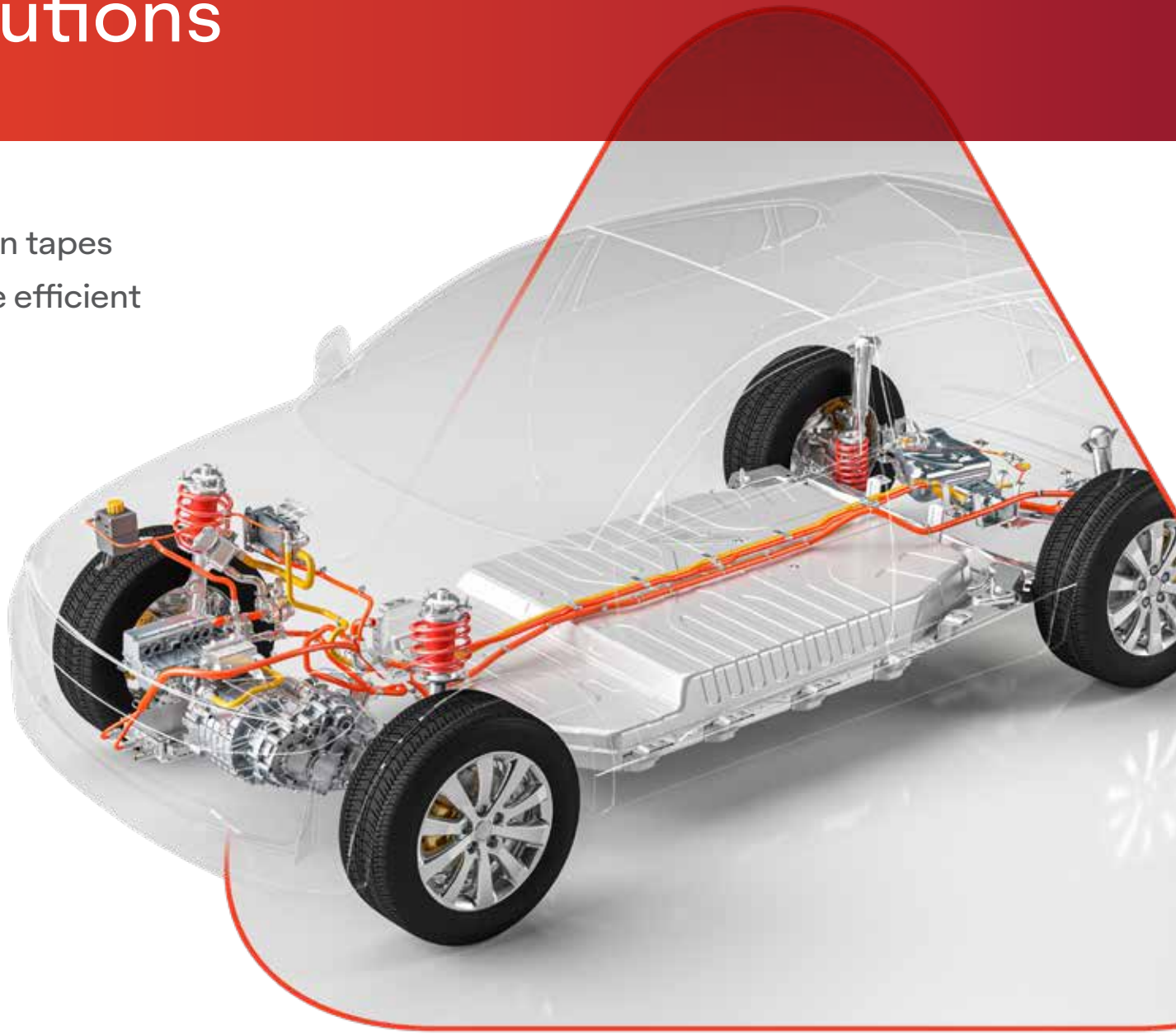
Avery Dennison Performance Tapes

EV Battery Solutions

Functional bonding and protection tapes that make EV batteries safer, more efficient and easier to assemble



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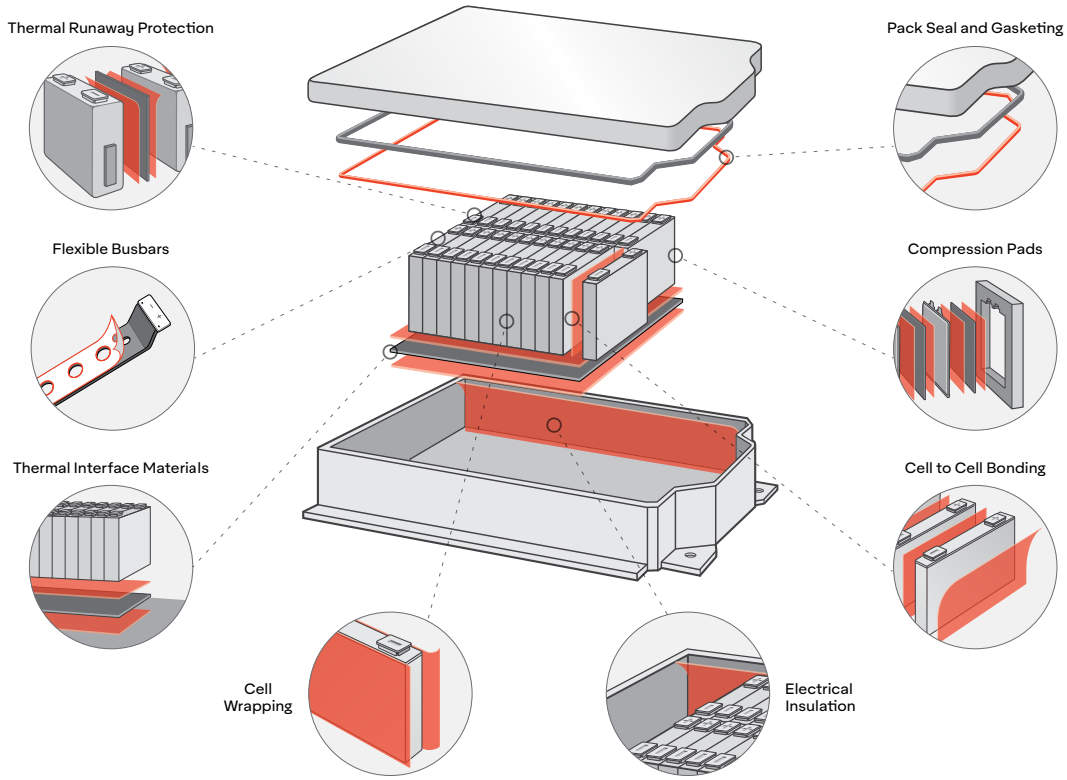

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The Future of Global Electric Vehicle Demand

The Future of Global Electric Vehicle Demand

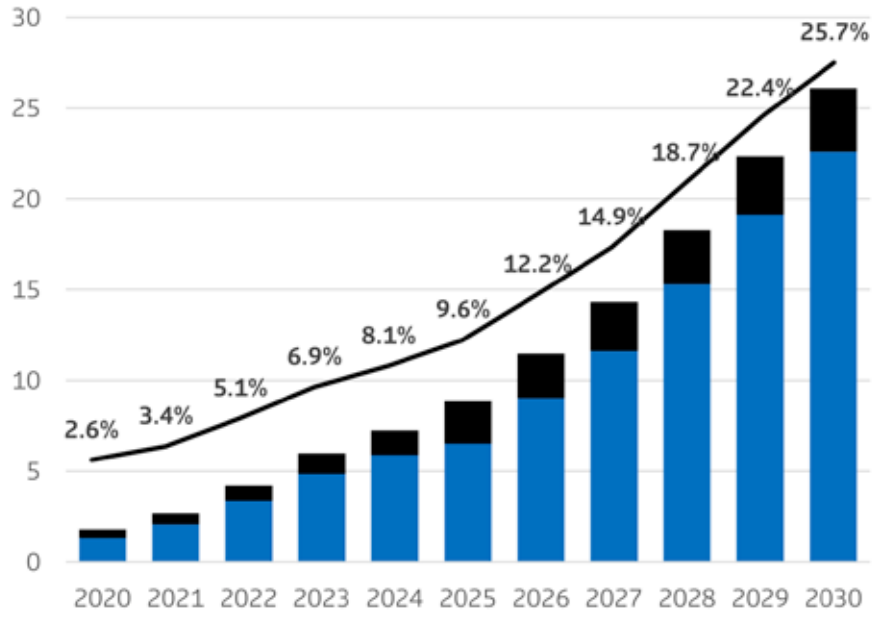
Electrified vehicles are expected to rise from just 2.6% share in 2020 to 25.7% share in 2030.

Drivers

- Battery technology continues to improve capacity and range
- Increased OEM investments and goals
- Falling battery costs (below $100/kwh)
- Policy and emission regulations

Implications

- EV battery packs have needs that can be addressed with tapes and functional, flexible materials
- This represents a tremendous opportunity for converters



Source: Cowen and Company, IHS Global Production Forecast, Sept. 20, 2020

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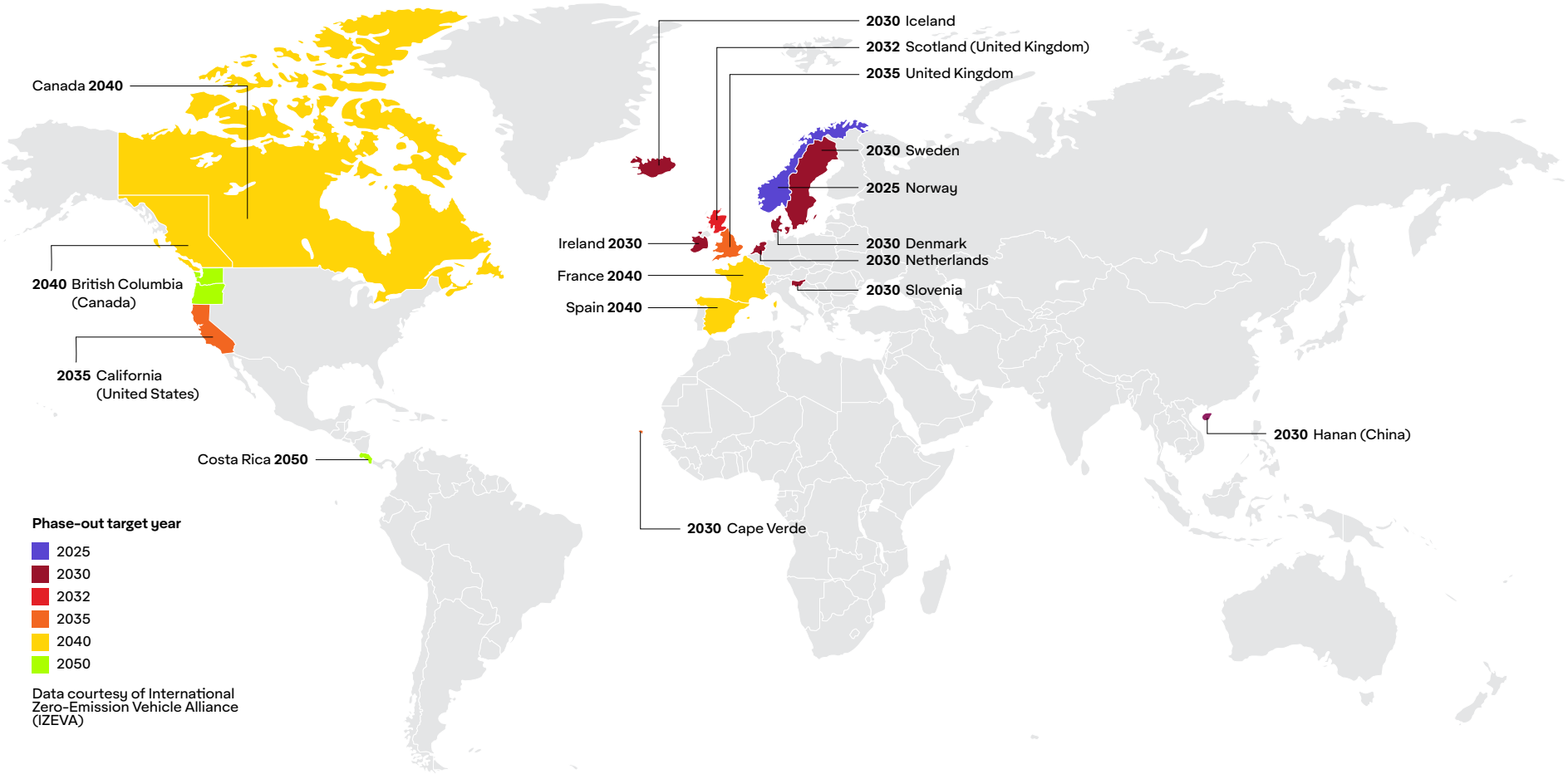
Governments with set targets for phasing out new sales of internal combustion engine passenger cars

(as of February 2021)



Data courtesy of International Zero-Emission Vehicle Alliance (IZEVA)


EV

Pain Points and Common Challenges

OEM and End Customer Pain Points

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Typical Architecture

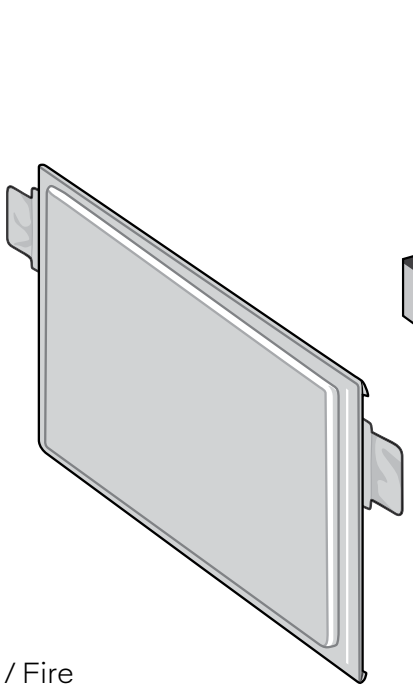
- Cells
- Modules
- Pack

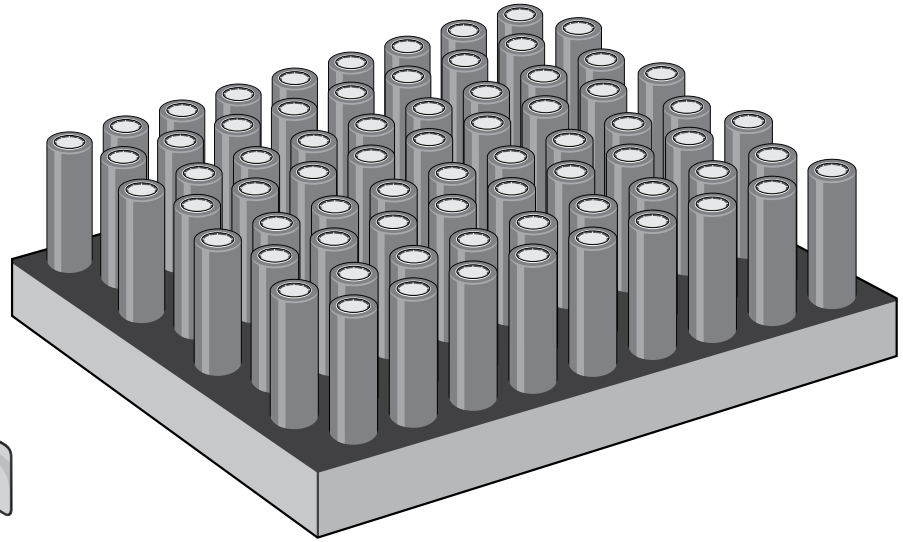
Cell Types

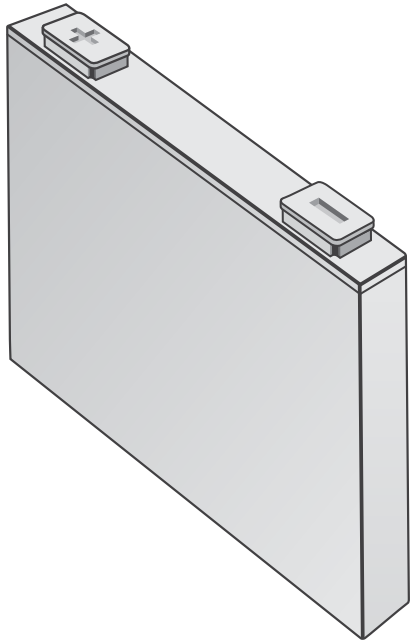
- Cylindrical
- Prismatic
- Pouch

Cell Protection

- Thermal Energy — Thermal transfer / Fire
- Retention — Adhesion / Cell Expansion / Shock absorption
- Electrical — Dielectric protection / Electromagnetic / Sensors
- Environmental — Water / Humidity / Salt







Solutions for Common Challenges

The Avery Dennison EV Battery Portfolio can help you solve some of the most common challenges in battery design and construction:

Reducing flammability

Acrylic- and silicone-based adhesives with Flame Tough™ flame-retardant properties that allow composites and materials to meet UL® 94 V-0 and other flame requirements.

Boosting dielectric strength

Single- and double-coated tapes that incorporate dielectric films. Our materials and adhesives are tested for breakdown voltage and dielectric strength requirements using GB/T 1408.1-2016 and IEC 60243-2 test methods.

Protecting pack materials

Single- and double-coated tapes providing dimensional stability and material encapsulation, along with easy release liners that can help protect delicate fibrous materials during assembly.

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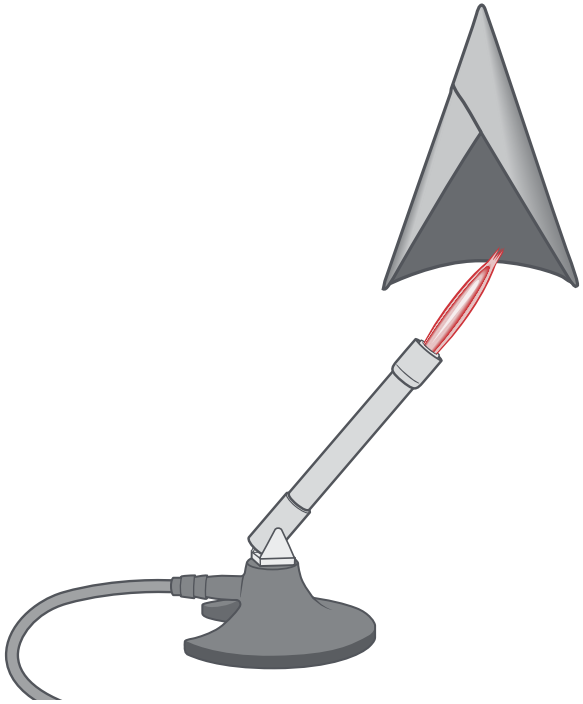
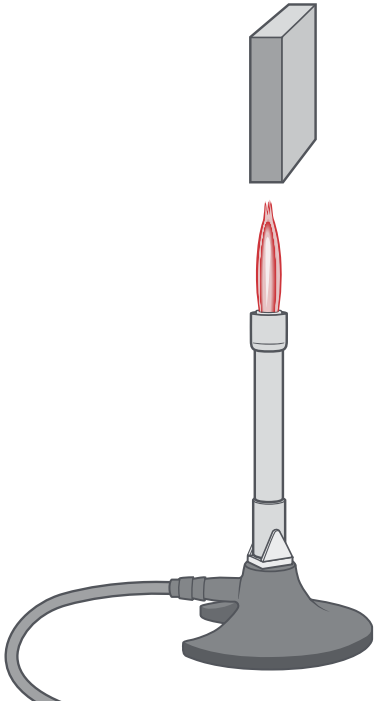
Insulating and Protecting EV Materials

Reducing flammability within EV Battery assemblies

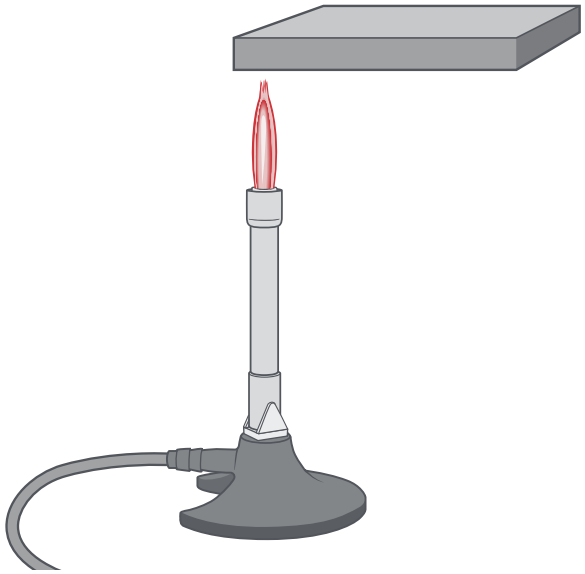
Acrylic- and silicone-based adhesives with Flame Tough™ flame-retardant properties that allow composites and materials to meet UL® 94 V-0 and other flame requirements.



UL 94VTM



UL 94V



UL 94HBF / FMVSS302

Insulating and Protecting EV Materials

Boosting dielectric strength

Single- and double-coated tapes that incorporate dielectric films. Our materials and adhesives are tested for breakdown voltage and dielectric strength requirements using GB/T 1408.1-2016 and IEC 60243-2 test methods.

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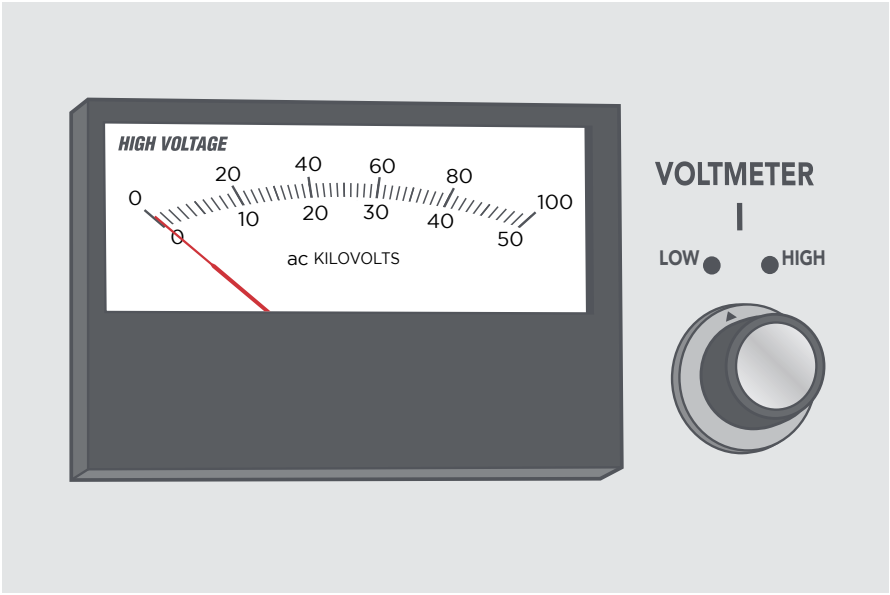

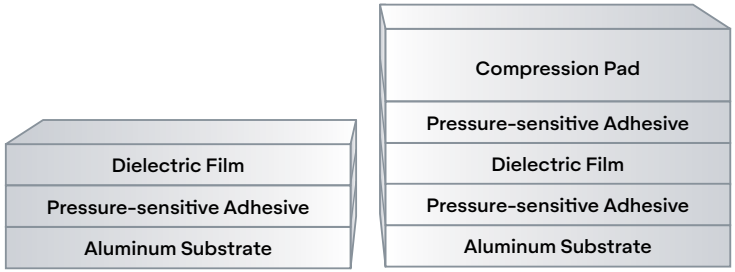

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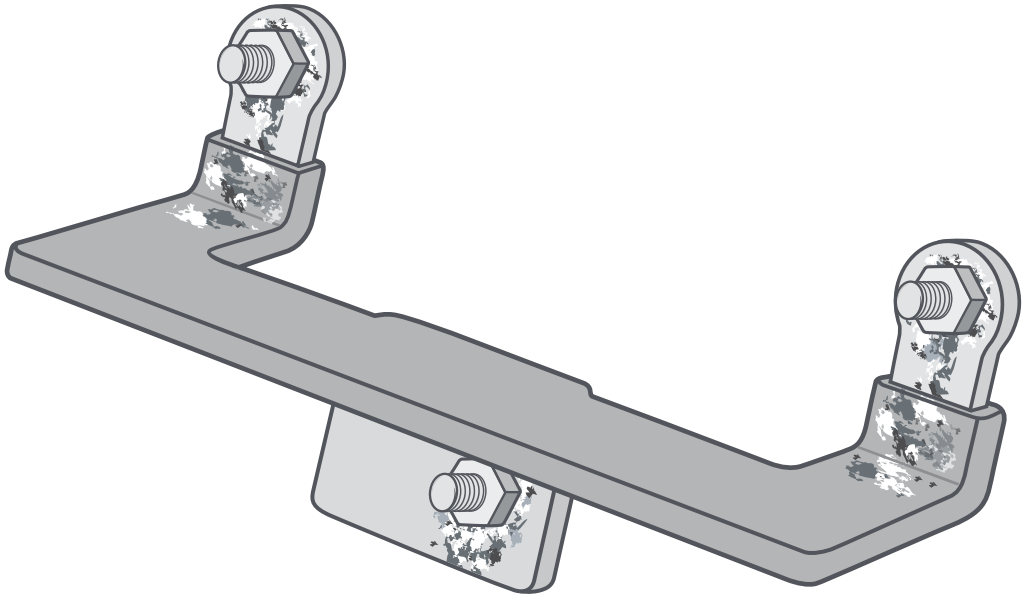
Protecting from Galvanic Corrosion

Critical battery components need to be protected from both oxidizing corrosion and dielectric corrosion from dissimilar materials. Corrosion can compromise the electrical conductivity, heat transfer, and structural integrity of critical battery components such as:

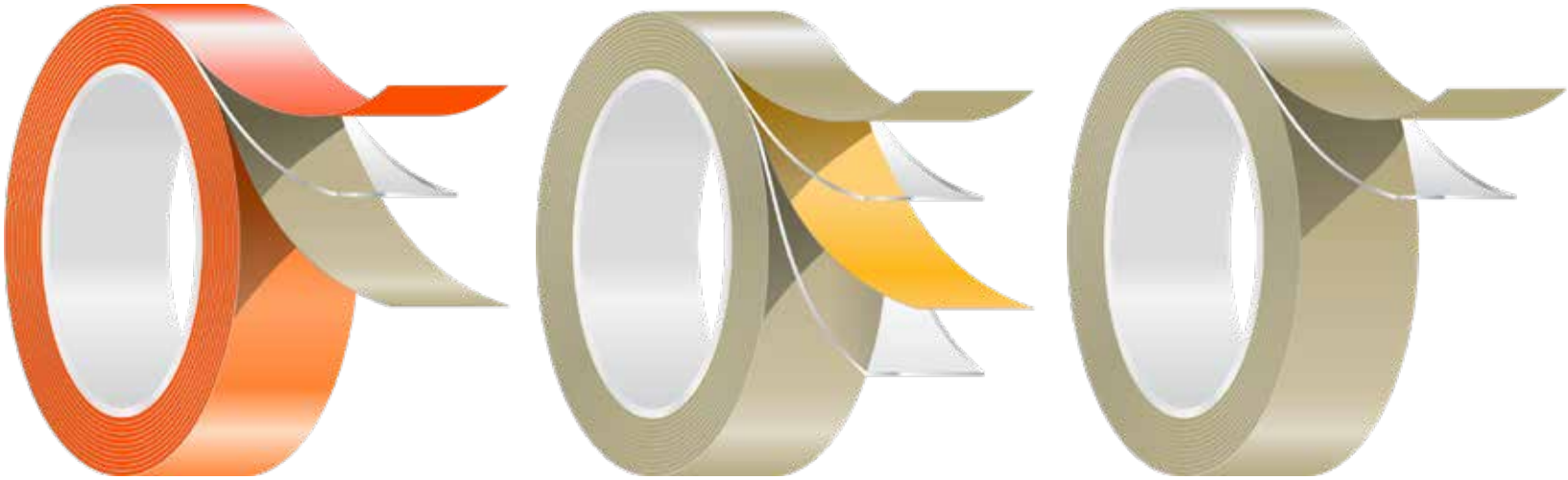
- Chiller or cold plates
- Busbars
- Battery module castings
- Battery pack housing



Insulating and Protecting EV Materials

Protecting pack materials

Single- and double-coated tapes providing dimensional stability and material encapsulation, along with easy release liners that can help protect delicate fibrous materials during assembly.



Single Coated

Double Coated

Transfer Tape

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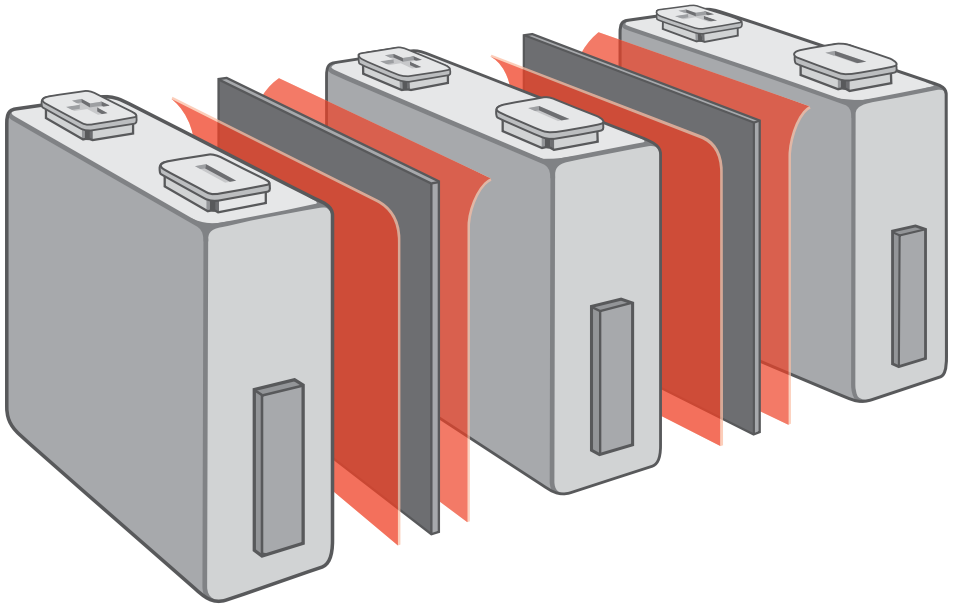
Applications

EV Battery Applications

Thermal Runaway Protection

Functional bonding solutions for materials that protect cells from thermal runaway



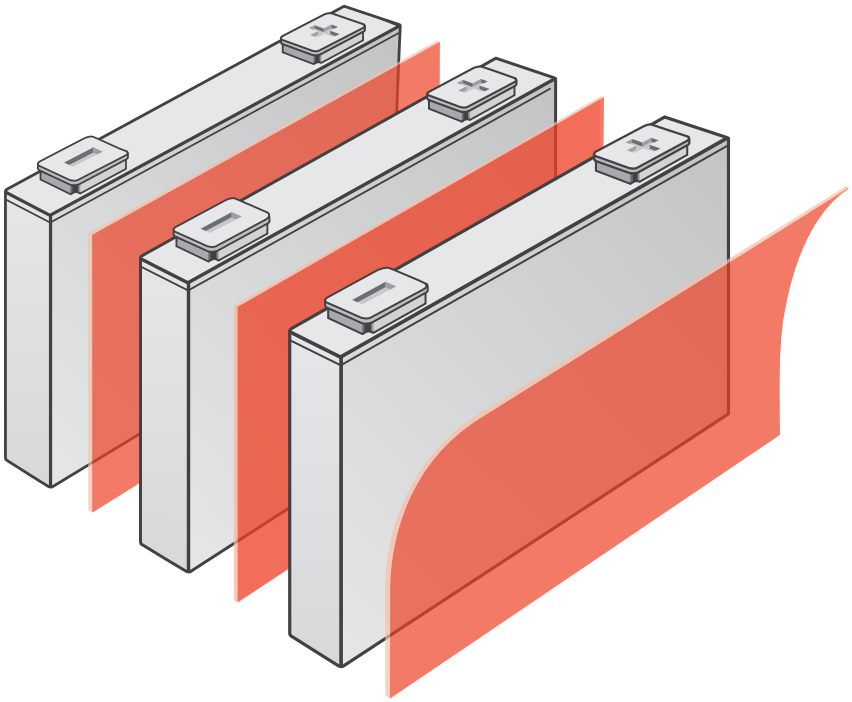
EV and battery manufacturers have strict requirements against thermal runaway events and rely on mica, ceramic fibers and other composite materials for protecting cells and passengers.

Avery Dennison offers a variety of solutions for bonding these materials to cells, modules and pack structures:

- Flame retardant adhesives that enable composites and materials to meet UL® 94 V-0 and other flame requirements.
- Single- and double-coated filmic tapes for fiber encapsulation and dielectric strength.
- Easy release liners for preventing cohesive failure of delicate fibrous based materials during processing.

Cell to Cell Bonding

Pressure-sensitive adhesives for bonding cells together in EV Batteries



Avery Dennison adhesives and tapes offer a quick and strong way to provide structural integrity in an EV Battery pack.

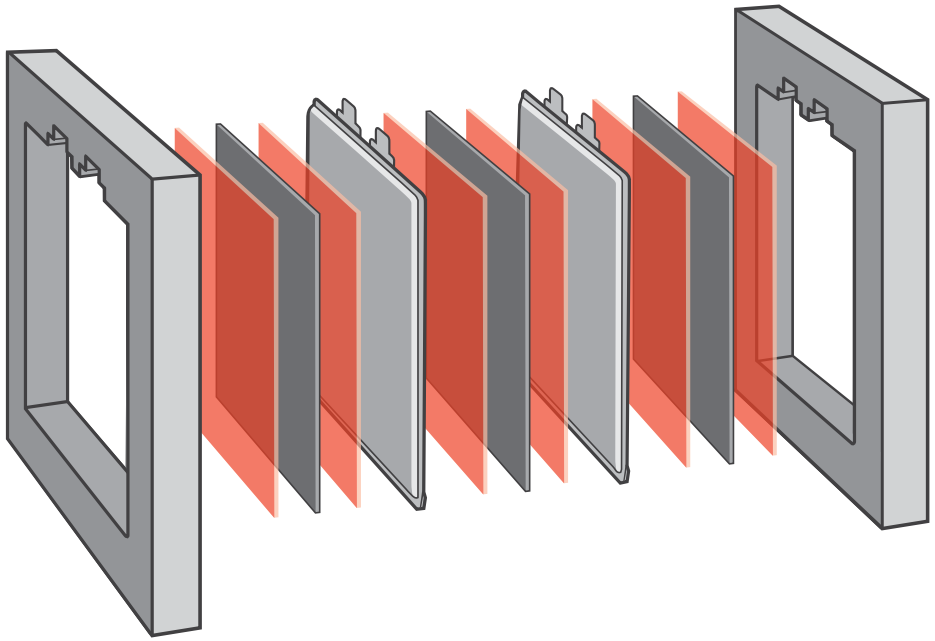
The use of pressure-sensitive tapes to bond pouch and/or prismatic cells together in EV Battery pack assemblies offer key benefits:

- Pressure-sensitive adhesives require no cure time, with immediate strength — they can act as an assembly aid and a bonding solution, unlike liquid applied products.
- There is no need for mixing nozzles or pot life concerns, as pressure-sensitive adhesives feature single-component functionality.
- Flame retardant and dielectric tapes are available when there are flame or electrical requirements.

EV Battery Applications

Compression Pads

Pressure-sensitive adhesives for bonding compression pads to cells and modules



Avery Dennison offers pressure-sensitive adhesives and tapes to bond compression pad foam that protects EV Battery cells.

Individual prismatic and pouch cells in EV Battery packs need protection from impact and movement. Pouch cells can also swell during charging and discharging. To help prevent damage, EV Battery manufacturers are placing foams backed with pressure-sensitive tape between each cell.

The use of pressure-sensitive tapes for cell cushioning offers some key benefits:

- Pressure-sensitive tapes require no cure time and provide immediate strength — they can act as an assembly aid and a bonding solution, unlike liquid applied products.
- Full coverage adhesion between the metalized polyester pouch cell and cushion foam when pressure-sensitive tapes are used.
- Flame retardant and dielectric tapes are available when there are flame or electrical requirements.

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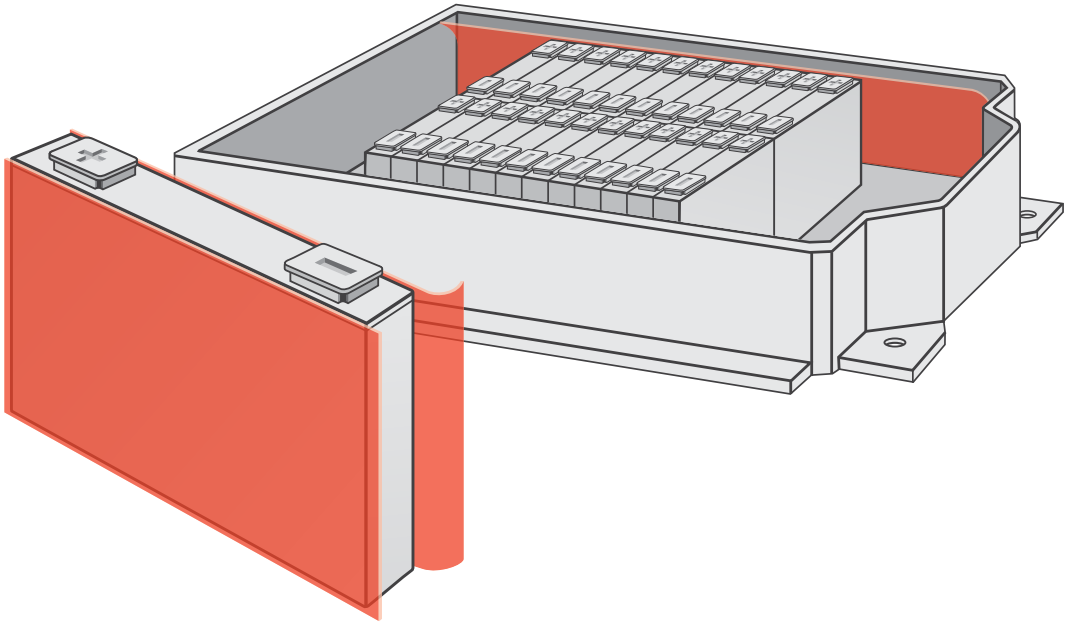
Electrical Insulation and Cell Wrapping

Adhesive tapes incorporating dielectric films, providing necessary electric insulation for sensitive EV Battery components



Electrical insulation and cell wrapping are critical for protecting certain sensitive components in EV batteries.

Avery Dennison offers single- and double-coated tapes that incorporate dielectric films for electrical insulation in EV batteries.

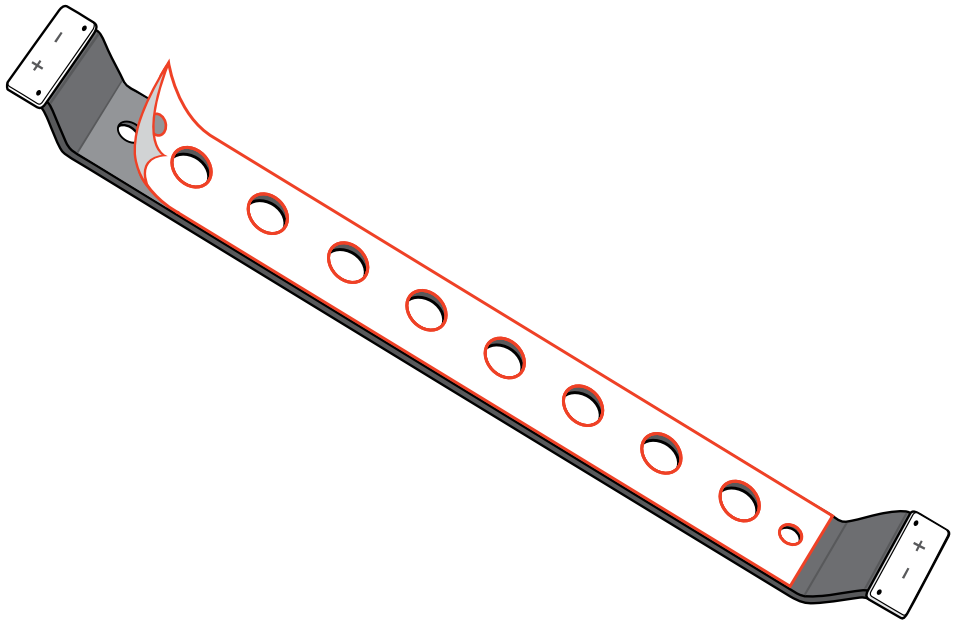
Our electrically insulative tapes for EV batteries offer the following features:

- Single- and double-coated adhesive constructions with non-conductive films.
- Flame-retardant adhesives for dual dielectric and flame protection.
- High durability for demanding environmental resistance.
- Flexibility to conform to irregular contours.
- Dielectric material and adhesives tested for breakdown voltage and dielectric strength requirements using GB/T 1408.1-2016 and IEC 60243-2 test methods.

EV Battery Applications

Flexible Busbars and Battery Health Sensors

Dielectric tapes to bond and protect flexible printed circuits in EV Battery assemblies



Flexible printed busbar and battery health monitoring circuits offer flexibility, safety and cost effectiveness in EV Battery applications.

Avery Dennison offers adhesives that secure and protect these flexible, printed circuits. The adhesives provide electrical insulation and flame retardance.

Our flexible busbar adhesive solutions for EV batteries offer the following features:

- Double-coated, filmic carrier constructions.
- Available with flame retardant adhesives tested in accordance with UL® 94 V-0.
- Dielectric material and adhesives tested for breakdown voltage and dielectric strength requirements using GB/T 1408.1-2016 and IEC 60243-2 test methods.

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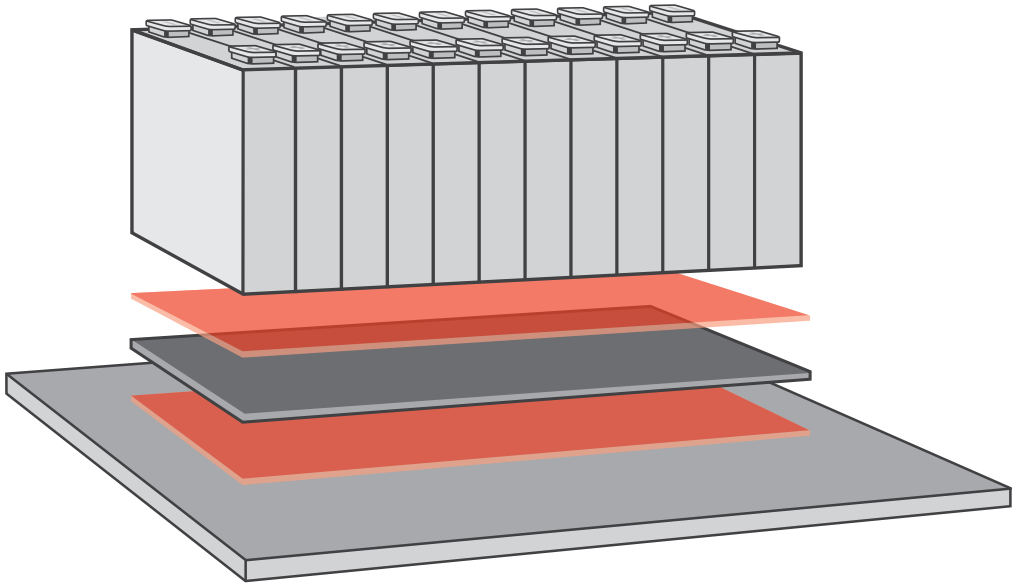
Thermal Interface Materials (TIMs)

Adhesive bonding solutions for heat transferring materials in EV Batteries



Thermal interface materials (TIMs) facilitate the transfer of heat between components in EV Battery assemblies.

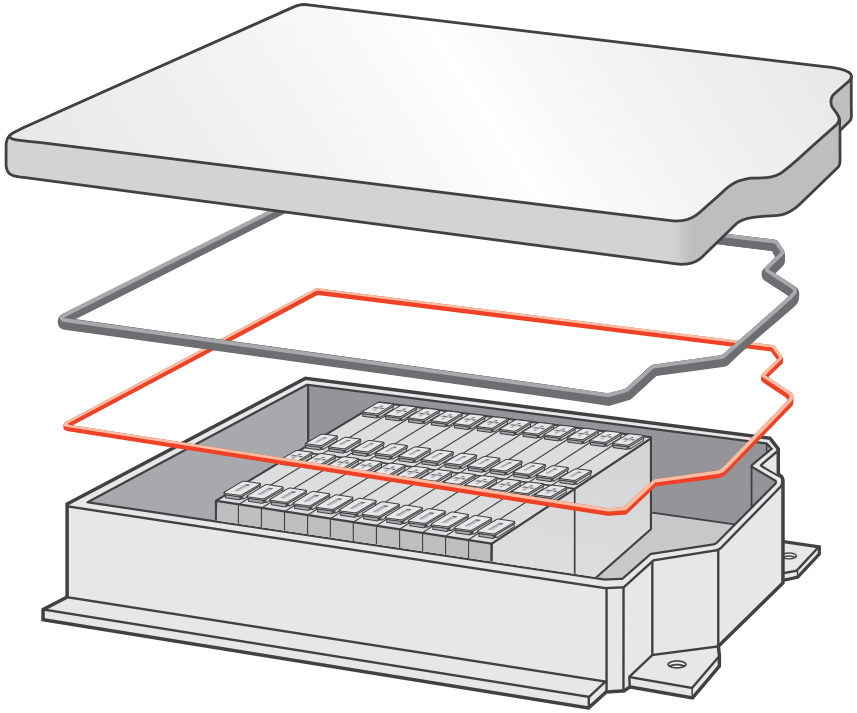
Avery Dennison offers multiple adhesive solutions — for TIMs bonded to either heat sink or chiller plate materials — to assist with battery cell and battery module cooling. These include:

- High wet out adhesives to lower thermal impedance between TIM and heat source.
- Silicone-based, pressure-sensitive adhesive offering excellent adhesion to silicone TIMs.
- Acrylic-based pressure-sensitive adhesives offering excellent adhesion to non-silicone based TIMs.
- Flame-retardant adhesives, tested in accordance with UL® 94 V-0, are also available.

EV Battery Applications

Pack Seal and Gasketing

Heat-activated and pressure-sensitive acrylic foam tapes for extrusions and rigid material bonding



Creating a tight seal for components is critical in the construction of EV Battery assemblies.

Avery Dennison offers heat activated, acrylic foam tapes to help maintain a watertight seal between the casing and rubber gaskets. Avery Dennison also offers pressure-sensitive acrylic foam tapes for bonding and sealing rigid components. Also in the portfolio are PSA tapes for attaching PUR and silicone foam gaskets.

Our acrylic foam tapes for EV batteries offer the following features:

- High durability and strength for demanding environments, shock absorption and dynamic resistance.
- Acrylic foam core enables gap filling between rigid components.
- Continuous bond line helps seal out unwanted intrusion and reduces need for fasteners.

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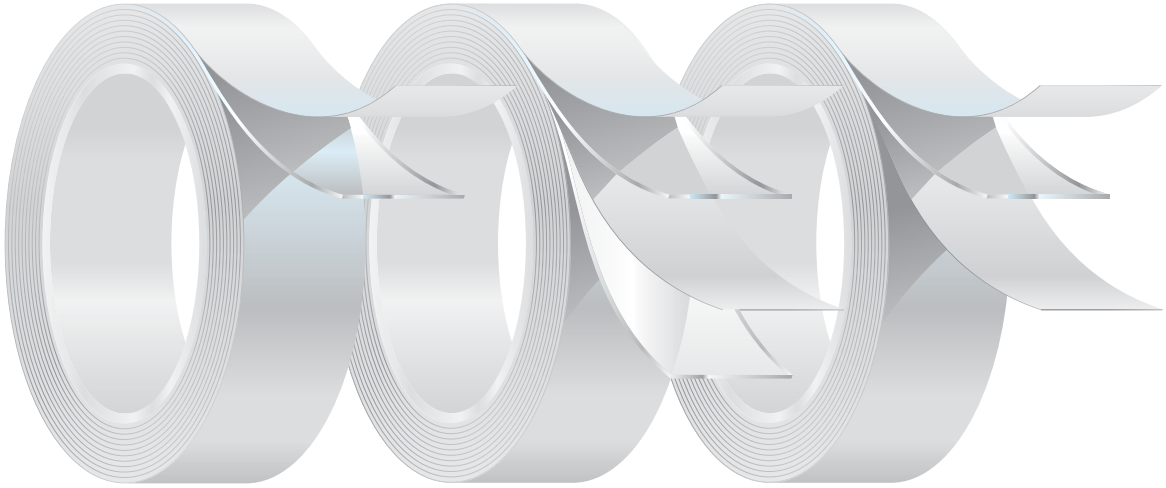
Avery Dennison EV Battery Portfolio and Capabilities

EV Battery Portfolio Adhesive and Film Types

There are three tape construction options within the Avery Dennison EV Battery Portfolio. These are:



Transfer Tape | Double-coated | Single-coated

EV Battery bonding tapes

Bonding Tapes are transfer tapes and double-coated tapes designed to bond two materials together within an EV Battery application. These tapes offer varying degrees of flame retardance, extra-low-surface bonding ability, gap-filling and dielectric strength.

EV Battery protection tapes

Protection tapes are single-coated tapes designed to protect a single substrate with a filmic facestock when applied to an EV Battery application. These tapes provide dielectric strength and dimensional stability, with some adhesive options offering flame retardance.

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Adhesives, Carriers and Facestocks

Avery Dennison offers a range of adhesive and film options to accommodate varying requirements. Flame Tough™ adhesives are recommended where flame retardancy is needed. Single- and double-coated filmic tapes are recommended where dielectric strength is needed.

When determining the correct Avery Dennison EV Battery tape product, refer to this chart for the performance level upgrade you may require for your application.

Adhesive Categories

General Automotive Acrylic	High Performance Acrylic (HPA™)	Flame Tough™ Acrylic	Flame Tough™ Silicone	AFB™
Designed for general automotive requirements with good initial tack and low surface energy bonding coupled with good temperature resistance.	Designed for the highest performance needs such as temperature resistance and shear strength.	Similar in performance to the General Automotive Acrylic with flame retardant properties.	Offers the highest flame retardancy and temperature resistance in the portfolio with the ability to bond to silicone-based materials.	Acrylic foam tapes designed for gap filling and bonding rigid components to each other.

Carrier/Facestock Categories

Polyester	Flame Tough™ Polyester	Flame Tough™ Polyimide
Polyester film with 6+ kV/mil dielectric strength.	Proprietary polyester film with 6+ kV/mil dielectric strength and flame retardant properties.	Polyimide film with ~7 kV/mil dielectric strength and excellent flame retardant properties and temperature resistance.

Capabilities and Support

Avery Dennison Performance Tapes prides itself by going beyond bonding to provide converters and end users with access to testing and collaboration with subject matter experts in order to offer solutions for your EV Battery applications.

Collaboration

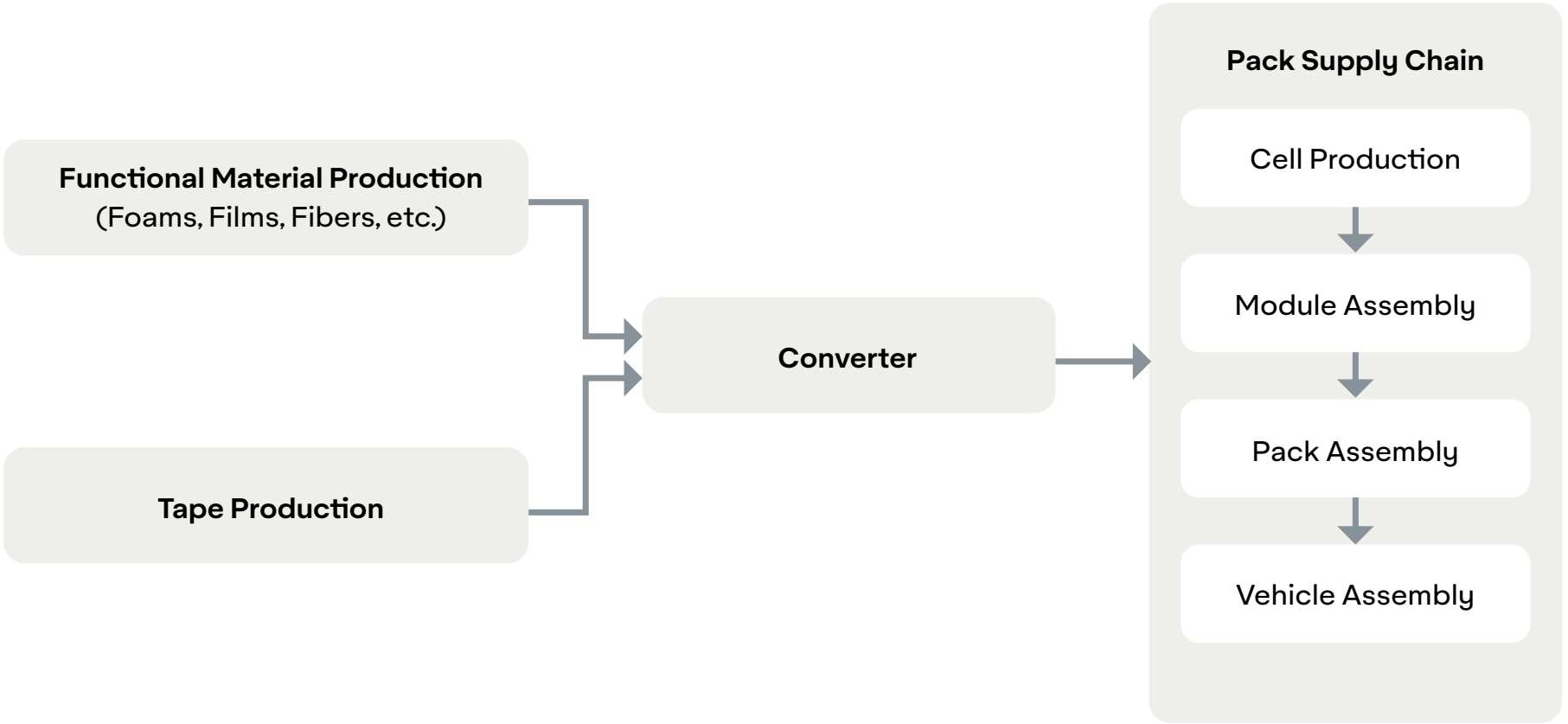
- New product development for developing custom solutions for specific applications.
- Business development and specification support for emerging applications.
- Application engineering and technical support.

Testing Capabilities

- Flame performance testing at the tape and composite level.
- Dielectric strength testing at the tape and composite level.
- Traditional bulk property testing (peel, tack and shear).
- Environmental conditioning (temperature, humidity, UV, chemical and more).

Supply Chain and the Converter's Role

Navigating the Supply Chain



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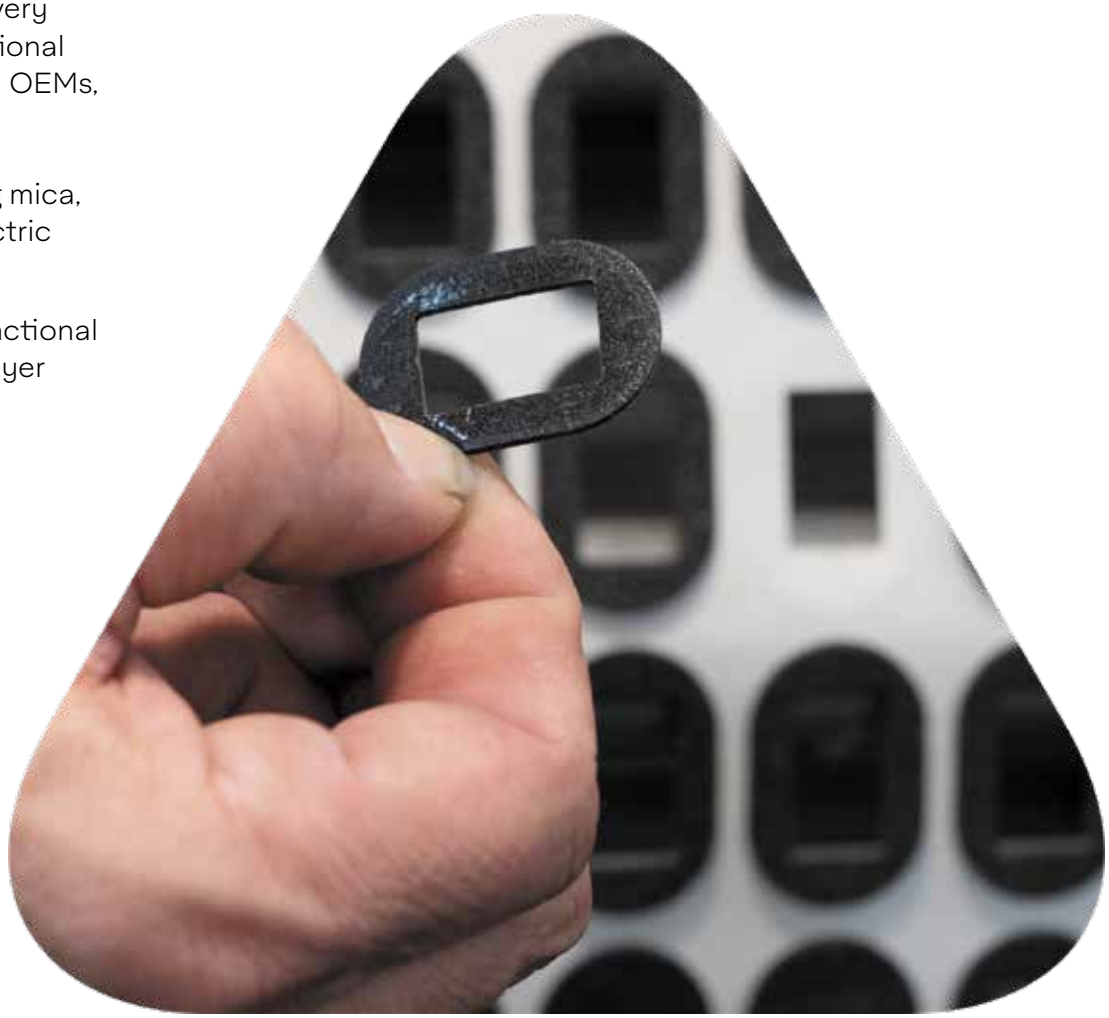
The Converter's Role

Converters can play a role in the production of EV Batteries in a number of ways. Working hand-in-hand with Avery Dennison Performance Tapes, you can assist functional material suppliers, battery pack manufacturers and OEMs, in the following ways:

- Laminating a wide range of materials, including mica, ceramic papers, polyurethane foam and dielectric films to Avery Dennison tape constructions
- Creating multilayer composites for various functional purposes, such as adding a dielectric barrier layer
- Die cutting to custom shapes
- Creating part presentations and providing consultation to facilitate automation through kiss cutting, dispensing and offering extended liners
- Providing quick prototypes and samples



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