



DuPont Automotive Materials and Technology
FOR HYBRID AND ELECTRIC VEHICLES



The miracles of science™

TODAY...

every major global vehicle manufacturer offers a hybrid-powered or—soon—a plug-in hybrid or battery-electric vehicle to help reduce carbon emissions and dependence on petroleum.

While adoption forecasts vary, no one doubts this technology will play an important role in shaping how vehicles are powered. Similarly, the role of materials and polymer science is increasingly critical in the development of safer, lighter, more cost-effective and energy-dense battery systems.

Go to hybrid-electric.automotive.dupont.com to see where DuPont Automotive can put the industry's broadest range of high-performance materials, polymer science capabilities and application knowledge to work to help you develop more cost-effective, safer, lighter and more energy dense battery systems quickly.



OUR GLOBAL DEVELOPMENT TEAM IS WORKING TO IMPROVE:

Energy Density and Power

- Boost kilowatt-per-hour and power capabilities with improved battery chemistries and materials for critical binders and DuPont™ Energain™ separators.
- Prevent electrical discharge with improved insulation systems that draw from the broadest array of material choices.

Weight and Packaging

- Reduce weight up to 40% using plastics instead of aluminum and steel.
- Invite component and functional integration that reduces space and improves packaging using high-performance polymers and elastomers.

Safety

- DuPont™ Energain™ Battery Separators for high performance lithium ion batteries can improve safety by providing stability at high temperatures.
- Protect batteries with new materials that include higher voltage, reduced flammability electrolyte technology, high temperature stability separators, and electrode materials to reduce battery heating.
- Improved battery pack performance with flame retardant and thermoplastic materials.
- USCAR-rated thermoplastic materials for 650 volt system requirements.

Thermal Management

- Maintain “sweet spot” operating temperatures (0 to 55 °C) while protecting against highs and lows (-40 to 120 °C) through integrated thermal management systems with materials that resist exposure to coolant and automatic transmission fluid.

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Battery Solutions

DuPont™ Energain™ Separators
DuPont™ Kapton® tape and insulators
DuPont™ Kalrez® elastomers
DuPont™ Nomex® brand paper or pressboard
DuPont™ Vamac® AEM
DuPont™ Vespel® Parts and Shapes

Electrical Insulation Systems for Motors

DuPont™ Kapton® polyimide film
DuPont™ Nomex® brand paper
DuPont™ Voltatex® VS wire enamels
DuPont™ Voltatex® resins and varnishes

Film Capacitors

Teonex® PEN film



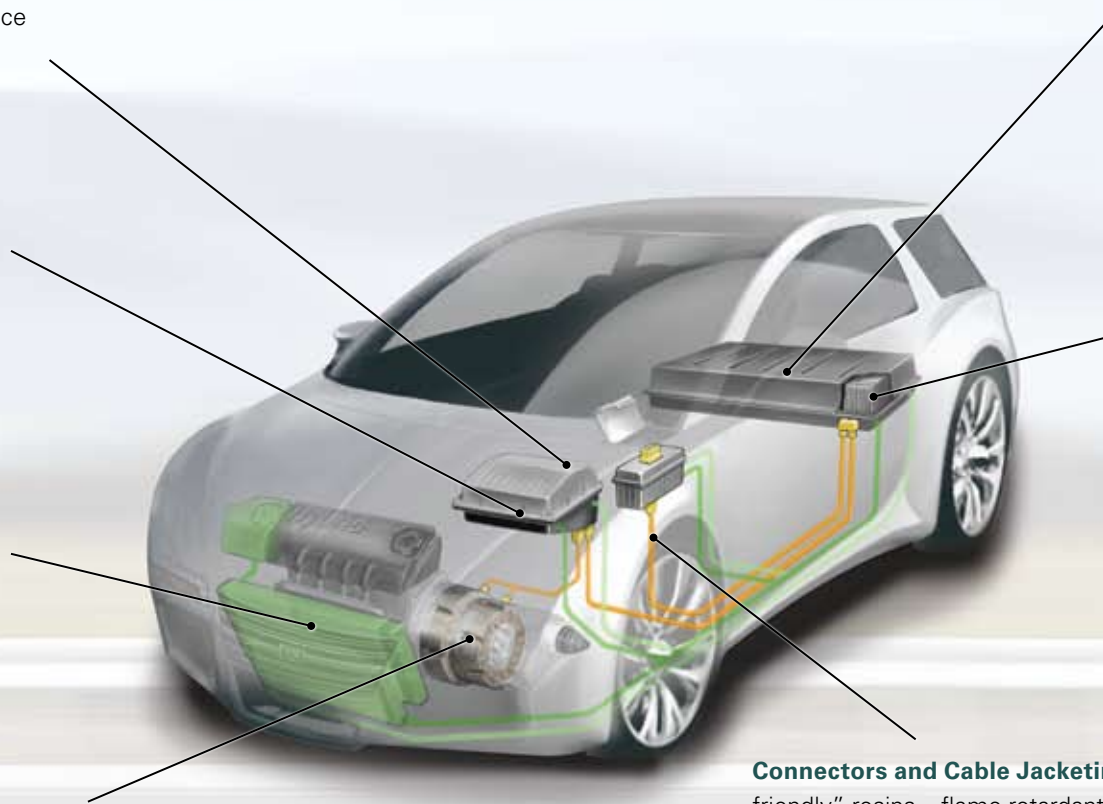
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Power Control Unit: High performance “electrically friendly” resins with CTI above 600 volts can combat ionic corrosion of copper wires.

Film Capacitors: High-temperature Teijin DuPont Films Teonex® PEN film can reduce capacitor size and improve power density over a broad temperature range. Ultra-thin DuPont™ Kapton® polyimide films are under development, which may lead to even higher temperature operation, if needed.

Thermal Management Systems: High-performance plastics provide excellent heat aging, coolant and ATF resistance to optimize operating temperatures while reducing mass up to 40%.

Electric Motors: Electrical insulation systems that are designed specifically for automotive traction applications — including DuPont™ Nomex® brand papers, DuPont™ Kapton® polyimide films, DuPont™ Voltatex® VS wire enamels and DuPont™ Voltatex® resins and varnishes



Battery Pack Structures: Flame retardant plastics to help meet emerging safety requirements. Dimensionally stable and impact resistant resins to improve crash worthiness. Plastics with excellent coolant resistance for liquid cooled pack systems.

Battery Pack Cells: DuPont™ Energain™ Battery Separators for high performance lithium ion batteries can boost power by 15%–30%, improve safety by providing stability at high temperatures so hybrid vehicle drivers can drive longer on a single charge, and reach their desired speed more quickly and safely.

Connectors and Cable Jacketing: “Electrically friendly” resins – flame retardant, V-0, UL rated nylon, PPA products with CTI above 600 volts; hydrolysis-resistant, USCAR Class IV capable PBTs. DuPont™ Vamac® AEM and DuPont™ ETPV for high energy cable insulation.

Elastomers and Thermoplastic Elastomers

DuPont™ Vamac® AEM
DuPont™ ETPV

High-Performance Parts

DuPont™ Vespel®
DuPont™ Kalrez® elastomers

“Electrically Friendly” Polymers

DuPont™ Crastin® PBT
DuPont™ Zytel® HTN PPA
DuPont™ Zytel® PLUS nylon
DuPont™ Vespel® Parts and Shapes

Thermal Polymers

DuPont™ Zytel® HTN PPA
DuPont™ Zytel® PLUS nylon
DuPont™ Zytel® nylon

To find out more, contact us...

DuPont Europe:

Western Europe: 0800 3876 6838

Europe, Middle-East & Africa: 0034 985 12 3773

DuPont North America:

United States: 1 800 441 7515

Canada: 1 800 387 2122

Dial DuPont First 1.800.441.0575

DuPont Latin America:

Brazil: 0800 171715

Others — Latin America: 0055 11 4166 8000

DuPont Asia Pacific:

Australia: 0061 2 9923 6111

China: 0086 21 38622888

India: 0091 124 2540900

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