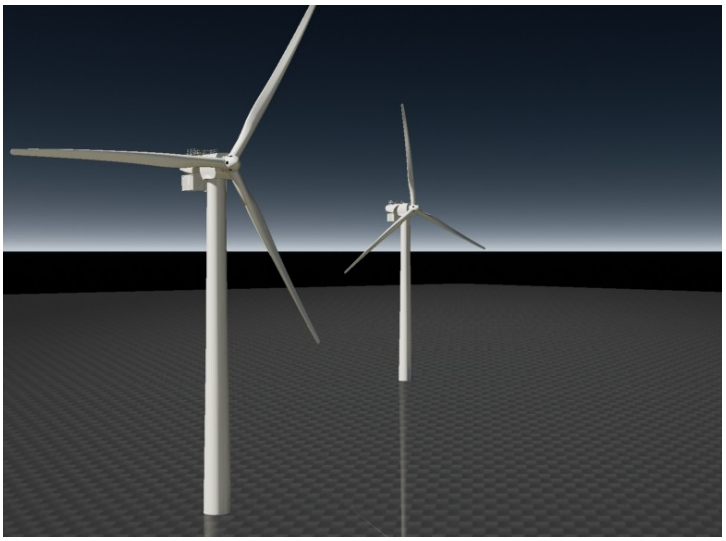
USER GUIDE

HexPly® SuperCap™
Glass UD Prepregs



SuperCap™

The Best of Both Worlds

HEXCEL®

HexPly® Glass UD User Guide

1. General – SuperCap™

Hexcel has developed a new range of heavy UD prepregs in glass and carbon fibre to meet evolving challenges of bigger blades for greater power output.

- SuperCap™ materials are specifically designed for the use in critical load carrying parts in wind blades

The SuperCap™ process combines the benefits of prepreg technology and infusion technology in one advanced concept : manufacturing a pre-cured sparcap (or girder structure) in a separate mould, then transfering the cured part into the shell mould for final infusion

Benefits:

- Perfect fibre alignment in the prepreg and therefore in the critical, load carrying structure of the blade
- No stitching in the UD reinforcement means no fibre damage or buckling of materials
- No risk of dry unimpregnated reinforcement
- Superior laminate performance for structural parts in wind blades

Benefits in Manufacturing:

- Excellent exotherm management in thick sections usually required for sparcaps (girder structures)
- Consistent results every time
- Uses less materials and saves costs due to better mechanical performance
- Easy to introduce carbon fibre into blade design

2. Product Description

2.1 Resin system:

HexPly® M9.6G/M9.1G is a formulated epoxy resin which is suitable for low pressure moulding processes. It is very versatile and allows a range of processing temperatures from 75°C up to 160°C.

HexPly® M9.6G/M9.1G can be used for very large industrial components, subjected to severe environmental conditions.

HexPly® M9.6G/M9.1G has high fatigue resistance and gives a good surface finish.

HexPly® M9.6G/M9.1G exhibits a very long shelf life at room temperature.

Prepreg Products:

HexPly® M9.6G/M9.1G/32%/1200/G: Glass UD prepreg with FAW of 1200 g/m²

HexPly® M9.6G/M9.1G/32%/1500/G: Glass UD prepreg with FAW of 1500 g/m²

HexPly® M9.6G/M9.1G/32%/1600/G: Glass UD prepreg with FAW of 1600 g/m²

HexPly® M9.6G/M9.1G/32%/1600+50/G: Glass UD prepreg with FAW of 1600 g/m² plus 50 g/m² dry fleece attached to aid breathing

Prepreg storage life

@ +23°C	6 weeks
@ +5°C	6 months
@ -18°C	12 months

2.2 Reinforcement

	Fibre type	Fibre areal weight	Direction
Glass UD: Rovings	2400 tex E-Glass (Epoxy Compatible sizing)	1200—1600 g/m^2	0°
Glass Fleece	E-glass	50 g/m^2	Random

2.3 Delivery form

Delivery form:	Rolls		
Release film:	Easy to peel release foil (PE 40µm – 50µm)		
Roll length:	Roll lengths between 100lm and 300lm possible.		
Inner core diameter:	300 mm		minimum value
Prepreg widths:	30 – 1500 mm		-10mm / +20mm
Fibre areal weight:	1200 - 1600 g/m²		-5% / +5%
Resin content:	Nominal 32%	Low 29%	High 35%

3. Material conditioning

3.1 Storing

HexPly® M9.6G/M9.1G epoxy resin is a composition of basic epoxy resin and temperature activated hardeners. The shelf life depends on the storage temperature. If individual rolls are not fully used they may be repacked and frozen again. For re-packing use the packaging material as provided by Hexcel or similar in order to prevent water absorption during freezing and conditioning.

Hexcel recommends that the prepreg is always stored at temperatures below +5°C.

3.2 Conditioning before use

After removal from the cold store, the prepreg should be allowed to reach room temperature before opening the bag, to prevent condensation, as water negatively influences the quality of the resulting laminate. A full reel in its packing can take up to 48 hours to reach temperature equilibrium.

As a minimum duration Hexcel strongly recommends leaving the material at room temperature for 24 hours before using.

3.3 Environmental conditions

Environmental conditions have an influence on the handling properties of the prepreg as well as on the resulting laminate quality.

To assure consistent quality and handling properties, constant environmental conditions are required.

- Shop floor temperature: should preferably be in a range between +18°C and +28°C.
- Shop floor humidity: should preferably not exceed 70% relative humidity.

4. Lay up

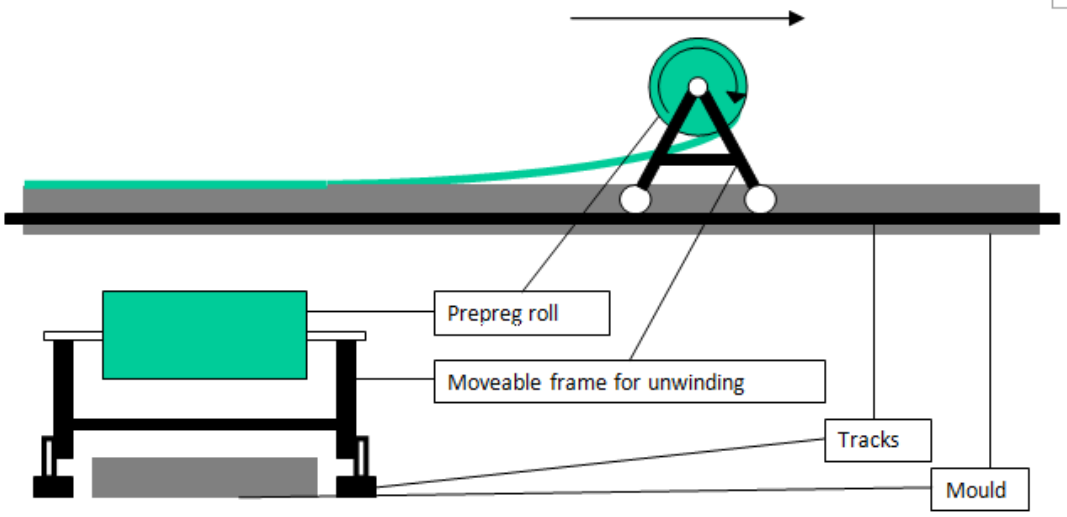
4.1 Mould preparation

- Sealing of mould surface: Epoxy resins are strong adhesives. A proper sealing of the mould is mandatory, in order not to destroy the mould surface.
- The use of a non transferring release agent is highly recommended
- Surface preparation: If the resulting laminate has to be bonded to a surface or embedded into a structure, it should be covered by a layer of peel ply, providing protection against impurities as well as a rough surface for good bonding. Peel plies can be attached to the dry mould by using tacky sprays.

4.2 Handling

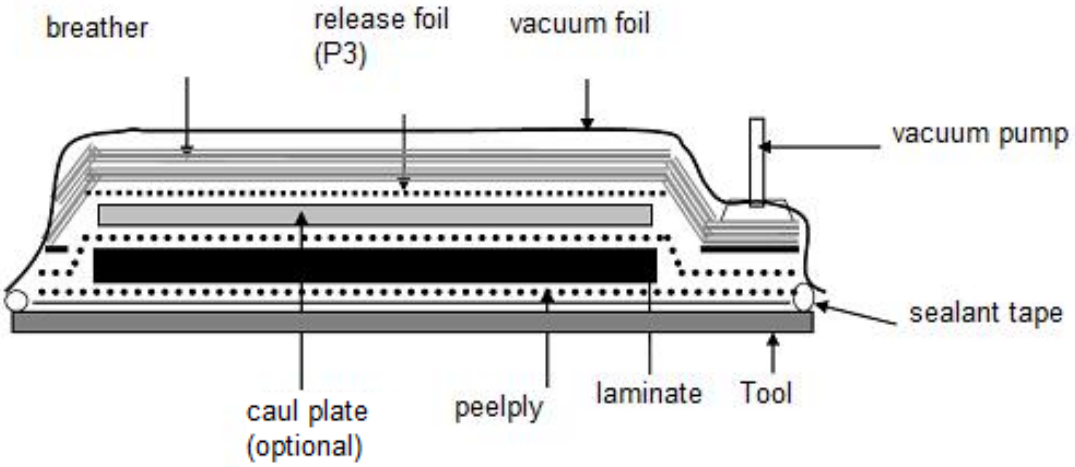
- HexPly® M9.6G/M9.1G Glass UD-Prepregs should never be bent around radii, narrower than provided on the roll. Once buckles, forced by bending, occur, it is impossible to get rid of them.
- Don’t lay the prepreg roll with the prepreg side on a flat surface (e.g. floor) for longer than 15min. Due to its weight, the shape will slightly modify, and wrinkles may result.
- For HexPly® M9.6G/M9.1G/32%/1600+50/G: In order to achieve best laminate quality, always stack “fleece-side” in contact with the “pure UD-side”.
- Changing mould temperatures during the lay up process force the prepreg to build folds or wrinkles (different CTE between mould and prepreg). For that reason, the mould temperature must be constant or slowly be increased (optimum) during lay up.

- Using a movable frame for lay up, provides many advantages



- The elimination of pre-stacking saves time and working space.
- Material is “in place” and can be adjusted to the mould shape layer by layer
- Easy removal of polyethylene foil
- The material immediately adjusts to the mould temperature.
- Less risk of creating wrinkles
- Cheap and effective tool

4.3 Suggested vacuum bag set up



- Auxiliary material:
  - Vacuum distribution hose (vacuum connectors shall not be placed on top of the prepreg stack)
  - Sealant tape

5. Curing

5.1 Degassing

For optimum performance, voids must be prevented. To achieve this effective degassing of the stack is necessary.

Before starting the cycle, the stack should be allowed to degas for at least 1h at max. vacuum.

During the curing cycle, the vacuum should always be in a range between -0,5 and -0,95bar. This should be controlled on 3 individual points along the vacuum bag (2 x on the ends and one in the middle)

During the degassing time (1 hour), before starting the cycle, the temperature should not rise above 40°C, as liquid resin would seal the edges and prevent proper degassing.

5.2 Cure cycle

The cure cycle always depends on the capability and quality of the mould, and is also directly linked to the part thickness!

- Maximum heating temperature
- Maximum mould temperature (Tg max. of the mould)
- Maximum heat up speed
- Possibility of cooling the mould
- Possibility of running temperature controlled cycles
- Temperature constancy of the mould

The following cure cycles demonstrate the interrelation of cycle profile and laminate thickness.

cc#1 Cure cycle for laminates with a maximum thickness of 5mm

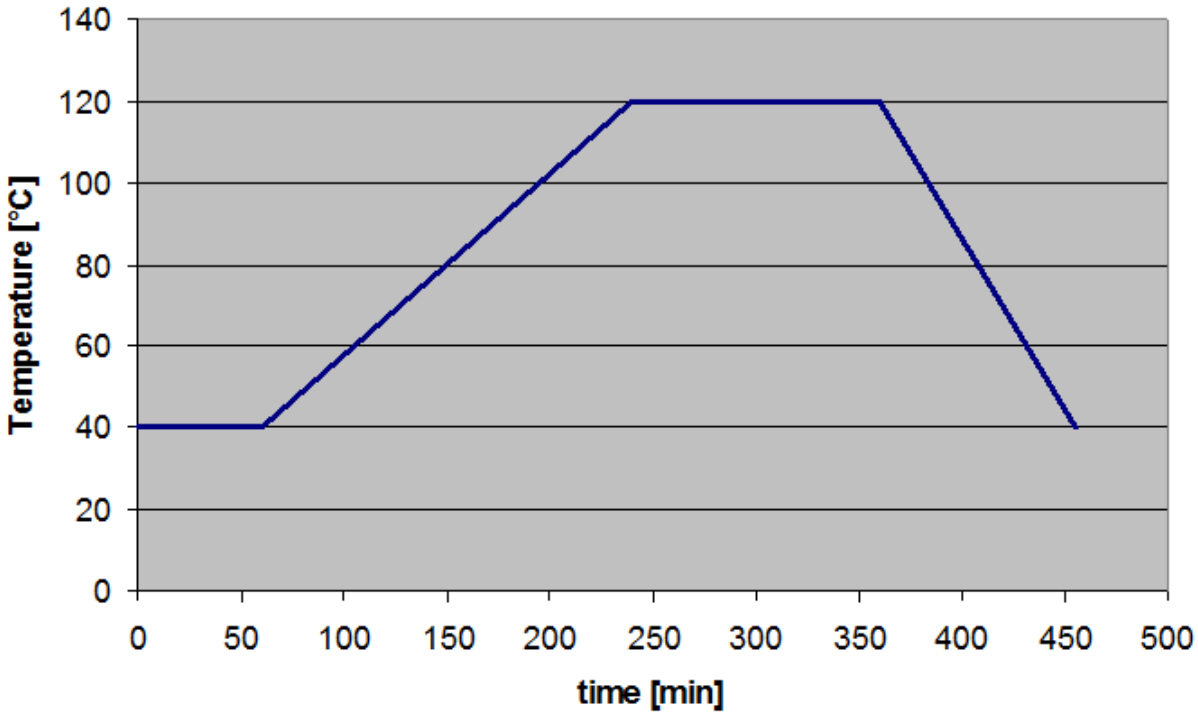
cc#2 Cure cycle for laminates >15mm.

In general, cure cycles have to be “tailor made” for each application. The cure cycles attached demonstrate how even single variations (thickness) influence the cure process.

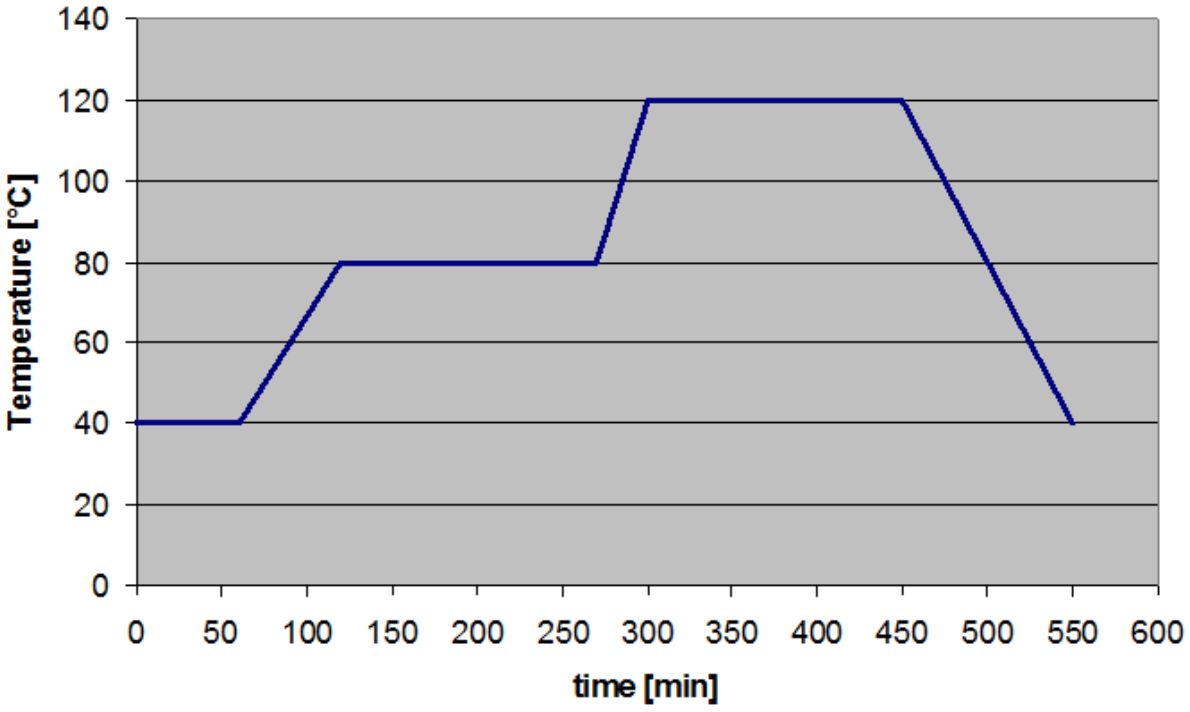
These cycles are valid, provided the mould can withstand peak temperatures of 150°C, prolonged periods at 120°C and is equipped with an active cooling system.

The durations and temperatures in the graphs are seen to be mould surface temperatures, The temperature should be monitored and registered during the entire cure cycle.

Proposed Cure Cycle for Part Thickness < 15 mm



Proposed Cure Cycle for Part Thickness > 15 mm



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Precautions for Use

The usual precautions when handling uncured synthetic resins and fine 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.

Important

All information is believed to be accurate but is given without acceptance of liability. All users should make their own assessment of the suitability of any product for the purposes required. All sales are made subject to our standard terms of sale which include limitations on liability and other terms.