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TECHNICAL INFORMATION

RESINS

CARBON TEXTILE

PREPREGS

ADHESIVES

TOOLING

Company

About us

ITECMA produces carbon composite materials for the most demanding industries, including **aerospace**. Our specialty is high-quality structural polymer resins for a wide range of temperatures from -100 to + 450 °C. We also produce carbon fabrics, prepregs, as well as a system of adhesives and fillers to create three-layer honeycomb laminates. Our new direction of development is composite tooling.

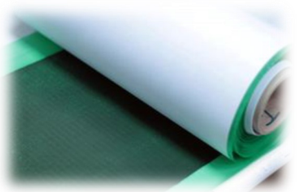
Our mission is to provide customers with **world-class materials** and **technical support** for the rapid and effective implementation of composite technologies in products. We created a special design and calculation department to support our customers' designers and a technical support department to assist in the manufacture of products at customer sites.

Our scientific base and developer of materials is the well-known private research company "Institute of New Carbon Materials and Technologies". INCMaT is established jointly with Department of chemistry of Lomonosov Moscow State University. INCMaT has its own production laboratories and test center, which occupy more than 1000 sqm. More than 30% of the company's employees are PhD and Dr. degree. The achievements of the working team are more than 150 publications and 50 patents.

Products and Solutions

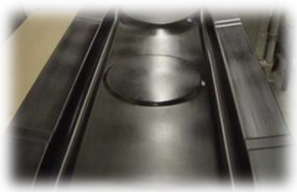
Vacuum infusion

Resins
binders,
carbon fabrics
UD tapes



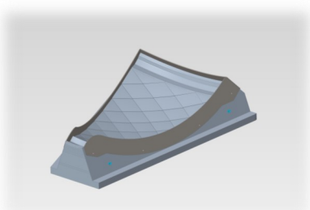
Prepregs

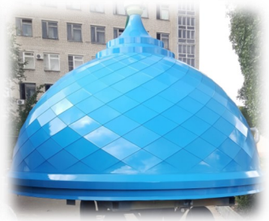
Epoxy
Out-of-autoclave
BMI
Phtalonitrile



Materials for tooling

Epoxy Resins
Carbon fabrics
BMI prepregs
Phtalonitrile resins

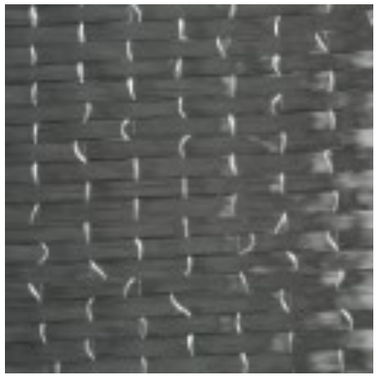




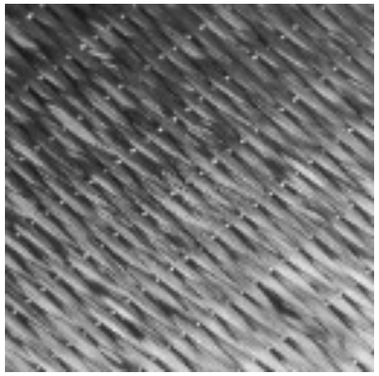
Turn-key tooling

Warp distortion calculations
Design
Manufacturing

Carbon textile

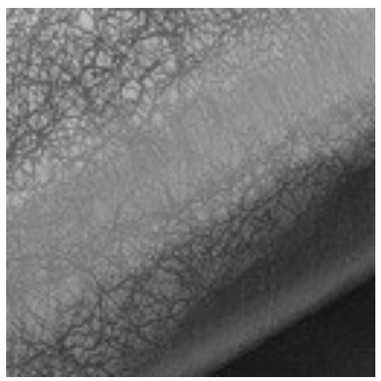


Carbon fabrics and tapes are produced from carbon fiber and they are meant to be used as reinforcing filler in composites. Carbon fiber Carbon fiber has a specific strength of 8-17 times, and the modulus of elasticity is 5-13 times higher than steel, aluminum and titanium. The thermal expansion coefficient of carbon fiber is 15-20 times lower than that of steel and aluminum. The high thermal stability of carbon fibers allows them to be used as thermal insulation and thermal screens: up to 2000°C in an inert atmosphere, up to 450°C in the air. Carbon fiber has good corrosion resistance to gas and liquid media in comparison with steel.



We manufacture our carbon fabrics from fibers of leading global producers such as TORAY (Japan), Formosa (Taiwan) and UMATEX (Russia). The most popular brands fabrics are always at depot, but we can also make a batch from any fiber available on the market to your order.

CARBON TAPES have better mechanical characteristics than the fabric in the direction along the fibers, due to the absence of kinks during weaving. Therefore, carbon tapes are suitable for power structures experiencing high loads in one direction, for example, for the wing spar of an airplane.

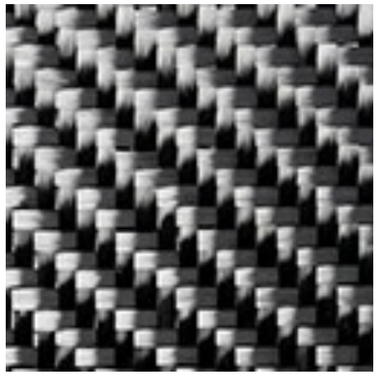


Benefits:

- Possible to produce carbon tapes with a width of 300 to 1500 mm;
- Possible to produce carbon tapes with a density of 90-1200 g/m2.
- Unidirectional TENZOCHEM tapes designed specifically for application in construction
- Non-woven tape with a veil for increased crack resistance and impact resistance

When choosing **CARBON FABRICS**, the following characteristics should be considered:

- Fiber brand: mechanical characteristics of the fabric depend on it, such as strength and modulus of elasticity;
- Drapeability: important in the manufacture of parts with a complex shape;
- Drapeability: important in the manufacture of parts with a complex shape;
- Mechanical characteristics: it is important to take into account the fiber brand, as well as the direction and degree of load on the part;
- Stability of the fabric: determines the uniformity of mechanical properties throughout the area and the convenience of working with the fabric.



Benefits:

- Fabrics with any weaving (plain, twill, satin)
- Possible to make a fabric with a binder. This fabric is used for particularly critical products and does not require the use of temporary fixation glue, which, when applied excessively, affects the mechanical characteristics of the part. On request, it is possible to apply a binder to any type of fabric;
- Fabrics width - from 300 to 1500 mm;
- Fabrics with density of 90 to 1200 g/m2;
- 1K, 1,5K, 3K, 6K, 12K, 24K, 48K fibers.

Resins

The polymeric matrix (resin) allocates the load between the fibers of the reinforcing filler. The resin is responsible for composite specifications, such as mechanical strength especially the shear and compression strength, operating temperature and moisture absorption.

The major specification of a resin is its processability - the operability in manufacturing. The processability of a resin is described by an impregnation temperature, viscosity at the infusion moment, pot life and a temperature of pre- and post-curing. Processability is a main goal for ITECMA

The line of ITECMA resins is well balanced for various applications, operating temperatures and methods of manufacturing (like vacuum infusion, RTM, winding and manual lamination).

Application	Type	Details
General use, room temperature cure	T20-60	Best value resin for moderate-loaded parts and low temperature applications (up to 70° C). Cure at room temperature.
	TK123	Higher mechanical characteristics, applications up to 90°C. Cure at room temperature.
Demanding applications	T26	High mechanical characteristics for load-carrying structures (T≤150°C, spars, ribs and so on)
Tooling	TO-200	High-temperature tooling, up to 180°C. Tracking of infusion process in UV light.
	TO-29-2	High-temperature tooling, up to 190°C. Super low viscosity for bulky parts. Tracking of infusion process using UV light.
High temperature	SB 332	High mechanical characteristics for high-temperature applications up to 250 °C.
	PN-3M	For extremely hi-temperature applications (up to 450 °C) with epoxy like processability. Incombustible.

Prepreg systems

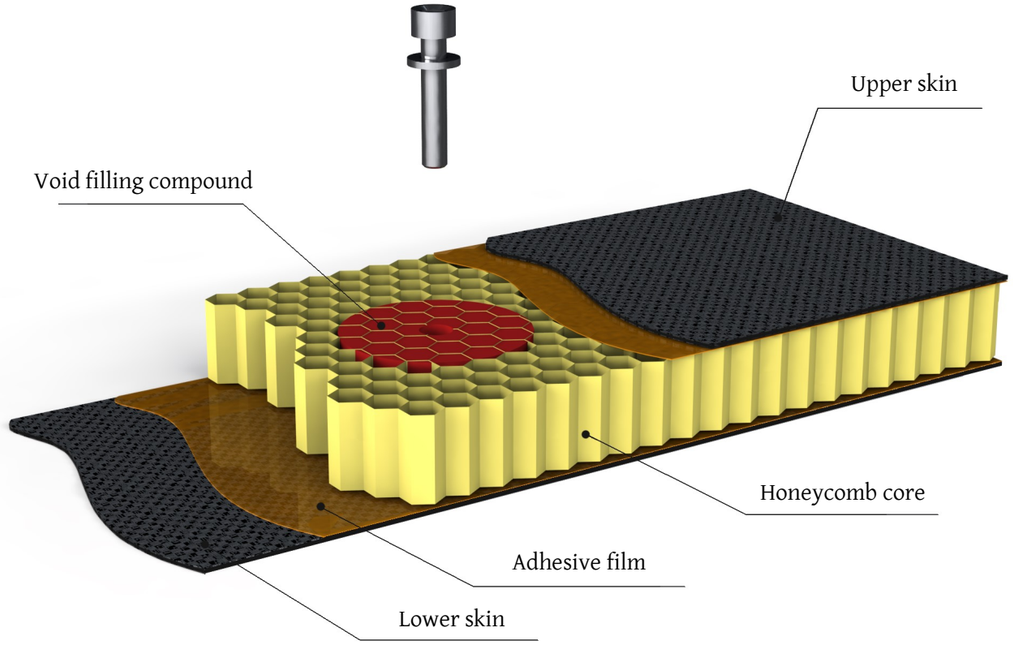
Pre-preg is "pre-impregnated" composite fibers where a thermoset polymer matrix material, such as epoxy, is already present. The fibers often take the form of a weave and the matrix is used to bond them together and to other components during manufacture. The thermoset matrix is only partially cured to allow easy handling; this B-Stage material requires cold storage to prevent complete curing. B-Stage pre-preg is always stored in cooled areas since heat accelerates complete polymerization. Hence, composite structures built of pre-pregs will mostly require an oven or autoclave to cure.

Type	Operation temperature	Resin
Autoclave prepreg T107	120°C	Epoxy
OoA prepreg B180	120°C	Epoxy
Autoclave prepreg PSB250	200°C, briefly 250°C	BMI
OoA prepreg PPN350	300°C, briefly up to 450°C, incombustible	Phthalonitrile

Except prepregs, ITECMA produces systems for three-layer structures:

- Thixotropic adhesive;
- Low temperature adhesive film;
- High temperature adhesive film;
- High temperature syntactic compound.

Each adhesive film has a foaming version.



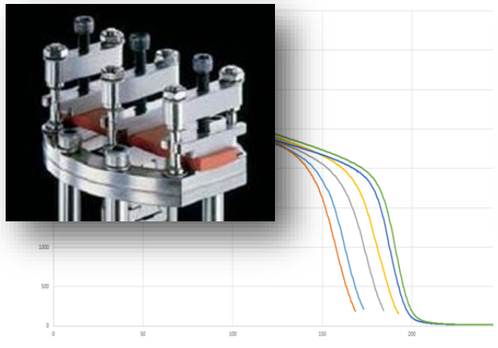
Tooling

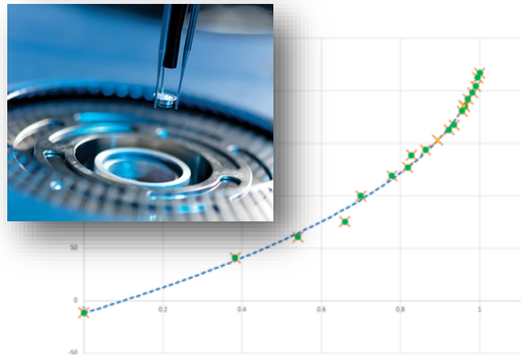
Design of warp distortion compensated tooling

Nominal shape tooling lead to significant distortions in highly-curved composite parts.
We eliminate warp distortions by introducing a new concept of tooling design.

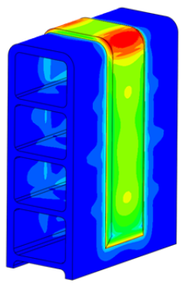
Step 1 – Material model preparation

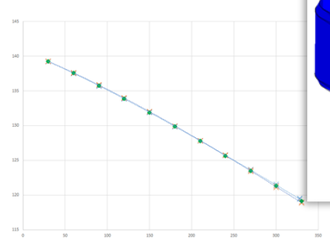
Experimental measurements
are required to determine resin and ply characteristics that are the main causes of warpage.

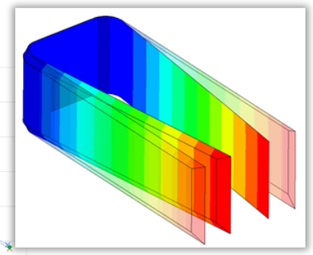




Model calibration
the U-shape samples are used to obtain precise mechanical solutions for the given material system.

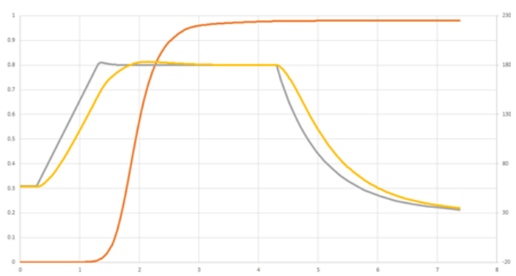


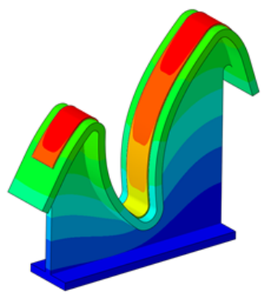




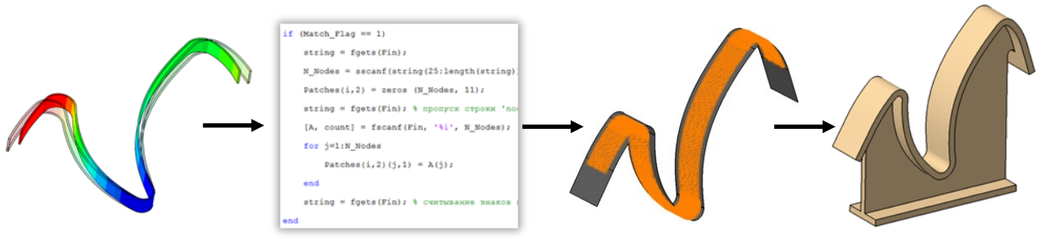
Step 2 – Optimizing the tooling shape

Solution of thermal problem
gives distribution of temperature and degree of cure within the part which are required for mechanical calculations





Mechanical model
accounts for state-dependent part-to-tooling contact interaction and correctly deals with the liquid state of resin which is no more an issue.



Tooling shape optimization procedure
involves in-house software for point cloud processing that gives connection from FEA to CAD.

Step 3 – Design documentation and manufacturing

Epoxy Resin T20-60

ITECMA

Technical Data Sheet

T20-60 is a two-part low viscosity epoxy infusion resin developed for mass CFRP production. The resin offers simple and flexible processing due to low viscosity and room temperature impregnation. T20-60 was developed specially for vacuum infusion molding, to produce laminates with low porosity and optimal mechanical performance.

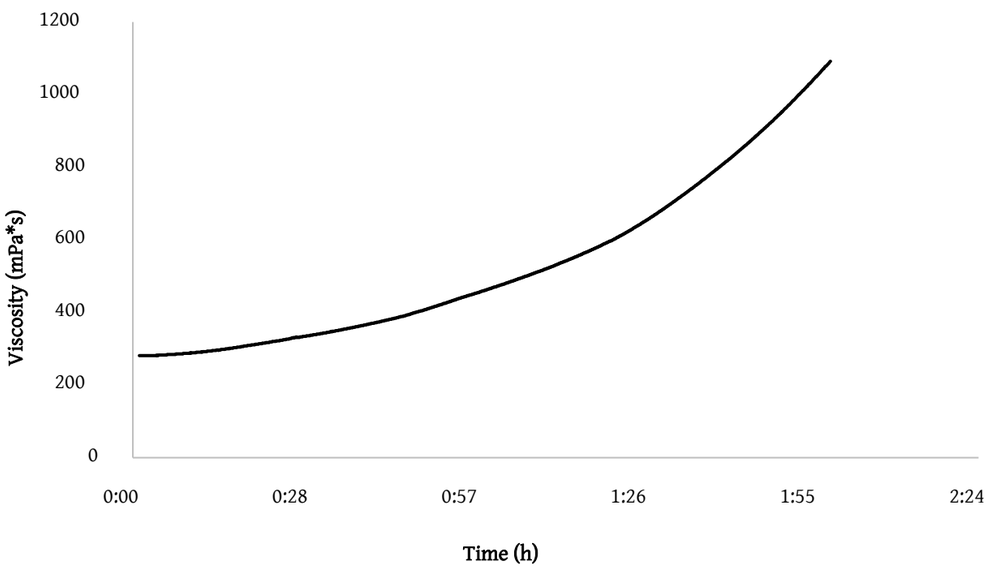
Features & Benefits

- Two-part resin system for vacuum infusion and RTM
- Wide processing window > 2 hours at 25°C
- Curing at room temperature
- Low exotherm
- High crack resistance
- Optimal price/quality ratio

Neat resin characteristics

Tensile strength, MPa	ASTM D638	80
Tensile modulus, GPa	ASTM D638	3.2
Flexural strength, MPa	ASTM D790	155
Fracture toughness, K_{IC}, MPa·m$^{1/2}$	ASTM D5045	0.763
Strain energy release, G_{IC}, J/m^2	ASTM D5045	386
Dry glass transition temperature, Tg, °C	ASTM E2092	87
Density, g/cm^3	ASTM D792	1.273

Viscosity Data



Recommended processing parameters

ITECMA

- Mix the components A and B and weight proportion 100:32.
- Degas the resin with intensive mixing for 15-20 minutes at 20-25 °C.
- Maintaining resin pot temperature of 20-25°C and tool temperature of 20-25°C, begin resin infusion.
- Cure at room temperature for 24h.
- Make sure the resin is gelled.
- Remove auxiliary materials.
- Increase temperature at rate 0,5-2°C/min to 80°C.
- Postcure at 80°C for 3-6h.

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on T20-60 resin and carbon fabric 22502 (twill 2x2, 200 g/m2, HTA40-3K, 3.95 GPa)

Tensile strength 0°σ_{11}^{+}, MPa at 25°C	ASTM D3039	777
Tensile modulus 0°E_{11}^{+}, GPa at 25°C	ASTM D3039	61
Compression strength 0° σ_{11}^{-}, MPa at 25°C	ASTM D6641	583
Compression strength 0° σ_{11}^{-}, MPa at 80°C	ASTM D6641	460
Compression modulus 0° E_{11}^{-}, GPa at 25°C	ASTM D695	61
Compression modulus 0° E_{11}^{+}, GPa at 80°C	ASTM D695	56
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	58
Shear strength τ_{13} , MPa at 80°C	ASTM D2344	36
Shear strength τ_{12} , MPa at 25°C	ASTM D5379	110
Shear strength τ_{12} , MPa at 80°C	ASTM D5379	56
Shear modulus G_{12} , GPa at 25°C	ASTM D5379	4.1
Shear modulus G_{12} , GPa at 80°C	ASTM D5379	2.5

Suggested application

- Wind turbine blades
- Construction
- High-pressure cylinders
- Sports and leisure
- Design
- Room temperature tooling

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Epoxy Resin TK123

ITECMA

Technical Data Sheet

TK123 is a two-part low viscosity epoxy infusion resin developed for tooling up to 120°C, or CFRP parts with sustainable properties up to 90°C. The resin offers simple and flexible processing due to low viscosity at room temperature (lower than 500 mPa*s at 25°C). TK123 was developed specially for vacuum infusion molding, to produce laminates with low porosity and good mechanical performance.

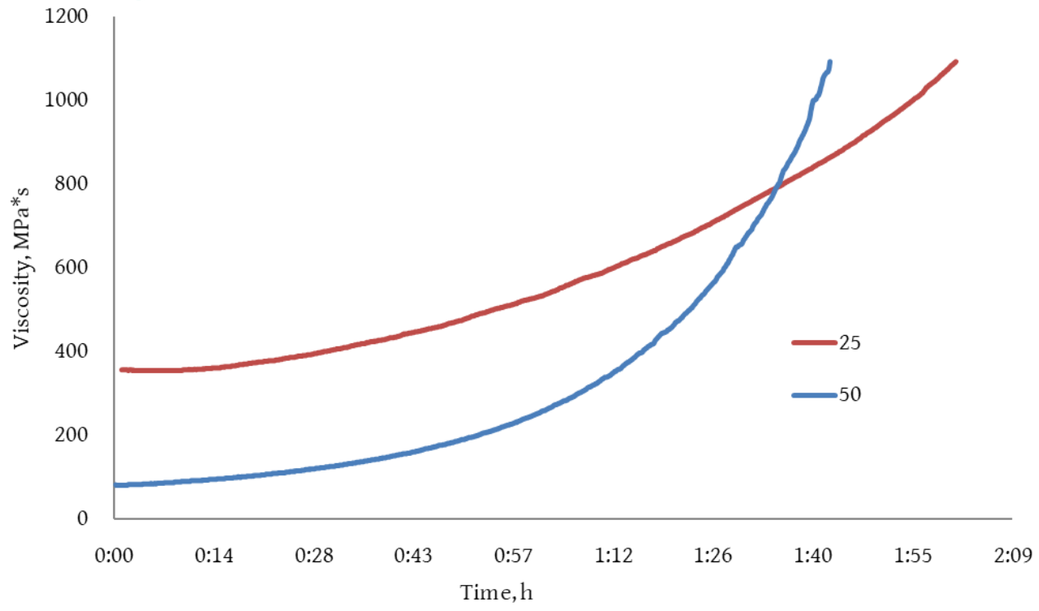
Features & Benefits

- Two-part resin system for vacuum infusion and RTM
- Wide processing window > 2 hours at 25°C
- Curing at room temperature
- Low exotherm
- High mechanical properties.
- For tooling up to 120°C

Neat resin characteristics

Tensile strength, MPa	ASTM D638	80
Tensile modulus, GPa	ASTM D638	3.56
Flexural strength, MPa	ASTM D790	161
Fracture toughness, K_{IC}, $MPa{\cdot}m^{1/2}$	ASTM D5045	0.964
Strain energy release, G_{IC}, J/m^2	ASTM D5045	393
Dry glass transition temperature, Tg, °C	ASTM E2092	101
Density, g/cm^3	ASTM D792	1.137

Viscosity Data



Recommended processing parameters

ITECMA

- Thoroughly mix components A and B at 25 ° C in a 1: 0.434 weight ratio. The error in the dosage of components should not exceed 2%. Particular attention should be given to mixing at the walls and bottom of the mixing tank. It is recommended to use devices with automatic mixing and mix under vacuum.
- Degas the resin with intensive mixing for 15-30 minutes at 20-25 °C, pressure no more than 10 mbar.
- Assemble vacuum bag. Perform a leak test, the rate of the vacuum loss should not be more than 1 mbar per minute. The residual pressure in the bag must not be more than 10 mbar. Assemble the second vacuum bag, between the layers of the vacuum film airweave should be laid . Carry out a leak test of the second vacuum bag. The residual pressure in the bag must not be more than 10 mbar.
- Maintain temperature at 25-40°C. The recommended impregnation temperature is 25-35°C. It is recommended to preliminarily dry the reinforcing material in vacuum bag at 60-80 ° C for at least 1 hour.
- Maintaining the temperature of the mold at 25-35°C, start the infusion process;
- After complete impregnation, close the resin inputs, continue evacuation from inner bag for at least 30 minutes at 25-40 ° C.
- Close the outputs from the inner bag. Continue evacuation from outer vacuum bag until gelation (~ 24 h at 25°C). After 48-72 hours, you can remove the part from the mold and post-cure without mold.

Post-cure:

- Increase the temperature at a rate of 2°C/h to 80°C; keep it at 80°C for 6 hours;
- Curing is allowed immediately after the impregnation process without being removed from the mold. Increase the temperature at a rate of 2°C/min to 80°C; exposure at 80°C for 6 hours.
- Before removing the part, cool the tooling to at least 50°C at a speed of no more than 5°C/min.
- Curing (heating rate 2°C/min) or post-curing (heating rate 2°C/h) to 120°C is permissible to obtain a glass transition temperature of 140°C.

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on TK123 resin and carbon fabric 22502 (twill 2x2, 200 g/m2, 3K, 3.95 GPa)

Tensile strength 0°σ_{11}^{+}, MPa at 25°C	ASTM D3039	787
Tensile modulus 0°E_{11}^{+}, GPa at 25°C	ASTM D3039	62
Compression strength 0° σ_{11}^{-}, MPa at 25°C	ASTM D6641	564
Compression modulus 0° E_{11}^{-}, GPa at 25°C	ASTM D695	62
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	66
Shear strength τ_{12} , MPa at 25°C	ASTM D5379	79
Shear modulus G_{12} , GPa at 25°C	ASTM D5379	4.3

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Epoxy Resin TO200

Technical Data Sheet

TO200 is a two-part epoxy resin with unique characteristics, combining high heat resistance, strength and processability. The impregnation temperature is 20-25°C. Flexible curing mode in combination with post-curing allows achieving the required heat resistance at the minimum curing temperature. The resin can be used for manufacturing CFRP or GFRP with sustainable properties up to 120°C, or for composite tooling with service temperatures up to 180 ° C.

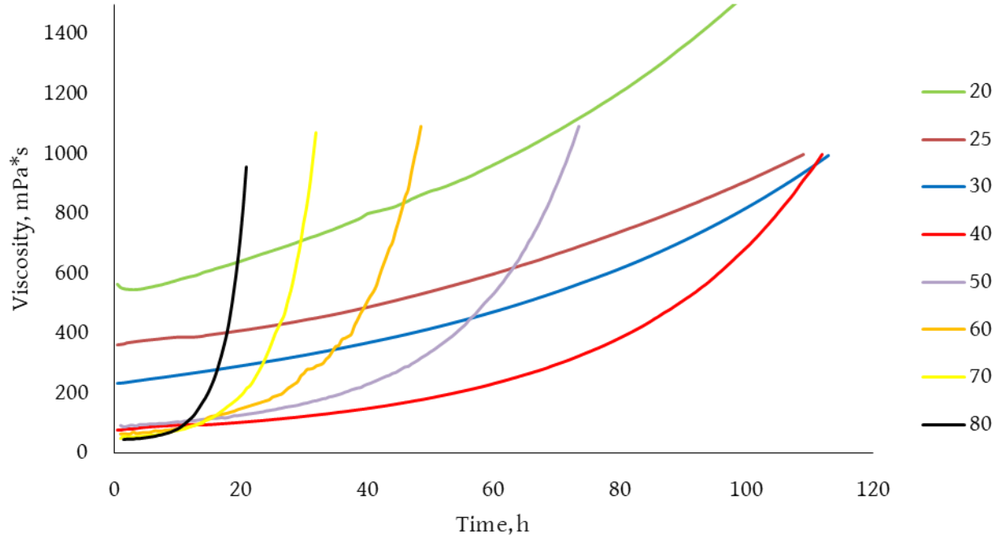
Features & Benefits

- Wide processing window > 2 hours at 25°C
- Curing at room temperature
- Tracking of infusion process under UV light
- Low exotherm
- High mechanical properties.
- For tooling up to 200°C

Neat resin characteristics

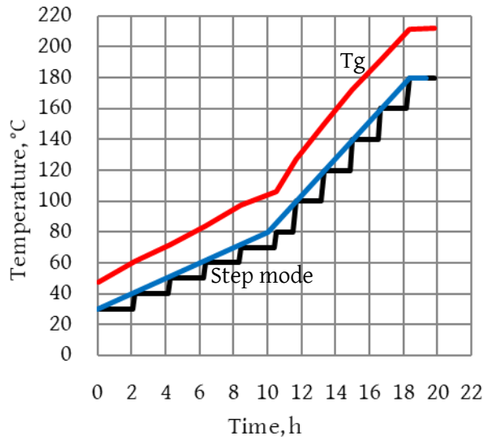
Tensile strength, MPa	ASTM D638	60
Tensile modulus, GPa	ASTM D638	3.26
Flexural strength, MPa	ASTM D790	94
Fracture toughness, K_{IC}, MPa·$m^{1/2}$	ASTM D5045	0.639
Strain energy release, G_{IC}, J/m^2	ASTM D5045	223
Dry glass transition temperature, Tg, °C	ASTM E2092	211
CTE, K^{-1}	ASTM E831	87•10^{-6}
Density, g/cm^3	ASTM D792	1.147

Viscosity Data



Recommended processing parameters

- Thoroughly mix components A and B at 25 ° C in a 1: 0.4388 weight ratio.
  It is recommended to use devices with automatic mixing and mix under vacuum.
- Degas the resin with intensive mixing for 15-30 minutes at 20-25 °C, pressure no more than 10 mbar.
- Assemble vacuum bag. Perform a leak test, the rate of the vacuum loss should not be more than 1 mbar per minute. The residual pressure in the bag must not be more than 10 mbar. Assemble the second vacuum bag. Carry out a leak test of the second vacuum bag with same conditions.
- The recommended impregnation temperature is 25°C. It is recommended to preliminarily dry the reinforcing material in a vacuum bag at 60-80°C for at least 1 h or 6 h at 25°C. Maintaining the temperature of the mold at 20-30°C, start the infusion process;
- After complete impregnation, close the resin inputs, continue evacuation from inner bag for at least 30 minutes at 25-40 ° C.
- Close the outputs from the inner bag. Continue evacuation from outer vacuum bag until gelation (~ 24 h at 25°C). After 48-72 hours, you can remove the part from the mold and post-cure.



Post-cure:

- Increase the temperature at a rate of 5°C/h to 80° C; then at rate 10-15°C/h to 180°C, dwell for 1 hour; (or with step mode same as in picture)
- Highest mechanical properties of CFRP are achieved at a temperature of 80-120°C. When cured at higher temperatures, a higher heat resistance is achieved with a slight fall in the mechanical characteristics of the CFRP

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on TO200 resin and carbon fabric 22502 (twill 2x2, 200 g/m2, 3K, 3.95 GPa)

Tensile strength 0°σ_{11}^{+}, MPa at 25°C	ASTM D3039	814
Tensile modulus 0°E_{11}^{+}, GPa at 25°C	ASTM D3039	61
Compression strength 0° σ_{11}^{-}, MPa at 25°C	ASTM D6641	602
Compression modulus 0° E_{11}^{-}, GPa at 25°C	ASTM D695	59
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	65
Shear strength τ_{13} , MPa at 80°C	ASTM D2344	48
Shear strength τ_{13} , MPa at 120°C	ASTM D2344	34
Shear strength τ_{12} max (5%), MPa at 25°C	ASTM D5379	113(82)
Shear modulus G_{12} , GPa at 25°C	ASTM D5379	3.34

Tooling Resin TO-29-2

Technical Data Sheet

TO-29-2 is a two part low viscosity epoxy infusion resin developed for high temperature complex shape composite tooling. TO-29-2 offers simple and flexible processing due to low viscosity at low impregnation temperature (25°C). Pre-curing at room temperature allows to remove composite tool from plastic model. Post-curing at 200°C provides service temperature of tool up to 220°. Self-heating time of 500g from 20°C to 60°C is more than 8 hours.

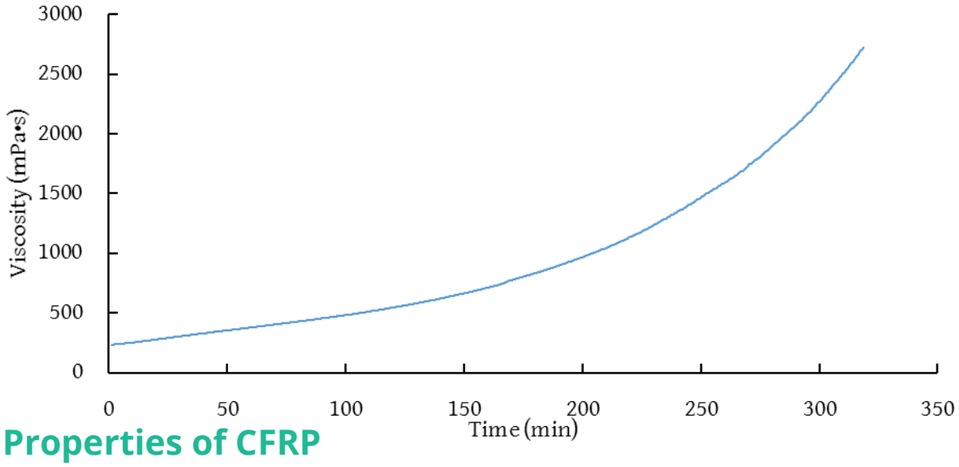
Features & Benefits

- Wide processing window > 4 hours at 25°C
- Tracking of infusion process under UV light
- Pre-curing at room temperature
- Glass transition temperature 220°C
- Low moisture saturation

Neat resin characteristics

Tensile strength, MPa	ASTM D638	56
Tensile modulus, GPa	ASTM D638	3.6
Dry glass transition temperature, Tg, °C	ASTM E1640	220
CTE, K^{-1}	ASTM E831	$79 \cdot 10^{-6}$
Density of uncured resin, g/cm^3	ASTM D792	1.096
Density of cured resin, g/cm^3	ASTM D792	1.158
Moisture absorption, % (54h, boiling water)		3.22

Viscosity Data



Properties of CFRP

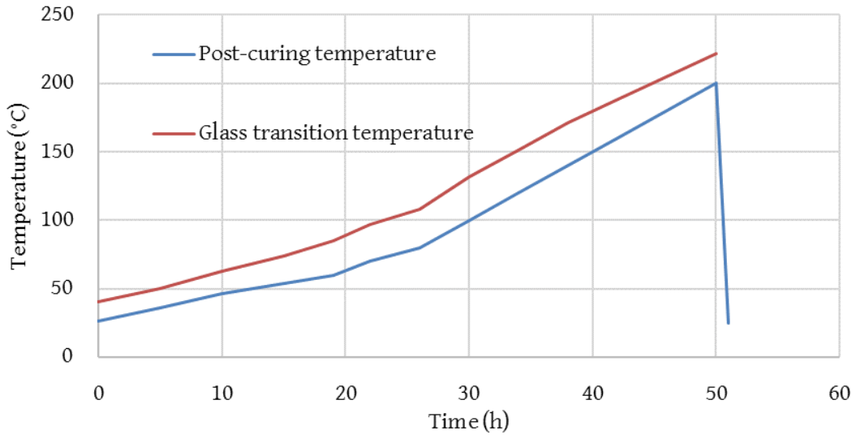
Samples for testing were obtained by vacuum infusion based on TO-29-2 resin and carbon fabrics 22502 (twill 2x2, 200 g/m2, 3K, 3,95 GPa)

Shear strength τ_{13}, MPa	ASTM D2344	47
CTE in XY direction, K^{-1}, 12K fiber	ASTM E831	$1.8\text{-}2.9 \cdot 10^{-6}$
CTE in XY direction, K^{-1} , 24K fiber	ASTM E831	$1.4\text{-}2.4 \cdot 10^{-6}$

Recommended processing parameters

- Assemble the vacuum bag. Perform a leak test, the rate of the vacuum drop should not be more than 1 mbar per minute. The residual pressure in the bag must not be more than 10 mbar. Assemble the second vacuum bag, put airweave material between the layers of the vacuum film. Perform a leak test for the second vacuum bag. The residual pressure in the bag must not be more than 10 mbar.
- Thoroughly mix components A and B at 25°C in a weight ratio of 100: 58.3. The error in the dosage of components should not exceed 2%. Particular attention should be paid to mixing at the walls and bottom of the mixing tank. It is recommended to use devices with automatic mixing and mix under vacuum.
- Degas for 15-30 minutes, at a pressure of no more than 10 mbar. During the degassing, the resin should be stirred intensively.
- Maintain a temperature of 20-25°C indoors. The recommended impregnation temperature is 25°C. It is also recommended to dry the reinforcing material in a vacuum bag for at least 3 hours.
- Maintaining the temperature of the mold at 20-25°C, start the infusion process.
- After complete impregnation of the bag, close the resin inputs, but continue evacuation from the inner bag for at least 30 minutes.
- Close the outputs from the inner bag.
- Continue evacuation from outer vacuum bag until gelation (~ 24h at 25°C). After 48-72 hours, you can remove tool from the master model and post-cure without auxiliary materials.
- It is recommended to use a quasi-isotropic layouts for tooling. The recommended thickness of the tooling is not less than 5mm. Particular attention should be given to the stiffeners.
- It is not recommended to mix more than 25kg in same container.
- For the measurement of vacuum, the use of absolute pressure sensors is recommended.
- UV lamp can be used for resin front tracking.

Post-cure



- Heat up to 70°C at rate < 2°C/hour.
- Heat up to 70 to 190-200 ° C at rate of 5°C/h.
- Hold at 200°C for 1 hour.
- Cool to room temperature no faster than 5°C/min.

Tooling Resin SB322

Technical Data Sheet

SB322 is a one part low viscosity bismaleimide infusion resin developed for high temperature composite tooling with service temperature up to 250°C. The resin is characterized by low viscosity at impregnation and molding temperatures (200 cP at 100 ° C), which makes it possible to obtain CFRP with low porosity. Pre-curing at 190 °C allows to remove composite tool from plastic model. Post-curing at 230°C provides service temperature of tool up to 250°.

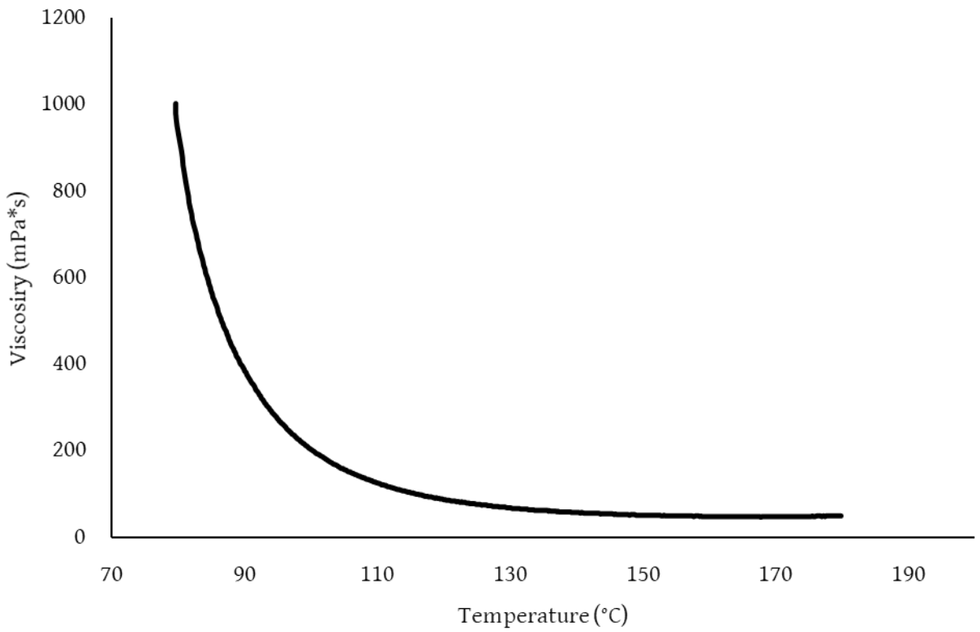
Features & Benefits

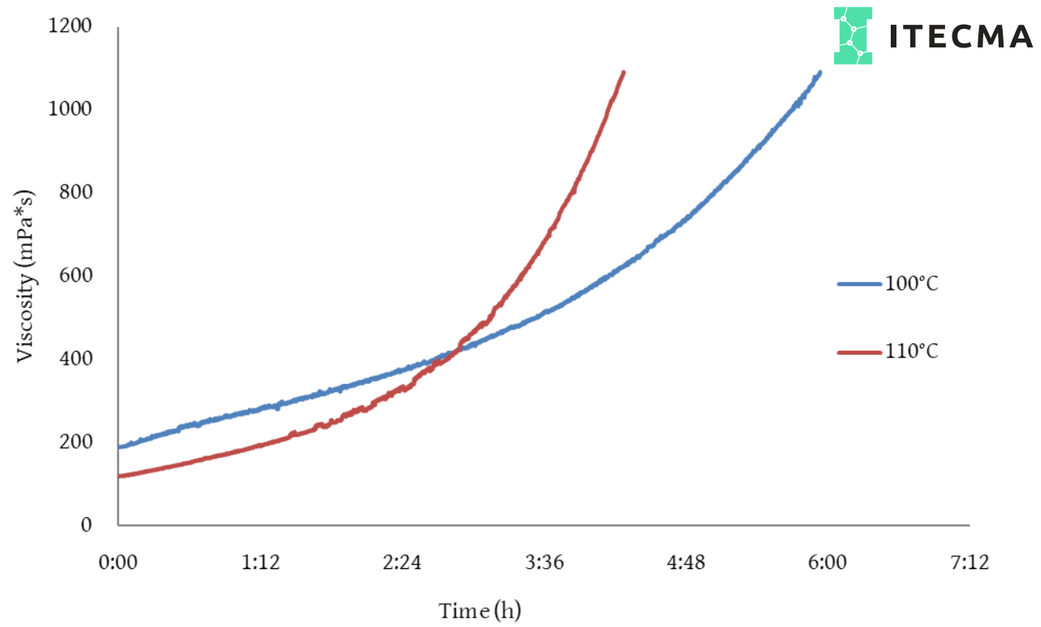
- Wide processing window > 3 hours at 110°C
- Pre-curing at 190°C
- Post-curing at 230°C
- Glass transition temperature 270°C
- Low Coefficient of Thermal Expansion

Neat resin characteristics

Tensile strength, MPa	ASTM D638	82
Tensile modulus, GPa	ASTM D638	3.9
Dry glass transition temperature, Tg, °C	ASTM E1640	270
CTE, K^{-1}	ASTM E831	$1.5 \cdot 10^{-6}$
Fracture toughness, K_{IC}, $MPa \cdot m^{1/2}$	ASTM D5045	0.780
Strain energy release, G_{IC}, J/m^2	ASTM D5045	165
Moisture absorption, % (60h, boiling water)		4.78

Viscosity Data





Recommended processing parameters

- Assemble the vacuum bag. Perform a leak test, the rate of the vacuum drop should not be more than 1 mbar per minute. The residual pressure in the bag must not be more than 10 mbar. Assemble the second vacuum bag, put airweave material between the layers of the vacuum film. Perform a leak test for the second vacuum bag. The residual pressure in the bag must not be more than 10 mbar.
- Degas for 20-30 minutes, at 100-120°C, at a pressure of no more than 10 mbar. During the degassing, the resin should be stirred intensively.
- It is also recommended to dry the reinforcing material in a vacuum bag for at least 6 hours.
- Heat the mold up to 100-110 ° C (in case of complex geometry or unidirectional parts, it is possible to increase the temperature of the tooling to 120°C);
- Maintaining the temperature of the mold 100-110°C and the temperature of resin dispenser at 100°C, start the infusion process.
- After complete impregnation of the bag, close the resin inputs, but continue evacuation from the inner bag for at least 30 minutes.
- Close the outputs from the inner bag.
- Maintain the outer vacuum bag until the end of curing process.
- Increase the temperature at a rate of 2°C/min to 160°C. Dwell at 160°C for 3 hours ; heat to 190°C at a rate of 2°C/min; dwell at 190°C for 3 hours.
- It is possible to heat up to 190°C without exposure at 160°C, in the case that the auxiliary materials and mold materials withstand such conditions.
- Before removing the part, cool the mold to at least 90°C at a speed of no more than 5°C/min.
- Post-cure can be performed without mold. Heat to 180°C at a rate of 2°C/min, from 180°C to 230°C, heat to 190°C at a rate of 0.5°C/min; dwell 5 hours at 230°C. Do not cool faster than 5°C/min.
- It is recommended to use a quasi-isotropic layouts for tooling. The recommended thickness of the tooling is not less than 5mm. Particular attention should be given to the stiffeners.
- For the measurement of vacuum, the use of absolute pressure sensors is recommended.

Structural epoxy resin T26

ITECMA

Technical Data Sheet

T26 is a single part low viscosity epoxy infusion resin developed for high-loaded structures. T26 offers simple and flexible processing due to low viscosity at relatively low impregnation temperatures (110°C). T26 was developed specially for RTM and vacuum infusion molding, to produce laminates with low porosity and extremely high mechanical performance, especially in crack resistance.

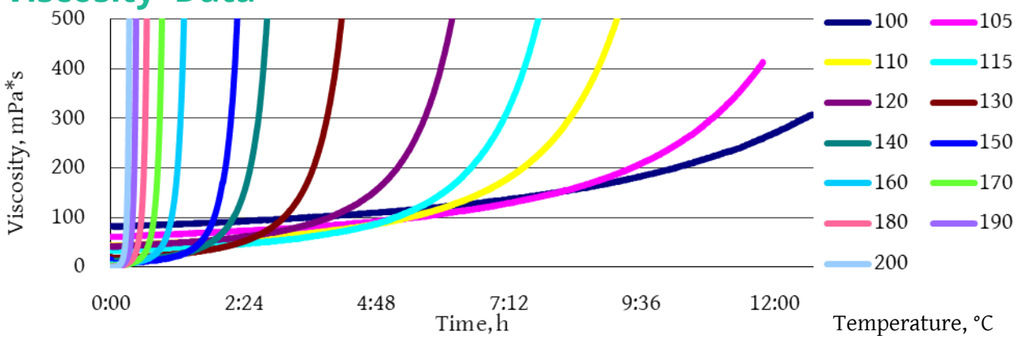
Features & Benefits

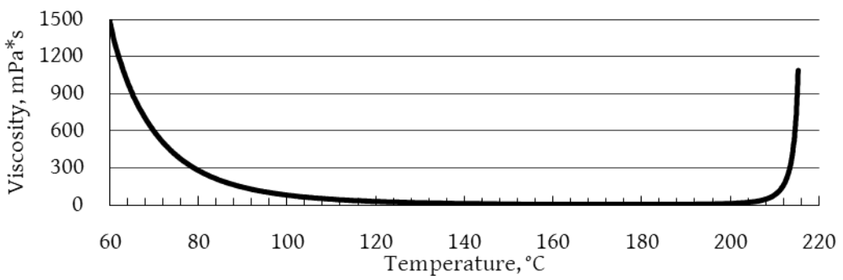
- One-part resin designed specifically for high-temperature infusion or RTM.
- Wide processing window > 7 hours at 110°C
- Curing at 180°C provides glass transition temperature of 205°C
- High wet glass transition temperature —172°C
- Very high resistance to impact.
- Operating temperatures from –60°C to 150°C

Neat resin characteristics

Tensile strength, MPa	ASTM D638	95
Tensile modulus, GPa	ASTM D638	3.1
Elongation at break, %		4-7,2
Flexural strength, MPa	ASTM D790	152
Dry glass transition temperature, Tg, °C	ASTM E1640	202
Fracture toughness, K_{IC}, MPa·$m^{1/2}$	ASTM D5045	0.624
Strain energy release, G_{IC}, J/m^2	ASTM D5045	188
CTE, K^{-1}	ASTM E831	$72 \cdot 10^{-6}$
Density, g/cm^3	ASTM D792	1.17
Moisture absorption, % (54h, boiling water)		1.6

Viscosity Data





Recommended processing parameters

ITECMA

- Preheat the resin to 60-90 °C in its container for transfer to the resin pot.
- Degas the resin for 30-40 minutes while heating to 90 °C.
- Preheat the tool to 100-110 °C (or to 115 - 120°C for parts having complex shape or for UD parts);
- Maintaining resin pot temperature of 95 °C and tool temperature of 100-115 °C, begin resin infusion;
- After complete impregnation increase tool temperature at 2°C/min to 180 °C. Dwell at 180 °C for 3 h
- Cool the tool to 90°C at < 5 °C/min before releasing part from tool.

Properties of CFRP

FABRICS: Samples for testing were obtained by vacuum infusion based on T26 resin and carbon fabric (CF) 22508 (sateen 8H, 200 g/m2, 3K, 3.95 GPa) or plasticized carbon fabric (PCF) 22508 covered by veil.

Properties and conditions	Test method	CF	PCF
Tensile strength 0°σ_{11}^{+}, MPa at 25°C	ASTM D3039	910	904
Tensile strength 90°σ_{22}^{+}, MPa at 25°C	ASTM D3039	881	904
Tensile modulus 0°E_{11}^{+}, GPa at 25°C	ASTM D3039	65	66
Tensile modulus 90°E_{22}^{+}, GPa at 25°C	ASTM D3039	66	66
Compression strength 0° σ_{11}^{-}, MPa at 25°C	ASTM D6641	643	638
Compression strength 90° σ_{22}^{-}, GPa at 25°C	ASTM D6641	679	608
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	74	66
Shear strength τ_{13} , MPa at 120°C	ASTM D2344	51	40
Shear strength τ_{13} , MPa at 150°C	ASTM D2344	45	34
Shear strength τ_{12} , MPa at 25°C	ASTM D3518	84	79
Shear modulus G_{12} , GPa at 25°C	ASTM D3518	4.5	4.3
Compression after impact 6.67 J/mm, MPa	ASTM D7137	225	301
Delamination area, mm^2		679	483
G_{IC}, kJ/m^2	ASTM D5528	0.4-0.5	0.8-2.8

UD TAPES: Samples for testing were obtained by vacuum infusion based on T26 resin and UD tape covered by veil 11424 (200 g/m2, 12K, 4.5 GPa/240 GPa)

Tensile strength 0°σ_{11}^{+}, MPa	ASTM D3039	1886
Compression strength 0° σ_{11}^{-}, MPa at 25°C	ASTM D6641	1210
Compression strength 0° σ_{11}^{-}, MPa at 80°C	ASTM D6641	920
Compression strength 0° σ_{11}^{-}, MPa at 120°C	ASTM D6641	772
Compression strength 0° σ_{11}^{-}, MPa at 150°C	ASTM D6641	691
Tensile strength 90° σ_{22}^{+}, MPa	ASTM D3039	59
Compression strength 90° σ_{22}^{-}, MPa	ASTM D6641	166
Tensile modulus 0° E_{11}^{+}, GPa	ASTM D3039	108
Tensile modulus 90° E_{22}^{+}, GPa	ASTM D3039	7,0
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	69
Shear strength τ_{13} , MPa at 80°C	ASTM D2344	46
Shear strength τ_{13} , MPa at 120°C	ASTM D2344	34
Shear strength τ_{13} , MPa at 150°C	ASTM D2344	28
Shear strength τ_{12} , MPa	ASTM D3518	80
Shear modulus G_{12}, GPa	ASTM D3518	4,0
Compression after impact 6,67J/mm, MPa	ASTM D7137	340

sales@itecma.ru www.itecma.ru March 1, 2018

Structural BMI Resin SB332

Technical Data Sheet

SB332 is a one part low viscosity bismaleimide infusion resin developed for high temperature composite parts with service temperature up to 200°C. The resin is characterized by low viscosity at impregnation and molding temperatures (100 cP at 120°C), which makes it possible to obtain CFRP with low porosity. Pre-curing at 190 °C allows to remove composite tool from plastic model. Post-curing at 230°C provides service temperature composite part up to 200°.

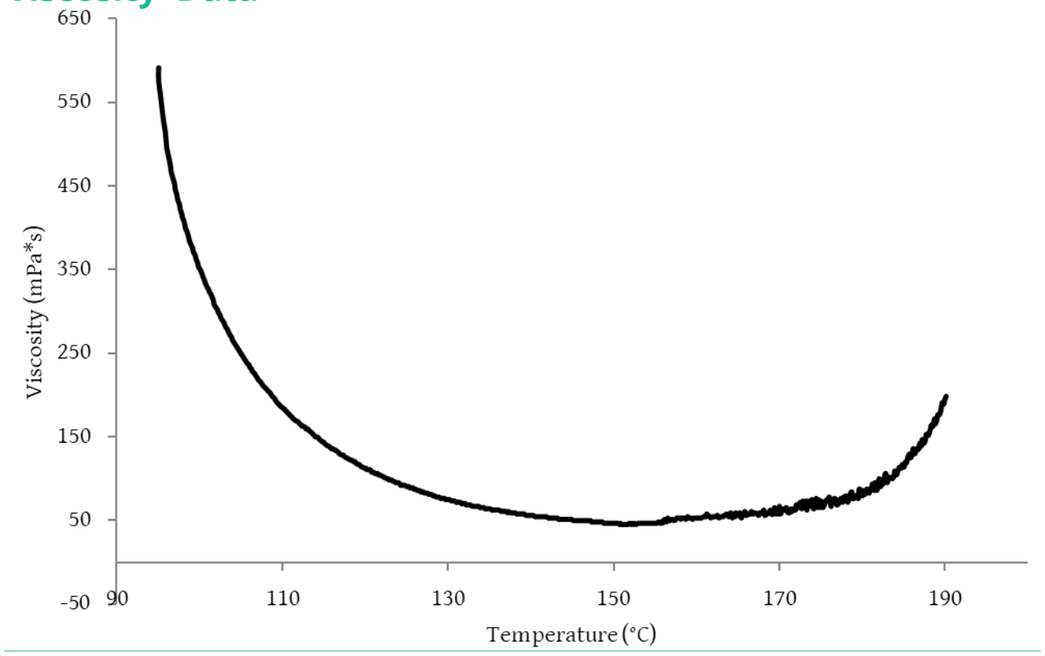
Features & Benefits

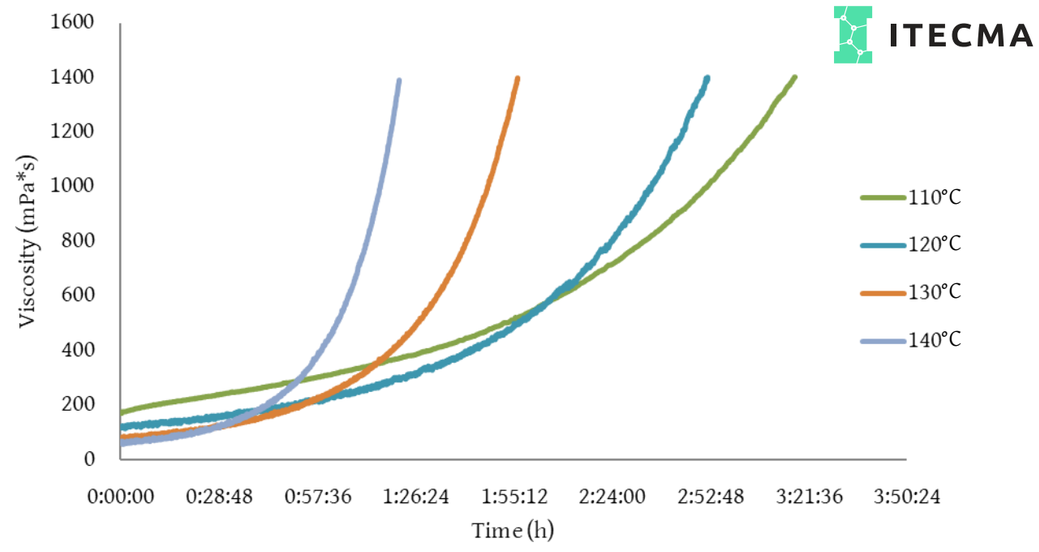
- Wide processing window > 2 hours at 120°C
- Pre-curing at 190°C
- Post-curing at 230°C
- Glass transition temperature 280°C
- High mechanical performance

Neat resin characteristics

Tensile strength, MPa	ASTM D638	85
Tensile modulus, GPa	ASTM D638	4.4
Flexural strength, MPa	ASTM D790	165
Dry glass transition temperature, Tg, °C	ASTM E1640	2780
CTE, K^{-1}	ASTM E831	$51 \cdot 10^{-6}$
Fracture toughness, K_{IC}, $MPa \cdot m^{1/2}$	ASTM D5045	0.841
Strain energy release, G_{IC}, J/m^2	ASTM D5045	194
Moisture absorption, % (60h, boiling water)		4.6

Viscosity Data





Recommended processing parameters

- Assemble the vacuum bag. Perform a leak test, the rate of the vacuum drop should not be more than 1 mbar per minute. The residual pressure in the bag must not be more than 10 mbar. Assemble the second vacuum bag, put airweave material between the layers of the vacuum film. Perform a leak test for the second vacuum bag. The residual pressure in the bag must not be more than 10 mbar.
- Degas for 20-30 minutes, at 100-120°C, at a pressure of no more than 10 mbar. During the degassing, the resin should be stirred intensively.
- Heat the tool up to 120-130°C. Maintaining the temperature of resin dispenser at 120°C, start the infusion process.
- After complete impregnation of the bag, close the resin inputs, but continue evacuation from the inner bag for at least 30 minutes. Then close the outputs from the inner bag. Maintain the outer vacuum bag until the end of curing process.
- Increase the temperature at a rate of 2°C/min to 160°C. Dwell at 160°C for 3 hours ; heat to 190°C at a rate of 2°C/min; dwell at 190°C for 3 hours.
- It is possible to heat up to 190°C without exposure at 160°C, in the case that the auxiliary materials and mold materials withstand such conditions.
- Before removing the part, cool the mold to at least 90°C at a speed of no more than 5°C/min.
- Post-cure can be performed without tooling. Heat to 180°C at a rate of 2°C/min, from 180°C to 230°C, heat to 190°C at a rate of 0.5°C/min; dwell 5 hours at 230°C. Do not cool faster than 5°C/min.
- For the measurement of vacuum, the use of absolute pressure sensors is recommended.

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on SB332 resin and carbon fabric (CF) 22508 (sateen 8H, 200 g/m2, 3K, 3.95 GPa).

Tensile strength 0° σ_{11}^{+}, MPa	ASTM D3039	853
Compression strength 0° σ_{11}^{-}, MPa	ASTM D6641	797
Tensile modulus 0° E_{11}^{+}, GPa	ASTM D3039	62
Compression modulus 0° E_{11}^{-}, GPa	ASTM D6641	57
Shear strength τ_{13} , MPa	ASTM D2344	84
Shear strength τ_{12} , MPa	ASTM D3518	102

Phthalonitrile resin PN-3M

Technical Data Sheet

PN-3M is a single part phthalonitrile resin with higher glass transition temperature and outstanding thermal stability, specially developed for vacuum infusion and RTM technologies.

Pre-curing at 180°C allows to remove parts from tool after cooling. Post-curing provides glass transition temperature above 450°C. Moreover, PN-3M does not support combustion. Can be used for high temperature tooling up to 450°C.

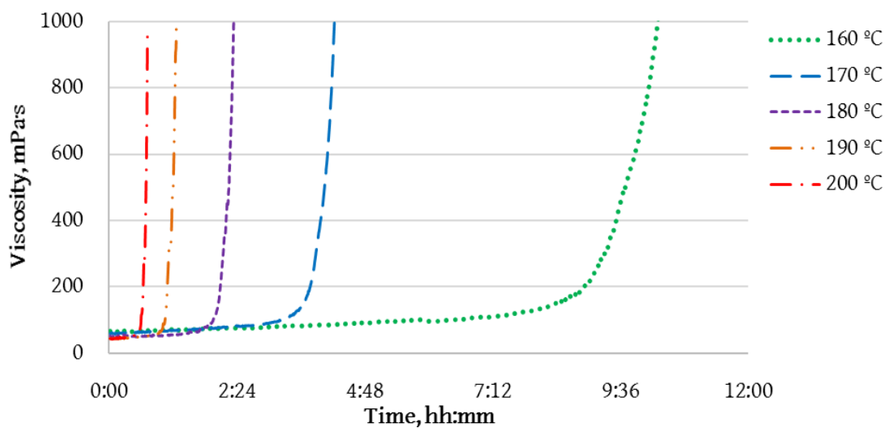
Features & Benefits

- One-part resin system
- Epoxy-like processability
- Incombustible (check our test movie)
- Decomposition temperature 520°C
- Low moisture saturation
- Low softening temperature 80°C

Neat resin characteristics

Test characteristic	Standard	Curing T	
		375°C	180°C
Tensile strength, MPa	ASTM D638	36	60
Tensile modulus, GPa	ASTM D638	4.7	4,8
Flexural strength, MPa	ASTM D790	86	190
Flexural modulus, GPa	ASTM D790	4.5	4.6
Fracture toughness, K_{IC}, MPa·m$^{1/2}$	ASTM D5045	0.562	0.756
Strain energy release, G_{IC}, J/m^2	ASTM D5045	145	276
Dry heat deflection temperature, HDT, °C	ASTM E2092	>450	200
CTE, K^{-1}·10^{-6}	ASTM E831	39	90
Density, g/cm^3	ASTM D792	1.347	1.336
Moisture absorption, % (54h boiling water)		3.15	

Viscosity Data



Recommended processing parameters

- Assemble the vacuum bag. Perform a leak test, the rate of the vacuum drop should not be more than 1 mbar per minute. The residual pressure in the bag must not be more than 10 mbar. Assemble the second vacuum bag, put airweave material between the layers of the vacuum film. Perform a leak test for the second vacuum bag. The residual pressure in the bag must not be more than 10 mbar.
- Degas for 30-40 minutes, at 150-160°C, at a pressure of no more than 10 mbar. During the degassing, the resin should be stirred intensively.
- Heat the tool up to 150-170°C. Maintaining the temperature of resin dispenser at 160°C, start the infusion process.
- After complete impregnation of the bag, close the resin inputs, but continue evacuation from the inner bag for at least 30 minutes. Then close the outputs from the inner bag. Maintain the outer vacuum bag until the end of curing process.
- Increase the temperature at a rate of 2°C/min to 180°C. Dwell at 180°C for 6 hours ;
- Before removing the part, cool the mold to at least 60°C at a speed of no more than 5°C/min.
- Post-cure can be performed without tooling.
- Heat to 180°C at a rate of 2°C/min
- Heat to 375°C at a rate of 5-10°C/min
- Dwell at 375°C for 8 hours.
- Cool down the part to 60°C at rate <5°C/min
- For the measurement of vacuum, the use of absolute pressure sensors is recommended.

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on PN-3M resin and carbon fabric 22502 (twill 2x2, 200 g/m2, HTA40-3K, 3.95 GPa)

Tensile strength 25°C σ_{11}^+, MPa	ASTM D3039	717
Compression strength 25°C σ_{11}^-, MPa	ASTM D6641	623
Tensile modulus 25°C E_{11}^+, GPa	ASTM D3039	69
Compression modulus 25°C E_{11}^-, GPa	ASTM D3039	64
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	36
Shear strength τ_{13} , MPa at 300°C	ASTM D2344	43
Shear strength τ_{13} , MPa at 350°C	ASTM D2344	41
Shear strength τ_{13} , MPa at 400°C	ASTM D2344	38
Shear strength τ_{13} , MPa at 450°C	ASTM D2344	33
Shear strength τ_{12} , MPa, 25 °C	ASTM D3518	85
Shear modulus G_{12}, GPa	ASTM D3518	5.7
Shear strength τ_{12} , MPa, 300 °C	ASTM D3518	75
Shear strength τ_{12} , MPa, 350 °C	ASTM D3518	69
Shear strength τ_{12} , MPa, 400 °C	ASTM D3518	68

Suggested application

- Structures requiring high heat resistance
- Parts requiring non-combustibility
- Parts of engines and other special applications
- High temperature tooling for thermoplastics

Autoclave epoxy prepreg T107

ITECMA

Technical Data Sheet

Features & Benefits

- High mechanical performance
- High resistance to impact and cracking
- Glass transition temperature 155°C

Neat resin characteristics

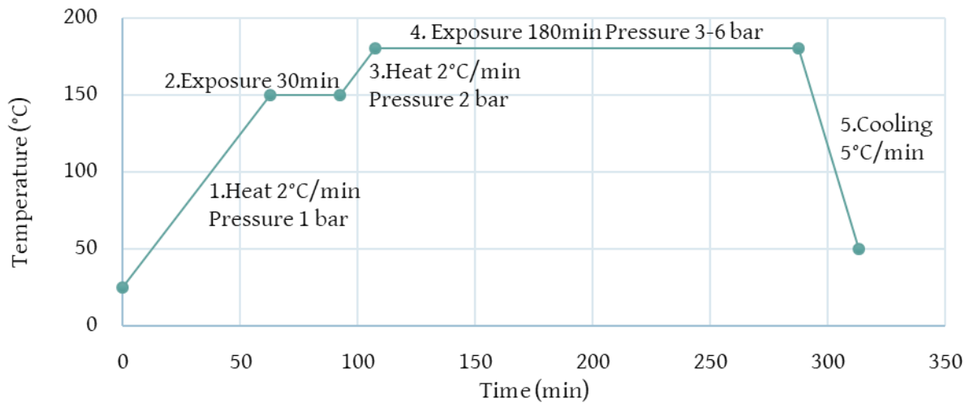
Tensile strength, MPa	ASTM D638	82
Flexural strength, MPa	ASTM D790	189
Fracture toughness, K_{IC}, MPa·m$^{1/2}$	ASTM D5045	2.081
Strain energy release, G_{IC}, J/m^2	ASTM D5045	1455
Dry glass transition temperature, Tg, °C	ASTM D3418	175
Wet glass transition temperature, Tg, °C	ASTM D3418	155
Moisture absorption, % (54h, boiling water)		3.57

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on T60-180 resin and carbon fabric 22502 (twill 2x2, 200 g/m2, 3K, 3.95 GPa)

Tensile strength 25°C σ_{11}^{+}, MPa	ASTM D3039	904
Compression strength 25°C σ_{11}^{-}, MPa	ASTM D6641	783
Tensile modulus 25°C E_{11}^{+}, GPa	ASTM D3039	62
Compression modulus 25°C E_{11}^{-}, GPa	ASTM D695	62
Compression strength 120°C σ_{11}^{-}, MPa	ASTM D6641	623
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	81
Shear strength τ_{13} , MPa at 90°C	ASTM D2344	73
Shear strength τ_{13} , MPa at 120°C	ASTM D2344	66
Shear strength τ_{13} , MPa at 150°C	ASTM D2344	57
Shear strength τ_{12} (5% / max), MPa, 25 °C	ASTM D5379	106/140
Shear modulus G_{12}, GPa, 25 °C	ASTM D3518	4.9
Compression after impact 6.67 J/mm, MPa	ASTM D7137	260

Recommended processing parameters



OoA epoxy prepreg B180

ITECMA

Technical Data Sheet

Features & Benefits

- High mechanical performance
- Glass transition temperature 154°C
- Out of autoclave processing

Neat resin characteristics

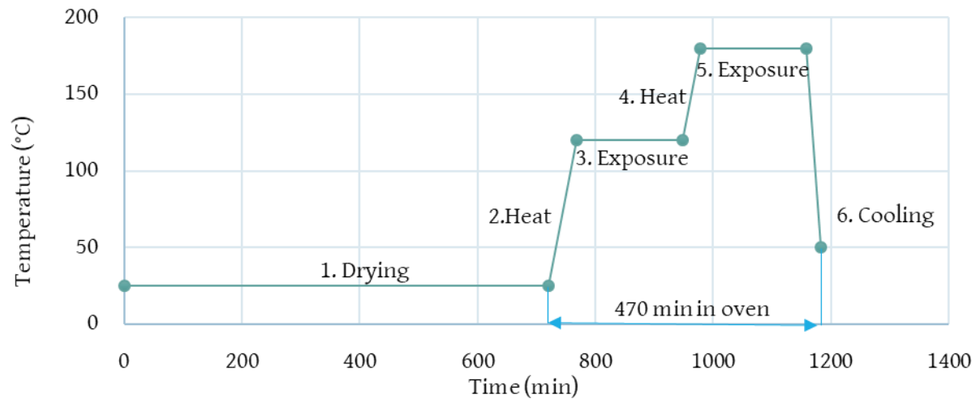
Tensile strength, MPa	ASTM D638	94
Flexural strength, MPa	ASTM D790	162
Fracture toughness, K_{IC}, MPa·m$^{1/2}$	ASTM D5045	1.88
Strain energy release, G_{IC}, J/m^2	ASTM D5045	1340
Dry glass transition temperature, Tg, °C	ASTM E2092	175
Wet glass transition temperature, Tg, °C	ASTM D3418	154
Moisture absorption, % (54h, boiling water)		4.17

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on T60-180 resin and carbon fabric 22502 (twill 2x2, 200 g/m2, 3K, 3.95 GPa)

Tensile strength 25°C σ_{11}^{+}, MPa	ASTM D3039	871
Compression strength 25°C σ_{11}^{-}, MPa	ASTM D6641	802
Tensile modulus 25°C E_{11}^{+}, GPa	ASTM D3039	71
Compression modulus 25°C E_{11}^{-}, GPa	ASTM D695	60
Compression strength 25°C $[0,+45]_{nS}$, σ_{11}^{-}, MPa	ASTM D6641	708
Compression strength 85°C $[0,+45]_{nS,}$ σ_{11}^{-}, MPa	ASTM D6641	639
Tensile strength 25°C $[0,+45]_{nS}$, σ_{11}^{+}, MPa	ASTM D3039	668
Tensile strength 85°C $[0,+45]_{nS,}$ σ_{11}^{+}, MPa	ASTM D3039	670
Shear strength τ_{12} (5% / max), MPa, 25 °C	ASTM D5379	126
Shear modulus G_{12}, GPa, 25 °C	ASTM D3518	5.7
Shear strength 25°C $[0,+45]_{nS}$, τ_{13}, MPa	ASTM D2344	66
Shear strength 85°C $[0,+45]_{nS,}$ τ_{13}, MPa	ASTM D2344	59

Recommended processing parameters



Autoclave BMI prepreg PSB250

ITECMA

Technical Data Sheet

Prepreg PSB250 is designed for the production of composite parts or tools operated at temperatures up to 250°C. As a reinforcing material for a prepreg based on the bismaleimide resin PSB250, unidirectional belts and fabrics of various weave can be used.

Features & Benefits

- Glass transition temperature 266 ° C
- High strength and stiffness.
- Curing temperature 190 ° C, post-curing 230 ° C
- Good stickiness

Neat resin characteristics

Test characteristic	Standard	Value
Tensile strength, MPa	ASTM D638	92
Tensile modulus, GPa	ASTM D638	4.4
Flexural strength, MPa	ASTM D790	164
Flexural modulus, GPa	ASTM D790	4.5
Fracture toughness, K_{IC}, MPa·$m^{1/2}$	ASTM D5045	1.07
Strain energy release, G_{IC}, J/m^2	ASTM D5045	350
Dry heat deflection temperature, HDT, °C	ASTM E2092	266
Moisture absorption, % (54h boiling water)		4.05

Recommended processing parameters

Molding mode

- Heat 2°C/min to 145 °C, vacuum –1bar, pressure 0 bar;
- Hold at 145 ° C for 120 min, vacuum -1 bar, pressure 0 bar;
- Heat 2 ° C / min to 180 ° C, pressurize 5.5 bar, release vacuum;
- Hold at 180 ° C for 240 minutes, pressure 5.5 bar;
- Cool no faster than 5 ° C / min to 60 ° C, pressure 5.5 bar.

Post-curing cycle:

- Post-cure of the part can be carried out without a tooling;
- Heat at rate 2 ° C / min to 180 ° C;
- Heat no faster than 0.2 ° C / min to 230 ° C;
- Holding at 230 ° C for 300 min;
- Cooling is not faster than 5 ° C / min to 25 ° C.
- To achieve heat resistance up to 250 ° C, additional post-curing is required at 250 ° C for 240 minutes. Heat from 230 ° C to 250 ° C at rate 2 ° C / min.

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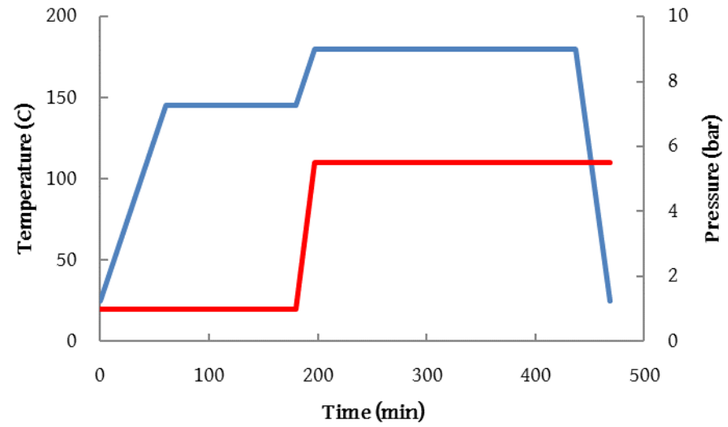

Properties of CFRP

Samples for testing were obtained by vacuum infusion based on PN-3M resin and carbon fabric 22502 (twill 2x2, 200 g/m2, HTA40-3K, 3.95 GPa)

Test characteristic	Standart	Value
Tensile strength 25°C σ_{11}^{+} 0°, MPa	ASTM D3039	1711
Tensile strength 25°C σ_{22}^{+} 90°, MPa	ASTM D3039	30
Compression strength 25°C σ_{11}^{-} 0°, MPa	ASTM D6641	1071
Compression strength 150°C σ_{11}^{-} 0°, MPa	ASTM D6641	973
Compression strength 180°C σ_{11}^{-} 0°, MPa	ASTM D6641	860
Compression strength 230°C σ_{11}^{-} 0°, MPa	ASTM D6641	810
Compression strength 250°C σ_{11}^{-} 0°, MPa	ASTM D6641	780
Compression strength 25°C σ_{22}^{-} 90°, MPa	ASTM D6641	205
Compression strength 150°C σ_{22}^{-} 90°, MPa	ASTM D6641	158
Compression strength 180°C σ_{22}^{-} 90°, MPa	ASTM D6641	151
Compression strength 250°C σ_{22}^{-} 90°, MPa	ASTM D6641	118
Tensile modulus 25°C E_{11}^{+}0°, GPa	ASTM D3039	137
Tensile modulus 25°C E_{22}^{+}90°, GPa	ASTM D3039	9.5
CAI (6.7 J/mm), MPa	ASTM D7137	149
Shear strength τ_{13} , MPa at 25°C	ASTM D2344	87
Shear strength τ_{13} , MPa at 150°C	ASTM D2344	73
Shear strength τ_{13} , MPa at 180°C	ASTM D2344	70
Shear strength τ_{13} , MPa at 250°C	ASTM D2344	52
Shear strength τ_{12} , MPa, 25 °C	ASTM D3518	72

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