

## TECHNICAL DATASHEET

### **GRILAMID XE 4116 BLACK 9288**

#### **Product description**

Grilamid XE 4116 black 9288 is a 55% glass fibre reinforced Polyamide 1010 injection moulding grade. This grade is especially suitable for the manufacturing of thin-walled, painted parts in complex designs.

Grilamid XE 4116 black has the following product profile:

- Polymer based primarily on renewable resources
- High stiffness and strength
- Excellent impact and notched impact strength
- Improved warpage performance
- Improved flowability
- Easy processing
- Excellent surface finish
- Good UV and chemical resistance
- Improved paint adhesion

Grilamid XE 4116 black 9288 is suitable for the manufacturing of production of mouldings in the application fields of:

- Electronic devices
- Automotive structural parts
- Mechanical engineering, industry goods
- Sports & leisure goods



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## PROPERTIES

Mechanical Properties		Standard	Unit	State	Grilamid XE 4116 black 9288
Tensile E-Modulus	1 mm/min	ISO 527	MPa	dry cond.	17'500 16'500
Tensile strength at break	5 mm/min	ISO 527	MPa	dry cond.	210 180
Elongation at break	5 mm/min	ISO 527	%	dry cond.	2.5 2.5
Impact strength	Charpy, 23°C	ISO 179/1eU	kJ/m <sup>2</sup>	dry cond.	90 75
Impact strength	Charpy, -30°C	ISO 179/1eU	kJ/m <sup>2</sup>	dry cond.	85 80
Notched impact strength	Charpy, 23°C	ISO 179/1eA	kJ/m <sup>2</sup>	dry cond.	20 15
Notched impact strength	Charpy, -30°C	ISO 179/1eA	kJ/m <sup>2</sup>	dry cond.	15 14
Ball indentation hardness		ISO 2039-1	MPa	dry cond.	230 215

## Thermal Properties

Melting point	DSC	ISO 11357	°C	dry	200
Heat deflection temperature HDT/A	1.80 MPa	ISO 75	°C	dry	185
Heat deflection temperature HDT/C	8.00 MPa	ISO 75	°C	dry	150
Thermal expansion coefficient long.	23-55°C	ISO 11359	10 <sup>-4</sup> /K	dry	0.1
Thermal expansion coefficient trans.	23-55°C	ISO 11359	10 <sup>-4</sup> /K	dry	0.8
Maximum usage temperature	long term	ISO 2578	°C	dry	100
Maximum usage temperature	short term	ISO 2578	°C	dry	150

## Electrical Properties

Dielectric strength		IEC 60243-1	kV/mm	dry cond.	36 36
Comparative tracking index	CTI	IEC 60112	-	cond.	600
Specific volume resistivity		IEC 60093	Ω · m	dry cond.	10 <sup>10</sup> 10 <sup>10</sup>
Specific surface resistivity		IEC 60093	Ω	cond.	10 <sup>12</sup>

## General Properties

Density		ISO 1183	g/cm <sup>3</sup>	dry	1.59
Flammability (UL94)	0.8 mm	ISO 1210	rating	-	HB
Water absorption	23°C/sat.	ISO 62	%	-	1.7
Moisture absorption	23°C/50% r.h.	ISO 62	%	-	0.9
Linear mould shrinkage	long.	ISO 294	%	dry	0.1
Linear mould shrinkage	trans.	ISO 294	%	dry	0.3

Product-nomenclature acc. ISO 1874: PA1010+X, MH, 16-160, GF 55

# Processing information for injection moulding of Grilamid XE 4116 black 9288

This technical data sheet for Grilamid XE 4116 black 9288 provides you with useful information on material preparation, machine requirements, tooling and processing.

## MATERIAL PREPARATION

Grilamid XE 4116 black 9288 is delivered dry and ready for processing in sealed packaging. Predrying is not necessary provided the packaging is undamaged.

### Storage

Sealed, undamaged bags can be kept over a period of time of at least one year when stored in storage facilities which are dry, protected from the influence of weather.

### 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 4116 black 9288 is dried and packed with a moisture content of less than 0.10%. Should the packaging become damaged or if the material is left open too long, then the material must be dried. A too high moisture content becomes evident 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 - 12 hours
Dew point of the dryer	-25°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. Material, which is stored open over days, which shows strong foaming, unusually easy flowing, streaks and rough surface on the moulded part, then the maximal drying time is required.



Silver streaks can also be caused by overheating of the material or by too long melt residence time in the barrel.

### Drying temperature

Polyamides are affected by 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.

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

### Use of regrind

Grilamid XE 4116 black 9288 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 added 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 4116 black 9288 can be processed economically and without problems on all machines suitable for polyamides.

### Screw

Wear protected, universal screws (3 zones) with back flow valve are recommended.

#### 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

Shot volume = 0.5 - 0.8 x  
(max. shot volume)

### Heating

At least three separately controllable heating zones with the capacity to heat up to 300°C and separate

nozzle heating is required. 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

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

<sup>1)</sup> 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 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

Parts moulded from Grilamid XE 4116 black 9288 show excellent dimensional stability. Asymmetric demoulding and undercuts have to be avoided. Easy ejection can be achieved with many large ejector pins or a stripper plate. Demoulding draft angles between 1 to 5° are acceptable. Following values can be considered:

(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 an optimal mould-fill and to 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 burn marks and improve weld line strength, proper venting of the mould cavity should be provided (venting channels on the parting surface dimensions: Depth <0.01 mm, shoulder width 1.5 - 2 mm, groove 2 - 5 mm).

## PROCESSING

### Mould filling, post pressure and dosing

The best surface finish and a high weld line strength is achieved with a high injection speed and when a sufficiently long post pressure is 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 machines for processing Grilamid XE 4116 black 9288, following basic settings are recommended:

### Temperatures

Flange	40 - 60°C
Zone 1	260°C
Zone 2	265°C
Zone 3	270°C
Nozzle	265°C
Tool	80 - 100°C
Melt	260 - 290°C

### Pressures / Speeds

Injection speed	medium - high
Hold-on pressure (spec.)	300 - 800 bar
Dynamic pressure (spec.)	50 - 100 bar
Screw speed	0.1 - 0.3 m/s

## 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.

Generated / updated: STA/ 08.2010

This version replaces all previous product specific data sheets

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