CYCOM 977-6 Epoxy Prepreg

Description

CYCOM 977-6 is the industry benchmark for tough lower temperature curing modified epoxy resins.

It is a versatile curing toughened epoxy resin which can be cured from 135°C to 177°C, depending on service temperature requirements. Following a 177°C cure, 977-6 has a 138°C dry and a 104°C wet service temperature. CYCOM 977-6 is formulated for lower temperature autoclave or press mould processing.

Typical applications for CYCOM 977-6 include high performance automotive, aircraft primary and secondary structure, space structure, and any application where impact resistance and lightweight as well as versatile cure conditions are required.

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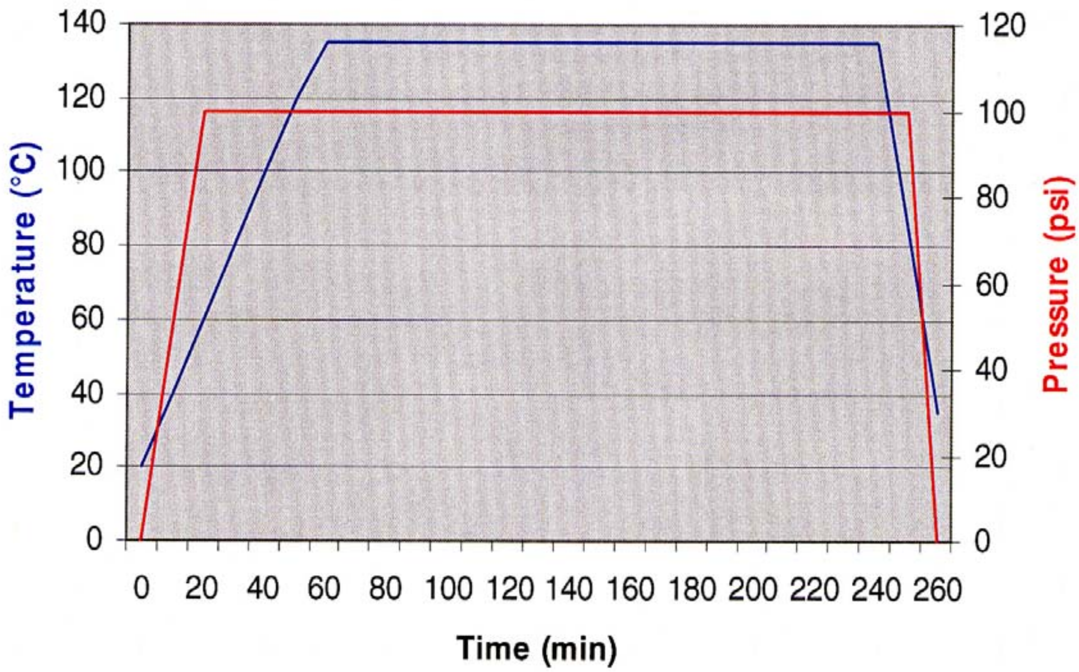
Features and benefits

- **Toughened epoxy uses "co-continuous" morphology**
- **Very high impact resistance**
- **CSAI up to 40ksi**
- **Controlled flow**
- **Can be cured between 135°C and 180°C**
- **Tg of ~150°C following 3hr @ 135°C cure. (DMA G')**
- **Excellent cured surface finish**
- **14 days shop life**
- **12 months shelf life at -18°C**
- **Available in a wide range of fibres and fabric weaves**

Cure cycle

The following is a typical cure cycle for 977-6, the cure time and temperature can be replaced with alternatives specified by Cytec Engineered Materials.

1 Apply full vacuum
2 Ramp temperature at 2°C/min to 135°C
3 Apply 45 - 100psi pressure, vent vacuum when pressure reaches 20psi
4 Hold at 135°C for 3hrs
5 Cool autoclave to below 60°C at 3°C/min



Preparation for laminate curing

Cut the laminate to the requisite number of plies having the correct dimensions and fibre orientation for the laminate to be produced. Lay up the laminate onto the tool or caul plate that has been treated with release agent or film, in the desired configuration, taking care not to distort the material. As each ply of material is positioned, work out any entrapped air using light pressure with a paddle or roller before removing the release paper or polythene from that ply. Resin bleeding can be achieved by placing a layer of porous release film directly onto the lay up with sufficient layers of dry glass above to absorb the excess resin. A layer of non-porous fluorocarbon should be placed over the bleed plies to protect the vacuum bag. Install a vacuum bag by standard techniques. Insert at least two vacuum stems through the bag, connecting one to the vacuum source and the other, at a point on the part furthest from the source to a calibrated vacuum gauge. Draw vacuum and check for bag or system leaks.

Cured neat resin properties

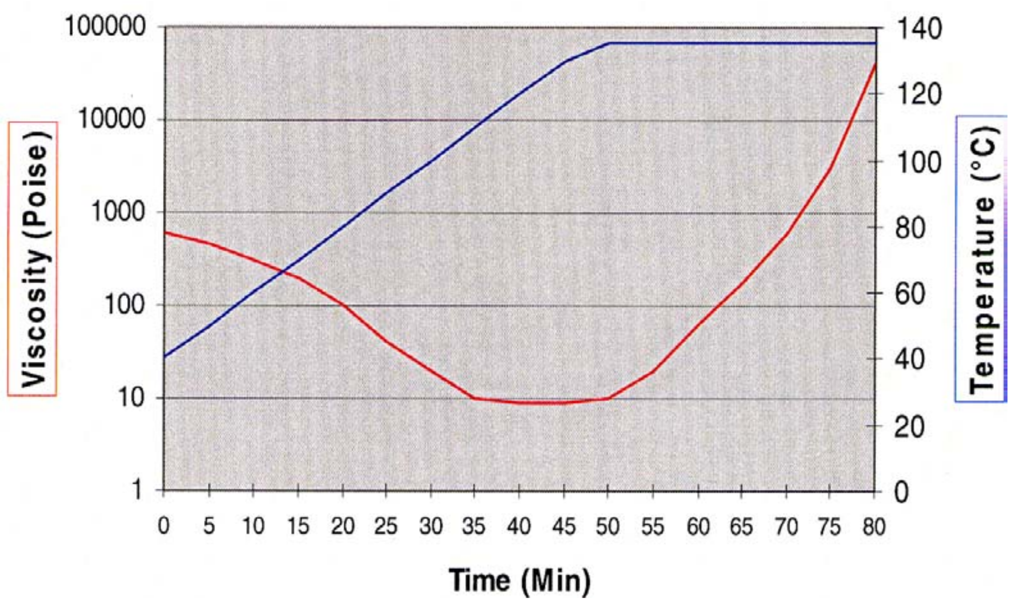
Cured for 6 hours @ 150°C

Wet= 14 day water immersion at 71°C

Property	Room temp.	121°C wet
Resin density (g/cm^3)	1.31	
Compressive strength (MPa)	179.3	
Flexural strength (MPa)	154.5	77.9
Flexural modulus (GPa)	3.93	3.03
K_{IC} (MPa/m^2)	1.59	
G_{IIC} (J/m^2)	638	
RDS DMA Tg (°C) 5°C/min Ramp Rate		
G'	165	
G"	173	
Tan d	185	

Resin viscosity

Viscosity trace of CYCOM 977-6 minimum viscosity = 9 poise

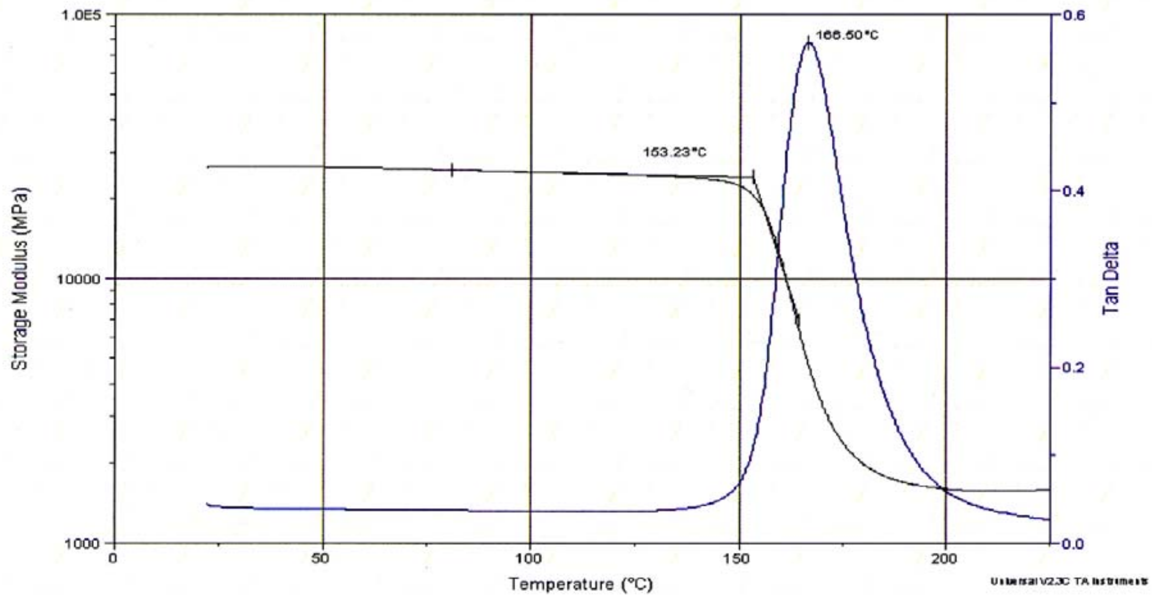


Laminate outgassing

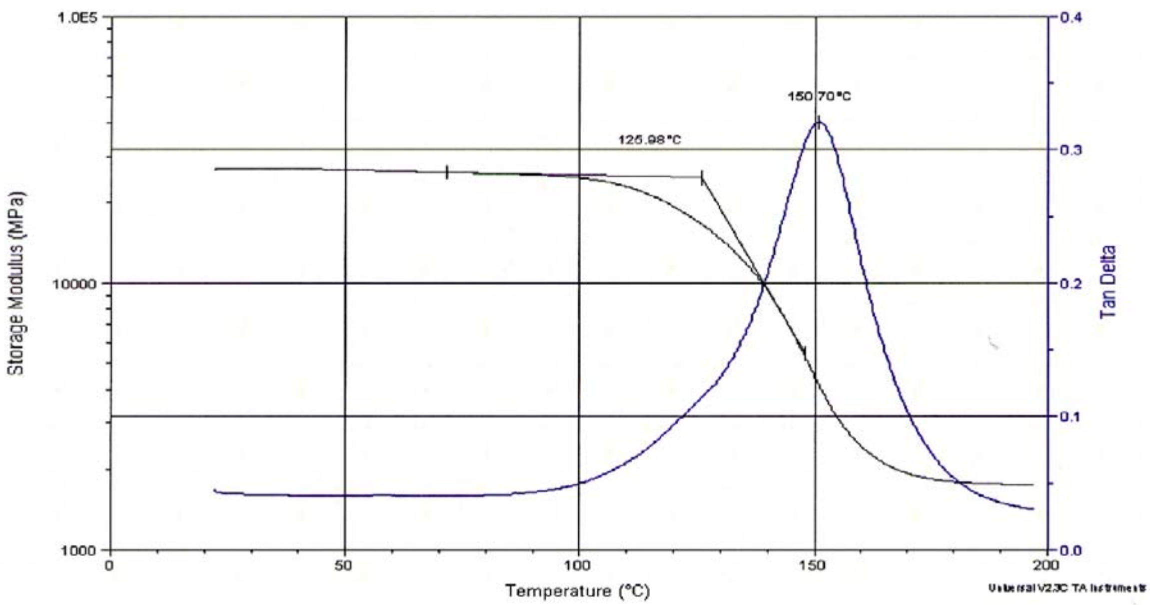
Property	Test method	Average
TML %	ASTM E 595	0.13
CVCM %	ASTM E 595	0.00
WVR %	ASTM E 595	0.07

Glass transition temperature

DMA trace of 977-6-38%-HTA-145 cured for 3 hours @ 135°C

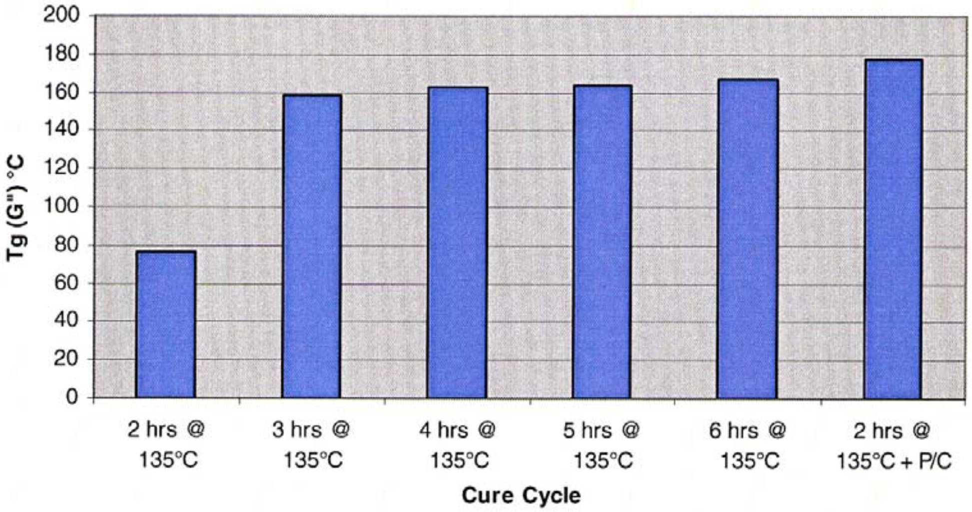


DMA trace of 977-6-38%-HTA-145 cured for 3 hours @ 135°C followed by a 24 hour water boil

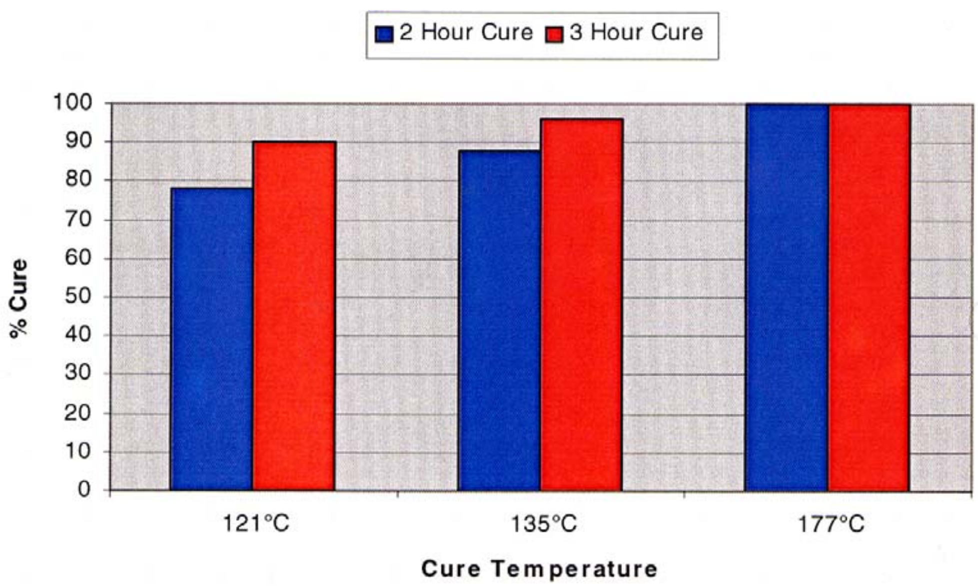


Cure study

Tg (G") of CYCOM 977-6 following various cures



% Cure following various cure cycles - tested by DSC



Mechanical properties

HTA unidirectional tape

977-6-38%-HTA-145-300

Property	Test temp.	Conditioning	Actual result 54.7% v.f.	Normalised 60% v.f.
Tensile strength (MPa)	RT	Dry	1591	1745
	100°C	Dry	1383	1517
Tensile modulus (GPa)	RT	Dry	104	114
	100°C	Dry	108	118
Compressive strength (MPa)	RT	Dry	1223	1341
	100°C	Dry	1042	1143
	132°C	Dry	1000	1097
	RT	Wet	768	842
	120°C	Wet	326	358
Compressive modulus (GPa)	RT	Dry	112	123
	100°C	Dry	116	127
	132°C	Dry	121	133
	RT	Wet	115	126
	120°C	Wet	119	131
Interlaminar shear strength (MPa)	RT	Dry	125	–
	100°C	Dry	91	–
	132°C	Dry	77	–
	RT	Wet	108	–
	100°C	Wet	63	–
	120°C	Wet	54	–
In plane shear strength (MPa)	RT	Dry	173	–
	100°C	Dry	135	–
	132°C	Dry	104	–
	RT	Wet	163	–
	120°C	Wet	85	–
In plane shear modulus (GPa)	RT	Dry	3.54	–
	RT	Wet	2.46	–
G_{IC} (J/M^2)	RT	Dry	301	–
G_{IIC} (J/M^2)	RT	Dry	1212	–
Compression after impact (MPa)	RT	Dry	252	–
(ksi)	RT	Dry	36.6	–

Mechanical properties, cont.

IM7 unidirectional tape

977-6-36%-IM7-140-300

Property	Test temp.	Conditioning	Actual result 56.1% v.f.	Normalised 60% v.f.
Tensile strength (MPa)	RT	Dry	2448	2618
Tensile modulus (GPa)	RT	Dry	154	165
Compressive strength (MPa)	RT	Dry	1579	1689
Interlaminar shear strength (MPa)	RT	Dry	121	
Flexural strength (MPa)	RT	Dry	1628	1741
Flexural modulus (GPa)	RT	Dry	144	154
Open hole compression (MPa)	RT	Dry	328	351
G_{IC} (J/M^2)	RT	Dry	333	
G_{IIC} (J/M^2)	RT	Dry	1138	
Compression after impact (MPa)	RT	Dry	276	
(ksi)	RT		40	

IM7 unidirectional tape

977-6-36%-T1000-140-300

Property	Test temp.	Conditioning	Actual result 56.4% v.f.	Normalised 60% v.f.
Tensile strength (MPa)	RT	Dry	3095	3293
Tensile modulus (GPa)	RT	Dry	162	172
Compressive strength (MPa)	RT	Dry	1462	1555
Compressive modulus (GPa)	RT	Dry	137	146
Interlaminar shear strength (MPa)	RT	Dry	112	

TECHNICAL DATASHEET

Mechanical properties, cont.

M46J unidirectional tape

977-6-36%-M46J-140-300

Property	Test temp.	Conditioning	Actual result 55.9% v.f.	Normalised 60% v.f.
Tensile strength (MPa)	RT	Dry	2024	2172
Tensile modulus (GPa)	RT	Dry	254	273
90° tensile strength (MPa)	RT	Dry	58	
90° tensile modulus (MPa)	RT	Dry	7.4	
Compressive strength (MPa)	RT	Dry	1009	1083
Compressive modulus (GPa)	RT	Dry	223	239
Flexural strength (MPa)	RT	Dry	1278	1372
Flexural modulus (GPa)	RT	Dry	212	228
Interlaminar shear strength (MPa)	RT	Dry	112	

M55J unidirectional tape

977-6-36%-M55J-140-300

Property	Test temp.	Conditioning	Actual result 54.9% v.f.	Normalised 60% v.f.
Tensile strength (MPa)	RT	Dry	1975	2159
Tensile modulus (GPa)	RT	Dry	309	338
90° tensile strength (MPa)	RT	Dry	36	
90° tensile modulus (MPa)	RT	Dry	6.3	
Compressive strength (MPa)	RT	Dry	959	1048
Compressive modulus (GPa)	RT	Dry	273	298
Flexural strength (MPa)	RT	Dry	1085	1186
Flexural modulus (GPa)	RT	Dry	271	296
Interlaminar shear strength (MPa)	RT	Dry	81	

Mechanical properties, cont.

T800 2X2T fabric

977-6-42%-6KT800-2X2T-300-1000

Property	Test temp.	Conditioning	Actual result	Normalised
			50.0% v.f.	**55% v.f.**
Tensile strength (MPa)	RT	Dry	941	1035
Tensile modulus (GPa)	RT	Dry	71	78
Weft tensile strength (MPa)	RT	Dry	946	1041
Weft tensile modulus (MPa)	RT	Dry	75	82
Compressive strength (MPa)	RT	Dry	764	840
Compressive modulus (GPa)	RT	Dry	67	74
In plane shear strength (MPa)	RT	Dry	138	
In plane shear modulus (GPa)	RT	Dry	3.7	
Interlaminar shear strength (MPa)	RT	Dry	85	

T1000 2X2T fabric

977-6-42%-12KT1000-2X2T-200-1000

Property	**Test temp.**	**Conditioning**	**Actual result**	**Normalised**
		50.1% v.f.	**55% v.f.**	
Tensile strength (MPa)	RT	Dry	1237	1358
Tensile modulus (GPa)	RT	Dry	80	88
Compressive strength (MPa)	RT	Dry	766	841
Compressive modulus (GPa)	RT	Dry	70	77
Interlaminar shear strength (MPa)	RT	Dry	89	

Mechanical properties, cont.

T300 plain weave fabric

977-6-50%-1KT300-P-120-1000

Property	Test temp.	Conditioning	Actual result 42.7% v.f.	Normalised 55% v.f.
Tensile strength (MPa)	RT	Dry	703	905
Tensile modulus (GPa)	RT	Dry	53	68
Weft tensile strength (MPa)	RT	Dry	720	927
Weft tensile modulus (MPa)	RT	Dry	51	66
Compressive strength (MPa)	RT	Dry	533	686
Compressive modulus (GPa)	RT	Dry	47	61
Weft compressive strength (MPa)	RT	Dry	498	641
Weft compressive modulus (GPa)	RT	Dry	48	62
In plane shear strength (MPa)	RT	Dry	139	
In plane shear modulus (GPa)	RT	Dry	3.9	
Interlaminar shear strength (MPa)	RT	Dry	83	

TECHNICAL DATASHEET

Health and safety information

Warning: CYCOM 977-6 contains epoxy resin. May cause allergic skin reaction or primary skin irritation. Avoid prolonged or repeated contact with skin. Wash thoroughly after handling. Over exposure to vapour during heat curing may cause irritation or injury of the respiratory tract and eye irritation.

First aid: In case of skin contact, wash skin with soap and water. In case of eye contact, immediately irrigate with plenty of water for 15 minutes. If heated vapour is inhaled, remove from exposure. Administer oxygen if there is difficulty breathing.

Ventilation required: Use mechanical exhaust ventilation when heat curing resin system.

Detailed handling instructions: Refer to the Cytec Engineered Materials Safety Datasheet (available on request) and product labels for this material.

Important notice

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