Toray BTCy-1A

'TORAY'
Toray Advanced Composites

PRODUCT DATA SHEET

DESCRIPTION

Toray BTCy-1A is a toughened version of the BTCy-1 cyanate ester prepreg resin system. Its proprietary toughening mechanism and controllable flow make it an ideal product for use not only as a high performance prepreg resin system, but also as an accompanying resin system for film adhesives. BTCy-1A's straight-up, easy processing at 177°C (350°F) (under low pressures) reduces curing time and production costs, while the system's negligible volatile emission upon cure allows low void laminates.

FEATURES

- **Toughened resin system for improved impact resistance**
- **Controlled flow**
- **Robust processing window**

PRODUCT TYPE

177°C (350°F) Cure Toughened Cyanate Ester

TYPICAL APPLICATIONS

- Aircraft
- Spacecraft
- High temperature radomes and antennas
- Radar transparent structures
- Low outgassing applications
- High performance bonding applications

SHELF LIFE

Out Life:	30 days at ≤ 21°C (≤ 70°F) and ≤ 60% RH
Frozen Storage Life:	6 months at ≤ -18°C (≤ 0°F)

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

TYPICAL NEAT RESIN PROPERTIES

Density	1.15 g/cc
Glass Transition (T_g)	207 °C (405°F) after 204°C (400°F) post cure 185°C (365°F) cured at 177°C (350°F)
CTE	77 ppm/°C (43 ppm/°F)
Dielectric Constant	2.7 (10 GHz)
Loss Tangent	0.003 (10 GHz)
Moisture Absorption	1% at saturation

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ELECTRICAL PROPERTIES OF COMPOSITE LAMINATES

BTCy-1A/4581 Quartz	C/X Band 8–18 GHz	Ku/K Band 18–26.5 GHz	Ka Band 26.5–40 GHz	G & U Band 40–60 GHz
Dielectric Constant	3.23	3.18	3.19	3.18
Loss Tangent	< 0.001*	< 0.010*	< 0.010*	< 0.010*

* The loss tangent under focused beam testing is only accurate to 0.010. This material is less than 0.010. This material represents one of Toray's best for high energy radome applications.

LAMINATE DATA—IM-7 GRAPHITE UNI-DIRECTIONAL LAMINATE

Property	Condition	Method	Results	
Tensile Strength 0°	RTD	ASTM D 3039	2723 MPa	395 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	165.5 GPa	24 Msi
Compressive Strength 0°	RTD	ASTM D 6641	1551 MPa	225 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	159 GPa	23 Msi
Short Beam Shear (G12)	RTD	ASTM D 3518	82.0 MPa	11.9 ksi

LAMINATE DATA—M55J PLAIN WEAVE FABRIC, 152GSM FAW

Property	Condition	Method	Results	
Tensile Strength 0°	RTD	ASTM D 3039	802 MPa	116 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	177 GPa	25.7 Msi
Compressive Strength 0°	RTD	ASTM D 6641	356 MPa	51.6 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	146.2 GPa	21.2 Msi
Flexural Strength 0°	RTD	ASTM D 7264	541 MPa	78.4 ksi
Flexural Modulus 0°	RTD	ASTM D 7264	152.4 GPa	21.1 Msi
Short Beam Shear Strength	RTD	ASTM D 2344	45.5 MPa	6.6 ksi

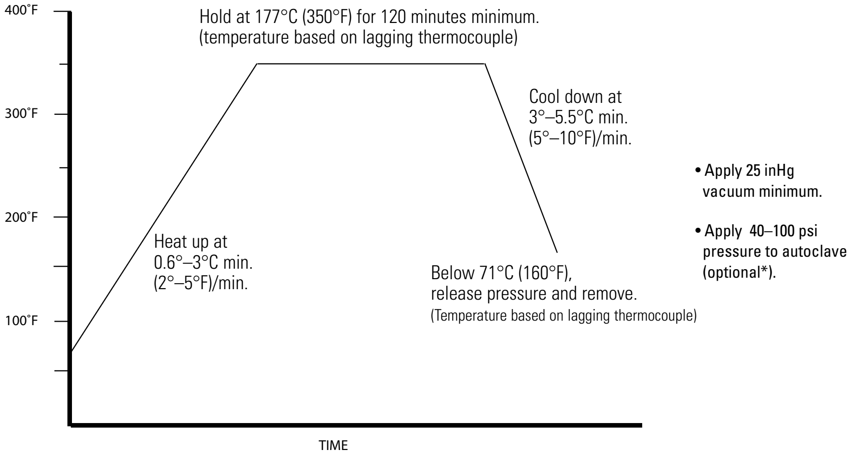
LAMINATE DATA—4581 AQIII/BTCY-1A, 300GSM FAW

Property	Condition (RTD, ETD, ETW)	Method	Results	
Tensile Strength 0°	RTD	ASTM D 3039	834 MPa	121 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	27 GPa	3.9 Msi
Tensile Strength 0°	ETD	ASTM D 3039	779.1 MPa	113 ksi
Tensile Modulus 0°	ETD	ASTM D 3039	25.5 GPa	3.7 Msi
Compressive Strength 0°	RTD	ASTM D 6641	558 MPa	81 ksi
Compressive Modulus 0°	RTD	ASTM D 6641	29.0 GPa	4.2 Msi
Compressive Strength 0°	ETD	ASTM D 6641	359 MPa	52 ksi
Short Beam Strength	RTD	ASTM D 2344	45.5 MPa	6.6 ksi

ETD is 141°C (285°F)
Data normalized to 60% fiber volume except interlaminar shear strength

PRODUCT DATA SHEET

BTCY-1A CYANATE ESTER RESIN SYSTEM:

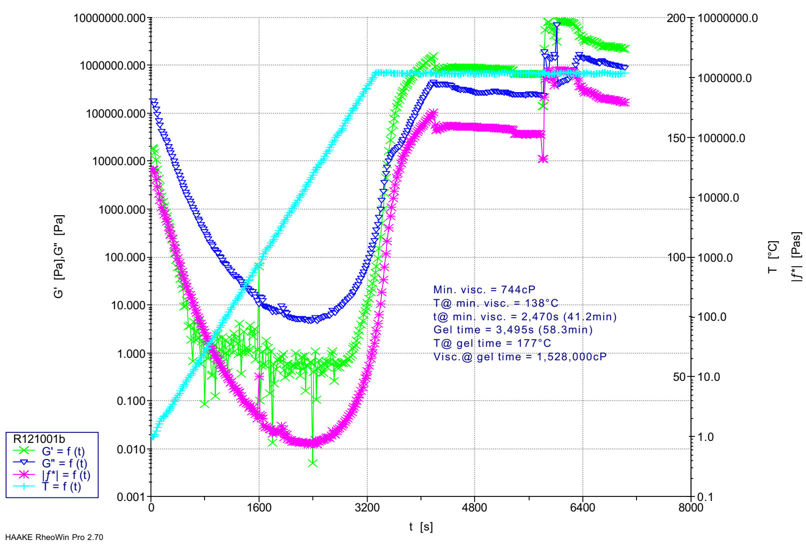


*Pressure at customer’s discretion as required by their application

Post cure: Heat at 2°-3°C/min (3°-5°F/min) to 204°C (400°F), dwell at 204°C (400°F) for 60 minutes minimum, cool at 3-5.5°C/min (5°-10°F) to 82°C (180°F) and remove.

RHEOLOGY

BTCy-1A, Lot# 060401-5MC2, 2°C/min (5°F/min), 25°C-177°C (77°F-350°F) hold 90 min.



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 (CEs) 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 pinhole in the bag or other problem occurs.

MOISTURE ABSORPTION AND SENSITIVITY

While very resistant to moisture absorption after cure, CEs 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 the 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.

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 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 to 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°C–71°C (150°F–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 or Oven Cure/Vacuum Bag. For any application where the optimum properties are needed, Toray Advanced Composites recommends the use of an autoclave 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. Lay-up 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

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.

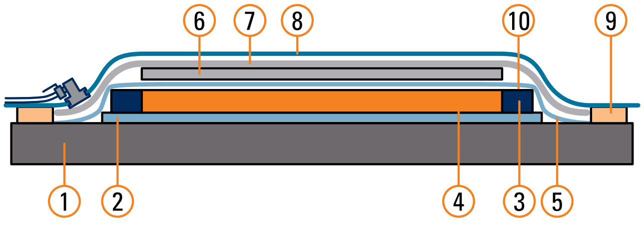


Figure 1

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