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NorPLY™ 1002

Description

Montana Advanced Composites' NorPLY™ 1002 is a cured epoxy composite material based on a unique non-woven, parallel filament construction. This type of construction minimizes filament stress abrasion that can shorten fatigue life in conventional reinforced plastics. NorPLY™ 1002 uses type E continuous filament fiberglass.

NorPLY™ 1002 is supplied as cured flat panels or cut to size shapes. Panel sizes up to 48" x 72" (122cm x 183cm) are available in thicknesses ranging from .030" to 2.0" (.76mm x 51mm).

NorPLY™ 1002 is available in unidirectional, cross-ply or isotropic fiber orientation, each offering a different balance of physical properties.

For more information, contact:
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https://montanacomposites.com/norply.php
info@montanacomposites.com

Features and benefits

- **High impact strength**
- **Chemical and corrosion resistance**
- **High strength-to-weight performance**
- **Excellent fatigue life and high strain capability**
- **Low notch sensitivity**
- **Increased design options (springs to rail joints)**
- **Resistant to cleaning fluids and solvents**
- **Less downtime in harsh environments**
- **Weight reduction**
- **Greater capacity to store energy than 1060 spring steel**

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Applications

- Vibratory springs
- Dock shelter staves
- Shocks and struts
- Insulation spacers
- Insulated rail joints
- Flexible couplings
- Furniture springs

Availability

NorPLY™ 1002 is available in cured flat sheets of unidirectional or crossply orientations in sizes to 48" x 72" (122 cm x 183 cm) and in thickness of 0.030" to 1 1/2" (0.76 mm to 38 mm).

Orientation	Average cured thickness	Average uncured thickness
Unidirectional (one ply)	0.010" (0.25 mm)	.011" (0.28 mm)
Crossply (two plies)	0.020" (0.50 mm)	.022" (0.56 mm)
Isotropic (three plies)	0.030" (0.76 mm)	.033" (0.84 mm)

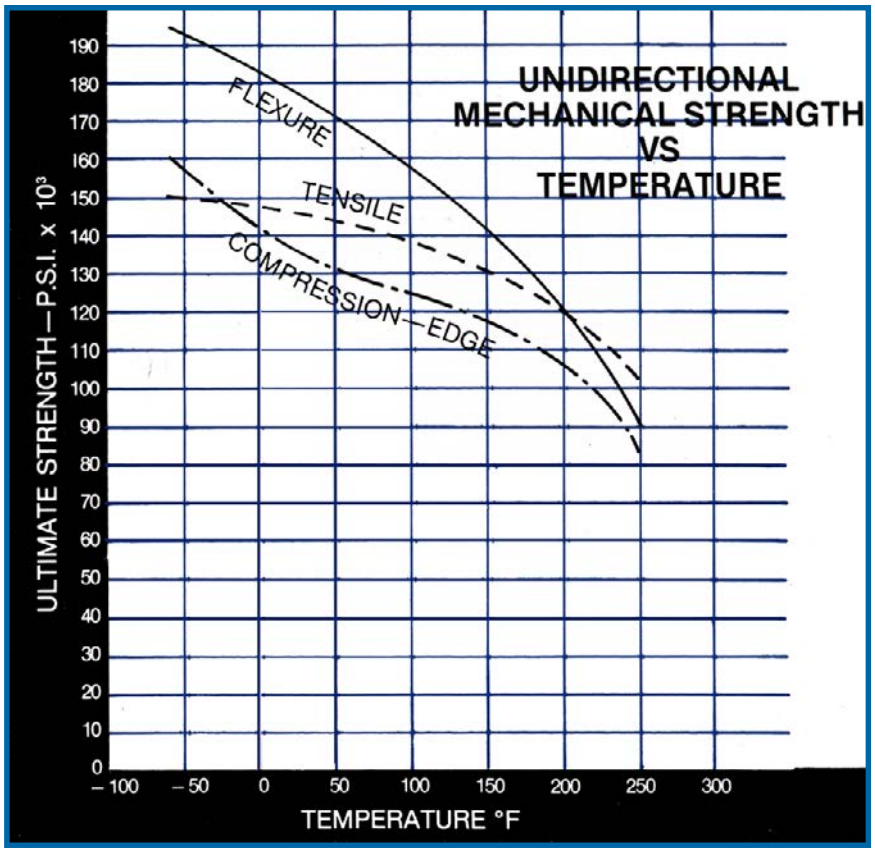
Physical properties

Weight per square yard in lbs. (kg/m2)	0.85 (0.46) unidirectional
Resin Content (% by weight)	36 ± 3%
Specific gravity (cured average)	1.85
Barcol hardness	70
Wet strength retention (2 hour boil)	85%

Mechanical properties at various temperatures

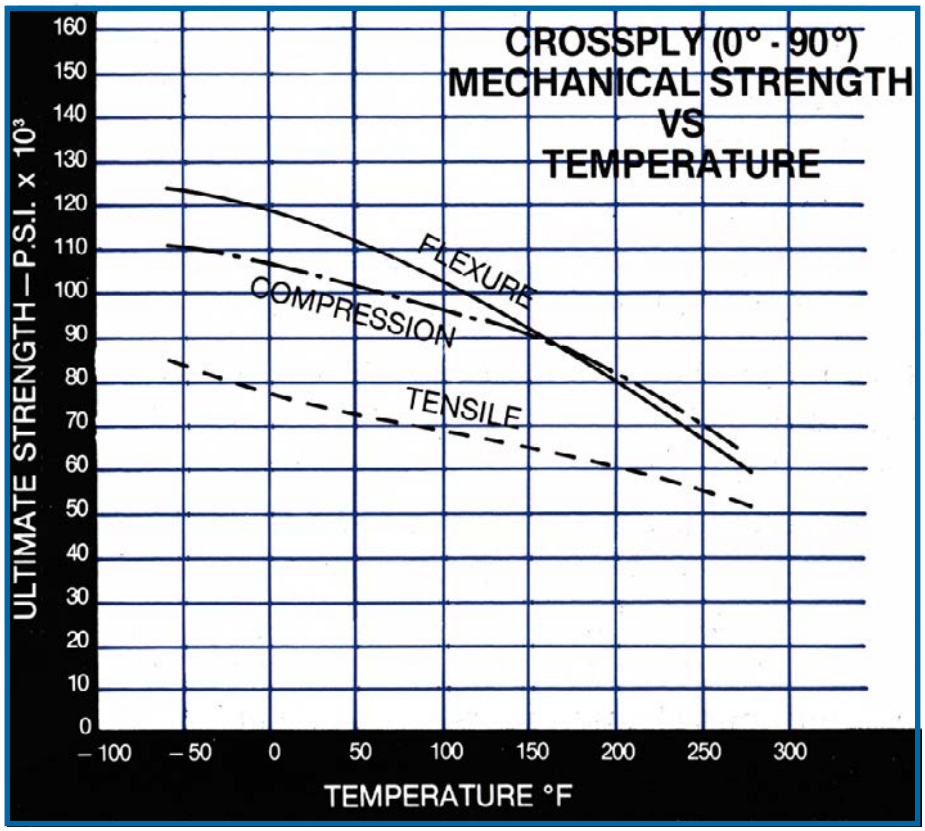
ASTM D-790 used for flexural strength and modulus
ASTM D-638 used for tensile strength and modulus
ASTM D-3410 used for compressive strength

Orientation	Mechanical property	-60°F (-50°C)	70°F (21°C)	160°F (71°C)	250°F (121°C)
UNIDIRECTIONAL	Flexural strength, PSI x 103	192 (1320 MPa)	167 (1150 MPa)	135 (930 MPa)	90 (620 MPa)
	Flexural modulus, PSI x 103	5.7 (39.3 GPa)	5.6 (38.6 GPa)	5.2 (35.9 GPa)	5.0 (34.5 GPa)
	Tensile strength, PSI x 103	150 (1035 MPa)	140 (965 MPa)	130 (895 MPa)	108 (745 MPa)
	Tensile modulus, PSI x 106		5.7 (39.3 GPa)	5.6 (38.6 GPa)	5.2 (35.8 GPa)
	Compressive strength, PSI x 103	160 (1100 MPa)	128 (880 MPa)	114 (785 MPa)	84 (580 MPa)



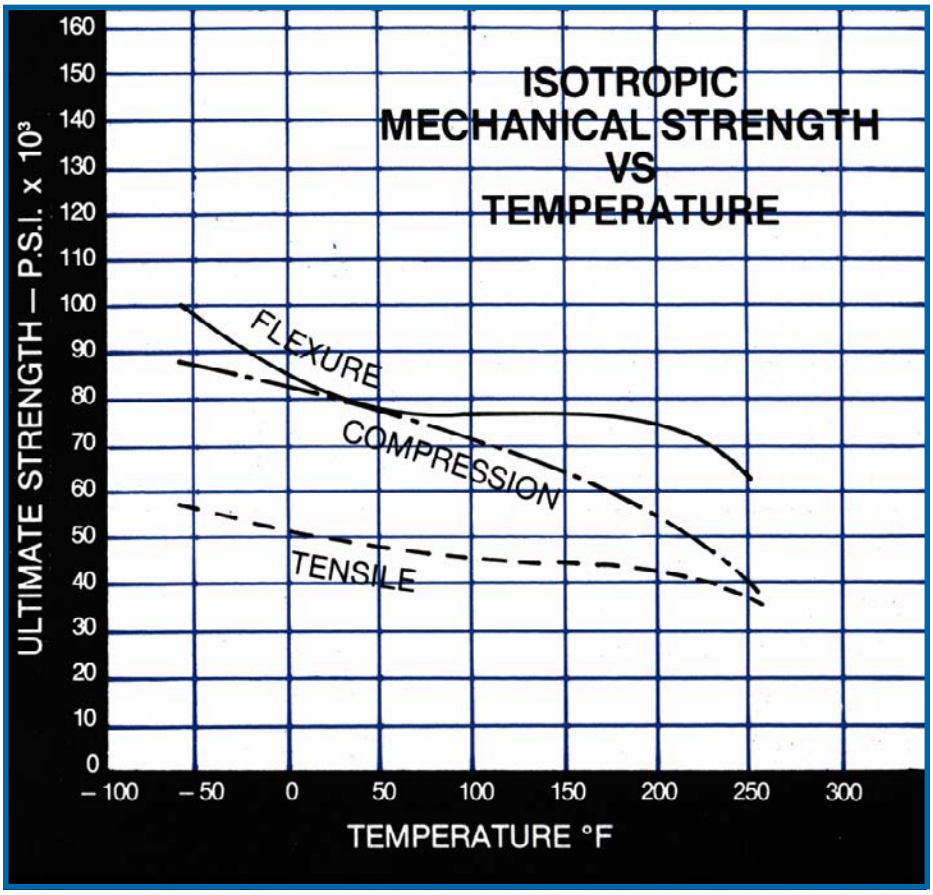
Mechanical properties at various temperatures, cont.

Orientation	Mechanical property	-60°F (-50°C)	70°F (21°C)	160°F (71°C)	250°F (121°C)
CROSSPLY	Flexural strength, PSI x 103	125 (865 MPa)	110 (760 MPa)	87 (600 MPa)	67 (460 MPa)
	Flexural modulus, PSI x 103	3.6 (24.8 GPa)	3.5 (24.1 GPa)	3.3 (22.8 GPa)	2.9 (20.0 GPa)
	Tensile strength, PSI x 103	85 (580 MPa)	70 (480 MPa)	65 (450 MPa)	61 (420 MPa)
	Tensile modulus, PSI x 106		3.4 (23.4 GPa)	3.4 (23.4 GPa)	2.7 (18.6 GPa)
	Compressive strength, PSI x 103	110 (760 MPa)	100 (690 MPa)	88 (605 MPa)	63 (435 MPa)



Mechanical properties at various temperatures, cont.

Orientation	Mechanical property	-60°F (-50°C)	70°F (21°C)	160°F (71°C)	250°F (121°C)
ISOTROPIC	Flexural strength, PSI x 103	100 (690 MPa)	76 (525 MPa)	76 (600 MPa)	68 (435 MPa)
	Flexural modulus, PSI x 103	2.9 (20.0 GPa)	2.9 (20.0 GPa)	2.9 (20.0 GPa)	2.3 (15.9 GPa)
	Tensile strength, PSI x 103	58 (400 MPa)	48 (330 MPa)	45 (310 MPa)	36 (250 MPa)
	Tensile modulus, PSI x 106		2.5 (17.2 GPa)	2.4 (16.5 GPa)	1.8 (12.4 GPa)
	Compressive strength, PSI x 103	87 (605 MPa)	75 (520 MPa)	61 (420 MPa)	39 (270 MPa)



Mechanical properties at various stress angles at 70°F (21°C)

	STRESS ANGLE		
	0°	45°	90°
Unidirectional			
Flexural strength, PSI x 103	167 (1150 MPa)	21 (145 MPa)	11 (75 MPa)
Flexural modulus, PSI x 106	5.6 (38.6 GPa)	2.0 (13.8 GPa)	1.6 (11.1 GPa)
Tensile strength, PSI x 103	140 (965 MPa)	3.5 (24.0 MPa)	2.9 (20 MPa)
Tensile modulus, PSI x 106	5.7 (39.3 GPa)	1.4 (9.7 GPa)	1.4 (9.7 GPa)
Compressive strength, PSI x 103	128 (880 MPa)	35 (240 MPa)	28 (195 MPa)
*Short beam shear, PSI x 103	11 (75.8 GPa)		
Crossply			
Flexural strength, PSI x 103	110 (760 MPa)	45 (310 MPa)	110 (760 MPa)
Flexural modulus, PSI x 106	3.5 (24.1 GPa)	2.0 (13.8 GPa)	3.5 (24.1 GPa)
Tensile strength, PSI x 103	70 (480 MPa)	21 (145 MPa)	70 (480 MPa)
Tensile modulus, PSI x 106	3.4 (23.4 GPa)	1.5 (10.3 GPa)	3.5 (24.1 GPa)
Compressive strength, PSI x 103	100 (690 MPa)	30 (205 MPa)	100 (690 MPa)
*Short beam shear, PSI x 103	9 (62.0 GPa)		
Isotropic			
Flexural strength, PSI x 103	76 (525 MPa)	70 (485 MPa)	75 (515 MPa)
Flexural modulus, PSI x 106	2.9 (20.0 GPa)	2.7 (18.6 GPa)	2.6 (17.9 GPa)
Tensile strength, PSI x 103	48 (330 MPa)	36 (250 MPa)	36 (250 MPa)
Tensile modulus, PSI x 106	2.5 (17.2 GPa)	2.8 (19.3 GPa)	2.8 (19.3 GPa)
Compressive strength, PSI x 103	75 (520 MPa)	64 (440 MPa)	64 (440 MPa)
*Short beam shear, PSI x 103	9.5 (65.5 GPa)		

*ASTM reinforced plastic test method D2344-76 – Span/depth 5 to 1.

Chemical properties

Crossply (0°- 90°) fiber orientation / Test method ASTM D543-T43 / 7 day immersion @ 70°F (21°C)

Chemical	Percent change in weight	Percent change in thickness	Flexural strength PSI x 103
Heptane	+ .02	+ .02	110
Isopropyl alcohol	+ .16	+ .23	104
Ethylene glycol	+ .06	+ .02	109
Jet engine oil	+ .08	- .14	111
Jet fuel (JP-4)	+ .07	+ .11	111
Hydraulic aircraft oil	+ .07	- .05	114
Sulfuric acid 3%	+ .06	+ .09	100
Sulfuric acid 30%	+ .07	+ .24	101
Sodium hydroxide 1%	+ .19	+ .04	95
Sodium hydroxide 10%	+ .20	+ .12	94
Hydrogen peroxide 3%	+ .21	+ .10	110
Distilled water	+ .17	+ .09	109

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Electrical properties

Property	Conditioned @ R.H.	Test temperature	FREQUENCY 60	1 KC	100 KC	1 MC	10 MC	30 MC
	50%	23°C	0.0052	0.006	0.014	0.017	0.016	0.023
	50%	60°C		0.0087				
Dissipation	50%	120°C		0.0033				
factor	50%	150°C		0.13				
	90%	23°C	0.036	0.05	0.032	0.019	0.024	0.033
	90%	60°C		0.054				
	50%	23°C	5.3	5.2	5.1	4.8	4.7	4.4
	50%	60°C		5.7				
Dielectric	50%	120°C		6.1				
constant	50%	150°C		7.3				
	90%	23°C	7.0	6.5	5.6	5.5	5.1	5.5
	90%	60°C		6.8				
					109 V.D.C.			
Volume	50%	23°C			4.9 x 1017			
resistivity	90%	23°C			4.9 x 1017			
(Ohms-cm)								
	50%	23°C			5.3 x 1015			
	50%	60°C			2.7 x 1014			
Insulation	50%	120°C			6.2 x 1011			
resistance	50%	150°C			6.8 x 1010			
(Ohms)	90%	23°C			3.3 x 1014			
	90%	60°C			9.7 x 1012			
					Volts/Mil			
Dielectric	50%	23°C			620			
strength								

			TIME IN SECONDS Across filaments	With filaments
Arc	50%	23°C	80	20
Resistance	90%	23°C	80	20

Thermal properties

Coefficient of linear expansion / method – ASTM D696-42T / Tested over temperature range of -30°F to +200°F

Fiber orientation	Directions of measurement	Coefficient of linear expansion per °F
Isotropic	Parallel to one array of filaments	8.4 x 10-6
Crossply	Parallel to lengthwise filaments	7.1 x 10-6
Crossply	Parallel to crosswise filaments	7.1 x 10-6
Unidirectional	Parallel to all filaments	4.8 x 10-6
Unidirectional	Perpendicular to all filaments	12.3 x 10-6

Thermal conductivity (k)

$$(k) = \frac{\text{B.t.u. of heat transmitted through 1 inch thickness}}{(°F)\ \ (\text{sq. ft.})\ \ (\text{hr.})}$$

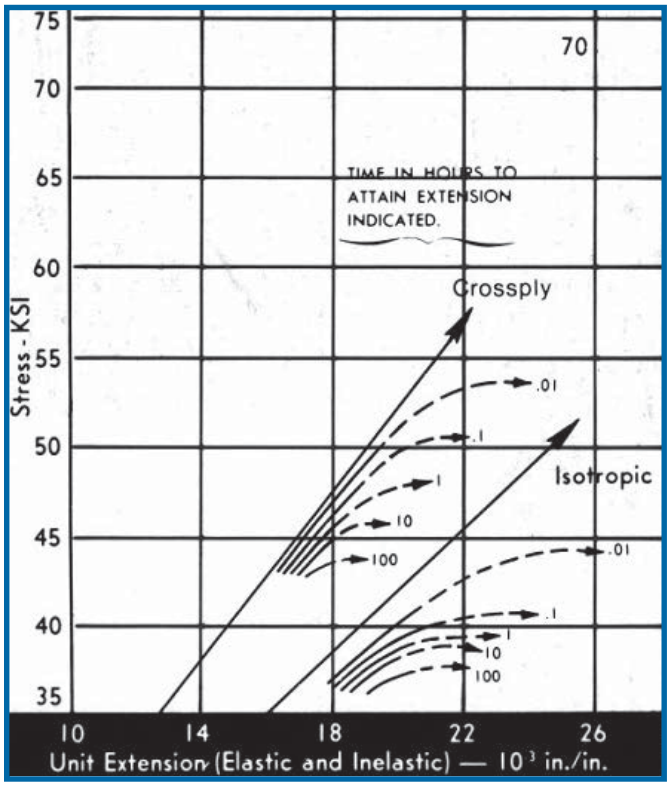
Tests conducted on a 1 inch thick isotropic laminate

Mean temperature	Thermalconductivity (k)
36°F	2.33
45°F	2.32
125°F	2.37
186°F	2.40

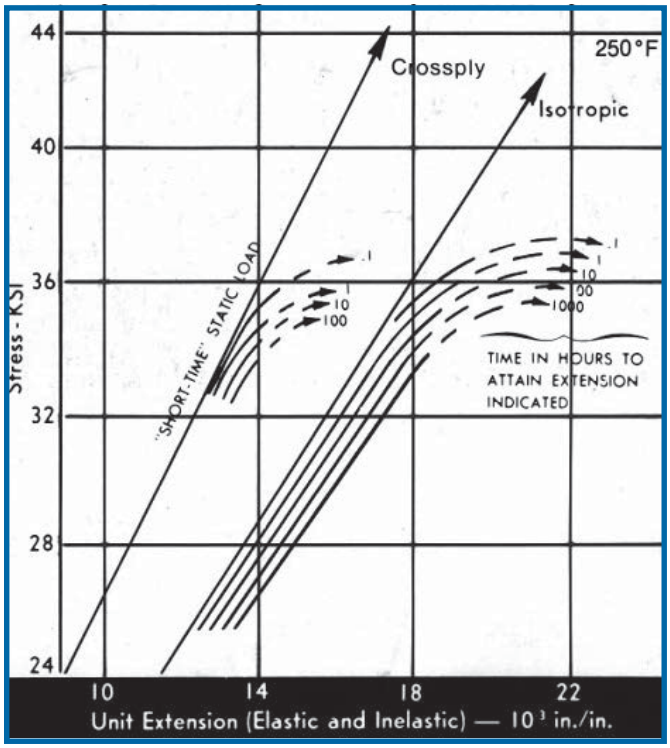
Specific heat = 0.21 CAL/g - DEG.C

Creep curves

Loaded in tension @ 70°F



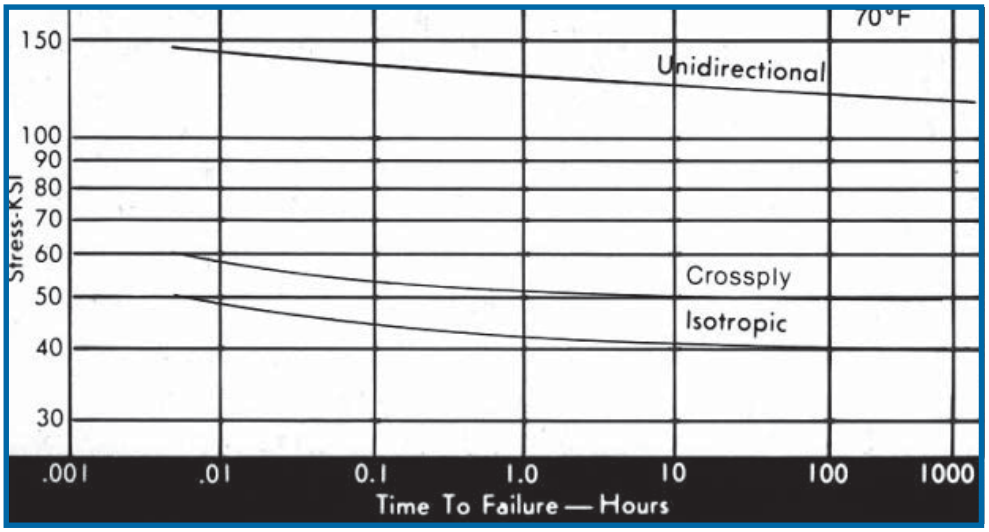
Loaded in tension @ 250°F



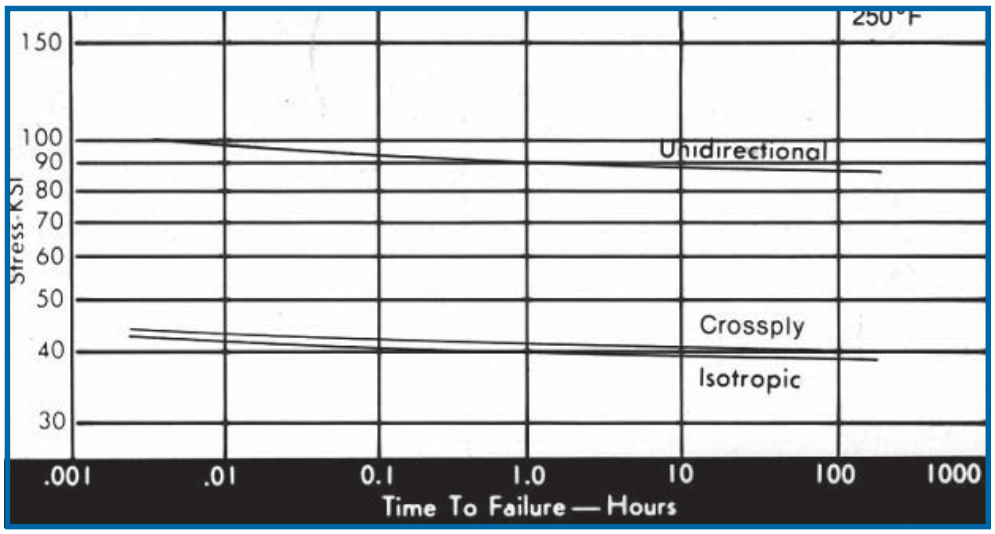
Note: The properties illustrated by the curves shown on this page, although not specifically based on the present Type 1002 product, are representative of what can be expected for a heat cured Type 1002 epoxy resin reinforced with continuous, non-woven Type E glass filaments. These curves should be suitable as a guide for design and should be used for customer evaluation purposes only.

Stress rupture

Tensile stress vs. time to failure @ 70°F



Tensile stress vs. time to failure @ 250°F



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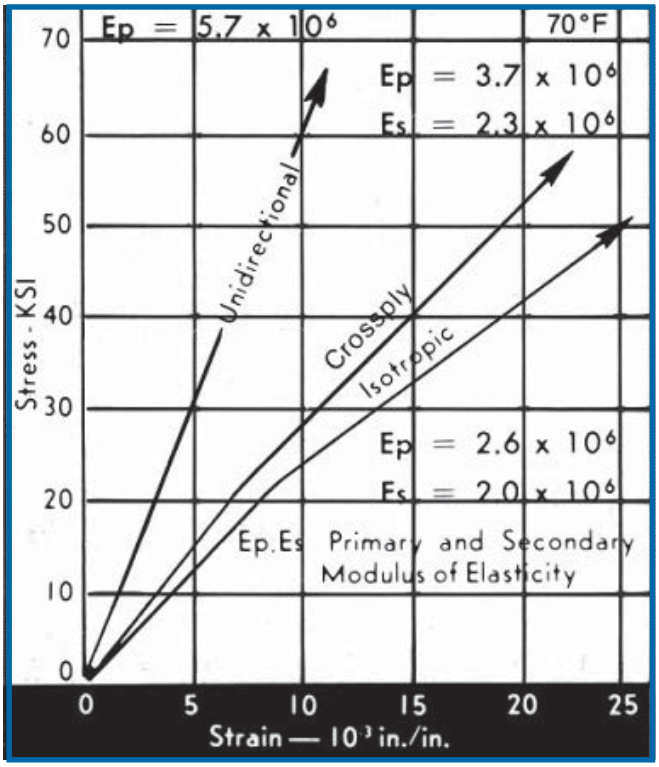
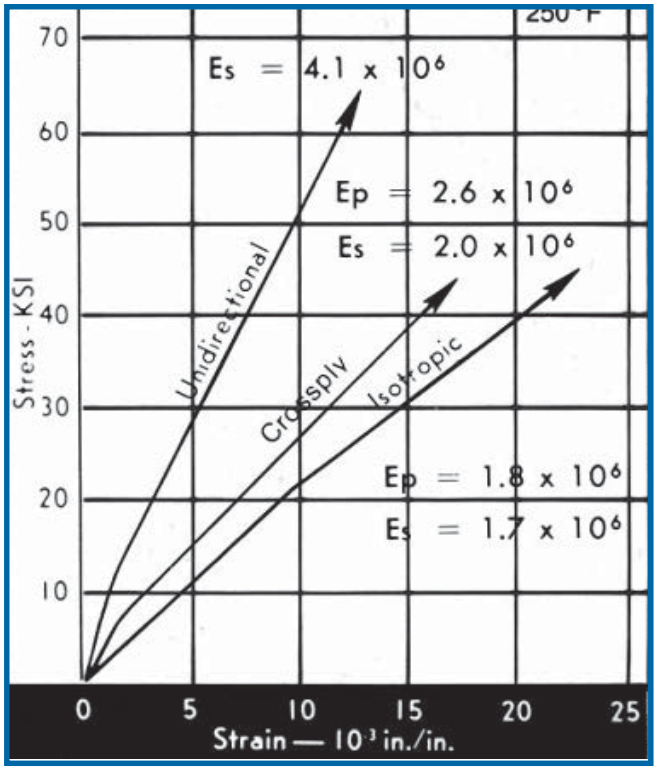
Tensile stress-strain curves

@ 70°F



@ 250°F



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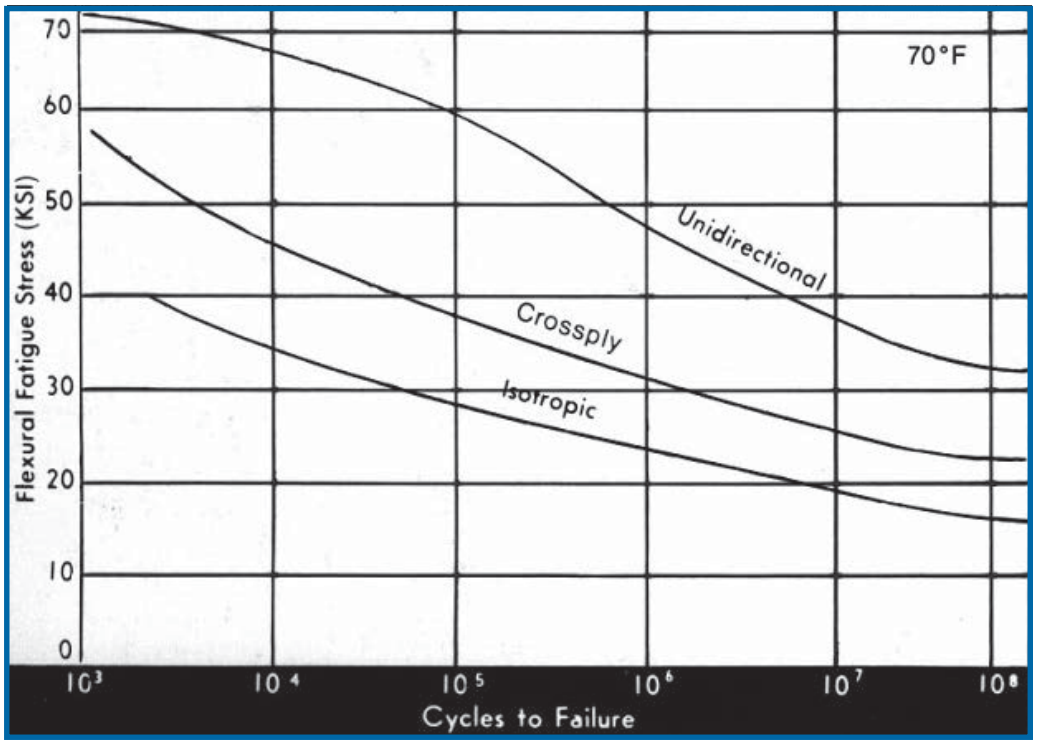
Flexural fatigue (SN) curves

@ 70°F



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Important notice

This data, while believed to be accurate and based on reliable analytical methods, is for informational purposes only. The terms and conditions of the agreement under which it is sold will govern any sales of this product. Data supplied above are "typical values"; not to be considered "specification values".

To assure the material's performance is adequate for a specific application; customers should verify, independent of Montana Advanced Composites, performance characteristics of interest.

It is the responsibility of the users of this information to make sure that they have the latest version of this TDB, and are urged to check with Customer Service or, preferably our website, https://montanacomposites.com/, to determine if the information is the most current available.

contact us

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