

PRODUCT DATA SHEET

DESCRIPTION

Toray TC522 is a highly toughened modified epoxy resin system. TC522 displays outstanding Compression After Impact (CAI), setting it apart from other resins designed for dielectric applications. TC522 exhibits excellent mechanical and thermal properties, along with very low moisture absorption. TC522 low dielectric constant and loss tangent along with very high CAI make it ideal for radome and antenna applications in environments where impact and high mechanical properties are required.

FEATURES

- ▶ Outstanding compression after impact (CAI)
- ▶ Low dielectric constant and loss tangent
- ▶ Outstanding hot/wet properties
- ▶ Very low moisture absorption
- ▶ Long room temperature out life and freezer storage life
- ▶ Meets NASA requirements for outgassing
- ▶ High performance product offering an excellent balance of electrical, mechanical, and general properties for highly loaded dielectric structures in severe impact environments

PRODUCT TYPE

180°C (356°F) Cure Highly Toughened Modified Epoxy

TYPICAL APPLICATIONS

- ▶ Radomes and antennas
- ▶ High impact and load environment applications
- ▶ Reflectors
- ▶ Low observable structures
- ▶ Aircraft and space structures

SERVICE TEMPERATURE

121°C (250°F)

SHELF LIFE

Out Life:	21 days out life < 21°C (70°F) and < 60% RH
Frozen Storage Life:	12 months storage life at -18°C (< 0°F) or below

**Out life is the maximum time allowed at 21°C (70°F) or below and 60% or less RH before cure, after a single frozen storage cycle in the original unopened packaging at -18°C (0°F) or below for a period not exceeding the frozen storage life noted above.*

TYPICAL NEAT RESIN PROPERTIES

Resin Density	1.21 g/cc	
T _g (by DMA)	Dry: 189°C (372°F) cured at 180°C (356°F)	
Outgassing (TML*)	0.47%	
Outgassing (CVCVM*)	< 0.01%	
Outgassing (WVR*)	0.29	
Dielectric Constant	2.98 (at 10 GHz)	2.85 (at 30 GHz)
	2.85 (at 20 GHz)	3.02 (at 40 GHz)
Loss Tangent	0.013 (at 10 GHz)	0.016 (at 30 GHz)
	0.014 (at 20 GHz)	0.015 (at 40 GHz)

**CVCVM: Collected Volatile Condensable Materials (Tested on Neat Resin)*

**TML: Total Mass Loss (Tested on Neat Resin)*

**WVR: Water Vapor Recovered (Tested on Neat Resin)*



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MECHANICAL PROPERTIES: LAMINATE PROPERTIES ON 7781 Fg

7781 Fg, 294gsm/TC522, 38% Resin Content Cured at 180°C (356°F) for 2 hours				
Properties	Condition	Methods	Results	
Tensile Strength 0°	RTD	ASTM D 3039	497 MPa	72.1 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	30.3 GPa	4.40 Msi
Tensile Strength 0°	ETD	ASTM D 3039	428 MPa	62.1 ksi
Tensile Modulus 0°	ETD	ASTM D 3039	31.0 GPa	4.49 Msi
Tensile Strength 0°	ETW	ASTM D 3039	363 MPa	52.7 ksi
Tensile Modulus 0°	ETW	ASTM D 3039	25.2 GPa	3.65 Msi
Tensile Strength 90°	RTD	ASTM D 3039	439 MPa	62.8 ksi
Tensile Modulus 90°	RTD	ASTM D 3039	30.6 GPa	4.44 Msi
Tensile Strength 90°	ETD	ASTM D 3039	361 MPa	51.7 ksi
Tensile Modulus 90°	ETD	ASTM D 3039	29.9 GPa	4.33 Msi
Tensile Strength 90°	ETW	ASTM D 3039	310 MPa	44.4 ksi
Tensile Modulus 90°	ETW	ASTM D 3039	26.6 GPa	3.86 Msi
Compressive Strength 0°	RTD	ASTM D 6641	678 MPa	98.3 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	25.2 GPa	3.65 Msi
Compressive Strength 0°	ETD	ASTM D 6641	568 MPa	82.4 ksi
Compressive Modulus 0°	ETD	ASTM D 6641	25.9 GPa	3.75 Msi
Compressive Strength 0°	ETW	ASTM D 6641	465 MPa	67.5 ksi
Compressive Modulus 0°	ETW	ASTM D 6641	28.2 GPa	4.09 Msi
Compressive Strength 90°	RTD	ASTM D 6641	527 MPa	76.4 ksi
Compressive Modulus 90°	RTD	ASTM D 6641	24.9 GPa	3.61 Msi
Compressive Strength 90°	ETD	ASTM D 6641	429 MPa	62.2 ksi
Compressive Modulus 90°	ETD	ASTM D 6641	24.6 GPa	3.57 Msi
Compressive Strength 90°	ETW	ASTM D 6641	359 MPa	52.1 ksi
Compressive Modulus 90°	ETW	ASTM D 6641	25.0 GPa	3.62 Msi
Short Beam Shear Strength	RTD	ASTM D 2344	75.9 MPa	11.0 ksi
Short Beam Shear Strength	ETD	ASTM D 2344	57.6 MPa	8.35 ksi
Short Beam Shear Strength	ETW	ASTM D 2344	38.3 MPa	5.55 ksi
In-Plane Shear Strength	RTD	ASTM D 3518	111 MPa	16.1 ksi
In-Plane Shear Modulus	RTD	ASTM D 3518	3.59 GPa	0.52 Msi
In-Plane Shear Strength	ETD	ASTM D 3518	93.4 MPa	13.5 ksi
In-Plane Shear Modulus	ETD	ASTM D 3518	2.76 GPa	0.40 Msi
In-Plane Shear Strength	ETW	ASTM D 3518	73.3 MPa	10.6 ksi
In-Plane Shear Modulus	ETW	ASTM D 3518	1.86 GPa	0.27 Msi
CAI-1500 in-lb/in	RTD	ASTM D 7136/7137	280 MPa	40.6 ksi

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7781 Fg, 294gsm/TC522, 38% Resin Content Cured at 180°C (356°F) for 2 hours			
Properties	Condition	Methods	Results
T _g	Dry		196°C (384°F)
T _g	Wet		165°C (329°F)
Laminate Water Absorption	-		0.53%
Dielectric Constant (at 10 GHz)	-	ASTM D 2520 A	4.48
Dissipation Constant (at 10 GHz)	-	ASTM D 2520 A	0.01

Notes:

Values were all normalized to 55% fiber volume for all samples except SBS. Fiber volume determined by acid digestion.

ETW specimens were soaked at 71°C (160°F) in water for 14 days.

ETD and ETW tested at 121°C (250°F).

MECHANICAL PROPERTIES: LAMINATE PROPERTIES ON 4581 ASTROQUARTZ III

4581 AQ III, 288gsm/TC522, 38% Resin Content Autoclave Cured @ 180°C (356°F) for 2 hours				
Properties	Condition	Methods	Results	
Tensile Strength 0°	RTD	ASTM D 3039	723 MPa	105 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	31.1 GPa	4.51 Msi
Tensile Strength 0°	ETD	ASTM D 3039	591 MPa	85.7 ksi
Tensile Modulus 0°	ETD	ASTM D 3039	29 GPa	4.20 Msi
Tensile Strength 0°	ETW	ASTM D 3039	484 MPa	70.2 ksi
Tensile Modulus 0°	ETW	ASTM D 3039	25.9 GPa	3.76 Msi
Tensile Strength 90°	RTD	ASTM D 3039	674 MPa	97.7 ksi
Tensile Modulus 90°	RTD	ASTM D 3039	30.1 GPa	4.36 Msi
Tensile Strength 90°	ETD	ASTM D 3039	562 MPa	81.5 ksi
Tensile Modulus 90°	ETD	ASTM D 3039	29.9 GPa	4.34 Msi
Tensile Strength 90°	ETW	ASTM D 3039	449 MPa	65.1 ksi
Tensile Modulus 90°	ETW	ASTM D 3039	25.5 GPa	3.70 Msi
Compressive Strength 0°	RTD	ASTM D 6641	557 MPa	80.8 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	28.8 GPa	4.17 Msi
Compressive Strength 0°	ETD	ASTM D 6641	493 MPa	71.5 ksi
Compressive Modulus 0°	ETD	ASTM D 6641	27.7 GPa	4.02 Msi
Compressive Strength 0°	ETW	ASTM D 6641	418 MPa	60.6 ksi
Compressive Modulus 0°	ETW	ASTM D 6641	27.2 GPa	3.95 Msi
Compressive Strength 90°	RTD	ASTM D 6641	500 MPa	72.6 ksi
Compressive Modulus 90°	RTD	ASTM D 6641	27 GPa	3.91 Msi
Compressive Strength 90°	ETD	ASTM D 6641	430 MPa	62.3 ksi
Compressive Modulus 90°	ETD	ASTM D 6641	25.4 GPa	3.68 Msi
Compressive Strength 90°	ETW	ASTM D 6641	370 MPa	53.7 ksi
Compressive Modulus 90°	ETW	ASTM D 6641	24.1 GPa	3.49 Msi

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4581 AQ III, 288gsm/TC522, 38% Resin Content Autoclave Cured @ 180°C (356°F) for 2 hours				
Properties	Condition	Methods	Results	
Short Beam Shear Strength	RTD	ASTM D 2344	77.7 MPa	11.3 ksi
Short Beam Shear Strength	ETD	ASTM D 2344	62.9 MPa	9.12 ksi
Short Beam Shear Strength	ETW	ASTM D 2344	47.0 MPa	6.81 ksi
In-Plane Shear Strength	RTD	ASTM D 3518	135 MPa	19.6 ksi
In-Plane Shear Modulus	RTD	ASTM D 3518	4.14 GPa	0.60 Msi
In-Plane Shear Strength	ETD	ASTM D 3518	91.8 MPa	13.3 ksi
In-Plane Shear Modulus	ETD	ASTM D 3518	3.1 GPa	0.45 Msi
In-Plane Shear Strength	ETW	ASTM D 3518	66.3 MPa	9.62 ksi
In-Plane Shear Modulus	ETW	ASTM D 3518	2.34 GPa	0.34 Msi
CAI-1500 in-lb/in	RTD	ASTM D 7136/7137	272 MPa	39.4 ksi
T _g	Dry		198°C (389°F)	
T _g	Wet		176°C (348°F)	
Laminate Water Absorption	-		0.53%	
Dielectric Constant (at 10 GHz)	-	ASTM D2520 A	3.33	
Dissipation Constant (at 10 GHz)	-	ASTM D2520 A	0.004	

Notes:

Values were all normalized to 55% fiber volume for all samples except SBS. Fiber volume determined by acid digestion.
 ETW specimens were soaked at 71°C (160°F) in water for 14 days.
 ETD and ETW tested at 121°C (250°F).

FREEZER STORAGE

Resin prepregs should always be sealed in an airtight bag and kept frozen below -18°C (0°F) when not being used. Best practice is to always keep a bag of activated desiccant (silica moisture absorber) in the core of the prepreg roll should a pinhole rupture develop in the bag or other problem occurs.

HANDLING OF MATERIALS

When handling any prepreg materials, one should always wear clean, powder-free latex gloves. This will assure that no hand oils are transferred to the prepreg and/or composite during processing. The presence of oils in the part could lead to problems in both mechanical and electrical performance of the part. This also guards against dermatitis that could occur with certain users.

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LAY-UP AREA ENVIRONMENTAL CONTROLS

Toray recommends that any composite or adhesive lay-up be performed in a clean area visibly free from dust and other contaminants. Any work surfaces should likewise be free of residue, dust, or debris. No eating or smoking shall be allowed in the shop area. For radome materials, conductive materials shall not be allowed in the process area. The processing shop area should be maintained between 16–25°C (60–77°F) with a relative humidity of no greater than 70%.

AUTOCLAVE CURE CYCLE

1. After debulking as shown in Figure 2 and assembling the laminate for cure as shown in Figure 3, proceed to cure the laminate as described (see Figure 1)
2. Apply vacuum to a level of at least 0.9 bar (27 inHg)
3. Ramp temperature at 0.5–1°C (1–2°F) per minute to 93°C (200°F) and hold for 1 hour
4. Apply 3 bar (45 psi) and vent vacuum after pressure reaches 1.3 bar (20 psi)
5. Ramp at 0.5–1°C (1–2°F) per minute to 180°C (356°F) and hold for 2 hours
6. Cool down to 49°C (120°F) at 3°C (5°F) per minute or slower before releasing pressure

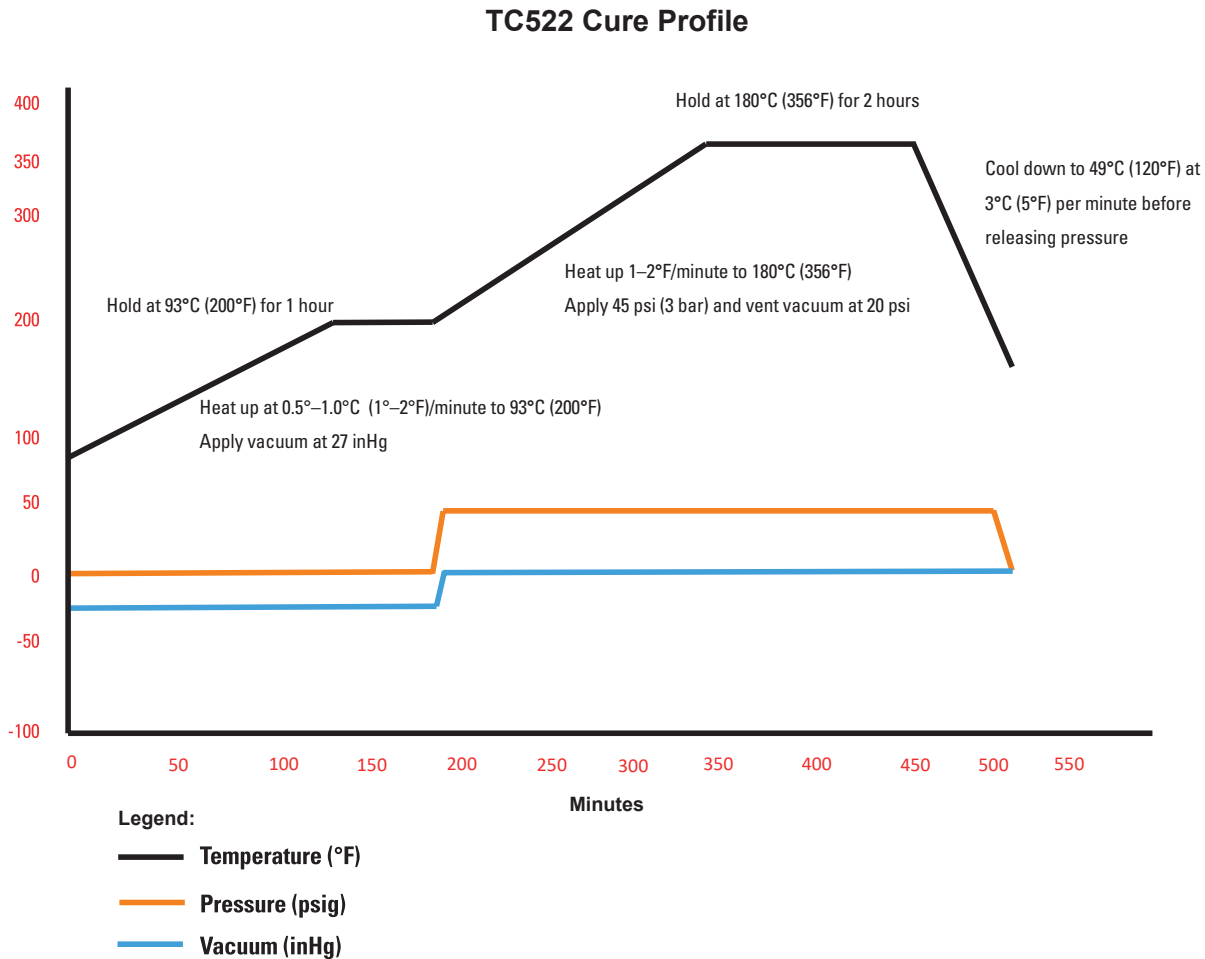


Fig. 1 TC522 Cure Profile

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BAGGING FOR DEBULKING

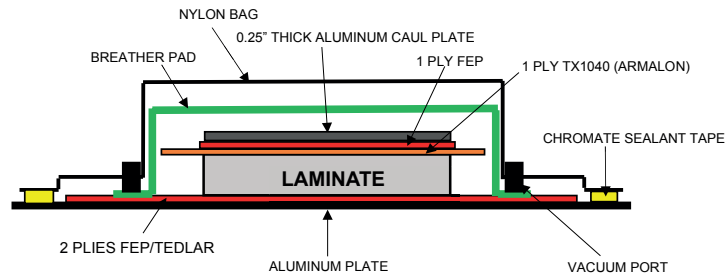
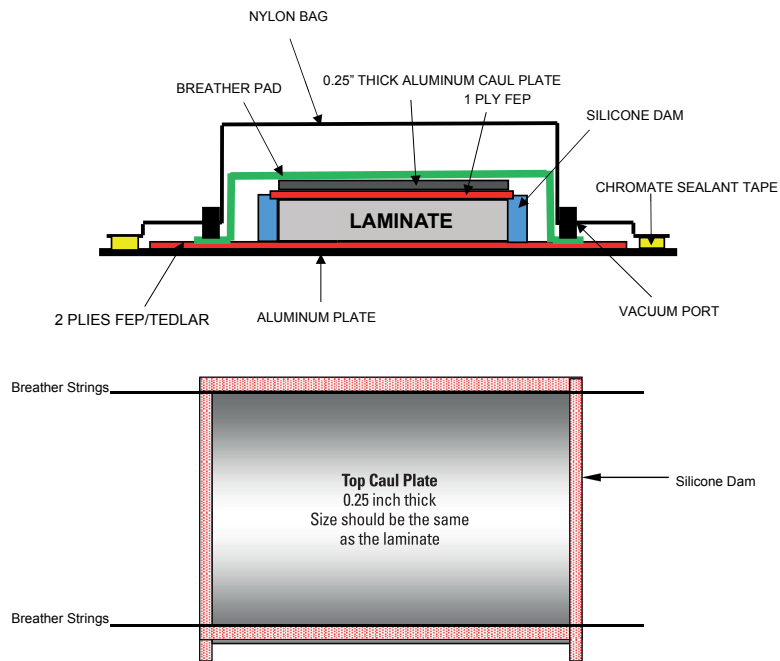


Fig. 2 Debulk Diagram - Sequential debulk every 4 plies



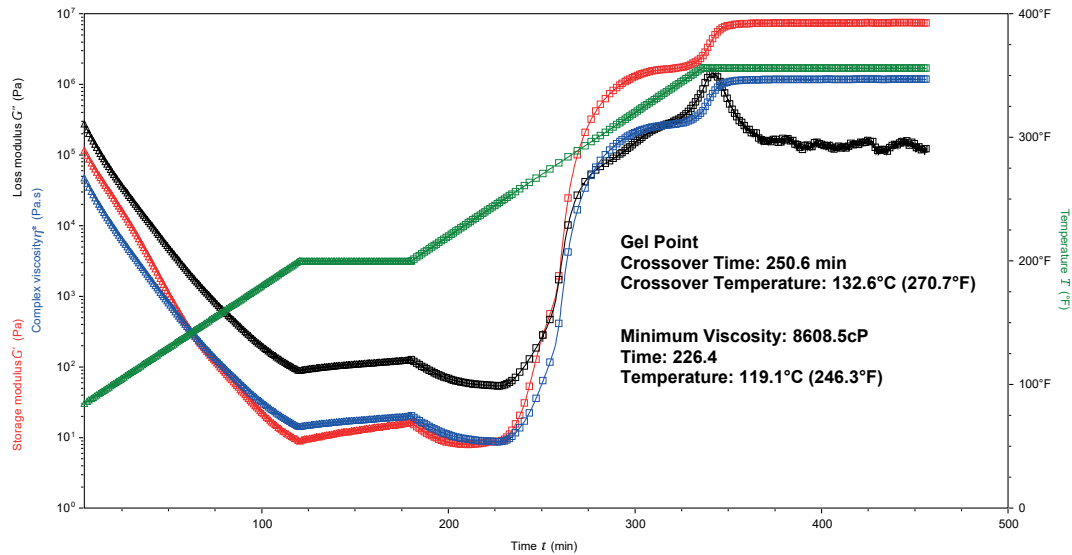
Note: The breather string must be in the edge of the part, must not lay on the top of the panel, and must extend out past the seal to touch the breather pad as shown

Fig. 3 Lay-up and Assembly for Cure Diagram

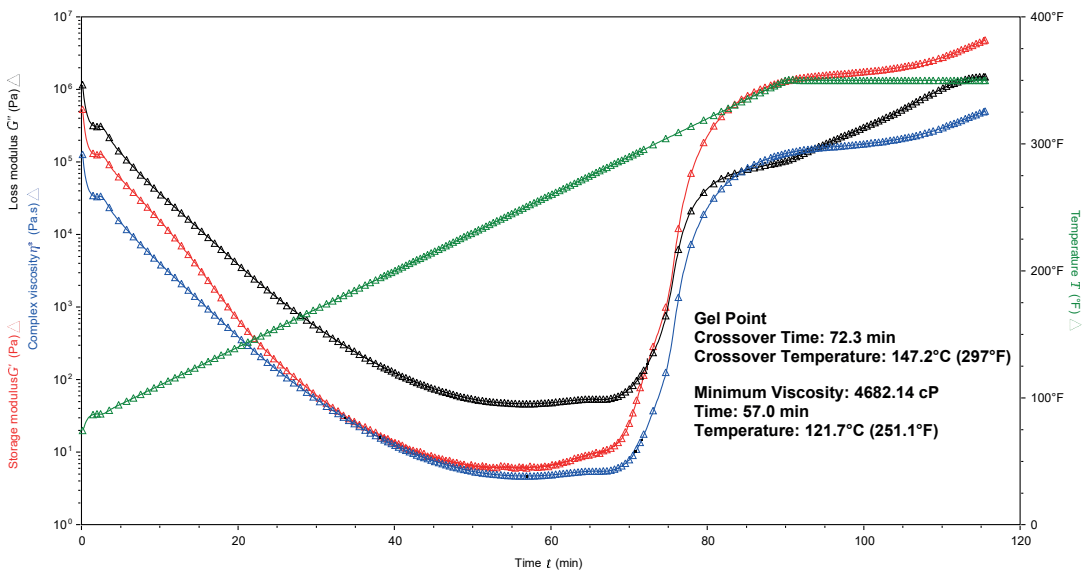
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TC522 RESIN RHEOLOGY PROFILE

TC522 Rheometric Cure Profile -
1°F/min to 93.3°C (200°F), 1-hour hold, 1°F/min to 180°C (356°F), 2-hour hold



TC522 Rheometric Cure Profile: 3°F/min to 180°C (356°F), 1-hour hold



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