HexPly® M51

180°C (350°F) Curing Epoxy Matrix

Product Data Sheet

Description

HexPly® M51 is a high performance, tough epoxy matrix for use in primary aerospace structures. It enables short cure cycles and is especially suited to press curing technologies. HexPly® M51 is a toughened epoxy resin system supplied with unidirectional or woven carbon or glass fibers. HexPly® M51 was developed as a controlled flow system to operate in environments up at 121°C (250°F).

Benefits and Features

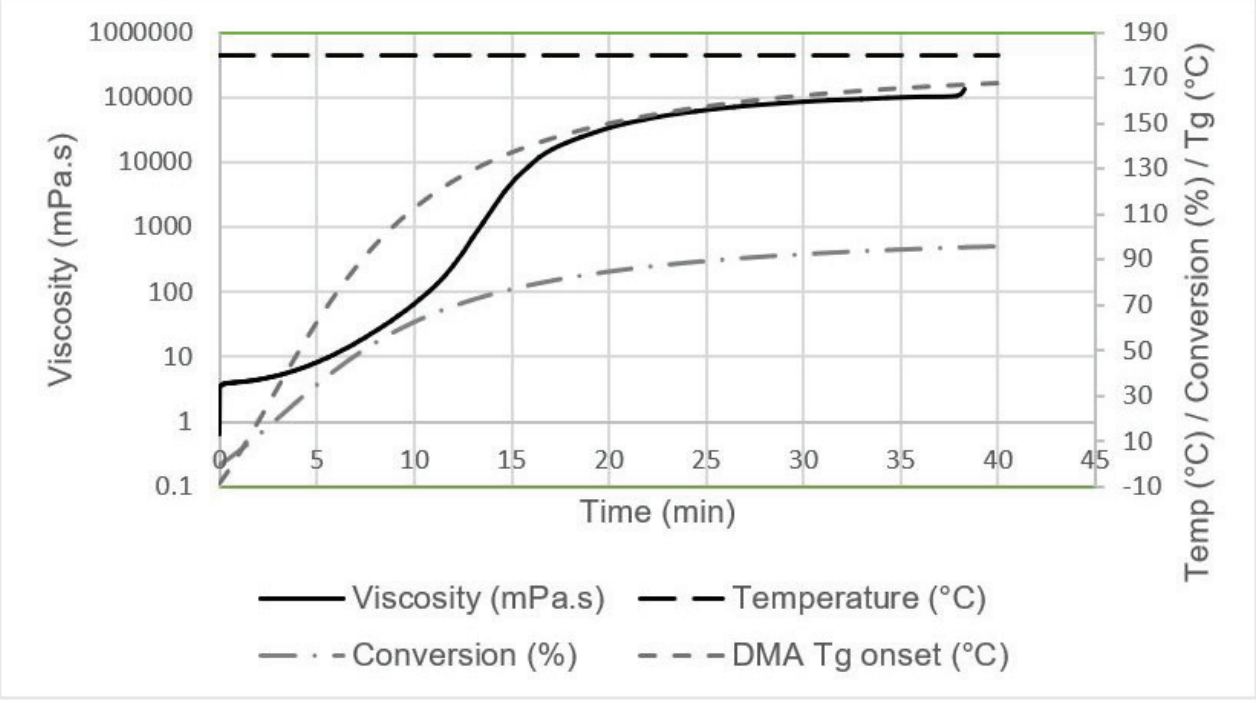
- Excellent toughness, in particular at high energy impact.
- High residual compression strength after impact.
- Effective translation of fiber properties.
- Good hot-wet properties.
- Fast cure kinetics to enable part manufacture in 40 minutes.

HexPly® M51 is best suited to press or autoclave cure to obtain optimum mechanical performance from the cured composite.

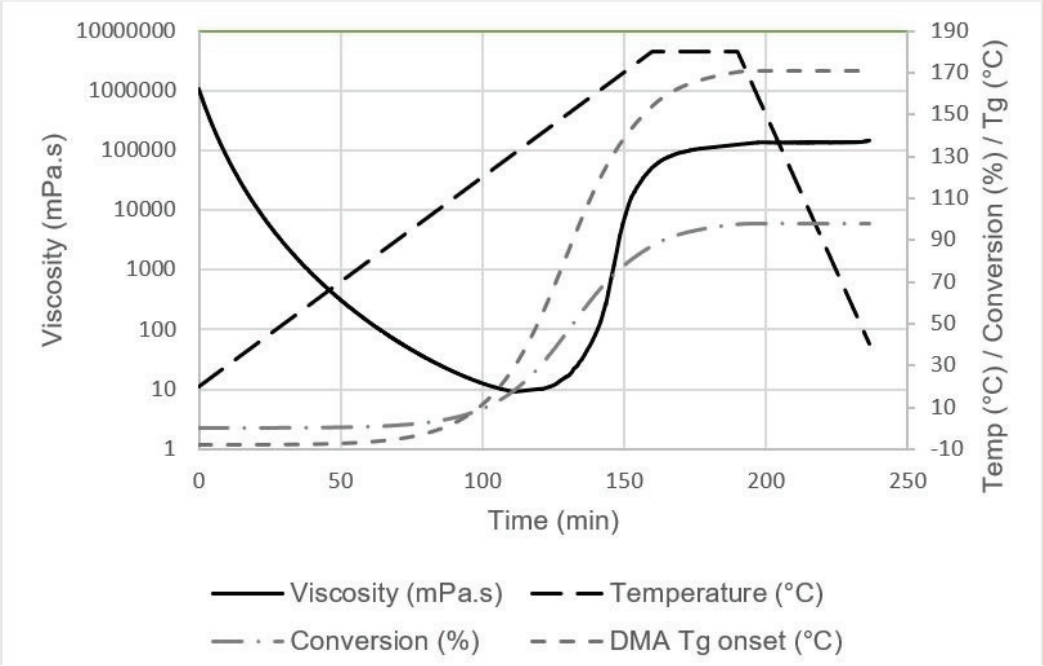
Resin Matrix Properties

Degree of cure, Tg and viscosity kinetic modeling is available to enable prediction of target cure cycles and optimization following empirical testing.

Press Cure Cycle



Autoclave Cure Cycle



Prepreg Lay-up

Press:

Lay-up both as flat sheets and net-shape preforming are possible. Debulking is recommended for all UD material and to enhance net-shape preform stability.

Autoclave:

Standard lay-up techniques may be used to tack plies to tool and debulking.

Prepreg Curing Conditions

Press:

Defined staging and cure times will vary depending on the tool design and part complexity.

Recommended cure cycle

1. Hot load preform at 180°C -0/+5°C (356°F -0/+9°F)
2. Staging step - hold without compressing preform (no/minimal pressure) 2-6 min*
3. Apply pressure 7-10 bar
4. Hold at 180°C (356°F -0/+9°F) for total 40 minutes (including staging time)
5. Open tool and demold

**Tooling dependent*

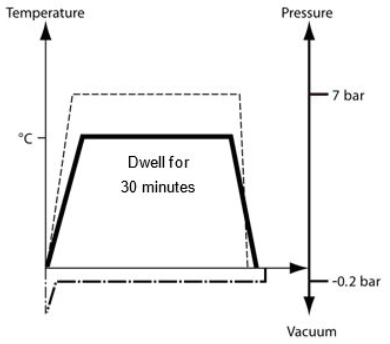
Cooling support jigs are recommended for alternate hot loading and unloading cure between 160°C and 180°C.

Autoclave

Defined heat-up rates will vary depending on the autoclave dimensions, the mass of tooling used and the size of the component to be manufactured. Cure cycle modification to limit temperature overshoot will depend on part dimensions.

Typical Autoclave Cure

1. Apply full vacuum (1 bar).
2. Apply 7 bar gauge autoclave pressure.
3. Reduce vacuum to a safety value of -0.2 bar when the autoclave pressure reaches ~ 1 bar gauge.
4. Set heat-up rate from room temperature to 180°C -0/+5°C (356°F -0/+9°F) to achieve an actual component heat-up rate between 1-2°C/minute (2-4°F/ minute).
5. Hold at 180°C -0/+5°C (356°F -0/+9°F) for 30 minutes -0 +10 minutes.
6. Cool component at an actual cooldown rate of 2-5°C/minute (4-9°F/minute).
7. Vent autoclave pressure when the component reaches 60°C (140°F) or below.



Guidance can be provided for thicker parts (5mm and above) and sandwich structures.

Cured Prepreg Properties

Nomenclature: resin/resin content by weight (%)/fiber weight (gsm)/fiber type

Physical Properties	Units	M51/40%/285T2/ AS4C-6K	M51/34%/ UD194/ IM5-24K	M51/34%/ UD194/ IM9-24K
Fiber	g/m²	AS4C	IM5	IM9
Weave/UD		2x2 Twill	UD	UD
Fiber Mass		285	194	194
Nominal Prepreg Mass	g/m²	475	294	294
Theoretical Calculated Cured Ply Thickness	mm (inch)	0.305 (0.0120)	0.185 (0.0073)	0.185 (0.0073)
Theoretical Calculated Fiber Volume	%	52.3	58.5	58.5
Resin Density	g/cm³ (lbs/ft³)	1.30 (81.2)		
Fiber Density	g/cm³ (lbs/ft³)	1.78 (111.1)	1.79 (111.1)	1.79 (111.1)
Theoretical Calculated Laminate Density	g/cm³ (lbs/ft³)	1.59 (99.3)	1.62 (101.1)	1.62 (101.1)

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HEXCEL®

Product Data Sheet

Mechanical Properties	Units	Temp °C (°F)	M51/40%/285T2/ AS4C-6K	M51/34%/ UD194/ IM5-24K	M51/34%/ UD194/ IM9-24K
Dry Glass Transition Temperature	°C (°F)		170 (338)		
Wet Glass Transition Temperature (2wk 70°C immersion)	°C (°F)		140 (284)		
Method			EN 6032 - DMA extrapolated onset E'		
Tension Strength	MPa (ksi)	23 (73)	1052 (153)	3000 (435)	3184 (462)
Tension Modulus	GPa (msi)	23 (73)	74 (10.7)	175 (25.4)	181 (26.3)
Method			EN 2561 B		
Compression Strength	MPa (ksi)	23 (73	919 (133)	—	—
Compression Modulus	GPa (msi)	23 (73)	54 (7.8)	—	—
Method			EN 2850 B		
ILSS	MPa (ksi)	23 (73)	81 (11.7)	104 (15.1)	104 (15.1)
Method			EN 2563		
In-plane Shear Strength	MPa (ksi)	23 (73)	137 (19.9)	120 (17.4)	117 (17.0)
In-plane Shear Modulus	GPa (msi)	23 (73)	4.7 (0.68)	5.3 (0.77)	5 (0.73)
Method			EN 6031		
Open Hole Tension	MPa (ksi)	23 (73)	321	—	504 (73.1)
Method - (25/50/25) (gross section)			EN6035		
Open Hole Compression	MPa (ksi)	23 (73)	305 (44.2)	—	317 (46.0)
Method - (25/50/25) (gross section)			EN 6063		
CAI @ 30.0J	MPa (ksi)	23 (73)	266 (38.6)	270 (39.2)	300 (43.5)
Method - (25/50/25)			EN6038		

Data normalized to Vf = 59% (0.184mm (0.0072") ply) for UD; Vf=52% (0.305mm (0.012") ply) for 285T2 Woven samples tested in the warp direction. Nominal cured ply thickness quoted is based on zero bleed and is determined using the fiber weight, resin content and resin & fiber density. Data for comparison purposes only.

Prepreg Storage Life

- Tack Life: 7-10 days at 23°C (73°F) dependent on lay-up process (hand lay-up, ATL, AFP)
- Out Life: 21 days at 23°C (73°F), extension possible for press cure
- Shelf Life: 12 months at -18°C (0°F) (from date of manufacture)

Definitions

Tack Life: The time, at room temperature, during which prepreg retains enough tack for easy component lay-up.

Out Life: The maximum accumulated time allowed at room temperature between removal from the freezer and cure.

Shelf Life: The maximum storage life for HexPly® M51 prepreg, from date of manufacture, when stored continuously, in a sealed moisture-proof bag at -18 °C (0 °F). To accurately establish the exact expiry date, consult the box label.

HexPly® M51 prepregs should be stored as received in a cool dry place or in a refrigerator. After removal from refrigerator storage, prepreg should be allowed to reach room temperature before opening the polythene bag, thus preventing condensation (a full reel in its packaging can take up to 48 hours).

Precautions for Use

The usual precautions when handling uncured synthetic resins and fibrous materials should be observed. A Safety Data Sheet is available for this product. The use of clean, disposable, inert gloves provides protection for the operator and avoids contamination of material and components.

For more information

Hexcel is a leading worldwide supplier of composite materials to aerospace and industrial markets. Our comprehensive range includes:

- HexTow® carbon fibers
- HexForce® reinforcements
- HiMax® multiaxial reinforcements
- HexPly® prepregs
- HexMC® molding compounds
- HiFlow® RTM resins
- HexBond® adhesives
- HexTool® tooling materials
- HexWeb® honeycomb
- Acousti-Cap® sound attenuating honeycomb
- Engineered core
- Engineered products
- Polyspeed® laminates & pultruded profiles

For U.S. quotes, orders and product information call toll-free 1-800-688-7734. For other worldwide sales office telephone numbers and a full address list, please go to:

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