Tape Solutions for EV Battery Pack Protection

SAINT-GOBAIN

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Saint-Gobain Norseal® Gasketing Foams and **ThermaCool**® Thermal Interface Products offer a wide range of solutions for protection of battery packs from extreme conditions of temperature, smoke, fire, air and water. **Norseal** series is suitable for uses such as compression/tolerance pads, thermal runaway protection and pack sealing/gasketing. **ThermaCool** series offers a range of solutions to eliminate excess heat. Their excellent electrical insulation properties and conformability make them a compliant material between modules and any configuration of cooling plate.

Compression/Tolerance Pads

Products: Silicone Foam Rubbers, Micro-cellular Polyurethane Foam
Function: Accommodates the expansion/contraction of cells by providing consistent deflection force over a wider range of compression and temperature. Electrically insulating to minimize/prevent arcing within module
Features: Range of densities & thicknesses, different levels of tackiness, flame retardancy from UL94 HBF to V-0

Silicone Foam Rubber: **Norseal** F-12 and F-20 are soft, lightweight silicone foams that provide excellent flame resistance with low toxicity and smoke generation, meeting the highest flame rating of UL94 V-0. **Norseal** F-12 has a modified cell structure and low density and **Norseal** F-20 has a finer closed cell structure with a medium density.

Micro-cellular Polyurethane Foam: **Norseal** PF Series is comprised of closed-cell microcellular foams that have low compression set. Their excellent resiliency is maintained within a narrow range, over a range of temperatures and compression forces. They also meet the flame performance per ASTM D4986 (equivalent to UL94 HBF). PF 20 products have the added advantage of being available in thicknesses as low as 1 mm and density as low as 200 Kg/m^3. **Norseal** PF100 Series, our most recent development, provides the flattest CFD curve over the widest workable compressive strain.

Thermal Runaway Protection Materials

Products: **Norseal** TRP and fire-blocking **Norseal** FS1000
Function: To prevent/minimize the fire propagation in the event of a thermal runaway
Features: Combination of thermal insulation with fire-blocking, excellent compression set resistance

Thermal Runaway Protection Pad: In addition to acting as a compression pad, **Norseal** TRP helps protect against thermal runaway by hindering the fire/heat from propagating from cell to cell, in the event of one cell going "exothermic." **Norseal** TRP is the ideal product for providing mechanical and thermal cushioning in the event of thermal runaway.

Fire-blocking Polyurethane Foam: **Norseal** FS1000 series is a multi-functional foam tape that is ideal for use as battery pack seal – 1) Its intumescent characteristics is demonstrated from a temperature of 200°C (392°F), by forming a fire-resistant char, blocking fire, smoke and hot gasses, thereby ensuring protection from thermal events, 2) Its soft nature makes it ideal to conform to uneven surfaces and can be easily compressed with minimal force to create air and water seals.

Pack Seals

Products: FIP Gasketing, Butyl-Coated PVC Foams, Silicone Foam Rubbers, Micro-cellular PU Foam
Function: To seal the batteries from the external environmental factors like air and water
Features: Low compression set, fire-blocking

Foam-In-Place Gasketing: **Dynafoam**® solvent-free products are single-component foam-in-place systems foamed by N_2 injection and cured by atmospheric moisture under ambient conditions. Curing can be accelerated by providing additional humidity and temperature. Its thixotropic behavior enables application in any direction (even upside down).

Butyl-Coated PVC Foam: **Norseal** FR-BCF is an efficient and cost-effective solution to demanding battery pack sealing applications. It features a PVC foam core with an outer layer of butyl that has excellent adhesion and sealing ability. The outer butyl layer also exhibits intumescent characteristics making it ideal for protection in case of a thermal event inside the battery pack. It has excellent water sealing performance that is equivalent/better than IPX7 performance.

In addition, **Norseal** Silicone Foams, Micro-cellular PU Foam and fire-blocking FS1000 are also available for pack sealing, catering to battery packs with different needs/demands.

Thermal Interface Materials

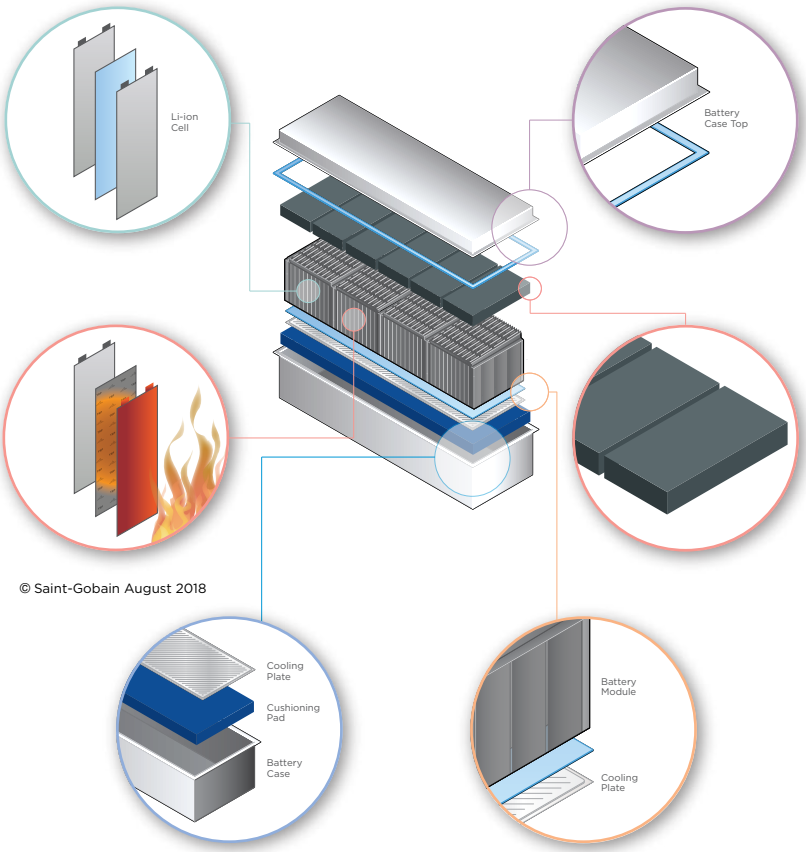
Products: Gap Pads
Function: Remove excess heat from cells
Features: Range of thermal conductivities with excellent electrical insulation

Gap pads: ThermaCool TC Series is comprised of soft ceramic-filled silicone elastomer-based gap pads with excellent electrical isolation properties and flame retardant performance of UL94 V-0 rating. **ThermaCool** TC Series comes with the ability to customize several characteristics for ease of assembly and rework, without compromising the thermal conductivity and electrical isolation properties.

Material Selection Guide

	Material	Product Code	Thickness, mm	Flame Performance	‡Compression Set, %	Density, Kg/m³	CFD, kPa	Thermal Conductivity, W/m.K	Key Features	Optional Features
Compression/ Tolerance Pad	Silicone	F-12	1.6 – 25.4	UL94 V-0	< 5%	190	20*	0.06	Low density and low compression set	Smooth 2 sides, textured 2 sides
		F-20	0.8 – 12.7	UL94 V-0	< 5%	320	70*	0.074	Medium density & low compression set	Textured surfaces
	Polyurethane	PF20	1.0 – 2.0	ASTM D4986 PASS	< 10%	200–350	9**	0.06	Low density & extremely thin pads with inherent tack	Various liners (perm., release), range of tack, different densities available for specific needs
		PF40	2.0 – 10.0	ASTM D4986 PASS	< 10%	200–350	18**	0.06	Low density with inherent tack	
		PF100	1.0 – 3.5	ASTM D4986 PASS	< 5%	140–320	23**	0.03	Flatter CFD curve, lowest density and compression set	
Thermal Runaway Protection Pad	Silicone	TRP	3.2	ASTM D3801 V-0	< 5%	–	–	–	Mechanical & Thermal cushioning	Thickness variations
	Polyurethane	FS1000	4.5 – 10.0	UL94 V-0	< 5%	240	23**	0.039	Tacky, intumescent, airtight, water-tight and resilient	PET supported, lower tack levels
Pack Seal	Silicone	F-Series	0.8 – 25.4	UL94 V-0	< 5%	190, 320	Refer above	0.06 – 0.07	Low compression set with extreme temperature capabilities	Smooth 2 sides, textured 2 sides
	Polyurethane	PF Series	1.0 – 10.0	ASTM D4986 PASS	< 10%	200 – 350	Refer above	0.06 – 0.07	Low density & extremely thin pads with inherent tack	PET supported, lower tack levels
		FS1000	4.5 – 10.0	UL94 V-0	< 5%	240	23**	0.039	Intumescent, airtight, water-tight and resilient	Range of thicknesses
		Dynafoam	–	–	< 20%	–	–	–	Single component, foam-in-place, good water seal	Range of densities
	PVC/Butyl	FR-BCF	–	UL94 V-0	< 10%	150 – 200		–	Intumescent, excellent water sealability (IPx7), tacky	Different shapes and densities
Thermal Interface Materials	Silicone	TC2006	0.5 – 7.0	UL94 V-0	–	1940	206††	1.6	Exceptional compression latitude	Different sheet sizes
		TC2005	0.5 – 7.0	UL94 V-0	–	2050	172††	1.6	High performance TC with low oil bleeding	Customizable CFD & Tackiness; liner options for ease of reworkability
		TC2008	0.5 – 7.0	UL94 V-0	–	2130	234††	2.0	Excellent TC, economical, low density & low oil bleeding	
		TC3007	0.5 – 7.0	UL94 V-0	–	2840	227††	3.0	High performance TC with low oil bleeding	
		R10404	0.8 – 6.4	UL94 V-0†	–	1105	125†††	0.9††	Multi-functional: thermally conductive, electrically insulating, conformable	Thickness range, with silicone or acrylic PSA

* 50% Compression per ASTM D1056 ** 30% Compression per ASTM D1667 † With **ThermaCool** TR3 adhesive. †† Under 50% compression. ††† 25% compression.
‡ Refer to individual datasheets for specific test conditions



Compression/Tolerance Pad: Accommodates expansion/ contraction of cells and tolerance stack.

Thermal Runaway Protection Pad: Prevents/minimizes fire propagation, in the event of a thermal runaway. ***Thermal Runaway Protection Materials***

Pack Seal: Seal pack cover for temperature, air, dust and water-tightness.

Thermal Interface Materials: Promotes heat flow.

Fire Blocking Polyurethane Foam: Prevents/minimizes fire propagation, in the event of a thermal runaway. ***Thermal Runaway Protection Materials***

Cushioning Pad: Resilient material between cooling plate and battery case to dampen mechanical vibrations.

Your Partner in Custom Tape Solutions

A custom tape solution can pay for itself many times over thanks to the process and product improvements it can provide. Tape development engineers will work with partners to design an economical but highly effective tape product.

Even with endless permutations of industrial tapes available there is only one company that can deliver a custom-made tape with optimal adhesive, the perfect backing materials, seamless process integration and superb performance.

To learn more about how **Saint-Gobain** can help solve tape and materials engineering challenges, call us or visit us online.

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