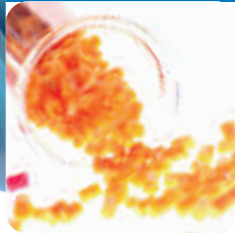




RÖCHLING

Engineering Plastics

Material Properties and Machining Guidelines






1/2009



Semi-finished products

Product Selection

 Sheets	 Rods	 Tubes
extruded 3/8" – 6" x 24" x 48" 5/8" – 2" x 48" x 96" 5/8" – 2" x 48" x 120"	extruded 1/4" – 6" dia, 10 ft lengths 7" – 12" dia, 3 ft lengths	extruded 3/4" OD x 7/16" ID up to 20–1/2" OD x 13–1/2" ID
calandered 1/8" – 1/2" x 48" x 96" 1/8" – 1/2" x 48" x 120"	cast 2" – 4–1/2" dia, 10 ft lengths 5" – 12–1/4" dia, 4 ft lengths 13" – 23–1/2" dia, 2 ft lengths	cast 4" OD x 2" ID up to 42" OD x 37" ID
cast 1/4" – 4" x 24" x 48" 1/4" – 4" x 48" x 96"		

Material Selection

	Trade Name	Common Name	Chemical Reference
POM C	Sustarin C	Acetal Copolymer	POM C
	Sustarin C ESD 60	Acetal Copolymer Static Dissipative	POM C
	Sustarin C ESD 90	Acetal Copolymer Conductive	POM C
POM H	Sustarin H	Acetal Homopolymer "Delrin"	POM H
	Sustarin H AF	Delrin AF Blend	POM H + 13% PTFE Fiber
	Sustarin H AF – DE588	Delrin AF –DE588	POM H + PTFE
PA 6G	Sustamid 6G	Cast Nylon	PA 6
	Sustamid 6G Blue	Cast Nylon Blue	PA 6 Blue
	Sustamid 6G MO	Cast Nylon MoS ₂ Filled	PA 6 + MoS ₂
	Sustamid 6G OL	Cast Nylon Oil Filled	PA 6 + Oil
PA 66	Sustamid 66	Extruded Nylon	PA 66
	Sustamid 66 GF 30	Extruded Nylon Glass Filled 30%	30% Glass Filled PA 66
	Sustamid 66 MO	Extruded Nylon MoS ₂ Filled	PA 66 + MoS ₂
ABS	Susta ABS	ABS	ABS
PPO	Susta PPO	Noryl EN 265	PPO Modified
PEI	Susta PEI	Ultem 1000	PEI
	Susta PEI GF 30	Ultem Glass-Filled 30%	30% Glass Filled PEI
PSU	Sustason PSU	Polysulfone	PSU
PPSU	Sustason PPSU	Radel R	PPSU
PPS	Sustatron PPS	PPS	PPS
PEEK	Susta PEEK	PEEK	PEEK
	Susta PEEK GF 30	PEEK Glass Filled 30%	30% Glass Filled PEEK
	Susta PEEK CF 30	PEEK Carbon Filled 30%	30% Carbon Fiber Filled PEEK
PVDF	Susta PVDF	Kynar 740	PVDF
PBT	Sustadur PBT	PBT	PBT
PET	Susta PET	PET	PET
	Sustadur PET TF	PET + PTFE	PET + PTFE
PC	Susta PC	Polycarbonate	PC
	Sustanat PC GF 20	Polycarbonate Glass Filled 20%	20% Glass Filled PC
PE	Polystone® G	High Density Polyethylene	HDPE
PP	Polystone® P-H	Polypropylene Homopolymer	PP Homopolymer
	Polystone® P-C	Polypropylene Copolymer	PP Copolymer

Material Properties																	
Specific Gravity	Tensile Strength	Tensile Modulus	Tensile Elongation	Flexural Strength	Flexural Modulus	Shear Strength	Compressive Strength	Rockwell Hardness	Rockwell Hardness	Durometer Shore D	Izod Impact Notched	Coefficient of Friction		Coefficient of Linear Thermal Expansion	Heat Deflection Temperature @ 66 psi	Heat Deflection Temperature @ 264 psi	Melting Point
												Static	Dynamic				
												D792	D638				
–	PSI	PSI	%	PSI	PSI	PSI	PSI	M	R	–	ft. lb/in	(dry vs. steel)	in/in/°F	°F	°F	°F	
1.41	9,500	400,000	40	12,000	400,000	8,000	15,000	M88	R120	D85	1.2	0.21	5.5 x 10 ⁻⁵	320	225	330	
1.33	11,000	425,000	30	18,000	450,000	6,000	8,000	M86	R120	D86	1	0.2	4.8 x 10 ⁻⁵	–	250	330	
1.44	11,400	425,000	5	16,000	1,050,000	8,000	15,000	M86	R120	D86	1	0.2	4.4 x 10 ⁻⁵	–	300	330	
1.42	10,500	420,000	40	12,000	400,000	9,000	16,000	M89	R121	D83	1.2	0.12	6.7 x 10 ⁻⁵	290	242	347	
1.50	8,000	410,000	20	12,500	450,000	–	15,000	M85	R115	D85	.7	–	5.1 x 10 ⁻⁵	334	248	347	
1.54	6,630	540,000	30	12,500	405,000	–	12,600	M50	R110	D76	–	–	4.4 x 10 ⁻⁵	334	244	350	
1.14	12,000	550,000	25	15,000	420,000	10,500	15,500	M85	R115	D78	0.6	0.22	4.5 x 10 ⁻⁵	370	195	450	
1.14	12,000	400,000	25	15,000	420,000	10,500	15,500	M85	R115	D78	0.6	0.22	4.5 x 10 ⁻⁵	370	195	450	
1.15	12,500	460,000	35	16,000	450,000	11,000	13,000	M80	R117	D80	0.6	0.22	4.0 x 10 ⁻⁵	370	200	430	
1.15	11,000	370,000	30	14,000	380,000	8,000	13,500	M85	R115	D74	1.2	0.12	5.0 x 10 ⁻⁵	380	200	430	
1.14	12,000	400,000	40	15,000	420,000	10,000	12,500	M85	R121	D80	0.6	0.25	4.5 x 10 ⁻⁵	390	195	500	
1.34	22,500	1,200,000	6	26,000	1,100,000	–	19,000	M101	R122	–	1.5	0.31	1.7 x 10 ⁻⁵	485	380	500	
1.15	12,000	450,000	25	17,000	460,000	10,500	16,000	M85	R115	D85	0.6	0.23	4.0 x 10 ⁻⁵	470	195	495	
1.04	6,100	310,000	40	10,500	340,000	–	7,600	–	R102	–	4.03	0.35	4.89 x 10 ⁻⁵	230	203	–	
1.08	9,400	350,000	30	13,400	360,000	–	–	–	R119	–	3.5	0.39	3.3 x 10 ⁻⁵	289	260	–	
1.27	16,700	480,000	80	20,000	500,000	15,000	22,000	M114	R123	D86	0.6	0.2	3.1 x 10 ⁻⁵	405	395	460	
1.51	20,000	900,000	3	33,000	950,000	–	31,000	M115	R127	D86	1	0.24	1.1 x 10 ⁻⁵	414	410	442	
1.24	10,200	360,000	30	15,400	390,000	9,000	13,900	M75	R125	D80	1.3	0.36	3.1 x 10 ⁻⁵	359	345	–	
1.29	11,000	390,000	30	15,500	350,000	9,000	14,000	M80	R120	D80	13	–	3.1 x 10 ⁻⁵	417	420	424	
1.35	13,000	480,000	15	21,000	575,000	9,000	21,000	M95	R125	D85	0.5	–	2.8 x 10 ⁻⁵	400	230	535	
1.32	16,000	500,000	20	25,000	600,000	7,700	18,000	M105	R126	D85	1.2	0.4	2.6 x 10 ⁻⁵	360	320	630	
1.51	24,000	1,300,000	3	28,000	1,350,000	14,000	26,000	M105	R126	D86	1.4	–	1.2 x 10 ⁻⁵	–	500	645	
1.41	20,000	1,100,000	5	25,000	1,300,000	–	29,000	M102	R124	D93	1	0.2	1.0 x 10 ⁻⁵	–	520	645	
1.78	7,000	250,000	100	8,000	290,000	–	10,500	M75	R84	D77	3	0.58	6.6 x 10 ⁻⁵	270	230	335	
1.31	8,000	425,000	30	14,000	425,000	–	–	M72	–	–	0.6	–	4.0 x 10 ⁻⁵	320	175	430	
1.41	12,000	460,000	30	17,000	480,000	8,000	15,000	M93	R125	D87	0.5	0.2	3.3 x 10 ⁻⁵	338	240	490	
1.44	10,500	377,000	5	14,000	360,000	8,500	15,000	M94	–	D80	0.4	0.19	4.5 x 10 ⁻⁵	338	180	491	
1.20	10,000	320,000	75	13,000	340,000	9,000	11,500	M75	R126	D80	10	0.38	3.8 x 10 ⁻⁵	295	280	310	
1.35	16,000	860,000	6	19,000	800,000	–	16,000	M91	R122	D87	2	0.22	1.5 x 10 ⁻⁵	298	295	330	
.95	3,000	–	–	–	175,000	–	–	–	–	D67	3.1	–	7 x 10 ⁻⁵	175	–	–	
.91	4,700	232,000	–	–	180,000	–	–	–	–	D72	1.9	–	1.1 x 10 ⁻⁴	221	149	329	
.91	3,700	200,000	–	–	155,000	–	–	–	–	D68	8	–	1.1 x 10 ⁻⁴	221	149	329	

Continuous Use	Thermal Conductivity	Volume Resistivity	Dielectric Strength	Dielectric Constant	Flammability	Dissipation Factor	Water Absorption 24 hours	Water Absorption Saturation	FDA Compliance
		D257	D149	D150	UL 94	D150	D570	D570	
°F	BTU in/hr/ft ² /°F	ohm-cm	volts /mil	1 MHz		1 MHz	% by weight	% by weight	
180	1.6	10 ¹⁶	450	3.8	HB	0.004	0.2	0.9	Yes
180	1.7	10 ⁹ –10 ¹¹	400	3.7	HB	0.005	1	2	No
200	1.7	10 ⁴	400	3.7	HB	0.005	0.5	1	No
185	2	10 ¹⁶	400	3.1	HB	–	0.2	0.7	Yes
185	2	10 ¹⁶	450	3.7	HB	0.009	0.2	0.8	No
185	2	10 ¹⁶	400	3.1	HB	0.009	0.2	0.8	No
200	1.7	>10 ¹³	500	3.8	HB	–	1	8.5	Yes
230	1.7	>10 ¹³	500	3.8	HB	–	1	8.5	No
200	1.7	>10 ¹²	410	3.8	HB	–	0.7	7	No
210	1.7	>10 ¹³	500	3.7	HB	–	1	5	No
220	1.7	>10 ¹³	350	3.8	HB	0.02	1	8.5	Yes
220	2	>10 ¹³	350	3.5	HB	0.018	0.7	5.5	No
220	1.7	>10 ¹³	350	3.8	HB	0.02	1	8.5	No
170	1.2	10 ¹⁶	450	3.2	HB	0.015	0.45	0.7	No
220	1.6	10 ¹⁷	500	2.7	V–1	0.001	0.07	0.2	No
340	1	10 ¹⁶	830	3.2	V–0	0.001	0.25	1.25	Yes
340	1.8	10 ¹⁶	770	3.7	V–0	0.0016	0.2	0.9	No
300	1.7	5.0 x 10 ¹⁶	425	3.06	V–0	0.005	0.3	0.6	Yes
320	2.42	10 ¹⁶	400	3.4	V–0	0.002	0.37	1.1	Yes
425	2	4.5 x 10 ¹⁶	540	3	V–0	0.001	0.01	0.03	–
480	1.73	10 ¹⁵	480	3.3	V–0	0.003	0.1	0.5	Yes
510	2.98	10 ¹⁶	500	–	V–0	–	0.1	0.3	No
480	6.3	<10 ⁵	32	3.3	V–0	–	0.06	0.3	–
290	0.75	10 ¹⁴	1600	8.5	V–0	0.06	0.03	0.05	Yes
230	1.4	>10 ¹³	400	3	HB	–	0.25	0.4	Yes
230	1.8	10 ¹⁶	385	3.1	HB	0.02	0.07	0.7	Yes
210	1.9	10 ¹⁶	400	3.2	HB	0.02	0.06	0.47	–
250	1.3	>10 ¹³	380	3.2	V–0	0.006	0.15	0.35	No
260	1.47	10 ¹⁷	490	3.13	V–1	0.0009	0.16	0.29	No
180	–	–	–	–	HB	–	<0.1	–	Yes
180	1.53	–	–	2.25	HB	0.0002	<0.1	0.03	Yes
180	1.53	–	–	2.25	HB	0.0002	<0.1	0.03	Yes

Test state: Dry. The specified electrical characteristic values were measured on the natural-colored, dry material. In the case of other colorings (particularly black) or moist material, significant changes in the electrical characteristic values can occur.

The short-term max. service temperature applies only to applications with extremely low loading over a few hours. The long-term max. service temperature is based on the thermal aging of the plastics due to oxidation, which results in a decrease in the mechanical properties.

Temperatures are specified which, after a minimum period of 5000 hours, cause a decrease in the tensile strength (measured at room temperature) by 50% compared with the initial value. This value does not provide any information about the mechanical strength of the material at high application temperatures. In the case of thick-walled parts, oxidation at high temperatures only affects the surface layer, which can be better protected by adding antioxidants. The core area of the parts always remains intact. The minimum service temperature is determined decisively by a possible shock or impact load during use.

The specified values refer to low impact loading. The specified values have been calculated as average values on the basis of numerous individual measurements and correspond to our present state of knowledge. They merely serve as information about our products and as guidance values when choosing materials. They are by no means to be construed as a legally binding promise of any specific properties or suitability for specific purposes.

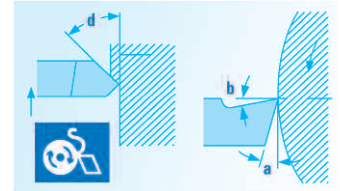
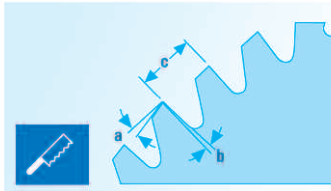
Since the properties are also governed by the dimensions of the semi-finished products and the degree of crystallization (e.g. nucleation through pigments), the actual values of the properties of a specific product can differ slightly from the information specified.

The following applies for polyamides: As a result of the absorption of moisture, the mechanical properties change, the material becomes tougher, more shock-resistant, the modulus of elasticity diminishes. Depending on the ambient atmosphere, temperature and time for the moisture to be absorbed, only one specific surface layer is however affected by the changes in properties. In the case of thick-walled parts, the core area remains unchanged.

The mechanical properties of fiber-reinforced materials have been calculated on injection-molded test specimens in grain direction. For the design of structures and the definition of material specifications, we are happy to supply you with appropriate information for your application upon request.

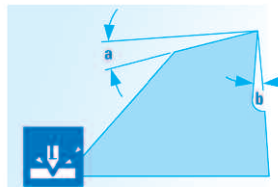
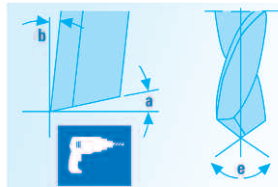
FDA Compliance based upon unfilled resins. Any special colors or additives can affect the compliance.

Machining Guidelines



		Sawing						Turning											
		a clearance angle (°)		b rake angle (°)		cutting speed (ft/min)		c tooth pitch (in)		a clearance angle (°)		b rake angle (°)		d setting angle (°)		cutting speed (ft/min)		feed (in/rev)	
		min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
POM C	Sustarin C	20	30	0	5	131	328	.079	.197	6	8	0	5	45	60	984	1969	.004	.157
	Sustarin C ESD 60	20	30	0	5	131	328	.079	.197	6	8	0	5	45	60	984	1969	.004	.157
	Sustarin C ESD 90	20	30	0	5	131	328	.079	.197	6	8	0	5	45	60	984	1969	.004	.157
POM H	Sustarin C TF	20	30	0	5	131	328	.079	.197	6	8	0	5	45	60	984	1969	.004	.157
	Sustarin H	20	30	0	5	131	328	.079	.197	6	8	0	5	45	60	984	1969	.004	.157
	Sustarin H AF	20	30	0	5	131	328	.079	.197	6	8	0	5	45	60	984	1969	.004	.157
PA 6G	Sustarin H AF - DE588	20	30	0	5	131	328	.079	.197	6	8	0	5	45	60	984	1969	.004	.157
	Sustamid 6G	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
	Sustamid 6G Blue	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
	Sustamid 6G MoS2	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
	Sustamid 6G OL	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
PA 66	Sustaglide	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
	Sustaglide Plus	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
	Sustamid 66	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
ABS	Sustamid 66 GF 30	15	30	10	15	98	328	.118	.197	6	8	2	8	45	60	492	656	.004	.020
	Sustamid 66 MO	20	30	2	5	131	328	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
PPO	SustaABS	15	30	0	5	98	328	.079	.315	5	15	25	30	45	60	656	1640	.008	.020
PEI	SustaPPO	15	30	0	5	98	328	.079	.315	5	15	25	30	45	60	656	1640	.008	.020
	SustaPEI	15	30	0	4	98	262	.079	.315	6	8	2	8	45	60	1148	1312	.004	.012
PSU	SustaPEI GF 30	15	30	10	15	98	328	.118	.315	6	8	2	8	45	60	492	656	.004	.020
	Sustason PSU	15	30	0	4	98	262	.079	.197	6	8	2	8	45	60	1148	1312	.004	.012
PPSU	Sustason PPSU	15	30	0	4	98	262	.079	.197	6	8	2	8	45	60	1148	1312	.004	.012
PEEK	Sustatron PPS	15	30	0	5	1640	2625	.118	.197	6	8	0	5	45	60	131	1148	.004	.012
	SustaPEEK	15	30	0	5	98	328	.118	.197	6	8	0	5	45	60	820	1640	.004	.197
PVDF	SustaPEEK GF 30	15	30	10	15	98	328	.118	.197	6	8	2	8	45	60	492	656	.004	.197
	SustaPEEK CF 30	15	30	10	15	98	328	.118	.197	6	8	2	8	45	60	492	656	.004	.197
PBT	SustaPVDF	20	30	5	8	131	328	.079	.197	6	8	5	8	45	60	492	1640	.004	.197
PET	Sustadur PBT	15	30	5	8	131	328	.118	.315	5	10	0	5	45	60	984	1312	.008	.016
	SustaPET	15	30	5	8	131	328	.118	.315	5	10	0	5	45	60	984	1312	.008	.016
PC	Sustadur PET TF	15	30	5	8	131	328	.118	.315	5	10	0	5	45	60	984	1312	.008	.016
	Susta PC	15	30	5	80	98	262	.118	.315	5	10	6	8	45	60	820	984	.004	.020
PE	Sustanat PC GF 20	15	30	5	80	98	262	.118	.315	5	10	6	8	45	60	820	984	.004	.020
	Polystone® G	20	30	2	5	1640	1640	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
PP	Polystone® P-H	20	30	2	5	1640	1640	.118	.315	6	10	0	5	45	60	820	1640	.004	.020
	Polystone® P-C	20	30	2	5	1640	1640	.118	.315	6	10	0	5	45	60	820	1640	.004	.020

		Drilling						Milling								
		a clearance angle (°)		b rake angle (°)		e acute angle (°)	cutting speed (ft/min)		feed (in/rev)		a clearance angle (°)		b rake angle (°)		cutting speed (ft/min)	
		min	max	min	max		min	max	min	max	min	max	min	max	min	max
POM C	Sustarin C	5	10	15	30	90	164	656	.004	.012	5	15	5	15	820	1640
	Sustarin C ESD 60	5	10	15	30	90	164	656	.004	.012	5	15	5	15	820	1640
	Sustarin C ESD 90	5	10	15	30	90	164	656	.004	.012	5	15	5	15	820	1640
POM H	Sustarin C TF	5	10	15	30	90	164	656	.004	.012	5	15	5	15	820	1640
	Sustarin H	5	10	15	30	90	164	656	.004	.012	5	15	5	15	820	1640
	Sustarin H AF	5	10	15	30	90	164	656	.004	.012	5	15	5	15	820	1640
PA 6G	Sustarin H AF - DE588	5	10	15	30	90	164	656	.004	.012	5	15	5	15	820	1640
	Sustamid 6G	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
	Sustamid 6G Blue	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
	Sustamid 6G MoS2	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
	Sustamid 6G OL	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
PA 66	Sustaglide	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
	Sustaglide Plus	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
	Sustamid 66	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
ABS	Sustamid 66 GF 30	6	6	5	10	120	262	328	.004	.012	15	30	6	10	262	1640
	Sustamid 66 MO	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
PPO	SustaABS	8	12	10	30	90	164	656	.008	.012	5	10	0	10	984	1640
PEI	SustaPPO	8	12	10	30	90	164	656	.008	.012	5	10	0	10	984	1640
	SustaPEI	3	10	10	20	90	66	262	.004	.012	2	10	1	5	820	1640
PSU	SustaPEI GF 30	6	6	5	10	120	262	328	.004	.012	15	30	6	10	262	1640
	Sustason PSU	3	10	10	20	90	66	262	.004	.012	2	10	1	5	820	1640
PPSU	Sustason PPSU	3	10	10	20	90	66	262	.004	.012	2	10	1	5	820	1640
PEEK	Sustatron PPS	5	10	10	30	90	65	191	.004	.012	5	15	6	10	820	1640
	SustaPEEK	5	10	10	30	90	164	656	.004	.012	5	15	6	10	820	1640
PVDF	SustaPEEK GF 30	6	6	5	10	120	262	328	.004	.012	15	30	6	10	262	1640
	SustaPEEK CF 30	6	6	5	10	120	262	328	.004	.012	15	30	6	10	262	1640
PBT	SustaPVDF	10	16	5	20	130	492	656	.004	.012	5	15	5	15	820	1640
	Sustadur PBT	5	10	10	20	90	164	328	.008	.012	5	15	5	15	984	1640
PET	SustaPET	5	10	10	20	90	164	328	.008	.012	5	15	5	15	984	1640
	Sustadur PET TF	5	10	10	20	90	164	328	.008	.012	5	15	5	15	984	1640
PC	Susta PC	8	10	10	20	90	164	328	.008	.012	10	20	5	15	984	1640
	Sustanat PC GF 20	8	10	10	20	90	164	328	.008	.012	10	20	5	15	984	1640
PE	Polystone® G	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
	Polystone® P-H	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640
PP	Polystone® P-C	5	15	10	20	90	164	492	.004	.012	10	20	5	15	820	1640



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