

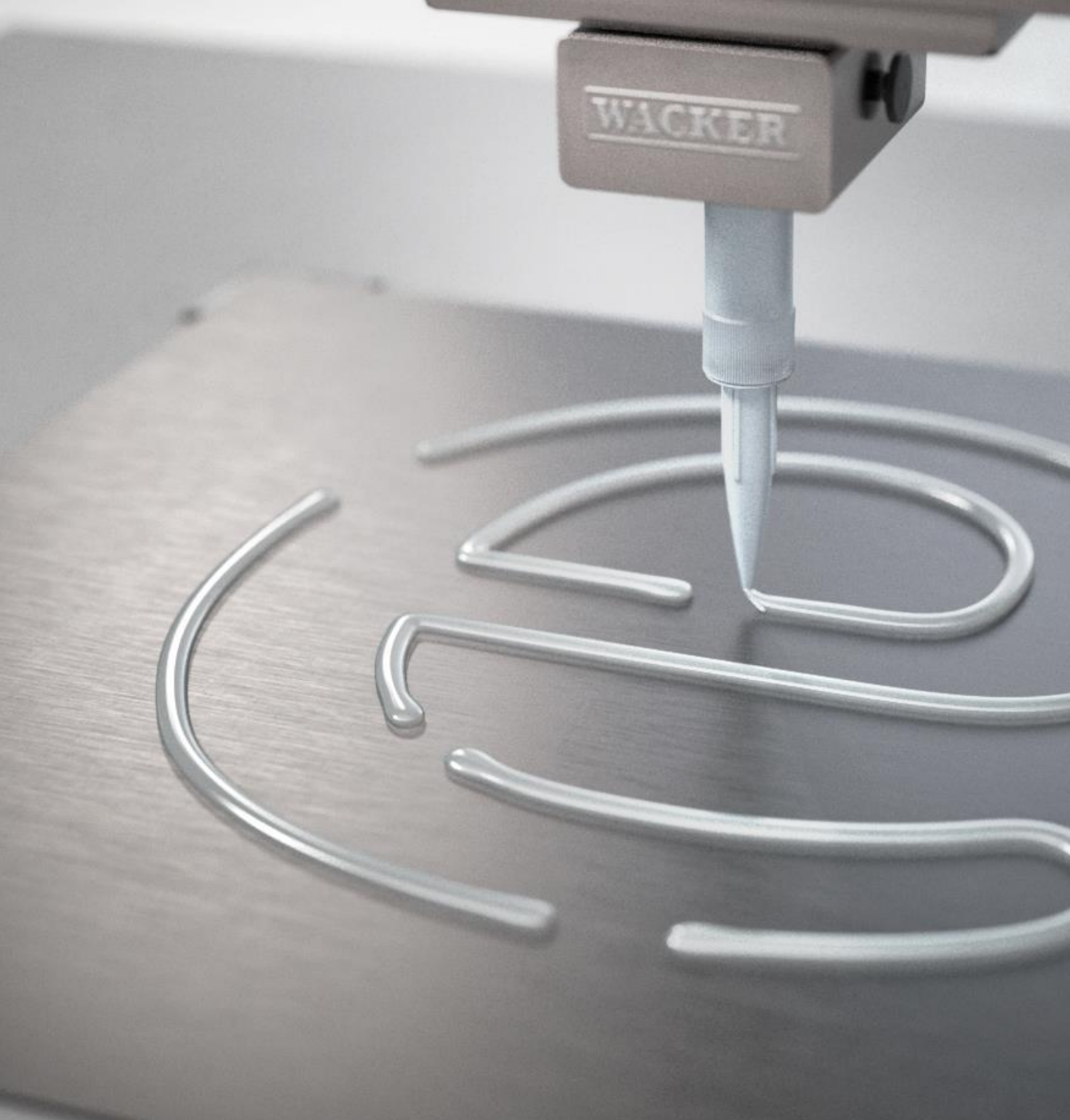
WACKER

CREATING TOMORROW'S SOLUTIONS



Driving Tomorrow's e-Innovation

e-Mobility Powered by Silicones



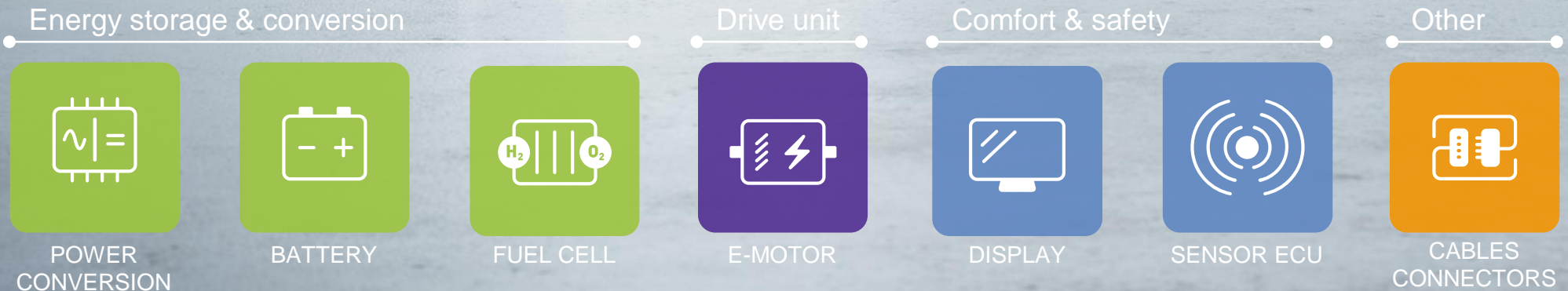
The automotive industry is facing probably the biggest challenges in its history.

The reduction of CO2 emissions required by governments is addressed by an electrification of the powertrain. Different concepts range from mild hybrid to the full electric vehicle.

Silicones are part of these concepts as bonding, sealing, potting or coating materials that ensure performance, functionality and a long service life.

Thermally conductive silicones assist in dissipating heat created by the compact design of electric components.

Silicones Support the Key Components in Alternative Drive Cars from Mild Hybrid to Electric and Fuel Cell Vehicles



Now in the Pole Position - Silicones Solve E-Mobility's Challenges



Silicones have proven to fulfill automotive industry's **thermal requirements**

- ▶ Silicones maintain their properties over a broad temperature range, heat resistance from 180 °C up to 230 °C
- ▶ Thermally conductive silicones assist in dissipation of heat / thermal management



Silicones **protect** sensitive electronics

- ▶ Gel type materials with low e-modulus protect against external influences and transmission of mechanical stress



Silicones assist **functional safety**

- ▶ Tight sealing: long-term and resistant (moisture, chemicals, coolants, fluids)
- ▶ Rel. constant electric insulation properties over broad temperature + frequency range
- ▶ Excellent vibration damping from -45 °C up to > 180 °C



Silicones help technology to be **fast, easy and affordable**

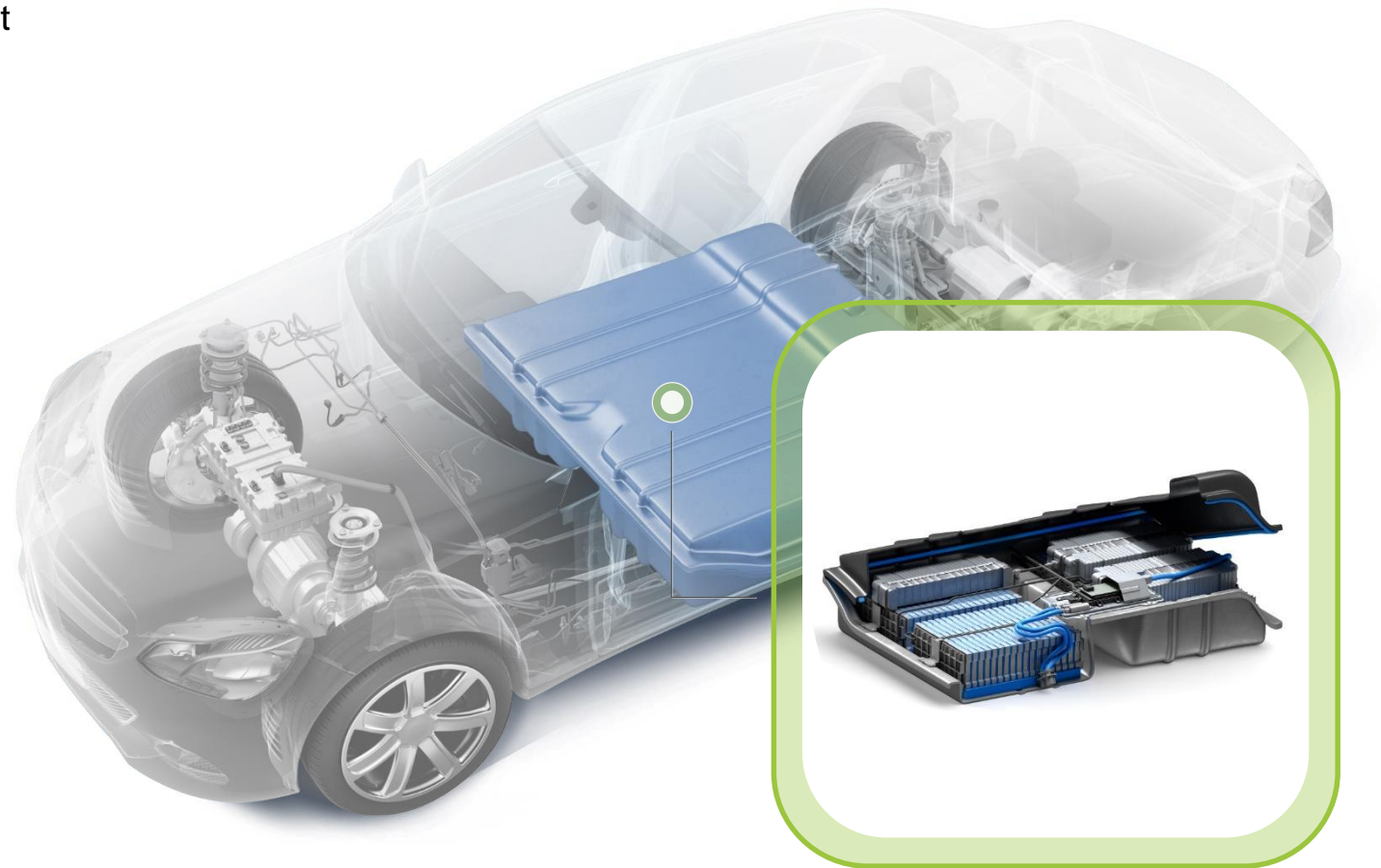
- ▶ Silicones are versatile to be adjusted in their properties (flow, wetting, adhesion, cure) to different production processes
- ▶ Automated mass production possible

Silicones Let the Heart of E-Mobility Beat Safely for a Long Time

Battery

The Challenge

- ▶ Increasing capacities / voltage let thermal management become a pressing matter to increase lifetime and safety
- ▶ Functional safety of HV battery components has to be ensured under harsh conditions (vibration, moisture, ...)



Silicones Assist Thermal Management and Reliable Sealing, They Increase Safety Through Dielectric Insulation

Battery

The Challenge

- ▶ Need for thermal management to increase lifetime
- ▶ Functional safety under harsh conditions

Our solution

- ▶ Thermal management with silicone gap fillers, pastes, adhesives and encapsulants
- ▶ Sealing, bonding and potting with silicone adhesives and gels

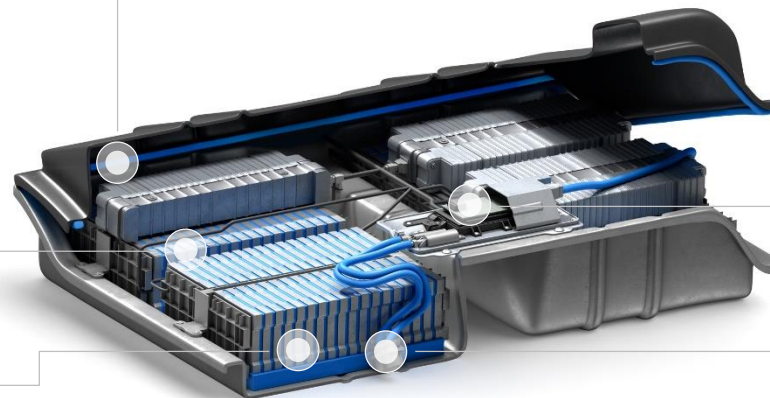
Sealing of battery module /
Sealing of battery housing



Couple cells for vibration control
(bonding)



Thermal management Coupling
of cells / modules to active cooling



Potting of electronics
in battery
management system



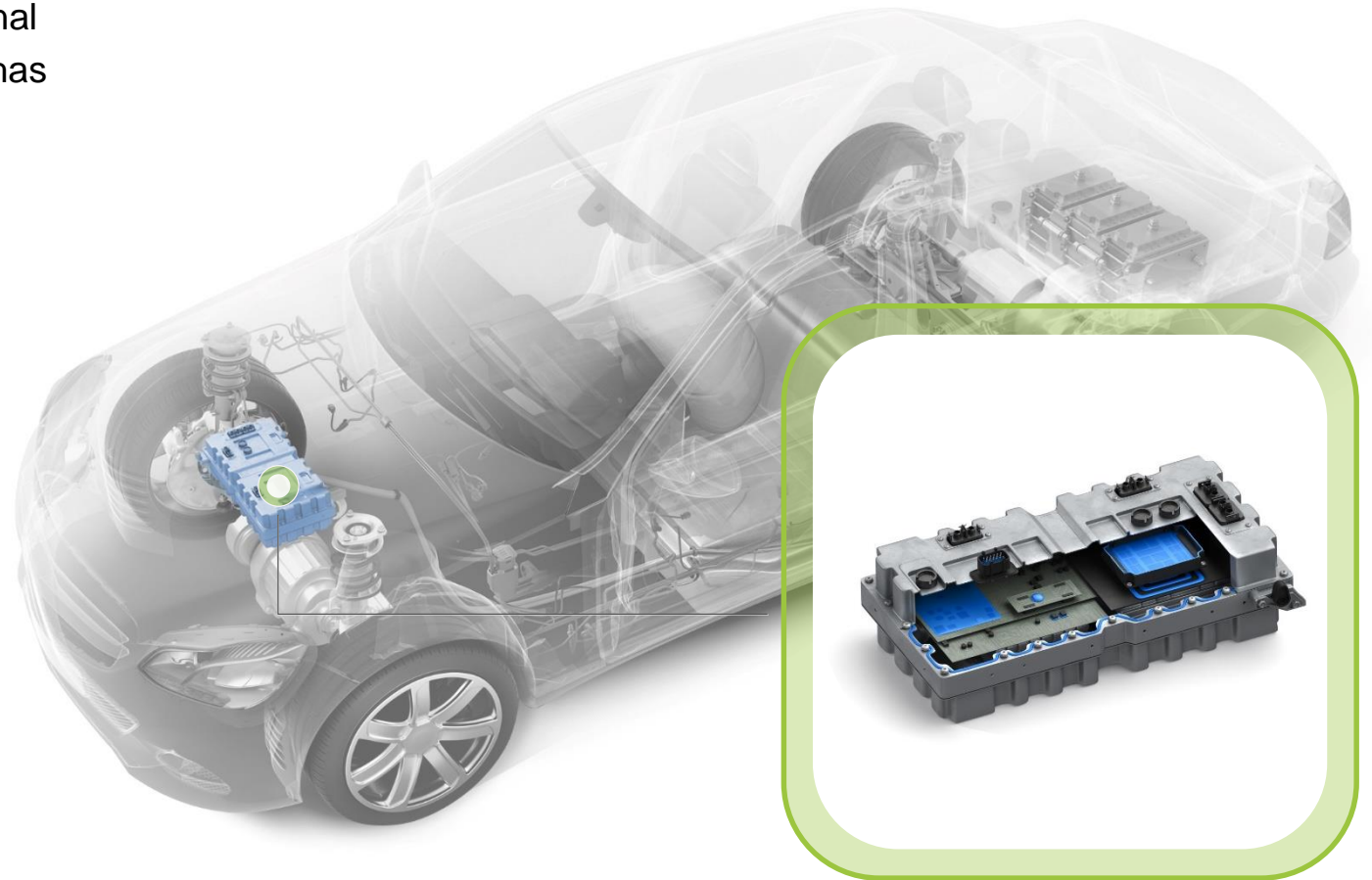
High voltage
cables & connectors

Silicones Protect the Brain of E-Mobility

Power Conversion

The Challenge

- ▶ Protection of electronics, functional safety & lifetime of components has to be ensured via
 - ▶ Dielectric insulation
 - ▶ Damping and minimization of thermomechanical stress
 - ▶ Thermal management



Silicones Assist Thermal Management and Reliable Sealing, They Increase Safety Through Dielectric Insulation

Power Conversion

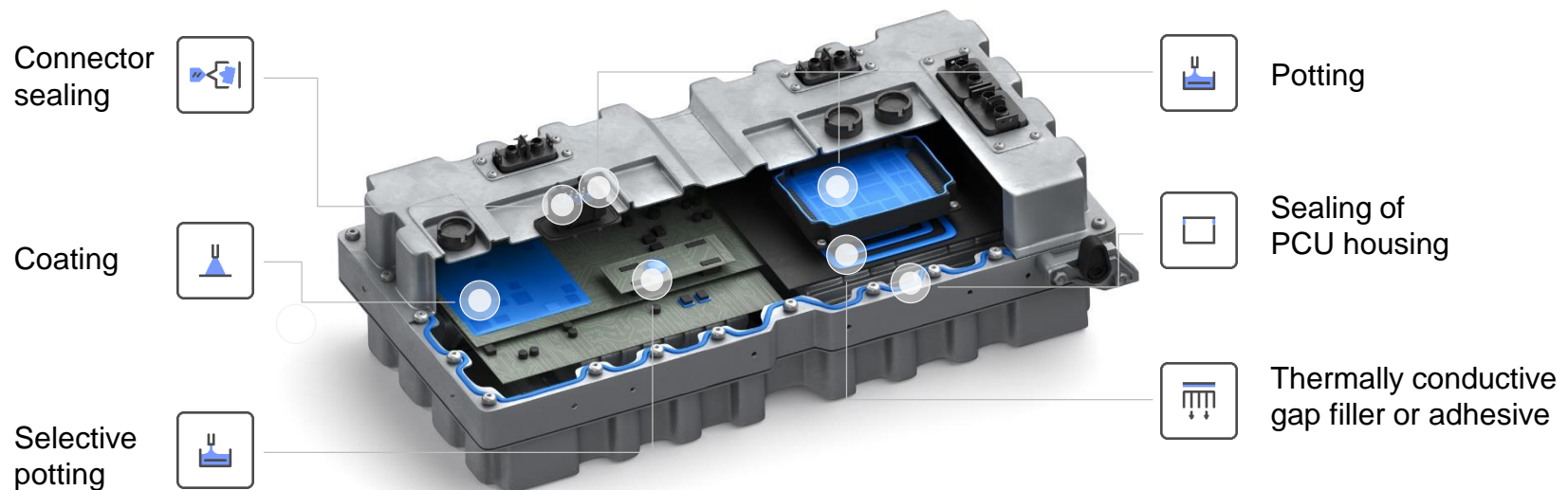
The Challenge

- ▶ Functional safety & long lifetime under harsh conditions: dielectric insulation, damping, thermal management needed

Our solution

- ▶ Sealing, bonding and potting with silicone adhesives and gels
- ▶ Thermal management with silicone gap fillers, pastes, adhesives and encapsulants

High voltage power control unit

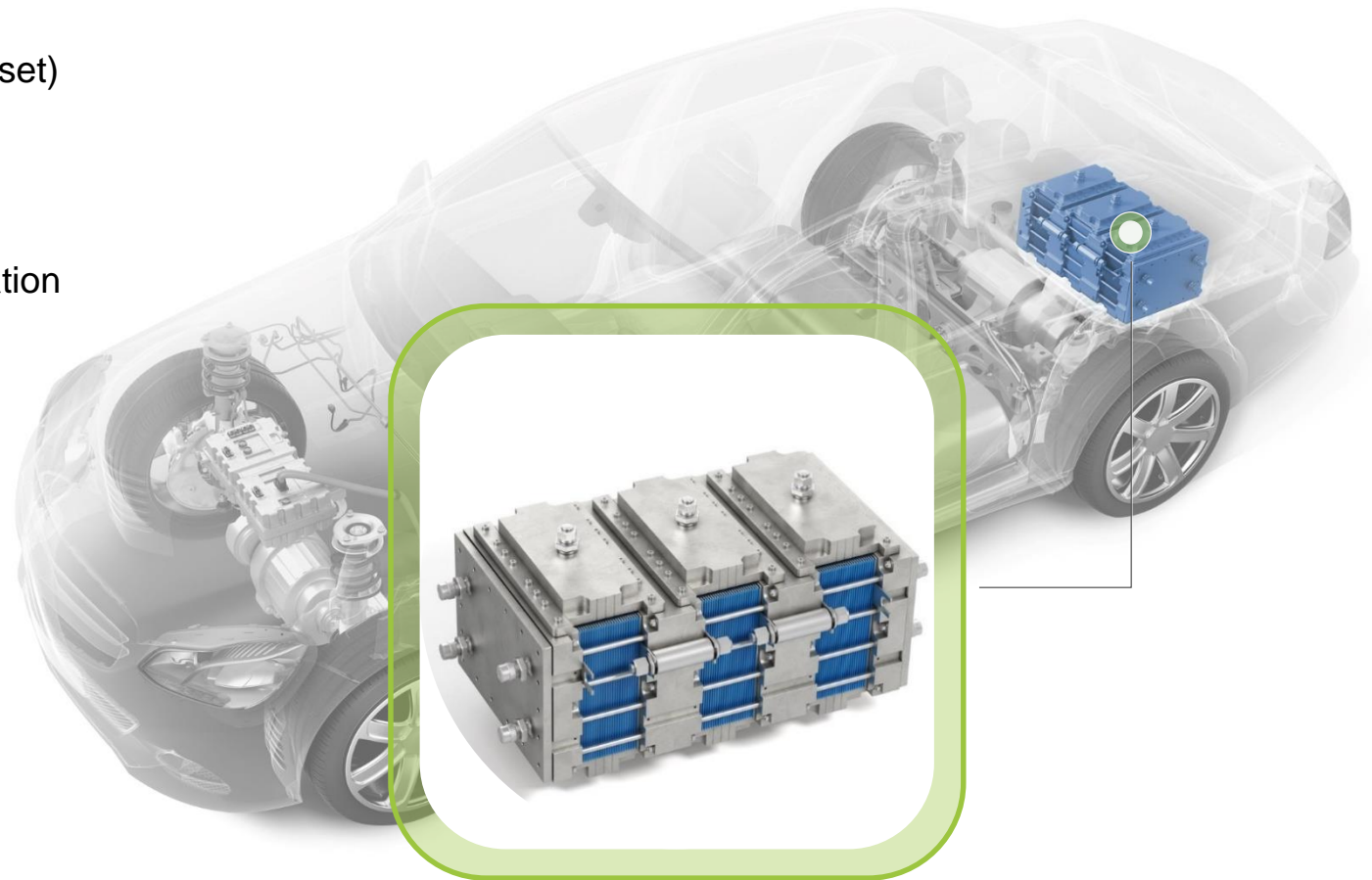


Silicones Ensure the Sustained Power of E-Mobility

Fuel Cell

The Challenge

- ▶ Tight sealing over the full lifetime
(need for excellent compression set)
- ▶ Protection against moisture, oxidation, chemicals, vibration
- ▶ Excellent temperature + degradation resistance to extend life and performance



Silicones Seal Tightly and Long-Term in the Harsh Environment of a Fuel Cell (Temperature, Acids, Hydrogen, Oxygen)

Fuel Cell

The Challenge

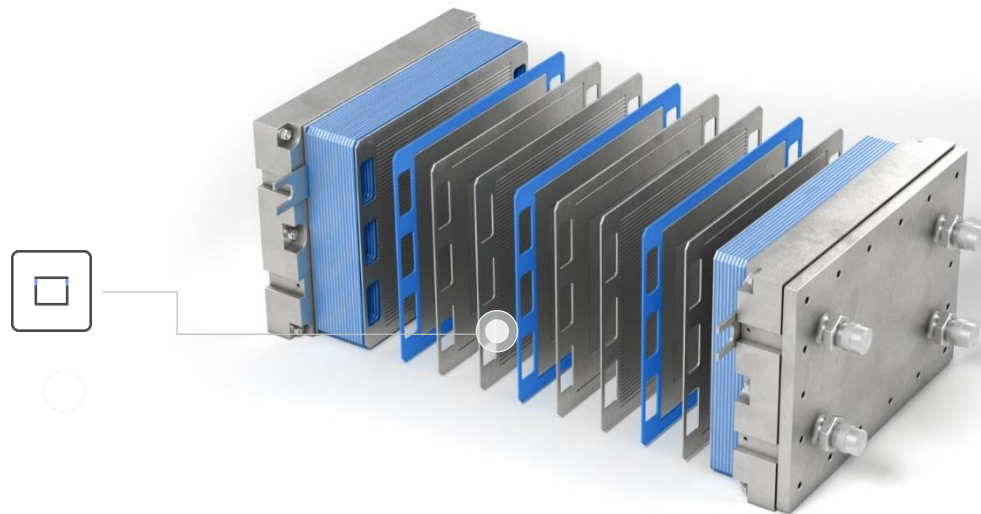
- ▶ Tight sealing / Protection in a harsh environment
- ▶ Temperature & degradation resistance

Our solution

- ▶ Silicone elastomers with excellent compression set, degradation resistance and low level of volatile siloxanes
- ▶ Products for different processes available

Individual cells:

Sealing bipolar plates (BPP) / membrane electrode assembly (MEA):
Dispensing / Screen printing / Injection molding

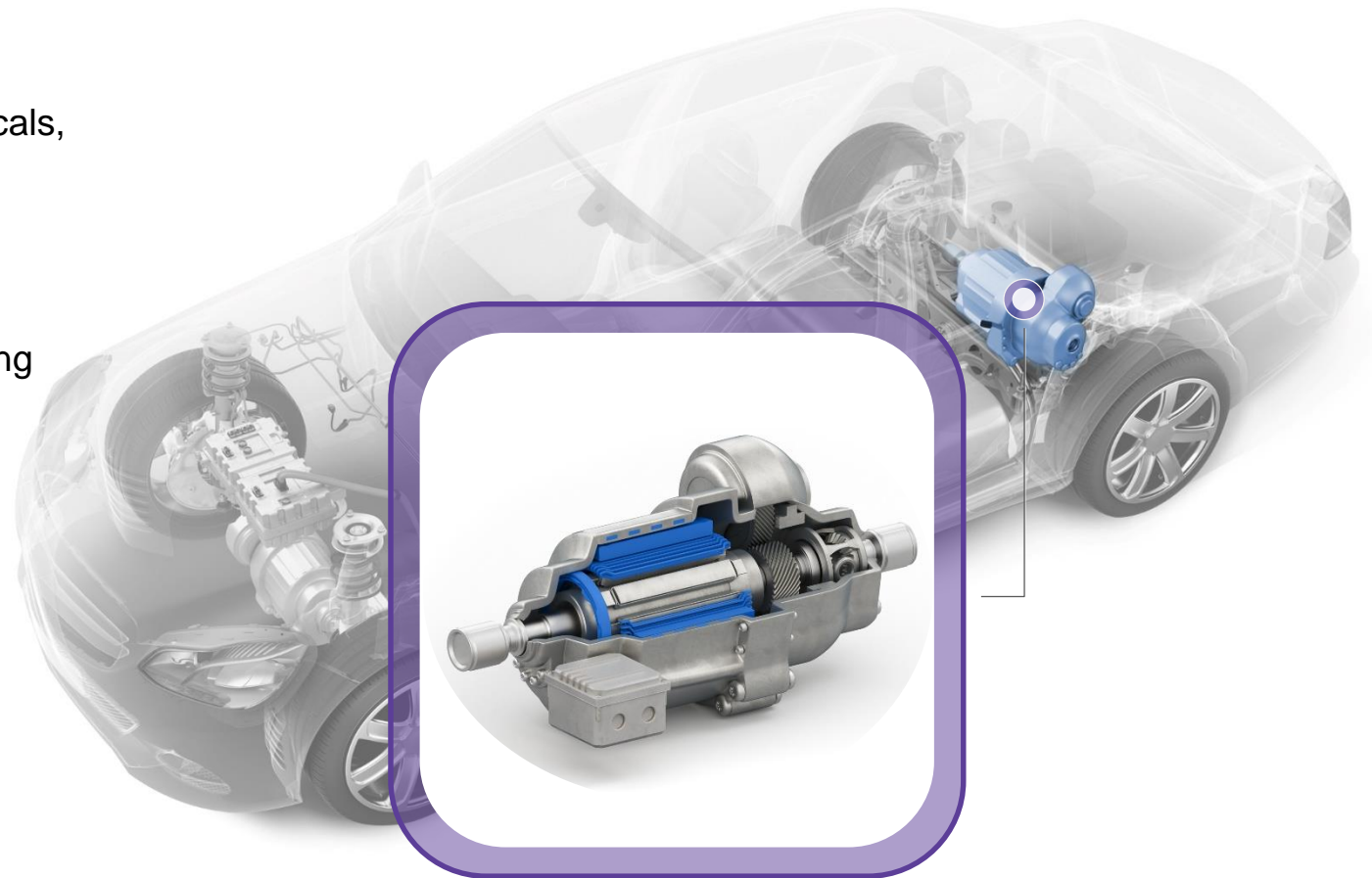


Silicones Ensure the Sustained Power of E-Mobility

e-Motor

The Challenge

- ▶ Functional safety of engine components has to be ensured (heat, vibration, moisture, chemicals, oxidation, electric surges)
- ▶ Temperatures are rising (limited space at axle / cardan shaft vs. increasing efficiency), disqualifying many organic materials



Silicones Increase Durability Through Reliable Sealing and Help Managing Heat

e-Motor

The Challenge

- ▶ Functional safety under harsh conditions
- ▶ Need for thermal management

Our solution

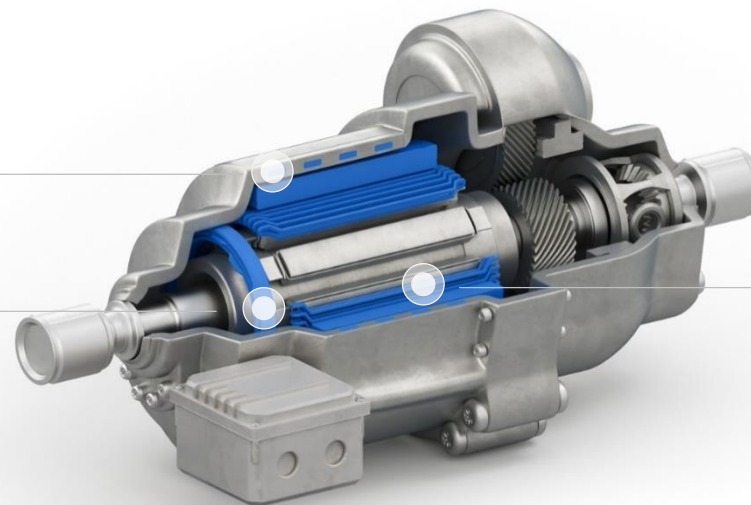
- ▶ Impregnation, sealing, bonding and potting with silicone resins, adhesives and gels
- ▶ Active cooling with silicone oils

Direct drive

Active cooling with silicone oil



Potting coil connector ring / connection box



Coil impregnation with silicone resins / Coil potting



Silicones Ensure Excellent Readability and Functional Safety of Displays

Display

The Challenge

- ▶ Displays have to meet automotive requirements re. lifetime, passenger safety and failure acceptance levels
 - ▶ display readability and damping
 - ▶ protection of electronics
 - ▶ materials have to be fit for mass production processes



Silicones Ensure Functional Safety and Allow for Fully Automated Mass Production

Display

The Challenge

- ▶ Excellent readability (high contrast / minimum reflection)
- ▶ Functional safety under harsh conditions (vibration, shock)

Our solution

- ▶ High transparent, thermal or UV cure silicones for optical bonding, different processes
- ▶ Silicone adhesives for bonding & sealing
- ▶ Silicone gels for potting & encapsulation



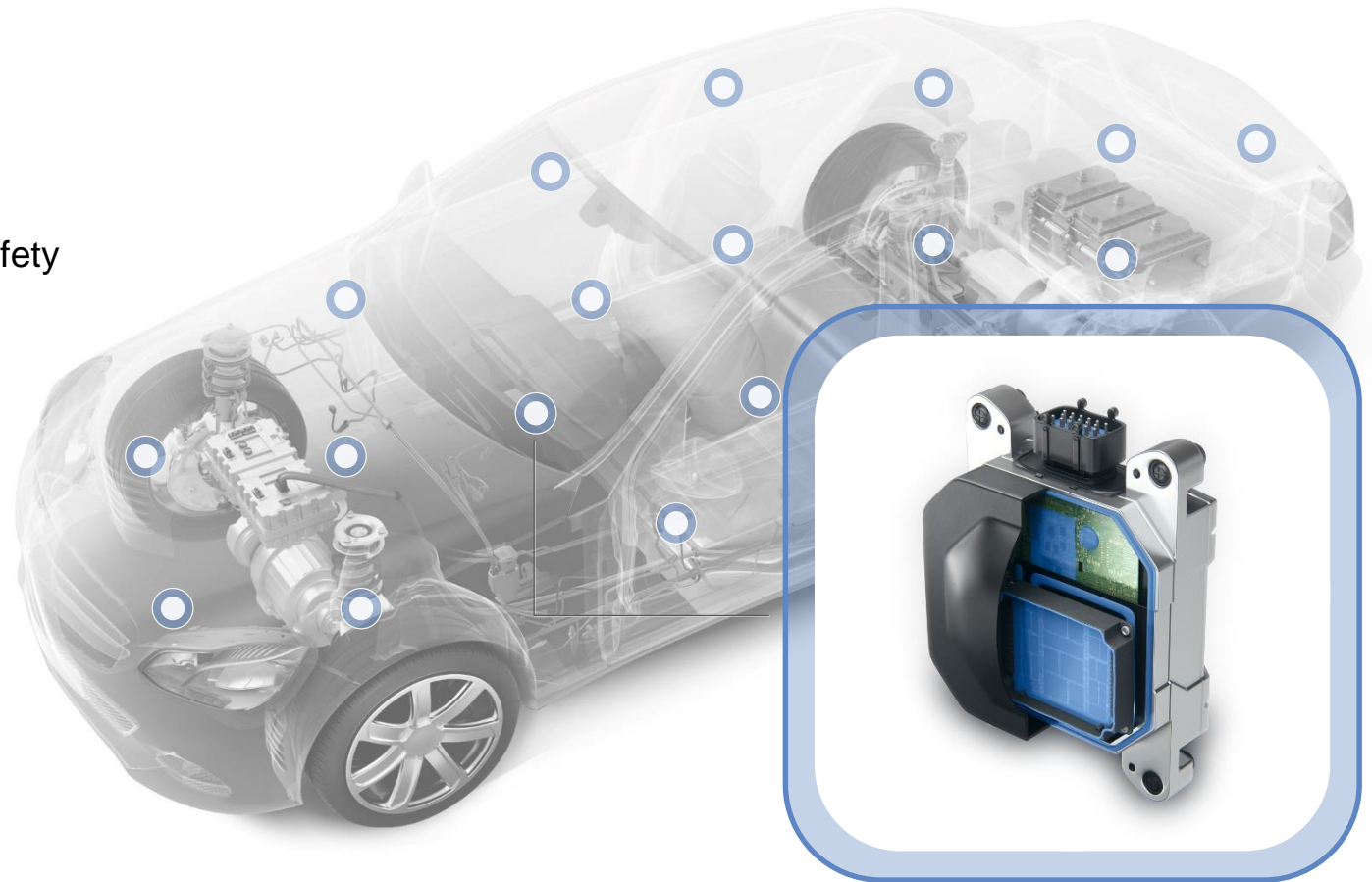
*Central Information Display

Silicones Ensure Safe and Reliable Performance of Sensors and Electronic Control Units

Sensor ECU

The Challenge

- ▶ Sensors and ECUs are key for safety, comfort and efficiency of today's and tomorrow's cars
- ▶ Sensitive electronics need to be protected to ensure functional safety and long lifetime



Silicones Ensure Functional Safety and Allow for Fully Automated Mass Production

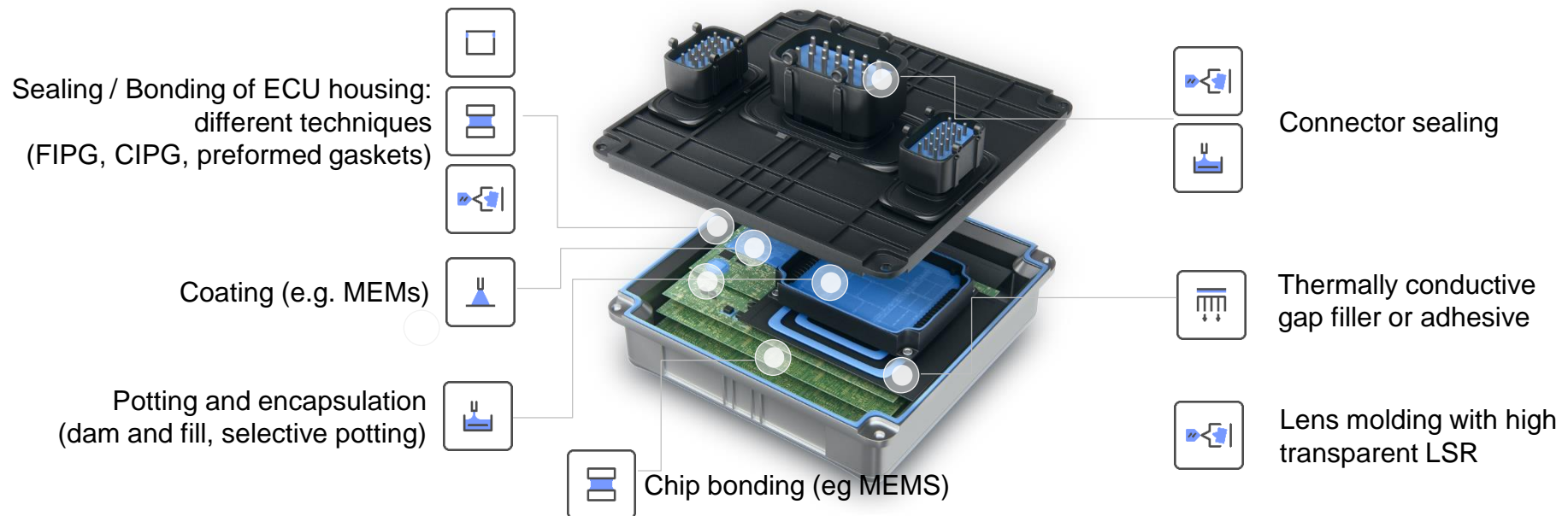
Sensor ECU

The Challenge

- ▶ Protect sensitive electronics
- ▶ Functional safety under harsh conditions (vibration, moisture)

Our solution

- ▶ Silicone gels for potting and encapsulation
- ▶ Silicone adhesives and oil-bleeding LSR / HCR for different sealing techniques
- ▶ High transparent LSR for lens molding



Silicones Ensure the Safe and Reliable Distribution of Power

Cables Connectors

The Challenge

- ▶ Good heat resistance
- ▶ Low temperature flexibility
- ▶ Excellent electrical insulation



Silicones Ensure Functional Safety and Allow for Fully Automated Mass Production

Cables Connectors

The Challenge

- ▶ Good heat resistance / low temperature flexibility
- ▶ Excellent electrical insulation
- ▶ Tight sealing (connectors)

Our solution

- ▶ HCR for cable extrusion (perox. / add.-cure)
- ▶ LSR / HCR with excellent compression set (standard / oil-bleeding / self-adhesive)
- ▶ Silicone gels (UV or heat curing)

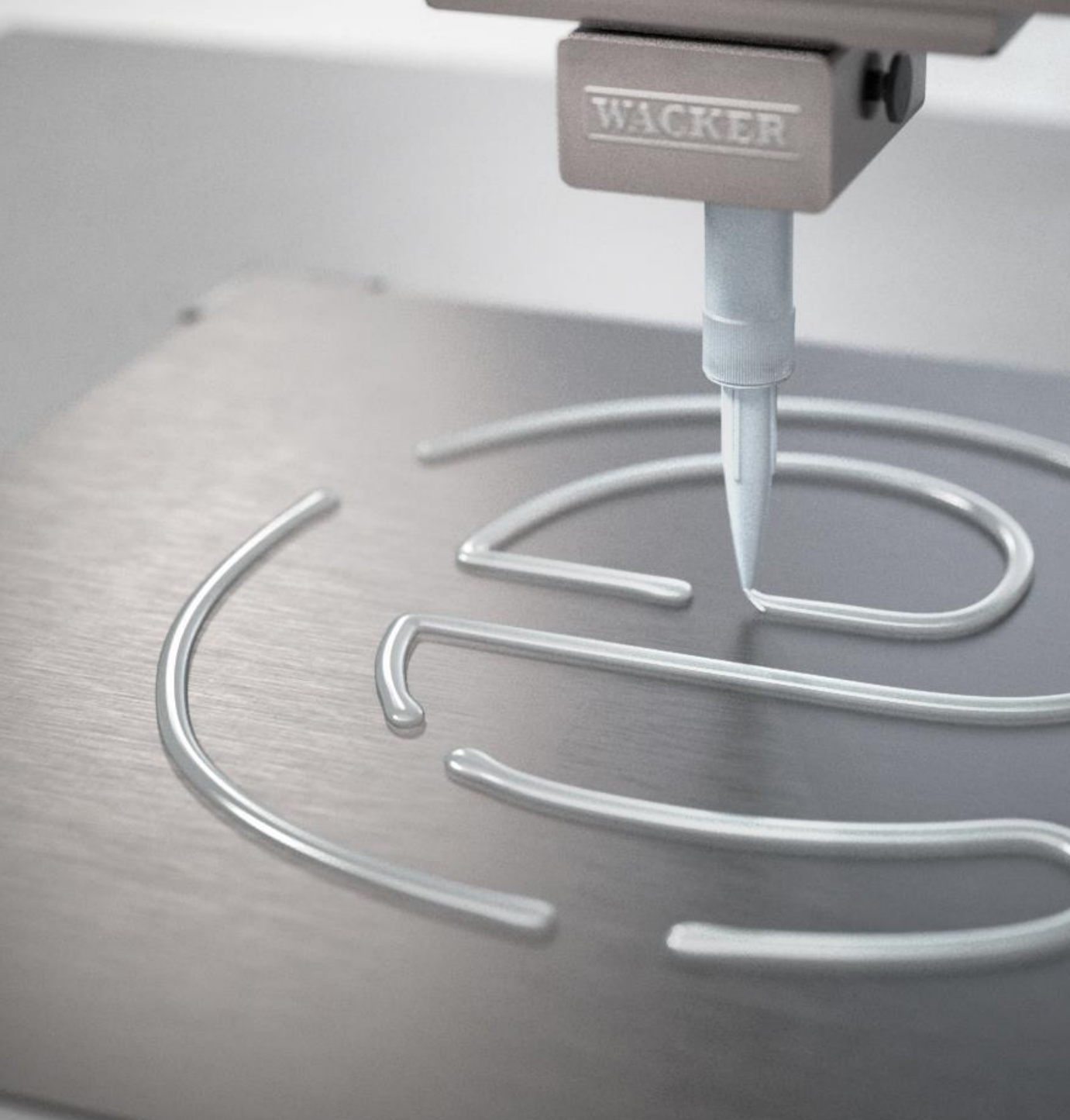


Extrusion of high voltage cables



Connector sealing /
Weather packs
(injection molding,
2k molding, potting)





Professional and Concentrated !

To have the necessary silicones available in time for when large-scale production of electric vehicles begins, Wacker established a global new solution project.

To serve China customers better, a competency center for E-Mobility is established in Shanghai.



+86 21 6130-2000



info.china@wacker.com
