

®
EXE



Reinforced, Polyarylamide based compounds

Perfection in injection





Polyarylamide based compounds

The IXEF range of compounds is a family of thermoplastic products reinforced with glass fibres and/or mineral fillers.

The base resin of IXEF compounds is polyarylamide (aromatic, semi-crystalline polyamide), which gives remarkable properties to injection moulded items for many industrial applications.

The IXEF range

The range of IXEF compounds comprises seven main product families, essentially for injection moulding.

Grades	Characteristics
1000 Series IXEF 1002 IXEF 1022 IXEF 1023 IXEF 1025 IXEF 1027 IXEF 1032	Compounds reinforced with glass fibres 30% glass fibres 50% glass fibres 50% glass fibres; UV stabilised for interior applications 50% glass fibres; UV stabilised for exterior applications 50% glass fibres; with improved thermal stability 60% glass fibres
1300 Series IXEF 1313	Impact-modified reinforced compounds Containing 40% glass fibres and an elastomer
1500 Series IXEF 1501 IXEF 1521	Flame-retardant compounds reinforced with glass fibres 30% glass fibres 50% glass fibres
2000 Series IXEF 2030 IXEF 2057	Compounds reinforced with mineral fillers or mineral fillers and glass fibres 55% mineral fillers and glass fibres Mineral fillers
2500 Series IXEF 2530	Flame-retardant compounds of the 2000 Series Flame-retardant version of IXEF 2030
3000 Series IXEF 3006	Compounds reinforced by carbon fibres 30% carbon fibres
5000 Series IXEF 5002	Self lubricated compositions Containing 20% glass fibres and PTFE

A remarkable combination of properties

Although they may vary from one grade to another, the most outstanding characteristics of items manufactured from IXEF compounds can be summarised as follows:



Very high rigidity

Tensile modulus up to 23 GPa at 23 °C (IXEF 1032).



High strength

Flexural strength as high as 400 MPa at 23 °C (IXEF 1032).



Very low creep

Deformation of less than 1 % after 1000 hours under 50 MPa at 50 °C, for certain grades. For the same glass fibre content, the creep resistance is superior to that of most engineering polymers.



Excellent surface finish

Superb surface appearance for a reinforced product even with a high glass fibre content.



Ease of processing

Good injectability, even with a high glass fibre content, allowing the manufacture of complex or thin-walled items.



Good dimensional stability

Low mould shrinkage, highly reproducible, allowing tight tolerances to be maintained (length tolerance, as little as ± 0.05 %, when the correct moulding conditions are used).



Slow rate of water absorption

Like all polyamides, polyarylamide has a certain sensitivity to water. Even so, the semi-aromatic character of polyarylamide induces a lower and slower water absorption in IXEF compounds than that found in items moulded in PA 6 and PA 66, which are more sensitive to humidity.



Other specific properties

Physical properties

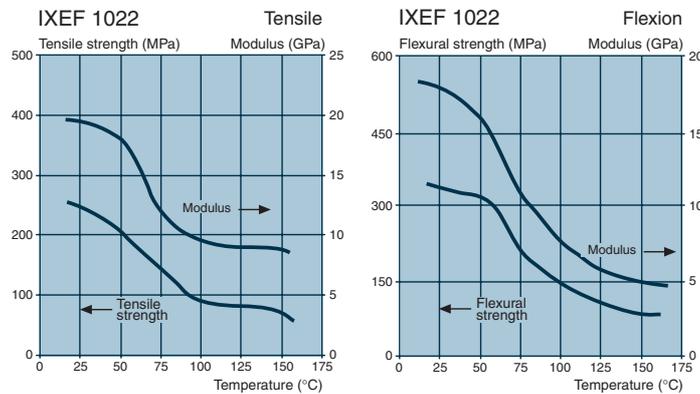
The polyarylamide resin used in IXEF compounds is a semi-crystalline polymer which has a glass transition temperature Tg of approximately 85 °C (passing from the vitreous to the rubbery state). Its melting temperature is in the region of 238 °C, whereas its crystallisation temperature is of the order of 200 °C. Under standard processing conditions, the solidification temperature is approximately 230 °C.

The coefficient of linear thermal expansion of IXEF polyarylamide is very low; similar to that of metals or metal alloys at ambient temperatures.

Mechanical properties

The tensile strength of IXEF compounds is equivalent or even superior to those of several metals at ambient temperature (see table below).

Tensile test (23 °C)		
	Tensile strength at break MPa	Modulus GPa
IXEF 1022 (dry as moulded)	255	20
IXEF 1032 (dry as moulded)	280	24
Tin Bronze	300	105
Brass	250	105
Annealed zinc	150	105
Zinc alloy (4 % Al, 0.04 % Mg)	280	85
Annealed aluminium (99.6 %)	70	69
Duralumin	190	74
Alloy Al AG3	140	69



Behaviour in contact with chemical products

IXEF compounds resist a wide range of chemical products :

- Common solvents: aliphatic and aromatic hydrocarbons, chlorinated solvents, ketones, esters, ethers and glycols.
- Aqueous solutions of many chemicals and cleaning fluids.
- No significant alteration of properties in engine oil type SAE 10W30, even after 2000 hrs at 120 °C.
- No significant alteration of properties in contact with fuel (gasoline), even after 2000 hrs at 40 °C.

The IXEF polyarylamide is, however, degraded by strong and concentrated mineral acids, powerful oxidants and strong bases. It is sensitive to certain organic acids and to some solutions of metallic salts (LiCl, ZnCl₂).

IXEF compounds are not as sensitive to water as standard nylons, but even so, their use should be carefully considered where the product is continuously in contact with water.

If IXEF items are to be used in applications where they are likely to come into contact with chemical products, tests should be performed to ensure the resistance of the item to those products during normal use.



High performance applications

IXEF compounds have been enthusiastically received by users, designers and processors alike for their high performance potential and their ease of processing.

In addition, their high degree of reliability has encouraged their use for applications in markets such as:

Automotive and transport sectors

Fuel pumps, cam covers, vandal-proof seats, rear-view mirror housings, clutch parts, wiper controls, oil filter bodies, headlamp control pivots, door handles, seat adjustment mechanisms, headlamp surrounds, etc.

Electrotechnology

Connectors, chassis and housings for electrical and electronic equipment, sliding parts in video recorders, safety switches, disk supports in CD players, induction motor supports, telecommunications parts, etc.

Domestic electrical

Electric razor heads, electric iron parts, vacuum cleaner motor supports, sewing machine parts, etc.

Others

Leisure industry applications, machine tools, furniture, medical, etc.



Properties	Standards	Units	Main grades		
(on dry as moulded products, natural colour)			IXEF 1022	IXEF 1032	IXEF 1521
GF: glass fibres MF: mineral fillers FR: flame retardant			50% GF	60% GF	50% GF FR
Physical properties					
Density	ISO 1183	g/cm ³	1.64	1.77	1.75
Filler content	-	%	50	60	50
Water absorption (24h; 23 °C)	ISO 62	%	0.16	0.13	0.15
Moisture regain at equilibrium (65 % R.H.)	(Solvay)	%	1.5	1.3	1.3
Mould shrinkage (flow direction)	(1)	%	0.1-0.3	0.1-0.3	0.1-0.3
Mechanical properties (at 23 °C)					
Tensile					
Tensile strength at break	ISO 527	MPa	255	280	230
Modulus		GPa	20	24	20
Elongation at break		%	1.9	1.8	1.9
Flexion					
Flexural strength	ISO 178	MPa	380	400	340
Modulus		GPa	18	21	18.5
IZOD impact strength					
Notched specimen	ASTM D 256	J/m	110	120	95
Unnotched specimen		J/m	850	900	700
Thermal properties and flame resistance					
HDT/A		°C	230	230	230
Coefficient of linear expansion at 23 °C	ISO 75	10 ⁻⁵ ·K ⁻¹	1.5	1.4	1.7
Thermal conductivity	ISO 11359	W/m·K	0.4	0.4	0.4
Fire classification according to UL 94	ISO 8302	(1.6 mm)	HB	HB	V-0
Limiting oxygen index (LOI)	-	%	25	25	31.5
	ISO 4589				
Electrical properties					
Dielectric strength	IEC 243	kV/mm	31	23.7	29
Volume resistivity	IEC 93/167	Ohm·cm	2·10 ¹⁵	2·10 ¹⁵	2·10 ¹⁵
Dielectric constant at 110 Hz	IEC 250	-	4.6	4.5	4.1
Dielectric loss angle at 110 Hz	IEC 250	-	0.017	0.009	0.012
Comparative tracking index (CTI)	IEC 112	V	570	600	> 400

(*) black coloured grades (**) 0.8 mm

(1) Solvay method (pressure = 750 bar; specimens 40x20xw mm; w between 2 and 4 mm)

This is not an exhaustive list. Other grades developed for special applications or particular markets are available on request

Properties	Stand.	Units	Other standard grades					
(on dry as moulded products, natural colour)			IXEF 1002	IXEF 1025 (*)	IXEF 1501	IXEF 2030 (*)	IXEF 2530 (*)	IXEF 2057 (*)
GF: glass fibres MF: mineral fillers FR: flame retardant			30% GF	50% GF UV Stab.	30% GF FR	GF + MF	GF + MF FR	MF
Physical properties								
Density	ISO 1183	g/cm ³	1.43	1.61	1.54	1.74	1.85	1.61
Filler content	-	%	30	46	30	55	55	45
Water absorption (24h; 23 °C)	ISO 62	%	0.20	0.16	0.19	0.19	0.10	0.18
Moisture regain at equilibrium (65 % R.H.)	(Solvay)	%	1.9	1.5	1.8	1.6	1.1	1.8
Mould shrinkage (flow direction)	(1)	%	0.1-0.4	0.1-0.3	0.1-0.4	0.1-0.4	0.1-0.3	0.4-0.5
Mechanical properties (at 23 °C)								
Tensile								
	ISO 527							
Tensile strength at break		MPa	190	230	185	140	150	100
Modulus		GPa	11.5	17	13	21.5	20	12
Elongation at break		%	2.0	1.9	2.3	1.2	1.2	1.6
Flexion								
	ISO 178							
Flexural strength		MPa	280	310	275	220	220	170
Modulus		GPa	11	16.5	11.5	19	20	11.5
IZOD impact strength								
	ISO 180							
Notched specimen		J/m	70	95	60	50	55	35
Unnotched specimen		J/m	460	700	450	260	290	300
Thermal properties and flame resistance								
HDT/A	ISO 75	°C	230	230	230	220	205	150
Coefficient of linear expansion at 23 °C	ISO 11359	10 ⁻⁵ ·K ⁻¹	1.8	1.5	1.8	1.8	2.2	3
Thermal conductivity	ISO 8302	W/m·K	0.3	0.4	0.3	0.5	0.3	0.5
Fire classification according to UL 94	-	(1.6 mm)	HB	HB	V-0	HB	V-0 (**)	HB
Limiting oxygen index (LOI)	ISO 4589	%	25	25	31.5	26	38.5	-
Electrical properties								
Dielectric strength	IEC 243	kV/mm	30	-	31	34.7	22.7	-
Volume resistivity	IEC 93/167	Ohm·cm	2·10 ¹⁵	-	2·10 ¹⁵	2·10 ¹⁵	2.5·10 ¹⁵	-
Dielectric constant at 110 Hz	IEC 250	-	3.9	-	3.8	4.8	5.3	-
Dielectric loss angle at 110 Hz	IEC 250	-	0.010	-	0.010	0.025	0.023	-
Comparative tracking index (CTI)	IEC 112	V	> 400	-	> 250	600	475	-

(*) black coloured grades (**) 0.8 mm

(1) Solvay method (pressure = 750 bar; specimens 40x20xw mm; w between 2 and 4 mm)

This is not an exhaustive list. Other grades developed for special applications or particular markets are available on request



Recommendations for easy processing

The following table summarizes the processing parameters recommended for IXEF compounds.

Temperatures	
Cylinder temperature (°C)	
• Feed zone	250 - 280
• Compression zone	250 - 280
• Homogenisation zone	250 - 280
• Nozzle	260 - 290
• Hot runners (when used)	250 - 260
Temperature of the melt (measured on purged material) (°C)	
• Standard grades (eg. IXEF 1022, 2030)	280
• Flame retardant grades (eg. IXEF 1521, 2530)	< 270
Mould temperature (°C)	120 - 140
Plasticising	
• Peripheral screw speed (m/min)	3 - 10
• Hydraulic back pressure (bar)	0 - 10
Injection	
• Injection speed	High
• Material injection pressure (bar)	500 - 1500
Holding and Cooling	
• Material holding pressure (bar)	300 - 1500
• Holding time* (s)	3 w **
• Cooling time*, including holding time (s)	2.5 w ² ***

* indicative

**w = wall thickness in mm

***w = wall thickness in mm, w ≥ 2mm

It is essential that the mould temperature be maintained between 120 and 140 °C to achieve maximum crystallinity during moulding.

An item moulded at too low a mould temperature will absorb more water and risk distortion by post-crystallisation after moulding, poor surface appearance and a higher tendency to creep.



Readily available technical support

SOLVAY technical services are at your disposal to help you bring projects to fruition:

- help with the design of parts and tooling;
- stress and flow calculations;
- advice and practical help with moulding.

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