Introduction

Fueled by cost-effective, increasingly powerful, and efficient battery technology, the automotive industry finds itself in a state of profound and ongoing transformation.

Consumers and governments are demanding environmentally conscious policies and technologies, driving innovation in the design and development of electric vehicles and power supply, including non-traditional materials, methods, and chemistry.

Vehicle lightweighting and thermal management are key to achieving required performance targets. That's where adhesive and potting/encapsulating products can play an important role in overcoming engineering challenges.

The Plexus and Devcon ranges of structural, thermally conductive, and semi-structural adhesive and sealants bond to metals (including difficult to bond EV cell materials), composites, thermoplastics with little to no surface treatment and can withstand fatigue and climate demands throughout and beyond the life of the battery pack.

Insulcast potting and encapsulating products are specifically developed to protect and insulate electrical assemblies, heat sink bonding, and surface mount and die attach points, improving battery performance and life-cycle.

Applications & Benefits

Durability: ITW Performance Polymers structural adhesives have excellent strength, elongation and fatigue resistance. Long-term durability of assemblies is enhanced by an even distribution of stress, and elimination of point-loads.

Lightweighting: ITW Performance Polymers structural adhesives bond key automotive and battery substrates and accommodate dissimilar substrates (ΔCLTE). This means designers can specify lighter materials and eliminate metal fasteners and assembly points.

Time Saving: Plexus, Devcon, and Insulcast products are formulated for manual and high-speed robotic application. Cure kinetics are optimized for room temperature curing, eliminating ovens and wait time. Little to no surface preparation saves steps and cost.

Fire Management: ITW Performance Polymers offers products that are UL94-V0 certified or contribute to UL94-V0 certified assemblies.

Thermal Management: Plexus brand thermally conductive 2K polyurethanes are available in formulations adjustable for working time and thermal performance. Insulcast potting and encapsulation materials reduce the chances of thermal runaway.

Environmental Resistance: ITW Performance Polymers products are designed to withstand long-term environmental exposure, extending vehicle and battery life-cycle.
2K Structural Polyurethane Adhesives

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Mix Ratio</th>
<th>Working Time</th>
<th>Fixture Time</th>
<th>Tensile Strength (MPa)</th>
<th>Tensile Elong, %</th>
<th>Max Gap Fill (mm)</th>
<th>Part A Viscosity, cP x 10^3</th>
<th>Part B Viscosity, cP x 10^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>MA8105 GB</td>
<td>Low Odor, High Toughness, Primerless to Metal</td>
<td>1:1</td>
<td>3 - 6</td>
<td>12 - 14</td>
<td>24.1 - 26.2</td>
<td>5 - 11</td>
<td>12.7</td>
<td>70 - 140</td>
<td>50 - 120</td>
</tr>
<tr>
<td>MA8110 GB</td>
<td>Low Odor, High Toughness, Primerless to Metal</td>
<td>1:1</td>
<td>8 - 12</td>
<td>33 - 36</td>
<td>24.1 - 26.2</td>
<td>25 - 45</td>
<td>12.7</td>
<td>40 - 80</td>
<td>40 - 80</td>
</tr>
<tr>
<td>MA8120 GB</td>
<td>Low Odor, High Toughness, Primerless to Metal</td>
<td>1:1</td>
<td>18 - 22</td>
<td>50 - 60</td>
<td>21.4 - 24.1</td>
<td>45 - 55</td>
<td>12.7</td>
<td>40 - 80</td>
<td>80 - 120</td>
</tr>
<tr>
<td>MA808</td>
<td>High Strength, High Elongation, Low Modulus</td>
<td>1.0 1.0</td>
<td>7 - 8</td>
<td>9 - 10</td>
<td>15.2 - 20</td>
<td>140</td>
<td>NA</td>
<td>35 - 70</td>
<td>15 - 50</td>
</tr>
<tr>
<td>MA830</td>
<td>Primerless to Aluminum, High Strength</td>
<td>1.0 1.0</td>
<td>4 - 6</td>
<td>15 - 25</td>
<td>22.0 - 26.2</td>
<td>30 - 60</td>
<td>12.7</td>
<td>80 - 120</td>
<td>35 - 80</td>
</tr>
<tr>
<td>MA832</td>
<td>Primerless to Aluminum, High Strength</td>
<td>1.0 1.0</td>
<td>12 - 16</td>
<td>55 - 60</td>
<td>18.6 - 20.7</td>
<td>30 - 60</td>
<td>12.7</td>
<td>80 - 130</td>
<td>35 - 80</td>
</tr>
</tbody>
</table>

1. Varies with bond gap, joint size, assembly weight, and ambient temperature. Present values were measured at 74°F (23°C).

2K Thermally Conductive Polyurethane Adhesives

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Mix Ratio</th>
<th>Working Time</th>
<th>Fixture Time</th>
<th>Tensile Strength (MPa)</th>
<th>Tensile Elong, %</th>
<th>Max Gap Fill (mm)</th>
<th>Part A Viscosity, cP x 10^3</th>
<th>Part B Viscosity, cP x 10^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUDT2430</td>
<td>Impact Resistant, Low Modulus, Moderate Thermal Cond.</td>
<td>1:1</td>
<td>25 - 35</td>
<td>3.5h</td>
<td>70 - 120</td>
<td>&gt;8</td>
<td>&gt;30</td>
<td>1.0</td>
<td>1.3 x 10^11</td>
</tr>
<tr>
<td>PUDT2435</td>
<td>Impact Resistant, Low Modulus, Moderate Thermal Cond.</td>
<td>1:1</td>
<td>30 - 40</td>
<td>4h</td>
<td>50 - 300</td>
<td>&gt;5</td>
<td>30</td>
<td>&gt;1 x 10^11</td>
<td>1.7 x 10^10</td>
</tr>
<tr>
<td>PUDT2530</td>
<td>Impact Resistant, Low Modulus, High Thermal Cond.</td>
<td>1:1</td>
<td>25 - 35</td>
<td>4h</td>
<td>50 - 300</td>
<td>&gt;7</td>
<td>&gt;20</td>
<td>1.5</td>
<td>&gt;1 x 10^11</td>
</tr>
<tr>
<td>PUDT2630</td>
<td>Impact Resistant, Low Modulus, High Thermal Cond.</td>
<td>1:1</td>
<td>25 - 35</td>
<td>4h</td>
<td>100 - 300</td>
<td>8.5</td>
<td>1.0</td>
<td>&gt;1 x 10^11</td>
<td>&gt;1.3 x 10^9</td>
</tr>
</tbody>
</table>

1. Varies with bond gap, joint size, assembly weight, and ambient temperature. Present values were measured at 74°F (23°C).

2K Hybrid Semi-Structural Adhesive/Sealants

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Mix Ratio</th>
<th>Working Time</th>
<th>Fixture Time</th>
<th>Tensile Strength (MPa)</th>
<th>Tensile Elong, %</th>
<th>Max Gap Fill (mm)</th>
<th>Part A Viscosity, cP x 10^3</th>
<th>Part B Viscosity, cP x 10^3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU2105</td>
<td>Primerless to Metal, No Odor, Low Shrink, Non-Flammable</td>
<td>1:1</td>
<td>3 - 4</td>
<td>25 - 30</td>
<td>28</td>
<td>5</td>
<td>NA</td>
<td>60 - 80</td>
<td>60 - 90</td>
</tr>
<tr>
<td>PU2325</td>
<td>Low Odor, High Toughness, Primerless to Metal</td>
<td>1:1</td>
<td>25 - 35</td>
<td>Sh</td>
<td>9</td>
<td>&gt;150</td>
<td>NA</td>
<td>70 - 120</td>
<td>70 - 120</td>
</tr>
</tbody>
</table>

1. Varies with bond gap, joint size, assembly weight, and ambient temperature. Present values were measured at 74°F (23°C).

Product Recommendations

Plexus two-component adhesive systems are designed to be applied between 18 - 27°C. Lower temperatures will slow cure-speed, higher temperatures will increase cure-speed. The viscosity of both components is affected by temperature. For consistent dispensing, it is best practice to maintain relatively constant application temperatures throughout the year.

For maximum bond strength, ensure the joint is completely filled and mate the parts within the specified working time. After joining, the parts must remain undisturbed until the fixture time has elapsed. Clean-up should be done before the adhesive is cured. In case of cured material, carefully remove adhesives by mechanical means and clean as needed.

Spills should be cleaned-up with absorbent material. (See Plexus SDS and follow local regulations for disposal).

Plexus adhesives can be applied with hand-held applicators or pumping equipment through a static mixer. ITW Performance Polymers Technical Services should be consulted regarding wetted components of dispensing equipment. Refer to equipment manuals for preventative maintenance, cleaning, and shut-down procedures.

Plexus product shelf-life ranges from 6 - 18 months. Consult product TDS for specific information. Shelf-life is based on continuous storage at 12 - 25°C. Prolonged exposure to higher temperatures (>35°C) quickly reduces product reactivity and should be avoided.

Working Time: The time period that begins when the two adhesive components are mixed and ends when the adhesive is no longer usable for bonding. Values shown are tested at 23°C.

Fixure Time: The time required after joining for the adhesive to develop cohesive strength of 0.35 MPa at 23°C.

Tensile Strength: The ultimate cohesive strength of the material tested according to ASTM D638.

Contact ITW Performance Polymers for further information. Consult product SDS for detailed safety and handling information. Product SDS are available at: itwpp.com
Devcon Epoxy Adhesives

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Color</th>
<th>Mix Ratio</th>
<th>Working Time</th>
<th>Fixure Time</th>
<th>Func. Cure Time</th>
<th>Mixed Visc. (cP/15℃)</th>
<th>Lap Shear Strength (MPa)</th>
<th>Tensile Elong. (%)</th>
<th>Peel Strength (N/cm)</th>
<th>Diaclectic Strength (kV/mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minute Epoxy Gel</td>
<td>Primerless to Metal, Elastic, Low Shrink, Non-Flammable</td>
<td>Trans.</td>
<td>1:1</td>
<td>0.75</td>
<td>1</td>
<td>30 - 45</td>
<td>70</td>
<td>11</td>
<td>1</td>
<td>4 - 5</td>
<td>1.96 x 10^1</td>
</tr>
<tr>
<td>5 Minute Epoxy</td>
<td>General purpose, Rigid Bonding or Coating</td>
<td>Amber</td>
<td>1:1</td>
<td>3 - 6</td>
<td>10 - 15</td>
<td>45 - 60</td>
<td>10</td>
<td>13</td>
<td>1</td>
<td>4 - 5</td>
<td>1.96 x 10^1</td>
</tr>
<tr>
<td>2 Ton Epoxy</td>
<td>Primerless to Metal, Elastic, Low Shrink, Non-Flammable</td>
<td>Clear</td>
<td>1:1</td>
<td>8 - 12</td>
<td>30 - 35</td>
<td>120</td>
<td>8</td>
<td>15.5</td>
<td>1</td>
<td>4 - 5</td>
<td>2.4 x 10^1</td>
</tr>
<tr>
<td>Epoxy Plus 24</td>
<td>Rubber Toughened, Non-Corrosive, Broad Adhesion</td>
<td>Grey</td>
<td>1:1</td>
<td>25</td>
<td>210</td>
<td>1 day</td>
<td>70</td>
<td>19</td>
<td>20</td>
<td>35 - 45</td>
<td>2.16 x 10^1</td>
</tr>
<tr>
<td>HP250</td>
<td>High Shear &amp; Impact Strength, Fatigue and Chemical Resistant</td>
<td>Straw</td>
<td>2:1</td>
<td>65</td>
<td>300</td>
<td>1 day</td>
<td>105</td>
<td>22</td>
<td>25</td>
<td>60 - 70</td>
<td>2.16 x 10^1</td>
</tr>
</tbody>
</table>

1. Based on 28 g mass @ 23°C. 2. Tested at 25°C

Product Recommendations

Surface Preparation: Devcon epoxies work best on clean surfaces. Surfaces should be free of heavy deposits of grease, oil, dirt or other contaminants, or cleaned with industrial cleaning equipment such as vapour phase degreasers or hot aqueous baths. Abrading or roughing the surfaces of metals will increase the microscopic bond area significantly and optimize the bond strength.

Mixing: Cartridges should be used with an applicator gun and a static mixer. The static mixer nozzle allows the material to be thoroughly mixed when dispensed, so it can be applied directly to the surfaces to be bonded. Please note: Once the product goes beyond its working time the nozzle must be thrown away and a new nozzle used for further dispensing.

Application: Apply mixed epoxy directly to one surface in an even film or as a bead. Assemble the parts within the recommended working time. Maintain firm contact between the parts to ensure good contact of the epoxy between the mating parts. Clamping may optimize this part of the process. A small volume of epoxy should flow out the edges to show there is adequate gap filling.

For very large gaps, apply epoxy to both surfaces and spread to cover the entire area, or make a bead pattern, that will allow material to flow throughout the joint. Let bonded assemblies stand for the recommended functional cure time before handling. They are capable of withstanding processing forces at this point, but should not be dropped, shocked, or heavily stressed.

Storage / Shelf Life: Devcon epoxy adhesives should be stored in a cool, dry place when not used for a long period of time. A shelf life of 1 year from date of manufacture can be expected when stored at room temperature (23ºC) in their original containers.

Insulcast Weld-Protect, Potting, and Encapsulation 2K Epoxies

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Pot Life, min. (25°C)</th>
<th>Mixed Visc. (cP/10℃)</th>
<th>Cure Cycle, h</th>
<th>Shore Hardness</th>
<th>Thermal Cond. (W/m·K)</th>
<th>Dielectric Prop. Cons.</th>
<th>Vol. Res. (Ω·cm)</th>
<th>Tg (°C)</th>
<th>CLTE (m/m·K)</th>
<th>UL94 Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>11F1FR</td>
<td>Convenient mixing and worker friendly formulation. Fast room temp., Cure</td>
<td>90</td>
<td>8.1</td>
<td>24</td>
<td>75D</td>
<td>0.65</td>
<td>4.4</td>
<td>1.6 x 10^7</td>
<td>1 x 10^15</td>
<td>70</td>
<td>30 x 10^4</td>
</tr>
<tr>
<td>140FR11B</td>
<td>High thermal conductivity</td>
<td>150</td>
<td>50</td>
<td>See TDS 90 - 95D</td>
<td>2.3</td>
<td>6.3</td>
<td>1.65 x 10^7</td>
<td>1 x 10^11</td>
<td>100</td>
<td>26 x 10^4</td>
<td>V1</td>
</tr>
<tr>
<td>3236LW11B</td>
<td>Low viscosity, High thermal conductivity, Low CLTE, Highly filled</td>
<td>300</td>
<td>12</td>
<td>See TDS 92D</td>
<td>90</td>
<td>2.1</td>
<td>1.97 x 10^7</td>
<td>5 x 10^14</td>
<td>150</td>
<td>28 x 10^4</td>
<td>V0</td>
</tr>
</tbody>
</table>

1. Tested at 25°C

Insulcast Weld-Protect, Potting, and Encapsulation 2K Silicones

<table>
<thead>
<tr>
<th>Product</th>
<th>Description</th>
<th>Pot Life, min. (25°C)</th>
<th>Mixed Visc. (cP/10℃)</th>
<th>Cure Cycle, h</th>
<th>Shore Hardness</th>
<th>Thermal Cond. (W/m·K)</th>
<th>Dielectric Prop. Cons.</th>
<th>Vol. Res. (Ω·cm)</th>
<th>Tg (°C)</th>
<th>CLTE (m/m·K)</th>
<th>UL94 Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTVS 27 FC</td>
<td>Low viscosity, Fast-curing, Excellent electric properties</td>
<td>&lt;5</td>
<td>2.9</td>
<td>1</td>
<td>60A</td>
<td>0.3</td>
<td>3</td>
<td>2.17 x 10^7</td>
<td>1 x 10^15</td>
<td>NA</td>
<td>22 x 10^4</td>
</tr>
<tr>
<td>RTVS 27HTC</td>
<td>Low viscosity, High TC, Ideal for high-density components needing heat dissipation</td>
<td>60</td>
<td>6</td>
<td>24</td>
<td>60A</td>
<td>1.0</td>
<td>4</td>
<td>1.97 x 10^7</td>
<td>1 x 10^14</td>
<td>NA</td>
<td>17 x 10^4</td>
</tr>
<tr>
<td>RTVS 8127</td>
<td>Paste catalyst, Low viscosity</td>
<td>160 - 220</td>
<td>4</td>
<td>24</td>
<td>55A</td>
<td>0.75</td>
<td>4</td>
<td>1.97 x 10^7</td>
<td>5 x 10^14</td>
<td>NA</td>
<td>18 x 10^4</td>
</tr>
<tr>
<td>RTVS 3-95Z</td>
<td>High TC, Ideal for high-density components needing heat dissipation</td>
<td>90</td>
<td>35</td>
<td>24</td>
<td>65A</td>
<td>1.44</td>
<td>5</td>
<td>1.67 x 10^7</td>
<td>1 x 10^14</td>
<td>NA</td>
<td>15 x 10^4</td>
</tr>
</tbody>
</table>

1. Tested at 25°C

Product Recommendations

1. Mix RTVS compound in original container to be sure of uniformity.
2. Weigh out sufficient RTVS compound for application. NOTE: Be sure container and stirrer are clean.
3. Add catalyst in calculated amount for the desired cure rate. If unsure, use a small amount of compound to check cure rate.
4. Mix thoroughly, being sure to incorporate material from sides and bottom of container. Keep air entrainment to a minimum.
5. De-aeration under vacuum may be necessary if absolutely void-free castings are needed.
6. Pour into mold, cavity, etc.
7. Cure at room temperature. Length of cure will depend on amount and type of catalyst used. Faster cure speed can be achieved at 51ºC (125°F) for 2 - 3 hours.
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