MATERIALS FOR AUTOMOTIVE CAMERAS
BONDING, CONNECTING, PROTECTING AND THERMAL SOLUTIONS
CONTENTS

Introduction .......................................................................................................................................................... 3

Product Portfolio ............................................................................................................................................... 4

ADAS Stereo Camera Solutions ....................................................................................................................... 5

ADAS Surround Camera Solutions ................................................................................................................... 6

Bonding Solutions for Multiple Assembly Applications .................................................................................. 7

MATERIALS FOR ADAS CAMERAS

Bonding Materials ........................................................................................................................................... 8

Connecting Materials ...................................................................................................................................... 13

Protecting Materials ....................................................................................................................................... 18

Thermal Materials .......................................................................................................................................... 24
ADAS: THE ROAD TO A SAFER DRIVING EXPERIENCE

Advanced Driver Assistance Systems, commonly referred to as ADAS, are becoming far more common in modern-day vehicles. The current adoption rate of 20% is expected to grow dramatically over the next few years, as ADAS proliferation continues and new technologies deliver greater levels of safety behind the wheel. Key to enabling ADAS functionality is the cooperation of cameras, radar and LiDAR, as well as multiple ultrasonic sensor systems, all of which work in concert to identify objects, pedestrians and potential hazards for the driver. In some cases, these technologies even take independent action to ensure driver, passenger and pedestrian safety.

The camera component is essential, with today’s automobiles incorporating as few as one or as many as nine cameras – and the number of cameras and the various technology types are expanding quickly. With driver safety often dependent on camera visibility, the performance reliability of these optical systems is crucial.

FOCUSED EXPERTISE

As the world’s leading adhesives and electronic materials supplier, Henkel’s experience with innovative formulations for functional, reliability-enhancing products is broad and deep. Leveraging our successful work with the top global handheld manufacturers’ camera technologies, Henkel has developed high-reliability camera materials solutions tailored to the unique requirements of automotive camera systems. At every level of camera construction – from the die within the image processor to component connection, thermal management, PCB protection and structural bonding of the final lens assembly – Henkel’s automotive camera materials are the comprehensive, enabling factor for safety-enhancing functionality. The ability to facilitate reliable performance and a clear view in temperature extremes, during rough rides and after exposure to harsh conditions – all while making the move toward greener, more environmentally friendly formulations – is what sets Henkel automotive camera materials apart.
MATERIALS FOR ADAS CAMERAS

- **Bonding**
  - Die Attach Adhesives
  - Lens Bonding Adhesives
  - Module Assembly Adhesives
  - Thread Locking Adhesives
  - Electrically Conductive Adhesives
- **Connecting**
  - Solder Materials
  - Printed Inks
  - Board Level Underfills
  - Conformal Coatings
  - EMI Shielding Materials
- **Protecting**
  - Encapsulants
  - Low Pressure Molding
  - Potting
  - Gap Filler
  - GAP PAD
- **Thermal**
  - Phase Change Materials
BONDING SOLUTIONS FOR MULTIPLE ASSEMBLY APPLICATIONS

Lens To Inside of Lens Barrel

- **Lens Bonding Adhesive**
  - Designed to attach lens to inside of lens barrel
  - Specialized adhesives that accommodate low temperature processing with rapid UV cure

Lens Barrel To Lens Barrel Housing

- **Module Assembly Adhesive**
  - Designed for bonding module housing assemblies with various surface materials

Lens Barrel Housing To PCB

- **Thread Locking Adhesive**
  - Designed for locking and sealing of threaded fasteners
  - Used for active optical alignment of lens assemblies

Lens Barrel Housing To Camera Module Housing

Image Sensor Die to Substrate

- **Die Attach Adhesive**
  - Used to bond image sensor die to substrate
  - Low-temperature cure, low-stress, low-outgassing adhesives
STRONG AND RELIABLE BONDS

When it comes to automotive safety, failure is not an option, making lens precision and module durability vital to camera effectiveness. Henkel’s broad portfolio of lens bonding, module assembly, thread locking and die attach adhesives – both in customized and original formulations – offer cure flexibility and processing adaptability. UV-, thermal- and dual-cure adhesives for lens bonding provide high stability, with less than a 1% change in size after cure to ensure precision active alignment and in-use focus reliability. Module assembly materials are also as versatile, with UV only, as well as dual-cure (UV and thermal) options for reliable bonding of the lens barrel, housing, PCB, camera module, IR filter and image sensor.

At the chip level, non-conductive die attach adhesives in multiple formulations and mediums offer strong die bonding for reliable image sensor performance. Strong adhesion, robust temperature stability, application-specific customization and a move toward green formulations are why automotive camera specialists are increasingly turning to Henkel for bonding solutions.

*Bonding Materials for ADAS Cameras*

<table>
<thead>
<tr>
<th>BONDING</th>
<th>Film</th>
<th>Paste</th>
<th>Thermal Cure</th>
<th>UV + Moisture Cure</th>
<th>UV + Thermal Cure</th>
<th>Module Assembly Adhesives</th>
<th>Die Attach Adhesives</th>
<th>Lens Bonding Adhesives</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Product not available in Europe</em></td>
<td>LOCTITE ABLESTIK ABT 100U SERIES</td>
<td>LOCTITE ABLESTIK 2035 SCR</td>
<td>LOCTITE 3129</td>
<td>LOCTITE ECCOBOND UV 9052</td>
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<tr>
<td></td>
<td>LOCTITE ABLESTIK 2040 LV</td>
<td>LOCTITE ABLESTIK GA 2W</td>
<td>LOCTITE ABLESTIK 8420</td>
<td>LOCTITE ABLESTIK NCA 2350</td>
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<td></td>
<td>LOCTITE ABLESTIK 8420</td>
<td>LOCTITE ABLESTIK NCA 2360</td>
<td>LOCTITE ABLESTIK NCA 2360</td>
<td>LOCTITE ABLESTIK NCA 2380</td>
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<tr>
<td></td>
<td>LOCTITE 3131</td>
<td>LOCTITE 3217</td>
<td>LOCTITE ABLESTIK NCA 2280</td>
<td>LOCTITE ABLESTIK NCA 2280</td>
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<tr>
<td></td>
<td>LOCTITE 3131</td>
<td>LOCTITE 3217</td>
<td>LOCTITE ABLESTIK NCA 2280 LV</td>
<td>LOCTITE ABLESTIK NCA 2340</td>
<td></td>
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<tr>
<td></td>
<td>LOCTITE ABLESTIK NCA 2280</td>
<td>LOCTITE ABLESTIK NCA 2280 LV</td>
<td>LOCTITE ABLESTIK NCA 2380</td>
<td>LOCTITE ABLESTIK NCA 2350</td>
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</tr>
<tr>
<td></td>
<td>LOCTITE 4031</td>
<td>LOCTITE 4601</td>
<td>LOCTITE ABLESTIK NCA 2280</td>
<td>LOCTITE ABLESTIK NCA 2280 LV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Product not available in Europe*
## DIE ATTACH ADHESIVES

### Die Attach Film

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Glass Transition Temperature, $T_g$ (°C)</th>
<th>Film Thickness (µm)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C)</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE ABLESTIK ATB 100U Series | Silica-filled, rubberized epoxy die attach adhesive film | • Fast cure  
• Thin bondline  
• Excellent gap filling ability  
• MS12 260°C capable  
• Compatible with Cu wire or Au wire packages  
• Compatible with Stealth Dicing Before Grind (SDBG) process | 75 | 15  
10  
20 | 62  
238 | 875 | 30 min. ramp + 30 min. hold at 120°C |

### Die Attach Paste

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Glass Transition Temperature, $T_g$ (°C)</th>
<th>Viscosity at 25°C (cP)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C)</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE ABLESTIK ABP 2035SCR | Silica-filled die attach adhesive | • One component  
• Low stress  
• Snap cure or low temperature oven cure  
• Excellent dispensing performance for high throughput applications  
• Compatible with dam and fill encapsulants | 118 | 9,830 at 5 rpm | 50  
135 | 1,500 | 2 min. at 120°C |
| LOCTITE ABLESTIK ABP 2024 | BMI hybrid die attach adhesive | • Low outgassing  
• One component  
• High reliability | 47 | 13,000 at 5 rpm | 127  
156 | 510 | 30 min. ramp + 30 min. hold at 175°C |
| LOCTITE ABLESTIK ABP 2040 LV | Epoxy non-conductive die attach adhesive | • One component  
• Fast cure  
• Low temperature cure  
• Low stress  
• Low warpage | 28 | 11,000 at 5 rpm | 3  
129  
4  
2,603 | 2 min. at 120°C |
| LOCTITE ABLESTIK GA 2W | Acrylic die attach adhesive | • Very low stress  
• Low chip warpage  
• Improved viscosity  
• Thixotropic  
• Good dispensability  
• One component | 25 | 10,000 at 5 rpm | 58  
164 | 70 | 30 min. ramp + 15 min. hold at 175°C |
# Lens Bonding Adhesives

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Glass Transition Temperature, $T_g$ (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C)</th>
<th>Viscosity at 25°C (cP)</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermal Cure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCTITE 3129 Epoxy adhesive and sealant</td>
<td>• Excellent adhesion</td>
<td>35</td>
<td>47</td>
<td>145</td>
<td>11,800</td>
<td>200</td>
<td>30 min. at 80°C</td>
</tr>
<tr>
<td>LOCTITE 3220 Epoxy adhesive and sealant</td>
<td>• One component, Fast cure at low temperatures, Excellent adhesion</td>
<td>26</td>
<td>47</td>
<td>145</td>
<td>8,200</td>
<td>3,240</td>
<td>5 – 10 min. at 80°C</td>
</tr>
<tr>
<td>LOCTITE 3220WH Epoxy adhesive and sealant</td>
<td>• One component, Fast cure at low temperatures, Excellent adhesion, White pigmentation for excellent light reflection</td>
<td>29</td>
<td>55</td>
<td>162</td>
<td>8,940</td>
<td>550</td>
<td>5 – 10 min. at 80°C</td>
</tr>
<tr>
<td>LOCTITE ABLESTIK ABP 8420 Epoxy adhesive</td>
<td>• Excellent resin bleed out (RBO) performance, Fast cure at low temperatures, One component, Good adhesion, Medium viscosity</td>
<td>33</td>
<td>53</td>
<td>171</td>
<td>13,500</td>
<td>2,054</td>
<td>15 min. at 150°C</td>
</tr>
<tr>
<td>LOCTITE ABLESTIK NCA 2350 Epoxy adhesive and sealant</td>
<td>• Fast cure at low temperatures, One component, Good adhesion, Hot plate or oven cure, Medium viscosity</td>
<td>28</td>
<td>66</td>
<td>180</td>
<td>13,670</td>
<td>2,533</td>
<td>2 min. at 80°C in hot plate</td>
</tr>
<tr>
<td>LOCTITE ABLESTIK NCA 2360 Epoxy adhesive and sealant</td>
<td>• Fast cure at low temperatures, One component, Good adhesion, Hot plate or oven cure, Low viscosity</td>
<td>33</td>
<td>53</td>
<td>171</td>
<td>6,296</td>
<td>550</td>
<td>2 min. at 80°C in hot plate</td>
</tr>
<tr>
<td><strong>UV + Moisture Cure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCTITE ECCOBOND UV 9052 Acrylate adhesive</td>
<td>• One component, Withstands exposure to ink, Cures in shadowed areas, No stringing, $T_g$ can be increased with alternative cure</td>
<td>2</td>
<td>49</td>
<td>248</td>
<td>6,400</td>
<td>1,987</td>
<td>UV cure 0.5 - 1 J for 5 – 10 sec. + moisture cure at ambient humidity</td>
</tr>
<tr>
<td><strong>UV + Thermal Cure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCTITE 3131 Acrylated epoxy adhesive</td>
<td>• Designed for image sensor module assemblies and temperature sensitive electronics components, Fast cure at low temperatures, Low viscosity, Low stress</td>
<td>85</td>
<td>49</td>
<td>175</td>
<td>14,000</td>
<td>954</td>
<td>1 sec. at 100 mW/cm² + 30 min. at 60°C</td>
</tr>
<tr>
<td>LOCTITE 3217 Acrylated epoxy adhesive</td>
<td>• Designed for image sensor module assemblies and temperature sensitive electronics components, Fast cure at low temperatures</td>
<td>82</td>
<td>53</td>
<td>178</td>
<td>37,600</td>
<td>2,865</td>
<td>1 sec. at 100 mW/cm² + 30 min. at 60°C</td>
</tr>
<tr>
<td>LOCTITE ABLESTIK NCA 2200 Acrylated epoxy adhesive</td>
<td>• One component, Low viscosity, Fast cure at low temperatures, Designed for image sensor module assemblies and temperature sensitive electronics components</td>
<td>97</td>
<td>43</td>
<td>150</td>
<td>22,000</td>
<td>5,000</td>
<td>2 sec. at 100 mW/cm² + 30 min. at 80°C</td>
</tr>
</tbody>
</table>
### LENS BONDING ADHESIVES – CONTINUED

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Glass Transition Temperature, ( T_g ) (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C)</th>
<th>Viscosity at 25°C (cP)</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| **LOCTITE ABLESTIK NCA 2280** | Acrylated epoxy adhesive | • One component  
• High thixotropic index  
• High viscosity  
• Black in color to prevent light penetration  
• Fast cure at low temperatures  
• Good adhesion to liquid crystal polymer (LCP) substrates  
• Designed for image sensor module assemblies and temperature sensitive electronics components | 90 | 45 | 156 | 54,000 | 4,500 | 2 sec. at 100 mW/cm² + 30 min. at 80°C |
| **LOCTITE ABLESTIK NCA 2280LV** | Acrylated epoxy adhesive | • One component  
• High thixotropic index  
• Fast cure at low temperatures  
• Low transmittance  
• Good adhesion to liquid crystal polymer (LCP) substrates  
• Black in color to prevent light penetration  
• Designed for image sensor module assemblies and temperature sensitive electronics components | 75 | 54 | 160 | 32,800 | 3,000 | 2 sec. at 100 mW/cm² + 30 min. at 80°C |
| **LOCTITE ABLESTIK NCA 2340** | Acrylated epoxy adhesive | • Excellent adhesion  
• High viscosity  
• High thixotropic index  
• Designed for active alignment in camera module assemblies and temperature sensitive electronics components | 83 | 61 | 195 | 35,000 | 3,000 | 2 sec. at 100 mW/cm² + 30 min. at 80°C |
| **LOCTITE ABLESTIK NCA 2380** | Acrylated epoxy adhesive | • Excellent adhesion  
• Good flow performance  
• High \( T_g \)  
• Low CTE  
• Designed for active alignment in camera module assemblies and temperature sensitive electronics components | 95 | 56 | 183 | 35,000 | 3,000 | 3 sec. at 1000 mW/cm² + 60 min. at 80°C |

*Product not available in Europe
## Module Assembly Adhesives

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Glass Transition Temperature, ( T_g ) (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C)</th>
<th>Viscosity at 25°C (cP)</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UV + Thermal Cure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE 3217 | Acrylated epoxy adhesive | • Designed for image sensor module assemblies and temperature sensitive electronics components  
• Fast cure at low temperatures | 82 | 53 | 178 | 37,600 | 2,865 | 1 sec. at 100 mW/cm² + 30 min. at 60°C |
| LOCTITE ABLESTIK NCA 2200 | Acrylated epoxy adhesive | • One component  
• Low viscosity  
• Fast cure at low temperatures  
• Good adhesion to a variety of substrates  
• Designed for image sensor module assemblies and temperature sensitive electronics components | 97 | 43 | 150 | 9,000 | 5,000 | 2 sec. at 100 mW/cm² + 30 min. at 80°C |
| LOCTITE ABLESTIK NCA 2280 | Acrylated epoxy adhesive | • One component  
• High thixotropic index  
• High viscosity  
• Black in color to prevent light penetration  
• Fast cure at low temperatures  
• Good adhesion to liquid crystal polymer (LCP) substrates  
• Designed for image sensor module assemblies and temperature sensitive electronics components | 90 | 45 | 156 | 54,000 | 4,500 | 2 sec. at 100 mW/cm² + 30 min. at 80°C |
| LOCTITE ABLESTIK NCA 2280LV | Acrylated epoxy adhesive | • One component  
• High thixotropic index  
• Low transmittance  
• Good adhesion to liquid crystal polymer (LCP) substrates  
• Black in color to prevent light penetration  
• Designed for image sensor module assemblies and temperature sensitive electronics components | 75 | 54 | 160 | 32,800 | 3,000 | 2 sec. at 100 mW/cm² + 30 min. at 80°C |

## Thread Locking Adhesives

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Color</th>
<th>Viscosity at 25°C (cP)</th>
<th>Operating Temperature (°C)</th>
<th>Fixture Time at 25°C</th>
<th>Recommended Cure</th>
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<tr>
<td><strong>Moisture Cure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE 4031 | Cyanocrylate thread locking adhesive | • One component  
• Low odor for applications where vapor control is vital  
• Low bloom for cosmetic applications  
• Suitable for metals, plastics and elastomers | Transparent, colorless to pale yellow | 1,650 | -50 – 70 | 5 – 180 sec. depending on substrate | 24 hr. at 22°C |
| LOCTITE 4601 | Cyanocrylate thread locking adhesive | • One component  
• Low odor for applications where vapor control is vital  
• Low bloom for cosmetic applications  
• Suitable for metals, plastics and elastomers  
• Low viscosity | Transparent, colorless to pale yellow | 30 – 60 | -50 – 70 | 5 – 180 sec. depending on substrate | 24 hr. at 22°C |
OUTSTANDING INTERCONNECTION

At the board level, reliable electrical interconnection is the foundation of camera function. A history of innovative solder formulations and market firsts – from high-reliability alloys to game-changing, temperature-stable solder pastes – continue to deliver the performance that electronics specialists require for today’s demanding assemblies. As the leading global supplier of electronics assembly materials, Henkel is uniquely capable of delivering a holistic materials approach for reliable electronic performance. Market-leading solder pastes, cored wire and liquid fluxes; electrically conductive adhesives; and, innovative printed inks offer strong component and PCB interconnect for on-demand, long-term, reliable performance.

CONNECTING MATERIALS FOR ADAS CAMERAS

CONNECTING

Solder Materials

Electrically Conductive Adhesives

Cored Wire

Liquid Flux

Solder Paste

Printed Inks

Conductive Inks

Non-Conductive Inks

Acrylate

Epoxy

Silicone

LOCTITE ABLESTIK CA 3556HF

LOCTITE ABLESTIK CE 3103WLV

LOCTITE ABLESTIK ICP 4000

LOCTITE C 400

LOCTITE C 502

LOCTITE C 511

LOCTITE HYDX

LOCTITE HYDX-20

LOCTITE MF 210

LOCTITE MF 300

LOCTITE MF R301

LOCTITE GC 10

LOCTITE MF 212

LOCTITE ECI 5003 E&C

LOCTITE ECI 8001 E&C

LOCTITE ECI 1010 E&C

LOCTITE ECI 5005 E&C

LOCTITE ECI 8120 E&C

LOCTITE ECI 1011 E&C

LOCTITE NCI 9001 E&C
## ELECTRICALLY CONDUCTIVE ADHESIVES

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Volume Resistivity (Ω∙cm)</th>
<th>Glass Transition Temperature, $T_g$ (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C)</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acrylate</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE ABLESTIK CA 3556HF | Acrylate electrically conductive adhesive | • One component  
• Fast, low-temperature cure  
• Excellent flexibility  
• Good adhesion  
• Low contact resistance | $2.5 \times 10^{-3}$ | -30 | 95 | 278 | 650 | 2 min. at 110°C |
| **Epoxy** |             |                |                          |                                          |                               |                      |                |
| LOCTITE ABLESTIK CE 3103WLV | Epoxy electrically conductive adhesive | • Pb-free alternative to solder  
• Low-temperature cure  
• Stable contact resistance | $8 \times 10^{-4}$ | 114 | 45 | 225 | 4,500 | 10 min. at 120°C |
| **Silicone** |             |                |                          |                                          |                               |                      |                |
| LOCTITE ABLESTIK ICP 4000 | Silicone electrically conductive adhesive | • One component  
• High flexibility  
• Excellent electrical conductivity  
• High-temperature performance  
• Pb-free alternative to solder  
• High electrical current carrying capability  
• Low-temperature cure  
• Outstanding elongation performance  
• Low outgassing | $6 \times 10^{-3}$ | -45 | N/A | 330 | 101 | 1 hr. at 130°C |
### SOLDER MATERIALS

#### Cored Wire

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Approximate Flux Content (% by Weight)</th>
<th>Diameter Range (mm)</th>
<th>Pb-Free Alloy</th>
<th>SnPb Alloy</th>
<th>IPC J-STE-004B Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOCTITE C 400</td>
<td>Cored solder wire</td>
<td>• Clear residue&lt;br&gt;• Increased flux content for improved wetting on challenging surfaces&lt;br&gt;• Award-winning multiple flux core technology that ensures consistent distribution of flux throughout the solder wire&lt;br&gt;• Suitable for manual and robotic soldering</td>
<td>2.2</td>
<td>0.38 – 1.63</td>
<td>905C&lt;br&gt;99C&lt;br&gt;SAC305&lt;br&gt;SAC387</td>
<td>Sn60&lt;br&gt;Sn62&lt;br&gt;Sn63</td>
<td>ROLO</td>
</tr>
<tr>
<td>LOCTITE C 502</td>
<td>Cored solder wire</td>
<td>• Clear residue&lt;br&gt;• Good wetting on difficult substrates&lt;br&gt;• Medium activity flux</td>
<td>2.7</td>
<td>0.25 – 1.63</td>
<td>99C&lt;br&gt;SAC305&lt;br&gt;SAC387</td>
<td>Sn60&lt;br&gt;Sn62&lt;br&gt;Sn63</td>
<td>ROM1</td>
</tr>
<tr>
<td>LOCTITE C 511</td>
<td>Cored solder wire</td>
<td>• Amber residue&lt;br&gt;• Good wetting on difficult substrates&lt;br&gt;• Heat stable&lt;br&gt;• Medium activity flux</td>
<td>2.7</td>
<td>0.38 – 1.63</td>
<td>99C&lt;br&gt;SAC305&lt;br&gt;SAC387</td>
<td>Sn60&lt;br&gt;Sn62&lt;br&gt;Sn63</td>
<td>ROM1</td>
</tr>
<tr>
<td>LOCTITE HYDX</td>
<td>Cored solder wire</td>
<td>• High activity flux&lt;br&gt;• Excellent wetting on difficult substrates</td>
<td>2.0</td>
<td>0.38 – 1.63</td>
<td>99C&lt;br&gt;SAC305&lt;br&gt;SAC387</td>
<td>Sn60&lt;br&gt;Sn62&lt;br&gt;Sn63</td>
<td>ORH1</td>
</tr>
</tbody>
</table>
### Liquid Flux

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Solid Content (% by Weight)</th>
<th>Acid Value (mg KOH/g)</th>
<th>Application</th>
<th>IPC J-STE-004B Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Halide-Containing, Water Wash</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE HYDX-20 | Liquid Flux           | • Highly water soluble  
• Residues designed to be cleaned with deionized water  
• Solders onto copper, brass, nickel and mild steel efficiently  
• Compatible with Pb-free and SnPb wave solder processes | 20                         | 24                     | Spray/Foam   | ORH1                        |
| **Halide-Free, No-Clean** |
| LOCTITE MF 210 | Liquid Flux           | • Resin-free flux designed to solder onto surfaces known to have poor solderability  
• Recommended for applications where high throughput is required  
• Compatible with Pb-free and SnPb wave solder processes | 2.9                        | 22.5                   | Spray/Foam   | ORM0                        |
| LOCTITE MF 3001 | Liquid Flux           | • Higher solids flux for better wetting on surfaces known to have reduced solderability  
• Minimizes bridging on complex geometries  
• Fully Pb-free and dual wave compatible  
• Solvent-based flux may be thinned with isopropyl alcohol (IPA)  
• Compatible with Pb-free and SnPb wave solder processes | 6.0                        | 40                     | Spray/Foam   | ROMO                        |
| **Halogen-Free, VOC-Free, No-Clean** |
| LOCTITE MF 300 | Liquid Flux           | • General-purpose, resin-free, water-based flux with special formulation designed to minimize solder balling  
• Compatible with Pb-free and SnPb wave solder processes | 4.6                        | 37                     | Spray/Foam   | ORM0                        |
| **Halogen-Free, No-Clean** |
| LOCTITE MF 390HR | Liquid Flux           | • Exceptional through-hole fill  
• Recommended for automotive applications and general electrical soldering applications  
• Compatible with Pb-free and SnPb wave solder processes | 6.0                        | 20 – 25                 | Spray/Foam   | ROL0                        |

### Solder Paste

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Alloy</th>
<th>Particle Size Distribution</th>
<th>IPC J-STE-004B Classification</th>
<th>Optimal Shelf Life</th>
<th>Reflow Atmosphere</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Temperature Stable, Halogen-Free, No-Clean</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE GC 10 | Pb-free, solder paste | • RoHS-compliant  
• Excellent resistance to high humidity  
• Industry leader in paste transfer efficiency  
• Improved stability at different storage and operating temperatures  
• Extended stencil life up to 72 hr.  
• Extended abandon time up to 24 hr.  
• Suitable for high-density, small to large boards | SAC305 | • Type 3  
• Type 4  
• Type 4.5 (4A)  
• Type 5 | ROLO | 1 year at 26.5°C | Designed for air; suitable with nitrogen |
| **Halogen-Free, No-Clean** |
| LOCTITE HF 212 | Pb-free, solder paste | • High tack  
• Low voiding  
• RoHS-compliant  
• Excellent fine pitch coalescence  
• Designed for medium to large boards | SAC307  
SAC305  
SAC387 | • Type 3  
• Type 4  
• Type 4.5 (4A)  
• Type 5 | ROLO | 6 months at 0°C – 10°C | Air and nitrogen |
## PRINTED INKS

### Conductive Inks

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Coverage at 10 μm (m²/kg)</th>
<th>Sheet Resistance (Ω/sq/25 μm)</th>
<th>Processing</th>
<th>Substrates</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transparent Inks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE ECI 5003 E&C | Conductive printable ink | • Low temperature cure  
• No need for laser etching | 2.6 | < 100 | Screenprint | PET* | 3 min. at 85°C + 5 min. at 140°C |
| LOCTITE ECI 5005 E&C | Conductive printable ink | • Low temperature cure  
• ITO replacement | 2.6 | < 100 | Screenprint | PET* | 3 min. at 85°C + 5 min. at 140°C |
| **PTC Carbon Inks** |
| LOCTITE ECI 8001 E&C | Positive temperature coefficient (PTC) printable ink | • Flexible  
• Printable on most common substrates  
• Self-regulating heater with PTC temperature of 65°C | 48 | 1,700 | Screenprint | Polyester  
PET*  
Polyimide film | 10 min. at 120°C |
| LOCTITE ECI 8120 E&C | Positive temperature coefficient (PTC) printable ink | • Flexible  
• Printable on most common substrates  
• Self-regulating heater with PTC temperature of 120°C | 43 | 1,700 | Screenprint | Polyester  
PET*  
Polyimide film | 10 min. at 140°C |
| **Silver Inks** |
| LOCTITE ECI 1010 E&C | Conductive printable ink | • Flexible  
• Good adhesion  
• High conductivity with optimum mechanical performance  
• Compatible with LOCTITE EDAG 440A E&C, LOCTITE EDAG 440B E&C and LOCTITE EDAG PF 455B E&C | 10.6 | 0.007 | Screenprint | Polyimide film  
PET* | 15 min. at 120°C |
| LOCTITE ECI 1011 E&C | Flexography and conductive printable ink | • High conductivity  
• Small particle size  
• Excellent adhesion  
• Excellent printability with flexography  
• Flexible | 8.3 | < 0.005 | Screenprint  
Flexographic  
Rotogravure | Paper  
PET*  
Polyimide film  
ITO film*** | 10 min. at 150°C |

### Non-Conductive Inks

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Coverage at 10 μm (m²/kg)</th>
<th>Processing</th>
<th>Substrates</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dielectric Inks</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE NCI 9001 E&C | Printable dielectric ink | • Insulating  
• Excellent transparency  
• Good flexibility  
• Minimal dielectric strength  
• Excellent flexibility  
• Resistant to abrasion  
• Primer coat to adhere to difficult substrates | 18.8 | Screenprint  
Flexographic | Flexible copper circuits  
ITO*** sputtered polyester film  
Metals  
Glass | 5 min. at 130°C |

*Polyethylene terephthalate (PET)  
**Polyethylene naphthalate (PEN)  
***Indium-tin-oxide (ITO)
RELIABLE CIRCUIT BOARD PROTECTION

Safeguarding all elements of automotive cameras from the effects of moisture, corrosion, adverse environmental conditions, electromagnetic interference, vibration and shock is vital. With many camera technologies now integrated into the vehicle’s exterior bumpers, proper protection against external conditions guarantees dependable function. Henkel’s range of protecting materials is broad, covering everything from conformal coatings for PCB performance longevity to underfills and encapsulants for image sensor reliability, and EMI shielding coatings and sealants for minimized signal noise.

This focus on exceptional protection extends from the inside out – all the way to the camera housing, where Henkel’s TECHNOMELT low-pressure molding materials offer a fast, cost-effective alternative to traditional plastic injected molding techniques, and our potting materials provide rugged defense for cameras mounted on vehicle exteriors. With Henkel materials protecting them, automotive cameras are fail-safe.
## BOARD LEVEL UNDERFILLS

### Capillary Underfills

| Product Name               | Description                                | Key Attributes                                                                 | Modulus at 25°C (MPa) | Glass Transition Temperature, $T_g$ (°C) | Coefficient of Thermal Expansion, CTE (ppm/°C) | Pot Life                                      | Recommended Cure                |
|----------------------------|--------------------------------------------|--------------------------------------------------------------------------------|------------------------|-----------------------------------------|-----------------------------------------------|----------------------------------|
| **LOCTITE ECCOBOND E 1172 A** | Non-reworkable, capillary flow, epoxy underfill | • Snap curable  
• Fast cure at low temperatures  
• One component  
• Non-anhydride curing chemistry  
• Void-free | 10,000 | 135 | 27 | 85 | 48 hr. at 25°C | 6 min. at 135°C |
| **LOCTITE E 1216M** | Non-reworkable capillary flow underfill | • Snap or inline cure  
• Fast, void-free underfill of area array devices  
• Excellent stability during shipping, storage and use  
• Excellent adhesion and strength  
• Non-anhydride curing chemistry | 2,970 | 125 | 35 | 131 | 5 days at 25°C | 3 min. at 165°C |
| **LOCTITE ECCOBOND FP4531** | Capillary flow underfill | • Snap curable  
• Fast flow  
• High adhesion strength  
• Proven workability at high temperatures  
• Qualified in automotive reliability conditions | 7,600 | 161 | 28 | 104 | 24 hr. at 25°C | 7 min. at 160°C |
## BOARD LEVEL UNDERFILLS – CONTINUED

### Cornerbond & Edgebond Underfills

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Viscosity at 25°C (cP)</th>
<th>Glass Transition Temperature, $T_g$ (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C)</th>
<th>Pot Life</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cornerbond</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCTITE 3508NH</td>
<td>Reworkable epoxy underfill</td>
<td>• One component</td>
<td>70,000</td>
<td>118</td>
<td>65</td>
<td>175</td>
<td>30 days at 25°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Reflow curable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Cure during Pb-free solder reflow profile at 245°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Eliminates post-reflow dispense and cure steps</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>• Reworkable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Halogen-free</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Edgebond</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>LOCTITE 3128</td>
<td>Epoxy underfill</td>
<td>• One component</td>
<td>22,000</td>
<td>45</td>
<td>40</td>
<td>130</td>
<td>3 weeks at 25°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Low temperature cure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20 min. at 80°C bondline temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Excellent adhesion to a wide range of materials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCTITE 3705</td>
<td>Acrylate underfill</td>
<td>• One component</td>
<td>44,000</td>
<td>-39 ($T_g$ 1) 77 ($T_g$ 2)</td>
<td>66</td>
<td>151</td>
<td>30 days at 25°C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Thixotropic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>80 sec. at 30 mW/cm²</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Medium viscosity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Fast UV cure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• No post cure required</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Good adhesion to a variety of substrates</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PROTECTING MATERIALS FOR ADAS CAMERAS**
**CONFORMAL COATINGS**

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Viscosity at 25°C (cP)</th>
<th>Operating Temperature (°C)</th>
<th>Volume Resistivity (Ω∙cm)</th>
<th>Color</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UV + Moisture Cure</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LOCTITE SI 5290 | Silicone conformal coating | • One component  
• Designed for severe temperature environments and high-reliability automotive applications  
• Solvent-free | 100 – 350 | -53 – 200 | 2 × 10¹⁴ | Transparent amber to yellow | 20 – 40 sec. at 70 mW/cm² + 72 hr. at 50% relative humidity |
| LOCTITE SI 5293 | Silicone conformal coating | • One component  
• Exhibits positive fluorescence under UV light  
• Repairable  
• Solvent-free  
• Designed for severe temperature environments and high-reliability automotive applications | 400 – 800 | -40 – 200 | 1 × 10¹⁴ | Transparent amber to yellow | 20 – 40 sec. per side at 70 mW/cm² + 72 hr. at 50% relative humidity |
| LOCTITE STYCAST PC 40-UMF | Urethane acrylate conformal coating | • One component  
• VOC-free  
• Conforms to IPC-CC-830 requirements | 250 | -40 – 135 | 3.5 × 10¹⁴ | Clear | 10 sec. at 300 – 600 mW/cm² + 2 – 3 days at atmospheric moisture |
| LOCTITE STYCAST UV 7993 | Urethane conformal coating | • One component  
• Solvent-free  
• Good moisture resistance  
• Excellent chemical resistance | 120 | -40 – 130 | 2.2 × 10¹⁴ | Translucent yellow | 5 sec. at 400 – 700 mW/cm² + 100 hr. at 50% relative humidity |

**EMI SHIELDING MATERIALS**

**Assembly-Level EMI Shielding Coatings**

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Attenuation</th>
<th>Sheet Resistance (Ω/sq/25 μm)</th>
<th>Surfaces</th>
<th>Coverage at 10 μm (m²/kg)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE EDAG 437 E&C | Cu-filled, thermoplastic EMI shielding coating | • Burnish resistant  
• Excellent environmental resistance  
• Stable electrical properties after heat cycling  
• Excellent shielding against radiated electromagnetic interference (EMI) and protection against electrostatic discharge (ESD)  
• Room temperature cure | 50 – 70 dB at 50 μm | < 0.5 | Plastic | 23 | 30 min. at 25°C |
| LOCTITE EDAG 440 AS E&C | Ni-filled, thermoplastic EMI shielding coating | • Excellent shielding against radiated electromagnetic interference (EMI)  
• Protection against electrostatic discharge (ESD)  
• Stable in difficult environmental conditions such as high humidity or heat  
• Room temperature or heat cure | 50 – 70 dB at 50 μm | < 0.5 | Plastic | 17 | 20 min. at 70°C |
| LOCTITE EDAG I415M E&C | Ag-filled, thermoplastic EMI shielding coating | • Excellent shielding against radiated electromagnetic interference (EMI)  
• Maintains low resistance after exposure to heat, cold, humidity and salt spray  
• Air drying system that requires no primer or top coat  
• Room temperature or heat cure | 60 dB at 25 μm | < 0.015 | Plastic | 9 | 30 min. at 70°C |
## PROTECTING MATERIALS FOR ADAS CAMERAS

### EMI SHIELDING MATERIALS – CONTINUED

#### Assembly-Level EMI Shielding Gasketing

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Attenuation</th>
<th>Shore A Hardness</th>
<th>Volume Resistivity (Ω·cm)</th>
<th>Tensile Lap Show Strength, N/m² (TLSS)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE SI 5421 | Ag-filled, silicone gasketing material | • Room temperature cure  
• Low stress  
• High flexibility | • 80 dB at 10 MHz  
• 110 dB at 100 MHz  
• 100 dB at 10 GHz | 50 – 65 | < 1 × 10² | 0.7 | 24 hr. at 25°C |

#### Package-Level EMI Shielding Coatings

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Attenuation</th>
<th>Volume Resistivity (Ω·cm)</th>
<th>Surfaces</th>
<th>Coating Thickness (μm)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE ABLESTIK EMI 8660S | Package-level, conformal EMI shielding coating | • Thinly spray-coated material provides uniform coverage on top and sidewalls of package  
• Excellent adhesion to mold compound  
• Excellent EMI shielding performance at > 100 MHz | 90 dB at 3 μm | 1.5 × 10⁴ | • Epoxy mold compound  
• Copper | 3 – 5 | 1 hr. at 175°C in air |
| LOCTITE ABLESTIK EMI 8880S | Package-level, conformal EMI shielding coating | • Thinly spray-coated material provides uniform coverage on top and sidewalls of package  
• Excellent adhesion to mold compound  
• Excellent EMI shielding performance at > 10 MHz | 90 dB at 3 μm | 7.9 × 10⁴ | • Epoxy mold compound  
• Copper | 3 – 5 | 1 hr. at 175°C in air |

### ENCAPSULANTS

#### Dam

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Viscosity at 25°C (cP)</th>
<th>Glass Transition Temperature, Tg (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C) Below Tg Above Tg</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE ECCOBOND FP4451TD | Epoxy dam encapsulant | • Excellent chemical resistance and thermal stability  
• High thixotropy with high height-to-width aspect ratio (0.7)  
• Designed for use with fill encapsulant LOCTITE ECCOBOND FP4450 | 300,000 | 150 | 21 | 65 | 14,300 | 30 min. at 125°C + 90 min. at 165°C |

#### Fill

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Viscosity at 25°C (cP)</th>
<th>Glass Transition Temperature, Tg (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C) Below Tg Above Tg</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE ECCOBOND FP4450 | Epoxy fill encapsulant | • Low stress  
• Good moisture resistance and excellent chemical resistance  
• Exhibits relatively high flow  
• Excellent pressure pot performance on live devices up to 500 hr. | 43,900 | 155 | 22 | 80 | 13,500 | 30 min. at 125°C + 90 min. at 165°C |

#### Glob Top

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Viscosity at 25°C (cP)</th>
<th>Glass Transition Temperature, Tg (°C)</th>
<th>Coefficient of Thermal Expansion, CTE (ppm/°C) Below Tg Above Tg</th>
<th>Modulus at 25°C (MPa)</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| LOCTITE ECCOBOND E01072 | Epoxy glob top encapsulant | • High Tg  
• Low extractable ionics  
• High performance  
• Long shelf life  
• Fast curing  
• One component | 80,000 | 135 | 43 | 123 | 6,700 | 5 min. at 140°C – 150°C |
# LOW PRESSURE MOLDING

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Color</th>
<th>Operating Temperature (°C)</th>
<th>Shore Hardness</th>
<th>Flammability Rating</th>
<th>Glass Transition Temperature, T&lt;sub&gt;g&lt;/sub&gt; (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased Hardness</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECHNOMELT PA 641</td>
<td>Moldable polyamide                                           • Ideal for applications where strength and hardness are needed</td>
<td>Amber</td>
<td>-40 – 125</td>
<td>92A</td>
<td>UL 94 V-0</td>
<td>-30</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Good adhesion for high-temperature applications</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECHNOMELT PA 646</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td><strong>High-Temperature Resistant</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECHNOMELT PA 673</td>
<td>Moldable polyamide                                           • Good adhesion to a variety of substrates</td>
<td>Amber</td>
<td>-40 – 140</td>
<td>88A</td>
<td>UL 94 V-0</td>
<td>-45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Excellent moisture resistance</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECHNOMELT PA 678</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECHNOMELT PA 682</td>
<td>Moldable polyamide                                           • Suitable for high-humidity applications</td>
<td>Amber</td>
<td>-40 – 150</td>
<td>88A</td>
<td>UL 94 V-0</td>
<td>-40</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Formulated for very low water vapor transmission</td>
<td>Black</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TECHNOMELT PA 687</td>
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</tbody>
</table>

# POTTING

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Color</th>
<th>Viscosity at 25°C (cP)</th>
<th>Glass Transition Temperature, T&lt;sub&gt;g&lt;/sub&gt; (°C)</th>
<th>Shore Hardness</th>
<th>Recommended Cure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Two Component</strong></td>
<td></td>
<td></td>
<td></td>
<td>Part 1</td>
<td>Part 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOCTITE UK U-09FL</td>
<td>Industrial-grade urethane adhesive</td>
<td>• Excellent peel strength • Ideal for bonding glass, metal, polycarbonate and other plastics • Provides an ultra-clear, highly flexible bond line that does not yellow</td>
<td>Transparent</td>
<td>7,800</td>
<td>1,100</td>
<td>25.8</td>
<td>45D</td>
</tr>
</tbody>
</table>
Thermal management is one of the most pressing issues in electronics today. As board densities increase and higher-functioning, smaller form factor components become the norm, managing the heat has become challenging. The CMOS sensor and the logic chip within an automotive camera assembly are prime examples; massive image processing equates to power increases and the need to effectively dissipate the resulting thermal load. As the market leader in thermal management materials, Henkel delivers high-performance BERGQUIST brand thermal interface materials (TIMs) spanning a wide range of mediums and thermal conductivities to accommodate various heat dissipation requirements and manufacturing preferences. Printable phase change TIMs, custom die-cut GAP PADs and liquid dispensable gap fillers offer the conformity, low stress and thermal conductivity required to move heat away from critical components so that automotive cameras maintain their cool to offer safety-enhancing performance.
## GAP FILLER

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Thermal Conductivity (W/m∙K)</th>
<th>Viscosity at 25°C (cP)</th>
<th>Dielectric Strength (V/25 µm)</th>
<th>Flammability Rating</th>
<th>Recommended Cure</th>
</tr>
</thead>
</table>
| BERGQUIST GAP FILLER 1100SF | Silicone-free, thermally conductive liquid gap filling material | • No silicone outgassing or extraction  
• Ultra-conforming material designed for fragile and low-stress applications  
• Ambient and accelerated cure schedules  
• 100% solids – no cure by-products | 1.1                      | 450,000                       | 400                      | UL 94 V-0            | 24 hr. at 25°C     |
| BERGQUIST GAP FILLER 1500  | Thermally conductive liquid gap filling material | • Optimized shear thinning characteristics for ease of dispensing  
• Excellent slump resistance  
• Ultra-conforming with excellent wet-out for low-stress interface applications  
• 100% solids – no cure by-products  
• Excellent low- and high-temperature mechanical and chemical stability  
• Ambient and accelerated cure schedules | 1.8                      | 25,000                        | 400                      | UL 94 V-0            | 5 hr. at 25°C      |
| BERGQUIST GAP FILLER 1500 LV | Thermally conductive liquid gap filling material | • Low volatility for silicone sensitive applications  
• Ultra-conforming with excellent wet-out  
• 100% solids – no cure by-products  
• Excellent low- and high-temperature, chemical and mechanical stability  
• Ambient or accelerated cure schedules | 1.8                      | 20,000                        | 400                      | UL 94 V-0            | 8 hr. at 25°C      |
| BERGQUIST GAP FILLER 3500LV | Thermally conductive liquid gap filling material | • Low volatility for outgassing sensitive applications  
• Ultra-conforming with excellent wet-out for low-stress interfaces on applications  
• 100% solids – no cure by-products  
• Ambient or accelerated cure schedules | 3.5                      | 45,000                        | 275                      | UL 94 V-0            | 24 hr. at 25°C     |
| BERGQUIST GAP FILLER 3500S35 | Thermally conductive liquid gap filling material | • High thermal performance  
• Thixotropic nature makes it easy to dispense  
• Ultra-conforming material designed for fragile and low-stress applications  
• Ambient or accelerated cure schedules | 3.6                      | 150,000                       | 275                      | UL 94 V-0            | 15 hr. at 25°C     |
| BERGQUIST GAP FILLER 4000  | Thermally conductive liquid gap filling material | • High thermal performance  
• Extended working time for manufacturing flexibility  
• Ultra-conforming with excellent wet-out  
• 100% solids – no cure by-products  
• Excellent low- and high-temperature, chemical and mechanical stability  
• Ambient or accelerated cure schedules | 4.0                      | 50,000                        | 450                      | UL 94 V-0            | 24 hr. at 25°C     |
# THERMAL MATERIALS FOR ADAS CAMERAS

## GAP PAD

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Thermal Conductivity (W/m•K)</th>
<th>Modulus at 25°C (kPa)</th>
<th>Dielectric Breakdown Voltage</th>
<th>Thickness (mm)</th>
<th>Flammability Rating</th>
</tr>
</thead>
</table>
| BERGQUIST GAP PAD 1000SF      | Silicone-free, thermally conductive gap filling material                    | • No silicone outgassing  
• No silicone extraction  
• Reduced tack on one side to aid in application assembly  
• Electrically isolating | 0.9                          | 234                   | 6,000 V at 250 µm | 0.254 – 3.175 | UL 94 V-1 |
| BERGQUIST GAP PAD 2200SF      | Silicone-free, thermally conductive gap filling material                    | • Medium compliance with easy handling  
• Electrically isolating | 2                            | 228                   | 5,000 V at 250 µm | 0.254 – 3.175 | UL 94 V-0 |
| BERGQUIST GAP PAD 2202SF      | Silicone-free, high performance, thermally conductive gap filling material  | • Minimal compression set  
• 12.7 µm film provides tack-free surface  
• Tacky side allows for ease of handling and placement | 2                            | 1,500                 | 5,000 V at 250 µm | 0.254 – 3.175 | UL 94 V-0 |
| BERGQUIST GAP PAD 3004SF      | Silicone-free, high performance, thermally conductive gap filling material  | • Excellent thermal performance  
• 6.4 µm polyethylene terephthalate (PET) provides easy disassembly, leaving no residue  
• Tacky side allows for ease of handling and placement | 3                            | 2,450                 | 6,000 V at 250 µm | 0.254 – 3.175 | UL 94 V-0 |
| BERGQUIST GAP PAD HC3.0       | Thermally conductive gap filling material                                  | • High-compliance, low compression stress  
• Fiberglass reinforced for shear and tear resistance  
• Low modulus | 3                            | 110                   | 5,000 V at 500 µm | 0.508 – 3.175 | UL 94 V-0 |
| BERGQUIST GAP PAD HC5.0       | Thermally conductive gap filling material                                  | • Highly conformable  
• Exceptional thermal performance  
• High-compliance, low compression stress  
• Fiberglass reinforced for shear and tear resistance  
• Low modulus | 5                            | 121                   | 5,000 V at 500 µm | 0.508 – 3.175 | UL 94 V-0 |
| BERGQUIST GAP PAD VO ULTRA SOFT | Thermally conductive gap filling material                                | • Highly conformable, low hardness  
• "Gel-like" modulus  
• Decreased strain  
• Puncture, shear and tear resistant  
• Electrically isolating | 1                            | 55                    | 6,000 V at 500 µm | 0.508 – 6.350 | UL 94 V-0 |
# PHASE CHANGE MATERIALS

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Description</th>
<th>Key Attributes</th>
<th>Thermal Conductivity (W/m·K)</th>
<th>Phase Change Temperature (°C)</th>
<th>Dielectric Strength (V/25 µm)</th>
<th>Thickness (mm)</th>
<th>Flammability Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aluminum Carrier</strong></td>
<td></td>
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</tr>
</tbody>
</table>
| BERGQUIST HI-FLOW 22SF-AC | Phase change thermal interface material | • Low thermal impedance  
• Can be manually or automatically applied to the surfaces of room-temperature heat sinks  
• Foil reinforced, adhesive coated  
• Soft phase change compound | 1 | 55 | N/A | 0.102 | UL 94 V-0 |
| LOCTITE TCF 1000 | Non-insulating, phase change thermal interface material | • Low thermal impedance  
• Coated on aluminum foil  
• Used between any non-isolated heat dissipating component and a heat sink or chassis | 1 | 60 | N/A | 0.06 – 0.2 | None |
| LOCTITE TCF 2000 | Non-insulating, phase change thermal interface material | • Used between any non-isolated heat dissipating component and a heat sink or chassis  
• High thermal conductivity | 3 | 51 | N/A | 0.076 | UL 94 V-0 |
| **Polyimide Carrier** | | | | | | | |
| LOCTITE EIF 1000 | High-performance, phase change thermal interface material | • High dielectric strength  
• Excellent cut-through resistance | 0.45 | 60 | > 5,000 | 0.05 – 0.2 | UL 94 V-0 |
| BERGQUIST HI-FLOW 300P | High-performance, phase change thermal interface material | • Field-proven polyimide film  
• Excellent dielectric performance  
• Excellent cut-through resistance  
• Outstanding thermal performance in an insulated pad | 1.6 | 55 | 5,000 | 0.102 – 0.127 | UL 94 V-0 |
| **No Carrier** | | | | | | | |
| BERGQUIST HI-FLOW 550UT | High-performance, phase change thermal interface material | • Very low thermal impedance  
• High thermal conductivity  
• Naturally tacky  
• Tabulated for ease of assembly | 3 | 52 | N/A | 0.127  
• 0.254 | UL 94 V-0 |