

PRODUCT DATA SHEET

DESCRIPTION

Toray 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 14-day total out time to allow the construction of thick or larger composite structure. TC275-1 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

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

PRODUCT TYPE

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

TYPICAL APPLICATIONS

- ▶ Aircraft structures
- ▶ Thick parts cured under low pressure
- ▶ Honeycomb stiffened parts

SHELF LIFE

Out Life: Up to 14 days at ambient

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

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 8 ply 15 x 15 cm (6 x 6 in.) laminate. Users may need to separately evaluate out life limits on thicker, more complex parts.

TYPICAL NEAT RESIN PROPERTIES

Density	1.17 g/cc
T _g by DMA w/Post Cure 177°C (350°F) 2 Hours Dry	183°C (362°F)
T _g by DMA Wet (saturated at 71°C (160°F) 85% RH)	136°C (277°F)
Resin Gel Time at 135°C (275°F)	19–23 min
Gel Time at 177°C (350°F)	9–14 min
Dynamic Viscosity	~12k cps at 135°C (275°F) /-1.6°C (-3°F) /min to 275°F to gel
T _g Cured 1.6°C (3°F)/min to 135°C (275°F) Hold for 6 Hours T _g by DMA Dry	164°C (327°F)



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TR50S/TC275-1 UD TAPE LAMINATE PROPERTIES

Property	Condition	Method	A—Cured at 135°C (275°F)		B—Cured at 177°C (350°F)	
Tensile Strength 0°	RTD	ASTM D 3039	1007 MPa	388 ksi	1069 MPa	419 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	152.3 GPa	22.1 Msi	146.1 GPa	21.2 Msi
Tensile Strength 0°	ETD	ASTM D 3039	1014 MPa	335 ksi	1014 MPa	398 ksi
Tensile Modulus 0°	ETD	ASTM D 3039	148.2 GPa	21.5 Msi	159.9 GPa	23.2 Msi
Tensile Strength 0°	ETW	ASTM D 3039	972 MPa	350 ksi	1035 MPa	384 ksi
Tensile Modulus 0°	ETW	ASTM D 3039	153.0 GPa	22.2 Msi	157.8 GPa	22.9 Msi
Tensile Strength 90°	RTD	ASTM D 3039	41 MPa	6 ksi	48 MPa	7 ksi
Tensile Modulus 90°	RTD	ASTM D 3039	9.7 GPa	1.4 Msi	9.7 GPa	1.4 Msi
Tensile Strength 90°	ETD	ASTM D 3039	35 MPa	5 ksi	35 MPa	5 ksi
Tensile Modulus 90°	ETD	ASTM D 3039	9.0 GPa	1.3 Msi	8.3 GPa	1.2 Msi
Tensile Strength 90°	ETW	ASTM D 3039	28 MPa	4 ksi	28 MPa	4 ksi
Tensile Modulus 90°	ETW	ASTM D 3039	7.6 GPa	1.1 Msi	6.9 GPa	1 Msi
Compressive Strength 0°	RTD	ASTM D 695	241 MPa	222 ksi	248 MPa	225 ksi
Compressive Modulus 0°	RTD	ASTM D 695	126.8 GPa	18.4 Msi	139.2 GPa	20.2 Msi
Compressive Strength 0°	ETD	ASTM D 695	200 MPa	216 ksi	179 MPa	216 ksi
Compressive Modulus 0°	ETD	ASTM D 695	123.4 GPa	17.9 Msi	133.0 GPa	19.3 Msi
Compressive Strength 0°	ETW	ASTM D 695	172 MPa	210 ksi	159 MPa	203 ksi
Compressive Modulus 0°	ETW	ASTM D 695	123.4 GPa	17.9 Msi	135.1 GPa	19.6 Msi
Compressive Strength 90°	RTD	ASTM D 695	241 MPa	35 ksi	248 MPa	36 ksi
Compressive Modulus 90°	RTD	ASTM D 695	9.0 GPa	1.3 Msi	9.0 GPa	1.3 Msi
Compressive Strength 90°	ETD	ASTM D 695	200 MPa	29 ksi	179 MPa	26 ksi
Compressive Modulus 90°	ETD	ASTM D 695	8.3 GPa	1.2 Msi	8.3 GPa	1.2 Msi
Compressive Strength 90°	ETW	ASTM D 695	172 MPa	25 ksi	159 MPa	23 ksi
Compressive Modulus 90°	ETW	ASTM D 695	8.3 GPa	1.2 Msi	9.0 GPa	1.3 Msi
Compressive Strength 0°	RTD	ASTM D 6641	1531 MPa	222 ksi	1628 MPa	236 ksi
Compressive Strength 0°	ETD	ASTM D 6641	1448 MPa	210 ksi	1393 MPa	202 ksi
Compressive Strength 0°	ETW	ASTM D 6641	1421 MPa	206 ksi	1372 MPa	199 ksi
In-Plane Shear Strength	RTD	ASTM D 3518	103 MPa	15 ksi	103 MPa	15 ksi
In-Plane Shear Modulus	RTD	ASTM D 3518	4.8 GPa	0.7 Msi	4.8 GPa	0.7 Msi
In-Plane Shear Strength	ETD	ASTM D 3518	103 MPa	15 ksi	97 MPa	14 ksi
In-Plane Shear Modulus	ETD	ASTM D 3518	4.1 GPa	0.6 Msi	4.1 GPa	0.6 Msi
In-Plane Shear Strength	ETW	ASTM D 3518	97 MPa	14 ksi	83 MPa	12 ksi
In-Plane Shear Modulus	ETW	ASTM D 3518	3.4 GPa	0.5 Msi	4.1 GPa	0.6 Msi
Open-Hole Tensile Strength	RTD	ASTM D 5766	462 MPa	67 ksi	483 MPa	70 ksi
Open-Hole Tensile Strength	ETD	ASTM D 5766	469 MPa	68 ksi	490 MPa	71 ksi
Open-Hole Tensile Strength	ETW	ASTM D 5766	462 MPa	67 ksi	503 MPa	73 ksi
Open-Hole Compression Strength	RTD	ASTM D 6484	331 MPa	48 ksi	303 MPa	44 ksi
Open-Hole Compression Strength	ETD	ASTM D 6484	324 MPa	47ksi	283 MPa	41 ksi
Open-Hole Compression Strength	ETW	ASTM D 6484	317 MPa	46 ksi	269 MPa	39 ksi

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TR50S/TC275-1 UD TAPE LAMINATE PROPERTIES

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Property	Condition	Method	A–Cured at 135°C (275°F)		B–Cured at 177°C (350°F)	
Flexural Strength at 0°	RTD	ASTM D 790	2193 MPa	318 ksi	2621 MPa	380 ksi
Flexural Modulus at 0°	RTD	ASTM D 790	96.5 GPa	14.0 Msi	115.8 GPa	16.8 Msi
Flexural Strength at 0°	ETD	ASTM D 790	1828 MPa	265 ksi	1910 MPa	277 ksi
Flexural Modulus at 0°	ETD	ASTM D 790	88.9 GPa	12.9 Msi	103.4 GPa	15.0 Msi
Flexural Strength at 0°	ETW	ASTM D 790	1586 MPa	230 ksi	1628 MPa	236 ksi
Flexural Modulus at 0°	ETW	ASTM D 790	86.8 GPa	12.6 Msi	88.9 GPa	12.9 Msi
ILSS at 0°	RTD	ASTM D 2344	110 MPa	16 ksi	110 MPa	16 ksi
ILSS at 0°	ETD	ASTM D 2344	83 MPa	12 ksi	76 MPa	11 ksi
ILSS at 0°	ETW	ASTM D 2344	69 MPa	10 ksi	62 MPa	9 ksi
Water Absorption			0.61% saturated at 160°F, 85% humidity		0.81% saturated at 160°F, 85% humidity	
Laminate DMA Onset T _g Dry			159°C (318°F)		186°C (367°F)	
Laminate DMA Onset T _g Wet			146°C (295°F)		156°C (313°F)	

(1) Uni-directional laminate data used Grafil TR50S 15K fiber with a FAW 150gsm, 35% RC. The data below represents limited lot data. Results above were normalized to 60%. Soak condition 71°C (160°F), 85% RH to saturation.
 1. Cure A results, ETD and ETW tested at 82°C (180°F)
 2. Cure B results ETD and ETW tested at 121°C (250°F)

FABRIC/TC275-1 LAMINATE PROPERTIES

Property	Condition	Method	A–Cured at 135°C (275°F)		B–Cured at 177°C (350°F)	
Tensile Strength 0°	RTD	ASTM D 3039	1003 MPa	146 ksi	1065 MPa	155 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	69.6 GPa	10.1 Msi	66.2 GPa	9.6 Msi
Tensile Strength 0°	ETD	ASTM D 3039	1012 MPa	147 ksi	1010 MPa	147 ksi
Tensile Modulus 0°	ETD	ASTM D 3039	75.2 GPa	10.9 Msi	82.7 GPa	12 Msi
Tensile Strength 0°	ETW	ASTM D 3039	972 MPa	141 ksi	1037 MPa	150 ksi
Tensile Modulus 0°	ETW	ASTM D 3039	77.2 GPa	11.2 Msi	78.6 GPa	11.4 Msi
Tensile Strength 90°	RTD	ASTM D 3039	1069 MPa	155 ksi	1083 MPa	157 ksi
Tensile Modulus 90°	RTD	ASTM D 3039	75.9 GPa	11 Msi	78.6 GPa	11.4 Msi
Tensile Strength 90°	ETD	ASTM D 3039	1069 MPa	155 ksi	1041 MPa	151 ksi
Tensile Modulus 90°	ETD	ASTM D 3039	82.7 GPa	12 Msi	81.3 GPa	11.8 Msi
Tensile Strength 90°	ETW	ASTM D 3039	979 MPa	142 ksi	966 MPa	140 ksi
Tensile Modulus 90°	ETW	ASTM D 3039	76.5 GPa	11.1 Msi	80.6 GPa	11.7 Msi
Compressive Strength 0°	RTD	ASTM D 695	923 MPa	134 ksi	938 MPa	136 ksi
Compressive Modulus 0°	RTD	ASTM D 695	71.7 GPa	10.4 Msi	66.2 GPa	9.6 Msi
Compressive Strength 0°	ETD	ASTM D 695	884 MPa	128 ksi	825 MPa	120 ksi
Compressive Modulus 0°	ETD	ASTM D 695	68.3 GPa	9.9 Msi	66.2 GPa	9.6 Msi
Compressive Strength 0°	ETW	ASTM D 695	783 MPa	114 ksi	737 MPa	107 ksi
Compressive Modulus 0°	ETW	ASTM D 695	67.6 GPa	9.8 Msi	64.8 GPa	9.4 Msi

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FABRIC/TC275-1 LAMINATE PROPERTIES

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Property	Condition	Method	A—Cured at 135°C (275°F)		B—Cured at 177°C (350°F)	
Compressive Strength 90°	RTD	ASTM D 695	959 MPa	139 ksi	924 MPa	134 ksi
Compressive Modulus 90°	RTD	ASTM D 695	70.3 GPa	10.2 Msi	67.5 GPa	9.8 Msi
Compressive Strength 90°	ETD	ASTM D 695	917 MPa	133 ksi	855 MPa	124 ksi
Compressive Modulus 90°	ETD	ASTM D 695	68.9 GPa	10.0 Msi	63.4 GPa	9.2 Msi
Compressive Strength 90°	ETW	ASTM D 695	821 MPa	119 ksi	752 MPa	109 ksi
Compressive Modulus 90°	ETW	ASTM D 695	68.2 GPa	9.9 Msi	66.2 GPa	9.6 Msi
Compressive Strength 0°	RTD	ASTM D 6641	731 MPa	106 ksi	806 MPa	117 Msi
Compressive Strength 0°	ETD	ASTM D 6641	681 MPa	99 ksi	721 MPa	105 Msi
Compressive Strength 0°	ETW	ASTM D 6641	621 MPa	90 ksi	594 MPa	86 Msi
Compressive Strength 90°	RTD	ASTM D 6641	752 Mpa	109 ksi	738 Mpa	107 ksi
Compressive Strength 90°	ETD	ASTM D6641	683 Mpa	99 ksi	717 Mpa	104 ksi
Compressive Strength 90°	ETW	ASTM D 6641	635 Mpa	92 ksi	607 Mpa	88 ksi
In-Plane Shear Strength	RTD	ASTM D 3518	166 MPa	24 ksi	151 MPa	22 ksi
In-Plane Shear Modulus	RTD	ASTM D 3518	4.8 GPa	0.7 Msi	4.8 GPa	0.7 Msi
In-Plane Shear Strength	ETD	ASTM D 3518	141 MPa	21 ksi	109 MPa	16 ksi
In-Plane Shear Modulus	ETD	ASTM D 3518	4.3 GPa	0.6 Msi	3.4 GPa	0.5 Msi
In-Plane Shear Strength	ETW	ASTM D 3518	104 MPa	15 ksi	86 MPa	13 ksi
In-Plane Shear Modulus	ETW	ASTM D 3518	3.4 GPa	0.5 Msi	3.4 GPa	0.5 Msi
Open-Hole Tensile Strength	RTD	ASTM D 5766	434 MPa	63 ksi	429 MPa	62 ksi
Open-Hole Tensile Strength	ETD	ASTM D 5766	444 MPa	64 ksi	424 MPa	62 ksi
Open-Hole Tensile Strength	ETW	ASTM D 5766	429 MPa	62 ksi	436 MPa	63 ksi
Open-Hole Comp. Strength	RTD	ASTM D 6484	371 MPa	54 ksi	371 MPa	54 ksi
Open-Hole Comp. Strength	ETD	ASTM D 6484	338 MPa	49 ksi	350 MPa	51 ksi
Open-Hole Comp. Strength	ETW	ASTM D 6484	304 MPa	44 ksi	300 MPa	44 ksi
Flexural Strength 0°	RTD	ASTM D 790	1251 MPa	181 ksi	1250 MPa	181 ksi
Flexural Modulus 0°	RTD	ASTM D 790	60.0 GPa	8.7 Msi	57.9 GPa	8.4 Msi
Flexural Strength 0°	ETD	ASTM D 790	1086 MPa	158 ksi	1073 MPa	156 ksi
Flexural Modulus 0°	ETD	ASTM D 790	60.0 GPa	8.7 Msi	57.2 GPa	8.3 Msi
Flexural Strength 0°	ETW	ASTM D 790	1007 MPa	146 ksi	883 MPa	128 ksi
Flexural Modulus 0°	ETW	ASTM D 790	59.3 GPa	8.6 Msi	55.8 GPa	8.1 Msi
ILSS 0°	RTD	ASTM D 2344	72 MPa	11ksi	68 MPa	10 ksi
ILSS 0°	ETD	ASTM D 2344	66 MPa	10 ksi	61 MPa	9 ksi
ILSS 0°	ETW	ASTM D 2344	50 MPa	7 ksi	43 MPa	6 ksi
Laminate DMA Onset T _g Dry			160°C (320°F)		189°C (372°F)	
Laminate DMA Onset T _g Wet			133°C (271°F)		161°C (322°F)	

Results above were normalized to 60%. Soak condition 71°C (160°F), 85% RH to saturation.
 1. Cure A results, ETD and ETW tested at 82°C (180°F)
 2. Cure B results ETD and ETW tested at 121°C (250°F)

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MECHANICAL PROPERTIES

Property	Condition	Method	QiSO Fabric (a)		PW Fabric (b)		% Diff
Tensile Strength	RTD	ASTM D 3039	775 MPa	112 ksi	657 MPa	95 ksi	18%
Tensile Modulus	RTD	ASTM D 3039	47 GPa	6.7 Msi	46.2 GPa	6.7 Msi	
Tensile Strength 90°	RTD	ASTM D 3039	681 MPa	99 ksi	648 MPa	94 ksi	
Tensile Modulus 90°	RTD	ASTM D 3039	43 GPa	6.2 Msi	44.6 GPa	6.5 Msi	
Compression Strength 0°	RTD	ASTM D 6641	603 MPa	87 ksi	465 MPa	67 ksi	30%
Compression Modulus 0°	RTD	ASTM D 6641	42 GPa	6.2 Msi	41.8 GPa	6.1 Msi	
Compression Strength 90°	RTD	ASTM D 6641	464 MPa	67 ksi	425 MPa	62 ksi	9%
Compression Modulus 90°	RTD	ASTM D 6641	43 GPa	6.2 Msi	43.1 GPa	6.2 Msi	
In-Plane Shear Strength	RTD	ASTM D 7078	305 MPa	44 ksi	360 MPa	52 ksi	
In-Plane Shear Modulus	RTD	ASTM D 7078	16 GPa	2.4 Msi	17 GPa	2.5 Msi	
Open-Hole Compression Strength	RTD	ASTM D 6484	374 MPa	54 ksi	298 MPa	43 ksi	26%

Data supplied by A&P Technology, actual mechanical data provided by CTL. The above data is part of a SAMPE paper presented on 2015 titled "A Comparative Evaluation of Quasi-Isotropic Laminates Composed of Either Braided Tri-axial Fabric or Woven Fabric."

(a) Represents data from TC275-1 QiSO fabric at 272gsm, 38% resin content. All data normalized to 55% fiber volume.

(b) Represents data from TC275-1 plain weave fabric at 205gsm, 38% resin content in 0°/45° orientation. All data normalized to 55% fiber volume.

TYPICAL CURE PARAMETERS

Cure A – 1°C (2°F)/min to 107°C (225°F) and hold for 1 hour, then 0.6°C (1°F)/min to 135°C (275°F) for 6 hours, follow by cool down to 49°C (120°F) at 2.8°C (5°F)/min or less.

Cure B – 1°C (2°F)/min to 107°C (225°F) and hold for 1 hour, then 0.6°C (1°F)/min to 135°C (275°F) for 3 hours, follow by freestanding post cure for 2 hours at 177°C (350°F).

Cure C – 1°C (2°F)/min to 107°C (225°F) for 1 hour, then cure at 177°C (350°F) for 2 hours.

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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 Toray Advanced Composites 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 ingress.

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

A robust debulking procedure is necessary to minimize entrapped air between plies as shown in Figure 1. Vacuum level should be at least at 27 inHg. TC275-1 was debulked every 4 plies for 5–10 minutes. TC275-1 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.

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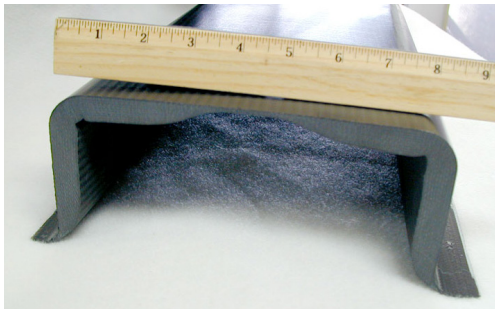
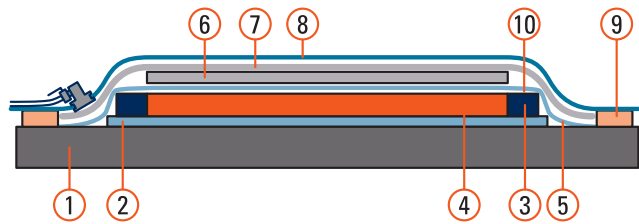
TYPICAL COMPOSITE LAMINATE STACKING SEQUENCE

List of Materials

1. Tool—aluminum, steel, Invar, composite (tool plates must be release coated or film covered).
2. Release coat or film—Frekote 700NC or 770NC, FEP, TEDLAR
Lay-up part using standard debulking procedures
3. Silicone edge dams for cure—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)

Follow the provided Toray Advanced Composites cure cycle for the particular resin system.

Figure 1



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