

Driving EV performance and passenger safety

Industry challenges & DuPont solutions

Frank V. Billotto | Feb. 2022

Global Footprint to Meet Customer Needs



DuPont Automotive

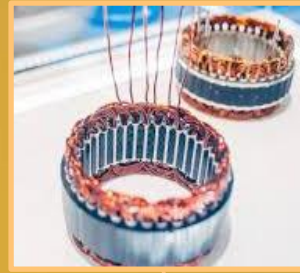
Examples of Products and Applications



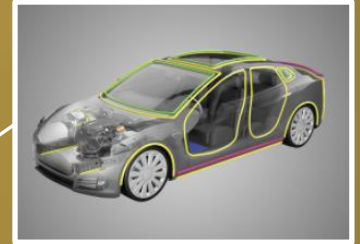
Belt & Hose Reinforcement
Kevlar® in tires
Nomex®/Vamac® in turbo hoses



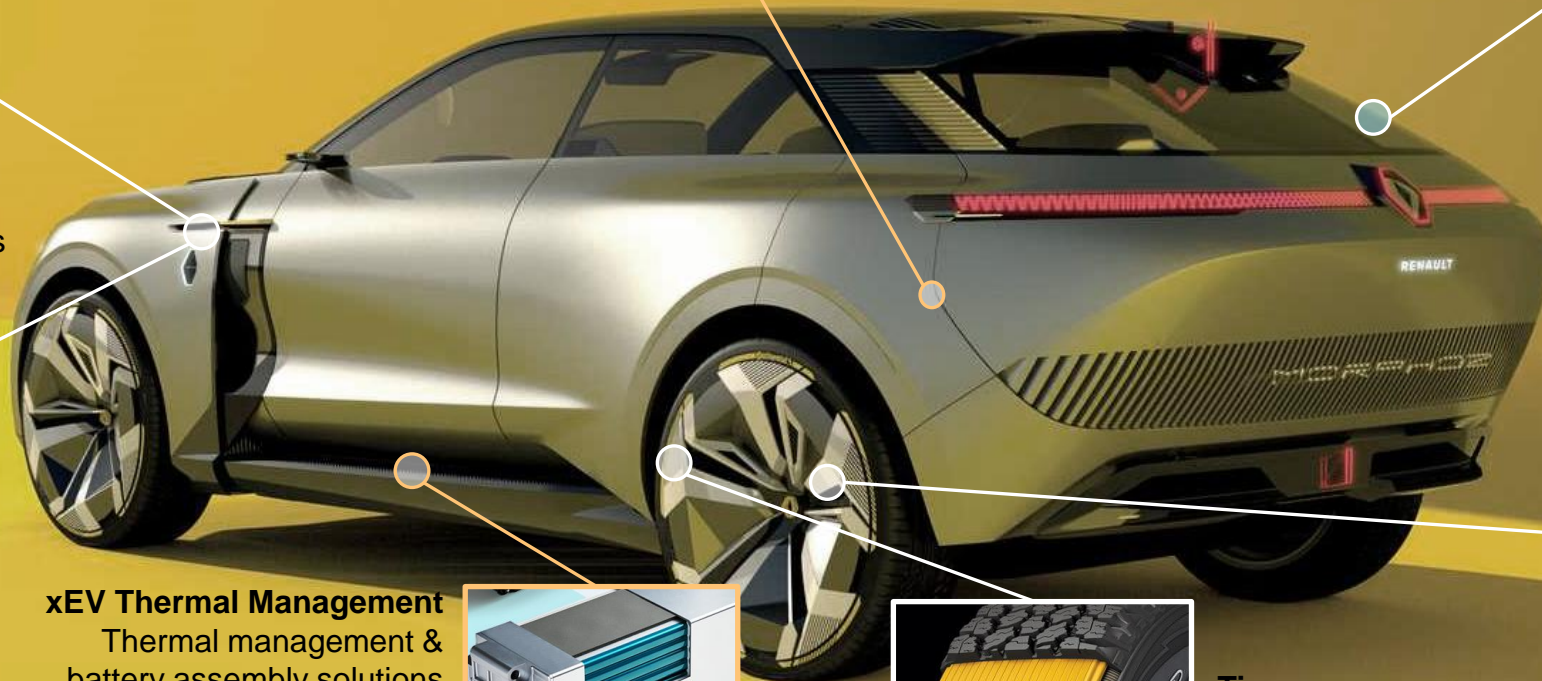
Starter & Alternators Insulation
Zytel® PA, Crastin® PBT in insulation parts, connectors, frames
Nomex® in stator



E-Motor Solutions
Nomex® & Kapton® in e-motors
Zytel® PPA and Crastin® PBT for bus bar rings, sensors and HV connectors
Temprion® for wide bandgap chipset inverter power electronics



Structural Adhesives
BETAMATE™ & BETAFORCE™
BETASEAL™ Glass Bonding



Friction Material
Kevlar® for clutch & brake pad materials

xEV Thermal Management
Thermal management & battery assembly solutions
Zytel® PA for frames, end plates
Zytel® LCPC cooling pipes and connectors
Kapton® for EV PTC heaters
Kevlar® MicroCore™ battery separator technology
Vespel® for battery insulation

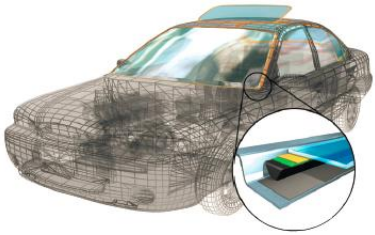


Tires
Kevlar® reinforcement

DuPont Mobility & Materials

Adhesives and Battery Solutions

GLASS BONDING

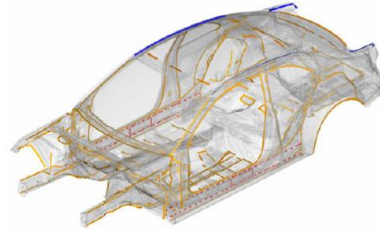


BETASEAL™

PU Technology
1K & 2K
Elastic sealants
Primerless Adhesives

BETAPRIME™ & BETASEAL™
Primers

BODY

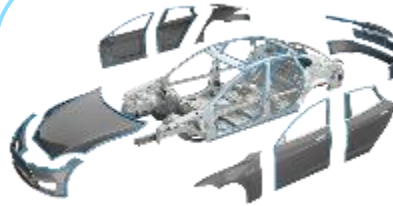


BETAMATE™

Epoxy Technology
1K & 2K
Structural Adhesives

Multi-material Bonding
Expandable Adhesives
Low Temperature Cure
Wash-off Resistance

MIXED MATERIAL BONDING

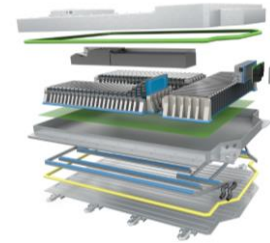


BETAFORCE™

PU Technology
1K & 2K
Structural Adhesives

Multi-material Bonding
Modular Assembly

BATTERY

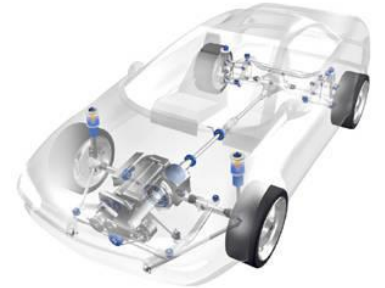


BETAFORCE™ and BETAMATE™ TC

Epoxy & PU Technology
1K & 2K
Structural Adhesives
Thermally Conductive
Adhesives

BETATECH™
Thermal Interface Materials

ANTI-VIBRATION



MEGUM™ THIXON™

Cl, Br polymers
Siloxane Seal Adhesives
Single Coat
Primers + Cover Cements

W-series waterborne AVS

Thermal Adhesives for Battery Pack Assembly



Key Application Needs

- Broad range of applications, most involving direct adhesion to battery cells
- Thermal management without sacrificing bonding performance
- Solutions ranging from elastic to highly rigid
- Solutions with low abrasion and excellent electronic properties

Key Development Challenges

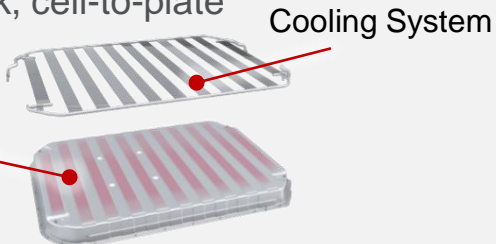
- High thermal conductivity with robust adhesion
- Materials with varying mechanical performance
- Broad range on mechanical & processing properties

BETAFORCE™ TC

Shear Strength: 3 – 7 MPa

- Thermal conductivity: 1.0 – 3.0 W/m·K
- Good bonding to treated Al and composites
- Long open time for large application areas
- Heat acceleration for rapid assembly
- Applications: cell-to-cell, cell-to-pack, module-to-pack, cell-to-plate

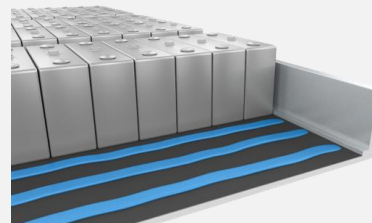
BETFORCE™ TC



BETAMATE™ TC 2K Acrylic

10 – 20 MPa

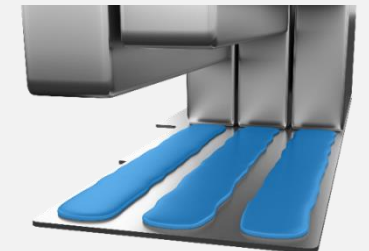
- Thermal conductivity: 1.0 – 1.5 W/m·K
- Very rapid assembly, no heat acceleration
- Good adhesion to metals & plastics, often without pretreatment
- Applications: cell-to-plate, cell-to-pack



BETAMATE™ TC 2K Epoxy

15 – 25 MPa

- Thermal conductivity: 1.0 – 1.5 W/m·K
- Excellent adhesion to metals & composites
- Long open time & fast heat cure acceleration
- Dielectric strength: >30 kV/mm
- Applications: module to pack, cell-to-pack



BETATECH™ Thermal Interface Materials – using new innovative chemistry devoid of silicones

Technology Needs

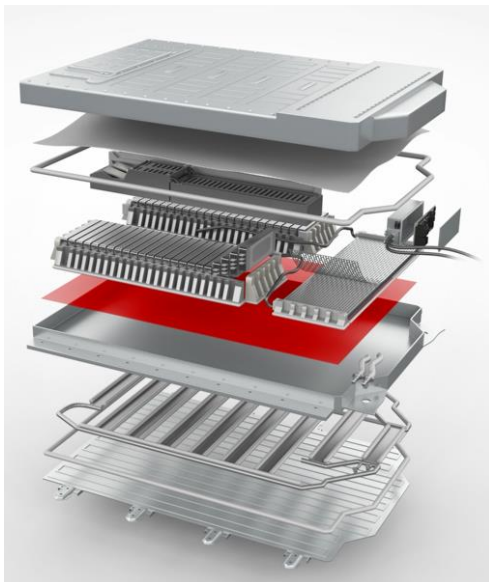
Thermal connection of cells to cooling system

- **High thermal conductivity**
- **Low viscosity** – low press-in force for efficient process
- **Repairability:** non-destructively remove single cells

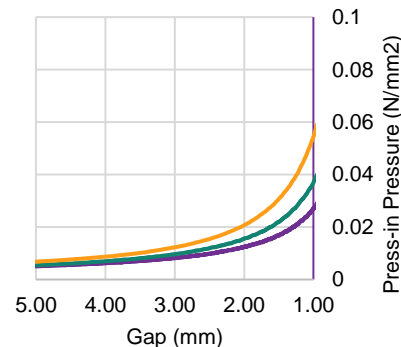
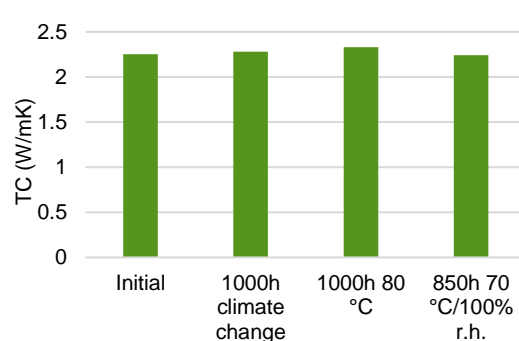
Key Products

- BETATECH™ – 1K PU, 2 W/mK – ease of application
- BETATECH™ – 2K PU, 2 W/mK – lowest viscosity
- BETATECH™ – 2K PU, 3.5 W/mK – high TC, low viscosity

Our Solution

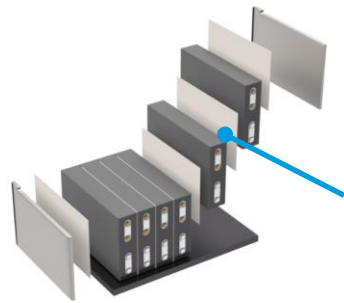


- **Proprietary polymer technology** combined with engineered filler package offers low viscosity, low density, high TC formulations
- **Robust performance over aging**
- **Low pull-out** for non-destructive repair solution
- **Free of silicone** thermal interface materials



A single source for safer EV batteries

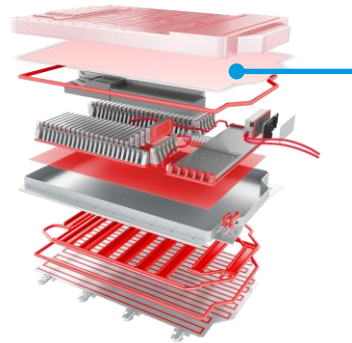
DuPont offers packaged solutions using Nomex® to help OEMs design safer EV batteries using a system approach and by collaborating with leading battery manufacturers and auto OEMs to address the increasing challenges.



Between cell
thermal barrier:
**Nomex®
CellShield™**

Between cell thermal barrier solution

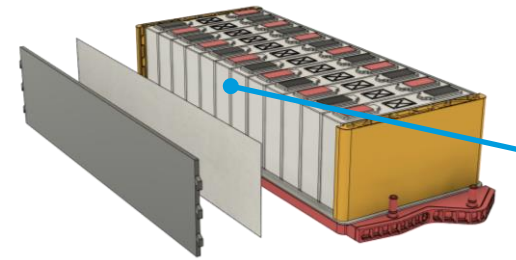
Mitigate thermal propagation
between cells



Battery
enclosure flame
protection:
**Nomex®
SafePak™**

Battery enclosure flame protection solution

Helps prevent fire penetration
through battery enclosure



Electrical
insulation:
**Nomex® 410,
Nomex® 818**

Battery pack electrical insulation

Inherently flame-retardant
electrical insulation



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