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Notes concerning Injection Moulding

Grilamid **(PA12, Amorphous Nylon)**
Grivory **(Partially Aromatic Nylon)**
Grilon **(Nylon 6, Nylon 66, Nylon 6/66)**

Grilamid, Grivory and Grilon grades can be processed economically to manufacture moulded parts, using commercially available injection moulding equipment.

This technical data sheet is intended to serve as a correct guide to processing and in particular, to provide guidelines for the selection of optimal processing and mould temperatures.

Please request our specialised literature for data concerning mechanical, thermal and electrical properties as well as for long term test values (behaviour when stressed by force, temperature, humidity and exposure to chemicals etc).

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Temperatures

1. Melt Temperature

It should be noted that the melt temperature must not necessarily correspond to the barrel wall temperature set at the injection-moulding machine. This difference is influenced by:

a. Screw speed during metering
b. Back pressure during metering
c. Residence time in the barrel
d. Design and diameter of the screw
e. Viscosity of the melt
f. Degree of wear of screw and barrel

A further temperature increase due to friction can be caused, in addition to the shearing of the screw, by a rapid melt flow through a small gate cross section (pin or film gates).

Grillamid, Grivory and Grilon injection moulding grades have excellent thermal stability. The relevant injection moulding material can be processed without problem at the maximum permissible melt temperature for parts with extended flow distances and small wall thicknesses. However, in such cases the influence of point's a-f given above should be taken into consideration and monitored. Wear of screw and barrel wall have particularly disadvantageous effects. Leakage flow between the screw flight / barrel wall and non-return valve / thrust ring, results in quantities of melt remaining in the barrel for long periods of time.

Additional overheating of small amounts of metered melt in these areas of radial screw clearance is not registered by the melt temperature measurements (average temperatures). This in one reason why injection moulded parts produced at correct melt temperature settings may exhibit discolouration or streaks caused by overheating. A low melt temperature is recommended when producing solid parts with large wall thickenesses, long cooling times and short flow distances as this reduces thermal stressing of the melt.

The choice of a lower melt temperature may also give improved surface quality of thick walled parts made of non-reinforced material.

A range of melt temperatures is given in the tables on page 4 – 6. In addition the recommended melt temperatures and melting points are listed.

2. Barrel Temperatures

The temperature settings of the heating barrel normally result in a profile where the temperature increases from feed hopper to nozzle. The choice of nozzle temperature is dependant on the design of nozzle used. It should be selected in such a way to avoid filament formation (stringing) at temperatures, which are too high, and cold slug formation at temperatures, which are too low. During long contact times between nozzle and mould, cooling of the nozzle tip from contact with the mould

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must be compensated by increasing the nozzle temperature. A low temperature setting in zone 1 (feed zone), together with cooling of the hopper flange, prevents premature melting of the granules and therefore, promotes uniform and trouble free metering.

Exceptions:

Deviation from these rules is permissible when the maximum volume that can be metered by the plasticising unit has to be used within a short metering time (normally not exceeding 80% of maximum volume). In this case, a higher barrel temperature in the feed zone must be selected in order to create sufficient heat to allow the increased throughput. A temperature profile decreasing from hopper to nozzle is thus created. If production is interrupted, this temperature must be reduced immediately to normal levels in order to prevent melting of the granules in the hopper and feed zone, impeding or preventing restarting of production. Starting up of production runs requiring such high temperatures should be carried out with a normal temperature profile. The temperature in the feed zone is then increased during optimisation of the cycle time.

3. Mould Temperature

The mould surface temperature is one of the decisive factors influencing the quality of parts made of Grillamid, Grivory or Grilon. Heating is carried out be a heating unit, which pumps water (up to 95° C, pressurised water up to 160° C) or oil (> 160° C) through heating channels in the mould.

Water is preferable as use of a heating medium as it provides better and quicker heat transfer than oil. The heating systems are equipped with a control device, which maintains a constant mould surface temperature throughout production. The control tolerance should not exceed ± 3° C.

Using Grilon injection moulding materials at high mould temperatures, parts are obtained which have a high degree of crystallinity and which exhibit excellent mechanical properties and have a low tendency to warp.

Optical surface quality of parts made of glass reinforced Grillamid, Grivory and Grilon grades is achieved when mould temperatures above 80° C are used, following the recommendations in the temperature setting tab.

If an injection-moulded part is to be sterilised with super heated steam (e.g. at 121° C), the mould temperature selected should be as high as possible. This reduces warping of the part during sterilizing to a minimum or may even prevent it. Large moulds should have separate heating circuits for ejector and nozzle areas. It is important to always have an even temperature distribution over the complete cavity surface of the mould.

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Temperature settings

Product	Melting point in °C	Melt temperature in °C	Recommended melt temperature in °C	Mould surface temperature in °C	Normal initial humidity in %
Grilamid					
Grilamid ELY 20 NZ	160	210 – 260	230	20 – 40	≤ 0.1
Grilamid ELY 60	160	210 – 260	230	20 – 40	≤ 0.1
Grilamid ELY 2475	167	210 – 260	220	20 – 40	≤ 0.1
Grilamid ELY 2694	176	210 – 260	220	20 – 40	≤ 0.1
Grilamid ELY 2702	162	210 – 260	220	20 – 40	≤ 0.1
Grilamid L20 EC	178	210 – 260	250	40	≤ 0.1
Grilamid L20 G	178	210 – 260	250	40	≤ 0.1
Grilamid L20H FR	178	210 – 260	240	40	≤ 0.1
Grilamid L20 LF	178	210 – 260	240	40	≤ 0.1
Grilamid L20 W20	174	210 – 260	250	20 – 40	≤ 0.1
Grilamid LC-3H	178	240 – 300	260	80 – 120	≤ 0.1
Grilamid LV-3H	178	240 – 300	260	80	≤ 0.1
Grilamid LKN-5H	178	240 – 300	260	80	≤ 0.1
Grilamid TR					
Grilamid TR 55	160[1)]	280 – 305	280	80	≤ 0.06
Grilamid TR 55 LX	110[1)]	250 – 270	265	40	≤ 0.06
Grilamid TR 55 LY	105[1)]	250 – 270	265	40	≤ 0.06
Grilamid TR 55 LZ	110[1)]	250 – 270	265	40	≤ 0.06
Grilamid TR 70 LX	190[1)]	290 – 320	290	110	≤ 0.06
Grilamid TR 90	155[1)]	260 – 290	265	80	≤ 0.06
Grilamid TRV-4X9	155[1)]	270 – 300	280	80	≤ 0.06
Grilamid TR 90 UV	155[1)]	260 – 290	265	80	≤ 0.06
Grilamid TR 90 LX	125[1)]	250 – 270	265	80	≤ 0.06
Grivory G					
Grivory GC-4H	260	270 – 300	290	80 – 100	≤ 0.08
Grivory GM-4H	260	270 – 300	290	80	≤ 0.08
Grivory GTR 45	125[1)]	250 – 280	270	80	≤ 0.08
Grivory GV-2H	260	270 – 300	290	80 – 120	≤ 0.08
Grivory GV-4H	260	270 – 300	290	80 – 120	≤ 0.08
Grivory GV-5H	260	270 – 300	290	80 – 120	≤ 0.08
Grivory GV-6H	260	270 – 300	290	80 – 120	≤ 0.08
Grivory GVN-35H	260	270 – 300	290	80 – 120	≤ 0.08

The drying temperature for all grades is 80 °C, drying time 4 – 12 hours. Use of dry air is necessary.
[1)] Glass transition temperature

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Product	Melting point in °C	Melt temperature in °C	Recommended melt temperature in °C	Mould surface temperature in °C	Normal initial humidity in %
Grivory HT					
Grivory HTM-4H1	325	330 – 345	340	140 – 160	≤ 0.06
Grivory HTV-3H1	325	330 – 345	340	140 – 160	≤ 0.06
Grivory HTV-4X1	325	330 – 345	340	140 – 160	≤ 0.06
Grivory HTV-5H1	325	330 – 345	340	140 – 160	≤ 0.06
Grivory HTV-6H1	325	330 – 345	340	140 – 160	≤ 0.06
Grivory XE3818	310	315 – 325	320	100 – 140	≤ 0.06
Grivory XE3819	310	315 – 325	320	100 – 140	≤ 0.06
Grilon (PA6)					
Grilon BS23 FC	222	240 – 280	260	80	≤ 0.1
Grilon BS	222	240 – 280	260	80	≤ 0.1
Grilon BS /2	222	240 – 280	260	80	≤ 0.1
Grilon BZ 1	222	240 – 300	260	80	≤ 0.1
Grilon BZ 1/2	222	240 – 300	260	80	≤ 0.1
Grilon BZ 3	222	240 – 300	260	80	≤ 0.1
Grilon BZ 3/2	222	240 – 300	260	80	≤ 0.1
Grilon BT40 Z	220	270 – 300	280	80	≤ 0.1
Grilon BS V0	222	240 – 260	250	80	≤ 0.1
Grilon BG-15S	222	270 – 300	290	80 – 100	≤ 0.1
Grilon BG-25S	222	270 – 300	290	80 – 100	≤ 0.1
Grilon BG-30S	222	270 – 300	290	80 – 100	≤ 0.1
Grilon BG-30/2	222	270 – 300	290	80 – 100	≤ 0.1
Grilon BG-50S	222	270 – 300	290	80 – 100	≤ 0.1
Grilon BG-50H	222	270 – 300	290	80 – 100	≤ 0.1
Grilon BGZ-15/2	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BGZ-30/2	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BGZ-50/2	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BS EC	222	240 – 280	260	80	≤ 0.1
Grilon BK-30	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BK-50	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BGK-30 X	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BGM-40 X	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BG-15 HM	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BG-30 HM	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BG-40 HM	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BG-50 HM	222	270 – 300	280	80 – 100	≤ 0.1
Grilon BGM-65 X V0	222	280 – 310	300	80 – 120	≤ 0.1
Grilon (PA66)					
Grilon AS/2	260	260 – 290	280	80	≤ 0.1
Grilon AZ 3	260	260 – 290	280	80	≤ 0.1
Grilon AZ 3/2	260	260 – 290	280	80	≤ 0.1
Grilon T302 V0	260	260 – 270	270	80	≤ 0.1
Grilon AG-25 HM	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TS (PA66 + PA6)					
Grilon TSS	260	270 – 300	280	80	≤ 0.1
Grilon TSS/4	260	270 – 300	280	80	≤ 0.1
Grilon TSZ 1	260	270 – 300	280	80	≤ 0.1
Grilon TSZ 3	260	270 – 300	280	80	≤ 0.1
Grilon TSG-30	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSG-30/4	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSG-50	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSG-50/4	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSK-30/4	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSM-30	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSGK-30	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSGZ-15	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSGZ-30 X	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TS V0	260	260 – 270	270	80	≤ 0.1
Grilon TS FR	260	260 – 270	270	80	≤ 0.1

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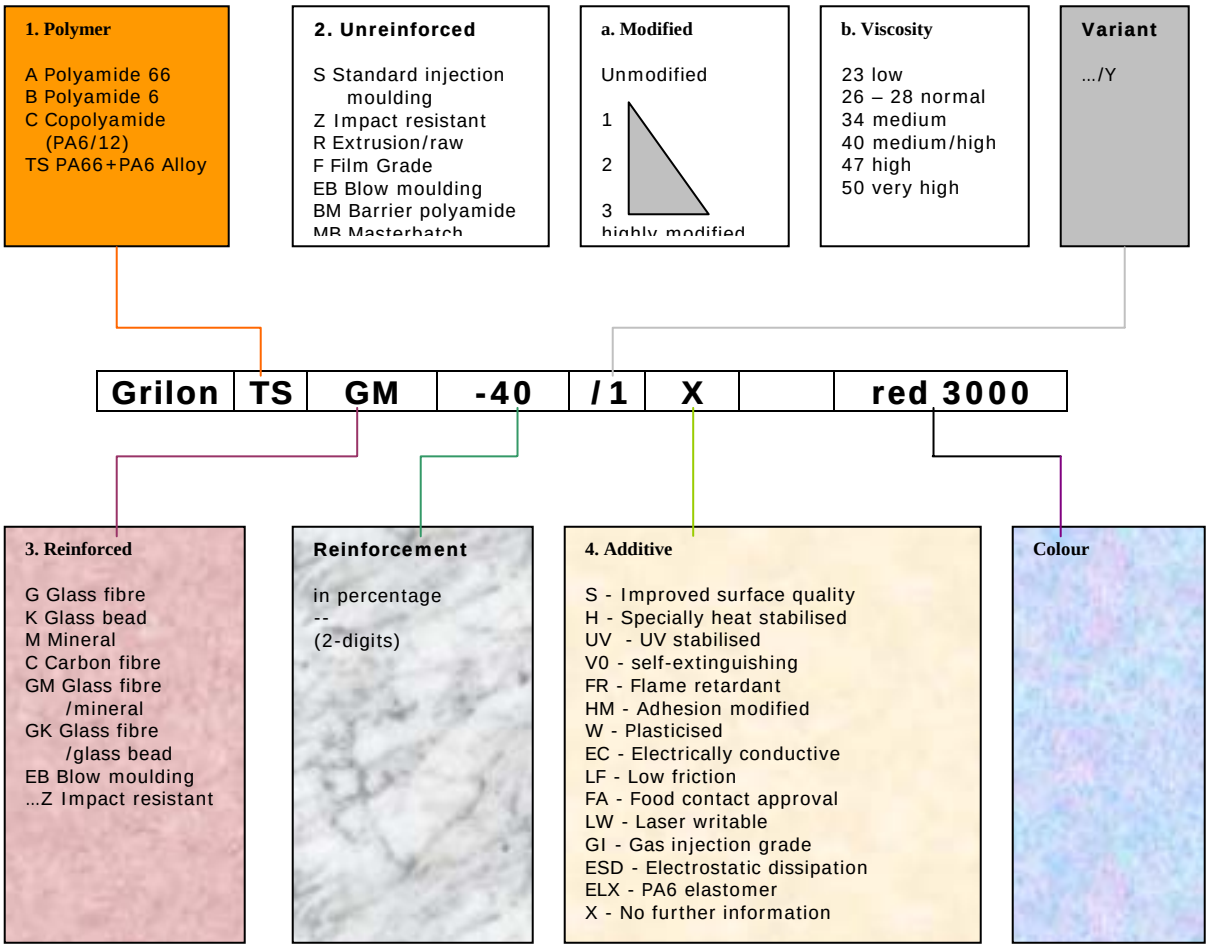
Product	Melting point in °C	Melt temperature in °C	Recommended melt temperature in °C	Mould surface temperature in °C	Normal initial humidity in %
Grilon TS (PA66 + PA6)					
Grilon TSG-30 FR	260	270 – 290	285	80 - 100	≤ 0.1
Grilon TSS/4 LF 2	260	270 – 300	280	80	≤ 0.1
Grilon TSS/4 LF 20	260	270 – 300	280	80	≤ 0.1
Grilon TSC-10/4 EC	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSC-20/4 EC	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSC-30/4 EC	260	280 – 300	290	80 – 100	≤ 0.1
Grilon TSC-40/4 EC	260	280 – 300	290	80 – 100	≤ 0.1

Grilon Nomenclature



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Grilamid and Grivory nomenclature

Grilamid		
Grilamid	Registered trade name for polyamide 12 injection moulding and extrusion materials from EMS-GRIVORY	
Basic grade	L	= polyamide 12 grades
	LC	= carbon-fibre reinforced
	LV	= glass-fibre reinforced
	LKN	= reinforced with glass beads
	ELY	= polyamide elastomer
	TR	= transparent
	DS	= dimensionally stable
	MB	= masterbatch
	XE	= development product
Viscosity index	16	= low viscosity
	20	= normal viscosity
	25	= high viscosity
Additives / properties	-3	= 30% reinforcing material content
	-5	= 50% reinforcing material content
	G	= lubricant and demoulding agent
	H	= heat stabilised
	UV	= stabilised for resistance to weathering
	M	= fine crystalline
	X	= good impact properties
	W20	= semi-flexible
	W40	= flexible
	NZ	= extremely high impact strength
	EC	= electrically conductive
	LF	= low sliding friction
	FR	= self extinguishing
Grivory		
Grivory	Registered trade name for partially aromatic polyamide injection moulding and extrusion materials from EMS-GRIVORY	
Basic grade	G	= injection moulding and extrusion grade
	GC	= carbon-fibre reinforced
	GV	= glass-fibre reinforced
	GVN	= glass-fibre reinforced, high impact strength
	GM	= mineral reinforced
	GTR	= transparent
	HT	= High Temperature Nylon
	XE	= development product
Additives / properties	-3	= 30% reinforcing material content
	-5	= 50% reinforcing material content
	H	= heat stabilised
	NZ	= extremely high impact strength
	V0	= self extinguishing according to UL-94

The recommendations and data given here are based on our experience to date. No liability can be assumed in connection with application and processing.

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