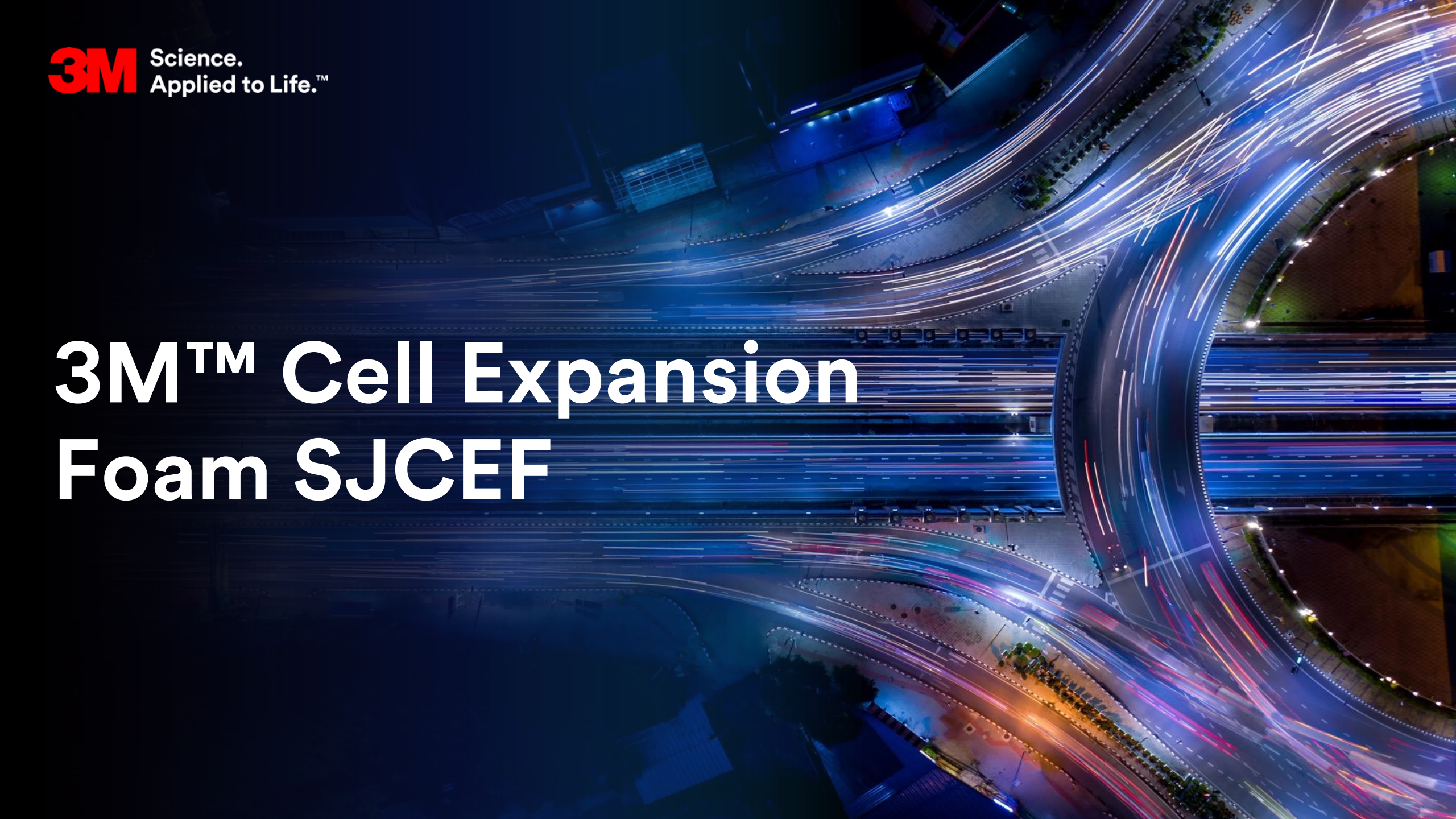
3M Science. Applied to Life.™

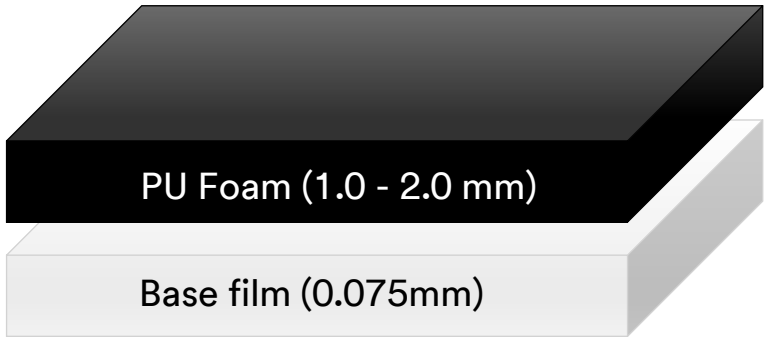
3M™ Cell Expansion Foam SJCEF



3M™ Cell Expansion Foam SJCEF Product Construction

Key Properties

- Flame retardant
- CFD (Compression Force Deflection)
- Self Tackiness (Adhesion)
- Release Force (PET Liner)



Key drivers → Trends → Solutions

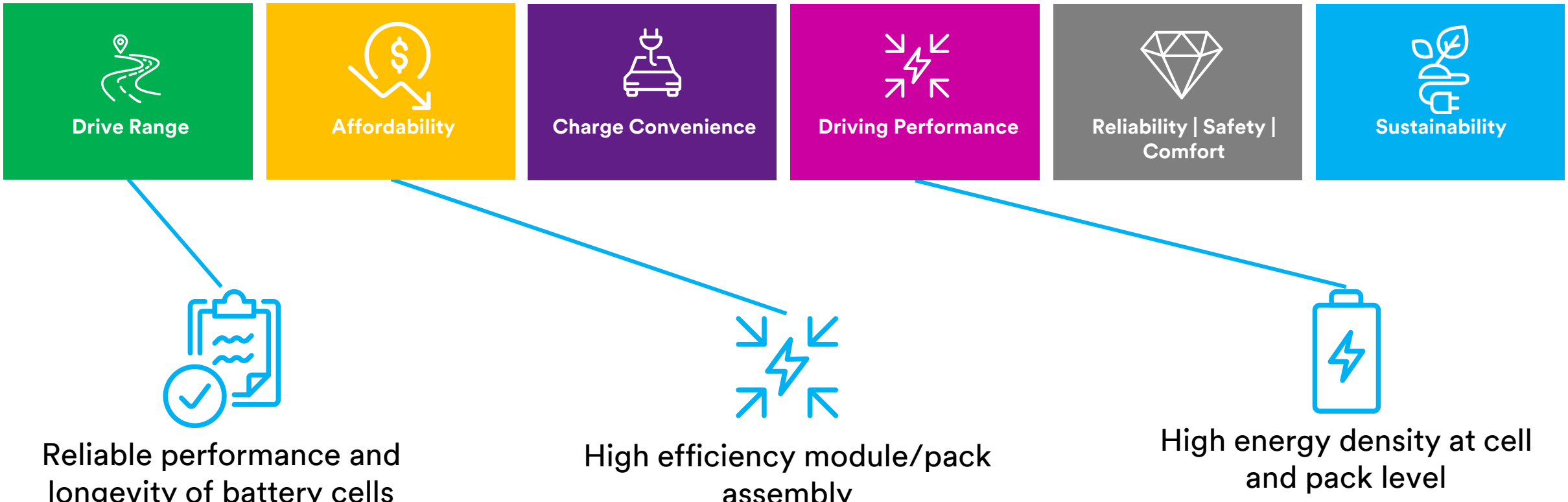
Drive Range	Affordability	Charge Convenience	Driving Performance	Reliability | Safety | Comfort	Sustainability

Battery

Global Safety Regulation & Standard	
Journey to $70/KWh	
Cell to Pack/Chassis Design	
Higher Pack Energy Density, ≥250 Wh/kg	
High C Rate Charging, ≥350 kW	
Pack Manufacturing Automation	

Barrier materials	Between cell thermal barrier | Above cell barrier | Vent path solutions
Pressure management	Between cell cushioning materials
Thermal management	Thermal insulation | Glass Bubbles | Boron Nitride Cooling Fillers
Assembly | Disassembly	Adhesive transfer and double-sided tapes | Structural adhesives | Cure-in-place gasket
Electrical insulation	Powder insulation | Semi-structural Insulation Tape | Insulation Films
Lightweighting	Glass Bubbles

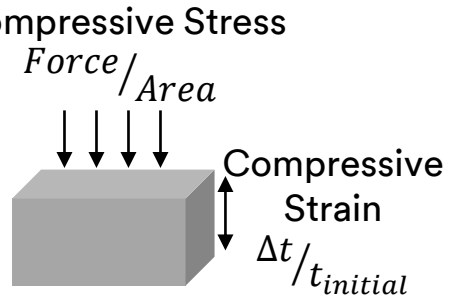
Trends/Design Challenges in Pouch Battery Packs



3M can help you enable your next generation design by addressing your pack compression needs

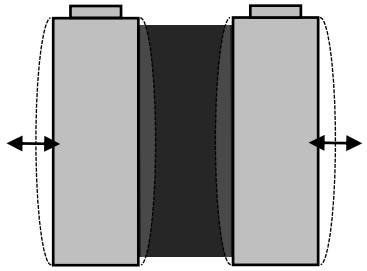
Why is CFD Important?

Compression Force Deflection

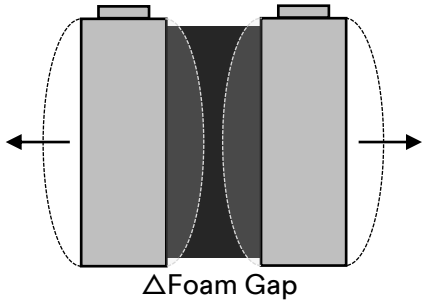


ASTM D3574, Test C
8 mm/min compression rate,
One Layer Thick x 50 mm * 50 mm

Small Cyclic Volumetric Change with Charge



Large Expansion Over Useable Life



The more consistent the pressure the more uniform the battery performs, which is directly correlated to battery lifespan.

An excellent compression plateau is one of the most important factors in cushioning materials. The plateau represents the area of consistent battery pressure.

Customer Challenges

Reliable performance and longevity of battery cells

Higher internal resistance caused by poor particle to particle contact

Poor porosity leads to reduced electrolyte mobility in separator

Anode Si degradation/Accelerated anode aging caused by incomplete lithiation and de-lithiation

Differential lithiation caused by local pressure concentration

Improper pressure control can result in cells not operating as designed

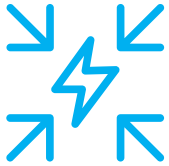
How Can 3M Cell Expansion Foam SJCEF Help?

Reliable performance and longevity of battery cells

- Excellent thickness tolerance
- Wide range of CFD
- Customized CFD
- Excellent compression plateau
- Low density/Light weight
- Excellent technical support with accumulated data pool
- Wide thickness range

3M can tailor the material properties to meet your specific application needs

Customer Challenges



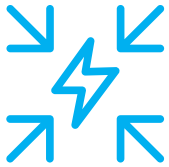
High efficiency module/pack assembly process

Lamination of multiple layers

Multiple liner waste and equipment calibration

Multiple complex processing steps and assembly constraints can lead to poor yields and scrap

How Can 3M Cell Expansion Foam SJCEF Help?



High efficiency module/pack assembly

Easy liner release

Easy reposition during assembly

Self tackiness

Single liner

The self-tacky properties mean 3M Cell Expansion Foam SJCEF can be applied without additional adhesives, which are less compressible

Customer Challenges

High energy density at module and pack level

Larger volume changes during cycling of high energy cell chemistry

Variation in all the component tolerances in the assembly

High usage of non-battery materials results in low cell-to-pack ratio

New battery designs are challenged to reduce non-active materials while accommodating for large variations in volume changes

How Can 3M Cell Expansion Foam SJCEF Help?

High energy density at cell and pack level

Thin profiles

Low density/Light weight

Excellent thickness tolerance

3M Cell Expansion Foam SJCEF can help minimize the footprint of non-cell related components

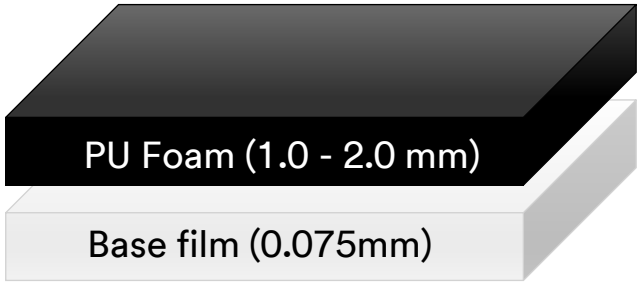
3M Cell Expansion Foam SJCEF Product Construction

Key Properties

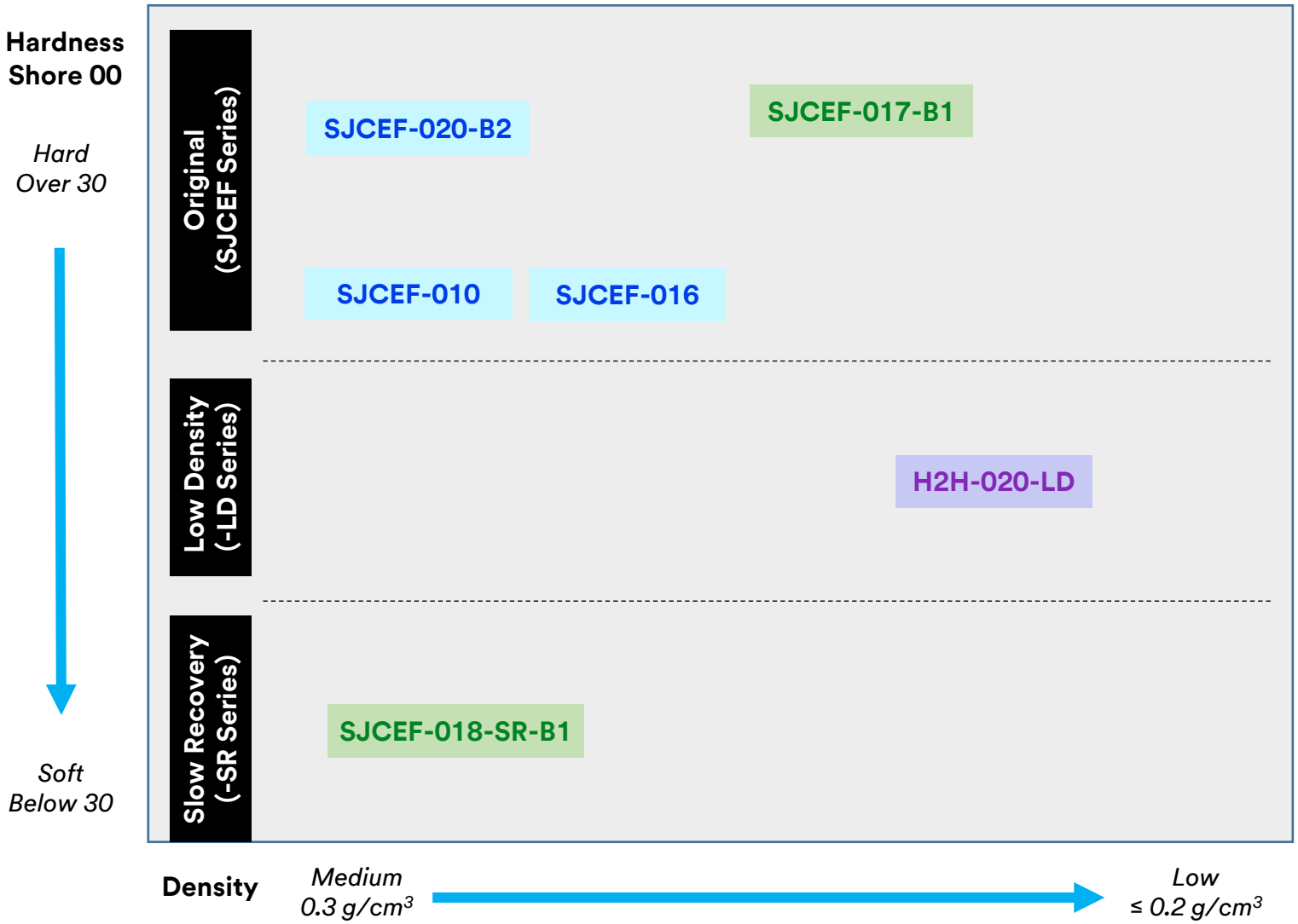
- Flame retardant
- CFD (Compression Force Deflection)
- Self Tackiness (Adhesion)
- Release Force (PET Liner)

Property	Value
Material	Microcellular Polyurethane
Color	Black
Release Liner	Silicone coated, Polyester film 0.075 mm
Foam Thickness*	1.0 - 2.0 mm
Adhesion	30 - 80 gf/in
Roll Size	550-1,035 mm (Width) X 50-100 m (Length)

* For additional thicknesses please contact your 3M Application Engineer



3M Cell Expansion Foam SJCEF Portfolio



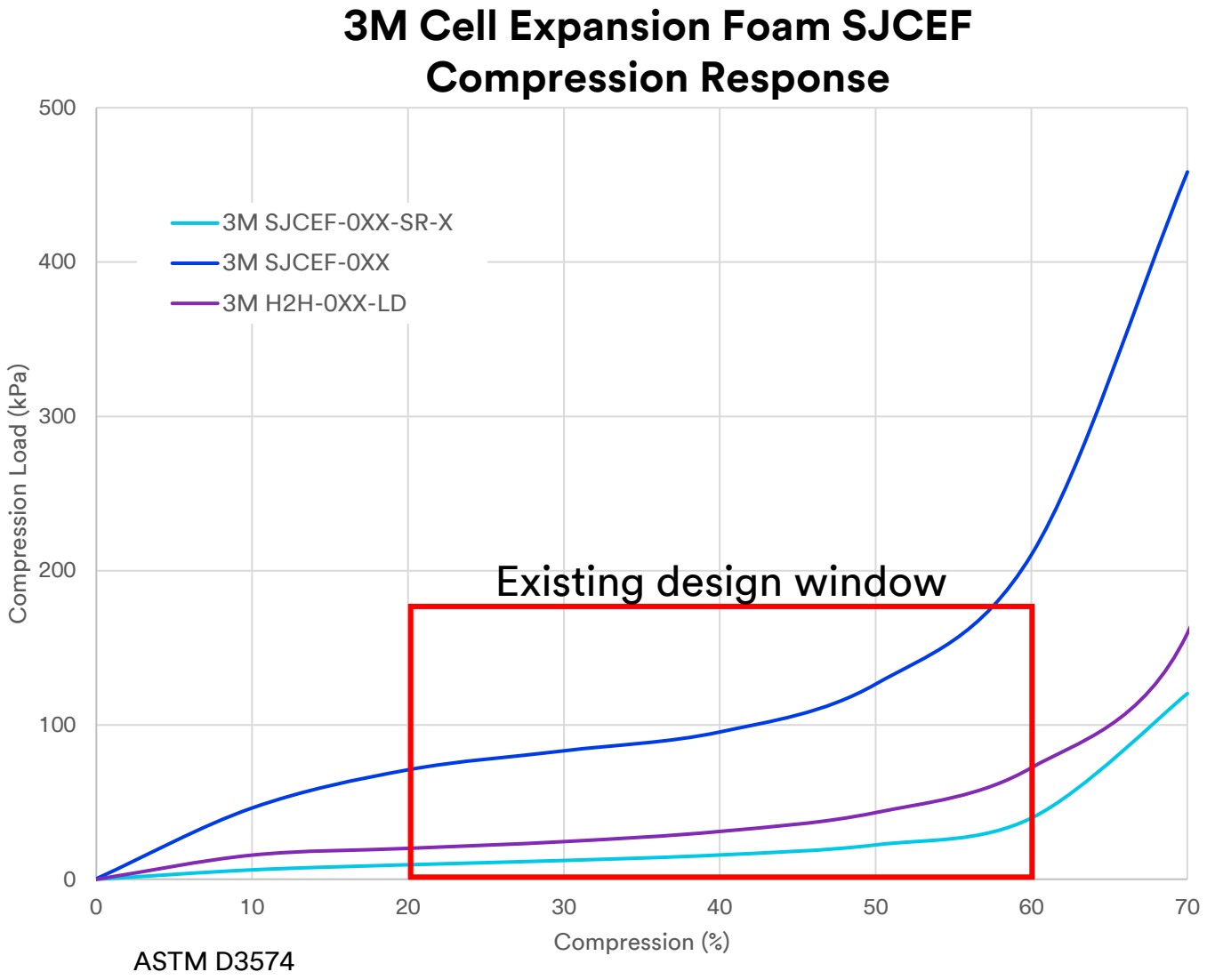
LD: Low Density
SR: Slow Recovery
P: Permanent PET Liner (Cast Liner)

Typical Physical Properties

Note: The following technical information and data should be considered as representative or typical only and should not be used for specification purposes.

Product Name	SJCEF-010	SJCEF-016	SJCEF-020-B2	SJCEF-017-B1	H2H-020-LD	SJCEF-018-SR-B1
Concept Requirement	Customized CFD Self Tackiness	Customized CFD Self Tackiness	Customized CFD Self Tackiness	Customized CFD	Low Density Customized CFD	Low Hardness Low CFD
Thickness (mm)	1.0	1.6	2.0	1.7	2.0	1.8
Density (g/cm^3)	≤ 0.31	≤ 0.34	0.3 ± 0.05	≤ 0.30	≤ 0.20	≤ 0.30
Flame retardant	Yes					
CFD (kPa)	≤ 60 @ 20%	≤ 60 @ 20%	≥ 30.4 @ 21.6%	21 - 48@ 20% 82 - 186 @ 60%	20 - 37 @ 20% 63 - 132 @ 60%	8 - 20 @ 20% 32 - 65 @ 60%
Adhesion (gf/in)	25 - 49	≤ 39	-	≥ 40	40 - 80	≥ 50
Release Force (gf/in)	≤ 24	≤ 24	≤ 20	≤ 24	-	≤ 20

Compression Plateau



ASTM D3574

3M Cell Expansion Foam SJCEF offers customizable compression range based on customer requirements

Summary

Note: Product selection is ultimately the customer's responsibility. Customers should conduct their own tests under actual use and storage conditions to determine whether the product is fit for a particular purpose and method of application.

- Customizable compression plateau for consistent battery pressure
- Minimal compression set for long term durability
- Wide range of thicknesses allows material to accommodate multiple battery designs
- Thickness tolerance for consistent dimensions and pressure
- Low density material can help OEMs meet their lightweighting goals
- Self-adhering properties reduces process steps to help improve assembly efficiency
- Proven solution in several major OEM electric vehicle designs since 2016

Intended Use: These products are intended for use within a high voltage lithium-ion battery pack to help address forces generated in the assembly and operation of modules in automotive, off-highway, industrial and marine applications. Since there are many factors that can affect a product's use, the customer remains responsible for determining whether the 3M product is suitable and appropriate for the customer's specific application and system, including customer conducting an appropriate risk assessment and evaluating the 3M product in customer's application and system.

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