Silicone Elastomers
UV-Cure Silicone Rubber
A Leader in Silicones

Momentive Performance Materials Inc. is a global leader in silicones and advanced materials, delivering the science behind the solutions for a wide range of specialty performance applications.

Our rich, blended, 70+ year heritage of innovation and market firsts provides product portfolios and technical competencies that link custom technology platforms to opportunities for our customers.

Across the globe, Momentive’s silicone elastomers have been shown to provide outstanding properties to rubber products. Excellent heat resistance and lower impact on the environment are offered for applications in the healthcare, consumer goods, electronics and automotive industries. Electrical properties of our products have earned widespread use of silicone rubber in the energy sector. Low viscosity allows liquid silicone rubber to be pumped and used efficiently in the injection molding process.

Momentive has pioneered many of these applications and processes, and we continue to serve our customers with leading innovations and creative ideas. We offer a comprehensive portfolio of liquid silicone rubber (LSR) and high consistency rubber (HCR) products.

You’re Global, We’re Global

Our Silplus® HCR product line is standardized to the same high quality properties and specifications around the world, including products for extrusion, calendering, multipurpose molding and high strength applications. Our global portfolio includes our Addisil® products and fluorosilicones including the Addisil and Silopren® UV-cure elastomers discussed in this brochure.

You’re Local, We’re Local

Momentive has facilities in North America, Latin America, Europe and Asia Pacific and local personnel to support your local needs. Visit us on the web at customerelastomers.com. Our Application Development Centers in Asia, Europe and Americas are staffed to help customers develop LSR products to suit their application requirements.

You’re Innovative, We’re Innovative

Demand for distinctive products is growing, and our materials and enabling UV technologies are at the frontline of innovation. We offer a variety of silicone rubber products and extensive technical expertise to support your needs.

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*Addisil and Silplus are trademarks of Momentive Performance Materials Inc.
Typical Benefits of UV-Cure Silicone Rubber

UV-cure silicone rubber belongs to a new class of rubber that offers high cure speed at low temperatures. UV light initiates crosslinking through a photochemical reaction, not heat. The rubber can be processed via injection molding with special molds or via extrusion without additional heat cure.

Our UV-cure technology offers the possibility to produce parts and combinations that were previously difficult to manufacture, since heat curing processes limit the use of temperature sensitive ingredients. And, this new technology can help save energy.

This graph compares the curing behavior of heat cured silicone rubber to UV cured silicone rubber.

Note: Test data. Actual results may vary.

UV lamps for Momentive's UV-Cure Silicone Rubber

Common UV lamp systems that emit light in wavelengths of UVA (400-315nm) activate the photosensitive catalyst in Momentive’s UV-cure silicone rubber. Momentive’s technical experts can help you adjust for differences in the UV spectrum, IR emissions, generator position and other factors.
Silopren UV LSRs are two-component liquid silicone rubbers with a mixing ratio of 100:2.

Silopren UV LSRs can be molded quickly at low temperatures by using a typical injection molding process with UV light. Scorch performance can be controlled due to the low temperature with less shrinkage and air entrapment. Due to low cavity pressure, the clamping forces are also minimized. Our Application Development Center experts can help you design the material and the mold.

Cross sections from 5-100 mm can be easily cured in a few minutes.

It has been shown that time and energy can be saved by using Silopren UV LSRs for curing high-quality, thick-walled, molded articles such as high voltage insulators or cable accessories.

For other applications such as consumer goods and healthcare, the low temperatures in this process are excellent properties to consider for new design opportunities.

### Typical Property

<table>
<thead>
<tr>
<th></th>
<th>UV Electro 235-2</th>
<th>UV Electro 225-1</th>
<th>UV LSR 2030</th>
<th>UV LSR 2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity base [Pa·s] @ 10s&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>120</td>
<td>70</td>
<td>500</td>
<td>990</td>
</tr>
<tr>
<td>Viscosity cat [Pa·s] @10s&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

### Properties of the Vulcanizate<sup>1</sup>

<table>
<thead>
<tr>
<th></th>
<th>UV Electro 235-2</th>
<th>UV Electro 225-1</th>
<th>UV LSR 2030</th>
<th>UV LSR 2060</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness [Shore A]</td>
<td>35</td>
<td>25</td>
<td>27</td>
<td>57</td>
</tr>
<tr>
<td>Density [g/cm³]</td>
<td>1.09</td>
<td>1.07</td>
<td>1.09</td>
<td>1.15</td>
</tr>
<tr>
<td>Tensile Strength [MPa]</td>
<td>4.6</td>
<td>4.5</td>
<td>5.3</td>
<td>11.0</td>
</tr>
<tr>
<td>Elongation at Break [%]</td>
<td>520</td>
<td>580</td>
<td>690</td>
<td>440</td>
</tr>
<tr>
<td>Tear [N/mm]</td>
<td>15</td>
<td>9</td>
<td>11</td>
<td>35</td>
</tr>
</tbody>
</table>

<sup>1</sup>Mixing ratio of components Base : Catalyst = 100 : 2.
Laboratory Vulcanization Conditions: applied to UV light for 2 min at an intensity of 1 kW Power (Fe dotted Hg bulb) and distance of 15 cm

Typical data are average data and are not to be used as or to develop specifications. Customized versions are available on request, please ask our technical experts (see pg.10).
Molding with Silopren® UV-Cure Liquid Silicone Rubber (LSR)

Standard LSR for injection molding can be cured at 180 – 200°C for fast cycle times. For large parts, when filling molds with LSR, the cure temperatures must be reduced to fill the molds completely and to eliminate air entrapment in the molded part. Dependent on the total shot volume, the mold temperature, while filling, may be reduced to 80°C. The scorch time of the LSR is prolonged so flow lines and air entrapment can be minimized. When filling is completed the temperature can be increased to 95 – 120°C for faster cure. However, the required reduction of temperature leads to longer production cycles.

With UV-cure LSR technology, the process has been shown to be more efficient, as filling can be accomplished at ambient temperature. There is virtually no risk of generating scorch. When filling is complete, the UV light is activated, travels through UV transparent cavity inserts, and starts the very fast curing reaction. Even a large article (up to 100mm cross-section) will cure in several minutes.

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*Addisil is a trademark of Momentive Performance Materials Inc.
Molding with Silopren® UV-Cure Liquid Silicone Rubber (LSR)

Since our launch of the first self-bonding LSR, 2 component (2C) injection molding processes using this material have been established in a number of applications in the automotive, consumer goods, medical and industrial industries. The technology, which uses heat to cure the silicone, requires a high temperature (120°C and higher) for short and efficient cycle times. Therefore, one of the limiting factors in selecting the polymer for the second component was its temperature stability. Nylon, polyester and other comparable plastic polymers have been used for this process, but inserts made from polyolefins or other standard thermoplastics were not a viable choice for the 2C process with LSR.

However, increasing numbers of designers are seeking to combine the unique properties of silicone elastomers with standard plastics or temperature sensitive materials and applications such as electronics. Momentive’s new UV LSR technology is an excellent candidate to consider for resolving the 2C thermal stability issue.

To give an example of the manner in which UV-cure can enable the 2C process, a wine bottle plug was designed with a polypropylene (PP) insert molded in a standard PP injection molding process. After cooling, the PP insert was demolded by a robotic handling system and positioned in the UV LSR cavity. The UV LSR was then cured via an integrated UV light LED systems for 20 seconds in a 30 – 40°C (warm) tool.

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**Addisil® UV-Cure Solid Silicone Rubber for Extrusion**

Addisil UV EX silicone rubber is a new family of UV-cure materials that offers high cure speed at room temperature using extrusion. Addisil UV EX silicone rubber is two-component, with a mixing ratio of 100:0.5 (Rubber Base: Catalyst).

Addisil UV EX silicone rubber can be extruded with standard silicone rubber extruders and cured with UV light, as mentioned in UV lamps for Momentive’s UV-Cure Silicone Rubber (see pg.4). Cure on demand with UV light and at low temperature results in high dimensional stability for the parts. Less air entrainment (compared to heat cure materials) is generally typical for UV-cured silicone rubber. Representative samples of several Addisil UV-curing products have been tested for compliance with USP Class VI, ISO 10993 (parts 6, 10 and 11) and FDA extractables. Please contact the Product Stewardship and Regulatory group for details.

<table>
<thead>
<tr>
<th>Addisil Product</th>
<th>UV 50 EX</th>
<th>UV 60 EX</th>
<th>UV 70 EX</th>
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</thead>
<tbody>
<tr>
<td>Typical Properties of the Vulcanizate¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardness [Shore A]</td>
<td>54</td>
<td>64</td>
<td>68</td>
</tr>
<tr>
<td>Density [g/cm³]</td>
<td>1.13</td>
<td>1.17</td>
<td>1.19</td>
</tr>
<tr>
<td>Tensile Strength [MPa]</td>
<td>10.8</td>
<td>11.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Elongation at Break [%]</td>
<td>550</td>
<td>450</td>
<td>470</td>
</tr>
<tr>
<td>Modul 100 % [MPa]</td>
<td>1.5</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>Tear [N/mm]</td>
<td>31</td>
<td>39</td>
<td>39</td>
</tr>
</tbody>
</table>

¹Mixing ratio of components Base : Catalyst = 100:0.5. Laboratory vulcanization conditions: applied to UV light for 2 min at an intensity of 1 kW Power (Fe doted Hg bulb) and distance of 15 cm. Post cured 4h at 200⁰C.

Typical data are average data and are not to be used as or to develop specifications.

**UV-Cure High Consistency Rubber (HCR) for Extrusion**

Material extruded through die over thermal shock heater in heating tunnel

**Silplus® UV-Cure HCR**

- **Fast** Command cure at room temperature
- **New** Combinations with low temperature materials
- **Efficient** Lower energy consumption potential
  - no heating of material required
  - better temperature control of clean room conditions
  - addition cure technology

Silplus UV-curable silicone rubber can be extruded with standard extruders and cured using UV light. As with the molding process, no heat is required.

With Momentive’s UV-curable HCR, or Addisil UV EX products, manufacturers can increase throughput and reduce manufacturing costs as the UV extrusion curing process uses much less space and equipment than the thermal curing process and may lower energy costs. This UV-curing technology has been demonstrated to cure cross sections >25mm without micro bubbles at atmospheric pressure.

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Using Color with UV-Cure Silicone Rubber

Generally, the cure time is extended compared to transparent silicone rubber. Please contact our technical experts for more information.
Application Development Centers and Technical Support

Our Application Development Centers offer support globally. We are experts in process modeling, prototyping, productivity analysis and troubleshooting.

We offer technical support for UV-cure technology, especially in the high voltage industry.

Our support can start at the beginning of your project, but at any stage, the right support and our global expertise can be brought to bear on material selection, product design, mold and process set up and prototypes. And we can continue to support your needs after your full-scale production begins.
Patent Status

Nothing contained herein shall be construed to imply the nonexistence of any relevant patents or to constitute the permission, inducement or recommendation to practice any invention covered by any patent, without authority from the owner of the patent.

Product Safety, Handling and Storage

Customers should review the latest Material Safety Data Sheet (MSDS) and label for product safety information, safe handling instructions, personal protective equipment if necessary, emergency service contact information, and any special storage conditions required for safety. Momentive Performance Materials (MPM) maintains an around-the-clock emergency service for its products. MSDS are available at www.momentive.com or, upon request, from any MPM representative. For product storage and handling procedures to maintain the product quality within our stated specifications, please review Certificates of Analysis, which are available in the Order Center. Use of other materials in conjunction with MPM products (for example, primers) may require additional precautions. Please review and follow the safety information provided by the manufacturer of such other materials.

Limitations

Customers must evaluate Momentive Performance Materials products and make their own determination as to fitness of use in their particular applications.
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