

TECHNICAL DATA SHEET GRIVORY HT

GRIVORY XE 4101

Grivory XE 4101 is a 40% glass fibre reinforced engineering thermoplastic material based on a semi-crystalline, partially aromatic copolyamide.

This Grivory HT product is partially based on renewable raw materials.

ISO polymer designation: PA 10T/X
ASTM designation: PPA, polyphthalamide

Grivory XE 4101 is an injection moulding material.

The main distinguishing feature of Grivory HT, when compared to other polyamides, is its good performance at high temperatures. Parts made of Grivory HT provide high stiffness and heat distortion temperatures. Further attributes of Grivory HT are the low moisture absorption, good dimensional stability and excellent chemical resistance.



Grivory XE 4101 is suitable for engineering thermoplastic applications with the requirement for approvals in contact with food or drinking water.



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APPROVALS

Grivory HT in contact with drinking water

Germany (KTW, DVGW W270): Grivory XE 4101 natural and black 9225 have been tested according to the KTW recommendations of the German Federal Environmental Authority and are approved for applications in contact with cold and hot drinking water (85°C). Additionally, Grivory XE 4101 natural and black 9225 have both passed the test according to "DVGW Arbeitsblatt W 270: The growth of microorganisms on materials intended for use in drinking water systems - examination and assessment".

France (ACS): Grivory XE 4101 black 9225 has been tested according to AFNOR XP P 41-250 and obtained an ACS ("Attestation de Conformité Sanitaire") and is approved for direct contact with drinking water in France.

The formulation of Grivory XE 4101 natural is in compliance with ACS requirements.

UK (WRAS): Grivory XE 4101 natural and black 9225 have been tested according to BS 6920:2000 and are "Water Regulations Advisory Scheme (WRAS) - approved products". They are suitable for cold and hot drinking water up to 85°C in the UK.

USA (NSF 61): NSF (National Sanitation Foundation) carries out tests to determine whether or not materials are suitable for drinking water applications. Grivory XE 4101 natural and black 9225 are certified for hot water applications (82°C) according to NSF/ANSI Standard 61, "Drinking Water System Components - Health Effects".

Grivory HT in contact with food stuffs

EU: Grivory XE 4101 natural and black 9225 meet the relevant requirements laid down in Regulation (EC) No. 1935/2004 as amended and are in compliance with Regulation (EC) No. 10/2011 of 14. January 2011 as amended. They can be used for repeated use articles in contact with aqueous, acidic and dairy foodstuffs at room temperature or for short term contact up to 150°C.

USA (FDA): According to FDA (Food and Drug Administration) Grivory XE 4101 natural and black 9225 are approved for use in repeat-use food contact articles in contact with all food types under Conditions of Use A through H and J, as described in 21 CFR § 176.170, Table 1 and 2. The basic polymer has been approved in Food Contact Notification (FCN) 1170.

USA (NSF 51): Grivory XE 4101 black 9225 is certified by NSF (National Sanitation Foundation) to NSF/ANSI Standard 51 "Food Equipment" for use in contact with all types of food up to 250°F (120°C).

PROPERTIES

Mechanical Properties

		Standard	Unit	State	Grivory XE 4101	
Tensile E-Modulus	1 mm/min	ISO 527	MPa	dry	13000	
				cond.	13000	
Tensile strength at break	5 mm/min	ISO 527	MPa	dry	190	
				cond.	175	
Elongation at break	5 mm/min	ISO 527	%	dry	2.8	
				cond.	2.6	
Impact strength	Charpy, 23°C	ISO 179/2-1eU	kJ/m ²	dry	85	
				cond.	75	
Impact strength	Charpy, -30°C	ISO 179/2-1eU	kJ/m ²	dry	80	
				cond.	70	
Notched impact strength	Charpy, 23°C	ISO 179/2-1eA	kJ/m ²	dry	10	
				cond.	10	
Notched impact strength	Charpy, -30°C	ISO 179/2-1eA	kJ/m ²	dry	9	
				cond.	8	
Ball indentation hardness		ISO 2039-1	MPa	dry	220	
				cond.	230	

Thermal Properties

Melting point	DSC	ISO 11357	°C	dry	295
Heat deflection temperature HDT/A	1.8 MPa	ISO 75	°C	dry	265
Heat deflection temperature HDT/C	8.0 MPa	ISO 75	°C	dry	190
Thermal expansion coefficient long.	23-55°C	ISO 11359	10 ⁻⁴ /K	dry	0.2
Thermal expansion coefficient trans.	23-55°C	ISO 11359	10 ⁻⁴ /K	dry	0.7
Maximum usage temperature	long term	ISO 2578	°C	dry	150
Maximum usage temperature	short term	ISO 2578	°C	dry	250

Electrical Properties

Dielectric strength		IEC 60243-1	kV/mm	dry	32
				cond.	31
Comparative tracking index	CTI	IEC 60112	-	cond.	600
Specific volume resistivity		IEC 60093	Ω · m	dry	10 ¹⁰
Specific surface resistivity		IEC 60093	Ω	cond.	10 ¹⁰
					10 ¹¹

General Properties

Density		ISO 1183	g/cm ³	dry	1.49
Flammability (UL 94)	0.8 mm	ISO 1210	rating	-	HB
Water absorption	23°C/sat.	ISO 62	%	-	2.0
Moisture absorption	23°C/50% r.h.	ISO 62	%	-	0.9
Linear mould shrinkage	long.	ISO 294	%	dry	0.5
Linear mould shrinkage	trans.	ISO 294	%	dry	0.9

Product-nomenclature acc. ISO 1874: PA 10T/X, MH, 18-120, GF40

Processing information for the injection moulding of Grivory XE 4101

This technical data sheet for Grivory XE 4101 provides you with useful information on material preparation, machine requirements, tooling and processing.

MATERIAL PREPARATION

Grivory XE 4101 is delivered dry and ready for processing in sealed, air tight packaging. Predrying is not necessary provided the packaging is undamaged.

Storage

Sealed, undamaged bags can be kept over a long period of time in storage facilities which are dry, protected from the influence of weather and where the bags are safe from getting damaged.

Handling and safety

Detailed information can be obtained from the Material Safety Data Sheet (MSDS) which can be requested with the material order.

Drying

Grivory XE 4101 is dried and packed with a moisture content of $\leq 0.10\%$. Should the packaging become damaged or be left open too long, then the material must be dried. Too high moisture content can be shown by a foaming melt, excessive nozzle drool and silver streaks on the moulded part.

Drying can be done as follows:

Desiccant dryer

Temperature	max. 80°C
Time	4 - 12 hours
Dew point of the dryer	-40°C

Vacuum oven

Temperature	max. 100°C
Time	4 - 12 hours

Drying time

If there is only little evidence of foaming of the melt or just slight silver streaks on the part, then the above mentioned minimal drying time will be sufficient. If material is stored open for days, shows strong foaming, unusually easy flow, streaks or a rough surface on the moulded part, then the maximum drying time is required.



Silver streaks can also be caused by overheating of the material (over 350°C) or by too long melt residence time in the barrel.

Drying temperature

Temperatures above 80°C for desiccant dryers and temperatures above 100°C for vacuum ovens should be avoided.

At longer residence times (over 1 hour) a hopper dryer (80°C) is useful.

Use of regrind

Grivory XE 4101 is a thermoplastic material. Hence, incomplete mouldings as well as sprues and runners can be reprocessed. The following points should be observed:

- Moisture absorption
- Grinding: Dust particles and particle size distribution
- Contamination through foreign material, dust, oil, etc.
- Level of addition to original material
- Reduction of mechanical properties

When adding regrind, special care has to be taken by moulder.

The use of regrind for components used in direct contact with foodstuffs should be avoided.

MACHINE REQUIREMENTS

Grivory XE 4101 can be processed economically and without problems on all machines suitable for polyamides.

Screw

Wear protected universal screws (3 zones) with non-return valves are recommended.

Screw

Length	18 D - 22 D
Compression ratio	2 - 2.5

Shot volume

The metering stroke (less decompression distance) must be longer than the length of the non-return-valve.

Selecting the injection unit

Shot volume = $0.5 - 0.8 \times$
(max. shot volume of injection unit)

Heating

At least three separately controllable heating zones, capable of reaching cylinder temperatures up to 350°C are recommended. Separate nozzle heating is necessary. The cylinder flange temperature must be controllable (cooling).

Nozzle

Open nozzles are simple, allow an easy melt flow and are long lasting. There is however, the danger that during retraction of the screw following injection of the melt, air maybe drawn into the barrel (decompression). For this reason, needle shut-off nozzles are often used.

Clamping force

As a rule of thumb the clamping force can be estimated using the following formula:

Clamping force

$$7.5 \text{ kN}^1 \times \text{projected area (cm}^2\text{)}$$

¹⁾ for a cavity pressure of 750 bar

TOOLING

The design of the mould tool should follow the general rules for reinforced thermoplastics.

For the mould cavities common mould tool steel quality (e.g. hardened steel) which has been hardened to a level of 56 - 65 HRC is necessary. We recommend additional wear protection in areas of high flow rates in the tool (e.g. pin point gates, hot runner nozzles).

Demoulding / Draft angle

Asymmetric demoulding and undercuts are to be avoided if possible. Generous provision should be made for ejection with many large pins or a stripper plate. Draft angles for the inner and outer wall between 0.5 and 3° is usually sufficient. Textured surfaces require a larger draft angle (1° per 0.025 mm depth of roughness).

(VDI 3400)	12	15	18	21	24	27
Depth of roughness (µm)	0.4	0.6	0.8	1.1	1.6	2.2
Demoulding angle (°)	1	1	1.1	1.2	1.3	1.5

(VDI 3400)	30	33	36	39	42	45
Depth of roughness (µm)	3.2	4.5	6.3	9	13	18
Demoulding angle (°)	1.8	2	2.5	3	4	5

Gate and runner

To achieve the best mould filling and avoid sink marks, a central gate at the thickest section of the moulding is recommended. Pin point (direct) or tunnel gates are more economical and more common with technical moulding.

To avoid premature solidification of the melt and difficult mould filling, the following points should be considered:

Gate diameter

0.8 x thickest wall section of the injection moulding part

Runner diameter

1.4 x thickest wall section of the injection moulding part (but minimum 4 mm)

VENTING

In order to prevent burning marks and improve weld line strength, proper venting of the mould cavity should be provided (venting channels on the parting surface dimensions: Depth 0.02 mm, width 2 - 5 mm).

PROCESSING

Mould filling, post pressure and dosing

The best surface finish and a high weld line strength are achieved when a high injection speed and a sufficiently long post pressure time are employed.

The injection speed should be regulated so as to reduce towards the end of the filling cycle in order to avoid burning. For dosing at low screw revolutions and pressure the cooling time should be fully utilised.

Basic machine settings

In order to start up the machine for processing XE 4101, the following basic settings can be recommended:

Temperatures

Flange	80 - 100°C
Zone 1	300 - 330°C
Zone 2	300 - 330°C
Zone 3	305 - 330°C
Nozzle	305 - 330°C
Tool	130 - 160°C
Melt	320 - 340°C

Pressures / Speeds

Injection speed	medium - high
Hold-on pressure (spec.)	500 - 800 bar
Dynamic pressure (hydr.)	5 - 15 bar
Screw speed	0.1 - 0.3 m/s

Start up and purging

Foreign materials in the cylinder should be removed with suitable purging materials. Hot-runner systems should be purged likewise. Glass fibre reinforced polyamide 66 is a suitable "bridging material".

Cylinder heating should start with a clean, product-free screw, starting from the temperature level of the "bridging material" of 300°C up to the required temperature level of 300 - 330°C (see processing data).

After at least three full air-shots the start up procedure can be performed/carried out.

After completion of production with Grivory HT the screw, cylinder and melt distribution system should be cleaned out thoroughly.

Conditioning

The dimensions and the mechanical properties of Grivory HT products are only marginally influenced by moisture absorption. For testing purposes, parts can be stored in a climatic chamber until an increase in weight of 1 % has been achieved.

CUSTOMER SERVICES

EMS-GRIVORY is a specialist in polyamide synthesis and the processing of these materials. Our customer services are not only concerned with the manufacturing and supply of engineering thermoplastics but also provide full technical support including:

- Rheological design calculation / FEA
- Prototype tooling
- Material selection
- Processing support
- Mould and component design

We are happy to advise you. Simply call one of our sales offices.

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