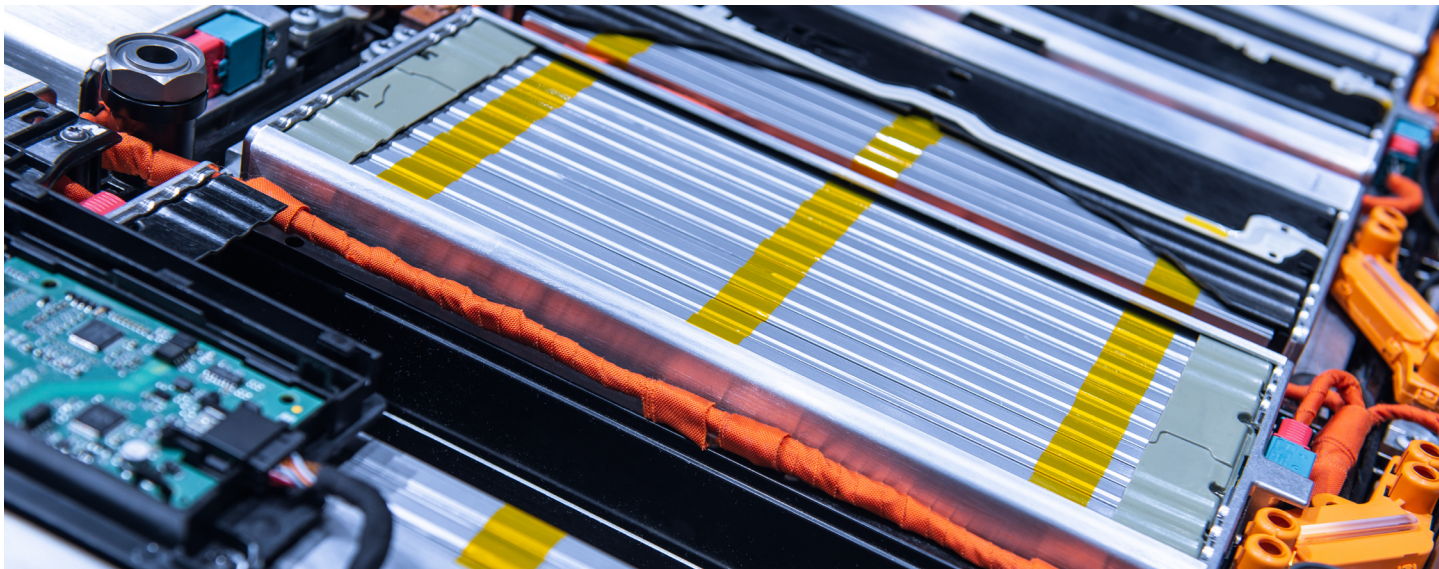




Thermal management – VORATRON™ Polyurethane Systems

Be sure to get your fill.

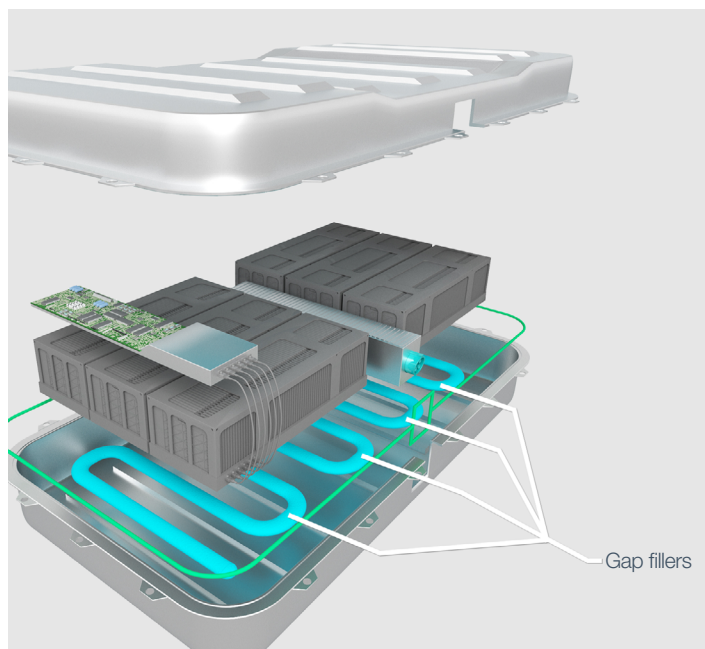


Virtually every hybrid/electric vehicle (H/EV) battery system uses some type of thermally conductive, polymeric gap filler to help attach the battery to its cooling plate. Now, as batteries become higher performing with increased energy density, demand for gap fillers that combine strong performance in the vehicle and on the assembly line is rising significantly.

MobilityScience™ – Dow's platform for driving innovation in the transportation/mobility industry – is helping OEMs and tiers navigate the complex, rapidly growing H/EV market with a broad range of materials and services that can help improve performance, processability and sustainability.

VORATRON™ Systems for battery pack gap fillers

VORATRON™ GF-1000 Series Polyurethane Systems are designed to offer the highest levels of gap filler performance alongside state-of-the-art battery assembly that combines fast, efficient application with safe handling and use. These two-part, room temperature cure materials also feature excellent thermal conductivity and enhanced elongation. Like all VORATRON™ products, their low density results in lighter weight materials, which help reduce battery and vehicle weights, as well as carbon footprint.

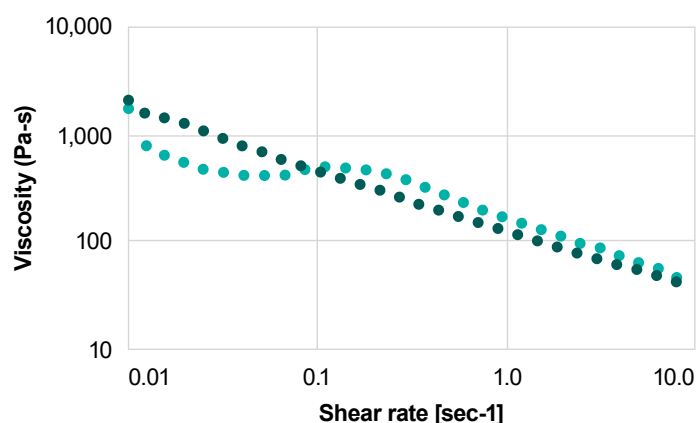


Outstanding performance, processing and sustainability

Our primary formulation in this series, VORATRON™ GF-1002 Polyurethane System, is a 2-watt (2W) gap filler specially designed to enable low energy assembly of battery packs. This is accomplished via very low squeeze force levels at a displacement speed of 1 millimeter per second – the benchmark for low energy battery pack assembly. The material's shear thinning behavior (Figure 1) with no self-leveling also supports easy dispensing and processing to help:

- Ensure complete module coverage
- Prevent excessive stress in finished parts
- Avoid air entrapment
- Minimize wear on equipment and battery modules

Figure 1: Viscosity vs. shear rate of VORATRON™ GF-1002 Polyurethane System⁽¹⁾



VORATRON™ GF-1000 series systems enable low energy assembly due to their very low squeeze force requirements.



⁽¹⁾ Typical values, not to be construed as specifications. Users should confirm results by their own tests.

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VORATRON™ GF-1000 series systems are also free of volatile components that could potentially contaminate surfaces on the assembly line, interfere with vehicle painting operations or – most importantly – jeopardize the health and safety of operators.

Table 1 highlights some important attributes of these materials.

Table 1: VORATRON™ GF-1000 series systems for gap filling⁽¹⁾

Key attributes	Units	2W/mK	3W/mK
2-part, room temperature cure, low NCO, open time >30 min.	—	✓	✓
Squeeze force for low energy assembly	N	<120	<160
Density	g/mL	2	2.1
Rheology	—	Shear thinning, not self-leveling	
Hardness	—	75	75-85
Thermal conductivity	W/mK	2	3.1

Collaboration is the key

By leveraging all our MobilityScience™ resources and partnering with OEMs and tiers, we're able to develop the best possible gap filling materials for each H/EV battery design. Our decades of material science, technological, R&D and manufacturing experience, combined with the expertise of our customers, allows us to keep producing innovative, efficient and sustainable solutions to mobility challenges.

Please contact your Dow representative or visit us online at dowmobilityscience.com to learn more about MobilityScience™, VORATRON™ Polyurethane Systems and our full portfolio of advanced battery pack gap filler solutions.

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