○	○
380		140.0	+	+		1100	○	○
390		144.0	+	+		1150	○	○
400		153.0	+	+	○	1200	○	○
410	+1.5/+16.5	165.0	+	+		1250	○	○
420		173.8	+	+		1300	○	○
430		183.0	+	+	○	1350	○	○
440		187.0	+	+	○	1400	○	○
450		195.0	+	+	○	1450	○	○
460	+1.5/+18.0	205.0	+	+		1500	○	○
470		216.6	+	+		1650	○	○
480		221.0	+	+				
490		233.0	+	○				
500		242.0	+	+	○			
510	+3.0/+21.0	251.0	+	+				
520		262.4	+	+				
530		268.0	+	+				
540		276.5	+	+				
550		294.0	+	+	○			
560		309.0	+	+				
570		311.0	+	○	○			
580		316.0	+	+				
590		331.0	+	○				
600		346.0	+	+	○			
610	+3.0/+25.0	348.0	+	+	○			
620		365.0	+	+				
625		367.0	○	○				
630		376.0	+	+	○			
640		385.0	+	+	○			
650		400.0	+	+	○			
660		408.0	+	+	○			
670		425.0	+	○				
690		449.0	+	+				
700		470.0	+	+				
710		483.0	+	+				
720		492.0	○	○				
730		506.0	○	○				
750		535.0	+	○				
790		591.0	○	○				
800		601.0	+	○				

- + Stock item
- Make to order product

Length Tolerance: +0%/+3%

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# Tubes of LINNOTAM

$\rho = 1.15 \text{ g/cm}^3$

Weight in kg/m

AD ID \	50	55	60	65	70	75	80	85	90	95	100	110	120	130	140	150	160	170	180
30	1.8	2.4	3.1	3.5	4.2	5.0	5.8												
40	1.3		2.5	3.1	3.6	4.4	5.0	6.0	6.9		8.7	10.6	12.7	15.0	17.8	20.5	23.7	26.5	29.8
50				2.3	3.3	3.6	4.4		6.2		8.0	9.8	12.1	14.2	17.1	20.6	22.7	25.8	29.1
60						2.7	3.5		5.2		7.1	9.3	11.3	13.4	17.0	18.2	21.9	25.2	27.3
70								3.2	4.1	5.1	6.0	7.9	10.5	12.7	15.5	18.2	20.8	23.8	27.0
80											4.6	7.0	8.9	11.5	14.8	17.2	20.1	23.2	26.6
90												5.5	7.9	10.0	12.9	15.8	18.7	21.8	24.8
100													5.8	8.4	11.2	14.2	17.1	20.2	23.6
110															9.4	12.4	15.3	18.4	21.4
120															7.4	10.4	13.3	16.4	19.4
130																9.1	11.2	14.3	17.3
140																		11.9	15.2
150																			12.4

AD ID \	190	200	210	220	230	240	250	260	270	280	290	300	310	320	330	340	350	360	370
40	32.7	36.7	40.3	44.5	48.8	52.6													
50	32.0	36.0	39.9	43.9	48.4	52.0	58.0	63.2	67.7	72.3	78.6	83.0							
60	32.1	35.2	39.2	43.3	47.4	51.3	57.2	62.5	66.9	71.5	77.9	82.2							
70	30.4	35.3	38.4	42.2	46.4	50.3	56.3	61.5	65.9	70.5	76.9	80.7							
80	29.0	33.3	37.3	41.0	45.2	49.2	55.1	60.4	64.8	69.4	75.7	80.2	85.7	92.8	97.5	104.4	110.1	116.7	124.0
90	27.7	32.1	35.8	39.8	43.9	47.9	53.8	61.2	63.5	68.0	74.4	78.8	84.4	91.4	96.2	103.0	108.8	115.3	122.8
100	26.7	30.7	34.3	38.3	42.3	46.4	52.3	57.5	62.0	66.5	72.9	77.4	83.1	89.9	94.9	101.5	107.3	113.0	121.2
110	24.9	28.9	32.4	36.5	40.8	44.7	50.5	55.8	60.3	64.8	71.4	75.7	81.4	88.4	93.2	99.8	105.8	112.3	119.7
120	22.9	27.0	30.4	34.8	38.9	42.9	49.6	54.0	58.4	62.9	69.5	73.9	79.5	86.5	91.3	98.1	103.9	110.6	117.8
130	20.7	24.8	28.2	32.5	36.8	40.8	46.8	51.9	56.3	60.9	67.4	71.8	77.5	84.5	89.3	96.3	102.0	108.4	116.0
140	18.4	22.4	25.9	30.3	35.0	38.6	44.4	49.7	54.0	58.6	65.5	73.2	75.5	82.0	87.3	94.1	99.9	106.6	114.3
150	15.9	19.9	23.3	27.8	32.5	36.5	45.0	50.2	51.7	56.7	63.0	67.8	73.1	80.0	84.9	91.7	97.7	104.3	111.7
160	13.1	17.2	20.7	25.1	29.9	33.9	42.2	47.3	52.6	58.1	63.8	65.1	70.5	77.8	82.5	89.4	95.2	101.7	109.1
170		14.3	17.7	22.2	27.0	31.0	39.1	44.3	49.5	55.1	60.7	66.7	67.8	75.0	79.9	86.5	92.4	99.0	106.4
180			15.0	19.0	23.9	28.0	35.9	41.1	46.3	51.6	57.5	63.4	69.4	75.8	76.9	83.8	89.5	96.4	103.4
190				15.8	20.7	24.7	32.4	37.5	42.9	48.0	54.1	60.0	66.1	72.4	78.9	80.7	87.6	94.8	102.2
200					17.3	21.3	28.9	34.0	39.3	44.8	50.5	56.4	62.5	68.8	75.3	82.0	88.8	92.0	99.1
210						25.0	30.2	35.4	40.9	46.7	52.6	58.6	64.9	71.4	78.1	85.0	92.0	96.1	96.1
220							26.1	31.4	36.9	42.7	48.5	54.6	60.9	67.4	74.1	81.0	88.0	95.3	95.3
230							22.0	27.2	32.8	38.4	44.3	50.4	56.7	63.2	69.9	76.8	83.8	91.1	91.1
240								22.9	28.4	34.1	40.0	46.1	52.3	58.8	65.5	72.4	79.4	86.7	86.7
250									23.7	29.6	35.3	41.5	47.7	54.2	60.8	67.8	74.8	82.0	82.0
260										24.6	30.5	36.6	42.9	49.4	56.1	63.0	70.0	77.3	77.3
270											25.5	31.6	37.9	44.4	51.0	58.0	65.0	72.3	72.3
280												26.5	32.7	39.2	45.9	52.8	59.8	67.1	67.1
290													27.4	33.8	40.5	47.4	54.5	61.7	61.7
300														28.2	34.9	41.8	48.8	56.1	56.1
310															29.2	36.0	43.1	50.4	50.4
320																30.1	37.1	44.4	44.4
330																	31.0	38.2	38.2
340																		31.9	31.9



# Tubes of LINNOTAM



$\rho = 1.15 \text{ g/cm}^3$

Weight in kg/m

AD ID	380	390	400	410	420	430	440	450	460	470	480	490	500	510	520	530	540	550
80	130.3	138.8	146.8	155.9	161.3	170.0	178.0	186.3	193.8	203.3								
90	129.1	137.5	145.7	154.6														
100	127.5	136.0	143.3	152.3	158.5	167.2	175.2	183.5	191.0	200.5	209.3		228.4	239.6	245.3	256.9	277.3	283.3
110	125.8	134.5	141.6	150.8	157.0	165.6	173.7	181.9	189.5	198.8		217.6	226.8	237.9	243.7	255.4	265.4	281.6
120	124.1	132.6	139.9	149.0	155.1	163.8	171.8	180.2	187.9	197.1	205.9	215.8	225.0	236.2	242.7	253.6	263.7	280.0
130	122.1	130.8	137.9	147.1	153.3	161.9	170.0	178.2	185.8	195.3	204.0	214.0	223.0	244.2	241.2	251.8	261.7	277.9
140	120.0	128.6	135.9	144.9	151.0	159.7	167.8	176.0	183.6	193.0	201.9	211.8	221.0	232.2	239.0	248.8	259.7	275.9
150	117.9	126.4	133.8	142.8	148.9	157.6	165.6	173.9	181.5	190.9	199.7	209.6	218.5	230.0	237.0	246.3	257.4	273.6
160	115.3	123.9	131.2	140.2	146.4	162.9	163.1	171.3	178.9	188.4	197.2	207.1	216.3	227.5	234.5	243.9	254.8	271.0
170	112.6	121.1	128.5	137.5	143.6	152.3	160.4	168.8	176.2	185.6	194.5	204.3	213.5	225.0	233.2	241.4	252.3	268.6
180	111.8	120.3	127.6	134.6	140.7	149.4	157.4	165.7	173.6	182.7	191.8	201.7	210.9	222.2	230.8	238.5	249.4	265.6
190	109.4	117.0	124.3	131.5	137.6	146.3	154.7	162.9	170.5	179.6	188.7	198.6	207.8	219.4	227.9	235.5	246.4	262.6
200	106.1	114.0	119.9	128.5	134.3	143.3	151.4	160.3	167.2	176.7	185.5	195.4	204.5	216.1	224.8	232.5	243.4	259.6
210	102.7	110.6	116.4	125.1	130.9	140.6	149.3	157.6	164.5	174.6	183.4	193.3	201.4	213.0	221.8	229.1	240.0	256.2
220	99.0	106.9	112.8	121.4	127.6	136.3	145.0	153.3	160.1	169.6	178.8	189.0	198.2	209.0	218.4	225.8	236.4	252.6
230	98.6	103.1	109.0	117.6	123.8	133.2	141.3	149.5	157.0	166.6	175.3	185.2	194.4	205.3	214.8	222.0	233.0	249.1
240	94.2	101.8	105.0	113.6	119.8	129.3	137.3	145.6	153.1	162.6	171.4	181.3	190.5	201.3	211.4	218.1	229.0	245.2
250	89.6	97.2	105.0	109.4	115.6	125.5	133.6	141.9	149.4	158.9	167.7	177.6	186.7	197.6	207.4	214.0	224.8	241.1
260	84.8	92.4	100.3	109.4	111.2													
270	79.8	87.4	95.3	103.3	106.7	116.7	124.8	133.0	140.6	150.0	158.9	168.8	177.9	189.2	195.0	205.6	216.5	232.7
280	74.6	82.3	90.0	98.2	106.7													
290	69.2	76.9	84.7	92.8	97.0	107.7	115.8	124.0	131.6	141.0	149.9	159.7	168.9	180.2	185.9	196.6	207.5	223.7
300	63.6	66.3	79.1	87.1	95.4													
310	57.8	65.5	73.3	81.4	89.6	98.4	105.5	113.8	121.4	130.8	139.6	149.5	158.7	170.0	178.4	186.4	197.2	213.5
320	51.8	59.5	67.4	75.4	83.7	92.2	100.7											
330	45.7	53.3	61.2	69.2	77.5	86.0	94.6	103.4	113.2	122.7	131.5	141.4	150.5	159.0	170.3	181.5	192.4	208.0
340	39.3	47.0	54.8	62.9	71.1	79.6	88.2	97.0	107.6	117.0	125.8	135.7	144.9	153.3	164.7	175.4	186.8	203.0
350	35.4	40.4	48.3	56.3	64.6	73.0	81.6	91.5	99.5	111.2	120.0	129.8	139.2	147.3	160.2	170.8	181.7	197.9
360		36.4	41.5	49.5	57.8	66.3	74.9	83.7	92.8	102.0	114.0	123.8	133.1	145.7	154.3	164.9	175.8	192.0
370				42.6	50.8	59.3	67.9	76.8	85.8	95.0	97.3	117.7	126.8	139.6	148.2	158.8	169.7	186.0
380					43.7	52.1	60.8	69.6	78.6	87.9	98.3	111.3	120.0	133.9	141.9	153.2	164.1	180.0
390						44.8	53.5	62.3	71.3	80.5	90.0	99.6						
400						40.3	45.9	54.7	66.1	73.0	83.4	92.0	101.8	112.9	127.8	140.2	151.8	167.3
410								47.0	56.0	65.2	76.7	84.3	94.1	104.2	120.3	130.8		
420								42.2	48.1	57.3	66.7	76.4	86.2	96.2	112.5	122.9	138.0	154.3
430										49.2	58.6	68.2	78.0	88.1	104.4	114.9	131.4	147.1
440											50.3	59.9	69.7	79.8	96.2	106.6	117.3	140.6
450												51.4	61.2	71.2	87.7	98.2	108.9	119.6
460													52.5	62.5	79.2	98.3	100.2	111.0
470														53.6	70.3	80.8	91.4	102.3
480															61.3	71.8	82.4	93.3
490																62.5	73.2	84.0
500																	63.8	74.6

All diameters are available on request in different colors and grades including **LINNOTAM GLiDE**, **LINNOTAM GLiDE PRO T** and **LINNOTAM HiPERFORMANCE**.  
Cut to size pieces also available on request.

- Stock item**
- Length 500 mm
  - Length 1000 mm
  - Length 2000 mm

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.  
Length Tolerance: +0%/+3%



# Tubes of LINNOTAM






$\rho = 1.15 \text{ g/cm}^3$

Weight in kg/m

AD ID	640	650	660	680	700	720	740	750	760	780	800	860	875	900	975	1.000
580	94.2	106.2		159.3	168.6	201.6	287.6	235.7								
590	83.8	95.8						225.3								
600	73.2	85.2		138.7	147.7	180.6	249.2	214.7		305.0	315.4					
610		74.4						203.9								
620				117.4	125.9	158.9	249.2									
630								181.9								
640				95.3	103.5	136.4	209.0			230.8	242.2					
650								159.1								
660					80.4	113.3	151.7			208.0	219.0					
670								135.5								
680						89.4	128.2	123.5		184.5	195.1					
690								111.3			182.9					
700							104.0	98.8		160.3	170.5					
710								92.5			157.9					
720										135.4	145.1	237				
730																
740										109.8	119.0	210.9				
750												197.7				
760												184.2	216.3			
770																
780												156.6	188.7	229.9		
790												142.6				
800												128.3	160.4	201.6		
810														187.2		
820												99.3		172.6		
830														157.8		
840														142.8		
850																
860														112.4		
870																
875															219.4	
880																
890																
895															187.6	
900																225.4
910																
920																192.7
930																176
940																159.3
950																
960																125.15

All diameters are available on request in different colors and grades including **LINNOTAMGLiDE**, **LINNOTAMGLiDE PROT** and **LINNOTAMHiPERFORMANCE**.  
Cut to size pieces also available on request.

**Stock item**

-  Length 500 mm
-  Length 1000 mm
-  Length 2000 mm

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.  
Length Tolerance: +0%/+3%

# Sheets of LINNOTAMGLIDE

$\rho = 1.15 \text{ g/cm}^3$

Thickness	Tolerance	3050 x 1220		2000 x 1220		2000 x 1000					1000 x 1000		
		kg/m		kg/m		kg/m					kg/m		
8	+0.2/+1.5					11.5	+	o	+	o	+		
10				16.5	o o	13.5	+	+	+	+	+		
12	+0.3/+2.5			19.4	o o	16.0	+	+	+	+	+		
15		24.3	+ o	24.3	o o	20.0	+	o	+	o	o		
16		25.0	o o	25.0	o o	21.5	o	o	+	o	+		
18						24.5	+	o	o	o	o		
20		31.0	+ o	31.0	o o	26.0	+	+	+	+	+		
22						29.0	+	o	o	o	o		
25		39.0	+ o	39.0	o o	32.0	+	+	+	+	+		
30	+0.5/+3.5	47.0	+ o	47.0	o o	38.5	+	+	+	+	o		
35		55.8	+ o	55.8	o o	45.3	+	o	o	o	o		
40		62.0	+ o	62.0	o o	51.0	+	+	+	+	+		
45		68.0	+ o	68.0	o o	57.0	+	o	o	o	o		
50	+0.5/+5.0	78.0	+ o	78.0	o o	63.5	+	+	+	+	+		
55		84.0	+ o	84.0	o o	70.0	+	o	o	o	o		
60		93.0	+ o	93.0	o o	76.0	+	o	o	o	o		
65		100.0	o o	100.0	o o	82.5	o	o	o	o	o		
70		108.0	+ o	108.0	o o	88.5	+	o	o	o	o		
75	+0.5/+7.0			115.8	o o	94.5	o	o	o	o	o		
80		122.0	+ o	122.0	o o	101.0	+	o	o	o	o		
85				131.0	o o	108.0	o	o	o	o	o		
90		135.0	+ o	135.0	o o	113.0	+	o	o	o	o		
95				146.4	o o	120.5	o	o	o	o	o		
100		148.0	o o	148.0	o o	126.0	+	o	o	o	o		
110	+0.5/+9.0	161.0	o o									137.7	+ o
120		180.0	o o									149.8	+ o
130												161.8	+ o
140	+0.5/+10.0											173.9	+ o
150												186.0	+ o
160												198.1	+ o
165												202.9	o o

- + Stock item
- o Make to order product

Length Tolerance: +0%/+3%  
Width Tolerance: +0.5%/+4%

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.

# Rods of LINNOTAMGLIDE

$\rho = 1.15 \text{ g/cm}^3$

Nominal size ø in mm	Tolerance in mm	2000		1000			
		kg/m		kg/m			
30	+0.2/+1.4	0.8	+ +	0.8	+ + +	o	
35				1.2	+ +	o	o
40		1.5	+ +	1.5	+ + +	o	
45	+0.3/+1.9			1.9	+ +	o	o
50		2.4	+ +	2.4	+ + +	o	
55				2.8	+ +	o	o
60	+0.3/+2.5	3.4	+ +	3.4	+ + +	o	
65				4.0	+ +	o	o
70		4.8	+ +	4.8	+ + +	o	
75	+0.4/+2.8			5.6	+ o	o	o
80		6.2	+ +	6.2	+ + +	o	
85	+0.5/+3.2			6.9	+ o	o	o
90		7.8	+ +	7.8	+ + +	o	
100	+0.6/+3.5		+ o	9.6	+ + +	o	
110	+0.7/+3.9	9.6	+ o	11.6	+ + +	o	
115	+0.8/+4.3	11.6	+ o	12.9	+ o	o	o
120		12.9	+ o	13.6	+ + +	o	
125		13.6	+ o	15.3	+ o	o	o
130	+0.8/+5.0	15.3	+ o	16.4	+ + +	o	
135		16.4	+ o	17.7	o	o	o
140		17.7	+ o	18.9	+ + +	o	
145	+0.8/+5.3	18.9		20.4	o	o	o
150			+ o	21.6	+ + +	o	
155	+0.8/+6.0	21.6		23.9	o	o	o
160			+ o	24.6	+ o	o	o
165	+1.0/+6.5	24.6		26.0	+ o	o	o
170			o o	27.4	+ o	o	o
175		27.4		29.7	o	o	o
180			o o	30.6	+ +	o	o
190	+1.0/+7.5	30.6	o o	34.5	o	o	o
200		34.5	o o	38.2	+ +	o	o
210	+1.0/+8.5	38.2		42.2	+ o	o	o
220				46.9	+ o	o	o
230	+1.0/+9.5			50.0	o +	o	o
240				55.0	o	o	o
250				60.4	+ +	o	o
260	+1.0/+11.0			65.2	+ o	o	o
270				70.0	o	o	o
280				75.0	o +	o	o

+ Stock item  
o Make to order product

Length Tolerance: +0%/+3%

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.



# Rods of LINNOTAMGLIDE

$\rho = 1.15 \text{ g/cm}^3$

Nominal size	Tolerance	1000				
		kg/m				
ø in mm	in mm					
290	+1.5/+12.0	80.7	o	o	o	o
300		86.3	o	o	o	o
310		92.0	o	o	o	o
320		98.0	o	o	o	o
330	+1.5/+13.5	104.0	o	o	o	o
340		113.0	o	o	o	o
350		117.5	o	o	o	o
360		124.0	o	o	o	o
370	+1.5/+15.0	131.0	o	o	o	o
380		140.0	o	o	o	o
390		144.0	o	o	o	o
400		153.0	o	o	o	o
410	+1.5/+16.5	165.0	o	o	o	o
420		173.8	o	o	o	o
430		183.0	o	o	o	o
440		187.0	o	o	o	o
450		195.0	o	o	o	o
460	+1.5/+18.0	205.0	o	o	o	o
470		216.6	o	o	o	o
480		221.0	o	o	o	o
490		233.0	o	o	o	o
500		242.0	o	o	o	o
510	+3.0/+21.0	251.0	o	o	o	o
520		262.4	o	o	o	o
530		268.0	o	o	o	o
540		276.5	o	o	o	o
550		294.0	o	o	o	o
560		309.0	o	o	o	o
570		311.0	o	o	o	o
580		316.0	o	o	o	o
590		331.0	o	o	o	o
600		346.0	o	o	o	o
610	+3.0/+25.0	348.0	o	o	o	o
620		365.0	o	o	o	o
625		367.0	o	o	o	o
630		376.0	o	o	o	o
640		385.0	o	o	o	o
650		400.0	o	o	o	o
660		408.0	o	o	o	o
670		425.0	o	o	o	o
680		449.0	o	o	o	o

Nominal size	Tolerance	1000				
		kg/m				
ø in mm	in mm					
690		449.0	o	o	o	o
700		470.0	o	o	o	o
710		483.0	o	o	o	o
720		492.0	o	o	o	o
730		506.0	o	o	o	o
750		535.0	o	o	o	o
790		591.0	o	o	o	o
800		601.0	o	o	o	o

Slices	
50 - 200	
AD	
850	o
900	o
950	o
1000	o
1050	o
1100	o
1150	o
1200	o
1250	o
1300	o
1350	o
1400	o
1450	o
1500	o
1650	o

- + Stock item
- o Make to order product

Length Tolerance: +0%/+3%

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.

# Sheets of LINNOTAMGLIDE PRO T

$\rho = 1.15 \text{ g/cm}^3$

Thickness	Tolerance	3050 x 1220				2000 x 1220				2000 x 1000				1000 x 1000			
		kg/m				kg/m				kg/m				kg/m			
8	+0.2/+1.5									11.5	+	o	o				
10						16.5	o	o	o	13.5	+	o	o				
12	+0.3/+2.5					19.4	o	o	o	16.0	+	o	o				
15		24.3	o	o	o	24.3	o	o	o	20.0	+	o	o				
16		25.0	o	o	o	25.0	o	o	o	21.5	o	o	o				
18										24.5	o	o	o				
20		31.0	o	o	o	31.0	o	o	o	26.0	+	o	o				
22			o	o	o					29.0	o	o	o				
25		39.0				39.0	o	o	o	32.0	+	o	o				
30	+0.5/+3.5	47.0	o	o	o	47.0	o	o		38.5	+	o	o				
35		55.8	o	o	o	55.8	o	o	o	45.3	o	o	o				
40		62.0	o	o	o	62.0	o	o	o	51.0	+	o	o				
45		68.0	o	o	o	68.0	o	o	o	57.0	o	o	o				
50		78.0	o	o	o	78.0	o	o	o	63.5	+	o	o				
55	+0.5/+5.0	84.0	o	o	o					70.0	o	o	o				
60		93.0	o	o	o	93.0	o	o	o	76.0	o	o	o				
65		100.0	o	o	o					82.5	o	o	o				
70		108.0	o	o	o	108.0	o	o	o	88.5	o	o	o				
75	+0.5/+7.0									94.5	o	o	o				
80		122.0	o	o	o	122.0	o	o	o	101.0	o	o	o				
85										108.0	o	o	o				
90		135.0	o	o	o	135.0	o	o	o	113.0	o	o	o				
95										120.5	o	o	o				
100		148.0	o	o	o	148.0	o	o	o	126.0	o	o	o				
110	+0.5/+9.0	161.0	o	o	o									137.7	o	o	o
120		180.0	o	o	o									149.8	o	o	o
130														161.8	o	o	o
140	+0.5/+10.0													173.9	o	o	o
150														186.0	o	o	o
160														198.1	o	o	o
165														202.9	o	o	o

- + Stock item
- o Make to order product

Length Tolerance: +0%/+3%  
Width Tolerance: +0.5%/+4%

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.





# Rods of LINNOTAMGLIDE PRO T

$\rho = 1.15 \text{ g/cm}^3$

Nominal size ø in mm	Tolerance in mm	2000			1000				
		kg/m			kg/m				
30	+0.2/+1.4	0.8	o	o	o	0.8	+	o	o
35			o	o	o	1.2	o	o	o
40		1.5	o	o	o	1.5	+	o	o
45	+0.3/+1.9		o	o	o	1.9	o	o	o
50		2.4	o	o	o	2.4	+	o	o
55			o	o	o	2.8	o	o	o
60	+0.3/+2.5	3.4	o	o	o	3.4	+	o	o
65			o	o	o	4.0	o	o	o
70		4.8				4.8	+		
75	+0.4/+2.8					5.6			
80		6.2				6.2	+	o	o
90	+0.5/+3.2	7.8				7.8	+	o	o
95	+0.6/+3.25					8.7	o	o	o
100		9.6	o	o	o	9.6	+	o	o
110	+0.7/+3.9	11.6	o	o	o	11.6	+	o	o
115	+0.8/+4.3	12.9	o	o	o	12.9	o	o	o
120		13.6	o	o	o	13.6	+	o	o
125		15.3	o	o	o	15.3	o	o	o
130	+0.8/+5.0	16.4	o	o	o	16.4	+	o	o
135		17.7	o	o	o	17.7	o	o	o
140		18.9	o	o	o	18.9	+	o	o
145	+0.8/+5.3					20.4	o	o	o
150		21.6	o	o	o	21.6	+	o	o
155	+0.8/+6.0					23.9	o	o	o
160		24.6	o	o	o	24.6	+	o	o
165	+1.0/+6.5					26.0	o	o	o
170		27.4	o	o	o	27.4	+	o	o
175						29.7	o	o	o
180		30.6	o	o	o	30.6	+	o	o
190	+1.0/+7.5	34.5	o	o	o	34.5	o	o	o
200		38.2	o	o	o	38.2	+	o	o
210	+1.0/+8.5					42.2	o	o	o
220						46.9	o	o	o
230	+1.0/+9.5					50.0	o	o	o
240						55.0	o	o	o
250						60.4	o	o	o
260	+1.0/+11.0					65.2	o	o	o
270						70.0	o	o	o
280						75.0	o	o	o

- + Stock item
- o Make to order product

Length Tolerance: +0%/+3%

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.



Nominal size	Tolerance	1000		
		kg/m		
290	+1.5/+12.0	80.7	o	o
300		86.3	o	o
310		92.0	o	o
320		98.0	o	o
330	+1.5/+13.5	104.0	o	o
340		113.0	o	o
350		117.5	o	o
360		124.0	o	o
370	+1.5/+15.0	131.0	o	o
380		140.0	o	o
390		144.0	o	o
400		153.0	o	o
410	+1.5/+16.5	165.0	o	o
420		173.8	o	o
430		183.0	o	o
440		187.0	o	o
450		195.0	o	o
460	+1.5/+18.0	205.0	o	o
470		216.6	o	o
480		221.0	o	o
490		233.0	o	o
500		242.0	o	o
510	+3.0/+21.0	251.0	o	o
520		262.4	o	o
530		268.0	o	o
540		276.5	o	o
550		294.0	o	o
560		309.0	o	o
570		311.0	o	o
580		316.0	o	o
590		331.0	o	o
600		346.0	o	o
610	+3.0/+25.0	348.0	o	o
620		365.0	o	o
625		367.0	o	o
630		376.0	o	o
640		385.0	o	o
650		400.0	o	o
660		408.0	o	o
670		425.0	o	o
680		449.0	o	o
690		449.0	o	o
700		470.0	o	o
710		483.0	o	o

Slices 50 - 200		
AD		
750	o	o
800	o	o
850	o	o
900	o	o
950	o	o
1000	o	o
1050	o	o
1100	o	o
1150	o	o
1200	o	o
1250	o	o
1300	o	o
1350	o	o
1400	o	o
1450	o	o
1500	o	o
1650	o	o

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.

- + Stock item
- o Make to order product

Length Tolerance: +0%/+3%

# Sheets of LINNOTAM*HiPERFORMANCE* 612

$\rho = 1.15 \text{ g/cm}^3$

Thickness	Tolerance	2000 x 1000	
in mm	in mm	kg/m	
8	+0.2/+1.5	11.5	○
10		13.5	○
12	+0.3/+2.5	16.0	○
15		20.0	○
16		21.5	○
20		26.0	○
25		32.0	○
30	+0.5/+3.5	38.5	○
35		45.3	○
40		51.0	○
45		57.0	○
50		63.5	○
55	+0.5/+5.0	70.0	○
60		76.0	○
65		82.5	○
70		88.5	○
75	+0.5/+7.0	94.5	○
80		101.0	○
85		108.0	○
90		113.0	○
95		120.5	○
100		126.0	○

- + Stock item
- Make to order product

Length Tolerance: +0%/+3%  
Width Tolerance: +0.5%/+4%

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.

# Sheets of LINNOTAM*Hi*PERFORMANCE 1200

$\rho = 1.03 \text{ g/cm}^3$

Thickness	Tolerance	3000 x 1000	
in mm	in mm	kg/m	
8	+0.5/+1.5	10.1	+
10		12.1	+
12		14.2	o
15	+0.5/+2.0	18.2	+
16		20.3	o
18		21.1	o
20		23.1	+
25	+0.5/+2.5	29.0	+
30		34.2	+
35		39.5	+
40	+0.5/+3.0	45.3	+
45		50.4	o
50		55.7	+
55	+0.5/+3.5	64.6	o
60		66.8	o

- + Stock item
- o Make to order product

Length Tolerance: +0/+20 mm  
Width Tolerance: +0/+20 mm

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.



# Rods of LINNOTAMHiPERFORMANCE 612

$\rho = 1.15 \text{ g/cm}^3$

Nominal size	Tolerance	1000		Nominal size	Tolerance	1000	
in mm	in mm	kg/m		in mm	in mm	kg/m	
30	+0.2/+1.4	0.9	○	330	+1.5/+13.5	104.0	○
35		1.2	○	340		113.0	○
40		1.5	○	350		117.5	○
45	+0.3/+1.9	1.9	○	360		124.0	○
50		2.4	○	370	+1.5/+15.0	131.0	○
55		3.1	○	380		140.0	○
60	+0.3/+2.5	3.4	○	390		151.5	○
65		4.2	○	400		153.0	○
70		4.8	○	410	+1.5/+16.5	165.0	○
75	+0.4/+2.8	5.6	○	420		173.8	○
80		6.2	○	430		183.0	○
85	+0.5/+3.2	6.9	○	440		187.0	○
90		7.8	○	450		195.0	○
95	+0.6/+3.5	8.7	○	460	+1.5/+18.0	205.0	○
100		9.6	○	470		216.6	○
110	+0.7/+3.9	11.6	○	480		226.0	○
115	+0.8/+4.3	12.9	○	490		233.0	○
120		13.6	○	500		242.0	○
125		15.3	○	510	+3.0/+21.0	251.0	○
130	+0.8/+5.0	16.4	○	520		262.4	○
135		17.7	○	530		274.5	○
140		18.9	○	540		284.8	○
145	+0.8/+5.3	20.4	○	550		294.0	○
150		21.6	○	560		309.0	○
155	+0.8/+6.0	23.9	○	570		323.5	○
160		24.6	○	580		329.0	○
165	+1.0/+6.5	26.0	○	590		343.7	○
170		27.4	○	600		352.9	○
175		29.7	○	610	+3.0/+25.0	360.0	○
180		30.6	○	620		377.6	○
190	+1.0/+7.5	34.5	○	625		383.6	○
200		38.2	○	630		386.0	○
210	+1.0/+8.5	42.2	○	640		397.0	○
220		46.9	○	650		415.6	○
230	+1.0/+9.5	50.0	○	660		425.7	○
240		55.0	○	670		441.1	○
250		60.4	○	680		454.1	○
260	+1.0/+11.0	65.2	○	690		468.7	○
270		70.0	○	700		488.9	○
280		75.0	○	710		498.5	○
290	+1.5/+12.0	80.7	○				
300		86.3	○				
310		92.0	○				
320		98.0	○				

+ Stock item  
 ○ Make to order product  
 Length Tolerance: +0%/+3%

For cut to size pieces, other colors or food grade quality, please contact us.  
 Our semi-finished products meet DIN EN ISO 9001 : 2008.



$\rho = 1.03 \text{ g/cm}^3$

Nominal size ø in mm	Tolerance in mm	3000		500	
		kg/m		kg/m	
20	+0.1/+0.2	0.3	+		
25		0.5	+		
30	+0.1/+0.3	0.7	+		
35	+0.1/+0.4	1.0	+		
40	+0.1/+0.5	1.3	+		
45	+0.1/+0.6	1.7	+		
50	+0.1/+0.7	2.1	+		
55	+0.1/+0.8	2.5	+		
60	+1.0/+0.9	3.0	+		
70	+1.0/+2.0			4.4	+
80				5.7	+
90				7.2	+
100	+1.0/+2.5			8.9	+
110				10.2	+
120	+1.0/+3.0			12.9	+
130				15.1	+
140				17.4	+
150				19.7	+
160	+1.0/+3.5			22.8	+
170				25.6	o
180				28.7	o
190				31.9	o
200				35.3	o

- + Stock item
- o Make to order product

Length Tolerance: +0/+30 mm

For cut to size pieces, other colors or food grade quality, please contact us.  
Our semi-finished products meet DIN EN ISO 9001 : 2008.



# Tubes of LINNOTAMHiPERFORMANCE 1200

$\rho = 1.03 \text{ g/cm}^3 \text{ (1200)}$

Nominal size		500		Nominal size		500	
ø in mm		kg/m		ø in mm		kg/m	
AD	ID			AD	ID		
80	30	5.1	○	160	80	17.2	○
90	30	6.5	○	160	90	15.9	○
100	30	8.2	○	170	30	24.2	○
100	50	7.0	○	170	50	23.0	○
100	60	6.2	○	170	60	22.2	○
110	30	9.9	○	170	80	20.0	○
110	50	8.8	○	170	90	18.7	○
110	60	7.9	○	170	120	13.7	○
120	30	11.9	○	180	30	27.2	○
120	50	10.7	○	180	50	26.0	○
120	60	9.9	○	180	60	25.2	○
130	30	14.1	○	180	80	22.9	○
130	40	13.5	○	180	90	21.6	○
130	50	12.9	○	180	120	16.6	○
130	60	12.0	○	190	30	30.3	○
130	80	9.9	○	190	50	29.1	○
140	30	16.3	○	190	60	28.3	○
140	50	15.1	○	190	80	26.1	○
140	60	14.3	○	190	90	24.8	○
140	80	12.1	○	190	120	19.8	○
150	30	18.8	○	190	140	15.6	○
150	50	17.6	○	200	30	33.6	○
150	60	16.8	○	200	50	32.4	○
150	80	14.6	○	200	60	31.6	○
150	90	13.2	○	200	80	29.4	○
160	30	21.4	○	200	90	28.1	○
160	50	20.2	○	200	120	23.1	○
160	60	19.4	○	200	140	18.9	○

+ Stock item

○ Make to order product

Length Tolerance: +0/+30 mm





# Sheets of PA 6E

$\rho = 1.14 \text{ g/cm}^3$

Thickness	Tolerance	3000 x 610			2000 x 1000		
		in mm	in mm	kg/m	kg/m	kg/m	kg/m
1	-0.1/+0.1				1.1	+	
2	-0.15/+0.15				2.3	+	+
3	-0.2/+0.2				3.5	+	+
4	-0.2/+0.2				4.7	+	+
5	+0.2/+0.7				5.9	+	+
6					7.0	+	+
8	+0.2/+1.1	6.6	+	+	10.7	+	
10		8.0	+	+	13.2	+	
12	+0.3/+1.5	9.9	+	○	16.3	+	
15		12.1	+	+	19.9	+	
20		15.8	+	+	26.0	+	
25		19.5	+	+	32.0	○	
30	+0.5/+2.5	23.2	○	○	38.1	+	
35		27.6	○	○	45.3	○	
40		31.3	○	○	51.4	○	
50		38.7	○	○	63.5	○	
60	+0.5/+3.5	46.8	○	○	76.8	○	
70		54.2	○	○	88.9	○	
80	+0.5/+5.0	61.5	○	○	100.9	○	
100		75.5	○	○	124.5	○	

- + Stock item
- Make to order product

# Rods of PA 6E

$\rho = 1.14 \text{ g/cm}^3$



Nominal size	Tolerance	3000			1000		
		kg/m			kg/m		
ø in mm	in mm						
6	+0.1/+0.6	0.04	○	+	0.0	○	
8	+0.1/+0.7	0.07	○	○	0.0	○	
10		0.1	+	○	0.1	○	
12	+0.2/+0.8	0.15	○	○	0.1	○	
15		0.23	+	+	0.2	○	
16		0.26	○		0.2	○	
18		0.33	○		0.3	○	
20		0.4	+	+	0.4	+	
22	+0.2/+1.0	0.49	○		0.4	○	
25		0.62	+	+	0.6	+	
30		0.8	+	+	0.8	+	
35	+0.2/+1.2	1.2	+	+	1.2	+	
40		1.5	+	+	1.5	+	
45	+0.3/+1.3	1.9	+	○	1.9	+	
50		2.4	+	+	2.4	+	
55		2.9	○	○	2.9	○	
60	+0.3/+1.6	3.5	+	+	3.5	+	
65		4.0	+	○	4.0	○	
70		4.7	+	○	4.7	+	
75	+0.4/+2.0	5.4	○	○	5.4	○	
80		6.2	+	+	6.2	+	
85	+0.5/+2.2			○	6.9	○	
90		7.8	+	○	7.8	○	
95	+0.6/+2.5				8.6	○	
100		9.6	+	○	9.6	+	

Nominal size	Tolerance	3000			1000		
		kg/m			kg/m		
ø in mm	in mm						
110	+0.7/+3.0	11.7	○	○	11.7	○	
120	+0.8/+3.5	14.0	+	○	14.0	○	
125		15.2	○		15.2	○	
130	+0.9/+3.8	16.4	○	○	16.4	○	
140		19.0	○	○	19.0	○	
150	+1.0/+4.2	21.7	○	○	21.7	○	
160	+1.1/+4.5	24.8	○	○	24.8	○	
170	+1.2/+5.0	28.0	○	○	28.0	○	
180		31.5	○	○	31.5	○	
190	+1.3/+5.5	35.0	○	○	35.0	○	
200		38.8	○	○	38.8	○	
250	+1.5/+6.2				60.5	○	
280	+1.5/+6.6				75.5	○	
300	+1.5/+7.5	86.7	○		86.7	○	

- + Stock item
- Make to order product



# Tubes of PA 6E

$\rho = 1.14 \text{ g/cm}^3$

Nominal size		Tolerance	Tolerance	3000		
ø in mm		in mm	in mm	kg/m		
AD	ID	AD	ID			
25	12	+0.4/+1.1	-0.4/-1.1	0.5	+	o
25	15			0.4	+	o
30	15	+0.6/+2.0	-0.6/-2.0	0.6	+	o
35	15			1.0	+	o
35	20			0.9	+	o
40	20			1.2	+	+
40	25			1.0	+	+
40	30			0.8	+	+
45	20			1.6	+	o
45	25			1.4	+	o
50	20			2.1	+	o
50	25			1.8	+	o
50	30			1.6	+	o
50	35			1.3	o	o
55	30	+0.8/+2.5	-0.8/-2.5	2.1	o	o
55	35			1.9	+	o
60	35			2.4	+	o
60	40			2.1	+	o
60	50			1.3	+	o
65	35	+0.8/+3.0	-0.8/-3.0	3.0	+	o
65	40			2.7	+	o
70	50			2.6	+	o
80	30			5.4	+	o
80	50			3.9	+	o
90	40	+1.2/+3.6	-1.6/-5.0	6.4	+	o
90	60			4.7	+	o
100	60			6.5	+	o
100	70			5.4	+	o
125	80	+1.5/+4.5	-2.0/-6.5	10.0	+	o

- + Stock item
- o Make to order product

# Sheets of PA 66 | PA 66-GF

$\rho = 1.14 \text{ g/cm}^3$  |  $\rho = 1.35 \text{ g/cm}^3$

Thickness	Tolerance	3000 x 610		2000 x 1000	
in mm	in mm	kg/m		kg/m	
1				1.1	○
2				2.3	○
3				3.8	+
4				4.8	○
5	+0.2/+0.7			6.3	○
6				7.5	+
8	+0.2/+1.1	6.5	+		
10		8.0	+		
12	+0.3/+1.5	9.9	○		
15		12.1	+		
20		15.8	+		
25		19.5	+		
30	+0.5/+2.5	23.2	+		
35		27.6	○		
40		31.3	○		
50		38.7	+		
55	+0.5/+3.5	42.9	○		
60		46.8	○		

Thickness	Tolerance	PA 66-GF 3000 x 610	
in mm	in mm	kg/m	
10	+0.3/+1.5	9.5	+
15		14.4	+
20		18.7	+
25		23.1	○
30	+0.5/+2.5	27.5	+
40		37.1	○
50		45.8	○
60		55.4	○
80	+0.5/+3.5	72.9	○
100		89.4	○

- + Stock item
- Make to order product

PA 66 is also available in black.



# Rods of PA 66 | PA 66-GF

$\rho = 1.14 \text{ g/cm}^3$  |  $\rho = 1.35 \text{ g/cm}^3$

Nominal size		PA 66 3000	
$\varnothing$ in mm	Tolerance in mm	kg/m	
6	+0.1/+0.6	0.04	o
8	+0.1/+0.7	0.07	o
10		0.1	o
12	+0.2/+0.8	0.15	o
15		0.23	o
16		0.26	o
18		0.33	o
20		0.4	+
25	+0.2/+1.0	0.62	+
28		0.77	o
30		0.8	+
35	+0.2/+1.2	1.2	o
40		1.5	+
45	+0.3/+1.3	1.9	+
50		2.4	+
55		2.9	+
60	+0.3/+1.6	3.5	+
65		4.0	o
70		4.7	+
75	+0.4/+2.0	5.4	o
80		6.2	+
85	+0.5/+2.2	6.9	o
90		7.8	+
100	+0.6/+2.5	9.6	+
110	+0.7/+3.0	11.7	o
120	+0.8/+3.5	14.0	o
130	+0.9/+3.8	16.4	o
140		19.0	o
150	+1.0/+4.2	21.7	o

Nominal size		PA 66-GF 3000	PA 66-GF 1000
$\varnothing$ in mm	Tolerance in mm	kg/m	kg/m
10	+0.1/+0.7	0.1	0.1
12	+0.2/+0.8	0.1	0.1
15		0.2	0.2
20		0.4	0.4
25	+0.2/+1.0	0.7	0.7
30		1.0	1.0
40	+0.2/+1.2	1.8	1.8
50	+0.3/+1.3	2.8	2.8
60	+0.3/+1.6	4.1	4.1
70	+0.4/+2.0	5.5	5.5
80		7.2	7.2
100	+0.5/+2.2	11.3	11.3
120	+0.8/+3.5	16.4	16.4
150	+1.0/+4.2	25.5	25.5

- + Stock item
- o Make to order product

PA 66 is also available in black.

# Sheets of POM-C

$\rho = 1.41 \text{ g/cm}^3$

Thickness	Tolerance	3000 x 1220		3000 x 610		2000 x 610		2000 x 1000	
		kg/m		kg/m		kg/m		kg/m	
1	-0.1/+0.1							1.5	+ ○
2	-0.15/+0.15							2.9	+ ○
3	-0.2/+0.2							4.5	+ ○
4								6.0	+ +
5	+0.2/+0.7							7.5	+ +
6								8.9	+ +
8	+0.2/+1.1	16.2	+	7.8	○ ○	7.8	○ ○	13.1	+ +
10		19.8	+	9.4	+ +	9.4	+ ○	16.0	+ +
12	+0.3/+1.5	24.6	○	12.0	○ +	12.0	+ +	19.0	+ +
15		30.1	+	14.5	+ +	14.5	+ +	23.7	+ +
20		39.2	+	18.6	+ +	18.6	+ +	31.1	+ +
25		48.3	+	23.6	+ +	23.6	+ +	39.0	+ +
30	+0.5/+2.5	57.4	+	27.9	+ +	27.9	+ +	46.3	+ +
35		68.4	○	33.4	+ +	33.4	○ +	55.1	+ +
40		77.5	○	37.8	+ +	37.8	+ +	62.3	+ +
45		86.6	○	42.4	○ +	42.4	○ ○	71.5	○ ○
50		95.7	+	46.8	+ +	46.8	+ +	77.5	+ +
60	+0.5/+3.5	115.8	+	56.5	○ +	56.5	○ +	92.0	+ +
70		131.9	+	66.0	○ ○	66.0	○ +	104.0	+ +
80	+0.5/+5.0	149.8	+	74.0	○ +	74.0	○ +	120.0	+ +
90		169.6	+	84.8	○ ○	84.8	○ ○	138.0	+ +
100		189.3	+	95.0	○ +	95.0	○ +	154.0	+ +
110	+0.5/+6.0	207.3	+	103.7	○ +	103.7	○ +		
120								169.2	○ ○
125		235.1	○	117.4	○ ○	117.4	+ +		
150	+0.5/+7.0	280.0	○	140.0	○ -	140.0	+ +		
200						187.5	○ ○		

- + Stock item
- Make to order product

POM-C is also available in Food Grade,  
Food Grade blue, with lubricant or anti-static.





# Rods of POM-C

$$\rho = 1.41 \text{ g/cm}^3$$

Nominal size	Tolerance	3000			1000		
		kg/m			kg/m		
ø in mm	in mm						
6	+0.1/+0.6	0.0	+	○			
8	+0.1/+0.7	0.0	+	○	0.0	○	○
10		0.1	+	○	0.1	○	○
12	+0.2/+0.8	0.1	○	○	0.1	○	○
15		0.2	+	○	0.2	○	○
16		0.3	+	+			
18		0.4	○	○	0.4	○	○
20		0.4	+	+	0.4	+	+
22	+0.2/+1.0	0.5	+	○	0.5	○	○
25		0.7	+	+	0.7	+	+
28		0.9	+	○	0.9	○	○
30		1.0	+	+	1.0	+	+
32	+0.2/+1.2	1.2	+	+	1.2	+	○
35		1.4	+	+	1.4	+	+
40		1.9	+	+	1.9	+	+
45	+0.3/+1.3	2.4	+	+	2.4	+	+
50		2.9	+	+	2.9	+	+
55		3.5	+	+	3.5	+	○
60	+0.3/+1.6	4.2	+	+	4.2	+	+
65		5.0	+	+	5.0	+	○
70		5.7	+	+	5.7	+	+
75	+0.4/+2.0	6.6	+	+	6.6	+	○
80		7.5	+	+	7.5	+	+
85	+0.5/+2.2	8.5	○	○	8.5	○	○
90		9.4	+	+	9.4	+	+
95	+0.6/+2.5	10.8	○	○	10.8	○	○
100		11.6	+	+	11.6	+	+

Nominal size	Tolerance	3000			1000		
		kg/m			kg/m		
ø in mm	in mm						
110	+0.7/+3.0	14.4	+	+	14.4	+	+
120	+0.8/+3.5	17.0	+	+	17.0	+	+
125		18.7	+	+	18.7	+	+
130	+0.9/+3.8	20.1	+	+	20.1	+	+
140		22.9	+	+	22.9	+	+
150	+1.0/+4.2	26.6	+	+	26.6	+	+
160	+1.1/+4.5	30.5	+	+	30.5	+	+
170	+1.2/+5.0	34.6	+	+	34.6	+	+
180		38.8	+	+	38.8	+	+
190	+1.3/+5.5	43.6	+	+	43.6	+	+
200		47.7	+	+	47.7	+	+
210	+1.3/+5.8	52.2	+	+	52.2	+	+
220		57.0	+	+	57.0	+	+
230	+1.5/+6.2	62.4	+	○	62.4	+	○
250		74.6	+	○	74.6	+	+
260	+1.5/+6.6	80.9	+	○	80.9	+	+
280		93.9	+	+	93.9	+	+
300	+1.5/+7.5	107.0	+	+	107.0	+	+
310					116.0	○	○
350	+1.5/+8.5	147.0	○		147.0	+	○
400	+1.5/+9.5	191.2	○	○	191.2	+	+
450	+1.5/+10.5				243.1	+	○
500	+1.5/+11.5	298.8	○		298.8	+	○

- + Stock item
- Make to order product

POM-C is also available in Food Grade,  
Food Grade blue, with lubricant or anti-static.

# Tubes of POM-C



$\rho = 1.41 \text{ g/cm}^3$

Nominal size		Tolerance	Tolerance	3000			1000	
ø in mm		in mm	in mm	kg/m			kg/m	
AD	ID	AD	ID					
25	15	+0.4/+1.1	-0.4/-1.1	0.5	+	o	0.5	+
30	15			0.8	+	o	0.8	+
	20			0.6	+	o	0.6	+
35	15	+0.6/+2.0	-0.6/-2.0	1.2	+	o	1.2	+
	20			1.1	+	o	1.1	+
	25			0.8	+	o	0.8	+
40	20			1.5	+	o	1.5	+
	25			1.2	+	o	1.2	+
	30			1.0	+	o	1.0	+
45	20			2.0	+	o	2.0	+
	25			1.7	+	o	1.7	+
	30			1.4	+	o	1.4	+
50	20			2.6	+	o	2.6	+
	25			2.3	+	o	2.3	+
	30			2.0	+	+	2.0	+
	35			1.7	+	o	1.7	+
55	30	+0.8/+2.5	-0.8/-2.5	2.7	+	o	2.7	+
	35			2.3	+	o	2.3	+
60	30			3.4	+	o	3.4	+
	35			3.0	+	o		
	40			2.6	+	+	2.6	+
	50			1.6	+	o	1.6	+
65	30	+0.8/+3.0	-0.8/-3.0	4.1	+	o	4.1	+
70	30			4.9	+	+	4.9	+
	50			3.2	+	o	3.2	+
80	40			5.9	+	o	5.9	+
	50			4.9	+	+		
	60			3.7	+	o	3.7	+
90	40	+1.2/+3.6	-1.6/-5.0	7.9	+	o	7.9	+
	50			7.1	+	+	7.1	+
	60			6.0	+	o	6.0	+
	70			4.6	+	o	4.6	+
100	40			10.2	+	o	10.2	+
	50			9.3	+	o	9.3	+
	60			8.8	+	o		
	70			6.9	+	o	6.9	+
	80			5.2	+	o	5.2	+
110	50			11.6	+	+	11.6	+
	60			10.5	+	o	10.5	+
	80			7.5	+	o	7.5	+
120	60	+1.5/+4.5	-2.0/-6.5	13.4	+	o	13.4	+
	80			10.4	+	o	10.4	+
	100			6.6	+	o	6.6	+
125	80			12.2	+	o	12.2	+

+ Stock item  
o Make to order product



# Tubes of POM-C

$\rho = 1.41 \text{ g/cm}^3$

Nominal size		Tolerance	Tolerance	3000			1000		
ø in mm		in mm	in mm	kg/m			kg/m		
AD	ID	AD	ID						
130	100	+1.5/+4.5	-2.0/-6.5	9.6	+	○	9.6	+	
	110			7.3	+	○	7.3	+	
140	100			13.0	+	○	13.0	+	
	110			10.5	+	○	10.5	+	
150	80			19.9	+	○	19.9	+	
	100			16.1	+	○	16.1	+	
170	100	+1.8/+5.4	-2.2/-7.5	23.8	+	○	23.8	+	
	130			14.3	+	○	14.3	+	
180	100			26.9	+	○	26.9	+	
	140			17.5	+	○	17.5	+	
	160			10.8	+	○	10.8	+	
210	160	+2.0/+6.0	-2.5/-8.5	24.8	+	○	24.8	+	

- + Stock item
- Make to order product

# Sheets of PET | PET-GL

$\rho = 1.37 \text{ g/cm}^3$  |  $\rho = 1.43 \text{ g/cm}^3$

Thickness	Tolerance	2000 x 1000		2000 x 610		PET GL 2000 x 610	
		kg/m		kg/m		kg/m	
8	+0.2/+1.1	13.2	+	8.0	○ ○	7.9	+
10		16.1	+	9.8	+ ○	9.7	+
12	+0.3/+1.5	20.0	+	12.2	○ ○	12.0	+
15		24.5	+	14.9	+ ○	14.7	+
20		31.9	+	19.4	+ ○	19.1	+
25		39.3	+	24.0	+ ○	23.6	+
30	+0.5/+2.5	46.8	+	28.5	+ ○	28.1	+
35		55.7	+			33.5	○
40		63.1	+	38.4	+ ○	37.9	+
45		68.5					
50		78.0	+	47.5	+ ○	46.8	+
60	+0.5/+3.5	94.3	+	57.5	+ ○	56.6	+
70				66.6	○ ○	65.6	○
80	+0.5/+5.0			73.0	○ ○	74.5	○
90				85.6	○ ○	84.3	○
100				93.3	○ ○	94.1	○

- + Stock item
- Make to order product



# Rods of PET | PET-GL

$\rho = 1.37 \text{ g/cm}^3$  |  $\rho = 1.43 \text{ g/cm}^3$

Nominal size	Tolerance in mm	3000			1000			PET-GL 3000		PET-GL 1000	
		kg/m			kg/m			kg/m		kg/m	
8	+0.1/+0.7							0.0	○		
10		0.1	○	○				0.1	○		
12	+0.2/+0.8	0.1	○	○				0.1	○		
16		0.3	○	○				0.3	○		
18		0.4	○	○				0.4	○		
20		0.5	+	○				0.4	+		
22	+0.2/+1.0							0.6	○		
25		0.7	○	○				0.7	+		
28								0.9	○		
30		1.0	+	○	1.0	○		1.0	+	1.0	+
32	+0.2/+1.2							1.2	○		
35		1.5	+	○	1.5	○		1.4	+		
40		1.9	+	○	1.9	○		1.9	+	1.9	+
45	+0.3/+1.3	2.4	○	○				2.4	○		
50		3.0	+	○	3.0	○		2.9	+	2.9	+
55		3.6	○	○				3.5	○		
60	+0.3/+1.6	4.3	+	○	4.3	○		4.2	+	4.2	+
65		5.0	○	○				4.99	○		
70		5.8	+	○	5.8	○		5.78	+	5.7	+
75	+0.4/+2.0	6.7	○	○				6.61	○		
80		7.6	+	○	7.6	+		7.57	+	7.5	+
85	+0.5/+2.2	8.6	○	○				8.51	○		
90		9.7	+	○	9.7	+		9.56	+	9.5	+
100	+0.6/+2.5	11.9	+	○	11.9	+		11.82	+	11.8	+
110	+0.7/+3.0	14.5	+	○	14.5	+		14.36	+		
120	+0.8/+3.5	17.4	○	○				17.16	+	17.1	
130	+0.9/+3.8	20.3	○	○	20.3	+		20.05	+	20.0	+
140	+1.0/+4.2	23.6	○	○				23.26	○	23.2	+
150	+1.1/+4.5	27.0	○	○	27.0	+		26.61	+	26.6	○
160		30.7	○	○							
170	+1.2/+5.0	37.7	○	○							
180		39.0	○	○							
200	+1.3/+5.5	48.1	○	○							

- + Stock item
- Make to order product

# Tubes of PET



$\rho = 1.37 \text{ g/cm}^3$

Nominal size		Tolerance	Tolerance	3000	
ø in mm		in mm	in mm	kg/m	
AD	ID	AD	ID		
30	20	+0.4/+1.1	-0.4/-1.1	0.6	○
35	25	+0.6/+2.0	-0.2/-0.6	0.8	○
45	30			1.4	○
50	40			1.2	○
60	30	+0.8/+2.5	-0.8/-2.5	3.3	○
65	50	+0.8/+3.0	-0.8/-3.0	2.3	○
70	40			4.1	○
80	60			3.7	○
90	70	+1.2/+3.6	-1.6/-5.0	4.5	○
100	80			5.1	○

- + Stock item
- Make to order product

# Sheets of PEEK

$\rho = 1.32 \text{ g/cm}^3$

Thickness	Tolerance	2000 x 1000	
in mm	in mm	kg/m	
8	+0.2/+1.1	12.4	○
10		15.2	○
12	+0.3/+1.5	18.9	○
15		23.1	○
20		30.1	○
25		37.1	○
30	+0.5/+2.5	44.1	○
40		59.5	○
50		73.5	○
60	+0.5/+3.5	88.9	○

- + Stock item
- Make to order product



# Rods of PEEK

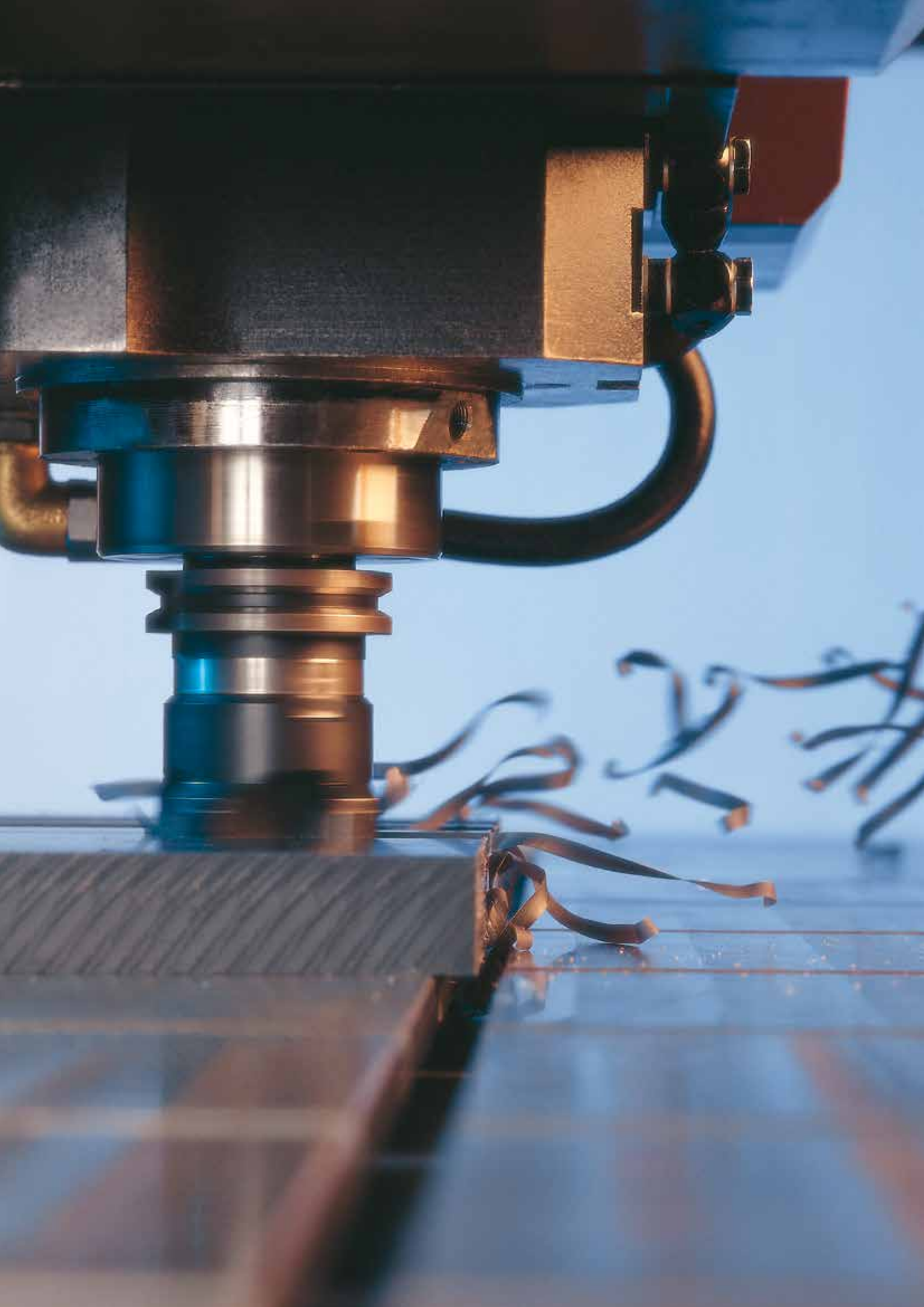
$\rho = 1.32 \text{ g/cm}^3$

35

PEEK

Nominal size	Tolerance	3000	
$\phi$ in mm	in mm	kg/m	
10	+0.1/+0.7	0.1	+
12	+0.2/+0.8	0.1	+
16		0.3	+
20		0.4	+
25	+0.2/+1.0	0.7	+
30		1.0	+
35	+0.2/+1.2	1.3	+
40		1.7	+
50	+0.3/+1.6	2.7	+
60		4.0	+
70	+0.4/+2.0	5.4	+
80		7.1	+

- + Stock item
- o Make to order product



### 1. Machining of thermoplastics

With the increasing variety of engineering plastics and the resulting applications, design engineers now have many new horizons that were previously unthinkable with conventional materials. In many cases, in addition to material limitations, the only other limits to design possibilities are the restrictions imposed by the manufacturing process. Particularly if large volume parts are required from cast polyamides and polyacetal (POM) or polyethylene terephthalate (PET), manufacturing processes such as injection moulding cannot be used.

This applies equally to complex parts that require machining from all sides with narrow tolerances.

Fig. 1: Complex component made from POM



In this area, machining has proven to be the best method. Highly precise parts and large components can be manufactured especially economically in small and medium batches by machining.

For the manufacture of high quality products, certain specific features of plastics must be considered when machines and tools are being chosen and used.

#### 1.1 Machining equipment/tools

No special machines or processes are required for machining. The machines that are normally used in the woodworking and metal industries with HSS tools (high speed steel) or hard metal tools can be used. The only thing to consider is that when a circular saw is used to cut plastic, hard metallic saw blades must be used.

The group of glass fibre reinforced plastics is a special case. While it is possible to machine them with hard metal tools, it is very difficult to achieve economic results due to the short service life of the tools. In this case it is advisable to use diamond tipped tools, which are much more expensive than conventional tools but have a much longer service life.

#### 1.2 Machining and clamping the workpiece

Plastics have lower thermal conducting properties than metals, as well as a lower modulus of elasticity. If not handled properly, the workpiece can become extremely warm and thermal expansion can occur. High clamping pressures and blunt tools cause deformation during machining. Dimensional and shape deviations outside the tolerance range are the consequence. Satisfactory results are only achievable if several material-specific guidelines are considered when machining plastics.

# Machining guidelines

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## Machining and post-machining processes

In detail, these guidelines are:

- The highest possible cutting speed should be chosen.
- Optimum chip removal must be ensured so that the chips are not drawn in by the tool.
- The tools that are used must be very sharp. Blunt tools can cause extreme heat, which results in deformation and thermal expansion.
- The clamping pressures must not be too high as this would result in deformation of the workpiece and the clamping tool would leave marks in the workpiece.
- Because of the low degree of stiffness, the workpiece must be adequately supported on the machine table and should lie as flat as possible.
- Perfect, high-quality surfaces can only be obtained when the machines operate with low vibration.

Particularly problematic to produce accurately are parts which require high cutting volumes or an uneven depth of cut. In both cases it is advisable to make a preliminary cut leaving an allowance and apply intermediate tempering. That and subsequent 24-hour storage ensure that machining-induced thermal stresses and residual stresses in the semi-finished product are largely relieved. The parts can then be finish machined.

If these guidelines are complied with, it is not difficult to obtain narrow, plastic-oriented tolerances with a high level of reproducibility.

### 1.3 Cooling during machining

As a rule it is not absolutely necessary to cool the workpiece during machining. If cooling is to be applied it is recommended that compressed air is used. This has the advantage that in addition to the cooling effect, the chips are removed from the working area and cannot be drawn into the workpiece or tool.

Common drilling emulsions and cutting oils can also be used for cooling. The application is particularly recommended when deep holes are to be introduced or a thread is to be cut. It also enables higher feed rates and therefore achieves lower run times. However, it must be kept in mind that some plastics may not be resistant to some ingredients of the drilling emulsions and cutting oils and can be irreversibly damaged. Therefore it is advisable to check the resistance of the plastic before use. Alternatively, the emulsion or oil manufacturers can provide information and advice on any known incompatibilities with plastics. Workpieces with emulsion or cutting oil on them should be thoroughly cleaned after machining. It is important to ensure that any residues are completely removed. This ensures that any follow-up operations such as gluing or painting remain trouble free. With polyamides particular care must be taken to prevent the water content of the emulsion from causing changes in the parts through moisture absorption.

### 2. Parameters for the individual machining processes

#### 2.1 Sawing

Plastics can be sawn with a band saw or a circular saw. The choice depends on the shape of the semi-finished product. The use of a band saw is particularly recommended when a "support groove" (prism) is used to cut rods and tubes and also has the advantage that the heat is dissipated via the long saw blade. However, the teeth of the blade must be set adequately so that the blade cannot jam.

Circular saws, on the other hand, are mainly used for cutting sheets and blocks with straight edges. Here, attention should be paid that the feed rate is adequate so that chips are removed, that the saw blade does not jam and that the plastic does not overheat at the point where it is being cut. Table 1 contains guiding values for the cutting geometry of the saw blades.

#### 2.2 Milling

Milling on conventional machining centres is unproblematic. With a high cutting speed and medium feed rate it is possible to achieve high levels of machining performance with good surface quality and accuracy. Care must be taken that tools with sufficiently large chip space are used. It guarantees a reliable chip removal and it avoids heat congestion. We recommend the values given in the Table in regard to the cutter geometry.

#### 2.3 Turning on a lathe

Since most plastics produce unbroken chips, it is important to ensure that the chips are removed, as they would otherwise catch and revolve with the part being turned on the lathe. In addition, because of the low degree of stiffness of plastics, there is a great danger of longer parts sagging, and it is thus advisable to use a steady rest. The values given in the Table apply to the cutter geometry.

#### 2.4 Drilling

Drill holes can be made with a conventional HSS drill. If deep holes are being drilled, it must be ensured that the chips are removed, as otherwise the plastic on the walls of the hole will heat to the point of melting and the drill will "clog". This especially applies to deep holes. For drilled holes in thin-walled workpieces, it is advisable to choose a high drilling speed and, if applicable, a neutral (0°) effective cutting angle. This prevents the drill from sticking in the workpiece and hinders the associated stripping of the hole or the workpiece being drawn up by the drill. The recommended values for drill cutting geometry are shown in the table.

#### 2.5 Drilling large diameters in sections of round rod

When drilling, high temperatures build up on the cutting edges, especially with highly crystalline materials such as **LiNOTAM**, which cannot be adequately dissipated because of the good insulation properties of the plastics. The heat causes an internal expansion in the material, which in turn causes compressive stress in the inside of the rod section. This stress can be so high that the rod tears and splits. This can be avoided to a great extent if the material is machined correctly.

# Machining guidelines

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## Machining and post-machining processes

It is advisable to pre-drill the hole and complete it with a right side tool. The pre-drilled holes should not exceed 35 mm in diameter. Drilled holes in long sections of rod must only be made from one side, as otherwise an unfavourable stress relationship is created when the drilled holes meet in the middle of the rod, which can lead to the rod section cracking.

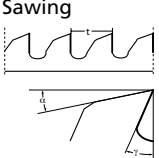
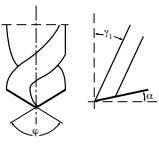
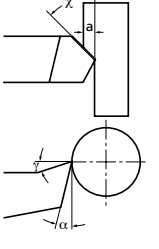
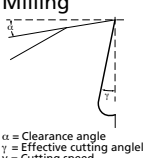
In extreme cases it may be necessary to heat the blank to approx. 120-50 °C and pre-drill it in this condition. The hole can then be completed when the rod has cooled down and when an even temperature has set in throughout the blank. Finishing can take place after complete cooling and achieving a uniform temperature level inside the blank.

### 2.6 Notes on reinforced and filled plastics

Plastics that are reinforced or filled with glass fibres, carbon fibres, glass beads, mineral substances or other substances have a higher level of residual stress compared to non-reinforced or unfilled plastics. The reinforcement and filler materials also make the products harder and more brittle and reduce impact strength. This makes these products susceptible to cracking. During machining the residual stresses may be relieved, which makes itself noticeable by strong deformation, cracking or full failure. The following notes should therefore be taken into account when machining and manufacturing:

- If possible the semi-finished products should be heated to approximately 120 °C before drilling or sawing. (Suggested exposure time: approx. 5-6 min per mm of cross-section).
- As a minimum a carbide-tipped, but preferably diamond-coated tools should be used for machining.
- When clamping and fixing ensure freedom from deformation and expose the material to the minimum possible bending, tensile or compressive forces.

If the above guidelines are observed the production of complex products from engineering plastics using machining processes can be easily achieved even where the highest quality standards of accuracy and functionality are required.

	PA	POM	PET	PE/PP-H	PVC	PVDF	PTFE	PSU	PEI	PEEK	Reinforced materials
<b>Sawing</b>  <p> <math>\alpha</math> = Clearance angle (°)  <math>\gamma</math> = Effective cutting angle (°)  <math>v</math> = Cutting speed (m/min)  <math>t</math> = Number of teeth                      Values for circular saw without ( )                      Values for band saw with ( )                      Use offset bandsaw blades!                 </p>											
$\alpha$	30-40 (10-20)	30-40 (10-20)	30-40 (10-20)	20-30 (20-30)	5-10 (30-40)	30-40 (10-20)	10-15 (10-30)	10-15 (10-30)	10-15 (15-30)	10-15 (15-30)	15-30 (15-30)
$\gamma$	0-10 (0-8)	0-10 (0-8)	0-10 (0-8)	6-10 (2-8)	0-6 (0-5)	0-10 (0-8)	0-15 (0-4)	0-15 (0-4)	10-15 (15-30)	0-15 (0-5)	15-30 (10-15)
$v$	1000-3500 (200-1000)	1000-3500 (200-1000)	1000-3500 (200-1000)	1000-3500 (500-800)	3000-4000 (800-1200)	1000-3500 (200-1000)	1800-2000 (300-500)	1800-2000 (300-500)	1800-2000 (300-500)	1800-2500 (500-800)	500-1500 (200-300)
$t$	24-80 (3-5/inch)	24-80 (3-5/inch)	24-80 (3-5/inch)	24-80 (3-8/inch)	36-80 (3-5/inch)	24-80 (3-5/inch)	24-80 (2-5/inch)	24-80 (3-5/inch)	24-80 (3-5/inch)	24-80 (3-5/inch)	24-80 (3-5/inch)
<b>Drilling</b>  <p> <math>\alpha</math> = Clearance angle (°)  <math>\gamma</math> = Effective cutting angle (°)  <math>\phi</math> = Point angle (°)  <math>v</math> = Cutting speed (m/min)  <math>s</math> = Forward feed (mm/rev.)                      The angle of twist of the drill should be at least 12-16°                 </p>											
$\alpha$	5-15	5-10	5-10	10-20	5-10	5-15	10-15	8-15	8-15	5-15	5-10
$\gamma$	5-10	5-15	5-15	10-15	0-5	5-20	5-20	10-20	10-20	10-15	5-10
$\phi$	60-90	60-90	60-90	60-90	60-100	110-130	110-130	60-90	60-90	90-120	110-120
$v$	50-150	50-150	50-150	50-150	30-120	100-300	100-300	50-100	50-100	50-200	80-100
$s$	0.1-0.5	0.1-0.3	0.1-0.3	0.1-0.5	0.1-0.5	0.1-0.3	0.1-0.3	0.1-0.4	0.1-0.4	0.05-0.3	0.1-0.3
<b>Turning on a lathe</b>  <p> <math>\alpha</math> = Clearance angle (°)  <math>\gamma</math> = Effective cutting angle (°)  <math>\epsilon</math> = Setting angle (°)  <math>v</math> = Cutting speed (m/min)  <math>s</math> = Forward feed (mm)  <math>a</math> = Rate of cut (mm)                      The point radius should be at least 0.5 mm                 </p>											
$\alpha$	5-15	5-10	5-10	5-10	8-10	5-15	5-10	5-10	5-10	5-10	6-8
$\gamma$	0-10	0-5	0-5	0-5	0-5	5-15	0-5	0-5	0-5	0-5	2-8
$\chi$	0-45	0-45	0-45	0-60	30-60	0-45	0-45	0-45	0-45	0-45	45-60
$v$	200-500	200-500	200-500	250-500	250-750	150-200	200-500	150-400	150-400	200-500	150-200
$s$	0.05-0.5	0.05-0.5	0.05-0.5	0.1-0.5	0.3-0.5	0.1-0.3	0.05-0.5	0.1-0.3	0.1-0.3	0.2-0.5	0.1-0.5
$a$	to 15	to 15	to 15	to 15	to 10	to 15	to 15	to 10	to 10	to 15	to 10
<b>Milling</b>  <p> <math>\alpha</math> = Clearance angle (°)  <math>\gamma</math> = Effective cutting angle (°)  <math>v</math> = Cutting speed (m/min)                      Feed up to 0.5 mm per tooth                      Helix angle of the cutter from 0-40°                 </p>											
$\alpha$	5-15	5-10	5-10	5-20	5-10	5-15	10-15	10-20	10-20	5-15	15-30
$\gamma$	0-15	0-10	0-10	5-15	0-15	5-15	15-20	5-15	5-15	5-10	5-10
$v$	to 1000	to 1000	to 1000	to 1000	to 1000	to 1000	to 600	to 400	to 400	to 500	to 100

**Instructions for cutting:**

For the following dimensions/materials we recommend heating before making the cut:

from Ø 50:	PA 66-GF	before drilling in the center:	from Ø 60:	PEEK-GF, PEEK-GL, POM-GF
from Ø 60:	PEEK-GF, PEEK-GL, POM-G		from Ø 80:	PA 66-GF
from Ø 100:	PA 6-GF, PA 12-GF, PE		from Ø 100:	PA 66, PA 6-GF, PA 12-GF, PET
			from Ø 180:	<b>LINNOTAM, LINNOTAM-HiPERFORMANCE 612, LINNOTAM-HiPERFORMANCE 1200</b>

Do not use lubricants/oils. Risk of tension cracks!

Use of carbide and diamond tools is recommended

Heat semi-finished products to approx. 120° C!  
Suggested exposure time: approx. 5-6 min per mm of cross-section

## Machining and post-machining processes

### 3. Post-machining processes

#### 3.1 Conditioning

The process of conditioning is defined as treatment of dry polyamide products aiming at the fastest possible moisture accumulation. This can be necessary where parts made from polyamides must not change dimensions due to further water absorption, where parts are to be in permanent contact with water or submerged in water, or where specific material changes are should be brought about by water absorption.

Polyamide products are usually distinguished by the following moisture conditions:

- dry (moisture content <0.2%)
- humid (constant weight when stored in standard air at 23 °C/50% relative humidity)
- wet (constant weight even after prolonged immersion in water)

For conditioning, besides the processes that use warm air and humidity, it is also possible to store in hot water (water temperature approx. 80 °C-100 °C max). In terms of effort this is the simplest method, but it does have some significant disadvantages. With thick-walled parts the water first diffuses in the surface regions and saturates them. However, after the conditioning period the lower layers still do not have the desired water content. After removing the parts from the water bath a portion of the absorbed water evaporates back into the air. The water content of the near-surface layers settles at the desired value, but the lower-lying levels fall below the intended value. It is therefore prudent to slightly extend the time in the water bath and then store the part in normal room air for several days of conditioning. After the loss of water from the near-surface layers this achieves virtually uniform water content over the cross section.

#### 3.2 Important factors in the water absorption of polyamides

The process of water absorption is generally only very slow and is influenced by various factors.

The most important factors can be illustrated as follows:

##### 3.2.1 Speed of water absorption

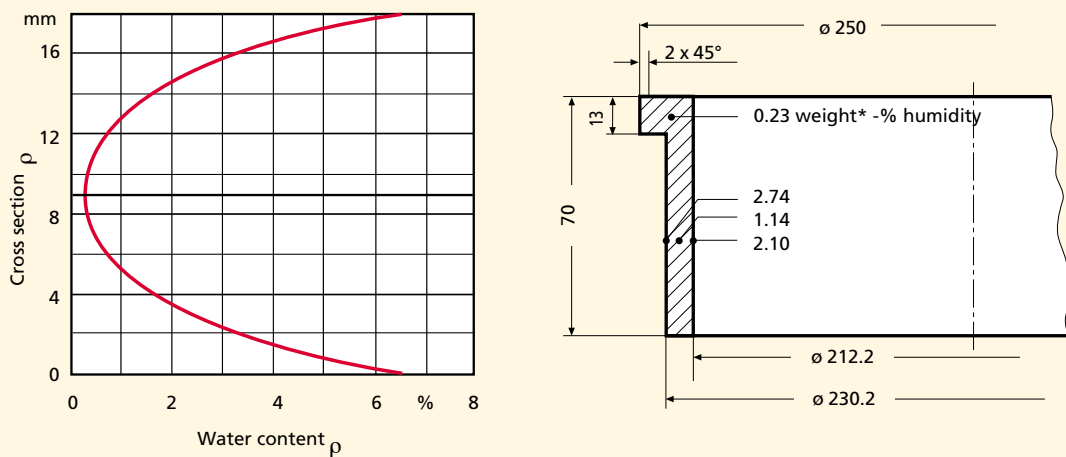
Water or moisture is absorbed very slowly by polyamide until a state of equilibrium is achieved. Once equilibrium is reached moisture content can only be influenced by altering the environmental conditions, such as increasing the moisture content and/or increasing the temperature. The tendency of water molecules to diffuse into a solid increases significantly with increasing temperature. It therefore follows that, with increasing ambient temperature, less time is required to make a defined amount of water penetrate into a part made of polyamide. The size of the specific surface area (surface area per unit volume) is crucial. The larger the specific surface area of a part is, the larger the surface area available for attack by the water molecules and the resulting absorption speed is faster. It may be concluded from the above that for the practical use of polyamides short-term fluctuations in humidity in the environment have only a limited impact on the material properties, but that long-term fluctuations and possibly associated with high temperature can induce the changes in material properties previously described.



### 3.2.2 Water absorption in air

Water absorption due to humidity is primarily determined by the relative humidity and not the air temperature. It should be noted that the process of water absorption due to humidity only takes place in the near-surface areas of thick-walled components and water absorption in the core of the part with the consequences described is normally not expected. (Fig.2)

Fig. 2 Moisture distribution in thick-walled components from cast polyamide



### 3.2.3 Influence of the degree of crystallinity

Since water is absorbed only by the amorphous proportions in the polyimide, the water intake also significantly depends on the degree of crystallinity. With increasing crystallinity the saturation concentration (depending on the chemical composition and the type of polyamide) as well as the absorption speed and the absorption capacity also increase. Cast polyamides have a higher degree of crystallinity compared to extruded polyamides. They absorb much less water and require significantly more time.

### 4. Tempering

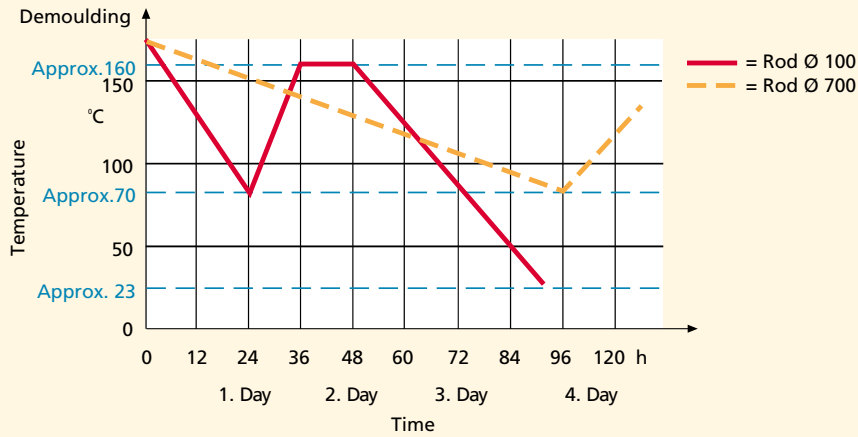
The tempering process is defined as the heat treatment of parts or semi-finished products in order to

- largely reduce residual stresses from the manufacturing or production process
- increase the crystallinity and thereby to improve the mechanical characteristics of the material
- prevent warping and dimensional changes during or after machining
- improve the permanent dimensional stability

Usually semi-finished products and parts are tempered in an oven using hot circulating air. Hot oil baths using a paraffin or silicone oil base are also commonly used. The process is based on a uniform scheme regardless of the heat transfer medium used. The products are slowly and evenly heated in a heating cabinet (in the media) and brought to the material-specific tempering temperature. Once this is achieved the products are kept at this temperature for several hours. The complete warming through of the products is essential and crucial for tempering to be a success. The holding period required is dependent on the product dimensions and shape as well as its mass and is set based on these parameters. On completion of the holding period ensure that the tempered material cools to room temperature slowly, draught-free and under control. This will ensure the formation of a highly crystalline structure in the material and that only minimum residual stresses result from uneven heat losses during the cooling phase.

The temperature range for common technical plastics is usually between 130 °C and 170 °C. Some materials (such as the high-temperature plastics) require higher temperatures.

In special cases technical plastics can also be tempered at higher temperatures. However, specific process conditions must be complied with and it must be ensured that the maximum temperature is always 30 to 40 °C below the melting point. The general specification of the required heating, holding and cooling times is only possible to a very limited extent. The dependencies on product dimensions, shape and mass of the goods to be tempered are very large. For example, a large mass requires a significantly higher quantity of heat and heating period to reach full and uniform heating than a small mass. It also needs a significantly longer cooling time as the quantity of heat adsorbed is released at a slow rate due to the large mass. The following diagram clearly shows these differences using newly cast solid **LINNOTAM** rods as an example.



It is evident that a solid rod with Ø 100 is cooled enough to be tempered one day after demoulding. However, a solid rod with Ø 700 mm needs at least four days until it is cooled down enough for the tempering process to begin.

But also the product form has a significant influence on the tempering times. Pipes are for example completely warmed faster than solid rods because they offer a greater surface area to heat absorption due to inner and outer diameter. Accordingly these cool down faster again after tempering than solid bars.

If parts are to be intermediately tempered during manufacturing, in addition to the above parameters also the geometric conditions of the construction part as well as the existing wall thicknesses and their distribution on the workpiece are to be considered.

Taking previous versions into consideration the following data can be used as a rough guideline:

Material	Temperature in °C	Heating in °C/Hr.	Holding time in min/mm	Cooling in °C/Hr.
Polyamide (PA):	ap. 160-165	ap. 10-15	ap. 5-6	ap. 15-20
Polyacetal (POM):	ap. 150-152	ap. 10-15	ap. 5-6	ap. 15-20
Polyethylene terephthalate (PET):	ap. 170-175	ap. 10-15	ap. 5-6	ap. 15-20
Polyetheretherketone (PEEK):	ap. 220-225	ap. 10-15	ap. 5-6	ap. 15-20

More exact details for the tempering of our products are available on request.



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