ADHESIVES FOR AUTOMOTIVE ASSEMBLY

Parker Lord

LIGHTWEIGHTING

Lightweighting is a global trend in the automotive industry, driven by the U.S. Corporate Average Fuel Economy (CAFE) standards and the Clean Air for Europe program to reduce CO_2 emissions from automotive vehicles. Over the next few decades, vehicle design will shift away from the traditional use of steel towards alternative lightweight steels, such as high strength low alloy (HSLA), advanced high strength steel (AHSS) and ultra high strength steel (UHSS).

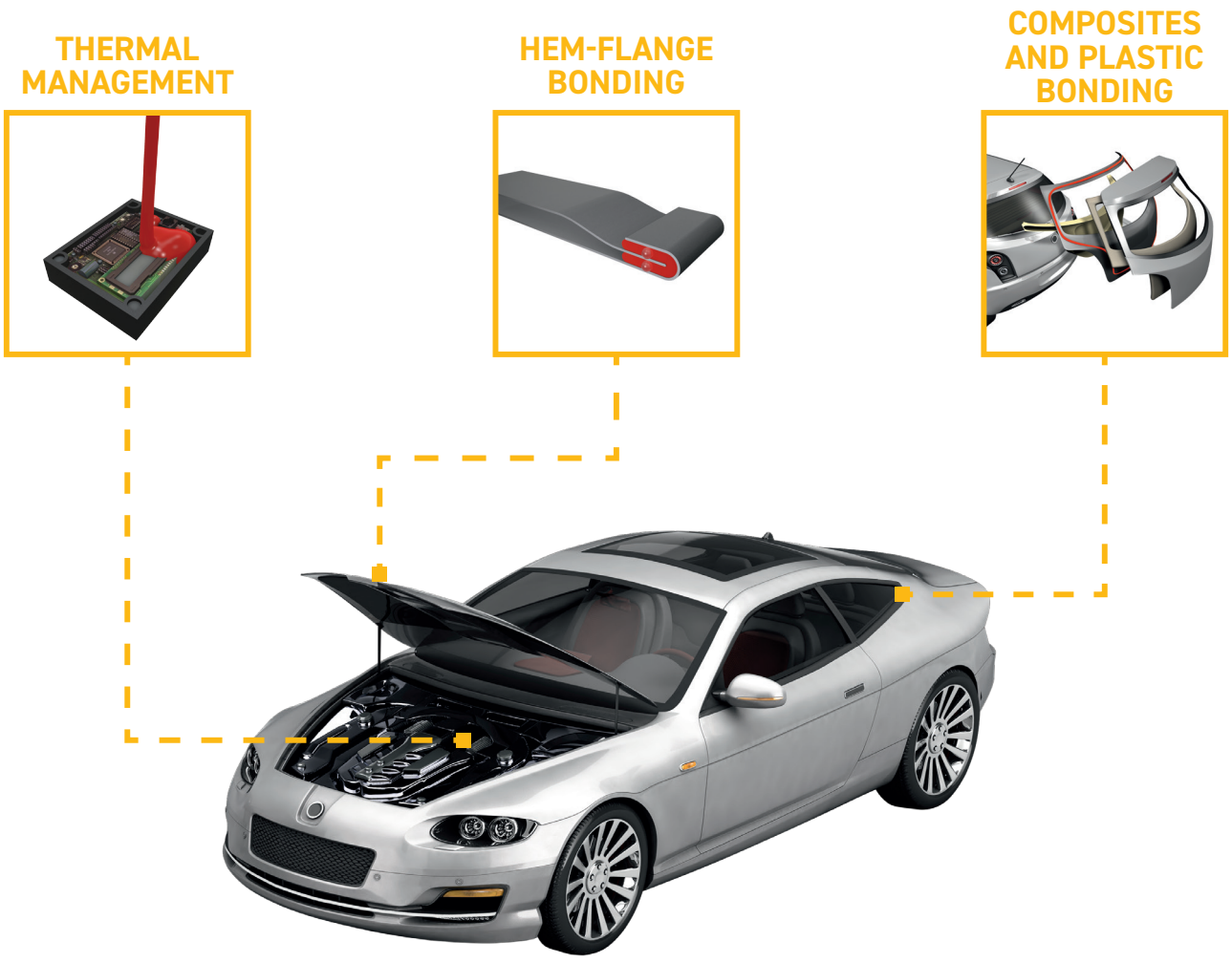
Using a combination of lighter-weight materials in vehicle design and manufacturing significantly improves fuel consumption.

Today, approximately 25 percent of a car's fuel consumption is attributable to vehicle weight. Cutting-edge materials boost the fuel economy because it takes less energy to accelerate a lighter object than a heavier one. There is a distinct difference between using conventional joining methods for metal parts, such as rivets and welding, as well as structural adhesives.

Lightweight materials need to be sustained by specific structural adhesives that fit both the materials and the processes used. An effective structural adhesive should be adaptive to design and process needs; provide the ability to bond a variety of substrates; guarantee its structural bonding performance; and avoid read-through, especially in the case of low density and thinner gauge composites.

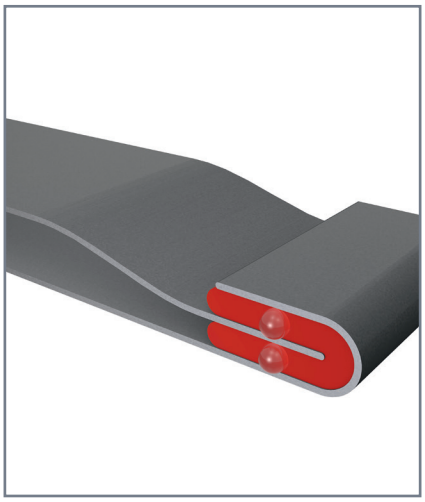
Challenges of Rivets and Welding:

- **Heavier weight, reducing fuel economy of vehicles**
- **Stress points caused by the joining process**
- **Environmental factors may cause corrosion around the weld, leading to rivet and aesthetic distortions**
- **More complex when using lightweight composite substrates**
- **Often more expensive due to the joining process**



HEM-FLANGE BONDING

One of the most important functions of under-hem adhesives is to bond inner and outer panels, providing corrosion-resistant sealing. Another critical function is to ensure the dimensional stability of automotive closure panels throughout the entire production process from Body-in-White (BIW) to e-coating. Versilok® under-hem adhesives are used to bond two panels together in the following applications: hoods, doors, liftgates, trunk lids and fenders.



When selecting an under-hem adhesive, it is important to consider whether it meets these success factors:

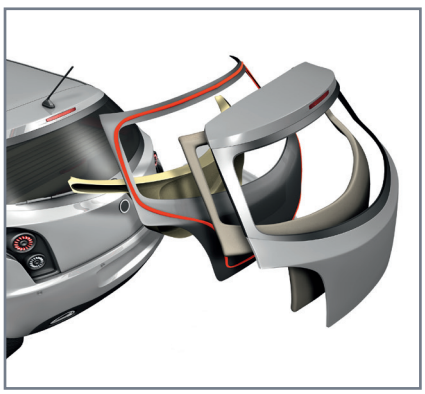
- **High initial handling strength that aids in production processes to improve quality and drastically reduce waste and scrap parts**
- **Dimensional stability. Freedom in the production processes and the transportation of finished parts to other assembly plants**
- **Improved crash resistance**
- **Improved corrosion resistance. Sustained through the "harsh" traditional OEM environmental failure**

	Versilok® 271/331		Versilok® 281/331	
	Data	**Failure Mode**	**Data**	**Failure Mode**
Lap Shear (MPa) @ RT	6.80	CF	10.44	AF / CF
Lap Shear (MPa) @ Full cure	13.29	CF	14.32	CF
T-peel (N/cm)	108	CF	115	CF
Over-bake Resistance (N/cm)	102	CF	105	CF
Impact Wedge Peel (N/mm) DIN EN ISO 11343	< 20	CF	29	CF

AF = Adhesive Failure
CF = Cohesive Failure

COMPOSITES AND PLASTIC BONDING

LORD® adhesives bond metals, plastics and composites lightweight materials, replacing mechanical fasteners.



- **Suitable for a wide variety of materials and substrates – improves the appearance, strength and durability of assemblies**
- **Increases component life – excellent environmental resistance of bonded parts**
- **Unmatched bonding performance on metals – compatible with e-coat and powder coating processes**

LORD® adhesives can replace welding, brazing, riveting and other mechanical fastening methods. These adhesives perform particularly well in low-temperature environments and applications that are subject to high impact or high peel loads.

VARIETY OF CHEMISTRIES

Acrylic Adhesives

LORD® acrylic adhesives provide a range of working times to accommodate a wide variety of process requirements. Acrylic-based adhesives deliver world-class performance in bonding bare metals, composites and many thermoplastic materials.

Benefits of Acrylic Adhesives:

- **Minimal need for surface preparation**
- **Broad temperature performance**
- **Alternative to polyurethane and isocyanate exposure risk**
- **Low read-through performance**
- **Excellent cure kinetics at room temperature**
- **Outstanding toughness that delivers impact resistance**

Polyurethane Adhesives

Our urethane adhesives are the ideal choice for lightweight structural assembly. They are also an excellent choice for bonding a wide variety of materials including thermoplastics and composites; low surface energy plastics such as polypropylene; difficult-to-bond substrates such as fabric, foam, and wood; and primed or coated metal.

Benefits of Urethane Adhesives:

- **Low odor**
- **Flexibility in process – formulations deliver varied cure times**
- **High toughness and strength coupled with flexibility**

Epoxy Adhesives

Our epoxy adhesives are chemically resistant and can bond a wide variety of substrates including bare and coated metals.

Benefits of Epoxy Adhesives:

- **Advanced strength and high temperature performance**
- **Low odor**
- **Accelerated cure time with heat**
- **Versatile mix ratio to adapt flexibility and modulus**
- **Range from fluid to non-sagging**

Composites and Plastic Bonding Solutions

Product	Accelerator/ Component	Chemistry	Mixed Appearance	Open Time (min)	Handling Time (min)	Elongation (%)	Viscosity (cP)	Density (kg/m³)	Service Temp (°C)
LORD® 406E	17	Acrylic	Off white to tan, non-sag paste	6-10 @ 24°C	12-17 @ 24°C	25	100,000-300,000	1090-1162	-40/+150
	19	Acrylic	Off white to tan, non-sag paste	6-10 @ 24°C	12-17 @ 24°C	25	100,000-300,000	1090-1162	-40/+150
	19 Black	Acrylic	Black non-sag paste	6-10 @ 24°C	12-17 @ 24°C	25	100,000-300,000	1090-1162	-40/+150
	19GB	Acrylic	Off white to tan, non-sag paste	6-10 @ 24°C	12-17 @ 24°C	25	100,000-300,000	1090-1162	-40/+150
LORD® 802	20GB	Acrylic	Grey paste	2-4 @ 25°C	10-12 @ 25°C	230	40,000-240,000	935-970	-40/+150
LORD® 810S	20GB	Acrylic	Dark grey paste, non-sag paste	8-12 @ 21°C	20-25 @ 21°C	190	40,000-130,000	935-970	-40/+150
LORD® 850S	25GB	Acrylic	Red paste, non-sag paste	6-10 @ 24°C	18-24 @ 24°C	100	150,000-550,000	959-995	-40/+150
LORD® 852S	25GB	Acrylic	Red paste, non-sag paste	20-25 @ 24°C	50-70 @ 24°C	100	150,000-550,000	959-995	-40/+150
LORD® 7545A	7545G	Urethane	Black non-sag paste	1.5 @ 24°C	10 @ 24°C	70	7545A: 25,000-70,000 7545G: 230,000-650,000	7545A: 1498-1534 7545G: 1294-1342	-40/+100
	7545B	Urethane	Off white or black non-sag paste	3-5 @ 24°C	30 @ 24°C	70	7545A: 25,000-70,000 7545B: 230,000-650,000	7545A: 1498-1534 7545B: 1294-1342	-40/+100
	7545C	Urethane	Off white non-sag paste	6-8 @ 24°C	60 @ 24°C	70	7545A: 25,000-70,000 7545C: 230,000-650,000	7545A: 1498-1534 7545C: 1294-1342	-40/+100
	7545E	Urethane	Off white non-sag paste	22-38 @ 24°C	120-180 @ 24°C	160	7545A: 25,000-70,000 7545E: 230,000-650,000	7545A: 1498-1534 7545E: 1270-1318	-40/+100
	7545F	Urethane	Off white non-sag paste	45-65 @ 24°C	240-300 @ 24°C	145	7545A: 25,000-70,000 7545F: 230,000-650,000	7545A: 1498-1534 7545F: 1258-1330	-40/+100
LORD® 7800A	7800C	Urethane	Black paste	2-4 @ 24°C	12 @ 24°C	130	7800A: 8,000-25,000 7800C: 33,000-60,000	7800A: 1282-1420 7800C: 1198 -1282	-40/+100
	7800D	Urethane	Black Paste	4-8 @ 24°C	25 @ 24°C	130	7800A: 8,000-25,000 7800D: 33,000-60,000	7800A: 1282-1420 7800D: 1198-1282	-40/+100
Fusor® 380NS	383NS	Epoxy	Grey Paste	>20 @ 23°C	120 @ 18°C	2-4	380NS: 750,000-2,200,000 383NS: 500,000-2,500,000	380NS: 1504-1552 383NS: 1378-1498	-40/+148

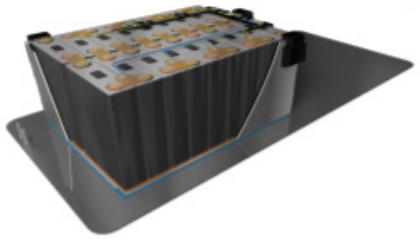
THERMAL MANAGEMENT

As electric vehicle (EV) technology evolves, so should your expectations. CoolTherm® is the leader in thermal management materials. Our customizable products help EVs go longer, charge faster and have higher reliability by managing heat in batteries, chargers, motors and power electronics.

Our adhesives for electric vehicles improve design flexibility and reduce complexity. Adhesives reduce the need for fasteners, thereby simplifying your battery pack design. They also give the ability to bond a wide variety of substrates. Formulated for standard MMD equipment, our adhesives provide your application with structural integrity and mechanical rigidity.

Benefits of Adhesives for Battery Assembly:

- **Improve appearance, strength and durability of assemblies**
- **Extend component life through excellent environmental resistance of bonded parts**
- **Enable novel designs using plastic and composite materials, contributing to a lighter weight vehicle**
- **Increase design freedom by easily joining dissimilar materials and complex geometries**
- **Provide processing convenience and reduction in overall assembly cost**



Prismatic Battery Pack

Pouch Battery Pack

Electric Vehicle Battery Pack Adhesives

Product	Chemistry	Thermally Conductive	Mixed Appearance	Open Time (min)	Handling Time (min)	Shear (MPa)	Elongation (%)	Viscosity (cP)	Density (kg/m³)	Service Temp (°C)
CoolTherm® TC-2002	Acrylic	Yes	Tan paste	7-8 @ 25°C	20-25 @ 25°C	15.8	5	TC-2002 A: 600,000 TC-2002 B: 325,000	TC-2002 A: 1710 TC-2002 B: 1240	-65/+100
LORD® 5206/55GB	Acrylic	No	Grey paste	6-8 @ 25°C	24-28 @ 25°C	18.4	2	5206: 100,000-220,000 55GB: 170,000-320,000	5206: 1002-1044 55GB: 1378-1450	-40/+150
Maxlok® MX/T6S	Acrylic	No	Grey paste	6-9 @ 25°C	20-24 @ 25°C	19.3	>10	MX: 100,000-500,000 T6: 70,000-200,000	MX: 1372 -1456 T6: 1007-1066	-40/+150
Versilok® 281/331	Acrylic	No	Grey paste	15-20 @ 25°C	50-70 @ 25°C	14.0	15-25	281: 200,000-500,000 331: 130,000-400,000	281: 1030-1100 331: 1380-1480	-40/+121
Fusor® 380NS/383NS	Epoxy	No	Grey paste	>20 @ 21°C	120 @ 18°C	SMC/SMC: 5.0 SMC/E-coat: 6.0-8.0	2-4	380NS: 750,000-2,200,000 383NS: 500,000-2,500,000	380NS: 1504-1552 383NS: 1378-1498	-40/+148
LORD® 850S/25GB	Acrylic	No	Red paste, non-sag paste	6-10 @ 24°C	18-24 @ 24°C	18.0	100	850: 150,000-550,000 25GB: 100,000-300,000	850: 959-995 25GB: 1174-1222	-40/+150
LORD® 852S/25GB	Acrylic	No	Red paste, non-sag paste	20-25 @ 24°C	50-70 @ 24°C	18.5	100	852: 150,000-550,000 25GB: 100,000-300,000	852: 959-995 25GB: 1174-1222	-40/+150

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PB8399E OD 07/25 Rev.2