Toray BTCy-1

Toray Advanced Composites

PRODUCT DATA SHEET

DESCRIPTION

BTCy-1 is a 177°C (350°F) curing cyanate ester and is an industry standard for use on satellite structure and radomes.

FEATURES

- **Good resistance to galvanic corrosion**
- **Low outgassing**
- **Low dielectric performance**

PRODUCT TYPE

177°C (350°F) Cure Cyanate Ester

TYPICAL APPLICATIONS

- Aircraft
- Spacecraft
- High temperature radomes and antennas
- Radar transparent structures
- Low outgassing applications
- BMI replacement
- High performance electronic substrates

SHELF LIFE

Out Life:	14 days at ≤ 21°C (70°F) and ≤ 60% RH
Frozen Storage Life:	12 months at ≤-18°C (≤ 0°F)

Out life is the maximum time allowed at 21°C (70°F) or below and 60% or less RH before cure, after a single frozen storage cycle in the original unopened packaging at -18°C (≤ 0°F) or below for a period not exceeding the frozen storage life noted above.

Out life was verified from 4581 prepreg and laminates cured at 177°C (350°F) via gel time, flow, heat of reaction and short beam interlaminar shear.

TYPICAL NEAT RESIN PROPERTIES

Density	1.17 g/cc
Moisture Absorption	1% at 100°C (212°F) saturation
Dry T_g with 177°C/350°F cure*	190°C (374°F)
Dry T_g with 260°C/500 °F cure*	241°C (466°F)
Dielectric Constant	2.7 (10 GHz)
Loss Tangent	0.003 (10 GHz)
G_{IC} Value	1.2 in-lb/in^2

Outgassing (TML)	0.36%
Outgassing (CVCM)	0.00%
Outgassing (WVR)	0.33%

Tensile Modulus	3.93 GPa (0.57 Msi)
Poisson's Ratio	0.48
Shear Modulus	6.10 GPa (0.885 Msi)

*4581 Laminate

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ELECTRICAL PROPERTIES OF COMPOSITE LAMINATES

BTCy-1/4581	1.0 MHz	10.0 GHz
Dielectric Constant	3.19	3.20
Loss Tangent	0.001	0.004

BTCy-1/4781	1.0 GHz	10.0 GHz
Dielectric Constant	-	3.89
Loss Tangent	-	0.005

BTCy-1/7781	1.0 GHz	10.0 GHz
Dielectric Constant	4.30	-
Loss Tangent	0.006	-

MECHANICAL PROPERTIES — 4581 ASTROQUARTZ®III, 286 GSM FAW

Property	Condition	Method	Results	
Tensile Strength 0°	RTD	ASTM D 3039	696.4 MPa	101 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	26.2 GPa	3.8 Msi
Tensile Strength 0°	ETD	ASTM D 3039	584.7 MPa	84.8 ksi
Tensile Modulus 0°	ETD	ASTM D 3039	21.4 GPa	3.5 Msi
Compressive Strength 0°	RTD	ASTM D 6641	537.1 MPa	77.9 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	25.5 GPa	3.7 Msi
Compressive Strength 0°	ETD	ASTM D 695	288.2 MPa	75.4 ksi
Compressive Modulus 0°	ETD	ASTM D 695	21.4 GPa	4.0 Msi
Flexural Strength 0°	RTD	ASTM D 7264	745 MPa	108 ksi
Flexural Modulus 0°	RTD	ASTM D 7264	32 GPa	4.7 Msi
Flexural Strength 0°	ETD	ASTM D 7264	509 MPa	73.8 ksi
Flexural Modulus 0°	ETD	ASTM D 7264	28 MPa	4.1 Msi
Short Beam Shear Strength	RTD	ASTM D 2344	59 MPa	8.6 ksi
Short Beam Shear Strength	RTD	ASTM D 2344	39 GPa	5.7 ksi

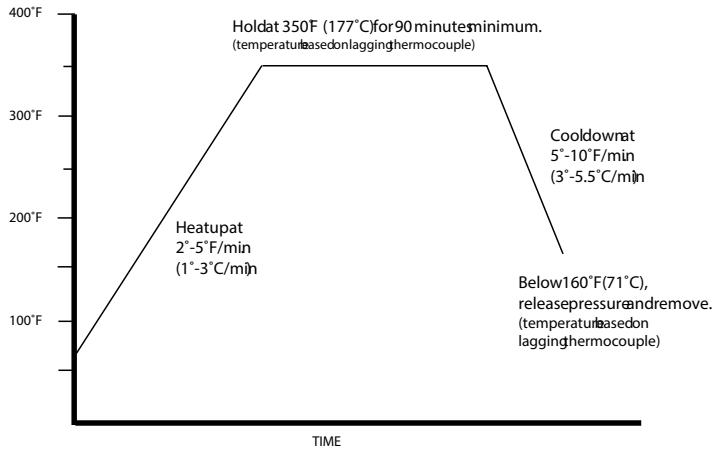
MECHANICAL PROPERTIES — 4781 L-GLASS FABRIC, 286 GSM FAW

Property	Condition	Method	Results	
Tensile Strength 0°	RTA	ASTM D 3039	404.7 MPa	58.7 ksi
Tensile Modulus 0°	RTA	ASTM D 3039	21.4 GPa	3.1 Msi
Compressive Strength 0°	RTA	ASTM D 695	509.5 MPa	73.9 ksi
Compressive Modulus 0°	RTA	ASTM D 695	23.4 GPa	3.4 Msi
Flexural Strength 0°	RTA	ASTM D 790	555 MPa	80.5 ksi
Flexural Modulus 0°	RTA	ASTM D 790	20.3 MPa	2.94 Msi
Flexural Strength 90°	RTA	ASTM D 790	599.2 MPa	86.9 ksi
Flexural Modulus 90°	RTA	ASTM D 790	19 GPa	2.76 Msi
Short Beam Shear Strength 0°	RTA	ASTM D 2344	63.4 MPa	9.2 ksi
Short Beam Shear Strength 90°	RTA	ASTM D 2344	65.5 MPa	9.5 ksi
T_g by DMA	As-Is	ASTM D 7028	198.1° C	388.6° F

MECHANICAL PROPERTIES — 7781 FG REINFORCEMENT, 300 GSM FAW

Property	Condition	Method	Results	
Tensile Strength 0°	RTD	ASTM D 3039	483 MPa	70 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	22.1 GPa	3.2 Msi
Compressive Strength 0°	RTD	ASTM D 6641	441 MPa	64 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	21 GPa	3 Msi
Flexural Strength 0°	RTD	ASTM D 7264	593 MPa	86 ksi
Flexural Modulus 0°	RTD	ASTM D 7264	21 GPa	3 Msi
Short Beam Shear Strength	RTD	ASTM D 2344	55 MPa	8 ksi

BTCY-1 CYANATE ESTER RESIN SYSTEM

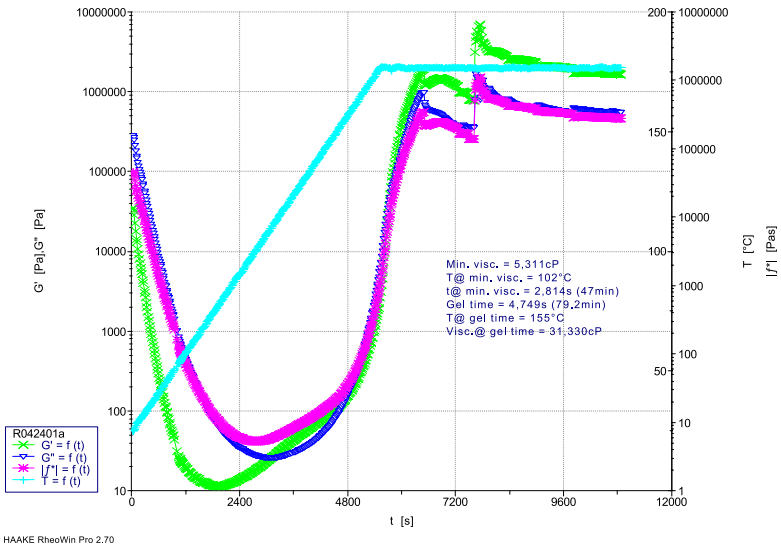


- Apply 25 inches Hg vacuum minimum.
- Apply 40 - 50 psig pressure to autoclave (optional).

Optional Post cure: Heat at 2°–3°C/min (3°–5°F/min) to 233°C (450°F), dwell at 233°C (450°F) for two hours minimum, cool at 3–5.5°C/min (5°–10°F) to 82°C (180°F) and remove.

RHEOLOGY

BTCy-1, Lot# 060900-30C2, 3°F/min (1°C/min), 77°F-350°F (25°C-177°C) hold 90 min.



HAAKE RheoWin Pro 2.70

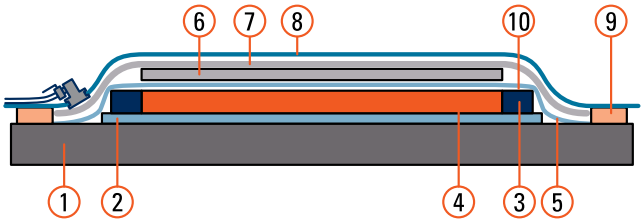
TYPICAL COMPOSITE LAMINATE STACKING SEQUENCE

List of Materials

1. Tool—aluminum, steel, Invar, composite (tool plates must be release coated or film covered). See the list below
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



CYANATE ESTER PREPREG, ADHESIVE AND RESIN GUIDELINES AND HANDLING PROCEDURES

The following guidelines are provided to our customers for one specific purpose: to assure that all customers are aware of the manner by which to attain the best possible results from Toray Advanced Composites cyanate ester 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

Cyanate Esters (CE's) should always be sealed in an airtight bag and kept frozen below -12°C (10°F) when not being used. 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, CE's 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. 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: 121°C (250°F) for 3–4 Hours

SELF ADHESIVE PROPERTIES AND FILM ADHESIVE USE

Toray Advanced Composites cyanate ester resins have been formulated to have good self-adhesive properties to core materials. However, this should not be taken as a green light to eliminate a film adhesive from a cored, structural piece of hardware. This option has been given by Toray Advanced Composites for customers who are looking for the best electrical properties available by not using a film adhesive. Toray Advanced Composites recommends that the structural integrity be verified your specification prior to end item usage and takes no responsibility otherwise.

If this option is exercised, the following modified cure cycle has been found to work well.

1. Ramp the part to 66–71°C (150–160°F) (Keep Pressure <15 Psi)
2. Dwell for approximately 1 hour
3. Ramp the part to the dictated cure temperature for the resin and cure per the provided standard cure cycle.

LAY-UP AREA ENVIRONMENTAL CONTROLS

Toray Advanced Composites recommends that any composite or adhesive lay-up be performed in a clean area visibly free from dust. Any work surfaces should likewise be free of residue, dust or debris. No eating or smoking shall be allowed in the shop area. For radome materials, conductive materials shall not be allowed in the process area. The processing shop area should be maintained between 16°C to 32°C (60°F to 90°F) with a relative humidity of no greater than 70% rH.

PROCESSING METHODOLOGY

Cyanate esters can be processed using an Autoclave, Press, Pressclave, or Oven Cure/Vacuum Bag. For any application where the optimum properties are needed, Toray Advanced Composites recommends the use of an autoclave, or press especially for its BTCy–1 & BTCy-2 resin systems. This is due to the fact that air voids caused by vacuum bag/oven cure processing may darken upon post cure and create unsightly dark specs in the laminate. Although the structural deficit caused by these voids has not been assessed, it can most probably be assumed that the detriment would be no more than that caused by the voids themselves created via vacuum bag processing.

BAGGING FOR CURE

Toray Advanced Composites recommends that CE composite parts bagged for cure should be performed as follows.

1. Release the tool surface
2. Layup part using standard debulking procedures
3. Dam the edges of the part for cure
4. Place one ply of porous Teflon® or perforated Teflon® onto the bag surface of the part
5. Place bleeder layers over porous Teflon® material and trim to the part periphery
6. Place a non-porous layer of Teflon® over the part
7. Utilize a breather cloth to facilitate vacuum draw
8. Install vacuum bag on the tool for cure
9. Follow the provided Toray Advanced Composites cure cycle for the particular resin system

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