

TECHNICAL DATA SHEET

GRILAMID XE 4010

Product description

Grilamid XE 4010 is an amorphous cycloaliphatic copolyamide based on 58 % renewable resources. The material is designed for applications where high chemical resistance, high fatigue strength and toughness is required. The material is resistant to boiling water, a broad range of chemicals and to stress cracking. Articles can be easily produced by injection molding or extrusion.

Grilamid XE 4010 offers a variety of interesting properties such as:

- High transparency
- High gloss
- High fatigue strength
- Resistance to boiling water
- Resistance to a broad range of solvents and chemicals
- Excellent toughness
- Low density
- Outstanding weather resistance

Grilamid XE 4010 is suitable for optical and technically demanding parts.

Grilamid TR[®]
EMS

PROPERTIES

Mechanical Properties

		Standard	Unit	State	Grilamid XE 4010
Tensile E-Modulus	1 mm/min	ISO 527	MPa	cond.	1700
Tensile strength at yield	50 mm/min	ISO 527	MPa	cond.	65
Elongation at yield	50 mm/min	ISO 527	%	cond.	7
Tensile strength at break	50 mm/min	ISO 527	MPa	cond.	55
Elongation at break	50 mm/min	ISO 527	%	cond.	>50
Impact strength	Charpy, 23°C	ISO 179/2-1eU	kJ/m ²	cond.	no break
Impact strength	Charpy, -30°C	ISO 179/2-1eU	kJ/m ²	cond.	no break
Notched impact strength	Charpy, 23°C	ISO 179/2-1eA	kJ/m ²	cond.	10
Notched impact strength	Charpy, -30°C	ISO 179/2-1eA	kJ/m ²	cond.	10
Ball indentation hardness		ISO 2039-1	MPa	cond.	110

Thermal Properties

Glass transition temperature	DSC	ISO 11357	°C	dry	118
Heat deflection temperature HDT/A	1.80 MPa	ISO 75	°C	dry	90
Heat deflection temperature HDT/B	0.45 MPa	ISO 75	°C	dry	105
Thermal expansion coefficient long.	23-55°C	ISO 11359	10 ⁻⁴ /K	dry	1.0
Thermal expansion coefficient trans.	23-55°C	ISO 11359	10 ⁻⁴ /K	dry	1.0
Maximum usage temperature	long term	ISO 2578	°C	dry	60 - 80
Maximum usage temperature	short term	ISO 2578	°C	dry	90

Electrical Properties

Dielectric strength		IEC 60243-1	kV/mm	cond.	40
Comparative tracking index	CTI	IEC 60112	-	cond.	600
Specific volume resistivity		IEC 60093	Ω · m	cond.	10 ⁹
Specific surface resistivity		IEC 60093	Ω	cond.	10 ¹¹

General Properties

Density		ISO 1183	g/cm ³	dry	1.02
Flammability (UL94)	0.8 mm	ISO 1210	rating	-	HB
Water absorption	23°C/sat.	ISO 62	%	-	3.8
Moisture absorption	23°C/50% r.h.	ISO 62	%	-	1.8
Linear mould shrinkage	long.	ISO 294	%	dry	0.45
Linear mould shrinkage	trans.	ISO 294	%	dry	0.5

Product-nomenclature acc. ISO 1874: PA MACM10/1010, GTL, 18-020

Processing information for the injection moulding of Grilamid XE 4010

This technical data sheet for Grilamid XE 4010 provides you with useful information on material preparation, machine requirements, tooling and processing.

MATERIAL PREPARATION

Grilamid XE 4010 is delivered dry and ready for processing in sealed, air tight packaging. Predrying is not necessary.

Storage

Amorphous polyamides can be stored over years without negatively influencing its mechanical properties. However, in order to ensure optimal colour and transparency, Grilamid should not be stored for more than 6 months. At temperatures above 25°C in combination with long storage times, the oxidation saturation process of the granulate is accelerated. Hence, it is advised to keep storage temperatures below 25°C. The above mentioned effect becomes only visible after injection moulding and shows itself in parts which have a more yellow appearance. Storage facilities must be dry and protect the bags from the influence of weather and damage.

Handling and safety

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

Drying

Grilamid XE 4010 is dried and packed with a moisture content of less than 0.08 %. Should the packaging become damaged or the material is left open too long, then the material must be dried. A too high moisture content can be shown by a foaming melt and silver streaks on the moulded part when injected freely into the atmosphere (free shot).

Drying can be done as follows:

Desiccant dryer

Temperature	max. 80°C
Time	4 - 6 hours
Dew point of the dryer	-30°C

Vacuum oven

Temperature	max. 80°C
Time	4 - 8 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. Material, which is stored open over days, which shows strong foaming, unusually easy flowing, streaks and rough surface on the moulding part, then the maximal drying time is required.



Silver streaks can also be caused by overheating of the material (over 320°C) or by too long melt residence time in the barrel.

Drying temperature

Polyamides are subjected to the affects of oxidation at temperatures above 80°C in the presence of oxygen. Visible yellowing of the material is an indication of oxidation. Hence temperatures above 80°C for desiccant dryers and temperatures above 100°C for vacuum ovens should be avoided. In order to detect oxidation it is advised to keep a small amount of granulate (light colour only !) as a comparison sample.

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

Use of regrind

Grilamid XE 4010 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.
- Quantity addition to original material
- Colour variation
- Reduction of mechanical properties

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

MACHINE REQUIREMENTS

Grilamid XE 4010 can be processed economically and problem-free on all machines suitable for polyamides.

Screw

Wear protected, universal screws with shut-off nozzles are recommended (3 zones).

Screw

Length	18 D - 22 D
Compression ratio	2 - 2.5

Shot volume

The metering stroke must be longer than the length of the back flow valve (without decompression distance).

Selecting the injection unit

$$\text{Shot volume} = 0.5 - 0.9 \times (\text{max. shot volume})$$

Heating

At least three separately controllable heating zones, able of reaching cylinder temperatures up to 350°C. A 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 screws 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⁾ in cavity pressure of 750 bar

TOOLING

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

For the mould cavities common mould tool steel quality (e.g. hardened steel) which has been hardened to level of 56 HRC is recommend.

Gate and runner

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

To avoid premature solidification of the melt and difficult mould filing, 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 weldline 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 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 machines for processing Grilamid XE 4010, following basic settings are recommended:

Temperatures

Flange	40°C
Zone 1	255°C
Zone 2	260°C
Zone 3	265°C
Nozzle	260°C
Tool	80°C
Melt	265°C

Pressures / Speeds

Injection speed	medium - high
Hold-on pressure (spec.)	300 - 600 bar
Dynamic pressure (hydr.)	5 - 10 bar
Screw speed	50 - 100 min ⁻¹

CUSTOMER SERVICES

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

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

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

The recommendations and data given are based on our experience to date, however, no liability can be assumed in connection with their usage and processing.

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