Description
HexPly® M35-4 is an epoxy matrix with excellent mechanical and temperature performances combined with wide process flexibility, designed specifically for the high performance car industry. Curing temperature ranges from 80–180°C providing process flexibility.

Benefits and Features
- Cure temperature 80 – 180 °C
- Elevated temperature performance: Tg and service temperature
- Cured using a variety of processes (press, autoclave and vacuum)
- Optional post-cure
- Excellent drape and tack

Resin Matrix Properties

**Rheology**

**Complex Viscosity (Pas)**

- Temperature (°C)

**Gel time**

- Time mins
- Temperature (°C)
Curing Conditions

HexPly® M35-4 is a flexible curing system and can be cured at temperatures from 80 to 180°C, using a variety of curing processes including autoclave, press, and vacuum bag/oven cure.

A typical autoclave cure cycle for a thin monolithic laminate is 90 minutes at 135°C.
(1) Apply full vacuum (1 bar).
(2) Apply 7 bar gauge autoclave pressure.
(3) Reduce the vacuum to a safety value of 0.2 bar when the autoclave pressure reaches approximately 1 bar gauge.
(4) Heat-up at 1 – 3 °C/minute to 135°C ± 5°C.
(5) Hold at 135°C ± 5°C for 90 minutes ± 5 minutes.
(6) Cool at 2 – 5 °C per minute.
(7) Vent autoclave pressure when the component reaches 60°C or below.

![Diagram of autoclave cure cycle for a thin monolithic laminate]

A typical autoclave cure cycle for a thick (> 10mm) monolithic laminate is 180 minutes at 120°C.
(1) Apply -0.85 bar vacuum.
(2) Apply 7 bar gauge autoclave pressure when the autoclave temperature reaches approximately 45°C.
(3) Heat-up at 1°C/minute to 75°C ± 5°C.
(4) Hold at 75°C ± 5°C for 360 minutes ± 5 minutes.
(5) Heat-up at 1°C/minute to 120°C ± 5°C.
(6) Hold at 120°C ± 5°C for 180 minutes ± 5 minutes.
(6) Cool at 1°C per minute.
(7) Vent autoclave pressure when the component reaches 60°C (140°F) or below.

![Diagram of autoclave cure cycle for a thick monolithic laminate]

These cure cycles can be followed by a free-standing post-cure for 2 hours at 180°C to achieve a higher glass transition temperature.
Heat-up rates are dependent on component thickness, e.g., slow heat-up rates should be used for thicker components and large tools. Accurate temperature measurements of the component should be made during the cure cycles by using thermocouples. For a honeycomb sandwich panel, a cure pressure of 1 – 3 bars should be used, dependent on honeycomb density.

HexPly® M35-4 is designed for process flexibility and alternative cure cycles can be used.

<table>
<thead>
<tr>
<th>Cure temperature (°C)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>12 hours</td>
</tr>
<tr>
<td>100</td>
<td>4 hours</td>
</tr>
<tr>
<td>120</td>
<td>90 minutes</td>
</tr>
<tr>
<td>140</td>
<td>60 minutes</td>
</tr>
<tr>
<td>150</td>
<td>30 minutes</td>
</tr>
</tbody>
</table>

Performance testing should be done for alternative cure cycles to ensure suitability for the particular application.

### Cured Prepreg Physical Properties

<table>
<thead>
<tr>
<th>Fibre</th>
<th>Mass</th>
<th>Nominal Cured Ply Thickness</th>
<th>Nominal Fibre Volume</th>
<th>Nominal Laminate Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS Carbon 24K</td>
<td>UD</td>
<td>0.154</td>
<td>53.4</td>
<td>1.57</td>
</tr>
<tr>
<td>HS Carbon 12K</td>
<td>Plain weave</td>
<td>0.2</td>
<td>53.7</td>
<td>1.56</td>
</tr>
<tr>
<td>HS Carbon 3K</td>
<td>Twill 2x2</td>
<td>0.255</td>
<td>54.0</td>
<td>1.55</td>
</tr>
<tr>
<td>HS Carbon 12K</td>
<td>Twill 2x2</td>
<td>0.398</td>
<td>53.7</td>
<td>1.54</td>
</tr>
</tbody>
</table>

### Cured Prepreg Mechanical Properties

Mechanical properties are based on 135°C cure for 90 minutes at 7 bar pressure and 0.9 bar vacuum + PC 120 minutes at 180°C.

Data is the result from several tests on autoclave cured laminates. Some of the values achieved will have been higher, and some lower than the figure quoted. These are nominal values.

<table>
<thead>
<tr>
<th>Test</th>
<th>Units</th>
<th>Method</th>
<th>Temp °C</th>
<th>M35-4/38%/UD150/CHS/460</th>
<th>M35-4/38%/193P/CHS-12K</th>
<th>M35-4/38%/245T2/CHS-3K</th>
<th>M35-4/42%/385T2/CHS-12K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>MPa</td>
<td>EN2561</td>
<td>23</td>
<td>2000</td>
<td>980</td>
<td>950</td>
<td>880</td>
</tr>
<tr>
<td>Tensile Modulus</td>
<td>GPa</td>
<td>EN2561</td>
<td>23</td>
<td>142</td>
<td>65</td>
<td>67</td>
<td>62</td>
</tr>
<tr>
<td>Flexural Strength</td>
<td>MPa</td>
<td>EN 2562</td>
<td>23</td>
<td>1700</td>
<td>1030</td>
<td>990</td>
<td>850</td>
</tr>
<tr>
<td>Flexural Modulus</td>
<td>GPa</td>
<td>EN 2562</td>
<td>23</td>
<td>117</td>
<td>55</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>ILSS</td>
<td></td>
<td>EN 2563</td>
<td>23</td>
<td>95</td>
<td>60</td>
<td>65</td>
<td>47</td>
</tr>
<tr>
<td>Compression Strength</td>
<td>MPa</td>
<td>EN 2850B</td>
<td>23</td>
<td>1550</td>
<td>830</td>
<td>900</td>
<td>830</td>
</tr>
<tr>
<td>Compression Modulus</td>
<td>GPa</td>
<td>EN 2850B</td>
<td>23</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>55</td>
</tr>
</tbody>
</table>

NB: Data normalised to Vf = 55% for fabrics and 60% for UD, except for ILSS and Flexural.
Effect of cure cycle and post-cure on glass transition and ILSS properties

<table>
<thead>
<tr>
<th>Cure Cycle</th>
<th>Tg Onset °C</th>
<th>Tan δ °C</th>
<th>Plus Post-Cure cycle</th>
<th>Tg Onset °C</th>
<th>Tan δ °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 hours @ 100°C</td>
<td>100</td>
<td>122</td>
<td>2 hours @ 180°C</td>
<td>195</td>
<td>219</td>
</tr>
<tr>
<td>90 minutes @ 120°C</td>
<td>125</td>
<td>145</td>
<td>2 hours @ 180°C</td>
<td>200</td>
<td>223</td>
</tr>
<tr>
<td>90 minutes @ 135°C</td>
<td>138</td>
<td>163</td>
<td>2 hours @ 180°C</td>
<td>206</td>
<td>230</td>
</tr>
<tr>
<td>60 minutes @ 140°C</td>
<td>149</td>
<td>-</td>
<td>2 hours @ 180°C</td>
<td>199</td>
<td>220</td>
</tr>
<tr>
<td>30 minutes @ 150°C</td>
<td>160</td>
<td>-</td>
<td>2 hours @ 180°C</td>
<td>199</td>
<td>221</td>
</tr>
</tbody>
</table>

Results after an autoclave cure. Tg measurements made on Rheometrics DMTA Mark III, Heat-up rate 5°C/min.

Prepreg Storage Life
- Outlife @ 23°C 28 days
- Guaranteed Shelf Life @ -18°C 12 months (maximum, from date of manufacture)

Definitions:
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® prepreg from date of manufacture, when stored continuously, in a closed moisture proof bag, at -18°C (0°F). To accurately establish the exact expiry date, consult the box label.

Storage Conditions
HexPly® M35-4 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 it's packaging can take up to 48 hours).

Precautions for Use
The usual precautions when handling uncured synthetic resins and fibrous materials should be observed, and 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®-i molding compounds
- HexFlow® RTM resins
- HexBond™ adhesives
- HexTool® tooling materials
- HexWeb® honeycombs
- Acousti-Cap® sound attenuating honeycomb
- Engineered core
- Engineered products
- Polyspeed® laminates & pultruded profiles
- HexAM® additive manufacturing

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:

https://www.hexcel.com/contact

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