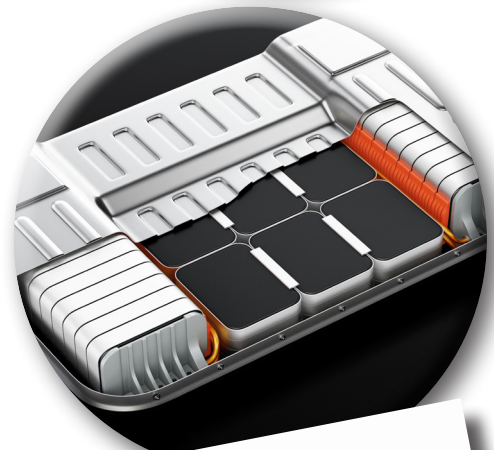


Permabond®

Adhesives for Battery Bonding

ISO 9001 Certified
 "Our Science ... Your Success"

Adhesives play an important role in the production of battery packs, hybrid and electric vehicle battery cells and modules. They are used to secure components, drive heat away from the battery cells, absorb impact stresses and vibration and in many cases electrically isolate cells and reduce the risk of fire. Permabond has a unique range of liquid adhesive products suitable for use in battery and electric vehicle applications and specialises in customising formulations to meet battery manufacturers' specific requirements.



Permabond® Features & Benefits

- Fire retardancy to UL94-V0
 – helps to reduce fire risk
- High level of thermal conductivity
 – to drive heat away from cells & sensitive components
- Flexible, compressible products available
- Fast cure at ambient temperature
- Excellent environmental resistance & 100% seal against humidity
- Ability to bond and seal hard to bond materials such as polyethylene, polypropylene, PEEK, PBT, and PTFE

Ideal for bonding:

Aluminum

Carbon

Copper

Glass-filled plastic

Graphite

PBT & PEEK

Phenolic

Polyethylene

Polypropylene

PTFE

Steel

Zinc

+ many more materials

Patented Technology, Thermal Management & Weight Reduction

Permabond's patented new thermally conductive expanding adhesive helps reduce battery weight, while helping drive heat away from battery cells. The foam forms a highly conductive skin which transports heat quickly and efficiently while providing electrical insulation.

- Reduces component weight – easier handling
- Helps improve vehicle economy and performance
 -faster acceleration, higher speeds
 -reduction in energy consumption

Title: Solution for Weight reduction in Thermal Management

Abstract: Permabond ET thermally conductive resin based on a breakthrough patent-pending technology. The two components of the adhesives are mixed and poured inside the battery pack. The resin contains an expanding agent that makes it increase its volume during cure. The pack itself is enclosed in the external case, and the free expansion of the mixed adhesive is higher than the available volume of the case. In this way, it gives rise to an internal pressure that generates a dual structure comprised of skin and foam. The compact, highly thermally conductive skin is in close contact with the batteries and the wall of the case, including the cooling plates. This skin provides a thermal bridge for heat conduction and dissipation. Inside the skin, the low-density foam also provides a level of thermal conductivity.

Background of the invention:

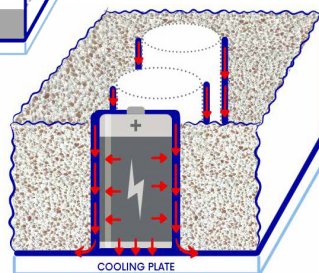
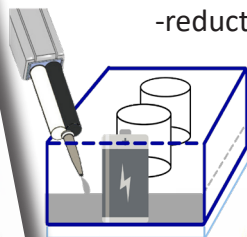
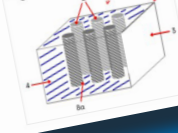
Batteries are a significant part of the vehicle at the power consumption of the performance of the vehicle. Batteries are a key element in the management of a key electric power.

Claims of the concept

- 1) Internal pressure generates a dual structure comprised of skin and foam.
- 2) Compact, highly thermally conductive skin is in close contact with the batteries and the wall of the case, including the cooling plates.
- 3) The skin provides a thermal bridge for heat conduction and dissipation.
- 4) The foamed structure provides a better absorption of vibrations
- 5)

Examples
 Example 1: Permabond ET density 1.2 g/cm³, thermoconductivity 0.5 W/mK
 Example 2: Permabond ET density 1.1 g/cm³, thermoconductivity on the foam 0.2 W/mK

Fig.1



Thermally conductive skin



Cooling plate

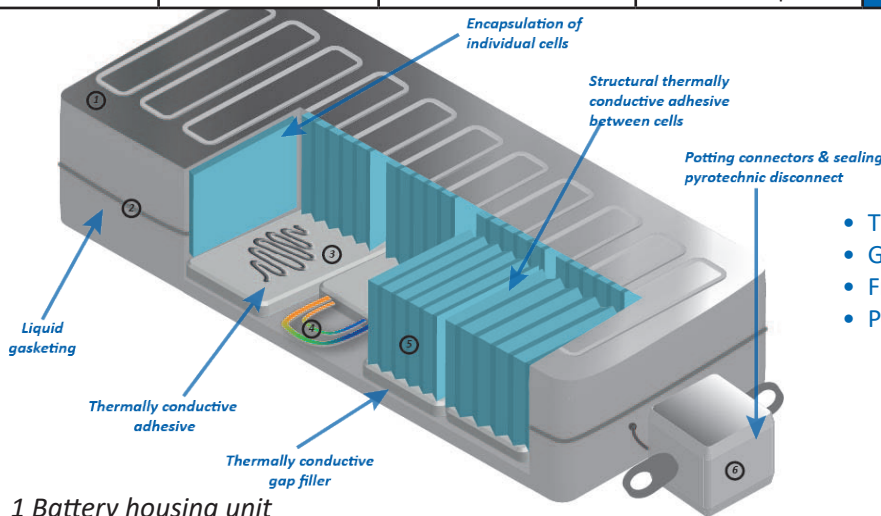
Adhesives for battery bonding Product data

The following technical data for Permabond adhesives for batteries is a guideline and does not constitute a specification. For full technical information, please refer to the technical data sheet, available at www.permabond.com. Our experienced worldwide trained distributor network means no matter where in the world you are located, Permabond representatives can be called upon to assist you with your bespoke applications.

	ET5441	MT3836	TA4611	Expanding TC* Filler	Graphite Bonder	825
Description	Thermally conductive, high temperature resistant (to 390°F) 2-part epoxy.	Flexible / compressible thermally conductive, fire retardant 2-part hybrid system.	Acrylic adhesive for bonding polyolefin materials, PTFE, etc. Ideal for bonding battery housing.	Thermally conductive 2-part epoxy that expands to form a lightweight foam structure. Patent pending.	Single part heat cure epoxy for bonding graphite plates for hydrogen fuel cells.	Cyanoacrylate instant bonder with super-high temperature resistance (to 390°F). Patented technology.
Appearance	Grey	Light grey	Transparent			Clear, colourless
Viscosity	Thixotropic	Paste	19,000 mPa.s			100-150 mPa.s
Gap fill	2mm	5mm	0.5mm			0.15mm
Handling time	2-3 hours	2-3 hours	40-50 mins			5-60 secs**
Shear strength	20 MPa (steel)	2.5 MPa (steel)	11 MPa			15-20 MPa
TC*	1.1 W/m.K	1.05 W/m.K	N/A			N/A
Specific gravity	2.1	1.4	1.0			1.05
Packaging	1 x 50ml cartridges 6 x 400ml cartridges Bulk on request	6 x 400ml cartridges Bulk on request	15 x 25ml syringes 10 x 50ml cartridges 6 x 400ml cartridges Bulk on request			15 x 20g bottles 10 x 50g bottles 1 x 500g bottle Bulk on request

Please contact Permabond for further information

* TC = Thermal Conductivity / ** Depending on substrate



- 1 Battery housing unit
- 2 Housing unit assembly seam
- 3 Cooling plate
- 4 Cooling elements inside cooling plate
- 5 Battery module of cells
- 6 Safety pyrotechnic disconnect unit

Other featured adhesives include:

- Threadlockers to protect nuts & bolts from vibration loosening
- Gasketmakers to seal batteries
- Friable adhesive for pyrotechnic disconnect
- Potting & encapsulation resins

A comprehensive range of adhesives is also available for electric motor bonding, please check out our Electric Motor brochure for further details.

Authorised distributor stamp:



- www.permabond.co.uk
www.permabond.com
- US Helpline - 800-640-7599
 - UK - 0800 975 9800
 - Asia + 86 21 5773 4913
 - General Enquiries +44(0)1962 711661
 - Deutschland 0800 101 3177
 - France 0805 111 388
- info.europe@permabond.com
info.americas@permabond.com
info.asia@permabond.com



Wessex Business Park
 Wessex Way
 Colden Common
 Winchester
 Hampshire
 SO21 1WP
 United Kingdom

The information given and the recommendations made herein are based on our experience and are believed to be accurate. No guarantee as to, or responsibility for, their accuracy can be given or accepted, however, and no statement herein is to be treated as a representation or warranty. In every case we urge and recommend that purchasers, before using any product, make their own tests to determine, to their own satisfaction, its suitability for their particular purposes under their own operating conditions. Always refer to current product technical datasheet for most recent and accurate technical information.