Avery Dennison Performance Tapes EV Battery Solutions

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



Performance Tapes

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The Future of Global Electric Vehicle Demand

The Future of Global Electric Vehicle Demand

Sales of electric cars, including battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs) – exceeded 10 million in 2022, up 55% relative to 2021.

From 2017 to 2022, EV sales increased from nearly 1 million to more than 10 million, having previously taken five years from 2012 to 2017 to grow from 100,000 to 1 million, showing the exponential nature of EV sales growth.

- Battery technology continues to improve capacity and range
- Increased OEM investments and goals
- Falling battery costs (ideally under \$100/kWh to compete with Internal Combustion Engines)
- Policy and emission regulations such as the ratification by the European Parliament to only allow registration of zero CO₂ emission cars after 2035



IEA 2023; Global EV Outlook: Trends in light-duty vehicles [https://www.iea.org/reports/globalev-outlook-2023/trends-in-electric-light-duty-vehicles], License. CC BY 4.0



Implications

- These needs include pressure-sensitive adhesives for assembling functional materials and providing protection to battery materials and components
- Many of these assembly needs, requiring high throughput and consistency, are more effectively addressed with tapes than other bonding methods
- Electric vehicle batteries therefore contain more solutions with pressure-sensitive adhesives than conventional combustion engine vehicles
- This represents a tremendous opportunity for both functional material and component suppliers as well as tape converters





Pain Points and Common Challenges

OEM and End Customer Pain Points

The transition from internal combustion to electric powertrains brings different needs for the OEM and the consumer.

These challenges revolve around several aspects:

- 1. Safety of lithium chemistries used for the cells as energy density demands increase
- 2. Durability of the battery under demanding conditionsincluding high energy flows, heat generation, and mechanical shocks and vibrations
- 3. Giving the battery greater functionality, for example improved thermal management to enable fast charging
- 4. Solutions that integrate well with the production, independent of the volumes and degree of automation

All to deliver the balance of performance and cost acceptable to each customer.

Global safety and testing standards are focused at a pack level, leaving the design and engineering at the component and layer level open to different interpretations. This is leading to many different approaches to similar challenges and the need for flexible solutions.





Performance Tapes

Introduction

The Avery Dennison EV Battery Portfolio includes a range of functional bonding and protection tapes, built on multiple pressuresensitive adhesive (PSA) technologies.

These solutions are engineered to make EV batteries safer, more efficient and easier to assemble. Our products are backed by our superior customer service and technical support staff. You can be confident you will get an adhesive tape tailored to your EV Battery application.

- Single coated, double coated and transfer tape constructions, with a variety of liner options for optimized release and efficient processing
- Acrylic and silicone adhesive chemistries with a range of performance for adhesion, shear, tack and environmental resistance
- Functional additives and films for specific EV Battery component needs, such as flame-retardant additives for enhanced fire safety or dielectric films for electrical insulation
- Designed for and certifiable to OEM and battery pack manufacturer specifications



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 that are tested for breakdown voltage and dielectric strength requirements using and IEC 60243-1 and GB/T 1408.1-2016 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 and reduce fiber and particle shedding.



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.





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 IEC 60243-2 and GB/T 1408.1-2016 test methods. The Avery Dennison EV Battery Portfolio can help you solve for some of the most common challenges in battery design and construction:









Electrical insulation

Critical battery components need to be protected from possible arcing from live battery components, either in operation or during a catastrophic event. Self-adhesive dielectric films can provide reliable protection from arcing across surfaces and edges, even on complex shaped components while still satisfying energy flow requirements.

Self-adhesive dielectric films can protect many of the critical battery components such as:

- Cooling or heat exchange plates and ribbons
- Cell connect systems and busbars
- Battery and electric module castings
- Battery pack housing and structural supports
- Protect components susceptible to galvanic corrosion





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.

These protect delicate thermal runaway materials like aerogels and ceramic fibres, prevent linting and allow automated assembly with pick-and-place robots.

Mica and other high-temperature materials can be assembled with tapes where the liner release is engineered to minimize delamination.



Single Coated

Double Coated

Transfer Tape



Applications

EV Battery Applications

Heat Management and Thermal Runaway Protection

Protecting and assembling 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 ceramic fiber, aerogel or mica encapsulation
- Easy release liners for preventing cohesive failure of delicate fibrous based materials during processing.
- Single-coated films for surface protection and assembly tapes for bonding lightweight graphite heat spreaders to pouch cell frames
- Bonding of mica venting channels, including gapfilling solutions



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 or heat spreaders for pouch cells — 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

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. Key applications include the electrical insulation of metal cooling plates and ribbons, electric module castings as well as metal reinforcements for pack stability.

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 to offer high breakdown voltage and tracking resistance
- Flame-retardant versions for dual dielectric and flame protection
- High durability for demanding environmental resistance
- Flexibility to conform to irregular contours
- Tear resistant versions for easier processing
- Dielectric material and adhesives tested for breakdown voltage and dielectric strength requirements using IEC 60243-1 and GB/T 1408.1-2016 test methods

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
- Acrylic tapes can act as spacers to maintain the separation during application and cure of liquid adhesives

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 to be kept under a specific compressive pressure and the cell stacks to be protected from impact and movement. To help prevent damage and manage swelling of the cells, EV Battery manufacturers are placing elastic layers such as 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
- Wide adhesive portfolio suitable for a wide range of compression set materials
- Flame retardant and dielectric tapes are available when there are flame or electrical insulation requirements

Cell and Battery Health Monitoring Systems

A range of bonding solutions compatible with Flexible Printed Circuits



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 vulnerable flexible, printed circuits. Our knowledge from bonding safety-critical sensors for other automotive applications also extends to understanding what adhesives are compatible with conductive inks and will not impact their performance.

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

- Single and double-coated, filmic carrier constructions
- Compatible with standard conductive inks
- 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 60243-1 test methods
- Proven experience with other automotive sensor applications

EV Battery Applications

Cell Connect Systems and Flexible Busbars

Dielectric tapes to bond and insulate current carrying components



Busbars and cell connect systems are seeing rapid transformation to efficiently connect the increasing number of cells in energy dense packs.

Avery Dennison offers adhesives that secure and protect these conducting components. Our range of dielectric selfadhesive films provide the electrical insulation required Our portfolio also includes transfer adhesive tapes that can be laminated to a range of dielectric materials s to produce thicker spacer bars or high temperature insulation.

Our adhesive solutions for cell connect systems and busbar components offer the following features:

- Single and double-coated, self-adhesive dielectric films with Easy to process, including die-cutting
- Transfer tapes to bond non-metallic dielectric spacers and bars to busbars
- 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 60243-1 test methods

Heating Foils

Adhesive bonding solutions for supplementary heating foils in EV Batteries



Heating foils such as PCT heaters are a popular solution on commercial vehicles to extract optimum performance from EV batteries in cold environments.

Bonding of these heating foils requires adhesives that can tolerate a wide temperature range and fluctuation, and durability to ensure the foil delivers a homogeneous heat pattern. These tapes offer a simple and durable solution that is very space efficient.

- Durable adhesion of heating foils to module and pack housings
- Compensates for the differing thermal coefficients of foil and housing
- Reduces tendency for foils to curl or peel during the battery operating life.
- Suitable for a wide temperature range and fluctuation
- Full surface bonding removes the issue of stress failures from mechanical fixings

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, and pressure-sensitive acrylic foam tapes for bonding and sealing rigid components. In the portfolio are also PSA tapes for attaching PUR and silicone foam gaskets as well as heat shielding around the pack housing.

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
- Secure attachment of additional insulation material between pack and vehicle, that is simply applied but robust to withstand aggressive environments



Performance Tapes 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 doublecoated 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.



Performance Tapes

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	Acrylic Foam Bond (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	Polypropylene	Polyimide		
Polyester film with 6+ kV/mil dielectric strength.	Proprietary polyester film with 6+ kV/mil dielectric strength and flame retardant properties.	Polypropylene film with dielectric properties to protect delicate pack materials.	Polyimide films with the highest flame retardancy 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

The pressure-sensitive adhesives from Avery Dennison Performance Tapes as well as many of the functional materials for battery packs are supplied as roll goods. The lamination of these and the production of customized parts is typically done by a converter, who introduces the components into the battery pack supply chain.





Performance Tapes

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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