

DuPont™ BETAFORCE™ Helps Reduce “Range Anxiety” for Audi’s First All-Electric SUV



Project

DuPont’s Transportation & Industrial team collaborated with Audi engineers to develop a bonding material that supports super-fast charging for the Audi e-tron, Audi’s first all-electric SUV launched in Spring 2019. In addition to thermal management capabilities, the thermal-conductive adhesive also had to be optimized to help attain best-in-class driving range, lengthen module lifecycle, and improve performance.



Challenges

Thermal management

One of the biggest challenges in designing batteries for plug-in hybrid (PH) and electrical vehicles (EV) is thermal management of the battery pack. Battery components must operate in the optimum temperature window of 25°C during operations and below 60°C while charging.

Maximize vehicle performance

Some drivers resist adopting EVs because of limited driving range, performance, and battery life. Audi’s goal was to ensure sufficient day-to-day capability without sacrificing performance.

Minimize charging time

Drivers don’t want delays because their EV takes too long to charge. Audi’s e-tron SUV needed to be capable of super-fast charging without generating excessive heat.

Solution

BETAFORCE™ 2800 TC thermal-conductive 2K adhesives for battery pack assembly were optimized and specified for use on the Audi e-tron.

Thermal and vibration management

The thermal management properties of BETAFORCE™ 2800 TC helps the 95kWh

Audi e-tron battery operate in the optimum window of 25°C during its operations and below 60°C while charging. The excellent combination of higher modulus and elongation helps ensure that the battery and the bonded substrates that support the battery assembly can last over the vehicle lifetime.

With a quieter-running electric drivetrain, the vibration inhibition properties of BETAFORCE™ 2800 TC were also important for user satisfaction.

Longer range

The new Audi e-tron battery – optimized with BETAFORCE™ 2800 TC that conducts temperature both during charging and driving – delivers a range of more than 400 kilometers and supports super-fast 150kW charging, freeing drivers from “range anxiety.”

Optimized handling

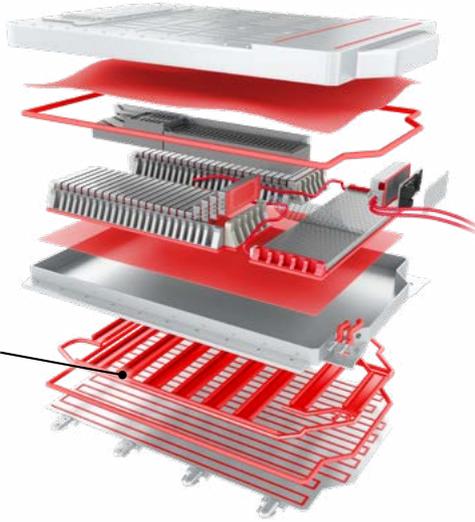
Placement of the bonded battery in the floor of the passenger compartment creates a low center of gravity for dynamic handling and helps achieve the Audi e-tron’s long-range capacity.

Manufacturing performance

Good shear thinning behavior of BETAFORCE™ 2800 TC allows for the fast dispensing needed to support high-volume production.

Testing confirmed that the material properties meet or exceed heat-cure performance, mixer dwell times, pump pressures, and press-in forces.

BETAFORCE™ 2800 TC
Thermally conductive
PU structural adhesive



BETAFORCE™ 2800 TC exhibits appropriate elongation to manage the potential temperature difference between the cooling unit and the cooling plate.

Note - not an illustration of e-tron battery system.

Key BETAFORCE™ properties

Thermal conductance (ASTM 5470-12, ZFW)	1.2W/mk
E-Modulus [MPa]	90
Elongation at Break [%]	30
Tensile Strength [MPa]	6
Lapshear Strength [MPa]	ca 5 MPa
Open Time at RT [min]	10-15
Handling Strength at RT	ca 1h
Curing time at RT	ca 24h
Curing time at 80°C	ca 2 min

BETAFORCE™ Enables Multi-material Mix

BETAFORCE™ 2800 TC is the bonding material that made it possible to develop the first organic thermal-conductive bonding for plug-in hybrid and electric vehicles.

BETAFORCE™ is an ideal choice for joining carbon fiber and glass fiber composites and other dissimilar materials in a variety of lightweight designs, including modular assemblies. It can be used to bond coated metals like steel to aluminum, carbon fiber panels to steel or aluminum, and sheet molding compound (SMC) to aluminum.

BETAFORCE™ polyurethane adhesives are two-component composite bonding adhesives. Formulations vary based on the vehicle production process and reflect variables such as viscosity, application temperature, conductivity, cure time, E-modulus, strength, and temperature. Both components can be dispensed from bulk containers into standard meter mix equipment for application. Products are also sold in single-use kits.

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Transportation & Industrial

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Form No. 001-20168-HMC0619