

TORAY CFRT®
Material Selector Guide



THE MATERIAL EDGE®

'TORAY'

Toray Performance Materials Corporation

CFRT[®]

Material Selector Guide

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OUR OBJECTIVES

▲
Engineered
Solutions

▲
Product
Performance

▲
High-Volume
Production

▲
Cost
Effectiveness

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Contributing to society through the creation of new value with innovative ideas, technologies, and products.



INTRODUCTION TO TORAY PMC

Materials Technology and Capabilities

Toray Performance Materials Corporation (TPMC) began as Medical Materials Corporation (MMC) in 1986 and was founded by William R. Olson, D.P.M., a leading University of California, Berkeley team Podiatrist. The primary market for MMC was medical foot orthotics. This was the beginning of the Toray PMC "TL" brand which continues to be the foremost premium orthotic material on the market today. Since our inception, we have produced tens of millions of thermoplastic composite components for diverse applications including Athletic Footwear, Medical and Orthopedic, Automotive, Consumer Electronics, Recreational and Industrial applications.

The acquisition by Toray Industries Inc. in July 2018, has signaled the beginning of a new era, continuing the legacy of innovation and service, now with the strength of the Toray Group behind us to provide the ultimate value to our customers.

Thermoplastic Composite Solutions

TPMC is the leading supplier of Toray CFRT® which are continuous fiber-reinforced thermoplastic composite materials, components, and solutions.

We help companies realize the advantages of thermoplastic composites as advanced structural reinforcements through the integration of engineered solutions and downstream processing. It's this vertical strength coupled with the advantages of thermoplastic composites that enables our customers to achieve innovations in their products - innovations that provide cost, performance and aesthetics advantages exceeding that of more conventional reinforcement solutions.

Our thermoplastic composites are used to make better products in almost any market and application where composite materials can provide benefit. Our goal is not only to provide expertise in continuous fiber-reinforced thermoplastic composites, but also to truly understand and respond to the needs of the markets and customers that we serve.

Medical Materials Corporation (MMC) founded by Dr. Olson, D.P.M. and head of Podiatric Surgery at the Center for Sports Medicine at St. Francis Memorial Hospital, San Francisco.

1986



2000

MMC renamed to Performance Materials Corporation (PMC) and acquired Baycomp Company in Canada.

Sheet Manufacturing

TPMC's CFRT® vertically integrated manufacturing allows for lower production costs, greater flexibility, and fast delivery. TPMC's CFRT® factory is operated using computer-aided manufacturing systems. The manufacturing processes for producing Toray CFRT® materials includes resin formulation, prepreg, and lamination.

Multiple opening lamination presses produce high throughput of consistent composite sheet materials, while allowing for manufacturing flexibility. The thermoplastic panels proceed from lamination presses to cutting operations. Our standard 3ft x 4ft (914mm x 1219 mm) sheet materials are produced in a multitude of grades and aesthetic options.

High-Volume Component Manufacturing

Using CAD/CAM programming and the latest waterjet technology, component parts are cut quickly and efficiently. Material utilization is maximized and tooling costs are minimized compared to other cutting process.

The waterjet-cut flat component patterns are then formed in seconds using relatively inexpensive tooling. TPMC ships over a million high quality composite components every month to facilities around the world. TPMC's integrated factor ensures timely delivery of high-quality components to customers.

TPMC CFRT® composite materials are offered in both woven and uni-directional formats. Our technology blends the benefits of a thermoplastic polymer matrix with fiber reinforcement. The result is a synergistic material with greater strength than the two alone.

Baycomp Company
closed. PMC acquired by
Toray Industries Inc.

2018

2012
PMC was
acquired
by Tencate
Group



2019
TL product line of orthotic CFRT®
materials celebrates over 30 years of
proven performance as. Continues
the legacy as the leading orthotic
material on the market today.





INTRODUCTION TO TORAY PMC

Global Locations

SOLUTIONS

- Thermoplastic composites
- Thermoplastic laminates
- Parts manufacture
- Sales office

CERTIFICATIONS

- ISO 9001:2015



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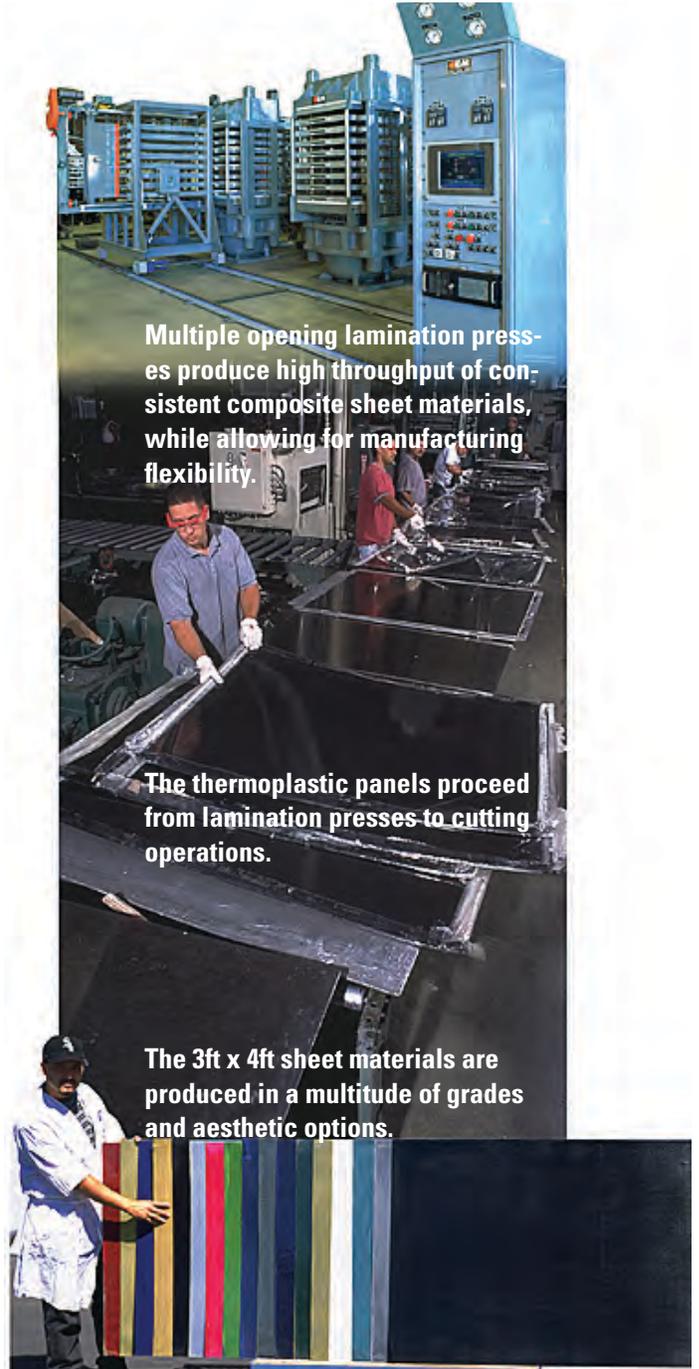
Phone: +1 886 4 22606718

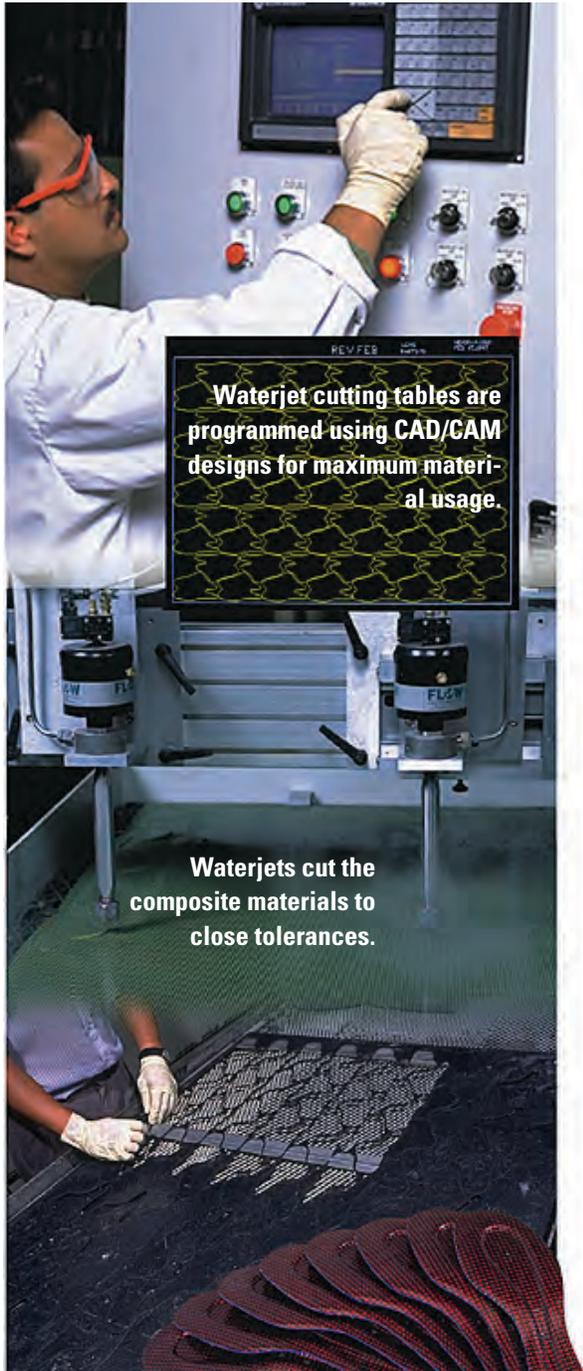
Sales contact: b.chen@toraypmc.com



INTRODUCTION TO TORAY PMC

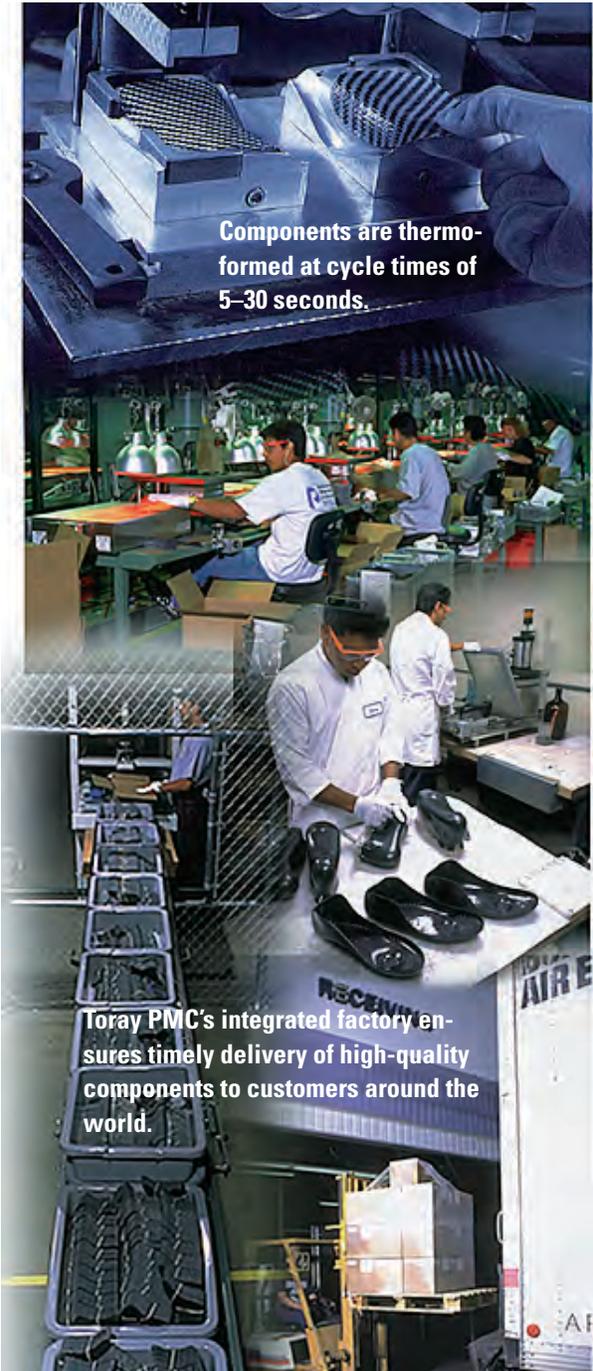
Virtual Tour





Waterjet cutting tables are programmed using CAD/CAM designs for maximum material usage.

Waterjets cut the composite materials to close tolerances.



Components are thermoformed at cycle times of 5-30 seconds.

Toray PMC's integrated factory ensures timely delivery of high-quality components to customers around the world.

THE MATERIAL EDGE®

Toray CFRT® composite materials are used to enhance the performance for various applications. Our materials have unique attributes and, when used strategically, they can reduce the weight of a product substantially while increasing stability. Our materials are used in combination with other components to develop product designs that are truly engineered.

“Resilience” (spring or responsiveness) is a key performance attribute of Toray CFRT® composite materials that is found typically in Athletic Footwear applications. It is used to describe how the

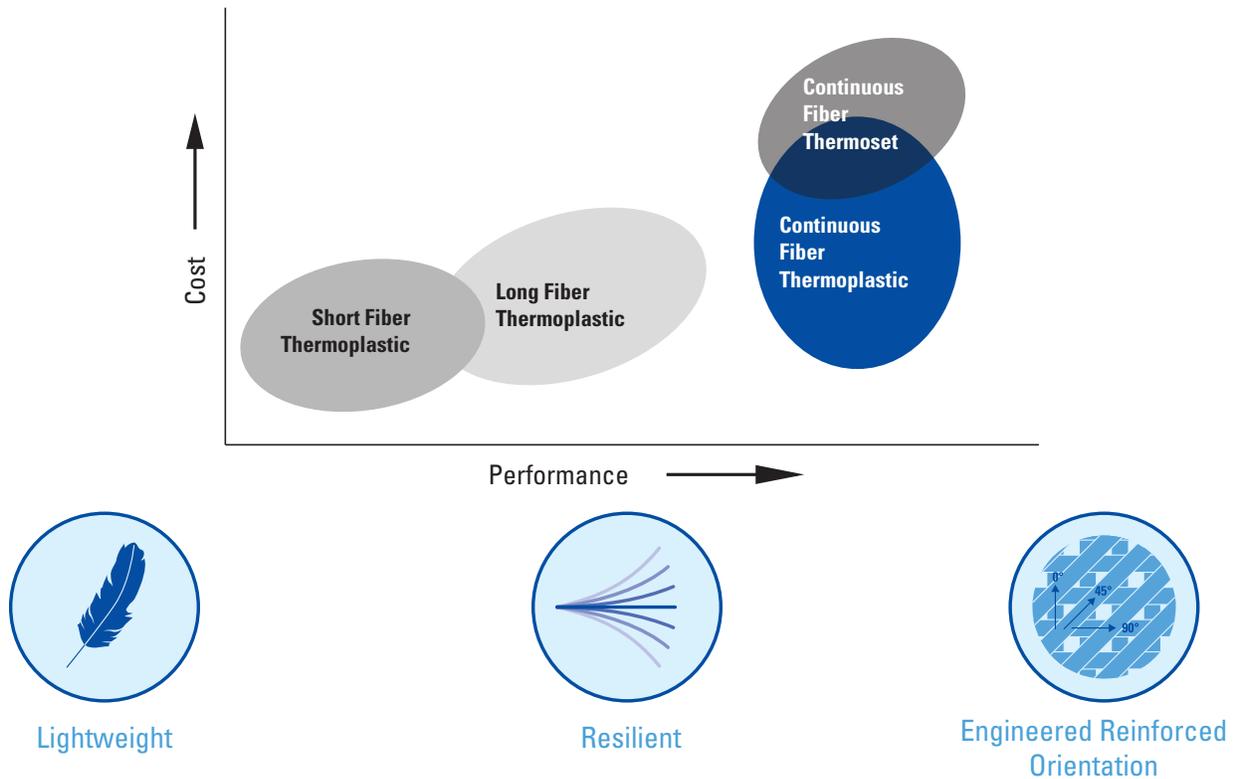
materials return to their original shape through millions of cycles; Thus, contributing to reduced foot fatigue and injury prevention.

Toray CFRT® materials have performance and weight advantages over “chopped fiber reinforced” or “nonreinforced” injection molded materials.

Toray CFRT® composite materials are “tunable.” They can be tailored to increase or limit the range of foot motion with fiber replacement, resin mix, and component design. The fiber placement can be selected to provide the

greatest mechanical properties in the desired direction. Similar to a continuous “bridge,” Toray CFRT® materials provide engineered strength from one end of the component to the other.

Toray CFRT® materials can be designed with different fiber types and content in each direction allowing for different properties in each direction. This allows the designer to develop a shoe component with different characteristics in the medial-lateral and longitudinal directions.





LAMINATE STYLES

Our woven and uni-directional (UD) materials are offered in a variety of styles and fiber (carbon and/or glass) combinations. The proprietary resin matrix systems used in Toray CFRT® materials offer unique processing and property characteristics to match a broad range of structural and service requirements.

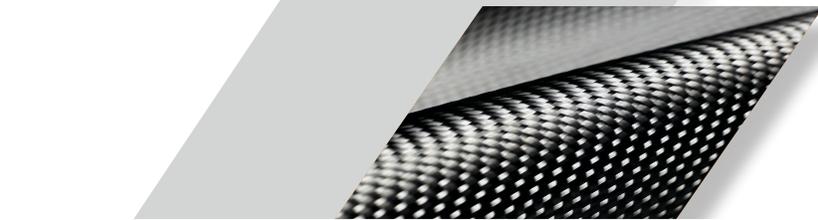
Uni-directional (UD) series - Toray CFRT® UD series of laminates are continuous fiber reinforced thermoplastic composites that blend the benefits of a thermoplastic polymer matrix with uni-directional carbon and/or glass fibers for enhanced performance. UD laminates can be multilayer products and are highly tunable. The UD material layups can be fine tuned for example by modifying the degree of orientations to achieve the highest level of mechanical properties for your product design or by adding glass layers to carbon constructions for cost efficiency. Our teams will work with you to find the best option that meets your design requirements.

Woven series - Our CFRT® woven laminates are offered in a variety of weave styles and fiber constructions. Similar to the UD series, each laminate construction is chosen for its own unique performance, aesthetic, and economic attributes.

Unidirectional Laminate Styles

Fiber Reinforcement	Laminate Style	Resin	Thickness mm	Rigidity N-cm	Modulus GPa	Strength MPa
Carbon	CFRT® SPEED	PET	1.05 (± 0.2)**	> 90**	> 32**	> 470**
Carbon/Glass	CFRT® SPEED	PET	1.15 (± 0.2)**	> 438 **	>44.7 **	> 460 **
Glass	CFRT® SPRINT	PET	0.75 (± 0.2) **	> 6.6 **	> 31 **	> 888 **

**Data is preliminary - for development. Based on a 4 Layer construction.

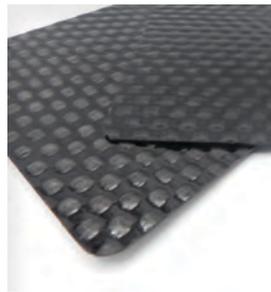


Products are offered in a variety of materials including:

- **Carbon Fiber** - The greatest strength-to-weight option available
- **Glass Fiber** - The most cost-effective composite
- **Carbon/Glass Fiber** - The most efficient carbon product



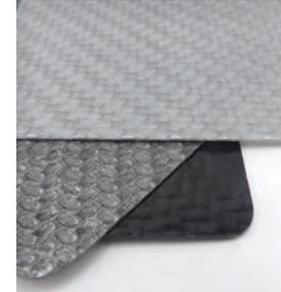
Toray CFRT® TW-2000



Toray CFRT® BW-1000



Toray CFRT® PW-1000



Toray CFRT® TWAG

Woven Laminate Styles

Fiber Reinforcement	CFRT® Laminate Style	Resin	Weave Style	Thickness mm	Rigidity N-cm	Modulus GPa	Strength MPa
Carbon	TW-2000 1L	PMMA	Twill	0.70 (±0.2)	~ 14.5	~ 22.8	> 450
Carbon	TW-2000 2L	PMMA	Twill	1.27 (± 0.2)	~ 17.5	~ 35.1	> 530
Carbon	TW-2000 1L EB®	PMMA	Twill	0.85 (± 0.2)	36	6	195
Carbon	SL-2000 (SuperLam)	PC	Twill or Plain	0.30 (± 0.1)	cosmetic	cosmetic	cosmetic
Carbon	SS-2000 (SuperSkin)	TPU	Twill or Plain	0.60 (± 0.1)	cosmetic	cosmetic	cosmetic
Carbon/Glass	BW-1000	PMMA	Basket	0.95 (± 0.3)	51-110	5-14	172-358
Carbon/Glass	BW-1000 Reemay®	PMMA	Basket	1.08 (± 0.2)	67-122	4-12	139-318
Carbon/Glass	PW-1000	PMMA	Plain	0.85 (± 0.15)	> 55	> 6.2	> 188
Carbon/Glass	TW-1000	PMMA	Twill	1.0 (± 0.2)	> 45	> 7.4	> 148
Carbon/Glass	TW-1000 401 EB®	PMMA	Twill	1.05 (± 0.15)	< 80	> 7.0	> 140
Carbon/Glass	TW-4000	PMMA	Twill	0.85 (± 0.2)	> 110	> 20	> 420
Glass	AG-18 2L	PMMA	Plain	0.95 (± 0.2)	5.5-6.5	13-16	470-604
Glass	AG-24 2L	PMMA	Plain	1.15 (± 0.2)	208-285	13.9-20.5	367-506
Glass	AG-7544 2L	PMMA	Plain	0.96 (± 0.2)	> 101	12.8	> 248
Glass	TWAG	PMMA	Twill	0.95 (± 0.2)	> 40	>6	> 250

ENVIR-Bond® (EB) is TPMC's material innovation to improve the ease of processing at the factory level and to help reduce the amount of harmful solvents used in the footwear manufacturing process. EB "tie-layers" are added for injection over molding.



Typical Applications

High-Performance, Athletic Footwear



Shank Plate - Toray CFRT® materials are typically used as a shank plate buried under the arch (typically in the midsole) or as an exposed torsional enhancement creating a “bridge” between the heel and forefoot. The shank plate is located under the mid-foot or arch area of the foot and adds structural support. This area of the shoe is often cut out or sculpted. Exposing the plate is a footwear design feature to add a unique look to the shoe. CFRT® materials have many cosmetic and color options to enhance the final look of the product. As with other footwear components, shank plates will reduce the weight of footwear significantly by using our CFRT® technology. Larger shank plates offer higher biomechanical support and creates a lighter-weight shoe.

Sock Liner or Insole - As an aftermarket improvement or provided as a comfort or performance aspect in footwear, Toray CFRT® composite materials can be used as a sock liner or insole providing added support just under the foot. The key benefits to using CFRT® composite materials for sock liners or insoles are: reduce foot fatigue, improved stability, and increased comfort. Our composite materials are thin and light, providing support while not taking up too much room in the shoe. The insole shells can also be heat adjusted for customization.

We recommend our composite materials for the following footwear components

Heel Stability Plate (Lateral/Medial) - Typically used in Running shoe design, the use of CFRT® materials for this component part will help to stabilize the heel during the heel strike. Adding a CFRT® heel stability plate will also help to minimize pronation and supination.

Spring Plate or Propulsion Plate - An extension of the shank plate, the spring plate or propulsion plate, extends to the forefoot. In some cases, the spring plates made from Toray CFRT® materials have been extended into the first and second metatarsals for added spring and resiliency. These plates can be engineered to give athletes a balance of stiffness versus compliance while absorbing the impact of the foot as it strikes against the ground. When wings are added to the spring plate, it increases the wearer’s medial and lateral control.

Turf Plate - CFRT® materials can be used in turf plate components in place of spring steel to limit the extension of the big toe. Toray PMC has developed very specific materials for this application. Please ask us for more information and recommendations for this component part. One added benefit of using CFRT® is that it reduces the amount of heat transferred from the turf to the wearer’s foot.



TYPICAL APPLICATIONS

Automotive- Advanced composite materials are not only strong and lightweight, facilitating reduced fuel consumption, but also promote an energy-efficient and cleaner solutions for high performance automotive applications. Composites are literally paving the road for the next-generation automobiles.

Foot Orthotics - Recommended for functional correction, the use of CFRT® materials for this medical application will help to stabilize and correct foot ailments while decreasing weight strain. CFRT® carbon or glass foot orthotics can be used to minimize pronation and supination. Our biomechanical heritage attributes to the vast product lines and material options we have available for Podiatrists and their patients.

NRG plates - Toray CFRT® NRG Plates are unique designs used in medical applications to limit motion such as with Turf Toe or Hallux Rigidus and partial foot amputations. They are also used to make improvements in patients' gait and to redistribute pressures to less sensitive areas of the foot for diabetic patients.

Other types of orthoses and prostheses - Toray CFRT® reinforcement panels bring an innovative technology to orthotic and prosthetic applications. They satisfy both the workshop need for ease of fabrication and the patient need for comfort and performance. Parts and devices made from thermoplastic sheets, such as polypropylene, are reinforced in strategic locations by thermobonding for example, an XRP panel to a part during vacuum forming or drape molding. The result is a part with increased strength and stiffness, without having to raise the basic sheet thickness.





Recreational - In sports and recreation, performance is king. Extra weight limits even the best of athletes. Lightweight performance composites from Toray let you make the most of your products to appeal to customer performance demands. Our products perform across a broad range of specialized sporting applications, from skate outsoles, bicycle helmets, paddle boards, and kayak paddles to high-end athletic footwear and insoles.



Consumer Electronics - Toray offers innovative, lightweight, and cost-effective solutions for the next generation of electronics. Our CFRT® continuous fiber reinforced thermoplastics from Toray integrate with high-volume manufacturing processes including one-shot compression molding and injection overmolding to deliver tough, protective, and cosmetically superior structural enclosures for laptops, handheld devices, and tablets.



General Hospital Devices and Therapeutic Products - CFRT® materials may be used for medical applications that are non-invasive and where there is a need for lightweight, structural support. This may include but is not limited to: sheet materials for surgical tables or medical computer carts, electronic devices, monitors, and other applications. Please consult with our Sales and Engineering teams for material recommendations.



TORAY CFRT® KEY BENEFITS:

Performance and weight improvements, biomechanical stability, cost effectiveness, tunability, and resiliency.

PROCESSING GUIDELINES

Toray CFRT® materials can be molded into composite components or devices using multiple forming options. CFRT® materials with hygroscopic resins, including: Nylon (PA6), Acrylic (PMMA), Polycarbonate (PC), and PET, must be dried for 24 hours prior to heating and forming. Polypropylene (PP) is non-hygroscopic and does not need to be dried prior to heating and forming.

Forming options:

- Vacuum forming
- Thermoforming with free edge closed mold
- Compression molding with match-die tool

The forming process that best suits the desired device or component is dictated by the complexity of the final molded component. With a higher forming pressure, more detail can be molded into the component part. Vacuum forming utilizes relatively low pressures, thermoforming utilizes moderate pressures, and compression molding utilizes high pressures.

Cutting

CFRT® materials can be cut with a band-saw or similar equipment. Our materials may also be cut with automated cutting systems using routing or high-pressure waterjet. The materials may be cut with or without abrasives.

Grinding

The material may be ground and polished using a stationary head grinder. Coarse grinding may be performed using 60–80 grit medium wheel. A 150–400 dry grit paper is recommended for final grinding. Edges may be polished with a cloth buffing wheel and compound. Contact with ground particles can cause skin irritation. Gloves, paper mask, safety glasses, and sleeves should be worn.

Drilling

Drilling can be accomplished using a standard drill press or handheld drill.

Heat Adjustment

Components can be heat-adjusted using a conventional industrial grade hot air blower.

Bonding

Our materials with acrylic-based systems provide excellent bonding results with all primers and adhesives.

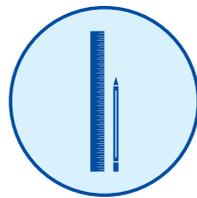
Storage

Drying is needed if the material is exposed to ambient elements outside original packaging.

Please ask your Sales account manager for a copy of our Processing Guide for complete and detailed instructions or call us at +1 805 482 1722 if you have any questions!



Color Options



Design Freedom



High Performance

DESIGNING WITH TORAY CFRT® MATERIALS



Transitional/Contour Areas - Minimum radius should be 6 mm.

Holes and Hole Placement - Holes are not recommended for designs that use Toray CFRT® materials as they disrupt the continuous fiber of the component. Holes may be incorporated into a design but we recommend to keep in mind that large holes, multiple holes, and holes close to the edge of the design, will weaken the composite and can cause catastrophic failure. Holes need to be addressed on a case-by-case basis. Please consult with our Engineering team about your specific design.

Flex Area - Materials placed in the flex zone will limit motion. Fiber placement and percent fiber content, will dictate the amount of motion limitation. For example, material running beyond the forefoot flex zone and around the forefoot will increase rigidity and limit flex.

Arch Area - Use of an arch wrap as typically found in footwear, will add stiffness to the component part and will subsequently add stiffness to the shoe as well. Arch wrap angle, height, and radius will determine the amount of stiffness added to the footwear. Extreme wrap, height, or radius may cause foot discomfort.

Carbon Fiber - Carbon fiber represents a noticeable increase in stiffness and weight reduction from fiberglass. It is also thinner than fiberglass.

Carbon Direction - Materials are offered in all carbon, hybrid-carbon/glass, and all glass. In the hybrid material, the carbon direction will have more stiffness. Carbon should be used in the direction in which stiffness/resiliency is desired.

Exposed Areas - Toray CFRT® materials should be protected from objects that can cause abrasion, puncture, or fracture.

Component designs should be reviewed through Toray Development teams for composite soundness and optimization. Our composite engineers are available to assist you in your application. Please do not hesitate to contact us at +1 805 482 1722.



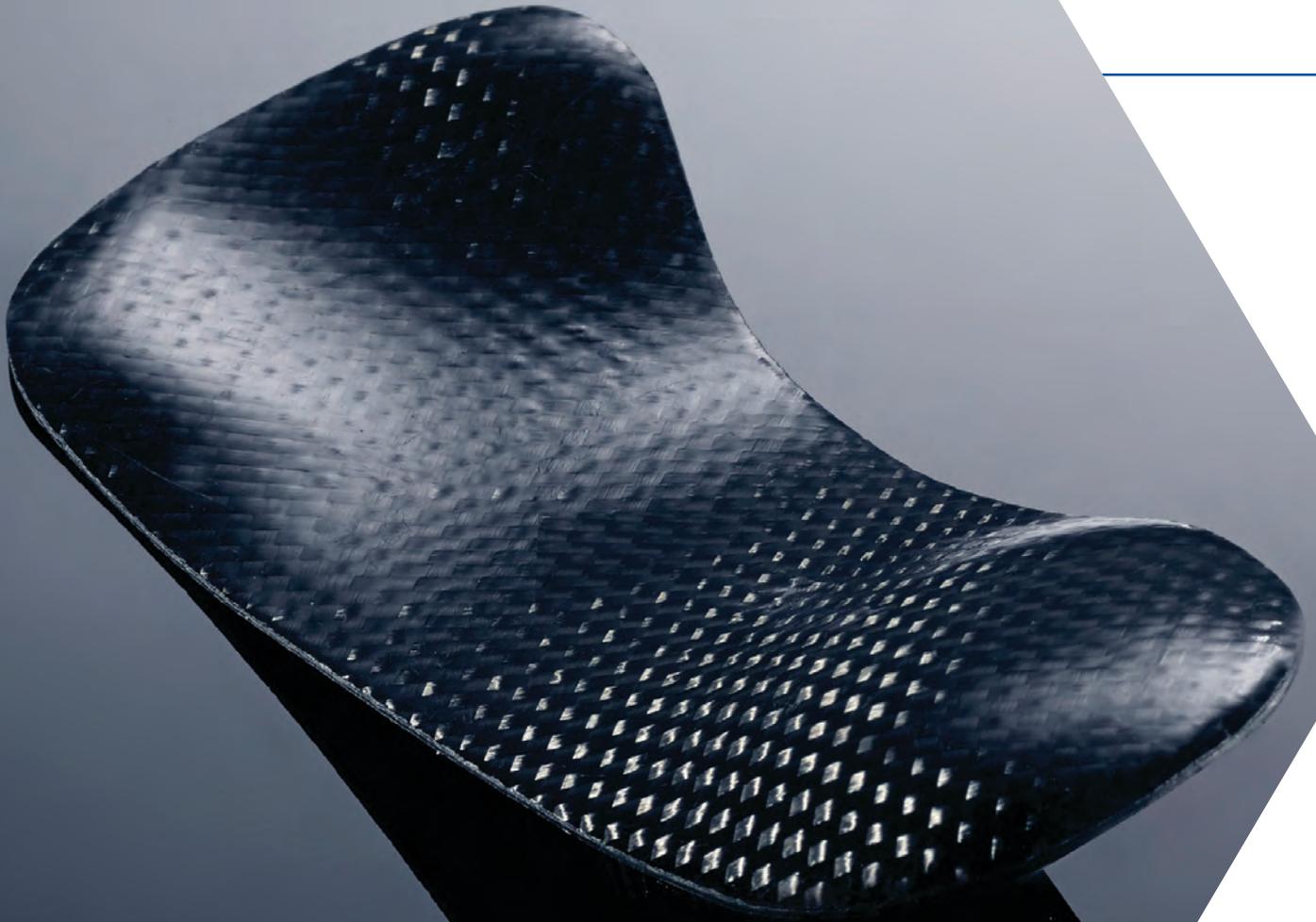
Thermoformable



Sustainable



Strong



PRODUCT DATA SHEETS

PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (TW-2000 1L & 2L) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon fibers in a twill weave for enhanced performance. The TW-2000 1L & 2L style laminate is available in a single or multilayer product; carbon fiber reinforcement at 0° and 90° orientations that is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Twill weave of 12K carbon fibers
- › Bi-directional carbon reinforcement
- › Lightest weight and thin
- › Color: Black (natural carbon)



PRODUCT TYPE AND COMPOSITION

Carbon (12K) fiber content: 58%
 Modified PMMA thermoplastic resin: 42%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.

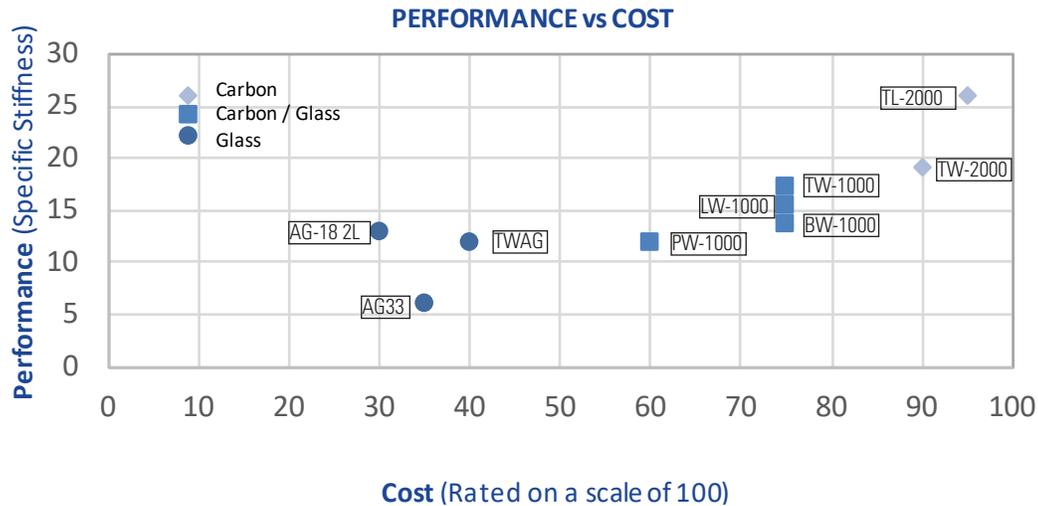
MATERIAL PARAMETERS

Specific Gravity	1.44 ± 0.15 (calculated based upon material volume)
Thickness	Available in single or multiple laminates
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Black (natural carbon)
Forming Temperature	195°C to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



Contact us for more information:
e contact@toraypmc.com
t +1 805 482 1722 (USA)

PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Condition	Method	1L** Results:	2L*** Results:
Flexural Rigidity	RTD	ASTM D790-10	~ 14.5 N-cm	~ 17.5 N-cm
Flexural Modulus	RTD	ASTM D790-10	~ 22.8 GPa	~ 35.1 GPa
Flexural Strength	RTD	ASTM D790-10	> 450 MPa	> 530 MPa
Thickness	—	*SI-QA-047	0.70 mm ± 0.15 mm	1.27 mm ± 0.15 mm

*SI-QA-047 is an internal Toray PMC inspection process

Note: Material properties and thickness listed above are of the base panel without ENVIR-Bond® layers.

**Tested at 0.67 mm thickness

***Tested at 1.32 mm thickness

Revised 12/2020

Toray(TW-2000 1L&2L)_DS_v7_2020-12-01 Page 2/2

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PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (TW-2000-1L EB®) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon fibers in a twill weave for enhanced shaped and performance. The TW-2000-1L EB® style laminate is available in a single-layer product; carbon in both directions (0° and 90°) coated with ENVIR-BOND™ (EB®) to reduce the need for harmful solvents and enhance the injection overmolding process. The TW-2000-1L EB® laminate is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Twill weave of carbon fibers
- › Bi-directional reinforcement
- › EB® tie-layers enhance bondability for injection overmolding.
- › Available in natural (carbon) color



PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 36%
 Polyurethane content: 18%
 Modified PMMA thermoplastic resin 46%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming.
 Please refer to the TPMC Processing Instructions.

MATERIAL PARAMETERS

Specific Gravity	1.5 ± 0.15 (calculated based upon material volume)
Thickness	0.85 mm (± 0.15 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Color	Natural (carbon)
Forming Temperature	195°C to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



Contact us for more information:
e contact@toraypmc.com
t +1 805 482 1722 (USA)

PRODUCT DATA SHEET

MECHANICAL PROPERTIES

Properties	Method	Results
Flexural Rigidity	ASTM D790-10	36 N-cm*
Flexural Strength	ASTM D790-10	195 MPa*
Flexural Modulus	ASTM D790-10	6000 MPa*
T _g	ASTM D3418-15	110°C

*Averaged results per testing performed on 0.9 mm thickness.

ENVIR-BOND® PRODUCT IDENTIFICATION

Chemical Family	Aromatic thermoplastic polyurethane
Chemical Name	Polyurethane elastomer
Hazardous Components	This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200

ENVIR-BOND® PHYSICAL AND CHEMICAL PROPERTIES

Form	Solid
Appearance	Plastic Film
Color	Natural
Odor	Odorless
pH	Not Applicable
Melting Point	150–200°C (302–392°F)
Boiling Point/Range	Not Applicable
Point	> 210°C (> 410°F)
Lower Explosion Limit	Not Established
Upper Explosion Limit	Not Established
Vapor Pressure	Not Applicable
Density	Not Applicable
Specific Gravity	1.1–1.3
Solubility in Water	Insoluble
Temperature	Not Applicable
Decomposition Temperature	Begins at 250°C (482°F)
Hazardous Reactions	Hazardous polymerization does not occur
Stability	Stable

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Weight %	Components	CAS - No.
> = 1%	Polyurethane Polyester Elastomer	CAS# is a trade secret
> = 1%	Thermoplastic Polyurethane	-

Note: Remove protective film from surface prior to processing.

Toray(TW-2000 1L EB®)_DS_v6_2019-04-24 Page 2/2

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PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (PW-1000) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon and glass fibers in a plain weave for enhanced performance. The PW-1000 style laminate is available in a single-layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon. This product is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Plain weave of carbon and glass fibers
- › Bi-directional carbon and glass reinforcement
- › Lightest weight, thin, single or multiple layers
- › Available in various colors



PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 30%
Glass fiber content: 30%
Modified PMMA thermoplastic resin: 40%
(Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming.
Please refer to the TPMC Processing Instructions.

MATERIAL PARAMETERS

Specific Gravity	1.48 ± 0.15 (calculated based upon material volume)
Thickness	0.85 mm (± 0.15 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



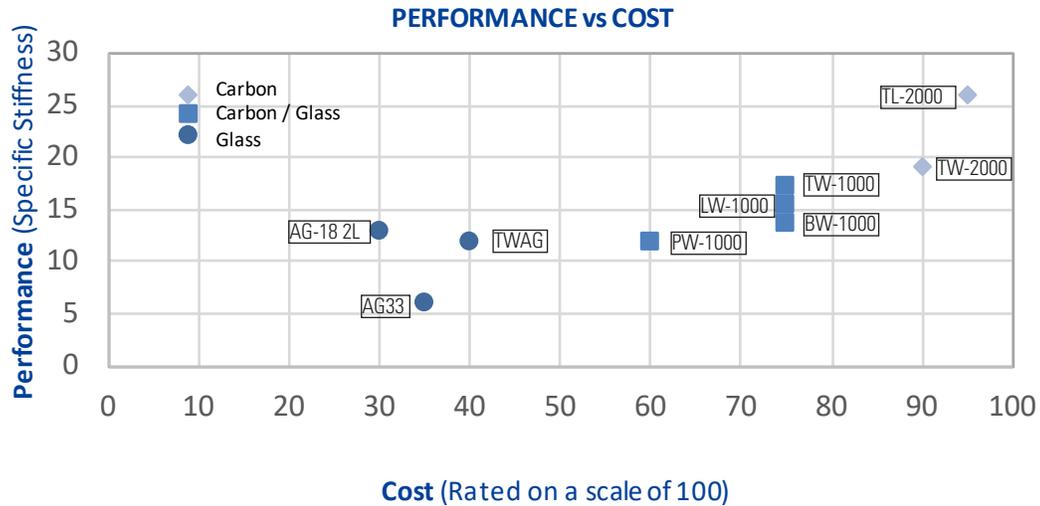
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CFRT®

Toray(PW-1000)_DS_v6_2019-04-24

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PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Method	Results
Flexural Rigidity	ASTM D790-10	> 55 N-cm
Flexural Strength	ASTM D790-10	> 188 MPa
Flexural Modulus	ASTM D790-10	> 6200 MPa

Revised 04/2019

Toray(PW-1000)_DS_v6_2019-04-24 Page 2/2

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PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (TW-1000) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon and glass fibers in a twill weave for enhanced shapes and performance. The TW-1000 style laminate is available in a single-layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon. This product is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Twill weave of carbon and glass fibers
- › Bi-directional reinforcement
- › Lightest weight, thin, single layer
- › Available in stock and custom colors



PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 26%
 Glass fiber content: 26%
 Modified PMMA thermoplastic resin: 48%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.

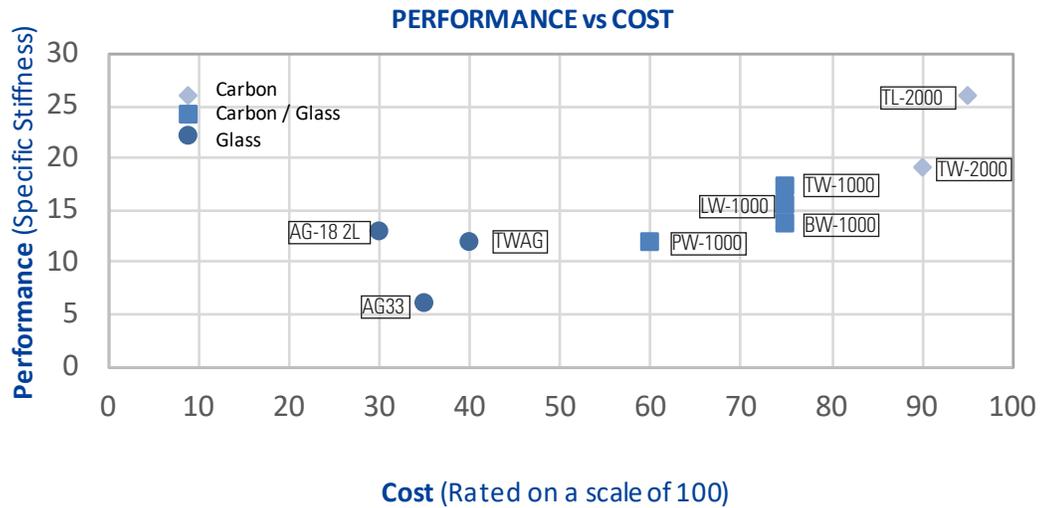
MATERIAL PARAMETERS

Specific Gravity	1.3 ± 0.15 (calculated based upon material volume)
Thickness	1.0 mm (± 0.2 mm) nominal
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



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PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Method	Results
Flexural Rigidity	ASTM D790-10	> 45 N-cm
Flexural Strength	ASTM D790-10	> 148 MPa*
Flexural Modulus	ASTM D790-10	> 7445 MPa*

*Results per testing performed in carbon direction.

PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (TW-1000 401EB®) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon and glass fibers in a twill weave for enhanced shapes and performance. The TW-1000 401EB® style laminate is available in a single-layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon that is ultra-thin, lightweight, and resilient for improved energy return.

Envir-Bond® is TPMC's newest material innovation to improve the ease of processing at the factory level and help reduce the amount of harmful solvents used in the footwear manufacturing process. EB® "tie-layers" are added for injection overmolding.

FEATURES

- › Twill weave of carbon and glass fibers
- › Bi-directional reinforcement
- › Highest mechanical properties of our woven fabrics
- › Lightest weight, thin, single layers
- › Available in stock and custom colors



PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 20%
 Glass fiber content: 20%
 TPU/PMMA proprietary thermoplastic resin: 48%
 Polyurethane Based Coating: 12%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.

MATERIAL PARAMETERS

Specific Gravity	1.5 ± 0.15 (calculated based upon material volume)
Thickness	1.05 mm (± 0.15 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



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PRODUCT DATA SHEET

MECHANICAL PROPERTIES

Properties	Results	
Flexural Rigidity	ASTM D790-10	< 80 N-cm
Flexural Strength	ASTM D790-10	> 140 MPa*
Flexural Modulus	ASTM D790-10	> 7000 MPa*

*Results based upon testing 1.09 mm thickness material in carbon direction.

**TW-1000 ENVIR-BOND®
PRODUCT IDENTIFICATION**

Chemical Family	Aromatic thermoplastic polyurethane
Chemical Name	Polyurethane elastomer
Hazardous Components	This material is not hazardous under the criteria of the Federal OSHA Hazard Communication Standard 29 CFR 1910.1200

**ENVIR-BOND®
PHYSICAL AND CHEMICAL PROPERTIES**

Form	Solid
Appearance	Plastic Film
Color	Natural
Odor	Odorless
pH	Not Applicable
Melting Point	150–200°C (302–392°F)
Boiling Point/Range	Not Applicable
Point	> 210°C (> 410°F)
Lower Explosion Limit	Not Established
Upper Explosion Limit	Not Established
Vapor Pressure	Not Applicable
Density	Not Applicable
Specific Gravity	1.1–1.3
Solubility in Water	Insoluble
Temperature	Not Applicable
Decomposition Temperature	Begins at 250°C (482°F)
Hazardous Reactions	Hazardous polymerization does not occur
Stability	Stable

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Weight %	Components	CAS - No.
> = 1%	Polyurethane Polyester Elastomer	CAS# is a trade secret
> = 1%	Thermoplastic Polyurethane	-

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Toray(TW-1000 401 EB)_DS_v6_2019-04-24 Page 2/2

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PRODUCT DATA SHEET

DESCRIPTION

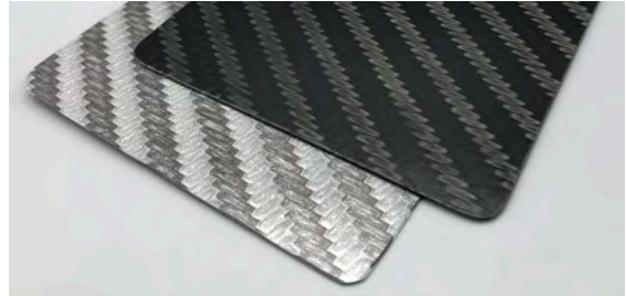
Toray PMC CFRT® (TW-4000) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon and glass fibers in a twill weave for enhanced shapes and performance. The TW-4000 laminate is available in a single-layer product; carbon in one direction and glass fibers at 90° orientation to the carbon. The TW-4000 laminate is thin, lightweight, and resilient for improved energy return.

FEATURES

- › Twill weave of carbon fibers and glass fibers
- › Light weight, thin, single layer

PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 24%–26%
 Glass fiber content: 24%–26%
 Modified PMMA thermoplastic resin: 48%–52%
 (Noted: Percentages are by volume and are nominal values)



TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.

MATERIAL PARAMETERS

Specific Gravity	1.5 ± 0.15 (calculated based upon material volume)
Thickness	0.85 mm (± 0.2 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F –140°F)

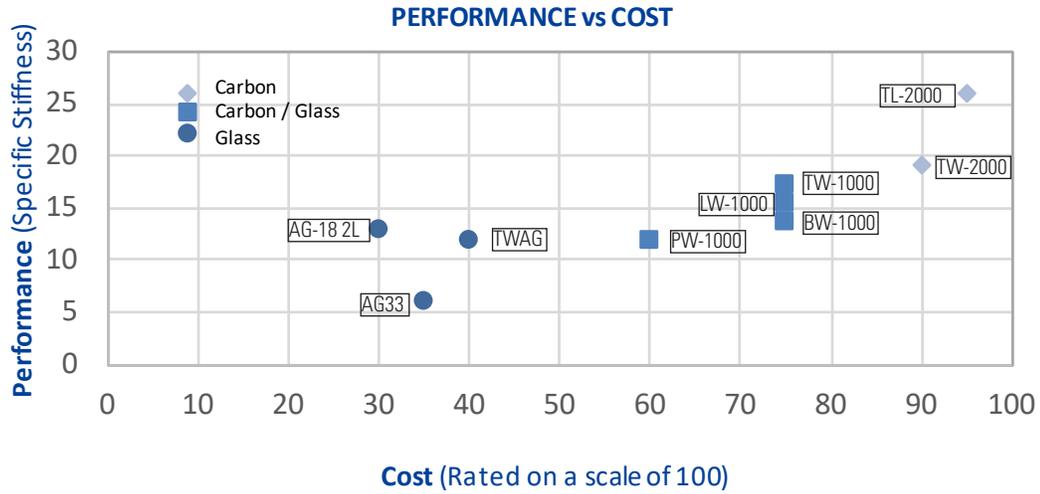


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Toray(TW-4000)_DS_v6_2019-04-24

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PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Method	Results
Flexural Rigidity	ASTM D790-10	> 110 N-cm*
Flexural Strength	ASTM D790-10	> 420 MPa*
Flexural Modulus	ASTM D790-10	> 20000 MPa*

* Results per testing performed in carbon direction on nominal thickness material.

PRELIMINARY PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (BW-1000) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon and glass fibers in a basket weave for enhanced shapes and performance. The BW-1000 style laminate is available in a single-layer product; carbon fibers in one direction and glass fibers at a 90° orientation to the carbon fibers. The BW-1000 laminate is ultra-thin, lightweight, and resilient for improved energy retention.

FEATURES

- › Basket weave of carbon fibers and glass fibers
- › Bi-directional reinforcement
- › Lightest weight, thin, single layer
- › Available in various colors



PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 30%
Glass fiber content: 30%
Modified PMMA thermoplastic resin: 40%
(Note: Percentages are by weight and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming.
Please refer to the TPMC Processing Instructions.

MATERIAL PARAMETERS

Specific Gravity	1.61-1.82(ASTM D792)
Thickness	0.95 mm (± 0.25 mm) nominal
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F – 392°F)
Bonding Temperature	55°C to 60°C (131°F – 140°F)



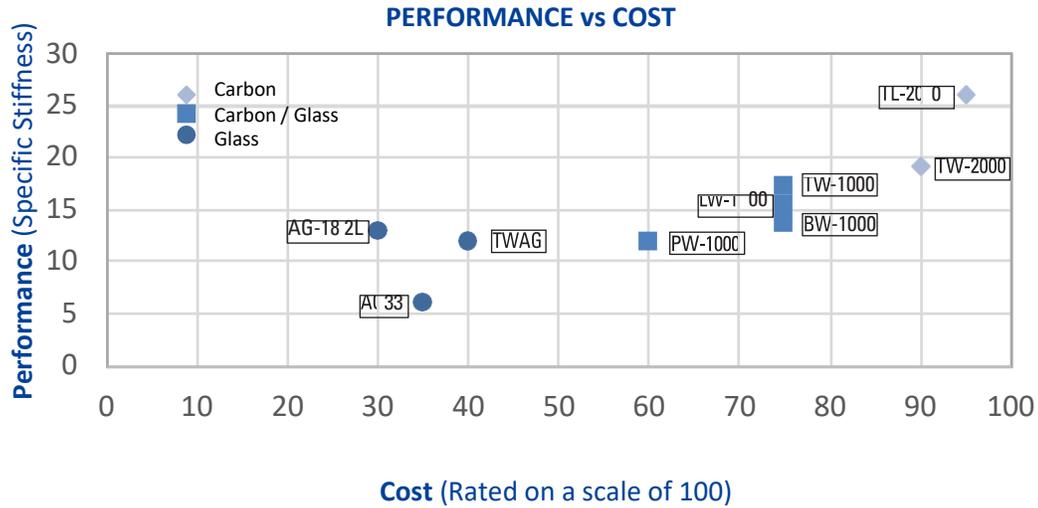
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CFRT®

Toray(BW-1000)_DS_v8_2022-01-10

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PRELIMINARY PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Results*	
Flexural Rigidity, Carbon Direction	ASTM D790-10 (modified)	51-110 N-cm
Flexural Strength, Carbon Direction	ASTM D790-10 (modified)	172-358 MPa
Flexural Modulus, Carbon Direction	ASTM D790-10 (modified)	5000-14000 MPa

*The results represent nominal property ranges which are dominated by the woven fabric reinforcement and crimp factor.

Revised 01/2021

Toray(BW-1000)_DS_v8_2022-01-10 Page 2/2

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PRELIMINARY PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT[®] (BW-1000/Reemay) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven carbon and glass fibers in a basket weave for enhanced shapes and performance. The BW-1000/Reemay style laminate is available in a dual-layer product; carbon fibers in one direction and glass fibers at a 90° orientation to carbon fibers laminated over a layer of non-woven polyester fiber. The BW-1000/Reemay laminate is thin, lightweight, and resilient for improved energy retention.

FEATURES

- › Basket weave of carbon and glass fibers
- › Bi-directional reinforcement with additional polyester fiber layer
- › Lightweight, thin, dual-layer
- › Available in various colors



PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 23%
 Glass fiber content: 34%
 Polyester fiber content: 3%
 Modified PMMA thermoplastic resin: 40%
 (Noted: Percentages are by weight and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

MATERIAL PARAMETERS

Specific Gravity	1.63-1.74 (ASTM D792)
Thickness	1.08 mm (± 0.24 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F – 392°F)
Bonding Temperature	55°C to 60°C (131°F – 140°F)

SHELF LIFE

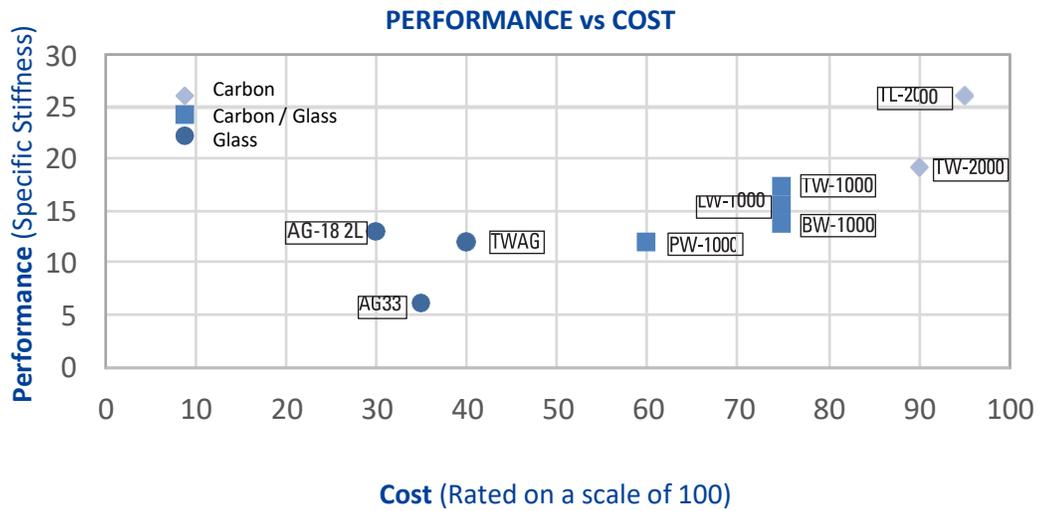
Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.



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PRELIMINARY PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Results*	
Flexural Rigidity, Carbon Direction	ASTM D790-10 (modified)	67-122 N-cm
Flexural Strength, Carbon Direction	ASTM D790-10 (modified)	139-318 MPa
Flexural Modulus, Carbon Direction	ASTM D790-10 (modified)	3968-12020 MPa

*The results represent nominal property ranges which are dominated by the woven fabric reinforcement and crimp factor.

Revised 1/29/2021

Toray (BW-1000/Reemay) DS_v7_2021-01-29 Page 2/2

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PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (AG-18 2L) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven glass fibers in a plain weave for enhanced performance. The AG-18 2L style laminate is available in a dual-layer product with glass fibers in both directions (0° & 90°). This construction is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Plain weave of glass fibers
- › Bi-directional glass reinforcement
- › Lightest weight, thin, multiple layers
- › Available in various colors

PRODUCT TYPE AND COMPOSITION

Glass (330) fiber content: 55%
 Modified PMMA thermoplastic resin: 45%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.



MATERIAL PARAMETERS

Specific Gravity	1.65 ± 0.15 (Calculated based upon material volume)
Thickness	0.95 mm (± 0.2 mm)
Standard Colors	Silver, Charcoal, and Black
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Forming Temperature	195°C to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



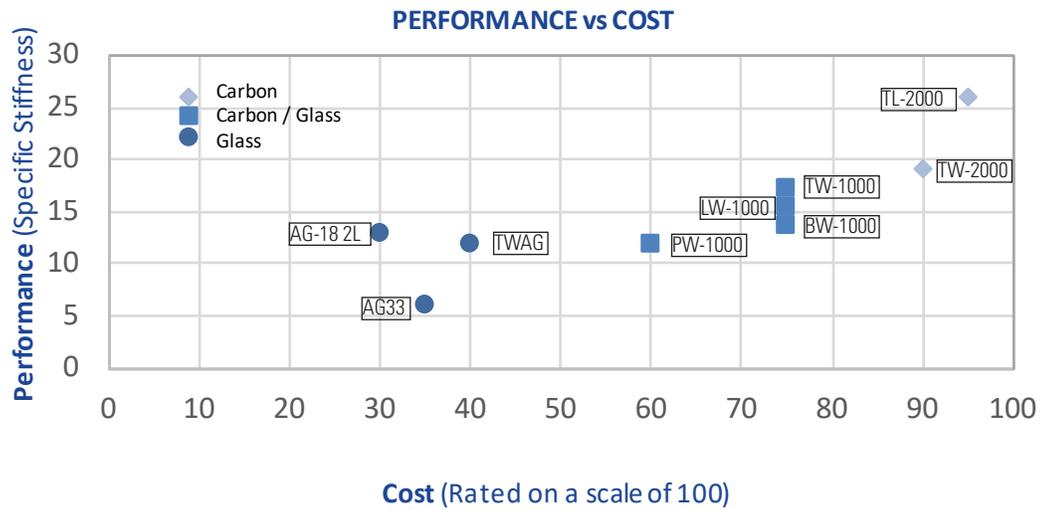
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CFRT®

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PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Method	Results: 4 tow per inch	Results: 5 tow per inch
Flexural Rigidity	ASTM D790-10	5.5 N-cm ² *	6.5 N-cm ² *
Flexural Strength	ASTM D790-10	470 MPa*	604 MPa*
Flexural Modulus	ASTM D790-10	13000 MPa*	16000 MPa*
T _g	ASTM D3418-15	110°C	110°C

*Performance results are based on 0.90 mm material thickness. Results will vary depending upon material thickness.

PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (AG-24 2L) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven glass fibers in a plain weave for enhanced and performance. The AG-24 2L style laminate is a dual-layer product with glass fibers in both directions (0° & 90°). This construction is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Plain weave of glass fibers
- › Bi-directional glass reinforcement
- › Lightest weight, thin, multiple layers
- › Standard Colors: Black, Silver, and Charcoal



PRODUCT TYPE AND COMPOSITION

Glass fiber content: 55%
Modified PMMA thermoplastic resin: 45%
(Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming.
Please refer to the TPMC Processing Instructions.

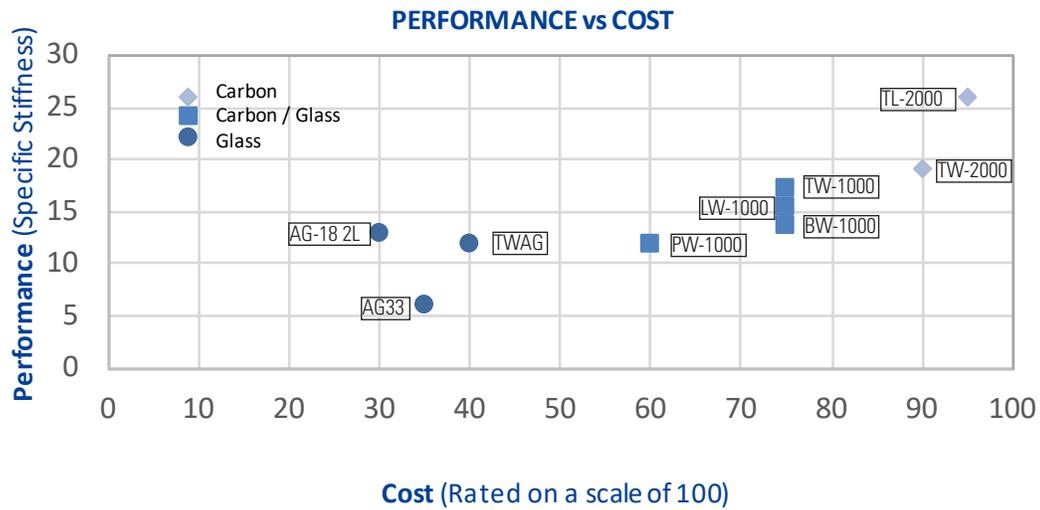
MATERIAL PARAMETERS

Specific Gravity	1.7 ± 0.15 (Calculated based upon material volume)
Thickness	1.15 mm (± 0.2 mm)
Standard Colors	Silver, Charcoal, and Black
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Forming Temperature	195°C to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



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PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Method	Results: 4 tow per inch	Results: 5 tow per inch
Flexural Rigidity	ASTM D790-10	208 N-cm*	285 N-cm*
Flexural Strength	ASTM D790-10	367 MPa*	506 MPa*
Flexural Modulus	ASTM D790-10	13850 MPa*	20475 MPa*

*Performance results are based on 1.20 mm material thickness. Results will vary depending upon material thickness.

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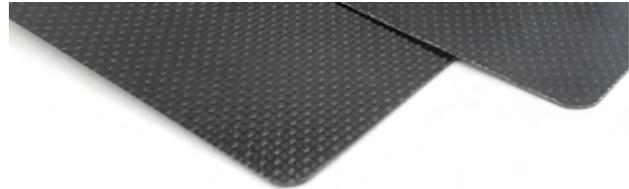
PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (AG-7544 2L) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven glass fibers in a plain weave for enhanced performance. The AG-7544 2L style laminate is available in a dual-layer product with glass fibers in both directions (0° & 90°). This construction is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Modified plain weave of glass fibers
- › Bi-directional glass reinforcement
- › Light weight, thin, multiple layers
- › Available in various colors



PRODUCT TYPE AND COMPOSITION

Glass (330) fiber content: 65%
 Modified PMMA thermoplastic resin: 35%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.

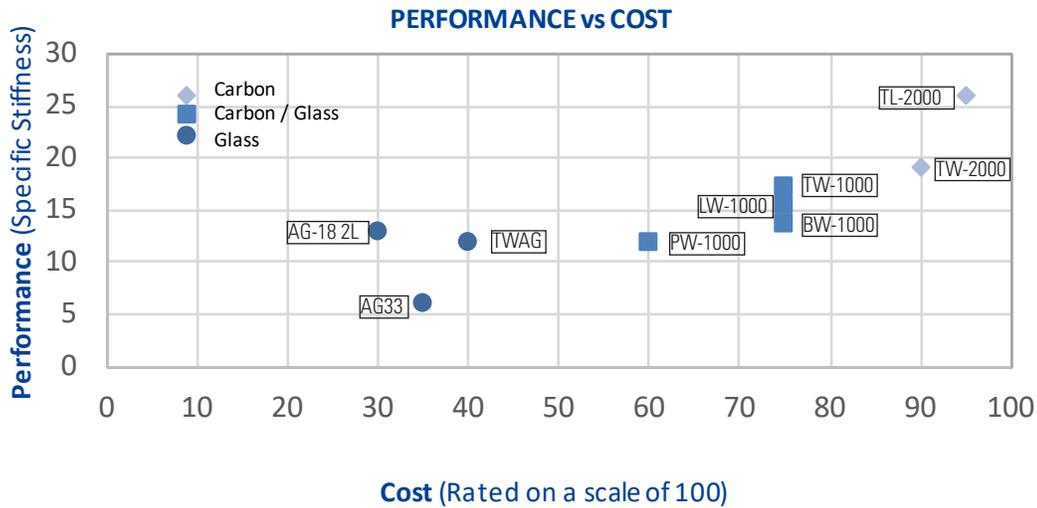
MATERIAL PARAMETERS

Specific Gravity	1.8 ± 0.15 (Calculated based upon material volume)
Thickness	0.96 mm (± 0.2 mm)
Standard Colors	Silver, Charcoal, Black
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Forming Temperature	195°C to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



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PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Method	Results
Flexural Rigidity	ASTM D790-10	> 101 N-cm*
Flexural Strength	ASTM D790-10	> 247.5 MPa*
Flexural Modulus	ASTM D790-10	> 12750 MPa*

*Performance results are based on 0.96 mm material thickness. Results will vary depending upon material thickness.

Revised 04/2019

Toray(AG-7544 2L)_DS_v6_2019-04-24 Page 2/2

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PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (TWAG) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven glass fibers in a twill weave for enhanced shapes and performance. The TWAG style laminate is available in a single-layer product. The TWAG laminate is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Twill weave glass fibers
- › Bi-directional reinforcement
- › Lightest weight, thin, single layer
- › Available in various colors

PRODUCT TYPE AND COMPOSITION

Glass fiber content: 60%
Modified PMMA thermoplastic resin: 40%
(Noted: Percentages are by volume and are nominal values)

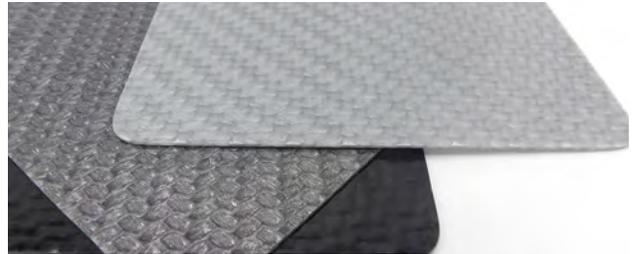
TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.



MATERIAL PARAMETERS

Specific Gravity	1.9 ± 0.15 (calculated based upon material volume)
Thickness	0.95 mm (± 0.2 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)



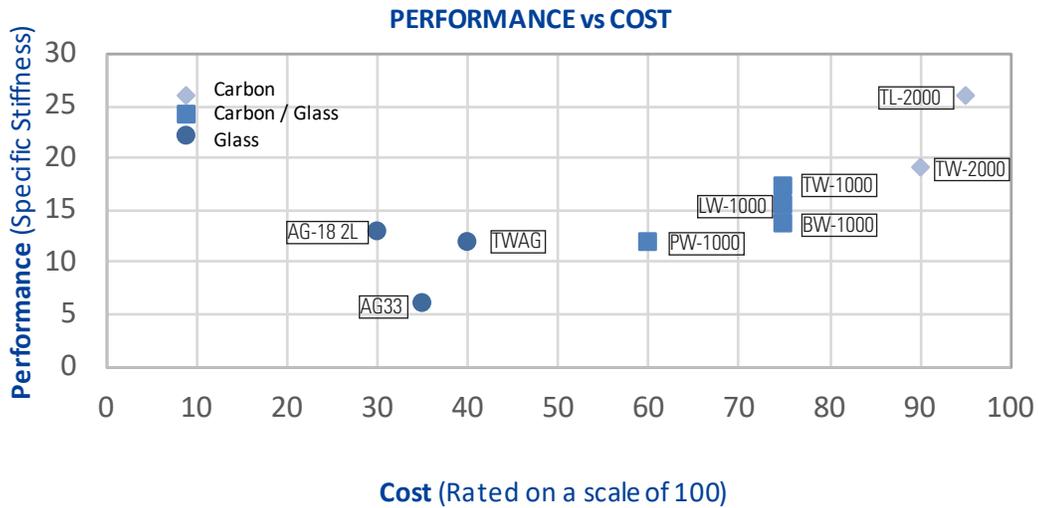
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CFRT®

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PRODUCT DATA SHEET



MECHANICAL PROPERTIES

Properties	Method	Results
Flexural Rigidity	ASTM D790-10	> 40 N-cm
Flexural Strength	ASTM D790-10	> 250 MPa
Flexural Modulus	ASTM D790-10	> 6000 MPa

Revised 04/2019

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PRODUCT DATA SHEET - PRELIMINARY FOR DEVELOPMENT

DESCRIPTION

Toray PMC CFRT[®] SPEED is a continuous fiber reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic PET polymer matrix with uni-directional carbon fibers for enhanced performance. This laminate is offered in a 4-layer construction that is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Uni-directional carbon fibers
- › Lightest weight, thin, multiple layers
- › Available in black

PRODUCT TYPE AND COMPOSITION

PET UD 4L carbon laminate with Reemay.

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.



MATERIAL PARAMETERS

Specific Gravity	1.5 ± 0.15 g/cc (calculated based upon material volume)
Thickness	1.05 mm (± 0.2 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Color	Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)

MECHANICAL PROPERTIES

Properties	Condition	Method	4-layer Results
Flexural Rigidity	RTL	ASTM D790-10	> 90 N-cm
Flexural Strength	RTL	ASTM D790-10	> 470 MPa
Flexural Modulus	RTL	ASTM D790-10	> 32 GPa

PRELIMINARY

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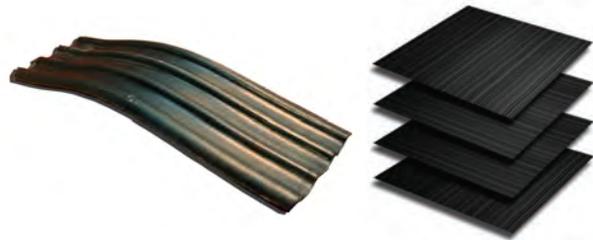
PRODUCT DATA SHEET - PRELIMINARY FOR DEVELOPMENT

DESCRIPTION

Toray PMC CFRT® SPRINT is a continuous fiber reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic PET polymer matrix with uni-directional glass fibers for enhanced performance. This laminate is offered in a 4-layer construction that is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › Uni-directional glass fibers
- › Lightest weight, thin, multiple layers
- › Available in black



PRODUCT TYPE AND COMPOSITION

PET UD 4L fiberglass laminate.

TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.

MATERIAL PARAMETERS

Specific Gravity	1.5 ± 0.15 g/cc (calculated based upon material volume)
Thickness	0.75 mm (± 0.2 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Color	Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)

MECHANICAL PROPERTIES

Properties	Condition	Method	4-layer Results
Flexural Rigidity	RTL	ASTM D790-10	> 6.6 N-cm
Flexural Strength	RTL	ASTM D790-10	> 888 MPa
Flexural Modulus	RTL	ASTM D790-10	> 31 GPa

PRELIMINARY

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PRODUCT DATA SHEET

DESCRIPTION

Toray Cetex® TC910 is a thermoplastic composite using a polyamide 6 (PA6) matrix resin. This product provides excellent mechanical performance at a good price-to-weight ratio. It features high strength and wear resistance and performs well at elevated temperatures. TC910 is also resistant to solvents. As a result of these attributes, Toray Cetex® TC910 is commonly used in a variety of automotive and transportation applications. Secondary details in the final part may be injection overmolded using injection-grade polyamides. Toray Cetex® TC910 is available in glass or carbon reinforced UD tapes.

FEATURES

- ▶ Good resistance to solvents
- ▶ Excellent balance of strength and impact resistance
- ▶ Moldable and formable
- ▶ Excellent temperature resistance and strength makes it ideal for housings and under the hood applications
- ▶ Excellent impact and solvent resistance
- ▶ Good elevated temperature resistance



PRODUCT TYPE

Nylon 6-based Thermoplastic Composite

TYPICAL NEAT RESIN PROPERTIES

Heat Deflection Temperature	200°C (392°F)
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TYPICAL APPLICATIONS

- ▶ Automotive structure
- ▶ Under the hood applications
- ▶ Replacement for highly loaded injection molded parts

SHELF LIFE

Indefinite at 25°C (77°F)



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PRODUCT DATA SHEET

MECHANICAL PROPERTIES

Property	Condition	Method	Typical Results	
Tensile Strength 0°	RTD	ASTM D 3039	900 MPa	131 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	30 GPa	4.4 Msi
Flexural Strength 0°	RTD	ASTM D 790	1050 MPa	152 ksi
Flexural Modulus 0°	RTD	ASTM D 790	29 GPa	4.2 Msi
Compressive Strength 0°	RTD	ASTM D 3410	345 MPa	50 ksi
Short Beam Shear ILSS	RTD	ASTM D 2344	42 MPa	6.1 ksi

Toray Cetex® TC910 Nylon 6 Fiberglass Uni-directional Tape
 Resin content by weight at 40%. Composite density 1.73 g/cm³.
 Tape width 166 mm (6.5"). Tape thickness 0.25 mm (0.010").
 Recommended processing temperature is 249–271°C (480–520°F)

MECHANICAL PROPERTIES

Property	Condition	Method	Typical Results	
Tensile Strength 0°	RTD	ASTM D 3039	1900 MPa	276 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	100 GPa	14.5 Msi
Flexural Strength 0°	RTD	ASTM D 790	950 MPa	138 ksi
Flexural Modulus 0°	RTD	ASTM D 790	97 GPa	14.1 Msi
Compressive Strength 0°	RTD	ASTM D 3410	375 MPa	54 ksi
Short Beam Shear ILSS	RTD	ASTM D 2344	43 MPa	6.2 ksi

Toray Cetex® TC910 Nylon 6 Carbon Fiber Uni-directional Tape
 Resin content by weight at 40%. Composite density 1.45 g/cm³.
 Tape width 166 mm (6.5"). Tape thickness 0.16 mm (0.007").
 Recommended processing temperature is 249–271°C (480–520°F)

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PRODUCT DATA SHEET

DESCRIPTION

Toray Cetex® TC940 is a thermoplastic composite using a semi-crystalline polyethylene terephthalate (PET) matrix resin. This product offers good impact resistance and stiffness, at a relatively low cost. It is typically used in recreational and sporting goods applications because of its exceptional durability and high interlaminar short beam shear results.

FEATURES

- ▶ Good toughness
- ▶ Good chemical and solvent resistance
- ▶ Lightweight
- ▶ Excellent clarity and toughness
- ▶ Good overall strength



PRODUCT TYPE

Engineered Polyethylene Terephthalate Composite

TYPICAL APPLICATIONS

- ▶ Industrial applications
- ▶ Recreational applications
- ▶ Sporting goods

SHELF LIFE

Indefinite at 25°C (77°F)

TYPICAL NEAT RESIN PROPERTIES

Density	1.3 g/cc
Tensile Strength	79 MPa (11.5 ksi)
Tensile Modulus	0.7 GPa (0.1 Msi)
Elongation at Break	70%
Strain at Yield	15%
UL94 Flammability	HB
Melt Temperature	254°C (490°F)
Heat Deflection Temperature	70°C (158°F) at 0.46 MPa (66 psi)



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PRODUCT DATA SHEET

MECHANICAL PROPERTIES

Properties	Condition	Method	Typical Results	
Tensile Strength 0°	RTD	ASTM D 3039	960 MPa	139 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	32.0 GPa	4.6 Msi
Flexural Strength 0°	RTD	ASTM D 790	1215 MPa	176 ksi
Flexural Modulus 0°	RTD	ASTM D 790	32.2 GPa	4.7 Msi
Compressive Strength 0°	RTD	ASTM D 3410	329 MPa	48 ksi
Short Beam Shear ILSS	RTD	ASTM D 2344	41 MPa	6.0 ksi

Toray Cetex® TC940 Fiberglass Fiber PET Unitape
 Resin content by weight at 40%. Composite density 1.89 g/cm³.
 Tape width 166 mm (6.5"). Tape thickness 0.26 mm (0.010").

MECHANICAL PROPERTIES

Properties	Condition	Method	Typical Results	
Tensile Strength 0°	RTD	ASTM D 3039	1272 MPa	184 ksi
Tensile Modulus 0°	RTD	ASTM D 3039	94.2 GPa	13.7 Msi
Flexural Strength 0°	RTD	ASTM D 790	825 MPa	120 ksi
Flexural Modulus 0°	RTD	ASTM D 790	80.2 GPa	11.6 Msi
Compressive Strength 0°	RTD	ASTM D 3410	271 MPa	39 ksi
Short Beam Shear ILSS	RTD	ASTM D 2344	35.8 MPa	5.2 ksi

Toray Cetex® TC940 Carbon Fiber PET Unitape
 Resin content by weight at 40%. Composite density 1.53 g/cm³.
 Tape width 166 mm (6.5"). Tape thickness 0.25 mm (0.010").
 Recommended processing temperature is 254–277°C (490–530°F)

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PRODUCT DATA SHEET

DESCRIPTION

Aluminized Glass is a hybrid product made of woven and unidirectional materials construction. XTS backing has 2 layers of UD Glass/ABS.

PRODUCT TYPE AND COMPOSITION

Glass fiber content: 65%
 Modified PMMA proprietary thermoplastic resin: 35%
 (Noted: Percentages are by volume and are nominal values)



TYPICAL APPLICATIONS

- › Footwear
- › Recreational equipment
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming. Please refer to the TPMC Processing Instructions.

MATERIAL PARAMETERS

Specific Gravity	1.8 ± 0.15 (calculated based upon material volume)
Thickness	0.95 mm (± 0.2 mm)
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Silver, Charcoal, and Black
Forming Temperature	195° to 200°C (383°F–392°F)
Bonding Temperature	55°C to 60°C (131°F–140°F)

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PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (SL2000-PC) is a reinforced thermoplastic composite laminate. It blends the benefits of a polycarbonate based thermoplastic polymer with woven carbon fibers for enhanced performance. The SL2000-PC style laminate is available in a single-layer product that is ultra-thin, lightweight, and resilient for improved energy return.

FEATURES

- › 3K carbon fibers available in a twill or plain weave pattern
- › Bi-directional carbon reinforcement
- › Highest mechanical properties of our woven fabrics
- › Lightweight, thin, single layer
- › Available in natural carbon fiber (black)



PRODUCT TYPE AND COMPOSITION

Carbon fiber content: 59%
 Polycarbonate resin content: 41%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Commercial Products
- › Industrial Products
- › Recreational Products

SHELF LIFE

Stable indefinitely at 25°C (77°F)

MATERIAL PARAMETERS

Specific Gravity	1.38 ± 15%
Thickness	0.30 mm ± 0.1 mm
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Natural Carbon (Black)

MECHANICAL PROPERTIES

Properties	Condition	Method	Results	
			*(Average based tests using 0.30 mm samples)	
Tensile Strength	RTD	ASTM-D3039	46790 psi*	322 MPa*
T _g (PC Resin)	RTD	DSC	293°F	145°C

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PRODUCT DATA SHEET

DESCRIPTION

Toray PMC CFRT® (SuperSkin SS-2000) is a reinforced thermoplastic composite laminate. It blends the benefits of a thermoplastic polymer matrix with woven 3K carbon fibers for enhanced shapes and performance. The SuperSkin SS-2000 style laminate is available in a single-layer product that is ultra-thin and lightweight. This product is typically used for cosmetic applications.

FEATURES

- › Plain or twill weave of 3K carbon fibers
- › Lightest weight, thin, single layer
- › Available in natural (carbon) black

PRODUCT TYPE AND COMPOSITION

Carbon (3K) fiber content: 12%
 Thermoplastic polyurethane resin: 88%
 (Noted: Percentages are by volume and are nominal values)

TYPICAL APPLICATIONS

- › Footwear
- › Skates

SHELF LIFE

Stable indefinitely at 25°C (77°F)

Materials must be dried prior to heating and thermoforming.
 Please refer to the TPMC Processing Instructions.

MECHANICAL PROPERTIES

Properties	Method	Results	
Tensile Strength	ASTM 3039	512 ksi	3438 MPa
Tensile Modulus	ASTM 3039	32 Msi	220 GPa



MATERIAL PARAMETERS

Specific Gravity	1.27 ± 0.15 (calculated based upon material volume)
Thickness	0.6 mm nominal
Size	Cut to customer specifications from sheet of 91 x 122 cm (36 x 48 inches)
Standard Colors	Natural Black (carbon)
Forming Temperature	N/A
Bonding Temperature	55°C to 60°C (131°F–140°F)

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