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% and 60% fiber reinforcement, giving them exceptional strength and rigidity. Yet even with high glass and carbon fiber 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

Ixef® FC-1022 and DW-1022 are approved for contact with food and potable water for black and natural resins. Regulatory compliance for these materials is summarized below.

Standard	Ixef® FC-1022	Ixef® DW-1022
EU Food	✓	✓
FDA	✓	✓
KTW		✓
DVGW W270		✓
ACS		✓
WRAS		✓
NSF ANSI 61		✓

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 and safety switches.

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

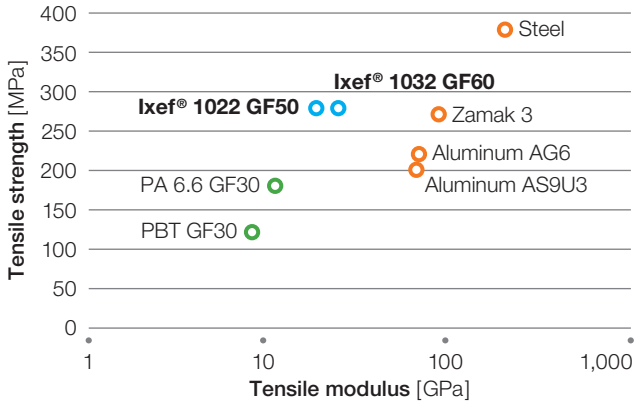
The tensile strength of Ixef® PARA compounds is similar to many cast metals and alloys at ambient temperature. Its flexural strength is also comparable to some metals.

Density and tensile properties comparison

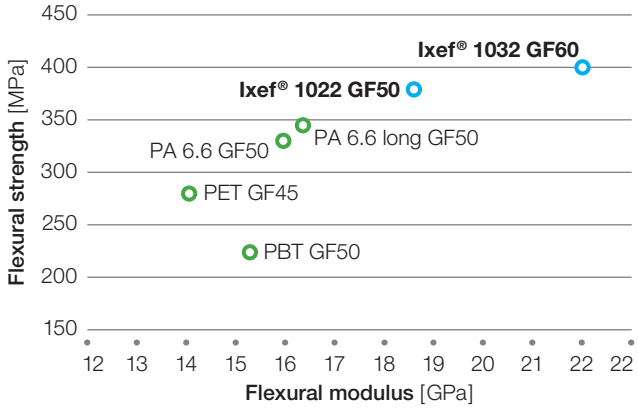
Material	Density	Tensile Strength [MPa (psi)]	Tensile Modulus [GPa (ksi)]
Ixef® 1022 (50% GF)	1.64	280 (40,610)	20 (2,900)
Ixef® 1032 (60% GF)	1.78	280 (40,610)	24 (3,480)
Aluminum	2.8	320 (46,400)	70 (10,200)
Magnesium	1.8	225 (32,600)	40 (5,800)
Steel	7.8	330 (47,900)	206 (30,000)
Die-cast zinc	6.6	280 (40,610)	70 (10,200)

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

Tensile strength vs. tensile modulus
ISO 527 test method



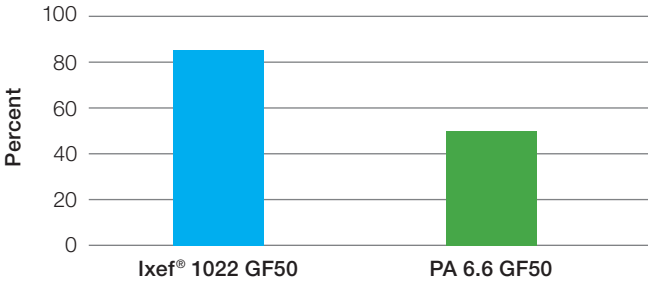
Flexural strength
ISO 178 test method



Excellent Surface Finish

Ixef® PARA's ultra-smooth, resin-rich surface finish provides best-in-class aesthetics in structural thermoplastics. Plus, molded parts exhibit a low tendency for sink marks in both thin and thick components.

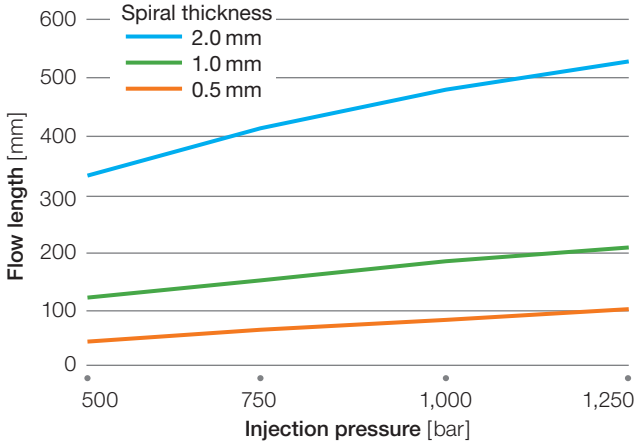
Gloss 60°
ASTM D2457



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

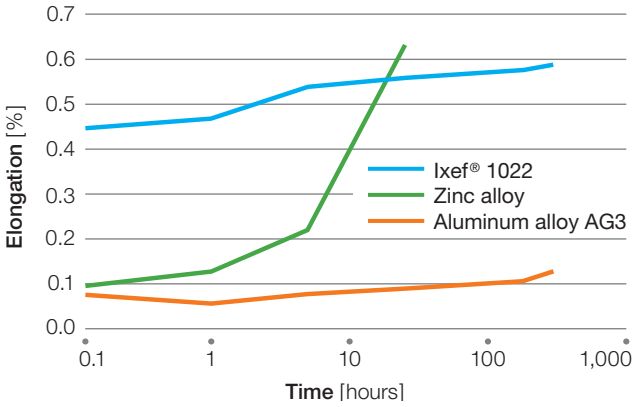


Very Low Creep

A 50% glass-filled Ixef® grade deforms less than 1% after 1,000 hours under 50 MPa (7,250 psi) at 50 °C (122 °F), offering lower creep than some metals and most engineering polymers with similar glass fiber content.

Creep resistance at elevated temperatures

120 °C/248 °F, 30 MPa/4,350 psi, 14 days



Good Chemical Resistance

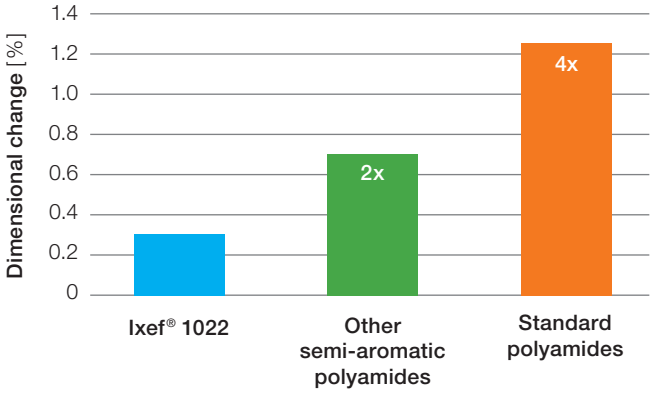
Ixef® PARA compounds are resistant to common solvents such as aliphatic and aromatic hydrocarbons, chlorinated solvents, ketones, esters, ethers and glycols. In addition, they resist aqueous solutions of many chemicals and cleaning fluids, standard engine oil (Type SAE 10W30), hydraulic oil and a variety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

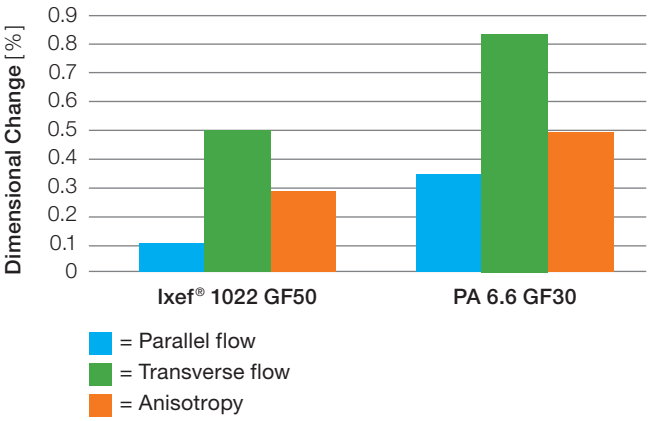
24 hours at 23 °C/74 °F, ISO 62 test method, 40 × 20 × 2 mm specimen



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 × 20 × 2 mm
Test conditions: 750 bar, 280 °C/536 °F
Tooling: 120 °C/248 °F, direct gating

Good Dimensional Stability

Ixef® PARA's unique chemical nature provides its low mold shrinkage and a low coefficient of expansion which translates into high reproducibility and the ability to maintain tight tolerances.

CLTE Comparison

ISO 11359 test method

Material	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

**FC-1022 and DW-1022 are compliant with regulatory standards for food contact and drinking water applications.*

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
Ixef® 3012	55% carbon/glass fiber hybrid, improved surface finish

Ease of Processing

Ixef® PARA compounds can be processed on conventional injection molding equipment. It is essential that the mold temperature is between 120 to 140 °C (248 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**.

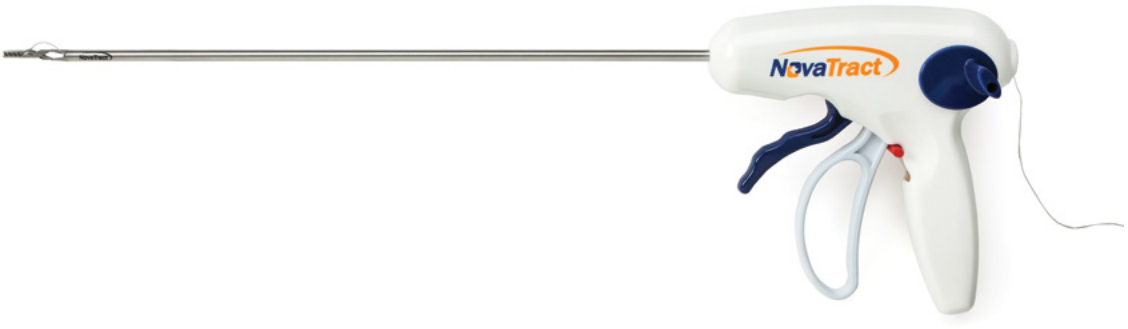
Processing recommendations

Cylinder Temperature	
Feed zone	250–280 °C (482–536 °F)
Compression zone	250–280 °C (482–536 °F)
Metering zone or homogenization zone	250–280 °C (482–536 °F)
Nozzle	260–290 °C (500–554 °F)
Hot runners (when used)	250–260 °C (482–500 °F)
Temperature of the Melt [1]	
Standard grades	280 °C (536 °F)
Flame retardant grades	< 270 °C (< 518 °F)
Mold temperature	120–140 °C (248–284 °F)
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	$3\ s \times w$ [3]
Cooling time, seconds	$2.5\ s \times w^2$ [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

		Standard Grades				Specialty Grades				
Property[1]	**Units**	**1022**	**1032**	**1622**	**1521 1524**	**GS-1022**	**1025**	**3008**	**3012**	**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]	55% CF/GF[3]	
Thermal										
Heat deflection temperature	°C (°F)	230 (446)	230 (446)	220 (428)	227–230 (441–446)	230 (446)	230 (446)	230 (446)	230 (446)	ISO 75
Glass transition temperature	°C (°F)	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)	85 (185)	DSC
Melting point	°C (°F)	235 (455)	235 (455)	235 (455)	235 (455)	235 (455)	235 (455)	235 (455)	235 (455)	DSC
Flame rating		HB	HB	HB	V-0	HB	HB	HB	HB	UL 94
Mechanical										
Tensile strength	MPa (ksi)	280 (40.6)	280 (40.6)	235 (34.1)	230 (33.4)	265 (38.4)	230 (33.4)	250 (36.3)	290 (42.0)	ISO 527-2
Tensile elongation	%	1.9	1.8	2.6	1.9	1.8	1.9	1.3	1.1	ISO 527-2
Tensile modulus	GPa (ksi)	20 (2,900)	24 (3,410)	17 (2,470)	20 (2,900)	22 (3,190)	17 (2,470)	26 (3,770)	38.5 (5,580)	ISO 527-2
Flexural modulus	GPa (ksi)	19 (2,760)	24 (3,410)	17 (2,470)	20 (2,900)	22 (3,190)	17 (2,470)	23 (3,330)	36 (5,220)	ISO 178
Izod impact notched	J/m (ft-lb/in)	110 (2.1)	120 (2.3)	120 (2.3)	70–95 (1.3–1.8)	70 (1.3)	95 (1.8)	59 (1.1)	70 (1.3)	ASTM D256
Izod impact unnotched	J/m (ft-lb/in)	850 (16.0)	900 (17.0)	1,100 (20.8)	600–700 (11.3–13.2)	460 (8.7)	700 (13.2)	360 (6.8)	360 (6.8)	ASTM D256
Electrical										
Electric strength	kV/mm (V/mil)	31 (790)	24 (600)	25 (640)	29 (740)	30 (760)	—	—	—	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	1.78	1.61	1.34	1.57	ISO 1183
Water absorption, 24 hours	%	0.16	0.13	0.19	0.15–0.30	0.20	0.16	0.22	0.24	ISO 62
Chemical Compatibility[4]										
Brake fluid		E	E	E	E	E	E	E	E	
Oxygenated solvents		E	E	E	E	E	E	E	E	
Alphatic hydrocarbons		E	E	E	E	E	E	E	E	
Aromatic hydrocarbons		E	E	E	E	E	E	E	E	
Hydrolytic stability		G	G	G	G	G	G	G	G	
Processing Parameters										
Melt temperature	°C (°F)	280 (536)	280 (536)	270 (518)	270 (518)	280 (536)	280 (536)	280 (536)	280 (536)	
Mold temperature	°C (°F)	120 (248)	120 (248)	120 (248)	120 (248)	120 (248)	120 (248)	120 (248)	120 (248)	
Mold shrinkage	%	0.1–0.3	0.1–0.3	0.1–0.3	0.1–0.3	0.1–0.3	0.1–0.3	0.03–0.1	0.03–0.1	
Fabrication process[5]		IM	IM	IM	IM	IM	IM	IM	IM	

[1] Dry as molded data [2] GF = glass fiber reinforced, CF = carbon fiber reinforced [3] CF/GF = carbon/glass fiber hybrid
[4] E = Excellent, G = Good, F = Fair, P = Poor [5] IM = Injection Molding

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D 10/2010 | R 06/2019 | Version 3.0