Advanced Materials
Composite Resins and Adhesives
for the Automotive Industry
Overview of Huntsman Automotive

From high-performance structural adhesives to stronger, faster composite resin systems, Huntsman understands the demands for faster processing and reduced production cycles. With over 60 years’ experience developing adhesive and composite resin technologies, Huntsman scientists work with designers and engineers every day to help solve increasingly complex design issues.

The level of global business competition in automotive is high, so manufacturers need solutions to help sustain their competitive edge and secure long-term growth. Production process improvement, innovation in design, weight savings, and compliance to stringent safety and environmental standards, have become vital to success. Our portfolio includes polyurethane systems for seating and acoustical applications, epoxy structural adhesives for assembly, and epoxy or polyurethane resins for structural composite applications. Our products help overcome a variety of challenges such as low emissions, lightweighting to meet new CAFE standards, fast curing cycles with high initial green strength, durability under dynamic stress, impact resistance and multi-substrate joining.

Our Global Manufacturing & Technical Center Footprint

Huntsman offers a global manufacturing footprint, so we are able to support global OEM platforms with product consistency, regional availability of materials and the regional technical expertise required for ensured success. Give us your challenge and see what we can do.

15 Manufacturing Sites
7 Advanced Technology Centers
The ARALDITE® and ARADUR® product lines provide fast-cure prepreg solutions for Class-A exterior surfaces or internal structural reinforcements. Our extensive portfolio of products can be custom tailored to answer the stringent demands of automotive designers.

Key Applications
- Class-A body panels – hoods, trunks, roofs
- Structural reinforcement patch panels

Advantages
- Variable cure times 2–5 mins
- Achievable Tg 120–180ºC
- Low to medium viscosities
- Class-A surface quality

ARALDITE® MY, GY, LY Epoxy Resins

ARALDITE® EPN Epoxy Resins

ARADUR® Hardeners

Selective Reinforcement
Selective reinforcement with Fast Cure Prepreg Patches deliver the required performance while maintaining cost and leveraging current production methods.

Class-A Body Panels
Huntsman provides commercial-ready technology to support the growing number of Class-A fast cure prepreg production applications.
Dynamic Fluid Compression Molding (DFCM)

Our systems for DFCM exhibit excellent demolding stiffness, enabling demold times as fast as thermoplastics. And when combined with their high elongation properties, DFCM makes composites an ideal candidate for high-volume automotive applications.

Simple and fast, the DFCM process bypasses the injection step and brings composite cycle times to less than 60 seconds.

The DFCM Advantage
- 30-60 second cure times
- Fiber volume up to 65%
- Void-free parts
- Consistent part quality
- No fiber preform
- Low-pressure molding
- Reduced capex investment

![DFCM Part Vf = 62%](image1)

<table>
<thead>
<tr>
<th>Part Type</th>
<th>Vf (%)</th>
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</thead>
<tbody>
<tr>
<td>Standard WCM</td>
<td>60</td>
</tr>
<tr>
<td>HP-RTM</td>
<td>50</td>
</tr>
<tr>
<td>DFCM</td>
<td>62</td>
</tr>
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</table>
Huntsman’s novel upgrade to Liquid Compression Molding (LCM), DFCM combines process IP with our ARALDITE® Epoxy systems to produce highly structural, void-free parts in less than 60 seconds – a fast, simple process for automotive parts.

**Key Applications**
- Exterior body panels
- Interior structural panels
- Load floors
- Under-the-rug parts

**ARALDITE® LY 3031 Resin / ARADUR® 3032 Hardener**
For Wet Compression Molding

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile modulus</td>
<td>2650–2850 MPa</td>
</tr>
<tr>
<td>ISO 527-2 on neat resin</td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td>70-80MPa</td>
</tr>
<tr>
<td>ISO 527-2 on neat resin</td>
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</tr>
<tr>
<td>Tensile elongation</td>
<td>5-7%</td>
</tr>
<tr>
<td>ISO 527-2 on neat resin</td>
<td></td>
</tr>
<tr>
<td>DMA Tg onset</td>
<td>95- 105 °C</td>
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<tr>
<td>ISO 6721 on CFRP</td>
<td></td>
</tr>
<tr>
<td>ILSS</td>
<td>65MPa</td>
</tr>
<tr>
<td>ASTM 02344 on CFRP</td>
<td></td>
</tr>
</tbody>
</table>

**ARALDITE® LY 3585 Resin / ARADUR® 3475 Hardener**
For RTM / Wet Compression Molding

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile modulus</td>
<td>2700–2900 MPa</td>
</tr>
<tr>
<td>ISO 527-2 on neat resin</td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td>75-80MPa</td>
</tr>
<tr>
<td>ISO 527-2 on neat resin</td>
<td></td>
</tr>
<tr>
<td>Tensile elongation</td>
<td>8-10%</td>
</tr>
<tr>
<td>ISO 527-2 on neat resin</td>
<td></td>
</tr>
<tr>
<td>DMA Tg onset</td>
<td>105-115 °C</td>
</tr>
<tr>
<td>ISO 6721 on CFRP</td>
<td></td>
</tr>
<tr>
<td>ILSS</td>
<td>58MPa</td>
</tr>
<tr>
<td>ASTM D2344 on CFRP</td>
<td></td>
</tr>
</tbody>
</table>
High-Pressure RTM – Epoxy

With the longest standing history of epoxy in automotive high-pressure RTM (HP-RTM) mass produced parts, Huntsman systems are tested and proven under the most demanding automotive applications. We leverage this experience to provide a complete range of solutions for the HP-RTM process.

Building on BMW i experience

The new epoxy solutions are built on the first generation ARALDITE® LY 3585 Resin / Hardener XB 3458 and ARALDITE® LT 3366, qualified for the first mass produced automotive carbon composites application (BMW i program).

ARALDITE® LY 3585 Resin / ARADUR® 3475 Hardener

For RTM / Wet Compression Molding

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile modulus</td>
<td>2700 - 2900 MPa</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>75-80 MPa</td>
</tr>
<tr>
<td>Tensile elongation</td>
<td>8-10%</td>
</tr>
<tr>
<td>DMA Tg onset</td>
<td>105 - 115ºC</td>
</tr>
<tr>
<td>ILSS</td>
<td>58MPa</td>
</tr>
</tbody>
</table>

ARALDITE® LT 3366 Preforming Solution

Epoxy binder qualified for mass production of powdered fabrics and preforms:

- High softening point preventing ply-to-ply adhesion during storage and fiber distortion during injection
- Fast preforming cycle

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Softening point</td>
<td>ca. 150ºC</td>
</tr>
<tr>
<td>DSC Tg mid-point</td>
<td>1s -85ºC</td>
</tr>
<tr>
<td>Typical preforming cycle</td>
<td>20 ± 10s at 180 ± 20ºC</td>
</tr>
</tbody>
</table>

Key Applications

- Body panels
- Pillars
- Load floors
- Underbody
- Wheels
- High temp structures

Advantages

- High latency during mold filling
- Fast cure
- Rapid demold stiffness
- High tensile elongation at break
High-Pressure RTM – Polyurethane

RIMLINE® and VITROX® polyurethane systems offer low, initial mixed resin viscosity, good wetting characteristics and no VOC emissions. These resin systems are ideally suited for high Vf% glass or carbon fiber composite components in demanding applications where superior strength and durability are required. RIMLINE® and VITROX® polyurethane systems are available with or without IMR and with a catalyst level tuned to suit customer processes.

RIMLINE® RTM 97049 Resin / SUPRASEC® 9701 MDI

VITROX® RTM resins

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile modulus</td>
<td>2850 – 3000 MPa</td>
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<tr>
<td>ASTM D638 on neat resin</td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td>80– 90 MPa</td>
</tr>
<tr>
<td>ASTM D638 on neat resin</td>
<td></td>
</tr>
<tr>
<td>Tensile elongation</td>
<td>8-10%</td>
</tr>
<tr>
<td>ASTM D638 on neat resin</td>
<td></td>
</tr>
<tr>
<td>Initial Mixed Resin Viscosity</td>
<td>250 – -300 mPa<em>s (25°C) 40 – 60 mPa</em>s (90°C)</td>
</tr>
<tr>
<td>DMA Tg onset</td>
<td>105 – 115ºC</td>
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<tr>
<td>ASTM D7028 on neat resin</td>
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<tr>
<td>G1e</td>
<td>450 – 500 J/m²</td>
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<tr>
<td>ASTM D5045 on neat resin</td>
<td></td>
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</tbody>
</table>

Advantages

- Low viscosity
- Durability
- Fast cure

Key Applications

- Structural load floors
- Underbody
- Leaf springs
- Seat frames and pans
- Pillars
- Hood inner panel
Pultrusion

The pultrusion process provides the most cost-effective and efficient method for lightweight replacement of existing metal parts on the vehicle.

Huntsman provides both epoxy and polyurethane systems depending on your requirements and production needs.

ARALDITE® LY 1568, 1556, 5201 Resins

ARADUR® 2954, 917, 906, 3473 Hardeners

RIMLINE® SK 97007 Resin / SUPRASEC® 9700 MDI

RIMLINE® SK 97018 Resin / SUPRASEC® 9701 MDI

Key Applications

- Engine supports
- Door intrusion beams
- Rocker panels
- Door sills
- Roof support members
- Bumper crash systems

Advantages

- Low capex investment
- Efficient manufacturing
- Part-to-Part repeatability
- Very low scrap rates
- Achievable Tg 120-220°C
- Low to medium viscosities
- Long pot life
- Injectionable systems

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- Engine supports
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Advanced Honeycomb

Honeycomb technology is advancing towards more complex, structural parts on the vehicle. The low cost, rapid process achieves cycles times between 1-2 minutes with carbon fiber/thermoplastic core or glass fiber/paper core. Today, designers are realizing the benefits of this technology with a focus on vehicle lightweighting.

ARALDITE® LY 3585 Resin / ARADUR® 3475 Hardener

RIMLINE® HC IMR 87466 Resin / SUPRASEC® 8700 MDI

VITROX® HC 98010 Resin / SUPRASEC® 9801 MDI

Key Applications
- Structural load floors
- Interior semi-structural parts
- Package trays
- Under carpet parts
- Sun shades

Advantages
- Highly loaded structural applications
- 30 sec – 2 min molding times
- Low investment costs
- Very fast demold stiffness
- High elongation & impact resistance
- Leverage existing stamping assets

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- Structural load floors
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Structural Bonding

The range of ARALDITE® adhesives for automotive applications contains a selection of epoxy, polyurethane, and methacrylate technologies to meet the great majority of high-performance bonding applications.

ARALDITE® two-component epoxy adhesives

• excellent adhesion to metals, thermoset composites and most thermoplastics
• high strength and high stiffness
• high creep resistance
• high fatigue resistance
• high temperature resistance (adhesive specific up to 210°C)
• excellent chemical resistance
• low shrinkage

ARALDITE® two-component polyurethane adhesives

• excellent adhesion to metals, thermoset composites and most thermoplastics
• good adhesion to metals
• mechanical properties from rigid to flexible
• good long-term durability
• good combination of strength and flexibility

ARALDITE® two-component methyl methacrylate adhesives

• excellent adhesion to metals, thermoset composites and most thermoplastics
• good adhesion with minimum surface preparation
• tolerant to mix-ratio variations
• wide spectrum of available reactivity
• optimum ratio open-time/cure time
• mechanical properties from rigid to flexible
• good long-term durability

Key Applications

• Multi-material bonding – metals, composites, plastics
• Improved fatigue resistance
• Weight reduction
• Uniform stress distribution
Structural Bonding Applications

For lightweighting, designers and engineers are employing the use of a wide range of materials to accomplish specific performance and cost objectives. Huntsman provides an extensive, but not inclusive range of products specifically engineered according to bonding substrates.

**CFRP**
- ARALDITE® 2014 Adhesive
- ARALDITE® 2015 Adhesive
- ARALDITE® 2029-1 Adhesive
- ARALDITE® EP 300 Adhesive

**GRP/SMC**
- ARALDITE® 2014 Adhesive
- ARALDITE® 2015 Adhesive
- ARALDITE® 2029-1 Adhesive

**Thermoplastics**
- ARALDITE® 2029-1 Adhesive
- ARALDITE® 2021-1 Adhesive
- ARALDITE® 2022-1 Adhesive
- ARALDITE® EP 200 Adhesive
- URALANE® 5772 A/B Adhesive
- URALANE® 5773 A/B Adhesive
- URALANE® 5776 A/B Adhesive

**Steel**
- ARALDITE® 2011 Adhesive
- ARALDITE® 2013 Adhesive
- ARALDITE® EP 100 Adhesive

**Aluminum**
- ARALDITE® 2013 Adhesive
- ARALDITE® 2014 Adhesive
- ARALDITE® EP 300 Adhesive

**Painted Metal**
- ARALDITE® 2011 Adhesive
- ARALDITE® 2029-1 Adhesive
- ARALDITE® EP 300 Adhesive
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