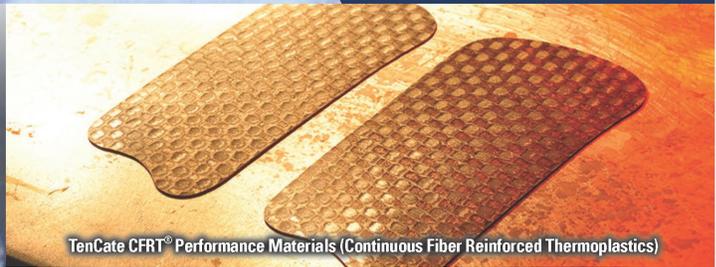


TENCATE PERFORMANCE COMPOSITES



www.tencateperformancecomposites.com

 **TENCATE**
PERFORMANCE COMPOSITES

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COMPANY OVERVIEW

TenCate acquired Performance Materials Corporation (PMC) in June 2012, and has been renamed TenCate Performance Composites (TCPC).

TenCate Advanced Composites - North America:

- › Aerospace and Satellite
- › TenCate Performance Composites (*sub-division*)
- › Armor

TenCate Performance Composites Consists of:



Performance Materials Corporation

- › Focus is on high-volume production of continuous fiber reinforced thermoplastic (CFRT®) composite sheet materials and components.



Performance Materials (Guangzhou) Ltd.

- › A Wholly Foreign Owned Enterprise (WFOE) established to manufacture components and value added assemblies from CFRT® Materials.

PRODUCTS

- Thermoplastic composites
- Thermoplastic laminates
- Thermoset composites
- Parts manufacture

QUALIFICATIONS

- ISO 9001
- AS 9100

Burlington - Ontario, Canada

Benicia - California, United States

Morgan Hill - California, United States

Camarillo - California, United States

Nottingham, United Kingdom

Nijverdal, the Netherlands

Guangzhou, China

TENCATE PERFORMANCE COMPOSITES LOCATIONS:

PRODUCTION

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INTRODUCTION

TenCate Performance Composites (TCPC) is the leading supplier of high performance continuous fiber reinforced thermoplastic CFRT® composite materials to the sporting goods, computer, construction, automotive, medical and other markets. Our composite materials can be found in over 100 million pairs of shoes worldwide and under the feet of more than 5 million patients who require podiatric correction. Additionally, TCPC composites are used for high performance braces in the orthopedic profession. Our composites are worn by all-star professional athletes, people who run 10K's, shoot hoops, try to break par, and climb mountains because they are there.

TCPC proprietary technology has advantages over other thermoplastic technologies in the method that the materials are produced, which leads to greater consistency and accuracy. TCPC composites have high durability with excellent damping and shock attenuation and resiliency, which results in enhanced energy return (spring) and response. TCPC composites provide superior stability and support, yet are lightweight and thin enough to minimize weight to reduce fatigue and stress.





Reinforced **Thermoplastics** for Every Industry

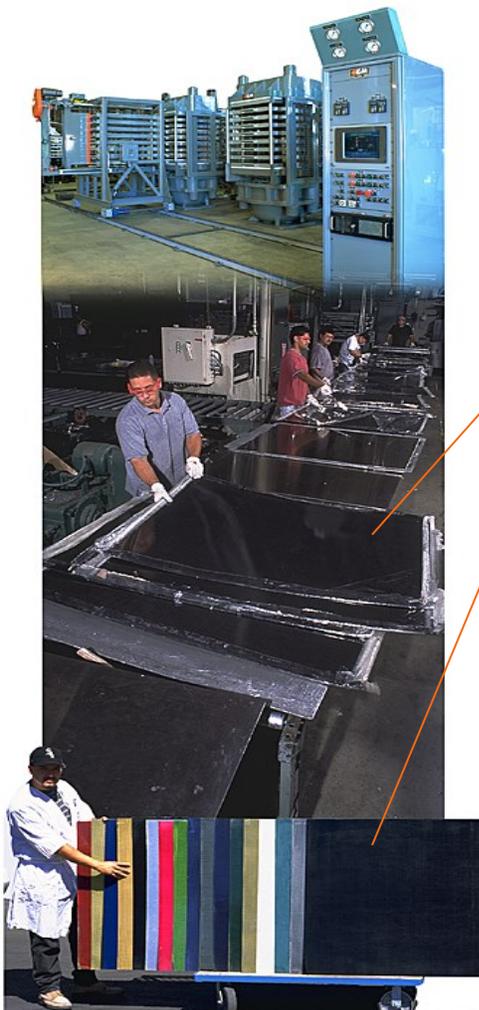
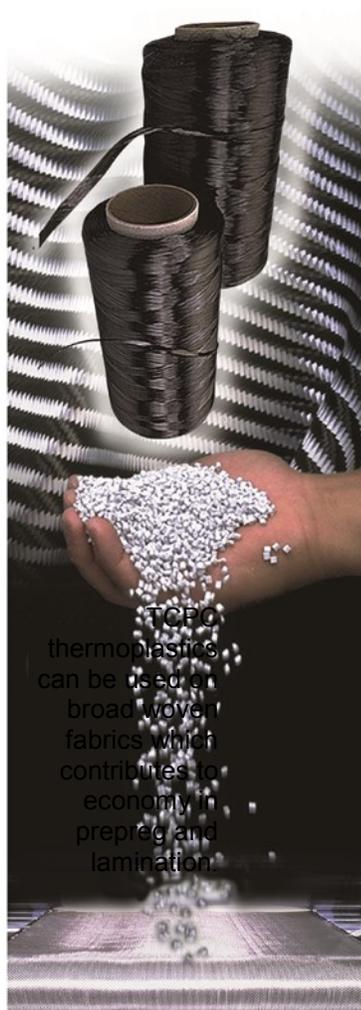
VIRTUAL TOUR

TCPC's global facilities maintain the highest standard of execution.

Sheet Manufacturing

TCPC's vertically integrated manufacturing allows for lower production costs, greater flexibility and fast delivery. TCPC's factory is operated using computer aided manufacturing systems.

The manufacturing processes for producing CFRT® (continuous fiber reinforced thermoplastic) sheet 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.

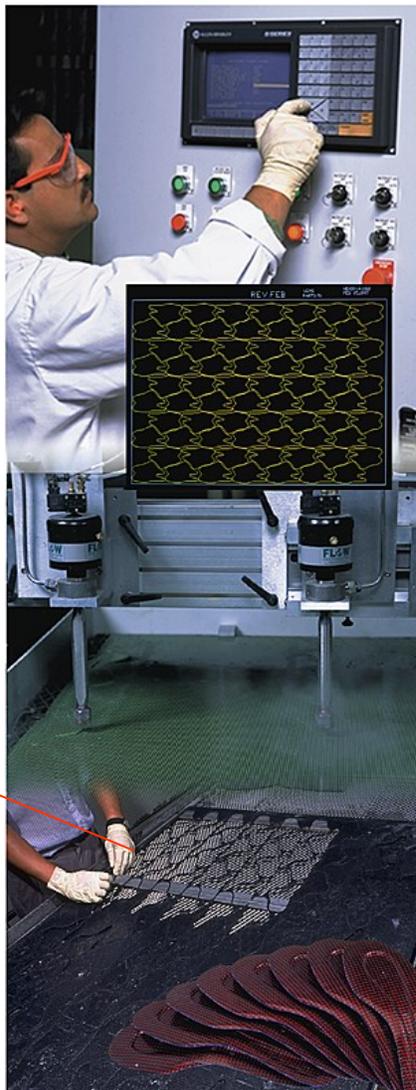
The 3' x 4' sheet materials are produced in a multitude of grades and aesthetic options.

High Volume Component Manufacturing

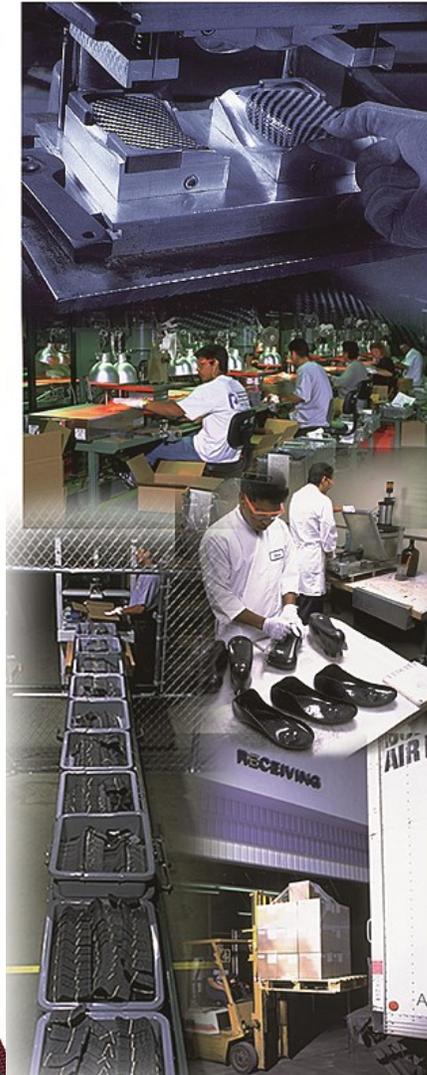
Using CAD/CAM programming and the latest waterjet technology, component parts are cut quickly and efficiently. Material utilization is maximized and tooling costs are minimized compared to other cutting processes.

The waterjet cut flat component patterns are then formed in seconds using relatively inexpensive tooling. TCPC ships over a million high quality composite components every month to facilities around the world.

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

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

The Material Edge

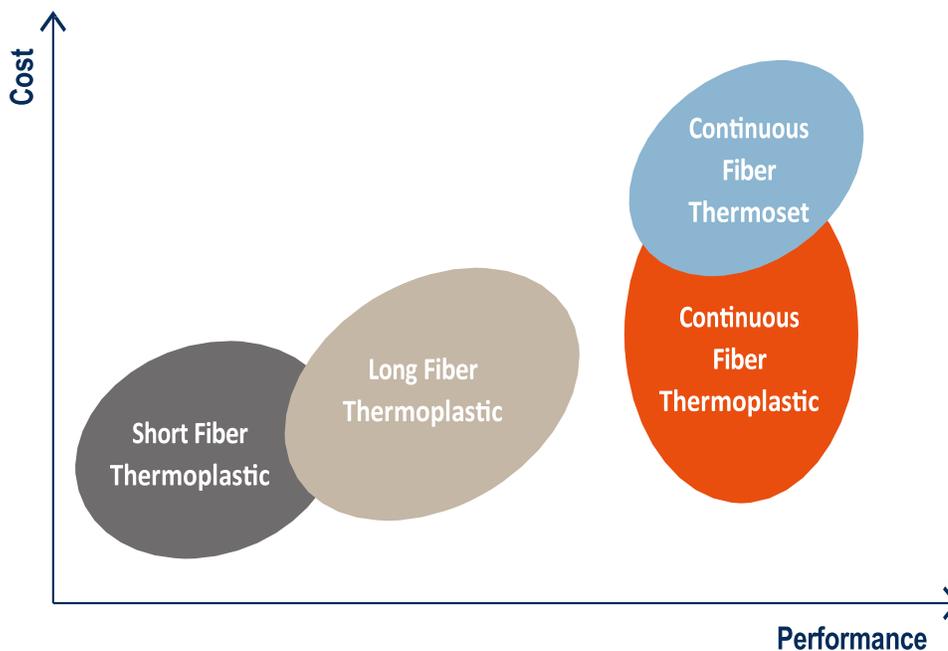
TCPC CFRT® composite materials are used to enhance footwear performance. Our materials have unique attributes when used strategically, can reduce the weight of footwear substantially while increasing biomechanical stability. Our materials are used in combination with other components to create footwear which is truly engineered.

The “resilience” (spring or responsiveness) effect of CFRT® composite materials means they return to their original shape through millions of cycles thus contributing to reduced foot fatigue and injury prevention.

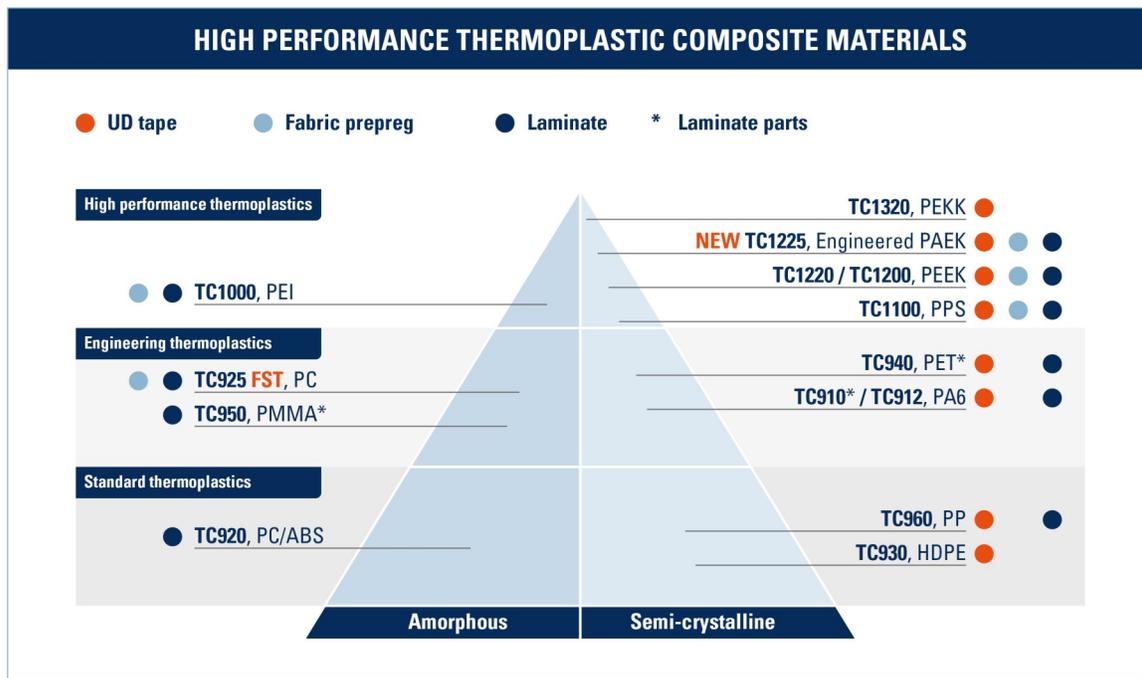
CFRT® materials have performance and weight advantages over “chopped fiber reinforced” or “non-reinforced” injection molded materials.

The CFRT® composite materials is “tunable”. It 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”, CFRT® provides engineered strength from one end of the component to the other.

CFRT® can be designed with a different fiber type 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 direction.



Our CFRT® composite materials are offered in laminate format. Our technology blends the benefits of a thermoplastic polymer alloy with fiber reinforcement. The result is a synergistic material with greater strength than the two alone.



WOVEN SERIES

Our woven series materials are offered in a variety of weave styles and fiber (carbon and glass) combinations. Each is chosen for its own unique performance, aesthetic and economic attributes.

CARBON FIBER - The greatest strength to weight option available

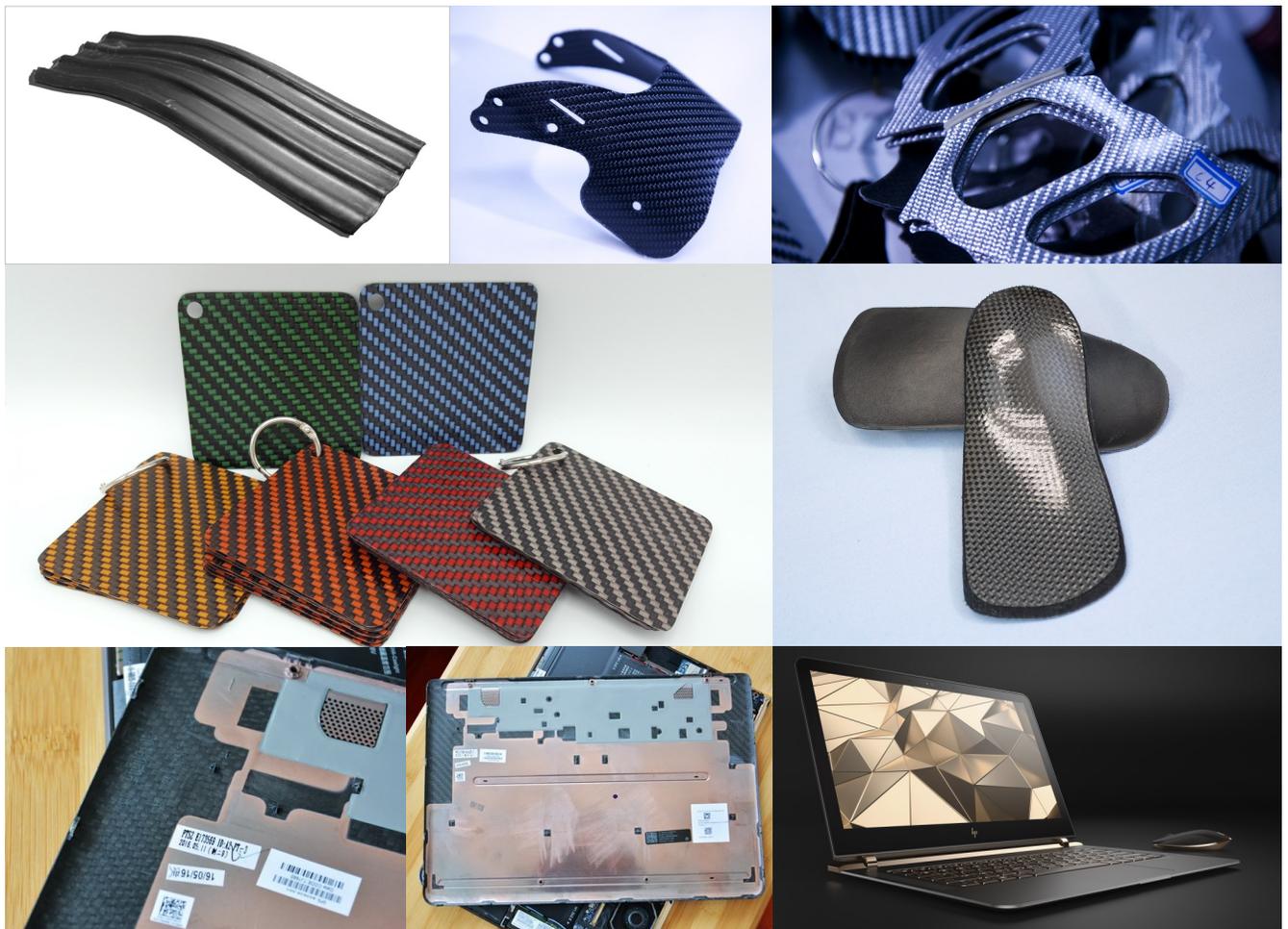
The carbon fiber products are ultra thin (<1mm thickness), lightweight and resilient for improved performance.

- › TL-2000: Single or multi-layer of 3K carbon in a plain weave
- › TW-2000: Single or multi-layer of 12K carbon in a twill weave
- › TW-2000 EB® : Multi-layer of 12K carbon in a twill weave

GLASS FIBER - The most cost effective woven composite

Glass fiber products (~1mm thickness) are the most cost effective composite materials with all woven glass fiber reinforcement. Similar performance characteristics compared to the carbon / glass options but slightly thicker and heavier (glass weighs more than carbon fibers). The all glass fiber products are available in several weave options:

- › AG18-2L - Basket weave, all glass 2 layers
- › AG24-2L - Basket weave, all glass 2 layers
- › AG7544-2L - Plain Weave 2 layers
- › TWAG - Twill Weave, all glass 1 layer



Some examples of CFRT® material products

CARBON / GLASS FIBER - The most efficient carbon product

Carbon/Glass fiber products are thin (~1mm thickness) that blend the optimal performance, aesthetics and cost effectiveness with glass replacing at least half of the carbon fibers. Carbon fibers are orientated 90 degrees to the glass fibers for bi-directional mechanical properties. Several fabric/weave options are available:

PW1000 - Plain Weave of 12K carbon and glass

TW1000 - Twill Weave of 12K carbon and glass

TW1000 EB - Twill Weave of 12K carbon and glass

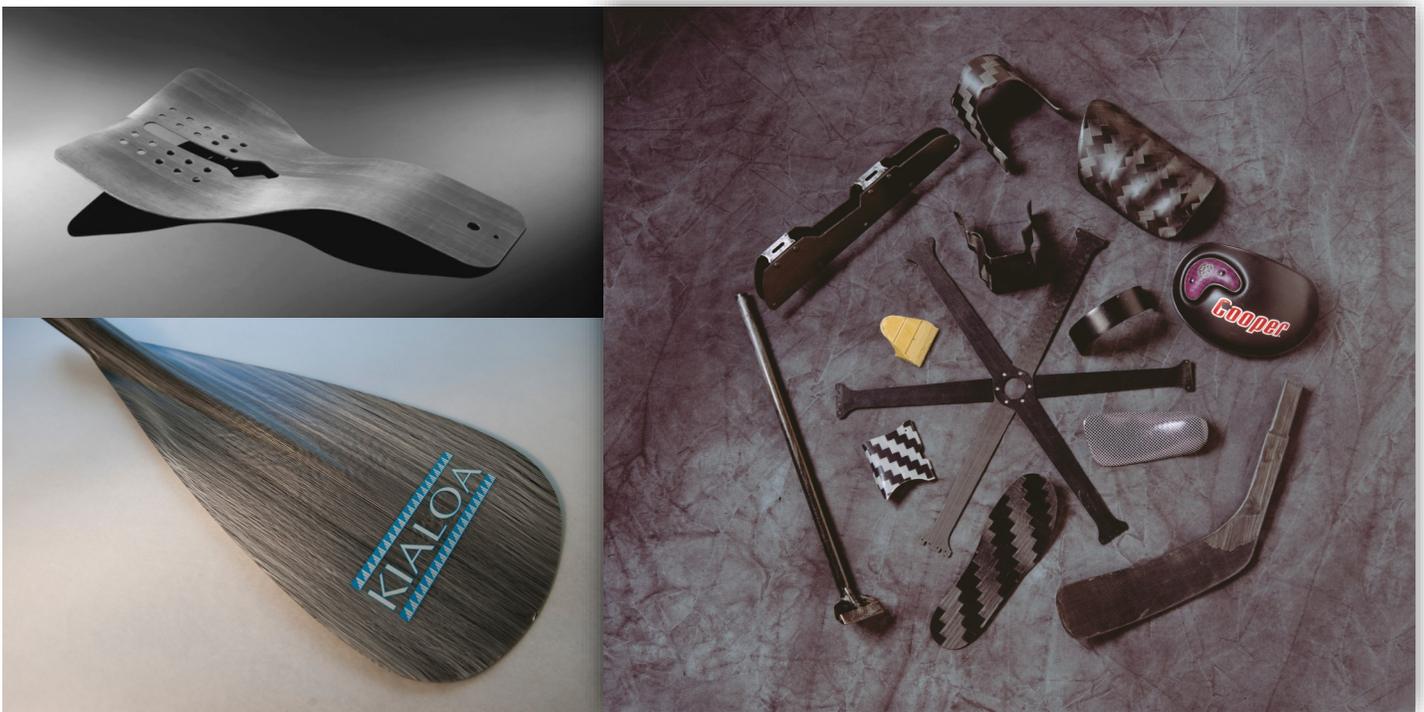
TW4000 - Twill Weave of 12K carbon and glass

BW1000 - Basket Weave of 12K carbon and glass

BW1000 Reemay[®] - Basket Weave of 12K carbon and glass

XTS UNI-DIRECTIONAL SERIES

XTS is a continuous fiber reinforced thermoplastic (CFRT[®]) composite that blends the benefits of a thermoplastic polymer alloy with uni-directional glass or carbon fibers for enhanced cost effective performance. XTS can be a multi-layer product engineered to deliver properties which will provide specific support, resiliency and energy return.



DESIGNING WITH CFRT® COMPOSITE MATERIALS

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

Holes and Hole Placement - Holes are not recommended for CFRT® applications as they disrupt the continuous fiber of the component. Holes may be incorporated into a design keeping in mind large holes, multiple holes and holes close to the edge will weaken the composite and can cause catastrophic failure. Holes need to be addressed on a case by case basis.

Flex Area - Materials placed in the flex zone will limit motion. Fiber placement and 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 arch wrap will add stiffness to the component and subsequently, the footwear. 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.

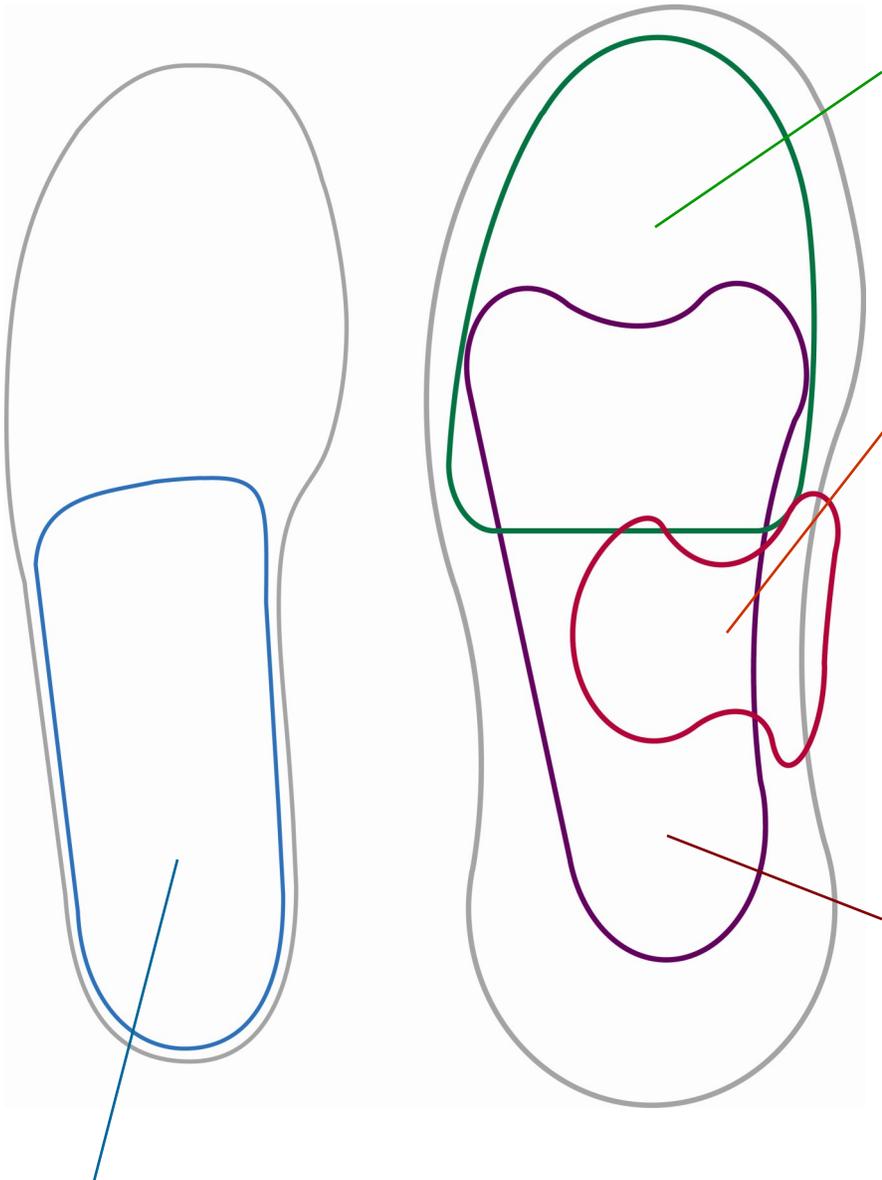
Carbon Direction - Materials are offered in all carbon, hybrid - carbon/glass and all glass. In the hybrid material, the carbon direction will have more stiffness. Carbon should be used in the direction in which stiffness / resiliency is desired.

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



Designs should be reviewed through TCPC Development for composite soundness and optimization.
Our composite engineers are available to assist you in your application.
Do not hesitate to contact us at 805-482-1722

We recommend our CFRT® composite materials for the following footwear components:



Sock Liner or Insole - As an aftermarket improvement or provided as a comfort or performance aspect of the footwear, TCPC CFRT® composite materials can be used as a sock liner or insole providing added support just under the foot. Studies have shown using TCPC CFRT® composite materials as a sock liner or insole will reduce foot fatigue, improve stability and make the footwear more comfortable. The composite material is thin and light providing support while not taking up too much room in the shoe. The shell can also be heat adjusted for customization.

Turf Plate - Typically used in turf footwear, the turf plate is used in place of spring steel to limit the **extension** of the great toe. TCPC has developed a very specific material for this application. Some added benefits using CFRT® is, it reduces the amount of heat transferred from the turf to the wearer's foot.

Shank Plate - The shank plate is located under the midfoot or arch area of the foot as a support. This area of the shoe is often cut-out or sculpted. CFRT® materials are used as a shank buried under the arch (typically in the midsole) or as an exposed torsional enhancement creating a "bridge" between the heel and forefoot. Both applications will reduce the weight of the footwear as typically other materials can be reduced by using the CFRT® technology. The larger the shank plate, the more biomechanical support and the lighter the footwear can be.

Spring Plate or Propulsion Plate - An extension of the shank plate, the spring plate or propulsion plate extends into the forefoot. CFRT® materials have been extended even into the first and second metatarsal for added spring and resiliency. The plate can be engineered to give the desired balance of stiffness vs. compliance while absorbing the impact of the foot striking the ground. For example, when wings are added to the spring plate, it provides added medial/lateral control to the wearer.

BONDING GUIDELINES

Our CFRT® materials can be In-Molded, Stock-Fit and Injection Over-molded. The following are our bonding guidelines.

- › Bonding requires that the surface be cleaned, but not dissolved with aggressive scrubbing or wiping, as the polymer can be removed exposing the fibers. Cleaners such as isopropyl alcohol, IPA, are preferred over aggressive solvents such as MEK. The surface of the material and adhesive layers should be free from contaminants such as mold release, oil from fingers in handling, etc. The content of aggressive solvents in primer and adhesives should be minimized where possible.
- › Excessive wiping, brushing or pooling of cleaners, primers and adhesives should be avoided.
- › Priming
 - Apply a thin layer of the primer with a clean brush with a light back and forth stroke.
 - Heat the material with primer at 55°C - 60°C for 2-3 minutes in a convection oven.
- › Adhesive Application
 - Apply a thin layer of the adhesive with a clean brush with a light back and forth stroke.
 - Heat the material with adhesive at 55°C - 60°C for 2-3 minutes in a convection oven.
- › Exposure to high temperature radiant heating elements should be avoided as the thermoplastic material can lose shape.
- › Attach the plate with adhesive to the other properly prepared component (e.g. - outsole) by applying uniform pressure over the entire surface.



CFRT[®] MATERIALS

PRODUCT DATA SHEETS

TW2000-1L PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon fibers for enhanced performance.

The TW2000 is a single layer product, ultra thin, lightweight, and resilient for improved energy return.



COMPOSITION

Fibers: Woven 12K carbon fibers - twill weave, carbon fiber reinforcement at 0° and 90° orientations. Fiber Content 58%

Resin: PMMA impact modified proprietary thermoplastic resin. Resin Content 42%
(Note: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.60 mm nominal

Color: Natural (carbon)

Size: Cut to customer specifications from sheet of 91 x 122 cm

TW 2000-1L MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.44
Flexural Rigidity	N-cm ²	13.2
Flexural Strength	Mpa	450
Flexural Modulus	Gpa	22.8

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55°C to 60°C

For more information on our materials please refer to the TCPC Processing Instructions

TW2000-1L EB PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon fibers for enhanced performance (ultra-thin, lightweight and resilient).

ENVIR-Bond™ (EB) is TCPC’s 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 over molding.



COMPOSITION

Fibers: Carbon (12K) fiber content: 48%
 Tie Layer: Polyurethane (18%)
 Resin: PMMA impact modified proprietary thermoplastic resin (34%)
 (Note: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.8 mm Nominal
 Color: Natural (carbon)
 Size: Cut to customer specifications from sheet of 91 x 122 cm

TW-2000-1L EB MATERIAL PROPERTIES

Specific Gravity		1.44
Flexural Rigidity	N-cm ²	13.2
Flexural Strength	Mpa	450
Flexural Modulus	Gpa	22.8

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55°C to 60°C

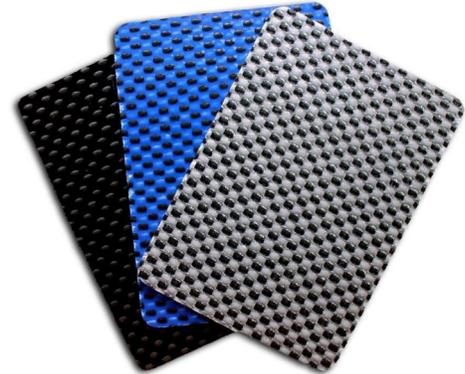
Note: Mechanical properties are for the base panel and do not reflect the added “Tie-Layer EB”.

For more information on our materials please refer to the TCPC Processing Instructions

PW1000 PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon and glass fibers in a plain weave for enhanced performance.

PW1000 is a single layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon.



COMPOSITION

Fibers: Carbon (12K) fiber content: 25% Glass (330) fiber content: 25%

Resin: PMMA impact modified proprietary thermoplastic resin (50%)
(Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.8 mm nominal

Color: Various

Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

PW1000 MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.48
Flexural Rigidity	N-cm ²	10.2
Flexural Strength	Mpa	145.6
Flexural Modulus	Gpa	8.5

Recommended Processing Temperature

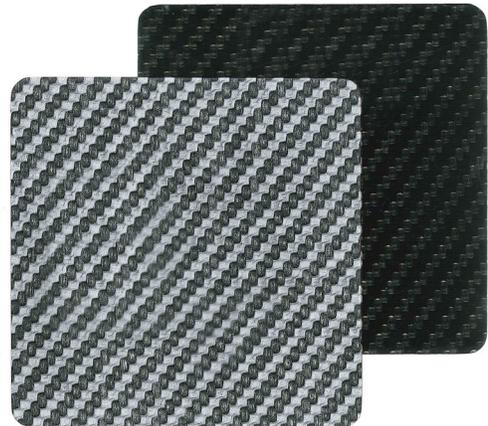
Forming	195°C to 200°C
Bonding	55° to 60°C

Note: Properties measured in Carbon Direction

For more information on our materials please refer to the TCPC Processing Instructions

TW1000 PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT®) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon and glass fibers in a twill weave for enhanced shapes and performance. TW1000 is a single layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon.



COMPOSITION

Fibers: Carbon (12K) fiber content: 26% Glass (330) fiber content: 26%
 Resin: PMMA impact modified proprietary thermoplastic resin (48%).
 (Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.89 mm nominal
 Color: Various
 Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

TW1000 MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.50
Flexural Rigidity	N-cm ²	24.3
Flexural Strength	Mpa	327
Flexural Modulus	Gpa	15.7

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

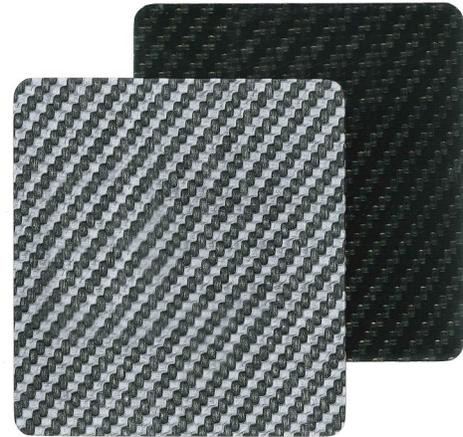
Note: Properties measured in Carbon Direction

For more information on our materials please refer to the TCPC Processing Instructions

TW1000 EB PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon and glass fibers in a twill weave for enhanced shapes and performance. TW1000 is a single layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon.

ENVIR-Bond[®] (EB) is TCPC’s 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 over molding.



COMPOSITION

Fibers: Carbon (12K) fiber content: 26% Glass (330) fiber content: 26%
 Resin: PMMA impact modified proprietary thermoplastic resin (48%).
 (Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 1.0 mm nominal
 Color: Various
 Size: Cut to customer specifications from sheet of 91 x 122 cm

TW1000 EB MATERIAL PROPERTIES

Specific Gravity		1.50
Flexural Rigidity	N-cm ²	24.3
Flexural Strength	Mpa	327
Flexural Modulus	Gpa	15.7

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55°C to 60°C

Note: Mechanical properties are for the base panel and do not reflect the added “Tie-Layer EB”.

For more information on our materials please refer to the TCPC Processing Instructions

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
Flash 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
Autoignition Temperature: Not Applicable
Decomposition Temperature: Begins at 250 °C (482 °F)
Hazardous Reactions: Hazardous polymerization does not occur
Stability: Stable

Massachusetts, New Jersey or Pennsylvania Right to Know Substance Lists:

<u>Weight %</u>	<u>Components</u>	<u>Cas-No.</u>
>=1%	Polyurethane polyester elastomer	CAS# is a trade secret
>=1%	Thermoplastic Polyurethane	

Note: Remove protective film from surface prior to processing

TW4000 PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon and glass fibers in a twill weave for enhanced shapes and performance.

TW4000 is a single layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon.



COMPOSITION

Fibers: Carbon (12K) fiber content: 27% Glass (330) fiber content: 27%

Resin: PMMA impact modified proprietary thermoplastic resin (46%).
(Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.84 mm nominal

Color: Various

Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

TW4000 MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.5	1.5
Flexural Rigidity	N-cm ²	28.7	5.4
Flexural Strength	Mpa	467.3	268.6
Flexural Modulus	Gpa	24.8	12.5

Recommended Processing Temperature

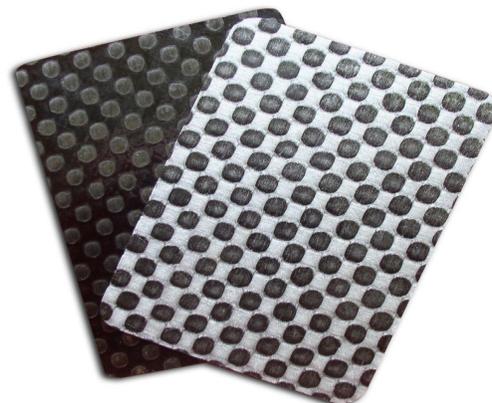
Forming	195°C to 200°C
Bonding	55° to 60°C

For more information on our materials please refer to the TCPC Processing Instructions

BW1000 PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon and glass fibers in a basket weave for enhanced performance.

BW1000 is a single layer product; carbon in one direction and glass fibers at a 90° orientation to the carbon.



COMPOSITION

Fibers: Carbon (12K) fiber content: 30% Glass (330) fiber content: 30%

Resin: PMMA impact modified proprietary thermoplastic resin (40%).
(Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.91 mm nominal

Color: Various

Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

BW1000 MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.57
Flexural Rigidity	N-cm ²	20.5
Flexural Strength	Mpa	218
Flexural Modulus	Gpa	13.5

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

For more information on our materials please refer to the TCPC Processing Instructions

Note: Properties measured in Carbon Direction

BW1000 Reemay[®] PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven carbon and glass fibers in a basket weave for enhanced performance.

BW1000 Reemay[®] is a woven fabric of carbon in one direction and glass fibers at a 90° orientation to the carbon, with a polyester backing



COMPOSITION

Fibers: Carbon (12K) fiber content: 24% Glass (330) fiber content: 25% Polyester fiber content 4%

Resin: PMMA impact modified proprietary thermoplastic resin (47%).
(Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 1.1 mm nominal
Color: Various
Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

BW1000 Reemay[®] MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.49
Flexural Rigidity	N-cm ²	22.8
Flexural Strength	Mpa	205
Flexural Modulus	Gpa	9.1

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

Note: Properties measured in Carbon Direction

For more information on our materials please refer to the TCPC Processing Instructions:

AG18-2L PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven glass fibers plain weave for enhanced performance.

AG18-2L is a dual layer product with glass fibers in both direction (0° & 90° orientations)



COMPOSITION

Fibers: Glass (330) fiber content: 55%

Resin: PMMA impact modified proprietary thermoplastic resin: (45%)
(Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.86 mm nominal

Color: Various

Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

AG18-2L MATERIAL PROPERTIES (per ASTM D790-10)

		4 Tow per inch	5 Tow per inch
Specific Gravity		1.65	1.65
Flexural Rigidity	N-Cm ²	23	28
Flexural Strength	MPa	260	360
Flexural Modulus	GPa	13	16

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

For more information on our materials please refer to the PMC Processing Instructions

AG24-2L PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT®) composite, blends the benefits of a thermoplastic polymer alloy with woven glass fibers for enhanced performance.

AG24-2L is a multi-layer product with glass fibers in both direction (0° and 90° orientations, 5 tows per inch by 4 tows per inch)



COMPOSITION

Fibers: Glass fiber content: 64%

Resin: PMMA impact modified proprietary thermoplastic resin: (36%)
(Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 1.2 mm nominal

Color: Various

Panel Size: Cut to customer specifications from sheet of 91 x 122 cm (36" x 48")

AG24-2L MATERIAL PROPERTIES (per ASTM D790-10)

		36" - 5 tow warp direction	48" - 4 tow fill direction
Specific Gravity		1.76	1.76
Flexural Rigidity	N-cm ²	67.3	55.6
Flexural Strength	Mpa	600	470
Flexural Modulus	Gpa	18.6	15.2

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

Note: Properties measured in 5 tows/inch Direction

For more information on our materials please refer to the TCPC Processing Instructions

AG7544-2L PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven glass fibers plain weave for enhanced performance.

AG-7544-2L is a dual layer product with glass fibers in both direction (0° and 90° orientations)



COMPOSITION

Fibers:	Glass (330) fiber content: 55.6%
Resin:	PMMA impact modified proprietary thermoplastic resin: (44.4%) (Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness:	0.9 mm nominal
Color:	Various
Panel Size:	Cut to customer specifications from sheet of 91 x 122 cm

AG-7544-2L MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.64
Flexural Rigidity	N-cm ²	24.3
Flexural Strength	Mpa	342
Flexural Modulus	Gpa	13.8

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

For more information on our materials please refer to the TCPC Processing Instructions

TWAG PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite, blends the benefits of a thermoplastic polymer alloy with woven glass fibers in a twill weave for enhanced performance. TWAG is a single layer product with glass fibers in both direction (0° and 90° orientations)



COMPOSITION

Fibers: Glass (330) fiber content: 60%
 Resin: PMMA impact modified proprietary thermoplastic resin: (40%)
 (Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness: 0.86 mm nominal
 Color: Various
 Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

TWAG-1 MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.85
Flexural Rigidity	N-cm ²	2.9
Flexural Strength	Mpa	323
Flexural Modulus	Gpa	11.5

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

For more information on our materials please refer to the TCPC Processing Instructions (Doc2001)

XTS PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT[®]) composite XTS, blends the benefits of a thermoplastic polymer alloy with uni-directional glass fibers for enhanced performance. XTS is offered in 3 layer (0°/90°/ 0° fiber orientations) and 4 layer (0°/ 90°/ 90°/ 0° fiber orientations)



COMPOSITION

Fibers: Uni Directional Glass (330) fiber content: 35% (3 layer) and 35% (4 layer)
 Resin: ABS polymer blend, polymer or resin: 65%
 (Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES (per ASTM D790-10)

Thickness: 0.9 mm (3 layer) and 1.1 mm (4 layer) nominal
 Color: Black
 Panel Size: Cut to customer specifications from sheet of 91 x 122 cm

XTS MATERIAL PROPERTIES (per ASTM D790-10)

		3 Layer	4 Layer
Specific Gravity		1.41	1.41
Flexural Rigidity	N-cm ²	29.3	55.6
Flexural Strength	Mpa	564	537
Flexural Modulus	Gpa	20.0	18.6

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55° to 60°C

For more information on our materials please refer to the TCPC Processing Instruction

ALUM AG/G/XTS-2L PRODUCT DATA SHEET

Continuous fiber reinforced thermoplastic (CFRT®) composite, blends the benefits of a thermoplastic polymer alloy with woven glass fibers for enhanced performance (ultra-thin, lightweight and resilient).

The Alum/G/XTS is a multi-layer product, used in the footwear/skate manufacturing process.

Note: XTS backing has 2-layers of UD Glass/ABS.



COMPOSITION

Fibers: Glass fiber content: 29.3%

Resin: PMMA impact modified proprietary thermoplastic Resin 70.7%.
(Noted: Percentages are by volume and are nominal values)

PHYSICAL ATTRIBUTES

Thickness Range: 1.0 mm

Color: Natural (carbon)

Size: Cut to customer specifications from sheet of 91 x 122 cm

AlumAG/G/XTS-2L MATERIAL PROPERTIES (per ASTM D790-10)

Specific Gravity		1.36
Flexural Rigidity	N-cm ²	31.6
Flexural Strength	Mpa	195
Flexural Modulus	Gpa	14.1

Recommended Processing Temperature

Forming	195°C to 200°C
Bonding	55°C to 60°C

For more information on our materials please refer to the TCPC Processing Instructions



Materials for the Future



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