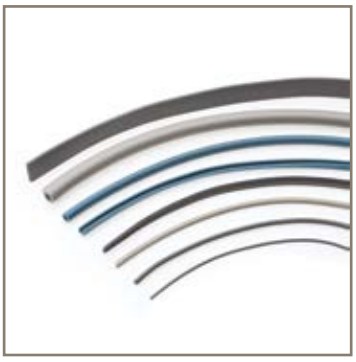
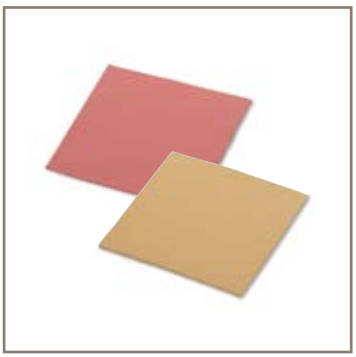




Thermal Interface Materials, EMI Shielding and Electronic Housings for EV/Hybrid Vehicles

Powering the Future of EV/Hybrid Vehicles

Parker Chomerics

ENGINEERING YOUR SUCCESS.

Solution Provider to the Electric and Hybrid Vehicle OEM Marketplace

With the growing demand for battery electric vehicles (BEV) and plug-in hybrid electric vehicles (PHEV), dissipating battery heat and providing protection against electrical interference have never been more pertinent. The Parker Chomerics family of thermal interface materials, coupled with our premier electromagnetic interference (EMI) shielding products, offers solutions for North American & Global OEMs and tier one suppliers of automotive modules.

3

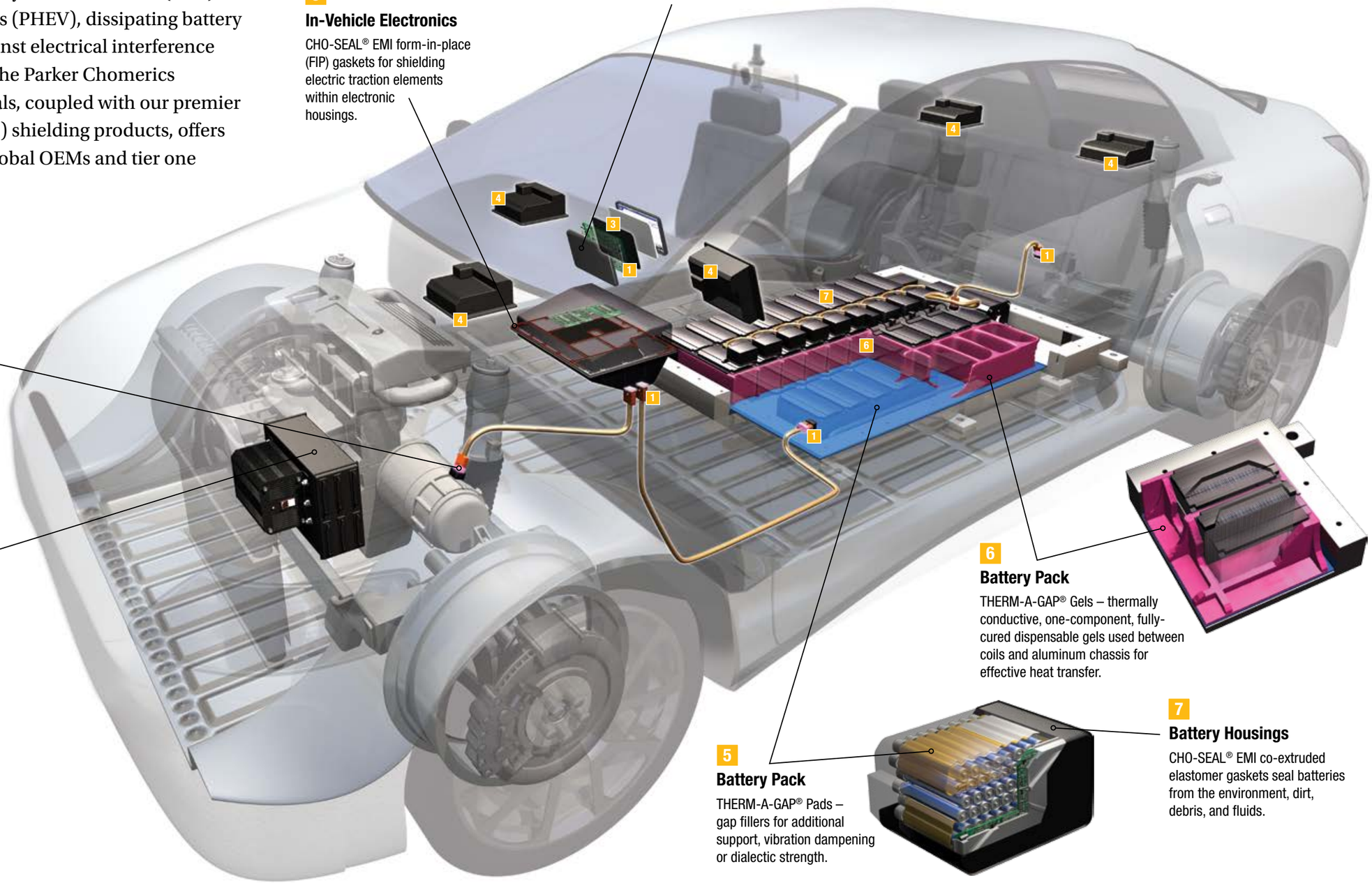
In-Vehicle Electronics

CHO-SEAL® EMI form-in-place (FIP) gaskets for shielding electric traction elements within electronic housings.

4

Infotainment/Advanced Driver Assistance Systems

PREMIER™ electrically conductive plastics used for metal-to-plastic conversion. Eliminates up to 35% of weight of traditional die cast aluminum housings.



1

Power Cables Connector

CHO-SEAL® EMI elastomer gaskets for EMI shielding of power cable connectors.

2

Power Inverter/Converter Cover

PREMIER™ electrically conductive plastics used for metal-to-plastic conversion. Eliminates up to 35% of weight of traditional die cast aluminum housings.

6

Battery Pack

THERM-A-GAP® Gels – thermally conductive, one-component, fully-cured dispensable gels used between coils and aluminum chassis for effective heat transfer.

5

Battery Pack

THERM-A-GAP® Pads – gap fillers for additional support, vibration dampening or dialectic strength.

7

Battery Housings

CHO-SEAL® EMI co-extruded elastomer gaskets seal batteries from the environment, dirt, debris, and fluids.

An OEM System Solution from Parker Chomerics

Although electric vehicles represent a greener and cleaner future, they come with a number of technology challenges for manufacturers and systems suppliers. Issues include dissipating heat generated by the battery pack, eliminating electromagnetic interference and reducing vehicle weight.

Battery Heat Management

Left unchecked, excessive heat causes faster battery wear, reduced performance (due to uneven temperature distribution) and reduced charge efficiency, not to mention the safety hazards associated with thermal runaway. Effective thermal management is therefore critical to optimizing battery performance and longevity, along with improved safety and reliability, allowing vehicles to travel greater distances and increasing the achievable run-time on a single charge.

The technique for delivering thermal management is often liquid cooling, whereby two cooling loops/coils typically serve various sub-assemblies of the battery to manage heat. This delivers long-term thermal stability and performance and also prevents any opportunity for an electrical short.

Chomerics Division is part of the Parker Hannifin Corporation Engineered Materials Group and is a global leader in development and application of electrically and thermally conductive materials in electronics, transportation and alternative energy systems. Chomerics is the first choice in EMI shielding and thermal management solutions for automotive, information technology, medical devices, military, commercial and consumer electronics industries.

For over 50 years, Chomerics' strong portfolio has delivered cutting edge solutions to our global customers using technology built on core competencies in material science and process technology.

Thermally conductive, dispensable gel products are proven in the function of battery heat management. Offerings include one-component, pre-cured gels featuring a cross-linked structure, as well as two-component cure-in-place (CIP) gels which can also act as a potting compound and flow around complex parts. Both silicone and non-silicone gels are available depending on specific thermal conductivity requirements.

These compounds are particularly suitable in high volume markets such as automotive due to ease-of-dispensing using robotics or automation, thus considerably reducing cycle times and costs. They also enhance safety, by providing stability at temperatures up to 392˚F (200˚C).

Thermally conductive filler pads are also available depending on the design of the battery packs. These products are ideal for assemblies that might require some additional support such as vibration dampening.

As a benefit for drivers during cold winter months, thermal interface gels and pads help the battery reach its optimum temperature and performance much quicker than without having these materials in place.

Electromagnetic Interference (EMI) Shielding

Beyond effective thermal management, another technology challenge is the need to shield against EMI. The cables that travel between the battery and engine, as well as the battery and charger, see high current produced at low frequency. This produces a large magnetic field that can negatively affect other electronics within the vehicle. High shielding attenuation is also required to protect the battery and its circuits from any incoming EMI.

To overcome these issues, a variety of EMI shielding elastomers or extruded gaskets can be used. EMI gaskets are filled with conductive particles and connect interfacing components to reduce the air gap and create a Faraday Cage that blocks EMI fields. Among many attributes, they resist compression set and accommodate low closure force.

Very often batteries also need to be sealed against environmental dirt, debris and fluids. Here, it is possible to deploy combined solutions to support EMI and environmental shielding/sealing.

For battery applications requiring co-extruded gaskets, such as shielding the electric traction elements, special form-in-place (FIP) materials are available. Again, these lend themselves to robot dispensing, while the ability to create bespoke shapes is a further benefit.

Metal-to-Plastic Conversion

Replacement of metal housings with plastic versions can contribute to reducing vehicle weight and cutting manufacturing costs. Here, an electrically conductive plastic alternative can be exchanged for the battery electronic control unit's (ECU) conventional die-cast aluminum housing. Metal to plastic conversions not only eliminate 35% of the housing weight, but also provide cost reductions of up to 65% by eliminating secondary operations such as assembly and machining.

Featured Parker Chomerics Products

Thermal Gap Filler Pads

THERM-A-GAP Thermally Conductive Gap Filler Pads for battery cooling, inverters, converters, on-board chargers

Parker Chomerics THERM-A-GAP™ gap fillers are a family of low modulus (soft), thermally conductive silicone elastomers for applications where heat must be conducted over a large and variant gap between the hot component to the heat dissipating surface. Available in standard or custom configurations, with or without dielectric layers used to protect against bite-through or shorting issues.

Fully Cured Dispensable Thermal Gels

THERM-A-GAP Thermally Conductive Dispensable Gels for battery cooling, inverters, converters, on-board chargers

Parker Chomerics THERM-A-GAP gels are supplied as pre-cured, single-component compounds that can be dispensed on the heat-generating component. These unique gel materials feature a high surface tack which offers proven reliability in extreme temperature cycling along with shock and vibration, resulting in much lower mechanical stress on delicate components than even the softest gap-filling pads. They are well suited for higher voltage systems, offering a rating of UL 94 V-0 for reduced flammability, and are ideal for filling variable gaps between multiple components and a common heat sink.

Fully RoHS compliant, THERM-A-GAP gels are environmentally conscious because they are free of dangerous and hazardous materials.

Cure-in-Place Dispensable Thermal Elastomers

Parker Chomerics THERM-A-FORM™ thermally conductive silicone elastomer products are dispensable form-in-place compounds designed for heat transfer without excessive compressive force in electronics cooling applications. These versatile liquid reactive materials can be dispensed and then cured into complex geometries for cooling of multi-height components on a PCB without the expense of a molded sheet. Each compound is available in ready-to-use cartridge systems, eliminating weighing, mixing, and degassing procedures.

Dielectric and Insulating Pads

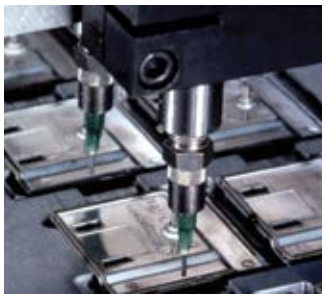
Parker Chomerics CHO-THERM® insulating pads were developed as a user-friendly alternative to greased mica insulators to be used between discrete power devices and heat sinks. Typical applications include power conversion equipment, power supplies, semiconductors, automotive electronics, motor and engine controls and other onboard electronics.

EMI Gaskets

Gaskets for shielding of battery packs and battery management systems (BMS) as well as on board chargers

CHO-SEAL Elastomer Gaskets
Parker Chomerics EMI shielding elastomer gaskets are the superior choice for elastomeric seals, corrosion resistance, environmental seals, and cost-effective electronic shielding. A comprehensive range of resins, conductive fillers, shapes and sizes that offers reliable long-term high EMI shielding performance.

CHOFORM Form-in-Place Gaskets
Parker Chomerics CHOFORM™ Form-In-Place EMI Gasketing System is ideal for today's densely populated electronics packaging, particularly where intercompartmental isolation is required to separate processing and signal generating functions such as in on-board battery chargers.



CHOFORM gaskets are the superior choice for elastomeric seals, corrosion resistance, environmental sealing and can cost up to 60% less than elastomer gasketing. The durable, highly conductive seals have low compression set, ensuring years of effective EMI shielding and mechanical performance.

Parker is also developing form-in-place (FIP) dispensable materials to allow design and manufacturing flexibility versus standard rope seals.

Conductive Plastics for Metal-to-Plastic Conversion

PREMIER™ PBT-225
Parker Chomerics PREMIER PBT-225 is a single pellet, polybutylene terephthalate (PBT) based, electrically conductive plastic that delivers superior reliability, making metal-to-plastic housing conversions possible for demanding automotive electronics applications. Metal to plastic conversions not only eliminate 35% of the housing weight (as compared to aluminum), but also provide up to a 65% cost reduction by eliminating secondary operations such as assembly and machining.

Automotive applications represent a great hydrolysis risk, as plastics are continuously exposed to harsh conditions for extended periods. Because of this, PBT-225 was specifically developed to deliver excellent hydrolysis resistance and provide a more reliable alternative solution to traditional cube blend conductive resin systems.

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