



# Thermal Runaway Shield (TRS)

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## PRODUCT DESCRIPTION

Thermal Runaway Shield® (TRS) patented by KULR Technology is highly effective in preventing thermal runaway incidents in storage, transportation, and built-in operational lithium-ion battery pack designs. Its exceptional performance is attributed to the phase change material's ability to absorb a significant amount of energy in liquid form and transform into vapor. When integrated into a battery pack, TRS creates a system with inherent passive propagation resistance and thermal runaway mitigation. Our patented technology enables the TRS liquid to circulate passively throughout the system, providing targeted relief to areas experiencing thermal stress, thereby reducing the risk of thermal runaway.

## FEATURES AND BENEFITS

- Excellent solution for environments requiring the mitigation of potential TR event
- Can be designed into a new system, or incorporated into an existing one
- Passively helps with propagation resistance
- U.S. Patent No. US-11018397-B, US-11502352-B2, US-10727462-B2

## TYPICAL APPLICATIONS

Used in battery applications where a Passive Propagation Resistance (PPR) is needed.

## TYPICAL PROPERTIES

Property	Value	Test Method
Construction	Encapsulated Coolant	N/A
Product Assembly Thickness	2mm (typical)	N/A
Tensile Strength (at break)	>14 lbs	ASTM D882
Tear Strength (375F; 26psi; 1 sec)	>1.7lbs	ASTM689
Seal Strength (375F; 26psi; 1 sec)	12 lbs/in	ASTM D882
Puncture Strength	>25 lbs	TMS 101-C, Method A
WVTR	0.0006 g/100 sq.in. /24h	ASTM F-1249
OTR	0.0006 cc/100 sq.in. /24h	MOCON



Property	Value	Benefits
<u>Density</u>		
Bulk	0.7 g/cc	Low mass
Areal	0.13 g/cm <sup>2</sup>	
Electrical Conductivity	Surface nonconductive	No leakage currents from the battery
Thermal Conductivity (x-y)	0.4 W/m <sup>2</sup> /K	Thermal barrier
Phase Transition Temperature	100°C	Good margin for thermal runaway shielding
Specific Heat	3.0 - 4.1 J/g/°C (up to 100°C) <sup>1</sup>	Increased system thermal inertia
Thermal Energy Dissipation	1700 – 2200 J/g (at 100°C) <sup>1</sup>	High thermal dissipation per mass
Hardness	NA, pliable	Amenable to various cell arrangements tolerant of battery pack dimensional variations
CTE	NA, pliable	Minimal mechanical stress coupling
Damage on Freezing (Environment Dependent)	None	Tolerant of cold temperatures

<sup>1</sup>Dependant on configuration/design

	Value	Benefits
Resistance to Propane Torch in Open Air	19 sec. for back face to reach 100C No sustained combustion after heat source removed. Cooled to 40C in 1 min.	Good resistance Fire safety

Durability and Reliability

Seal strength ≥ 12 lb./in.

**Assembled TRS's have been successfully evaluated and cycled under normal environmental conditions, such as nominal usage guidelines provided by lithium-ion battery manufacturers.**

TRS's are currently being evaluated under additional conditions of use.



## AVAILABILITY

Please contact KULR Technology Group for additional information.

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