# Grivory GVX

## Metal replacement at the highest level

GRIVORY®
EMS

## Introduction

### Our metal is called Grivory

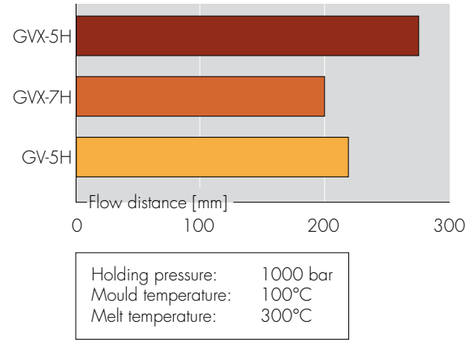
With the high-performance polymer Grivory GV, EMS-GRIVORY has been market leader in the field of metal replacement for many years now. The new material Grivory GVX now takes us a step further. With clearly improved mechanical properties, the range of metal replacement applications has been significantly widened. The exceptional performance provided by Grivory GVX is convincing in every detail!

Grivory GVX is characterised in particular by:

- highest stiffness and strength values
- very low warpage
- simple processing

### Excellent processability

Can this performance be increased by using glass fibres? Yes, but not at the cost of reduced processability! Despite up to 70% glass-fibre content, Grivory GVX products are characterised by excellent flow properties and are surprisingly simple to process.



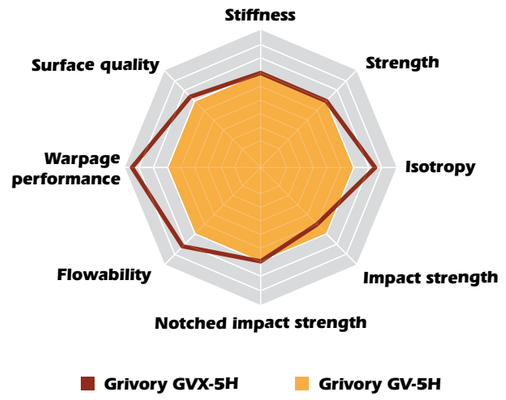

Holding pressure: 1000 bar
Mould temperature: 100°C
Melt temperature: 300°C

### Surface quality of Grivory GVX also shines

The new Grivory GVX is also visibly convincing. Thanks to its good flow properties it has exceptionally good surface gloss, even with a high degree of reinforcement.

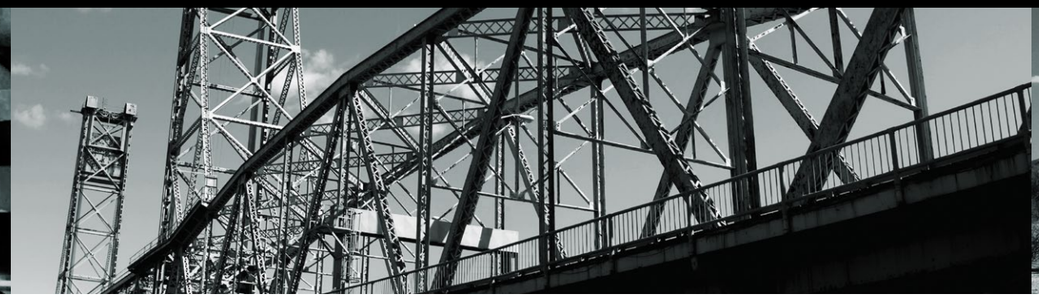
### Added performance

With its exceptional property specification profile, Grivory GVX opens up a completely new chapter in the field of metal replacement.

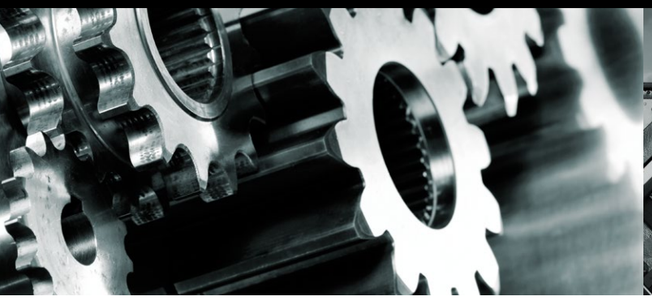



If all property values of Grivory GV-5H are compared with those of the new material Grivory GVX-5H, the consistent increase in performance is clearly apparent. The further development of Grivory GVX is particularly visible in its low warpage values, more isotropic material properties and flowability.

## Properties of Grivory GVX grades



| Mechanical properties | | | | | |
|---|---|---|---|---|---|
| | | | | | Grivory GVX-5H |
| Tensile modulus of elasticity | 1 mm/min | ISO 527 | MPa | dry | 18000 |
| | | | | cond. | 17000 |
| Tensile stress at break | 5 mm/min | ISO 527 | MPa | dry | 250 |
| | | | | cond. | 220 |
| Elongation at break | 5 mm/min | ISO 527 | % | dry | 2.5 |
| | | | | cond. | 2.5 |
| Impact strength | Charpy, 23°C | ISO 179/1eU | kJ/m² | dry | 80 |
| | | | | cond. | 75 |
| Impact strength | Charpy, -30°C | ISO 179/1eU | kJ/m² | dry | 65 |
| | | | | cond. | 60 |
| Notched impact strength | Charpy, 23°C | ISO 179/1eA | kJ/m² | dry | 15 |
| | | | | cond. | 15 |
| Notched impact strength | Charpy, -30°C | ISO 179/1eA | kJ/m² | dry | 15 |
| | | | | cond. | 15 |
| Ball indentation hardness | | ISO 2039-1 | MPa | dry | 290 |
| | | | | cond. | 265 |
| **Thermal properties** | | | | | |
| Melt temperature | DSC | ISO11357 | °C | dry | 260 |
| Heat deflection temperature HDT/A | 1.80 MPa | ISO 75 | °C | dry | 245 |
| Heat deflection temperature HDT/C | 8.00 MPa | ISO 75 | °C | dry | 175 |
| Thermal expansion longitudinal | 23-55°C | ISO 11359 | $10^{-4}$/K | dry | 0.20 |
| Thermal expansion transverse | 23-55°C | ISO 11359 | $10^{-4}$/K | dry | 0.50 |
| Max. working temperature | Permanent | ISO 2578 | °C | dry | 100 - 120 |
| Max. working temperature | Short-term | ISO 2578 | °C | dry | 220 |
| **Electrical properties** | | | | | |
| Dielectric strength | | IEC 60243-1 | kV / mm | dry | 33 |
| | | | | cond. | 33 |
| Comparative tracking index | CTI | IEC 60112 | - | cond. | 600 |
| Specific volume resistance | | IEC 600933 | Ω · m | dry | $10^{10}$ |
| | | | | cond. | $10^{10}$ |
| Specific surface resistance | | IEC 600933 | Ω | cond. | $10^{12}$ |
| **General properties** | | | | | |
| Density | | ISO 1183 | g/cm³ | dry | 1.56 |
| Flammability (UL-94) | 0.8 mm | IEC 60695-11-10 | rating | - | HB |
| Water absorption | 23°C/saturated | ISO 62 | % | - | 4.0 |
| Moisture absorption | 23°C/50 % r.h. | ISO 62 | % | - | 1.4 |
| Lineal mould shrinkage | longitudinal | ISO 294 | % | dry | 0.05 |
| Lineal mould shrinkage | transverse | ISO 294 | % | dry | 0.30 |
| Product designation as per ISO 16396 | | | | PA66+PA6I/X | MH, 14-190, GF50 |

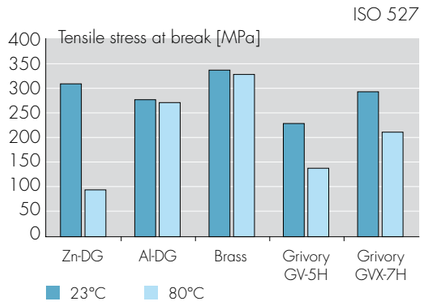


| Grivory GVX-6H | Grivory GVX-65H | Grivory GVX-7H |
|---|---|---|
| 22500 | 25500 | 28000 |
| 22000 | 25000 | 27500 |
| 290 | 300 | 290 |
| 260 | 280 | 260 |
| 2.0 | 1.9 | 1.5 |
| 2.0 | 1.9 | 1.5 |
| 75 | 75 | 60 |
| 70 | 70 | 60 |
| 70 | 70 | 60 |
| 70 | 70 | 60 |
| 15 | 15 | 15 |
| 15 | 15 | 15 |
| 15 | 15 | 15 |
| 15 | 15 | 15 |
| 320 | 345 | 370 |
| 305 | 330 | 360 |
| | | |
| 260 | 260 | 260 |
| 250 | 250 | 250 |
| 205 | 215 | 220 |
| 0.15 | 0.15 | 0.10 |
| 0.50 | 0.50 | 0.30 |
| 100 - 120 | 100 - 120 | 100 - 120 |
| 220 | 220 | 220 |
| | | |
| 33 | 33 | 33 |
| 33 | 33 | 33 |
| 600 | 600 | 600 |
| $10^{10}$ | $10^{10}$ | $10^{10}$ |
| $10^{10}$ | $10^{10}$ | $10^{10}$ |
| $10^{12}$ | $10^{12}$ | $10^{12}$ |
| | | |
| 1.69 | 1.79 | 1.85 |
| HB | HB | HB |
| 3.5 | 3.2 | 2.9 |
| 1.2 | 1.1 | 1.0 |
| 0.05 | 0.05 | 0.10 |
| 0.25 | 0.25 | 0.25 |
| MH, 14-220, GF60 | MH, 14-250, GF65 | MH, 14-250, GF70 |

### Die-cast metals under pressure

The advantages of Grivory GVX compared to die-cast metals are, above all, their lower density, simple processability and efficient production with up to 40% lower manufacturing costs.

With a tensile stress at break of up to 300 MPa, Grivory GVX is leader among thermoplastic materials and does not need to avoid direct comparison with property profiles of metals. At high temperatures for example, it exhibits much better performance than die-cast zinc. When combined with a component design suited for plastic materials, structural rigidity values, comparable to those of metal components, can be achieved.



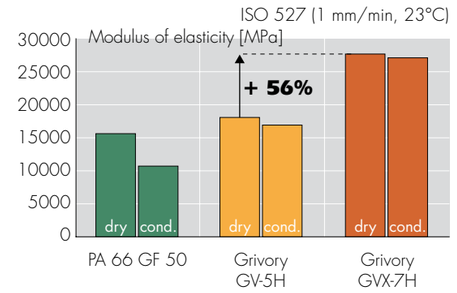

### The future for metal replacement

Due to its exceptional mechanical properties and simple processing, Grivory GVX expands the limits of metal replacement. The well-known advantages of weight reduction, freedom of design, functional integration and, above all cost savings, make polyamide materials much in demand as an alternative to more expensive metals.

Grivory GVX - metal replacement at the highest level!

### Stiff and strong

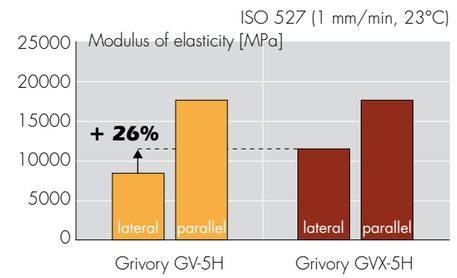
A significant increase in stiffness values - a new dimension for thermoplastic materials with glass-fibre reinforcement.




Grivory GVX achieves modulus of elasticity values of nearly 30'000 MPa. Compared to values for Grivory GV, this is an increase of more than 50%! These values also remain at the highest level for test bars in a conditioned state where conventional polyamides show a decrease of up to 35%.

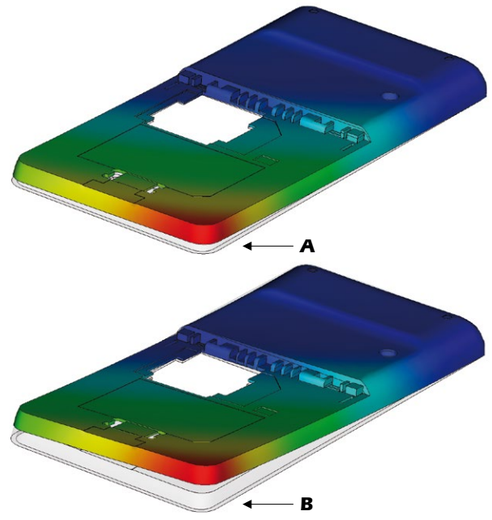
### Significantly higher lateral stiffness

Compared to Grivory GV, Grivory GVX shows an increase of 26% in lateral stiffness for the same glass-fibre content. This factor is particularly important in the manufacture of components exposed to internal pressure. The striking improvement is a great advantage for parts exposed to stress applied laterally to the direction of the fibres.




### Warpage

All semi-crystalline plastic materials are subject to the problem of warpage. With Grivory GVX, this warpage has been reduced by up to 50%. Due to an optimised interaction between the matrix and reinforcing glass-fibres, 25% lower lateral shrinkage to the direction of alignment of the fibres has been achieved. This low transverse shrinkage results in the manufacture of components with greatly reduced warpage.




The Moldflow analysis clearly shows the difference in warpage between Grivory GVX (A) and conventional products with the same amount of glass-fibre reinforcement (B). This reduced warpage is not only Moldflow-Theory. Both test bars and daily applications confirm this lower warpage in an impressive manner.

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EMS-GRIVORY is the leading manufacturer of high-performance polyamides and the supplier with the widest range of polyamide materials. Our products are well-known throughout the world under the trade marks Grilamid, Grivory and Grilon.

We offer our customers a comprehensive package of high-capacity and high-quality products along with segment-specific advisory competence in distribution and application development. We maintain our market leadership through continual product and application development in all segments.

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