TECHNICAL DATA SHEET

GRIVORY HT1V-5 FWA BLACK 9225

Grivory HT1V-5 FWA black 9225 is a 50 wt.-% glass fibre reinforced engineering thermoplastic material based on a semi-crystalline, partially aromatic copolyamide.

Acc. to ISO: PA 6T/6I
Acc. to ASTM: PPA, polyphthalamide

Grivory HT1V-5 FWA black 9225 is an injection moulding material.

The main distinguishing feature of Grivory HT, when compared to other polyamides, is its good performance at high temperatures providing parts which are stiffer, stronger and have better heat distortion stability and chemical resistance.

Grivory HT1V-5 FWA black 9225 is suitable for all engineering thermoplastic applications with the requirement of approvals in contact with food and/or drinking water.

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APPROVALS:

Grivory HT FWA in Contact With Drinking Water

Germany (KTW, W270): Grivory HT1V-5 FWA black 9225 has been tested according to 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 HT1V-5 FWA black 9225 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 HT1V-5 FWA black 9225 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 HT1V-5 FWA black 9225 has been tested according to BS 6920:2000 and is a "Water Regulations Advisory Scheme (WRAS) - Approved Product". It is suitable for cold and hot drinking water up to 85°C.

USA (NSF 61): Grivory HT1V-5 FWA black 9225 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 HT FWA in Contact With Foodstuffs

EU: Grivory HT1V-5 FWA black 9225 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.

The detailed compliance description can be obtained from the corresponding "Supplier Compliance Statement for Applications in Food Contact", available upon request.

USA (FDA): Grivory HT1V-5 FWA black 9225 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.

USA (NSF 51): Grivory HT1V-5 FWA black 9225 is certified according to NSF/ANSI Standard 51 ("Food Equipment Materials") for direct food contact with all food types up to 149°C (300°F).

The **Grivory HT FWA grades** fulfil the requirements of the following EU Directives:
76/769/EEC (substances that are carcinogenic, mutagenic and toxic to reproduction), 78/142/EEC (vinyl chloride), 94/62/EC (packaging), 2000/53/EC (end-of-life vehicles, ELV), 2002/16/EC (epoxy derivatives), 2002/61/EC (azo colourants), 2002/62/EC (organic tin compounds), 2002/95/EC und 2002/96/EC (RoHS and WEEE), 2003/11/EC (PBB, PBDE), 2003/53/EC (nonylphenol(-ethoxylates)), 2005/69/EC (PAH), 2005/80/EC (CMR), 2005/84/EC (phthalates), 2006/122/EC (PFOS, PFOA), 2009/251/EC (dimethyl fumarate)

as well as the following EU Regulations:
850/2004 (Persistent Organic Pollutants, POP), 1895/2005 (BADGE, BFDGE, NOGE), 282/2008 (recycled plastic), 1005/2009 (ozone depleting substances).

The **Grivory HT FWA grades** have a low flammability rating and are listed by UL (Underwriters Laboratories Inc.) with flame class UL94 HB, reference number E 53898.

PROPERTIES

Mechanical Properties

		Standard	Unit	State	Grivory HT1V-5 FWA black 9225
Tensile E-Modulus	1 mm/min	ISO 527	MPa	dry cond.	18'000 17'500
Tensile strength at break	5 mm/min	ISO 527	MPa	dry cond.	250 240
Elongation at break	5 mm/min	ISO 527	%	dry cond.	2 2
Impact strength	Charpy, 23°C	ISO 179/2-1eU	kJ/m²	dry cond.	80 80
Impact strength	Charpy, -30°C	ISO 179/2-1eU	kJ/m²	dry cond.	80 80
Notched impact strength	Charpy, 23°C	ISO 179/2-1eA	kJ/m²	dry cond.	11 11
Notched impact strength	Charpy, -30°C	ISO 179/2-1eA	kJ/m²	dry cond.	10 10
Ball indentation hardness		ISO 2039-1	MPa	dry cond.	340 340

Thermal Properties

Melting point	DSC	ISO 11357	°C	dry	325
Heat deflection temperature HDT/A	1.8 MPa	ISO 75	°C	dry	285
Heat deflection temperature HDT/C	8.0 MPa	ISO 75	°C	dry	210
Thermal expansion coefficient long.	23-55°C	ISO 11359	10^{-4}/K	dry	0.15
Thermal expansion coefficient trans.	23-55°C	ISO 11359	10^{-4}/K	dry	0.40
Maximum usage temperature	long term	ISO 2578	°C	dry	140
Maximum usage temperature	short term	ISO 2578	°C	dry	250

Electrical Properties

Dielectric strength		IEC 60243-1	kV/mm	dry cond.	30 30
Comparative tracking index	CTI	IEC 60112	-	cond.	600
Specific volume resistivity		IEC 60093	Ω · m	dry cond.	10^{11} 10^{11}
Specific surface resistivity		IEC 60093	Ω	cond.	10^{12}

General Properties

Density		ISO 1183	g/cm³	dry	1.65
Flammability (UL94)	0.8 mm	ISO 1210	rating	-	HB
Water absorption	23°C/sat.	ISO 62	%	-	3.0
Moisture absorption	23°C/50% r.h.	ISO 62	%	-	1.3
Linear mould shrinkage	long.	ISO 294	%	dry	0.05
Linear mould shrinkage	trans.	ISO 294	%	dry	0.45

Product-nomenclature acc. ISO 1874:	PA6T/6I, MH, 12-190, GF50

Processing information for the injection moulding of Grivory HT1V-5 FWA black 9225

This technical data sheet for Grivory HT1 provides you with useful information on material preparation, machine requirements, tooling and processing.

MATERIAL PREPARATION

Grivory HT1 is delivered dry and ready for processing in sealed, air tight packaging. Predrying is not necessary, provided that 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

Grivory HT1 is dried and packed with a moisture content of ≤ 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 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:	-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 (over 350°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 longer residence times (over 1 hour) hopper heating or a hopper dryer (80°C) is useful.

Use of regrind

Grivory HT1 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.

The use of regrind for parts coming into direct contact with drinking water and foodstuff should be avoided if possible If the mechanical performance of the device is ensured, an approval test with the maximum regrind content is required on the final part.

MACHINE REQUIREMENTS

Grivory HT1 can be processed economically and without problems on all machines suitable for polyamides.

Screw

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

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

Shot volume = 0.6 - 0.9 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. 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 screw 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 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 HT1 solidify very quickly, showing 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. The following guidelines are suggested:

(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 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)

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 Grivory HT1, 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 surface 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.

Pressures / Speeds

Injection speed	medium - high
Hold-on pressure (spec.)	500 - 750 bar
Dynamic pressure (spec.)	50 - 100 bar
Peripheral screw speed	5 - 15 m/min

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 (see processing data).

After at least three full dosings (free-shot) the start up procedure can be implemented.

After completion of production with Grivory HT1 the screw, cylinder and melt distribution system should be cleaned out thoroughly.

Conditioning

The dimensions and the mechanical properties of Grivory HT1 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 % has been achieved. In order to avoid the occurrence of swelling stress, conditioning in hot water is not advised.

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.

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www.emsgrivory.com