Technical Data Sheet

EPIKOTE™ Resin MGS BPR 135G-Series and EPIKURE™ Curing Agent MGS BPH 134G-137GF

Application

Adhesive EPIKOTE™ MGS™ BPR 135G-Series is a solvent free epoxy based bonding paste with a wide range of applications. It is suitable for bonding laminates and wood and appropriately metallic and mineral components.

Specifications

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Resin BPR</th>
<th>Curing Agent BPH 134G</th>
<th>Curing Agent BPH 135G</th>
<th>Curing Agent BPH 137G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td></td>
<td>yellow</td>
<td>red</td>
<td>red</td>
<td>red</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
<td>1.2 – 1.3</td>
<td>1.05 – 1.15</td>
<td>1.05 – 1.15</td>
<td>1.05 – 1.15</td>
</tr>
<tr>
<td>Viscosity (Pa·s)</td>
<td>30 – 50</td>
<td>25 – 35</td>
<td>15 – 20</td>
<td>15 – 20</td>
<td>15 – 20</td>
</tr>
</tbody>
</table>

The pot life measurement is a test to evaluate the quality of a product under constant conditions. Different local factors like humidity, temperature or mass of the applied material, time of exposure to atmosphere (and others) are directly influencing the material properties (processing and mechanical). To operate successfully the production parameters have to be determined individually by the user.

Measuring conditions:

1) measured at 25°C
2) 100g mixture of BPR 135G3 and particular hardener in water bath at 30°C
3) plate-to-plate rheometer, gap 0.5mm, 25°C, shear rate 100 s⁻¹

<table>
<thead>
<tr>
<th>Property</th>
<th>Unit</th>
<th>Resin BPR</th>
<th>Curing Agent BPH 135G</th>
<th>Curing Agent BPH 137GF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour</td>
<td></td>
<td>red</td>
<td>blue</td>
<td>blue</td>
</tr>
<tr>
<td>Density (g/cm³)</td>
<td></td>
<td>1.05 – 1.15</td>
<td>1.05 – 1.15</td>
<td>1.05 – 1.15</td>
</tr>
<tr>
<td>Viscosity (Pa·s)</td>
<td>10 – 20</td>
<td>10 – 20</td>
<td>10 – 20</td>
<td>10 – 20</td>
</tr>
<tr>
<td>Pot life (Pa·s)</td>
<td>45 – 90</td>
<td>90 – 160</td>
<td>130 – 200</td>
<td>130 – 210</td>
</tr>
</tbody>
</table>

Characteristics
Approval
Secondary bonding of FRP to FRP and various materials.

Application
Production of rotor blades for wind energy plants, shipbuilding, sporting goods, moulds and other devices.

Operational temperature
-60°C up to +50°C without heat treatment
-60°C up to +80°C with heat treatment

Processing
Generally process temperatures between 10°C – 50°C, depending on individual production conditions.

Features
fills gaps of up to approx. 30 mm without sagging,
good sag resistance at elevated temperature

Storage
Shelf life of at least 24 months in originally sealed containers

Bond lines
Bond line thickness control is important for any structural adhesive joint application to obtain consistent and optimal adhesive joint properties. For larger parts, such as found in boat and wind turbine blade production, bond line thicknesses of 1-10 mm are generally targeted. Due to the glass fibre in the 135G bonding paste system, improved fatigue properties, higher cohesive strengths and lower exotherms, have been observed. In applications where bond line thicknesses may be greater than 10 mm the effects of higher exotherm temperatures and lower adhesive joint properties should be evaluated.

Bonding Paste Systems
All the bonding paste resins (EPIKOTE™ Resin MGS™ BPR 135G2, 135G25, 135G3) can be processed with the following specially modified curing agents:

- EPIKURE™ Curing Agent MGS™ BPH 134G  
  very fast curing agent

- EPIKURE™ Curing Agent MGS™ BPH 1340G  
  very fast curing agent

- EPIKURE™ Curing Agent MGS™ BPH 1355G  
  fast curing agent

- EPIKURE™ Curing Agent MGS™ BPH 135G  
  medium curing agent

- EPIKURE™ Curing Agent MGS™ BPH 136G  
  slow curing agent

- EPIKURE™ Curing Agent MGS™ BPH 137G  
  very slow curing agent

- EPIKURE™ Curing Agent MGS™ BPH 137GF  
  very slow curing agent with fast Tg-development

Temperature Development
Development of temperature BPR 135G3

Measuring conditions: measured 100g in a paper cup with a lid isolated in a water bath at 30°C starting at 30°C
The optimum processing (mixing) temperature is in the range of 20°C to 30°C. Higher temperatures are possible, but will shorten pot life. A temperature increase of 10°C will halve the pot life. Water (e.g. high humidity or contained in additional fillers) causes an acceleration of the resin/curing agent reaction. Different temperatures and humidity during processing are not known to have significant impact on the mechanical properties of the cured product.

Do not mix large quantities – particularly of highly reactive systems – at elevated processing temperatures. As the heat dissipation in the mixing container is very slow, the contents will be heated up by the reaction heat (exothermic resin-curing agent reaction) rapidly. This can result in temperatures of more than 200°C in the mixing container, which may cause smoke-intensive burning of the resin mass.

**TG DEVELOPMENT**

Development of the glass transition temperature

![Graph showing Tg midpoint vs time for different curing agents](image)

**Measuring conditions:**
- Curing: in oven at 70°C
- DSC-measuring heat rate: 10 K/min

![Graph showing Tg midpoint vs time for different curing agents at 80°C](image)

**Measuring conditions:**
- Curing: in oven at 80°C
- DSC-measuring heat rate: 10 K/min

**Applying & Curing**

The recommended temperature for mixing and application is around 20 - 30°C. In general the part surface temperature should be <35°C when bonding paste is applied, depending on gap thickness and resin type, however higher surface temperatures can be possible. In any case, detailed processing tests are recommended. All excess bonding paste should be removed from the bond lines before cure. Parts should be heated at a slow rate (e.g. < 1°C/minute) to minimize internal stresses during the curing process, see the table below. For thick bond lines (typically > 10 mm) a stepped cure may be necessary to avoid temperature excursions due to exothermic reaction of the bonding paste.

In parts with thick bond lines, temperatures at the centre of the bonding paste can be measured to help design/define the cure profile to optimize manufacturing efficiency and adhesive performance.
<table>
<thead>
<tr>
<th>Gap thickness</th>
<th>Part surface temperature when applying bonding paste</th>
<th>Suggested cure schedule</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 10 mm</td>
<td>up to cure temperature</td>
<td>1. ramp at &lt; 1°C/minute&lt;br&gt;2. hold at ~ 75°C for 4 hrs&lt;br&gt;3. cool to ambient at &lt; 1°C/minute</td>
</tr>
<tr>
<td>10 – 20 mm</td>
<td>&lt; 40°C</td>
<td>1. ramp at &lt; 1°C/minute&lt;br&gt;2. hold at ~ 50°C at 1 hr&lt;br&gt;3. ramp at &lt; 1°C/minute&lt;br&gt;4. hold at ~ 75°C for 4 hrs&lt;br&gt;5. cool to ambient at &lt; 1°C/minute</td>
</tr>
<tr>
<td>20 – 30 mm</td>
<td>&lt; 35°C</td>
<td>1. ramp at &lt; 0.5°C/minute&lt;br&gt;2. hold at ~ 50°C at 1 hr&lt;br&gt;3. ramp at &lt; 1°C/minute&lt;br&gt;4. hold at ~ 75°C for 4 hrs&lt;br&gt;5. cool to ambient at &lt; 1°C/minute</td>
</tr>
</tbody>
</table>

The information in the table is just a basic recommendation and can’t replace processing tests based on the specific conditions at usage.

**FLOW CURVE**

Flow curve (Viscosity as a function of shear rate)

BPR 135G3 with curing agent BPH 137G

![Flow Curve](image)

Measuring conditions:

Shear rate: variable
Temperature: 25°C
Physica MC1, plate-plate configuration

**GLASS TRANSITION TEMPERATURE**

Development of the glass transition temperature
Measuring conditions:
Curing: in oven for 10 hours at different temperatures
DSC-measuring heat rate: 10 K/min
Diagram states Tg midpoint

### Mechanical Data

<table>
<thead>
<tr>
<th>Mechanical data</th>
<th>lap shear strength [N/mm²] DIN EN ISO 1465</th>
<th>bonding gap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing: 7h/70°C at standard climate</td>
<td>0.5 mm approx 24.0</td>
<td>3 mm approx 15.0</td>
</tr>
<tr>
<td>Peel strength [N/mm] DIN EN ISO 11339</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td>Curing: 7h/70°C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>tensile test DIN EN ISO 527</th>
<th>Tg midpoint [°C]</th>
<th>tensile strength [MPa]</th>
<th>tensile modulus [MPa]</th>
<th>ultimate strain [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing: 10h/70°C</td>
<td>81</td>
<td>75</td>
<td>5500</td>
<td>2.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>bending test DIN EN ISO 178</th>
<th>Tg midpoint [°C]</th>
<th>bending strength [MPa]</th>
<th>bending modulus [MPa]</th>
<th>ultimate strain [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curing: 10h/70°C</td>
<td>81</td>
<td>110</td>
<td>5300</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Advice:
Mechanical data is typical for the combination of EPIKOTE™ Resin MGS™ BPR 135G3 with EPIKURE™ Curing Agent MGS™ BPH 137G/137GF. Data can differ in other applications.

### Paste Application – Sagging / Vertical Gaps

The system is particularly suitable for vertical surfaces and wide gaps and is designed not to sag at typical cure temperatures. The bonding paste does not bleed out of vertical gaps even if the parts are immediately cured.

Bonding Paste Resins
EPIKOTE™ Resin MGS™ BPR 135G2 paste thickness up to app. 5 mm


© and ™ Licensed trademarks of Hexion Inc.

The information provided herein was believed by Hexion Inc. (“Hexion”) to be accurate at the time of preparation or prepared from sources believed to be reliable, but it is the responsibility of the user to investigate and understand other pertinent sources of information, to comply with all laws and procedures applicable to the safe handling and use of the product and to determine the suitability of the product for its intended use. All products supplied by Hexion are subject to Hexion’s terms and conditions of sale. HEXION MAKES NO WARRANTY, EXPRESS OR IMPLIED, CONCERNING THE PRODUCT OR THE MERCHANTABILITY OR FITNESS THEREOF FOR ANY PURPOSE OR CONCERNING THE ACCURACY OF ANY INFORMATION PROVIDED BY HEXION, except that the product shall conform to Hexion’s specifications. Nothing contained herein constitutes an offer for the sale of any product.
EPIKOTE™ Resin MGS™ BPR 135G25 paste thickness up to app. 15 mm
EPIKOTE™ Resin MGS™ BPR 135G3 paste thickness up to app. 30 mm

MIXING

Adding more or less curing agent outside the permissible tolerance range will not speed up or slow down the reaction rate (gel time) – it will cause incomplete curing of the bonding paste which cannot be corrected in any way by reworking. The resin and curing agent components are thick and must be mixed very thoroughly. Mix until no clouding is visible in the mixing container. The different colours of the resin and curing agent components facilitate visual verification. Pay special attention to the walls and the bottom of the mixing container. Manual mixing of larger quantities of resin and curing agent is very difficult due to the high viscosity of the components. In order to guarantee good mixing of large volumes in production, the use of suitable mixing machines is essential.

Mixing Ratio

<table>
<thead>
<tr>
<th></th>
<th>BPR 135G with all curing agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts by weight</td>
<td>100 : 45 ± 2</td>
</tr>
<tr>
<td>Parts by volume</td>
<td>100 : 50 ± 2</td>
</tr>
</tbody>
</table>

The mixing ratio stated must be observed very carefully. Adding more or less curing agent will not result in a faster or slower reaction, but in incomplete curing which cannot be corrected in any way.

Resin and curing agent must be mixed very thoroughly. Mix until no clouding is visible in the mixing container. Pay special attention to the walls and bottom of the mixing container.

Surface Preparation

Direct application to non-porous material surfaces is possible. Porous, absorbent surfaces should be primed with a liquid resin mix (e.g. laminating resin MGS™ LR135 with curing agents MGS™ LH133-138). The bonding paste can then be applied either immediately or following slight gelling. Priming with bonding paste is not recommended.

Storage

The resins and curing agents can be stored for at least 24 months in the carefully sealed original containers. The products do not crystallize at storage temperatures between 10°C and 30°C. At storage temperatures above 30°C, some liquid formation may be observed for the curing agents, which is a natural phenomenon for pastes. Liquid formation will increase with storage time and storage temperature.