

# TECHNICAL DATA SHEET

## GRILAMID TR 90 NATURAL

### General product description

Grilamid TR 90 natural is a high purity transparent thermoplastic polyamide, based on aliphatic and cycloaliphatic monomers.

Grilamid TR 90 natural offers outstanding properties such as:

- § Outstanding transparency and weathering stability
- § Unlimited colorability
- § Superb stress crack resistance
- § Toughness and stiffness
- § Good chemical resistance
- § High flexural fatigue strength
- § EU and FDA food approval

Grilamid TR 90 natural is especially suited for injection moulded outdoor applications in the application fields of:

- Optics
- Automotive
- Mechanical engineering
- Safety technology
- Sanitary
- Domestic appliances
- Electro / Electronics

# PROPERTIES

## Mechanical Properties

|                           |               | Standard      | Unit              | State | TR 90 natural |
|---------------------------|---------------|---------------|-------------------|-------|---------------|
| Tensile E-Modulus         | 1 mm/min      | ISO 527       | MPa               | cond. | 1600          |
| Tensile strength at yield | 50 mm/min     | ISO 527       | MPa               | cond. | 60            |
| 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. | 13            |
| Notched impact strength   | Charpy, -30°C | ISO 179/2-1eA | kJ/m <sup>2</sup> | cond. | 12            |
| Shore hardness D          |               | ISO 868       | -                 | cond. | 81            |
| Ball indentation hardness |               | ISO 2039-1    | MPa               | cond. | 90            |

\*not relevant according to ISO 10350-1

## Thermal Properties

|                                      |            |           |                     |     |          |
|--------------------------------------|------------|-----------|---------------------|-----|----------|
| Glass transition temperature         | DSC        | ISO 11357 | °C                  | dry | 155      |
| Heat deflection temperature HDT/A    | 1.80 MPa   | ISO 75    | °C                  | dry | 115      |
| Heat deflection temperature HDT/B    | 0.45 MPa   | ISO 75    | °C                  | dry | 135      |
| Thermal expansion coefficient long.  | 23-55°C    | ISO 11359 | 10 <sup>-4</sup> /K | dry | 0.9      |
| Thermal expansion coefficient trans. | 23-55°C    | ISO 11359 | 10 <sup>-4</sup> /K | dry | 0.9      |
| Maximum usage temperature            | long term  | ISO 2578  | °C                  | dry | 80 - 100 |
| Maximum usage temperature            | short term | ISO 2578  | °C                  | dry | 120      |

## Electrical Properties

|                              |     |             |       |       |                  |
|------------------------------|-----|-------------|-------|-------|------------------|
| Dielectric strength          |     | IEC 60243-1 | kV/mm | cond. | 34               |
| 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 | 1.00 |
| Flammability (UL94)    | 0.8 mm        | ISO 1210 | rating            | -   | HB   |
| Water absorption       | 23°C/sat.     | ISO 62   | %                 | -   | 3    |
| Moisture absorption    | 23°C/50% r.h. | ISO 62   | %                 | -   | 1.5  |
| Linear mould shrinkage | long.         | ISO 294  | %                 | dry | 0.65 |
| Linear mould shrinkage | trans.        | ISO 294  | %                 | dry | 0.75 |

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| Product-nomenclature acc. ISO 1874: PA MACM12, GT,14-020 |
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## Processing information for the injection moulding of Grilamid TR 90 natural

This technical data sheet for Grilamid TR 90 natural provides you with useful information on material preparation, machine requirements, tooling and processing.

### MATERIAL PREPARATION

Grilamid TR 90 natural 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 should not be stored for more than 6 months. At temperatures above 25°C in combination with long storage times, the oxidation 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 TR 90 natural is dried and packed with a moisture content of less than 0.08 %. 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: | < -30°C      |

| 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 320°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.

For a processing without any problem of humidity we recommend to use always a desiccant drying system.

### Use of regrind

Grilamid TR 90 natural is a thermoplastic material. Hence, incomplete mouldings as well as sprue and runner can be reprocessed. The following points have to be observed:

- § No thermal degradation in the previous 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 90 natural can be processed economically and without problems on all machines suitable for polyamides.

### Screw

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

|                    |           |
|--------------------|-----------|
| 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.

### Selecting the injection unit

|   |
|---|
| Shot volume = 0.5 - 0.9 x<br>(max. shot volume of injection unit) |
|---|

## 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> for a cavity pressure of 750 bar

## TOOLING

The design of the mould tool 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 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)

## PROCESSING

### Basic machine settings

In order to start up the machine for processing Grilamid TR 90 natural, the following basic settings are recommended:

#### Temperatures

|                     |           |
|---------------------|-----------|
| Flange (Intake)     | 60°C      |
| Feeding section     | 240-260°C |
| Compression section | 250-270°C |
| Metering section    | 260-280°C |
| Nozzle              | 260-280°C |
| Mould               | 60-80°C   |
| Melt                | 260-280°C |

#### Holding pressures / Metering

|                          |                |
|--------------------------|----------------|
| Holding pressure (spec.) | 400 - 600 bar  |
| Dynamic pressure (spec.) | 50 - 150 bar   |
| Screw speed              | 0.05 - 0.3 m/s |

The injection speed should be reduced towards the end of the filling cycle in order to avoid burning. For dosing the cooling time should be maximal utilised.

### Mould release agent

For easier demoulding of parts with high demoulding path, complicated part design, undercuts or hot cores, we recommend the use of the masterbatch Grilamid MB 5032 LS natural (blend ratio = 2-4%).

### Color neutralizer

To neutralize the inherent material colour, the masterbatch Grilamid MB blue 4545 can be used (blend ratio = 2-4%) for technical applications.

For applications involving direct contact with food, the masterbatch Grilamid MB violett 4516 must be used (blend ratio = 2-4%).

The masterbatches have no significant influence on the mechanical properties and have no negative effect on the transparency even at high wall thickness 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 tooling
- Material selection
- Processing support
- Mould and component design

We are happy to advise 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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