



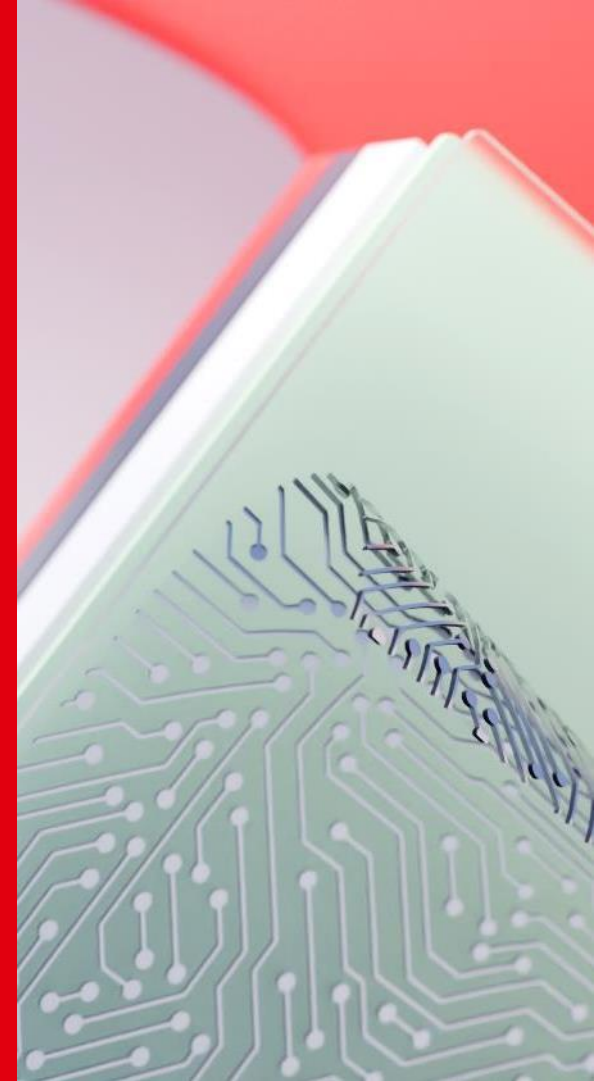
MATERIAL SOLUTIONS FOR  
**ALTERNATIVE ENERGY  
CONVERSION &  
STORAGE**



# AGENDA

## 01 Introduction

- 02 Application Overview
- 03 Thermal Management Solutions
- 04 Protecting Solutions
- 05 Bonding Solutions
- 06 Value of Henkel



# INTRODUCTION

- Extracting power from alternative energy sources like the sun not only addresses the objective of sustainability but also significantly increases the amount and extends the availability of power to serve global needs, even in areas where there is limited infrastructure. Driving up the efficiency of a solar power network is key to harnessing as much energy from the source as possible.
- From the solar panel's DC output to the conversion in the inverter to the battery cell storage or grid, a solar energy system requires high-performance, dependable components to deliver power when and where required. Our advanced adhesive and thermal formulations protect outdoor electronics from environmental impacts, remove heat to raise performance efficiency and deliver on the long lifetime expectations of solar power systems.



# MARKET NEEDS & TRENDS

## Differentiators

### SYSTEM COST

Fully automated production  
Shortened cycle times  
System design



### SUSTAINABILITY

SVHC / CMR sensitive  
Corporate citizenship  
More with less



## Design Targets

### INCREASED POWER

Increased function  
Increased communication  
Faster charging / Increased range



### SYSTEM INTEGRATION

Drive on motor  
Power conversion



### SMART SYSTEMS

Artificial intelligence  
Security  
Machine learning



### MINIATURIZATION

Higher packaging density  
Integration of electronics  
WBG



### EFFICIENCY

Better use of energy  
Legislation  
WBG



### CONNECTIVITY

More data  
Faster transmission  
Energy <-> Internet



## Must Haves

### RELIABILITY

Thermal management  
Environmental protection  
Remote installations



### SAFETY

Environmental Protection  
High voltage resistance  
Flammability





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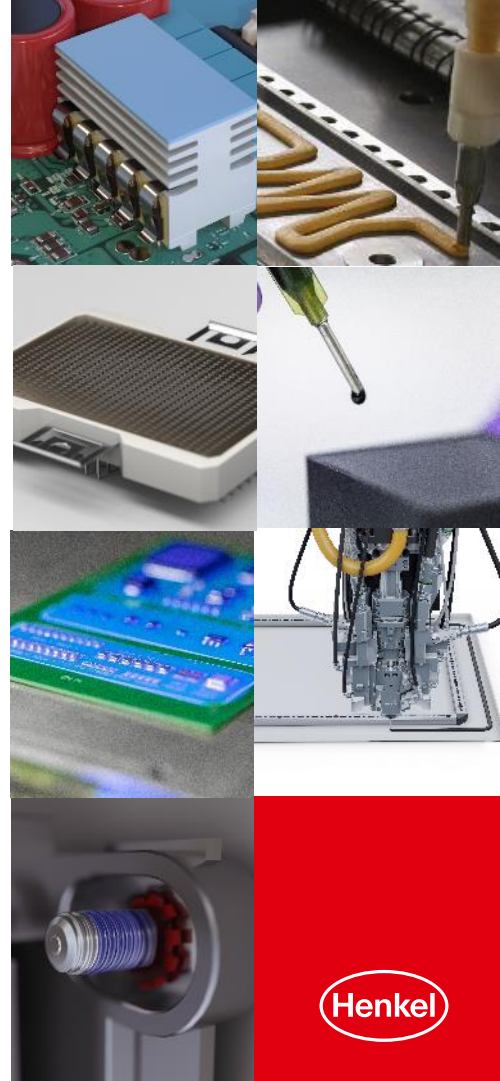
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# HENKEL MATERIAL SOLUTIONS

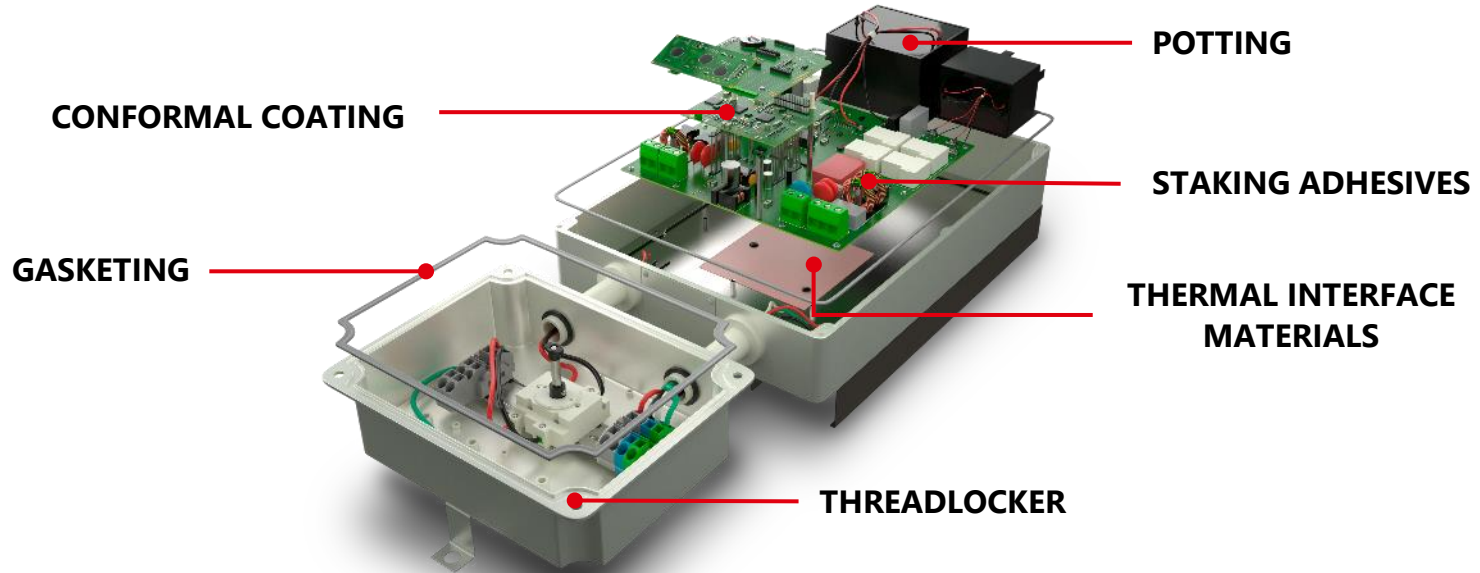
## Overview

| Application | Technology   | Power Conversion | Energy Storage |
|-------------|--|------------------|----------------|
| Thermal     | Thermally Conductive Insulating Films (Sil Pad, Hi Flow) | ✓                |                |
|             | Gap Filling Materials (GAP PAD, Gap Filler)              | ✓                | ✓              |
|             | Phase Change   | ✓                |                |
|             | Thermally Conductive Adhesives                           |                  | ✓              |
| Protecting  | Potting  | ✓                |                |
|             | Conformal Coating  | ✓                | ✓              |
|             | Gasketing / Sealing                                      | ✓                | ✓              |
| Bonding     | Thread Locking Adhesive                                  | ✓                |                |
|             | Staking Adhesives  | ✓                |                |
|             | Assembly and Structural Adhesives                        |                  | ✓              |



# POWER CONVERSION SOLAR POWER INVERTERS

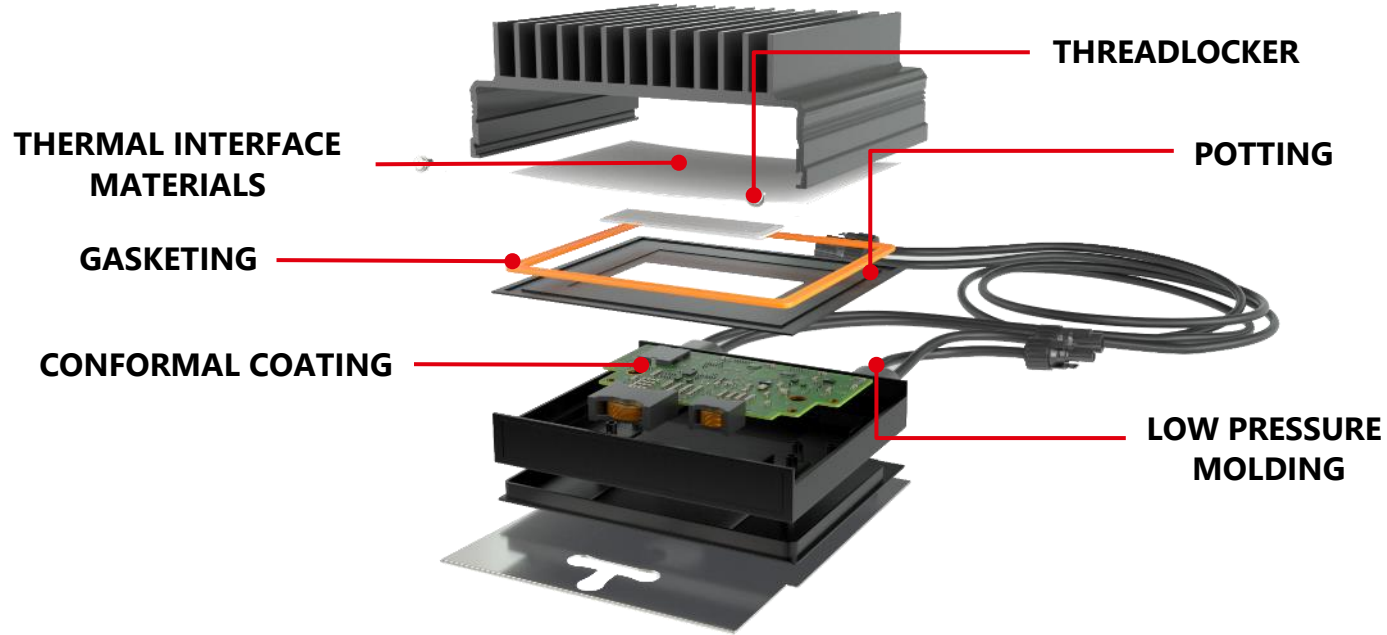
## Material Solutions



# POWER CONVERSION

## SOLAR POWER OPTIMIZERS

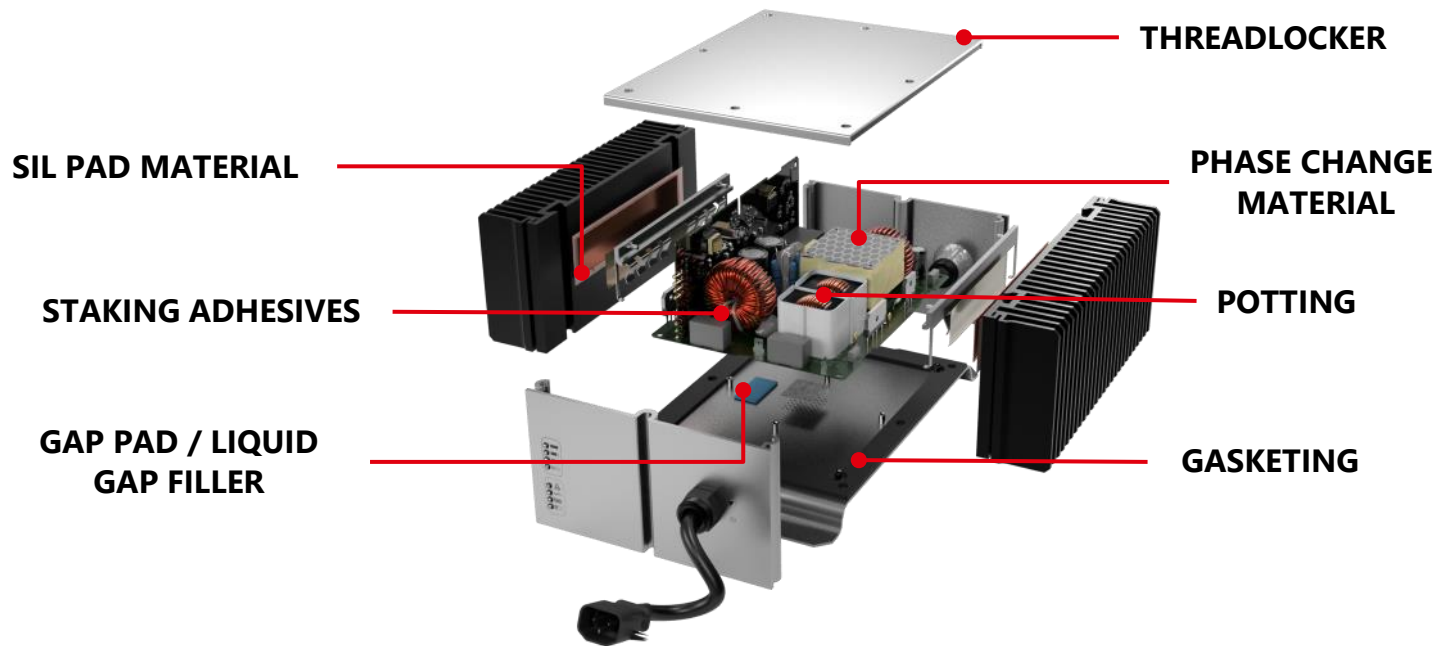
### Material Solutions





# POWER CONVERSION INDUSTRIAL BATTERY CHARGERS

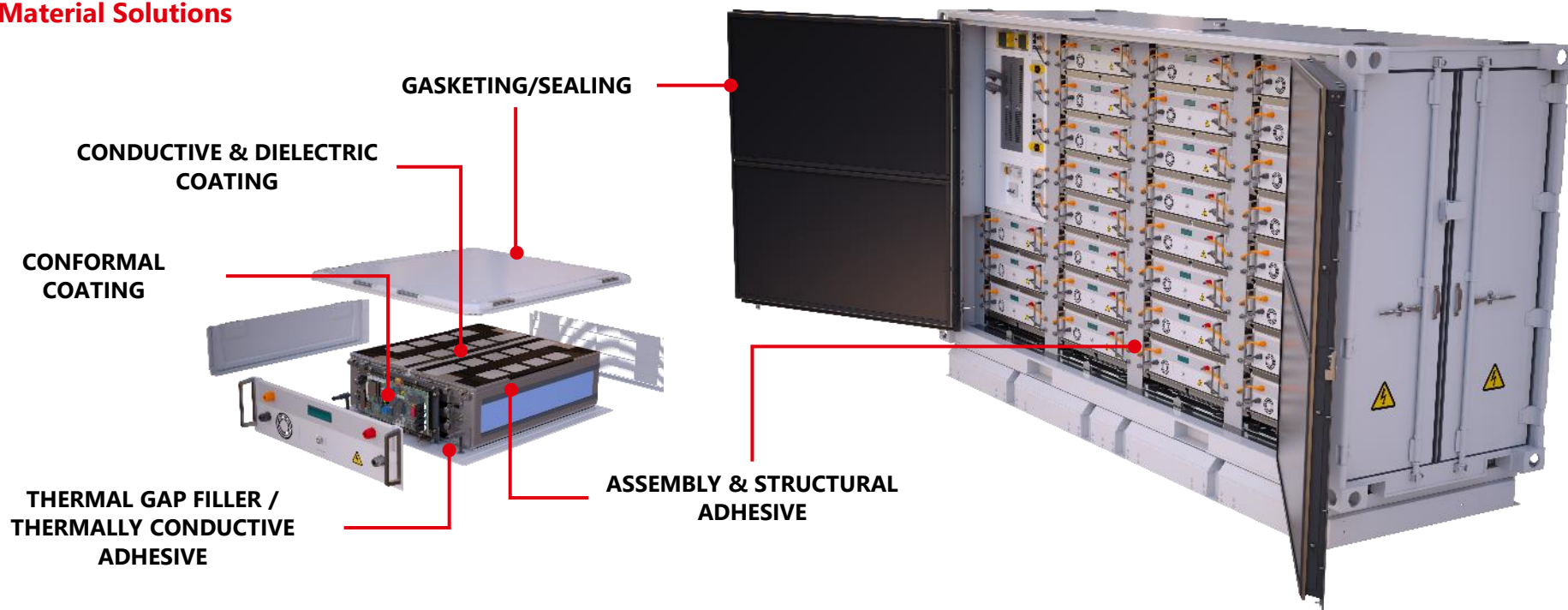
## Material Solutions



# BATTERY ENERGY STORAGE SYSTEMS (BESS)

## LITHIUM-ION BATTERIES

### Material Solutions



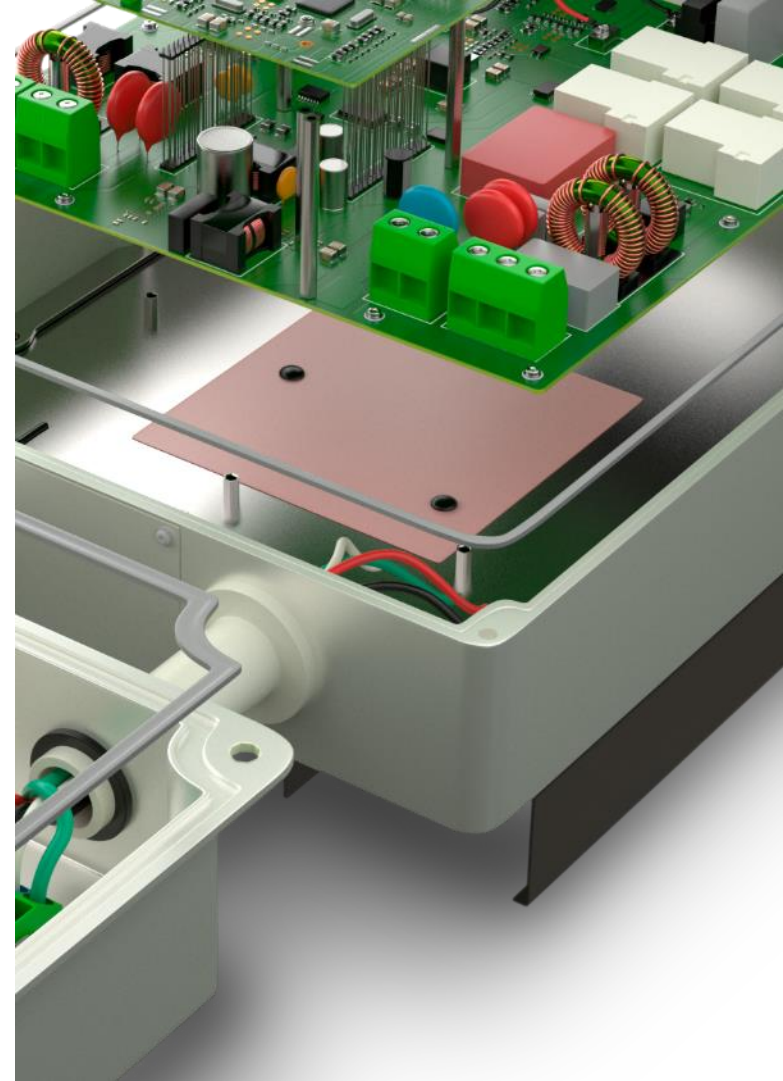
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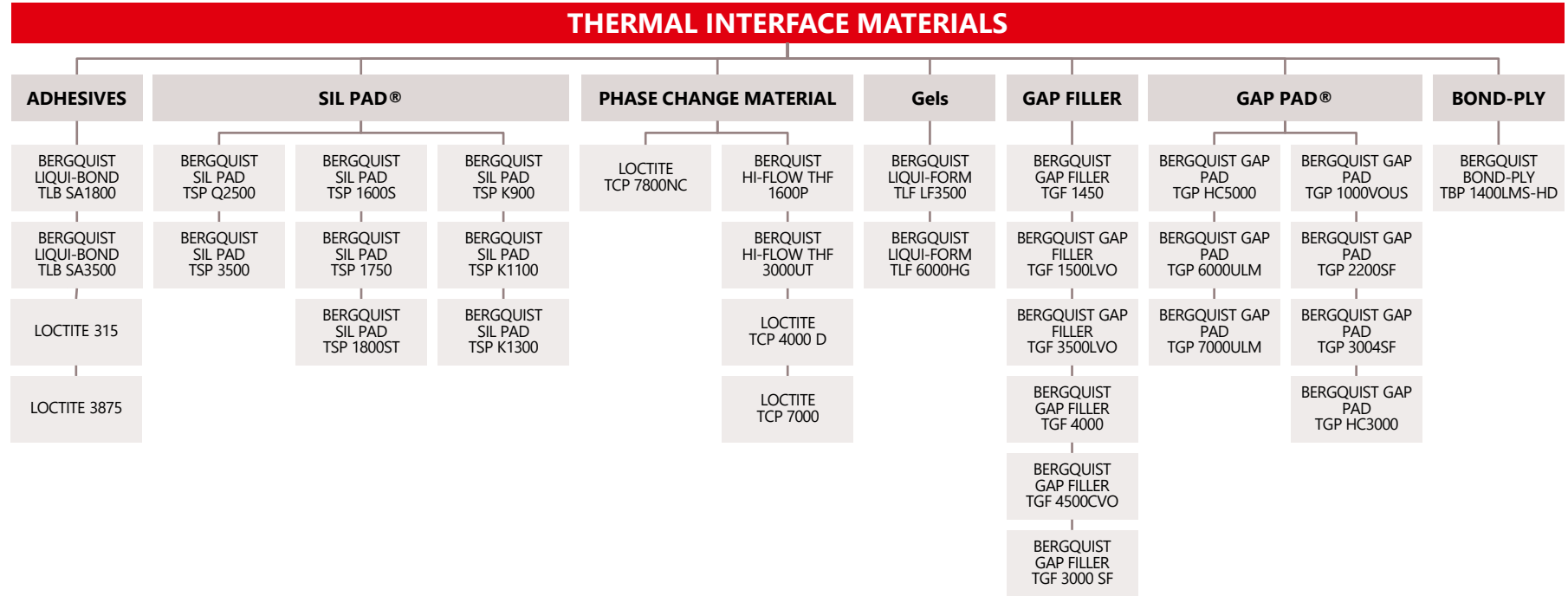
# THERMAL MANAGEMENT

- Thermal Interface Materials (TIM) help dissipate heat from power switching components while providing safety agency recognized insulation.
- Provide a safe reliable product with proven pedigree to meet expected lifetimes in outdoor and unprotected environments.
- A broad portfolio of suitable products that can meet performance needs and process capabilities with a sensitivity to total cost of ownership.
- Thermal pads, insulators and phase change materials provide a wide range of thermal performance and insulation properties opening many power electronics packaging options.



# POWER CONVERSION

## THERMAL MANAGEMENT SOLUTIONS





# ENERGY STORAGE

## THERMAL MANAGEMENT SOLUTIONS

### THERMAL MANAGEMENT MATERIALS

#### ADHESIVES

LOCTITE  
EA 9497

LOCTITE  
TLB 9200 APS

LOCTITE  
TLB 9300 APSi

#### GAP FILLER

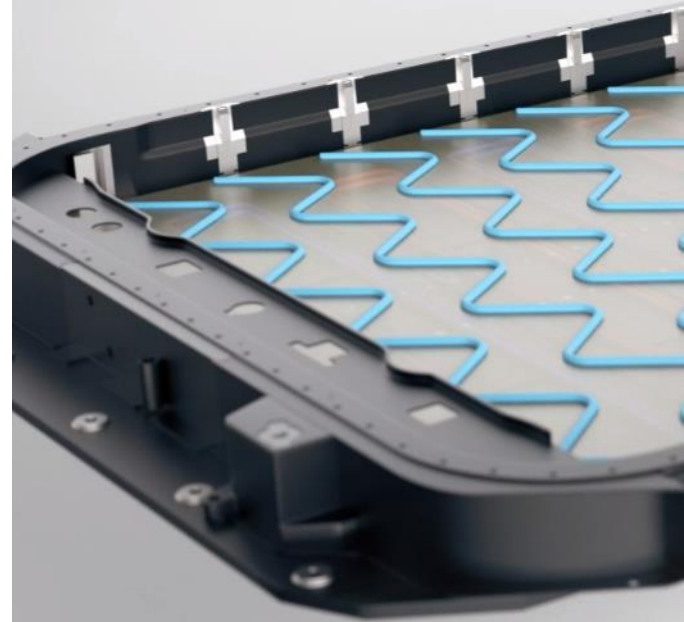
BERGQUIST  
TGF 2010 APS

BERGQUIST  
TGF 3010 APS

BERGQUIST  
TGF 2200 APS

#### GAP PAD®

BERGQUIST  
TGP 1350



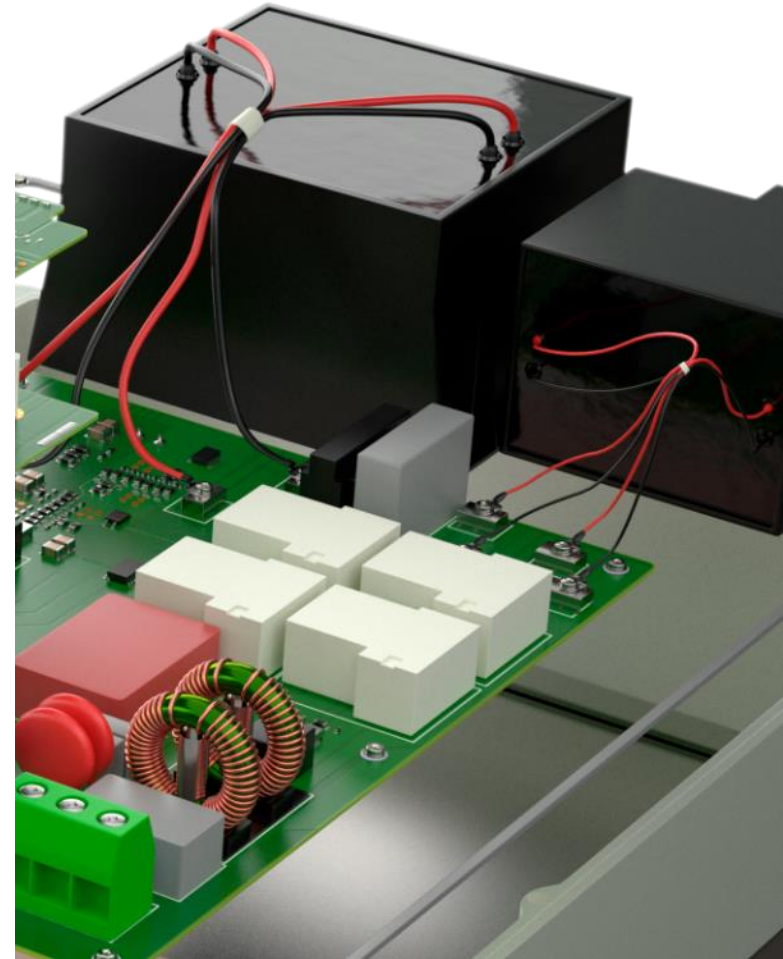
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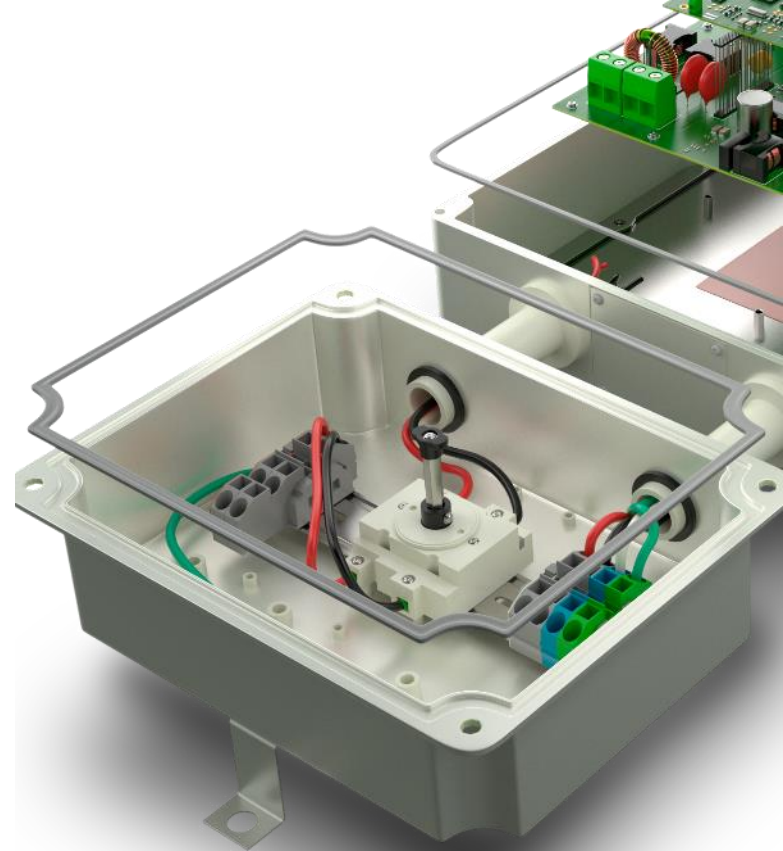
# POTTING

- UL V-0 potting with fast curing and easy dispensing:
  - Multiple gel time options to fit process requirements
  - Room temperature cure or can be accelerated by heat
- Tough materials with high elongation to break that are stable over a wide range of temperature and humidity.
- Good adhesion to common molding plastics to provide a high degree of protection.
- Strong dielectric properties for safe high voltage operation.



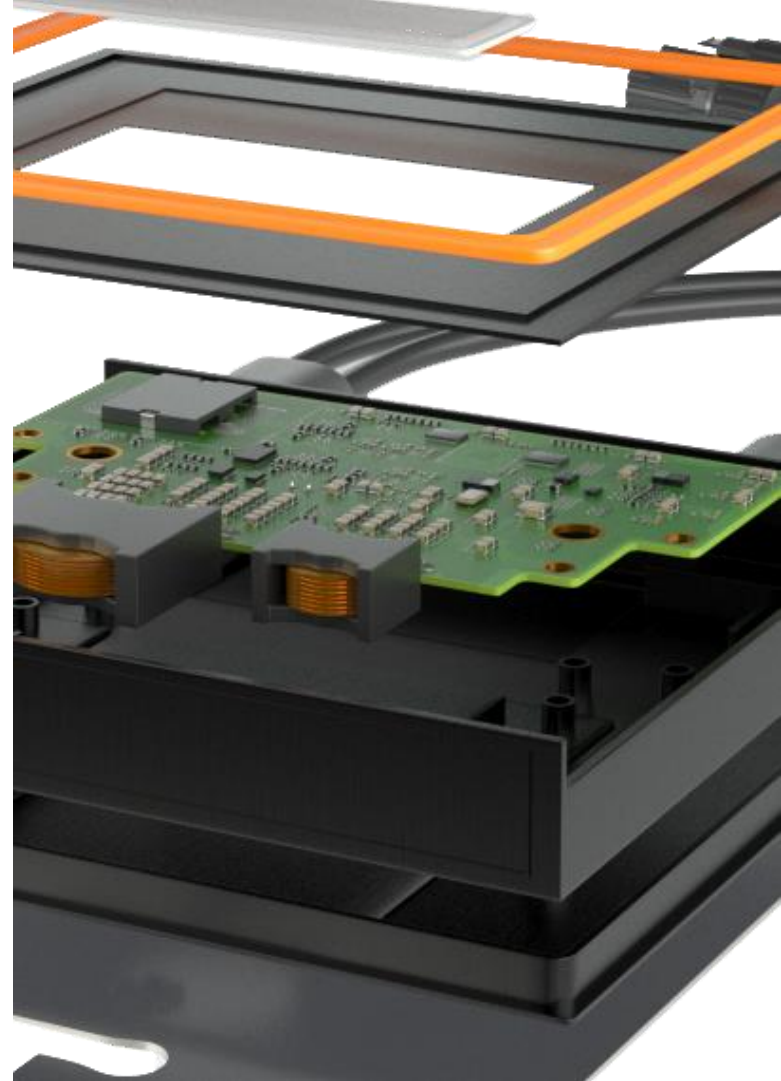
# GASKETING/SEALING

- Proven sealing solution for electrical enclosures and automotive applications.
- Automated to provide cost effective, repeatable deposition of gasket for high volume applications:
  - Deposition can be easily modified for different enclosure geometry for different charger types
  - Cures at room temperature or can be accelerated with heat.
- In situ foaming and curing in place to remove seams.
- Provides good adhesion to powder coated and plastic housings.
- NEMA certified solutions.
- Applicable for environments:
  - PU based solutions from -40C to 80C
  - PDMS based solutions extended from -55C to 150C.



# CONFORMAL COATING

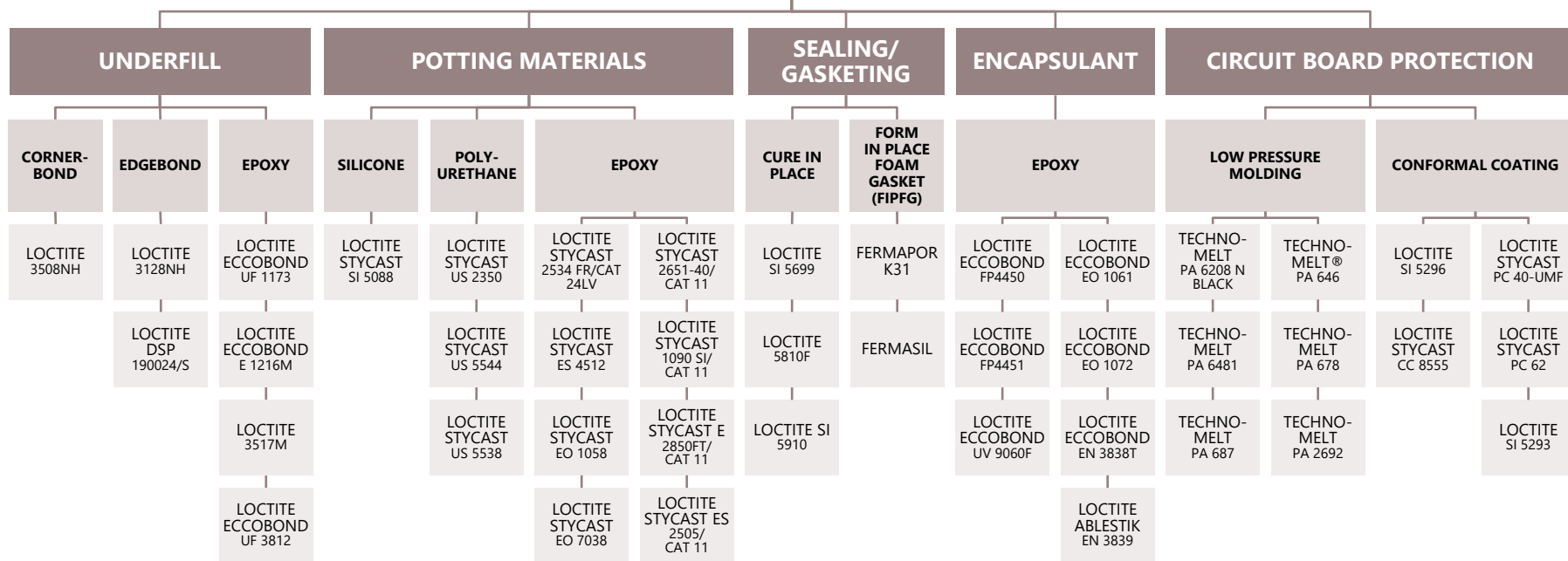
- Conformal coating materials protect PCBs and advanced substrates from thermal shock, moisture, corrosive liquids and other adverse environmental conditions, ensuring long product life cycles.
- With exceptionally fast cure capability and wide processing windows, Henkel's conformal coatings provide fast processing and high yields.
- Solventless, SVHC and Tin-free formulations with UL and moisture cure capability provide a sustainable advantage.





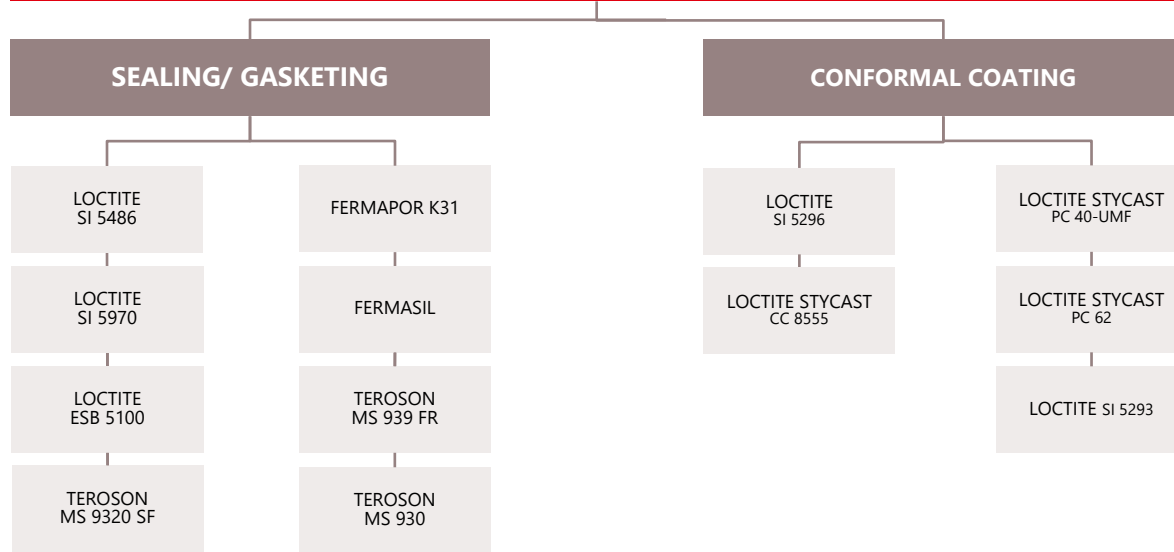
# POWER CONVERSION PROTECTING SOLUTIONS

## PROTECTING MATERIALS



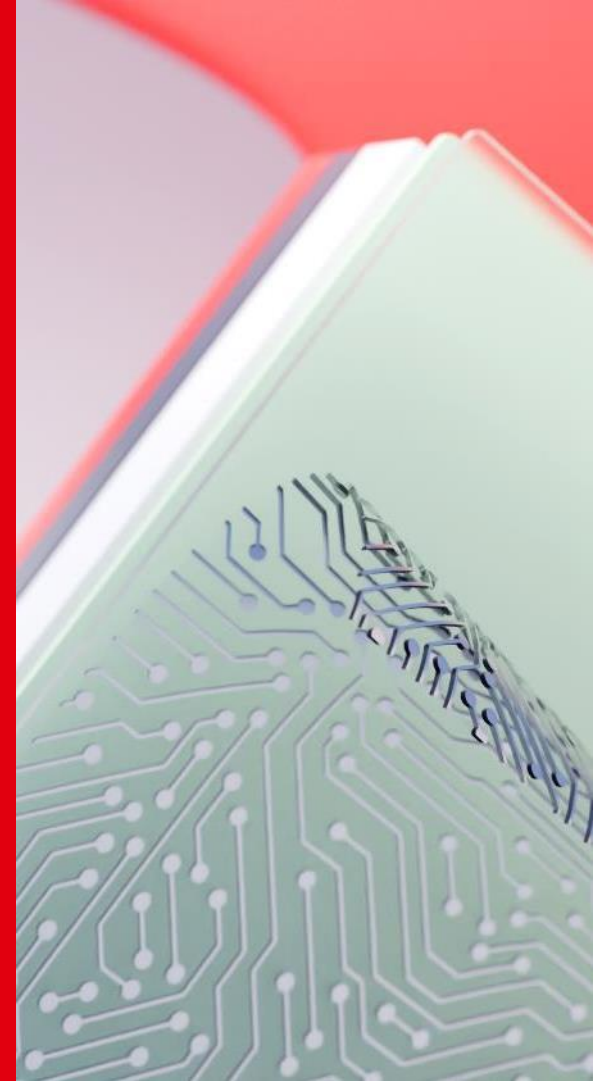
# ENERGY STORAGE PROTECTING SOLUTIONS

## PROTECTING MATERIALS



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# THREADLOCKERS

- Threadlockers will reliably lock, and seal threaded fasteners.
- Liquid threadlockers also provide reliable disassembly – you can take it apart when needed.
- Key benefits include:
  - Locks mating threads to prevent loosening from vibration & shock
  - Seals against fluids & corrosion
  - Provides lubricity to achieve controlled strength during assembly
  - Prevents galling and seizing for reliable disassembly.



# STAKING ADHESIVES

- Designed for bonding and enhancing mechanical and structural stability, staking adhesives offer resistance to multiple fluids, salts, acids and alkalis.
- Epoxy-based, solvent-free, low-outgassing and non-conductive, staking materials have adhesion compatibility with a wide range of materials for enhanced physical strength and reliability.



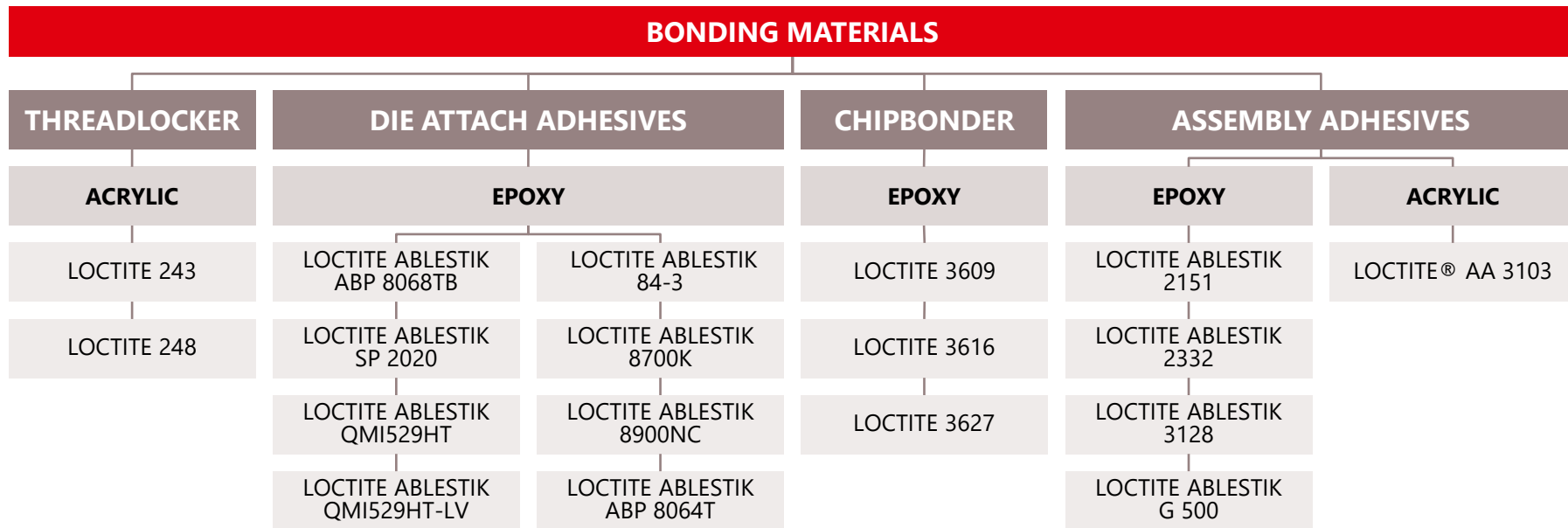


# ASSEMBLY AND STRUCTURAL ADHESIVES

- Assembly adhesives are used to mount battery cells with good adhesion and high bonding strength.
- Structural adhesives for energy storage applications are challenged with high requirements regarding a structural, primerless bonding at a high production speed.

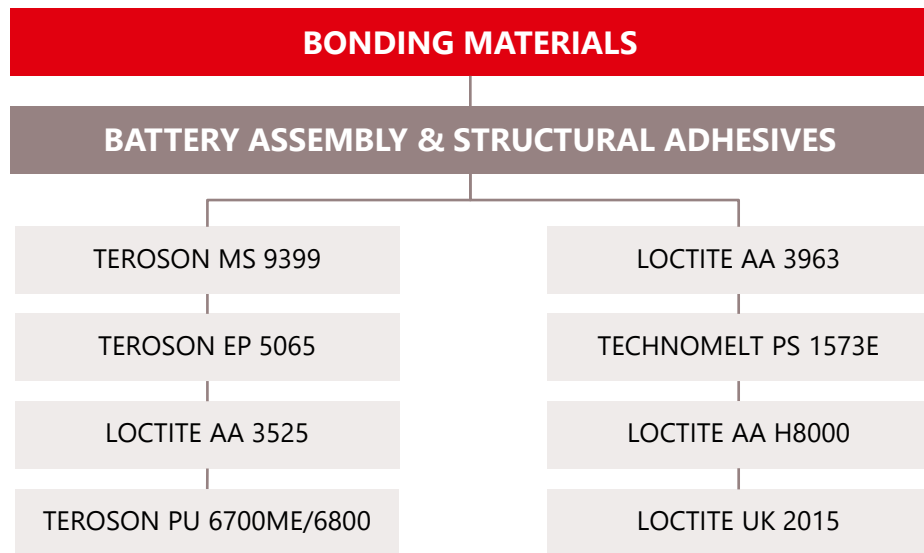


# POWER CONVERSION BONDING SOLUTIONS



# ENERGY STORAGE

## BONDING SOLUTIONS



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# VALUE OF HENKEL

## Power Conversion & Industrial Automation

A photograph of an industrial welding process. A robotic arm is visible, and a large amount of bright orange sparks is being generated from the welding point. The background is slightly blurred, showing other industrial equipment.

**FORMULATED** for  
**Continuous Performance**  
and **Sustainable Results**

Henkel materials are driving value for the Power Conversion & Industrial Automation market through high-performance formulas that secure steadily operation with effective thermal management, durable adhesion, efficient protection, reliable electrical function and long-term sustainability.



# VALUE OF HENKEL

## Products

- **Thermal products** from **Henkel's BERGQUIST** brand are proven in demanding applications and help increase **power density**, improve **reliability**, and reduce overall **cost of ownership**
- **Henkel's** potting solutions provide **protection** from environmental conditions that can damage sensitive electrical components while maintaining a low modulus to **minimize stress** on components.
- **LOCTITE** conformal coating materials **safeguard** printed circuit boards against harsh environments, ensuring **reliable**, long-term operation. Henkel's conformal coatings enable **high-throughput, environmentally-responsible** manufacturing.
- **LOCTITE** industrial adhesives are designed to aid in the manufacture of components and materials. These innovative industrial adhesive products are formulated to withstand severe impact and peel forces, provide high shear strength, and offer excellent chemical and temperature resistance.
- With **Henkel**, manufacturers can rely upon **high performance** electronic adhesives from recognized brands with a proven track record of **reliability** under harsh operating conditions and reducing total **cost of ownership** for our customers.
- **Our** focus on **safe** and **environmentally socially responsible** materials ensure that our customers can meet any legal requirements as well as the highest ideals of **corporate citizenship**.

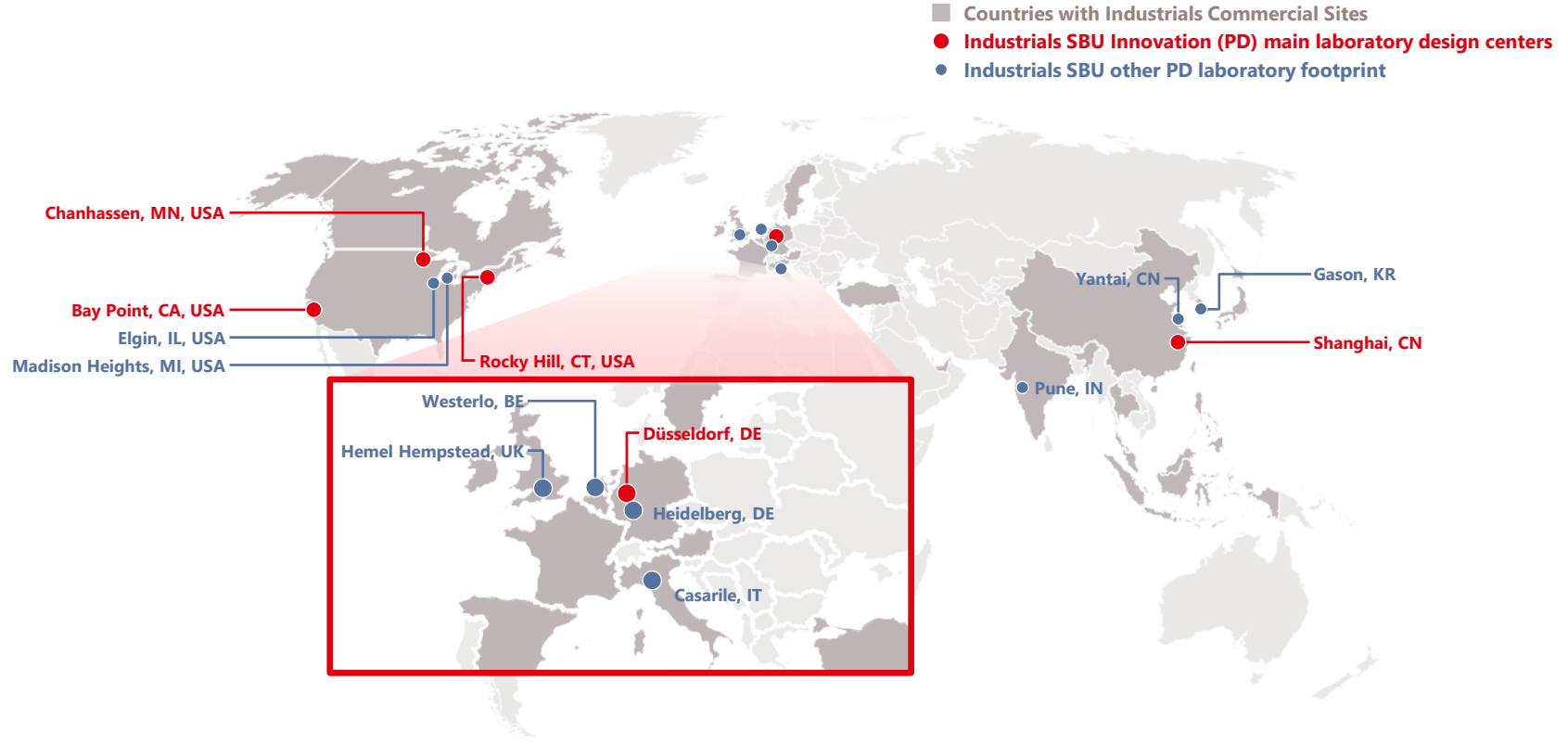
## ADHESIVE TECHNOLOGIES



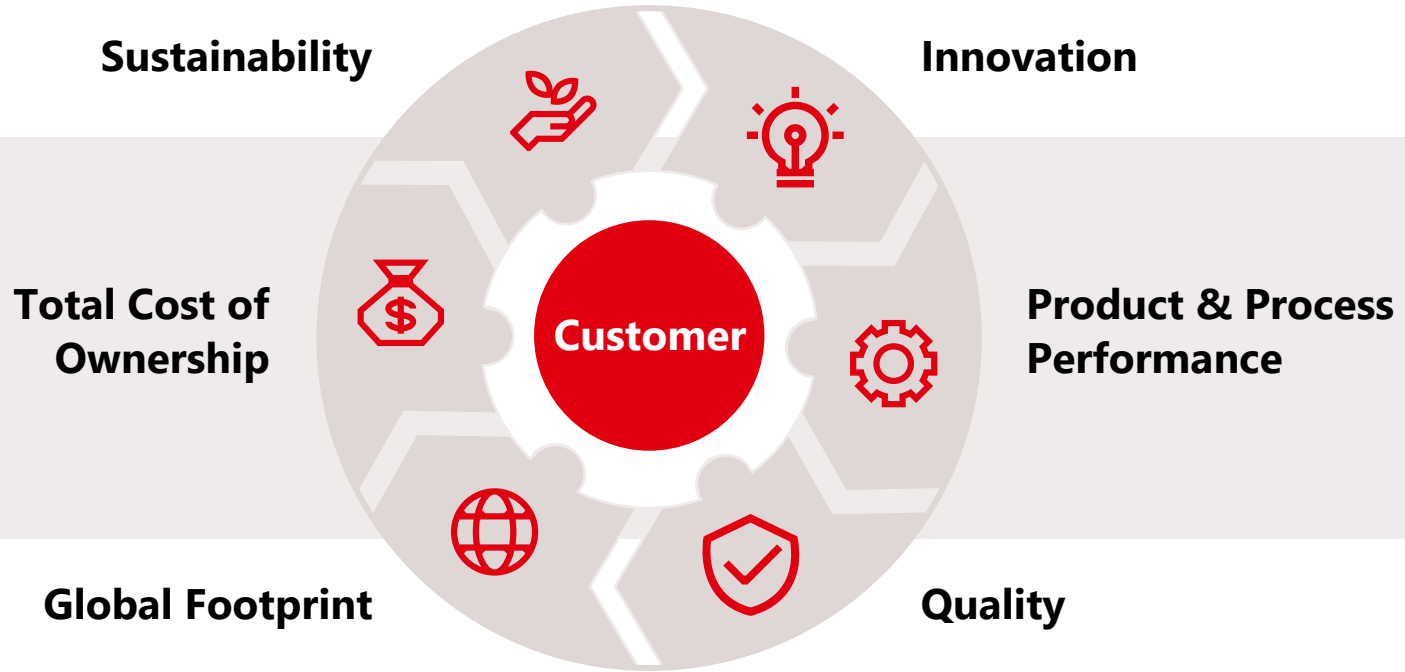
**LOCTITE®**  
**TECHNOMELT®**  
**BERGQUIST**

  
sonderhoff

# OUR GLOBAL FOOTPRINT



# VALUE OF HENKEL



# VALUE OF HENKEL

|  |  |   |
|--|--|---|
|  | <b>Innovation</b>                        | Collaboration at the design phase ensures product development initiatives hit the mark. Teams of materials scientists, broad global lab resources and advanced development capabilities secure innovation delivery. |
|  | <b>Product and Process Performance</b>   | Holistic understanding of systems design and compatible material platforms mitigate risk, raise performance and enhance reliability.  |
|  | <b>Quality</b>                           | A commitment to operational excellence and assurance of strict safety standards are foundational for quality outcomes and end user satisfaction.  |
|  | <b>Global Capability</b>                 | Personnel, R&D and manufacturing footprints in every region globally provide agility, well-resourced technical support and on-the-ground solutions.   |
|  | <b>Sustainability</b>                    | Embrace sustainability as a value driver through differentiated, high impact solutions that enable a low-carbon circular economy, driving efficiency and facilitating growth.                                       |
|  | <b>Optimized Total Cost of Ownership</b> | Cost reductions are achieved via streamlined production, material reliability, automation equipment solutions, access to technical expertise and manufacture of the highest-quality, durable end products.          |

# THANK YOU.



**FIND OUT MORE - SOLUTIONS FOR ALTERNATIVE ENERGY CONVERSION AND STORAGE**