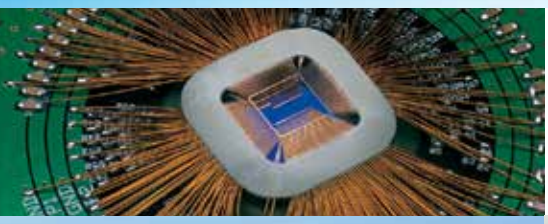
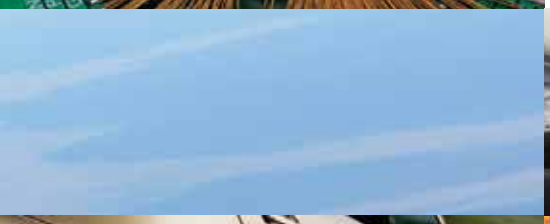
TENCATE ADVANCED COMPOSITES

TenCate Cetex® and CFRT® Thermoplastic Advanced Composites

Product Selection Guide
Aerospace
Electronics
Industrial
Medical
Oil & Gas
Recreational
Transportation

Thermoplastic Advanced Composites
Thermoplastic Laminates - Thermoplastic Bulk Molding Compounds






TENCATE
materials that make a difference

TenCate Cetex® and CFRT® Thermoplastic Advanced Composites

TenCate Cetex® and CFRT® brand of thermoplastic composites are widely valued in aerospace as a result of their durability, structural strength and processing advantages.

Advanced Thermoplastic Composites

TenCate Advanced Composites is a global leader in thermoplastic advanced composite materials. We have shipped hundreds of thousand of pounds of thermoplastic composite materials for a broad range of applications including aircraft structures, oil and gas exploration, medical devices, electronics, sporting goods and industrial components. With over 30 years of experience and pedigree, our TenCate Cetex® and CFRT® brand of thermoplastic composites sets the standard for high quality, engineered thermoplastic composite materials designed to meet the demands of nearly any application.

Current TenCate Cetex thermoplastic applications in aerospace.

Go lighter...

Thermoplastic advanced composites offer many **advantages over metals** including:

- **Lighter weight**
- **Higher strength**
- **Corrosion resistance**
- **Rapid forming**
- **Lower cost tooling**

Go faster...

Thermoplastic composites offer a number of **advantages over thermoset composites** including:

- Rapid thermoforming to net part shape to meet high volume production.
- Excellent smoke, flame and toxicity resistance
- Excellent moisture resistance
- Storable at ambient temperatures, no refrigeration needed
- Ability to be re-molded and/or reworked
- Low void content
- Ability to be fusion welded, eliminating the cost and weight of fasteners
- Recyclability

TenCate Cetex® RTL composites are used to produce complex, high volume clips, brackets and structures.

Thermoplastic composites utilize fusion welding which makes the rib to skin bond as strong as the material.

Southwest® Airlines' 737 galleys are produced with TenCate Cetex RTL laminates. TenCate Cetex meets the flammability, durability and aesthetic requirements and can be processed rapidly to minimize cost.

Meeting the challenge

Thermoplastic composites **are similar to thermoset composites**:

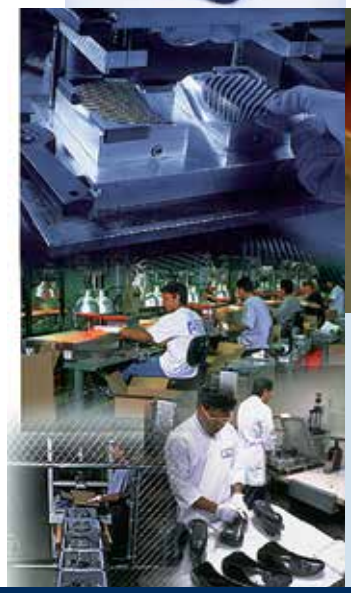
- Excellent resistance to solvents
- Good impact strength and toughness
- Ability to carry structural loads
- Excellent hot/wet performance
- Comprehensive mechanical property databases
- Ability to use automation in work cell manufacturing
- Good NDI inspectability
- Ability to utilize adhesives for structural bonding
- Exceed today's standards for FST performance.

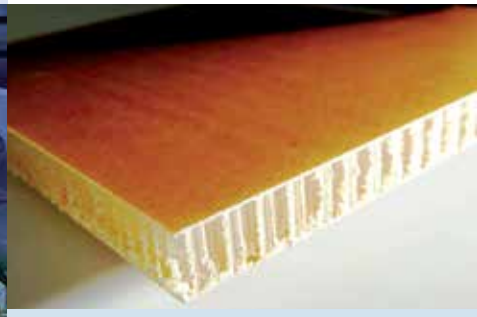
Thermoplastic advanced composite laminates can be produced with integral glass surface layers for galvanic protection and/or metallic screens to allow for high surface conductivity. And, thermoplastics can be die-cut, formed or trimmed into a variety of designs, overmolded with other materials, and bonded or joined into more complex structures. Imagine the possibilities.

The TenCate Cetex brand of thermoplastics are offered in a variety of material forms to facilitate your manufacturing process and part design:

- Fabric and unidirectional prepregs/semi-pregs
- Flat sheet stock consolidated multi-ply oriented reinforced thermoplastic laminates (RTL)
- Chopped thermoplastic bulk molding compounds

Commercial aircraft interiors value TenCate Cetex® thermoplastics because of their smoke and fire resistance and durability





TenCate Cetex® RTL laminates are used in conjunction with honeycomb core for use in business and first class seating which must withstand 16 g loading without failure.

TenCate with Fokker and KVE won the 2010 JEC Innovation Award with the Gulfstream G650 rudder which used induction welding to eliminate fasteners.

Airbus A340 and A380 J-nose leading edges are made with TenCate Cetex thermoplastic advanced composites for impact resistance and weight reduction.

TenCate recently won a 2011 JEC Innovation Award in partnership with Cutting Dynamics and A&P Technologies for an aircraft seat program.

Industry Applications

A Perfect Match – Advanced engineering polymers, combined with advanced fiber reinforcements are used to fabricate durable, structural and production-efficient components.

Go lighter...

Aerospace – The aerospace industry uses TenCate Cetex® composites for applications ranging from structural components, such as wing leading edges, engine pylon structures, cargo flooring, acoustic structures, interior galleys and a wide variety of molded parts including ducts, seats, clips and interior panels

Electronics – Computer and smartphone cases benefit from the impact resistance, high surface quality and lightweight of TenCate CFRT® thermoplastic composites. As designers move to thinner and lighter designs, thermoplastic composites provide the durability and manufacturability desired.

Go further...

Transportation – Thermoplastics offer rapid cycle times using thermoforming processes commonly found in the automotive industry. Combined with the high temperature and solvent resistance properties of these materials, thermoplastic composites are ideal for under the hood applications. In larger mass transit vehicles and rail cars, thermoplastic composites provide excellent durability, fire, smoke and toxicity resistance and a high strength to weight ratio.

Go deeper...

Energy – The oil and gas industry has long used advanced thermoplastic composites to achieve weight savings in corrosive environments. Composites provide weight savings of 80% over steel, and is 40% lower than aluminum.

Industrial – The unique ability of thermoplastic composites to be formed and machined make them ideal to replace heavier metal components in structural brackets, fly wheels and rotating.

Processing

Thermoplastics advanced composites offer enormous advantages for composite part manufacturers. Because thermoplastic composites are inert at room temperature and do not need freezer storage, they excel in large assemblies which require long fabrication cycles. On smaller parts, thermoplastics can be thermoformed rapidly using processing equipment typically found in production environments. And, because cycle times are fast, manufacturer's can meet high volume demands historically only possible with metals or with un-reinforced plastics.

Typical processes used with thermoplastic composites include:

- Thermoforming
- Automated tape laying
- Automated fiber placement
- Honeycomb stiffened panel fabrication
- Compression molding

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Product Forms

Prepregs/Semi-Pregs – This material form represents fabrics and unidirectional tapes which have been impregnated with thermoplastic resin. Depending upon the process and polymer used the resin may reside on the surface of the fabric (semi-preg) or may be fully impregnated (prepreg). Thermoplastic fabric based prepregs are drapable, but do not have tack. They are used for larger single curvature parts where plies are built up.

Unidirectional thermoplastic tapes are best suited for use in automated tape placement or automated blank lay up with secondary thermoforming operations, but can also be used in hand lay up processes.

TenCate Cetex® RTL (Reinforced Thermoplastic Laminates) – This material form represents multi-ply fabrics which have been consolidated into flat sheets. TenCate Cetex RTL laminates range from 1 to 24 plies for aerospace and 100+ plies for industrial applications. The layers can be oriented in a 0/90 or 0/+45/-45/90 type stacking sequence. TenCate Cetex RTL materials are valued because they are fully consolidated which allows them to be quickly formed into their final shape (minutes) without having to undergo a typical 30 minute consolidation step.

Thermoplastic Bulk Molding Compounds – These materials are derived from unidirectional thermoplastic prepregs which have undergone a slitting and chopping operation to provide half inch to one inch chopped fibers. The benefit of bulk molding compounds is that they allow complex components to be compression molded with very short cycle times and in a highly automated production environment.

Other benefits of bulk molding compounds include:

- Similar strength of aluminum or titanium
- BMC offers the strength of metals with the lightweight properties of composites
- Low FST properties
- Allows for complex part geometry
- High volume production with short cycle times

Molded Parts – TenCate offers compression molding part fabrication services. From tool design to prototype, to fabrication.

TENCATE CETEX® ENGINEERED THERMOPLASTIC COMPOSITES

Product Name	Resin Type	Tg	Cure Temp/ Cure Time	Description
Engineering Thermoplastics				
TenCate Cetex® TC925 FST	Polycarbonate (PC)	**307°F/153°C**	• Process temp. 437°F/255°C	PC-based, lower cost thermoplastic for interiors.
TenCate Cetex® TC1000 Design	Polyethermide (PEI)	**419°F/215°C**	• Process temp. 600°F/315°C	Low flammability - V-0. Good impact toughness. Value oriented version for interior applications.
TenCate Cetex® TC1000 Premium	Polyethermide (PEI)	**419°F/215°C**	• Process temp. 600°F/315°C	Ideal for interioir applications ranging from floor panels, to seat plynths to luggage bins.
TenCate Cetex® TC1100 PPS	PPS	**194°F/90°C**	• Process temp. 625°F/330°C	PPS-based thermoplastic composite solvent resistant.
TenCate Cetex® TC1200 PEEK	PEEK	**290°F/143°C**	• Process temp. 725°F/385°C	PEEK-based thermoplastic unitape and fabrics. Excellent solvent resistance.
TenCate Cetex® TC1220 PEEK NEW	PEEK	**290°F/143°C**	• Process temp. 725°F/385°C	PEEK-based thermoplastic unitape and fabrics. High 50 ksi CAI.
TenCate Cetex® TC1320 PEKK NEW	PEKK	**320°F/160°C**	• Process temp. 700°F/371°C	PEKK-based thermoplastic unitape and fabrics. Lower processing temperature than PEEK.
TenCate Cetex® MC1100 PPS NEW	PPS	**194°F/90°C**	• Process temp. 625°F/330°C	PPS-based thermoplastic bulk molding compound.
TenCate Cetex® MC1200 PEEK NEW	PEEK	**290°F/143°C**	• Process temp. 725°F/385°C	PEEK-based thermoplastic bulk molding compound.

TENCATE CFRT® PERFORMANCE THERMOPLASTIC COMPOSITES

Product Name	Thermoplastic Resin	Process Temp.	Neat Resin Heat Distortion under Load 1.8 MPa/ 265 psi	Applications
Performance Thermoplastics				
TenCate Cetex® TC910	Nylon 6 (PA6)	**480-520°F 249-271°C**	**392°F/200°C**	Automotive and recreational applications as a result of temperature resistance, toughness and solvent resistance.
TenCate Cetex® TC930	High Density Polyethelene (HDPE)	**360-390°F 182-199°C**	**253°F/123°C**	Oil and gas applications such as pipe overwrapping as a result of its strength and toughness.
TenCate Cetex® TC940	Polyethylene Terephthalate (PET)	**509°F/265°C**	**392°F/200°C**	Excellent for recreational and low cost applications for its good impact resistance.
TenCate Cetex® TC950	Polymethyl Methacrylate (PMMA)	**374-410°F 190-210°C**	**200°F/93°C**	Commonly used for athletic shoe inserts, orthotics. Good cosmetic surface appearance.
TenCate Cetex TC960	Polypropylene (PP)	**390-420°F 199-216°C**	**318°F/159°C**	Used in applications where low cost and high toughness desired (vehicles).

TENCATE ADVANCED COMPOSITES

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

QUALIFICATIONS
- ISO 9001
- AS 9100

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iPad / iPhone / Android Apps

Photos courtesy of Airbus, Boeing, Cirrus, General Atomics, Gulfstream, U.S. Military, NASA and of the respective companies.

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