



MOVING INTO THE FUTURE ELECTRICALLY.

Electromobility offers enormous growth opportunities, not only in the field of end products. Manufacturing and assembly involving live parts present new challenges – and great potential

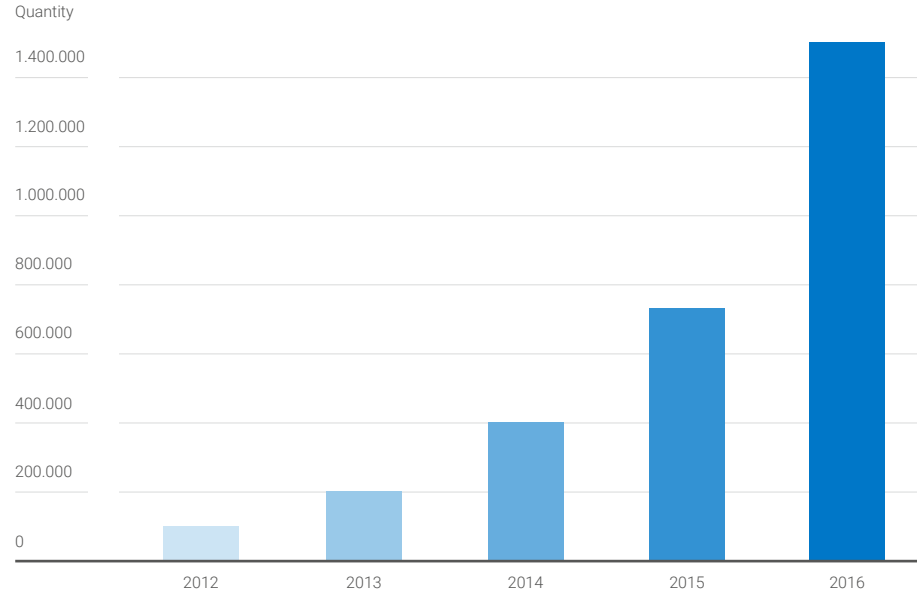
The streets of New York. Taxis glide past silently, not a trace of smog or noise. The reason: the taxis run on electricity. That is not a vision of the future, but a description of reality around 1900. Now, in the 21st century, electromobility is making a huge technological comeback. And as in any other fast growing industry, technical developments and the general legal framework are drifting apart. Legal loopholes currently exist in particular in the field of health and safety. Health and safety is crucial in high-voltage manufacturing, though – and technical solutions are available. In contrast to the automotive manufacturers, German companies are at the forefront of the global market in this regard.

Technology in the fast lane

The desire for reduced CO2 emissions, climate-friendly mobility and less noise, especially in urban spaces, is the reason why we are turning our attention back to electric mobility solutions. This led to the number of electric cars registered worldwide nearly doubling between 2015 and 2016. In Norway, for example, the share of electric and hybrid cars rose to 53 per cent in the summer of 2017. Even in Germany, a country that is highly attached to its internal combustion engines, the current "diesel crisis" will generate additional interest.

And the phenomenon is not restricted to passenger cars alone. Electric bicycles and motorcycles will also become a more common occurrence on streets around the world over the next decade. Electromobility will also have an impact on on-board power generation, electrics and electronics as well as energy and infrastructure.

Development of registered electric cars worldwide



Source: <https://de.statista.com/statistik/daten/studie/168350/umfrage/bestandsentwicklung-von-elektrofahrzeugen/>
Stand: 08.12.2016

Spark of success

There are various reasons for the growth of electromobility: It is a political objective and receives state support, such as through incentive programs. In China, for example, anyone buying an electric car receives a subsidy of up to 16,000 dollars. Nevertheless, the new technology also offers solid advantages in terms of manufacturing. A car with an internal combustion engine has 90 times the number of moving parts of an electric car. An internal combustion powertrain consists of 1400 parts, whereas an electric drive has only 210.

This offers a significant simplification of production and manufacturing processes. Planners and owners of production lines, however, face a substantial problem: manufacturing in the high voltage area of the lithium ion batteries.

0 to 60 V DC

No additional safety measures required for the production line

60 to 1.500 V DC

New solutions required for assembly

¹Source: it-times.de

²Source: umweltbrief.org

Health and safety in electromobility: The great unstandardized

Screwdriving operations on battery packs in the high-voltage range of 60 to 1500 V DC are a special challenge in the manufacturing of electric cars – whether manual, semi-automatic or fully automatic. When electric vehicles go into production, factories have to be set up, employees have to be trained and electrical engineering safety standards have to be complied with.

The infrastructure of the production facility, in particular the screwdriving technology, provides an important contribution to health and safety. This requires a high-voltage spindle concept that takes into account the clearance and creepage distances to ensure double insulation – because contact with live high-voltage components can endanger the health and life of employees. Previously, no suitable spindle concept for applications in this voltage range existed. In addition, there is no uniform product standard for the final assembly of electric vehicle batteries, only the standards for electrical safety in the workplace and for operating and equipping high-voltage systems.

Standards table

No special standard for battery assembly available!
Here an excerpt from different standards:

- + **DIN VDE 0105-100**
Operation of electrical systems. Covers operation and working with high-voltage systems. Correct condition of operating electrics and systems..

- + **ISO 6469-1**
Electrically propelled road vehicles – Safety specifications – Part 1: On-board rechargeable energy storage system (RESS). Aufbau und Sicherheit von Batterie Packs.

- + **ISO 6469-3**
Electrically propelled road vehicles – Safety specifications – Part 3: Protection of persons against electric shock.
Sicherheit für Personen ähnlich 60204.

- + **EN 60204**
Safety of machinery – electrical equipment of machines. Electrical safety of systems and devices.

- + **DIN EN 50178**
Equipping high-voltage systems with electronic production equipment..

- + **DIN VDE 0100-410**
Installation of low-voltage systems, part 4-41: Safety measures – protection against electric shock.

- + **DIN EN 60900 (VDE 0682-201)**
Working on live components; hand-held tools for using up to AC 1000 V and DC 1500 V

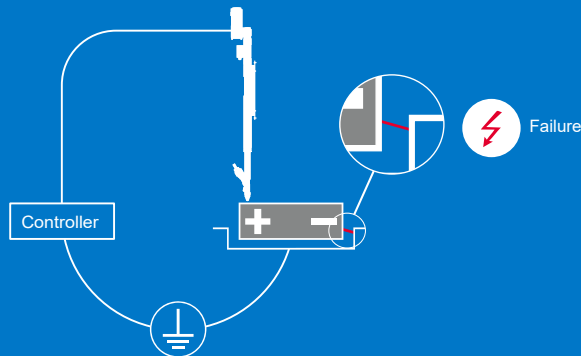
- + **DIN VDE 0680-1**
Body protection, safety devices and devices for working on live components up to 1000 V; insulating body protection and insulating safety devices.

Safe manufacturing with high-voltage – a solution “made in Germany”

As for many innovation processes, legislation is lagging behind the technical development of electromobility as well. Tried-and-tested solutions for assembly in the high-voltage range are already available today. One concept comes from WEBER Automatic Screwdriving Systems and addresses the grounding concept as well as the screwdriver used for assembly.

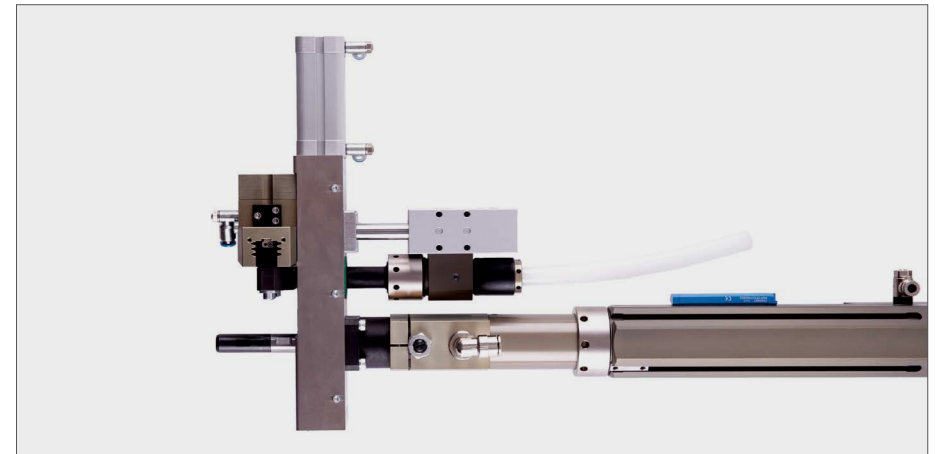
There are two basic scenarios for high-voltage screwdriving: In the first scenario, non-live components are joined, e.g. battery housings, and consequently no additional safety measures are required. Still, no parts should be dropped, such as screws lost by the screwdriver. To minimize this risk, WEBER uses a monitored vacuum system that detects the loss of fasteners.

In the second scenario, screwdriving is carried out on live parts such as the battery itself. ISO 6469-1 stipulates a floating design of the vehicle battery from 60 V DC, which must not be mounted without additional insulation and grounding. These are parts which could cause a short circuit or arc in the battery pack. With an insulated battery, grounded battery housing and insulated screwdriver, a dual safety concept offers employees additional contact protection, which can be further expanded with insulation monitoring from battery to housing and ground potential.



Safety with insulated bits

The new WEBER spindle concept allows work to be carried out on live components up to 1500 V. The screwdriving head assembly, including the bit, is insulated for this. WEBER uses both ceramic and plastic materials for this. The spindle concept also takes into account the relevant clearance and creepage distances while ensuring a high degree of cleanliness by avoiding metallic abrasion.



WEBER screwdriving system with integrated insulation for high-voltage assembly

Heavy battery, lightweight design: safe and efficient production

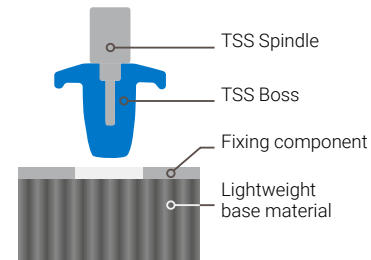
Another challenge of electromobility: due to the heavy battery, the remaining weight of the car body and equipment has to be as low as possible. Developers and design engineers focus on lightweight materials to reduce the weight of the materials and therefore their energy input. WEBER has already submitted two patents for secure screwdriving involving these materials.

The TSS (thermal bonding) spindle is a setting system for sandwich structures such as honeycomb panels. A honeycomb panel is a three-layer compound material with two weight-bearing cover layers and a support core with a honeycomb structure. The support core can be made of cardboard, resin-soaked paper, fiber plastic or thin aluminum foil, whereby cardboard, plastic, compound fiber materials or sheet metal can be used for the cover layers. To securely join these materials, fasteners are preferred for lightweight structures – the TSS bosses. The process heat from the setting process partially melts this boss and the component to reveal the glass fibers. The boss material plasticizes and adapts to the hole geometry. This creates a firm bond between the boss and the glass fibers.

The robot-based RSF screwdriving system is available for flow drilling screws in hybrid structures. Direct screw connections can be used here to create higher-strength connections with a high thread weight ratio and high dynamic safety. The key is to heat the metal sheet by means of precisely metered contact pressure and rotation speed. In combination with the right screw types, this creates a metric nut thread from the displaced material and therefore a stable connection with high breakaway torque and vibration strength.

TSS (Thermal adhesive bond)-spindle

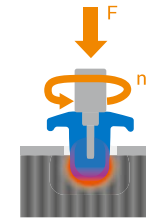
Step 1
Locating



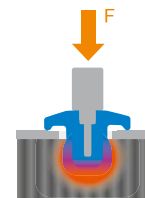
Step 2
Frictional heating



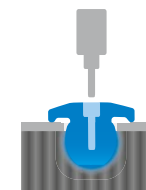
Phase 3
Penetration/
Melting



Step 4
Dwell time with
down force

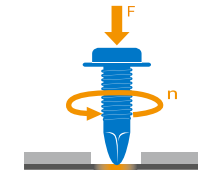


Step 5
Cooling /
Tool retract



RSF – Roboter-gestützte Schraubsystem

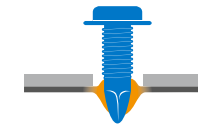
Step 1
Flow drilling screw
contacts the surface at
low pressure & RPM



Step 2
High RPM and force
brings the material to
plasticize and "flow"



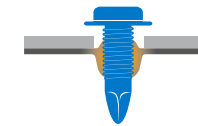
Step 3
Formation of
cylindrical
passage



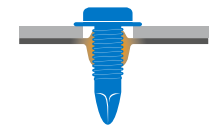
Step 4
End of "flow"-phase
beginning
of thread rolling
process



Step 5
Normal screwdriving



Step 6
Tightening the screw
with set torque



Create “Production 2025” across technical sections

Electromobility and its manufacturing are an innovative, complex and reciprocal process. Software and hardware, product and production all influence one another. The WEBER manufacturing solutions were developed in direct cooperation with different OEMs. The company wants to continue on this path. “We will continue to look for development partners for joint innovation processes in electromobility in the future. These are companies that want to restructure their classic manufacturing or new players on the market who want to benefit from our longstanding expert knowledge,” explains WEBER Managing Director Karl Ernst Bujnowski.

About WEBER Schraubautomaten

WEBER Automatic Screwdriving Systems has been a specialist in the development and manufacturing of top-quality automatic handheld screwdrivers and fixtured screwdriving systems for 60 years. WEBER has been developing, manufacturing and marketing “technology that connects” since 1956. With solutions for complex processes in automated screwdriving, WEBER ensures maximum reliability and has always prioritized innovation and quality – for uninterrupted service in the automation of assembly processes. And this also applies to electromobility. WEBER is an innovation partner and plays a decisive role in driving the standard production of electric vehicles. References include BMW (i3), VW (E-up) and Tesla. With innovations for screwdriving on high-voltage batteries and lightweight materials, WEBER is at the forefront when it comes to moving into the future electrically.



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MOVING INTO THE FUTURE ELECTRICALLY.

The WEBER logo, consisting of the word "WEBER" in a bold, white, sans-serif font, enclosed within a white rounded rectangular border. The background of the entire page is a dynamic, abstract image of blue and white light trails curving into the distance, suggesting speed and technology.