

# TECHNICAL DATA SHEET

## GRILAMID TR

### GRILAMID TR XE 4139 NATURAL

#### Product description

Grilamid TR XE 4139 Natural is a transparent thermoplastic polyamide based on aliphatic, cycloaliphatic and aromatic monomers.

Grilamid TR XE 4139 Natural contains a processing aid to improve the flow- and demoulding properties and is stabilized against heat aging.

Grilamid TR XE 4139 Natural offers a variety of interesting properties such as:

- very high stiffness
- good impact performance
- excellent transparency
- high surface hardness and gloss
- chemical resistance especially vs. oil, grease and fuels
- stress cracking resistance
- improved heat and weathering resistance
- easy processing

Grilamid TR XE 4139 Natural is suitable for production of optical and technically demanding parts in the application fields of:

- Electrical / Electronics
- Engineering, Pneumatics
- Agriculture
- Domestic appliances
- Automotive

**Grilamid TR<sup>®</sup>**  
**EMS**

## PROPERTIES

### Mechanical Properties

		Norm	Unit	State	TR XE 4139 Natural
Tensile E-Modulus	1 mm/min	ISO 527	MPa	cond.	2800
Tensile strength at yield	50 mm/min	ISO 527	MPa	cond.	90
Elongation at yield	50 mm/min	ISO 527	%	cond.	6
Tensile strength at break	50 mm/min	ISO 527	MPa	cond.	*
Elongation at break	50 mm/min	ISO 527	%	cond.	>50
Impact strength	Charpy, 23°C	ISO 179/2-1eU	kJ/m <sup>2</sup>	cond.	no break
Impact strength	Charpy, -30°C	ISO 179/2-1eU	kJ/m <sup>2</sup>	cond.	no break
Notched impact strength	Charpy, 23°C	ISO 179/2-1eA	kJ/m <sup>2</sup>	cond.	12
Notched impact strength	Charpy, -30°C	ISO 179/2-1eA	kJ/m <sup>2</sup>	cond.	12
Ball indentation hardness		ISO 2039-1	MPa	cond.	160

\* not relevant according to ISO 10350-1.

### Thermal Properties

Glass transition temperatures	DSC	ISO 11357	°C	dry	160
Heat deflection temperature HDT/A	1.80 MPa	ISO 75	°C	dry	125
Heat deflection temperature HDT/B	0.45 MPa	ISO 75	°C	dry	135
Thermal expansion coefficient long.	23-55°C	ISO 11359	10 <sup>-6</sup> /K	dry	60
Thermal expansion coefficient trans.	23-55°C	ISO 11359	10 <sup>-6</sup> /K	dry	60

### Electrical Properties

Dielectric strength		IEC 60243-1	KV/mm	cond.	27
Comparative tracking index	CTI	IEC 60112	-	cond.	600
Specific volume resistivity		IEC 60093	Ω · m	cond.	10 <sup>11</sup>
Specific surface resistivity		IEC 60093	Ω	cond.	10 <sup>12</sup>

### General Properties

Density		ISO 1183	g/cm <sup>3</sup>	dry	1.15
Flammability (UL94)	0.8 mm	ISO 1210	Rating	-	V2
Water absorption	23°C/sat.	ISO 62	%	-	9
Moisture absorption	23°C/50% r.h.	ISO 62	%	-	3.5
Linear mould shrinkage	long.	ISO 294	%	dry	0.65
Linear mould shrinkage	trans.	ISO 294	%	dry	0.70

Product-nomenclature: ISO 16396-PA 6I/X, , GT, C12-030
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## Processing information for the injection moulding of Grilamid TR XE 4139

This technical data sheet for Grilamid TR XE 4139 provides you with useful information on material preparation, machine requirements, tooling and processing.

### MATERIAL PREPARATION

Grilamid TR XE 4139 is delivered dry and ready for processing in sealed air tight packaging. Pre-drying is not necessary provided the packaging is undamaged.

#### Storage

Amorphous polyamides can be stored over years without negatively influencing its mechanical properties. However, in order to ensure optimal colour and transparency, Grilamid TR XE 4139 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. The storeroom 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 from wet granules

Grilamid TR XE 4139 is dried and packed with a moisture content of  $\leq 0.08\%$ . Should the packaging become damaged or be left open too long, then the material must be dried. A too high moisture content is shown by a foaming melt, excessive nozzle drool and silver streaks on the moulded part.

Drying has to be done as follows:

##### Desiccant air dryer

Temperature	max. 80 °C
Time	4 - 12 hours
Dew point of the dryer	< -30°C

or

##### Vacuum oven

Temperature	max. 100°C
Time	4- 10 hours

Circulating air drying ovens are not suitable for Grilamid TR. To review / monitor the effective moisture content it is recommended to use a moisture measuring device (eg Aboni or Aquatrac).

#### 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 330°C) 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. In order to detect oxidation it is advised to keep a small amount of granulate (light colours only !) as a comparison sample.

At long residence times of material in the feed hopper (over 1 hour) hopper heating or hopper dryer (80°C) is useful.

#### Use of regrind

Grilamid TR XE 4139 is a thermoplastic material. Hence, incomplete mouldings as well as sprues and runners can be reprocessed. The following points have to be observed:

- No thermal degradation in the previous last processing
- No contamination through foreign material, dust, oil, etc.
- Regrind has to be dry and dust-free

When adding regrind, special care has to be taken by the moulder. For high-quality technical parts only virgin material has to be used .

### MACHINE REQUIREMENTS

Grilamid TR XE 4139 can be processed economically and without problems on all injection moulding machines suitable for polyamides.

#### Screw

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

##### Screw

Length	18 - 25 D
Compression ratio	2 - 2.5

## Shot volume

The minimal metering stroke (without screw retraction) must be longer than the length of the non-return-valve.

## Heating

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

## Nozzle

Open nozzles with accurate heating are to prefer. There is however the danger that during screw retraction after metering air maybe drawn into the barrel. If shut-off nozzles are used high frictional heat and pressure loss have to be avoided. Axial sliding shut-off nozzles are not suitable.

## 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> max. cavity pressure of 750 bar

## TOOLING

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

For the selection of tool steel high tool and melt temperature have to be considered. For the mould cavities common tool steel quality (e.g. hardened steel) which has been hardened to a level of 56 HRC is recommended.

## Venting

In order to prevent burning marks at the end of filling and at positions of weld lines, proper venting of the mould cavity is important. For venting not in mold parting surface additional ejector pins should be provided (0.02 mm).

## 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 in technical injection 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)

## PROCESSING

### Mould filling, holding pressure and metering (dosage)

The injection speed should be reduced 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 maximal utilised.

### Basic machine settings

In order to start up the machine for processing Grilamid TR XE 4139, the following basic settings are recommended.

### Temperatures

Flange (Intake)	min. 60°C
Feeding section	260-280°C
Compression section	270-290°C
Metering section	290-300°C
Nozzle	280-300°C
Mould	80-120°C
Melt	290-310°C

### Holding pressure / Metering

Holding pressure (spec.)	400 - 600 bar
Dynamic pressure (hydr.)	5 - 15 bar
Screw speed	0.1 - 0.3 m/s

## COLOR NEUTRALIZER

To neutralize the inherent material colour, the masterbatch Grilamid TR XE 4066 blue 4548 can be used (blend ratio = 1 - 4%)

The masterbatch has no significant influence on the mechanical properties and has no negative effect on the transparency even at high wall thicknesses when used at the recommended blend ratio.

## 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 moulds
- 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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