CUSTOM MATERIAL OPTIONS FOR EV BATTERY DESIGNS

EV batteries present numerous challenges for design engineers seeking ways to extend range while achieving safety targets and minimizing complexity, volume, and weight. Rogers partners with OEMs and Tiers to improve and optimize battery performance by rapidly developing custom elastomeric material solutions unique and critical to each EV program.

Battery Safety
- Thermal propagation delay is critical to high-powered next gen cells
- While V0 may not be the biggest driver, flammability is still a key consideration
- Reduce shock & vibration in the system

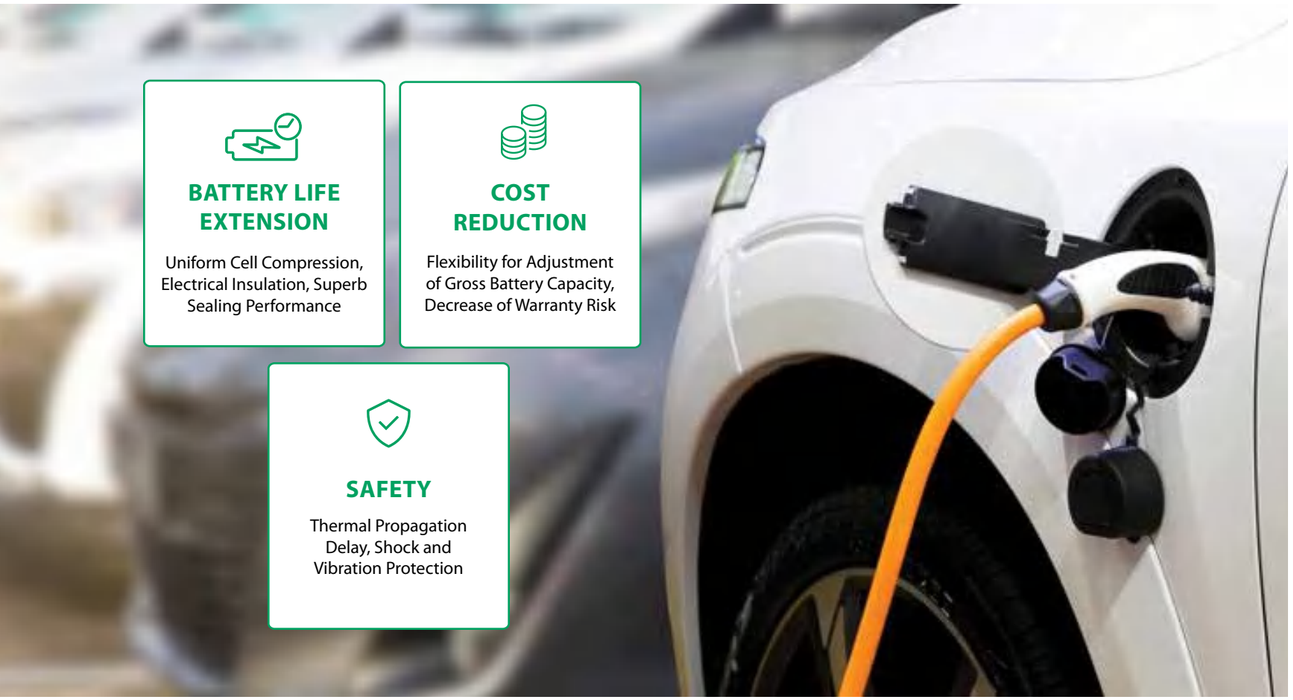
Long Term Performance
- Low compression set
- Uniformity of CFD curve over battery lifespan
- Optimization of charge/discharge cycles to increase efficiencies and the lifespan of the battery

Space Constraints
- Tighter tolerance for thickness and CFD

Packaging/Weight
- Meet beginning and end of life (BOL & EOL) compression force needs with a maximum usable range that minimizes incompressible space

Assembly Automation
- Meet tackiness requirement for optimal cell stack assembly automation

ADVANTAGES OF USING ROGERS TECHNOLOGIES



BATTERY LIFE EXTENSION

Uniform Cell Compression, Electrical Insulation, Superb Sealing Performance

COST REDUCTION

Flexibility for Adjustment of Gross Battery Capacity, Decrease of Warranty Risk

SAFETY

Thermal Propagation Delay, Shock and Vibration Protection

ROGERS EV DESIGN SOLUTION PORTFOLIO

Built to withstand the stresses of fluctuating compression and temperature, Rogers materials are designed to reliably hold a consistent force, keep battery cells aligned, seal against dust and fluid and isolate the damaging effects of vibration.

Environmental Seal

1 Cell-to-Chassis Battery Seal

2 Power Distribution Unit Seal

3 Battery Pack Seal

BISCO® silicone offers high reliability and repositionable sealing performance in the battery system.

Cell Seal

4 Prismatic Cell Venting Seal

BISCO silicone provides a seal between the vents and exhaust channel, allowing hot gas to exhaust via a designated path.

Cushion and Spring

5 Cooling Plate Spring Pads

PORON® polyurethane and BISCO silicone materials enable long-term cooling performance.

Battery Cell Pad

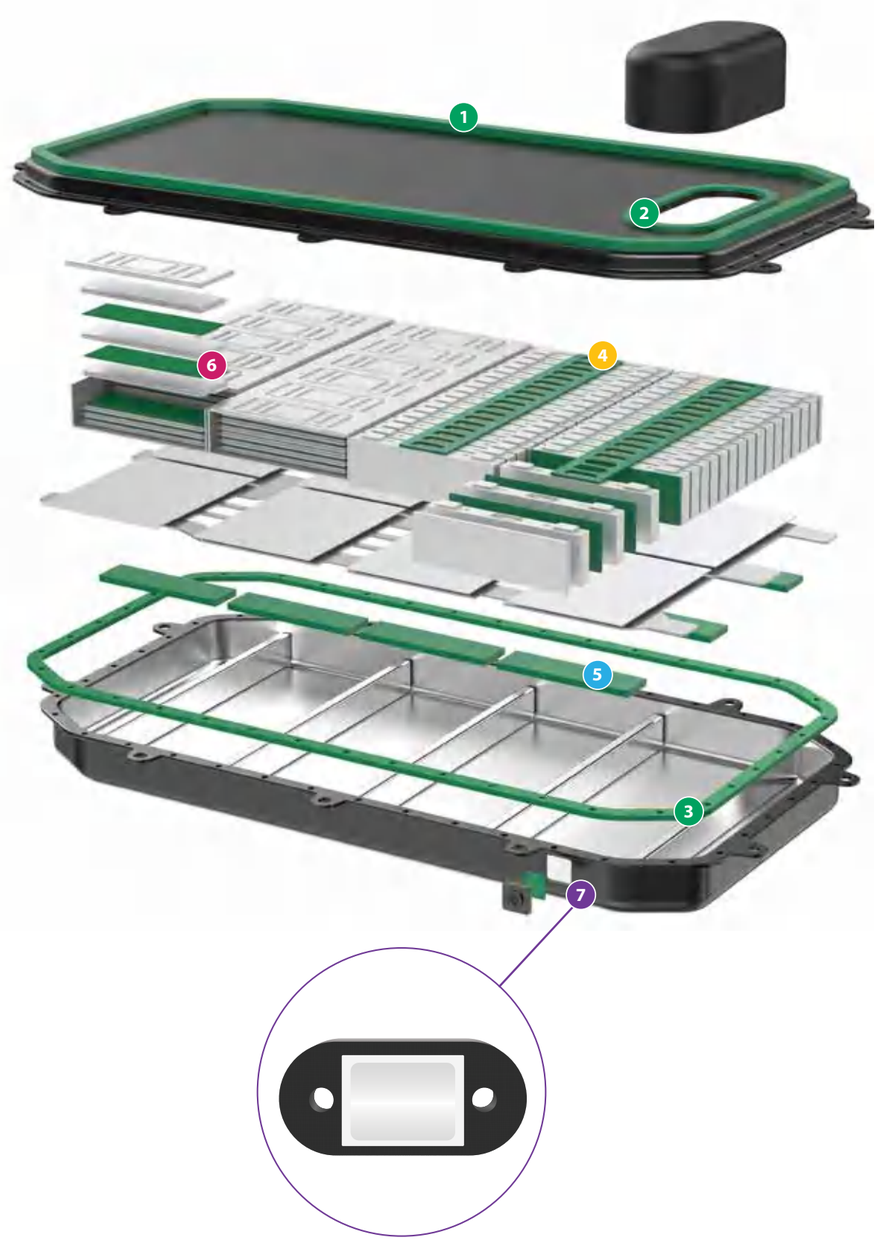
6 Cell Pads

Procell™ EV Firewall provides both compressibility and thermal propagation protection. PORON polyurethane and BISCO silicone materials deliver consistent push back force to optimize battery cell life and performance.

Pressure Equalization

7 Venting Film

DeWAL® multi-functional venting membranes equalize pressure and protect against dust and debris ingress, bursting for rapid pressure relief if needed.



poron ALWAYS THERE

poron EXTEND

POLYURETHANE

4790-92
PORON® Polyurethane
Extra Soft
Compression Management
Dimensional Stability
Reliability and Performance

4701-40
PORON Polyurethane
Soft
Compression Management
Dimensional Stability
Reliability and Performance

4701-43
PORON EVExtend® Material
Compression Management
Dimensional Stability
Thermal and Electrical Insulation

4701-30
PORON Polyurethane
Very Soft
Compression Management
Dimensional Stability
Reliability and Performance

4701-50
PORON Polyurethane
Firm
Compression Management
Dimensional Stability
Reliability and Performance

bisco TRUSTED TO THE EXTREME

ProCell EV FIREWALL

SILICONE

BA100
BISCO® Silicone
Ultra Soft
V0 Flame Retardant
Heat Shielding

BA200
BISCO Silicone
Extra Soft
V0 Flame Retardant
Heat Shielding

BA300
BISCO Silicone
Soft
V0 Flame Retardant
Heat Shielding

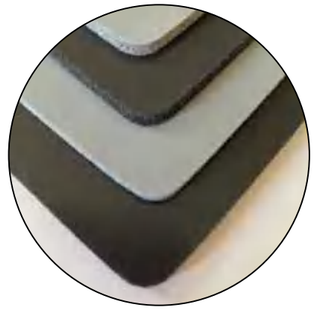
BA400
BISCO Silicone
Medium
V0 Flame Retardant
Heat Shielding
Environmental Sealing

BA500
BISCO Silicone
Firm
V0 Flame Retardant
Heat Shielding
Environmental Sealing

BA600
BISCO Silicone
Extra Firm
V0 Flame Retardant
Heat Shielding
Environmental Sealing

PCL350
ProCell™ EV Firewall Material
Thermal Propagation Delay

PCL400
ProCell EV Firewall Material
Thermal Propagation Delay



DeWAL® SHEER QUALITY

MEMBRANES & LAMINATES

V Series
DeWAL® ePTFE
Membranes & Laminates
Venting & Sealing

DW232DV
DeWAL PTFE
Dual Stage Vent

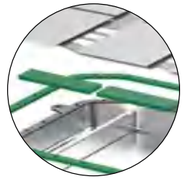
DW202/212BV
DeWAL PTFE
Burst Vent

POLYURETHANE MICROCELLULAR FOAMS

- Compression Set Resistance
- Stress Relaxation Resistance
- Energy Absorption
- Low Outgassing
- Chemical Resistance
- Flame Retardant

PORON polyurethane offers superb compression set, constant pushback force and long-term dimension stability.

It is a durable choice for compression management, sealing, cushioning or vibration protection.



Cooling Plate Spring Pad

Cell-to-cell Compression Pads

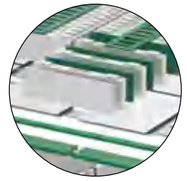
BMS Spring Pad

SILICONE MICROCELLULAR FOAMS

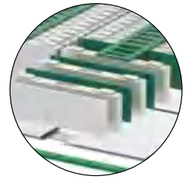
- Compression Set Resistance
- Superior Flame Ratings
- Chemical Resistance
- Energy Absorption
- High Thermal Stability
- Dielectric Properties

Exceptional performance, thermal stability and resiliency to mechanical fatigue make BISCO silicones a reliable choice for gasketing, cushioning and insulation. Our ProCell™ EV Firewall materials offer enhanced thermal properties to mitigate against thermal runaway on both a cell and module level.

Battery Pack Seal & Environmental Sealing



Thermal Propagation Protection & Compression

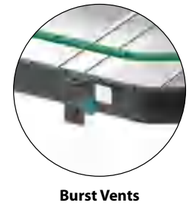


Prismatic Cell Venting Seal

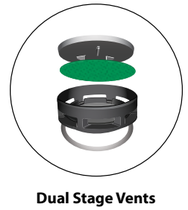
FILMS & TAPES

- Air Permeability
- Chemically Inert
- Pressure Equalization

Offered in a wide range of densities and thicknesses, DeWAL® PTFE and UHMW PE membranes offer good airflow, protect from ingress and repel water.



Burst Vents



Dual Stage Vents

ROGERS PARTNERS WITH OEMS AND TIERS TO DESIGN THE FUTURE OF VEHICLE ENERGY STORAGE

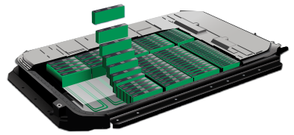
Rogers supports leading OEMs and Tiers with customized material solutions that both meet customer specifications and solve critical problems related to modern battery designs.

Solid State Batteries

Solid state battery cells tend to swell more than conventional cells due to their chemical composition. Proper pressure management via cell compression pads is critical for optimal functionality of the battery.

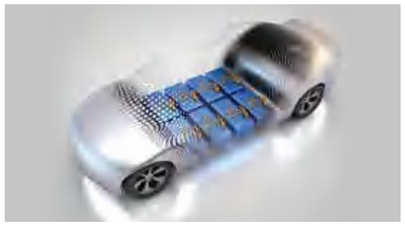
Vibration and shock may cause battery capacity loss and mechanical degradation in lithium-ion cells. Compression materials placed between the cells can aid in mitigating this effect by protecting battery cells in cell-to-pack and cell-to-chassis designs.

Cell to Pack



Cell to Chassis

Immersion Cooling



Indirect cooling is the most popular thermal management solution today. However direct, or immersion cooling, is also a viable option to handle higher thermal loads. In immersion cooling the batteries and supporting components are immersed in a dielectric cooling fluid which is continually circulated to promote heat transfer. For pouch and prismatic applications, the use of compression pads for pressure management is still desired.

800V architecture delivers the same power level as conventional 400V with a lower current, which shortens charging time. 800V also reduces the current required to deliver a given amount of power by half and supports the use of more powerful electric motors. Its architecture enables the use of lighter and smaller components and less copper, resulting in weight reduction and an improvement in efficiency. The architecture requires materials with a high dielectric strength and thermal performance that both protect critical components and mitigate against thermal runaway propagation.

800V Architecture

ROGERS BATTERY LAB & TECHNICAL SERVICES

The Rogers Battery Lab and Technical Services teams provide EV design engineers with the expertise and resources needed to support the process of battery design and material selection, such as aiding in the streamlining of design cycles, validating proper compression management and battery stack configuration.

Imaging Capability
- Scanning Electron Microscope

Cell Level Testing
- Flammability Testing
  - UL Burn Chamber & FMVSS302 Fixture
- Compression and Tensile Testing
  - -40°C to 200°C
- Thermal Analysis for Polymer Properties
  - TGA, DSC, RDA, DMA, TMA
- Peel Testing (Adhesive Characterization)

Analytical Capability
- GC/MS & FT-IR

Application Testing
- Hot Plate
- Impact Testing
- Nail Penetration
- Capacity Fade/Cell Cycling
- Airflow and Water Sealing
- Stress Relaxation and Creep
- Thermal Conductivity / Thermal Imaging

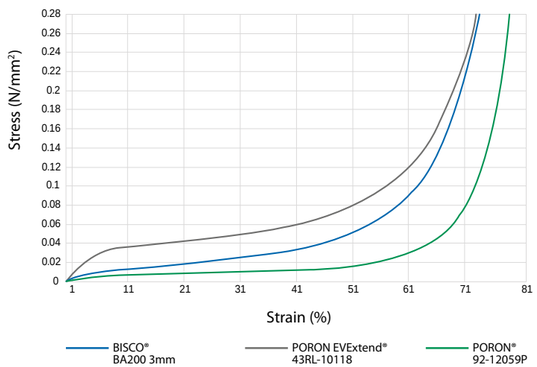
TECHNICAL SERVICE & DEVELOPMENT INSIGHT

Case Study: Designing Cell Pads

Specifications Provided by the Customer:

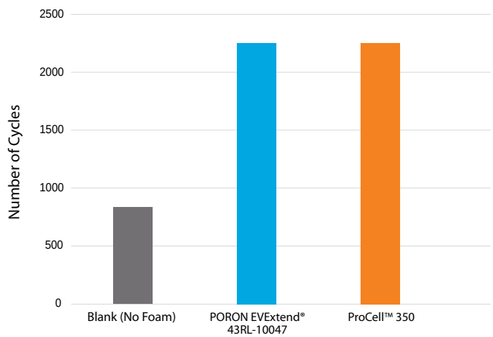
Cell Format: *Pouch*
Cell Thickness: *10mm*
Cell Expansion: *10%*
Beginning of Life (BOL) Pressure: *40kPa*
End of Life (EOL) Pressure: *300kPa*
Number of Cell Pads per Module: *13*
Number of Cells per Module: *12*
Number of Modules: *6*

Selecting Materials, Customization



The consideration of compression force deflection is critical when choosing a battery cell pad material.

Measurement of Battery Life Extension



- 70Ah pouch cells
- 1C charge and discharge rate
- Temperature = 45°C
- Test to 80% capacity retention

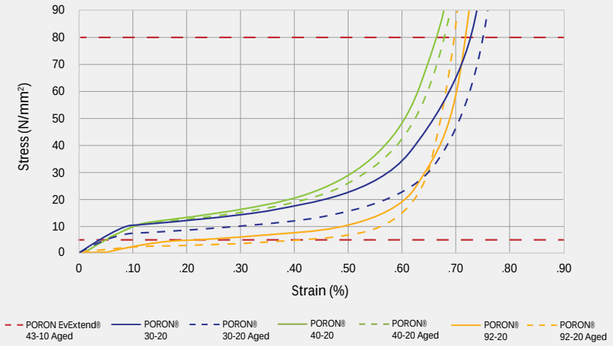
The greatest improvement in life extension provided by Rogers battery cell materials.

TECHNICAL AND DESIGN SUPPORT TOOLS TO OPTIMIZE BATTERY PERFORMANCE

Battery Pad Product Selection Tool

The Battery Pad Product Selection Tool provides product recommendations based on a user's unique design requirements. It is intended to be used as a starting point for material selection.

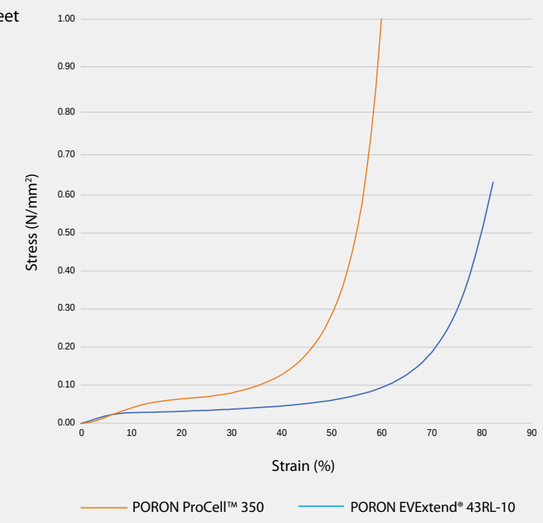
https://tools.rogerscorp.com /ems/battery/index.aspx



Compression Force Deflection (CFD) Tool

Using stress strain data, the CFD Curve Tool helps in the identification of the BISCO® or PORON® materials that meet your engineering requirements.

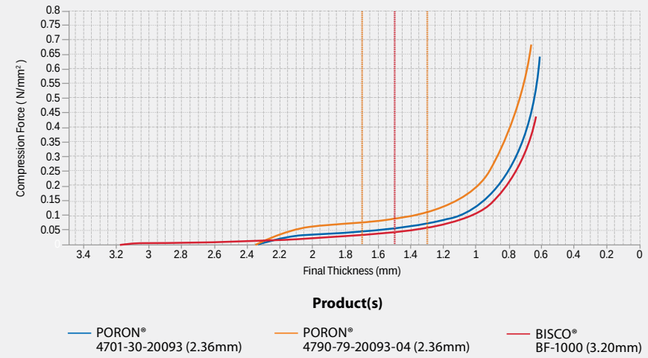
https://tools.rogerscorp.com /ems/cfdcurve/index.aspx



Gap Filling Tool

The Gap Filling Tool guides users to a selection of the best PORON or BISCO materials for water, dust, and environmental sealing applications.

https://tools.rogerscorp.com /ems/gapfilling/index.aspx



Vibration Isolation Tool

The Vibration Isolation Tool recommends the proper Rogers materials for vibration mitigation.

http://tools.rogerscorp. com /ems/vibration/index.aspx