

PRODUCT DATA SHEET

DESCRIPTION

Toray TC420 is a flow-controlled toughened high temperature cyanate ester resin. It can act as a self-adhesive system and is resistant to microcracking. This resin represents a new family of next generation high temperature resins, film adhesives, syntactic paste and expanding foams for ultra-high temperature conditions.

TC420 has epoxy-like processing flexibility and robustness and can yield low void laminates under both pressure and vacuum only curing processes. This system is also autoclave processable. TC420 is an attractive alternative to bismaleimide (BMI) and polyimide resins.

FEATURES

- ▶ High temperature stability and resistance to microcracking
- ▶ Capable of 260°C (500°F) extended dry service with short-term capability to 316°C (600°F)
- ▶ Low void content with OOA/VBO cure
- ▶ Utilizes standard 177°C (350°F) cure temperature with optional freestanding post cure at 232–260°C (450–500°F) to develop full high temperature capability

PRODUCT TYPE

177°C (350°F) Cure
High Temperature Toughened Cyanate Ester Resin System

TYPICAL APPLICATIONS

- ▶ Heat shields
- ▶ Ablative structure
- ▶ Missile nose cones/nozzles
- ▶ Supersonic aircraft
- ▶ Very high temperature radomes
- ▶ Attractive alternative to BMI or polyimides

SHELF LIFE

Out Life: 21 days at 21°C (70°F) or below and 60% RH or lower

Frozen Storage Life: 12 months at -18°C (< 0°F) or below

Out life is the maximum time allowed at the conditions noted 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.

Out life tested by SBS on 16-ply 15 x 15 cm (6 x 6") laminate, cured via out-of-autoclave/vacuum-bag only (OOA/VBO) process with 914–918 mbar (27–28 inHg) of vacuum. Users may need to separately evaluate out life limits on thicker, larger, and more complex parts.

TYPICAL NEAT RESIN PROPERTIES[^]

Density	1.22 g/cm ³ 177°C (350°F) Cure 1.20 g/cm ³ 260°C (500°F) Post Cure
CTE	60 ppm/°C 177°C (350°F) Cure 55 ppm/°C 260°C (500°F) Post Cure

Dry T _g - 2 hours (177°C/350°F) Cure	176°C (349°F)
Wet T _g * - 2 hours (177°C/350°F) Cure	167°C (333°F)
Dry T _g - After post cure 1 hour (260°C/500°F)	348°C (658°F)
Wet T _g * - After post cure 1 hour (232°C/450°F)	289°C (552°F)

Tensile Modulus	3.93 GPa (0.57 Msi)	
Poissons' Ratio	0.38	
Shear Modulus	1.45 GPa (0.21 Msi)	
Outgassing (ASTM E595)	TML	0.41 %
	CVCM	< 0.01%
	WVR	0.28 %

* 14 days water soak at 71°C (160°F)

[^] Resin T_g properties are reported based on loss modulus.



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ELECTRICAL PROPERTIES OF COMPOSITE LAMINATES

TC420/4581 Quartz	C/X Band 8–18 GHz	Ku/K Band 18–26.5 GHz	Ka Band 26.5–40 GHz	Q & U Band 40–60 GHz
Dielectric Constant	3.33	3.18*	3.24	3.27
Loss Tangent	< 0.010**	< 0.010**	< 0.010**	< 0.010**

* Tested per ASTM D 2520 method A, all other values tested via focused beam.

** The loss tangent under focused beam testing is only sensitive to 0.010. This material is less than 0.010 in all frequency bands noted.

This material represents one of Toray's best for high temperature, high energy radome applications.

FABRIC PROPERTIES

Property	Condition	Method	Results						
			T800HB 6K 5HS ⁽¹⁾	12K AS7 Plain Weave Graphite Fabric ⁽²⁾	3K Standard Modulus Plain Weave Graphite Fabric ⁽³⁾	IM7 4 Harness Satin Weave Graphite Fabric ⁽³⁾	High Modulus 5HS Satin Weave ⁽³⁾	1K Standard Modulus Plain Weave Graphite Fabric ⁽²⁾⁽⁴⁾	1K Standard Modulus Satin Weave Fabric ⁽²⁾
Tensile Strength 0°	RTD	ASTM D 3039	1069 MPa (155 ksi)	986 MPa (143 ksi)	724 MPa (105 ksi)	903 MPa (131 ksi)	703 MPa (102 ksi)	676 MPa (98 ksi)	-
Tensile Modulus 0°	RTD	ASTM D 3039	70 GPa (10.1 Msi)	70 GPa (10.1 Msi)	72 GPa (10.5 Msi)	81 GPa (11.7 Msi)	148 GPa (21.5 Msi)	72 GPa (10.5 Msi)	-
Compression Strength 0°	RTD	SRM1/D 695 modified	793 MPa (115 ksi)	-	-	-	-	-	-
Compression Modulus 0°	RTD	SRM1/D 695 modified	68 GPa (9.9 Msi)	-	-	-	-	-	-
Compression Strength 0°	RTD	ASTM D 6641	621 MPa (90 ksi)	600 MPa (87 ksi)	648 MPa (94 ksi)	593 MPa (86 ksi)	338 MPa (49 ksi)	607 MPa (88 ksi)	-
Compression Modulus 0°	RTD	ASTM D 6641	69 GPa (10 Msi)	67 GPa (9.7 Msi)	63 GPa (9.2 Msi)	74 GPa (10.7 Msi)	149 GPa (21.6 Msi)	57 GPa (8.2 Msi)	-
Short Beam Shear	RTD	ASTM D 2344	51 MPa (7.4 ksi)	57 MPa (8.2 ksi)	-	-	-	59 MPa (8.6 ksi)	-
Compression Strength ±22.5 QI	RTD	ASTM D 6641	-	-	-	-	-	386 MPa (56 ksi)	494 MPa (72 ksi)
Compression Modulus ±22.5 QI	RTD	ASTM D 6641	-	-	-	-	-	59 GPa (8.6 ksi)	-
Compression Strength ±22.5 QI	RTD	ASTM D 6641	-	-	-	-	-	335 MPa (48 ksi)	-
Compression Strength ±22.5 QI	ETD-177°C (350°F)	ASTM D 6641	-	-	-	-	-	283 MPa (41 ksi)	441 MPa (64 ksi)
Char Performance ⁽⁶⁾	N/A	TM-63	80%	-	-	-	-	-	-
TOS	N/A	See Note 5	6.35%	-	-	-	-	-	-

Fabric Properties Note: Tensile and compression results normalized to 60% fiber volume fraction unless noted otherwise.

⁽¹⁾ 85 psi autoclave cure at 177°C (350°F) for 120 minutes followed by freestanding post cure at 250°C (482°F) for 90 minutes.

⁽²⁾ 00A/VBO cured at 177°C (350°F) for 120–180 minutes followed by freestanding post cure at 232°C (450°F) for 60–90 minutes.

⁽³⁾ 30 psi autoclave cured at 177°C (350°F) for 120–180 minutes followed by freestanding post cure at 232°C (450°F) for 60–90 minutes.

⁽⁴⁾ Tensile results normalized to 55% fiber volume fraction.

⁽⁵⁾ 550°F/150 psia/ 125 hours. % weight loss.

⁽⁶⁾ Char Yield - TGA N2 gas, 10°C/min, Final Temp: 1000°C

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UNIDIRECTIONAL PROPERTIES

Property	Condition	Method	Results		
			T1100SC-12K-50C ⁽¹⁾	T1100GC-24K-91N ⁽¹⁾	M46J 12K ⁽²⁾
Tensile Strength 0°	RTD	ASTM D 3039	3213 MPa (466 ksi)	3020 MPa (438 ksi)	1630 MPa (236 ksi)
Tensile Modulus 0°	RTD	ASTM D 3039	172 GPa (25 Msi)	172 GPa (25 Msi)	238 GPa (34.5 Msi)
Tensile Strength 90°	RTD	ASTM D 3039	-	-	8.3 MPa (1.2 ksi)
Tensile Modulus 90°	RTD	ASTM D 3039	-	-	6.2 GPa (0.9 Msi)
Compression Strength 0°	RTD	SRM1/D 695 modified	1614 MPa (234 ksi)	1737 MPa (252 ksi)	643 MPa (93 ksi)
Compression Modulus 0°	RTD	SRM1/D 695 modified	159 MPa (23 Msi)	166 GPa (24 Msi)	226 GPa (32.8 Msi)
Compression Strength 90°	RTD	SRM1/D 695 modified	-	-	156 MPa (22.6 ksi)
Compression Modulus 90°	RTD	SRM1/D 695 modified	-	-	6.9 GPa (1.0 Msi)
Compression Strength 0°	RTD	ASTM D 6641	1772 MPa (257 ksi)	1772 MPa (257 ksi)	-
Compression Modulus 0°	RTD	ASTM D 6641	159 MPa (23 Msi)	172 GPa (25 Msi)	-
Short Beam Shear Strength 0°	RTD	ASTM D 2344	99 MPa (14.4 ksi)	105 MPa (15.2 ksi)	66.9 MPa (9.7 ksi)
Short Beam Shear Strength 0°	ETD 250°F	ASTM D 2344	90 MPa (13 ksi)	-	-
Short Beam Shear Strength 0°	ETD 450°F	ASTM D 2344	57 MPa (8.2 ksi)	-	-
Open-hole Tensile Strength	RTD	ASTM D 5766	-	-	396 MPa (57.5 ksi)
Open-hole Compression Strength	RTD	ASTM D 6484	279 MPa (40.4 ksi)	-	202 MPa (29.3 ksi)
Open-hole Compression Strength	ETD 450°F	ASTM D 6484	246 MPa (35.6 ksi)	-	-
Compression After Impact	RTD	ASTM D 7136/D 7137	101 MPa (14.7 ksi)	-	-
T _g by DMA	Dry	ASTM D 7028	684	680	683
Char Performance ⁽³⁾	-	TGA	84%	83%	-

Post Cure in an inert atmosphere.

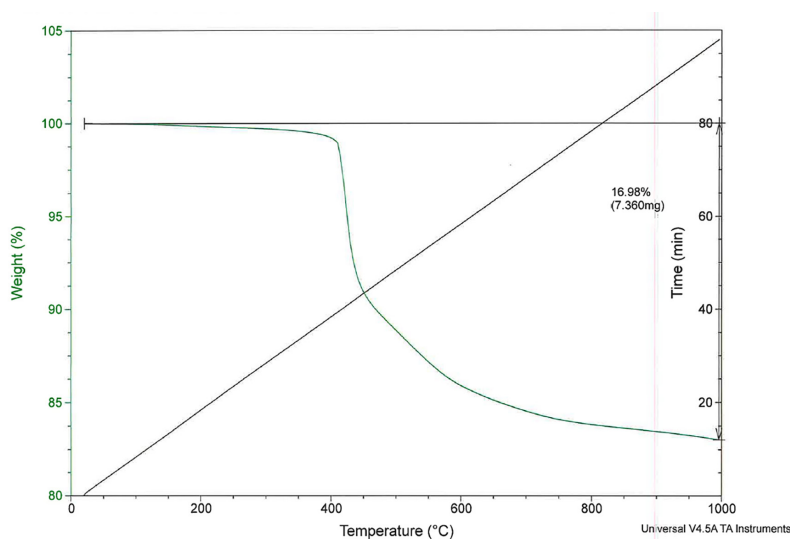
Axial tension and compression properties normalize to 60% FV.

⁽¹⁾ 85 psi autoclave cure at 177°C (350°F) for 120 minutes followed by post cure at 250°C (482°F) for 90 minutes.

⁽²⁾ OOA/VBO cured at 82°C (180°F) for 90 minutes followed by 177°C (350°F) for 120–180 minutes followed by freestanding post cure at 260°C (500°F) for 60–90 minutes.

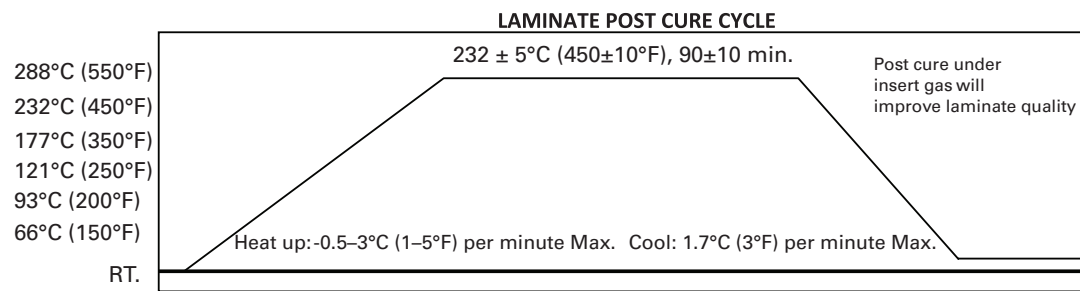
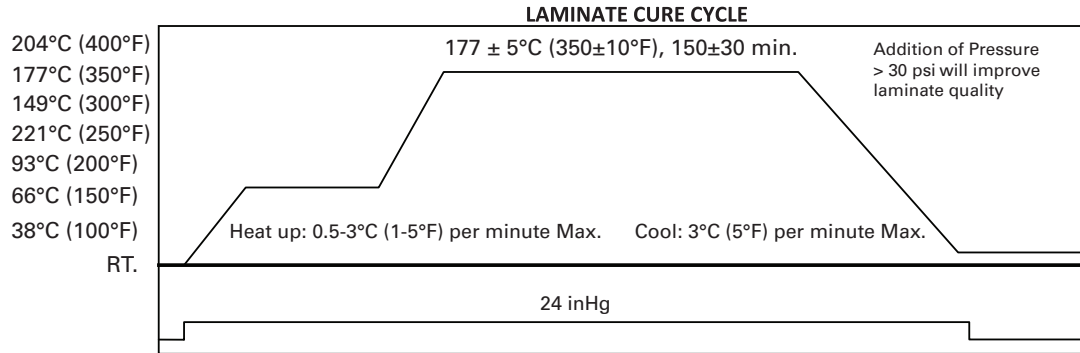
⁽³⁾ Char Yield - TGA N2 gas, 10°C/min, Final Temp: 1000°C

TC420/T1100TGA



Test Parameters: Use N2 @ 10C/minute to 1000C.

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TYPICAL COMPOSITE LAMINATE STACKING SEQUENCE

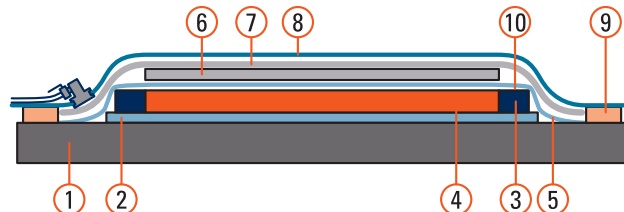
List of Materials

1. Tool—aluminum, steel, Invar, composite *(tool plates must be release coated or film covered). See the list below
2. Release coat or film—Frekote 700NC or 800NC, FEP¹, or TEDLAR²
3. Silicone edge dams for cure—slightly thicker than laminate
4. Laminate
5. FEP¹ or TEDLAR²
6. Caul plate—aluminum, steel, Invar, silicone rubber sheet (metal caul plates must be release coated or wrapped)
7. 2.2 oz/yd² polyester breather, 1 or more
8. Vacuum bag
9. Vacuum sealant
10. Glass yarn string (alternatively or additionally breather may wrap over top of dam to contact edge)

* Composite tools should be thoroughly dried before use.

¹ 260°C (500°F) max temp.

² 177°C (350°F) max temp.



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