

PRODUCT DATA SHEET



TENCATE ADVANCED COMPOSITES

TC275-1 Epoxy Resin System

PRODUCT TYPE

275-350°F (135-177°C) Cure
Toughened Epoxy Resin System

DUAL CURE OPTIONS

- Cure A - 2°F/1.1°C per minute to 225°F/107°C, hold for 1 hour, then cure at 275°F/135°C for 6 hours.
- Cure B - 2°F/1.1°C per minute to 225°F/107°C for 1 hour, then cure at 350°F/177°C for 2 hours

TYPICAL APPLICATIONS

- Aircraft Structures
- Thick parts cured under low pressure
- Honeycomb stiffened parts

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

1 year storage life at <0°F (-18°C) or
9 months storage life at <10°F (-12°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

TC275-1 is a dual cure toughened epoxy prepreg designed to facilitate composite part construction with low pressure or vacuum pressure cures. The resin system features a 14 day tack life and 21 day total out time to allow the construction of thick or larger composite structure. TC275-1 may be cured at a lower temperature of 275°F/135°C or can be cured at 350°F/177°C for higher temperature service.

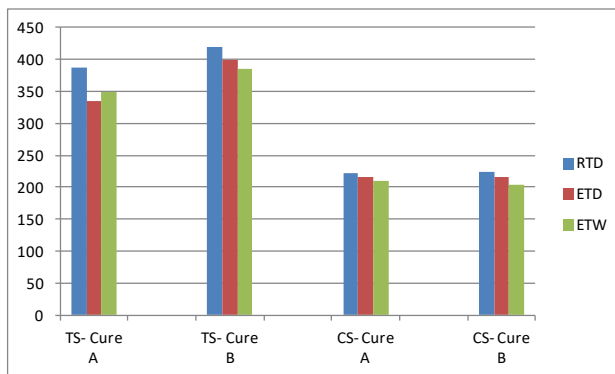
TC275-1 PRODUCT BENEFITS/FEATURES

- Dual cure prepreg system
- High toughness
- Excellent resistance to hot/wet exposure
- Robust processing and low voids under vacuum cure pressure
- Long outtime and tack life for shop floor handling

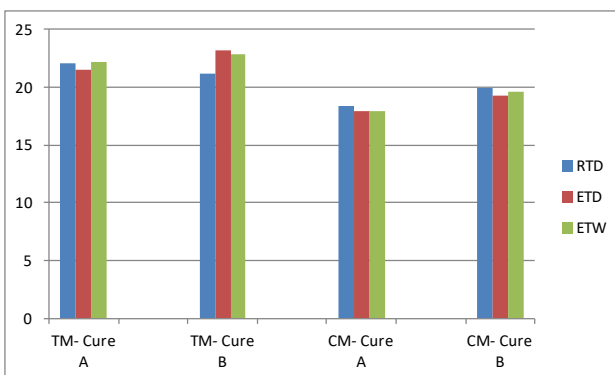
NEAT RESIN PHYSICAL PROPERTIES

Resin Density	1.17 g/cc
Resin Gel Time @ 275°F (135°C).....	19 – 23 min.
Gel Time @ 350°F (177°C).....	9 – 14 min.
Dynamic Viscosity	~12k cps @ 275°F (135°C) (– 3°F/min to 275°F to gel)
Tg cured 3°F/min to 275°F (135°C) hold for 6 hours Tg by DMA Dry	327°F (164°C)
Tg by DMA w/Post Cure 350°F (177°C) 2 hours Dry	362°F (183°C)
Tg by DMA Wet (saturated @ 160°F (77°C) 85%RH).....	277°F (136°C)

UNITAPE MECHANICAL PROPERTY COMPARISON - STRENGTH GRAFIL TR50S 15K FIBER WITH A FAW 150 GSM, 35% RC



UNITAPE MECHANICAL PROPERTY COMPARISON - MODULUS GRAFIL TR50S 15K FIBER WITH A FAW 150 GSM, 35% RC



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UNITAPE LAMINATE PROPERTIES

Unidirectional laminate data used Grafil TR50S 15K fiber with a FAW 150 gsm, 35% RC.
The data below represents limited lot data.

Property	Condition	Method	A - Cured at 275°F (135°C)		B - Cured at 350°F (177°C)	
Tensile Strength 0°	RTD	ASTM D3039	388 ksi	2,672 MPa	420 ksi	2,892 MPa
Tensile Modulus 0°	RTD	ASTM D3039	22.1 Msi	152.4 GPa	21.2 Msi	146.2 GPa
Tensile Strength 0°	ETD	ASTM D3039	335 ksi	2,310 MPa	398 ksi	2,747 MPa
Tensile Modulus 0°	ETD	ASTM D3039	21.5 Msi	148.2 GPa	23.2 Msi	160.0 GPa
Tensile Strength 0°	ETW	ASTM D3039	349 ksi	2,407 MPa	384 ksi	2,650 MPa
Tensile Modulus 0°	ETW	ASTM D3039	22.2 Msi	153.1 GPa	22.9 Msi	157.9 GPa
Compressive Strength 0°	RTD	ASTM D695	222 ksi	1,530 MPa	225 ksi	1,548 MPa
Compressive Modulus 0°	RTD	ASTM D695	18.4 Msi	126.9 GPa	20.2 Msi	139.3 GPa
Compressive Strength 0°	ETD	ASTM D695	216 ksi	1,488 MPa	216 ksi	1,491 MPa
Compressive Modulus 0°	ETD	ASTM D695	17.9 Msi	123.4 GPa	19.3 Msi	133.1 GPa
Compressive Strength 0°	ETW	ASTM D695	210 ksi	1,450 MPa	203 ksi	1,400 MPa
Compressive Modulus 0°	ETW	ASTM D695	17.9 Msi	123.4 GPa	19.6 Msi	135.1 GPa
Compressive Strength 0°	RTD	ASTM D6641	222 ksi	1,533 MPa	236 ksi	1,627 MPa
Compressive Strength 0°	ETD	ASTM D6641	210 ksi	1,449 MPa	202 ksi	1,391 MPa
Compressive Strength 0°	ETW	ASTM D6641	206 ksi	1,420 MPa	199 ksi	1,375 MPa
In Plane Shear Strength	RTD	ASTM D3846	15 ksi	102 MPa	15 ksi	106 MPa
In Plane Shear Modulus	RTD	ASTM D3846	0.5 Msi	3.4 GPa	0.6 Msi	4.1 GPa
Open Hole Tensile Strength	RTD	ASTM D5766	67 ksi	459 MPa	70 ksi	482 MPa
Open Hole Tensile Strength	ETD	ASTM D5766	68 ksi	468 MPa	71 ksi	492 MPa
Open Hole Tensile Strength	ETW	ASTM D5766	67 ksi	465 MPa	73 ksi	503 MPa
Open Hole Comp. Strength	RTD	ASTM D6484	48 ksi	332 MPa	44 ksi	300 MPa
Open Hole Comp. Strength	ETD	ASTM D6484	47 ksi	327 MPa	41 ksi	280 MPa
Open Hole Comp. Strength	ETW	ASTM D6484	46 ksi	315 MPa	39 ksi	270 MPa
Flexural Strength 0°	RTD	ASTM D790	318 ksi	2,195 MPa	380 ksi	2,623 MPa
Flexural Modulus 0°	RTD	ASTM D790	14 Msi	96.5 GPa	16.8 Msi	115.8 GPa

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TC275-1 Epoxy Resin System

UNITAPE LAMINATE PROPERTIES

Unidirectional laminate data used Grafil TR50S 15K fiber with a FAW 150 gsm, 35% RC.

The data below represents limited lot data.

Continue from page 2

Property	Condition	Method	A - Cured at 275°F (135°C)		B - Cured at 350°F (177°C)	
Flexural Strength 0°	ETD	ASTM D790	265 ksi	1,824 MPa	277 ksi	1,910 MPa
Flexural Modulus 0°	ETD	ASTM D790	12.9 Msi	88.9 GPa	15.0 Msi	103.4 GPa
Flexural Strength 0°	ETW	ASTM D790	230 ksi	1,584 MPa	236 ksi	1,625 MPa
Flexural Modulus 0°	ETW	ASTM D790	12.6 Msi	86.9 GPa	12.6 Msi	88.9 GPa
ILSS 0°	RTD	ASTM D2344	16 ksi	107 MPa	16 ksi	109 MPa
ILSS 0°	ETD	ASTM D2344	12 ksi	85 MPa	11 ksi	74 MPa
ILSS 0°	ETW	ASTM D2344	10 ksi	68 MPa	9 ksi	65 MPa

Laminate DMA Onset Tg Dry			318°F	159°C	367°F	186°C
Laminate DMA Onset Tg Wet			295°F	146°C	313°F	156°C

Results above were normalized to 60%. Soak condition 160°F/71°C, 85% RH to saturation.

1. Cure A results, ETD and ETW tested at 180°F/82°C

2. Cure B results ETD and ETW tested at 250°F/121°C

FABRIC LAMINATE PROPERTIES

Fabric data represents 2x2 Twill using HTS40 3k fiber, 193 faw, 42% RC

Property	Condition	Method	A - Cured at 275°F (135°C)		B - Cured at 350°F (177°C)	
Tensile Strength 0°	RTD	ASTM D3039	146 ksi	1,003 MPa	155 ksi	1,065 MPa
Tensile Modulus 0°	RTD	ASTM D3039	10.1 Msi	69.6 GPa	9.6 Msi	66.2 GPa
Tensile Strength 0°	ETD	ASTM D3039	147 ksi	1,012 MPa	147 ksi	1,010 MPa
Tensile Modulus 0°	ETD	ASTM D3039	10.9 Msi	75.2 GPa	12 Msi	82.7 GPa
Tensile Strength 0°	ETW	ASTM D3039	141 ksi	972 MPa	150 ksi	1,037 MPa
Tensile Modulus 0°	ETW	ASTM D3039	11.2 Msi	77.2 GPa	11.4 Msi	78.6 GPa
Compressive Strength 0°	RTD	ASTM D695	134 ksi	923 MPa	136 ksi	938 MPa
Compressive Modulus 0°	RTD	ASTM D695	10.4 Msi	71.7 GPa	9.6 Msi	66.2 GPa
Compressive Strength 0°	ETD	ASTM D695	128 ksi	884 MPa	120 ksi	825 MPa
Compressive Modulus 0°	ETD	ASTM D695	9.9 Msi	68.3 GPa	9.6 Msi	66.2 GPa
Compressive Strength 0°	ETW	ASTM D695	114 ksi	783 MPa	107 ksi	737 MPa
Compressive Modulus 0°	ETW	ASTM D695	9.8 Msi	67.6 GPa	9.4 Msi	64.8 GPa
Compressive Strength 0°	RTD	ASTM D6641	106 ksi	731 MPa	117 Msi	806 MPa
Compressive Strength 0°	ETD	ASTM D6641	99 ksi	681 MPa	105 Msi	721 MPa
Compressive Strength 0°	ETW	ASTM D6641	90 ksi	621 MPa	86 Msi	594 MPa

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TENCATE **ADVANCED COMPOSITES**

TC275-1 Epoxy Resin System

FABRIC LAMINATE PROPERTIES

Fabric data represents 2x2 Twill using HTS40 3k fiber, 193 faw, 42% RC.

Continue from page 3

Property	Condition	Method	A - Cured at 275°F (135°C)		B - Cured at 350°F (177°C)	
In Plane Shear Strength	RTD	ASTM D3846	24 ksi	166 MPa	22 ksi	151 MPa
In Plane Shear Modulus	RTD	ASTM D3846	0.7 Msi	4.8 GPa	0.7 Msi	4.8 GPa
In Plane Shear Strength	ETD	ASTM D3846	21 ksi	141 MPa	16 ksi	109 MPa
In Plane Shear Modulus	ETD	ASTM D3846	0.6 Msi	4.3 GPa	0.5 Msi	3.4 GPa
In Plane Shear Strength	ETW	ASTM D3846	15 ksi	104 MPa	13 ksi	86 MPa
In Plane Shear Modulus	ETW	ASTM D3846	0.5 Msi	3.4 GPa	0.5 Msi	3.4 GPa
Open Hole Tensile Strength	RTD	ASTM D5766	63 ksi	434 MPa	62 ksi	429 MPa
Open Hole Tensile Strength	ETD	ASTM D5766	64 ksi	444 MPa	62 ksi	424 MPa
Open Hole Tensile Strength	ETW	ASTM D5766	62 ksi	429 MPa	63 ksi	436 MPa
Open Hole Comp. Strength	RTD	ASTM D6484	54 ksi	371 MPa	54 ksi	371 MPa
Open Hole Comp. Strength	ETD	ASTM D6484	49 ksi	338 MPa	51 ksi	350 MPa
Open Hole Comp. Strength	ETW	ASTM D6484	44 ksi	304 MPa	44 ksi	300 MPa
Flexural Strength 0°	RTD	ASTM D790	181 ksi	1,251 MPa	181 ksi	1,250 MPa
Flexural Modulus 0°	RTD	ASTM D790	8.7 Msi	60.0 GPa	8.4 Msi	57.9 GPa
Flexural Strength 0°	ETD	ASTM D790	158 ksi	1,086 MPa	156 ksi	1,073 MPa
Flexural Modulus 0°	ETD	ASTM D790	8.7 Msi	60.0 GPa	8.3 Msi	57.2 GPa
Flexural Strength 0°	ETW	ASTM D790	146 ksi	1,007 MPa	128 ksi	883 MPa
Flexural Modulus 0°	ETW	ASTM D790	8.6 Msi	59.3 GPa	8.1 Msi	55.8 GPa
ILSS 0°	RTD	ASTM D2344	11 ksi	72 MPa	10 ksi	68 MPa
ILSS 0°	ETD	ASTM D2344	10 ksi	66 MPa	9 ksi	61 MPa
ILSS 0°	ETW	ASTM D2344	7 ksi	50 MPa	6 ksi	43 MPa
Laminate DMA Onset Tg Dry			320°F	160°C	372°F	189°C
Laminate DMA Onset Tg Wet			271°C	133°C	322°F	161°C

Results above were normalized to 60%. Soak condition 160°F/71°C, 85%RH to saturation.

1. Cure A results, ETD and ETW tested at 180°F/82°C

2. Cure B results ETD and ETW tested at 250°F/121°C

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TC275-1 Epoxy Resin System

EPOXY PREPREG, ADHESIVE AND RESIN GUIDELINES AND HANDLING PROCEDURES

The following guidelines are provided to our customer to assure that all customers are aware of the procedures to attain the best possible results from TenCate Advanced Composites (TCAC) Epoxy products. These resin systems will provide sound composite hardware and structures if some simple procedures are followed. Keep in mind that these procedures are good practice for all composite prepreg and adhesive materials and should be used whenever possible.

FREEZER STORAGE

Epoxy resin materials have good shelf life at room temperature; however, the life and performance of the material is best preserved with the following basic guidelines. Refer to the shelf life included in the product certificates. The epoxy material should be sealed in an airtight bag and kept frozen below 0°F (-18°C) when not being used for longest life and most consistent performance. A good safety measure is to have a bag of desiccant (Silica Moisture Absorber) in the core of the prepreg roll just in case a pin-hole in the bag or other problem occurs.

MOISTURE ABSORPTION AND SENSITIVITY

While very resistant to moisture absorption after cure, epoxies can be adversely affected by moisture uptake prior to cure. For this reason, all materials must be "Thoroughly Thawed" to room temperature prior to opening the sealed bag to avoid condensation on the material. Also, it is good practice to keep prepreg and in process hardware in a sealed bag or vacuum bag if to be exposed to atmosphere for long periods of time.

HANDLING OF MATERIALS

When handling any prepreg materials, one should always be wearing 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 any dermatitis that could occur with certain users.

NON-METALLIC HONEYCOMB AND FOAM CORE USE

When using Non-Metallic honeycomb and foam core materials for sandwich structures, the materials should always be dried in an oven prior to layup to drive off any moisture that may be in the core. The material should then be cooled in the presence of a desiccant, to avoid any moisture uptake. Following this procedure it is always a good idea to use the material as soon as possible to avoid re-hydration.

Recommended Core Dry Time/Temp: 250°F (121°C) for 3-4 Hours

DEBULK SEQUENCE FROM TOOL SURFACE TO BAGGING MATERIALS

- a. Bottom Tool
- b. Non porous FEP
- c. Prepreg
- d. Porous TX1040
- e. Non porous FEP
- f. Caul plate
- g. Breather (woven or thick breather)
- h. Vacuum bag
- i. Repeat above procedure

An excellent debulking procedure was necessary to minimize entrapped air between plies as shown in Figure 1. Pulled vacuum was at least at 27 in. Hg. TC275-1 system was debulked every 4 plies for 5-10 min. each until the needed plies for the sample was achieved. For TC275-1 woven fabric debulked every 2 plies for 5-10 mins. An additional ply of porous Teflon coated glass(TX1040) was used to help the removal of entrapped air and it was replaced after being used for 2-3 times of debulking.

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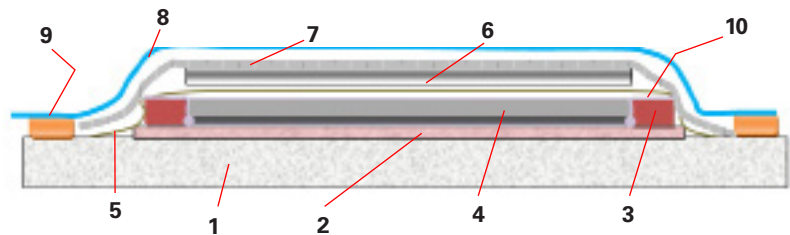


TENCATE ADVANCED COMPOSITES

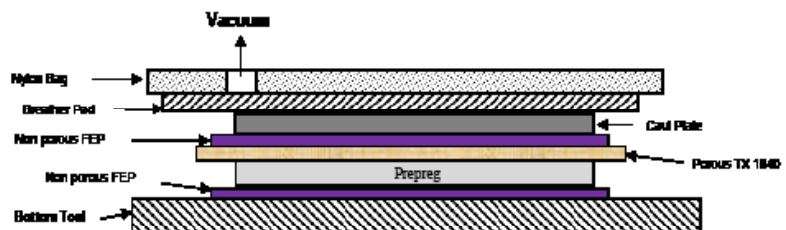
TC275-1 Epoxy Resin System

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 700NC or 770NC, 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)



Final bagging sequence for TC275-1 Unitape & Fabric



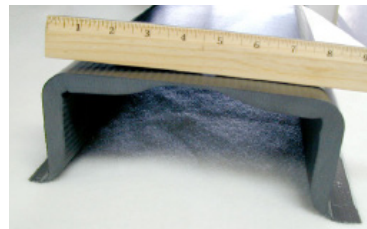
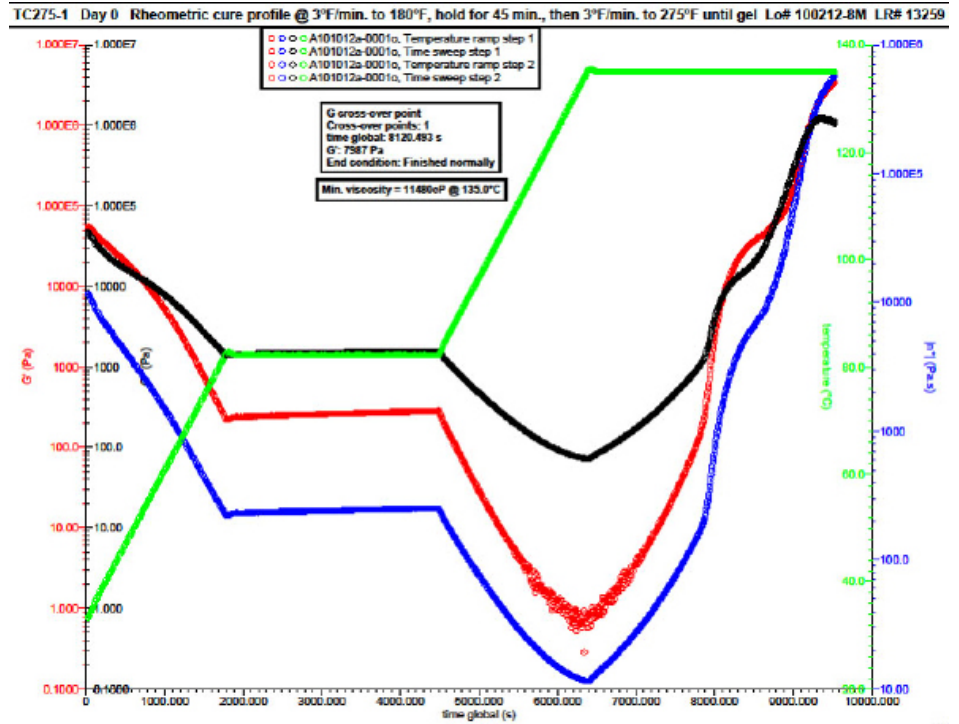
Debulk Sequence for TC275-1 Unitape and Fabrics

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Demonstration part of 100+ ply of TC275-1, less than 1% voids.

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All data given is based on representative samples of the materials in question. Since the method and circumstances under which these materials are processed and tested are key to their performance, and TenCate Advanced Composites has no assurance of how its customers will use the material, the corporation cannot guarantee these properties.

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TENCATE ADVANCED COMPOSITES

18410 Butterfield Blvd.
 Morgan Hill, CA 95037 USA
 Tel: +1 408 776 0700

2450 Cordelia Road
 Fairfield, CA 94534 USA
 Tel: +1 707 359 3400

Amber Drive, Langley Mill
 Nottingham, NG16 4BE UK
 Tel: +44 (0)1773 530899

www.tencateadvancedcomposites.com
 info@tcac-usa.com (USA)
 tcacsales@tencate.com (Europe)