# TECHNICAL DATA SHEET

# GRIVORY HT1VA-4 FWA NATURAL

Grivory HT1VA-4 FWA Natural is a 40 wt.-% glass fibre reinforced engineering thermoplastic material based on a semi-crystalline, partially aromatic copolyamide and intended for use as an injection moulding grade.

ISO designation: PA 6T/6I
ASTM designation: PPA, polyphthalamide

The main distinguishing feature of Grivory HT1VA-4 FWA Natural, when compared to other polyamides, is its good performance at high temperatures. Particular properties are:

- chemical resistance
- excellent hydrolysis resistance
- creep resistance
- mechanical properties at high temperatures
- approved for food and drinking water applications

**Grivory HT1VA-4 FWA Natural is suitable for all engineering thermoplastic applications with the requirement of approvals in contact with food and/or drinking water in combination with high hydrolysis resistance and creep resistance.**

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## APPROVALS:

### Grivory HT1VA-4 FWA in Contact With Drinking Water

**Germany (KTW, W270):** Grivory HT1VA-4 FWA Natural has been tested according to the KTW recommendations of the German Federal Environmental Authority and is approved for applications in direct contact with cold and hot drinking water up to 85°C.

Additionally, Grivory HT1VA-4 FWA Natural fulfils the requirements of DVGW-Arbeitsblatt W 270, "The Growth of Microorganisms on Materials Intended for Use in Drinking Water Systems - Examination and Assessment", for the protection of drinking water against microorganisms.

**France (ACS):** Grivory HT1VA-4 FWA Natural has been tested according to AFNOR XP P 41-250 and obtained an ACS ("Attestation de Conformité Sanitaire"), whereby it is approved for contact with drinking water in France.

**UK (WRAS):** Grivory HT1VA-4 FWA Natural has been tested according to BS 6920:2000 and is a "Water Regulations Advisory Scheme (WRAS) - Approved Product" approved for cold and hot drinking water up to 85°C.

**USA (NSF 61):** Grivory HT1VA-4 FWA Natural is certified by NSF for cold and hot drinking water applications up to 82°C ("commercial hot") according to NSF/ANSI Standard 61, "Drinking Water System Components - Health Effects".

### Grivory HT1VA-4 FWA in Contact With Food

**EU:** Grivory HT1VA-4 FWA Natural meets the relevant requirements laid down in Regulation (EC) No. 1935/2004 as amended and is in compliance with Regulation (EC) No. 10/2011 of 14. January 2011 as amended.

**USA (FDA):** Grivory HT1VA-4 FWA Natural is approved for direct, repeated food contact according to Food Contact Notification 380 and the applicable paragraphs of the FDA Code of Federal Regulations 21, for all food types and under all conditions of use.

The detailed compliance description can be found in the corresponding "Supplier Compliance Statement for Applications in Food Contact".

**Grivory HT1VA-4 FWA Natural fulfils** the requirements of the following EU Directives:
94/62/EC (packaging), 2000/53/EC (end-of-life vehicles, ELV), 2011/65/EU and 2012/19/EU (RoHS and WEEE)

as well as the following EU Regulations:
850/2004 (Persistent Organic Pollutants, POP), 1895/2005 (BADGE, BFDGE, NOGE), 1907/2006 (REACH), 282/2008 (recycled plastic), 1272/2008 (CLP), 552/2009 (Annex XVII REACH, CMR substances), 1005/2009 (ozone depleting substances) and 494/2011 (Cadmium).

## PROPERTIES

**Mechanical Properties**

| | | Standard | Unit | State | Grivory HT1VA-4 FWA Natural |
|---|---|---|---|---|---|
| Tensile E-Modulus | 1 mm/min | ISO 527 | MPa | dry<br>cond. | 14'500<br>14'500 |
| Tensile strength at break | 5 mm/min | ISO 527 | MPa | dry<br>cond. | 250<br>230 |
| Elongation at break | 5 mm/min | ISO 527 | % | dry<br>cond. | 2<br>2 |
| Impact strength | Charpy, 23°C | ISO 179/2-1eU | kJ/m² | dry<br>cond. | 70<br>70 |
| Impact strength | Charpy, -30°C | ISO 179/2-1eU | kJ/m² | dry<br>cond. | 65<br>65 |
| Notched impact strength | Charpy, 23°C | ISO 179/2-1eA | kJ/m² | dry<br>cond. | 11<br>11 |
| Notched impact strength | Charpy, -30°C | ISO 179/2-1eA | kJ/m² | dry<br>cond. | 11<br>11 |
| Ball indentation hardness | | ISO 2039-1 | MPa | dry<br>cond. | 300<br>300 |

**Thermal Properties**

| | | | | | |
|---|---|---|---|---|---|
| Melting point | DSC | ISO 11357 | °C | dry | 325 |
| Heat deflection temperature HDT/A | 1.8 MPa | ISO 75 | °C | dry | 280 |
| Heat deflection temperature HDT/C | 8.0 MPa | ISO 75 | °C | dry | 160 |
| Thermal expansion coefficient long. | 23-55°C | ISO 11359 | $10^{-6}$/K | dry | 15 |
| Thermal expansion coefficient trans. | 23-55°C | ISO 11359 | $10^{-6}$/K | dry | 45 |
| Maximum usage temperature | long term | ISO 2578 | °C | dry | 140 |
| Maximum usage temperature | short term | EMS | °C | dry | 250 |

**Electrical Properties**

| | | | | | |
|---|---|---|---|---|---|
| Dielectric strength | | IEC 60243-1 | kV/mm | dry<br>cond. | 30<br>30 |
| Comparative tracking index | CTI | IEC 60112 | - | cond. | 600 |
| Specific volume resistivity | | IEC 60093 | Ω · m | dry<br>cond. | $10^{10}$<br>$10^{10}$ |
| Specific surface resistivity | | IEC 60093 | Ω | cond. | $10^{10}$ |

**General Properties**

| | | | | | |
|---|---|---|---|---|---|
| Density | | ISO 1183 | g/cm³ | dry | 1.53 |
| Flammability (UL 94) | 0.8 mm | IEC 60695-11-10 | rating | - | HB |
| Water absorption | 23°C/sat. | ISO 62 | % | - | 3.5 |
| Moisture absorption | 23°C/50% r.h. | ISO 62 | % | - | 1.5 |
| Linear mould shrinkage | long. | ISO 294 | % | dry | 0.10 |
| Linear mould shrinkage | trans. | ISO 294 | % | dry | 0.55 |

Product nomenclature: ISO 16396-PA6T/6I,GF40,M1H,C12-140

# Processing information for the injection moulding of Grivory HT1VA-4 FWA Natural

This technical data sheet for Grivory HT1VA-4 FWA Natural provides you with useful information on material preparation, machine requirements, tooling and processing, based on our experience.

## MATERIAL PREPARATION

Grivory HT1VA-4 FWA Natural is delivered dry and ready for processing in sealed, air tight packaging. Pre-drying is not necessary, provided that the packaging is undamaged.

### Storage

Sealed, undamaged bags can be kept over a period of time of at least one year in storage facilities which are dry and can protect the bags from the influence of weather, direct sunlight and any kind of damage.

### Handling and safety

Detailed information on safe handling of the material can be found in the Material Safety Data Sheet (MSDS), which is available on request.

### Drying

Grivory HT1VA-4 FWA Natural is dried to a moisture content of ≤ 0.10 % and sealed air tight. If the packaging becomes damaged or is left open too long, then the material must be dried. A too high moisture content becomes evident by a foaming melt, excessive nozzle drool and silver streaks on the moulded part.
Drying can be done in two ways:

**Desiccant dryer**

| | |
|---|---|
| Temperature: | max. 80°C |
| Time: | 4 - 12 hours |
| Dew point: | -40°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. 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 or by a too long melt residence time in the barrel.

### Drying temperature

Temperatures above 100°C for both desiccant dryers and vacuum ovens should be avoided. Visible yellowing of the material is an indication of oxidation in case of light colours. In order to detect yellowing, it is recommended to keep a small granule sample as reference.

For longer residence times (over 1 hour) in the hopper a hopper heating or a hopper dryer (80°C) is required in order to avoid moisture uptake of the granules.

### Use of regrind

Grivory HT1VA-4 FWA 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 already occurred
- Grinding: Dust particles and particle size distribution
- Contamination through foreign material, dust, oil, etc.
- Level of addition to original material
- Possible colour variations
- Reduction of mechanical properties

When adding regrind, the operator has to take extra care during processing.

**For components in direct contact with drinking water or food the use of regrind should be avoided. As long as the mechanical performance of parts made with regrind is secured, a new drinking water approval or certification has to be obtained for parts with the maximum possible regrind content.**

## MACHINE REQUIREMENTS

Grivory HT1VA-4 FWA Natural can be processed economically and without problems 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

In order to reduce the average dwell time of the polymer melt in the cylinder, a suitable screw diameter has to be selected. The following rule applies:

**Selecting the injection unit**

Shot volume = 0.5 - 0.8 x
max. shot volume of injection unit

### Heating

At least three separately controllable heating zones, capable of reaching cylinder temperatures up to 350°C are recommended. Separate nozzle heating is necessary in order to avoid the formation of plugs. The cylinder flange temperature must be controllable by cooling in order to counteract the formation of condensate in the feed zone of the cylinder.

### Nozzle

Open nozzles are preferred because they allow an easy melt flow and last longer than needle shut-off nozzles, and they exhibit less wear. If the open nozzle remains open for too long, cold plugs can be formed at the tip. Removal of the open nozzle after dosing requires adapted decompression in most cases. Needle shut-off nozzles, however, increase the shear of the material during filling and may cause critical weld lines in the part, but they can still be used.

### Clamping force

As a rule of thumb the clamping force can be estimated using the following formula:

**Clamping force**

7.5 kN[1)] x projected area ($cm^2$)

[1)] for a 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 - 65 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 Grivory HT1VA-4 FWA Natural solidify very quickly and show excellent dimensional stability. Asymmetric demoulding and undercuts are to be avoided. Generous provision should be made for ejection with many large pins or a stripper plate. Demoulding draft angles between 1 and 5° are acceptable.

| (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 |

### 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).

### 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; however, they will also cause higher shear of the polymer melt.

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, post pressure and dosing

The best surface finish and 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 Grivory HT1VA-4 FWA Natural, the following basic settings can be recommended:

**Cylinder and melt temperatures**

| | |
|---|---|
| Flange | 80 - 100°C |
| Zone 1 | 330 - 340°C |
| Zone 2 | 330 - 345°C |
| Zone 3 | 330 - 345°C |
| Nozzle | 330 - 340°C |
| Melt | 340°C |

**Tool temperature**

| | |
|---|---|
| Tool temperature | $\geq$140°C |

The required tool surface temperature depends on the geometry and the wall thickness of the part. As a rule of thumb it can be assumed that the thinner the wall thickness is, the higher the tool surface temperature has to be.
Tool surface temperatures up to 190°C are recommended for small wall thicknesses.
The flow temperature of the temper unit should be adjusted so that the measured surface temperature of the mould cavity exceeds 140°C.

**Pressures / Speeds**

| | |
|---|---|
| Injection speed | medium - high |
| Hold-on pressure (spec.) | 500 - 750 bar |
| Dynamic pressure (spec.) | 50 - 100 bar |
| Peripheral screw speed | 0.1-0.3 m/s |

## Start up and purging

Foreign materials in the cylinder should be removed with suitable purging materials. Hot-runner systems should be purged likewise. Glass fibre reinforced polyamide 66 is a suitable “bridging material”.
Cylinder heating should start with a clean, product-free screw, starting from the temperature level of the “bridging material” of 300°C up to the required temperature level of 340°C.
After at least three full dosings (free-shots) - applying the shortest possible residence time - the start-up procedure can be implemented.

After completion of production with Grivory HT the screw, cylinder and melt distribution system should be cleaned out thoroughly.

## Conditioning

The dimensions and the mechanical properties of Grivory HT products are only marginally influenced by moisture absorption. For testing purposes, parts can be stored in a climatic chamber until an increase in weight of 1.5 % has been achieved.

## 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:

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

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



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