



Go Boldly into the New Space Age

Proven composite materials from orbit to beyond

TORAY

Innovation by Chemistry

Space, Satellite, & Launch

Introduction



Our Objectives

- ▲
Connecting
the planet
- ▲
Furthering
scientific
understanding
- ▼
Reducing
weight
- ▲
High
reliability

Credit: Airbus Defence and Space

SPACE TRANSFORMED: THE NEW ERA OF PRIVATE LAUNCHES AND SATELLITES

The space industry is experiencing a transformative evolution fueled by cutting-edge technological innovation and the commercialization of launch services. As humanity looks to space as the next frontier, falling launch costs are unlocking unprecedented access, paving the way for advancements ranging from satellite mega-constellations and high-bandwidth communications to next-generation space infrastructure such as space stations, orbital refueling depots, and space-based drones. In this dynamic environment, reliability is crucial, and technical solutions must be both cost-effective and capable of withstanding the extreme conditions of space.

For over 30 years, Toray has been a trusted partner in the space and satellite sector, offering innovative resin and fiber solutions that meet rigorous spaceflight standards for outgassing, radiation resistance, and thermocycling. With our deep expertise, established heritage, and extensive database, we are equipped to tailor material solutions to your specific needs.

Collaborating closely with our customers and staying attuned to shifting market demands, we have built a comprehensive portfolio of advanced material technologies designed for the evolving space industry, including:

- ▶ Standard Modulus (SM), Intermediate Modulus (IM), Intermediate Modulus Plus (IM+), and High Modulus (HM) TORAYCA™ carbon fibers
- ▶ Toughened thermoset prepregs available in fabric, uni-directional, and slit tape formats
- ▶ Epoxy, cyanate ester, bismaleimide, and polyimide resins
- ▶ Toray Cetex® thermoplastic composite materials
- ▶ Bulk molding compounds and compression molded components

In space, pedigree matters. Failure in deployment is not an option. Our proven track record ensures that we can help you meet the challenges of space with confidence.

 THERMOCYCLE STABILITY	 DIMENSIONAL STABILITY
 LOW MOISTURE ABSORPTION	 MICROCRACK RESISTANT
 ULTRA LIGHT WEIGHT	 AUTOMATED PROCESSABILITY
 RIGID	 HIGH TEMPERATURE RESISTANT
 RECYCLABLE	 OUT OF AUTOCLAVE PROCESSABLE



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 To confine our attention to terrestrial matters would be to limit the human spirit.
Stephen Hawking

Space, Satellite, & Launch

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- ▲ Furthering scientific understanding
- ▼ Reducing weight
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Satellite

Product Applications

SUPPORTING EQUIPMENT

Structural panels, deployable booms, struts and tubes hold cameras and antennas. Tight dimensional tolerance requirements enable accurate pointing, clear spacecraft communications and delivery of ultra high definition images of Earth and space.



STIFF



LOW OUTGASSING



DIMENSIONAL STABILITY

ANTENNAS AND REFLECTORS

From small sandwich panel sub reflectors to huge deployable spinning structures, and flat phased arrays meters across, Toray materials meet satellite communication needs. Reflectors demand tight dimensional tolerances for accurate operation.



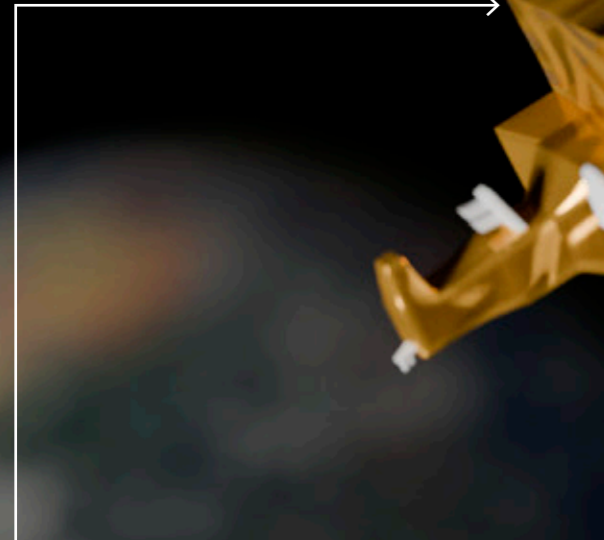
STIFF



LOW OUTGASSING



THERMAL CYCLE STABILITY



SATELLITE BUS STRUCTURE

Highly stiff and lightweight carbon fiber skinned sandwich panels support and protect the payload inside the satellite through launch, ensuring reliability of operation throughout the lifetime of the mission.



STIFF



LOW OUTGASSING

HEAT SINKS

All electronics equipment can generate heat and the satellite payload is no different. There's no convection of heat in the hard vacuum of space, so heat is "dumped" to the outside of the satellite by heat pipes, or sometimes composite plates with highly thermally conductive fibers.



HIGH TEMPERATURE RESISTANT



THERMOCYCLE STABILITY

SOLAR ARRAY PANEL SUBSTRATES

Thin skin sandwich panel structures supporting the solar cells, which provide all of the satellite's power requirements – there are no power sockets in space! For a satellite which maneuvers to generate Earth images, the stiffness of these panels is critical to the timing of how quickly it can take its next picture.



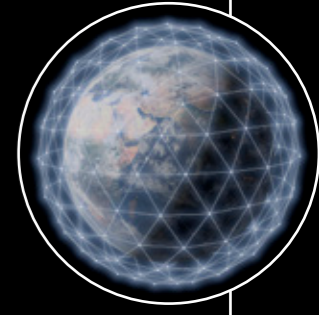
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LOW OUTGASSING

NEW SPACE, SMALL SATELLITES, AND CONSTELLATIONS IN LEO

As we progress towards smaller satellites and the rise of constellation networks, composite materials remain indispensable. The lightweight yet stiff properties of carbon fiber composite materials enable the creation of smaller, lighter structures, which reduce the load on the satellite supporting structure. This leads to significant mass savings and, in turn, a higher mass capacity and lower launch costs!



Launch Vehicle

Product Applications

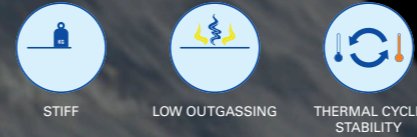
PAYLOAD ADAPTORS, INTERSTAGE, SKIRTS, STRUTS, TUBES, LATTICES, STRUCTURAL PANELS
 Toray exceptionally durable and microcrack resistant thermosets deliver a lightweight, high-strength structure for landing leg assemblies, secondary tubes, and struts and conduits.



MICROCRACK RESISTANT LIGHTWEIGHT STRONG

FAIRINGS, SATELLITE DISPENSERS

The latest generation of launch vehicles utilize TORAYCA™ SM, IM, IM+, HM carbon fibers and out-of-autoclave (OOA) processable prepreg systems for cost-competitive vehicle barrel assemblies, inner and outer stages, satellite dispenser units, and fairings for weight and cost savings.



STIFF LOW OUTGASSING THERMAL CYCLE STABILITY

HIGH TEMPERATURE CAPABILITIES, INCLUDING HEATSHIELDS AND OTHER HOT AREAS

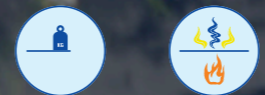
Toray's high temperature cyanate ester prepreps create lightweight, thermally stable structures. The high char yield of these materials acts as an ablator, protecting the structure from excessive heat.



THERMAL CYCLE STABILITY LIGHTWEIGHT HIGH TEMPERATURE RESISTANT

CRYOGENIC TANKS

Toray high-quality toughened epoxy prepreg systems are ideally suited for high strength, low weight tanks. Retaining toughness at a low temperature, coupled with a low coefficient of thermal expansion (CTE), results in a tank that can perform in the harsh environment of space.



STIFF LOW OUTGASSING



BACK TO EARTH

Reusability is key to a sustainable future in spaceflight. Toray's toughened and durable materials have a proven track record in the production of reusable components, including landing legs and fins, ensuring reliability and efficiency in every mission.

Space, Satellite, & Launch

Product Overview

Thermoset Prepregs Epoxy

	Resin matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	Outgassing, CTE/CME or hot/wet data	Public Database	OoA/VBO	Toughened	Low Moisture Absorption	Impact Resistant	High Temperature Performance
2510	Epoxy	131°C (294°F)	132°C (270°F) 2 hours	<ul style="list-style-type: none"> Qualified to AMS 3960, 3914, and 3915 Long freezer life 	Wet T _g 131°C (267°F) TML 0.46 % CVCM 0.02 % WVR 0.12 %	AGATE	●				
2511	Epoxy	162°C (324°F)	132°C (270°F) 2 hours	<ul style="list-style-type: none"> Qualified to AMS 3962 Low void content with OOA/VBO Long freezer life 	Wet T _g 118°C (244°F) TML 0.33 % CVCM 0.02 % WVR 0.07 %	CMH-17	●	●	●	●	
2700	Epoxy	163°C (326°F)	160°C (320°F) 5 minutes (press) 200°C (392°F) with post cure 132°C (270°F) 2 hours	<ul style="list-style-type: none"> Multi-process flexible system for high volume Short cure cycles < 5 min Low void content and optimized tack 	Wet T _g 146°C (294°F) TML 0.32 % CVCM <0.01 % WVR 0.06 %		●	●	●	●	●
3900	Epoxy	204°C (400°F)	177°C (350°F) 2 hours	<ul style="list-style-type: none"> Qualified to AMS 6891 Long out life Legacy commercial aerospace material 121°C (250°F) hot/wet service Outstanding toughness" 	Wet T _g 166°C (330°F) TML 0.38 % CVCM 0.04 % WVR 0.07 %	CMH-17		●	●	●	●
3960	Epoxy	204°C (400°F)	177°C (350°F) 2 hours	<ul style="list-style-type: none"> Long out life, extremely long freezer life Excellent balance of CAI and OHC properties 121°C (250°F) hot/wet service Outstanding toughness 	Wet T _g 166°C (330°F) TML 0.38 % CVCM 0.04 % WVR 0.07 %	NCAMP <i>in progress</i>	●	●	●	●	●
EX-1522	Modified Epoxy	180°C (356°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Excellent mechanical properties Good balance of properties between cyanate ester and epoxy Low D_k and D_L 	TML 0.28 % CVCM 0.01 % WVR 0.16 % TML-WVR 0.12 %			●	●		
TC250	Epoxy	140°C (285°F) or 180°C (356°F) with post cure	60 minutes at 88°C (190°F), followed by 2 hours at 130°C (265°F)	<ul style="list-style-type: none"> NCAMP qualified Long out life of 60 days and the ability to post cure makes it ideal for large structures 	Wet T _g 125°C (257°F) Cured at 130°C (265°F) TML 0.27 % CVCM 0.01 % WVR 0.32 %		●	●			
RS-36 / RS-36-1	Epoxy	181°C (358°F) or 190°C (374°F)	90 minutes at 177°C (350°F)	<ul style="list-style-type: none"> ESA qualified for solar array High toughness Low moisture absorption 	TML 0.4 % CVCM 0.01 % WVR 0.17 % TML-WVR 0.12 %		●	●	●		
TC275-1E	Epoxy	168°C (334°F)	6 hours at 135°C (275°F) Optional post cure of 2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Long out time version of TC275-1 Allows construction of thick or larger composites structures OOA/VBO processable 	Wet T _g 136°C (277°F) TML 0.44 % CVCM 0.01 % WVR 0.22 %		●	●	●		
TC350-1	Epoxy	191°C (376°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> OOA/VBO processable Good hot/wet properties 	Wet T _g 160°C (320°F) TML 0.55 % CVCM 0.01 % WVR 0.27 %		●	●	●		
TC380	Epoxy	204°C (399°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Extreme toughness for structural and cryogenic applications Excellent balance of CAI, OHC, and hot/wet properties 	TML 0.83 % CVCM 0.01 % WVR 0.75 %		●	●	●		

High and Ultra-High Temperature

	Resin matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	Public Database	OoA/VBO	Toughened	Low Moisture Absorption	Impact Resistant	High Temperature Performance
RS-8HT	BMI	203°C (397°F) or 285°C (545°F) with post cure	2 hours at 204°C (400°F) followed by 6 hours at 250°C (482°F)	<ul style="list-style-type: none"> Excellent elevated temperature performance Good moisture resistance 				●		
TC890	Polyimide 900HT	454°C (850°F)	Call for cure details	<ul style="list-style-type: none"> Non-MDA PMR-15 replacement Short-term service temperature capability of 538°C (1000°F) 						●
TC1810 NEW	Preceramic	TBD	Call for cure details	<ul style="list-style-type: none"> Retention of mechanical properties at high temperatures, up to 1000°C (1832°F) Low-temperature processing with standard thermoset techniques including AFP Co-curable 						●

Thermoset Prepregs Cyanate Ester

	Resin matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	Outgassing, CTE/CME or hot/wet data	OoA/VBO	Toughened	Low moisture absorption
EX-1515	Cyanate Ester	121°C (249°F) or 174°C (345°F) with post cure	3 hours at 121°C (250°F) Optional post cure of 2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Low density Resistant to microcracking Low residual stress with 121°C (250°F) cure 	TML 0.18 % CVCM 0.01 % CTE 61 ppm/°C		●	●
TC410	Cyanate Ester	112°C (234°F) or 181°C (358°F) with post cure	3 hours at 121°C (250°F) Optional post cure at 177°C (350°F)	<ul style="list-style-type: none"> Low CTE 58.4 μm/m/°C Extremely low CME 1205 μm/m/% Ideal system for stable structures 	TML 0.29 % CVCM < 0.01 % WVR 0.17 % TML-WVR 0.12 %		●	●
BTCy-1A	Cyanate Ester	185°C (365°F) or 207°C (405°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 60 minutes at 204°C (400°F)	<ul style="list-style-type: none"> Tough High T_g 	CTE 77 ppm/°C		●	●
RS-3/ RS-3C	Cyanate Ester	191°C (375°F) or 254°C (490°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 60 minutes at 232°C(450°F)	<ul style="list-style-type: none"> Extensive qualification portfolio Low CTE, CME High stability RS-3C is controlled-flow version 	TML 0.22 % CVCM 0.01 %	●	●	●
TC420	Cyanate Ester	176°C (349°F) or 348°C (658°F) with post cure	3 hours at 177°C (350°F) Optional post cure at 260°C (500°F)	<ul style="list-style-type: none"> Good resistance to microcracking Capable of high-temperature service Ideal for heat shield and ablative applications 	TML 0.41 % CVCM < 0.01% WVR 0.28% CTE 55 ppm/°C	●	●	●

Space, Satellite, & Launch

Product Overview

Toray Cetex® Thermoplastic

	Resin matrix	Melting temperature T _m	Processing temperature T _p	Key product characteristics	Public Database	OoA/VBO	Durability/Toughness	Low Moisture Absorption	Impact Resistant	High Temperature Performance
TC1225	LMPAEK™ Low-Melt Polyaryletherketone	305°C (581°F)	340-385°C (644-725°F)	<ul style="list-style-type: none"> Lower processing temperature with good high temperature performance May be overmolded with PEEK for final part Very good CAI properties 282 MPa (40.9 ksi) Ideal for structural applications 	NIAR NCAMP ¹ CMH-17	•	•	•	•	•

¹ Database is FAA accepted

RTM Resins

	Resin	Dry T _g onset	Cure time and temperature	Key product characteristics	Toughened	Low Moisture Absorption
EX-1545	Cyanate Ester	173°C (345°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Toughened resin system with low viscosity of 140 cPs at 43°C (110°F) Long pot life for complex parts 		•
RS-16	Cyanate Ester	151°C (304°F) 252°C (486°F) with elevated post cure	2 hours at 135°C (275°F)	<ul style="list-style-type: none"> Low-temperature cure resin system Post curable for higher T_g 	•	•
EX-1510	Cyanate Ester	193°C (380°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Low room temperature viscosity of 150 cPs Post curable for higher T_g 		•

Toray Microply™ Film Adhesives Epoxy

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
RS-15H	Epoxy	99°C (211°F)	6 hours at 93°C (200°F) Alternate cures are available	<ul style="list-style-type: none"> Low-temperature curing adhesive 	•	•	
TC263	Epoxy	110°C (230°F)	2 hours at 121°C (250°F)	<ul style="list-style-type: none"> High peel strength Ideal for metal or composite bonding 	•	•	
TC310	Epoxy	157°C (315°F)	2 hours at 177°C (350°F) or 2 hours at 121°C (250°F), followed by 1 hour at 177°C (350°F)	<ul style="list-style-type: none"> Ideal composite bonding film adhesive 	•	•	

Toray Microply™ Film Adhesives Cyanate Ester

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
EX-1516	Cyanate Ester	126°C (258°F)	5 hours at 121°C (250°F)	<ul style="list-style-type: none"> Compatible with Toray EX-1515 prepreg 	•	•	•
RS-4A	Cyanate Ester	195°C (383°F) or 238°C (460°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 1.5-2 hours at 232°C (450°F)	<ul style="list-style-type: none"> Moisture resistant 	•	•	•
EX-1543	Cyanate Ester	191°C (376°F) or 211°C (412°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 2 hours at 204°C (400°F)	<ul style="list-style-type: none"> Compatible with 177°C (350°F) curing cyanate ester prepregs Low shrinkage Low outgassing 	•		•
TC4015	Cyanate Ester	176°C (349°F) or 321°C (610°F) with post cure	2 hours at 177°C (350°F) Optional post cure of > 60 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Excellent high-temperature properties Compatible with TC420 	•		•

Toray Microply™ Syntactics Epoxy

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
EM-3	Epoxy	~116°C (240°F)	60 minutes at 121°C (250°F)	<ul style="list-style-type: none"> High expansion (8-10 x) 0.64 g/cc (40 pcf) density T_g estimated from base resin data 			
TCF4035	Epoxy	140°C (284°F)	3 hours at 130°C (265°F)	<ul style="list-style-type: none"> Low density 0.64 g/cc (40 pcf) Compatible with TC250, may be post cured for higher T_g 	•	•	

Toray Microply™ Syntactics Cyanate Ester

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
TCF4001	Cyanate Ester	176°C (349°F)	2 hours at 177°C (350°F) Optional post cure of 60-90 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Low density 0.38 g/cc (24 pcf) 	•		•
TCF4050	Cyanate Ester	176°C (349°F) or 232°C (450°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 60-90 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Expanding syntactic film/core splice Density of 0.28-0.55 g/cc (17-35 pcf) Compatible with TC420 prepreg system 	•	•	•
EM-5A	Cyanate Ester	204°C (400°F)	2 hours at 177°C (350°F) Optional post cure of 60-90 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Expansion ratio of 4 x 	•		•
EX-1541	Cyanate Ester	227°C (441°F) or 240°C (464°F) with post cure	177°C (350°F)—2 hours Optional post cure 232°C (450°F)—2 hours	<ul style="list-style-type: none"> Density of 0.16–0.38 g/cc (10–24 pcf) Good structural properties Low dielectric constant and loss 			•

Toray Composite Materials America Inc.

Tacoma, Washington

19002 50th Avenue East, Tacoma, WA 98446

+1-253-846-1777

salescmacontact@toraycma.com

Decatur, Alabama

2030 Highway 20, Decatur, AL 35601

+1-256-260-2626

salescmacontact@toraycma.com

Spartanburg, South Carolina

2202 Moore-Duncan Highway, Moore, SC 29369

+1-864-586-3444

salescmacontact@toraycma.com

Toray Advanced Composites

Morgan Hill, California

18255 Sutter Blvd, Morgan Hill, CA 95037

+1-408-465-8500

explore@toraytac-usa.com

Fairfield, California

2450 Cordelia Road, Fairfield, CA 94534

+1-707-359-3400

explore@toraytac-usa.com

Nottingham, United Kingdom

Amber Drive

Langley Mill, Nottingham, NG16 4BE

United Kingdom

+44-1773-530899

explore@toraytac-europe.com

Nijverdal, The Netherlands

G. van der Muelenweg 2, Nijverdal, 7443 RE

The Netherlands

+31-548-633-933

explore@toraytac-europe.com



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Satellite

Product Applications

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- LOW OUTGASSING
- DIMENSIONAL STABILITY

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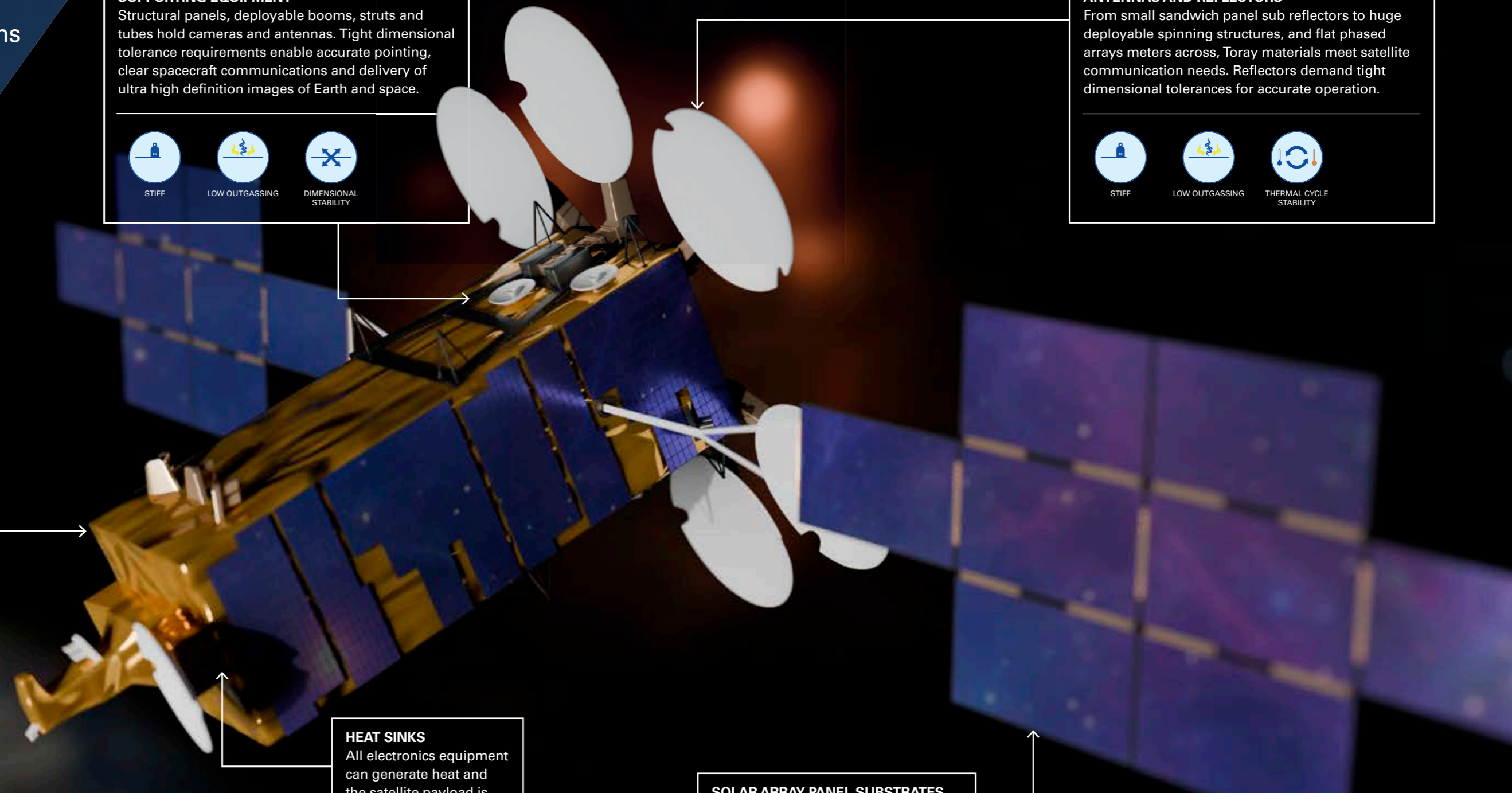
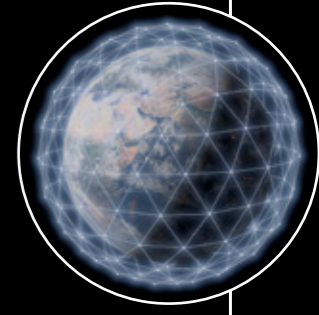
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Launch Vehicle

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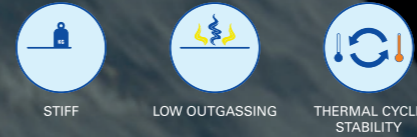
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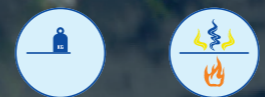
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STIFF LOW OUTGASSING



BACK TO EARTH

Reusability is key to a sustainable future in spaceflight. Toray's toughened and durable materials have a proven track record in the production of reusable components, including landing legs and fins, ensuring reliability and efficiency in every mission.

Space, Satellite, & Launch

Product Overview

Thermoset Prepregs Epoxy

	Resin matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	Outgassing, CTE/CME or hot/wet data	Public Database	OoA/VBO	Toughened	Low Moisture Absorption	Impact Resistant	High Temperature Performance
2510	Epoxy	131°C (294°F)	132°C (270°F) 2 hours	<ul style="list-style-type: none"> Qualified to AMS 3960, 3914, and 3915 Long freezer life 	Wet T _g 131°C (267°F) TML 0.46 % CVCM 0.02 % WVR 0.12 %	AGATE	●				
2511	Epoxy	162°C (324°F)	132°C (270°F) 2 hours	<ul style="list-style-type: none"> Qualified to AMS 3962 Low void content with OOA/VBO Long freezer life 	Wet T _g 118°C (244°F) TML 0.33 % CVCM 0.02 % WVR 0.07 %	CMH-17	●	●	●	●	
2700	Epoxy	163°C (326°F)	160°C (320°F) 5 minutes (press) 200°C (392°F) with post cure 132°C (270°F) 2 hours	<ul style="list-style-type: none"> Multi-process flexible system for high volume Short cure cycles < 5 min Low void content and optimized tack 	Wet T _g 146°C (294°F) TML 0.32 % CVCM <0.01 % WVR 0.06 %		●	●	●	●	●
3900	Epoxy	204°C (400°F)	177°C (350°F) 2 hours	<ul style="list-style-type: none"> Qualified to AMS 6891 Long out life Legacy commercial aerospace material 121°C (250°F) hot/wet service Outstanding toughness" 	Wet T _g 166°C (330°F) TML 0.38 % CVCM 0.04 % WVR 0.07 %	CMH-17		●	●	●	●
3960	Epoxy	204°C (400°F)	177°C (350°F) 2 hours	<ul style="list-style-type: none"> Long out life, extremely long freezer life Excellent balance of CAI and OHC properties 121°C (250°F) hot/wet service Outstanding toughness 	Wet T _g 166°C (330°F) TML 0.38 % CVCM 0.04 % WVR 0.07 %	NCAMP <i>in progress</i>	●	●	●	●	●
EX-1522	Modified Epoxy	180°C (356°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Excellent mechanical properties Good balance of properties between cyanate ester and epoxy Low D_k and D_L 	TML 0.28 % CVCM 0.01 % WVR 0.16 % TML-WVR 0.12 %			●	●		
TC250	Epoxy	140°C (285°F) or 180°C (356°F) with post cure	60 minutes at 88°C (190°F), followed by 2 hours at 130°C (265°F)	<ul style="list-style-type: none"> NCAMP qualified Long out life of 60 days and the ability to post cure makes it ideal for large structures 	Wet T _g 125°C (257°F) Cured at 130°C (265°F) TML 0.27 % CVCM 0.01 % WVR 0.32 %		●	●			
RS-36 / RS-36-1	Epoxy	181°C (358°F) or 190°C (374°F)	90 minutes at 177°C (350°F)	<ul style="list-style-type: none"> ESA qualified for solar array High toughness Low moisture absorption 	TML 0.4 % CVCM 0.01 % WVR 0.17 % TML-WVR 0.12 %		●	●	●		
TC275-1E	Epoxy	168°C (334°F)	6 hours at 135°C (275°F) Optional post cure of 2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Long out time version of TC275-1 Allows construction of thick or larger composites structures OOA/VBO processable 	Wet T _g 136°C (277°F) TML 0.44 % CVCM 0.01 % WVR 0.22 %		●	●	●		
TC350-1	Epoxy	191°C (376°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> OOA/VBO processable Good hot/wet properties 	Wet T _g 160°C (320°F) TML 0.55 % CVCM 0.01 % WVR 0.27 %		●	●	●		
TC380	Epoxy	204°C (399°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Extreme toughness for structural and cryogenic applications Excellent balance of CAI, OHC, and hot/wet properties 	TML 0.83 % CVCM 0.01 % WVR 0.75 %		●	●	●		

High and Ultra-High Temperature

	Resin matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	Public Database	OoA/VBO	Toughened	Low Moisture Absorption	Impact Resistant	High Temperature Performance
RS-8HT	BMI	203°C (397°F) or 285°C (545°F) with post cure	2 hours at 204°C (400°F) followed by 6 hours at 250°C (482°F)	<ul style="list-style-type: none"> Excellent elevated temperature performance Good moisture resistance 				●		
TC890	Polyimide 900HT	454°C (850°F)	Call for cure details	<ul style="list-style-type: none"> Non-MDA PMR-15 replacement Short-term service temperature capability of 538°C (1000°F) 						●
TC1810 NEW	Preceramic	TBD	Call for cure details	<ul style="list-style-type: none"> Retention of mechanical properties at high temperatures, up to 1000°C (1832°F) Low-temperature processing with standard thermoset techniques including AFP Co-curable 						●

Thermoset Prepregs Cyanate Ester

	Resin matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	Outgassing, CTE/CME or hot/wet data	OoA/VBO	Toughened	Low moisture absorption
EX-1515	Cyanate Ester	121°C (249°F) or 174°C (345°F) with post cure	3 hours at 121°C (250°F) Optional post cure of 2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Low density Resistant to microcracking Low residual stress with 121°C (250°F) cure 	TML 0.18 % CVCM 0.01 % CTE 61 ppm/°C		●	●
TC410	Cyanate Ester	112°C (234°F) or 181°C (358°F) with post cure	3 hours at 121°C (250°F) Optional post cure at 177°C (350°F)	<ul style="list-style-type: none"> Low CTE 58.4 μm/m/°C Extremely low CME 1205 μm/m/% Ideal system for stable structures 	TML 0.29 % CVCM < 0.01 % WVR 0.17 % TML-WVR 0.12 %		●	●
BTCy-1A	Cyanate Ester	185°C (365°F) or 207°C (405°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 60 minutes at 204°C (400°F)	<ul style="list-style-type: none"> Tough High T_g 	CTE 77 ppm/°C		●	●
RS-3/RS-3C	Cyanate Ester	191°C (375°F) or 254°C (490°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 60 minutes at 232°C(450°F)	<ul style="list-style-type: none"> Extensive qualification portfolio Low CTE, CME High stability RS-3C is controlled-flow version 	TML 0.22 % CVCM 0.01 %	●	●	●
TC420	Cyanate Ester	176°C (349°F) or 348°C (658°F) with post cure	3 hours at 177°C (350°F) Optional post cure at 260°C (500°F)	<ul style="list-style-type: none"> Good resistance to microcracking Capable of high-temperature service Ideal for heat shield and ablative applications 	TML 0.41 % CVCM < 0.01% WVR 0.28% CTE 55 ppm/°C	●	●	●

Space, Satellite, & Launch

Product Overview

Toray Cetex® Thermoplastic

	Resin matrix	Melting temperature T _m	Processing temperature T _p	Key product characteristics	Public Database	OoA/VBO	Durability/Toughness	Low Moisture Absorption	Impact Resistant	High Temperature Performance
TC1225	LMPAEK™ Low-Melt Polyaryletherketone	305°C (581°F)	340-385°C (644-725°F)	<ul style="list-style-type: none"> Lower processing temperature with good high temperature performance May be overmolded with PEEK for final part Very good CAI properties 282 MPa (40.9 ksi) Ideal for structural applications 	NIAR NCAMP ¹ CMH-17	•	•	•	•	•

¹ Database is FAA accepted

RTM Resins

	Resin	Dry T _g onset	Cure time and temperature	Key product characteristics	Toughened	Low Moisture Absorption
EX-1545	Cyanate Ester	173°C (345°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Toughened resin system with low viscosity of 140 cPs at 43°C (110°F) Long pot life for complex parts 		•
RS-16	Cyanate Ester	151°C (304°F) 252°C (486°F) with elevated post cure	2 hours at 135°C (275°F)	<ul style="list-style-type: none"> Low-temperature cure resin system Post curable for higher T_g 	•	•
EX-1510	Cyanate Ester	193°C (380°F)	2 hours at 177°C (350°F)	<ul style="list-style-type: none"> Low room temperature viscosity of 150 cPs Post curable for higher T_g 		•

Toray Microply™ Film Adhesives Epoxy

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
RS-15H	Epoxy	99°C (211°F)	6 hours at 93°C (200°F) Alternate cures are available	<ul style="list-style-type: none"> Low-temperature curing adhesive 	•	•	
TC263	Epoxy	110°C (230°F)	2 hours at 121°C (250°F)	<ul style="list-style-type: none"> High peel strength Ideal for metal or composite bonding 	•	•	
TC310	Epoxy	157°C (315°F)	2 hours at 177°C (350°F) or 2 hours at 121°C (250°F), followed by 1 hour at 177°C (350°F)	<ul style="list-style-type: none"> Ideal composite bonding film adhesive 	•	•	

Toray Microply™ Film Adhesives Cyanate Ester

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
EX-1516	Cyanate Ester	126°C (258°F)	5 hours at 121°C (250°F)	<ul style="list-style-type: none"> Compatible with Toray EX-1515 prepreg 	•	•	•
RS-4A	Cyanate Ester	195°C (383°F) or 238°C (460°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 1.5-2 hours at 232°C (450°F)	<ul style="list-style-type: none"> Moisture resistant 	•	•	•
EX-1543	Cyanate Ester	191°C (376°F) or 211°C (412°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 2 hours at 204°C (400°F)	<ul style="list-style-type: none"> Compatible with 177°C (350°F) curing cyanate ester prepregs Low shrinkage Low outgassing 	•		•
TC4015	Cyanate Ester	176°C (349°F) or 321°C (610°F) with post cure	2 hours at 177°C (350°F) Optional post cure of > 60 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Excellent high-temperature properties Compatible with TC420 	•		•

Toray Microply™ Syntactics Epoxy

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
EM-3	Epoxy	~116°C (240°F)	60 minutes at 121°C (250°F)	<ul style="list-style-type: none"> High expansion (8-10 x) 0.64 g/cc (40 pcf) density T_g estimated from base resin data 			
TCF4035	Epoxy	140°C (284°F)	3 hours at 130°C (265°F)	<ul style="list-style-type: none"> Low density 0.64 g/cc (40 pcf) Compatible with TC250, may be post cured for higher T_g 	•	•	

Toray Microply™ Syntactics Cyanate Ester

	Resin Matrix	Dry T _g onset	Cure time and temperature	Key product characteristics	OoA/VBO	Toughened	Low Moisture Absorption
TCF4001	Cyanate Ester	176°C (349°F)	2 hours at 177°C (350°F) Optional post cure of 60-90 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Low density 0.38 g/cc (24 pcf) 	•		•
TCF4050	Cyanate Ester	176°C (349°F) or 232°C (450°F) with post cure	2 hours at 177°C (350°F) Optional post cure of 60-90 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Expanding syntactic film/core splice Density of 0.28-0.55 g/cc (17-35 pcf) Compatible with TC420 prepreg system 	•	•	•
EM-5A	Cyanate Ester	204°C (400°F)	2 hours at 177°C (350°F) Optional post cure of 60-90 minutes at 232°C (450°F)	<ul style="list-style-type: none"> Expansion ratio of 4 x 	•		•
EX-1541	Cyanate Ester	227°C (441°F) 240°C (464°F) with post cure	177°C (350°F)—2 hours Optional post cure 232°C (450°F)—2 hours	<ul style="list-style-type: none"> Density of 0.16–0.38 g/cc (10–24 pcf) Good structural properties Low dielectric constant and loss 			•

Toray Composite Materials America Inc.

Tacoma, Washington

19002 50th Avenue East, Tacoma, WA 98446

+1-253-846-1777

salescmacontact@toraycma.com

Decatur, Alabama

2030 Highway 20, Decatur, AL 35601

+1-256-260-2626

salescmacontact@toraycma.com

Spartanburg, South Carolina

2202 Moore-Duncan Highway, Moore, SC 29369

+1-864-586-3444

salescmacontact@toraycma.com

Toray Advanced Composites

Morgan Hill, California

18255 Sutter Blvd, Morgan Hill, CA 95037

+1-408-465-8500

explore@toraytac-usa.com

Fairfield, California

2450 Cordelia Road, Fairfield, CA 94534

+1-707-359-3400

explore@toraytac-usa.com

Nottingham, United Kingdom

Amber Drive

Langley Mill, Nottingham, NG16 4BE

United Kingdom

+44-1773-530899

explore@toraytac-europe.com

Nijverdal, The Netherlands

G. van der Muelenweg 2, Nijverdal, 7443 RE

The Netherlands

+31-548-633-933

explore@toraytac-europe.com



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