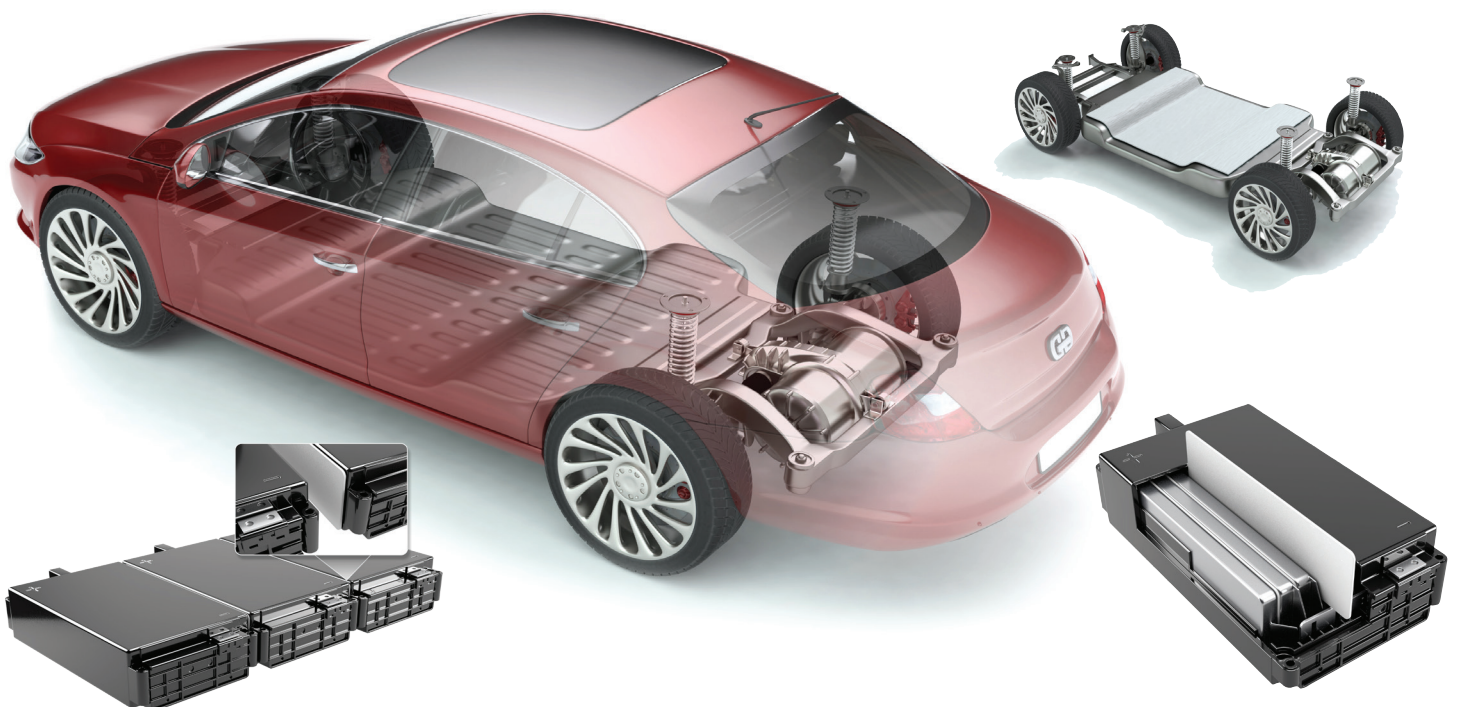
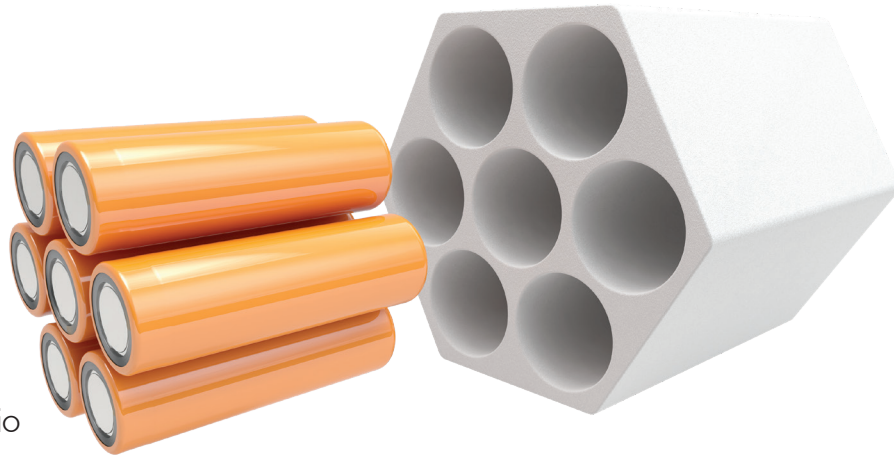


Thermal Runaway Protection

Our Energy Storage Technology (EST) portfolio developed with market leading innovation to provide unique solutions for mitigating thermal runaway.

The Thermal Ceramics business of Morgan Advanced Materials engineers, manufactures and supplies technologically advanced fibre and microporous materials to help the electric vehicle industry address complex thermal runaway and fire protection challenges.

With the recent consumer-driven demand to increase range and power, new platforms require their lithium ion battery packs to have higher energy densities and improved thermal management. To assist battery pack designers in meeting these requirements, along with the need to pass current and future standards, we have developed a suite of EST™ solutions to provide cell-cell, module-module, and pack level protection.



Manufacturing cutting edge materials to solve complex thermal runaway challenges

Thermal Runaway Protection

Our EST™ product line has been specifically designed for lithium ion systems to prevent or delay thermal runaway propagation. It comprises insulative, endothermic, and intumescent materials designed to optimize **space and weight constraints without loss of safety and performance:**

- EST Block is a rigid, machined housing designed to undergo a phase change to remove heat from a single cylindrical cell thermal runaway event
- EST Guard is a solution loaded with endothermic materials and is typically used in cylindrical and prismatic cell applications
- The EST Compression paper family is designed to accommodate the expansion and contraction of pouch cells while providing enhanced thermal runaway protection
- EST M Paper is a mica-laminated paper designed to reduce convection and conduction in module-module and pack level applications
- EST E Paper is a flexible material designed to undergo a phase change to remove heat from a pouch, prismatic, or module thermal runaway event
- EST D Paper is surface treated on one side and developed for pack level protection in lithium ion battery packs
- EST G Paper is a fibreglass encapsulated paper designed to be used for Prismatic cell, module and pack level thermal runaway protection
- EST P Paper is a composite product with a flame retardant heat sealing film commonly used in lithium ion pack level protection

EST Solution	EST Block	EST Guard	EST Compression Papers*	EST M Paper	EST E Paper	EST D Paper	EST G Paper	EST P Paper
Level of Protection								
Cell-Cell								
Cylindrical	•	•						
Pouch			•		•			
Prismatic		•		•	•		•	
Module-Module				•	•		•	
Pack				•			•	
Classification Temperature, °C	1300	1300	1100 to 1300					
Format	Board or Shape	Board or Shape	Paper	Paper	Paper	Paper	Paper	Paper
Density, kg/m³, typical	736	1570 - 1682	240 - 305	300 - 400	450 - 550	240 - 270	<500	272 - 352
Thickness, mm, typical	N/A	N/A	0.8 - 6.5	1.0, 3.0, 6.0	1.0 - 6.5	0.8 - 6	1.0 - 6.0	1 - 6

*EST Compression Papers can be customized for customer's compression/force curve

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