



Industrial Tools

ASSEMBLY SOLUTIONS FOR ELECTRIC VEHICLES

 BOOST YOUR
FLEXIBILITY

 BOOST YOUR
UPTIME

 BOOST YOUR
PRODUCTIVITY

More Than Productivity

OVERVIEW

KEY COMPONENTS OF AN ELECTRIC

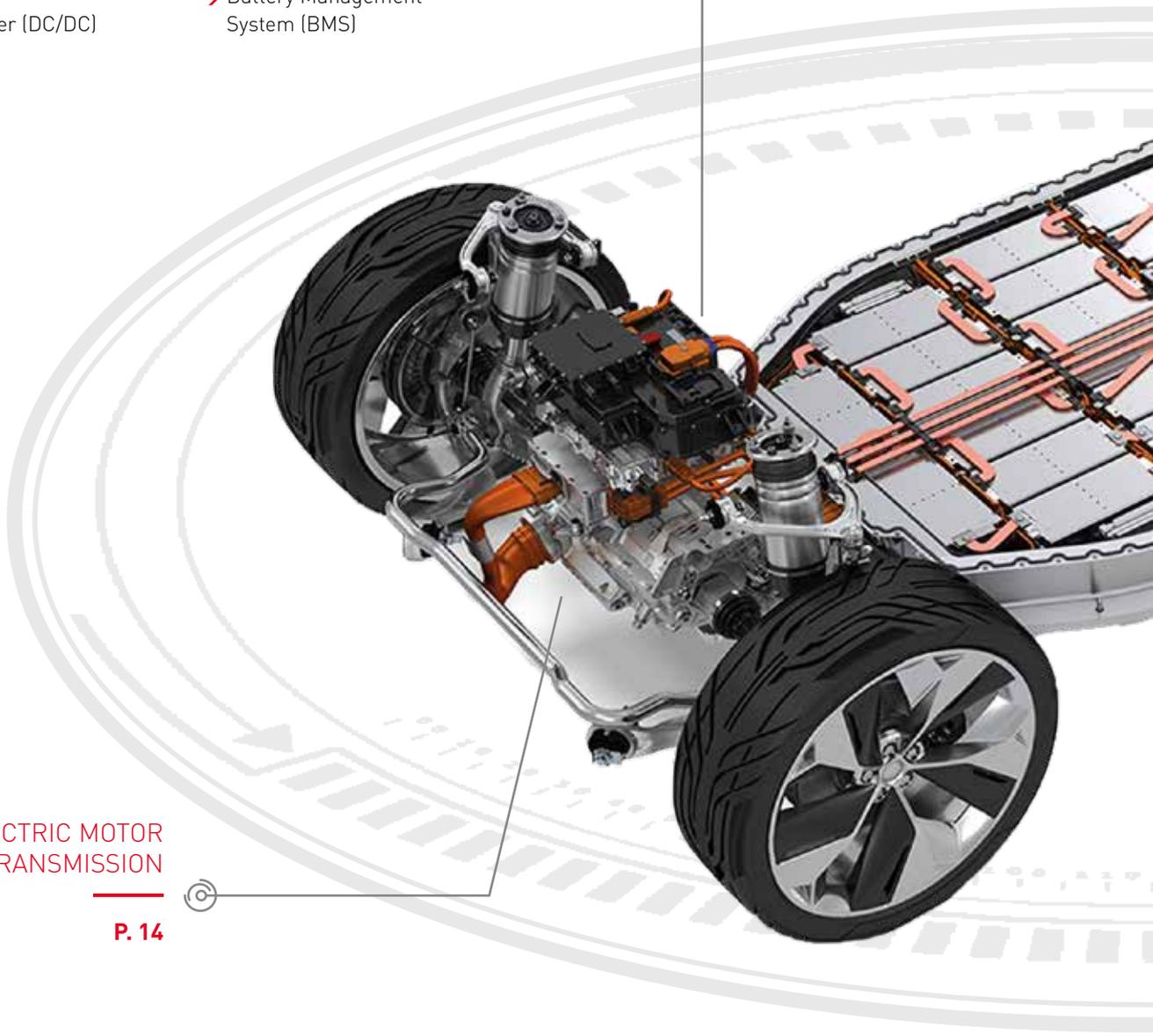
POWER ELECTRONICS

P. 16

- High Voltage Power Distributor
- Inverter (DC/AC)
- Converter (DC/DC)
- On Board Charger (OBC)
- Power Electronics Module
- Battery Management System (BMS)

ELECTRIC MOTOR AND TRANSMISSION

P. 14

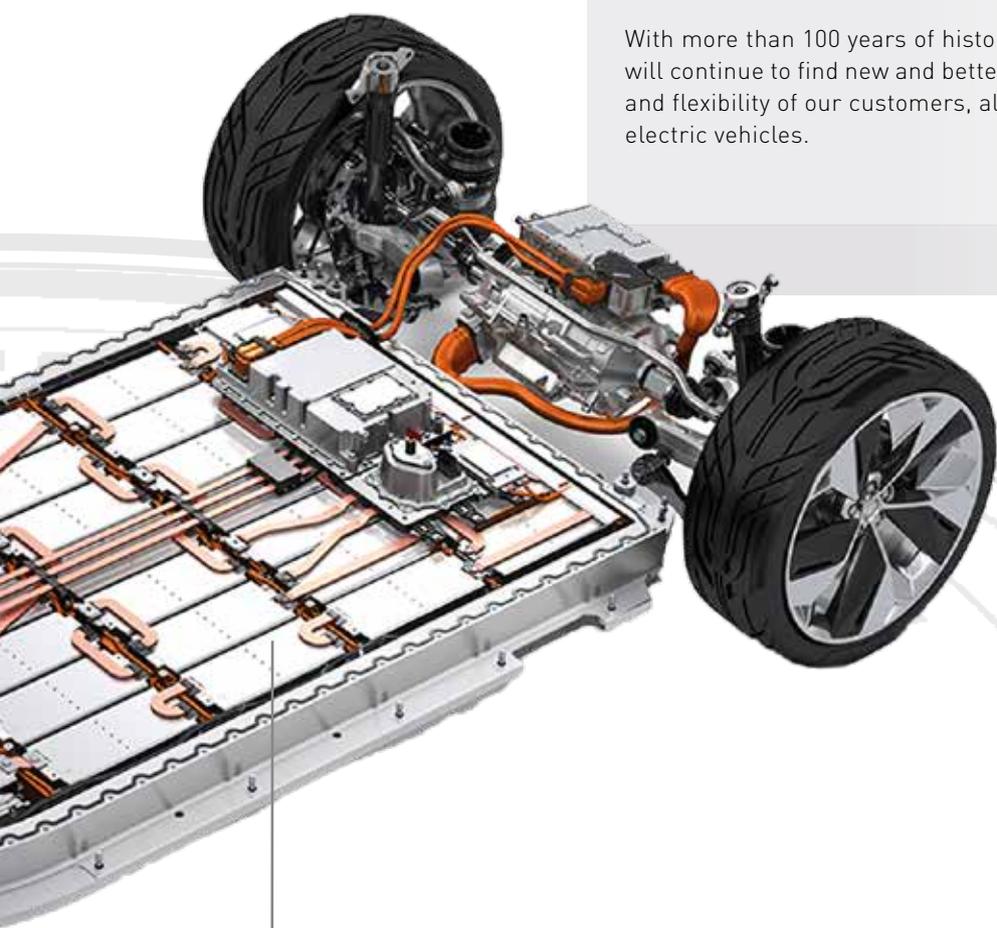


C VEHICLE

The electrification of internal combustion engines (ICE) vehicles, to be fully or partially replaced by an electric powertrain, leads to new assembly challenges. These include among others new tightening applications in different environments, higher levels of automation and requirements on traceability, but most importantly higher safety standards for operators during the assembly of components with high-voltage contact.

Desoutter, a trusted partner and expert for tightening solutions, has supported from the early beginning not only existing automakers and suppliers but also new companies entering into this new field with the right solution.

With more than 100 years of history and innovation as our heritage, Desoutter will continue to find new and better solutions to boost the productivity, up-time and flexibility of our customers, also for the assembly challenges arising from electric vehicles.



BATTERY PACK

P. 04

BATTERY PACK

BUSBAR 2

In the battery pack, where space is limited, copper busbars are frequently used to efficiently distribute power to the vehicles' various subsystems. Tightening busbars must guarantee safety and reliability.

SEE SOLUTIONS ON PAGE 8



HIGH VOLTAGE HARNESS 3

The harness supplies power and electric control signals throughout the electric vehicle through connectors, cables and other distributors. An advanced tightening process is required to ensure safety and reliability.

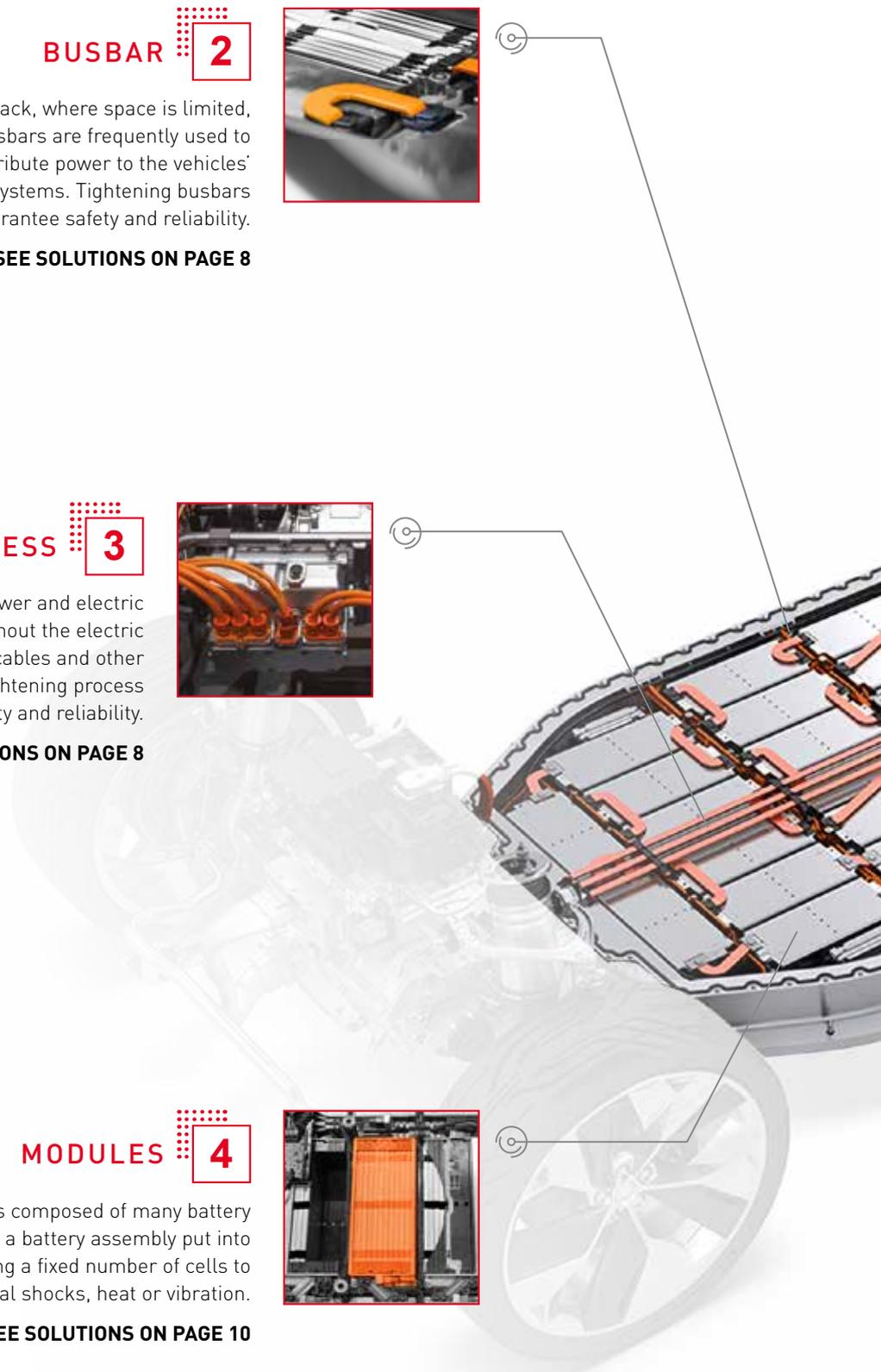
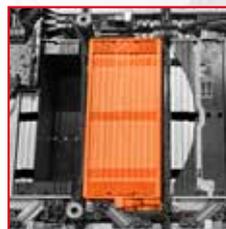
SEE SOLUTIONS ON PAGE 8

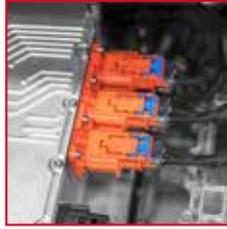
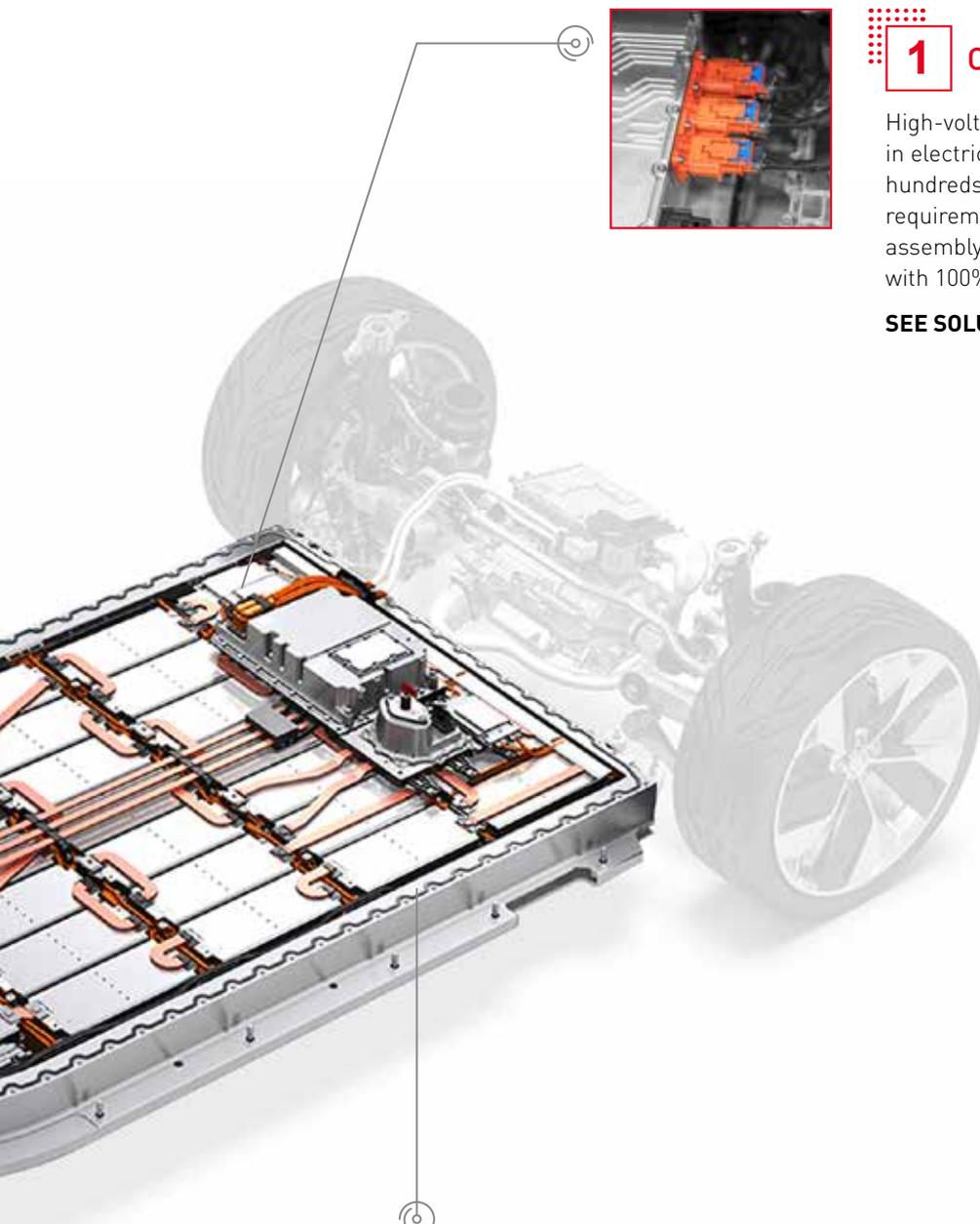


MODULES 4

The battery pack is composed of many battery modules. A module is a battery assembly put into a frame by combining a fixed number of cells to protect cells from external shocks, heat or vibration.

SEE SOLUTIONS ON PAGE 10





1 CONNECTORS

High-voltage connectors for power transmission in electric vehicles work under current loads up to hundreds of amperes with high quality and safety requirements. The same standards applies to the assembly and require advanced tightening solution with 100% traceability.

SEE SOLUTIONS ON PAGE 6



5 UPPER COVER

The aluminum case of the battery pack is usually assembled by dozens of bolts between the upper cover and the lower case. These screws need to be tightened by sequence.

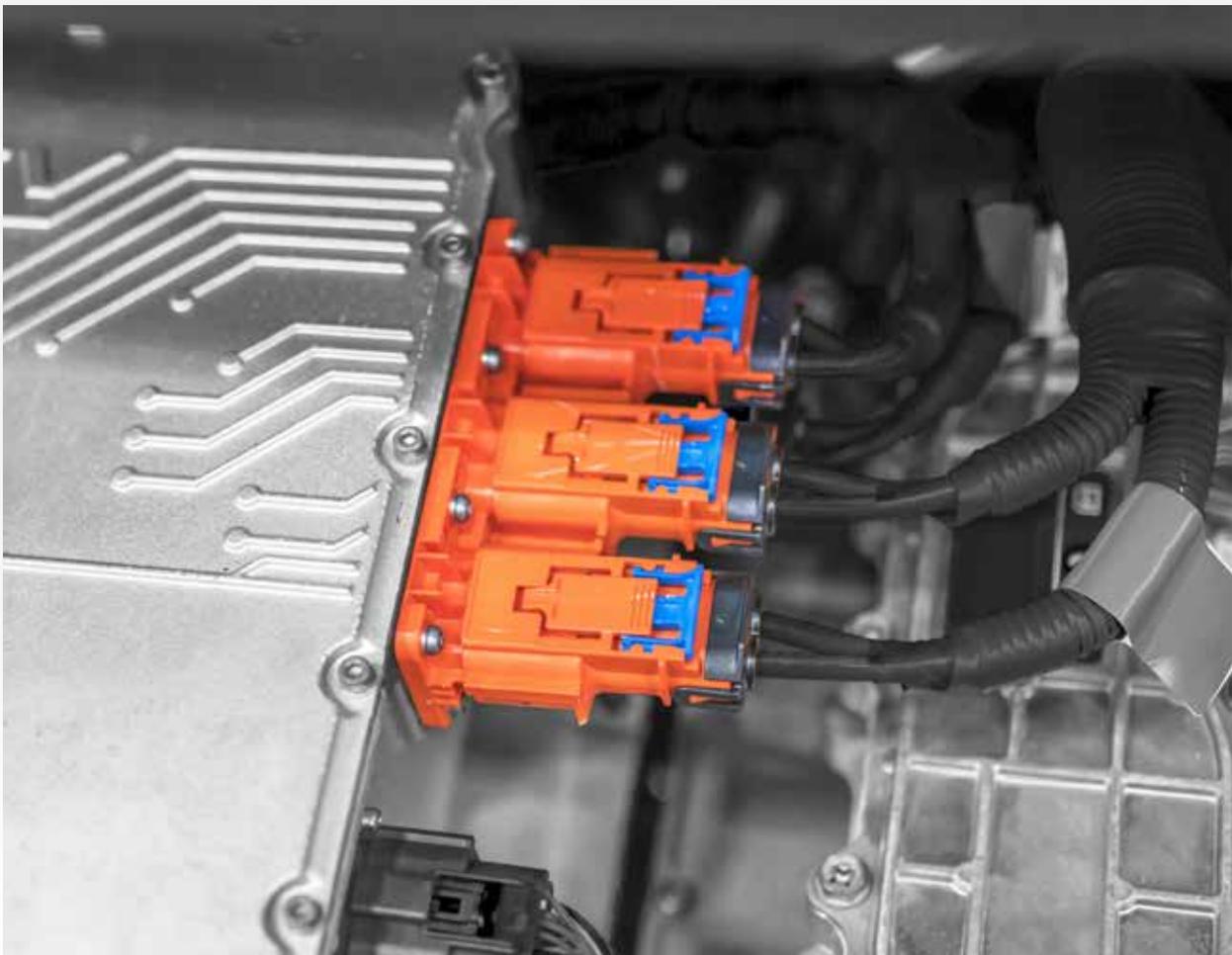
SEE SOLUTIONS ON PAGE 12

1 CONNECTORS



Connectors on electric vehicles

- Electric vehicles have large amount of electrical components compared to ICE vehicles, such as chargers, DC/AC inverter, DC/DC converter, battery pack etc.
- Numerous connectors are required to connect these electrical components.



ASSEMBLY CHALLENGE

- Operators need flexibility to hold connectors while tightening.
- A large area to cover due to size of the battery pack or distance between different components.
- Plastic material can be easily damaged during tightening process (particularly during high speed assembly).
- Safety-critical applications (class A joints).

ASSEMBLY SOLUTIONS FOR ELECTRIC VEHICLES

WIRELESS TRANSDUCERISED BATTERY TOOL



DESOUTTER SOLUTION

- Battery pistol/one hand tool (i.e. EPBC/EABS range)
- Tool can be operated by only one hand while the other is free to hold the connector
- Increases operator's flexibility as no cable restricts movement area
- Multi-step tightening program to avoid damage of plastic component while keeping high tact time
- Advanced tightening strategies to ensure zero-fault and full traceability

CONNECT INDUSTRIAL SMART HUB

MULTI-TOOL SOLUTION

Up to 20 tools connected to only one CONNECT.



TO KNOW MORE ON CONNECT <https://youtu.be/J8dW1jMSHL8>



DEMETER – WHEN DATA BECOMES SMART

DASHBOARD

Live dashboard composer



Dashboard KPIs

NOTIFICATIONS

Live alerts on smartphone application



Dashboard Results & Curves

BOOSTLAB

Prescription and insights from data analytics



Dashboard Events

2 & 3 BUSBAR AND HIGH VOLTAGE HARNESS



High voltage harnesses and busbars

- High voltage harnesses connect the battery pack, DC/AC inverter and motor in electric vehicle, but also battery components within the pack such as different modules. To save space in the narrow battery pack, copper busbars are frequently used for electric vehicles.
- These high voltage harnesses and busbars are charged with high current and voltage loads (rf. 800V). Manufacturing operations under high voltage conditions require special safety measures for operators as risks are high on these applications.



ASSEMBLY CHALLENGE

- Electric vehicles have significantly higher voltages (up to 800V DC) and accidental contact with an energised source from these vehicles can be fatal.
- Operators who will be coming into contact with live circuits when working on EV's can be at risk of electric shock, which can result in serious injury or death.
- Identify the positioning of the busbars and ensure the order of the tightening sequence
- Safety-critical applications (class A joints).

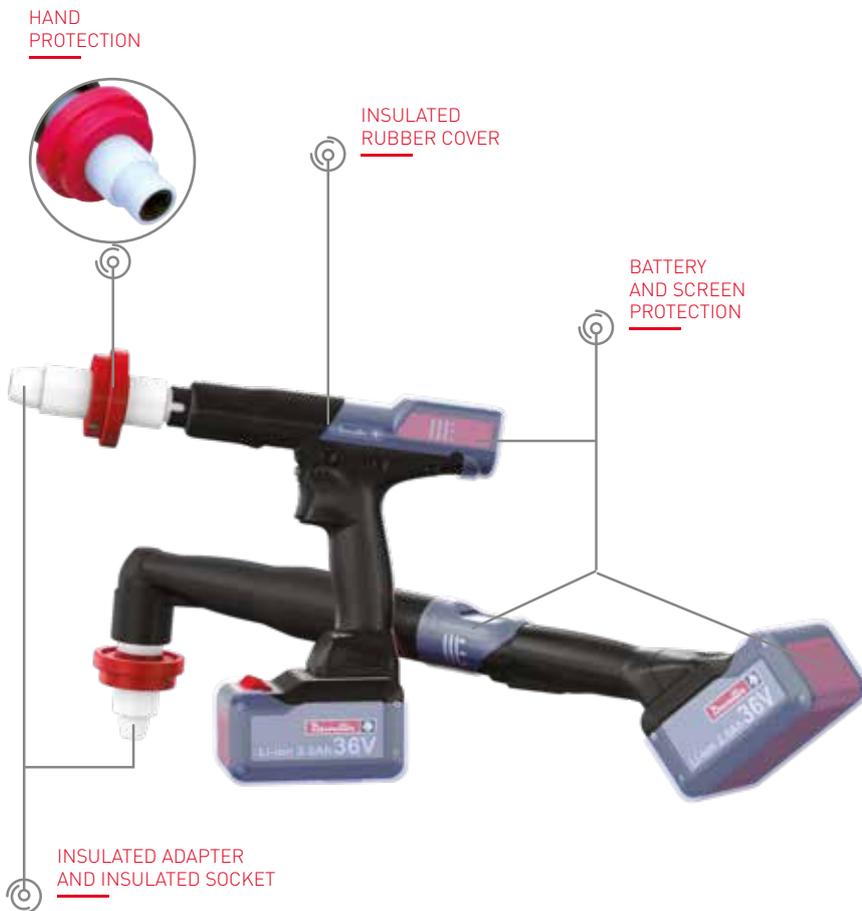


INSULATED SOLUTIONS

International Electrotechnical Commission (IEC) norm



- IEC 60900:2018
 - IEC 60664-1:2020
- Prevents electrical breakdown for currents less than 1000 V/AC and 1500 V/DC



DESOUTTER SOLUTION

- During the assembly of components exposed to high voltage such as busbars and harnesses, using insulated tools is one of the many important steps to protect from electrical shocks and damages:
 - the operators
 - the tools
 - the battery pack
 - the assembly line
 - Insulated tools and isolated sockets are designed to protect the operator in the event that they touch an energised source, such as the high voltage components (i.e. battery modules) and cabling of an electric vehicle.
 - The design is following strictly the requirements of the latest International Electro technical Commission (IEC) norms **IEC60900:2018 & IEC60664-1:2020** that entails to ensure operators are protected against electrical breakdown for currents less than 1000V/AC and 1500V/DC.
- Our solution is tested and approved by DEKRA:**



- Advanced tightening strategies to ensure zero-fault and full traceability.

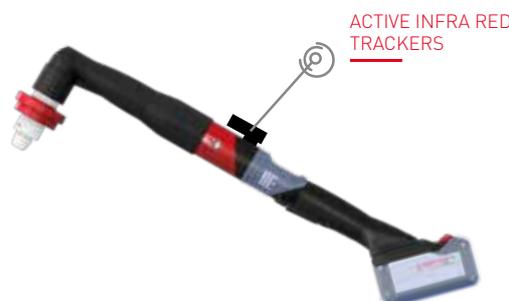


TO KNOW MORE ON INSULATED TOOLS

<https://youtu.be/qwefRj965BM>

INSULATED TOOLS WITH MOTION CAPTURE SOLUTION

- Real time process monitoring and guidance with conventional or advanced positioning guide solutions to ensure sequenced tightenings for total quality control.



INFRA RED SENSOR PRECISION



4 MODULES



Module assembly

- A module is a battery assembly put into a frame by combing a fixed number of cells to protect cells from external shocks, heat or vibration.
- The assembly of the battery modules requires moderate tightness, and each structural component requires sufficient strength to prevent deformation or damage from external force of the battery.



ASSEMBLY CHALLENGE

- High cycle time is requested for Module assembly
- Ensure that the modules are mounted with an adequate clamping force.
- Critical process step that require full traceability and quality control to avoid re-work.



Modules in battery pack

- Battery packs consist of several hundred cells. Each cell is delivered with at least a minimum state of charge. When connecting, the voltage can become a hazard for the worker.
- Simply put, cells, modules and packs are units of gathered batteries. A cluster of cells make up a module and a cluster of modules make up a pack.

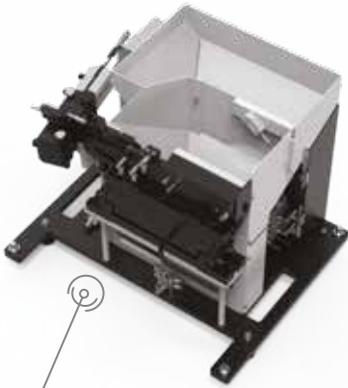


ASSEMBLY CHALLENGE

- Frequently, long screws are applied to tightening the modules and fix the modules on the battery pack tray.
- The assembly of modules into a battery pack are frequently highly automated (short takt time with large quantity of modules, high weight of modules, no risk electric shocks to operator) and require automatic tightening and screw-feeding solutions with long screws and high torque.
- Integration of modules are critical and require full traceability and quality control to avoid rework.

CUSTOMISED SOLUTIONS

Step feeder system



Bowl feeder system



DESOUTTER SOLUTION

Desoutter offers a wide range of products that are designed for high level of automation environments:

- Advanced multi-spindle solutions for the shortest takt time
- Highly integrated tightening and screw-feeding system
- Customised screw step feeder system for long module screws

For traceability:

Our advanced controller solutions guarantee 100% traceability and can be easily connected to higher level systems.

Multi spindle system



For further information, please contact your Desoutter representative for assistance

5 UPPER COVER



Upper cover in battery pack

- One of the final manufacturing steps for the battery pack assembly is the fastening of the upper cover on the tray, to close and seal the entire battery pack.
- Typically, tightening applications are used to control the clamping force and to improve serviceability of the battery pack.
- In order to protect the inner part of the battery from moisture and to also avoid exposure of hazardous gases or liquids from the inner part, a sealant is applied between cover and tray.



ASSEMBLY CHALLENGE

- Due to the large size of the battery pack a large quantity of screws need to be fastened within a short time.
- The screws need to be tightened in a sequential order to ensure a uniform clamping force on the battery pack.
- Different tightening behaviors between the upper cover and tray can affect residual torque because of the sealant material (i.e. rubber material).

CUSTOMISED SOLUTIONS

Screw feeding system



DESOUTTER SOLUTION

- Conventional or advanced positioning guide solutions to ensure sequenced tightenings for total quality control.
- Automatic screw feeding systems to boost productivity.
- Advanced tightening strategies and multi-step tightening program to ensure uniform clamping force and distribution of sealant.

Customised positioning system



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ELECTRIC MOTOR AND TRANSMISSION



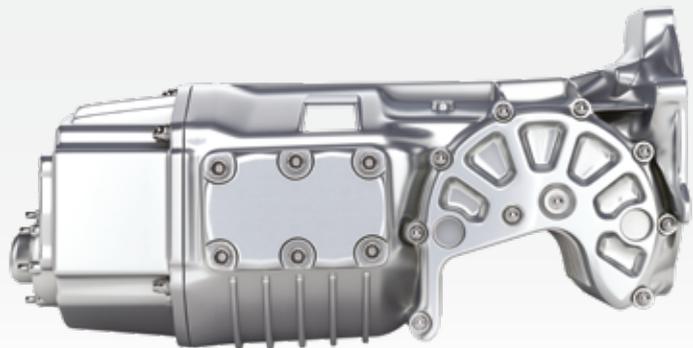
Electric motor

- The electric motor drives the vehicle's wheels by using power from the battery pack. Some vehicles use motor generators that perform both the drive and regeneration function.
- Usually, direct current (DC) electricity is fed into a DC/AC inverter where it is converted to alternating current (AC) electricity and this AC electricity is connected to a 3-phase AC motor.



Transmission

- The power produced by the electric motor (or ICE) is transferred to the drive wheel via a transmission system.
- Often referred as a gearbox in internal combustion vehicles. Most electric cars use a single speed transmission, because the motor is efficient in a wide range of operating conditions.



ASSEMBLY CHALLENGE

- High production rate.
- Uniform clamping force for best possible sealing of the motor and transmission system.
- Safety critical joints (class A-B).

END PLATE ASSEMBLY

Screw feeding system



DESOUTTER SOLUTION

- Conventional or advanced positioning guide solutions to ensure sequenced tightening for total quality control.
- Advanced tightening strategies and multi-step tightening program to ensure uniform clamping force and distribution of sealant.
- Automatic tightening and screw feeding systems to boost productivity.
- Desoutter customisable multi spindles solutions (easy robotic integration) for short takt time applications.

E-MACHINE ASSEMBLY

Motion capture



Telescopic reaction arms with positioning

POWER TERMINAL ASSEMBLY

Angle head nutrunner

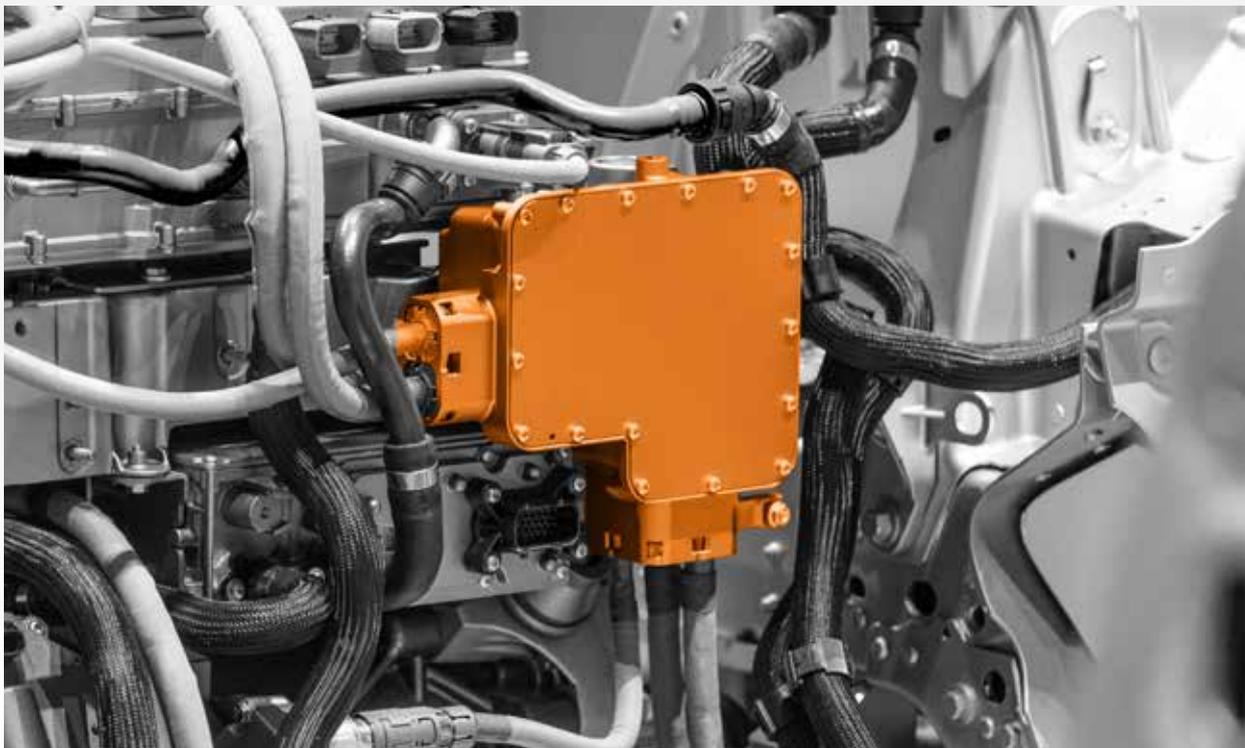


POWER ELECTRONICS



Power electronics in electric vehicle

- Inverter (DC/AC): Converts direct current (DC) power to alternating current (AC) power. The inverter can change the speed at which the motor rotates by adjusting the frequency of the alternating current.
- Converter (DC/DC): This device converts higher-voltage DC power from the battery pack to the lower voltage DC power needed to run vehicle accessories and recharge the auxiliary battery.
- On board charger (OBC): The OBC takes the incoming AC power supplied via the charge port and converts it to DC power for charging the traction battery.
- Battery Management System (BMS): The BMS is controlling multiple functions vital to the correct and safe operation of the electrical storage system (e.g. temperature management, battery performance optimisation).



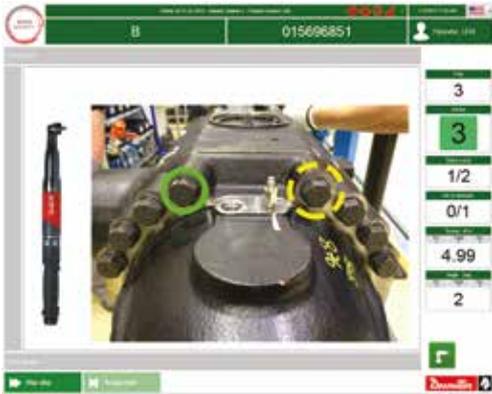
ASSEMBLY CHALLENGE

- Numerous components and complex assembly process for operator.
- Printed circuit board (PCB) and cover screws need to be tighten in right sequence.
- Accessibility issue due to the design of components with narrow inner parts.
- Safety-critical applications (class A joints).
- High production rate.

ASSEMBLY SOLUTIONS FOR ELECTRIC VEHICLES

ASSEMBLY PROCESS

Pivotware - Process control



DESOUTTER SOLUTION

- Advanced (digital) process control solutions with structured sequence of work instructions and visual guidance delivered to operator. The benefits are zero-fault assembly and complete traceability of all process steps and fastening results available.
- Conventional or advanced positioning guide solutions to ensure sequenced tightening for total quality control.
- For applications that are difficult to access, Desoutter offers different solutions depending on the customer's needs: crowfoot, delta wrench or angle head tools.
- Automatic tightening and screw feeding systems to boost productivity.
- Advanced tightening strategies to ensure zero-fault and full traceability.

CONNECTORS ASSEMBLE

Pistol wireless tool



PCB / COVER ASSEMBLY

Motion capture



Positioning arms

BUSBAR / FUSE / OTHERS COMPONENTS ASSEMBLY

Narrow space solution



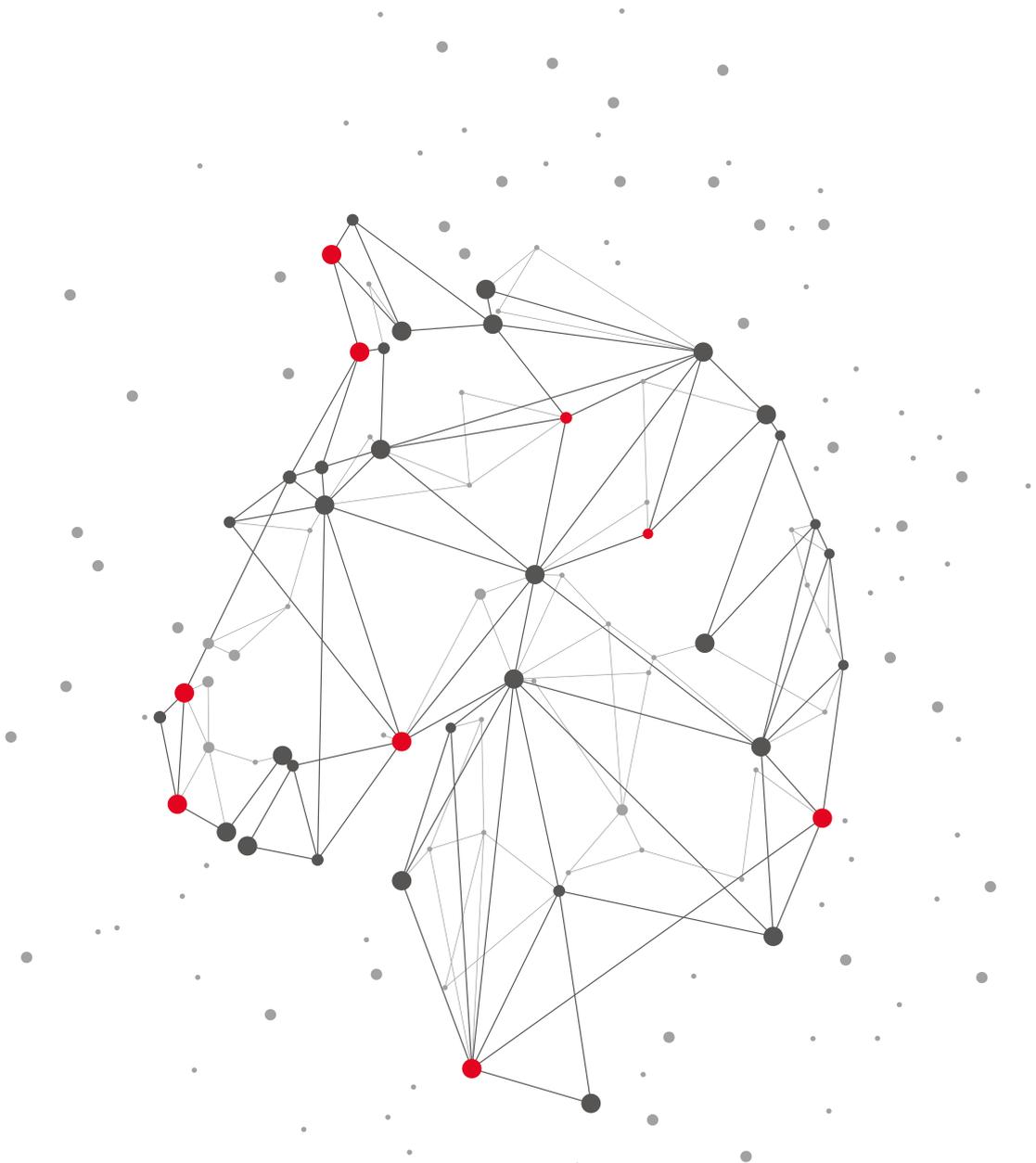
In line Open



Offset Open

Insulated solution





DESOUTTER 4.0

More Than Productivity