

# HIGH TEMPERATURE MATERIALS



*P<sup>2</sup>SI*

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materials that make a difference



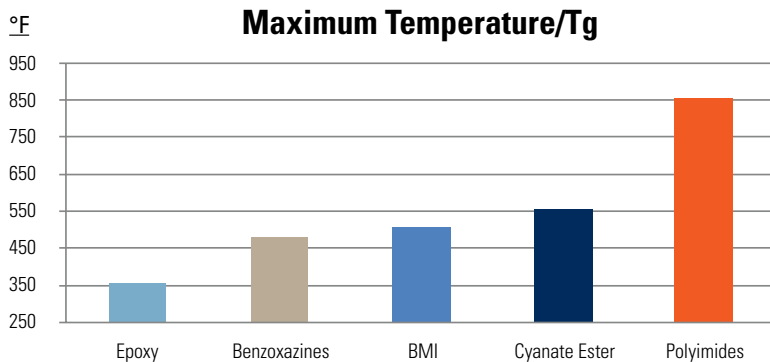
**TenCate Advanced Composites** and **Performance Polymer Solutions Inc.** have joined forces to supply leading-edge high temperature composites solutions. P<sup>2</sup>SI<sup>®</sup>, now part of PROOF Research™, is the world's leading developer of high temperature resins. Under exclusive license, TenCate is the supplier of prepregs made with P<sup>2</sup>SI<sup>®</sup> resins.

TenCate provides very high temperature composites for demanding applications ranging from:

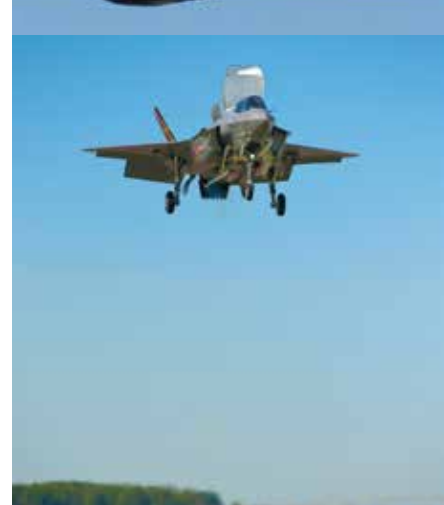
- **Jet engines, ducts and hot sections**
- **Leading edges on hypersonic vehicles**
- **Heat shields and heat protection systems**
- **Rocket engine nozzles, thrusters and powerplants**
- **High temperature titanium replacement in aircraft and launch vehicles**
- **Military specific applications**
- **High temperature composite tooling**

Very high temperature composites are generally defined as polymers that operate in the 450°- 800+°F (232-427°C) service temperature environment. This temperature range is above typical epoxy service temperatures and more associated with the service temperatures of metals. This resin category includes bismaleimides (BMI's), cyanate esters, benzoxazines and polyimides. These very high temperature polymers are:

- **Thermally stable**
- **Chemically resistant and**
- **Display excellent mechanical properties**



As advanced composites continue to replace metals in more demanding high temperature applications, today's designers look to this class of resin systems to achieve design flexibility, expand possibilities and realize significant weight savings. In addition to prepregs, TenCate has a complete portfolio of high temperature adhesives, resins, syntactics and molding compounds.



# Materials Selection Guide: High Temperature

Product Name	Resin Type	T <sub>g</sub>	Cure Temp/ Cure Time	Description	Key Resin Characteristics
<b>Prepregs</b>					
<b>RS-8HT</b>	BMI	<b>545°F/285°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 400°F/204°C, post cure at 360 minutes at 482°F/250°C</li> </ul>	<ul style="list-style-type: none"> <li>RS-8HT provides excellent high temperature properties</li> <li>Moderate toughness</li> <li>Good moisture resistance</li> <li>Available in RTM resin form</li> </ul>	Fracture Toughness G1c 1.2 in-lb/in <sup>2</sup>
<b>RS-51</b>	Polyimide	<b>690°F/366°C</b>	Call for details.	<ul style="list-style-type: none"> <li>Extremely high service temperature AFRPE-4™ resins</li> <li>Ideal for jet engine parts</li> </ul>	See data sheet for details.
<b>TC420</b>	Cyanate Ester	<b>350°F/177°C or 658°F/348°C with post cure</b>	<ul style="list-style-type: none"> <li>3 hours at 350°F/177°C.</li> <li>Optional post cure at 500°F/260°C</li> </ul>	<ul style="list-style-type: none"> <li>Very high temperature service</li> <li>Good resistance to microcracking</li> <li>Out-of-autoclave processible</li> </ul>	Ultra high temperature performance used in heat shields and ablatives
<b>TC890</b>	Polyimide	<b>850°F/454°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 700°F/371°C</li> </ul>	<ul style="list-style-type: none"> <li>Very high temperature service</li> <li>Service temperature capability up to 1000°F/538°C</li> </ul>	Ultra high temperature performance used in heat shields and ablatives
<b>Film Adhesives</b>					
<b>P<sup>2</sup>Si® DS77</b>	Polyimide	<b>N/A</b>	<ul style="list-style-type: none"> <li>620-700°F / 327-371°C</li> </ul>	<ul style="list-style-type: none"> <li>Compatible with PMR-15, Avimid R, RP46 &amp; RB</li> <li>Available in paste or film form</li> <li>500-550°F/260-288°C service capable</li> </ul>	See data sheet for details.
<b>TC310 NEW</b>	Epoxy	<b>315°F/157°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 350°F/177°C</li> </ul>	<ul style="list-style-type: none"> <li>Toughened composite bonding film adhesive</li> </ul>	21 days tack life
<b>TC4015</b>	Cyanate Ester	<b>350°F/177°C or 610°F/321°C with post cure</b>	<ul style="list-style-type: none"> <li>120 minutes at 350°F/177°C</li> </ul>	<ul style="list-style-type: none"> <li>Ablative structure</li> <li>Space structure</li> <li>High temp structure</li> </ul>	14 days at 77°F/25°C
<b>Resins</b>					
<b>P<sup>2</sup>Si® NRPE</b>	Polyimide	<b>690°F/366°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 700°F/371°C</li> </ul>	<ul style="list-style-type: none"> <li>Improved AFRPE-4 with improved processing performance (able to cure under lower pressure)</li> <li>Improved hot/wet performance</li> </ul>	See data sheet for details.
<b>P<sup>2</sup>Si® T3</b>	Polyimide	<b>561°F/294°C</b>	See data sheet for details	<ul style="list-style-type: none"> <li>Developed for vacuum assisted RTM</li> <li>May be cured as low as 600°F/315°C</li> <li>No MDA</li> </ul>	See data sheet for details.
<b>P<sup>2</sup>Si® 635LM</b>	Polyimide	<b>635°F/335°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 650°F/343°C</li> </ul>	<ul style="list-style-type: none"> <li>Well balanced high temperature polyimide resin</li> <li>Cure cycles range from 600-700°F/315-371°C</li> <li>Excellent thermo-oxidative stability</li> <li>Low viscosity, non MDA resin system with performance similar to PMR-15</li> <li>Excellent for high temperature jet engine or military applications</li> </ul>	See data sheet for details.
<b>P<sup>2</sup>Si® 700LM</b>	Polyimide	<b>723°F/384°C</b>	See data sheet for details	<ul style="list-style-type: none"> <li>Thermally stable resin system</li> <li>Robust processing window</li> <li>High T<sub>g</sub> without need for postcure</li> </ul>	See data sheet for details.
<b>P<sup>2</sup>Si® 900HT</b>	Polyimide	<b>870°F/466°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 700°F/371°C</li> </ul>	<ul style="list-style-type: none"> <li>High temperature prepreg system (TC890), also available as an adhesive, resin or syntactic</li> <li>Capable of short term 816°C/1500°F usage</li> </ul>	See data sheet for details.
<b>Syntactics</b>					
<b>SF-4</b>	BMI	<b>563°F/295°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 400°F/204°C and 360 minutes at 452°F/250°C</li> </ul>	<ul style="list-style-type: none"> <li>Compatible with RS-8HT and other BMI systems</li> </ul>	Low density syntactic film 39 pcf (0.62 g/cc)
<b>TCF4001 NEW</b>	Cyanate Ester (Syntactic Foam)	<b>350°F/177°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 350°F/177°C</li> <li>Optional post cure of 60-90 minutes at 450°F/232°C</li> </ul>	<ul style="list-style-type: none"> <li>Compatible with TC420</li> <li>Cyanate ester syntactic foam</li> <li>Packed or injected into tooling cavities and can also be extruded with the proper tooling</li> </ul>	Low density syntactic film 24 pcf (0.38 g/cc)
<b>TCF4050</b>	Cyanate Ester (Core Splice)	<b>350°F/177°C</b>	<ul style="list-style-type: none"> <li>120 minutes at 350°F/177°C</li> <li>Optional post cure of 60-90 minutes at 450°F/232°C</li> </ul>	<ul style="list-style-type: none"> <li>Expanding syntactic film (core splice)</li> <li>Tensile strength up to 500°F/260°C</li> <li>Compatible with TC420 prepreg resin systems</li> </ul>	Low density syntactic film 22-26 pcf (0.35-0.42 g/cc)



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[WWW.TENCATE.COM/HighTemp](http://WWW.TENCATE.COM/HighTemp)

#### PRODUCTS

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

#### QUALIFICATIONS

- ISO 9001
- AS 9100

Burlington - Ontario, Canada

Fairfield - California, United States

Morgan Hill - California, United States

Camarillo - California, United States

Nottingham, United Kingdom

Nijverdal, the Netherlands

Guangzhou, China

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