PRODUCT DATA SHEET

TENCATE ADVANCED COMPOSITES

TC420 Resin System

PRODUCT TYPE

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

TYPICAL APPLICATIONS

- Heat Shields
- Ablative Structure and Heat Shields
- Missile Nose Cones/Nozzles
- Supersonic Aircraft
- Very High Temperature Radomes
- Viable alternative to BMI or Polyimides

CURE SCHEDULE

- 2-5°F (1-3°C)/minute to 180°F (82°C) for 90 minutes, followed by 120-180 minutes at 350°F (177°C). Cool down at less than 7°F (4°C) per minute.
- Optional free standing postcure at 2-5°F (1-3°C)/minute to 450-500°F (232-260°C) for 90 minutes. Cool down at less than 7°F (4°C) per minute.

  Cure pressure - vacuum only or 30-100 psi positive pressure.

SHELF LIFE

Tack Life

14 days tack life at 75°F (24°C)

Out Life

21 days out life 75°F (24°C)

Frozen Storage Life

6 months storage life at <0°F (-18°C)

Tack life is the time during which the prepreg retains enough tack, drape and handling for easy component lay-up.

Out life is the maximum time allowed at room temperature before cure.

PRODUCT DESCRIPTION

TC420 is a flow controlled high temperature cyanate ester resin, toughened to resist microcracking. TC420 is specifically formulated for out of autoclave large structure, can act as a self adhesive system and is resistant to microcracking. This resin improves on the success of EX-1505 resin, and represents a new family of next generation high temperature resins, film adhesives, syntactic paste and expanding foams for ultra high temperature conditions. This resin system is easy to process and yields low void laminates with a flexible cure cycle under vacuum only pressure. This system is also autoclave processable.

TC420, with its high Tg, is a viable option to BMI and polyimide resins.

TC420 PRODUCT FEATURES AND BENEFITS

- High temperature stability and resistance to microcracking
- Capable of 500°F (260°C) continuous service with short term capability to 600°F (316°C)
- Low void content in vacuum pressure cure conditions *(out of autoclave)*
- Utilizes standard 350°F (177°C) cure temperature with optional free standing post cure at 450-500°F (232-260°C) for 90 minutes for full high temperature capability

TYPICAL NEAT RESIN PROPERTIES

Density		1.22 g/cc 350°F (177°C) Cure 1.20 g/cc 500°F (260°C) Post Cure
CTE		60 ppm/°C 350°F (177°C) Cure 55 ppm/°C 500°F (260°C) Post Cure
Dry Tg - 2 hours (350°F/177°C) Cure		349°F (176°C)
Wet Tg* - 2 hours (350°F/177°C) Cure		333°F (167°C)
Dry Tg - After post cure 1 hour (500°F/260°C)		658°F (348°C)
Wet Tg* - After post cure 1 hour (450°F/232°C)		552°F (289°C)
Tensile Modulus		0.57 Msi (3.93 GPa)
Poissons' Ratio		0.38
Shear Modulus		0.21 Msi (1.45 GPa)
Outgassing (ASTM E595)	TML	0.41 %
	CVCM	<0.01%
	WVR	0.28 %

** 14 days water soak at 160°F (71°C)*

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 D2520 method A, all other values tested via focused beam.

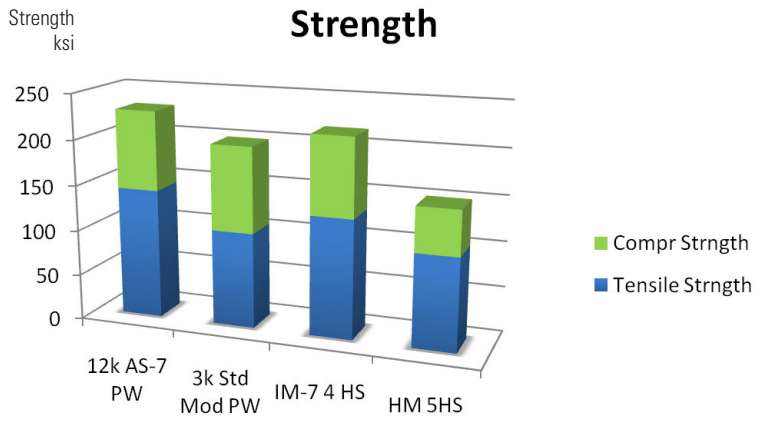
** * The loss tangent under focused beam testing is only accurate to 0.010. This material is less than 0.010. This material represents one of TenCate's best for high energy radome applications.*

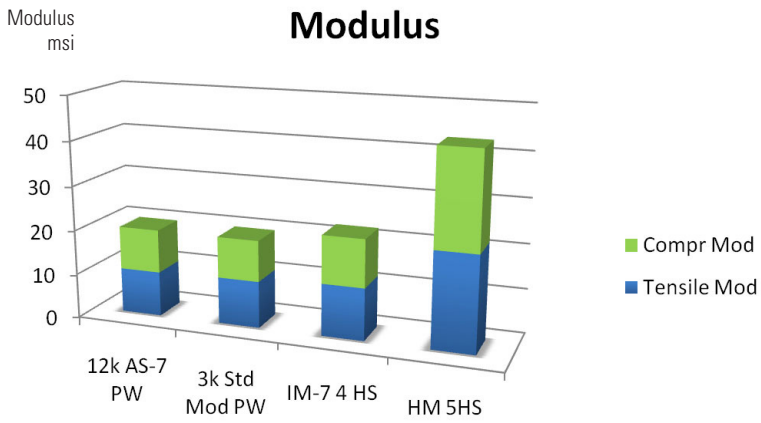
TC420 Resin System

LAMINATE PROPERTIES [4]

Properties	Condition (RTD, ETD, ETW)	Method	Results	
			1K Standard Modulus Plain Weave Graphite Fabric [1]	1k Standard Modulus Satin Weave Fabric [1]
Tensile Strength 0°	RTD	ASTM D3039	98 ksi (676 MPa)	
Tensile Modulus 0°	RTD	ASTM D3039	10.5 Msi (72 GPa)	
Compressive Strength 0°	RTD	ASTM D6641	88 ksi (607 MPa)	
Compressive Modulus 0°	RTD	ASTM D6641	8.2 Msi (57 GPa)	
Short Beam Shear	RTD	ASTM D2344	8.6 ksi (59 MPa)	
Compressive Strength ±22.5 QI	RTD	ASTM D6641	56 ksi (386 MPa)	71.7 ksi (494 MPa)
Compressive Modulus ±22.5 QI	RTD	ASTM D6641	8.6 Msi (59 GPa)	
Compressive Strength ±22.5 QI	ETD-350°F (177°C)	ASTM D6641	48 ksi (335 MPa)	
Compressive Strength ±22.5 QI	ETD-500°F (260°C)	ASTM D6641	41 ksi (283 MPa)	63.9 ksi (441 MPa)

Tensile and compression results normalized to 55% fiber volume.





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TENCATE ADVANCED COMPOSITES

TC420 Resin System

Properties	Condition (RTD, ETD, ETW)	Method	Results			
			12k AS7 Plain Weave Graphite Fabric [1]	3k Standard Modulus Plain Weave Graphite Fabric [2]	IM7 4 Harness Satin Weave Graphite Fabric [2]	High Modulus 5 HS Satin Weave [2]
Tensile Strength 0°	RTD	ASTM D3039	143 ksi (986 MPa)	105 ksi (724 MPa)	131 ksi (903 MPa)	102 ksi (703 MPa)
Tensile Modulus 0°	RTD	ASTM D3039	10.1 Msi (70 GPa)	10.5 Msi (72 GPa)	11.7 Msi (81 GPa)	21.5 Msi (148 GPa)
Compressive Strength 0°	RTD	ASTM D6641	87 ksi (600 MPa)	94 ksi (648 MPa)	86 ksi (593 MPa)	49 ksi (338 MPa)
Compressive Modulus 0°	RTD	ASTM D6641	9.7 ksi (67 GPa)	9.2 ksi (63 GPa)	10.7 ksi (74 GPa)	21.6 Msi (149 GPa)
Short Beam Shear	RTD	ASTM D2344	8.2 ksi (57 MPa)			

Tensile and compression results normalized to 60% fiber volume fraction.

[1] vacuum cured

[2] 30 psi autoclave cured

[3] Post cured at 500°F (260°C).

[4] Cured at 350°F (177°C) for 120-180 minutes followed by free standing post cure at 450°F (232°C) for 60-90 minutes.

Note: Data is average data from one or more datasets and no statistical confidence is assigned to the values.

M46J-12K 195 FAW, 36% RESIN CONTENT UNITAPE.

Properties	Condition (RTD, ETD, ETW)	Method	Results	
Tensile Strength 0°	RTD	ASTM D3039	236.4 ksi	1629.9 MPa
Tensile Modulus 0°	RTD	ASTM D3039	34.5 Msi	237.9 GPa
Tensile Strength 90°	RTD	ASTM D3039	1.2 ksi	8.3 MPa
Tensile Modulus 90°	RTD	ASTM D3039	0.9 Msi	6.2 GPa
Compressive Strength 0°	RTD	ASTM D695	93.3 ksi	643.3 MPa
Compressive Modulus 0°	RTD	ASTM D695	32.8 Msi	226.1 GPa
Compressive Strength 90°	RTD	ASTM D695	22.6 ksi	155.8 MPa
Compressive Modulus 90°	RTD	ASTM D695	1 Msi	6.9 GPa
Interlaminar Shear Strength	RTD (A)	ASTM D2344	9.7	66.9
Interlaminar Shear Strength	RTD	ASTM D2344	8.2	56.5
Open Hole Tensile Strength	RTD	ASTM D5766	57.5 ksi	396.5 MPa
Open Hole Comp. Strength	RTD	ASTM D6484	29.3 ksi	202.0 MPa

Cure cycle used was:

2°F/1°C per minute to 180°F/82°C, for 90 minutes, followed by a 350°F/177°C cure for 2-3 hours, under vacuum pressure only, no bleed. Laminates then underwent a freestanding postcure of 60-75 minutes at 500°F/260°C.

Laminates were debulked every 4 plies.

Values were normalized to 60% except for 90° values and interlaminar shear strengths.

(A) Room temperature value without 500°F/260°C postcure.

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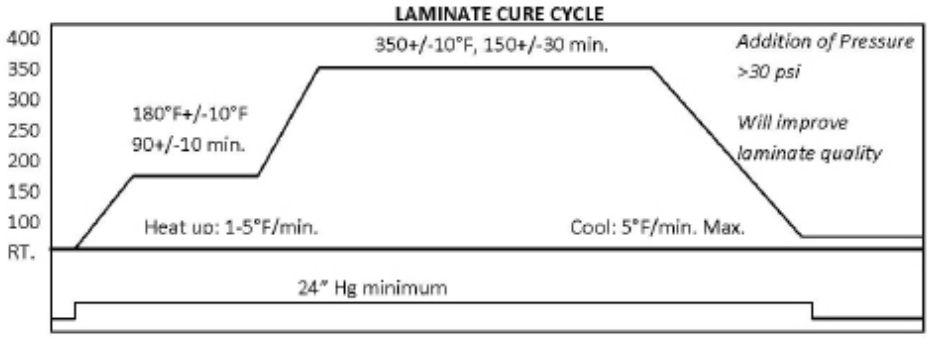
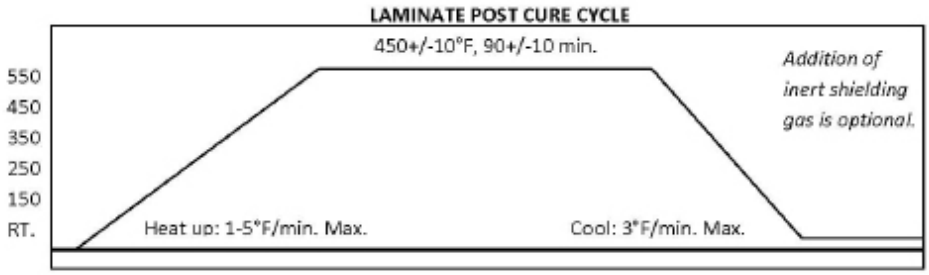
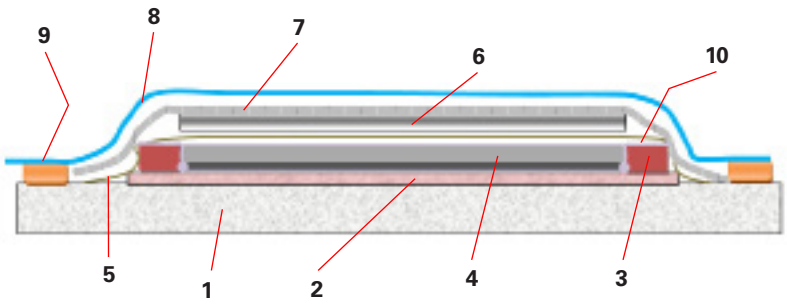




COMPOSITE LAMINATE STACKING SEQUENCE

LIST OF MATERIALS

1. Tool – aluminum, steel, Invar, composite
   (tool plates must be release coated or film covered)
2. Release coat or film – Frekote 800, FEP, TEDLAR
3. Silicone Edge Dams – Thicker than laminate
4. Laminate
5. Release coat or film – Frekote 700NC or 770NC, FEP, TEDLAR
6. Caul plate – aluminum, steel, Invar, silicone rubber sheet
   (metal caul plates must be release coated or wrapped)
7. 2.2 osy 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)



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