

## PROVISIONAL DATA SHEET

### GRILAMID LM-05 HX NATURAL

#### General product description

Grilamid LM-05 HX natural is a medium-viscosity, heat-stabilized nanocomposite PA12 extrusion and injection moulding grade.

The special features of Grilamid LM-05 HX natural are:

- Low coefficient of thermal expansion
- High stiffness and strength compared to standard PA12
- Good dimensional stability
- Good chemical resistance
- Good heat- and weathering resistance
- Low moisture absorption

#### Applications examples

The material is especially designed for tight buffering or compact (semi-tight) buffering of optical fibres as well as for technical injection moulding components in electro/electronic, automotive, mechanical and safety engineering, household appliances and sanitary installations.

**Grilamid®**  
**EMS**

## PROPERTIES

### Mechanical Properties

		Standard	Unit	State	Grilamid LM-05 HX natural
Tensile E-Modulus	1 mm/min	ISO 527	MPa	cond.	1700
Tensile strength at yield	50 mm/min	ISO 527	MPa	cond.	45
Elongation at yield	50 mm/min	ISO 527	%	cond.	7
Tensile strength at break	50 mm/min	ISO 527	MPa	cond.	50
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.	8
Notched impact strength	Charpy, -30°C	ISO 179/2-1eA	kJ/m <sup>2</sup>	cond.	6
Shore hardness D		ISO 868	-	cond.	75
Ball indentation hardness		ISO 2039-1	MPa	cond.	80

### Thermal Properties

Melting point	DSC	ISO 11357	°C	dry	178
Heat deflection temperature HDT/A	1.80 MPa	ISO 75	°C	dry	75
Heat deflection temperature HDT/B	0.45 MPa	ISO 75	°C	dry	125
Thermal expansion coefficient long.	23-55°C	ISO 11359	10 <sup>-4</sup> /K	dry	0.80
Thermal expansion coefficient trans.	23-55°C	ISO 11359	10 <sup>-4</sup> /K	dry	1.25
Maximum usage temperature	long term	ISO 2578	°C	dry	90 -110
Maximum usage temperature	short term	ISO 2578	°C	dry	150

### Electrical Properties

Dielectric strength		IEC 60243-1	kV/mm	cond.	50
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	1.03
Flammability (UL94)	0.8 mm	ISO 1210	rating	-	HB
Water absorption	23°C/sat.	ISO 62	%	-	1.4
Moisture absorption	23°C/50% RH	ISO 62	%	-	0.7
Linear mould shrinkage	long.	ISO 294	%	dry	0.9
Linear mould shrinkage	trans.	ISO 294	%	dry	1.0

Product-nomenclature acc. ISO 1874: PA12, EHL, 24-020

# Processing information for the Injection moulding and extrusion of Grilamid LM-05 HX Natural

This technical data sheet for Grilamid LM-05 HX natural provides you with useful information on material preparation, machine requirements, tooling and processing.

## MATERIAL PREPARATION

Grilamid LM-05 HX natural is delivered dry and ready for processing in sealed, air tight packaging. Pre-drying 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 can be protected from 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 LM-05 HX natural 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. A too high moisture content can lead to a reduction of optical and mechanical properties.

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 - 12 hours

### Drying temperature

Polyamides are subject 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.

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

### Use of regrind

Grilamid LM-05 HX natural 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
- Colour variation
- Reduction of mechanical properties

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

## MACHINE REQUIREMENTS FOR EXTRUSION

Grilamid LM-05 HX natural can be processed economically and without problems on all machines suitable for polyamides.

### Screw

Wear protected, universal screws are recommended (3 zones).

#### Screw

Length	24 D - 25 D
Compression ratio	2.8:1 - 3.5:1

### Grooved Feeding Zone

A grooved bush is usually not recommended for the extrusion of polyamides grades. Anyhow, in order to obtain a higher through-put by using a grooved bush its depth should not exceed 0.5 mm.

## PROCESSING

### Basic machine settings

In order to start up the machine for processing Grilamid LM-05 HX natural, the following basic settings are recommended:

#### Temperatures

Hopper zone	60-80 °C
Feeding zone	230-240 °C
Compression zone	240-250 °C
Metering zone	240-260 °C
Head	240-265 °C
Nozzle	240-265 °C
Melt	240-270 °C

## MACHINE REQUIREMENTS FOR INJECTION MOULDING

Grilamid LM-05 HX 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).

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

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

### 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 (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

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

<sup>1)</sup> for a cavity pressure of 750 bar

## TOOLING

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

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

### 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).

### 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

$$0.8 \times \text{thickest wall section of the injection moulding part}$$

#### Runner diameter

$$1.4 \times \text{thickest wall section of the injection moulding part (but minimum 4 mm)}$$

## 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 Grilamid LM-05 HX natural, the following basic settings can be recommended:

### Temperatures

Flange	40 - 80°C
Zone 1	235 - 245°C
Zone 2	245 - 255°C
Zone 3	250 - 260°C
Nozzle	260 - 270°C
Tool	40 - 80°C
Melt	265 - 275°C

### Pressures / Speeds

Injection speed	medium - high
Hold-on pressure (spec.)	500 - 1000 bar
Dynamic pressure (hydr.)	5 - 15 bar
Screw speed	50 - 100 min <sup>-1</sup>

## 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.

Generated: BES / 02.2005,  
updated: FPA / 02.2007, ETD / 03.2007

This version replaces all previous product specific data sheets

[www.emsgrivory.com](http://www.emsgrivory.com)