TenCate TC1320

TENCATE ADVANCED COMPOSITES

PRODUCT DATA SHEET

DESCRIPTION

TenCate Cetex® TC1320 is a PEKK-based thermoplastic composite available in unitape or fabric form. It is based on a semi crystalline thermoplastic polymer and as such has excellent resistance to chemicals and solvents. TenCate Cetex TC1320 offers excellent elevated service performance, good hot/wet strength and offers excellent performance in flammability properties.

FEATURES

- **Resistant to solvents and chemicals**
- **Low moisture uptake, good hot/wet strength retention**
- **Good impact resistance and toughness**
- **Flame retardant**
- **Ambient temperature storage, indefinitely**
- **Good compression after impact performance**

PRODUCT TYPE

Polyether-ketone-ketone (PEKK) Thermoplastic Resin System

TYPICAL APPLICATIONS

- Aircraft interiors
- Aircraft brackets and ribs
- Primary flight structure
- Secondary flight structure
- Access panels, conduits, and flooring

SHELF LIFE

Storage Life:	Indefinite 25°C (77°F)

NEAT RESIN PROPERTIES

Resin Density	1.29g/cc
T_g	159°C (318°F)
T_m	337°C (639°F)
T_c	265°C (509°F)

m = *melt*
c = *crystalline*

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MECHANICAL PROPERTIES

Property	Condition	Test Method	Results	
Tensile Strength	RTD	ASTM D 3039	2,300 MPa	334 ksi
Tensile Modulus	RTD	ASTM D 3039	139 GPa	20 Msi
Tensile Strength - 90°	RTD	ASTM D 3039	87.5 MPa	12.7 ksi
Tensile Modulus - 90°	RTD	ASTM D 3039	10.5 GPa	1.5 Msi
Compression Strength	RTD	ASTM D 6641	1,400 MPa	205 ksi
Compression Modulus	RTD	ASTM D 6641	124 GPa	18 Msi
Compression Strength	ETD	ASTM D 6641	1,222 MPa	177 ksi
Compression Modulus	ETD	ASTM D 6641	124 GPa	18 Msi
Compression Strength - 90°	RTD	ASTM D 6641	208 MPa	30 ksi
Compression Modulus - 90°	RTD	ASTM D 3518	11.2 GPa	1.6 Msi
In plane Shear Strength	RTD	ASTM D 3518	145 MPa	21 ksi
In plane Shear Strength 2% offset	RTD	ASTM D 3518	50.5 MPa	7.3 ksi
In plane Shear Modulus	RTD	ASTM D 3518	5.2 GPa	0.8 Msi
In plane Shear Strength	ETD	ASTM D 3518	141 MPa	20 ksi
In plane Shear Strength 2% offset	ETD	ASTM D 3518	37.2 MPa	5.4 ksi
In plane Shear Modulus	ETD	ASTM D 3518	5.0 GPa	0.73 Msi
Flexural Strength	RTD	ASTM D790	1,655 MPa	240 ksi
Flexural Modulus	RTD	ASTM D790	118 GPa	17 Msi
Flexural Strength - 90°	RTD	ASTM D790	139 MPa	20 ksi
Open Hole Tension Strength	RTD	ASTM D 5766	420 MPa	61 ksi
Open Hole Tension Strength	CTD	ASTM D 5766	422 MPa	61 ksi
Open Hole Tension Strength	ETW	ASTM D 5766	410 MPa	59 ksi
Open Hole Compression Strength	RTD	ASTM D 6484	332 MPa	48 ksi
Open Hole Compression Strength	ETD	ASTM D 6484	282 MPa	41 ksi
Open Hole Compression Strength	ETW	ASTM D 6484	268 MPa	39 ksi
CAI - 270 in-lb (30.5 J)	RTD	ASTM D7136/7137	305 MPa	44 ksi
G_1C Strain Energy	RTD	ASTM D 5528	1.04 kJ/M^2	5.9 lb/in
G_2C Strain Energy	RTD	ASTM D 7905	1.84 kJ/M^2	10.5 lb/in

TenCate Cetex® TC1320 PEKK on AS4D UD tape with 145 FAW, 34% resin content.

ETD is 121°C (250°F)
ETW is 60°C (140°F), after 85% relative humidity until saturation, soaked at 71°C (160°F)
Laminate T_g by DMA is 160°C (320°F)

PROCESSING GUIDELINES FOR TENCATE CETEX® TC1320 (POLYETHERKETONEKETONE) THERMOPLASTIC COMPOSITE MATERIALS

TenCate Cetex® TC1320 thermoplastic composite materials from TenCate are processed by heating the material above the PEKK melting point, molding it and cooling it under pressure to the desired shape. Because no chemical change occurs to the PEKK matrix, processing is very rapid. The quick easy processing of TenCate Cetex materials is also made possible because of the rapid crystallization rate of the PEKK matrix. The key thermal processing parameters are:

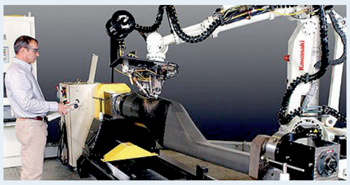
Melt Temperature	337°C (639°F)
Typical Processing Temperature	370–400°C (700–750°F)

TenCate also has the capability to chop the slit tape & simple profiles into discrete length long fiber thermoplastic type materials for compression molding type processes.

AUTOMATED PROCESSES

Below are several examples of automated processes utilized and available in the market today. The three processes eliminate the need for autoclave consolidation of thermoplastic composite parts, thereby dramatically reducing the cost and time of producing continuous fiber composite structures.

1. **Fiber Placement with In Situ Consolidation**: This process utilizes narrow width tapes typically 6–25 mm (0.25–1 inches) as its composite material medium and lays down with heat via hot gas, laser, or other heating methods, and consolidates the composite material onto the tool, in situ, without the need for further consolidation processes.



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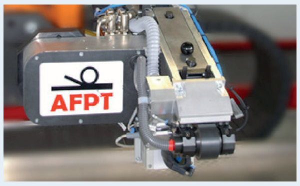
www.automateddynamics.com



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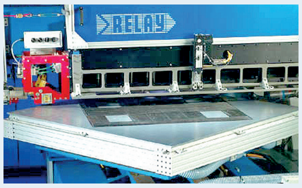
www.afpt.biz

2. **Rapid Lamination/Forming**: This process uses wider UD tapes typically 50 mm (≥ 2 inches) width automated tape laying equipment to rapidly lay down and consolidate the thermoplastic composite material into an engineered laminate structure that can then be transformed into parts via a secondary compression thermoforming process (thermoforming).

Automated tape laying of tailored blank followed by consolidation.



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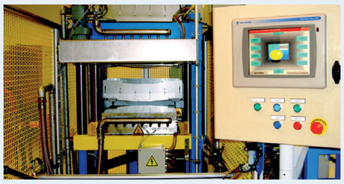
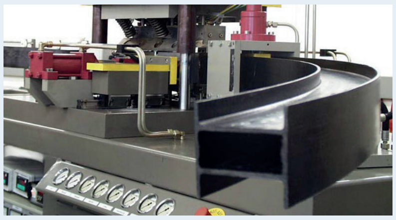
The consolidated flat laminate is first consolidated, then thermoformed to a 3-D final shape.



› Photo Courtesy of TenCate

3. **Continuous Compression Molding (CCM)**: In this multi-step process, multiple plies of thermoplastic UD tape are fed into a continuous process through a heated mold, and pressed into a laminate. This laminate is then pressed into a mold and thermoformed to the desired profile. A final step then molds with heat and pressure into the curved profile through a process called continuous compression molding. Items such as clips, rails, beams, and profiles are manufactured in this type of process.



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www.acm-fn.de

PRESS LAMINATION

A laminate can be fabricated from any TenCate Cetex® thermoplastic prepreg by stacking two or more plies in the desired orientation into a picture frame mold, transferring the assembly to a heated platen press where it is brought to approximately 370–400°C (700–750°F) at contact pressure until the material reaches temperature. The pressure should then be increased to 7–21 bar (100–300 psi) and held for approximately 15–30 minutes. The part should then be cooled to room temperature at a 5–10°C per minute cool-down rate to maintain the crystalline nature of PEKK for solvent resistance.

AUTOCLAVE LAMINATION

Autoclave consolidation may be used for fabricating laminates from any TenCate Cetex® prepreg tape. Individual layers are stacked in the desired orientation, and vacuum bagged. Vacuum should be maintained throughout the entire process. A high temperature bagging material, such as Kapton or polyimide should be used. The assembly should then be placed in the autoclave, and brought to approximately 370–400°C (700–750°F), at which time, the pressure is increased from ambient to 7–21 bar (100–300 psi) and maintained for around 15–30 minutes. The part should then be cooled to room temperature at a 5–10°C cool-down rate to maintain the crystalline nature of PEKK for solvent resistance.

THERMOFORMING LAMINATES INTO SHAPES

Thermoforming is used to convert a flat consolidated continuous fiber reinforced laminate into a complex shape with no change in starting laminate thickness. The laminate should be heated to around 370–400°C (700–750°F) in an infrared or similar oven, and then quickly transferred to a matched core/cavity mold where it can be formed at 10–40 bar (150–600 psi). For optimum properties and formability, heating of the composite laminate should take no longer than 8 minutes. Overall part production cycle times are between 2–10 minutes, depending on material thickness and part geometry. Production tooling consists of machined aluminum halves, one that has a compliant layer of cast silicone, and an associated laminate tensioning system to prevent wrinkling within the part being thermoformed.

CUTTING AND MACHINING

Thermoplastic composite laminates and thermoformed parts can be machined with feed rates and tip speeds similar to those used when machining brass.

The following are some general guidelines:

Circular Saw	**Blade speed:** 1830 mpm (6000 fpm) with water or soap solution as coolant. Diamond-grit-edge blade of 220 grit. Feed rates depend on thickness.
Turning Operations	**Cutting speed:** 105–120 mpm (350–400 fpm) for high speed tools, 180–455 mpm (1500–2500 fpm) for Stellite or carbide tools, and 600–1200 mpm (2000–4000 fpm) for diamond tools
Milling Operations	**Tip speed:** 75–135 mpm (250–450 fpm) for carbide and diamond tools **Plunge feed rate:** 0.15–0.30 mpm (0.5–1 fpm)
Drilling Operations	**Feed Rate:** 0.2–0.4 mm/rev (0.008–0.016 in/rev) **Drill speed:** 45–90 mpm (150–300 fpm) **Drill point angles:** 60° for thin parts, 90° for thick parts **Clearance angle:** 15°
Trapping	Tool rake of 0° to 5° negative
Shearing	Thicknesses up to 3.2 mm (0.125 inch)

JOINING

Thermoplastic composites can be joined via mechanical fasteners, adhesive bonding, or fusion welding. Fusion welding via resistance or inductive welding is a commonly preferred method of joining thermoplastics.

Strong adhesive bonds are possible with epoxy adhesives when PEKK surfaces are cleaned with a suitable degreasing solvent (i.e., MEK), abrasive treatment (i.e., abrasion wheels, sand-paper, or grit blasted with #100 or #200 aluminum oxide). The surface energy may also be enhanced by flame/corona treatment, chromic acid etching, laser treatment, or plasma techniques. Epoxy films or pastes with cure temperatures up to 177°C (350°F), anaerobics, silicone sealers, and cyanoacrylates are effective adhesives depending on specific requirements.

TenCate Cetex® TC1320 thermoplastic composites may also be bonded using conventional thermoplastic welding techniques. PEKK-based materials have high melt temperatures and considerable amounts of energy must be put into the interface to achieve a good bond. Satisfactory results have also been obtained using induction (for carbon prepregs) or resistance welding.

PAINTING

TenCate Cetex® TC1320 composite surfaces can be painted with a variety of products. It is recommended that a paintable (non-silicone) mold release be used, if possible, during the molding of all surfaces to be painted. If a silicone or Teflon mold release is used during molding, laminate and part surfaces may require abrasion prior to painting. In all cases, surfaces must be wiped with a suitable solvent to remove oils, release agents, or other impurities.

HEALTH & SAFETY

Health and safety information on handling and processing TenCate composite materials is described in the Safety Data Sheet (SDS) available from TenCate Advanced Composites. To obtain this or any other information about TenCate Cetex® PEKK thermoplastic composite materials, contact TenCate Advanced Composites at the addresses and telephone numbers below, or visit our website at www.tencatecomposites.com.

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