Toray BT250E-6

Toray Advanced Composites

PRODUCT DATA SHEET

DESCRIPTION

Toray BT250E-6 resin system is a 121°C (250°F) cure epoxy prepreg with excellent strength and stiffness. It provides an outstanding surface finish under vacuum bag/oven cure. BT250E-6 has an FAA-accepted database on carbon IM-7 uni-directional tape, S2-glass, and AS-4C plain weave.

FEATURES

- **Excellent system for out-of-autoclave cure and low pressure cure**
- **Good for high-fatigue cycle applications**
- **Ideal for low-to-medium service temperature applications**
- **Comparable to other supplier 121°C (250°F) cure resin systems**
- **FAA-accepted database on several fibers and fabrics including S2 and carbon fiber**

PRODUCT TYPE

121°C–127°C (250°F–260°F) Cure Epoxy

TYPICAL APPLICATIONS

- Secondary aircraft structures
- Rotorcraft and blades
- Propellers

SHELF LIFE

Out Life:	Up to 30 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 40-ply 15 x 15 cm (6 x 6") uni-directional tape laminate, cured in an 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.

TYPICAL NEAT RESIN PROPERTIES

Density	1.20 g/cc
T_g	131°C (268°F)
Dielectric Constant	3.06 at 10 GHz
Loss Tangent	0.011 at 10 GHz
Coefficient of Thermal Expansion (CTE)	59.6 ppm/°C

SERVICE TEMPERATURE

82°C (180°F) Continuous

Contact us for more information:

North America/Asia/Pacific
e **explore@toraytac-usa.com**
t **+1 408 465 8500**

Europe/Middle East/Africa
e **explore@toraytac-europe.com**
t **+44 (0)1773 530899**

PRODUCT DATA SHEET

MECHANICAL PROPERTIES

Property*	Condition	Method	Results (a) 7781 FG		Results (b) AS4C PW	
Tensile Strength 0°	RTD	ASTM D 3039	482 MPa	70 ksi	909.5 MPa	132 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	25.2 GPa	3.7 Msi	58.9 GPa	8.5 Msi
Tensile Poissons Ratio	RTD	ASTM D 3039	0.150		0.1	
Tensile Strength 0°	CTD	ASTM D 3039	555 MPa	80 ksi	860.2 MPa	125 ksi
Tensile Modulus 0°	CTD	ASTM D 3039	26.8 GPa	3.9 Msi	59.2 GPa	8.6 Msi
Tensile Poissons Ratio	CTD	ASTM D 3039	0.159		0.1	
Tensile Strength 0°	ETW	ASTM D 3039	310 MPa	45 ksi	849.2 MPa	123 ksi
Tensile Modulus 0°	ETW	ASTM D 3039	22.8 GPa	3.3 Msi	58.3 GPa	8.5 Msi
Tensile Poissons Ratio	ETW	ASTM D 3039	0.108		0.1	
Tensile Strength 90°	RTD	ASTM D 3039	403 MPa	58 ksi	864.1 MPa	125 ksi
Tensile Modulus 90°	RTD	ASTM D 3039	23.9 GPa	3.5 Msi	59.1 GPa	8.6 Msi
Tensile Strength 90°	CTD	ASTM D 3039	452 MPa	66 ksi	829.6 MPa	120 ksi
Tensile Modulus 90°	CTD	ASTM D 3039	25.0 GPa	3.6 Msi	59.4 GPa	8.6 Msi
Tensile Strength 90°	ETW	ASTM D 3039	263 MPa	38 ksi	759.6 MPa	110 ksi
Tensile Modulus 90°	ETW	ASTM D 3039	21.3 GPa	3.1 Msi	59.2 GPa	8.6 Msi
Compressive Strength 0°	RTD	ASTM D 6641	536 MPa	78 ksi	639.9 MPa	93 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	26.2 GPa	3.8 Msi	54.4 GPa	7.9 Msi
Compressive Strength 0°	CTD	ASTM D 6641	635 MPa	92 ksi	697.4 MPa	101 ksi
Compressive Modulus 0°	CTD	ASTM D 6641	27.6 GPa	4.0 Msi	54.7 GPa	7.9 Msi
Compressive Strength 0°	ETW	ASTM D 6641	343 MPa	50 ksi	382.3 MPa	55.4 ksi
Compressive Modulus 0°	ETW	ASTM D 6641	23.7 GPa	3.4 Msi	55.0 GPa	8.0 Msi
Compressive Strength 90°	RTD	ASTM D 6641	484 MPa	70 ksi	587.7 MPa	85.2 ksi
Compressive Modulus 90°	RTD	ASTM D 6641	24.5 GPa	3.6 Msi	54.3 GPa	7.9 Msi
Compressive Strength 90°	CTD	ASTM D 6641	573 MPa	83 ksi	642.3 MPa	93.2 ksi
Compressive Modulus 90°	CTD	ASTM D 6641	26.0 GPa	3.8 Msi	55.9 GPa	8.1 Msi
Compressive Strength 90°	ETD	ASTM D 6641	401 MPa	58 ksi	496.8 MPa	72.1 ksi
Compressive Modulus 90°	ETD	ASTM D 6641	23.5 GPa	3.4 Msi	53.3 GPa	7.7 Msi
Compressive Strength 90°	ETW	ASTM D 6641	300 MPa	43 ksi	343.8 MPa	49.9 ksi
Compressive Modulus 90°	ETW	ASTM D 6641	22.7 GPa	3.3 Msi	54.4 GPa	7.9 Msi
Interlaminar Shear Strength 0°	RTD	ASTM D 2344	71.2 MPa	10.3 ksi	56.2 MPa	8.2 ksi
Interlaminar Shear Strength 0°	CTD	ASTM D 2344	78.3 MPa	11.4 ksi	58.4 MPa	8.5 ksi
Interlaminar Shear Strength 0°	ETD	ASTM D 2344	56.7 MPa	8.2 ksi	49.0 MPa	7.1 ksi
Interlaminar Shear Strength 0°	ETW	ASTM D 2344	36.7 MPa	5.3 ksi	34.8 MPa	5.0 ksi
In-Plane Shear Strength Ultimate	RTD	ASTM D 3518	64.4 MPa	9.3 ksi	71.3 MPa	10.3 ksi
In-Plane Shear Strength 0.2% Offset	RTD	ASTM D 3518	38.5 MPa	5.6 ksi	57.9 MPa	8.4 ksi
In-Plane Shear Modulus	RTD	ASTM D 3518	3.93 GPa	0.57 Msi	4.0 GPa	0.58 Msi

Continued on page 3

MECHANICAL PROPERTIES

Continued from page 2

Property*	Condition	Method	Results (a) 7781 FG		Results (b) AS4C PW	
In-Plane Shear Strength Ultimate	CTD	ASTM D 3518	84.1 MPa	12.2 ksi	91.3 MPa	13.2 ksi
In-Plane Shear Strength 0.2% Offset	CTD	ASTM D 3518	50.9 MPa	7.4 ksi	57.9 MPa	8.4 ksi
In-Plane Shear Modulus	CTD	ASTM D 3518	4.84 GPa	0.70 Msi	4.6 GPa	0.66 Msi
In-Plane Shear Strength Ultimate	ETW	ASTM D 3518	35.1 MPa	5.1 ksi	39.5 MPa	5.7 ksi
In-Plane Shear Strength 0.2% Offset	ETW	ASTM D 3518	21.8 MPa	3.2 ksi	25.4 MPa	3.7 ksi
In-Plane Shear Modulus	ETW	ASTM D 3518	2.2 GPa	0.33 Msi	2.6 GPa	0.38 Msi
T_g by DMA	Dry	ASTM D 7028	137°C (278.6°F)		135°C (275.5°F)	
T_g by DMA	Wet	ASTM D 7028	119°C (245.3°F)		121°C (249.6°F)	

(a) Laminate data for 7781 fiberglass fabric reinforcement, 300gsm FAW. Cured at 127°C (260°F). Ref. CAM-RP-2015-041
(b) Laminate data for 3K PW AS4C graphite fabric reinforcement, 195gsm FAW. Cured at 127°C (260°F). Ref. CAM-RP-2015-039

*All properties represent raw test data results have not been normalized. CTD = -54°C (-65°F), ETD = 82°C (180°F), ETW = Tested at 82°C (180°F) after 71°C (160°F) 85% RH saturation.

MECHANICAL PROPERTIES

Property*	Condition	Method	Results (a) IM7		Results (b) S2	
Tensile Strength 0°	RTD	ASTM D 3039	2453 MPa	356 ksi	1495 MPa	217 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	155.8 GPa	22.6 Msi	44.7 GPa	6.5 Msi
Tensile Poissons Ratio	RTD	ASTM D 3039	0.309		0.278	
Tensile Strength 0°	CTD	ASTM D 3039	2460 MPa	357 ksi	1588 MPa	230 ksi
Tensile Modulus 0°	CTD	ASTM D 3039	155.7 GPa	22.6 Msi	44.5 GPa	6.5 Msi
Tensile Poissons Ratio	CTD	ASTM D 3039	0.322		0.291	
Tensile Strength 0°	ETW	ASTM D 3039	2274 MPa	330 ksi	781 MPa	113 ksi
Tensile Modulus 0°	ETW	ASTM D 3039	159.5 GPa	23.1 Msi	43.7 GPa	6.3 Msi
Tensile Poissons Ratio	ETW	ASTM D 3039	0.324		0.327	
Tensile Strength 90°	RTD	ASTM D 3039	39 MPa	5.7 ksi	42.6 MPa	6.2 ksi
Tensile Modulus 90°	RTD	ASTM D 3039	8.6 GPa	1.25 Msi	11.4 GPa	1. 6 Msi
Tensile Strength 90°	CTD	ASTM D 3039	41 MPa	6.0 ksi	46.3 MPa	6.7 ksi
Tensile Modulus 90°	CTD	ASTM D 3039	9.4 GPa	1.36 Msi	12.9 GPa	1.9 Msi
Tensile Strength 90°	ETW	ASTM D 3039	16 MPa	2.2 ksi	22.7 MPa	3.3 ksi
Tensile Modulus 90°	ETW	ASTM D 3039	6.5 GPa	0.94 Msi	6.0 GPa	0.9 Msi
Compressive Strength 0°	RTD	ASTM D 6641	1486 MPa	216 ksi	1100 MPa	159 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	139.5 GPa	20.2 Msi	45.6 GPa	6.6 Msi
Compressive Strength 0°	CTD	ASTM D 6641	1588 MPa	230 ksi	1210 MPa	175 ksi
Compressive Modulus 0°	CTD	ASTM D 6641	140.9 GPa	20.4 Msi	45.4 GPa	6.6 Msi
Compressive Strength 0°	ETD	ASTM D 6641	1225 MPa	178 ksi	1002 MPa	145 ksi

Continued on page 4

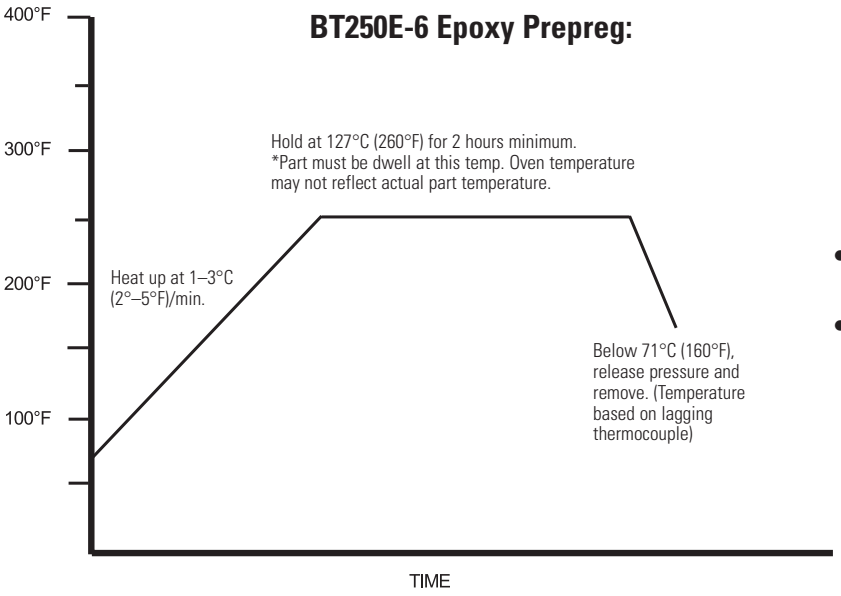
MECHANICAL PROPERTIES

Continued from page 3

Property*	Condition	Method	Results (a) IM7		Results (b) S2	
Compressive Strength 0°	ETW	ASTM D 6641	1051 MPa	152 ksi	701 MPa	102 ksi
Compressive Modulus 0°	ETW	ASTM D 6641	136.5 GPa	19.8 Msi	44.3 GPa	6.4 Msi
Compressive Strength 90°	RTD	ASTM D 6641	190 MPa	28 ksi	165.5 MPa	24.0 ksi
Compressive Modulus 90°	RTD	ASTM D 6641	9.2 GPa	1.3 Msi	12.3 GPa	1.8 Msi
Compressive Strength 90°	CTD	ASTM D 6641	229 MPa	33 ksi	209.4 MPa	30.4 ksi
Compressive Modulus 90°	CTD	ASTM D 6641	9.8 GPa	1.4 Msi	13.6 GPa	2.0 Msi
Compressive Strength 90°	ETW	ASTM D 6641	98 MPa	14 ksi	84.1 MPa	12.2 ksi
Compressive Modulus 90°	ETW	ASTM D 6641	7.6 GPa	1.1 Msi	8.1 GPa	1.2 Msi
Interlaminar Shear Strength 0°	RTD	ASTM D 2344	68.1 MPa	9.9 ksi	59.1 MPa	8.6 ksi
Interlaminar Shear Strength 0°	CTD	ASTM D 2344	85.6 MPa	12.4 ksi	72.9 MPa	10.6 ksi
Interlaminar Shear Strength 0°	ETD	ASTM D 2344	55.4 MPa	8.0 ksi	49.0 MPa	7.1 ksi
Interlaminar Shear Strength 0°	ETW	ASTM D 2344	35.7 MPa	5.2 ksi	34.0 MPa	4.9 ksi
In-Plane Shear Strength Ultimate	RTD	ASTM D 3518	69.5 MPa	10.1 ksi	56.3 MPa	8.2 ksi
In-Plane Shear Strength 0.2% Offset	RTD	ASTM D 3518	46.3 MPa	6.7 ksi	38.6 MPa	5.6 ksi
In-Plane Shear Modulus	RTD	ASTM D 3518	4.34 GPa	0.63 Msi	3.8 GPa	0.55 Msi
In-Plane Shear Strength Ultimate	CTD	ASTM D 3518	87.6 MPa	12.7 ksi	71.9 MPa	10.4 ksi
In-Plane Shear Strength 0.2% Offset	CTD	ASTM D 3518	61.0 MPa	8.8 ksi	49.1 MPa	7.1 ksi
In-Plane Shear Modulus	CTD	ASTM D 3518	5.05 GPa	0.73 Msi	4.5 GPa	0.65 Msi
In-Plane Shear Strength Ultimate	ETW	ASTM D 3518	35.4 MPa	5.1 ksi	31.8 MPa	4.6 ksi
In-Plane Shear Strength 0.2% Offset	ETW	ASTM D 3518	24.9 MPa	3.6 ksi	21.7 MPa	3.1 ksi
In-Plane Shear Modulus	ETW	ASTM D 3518	2.6 GPa	0.38 Msi	2.2 GPa	0.33 Msi
T_g by DMA	Dry	ASTM D 7028	138°C (281.2°F)		144°C (291.7°F)	
T_g by DMA	Wet	ASTM D 7028	117°C (241.9°F)		123°C (252.9°F)	

(a) Laminate data for 12K IM-7 graphite uni-directional tape reinforcement, 148gsm FAW. Cured at 127°C (260°F). Ref. CAM-RP-2015-038
(b) Laminate data for S2 fiberglass uni-directional tape reinforcement, 284gsm FAW. Cured at 127°C (260°F). Ref. CAM-RP-2015-040

*All properties represent raw test data, results have not been normalized. CTD = -54°C (-65°F), ETD = 82°C (180°F), ETW = Tested at 82°C (180°F) after 71°C (160°F) 85% RH saturation.



- Apply 25 inHg vacuum minimum.
- Apply 1–3.4 bar, 30–100 psi pressure to autoclave (optional).

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 ingression.

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 procedure

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. BT250E-6 was debulked every 4 plies for 5–10 minutes. BT250E-6 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.

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/yd^2 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.

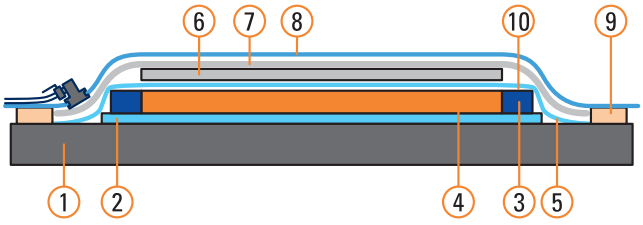


Figure 1

Toray Advanced Composites

18255 Sutter Blvd.
Morgan Hill, CA 95037, USA
t +1 408 465 8500

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

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

www.toraytac.com
explore@toraytac-usa.com (North America/Asia/Pacific)
explore@toraytac-europe.com (Europe/Middle East/Africa)