Highly Toughened Gap Filling Adhesives For Enhanced Body Structure Reinforcement

Daniel Sophiea / Raymond Bis
Dow Automotive Systems
• BETAMATE™ LWR Product Family
• Advantages of chemistry
• Advantages over manually applied tapes
• High modulus grade BETAMATE™ LWR
• Mid and low Modulus Grade BETAMATE™ LWR
• Performance Differences
• Recommended areas of use

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BETAMATE™ LWR is a toughened epoxy hybrid chemistry for use in the body shop.
BETAMATE™ LWR Expandable Adhesives

- Designed for BIW substrates
- Mass efficient solution
- Toughness and body stiffness
- Applied in bulk
BETAMATE™ LWR Products

• One Part Epoxy Hybrids
  Body Shop Bake bonds through oily substrates
• Toughened
  Absorbs energy and does not become brittle at cold temperatures
• Expandable
  Fills gaps and compensates for metal separation and movement during thermal loads

- Robotically applied in bulk
- Designed to endure wash and e-coat cycles
Robotically Applied Expandable Structural Adhesive

- Expands 150% by volume ➔ fills gaps
- Robotic Application
  - Removes risk of human error
  - Faster cycle times
  - Removes added labor and piece costs
- Tailored Application ➔ bead dimensions
- Useful for areas that are difficult to weld
- Robust adhesion to a variety of metals
- Useful for areas with variable design gaps – up to 15 mm
- Can bond substrates with different CLTE

Uniform Expansion

5mm
## Tape vs. Paste Application

<table>
<thead>
<tr>
<th>Tape Adhesive</th>
<th>Paste Adhesive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material Applied</td>
<td>Material Applied</td>
</tr>
<tr>
<td>Parts Mated</td>
<td>Parts Mated</td>
</tr>
<tr>
<td>Thermal Load</td>
<td>Thermal Load</td>
</tr>
<tr>
<td>Expansion &amp; Cure</td>
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</tr>
</tbody>
</table>
BETAMATE™ LWR Product Family

High Modulus (Crash Worthiness Stiffness Torsional rigidity)
- Fills gaps to improve structural integrity
- Weld accessibility
- Thermal expansion
- Galvanic corrosion

Low Modulus (NVH Performance moderate structural bond, class A surfaces)

Before Bake

High Modulus
- Storage Modulus
- Loss Modulus
- Tan δ

Low Modulus
- Temp (°C)

After Bake
# BETAMATE™ LWR Product Family

<table>
<thead>
<tr>
<th>Product</th>
<th>Status</th>
<th>Modulus</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>BETAMATE™ LWR High Modulus</td>
<td>Implemented</td>
<td>350 - 750MPa</td>
<td>Stiffness, crash worthiness</td>
</tr>
<tr>
<td>BETAMATE™ LWR Medium Modulus</td>
<td>Commercially available 4(^{th}) Quarter 2018</td>
<td>150 - 250 MPa</td>
<td>Tape replacement, NVH</td>
</tr>
<tr>
<td>BETAMATE™ LWR Low Modulus</td>
<td>Commercially available 2(^{nd}) quarter 2018</td>
<td>35 - 150 MPa</td>
<td>NVH, Low distortion to class A surfaces</td>
</tr>
</tbody>
</table>
Key Areas Targeted For BETAMATE™LWR

High modulus for crash and torsional stiffness

Mid modulus for areas that need high stiffness and have mild distortion issues

Low modulus for areas that have surfaces more sensitive to defects in the class A surface
Typical Uses for BETAMATE™ LWR High Modulus

Key areas for crash performance in pillar areas

Rocker panels for stiffness and torsional rigidity

Sun roof support rings (non class A surface)
BETAMATE™ LWR High Modulus

**Force Deflection Response**
(Standard Bake 171°C)

- **Toughened Material**: 150% Volume Expansion
- **Non toughened Material**: 150% Expansion

![Force Deflection Graph](image)
Special Case: Bonding Class A Surfaces

Class A Surfaces present special challenges

- “Read-through”
- Outer panel distortion
- Rigidity loss by light weighting
- Each application is unique

LWR performance tailored to alleviate distortion issues
Thermal loads cause:

- Metal expansion
- Induced strain
- Returns to original state upon cooling
When bonding two parts together the adhesive hardens and can prevent perfect hysteresis.

This can result in visual defects in class A surfaces.
Residual strain levels can be minimized through the optimization of LWR cured performance properties.
BETAMATE™ LWR Low Modulus

Possible applications on:
- lift gates
- doors
- roofs
- pillars
- and other class A areas in need of stiffness and improved NVH response

Areas with more contour and/or stiffness utilize mid modulus such as front and rear header areas and roof perimeter

- Lower Modulus (compared to most structural adhesives)
- Lower Tg (compared to most structural adhesives)
- Better NVH response (compared to most anti-flutters)
- More structure than anti-flutter material
Strength Differences

Lap Shear and T-peel geometry
Conclusion

BETAMATE™ LWR is a new tool for engineers that offers:

- Expansion
- Robotic application
- Tailored performance
- Potential cost savings
For More Information

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Thank You !!