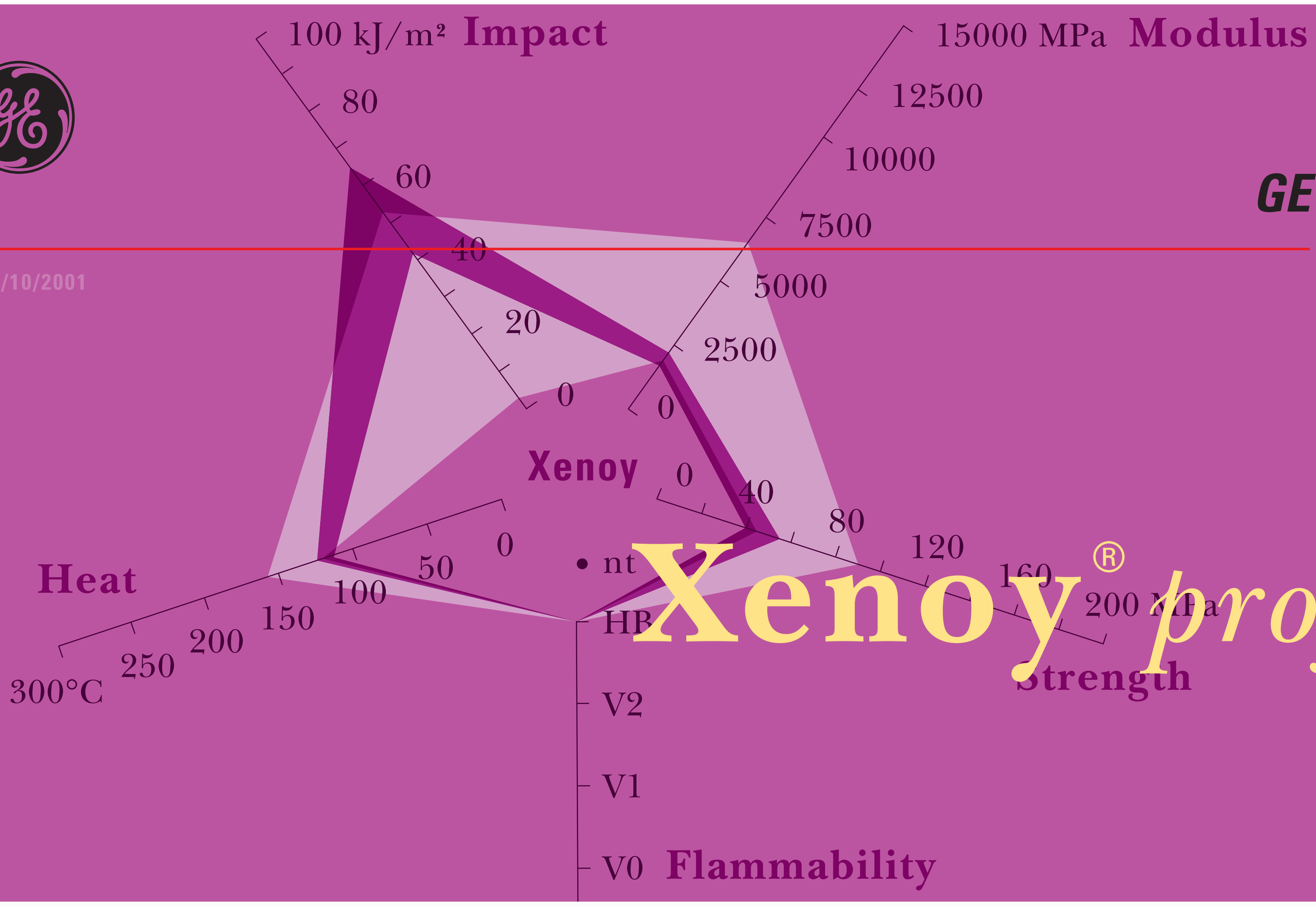
GE Plastics

EN/10/2001



Xenoy® *profile*

overview

CLICK TO CONTINUE

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make sure the magnification is always set to ‘**Fit Width**’.

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use the **Column Select Tool** to copy text to other applications.

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1 Introduction Xenoy® Thermoplastic Alloys

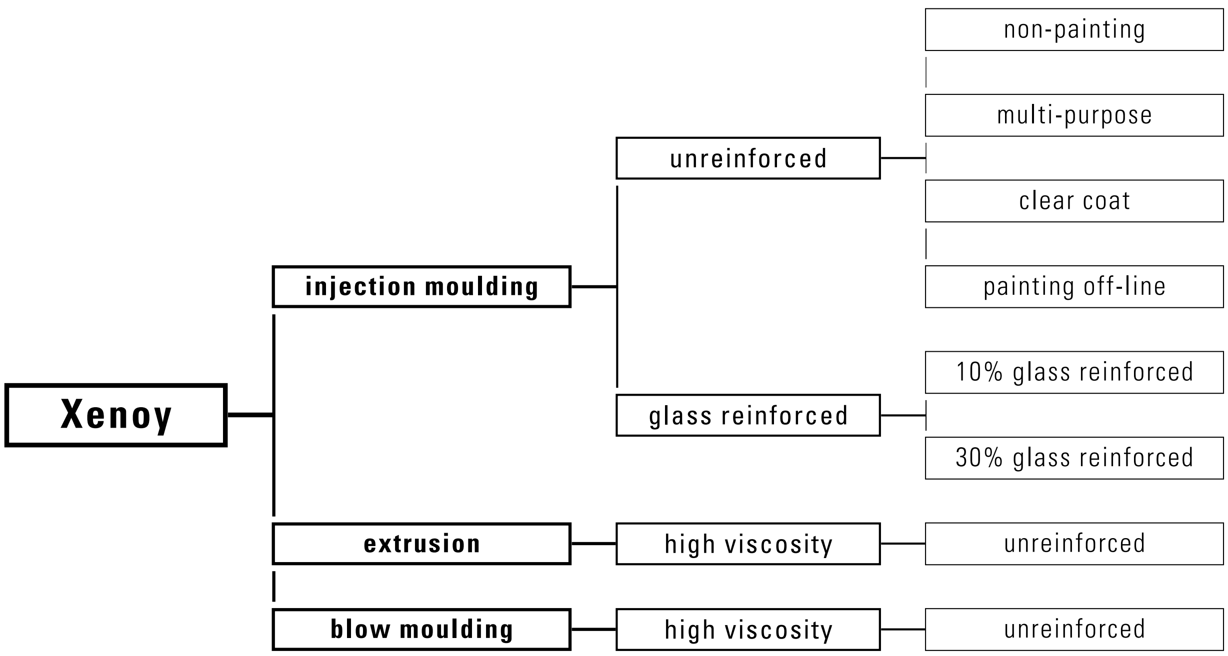
PC+PBT PC+PET

Characteristics

Xenoy resins offer an outstanding combination of mechanical strength, chemical resistance and dimensional stability. Originally developed for the automotive industry, Xenoy resin was designed to provide both resistance to petrol and oils, and a high level of impact strength at temperatures as low as -40°C. Xenoy resins are also proving an ideal material for other applications, such as lawn mowers, outdoor signs, exterior enclosures and hand-held power tools. Available only in opaque colours.

Chemical and Environmental Resistance

Xenoy resins are based on a technology that blends crystalline and amorphous resins in order to achieve specific desired properties and performance. The degree of chemical resistance is directly related to the relative percentage of crystallinity in the particular grade. In general, the higher the percentage of crystallinity, the higher is the grade's chemical resistance. Resistance to petrol may vary from grade to grade. Xenoy resins generally are not hydrolytically stable. Where an application requires contact with solvents, prototypes or suitably stressed samples should be tested under actual operating conditions.



2 Markets

Automotive

Appliances

Telecommunications

Electrical

2.1 Automotive

Originally developed for exterior automotive body parts, Xenoy thermoplastic alloy is today widely used for a variety of applications including bumper fascias, bumper beams, wheel trim, spoilers, tail-gate outer panels, exterior trim and door handles.

Key features of the material's high performance property profile include:

- Excellent impact resistance and mechanical strength, even at temperatures as low as -40°C
- Dimensional stability
- Light weight
- Resistance to gasoline and oils
- UV resistance
- Quality surface finish straight from the mould
- Injection moulding, gas injection moulding, extrusion and blow moulding grades

In addition to these inherent benefits, specific grades of Xenoy resin offer superior processibility and modulus. This enables the production of parts with very thin wall sections, saving material, processing time and money.

Xenoy resin has the UV resistance to make it suitable for unpainted use. In applications where painting is a requirement, tailor-made grades have been developed to enhance paint adhesion. Xenoy resin parts can be very cost-effectively painted off-line using primerless waterborne industrialized paint systems which give an excellent quality surface finish.

For large and highly demanding automotive body panels newly developed Xenoy products offer a unique combination of improved heat resistance, a low coefficient of thermal expansion (CTE), high flow and excellent impact. Special grades of 'molded in color' Xenoy are available for large automotive bodypanels. These Xenoy products eliminate the need to paint bodypanels in different colors. GE Plastics supplies these Xenoy grades with an exceptionally good 'lot to lot' color consistency. A simple clear coat is sufficient to ensure the 'molded in color' Xenoy parts meet the demanding automotive weathering and scratch resistance tests.

2.2 Appliances

Lawn Mowers

Xenoy resin is a well-established material for high quality lawn mower chassis production. Injection moulded in the manufacturer's house colour, Xenoy resin lawn mower decks eliminate the need for secondary operations including painting, providing a showroom quality finish straight from the mould. The mechanical, chemical and heat resistance properties of Xenoy resin furthermore ensure that this finish is long-lasting.

Power Tools

The power tool market is another area where excellent aesthetics, inherent toughness and chemical resistance make Xenoy resin the natural choice. Chain saw housings and power drill housings are particularly good examples of the demanding applications for which Xenoy grades have an ideal fit.

2.3 Telecommunications

Outdoor Enclosures

Xenoy polymer blend is an excellent material choice for unpainted, outdoor-weatherable telecommunications enclosures, providing a combination of UV stability, chemical resistance and impact strength at sub-zero temperatures. This high performance profile is complemented by design flexibility, good aesthetics and economical manufacturing, particularly when compared with traditionally used materials.

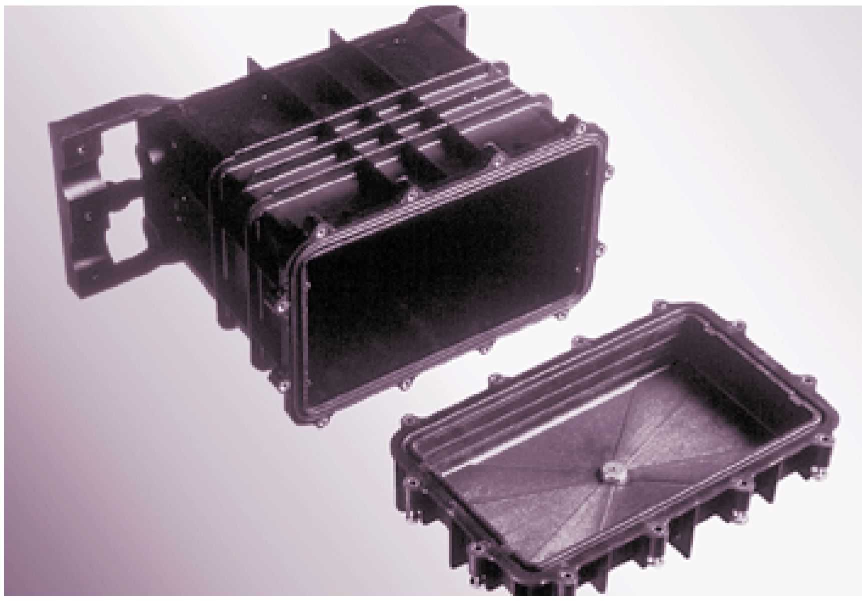
2.4 Electrical

Enclosures

Xenoy resins offer exceptional dimensional stability in large mouldings such as electrical enclosures. For applications such as housings for fuse boxes and cable distribution frames, Xenoy resin meets the stringent requirements for high impact resistance combined with good tracking resistance and constant electrical properties in humid conditions.

Wiring Devices

For non-current carrying parts that require high impact and superior UV stability, Xenoy resin is ideally suited.



3 Product Selection

3.1 Product description

3.1.1 Automotive grades

- All unreinforced
- All injection moulding
- Grades for exterior and interior automotive applications
- Non-painting and painting off-line grades
- Grades for use with solvent-based, water-based and PU-based paints available
- UV stabilized, mould release, low plate-out and chemical resistant grades
- Grades with high impact values at room temperature and/or sub-zero temperatures available

3.1.2 General purpose grades

- Unreinforced and glass reinforced grades
- All injection moulding
- UV stabilized, high flow, high heat, low warpage and chemical resistant grades available
- Some grades gas injection moulding

3.1.3 Extrusion and Blow moulding grades

- All unreinforced
- Multi-purpose
- High viscosity
- UV stabilized
- High impact values at sub-zero temperatures

P S C W

3.2 Selection tree

click on a section to jump to the related tree

Xenoy

- **injection moulding**
  - unreinforced | glass reinforced
- **extrusion**
  - high viscosity
- **blow moulding**
  - high viscosity

GRADE Heat • Impact / Modulus • Flow

Grade:	All Xenoy grades are unreinforced, except for 10% glass reinforced grade 1760T and 30% glass reinforced grades 6370 and 6380U
Heat:	Vicat B50 in °C (ISO 306)
Impact:	Izod Notched in kJ/m² at 23°C (-30°C) (ISO 180/1A)
Modulus:	Flexural in MPa (ISO 178)
Flow:	MVR in cm³/10min at 250°C/5.00kg (ISO 1133)
Flow*:	MVR at 265°C/1.20kg
Flow**:	MVR at 265°C/2.16kg

P S C W

unreinforced

Application	Requirement	Property	Grade	Properties
non-painting	UV stability	*mould release*	**CL100**	125°C • 46 (21) kJ/m² 2200 MPa • 13 cm³/10min
non-painting	UV stability	*low plate-out*	**CL100B**	125°C • 46 (21) kJ/m² 2200 MPa • 14 cm³/10min
multi-purpose	high heat high gloss		**XL1339**	130°C • 40 (25) kJ/m² 2200 MPa • 4 cm³/10min*
multi-purpose	high heat high gloss	*UV stability*	**XL1339U**	130°C • 40 (25) kJ/m² 2200 MPa • 4 cm³/10min*
multi-purpose			**5730**	121°C • 40 (25) kJ/m² 2000 MPa • 13 cm³/10min
multi-purpose	UV stability/ chemical resistance	*high flow*	**XL1562**	125°C • 45 (18) kJ/m² 2000 MPa • 27 cm³/10min

see charts on page 10

Xenoy › injection moulding | extrusion | blow moulding
unreinforced | glass reinforced

unreinforced

Application	Paint system	Requirement	Grade	Properties
clear coat	moulded in colour	*high flow high impact*	**XD1622**	115°C • 40 (15) kJ/m² 2100 MPa • 30 cm³/10min
painting off-line	solvent-based paints	*impact at -30°C*	**CL101**	121°C • 50 (30) kJ/m² 2000 MPa • 13 cm³/10min
painting off-line	solvent-based paints		**CL200**	119°C • 54 (18) kJ/m² 1700 MPa • 10 cm³/10min
painting off-line	water-based paints		**CL101M**	121°C • 45 (22) kJ/m² 2000 MPa • 14 cm³/10min
painting off-line	water-based paints	*low CTE*	**XD1647**	125°C • 12 (8) kJ/m² 3450 MPa • 13 cm³/10min
painting off-line	primerless solvent- or water-based paints	*high flow thin-wall parts*	**CL300**	116°C • 42 (20) kJ/m² 2100 MPa • 30 cm³/10min
painting off-line	primerless solvent- or water-based paints	high heat	**XD859**	131°C • 40 (20) kJ/m² 2200 MPa • 10 cm³/10min

see charts on page 10

Xenoy › injection moulding | e

unreinforced | **glass reinforced**

glass reinforced	10% glass		*gas assisted moulding*	**1760T**	135°C • 3 (3) kJ/m² 4000 MPa • 14 cm³/10min
	30% glass	high heat	*low warpage/ good ductility*	**6370**	148°C • 10 (6) kJ/m² 7750 MPa • 12 cm³/10min
		UV stability	*surface gloss*	**6380U**	180°C • 10 (7) kJ/m² 6500 MPa • 9 cm³/10min*

see charts on page 10

P S C W

Xenoy › injection moulding | **extrusion** | blow moulding

high viscosity

high viscosity	UV stability	*impact at -30°C*	**CL400**	123°C • 50 (40) kJ/m² 2100 MPa • 8 cm³/10min

see charts on page 10

P S C W

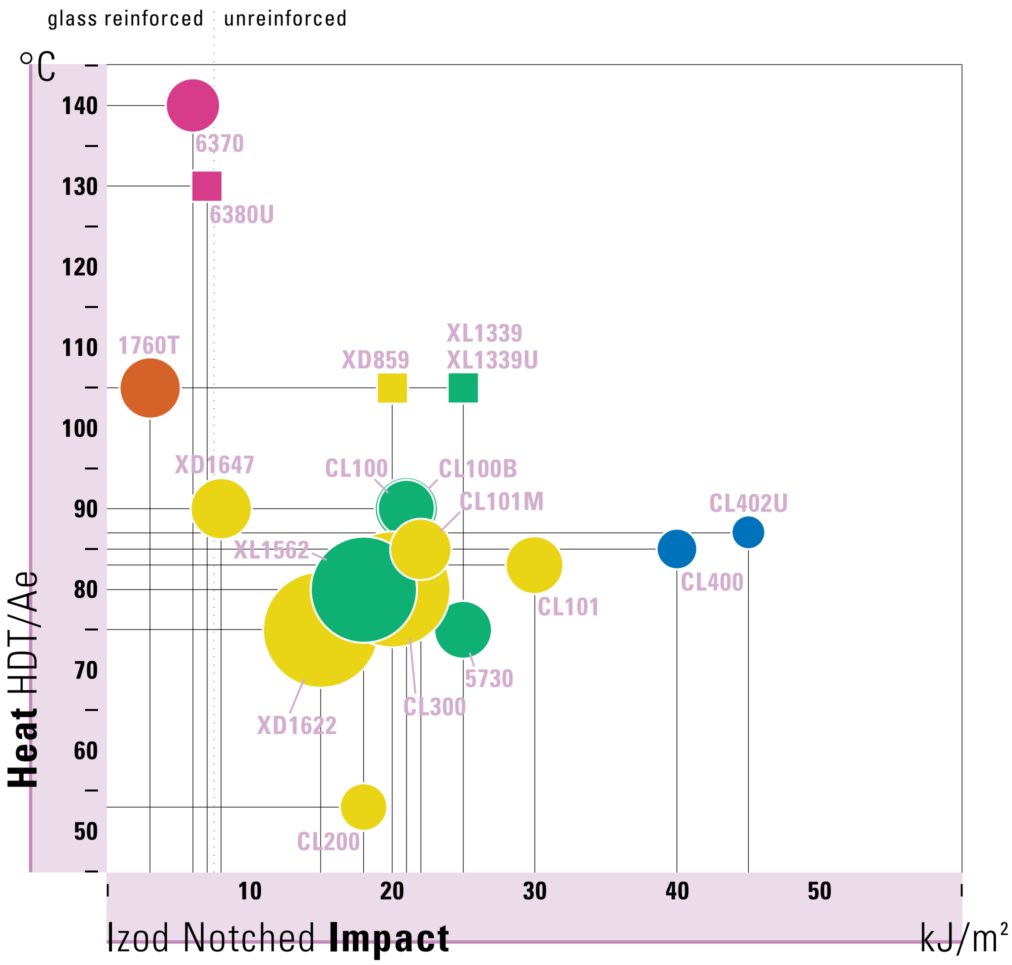
Xenoy › injection moulding | extrusion | **blow moulding**

high viscosity

high viscosity	UV stability	*impact at -30°C*	**CL402U**	123°C • 53 (45) kJ/m² 1900 MPa • 6 cm³/10min

see charts on page 10

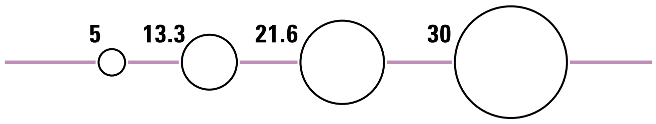
3.3 Heat - Impact (-30°C) - Flow comparison



Xenoy

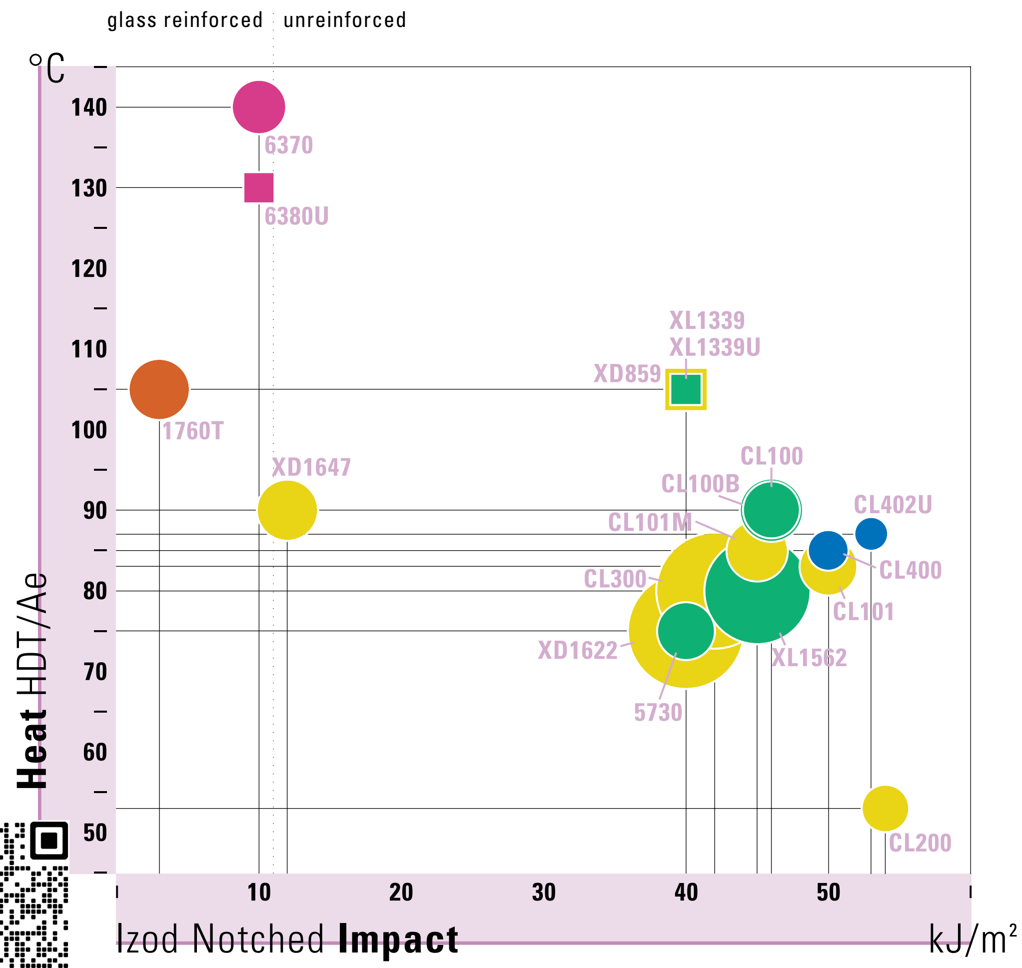
- unreinforced › non-painting, multi-purpose
- unreinforced › clear coat, painting off-line
- glass reinforced › 10% glass
- glass reinforced › 30% glass
- extrusion, blow moulding

Flow Melt Volume Rate* cm³/10 min



* *at 250°C/5.00 kg – size of squares has no meaning*

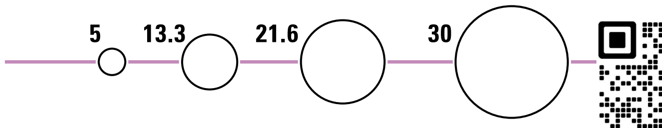
3.4 Heat - Impact (23°C) - Flow comparison



Xenoy

- unreinforced › non-painting, multi-purpose
- unreinforced › clear coat, painting off-line
- glass reinforced › 10% glass
- glass reinforced › 30% glass
- extrusion, blow moulding

Flow Melt Volume Rate* cm³/10 min



* *at 250°C/5.00 kg – size of squares has no meaning*

3.5 Typical properties

Typical values only.
Variations within normal tolerances are possible for various colours.

Test Method: ISO / IEC* — DIN / VDE* — ASTM / other*

Test Specimen: MPTS (multi purpose test specimen) as defined in ISO 3167. Smaller test specimens may be machined from MPTS. All dimensions in mm.

Property	Condition	Test condition	Unit	ISO / IEC*	DIN / VDE*	ASTM / other*	Test Specimen	Note
Mechanical								
Tensile stress	at yield [at break]	at 50 mm/min	MPa	R527				
	at break	at 5 mm/min	MPa	R527			MPTS (150 x 10 x 4)	
Tensile strain	at yield [at break]	at 50 mm/min	%	R527				
	at break	at 5 mm/min	%	R527			MPTS	
Tensile modulus		at 1 mm/min	MPa	R527			MPTS	
Flexural stress	at yield [at break]	at 2 mm/min	MPa	178			80 x 10 x 4	
Flexural modulus		at 2 mm/min	MPa	178			80 x 10 x 4	
Hardness	Ball indentation	H 358/30	MPa	2039-1	53456		50 x 50 x 4	
	Rockwell	R, M or L	scale	2039-2		D785		
Abrasion resistance	Taber, CS-17, 1 kg	per 1000 cycles	mg			GE*		
Impact								
Izod	notched	at +23°C [-30°C]	kJ/m²	180-1A			80 x 10 x 4	
	unnotched	at +23°C [-30°C]	kJ/m²	180-1U			80 x 10 x 4	
Charpy	notched	at +23°C [-30°C]	kJ/m²	179-1eA			80 x 10 x 4	
	unnotched	at +23°C [-30°C]	kJ/m²	179-1eU			80 x 10 x 4	
Thermal								
Vicat A/50	10N (method A)	at 50°C/h	°C	306				
B/50	50N (method B)	at 50°C/h	°C	306			10 x 10 x 4	
B/120	50N (method B)	at 120°C/h	°C	306	53460			
HDT/Ae	edgewise, span 100 mm	at 1.80 MPa	°C	75/Ae			120 x 10 x 4	
/Be		at 0.45 MPa	°C	75/Be			120 x 10 x 4	
Ball pressure	passes at °C		°C	335-1*				
Relative Temperature Index	RTI	Electrical properties	°C			UL746B*		1)
		Mechanical properties with Impact	°C			UL746B*		
		Mechanical properties without Impact	°C			UL746B*		
Thermal conductivity			W/m°C		52612	C177		
Coefficient of Thermal Expansion	CTE	in flow direction	1/°C		53752	D696		2)
		in ⊥ flow direction	1/°C		53752	D696	10 x 10 x 4	
Flammability								
UL94 rating	flame class rating	at mm thickness	class at mm			UL94*	125 x 13, thickness as noted	1) 3)
Limited Oxygen Index	LOI		%	4589		D2863	150/80 x 10 x 4	3)
Glow wire	passed at °C	at mm thickness	°C at mm	695-2-1*				
Electrical								
Dielectric strength	in oil	at 0.8 mm / 1.6 mm / 3.2 mm	kV/mm	243*	0303T2*	D149		
Surface resistivity			Ohm	93*	0303T3*	D257		
Volume resistivity			Ohm·cm	93*	0303T3*	D257		
Relative permittivity	or Dielectric constant	at 50 Hz	—	250*	0303T4*	D150		
		at 1 MHz	—	250*	0303T4*	D150		
Dissipation factor	or Loss tangent	at 50 Hz	—	250*	0303T4*	D150		
		at 1 MHz	—	250*	0303T4*	D150		
Comparative Tracking Index	CTI (CTI- M)	50 drops [M: wetting agent]	V	112/3rd*	0303T1*	D3638		4)
Physical								
Density			g/cm³	1183	53479	D792		
Moisture absorption	at saturation	at 23°C, 50% R.H.	%	62	53495	D570		
Water absorption	at saturation	at 23°C, in water	%	62	53495	D570		
Mould shrinkage		in flow direction	%			D955		5)
		in ⊥ flow direction	%			D955		
Rheological								
Melt Volume Rate	MVR	at xxx°C / y.yy kg	cm³/10 min	1133	53735		granules	

1) *as recognized on UL yellow cards; UL recognition may differ with colour*
2) *values may differ with glass fibre orientation*
3) *these ratings are not intended to reflect hazards presented by this or other material under actual fire conditions*
4) *values may differ with pigmented materials*
5) *only typical data for material selection purposes - not to be used for part/tool design; for glass reinforced grades: values may differ with glass fibre orientation*

: not broken · – : not relevant · n.t.: not tested

injection moulding — page 14
unreinforced — page 13

Typical values only.
Not to be used for
specification purposes.

		non-painting: mould release	non-painting: low plate-out	multi-purpose	multi-purpose: UV stability	multi-purpose	multi-purpose: high flow
Mechanical	**Unit**	**CL100**	**CL100B**	**XL1339**	**XL1339U**	**5730**	**XL1562**
Tens. stress y (b) 50	MPa	55 (n.t.)	55 (n.t.)	55 (40)	55 (40)	50 (45)	54 (42)
b 5	MPa	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
Tens. strain y (b) 50	%	5 (>75)	5 (>75)	5 (70)	5 (70)	5 (>75)	5 (>75)
b 5	%	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
Tens. modulus	MPa	2200	2200	2300	2300	2100	2100
Flex. stress y (b)	MPa	85 (n.t.)	85 (n.t.)	80 (n.t.)	80 (n.t.)	75 (n.t.)	74 (n.t.)
Flex. modulus	MPa	2200	2200	2200	2200	2000	2000
Hardness Ball	MPa	96	96	95	95	82	100
Rockwell	scale	L94	n.t.	n.t.	n.t.	L89	n.t.
Abrasion Taber	mg	30	30	20	20	30	30
Impact							
Izod notch. 23° (-30°) C	kJ/m²	46 (21)	46 (21)	40 (25)	40 (25)	40 (25)	45 (18)
unnotch. 23° (-30°) C	kJ/m²	NB (NB)	NB (NB)	NB (NB)	NB (NB)	NB (NB)	NB (NB)
Charpy notch. 23° (-30°) C	kJ/m²	50 (35)	50 (35)	45 (35)	45 (35)	56 (29)	50 (20)
unnotch. 23° (-30°) C	kJ/m²	NB (NB)	NB (NB)	NB (NB)	NB (NB)	NB (NB)	NB (NB)
Thermal							
Vicat A/50	°C	150	150	140	140	150	190
B/50	°C	125	125	130	130	121	125
B/120	°C	127	129	135	135	125	128
HDT/Ae 1.80 MPa	°C	90	90	105	105	75	80
/Be 0.45 Mpa	°C	110	110	125	125	105	110
Ball Pressure	°C	>75	>75	>125	>125	>75	>125
RTI Electrical	°C	75	n.t.	n.t.	n.t.	n.t.	n.t.
Mech. with Impact	°C	75	n.t.	n.t.	n.t.	n.t.	n.t.
without Impact	°C	75	n.t.	n.t.	n.t.	n.t.	n.t.
Thermal conductivity	W/m°C	0.18	0.18	0.18	0.18	0.18	0.18
CTE flow	1/°C	$9 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$7.5 \cdot 10^{-5}$	$7.5 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$11 \cdot 10^{-5}$
⊥flow	1/°C	$9 \cdot 10^{-5}$	$10 \cdot 10^{-5}$	$8.0 \cdot 10^{-5}$	$8.0 \cdot 10^{-5}$	$10 \cdot 10^{-5}$	$11 \cdot 10^{-5}$
Flammability							
UL94	class at mm	HB/1.50	HB/1.50*)	HB/1.50*)	HB/1.50*)	HB/1.50*)	HB/1.50*)
LOI	%	<21	<21	21	21	<21	<21
Glow wire	°C at mm	n.t.	n.t.	750/2.7	750/2.7	750/3.2	750/3.2
Electrical							
Diel. str. oil 0.8/1.6/3.2 mm	kV/mm	n.t./n.t./17	n.t./n.t./17	n.t./n.t./17	n.t./n.t./17	33/30/18	32/25/17
Surface resistivity	Ohm	$>10^{15}$	$>10^{15}$	$>10^{15}$	$>10^{15}$	$>10^{15}$	$>10^{15}$
Volume resistivity	Ohm·cm	10^{14}	10^{14}	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$
Rel. permitt. 50 Hz	—	3.3	3.3	3.3	3.3	2.9	2.8
1 MHz	—	3.3	3.3	3.1	3.1	2.8	2.9
Dissipation f. 50 Hz	—	0.002	0.002	0.002	0.002	0.002	0.002
1 MHz	—	0.020	0.020	0.020	0.020	0.020	0.020
CTI (CTI-M)	V	n.t. (n.t.)	n.t. (n.t.)	600 (n.t.)	600 (n.t.)	n.t. (n.t.)	n.t. (n.t.)
Physical							
Density	g/cm³	1.22	1.22	1.22	1.22	1.21	1.23
Moisture abs. 23°C	%	0.15	0.15	0.20	0.20	0.15	0.15
Water abs. 23°C	%	0.50	0.50	0.70	0.70	0.50	0.50
Mould shrink. flow	%	0.7-1.0	0.7-1.0	0.5-0.8	0.5-0.8	0.7-1.1	0.8-1.1
⊥flow	%	0.7-1.0	0.7-1.0	0.5-0.8	0.5-0.8	n.t.	0.8-1.1
Rheological							
MVR	cm³/10 min	13 3)	14 3)	4 4)	4 4)	13 3)	27 3)
		CL100	**CL100B**	**XL1339**	**XL1339U**	**5730**	**XL1562**

*) *UL94 in-house tested*
MVR at 250°C/1.20 kg
MVR at 250°C/2.16 kg
3) *MVR at 250°C/5.00 kg*
4) *MVR at 265°C/1.20 kg*
5) *MVR at 265°C/2.16 kg*

: not broken · – : not relevant · n.t.: not tested

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Typical values only.
Not to be used for
specification purposes.

		clear coat	painting off-line					
		high flow high impact	impact at -30°C			low CTE	high flow thin-wall parts	
Mechanical	**Unit**	**XD1622**	**CL101**	**CL200**	**CL101M**	**XD1647**	**CL300**	**XD859**
Tens. stress y (b) 50	MPa	55 (40)	50 (n.t.)	40 (n.t.)	50 (n.t.)	55 (45)	55 (50)	55 (n.t.)
b 5	MPa	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
Tens. strain y (b) 50	%	4.5 (>80)	5 (>75)	4 (>75)	5 (>75)	n.t. (10)	5 (>150)	5 (n.t.)
b 5	%	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
Tens. modulus	MPa	2200	2100	1900	2100	3500	2200	2300
Flex. stress y (b)	MPa	75 (n.t.)	80 (n.t.)	55 (n.t.)	80 (n.t.)	85 (n.t.)	85 (n.t.)	80 (n.t.)
Flex. modulus	MPa	2100	2000	1700	2000	3450	2100	2200
Hardness Ball	MPa	95	82	109	82	n.t.	100	95
Rockwell	scale	n.t.	L89	L80, R108	n.t.	n.t.	n.t.	n.t.
Abrasion Taber	mg	30	30	20	30	n.t.	30	20
Impact								
Izod notch. 23° (-30°) C	kJ/m²	40 (15)	50 (30)	54 (18)	45 (22)	12 (8)	42 (20)	40 (20)
unnotch. 23° (-30°) C	kJ/m²	NB (NB)	NB (NB)	NB (NB)	NB (NB)	NB (NB)	NB (NB)	NB (n.t.)
Charpy notch. 23° (-30°) C	kJ/m²	45 (20)	55 (40)	60 (55)	55 (40)	15 (9)	40 (20)	40 (n.t.)
unnotch. 23° (-30°) C	kJ/m²	NB (NB)	NB (NB)	NB (NB)	NB (NB)	n.t. (n.t.)	NB (NB)	n.t. (n.t.)
Thermal								
Vicat A/50	°C	n.t.	155	200	155	n.t.	n.t.	n.t.
B/50	°C	115	121	119	121	125	116	131
B/120	°C	120	125	122	123	128	120	135
HDT/Ae 1.80 MPa	°C	75	83	53	85	90	80	105
/Be 0.45 Mpa	°C	95	105	90	105	109	105	125
Ball Pressure	°C	>75	>75	n.t.	>75	n.t.	>75	>125
RTI Electrical	°C	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
Mech. with Impact	°C	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
without Impact	°C	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
Thermal conductivity	W/m°C	0.18	0.18	0.19	0.18	n.t.	0.18	0.18
CTE flow	1/°C	$9.5 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$11 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	$6.5 \cdot 10^{-5}$	$10.5 \cdot 10^{-5}$	$7.5 \cdot 10^{-5}$
⊥flow	1/°C	n.t.	$9.5 \cdot 10^{-5}$	$11 \cdot 10^{-5}$	$9 \cdot 10^{-5}$	n.t.	$11.5 \cdot 10^{-5}$	$8.0 \cdot 10^{-5}$
Flammability								
UL94	class at mm	HB/1.50*)	HB/1.50*)	HB/1.50*)	HB/1.50*)	n.t.	HB/1.50*)	HB/1.50*)
LOI	%	<21	<21	<21	<21	n.t.	<21	<21
Glow wire	°C at mm	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.	n.t.
Electrical								
Diel. str. oil 0.8/1.6/3.2 mm	kV/mm	n.t./n.t./17	n.t./n.t./17	n.t./14/17	n.t./n.t./17	n.t./n.t./n.t.	n.t./n.t./16	n.t./n.t./17
Surface resistivity	Ohm	$>10^{15}$	$>10^{15}$	$>10^{15}$	$>10^{15}$	n.t.	$>10^{15}$	$>10^{15}$
Volume resistivity	Ohm·cm	$>10^{14}$	10^{14}	$>10^{14}$	$>10^{14}$	n.t.	$>10^{14}$	$>10^{14}$
Rel. permitt. 50 Hz	—	3.3	3.3	3.3	3.3	n.t.	3.3	3.3
1 MHz	—	3.1	3.3	3.1	3.1	n.t.	3.1	3.1
Dissipation f. 50 Hz	—	0.002	0.002	0.002	0.002	n.t.	0.002	0.002
1 MHz	—	0.020	0.020	0.020	0.020	n.t.	0.020	0.020
CTI (CTI-M)	V	n.t. (n.t.)	n.t. (n.t.)	n.t. (n.t.)	n.t. (n.t.)	n.t. (n.t.)	n.t. (n.t.)	n.t. (n.t.)
Physical								
Density	g/cm³	1.22	1.22	1.22	1.22	n.t.	1.22	1.22
Moisture abs. 23°C	%	0.15	0.15	0.20	0.15	n.t.	0.15	0.20
Water abs. 23°C	%	0.50	0.50	0.50	0.50	n.t.	0.50	0.70
Mould shrink. flow	%	0.7-1.0	0.7-1.1	1.1-1.5	0.7-1.1	0.6-0.8	0.7-1.1	0.5-0.8
⊥flow	%	0.6-0.9	0.7-1.1	1.1-1.5	0.7-1.1	n.t.	0.7-1.1	n.t.
Rheological								
MVR	cm³/10 min	30 3)	13 3)	10 3)	14 3)	13 3)	30 3)	10 5)
		XD1622	**CL101**	**CL200**	**CL101M**	**XD1647**	**CL300**	**XD859**

*) UL94 in-house tested
MVR at 250°C/1.20 kg
MVR at 250°C/2.16 kg
3) MVR at 250°C/5.00 kg
4) MVR at 265°C/1.20 kg
5) MVR at 265°C/2.16 kg

: not broken · – : not relevant · n.t.: not tested

page 13

inj… | …n | blow moulding

reinforced | high viscosity | high viscosity

10% glass | 30% glass reinforced

gas assisted moulding | low warpage/ good ductility | surface gloss | impact at -30°C | impact at -30°C

Typical values only.
Not to be used for
specification purposes.

Mechanical	Unit	1760T	6370	6380U	CL400	CL402U
Tens. stress y (b) 50	MPa	n.t. (n.t.)	n.t. (n.t.)	n.t. (n.t.)	55 (n.t.)	45 (n.t.)
b 5	MPa	90	105	105	–	–
Tens. strain y (b) 50	%	n.t. (n.t.)	n.t. (n.t.)	n.t. (n.t.)	5 (n.t.)	4.0 (n.t.)
b 5	%	3	2.9	2.5	80	100
Tens. modulus	MPa	4500	8500	6800	2200	2000
Flex. stress y (b)	MPa	n.t. (140)	n.t. (160)	n.t. (120)	85 (–)	65 (–)
Flex. modulus	MPa	4000	7750	6500	2100	1900
Hardness Ball	MPa	105	100	115	85	85
Rockwell	scale	R113	R109	R110	n.t.	n.t.
Abrasion Taber	mg	n.t.	n.t.	n.t.	40	40
Impact						
Izod notch. 23° (-30°) C	kJ/m²	3 (3)	10 (6)	10 (7)	50 (40)	53 (45)
unnotch. 23° (-30°) C	kJ/m²	30 (30)	44 (42)	55 (55)	NB (NB)	NB (NB)
Charpy notch. 23° (-30°) C	kJ/m²	4 (3.5)	9 (10)	10 (9)	55 (50)	40 (25)
unnotch. 23° (-30°) C	kJ/m²	35 (35)	35 (22)	55 (55)	NB (NB)	NB (NB)
Thermal						
Vicat A/50	°C	n.t.	212	200	150	155
B/50	°C	135	148	180	123	123
B/120	°C	130	150	180	125	125
HDT/ Ae 1.80 MPa	°C	105	140	130	85	87
/ Be 0.45 Mpa	°C	115	205	185	110	105
Ball Pressure	°C	>75	>125	>125	>75	>75
RTI Electrical	°C	n.t.	140	n.t.	n.t.	n.t.
Mech. with Impact	°C	n.t.	130	n.t.	n.t.	n.t.
without Impact	°C	n.t.	140	n.t.	n.t.	n.t.
Thermal conductivity	W/m°C	0.19	0.19	0.19	0.19	0.19
CTE flow	1/°C	$4.0 \cdot 10^{-5}$	$2.5 \cdot 10^{-5}$	$2 \cdot 10^{-5}$	$9.5 \cdot 10^{-5}$	$10.5 \cdot 10^{-5}$
⊥flow	1/°C	$11.0 \cdot 10^{-5}$	$11 \cdot 10^{-5}$	$11 \cdot 10^{-5}$	$10.5 \cdot 10^{-5}$	$10.5 \cdot 10^{-5}$
Flammability						
UL94	class at mm	HB/1.50*)	HB/1.55 HB/3.10	HB/1.50*)	HB/1.50*)	HB/1.50*)
LOI	%	<21	<21	<21	<21	<21
Glow wire	°C at mm	n.t.	750/3.2	750/3.2	n.t.	n.t.
Electrical						
Diel. str. oil 0.8 / 1.6 / 3.2 mm	kV/mm	n.t./n.t./17	25/21/15	n.t./20/17	n.t./18/17	n.t./18/17
Surface resistivity	Ohm	$>10^{15}$	$>10^{15}$	$>10^{15}$	$>10^{15}$	$>10^{15}$
Volume resistivity	Ohm·cm	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$	$>10^{14}$
Rel. permitt. 50 Hz	—	3.3	3.7	4.2	3.3	3.3
1 MHz	—	3.1	3.5	4.0	3.3	3.3
Dissipation f. 50 Hz	—	0.002	0.002	0.002	0.002	0.002
1 MHz	—	0.020	0.020	0.020	0.020	0.020
CTI (CTI-M)	V	n.t. (n.t.)	300 (125)	300 (n.t.)	n.t. (n.t.)	n.t. (n.t.)
Physical						
Density	g/cm³	1.30	1.44	1.51	1.22	1.22
Moisture abs. 23°C	%	0.15	0.15	0.15	0.15	0.15
Water abs. 23°C	%	0.50	0.50	0.50	0.50	0.50
Mould shrink. flow	%	0.5-0.9	0.3-0.6	0.3-0.7	0.7-1.0	0.7-1.0
⊥flow	%	n.t.	0.4-0.8	0.7-1.3	0.7-1.0	n.t.
Rheological						
MVR	cm³/10 min	14 3)	12 3)	9 4)	8 3)	6 3)
		1760T	**6370**	**6380U**	**CL400**	**CL402U**

*) UL94 in-house tested
…VR at 250°C/1.20 kg
…VR at 250°C/2.16 kg
3) MVR at 250°C/5.00 kg
4) MVR at 265°C/1.20 kg
5) MVR at 265°C/2.16 kg

…: not broken · – : not relevant · n.t.: not tested

4 Properties and Design

4.1 General properties

Xenoy® thermoplastic alloys are based on a technology that blends crystalline and amorphous resins to achieve an outstanding combination of mechanical strength, chemical resistance and dimensional stability.

Design calculations for Xenoy resin are no different than for any other material. Physical properties of plastic are dependent on the expected temperature and stress levels. Once this dependency is understood, and the end-use environment has been defined for an application, standard engineering calculations can be used to accurately predict part performance.*

4.2 Mechanical properties

In general, Xenoy resin exhibits excellent mechanical properties. These are retained across a broad range of temperatures and also through time. Time and temperature will normally only result in slight decreases of the original properties. The impact resistance of Xenoy resin in particular remains fairly constant over a range of temperatures. Only at extremely low temperatures will the material become stiffer and more brittle.

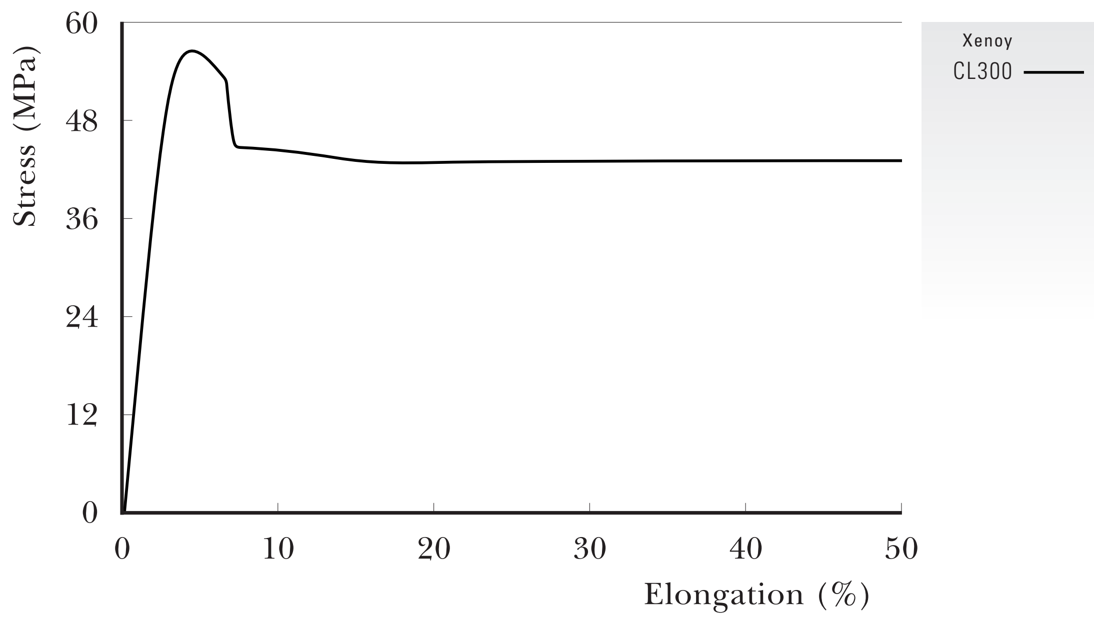
* *Data as shown in this brochure is measured on test bars. To determine actual performance, the final part must be tested before end use.*

4.2.1 Stiffness

The stiffness of a part is defined as the relationship between the load and the deflection of a part. The most important material property for stiffness is the stress/strain curve (see ■ FIGURES 1 and 2).

■ FIGURE 1

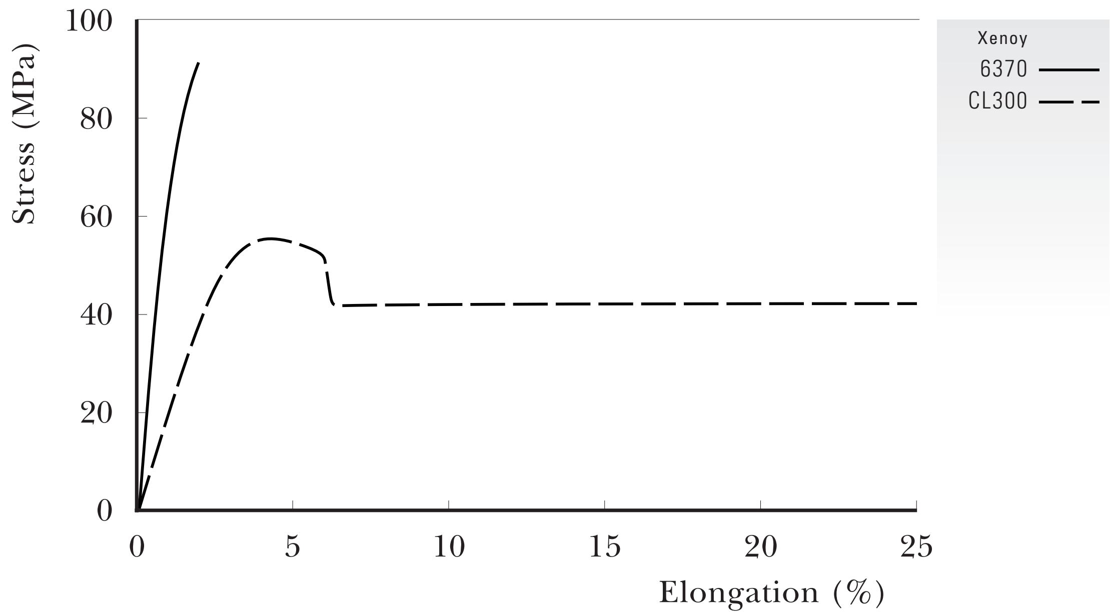
Stress-strain curve of standard Xenoy at room temperature and 0.8333%/sec strain rate



In general, the Young's modulus, which is determined from the stress/strain curve, is the best parameter to be used when comparing the stiffness of materials.

■ FIGURE 2

Stress-strain curve of filled and unfilled Xenoy at room temperature and 0.8333%/sec strain rate



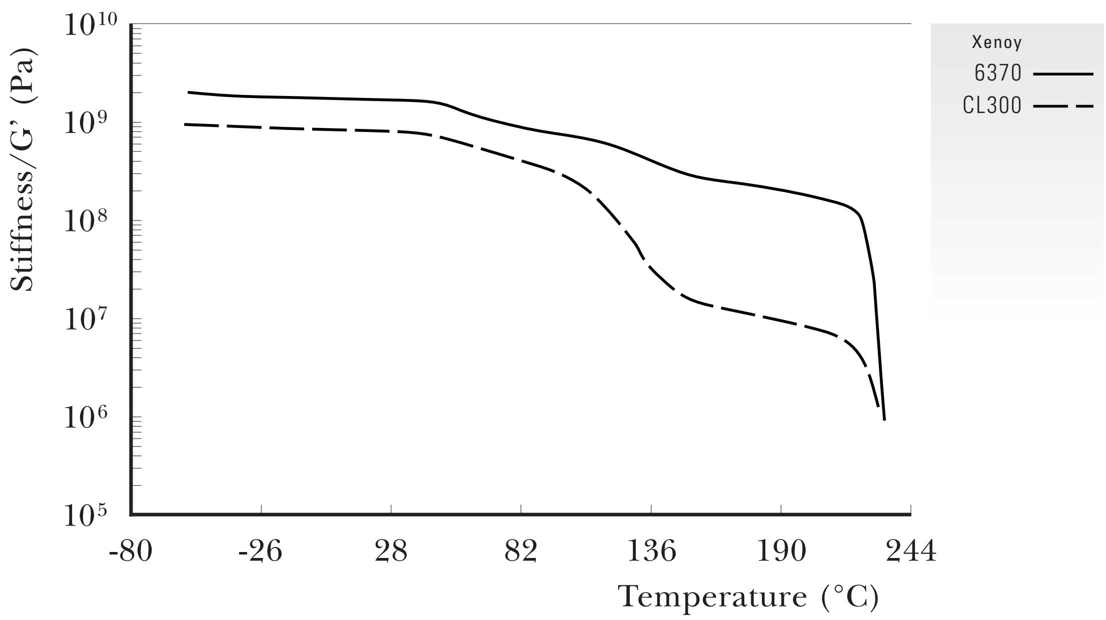
A further important consideration in the calculation of part stiffness is the temperature at which the load is applied, as can be seen in ■ FIGURE 3. The stress/strain curves of filled and unfilled Xenoy resins, like those of other thermoplastics, are strongly influenced by temperature.

4.2.2 Strength

The strength of a part is defined as the maximum load that can be applied to a part without causing part failure under given conditions. In order to be able to determine the strength of a part, failure has to be first defined. The right definition of failure depends on the application and how much deformation is allowed.

■ FIGURE 3

DMA bending curve of filled and unfilled Xenoy at 6.3 rad/sec

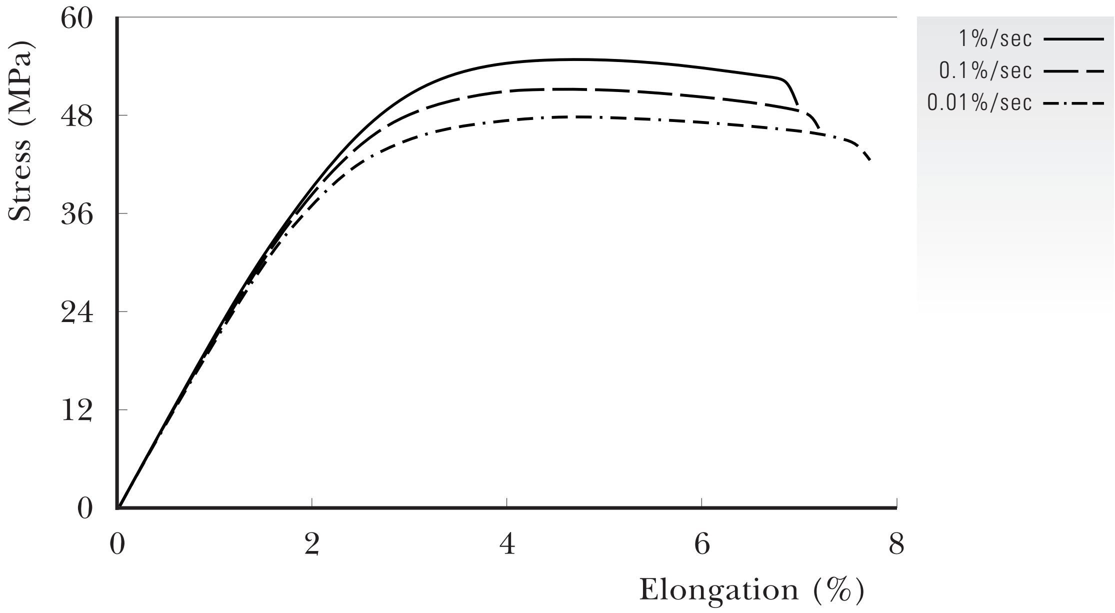


Material strength is a stress/strain re property which is inherent in the material. The tensile test provides the most useful information for engineering design. For unfilled Xenoy grades subjected to small strains, the stress increases proportionally with the strain. However, early in the test non-linearity will occur.

observation of the stress/strain curve reveals that a proportional part does not exist. With larger strains, yield will occur and the maximum stress is reached. If the strain is further increased, necking will occur. The neck will propagate through the structure until the material fails. The speed of deformation in the application is vital, as shown in FIGURE 4.

FIGURE 4

Stress-strain curve until start of necking of Xenoy CL100 at room temperature and various speeds



4.2.3 Impact strength

Impact strength can be described as the ability of a material to withstand an impulsive loading. There are several factors which determine the ability of a plastic part to absorb impact energy. In addition to the type of material these factors include:

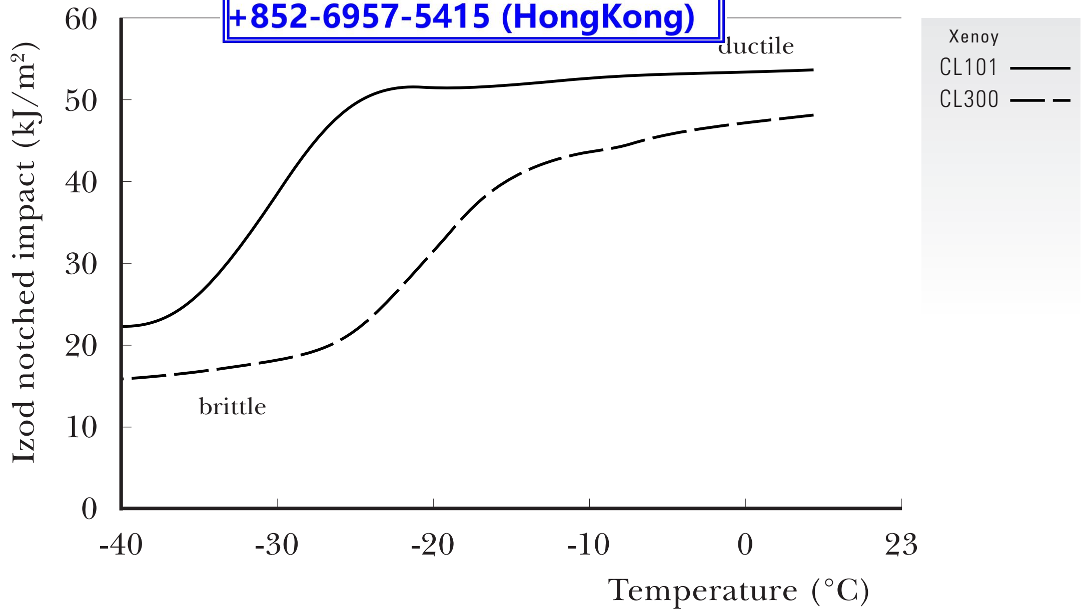
- Wall thickness
- Geometric shape and size
- Material flow
- Operating temperature and environment
- Rate of loading
- Stress state induced by loading

For ductile polymers such as Xenoy resin, the load at which yield occurs in a part is affected by the last three factors. Of even more significance to design is the fact that, under the appropriate circumstances, the impact behaviour of a ductile polymer will undergo a transition from a ductile and forgiving response to a brittle and catastrophic one. Usually this change in behaviour is described in terms of a ductile/brittle transition temperature above which the failure is more ductile by nature, and below which it is more brittle, as illustrated in FIGURE 5.

There are many methods and norms for evaluating the impact resistance of a material. The most common norms include ISO, ASTM and DIN. In general, standard samples are moulded and subjected to the impact test. Examples of the various tests include Izod, Charpy, Tensile, Falling Dart or High Speed impact. In some cases a notch is deliberately introduced into the test sample in order to concentrate stress at the point of impact. The determination of the ductile/brittle temperature as a function of the wall thickness gives some guidance in the prediction of whether a part with a given wall thickness will behave in a brittle or a ductile manner at a given temperature and test conditions.

FIGURE 5

Izod notched impact of standard Xenoy as a function of temperature



As stated earlier, the impact level, ductility or brittleness depends on the sample geometry. Changing the geometry of the test samples by reducing sample thickness will result in increased impact strength and, consequently, a reduced ductile/brittle temperature. This means that, while a higher flow Xenoy material normally exhibits inferior impact resistance, it may still behave in a ductile manner at low temperatures because it can be moulded in thin walled parts.

4.2.4 Behaviour over time

There are two types of phenomena which should be considered. Static time dependent phenomena such as creep are caused by the single, long-term loading of an application. Dynamic time dependent phenomena such as fatigue, on the other hand, are produced by the cyclic loading of an application. Both types of behaviour are heavily influenced by the operating environment and component design.

Creep behaviour

Under the action of an applied force, a viscoelastic material undergoes a time dependent increase in strain which is called creep or cold flow. Creep is defined as the increasing deformation of a geometrical shape when subjected to a constant load over a defined period of time. The creep rate for any material is dependent on temperature, load and time.

In situations where Xenoy resin parts are fixed to other parts under stress, or where stress is induced under the influence of the different thermal expansion coefficients of neighbouring materials, a thorough analysis of creep behaviour is required.

As shown in FIGURE 6, the creep of semi-crystalline materials such as Xenoy resin increases in direct proportion to the applied force. However, creep varies greatly with temperature, creep of the material becomes significantly larger at higher temperatures once the PBT in Xenoy has passed through the glass transition temperature. The curves illustrate the initial deformation due to the applied load on a specimen. Up to this point, the response is elastic in nature and therefore the specimen will fully recover after the load is removed. However, continued application of the load will result in a gradual increase in deformation. In other words it 'creeps'.

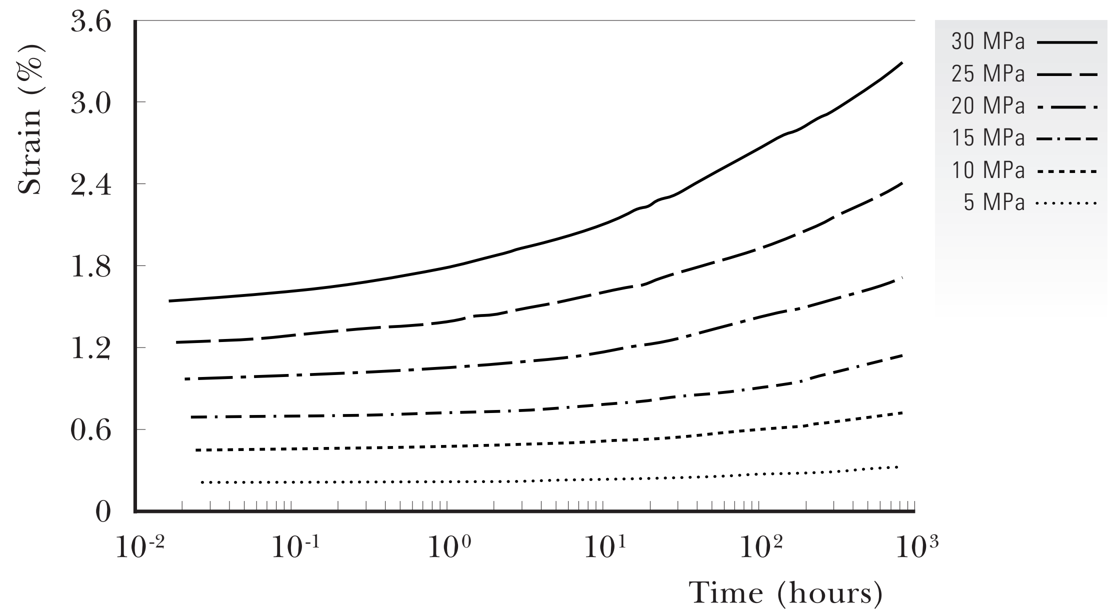


FIGURE 6

Creep performance of standard Xenoy as a function of time at room temperature and different stress levels

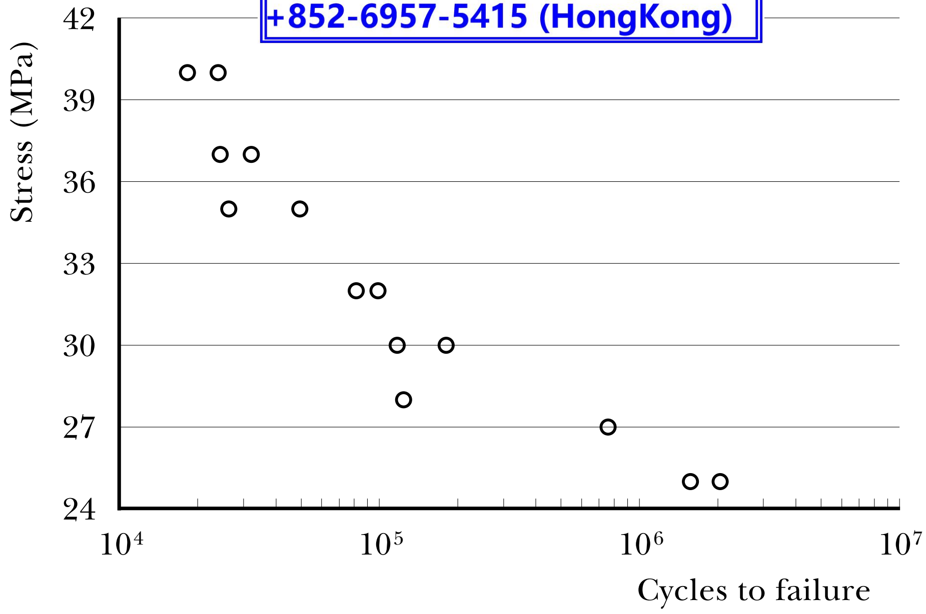
Fatigue endurance

Fatigue is an important design consideration for parts subjected to cyclic loading or vibration. Structural components subjected to vibration, components subjected to repeated impacts, reciprocating mechanical components, plastic snap-fit latches and moulded-in plastic hinges are all examples where fatigue can play an important role. Cyclic loading can result in mechanical deterioration and fracture propagation through the material, leading to ultimate failure. When parts are subjected to cyclic loading, fatigue failure can occur, often at a stress level considerably below the yield point of the material. In such applications, a uniaxial fatigue diagram could be used to predict product life. These curves can be used to determine the fatigue endurance limit, or the maximum cycle stress that a material can withstand without failure.

Fatigue tests are usually conducted under tensile conditions, though bending and torsional testing is also possible. A specimen of material is repeatedly subjected to a constant deformation at a constant frequency, and the number of cycles to failure is recorded. The procedure is then repeated over a range of deflections or applied stresses. The test data are usually presented as a plot of log stress versus log cycles; this is commonly referred to as an S-N curve, as shown in FIGURE 7.

■ FIGURE 7

Fatigue performance of Xenoy CL101 with a frequency of 5 Hz at room temperature



S-N curves obtained under laboratory conditions may be regarded as 'ideal'. However, practical conditions usually necessitate the use of a modified fatigue limit, as other factors may affect performance, including, most notably, the type of loading, the size of the component and the loading frequency.

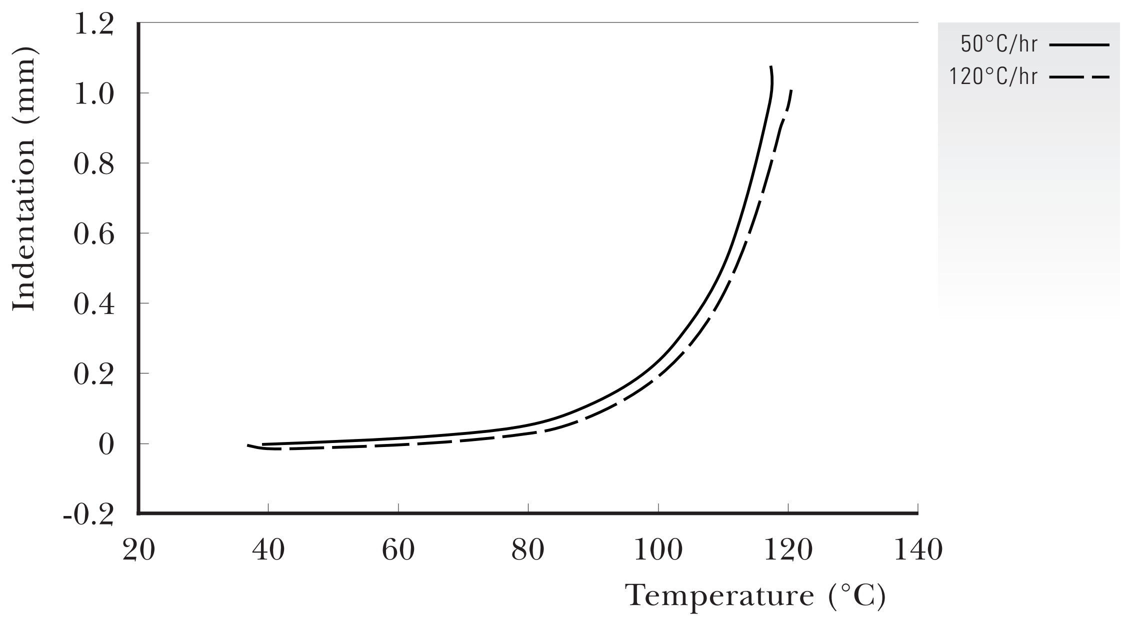
However, fatigue testing can only provide an indication as to a given material's relative ability to survive fatigue. It is therefore essential that tests are performed on actual moulded components, under actual end-use operating conditions.

4.3 Thermal properties

The Vicat softening temperature is widely used to provide an accurate measure of the thermal performance of engineering thermoplastics. The Vicat temperature of a Xenoy grade can determine whether it can be used in an application which is subjected to short-term high heat exposure. A good example of this is the paint curing process where temperatures as high as 100°C are applied (see ■ FIGURE 8).

■ FIGURE 8

Vicat indentation of Xenoy as a function of temperature

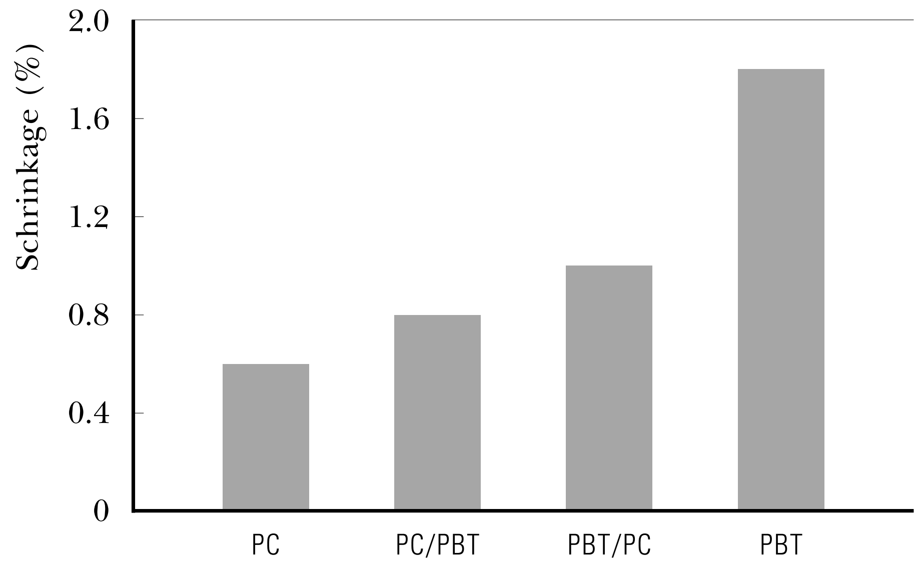


4.4 Mould shrinkage

Mould shrinkage refers to the shrinkage that a moulded part undergoes when it is removed from a mould and cooled at room temperature. Expressed as an average percentage, mould shrinkage can vary considerably depending on the mould geometry, the processing conditions and the type of resin.
For a semi-crystalline material like Xenoy resin, shrinkage depends on the ratio of amorphous and crystalline components. Typical examples are given in ■ FIGURE 9.

The packing or holding pressure phase in the injection moulding process has a significant effect on shrinkage. In general, the higher the holding pressure and the longer it is effective, the smaller the shrinkage.

■ FIGURE 9
Shrinkage of different combinations of PC and PBT



4.5 Processibility

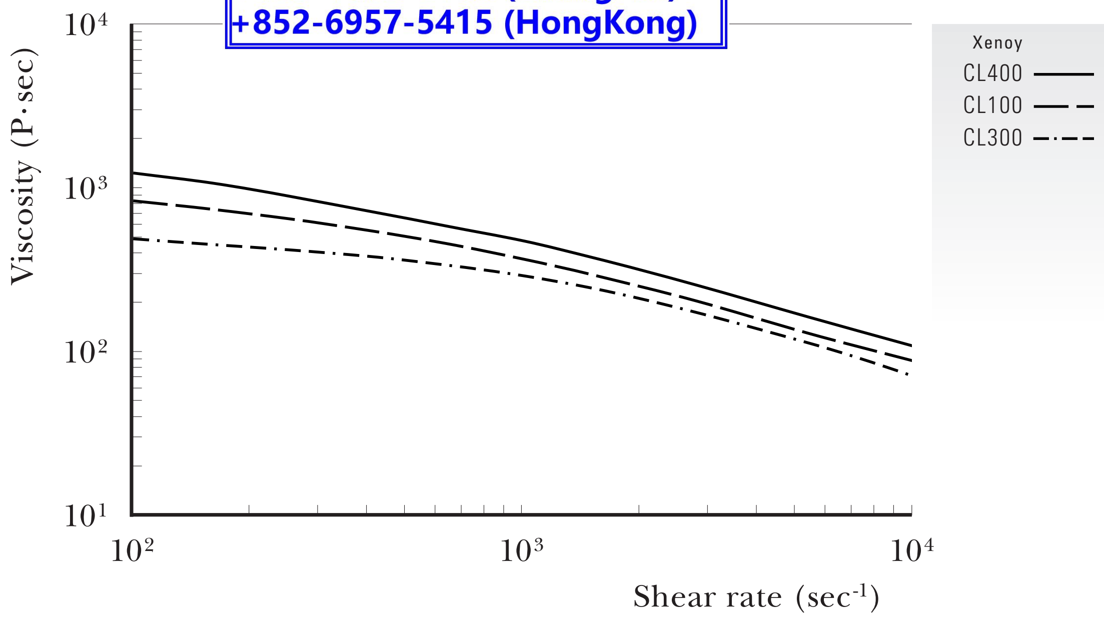
For moulding or extrusion processes, the material's flow properties are critical. These are measured based on melt flow length and melt temperature. The flow lengths of GE Plastics materials are given as calculated disk flow lengths, where the injection pressure is plotted against the radial flow length. Determination of the calculated disk flow length is important when trying to predict whether or not a part can be filled.

The melt flow length of a material is a function of viscosity, shear properties and thermal properties. Common viscosity tests include melt viscosity, MV, and melt volume rate, MVR, measurements.

In general, for a simple comparison or quality assurance check, the MVR is measured. However, as materials show significantly different MV curves, more accurate comparisons for design calculations should be made according to the MV curves rather than on the MVR. MV tests are carried out over a large range of shear rates. ■ FIGURE 10 shows the MV curves of various Xenoy grades.

■ FIGURE 10

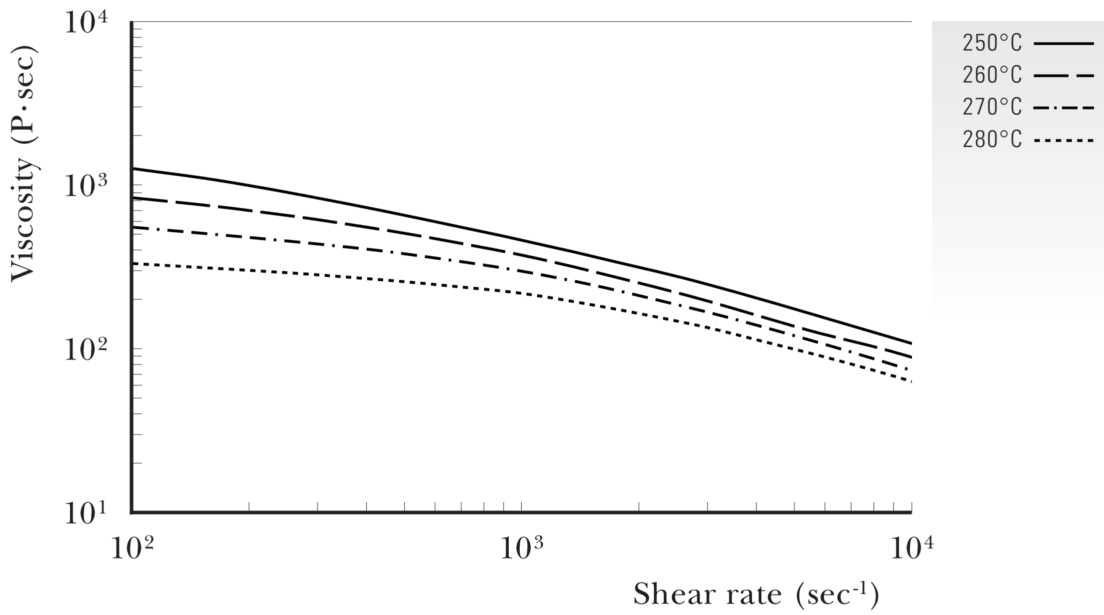
Capillary melt viscosity of Xenoy at 260°C



In order to facilitate the flow of the material in the tool, the melt temperature can be varied since the viscosity of semi-crystalline materials is a function of the temperature, as shown in ■ FIGURE 11.

■ FIGURE 11

Capillary melt viscosity of Xenoy CL100 at various temperatures



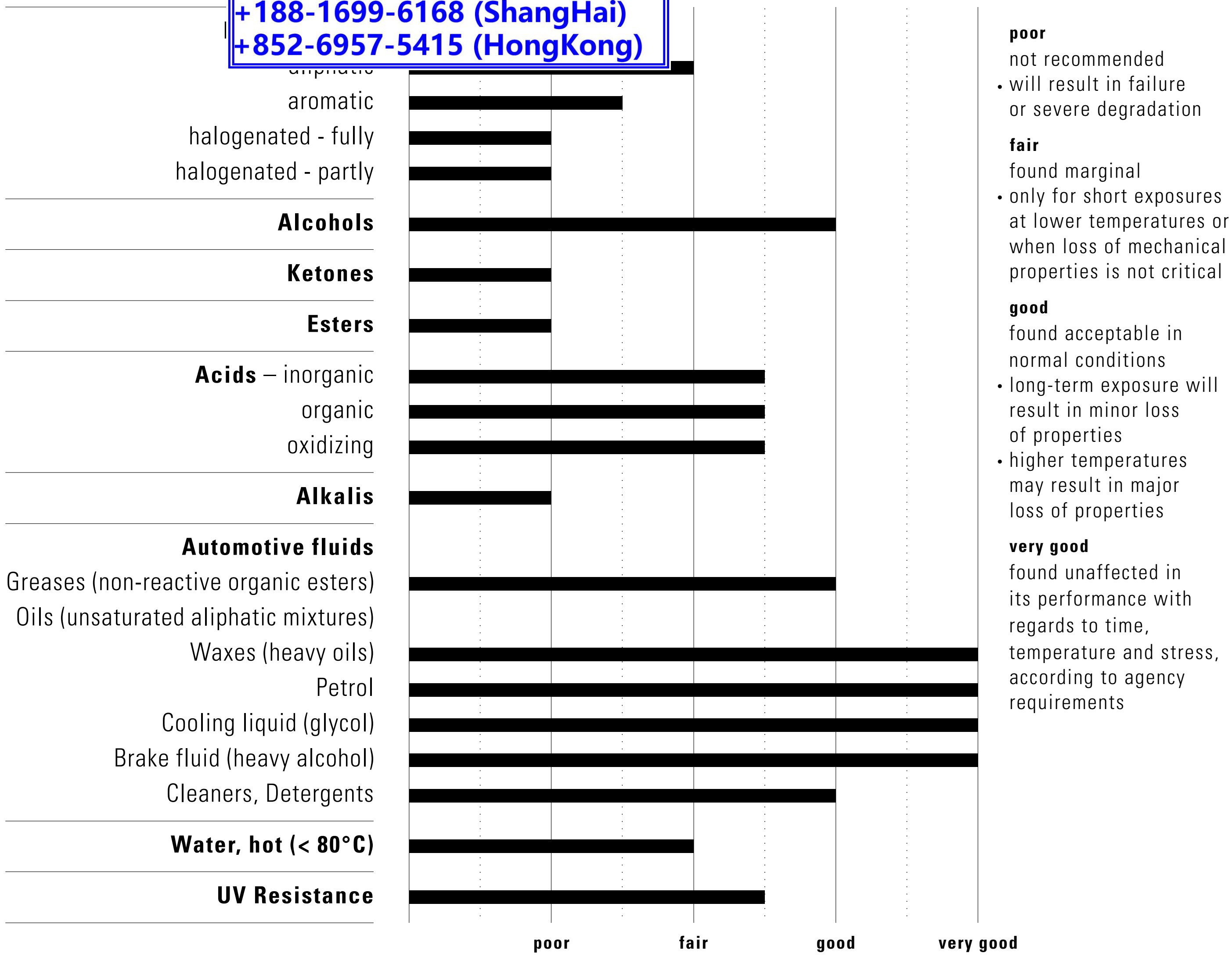
4.6 Chemical resistance*

As a semi-crystalline material, Xenoy resin exhibits excellent chemical resistance. Of particular note is its good retention of properties when exposed to automotive fluids. ■ FIGURE 12 provides an overview of Xenoy resin's resistance to a range of chemicals. Readers are asked to refer to the chemical compatibility guide for more detailed information.

* *In all cases, testing of the application under working conditions is strongly recommended. The actual performance and interpretation of the results of end use testing are the end producer's responsibility*

■ FIGURE 12

Chemical resistance of Xenoy



5 Processing

Xenoy® thermoplastic alloys can be successfully processed by injection moulding, extrusion and blow moulding. Extruded sheet from Xenoy resin can be thermoformed. Standard equipment can be used and the processing range is very broad. Fast cycle times are possible and any rejects can be ground and reused, providing contamination has not occurred during processing.

5.1 Pre-drying

Most thermoplastic materials absorb atmospheric moisture which will show on the surface of the part as streaking or splay and can, at normal processing temperatures, cause polymer degradation. This consequently lowers property levels, in particular impact strength. Xenoy resins therefore must be thoroughly dried after compounding to optimize material stability during moulding and to produce tougher, ductile parts.

For all Xenoy grades except those containing PET, it is recommended to pre-dry the material for a minimum of 2 hours at 110°C. For Xenoy blends with PET, the drying time should be at least 4 hours at 120°C. Excessive drying times of over 24 hours will not affect the properties of the polymer but they might decrease release performance during processing.

The moisture content prior to processing should not exceed 0.02%. This target is easily reached with standard dehumidifying dryers, usually within 2 hours (see below).

5.2 Equipment

Dryer

- Dehumidifying dryers are recommended for the pre-drying of Xenoy resin.
- Hot air circulation dryers are also successfully used, although account must be taken of longer drying times and therefore of reduced throughput.
- Tray oven dryers are not recommended because of their limited production capability.
- Due to the high drying temperatures required for Xenoy resins, it is important to check the suitability of the vacuum hoses transporting the material from the dryer to the hopper.

Hopper

The residence time of the material in the hopper should not be more than 30 minutes. The dimensions of the hopper are not so important as long as there is the possibility to adjust the hopper loading level and to keep the lid closed to avoid moisture pick-up.

Screw geometry and design

- High compression ratio screws or those with a short compression zone, such as a nylon type screw, should not be used. It is recommended to use a conventional 3-zone screw with a L:D ratio of 22:1 - 25:1 and a compression ratio of 2:1 - 2.5:1.
- Conventional metallic materials for screw and barrel are acceptable for the processing of unfilled Xenoy resin. However, screws and cylinders of a bimetallic type with high abrasion and corrosion resistance are preferred for glass- and mineral-filled Xenoy grades.
- The clearance between the flight of the screw and the barrel should be kept to a minimum to prevent leakage of the molten material across the flight land which would cause inconsistencies in plasticizing and dosing.
- A vented barrel and screw is not a satisfactory alternative to pre-drying and is therefore not recommended for Xenoy resin. If a vented barrel is used, then the level of moisture which is present in the material, and the percentage of the shot

capacity, will have a considerable influence on whether any degradation is encountered as a result of hydrolysis.
- The screw should be equipped with a sliding ring back flow valve. As Xenoy resin has a low melt viscosity, the performance of the valve is extremely important in the avoidance of surface defects, particularly when using a slow initial injection speed.
- Ball check valves are not recommended because they may cause local material degradation as a result of excessive shear or hang-up.
- Energy transfer, ET, screws provide good results in terms of throughput, impact performance and melt consistency.

Nozzles

- A free-flowing nozzle with its own heater band and temperature control is generally recommended for processing Xenoy resins.
- The nozzle temperature should be kept 10°C to 15°C below the melt setting to prevent material drooling or stringing.
- Nozzle openings have to be as large as possible: the diameter should be 1 mm smaller than that of the sprue tip in the mould.

5.3 Processing conditions

Melt temperature

In order to get the correct melt temperature, a profiled barrel temperature setting should be used. Following the recommendations in the relevant material data sheet, the temperature should increase progressively from the hopper to the machine nozzle. The temperature of the cooling ring around the hopper zone should be between 40°C and 60°C. When higher temperatures are used, the polymer may stick to the screw, creating a so-called ‘cold ring’.

It should be noted that the set melt temperature is seldom the same as the actual melt temperature which is determined by a number of combined factors: the cylinder heater settings, screw rotation speed, back pressure and residence time

Therefore the actual melt temperatu be measured while the machine is running using hand-held pyrometers.

Back pressure

A machine back pressure of 5-10 bar is recommended in order to improve melt quality and maintain a consistent shot size. For glass-reinforced grades, careful monitoring of back pressure is advisable in order to minimize fibre damage.

Screw rotation speed

The screw rotation speed, rpm, should be adjusted to suit the moulding cycle but must not result in a screw surface speed of more than 0.5 m/s. For a screw with a diameter of 30 mm this means a maximum 190 rpm and for a screw of 150 mm diameter it is a maximum of 38 rpm. The screw speed should be selected to enable screw rotation during the entire cooling cycle without delaying the overall cycle. Material degradation can occur at too high screw speeds due to excessive shear heating.

Drooling problems may be experienced on nozzles which have poor temperature control. If these problems persist after the nozzle temperature has been adjusted, the careful use of melt decompression or suck back is advised. The suck back stroke should be just enough to keep the resin in and the air out, as entrapped air can cause melt degradation and create moulding problems such as splay or burning. Suck back can also be used to depressurize hot runner systems.

Screw cushion

A screw cushion of 5-10 mm is recommended for a screw diameter of 50-100 mm. Above a screw diameter of 100 mm, a screw cushion of 10-15 mm is advised. Without a cushion it is not possible for the after pressure to have an effect.

Shot capacity and residence time

Normally shot weight should be between 30%-80% of the barrel capacity. When processing Xenoy resin on the upper limit of the melt

temperature range, however, it is recommended that the shot size is 60%-80% of the barrel capacity to minimize residence time.

The recommended residence time for Xenoy resin is between 4 and 8 minutes, depending on the selected melt temperature. A too long residence time can result in material degradation. A too short residence time, on the other hand, may cause moulding parameters to fluctuate, thereby reducing the plastification and the homogeneity of the material.

Injection speed and pressure

A medium to fast injection speed is desirable for all Xenoy grades. Care should be taken to providing adequate venting when selecting a fast injection speed. Programmed injection, with slow initial cavity filling, will provide a better surface finish around the gate area for nearly all gating systems.

In general, the injection pressure should be as low as possible to obtain parts without flash but sufficiently high to completely fill the part during the injection stage.

After pressure

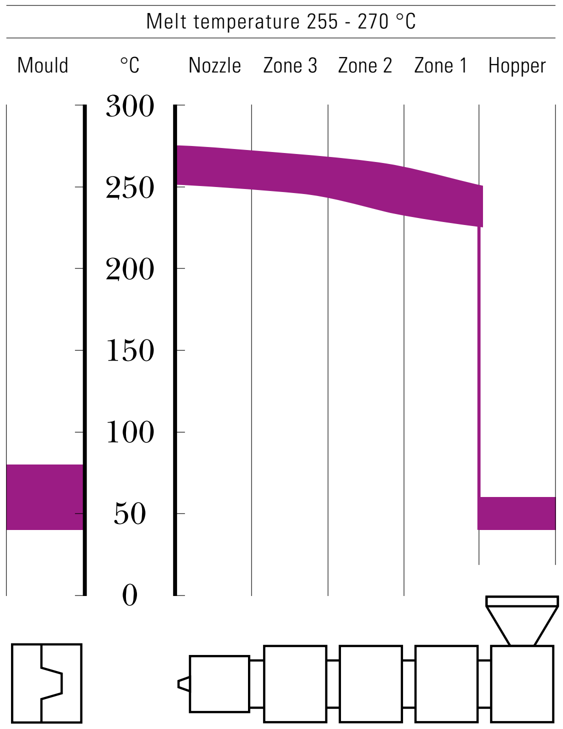
After pressure compensates for volume shrinkage of the melt in the mould during cooling. Due to the speed at which Xenoy resin crystallizes, the effect of after pressure is determined by the part design, wall thickness, flow length and gate.

If the part has thin walls with narrow gates, the material will freeze off very quickly which means that the level of after pressure should be high for a short period of time. If, on the other hand, the part has thick wall sections and large gates, a moderate or low after pressure can be applied for a longer period of time.

When the after pressure is too low, this will result in visible sink marks as well as voids and uneven part shrinkage. When the pressure is too high, localized stresses can occur, particula in the gating area, and ejection problems can be created. High stress will show up as warpage after painting or heat treatment.

■ FIGURE 13

Typical moulding temperatures for unfilled Xenoy



Mould temperature

Mould temperature is extremely important and therefore should be checked regularly. For a semi-crystalline material like Xenoy resin, high mould temperatures will produce higher degrees of in-mould crystallization. This in turn will result in high shrinkage values. Too low mould temperatures, on the other hand, may result in crystallization after moulding, with the risk of warpage during secondary operations. Typical mould temperatures for unfilled and filled Xenoy grades are shown in ■ FIGURES 13 and 14.

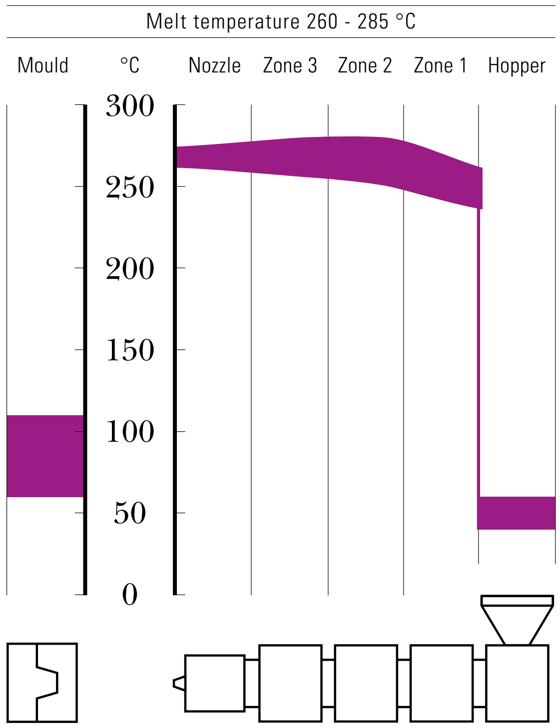
Clamping force

There are various factors influencing the required level of clamping force. These include the projected surface area of the part, the thickness of the part, the length of flow from the part and the injection speed and pressure.

Normally pressures are between 40 and 50 N/mm². However, for complex thin wall components, requiring fast injection speeds combined with high injection pressures, a clamping force of up to 80 N/mm² projected surface area can be required.

■ FIGURE 14

Typical moulding temperatures for filled Xenoy



5.4 Venting

Good mould venting is essential to prevent blistering or burning and to aid cavity filling. Ideally the vents should be located at the end of the material flow paths. Inadequate or poorly located venting can result in incomplete filling, poor weld line strength, uneven shrinkage, warping and the need for excessive injection pressure to fill the cavity.

For Xenoy resins, ideal vents have a depth of 0.05 mm to 0.1 mm and a width of 4 mm to 8 mm, and should be located at the end of the material low paths. Additional vents can be placed etween the clearance of moving cores, ejector ins and sleeves and between the mould inserts.

5.5 Purging of the barrel

Immediate, thorough purging of the cylinder is required when changing to another material after using Xenoy resin. The best purging materials for Xenoy resin are general purpose PS and HDPE. The cylinder temperature should then be lowered if the resins to be moulded afterwards are POM, ABS or PA.

The heating should never be switched off when PC/PBT or PC/PET is in the barrel but the barrel temperature should be reduced to 160°C.

5.6 Recycling

Properly moulded Xenoy resin can be reground, dried and remoulded repeatedly. Attention must be given to ensuring that the regrind is clean and free from impurities.

Particular care in the pre-drying of the regrind must be taken because it has a faster moisture pick-up rate than virgin material. In general drying should be carried out at 110°C for an extra hour.

Regrind utilization may produce a slight change in colour, UV resistance or impact properties. Great care should be taken therefore in applications where impact performance and/or agency compliance are required.

Note
Further information on the processing of engineering thermoplastics can be found in GE Plastics brochures:

- Injection Moulding guide
- Engineering Thermoplastics in the Extrusion Industry

6 Secondary Operations

Although Xenoy® resin parts are often moulded as finished components, the design and ultimate use of certain parts may require machining, assembly or finishing operations. Xenoy resin makes a wide variety of secondary operations possible for the design engineer.

6.1 Welding

Welding is a commonly used permanent assembly technique for engineering thermoplastics. Xenoy resin parts can be welded using different processes. Selecting the right process depends on the size, shape and function of the part:

- **Hot Plate Welding** allows excellent weld strengths to be achieved but the resin may stick to the hot plate. Heating by radiation hot plate can overcome this problem but requires precise part dimensions and process control.
- **Friction Welding**, using either the vibration, orbital or rotation method, can be applied to both unreinforced and glass-reinforced Xenoy grades. A special weld design for vibration welding has proven successful for 'class A' automotive exterior applications. Ribs of only 25% of wall thickness are placed on the back of the visible surface, and welded together.
- **Ultrasonic Welding** is commonly used.
- **Induction Welding**

6.2 Adhesives

In general, Xenoy resin parts can be bonded to other plastics, glass, aluminium, brass, steel, wood and other materials. Compatible adhesives include epoxy, polyurethane 2K, silicones, acrylic 2K and cyanoacrylate. Polyurethane 1K adhesive systems and reactive hot melts generally require the use of a primer to enhance adhesion.

Cleaning parts

Thorough cleaning of Xenoy parts before bonding is essential in order to avoid adhesion failure. All oil, grease, paint, mould releases, rust oxides, etc., must be removed by washing with solvents which are compatible with Xenoy resin. These solvents include isopropyl alcohol, heptane or a light solution of detergents.

ical assembly

Mechanical assembly techniques are widely used with Xenoy resin parts. To achieve optimum results, mechanical fasteners should be kept free from oil and grease. Depending on the type of fastener, a permanent stress or deformation is applied locally. Clamp forces should be controlled or distributed over a large surface area. This is in order to decrease local stresses in the part after assembly and to minimize the risk of loosening the fasteners through creep and relaxation. Notches in the design as well as notches resulting from mechanical fasteners should be avoided.

Recommended assembly techniques:

- Thread-forming screws rather than thread cutting screws are recommended. Screws with a maximum flank angle of 30° are preferred for minimal radial stresses
- Inserts which leave low residual stresses can be used. Installation by heat or ultrasonic are the preferred techniques. Press and expansion inserts produce high hoop stresses in bosses and should therefore be used with caution
- Snap fit assembly
- Rivets
- Staking

6.4 Painting

Xenoy resin's inherently high UV resistance means that parts can be left unpainted. On the other hand, compatibility with most painting systems, without the need for pre-treatment, allows the same part to be painted if required. This provides wide manufacturing flexibility as common mouldings can be used for different models or applications.

Painting of engineering thermoplastics can have a critical influence on the performance of an application. What follows here is a brief introduction to the painting of Xenoy resin. However, for more detailed information, please refer to the GE Plastics' 'Painting guide', or contact GE Plastics' Technical Marketing Department.

6.4.1 Xenoy CL300 resin

This impact modified, high flow grade was specifically developed for the manufacture of off-line painted exterior automotive applications. The material's relatively high stiffness (E modulus 2050 MPa), allows it to be used in applications with a wall thickness of down to 2.2-2.5 mm. This means shorter cycle times and more cost-effective manufacturing.

Adhesion

The adhesion performance of Xenoy CL300 with both water-based basecoats and solvent-based topcoats, satisfies even the toughest automotive specifications. The water-based basecoat can be applied directly onto the substrate without the need for an adhesion-promoting treatment.

sistance

The material's inherent chemical resistance has been tested with a range of solvent-based topcoats and, in each case, no attack has been recorded, even with a 1% applied strain.

Impact Performance

The type of paint system selected has a major influence on the ductility of the plastic substrate. Key factors include the overall flexibility of the paint layer, the chemical nature of the topcoat and the paint adhesion.

A fully flexible paint system will follow the deformation of the substrate upon impact, whereas insufficient flexibility in the paint layer will cause a crack which will propagate into the substrate and result in brittle failure.

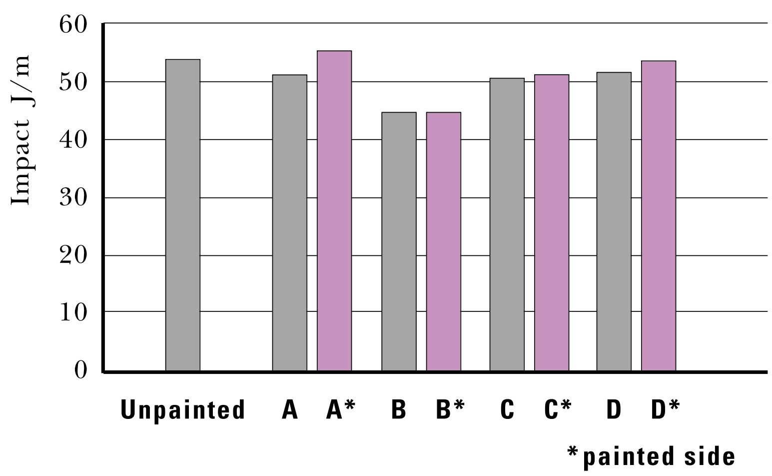
In applications using a solvent-based basecoat or uni colour, the solvent will penetrate the outer layer of the substrate forming a diffused interface. This produces excellent adhesion performance but can have a significant effect on impact performance. In parts where a fully flexible topcoat is used, the failure at -30°C will be ductile when the impact is on the painted side, but less ductile if the impact is on the unpainted side. However, the combination of Xenoy CL300 resin painted with a water-based basecoat and a 2K PUR fully flexible clearcoat shows a ductile failure mode at -30°C, both when impacted upon the painted and the unpainted side (see FIGURE 15).

Heat Resistance

The amorphous polycarbonate in the Xenoy polymer blend provides the required heat resistance and paintability at elevated temperatures, thereby ensuring that large automotive exterior parts are not distorted during paint curing.

FIGURE 15

High speed impact test on painted Xenoy CL300 resin at 1.1 m/s (4 km/hr) and -30 °C



paintsystem (primerless)

A: 'Nordic Green' metallic water-borne basecoat + 2K PUR flexible clearcoat

B: 'Nouveau Red' metallic water-borne basecoat + 2K PUR flexible clearcoat

C: 2K PUR Uni single coat 'Provence Green' (solvent-based)

D: 2K PUR Uni single coat 'Radiant Red' (solvent-based)

6.4.2 Primerless painting

Primerless painting not only contributes to a more cost-effective body panel system, but also produces less solvent emission and waste during the painting operation.

Xenoy CL300 resin has been tested using a range of both water-based primerless paint systems and solvent-based uni colours. With both systems the material has been proven in terms of adhesion performance, chemical resistance, impact performance and cosmetics. The grade's excellent flow properties result in no knit line marks, while consistently high UV resistance protects against discoloration.

ats for coloured Xenoy resin

In traditional paint systems for off-line painted automotive exterior parts, the coloured basecoat and clear topcoat combination is widely used. However, in the latest development in the off-line painting of Xenoy resin, only a single operation is required to have a finished part. In one step a clearcoat is applied to a coloured Xenoy resin substrate. In addition to providing shorter, more cost-effective production cycles, this allows the use of different decoration techniques in which the base colour of the substrate plays a key role.

Selection of the best Xenoy grade, colour and clearcoat system is critical to the successful production of applications using this new process. It is essential that all new applications are thoroughly tested for adhesion performance and weathering and impact resistance prior to industrialization. Assistance in making the selection of the correct combinations is available from GE Plastics' Technical Marketing Department.

6.4.4 Recycling

The Xenoy resin recovered from unpainted exterior body panels can be readily reused for parts such as off-line painted fixing brackets and beams, or in glass-filled structural applications. It may not be used, however, for unpainted exterior parts.

When recycling off-line painted parts, the currently used 2K polyurethane-based paint systems have to be first removed. A paint removal process has been developed which chemically separates the paint layer from the Xenoy resin substrate, providing regrind material which is comparable to that of recycled Xenoy resin from unpainted parts.

Note
General information on Secondary Operations like welding, mechanical assembly, bonding and painting of Xenoy resin can be found in the following GE Plastics brochures:

- Assembly guide
- Design guide
- Painting guide

Addresses

- More information relative to this **Xenoy® profile** can be found on: www.geplastics.com/resins/materials/xenoy.html
- Visit GE Plastics on: www.geplastics.com/resins

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