SOLVAY

asking more from chemistry®

Ixef® PARA

polyarylamide

SPECIALTY POLYMERS

A Remarkable Combination of Strength and Beauty

Ixef® PARA is ideal for molding complex parts needing overall strength and a smooth, beautiful surface finish.

Lightweight structural components can be very thin, extremely rigid, strong, and dimensionally stable.

Ixef® PARA compounds typically contain 50 % to 60 % glass fiber reinforcement, giving them exceptional strength and rigidity. Yet even with high glass loadings, molded parts have a smooth, resin-rich surface finish that's perfect for painting, metallization or producing a naturally reflective shell.



Designed for Success

Design engineers routinely use Ixef® PARA to replace expensive composite or machine-tooled metal parts in applications where strength, aesthetics and a variety of other attributes are needed.

Automotive and Transportation

Mirror housings, door handles, headlamp surrounds, cam covers and clutch cylinders must withstand extreme temperature shifts, high mechanical stress and exposure to automotive fluids without losing their smooth, high-quality appearance.

Food and Water Contact Application

Ixef® 1022 is approved for food contact meeting European standard 10/2011/EC for both black and natural resins. It is suitable for contact with cold water and meets the following European water approval standards:

Standard	Ixef® PARA grade
French Positive List (FPL)	1022/0006 (natural) 1022/0008 (natural)
KTW (Cold Water Only)	1022/0006 (natural) 1022/9006 (black)
ACS	1022/9006 (black)

Personal Care and Small Appliances

Shaver heads, vacuum cleaner motor supports and components for electric irons and sewing machines benefit from Ixef® PARA's metal-like strength and appearance.

Mobile Electronics

Structural components in laptops, tablets and smart phones molded from Ixef® PARA retain their aesthetics and strength over a lifetime of use. Other electronics applications include induction motor supports, safety switches, and DVD disk supports.

Healthcare

The high strength, stiffness and surface appearance of Ixef® GS-1022 gamma-stabilized colors make them a cost-effective alternative to metal in single-use medical instruments and devices.

Colors offer unique branding opportunities and give healthcare professionals a quick visual reference for differentiating sizes.

Get The Performance You Need

Ixef® PARA's broad product family gives you numerous ways to optimize performance, processing and price. Its high flow, dimensional stability, and high strength and stiffness make these materials suitable for replacing metal in a wide range of structural applications where aesthetics are important.

Very High Strength and Stiffness

The tensile strength of Ixef® PARA compounds is similar to many cast metals and alloys at ambient temperature. Its flexural strength is also comparable to some metals.

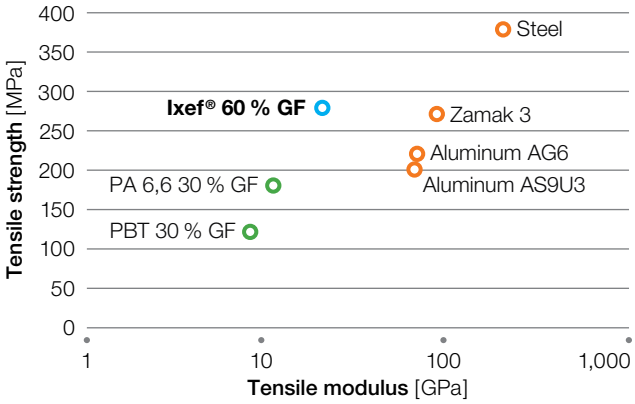
Density and tensile properties comparison

Material	Density	Tensile Strength [MPa]	Tensile Modulus [GPa]
Ixef® 1032	1.8	280	24
Aluminum	2.8	320	70
Magnesium	1.8	225	40
Steel	7.8	330	206
Die-cast zinc	6.6	280	70

ISO 1183 (density) and ISO 527 (tensile) test methods.

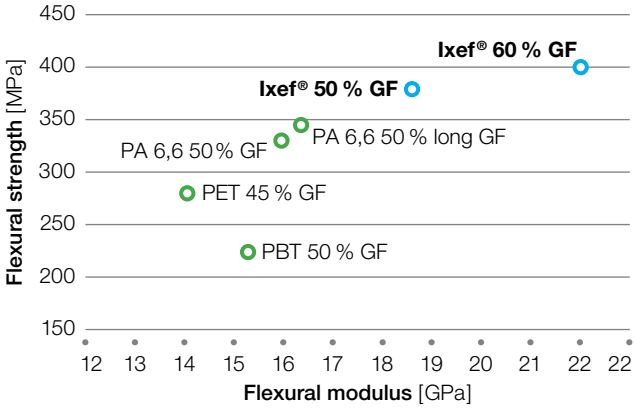
Tensile strength vs. tensile modulus

ISO 527 test method



Flexural strength

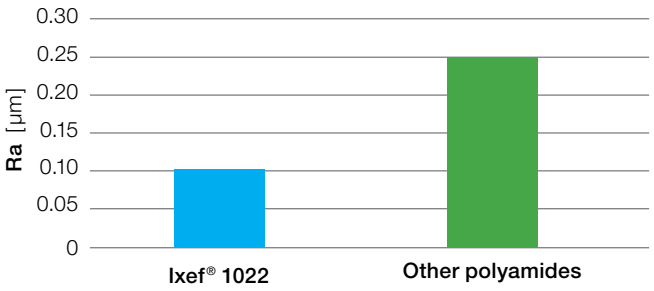
ISO 178 test method



Excellent Surface Finish

Ixef® PARA's highly polished surface has an Ra value (surface roughness) equivalent to mechanically polished steel and the lowest surface Ra value of any standard or semi-aromatic polyamide.

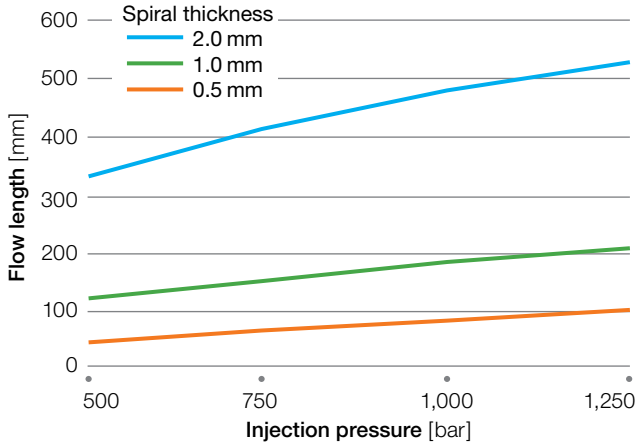
Surface roughness



High Flow for Thin-Walled Parts

Even with glass loadings as high as 60 %, Ixef® PARA can readily fill walls as thin as 0.5 mm.

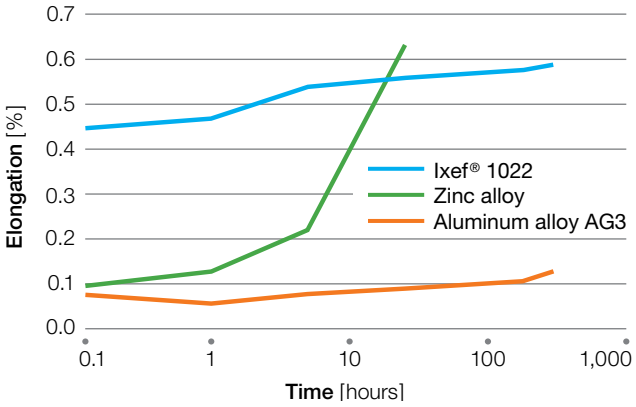
Flow rate of Ixef® 1022



Very Low Creep

A 60 % glass-filled Ixef® grade deforms less than 1 % after 1,000 hours under 50 MPa at 50 °C, offering lower creep than some metals and most engineering polymers with similar glass fiber content.

Creep resistance at elevated temperatures
120 °C, load 30 MPa, 14 days



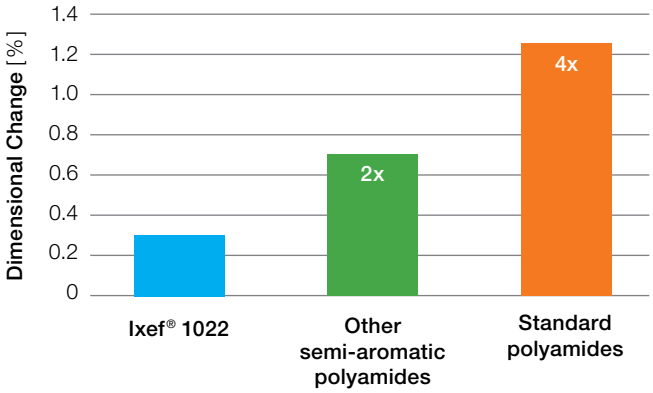
Good Chemical Resistance

Ixef® PARA compounds are resistant to common solvents such as aliphatic and aromatic hydrocarbons, chlorinated solvents, ketones, esters, ethers and glycols. In addition, they resist aqueous solutions of many chemicals and cleaning fluids, standard engine oil (Type SAE 10W30), hydraulic oil and a variety of automotive fuels.

Slow Water Absorption Rate

The partially aromatic molecular structure of Ixef® PARA results in lower and slower water absorption than standard polyamides, thereby reducing the tendency to warp. The dimensional change of 50 % glass-filled Ixef® 1022 is only 0.32 % after 24-hour water immersion at room temperature.

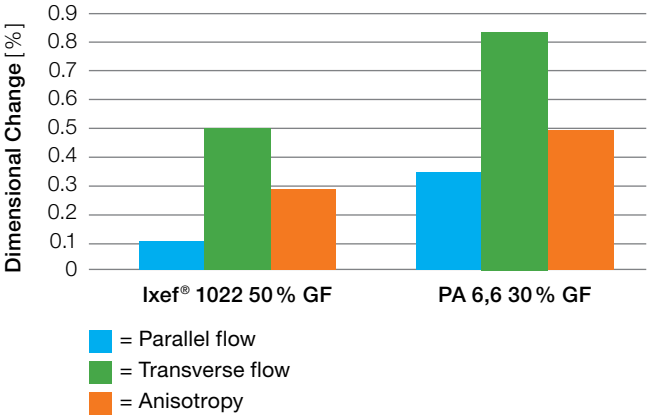
Moisture absorption
after 24 hours at 23 °C, ISO 62 test method



Low Warpage

Compounds filled with glass fiber have a tendency to warp due to the non-uniform (anisotropic) parallel and perpendicular shrinkage rates. Compared to standard polyamides, Ixef® PARA compounds have a lower tendency to warp due to their lower anisotropic behavior.

Warpage comparison



Test sample: 40 x 20 x 2 mm
Test conditions: 750 bar, 280 °C
Tooling: 120 °C, direct gating

Good Dimensional Stability

Ixef® PARA's low coefficient of linear thermal expansion (CLTE) translates to low mold shrinkage, high reproducibility, and the ability to maintain tight tolerances. Length tolerance can be as little as ±0.05 % when molded properly.

CLTE Comparison
ISO 11359 test method

	10^{-5} K^{-1}
Ixef® 1022	Flow direction: 1.5 Transverse direction: 3.6
Steel	1.2
Aluminum	2.4
Brass	1.8
Zinc	3.0

Ixef® PARA Product Line

Ixef® PARA compounds are available in a variety of grades to meet specific application requirements. The base resin is a semi-aromatic, semi-crystalline polyamide with mineral and/or advanced fillers and glass fiber reinforcement. Impact-modified and flame-retardant grades are available as well as custom colors.

Standard Grades

Glass Fiber Reinforced	
Ixef® 1022*	50 % glass fiber
Ixef® 1027	50 % glass fiber, improved thermal stability
Ixef® 1032	60 % glass fiber
Flame Retardant	
Ixef® 1521	50 % glass fiber, flame retardant
Ixef® 1524	50 % glass fiber, halogen-free, flame retardant
Toughened	
Ixef® 1622	50 % glass fiber, impact modified
Mineral/Glass Fiber Reinforced	
Ixef® 2030	55 % mineral/glass fiber, low warpage

** 1022/0006 and 1022/9006 are ISO 10993 compliant and suitable for potable water*

Specialty Grades

Glass Fiber Reinforced	
Ixef® GS-1022	50 % glass fiber, gamma-stabilized colors for healthcare applications
Ixef® 1025	50 % glass fiber, UV stabilized for exterior applications
Ixef® 1002	30 % glass fiber
Carbon Fiber Reinforced	
Ixef® 3008	30 % carbon fiber

Ease of Processing

Ixef® PARA compounds can be processed on conventional injection molding equipment. It is essential that the mold temperature is between 120 °C to 140 °C (248 °F to 284 °F) in order to achieve maximum crystallinity. This will assure a good surface finish, good dimensional stability, full mechanical properties, and low moisture absorption. For more detailed processing information, reference the Ixef® PARA Processing Guide at **www.ixef.com**.

Processing recommendations

Cylinder Temperature	
Feed zone	250 °C – 280 °C
Compression zone	250 °C – 280 °C
Metering zone or homogenization zone	250 °C – 280 °C
Nozzle	260 °C – 290 °C
Hot runners (when used)	250 °C – 260 °C
Temperature of the Melt [1]	
Standard grades	280 °C
Flame retardant grades	< 270 °C
Mold temperature	120 °C – 140 °C
Plasticizing	
Screw speed, peripheral[2]	3 – 10m/min
Back pressure	0 – 150 bar
Injection	
Injection speed	High
Injection pressure	500 – 1,500 bar
Hold and Cooling	
Hold pressure	500 – 1,500 bar
Hold time, seconds	3 s × w [3]
Cooling time, seconds	2.5 s × w^2 [4]

[1] Measured on purged material
[2] For screw diameters 25 – 50 mm
[3] w = wall thickness, mm
[4] w = wall thickness, ≥ 2 mm

Dedicated Global Support

At Solvay, we place a high value on establishing close working relationships with our customers. We believe that the better we know you, the better we can serve you. That's why we have a global network of sales and technical support dedicated to serving a broad range of industries. We understand the importance of reliable customer support and work hard to earn your confidence in us as your preferred materials supplier.

Typical Properties

Typical properties of select Ixef® PARA grades

		Standard Grades				Specialty Grades			
Property [1]	**Units**	**1022**	**1032**	**1622**	**1521 1524**	**GS-1002**	**1025**	**3008**	**Test Method**
Description		50 % GF [2]	60 % GF	Toughened, 50 % GF	Flame retardant, 50 % GF	Gamma stabilized, 50 % GF	UV stabilized, 50 % GF	30 % CF [2]	
Thermal									
Heat deflection temp.	°C	230	230	220	227 – 230	230	230	230	ISO 75
Glass transition temp.	°C	85	85	85	85	85	85	85	DSC
Melting point	°C	235	235	235	235	235	235	235	DSC
Flame rating		HB	HB	HB	V-0	HB	HB	HB	UL 94
Mechanical									
Tensile strength	MPa	280	280	235	230	190	230	250	ISO 574
Tensile elongation	%	1.9	1.8	2.6	1.9	2.0	1.9	1.3	ISO 574
Flexural modulus	GPa	19	24	17	19 – 20	12	17	26	ISO 178
Izod impact notched	J/m	110	120	120	70 – 95	70	95	59	ISO 180
Izod impact unnotched	J/m	850	900	1100	600 – 700	460	700	450	ISO 180
Electrical									
Electric strength	kV/mm	28	24	31	26 – 29	30	—	—	IEC 60243-1
Volume resistivity	ohm-cm	2×10^{15}	2×10^{15}	2×10^{15}	1×10^{15}	1×10^{13}	—	—	IEC 60093
General									
Density	g/cm^3	1.64	1.77	1.60	1.68 – 1.75	1.43	1.61	1.34	ISO 1183
Water absorption, 24 hours	%	0.16	0.13	0.19	0.15 – 0.30	0.20	0.16	0.22	ISO 62
Chemical Compatibility [3]									
Brake fluid		E	E	E	E	E	E	E	
Oxygenated solvents		E	E	E	E	E	E	E	
Alphatic hydrocarbons		E	E	E	E	E	E	E	
Aromatic hydrocarbons		E	E	E	E	E	E	E	
Hydrolytic stability		G	G	G	G	G	G	G	
Processing Parameters									
Melt temperature	°C	280	280	270	< 270	280	280	280	
Mold temperature	°C	120	120	120	120	120	120	120	
Mold shrinkage	%	0.1 – 0.3	0.1 – 0.3	0.1 – 0.3	0.1 – 0.3	0.1 – 0.4	0.1 – 0.3	0.03 – 0.1	
Fabrication process [4]		IM	IM	IM	IM	IM	IM	IM	

[1] Dry as molded data [2] GF = glass fiber reinforced, CF = carbon fiber reinforced
[3] E = Excellent, G = Good, F = Fair, P = Poor [4] IM = Injection Molding

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