

DESCRIPTION

TC275-1E represents a long out time version of TenCate’s popular TC275-1 resin system. TC275-1E 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 21-day tack life and 28-day total out time to allow the construction of thick or larger composite structures. TC275-1E may be cured at a lower temperature of 135°C (275°F) or can be cured at 177°C (350°F) for higher temperature service.

FEATURES

- › **Robust OOA/VBO system**
- › **Capable of freestanding post cure for higher T_g**
- › **Dual-cure prepreg system**
- › **Excellent resistance to hot/wet exposure**
- › **Long out time and tack life for shop floor handling**
- › **High toughness**

PRODUCT TYPE

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

TYPICAL APPLICATIONS

- › Aircraft structures
- › Launch and space structures
- › Thick parts cured under low pressure
- › Honeycomb stiffened parts

SHELF LIFE

Tack Life:	Up to 21 days at ambient
Out Life:	Up to 28 days at ambient
Frozen Storage Life:	12 months at -18°C (<0°F)

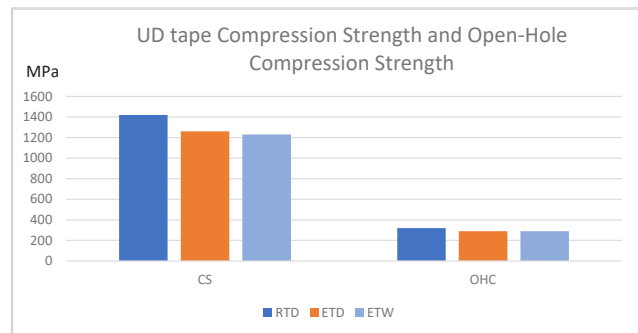
Tack life is the time during which the prepreg retains enough tack, drape, and handling for component lay-up.

Out life is the maximum time allowed at ambient temperature before cure.* Ambient is 18–22°C (65–72°F).

** Out life tested by SBS on 16-ply 15 x 15 cm (6 x 6 in.) laminate, cured in a out-of-autoclave/vacuum bag only (OOA/VBO) environment with 914–948 mbar (27–28 in. Hg). Users may need to separately evaluate out life limits on thicker, larger, and more complex parts.*

NEAT RESIN PROPERTIES

Resin Density	1.17 g/cc
Gel Time @ 135°C (275°F)	19–25 min
T _g by DMA after 6 hours @ 135°C (275°F)	168°C (334°F)



TenCate TC275-1E has outstanding strength retention after hot/wet conditioning.



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MECHANICAL PROPERTIES

Properties	Condition	Method	UD Tape (a)		2x2 Twill Carbon Fabric (b)	
Tensile Strength 0°	RTD	ASTM D 3039	2720 MPa	395 ksi	1060 MPa	155 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	170 GPa	24.3 Msi	67 GPa	9.8 Msi
Tensile Strength 0°	ETD	ASTM D 3039	2565 MPa	370 ksi	1020 MPa	150 ksi
Tensile Modulus 0°	ETD	ASTM D 3039	170 GPa	24.4 Msi	72 GPa	10.5 Msi
Tensile Strength 0°	ETW	ASTM D 3039	2500 MPa	365 ksi	1040 MPa	150 ksi
Tensile Modulus 0°	ETW	ASTM D 3039	170 GPa	24.9 Msi	72 GPa	10.5 Msi
Tensile Strength 90°	RTD	ASTM D 3039	38.1 MPa	5.5 ksi	925 MPa	135 ksi
Tensile Modulus 90°	RTD	ASTM D 3039	8.1 GPa	1.2 Msi	65 GPa	9.4 Msi
Tensile Strength 90°	ETD	ASTM D 3039	37 MPa	5.3 ksi	955 MPa	140 ksi
Tensile Modulus 90°	ETD	ASTM D 3039	7.7 GPa	1.1 Msi	68 GPa	9.8 Msi
Tensile Strength 90°	ETW	ASTM D 3039	32 MPa	4.6 ksi	935 MPa	135 ksi
Tensile Modulus 90°	ETW	ASTM D 3039	7.2 GPa	1.0 Msi	65 GPa	9.5 Msi
Compressive Strength 0°	RTD	ASTM D 695	1420 MPa	205 ksi	795 MPa	115 ksi
Compressive Modulus 0°	RTD	ASTM D 695	165 GPa	23.8 Msi	65 GPa	9.4 Msi
Compressive Strength 0°	ETD	ASTM D 695	1260 MPa	180 ksi	740 MPa	110 ksi
Compressive Modulus 0°	ETD	ASTM D 695	160 GPa	23.0 Msi	63 GPa	9.1 Msi
Compressive Strength 0°	ETW	ASTM D 695	1230 MPa	180 ksi	695 MPa	100 ksi
Compressive Modulus 0°	ETW	ASTM D 695	150 GPa	21.4 Msi	62 GPa	9.0 Msi
Compressive Strength 90°	RTD	ASTM D 695	240 MPa	34.8 ksi	875 MPa	125 ksi
Compressive Modulus 90°	RTD	ASTM D 695	9.9 GPa	1.4 Msi	64 GPa	9.3 Msi
Compressive Strength 90°	ETD	ASTM D 695	190 MPa	28.0 ksi	785 MPa	115 ksi
Compressive Modulus 90°	ETD	ASTM D 695	9.3 GPa	1.4 Msi	63 GPa	9.1 Msi
Compressive Strength 90°	ETW	ASTM D 695	190 MPa	27.4 ksi	740 MPa	110 ksi
Compressive Modulus 90°	ETW	ASTM D 695	9.1 GPa	1.3 Msi	62 GPa	9.0 Msi
Compressive Strength 0°	RTD	ASTM D 6641	1500 MPa	215 ksi	715 MPa	105 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	-	-	56 GPa	8.1 Msi
Compressive Strength 0°	ETD	ASTM D6641	1350 MPa	200 ksi	690 MPa	100 ksi
Compressive Modulus 0°	ETD	ASTM D 6641	-	-	59 GPa	8.6 Msi
Compressive Strength 0°	ETW	ASTM D 6641	1280 MPa	185 ksi	620 MPa	90 ksi
Compressive Modulus 0°	ETW	ASTM D 6641	-	-	58 GPa	8.4 Msi
Flexural Strength 0°	RTD	ASTM D 790	2000 MPa	290 ksi	1140 MPa	165 ksi
Flexural Modulus 0°	RTD	ASTM D 790	95 GPa	13.9 Msi	43 GPa	6.3 Msi
Flexural Strength 0°	ETD	ASTM D 790	1590 MPa	230 ksi	975 MPa	140 ksi
Flexural Modulus 0°	ETD	ASTM D 790	94 GPa	13.6 Msi	44 GPa	6.4 Msi
Flexural Strength 0°	ETW	ASTM D 790	1435 MPa	210 ksi	870 MPa	130 ksi
Flexural Modulus 0°	ETW	ASTM D 790	90 GPa	13.3 Msi	45 GPa	6.5 Msi
ILSS 0°	RTD	ASTM D 2344	105 MPa	15.1 ksi	64 MPa	9.2 ksi
ILSS 0°	ETD	ASTM D 2344	80 MPa	11.7 ksi	61 MPa	8.8 ksi
ILSS 0°	ETW	ASTM D 2344	70 MPa	9.8 ksi	59 MPa	8.5 ksi

MECHANICAL PROPERTIES

Continued from page 2

Properties	Condition	Method	UD Tape (a)		2x2 Twill Carbon Fabric (b)	
FHT (45/0/-45/90)	RTD	ASTM D 6742	515 MPa	75 ksi	400 MPa	57.7 ksi
Open-Hole Tensile Strength	RTD	ASTM D 5766	500 MPa	70 ksi	385 MPa	55.9 ksi
Open-Hole Tensile Strength	ETD	ASTM D 5766	475 MPa	70 ksi	390 MPa	56.6 ksi
Open-Hole Tensile Strength	ETW	ASTM D 5766	455 MPa	65 ksi	380 MPa	55.5 ksi
Open-Hole Comp. Strength	RTD	ASTM D 6484	320 MPa	45 ksi	325 MPa	47.3 ksi
Open-Hole Comp. Strength	ETD	ASTM D 6484	290 MPa	40 ksi	305 MPa	44 ksi
Open-Hole Comp. Strength	ETW	ASTM D 6484	290 MPa	40 ksi	285 MPa	41 ksi
In-Plane Shear Str. (+/-45)	RTD	ASTM D 3846	120 MPa	17.5 ksi	130 MPa	19 ksi
In-Plane Shear Str. (+/-45)	ETD	ASTM D 3846	115 MPa	16.9 ksi	115 MPa	17 ksi
In-Plane Shear Str. (+/-45)	ETW	ASTM D 3846	100 MPa	14.8 ksi	100 MPa	14 ksi
In-Plane Shear Mod. (+/-45)	RTD	ASTM D 3846	3.7 GPa	0.54 Msi	3.5 MPa	0.51 Msi
In-Plane Shear Mod. (+/-45)	ETD	ASTM D 3846	3.4 GPa	0.49 Msi	3.4 GPa	0.49 Msi
In-Plane Shear Mod. (+/-45)	ETW	ASTM D 3846	3.2 GPa	0.47 Msi	2.9 GPa	0.42 Msi
V-Notch Shear Strength 0°	RTD	ASTM D 5379	65 MPa	9.5 ksi	70 MPa	10.1 ksi
V-Notch Shear Strength 0°	ETD	ASTM D 5379	60 MPa	8.4 ksi	-	-
V-Notch Shear Strength 0°	ETW	ASTM D 5379	50 MPa	7.3 ksi	-	-
V-Notch Shear Modulus 0°	RTD	ASTM D 5379	4.1 GPa	0.60 Msi	4.1 GPa	0.60 Msi
V-Notch Shear Modulus 0°	ETD	ASTM D 5379	3.7 GPa	0.53 Msi	-	-
V-Notch Shear Modulus 0°	ETW	ASTM D 5379	3.6 GPa	0.52 Msi	-	-
Compressive Strength 90°	RTD	ASTM D 6641	-	-	725 MPa	105 ksi
Compressive Modulus 90°	RTD	ASTM D 6641	-	-	57 GPa	8.3 Msi
Compressive Strength 90°	ETD	ASTM D 6641	-	-	710 MPa	105 ksi
Compressive Modulus 90°	ETD	ASTM D 6641	-	-	57 GPa	8.3 Msi
Compressive Strength 90°	ETW	ASTM D 6641	-	-	620 MPa	90 ksi
Compressive Modulus 90°	ETW	ASTM D 6641	-	-	60 GPa	8.3 Msi
CAI @ 6.7 J/mm (1500 in-lb/in)	RTD	ASTM D 7136/7137	-	-	223 MPa	32 ksi
Water Absorption %			0.51% - after 14 days soaked @ 71°C (160°F) water temperature		0.46% - after 14 days soaked @ 71°C (160°F) water temperature	
Laminate T _g (Onset, DMA, Dry)			175°C (347°F)		174°C (345°F)	
Laminate T _g (Onset, DMA, Wet)			152°C (306°F)		154°C (309°F)	

(a) Uni-directional tape data from IM7 12K, 150gsm/TC275-1E, 35% resin content. All data was normalized to 60% fiber volume by acid digestion method except for ILSS, TS/TM 90°, and CS/CM 90°. CS6641 was back calculated to 0° properties. V-Notch strength was tested at 0.5% offset. ETD and ETW specimens were tested at 82°C (180°F). ETW specimens were soaked for 14 days in 71°C (160°F) water. Cure A (see page 6) was used in mechanical data above.

(b) Fabric data from HTS40 3K 2x2 Twill, 193gsm/TC275-1E, 42% resin content. All data was normalized to 55% fiber volume by acid digestion method except for ILSS. V-Notch strength was tested at 0.5% offset. ETD and ETW specimens were tested at 82°C (180°F). ETW specimens were soaked for 14 days in 71°C (160°F) water. Cure A (see page 6) was used in mechanical data above.

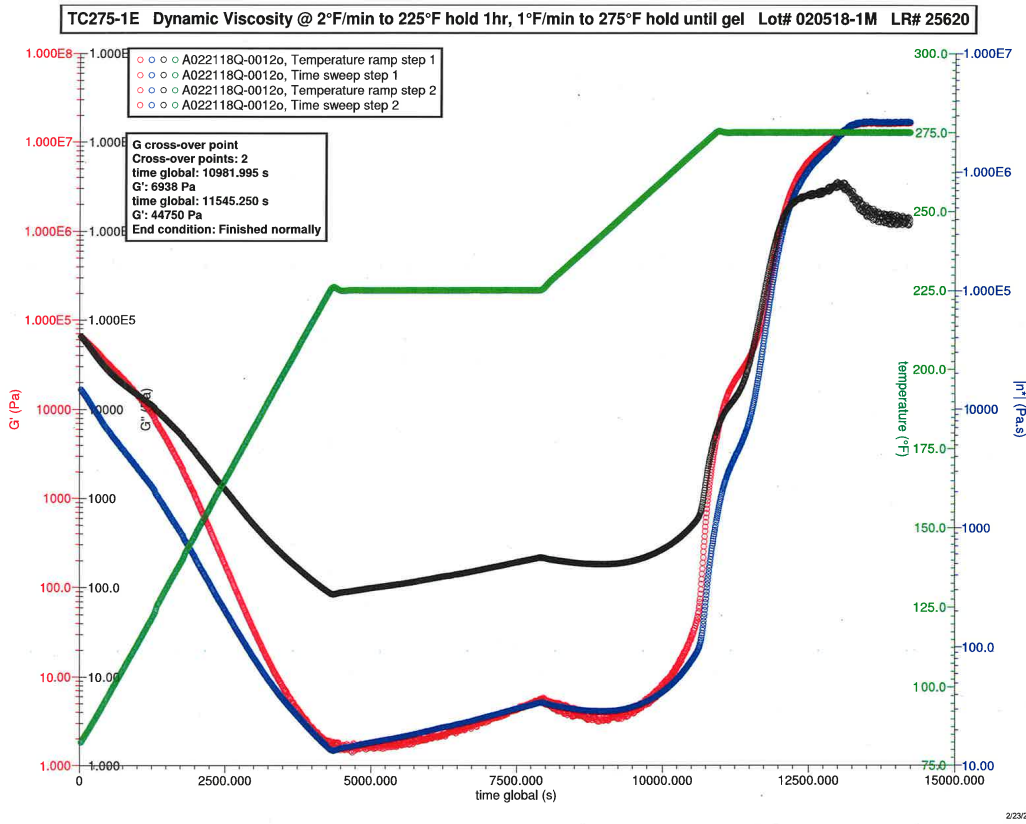
CURE OPTIONS

Cure A - 1°C (2°F)/minute to 107°C (225°F) and hold for 1 hour, then 0.6°C (1°F)/minute to 135°C (275°F) for 6 hours, follow by cool down to 49°C (120°F) at 2.8°C (5°F)/minute or less, under 914–948 mbar (27–28 in. Hg).

Cure B - 1°C (2°F)/minute to 107°C (225°F) and hold for 1 hour, then 0.6°C (1°F)/minute to 135°C (275°F) for 3 hours, follow by freestanding post cure for 2 hours at 177°C (350°F), under 914-948 mbar (27–28 in. Hg).

Cure C - 1°C (2°F)/minute to 107°C (225°F) for 1 hour, then cure at 177°C (350°F) for 2 hours, under 914–948 mbar (27–28 in. Hg).

RHEOLOGY



EPOXY PREPREG, ADHESIVE, AND RESIN GUIDELINES AND HANDLING PROCEDURES

The following guidelines are provided to our customers to assure that best practices are used to attain the best results from TenCate Advanced Composites (TCAC) epoxy products. Keep in mind that these procedures represent best practices for all composite prepreg and adhesive materials.

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 certifications. The epoxy material should be sealed in an airtight bag and kept frozen below -18°C (0°F) 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 to assure the best protection from moisture impregnation.

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 completely 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 it will be exposed to the atmosphere for long periods of time.

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 may occur with some users.

NONMETALLIC HONEYCOMB AND FOAM CORE USE

When using nonmetallic honeycomb and foam core materials for sandwich structures, the materials should always be dried in an oven prior to lay-up to drive off any moisture that may be in the core. The core should be cooled in the presence of a desiccant to avoid moisture uptake. Following drying, it is always best to use the material as soon as possible. Recommended core dry time/temp: 121°C (250°F) for 3–4 hours.

DEBULK LAY-UP MATERIAL SEQUENCE FROM TOOL SURFACE TO BAGGING MATERIALS

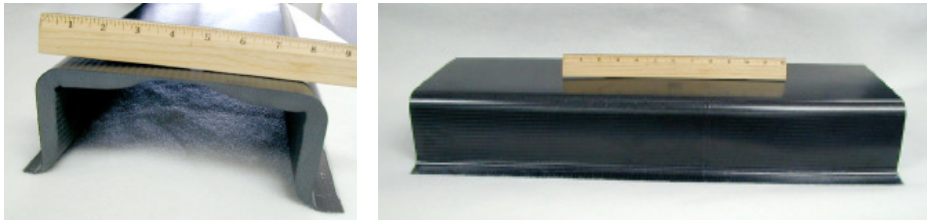
- 1. Bottom Tool**
- 2. Non-porous FEP**
- 3. Prepreg**
- 4. Porous TX1040**
- 5. Non-porous FEP**
- 6. Caul plate**
- 7. Breather (woven or thick breather)**
- 8. Vacuum bag**
- 9. Repeat above assembly sequence**

A robust debulking procedure is necessary to minimize entrapped air between plies as shown in Figure 1. The vacuum level should be at least at 27 in. Hg. TC275-1E was debulked every 4 plies for 5–10 minutes. TC275-1E woven fabric was debulked every 2 plies for 5–10 minutes. An additional ply of porous Teflon coated glass (TX1040) was used to help with the removal of entrapped air, and it was replaced every 2–3 cycles.

COMPOSITE LAMINATE STACKING SEQUENCE

List of Materials

1. Tool – aluminum, steel, Invar, composite (tool plates must be release coated or film covered). See below.
2. Release coat or film – Frekote 700NC or 770NC, FEP, TEDLAR
3. Silicone edge dams – slightly 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 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)



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

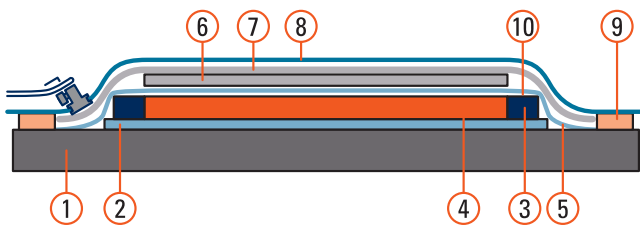


Figure 1

Revised 05/2018

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