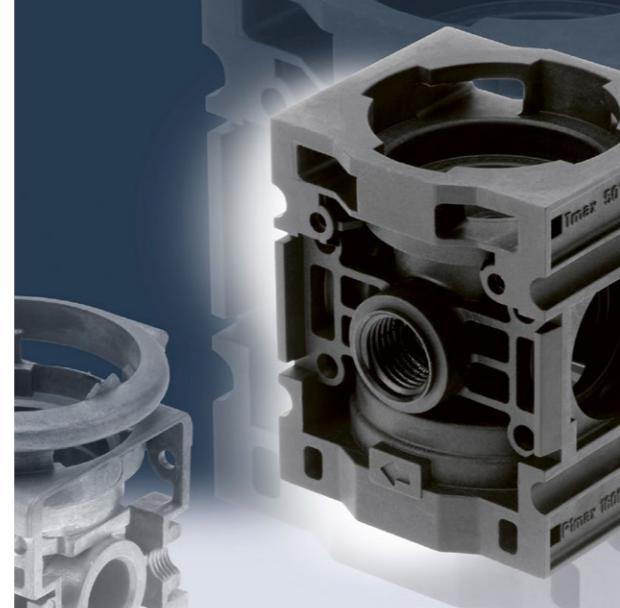




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## Introduction

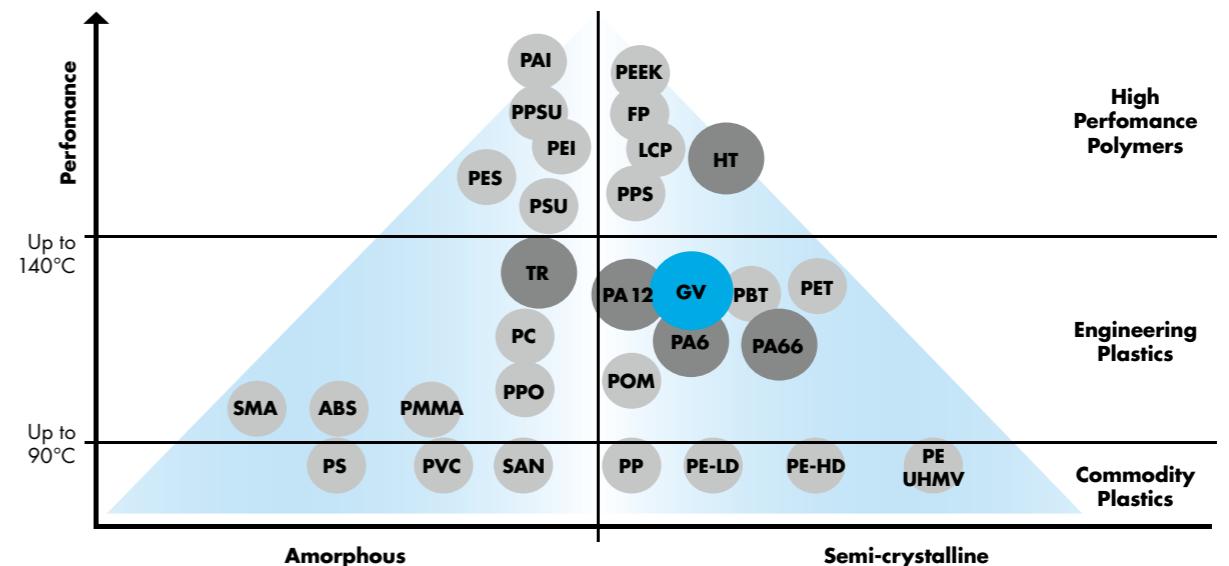
Grivory is the trade name for EMS-GRIVORY's family of semi-crystalline, partially aromatic polyamides for metal replacement. Grivory GV encompasses alloys of partially aromatic and aliphatic polyamides with the following basic properties:

- High stiffness and strength
- Excellent creep resistance
- Minimal influence of moisture on strength and stiffness
- High dimensional stability
- Good chemical resistance
- Very high surface quality

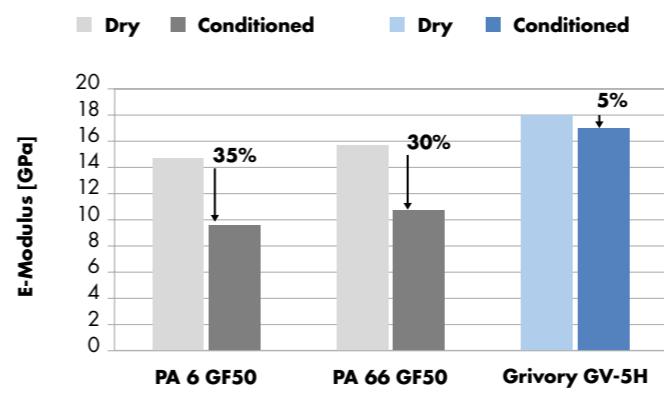
Grivory brings enhanced properties with each generation:

- G – PA 66 + PA61/X – Original The standard for metal replacement
- G6 – PA612 + PA 61/X low moisture absorption

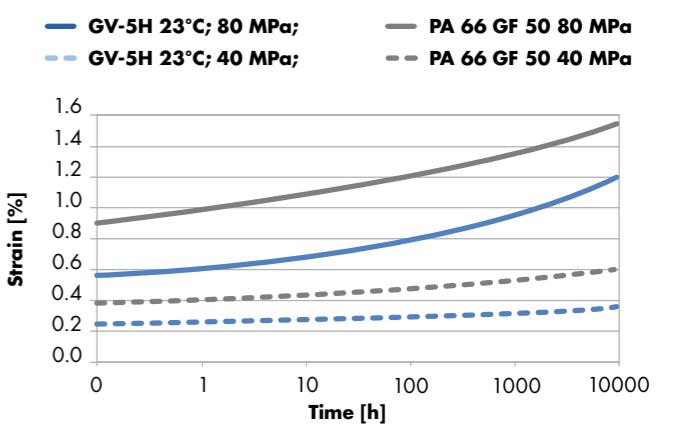
The Grivory G product portfolio is a powerhouse of reinforcement and modification combinations. The rugged properties of Grivory G complements metal replacement applications across all markets.



### Grivory GV maintains high stiffness and strength even after moisture absorption



### Grivory GV: Low Creep Grivory GV-5H vs. PA 66 GF50 (50% r.h.)



## Grivory GV Product Assortment

Grivory	GV	GV EF	GVS	GVX	G6V(X)
Flowability	○	+	++	+	○
Strength	+	+	○	+	○
Creep resistance	○	○	○	+	○
Surface quality	○	○	+	++	+
Warpage	○	○	○	+++	++
UV resistance	○	○	○	○	+
Moisture abs.	○	○	○	○	++
Max. operating temperature [°C]	80	80	80	70	80

+++ Best    ++ Very Good    + Better    ○ Good

## Grivory GV VO

Grivory GV VO is also suitable for metal replacement, where flame protection is necessary.

There are UL94 5VA-Materials additionally offering VL94 5VA for critical applications.

Products	Description
GV XE 3950 GV GF 30 VO	VO >0.35mm ALL, GWIT 775°C (2mm), RTI EL 140°C (0.75mm)
GV XE 3951 GV GF 40 VO	VO >0.45mm ALL, GWIT 775°C (1mm), RTI EL 140°C (1mm)
GV XE 11119 GVX GF50 VO	VO >0.75mm ALL, UL 94 5VA >0.75mm, GWIT 800°C (1mm)
GV XE 5106 GVL LGF40 VO	VO >1.6mm, UL 94 5VA >1.6mm (bk) GWIT 800°C (1.6mm)
GV XE 5107 GVL LGF50 VO	VO >1.6mm, UL 94 5VA >1.6mm (bk) GWIT 800°C (1.6mm)

## Grivory GV VO properties

Grade	Reinforcement	Characteristic
GV	20%, 40%, 50%, 60% glass fiber	The Standard for Metal Replacement
GV EF	50%, 60% glass fiber	Easy flow, Good Surface Quality
GVS	50%, 60% glass fiber	High Flow, Very Good Surface Quality
GVX	50%, 60%, 65%, 70% glass fiber	High Transversal Strength and Stiffness, Low Warpage
GV FWA	20%, 40%, 50%, 60% glass fiber	Food and Drinking Water Contact
GV VO	30%, 40%, 50% glass fiber	UL94 VO, some Products with UL 94 5VA
GVN	35%, 50% glass fiber	Impact Modified Grivory GV
GC	40% carbon fiber	Extreme Stiffness and Strength, Electrically Conductive
GM	40% mineral	Mineral Filled, Low Warpage
G4V	50% glass fiber	High Flow, Slow Crystallisation, Good Surface Quality
G6V	55%, 60%, 70% glass fiber	Low Moisture Absorption, Improved Dimensional Stability

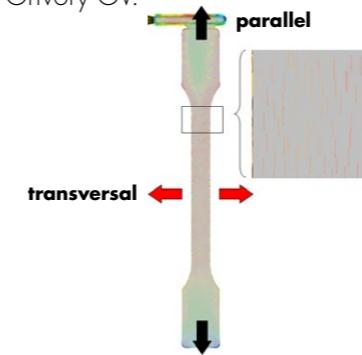
Conditioned	XE 3950 GF 30	XE 3951 GF40	XE 11119 XGF50	XE 5106 LGF 40	XE 5107 LGF 50
E-Modulus [GPa]	9.5	12	16.5	13	16.5
Strength [MPa]	110	120	130	175	205
Elongation at break [%]	2	2	1.5	2.1	2.4
Impact Charpy [kJ/m <sup>2</sup> ]	45	40	30	65	80
Notched Impact Charpy [kJ/m <sup>2</sup> ]	9	8	8	25	30
Density [g/cm <sup>3</sup> ]	1.4	1.53	1.65	1.54	1.59
UL 94 VO [mm]**	0.4 – 3.2	0.4 – 3.2	0.8 – 3.0	1.6 – 3.0*	1.6 – 3.0*
UL 94 5VA [mm]**	–	–	0.8 – 3.0	1.6 – 3.0*	1.6 – 3.0*
GWIT 1mm [°C]**	750	775	800	800	800

\* Black only. \*\*Acc. to UL Yellow Cards

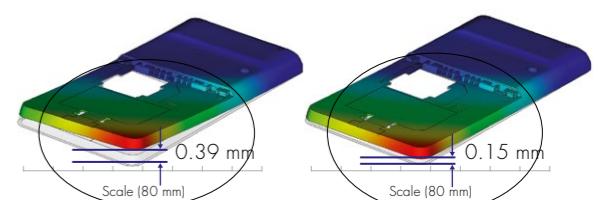
Grivory GV with  $\geq$  20% Postindustrial-Recyclate available upon Request (GF50+GF60).

## Grivory GVX – Low warpage

**Grivory GVX** shows higher transversal stiffness than Grivory GV.

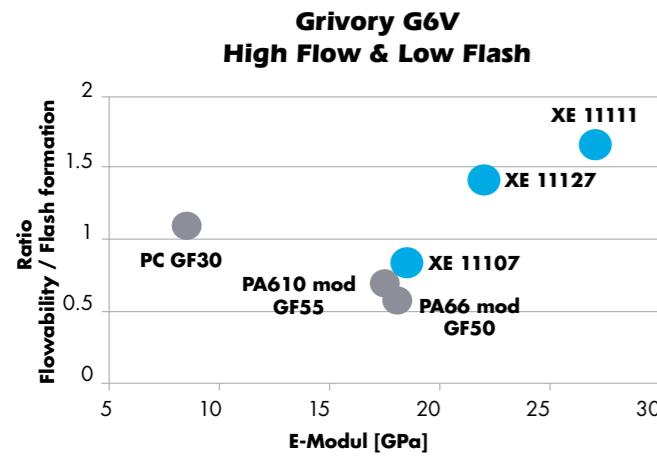


**Grivory GVX** shows lower warpage than Grivory GV.



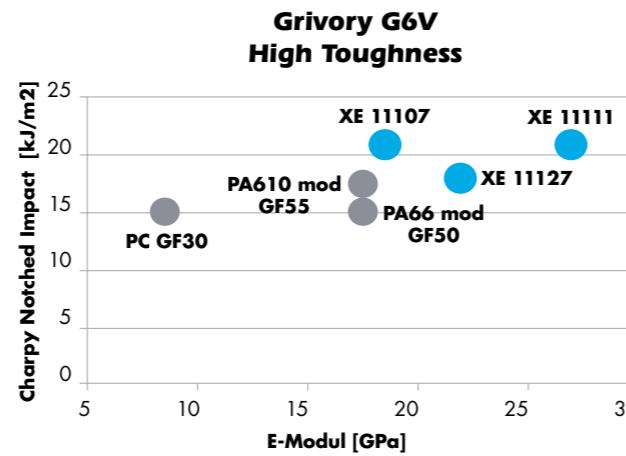
## Grivory G6V Advanced Performance

Grivory G6V is the choice for precision components in computers, smartphones, tablets, and wearable devices such as watches, fitness monitors, and virtual reality headsets. Extraordinary stiffness and impact strength with simultaneous high dimensional stability are the vital properties of Grivory G6V which supports progressive technology development.



Further properties:

- High flow with low flash
- Low warpage
- Excellent surface quality
- Easy processability
- Low moisture absorption



## Grivory G6V Product Assortment

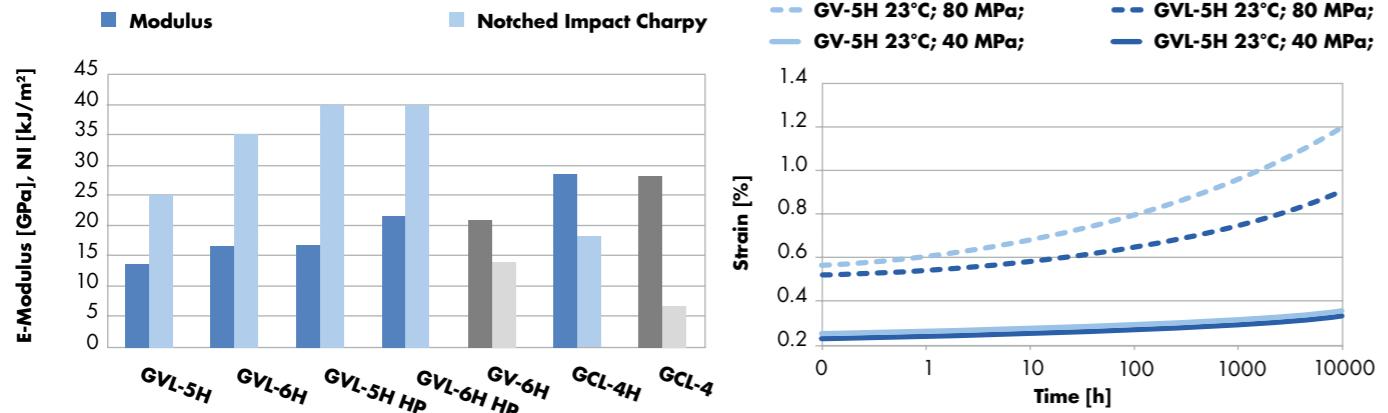
Property	Standard	Unit	XE 11107 Dry/Cond.	XE 11127 Dry/Cond.	XE 11111 Dry/Cond.
Degree of Reinforcement	ISO 3451	%	55	60	70
E-Modulus	ISO 527	GPa	18.5/17.5	22.0/21.0	27.0/26.0
Strength	ISO 527	%	245/215	250/220	265/225
Charpy Impact 23°C	ISO 179	kJ/m²	105/100	100/90	85/70
Charpy Notched Impact 23°C	ISO 179	kJ/m²	21/20	17/17	21/22
Melt Point	ISO 2039-1	°C	215/-	213/-	220/-
HDT 1.80 MPa	ISO 75	°C	200/-	200/-	-
Density	ISO 1183	kg/m³	1.60/-	1.67/-	1.87/-
Water Absorption, 23°C	ISO 1183	%	2.5	1.6	1.1
Moisture Absorption, 23°C/50%	ISO 62	%	1.0	0.7	0.6
Shrinkage (Longitudinal)	ISO 294	%	0.10/-	0.10/-	0.10/-
Mold Shrinkage (Transverse)	ISO 294	%	0.40/-	0.30/-	0.30/-
Melt Temperatures	-	°C	260 to 300	260 to 300	260 to 300
Tool Temperature	-	°C	60 to 100	60 to 100	60 to 100

## Grivory Long Fiber Reinforcement – stiff and tough

Grivory long fiber reinforced (LFT) polyamides are an excellent fit in challenging, highly technical metal-replacement applications. LFT products show enhanced properties at the same temperature and a wider application temperature range than short glass fiber reinforced grades. The LFT-properties lead to higher crash resistance. Grivory LFT products demonstrate the following properties:

- Superior strength and stiffness
- Very low creep under constant loads and stable fatigue behavior
- Crash Resistance: Excellent energy absorption through improved notched impact strength and high strength under rapid deformation speeds
- Low warpage
- High temperature resistance
- Chemical resistance as known from short fiber reinforced compounds.

### Grivory GVL, GVL HP und GCL – stiff and tough Stiffness and Notched Impact, LFT vs. short fiber compounds



## Grivory Long Glass Fibers vs Standard Glass Fibers

Property	Standard	Unit	GV-6H Dry	GVX-6H <sup>A</sup> Dry	GVL-6H Dry	GVL-6H HP <sup>A</sup> Dry
Degree of Reinforcement	ISO 3451	%	60% GF	60% GF	60% LFT	60% LFT
E-Modulus	ISO 527	GPa	22.0	22.5	23.0	23.5
Strength	ISO 527	%	260	290	290	310
Charpy Impact 23°C	ISO 179	kJ/m²	80	75	105	125
Charpy Notched Impact 23°C	ISO 179	kJ/m²	14	15	35	40
Melt Point	ISO 2039-1	°C	260	260	260	260
HDT 1.80 MPa	ISO 75	°C	235	250	255	255
Density	ISO 1183	kg/m³	1.69	1.69	1.69	1.69
Water Absorption, 23°C	ISO 62	%	3.5	3.5	3.5	3.5
Moisture Absorption, 23°C/50%	ISO 62	%	1.2	1.2	1.2	1.2
Shrinkage (Longitudinal)	ISO 294	%	0.05	0.05	0.1	0.15
Shrinkage (Transverse)	ISO 294	%	0.30	0.25	0.2	0.25
Melt Temperatures	–	°C	270 to 300	270 to 300	290 to 310	290 to 310
Tool Temperature	–	°C	80 to 120	80 to 120	80 to 120	80 to 120

<sup>A</sup> Specialty glass fiber

## Grivory LFT Product Assortment

Several options of LFT grades are available. The following table lists grade, reinforcement content, and key attributes. Grivory G5VL is a new LFT option for the crash resistance grade. Grivory G5VL demonstrates

higher stiffness and strength at 80°C to 100°C; improved creep resistance at 23°C, and similar processing behavior in comparison to standard Grivory GV.

Grade	Reinforcement	Characteristic
GVL	30%, 40%, 50%, 60% glass	Base grade, balanced profile
GVL HP	50%, 60% glass	Crash resistant, constant properties up to 80 °C
GVL HP FC	60% glass (FE 16147)	Easy flow
GVL VO	40%, 50%, 60% glass	Flame retardant grades
GCL	30%, 40% carbon	Extreme stiffness, low density



You receive comprehensive technical support from our Application Development Center.

## Service and Support

### EMS-GRIVORY - Your development partner for innovative solutions

EMS-GRIVORY is global leader in the development and production of high-performance polymers. As a development partner, EMS provides support throughout the entire development process, from the initial idea to series production.

#### Ideas and solutions

Providing solutions and generating ideas, EMS develops innovative, cost-effective and sustainable applications together with the customer.

#### Individual material adaptations

EMS adapts materials precisely for specific applications and legal requirements, including customer-specific colors and test samples.

#### Simulation and optimization

Simulations are used to optimize component designs and injection molding processes, thus reducing costs and saving development time.

#### Environmentally-friendly solutions and sustainability

EMS attaches great importance to environmentally-friendly and sustainable production and provides a wide range of bio-based materials and recyclate. All production sites worldwide are CO<sub>2</sub>-neutral.

#### Product characterization and approvals

Modern and extensively equipped test laboratories provide fast, targeted support for customer-specific applications and developments. Materials are approved worldwide for use in contact with food and drinking water, sanitary components and electrical appliances.

#### Series start-up and on-site support

EMS supports series start-up 24/7 on site for efficient production.

#### Global partner

With global production sites, on-site technical support and global application development centers, EMS provides uniformly high standards and service quality worldwide.

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EMS-GRIVORY  
The Best Solution!  
Innovative. Fast. Successful.





## EMS-GRIVORY worldwide

### EMS-GRIVORY – The leading manufacturer of high-performance polyamides

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 trademarks Grilamid, Grivory and Grilon.

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