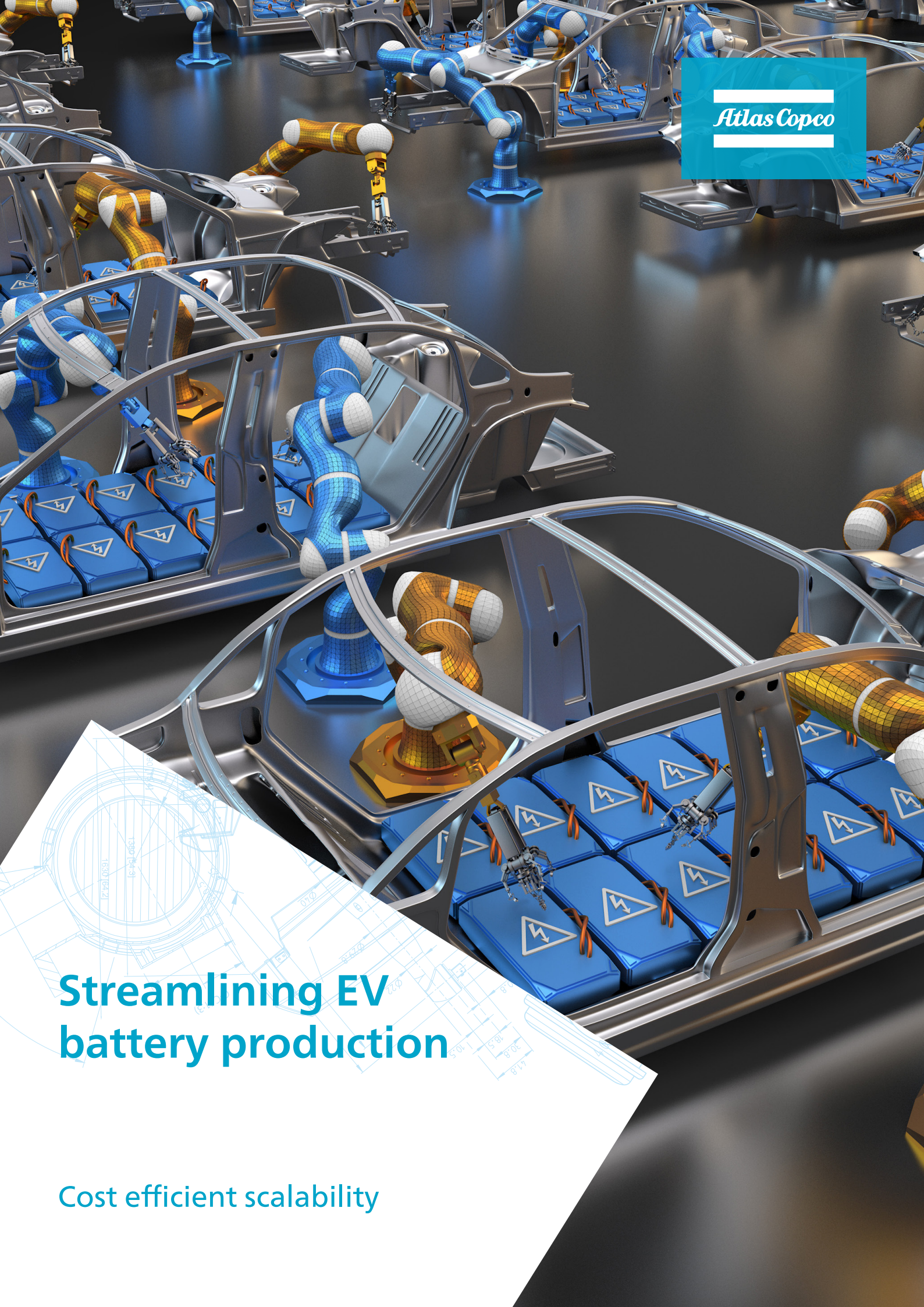

Streamlining EV battery production

Cost efficient scalability

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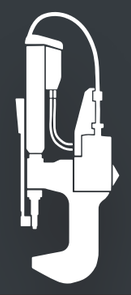
How the implementation of data-driven advanced joining technologies for EV battery assembly can help manufacturers overcome challenges in order to deliver profitable and scalable production.



Self-pierce Riveting

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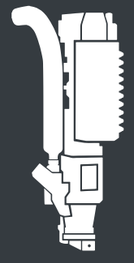

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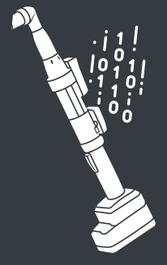


Tightening Solutions

Data Driven process optimization

Abstract

Vehicle electrification is not only the future – it is happening right now with a continuing stream of new electric vehicles (EVs) entering the market from both well-established manufacturers and new brands. This makes time to market critical and demands that production processes are scaleable to grow with high demand, but also flexible to handle the new requirements presented by future vehicle generations. The first vehicles were all powered with batteries and now the concept of the EV has come full circle.

Electromobility and lightweight design are radically changing the automotive industry, especially when it comes to the heart of the vehicle – the battery. Here, the required driving range increases continuously, while the speed to charge needs to be minimised. Battery weight needs to be reduced significantly to achieve this, while production processes need to be optimised and globally scalable. The assembly process of the battery has a strong influence on its safety, performance and durability, making the selection of the most appropriate joining technologies for the different steps in the battery manufacturing process crucial.

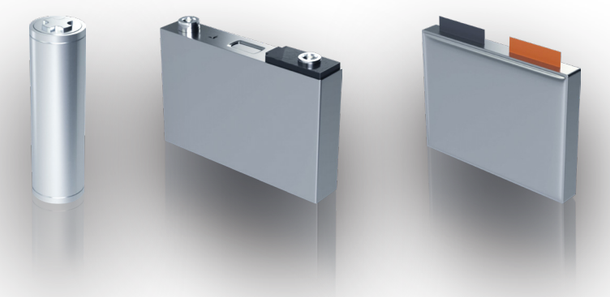
Introduction

Transitioning to EV

The motor industry is in transition with radical changes to fulfil climate change legislation that's accelerating the shift from internal combustion engines to fully electric powertrains. According to forecasts from the International Energy Agency's Sustainable Development Scenario, global EV growth is set to increase by 36% annually, reaching 245 million vehicles in 2030. That is over 30 times higher than today's level. This exponential spike in EV demand presents a range of new challenges for vehicle manufacturers when it comes to production in terms of scalability, as well as materials, battery design and joining technologies.

Optimising for safety and durability

As the weight of batteries is considerable, engineers are tasked with developing new techniques to make new electric cars as light as possible, whilst improving range and reducing CO2 emissions. Alongside weight reduction, the various types of batteries used in automotive drivetrains need to be optimized for safety, durability and performance. Different types of battery cell used within the battery, such as cylindric cells, prismatic cells, or pouch cells also affect the production process.



Lightweighting and range extending

The focus on increasing driving range and reducing charging time also influences battery design. Battery weight contributes a large part of total vehicle weight. The heavier the car, the more energy it consumes. This demands a lightweighting process through the use of lighter materials and efficient production methods to minimise battery and total vehicle weight.

EV battery assembly presents new and existing application challenges that need to be solved. To ensure efficient production, several technologies in joining, error-proofing, and quality assurance need to be implemented to meet quality standards and end-user expectations.

Challenges

- Cost
- Weight
- Performance & Longevity
- Safety
- Quality Assurance
- Sustainability

Advanced assembly technology for battery production

Atlas Copco has a long-standing partnership with the automotive sector and, as EV's become mainstream and manufacturing processes become digitised, we know and understand the value chain of battery production.

01

Our advanced battery assembly technologies are designed to deliver efficiency, speed and value throughout the production ecosystem through the use of fully integrated and connected joining solutions across the entire EV battery production process. These include tightening with fast and accurate assembly tools and adhesive dispensing systems that ensure consistent, bubble-free application and machine vision systems, as well as self-pierce riveting systems that securely join mixed materials without damage and flow drilling fastening to create reversible secure joints where there is only one-sided access.

02

To complement these, Atlas Copco's error-proofing technology with process optimisation delivers right-first-time production and quality assurance including calibration, measurement, and reporting to ensure faults are rectified cost-effectively and every assembly is fully traceable. Utilising the power of AI, data from all Atlas Copco joining technologies can also be analysed in real-time to accurately predict when maintenance is due, or take corrective action if a process is deviating from specific parameters.

03

Atlas Copco understands that EV battery technology in areas such as cell chemistry, battery format and integration into the vehicle's architecture will continue to evolve rapidly to meet performance requirements and limit environmental impact. Collaboration between OEMs and suppliers is key to achieving success in this fast-paced climate. Atlas Copco is focussed on building long-term strategic partnerships with customers to meet this challenge, enabling them to take the lead in the transition to electromobility whilst meeting their productivity and sustainability objectives.

A number of the challenges in terms of the performance and sustainability of EV's are specifically related to the battery manufacturing process. Major challenges include meeting safety standards, delivering quality and controlling costs

The Challenges to EV battery manufacturing

Controlling Costs

Even the smallest improvement can make a big difference in terms of achieving cost savings in high volume battery production. Areas to consider include reducing rework and rejects and cutting material waste. This is particularly relevant in dispensing applications, where there is a great potential for optimisation to reduce the consumption of sealant or gap filler.

Delivering Quality

The race to innovate in any industry can lead to lower levels of quality. In particular, undetected defects produced during battery manufacturing can lead to costly recalls for EV manufacturers. Problems can include application defects in cell bonding, battery sealing, or the many different materials that need to be joined, such as high-strength steel and aluminium.

Meeting safety standards

Battery temperature management is a significant issue, as the battery cells must be operated within a specific temperature range to preserve performance and avoid overheating. For these reasons, a heat-conducting, gap-filling paste is typically applied to the battery tray. This presents a challenge, as the high-volume application of the paste required can result in bubbles forming that damage thermal conductivity.

To protect the EV battery in the event of a collision, cell stacks can be reinforced with lateral braces. However, conventional joining techniques, such as spot welding, are not suitable because they create heat and welding splatter that can harm the sensitive battery cells.

Ensuring operator safety during battery production is critical because the cells and modules that comprise the battery are electrically charged, with DC voltage levels ranging from a few hundred up to a thousand volts. Risk assessment needs to be carried out. Operators must be trained in safe working practices for EV battery assembly and provided with special tools.

Meeting safety standards

Safety in EV battery manufacturing starts with the raw materials used in cell production. Here, advanced machine vision solutions can be utilised to find defects in the separator film or the coating of the electrodes. Short circuits in the battery can occur if either of these components is damaged.

Fire protection is also a key issue because, in the event of the battery cells getting inflamed, there is a risk that they will burn through the battery cover. The addition of a protective layer of fire-resistant material applied with a consistent and even bead to the lid mitigates this risk.

Sealing the battery tray and cover prevents humidity from entering the battery and prevents harmful gases from escaping into the vehicle cabin. This can be achieved through the use of a high-precision application system with a bead inspection solution to prevent gaps, air bubbles, or material accumulation in the seal that could lead to weak points and gas leakage.

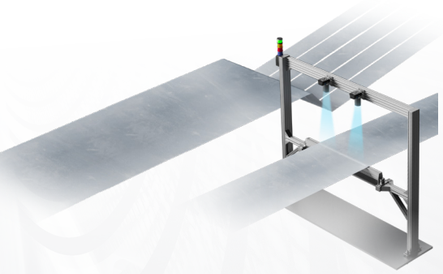
Ensuring operator safety in the production of EV batteries is also critical. The cells and modules that make up the battery are already electrically charged with voltage levels ranging from a few hundred up to 1,000 volts DC. Exposure to voltages higher than 120V DC, as well as electric arcs or exploding batteries, can cause significant injuries and death.

With this in mind, it is essential to undertake risk assessments and ensure operators working on live terminals are trained in safe working practices and provided with specialist insulated tools. Atlas Copco enables manufacturers to mitigate risk through a range of measures, including the development of fully insulated and isolated sockets and quick-change adapters, as well as insulated tool covers and protection for handheld electric assembly tools while working on batteries up to 1,000 volts in accordance with the IEC 60900 standard.

Ten steps of EV battery assembly

Improvements to the weight, capacity and charging times of EV batteries are needed to meet performance requirements and limit environmental impact. This demands efficient and sustainable EV battery production with quality assurance and data driven process improvement at every stage. From cell component quality inspection to closing the battery tray with a cover, Atlas Copco's smart integrated assembly technologies are designed to optimise process safety, quality and productivity while reducing costs.

1 Battery Cell Components Quality Inspection



The battery components are the centrepiece of the final electric battery that will power an EV. Using inspection systems to detect and monitor component and product quality from the start ensures resource and cost efficiency, as well as product safety in later production stages.

Powerful battery electrodes and the separator film are indispensable components of the lithium-ion battery. The coated electrode materials for cathodes and anodes must meet the highest requirements in terms of energy efficiency, storage density and safety. As a result, the aluminium and copper-coated electrode plates must have an extremely smooth and closed coating where required.

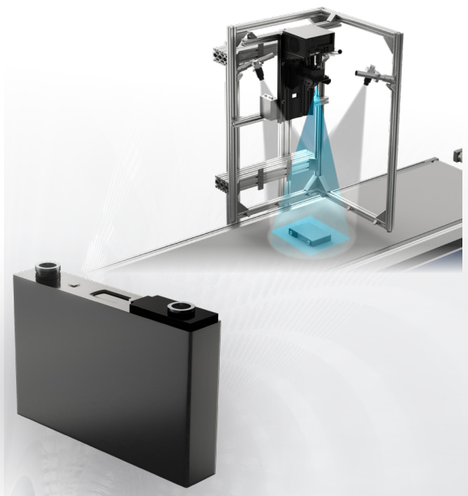
Another component of the battery cell with extreme quality requirements is the lithium-ion battery separator film. This film divides the anode from the cathode to enable lithium ions to be exchanged. The film is also an essential safety element that will prevent a short circuit in the battery and plays a significant role in cell service life. In addition, the film must possess flawless porosity and uniformity for use in a battery cell, as well as chemical stability and resistance to heat and tearing.

Atlas Copco's **SMASH** inline inspection system from ISRA VISION offers a comprehensive and reliable quality assurance solution for detecting and classifying all surface defects. The inspection system checks electrode material quality for damage such as streaks, holes, impurities, and air bubbles. This enables all relevant sources of error to be directly eliminated.

SMASH can also be utilised in the classification of production defects in the PVDF fluoroplastic coating used on the separator film for holes, stains, and oil contamination, as well as water drops and scratches. This highly detailed inspection is enabled through the use of high-resolution 8 and 16k cameras and multi-scan technology with up to three simultaneous scans.

The implementation of a quality assurance strategy for battery cell components offers a multitude of measurable advantages. These include minimised waste and reduced raw material and energy consumption, as well as reduced operational costs and streamlined manufacturing processes based on resource-efficient production.

2 Battery Cell Quality Inspection



High performance battery cells represent the core of EV powertrains. This is regardless of if they are based on pouch cells, cylindrical cells, or prismatic cells. Because cells are densely packed inside the EV battery assembly, the quality and integrity of the cells are key factors in ensuring the road safety of EVs.

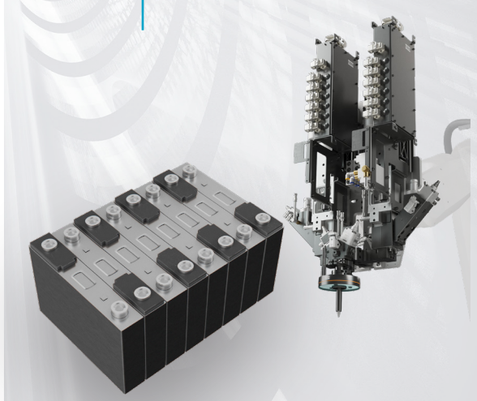
In addition, recalls due to defective cells are costly and can significantly impact a vehicle manufacturer's brand reputation. Therefore, it is in the interest of battery suppliers and EV manufacturers to test and document the quality of the battery cell to provide quality assurance.

Atlas Copco's **SMASH** cell inspection system offers the ideal solution by providing a complete optical 360° check of the battery cells to ensure a 100% comprehensive inspection. In addition to dimensional monitoring, cell inspection also detects surface defects and contamination. Defects are classified and the defective cells are automatically ejected or marked. The **SMASH** system also reliably checks barcodes and data codes and provides fully traceable production documentation.

The **ISRA SMASH** inspection system can be combined with other Atlas Copco **ISRA** solutions to further improve quality assurance and optimise production. For example, the **ISRA** graphical user interface (GUI) makes it possible to control and monitor multiple production lines at once. Detection results are displayed in real-time and provide a full picture of the defects found and their causes, using **ISRA** '**EPROMI**' production analytics software to create intelligent correlations to optimise production.

Quality assurance techniques also offer improved product safety levels for operators, thereby avoiding future incidents throughout the EV battery assembly process.

3 Cell stack assembly



To power an EV, multiple battery cells need to be combined or stacked, in a module. However, because battery cells are delicate and sensitive to heat and force and come in different shapes and forms, battery cell stack assembly can be challenging. This is particularly the case in terms of finding the best dispensing solution that delivers a result that meets the required safety, elasticity, and longevity requirements throughout the lifetime of the battery.

Stacking battery cells into modules is a short-cycle and precise process with high quality demands. Defects are unacceptable and there are no second chances in the cell stack assembly process to get it right. The battery cells need to be firmly attached and the joint must meet the highest requirements in terms of rigidity and crash behaviour. Full contact and insulation properties must also be achieved and pockets of air avoided. Should a collision occur, air pockets can lead to short circuits which are a major safety issue in high-voltage EV power systems.

Alongside these challenges, the joint needs to be elastic to provide a tolerance for the cells to expand slightly when charging and discharging. In addition, the form of the battery cells can vary. Battery cells come mainly in a cylindrical, prismatic or pouch format and for EVs, the prismatic cell is widely used due to its large capacity, thin profile, and effective use of space.

Taking these considerations into account, it is clear that cell stack assembly is a complicated and complex process. As a world-leading provider of multiple bonding and dispensing technologies, Atlas Copco offers solutions to these challenges through its **SCA** dispensing product line which enables flexibility, productivity and quality to be increased.

4 Module Assembly

After the single battery cells have been stacked together in modules, they need a solid framing for stabilisation and collision protection. While reinforcement is typically achieved through the use of lateral braces, it is important to note that common multi-material joining techniques such as welding are unsuitable. EV battery cells are sensitive to heat and need to be mounted in a clean environment. This makes techniques such as welding unviable because the process introduces both heat and the risk of contamination from welding splatter.

The solution is to apply a clean cold joining technology such as self-pierce riveting (**SPR**). **SPR** is a method of joining two or more pieces of material using a rivet without the need for a pre-drilled hole. The basic **SPR** process involves driving a rivet at high force through the material layers into a die which causes the tail of the rivet to flare out and form a tight joint. The result is a short cycle joining process with high strength characteristics and join integrity that can be visibly checked.

Alongside meeting the technical requirements for module assembly, **SPR** is also operator and environmentally friendly. **SPR** does not create debris, heat, sparks or hazardous vapours and the joining process is also energy efficient.

Atlas Copco offers a comprehensive range of self-piercing rivet systems that combine high joint integrity, structural stiffness and rigidity within short assembly cycle times. The flexible rivet solutions are developed by the Atlas Copco in-house joining laboratories in close partnership with customers to provide the best joining solution for specific materials. Sheets of different materials, such as aluminium to steel and composites to metals, as well as similar materials, such as steel to steel and aluminium to aluminium, can be joined. Requiring a compressed air operating pressure of just four bar, the Atlas Copco solution also reduces energy consumption.

SPR can also be combined with a die check camera for quality assurance. The camera continuously inspects the integrity of the die thereby increasing efficiency and reducing downtime helping to reduce C02 emissions.

A die changer for robot-mounted riveting tools can also be added to the process, enabling a die to be automatically changed without the need for operators to enter an automated cell. This affords an even more flexible manufacturing process that lowers the overall cost of production.

5 Battery Tray Assembly

The EV battery tray consists of several assembled battery modules. As well as ensuring the battery provides optimum performance, the battery tray also forms an essential part of the vehicle's structural stability. Assembling the battery tray involves several complex and interacted production steps, each of which presents specific joining challenges, as well as opportunities.

The process stages of battery tray assembly include tightening, sealant application, joining of the cooling system and riveting of the compartments. Each of these steps needs to be completed efficiently while ensuring quality levels are maintained at every stage. To achieve this, Atlas Copco offers coordinated and aligned, end-to-end, technologies that enable uninterrupted and continuous battery tray production

The initial stage in the battery tray assembly process is tightening with bolt positioning. With no room for error, positioning and ergonomics are crucial to support the operator in performing high-quality tightening on the right position of the battery tray. An articulated arm equipped with a positioning system and precise operator guidance enables full process control that reduces the risk of assembly defects. The result is a combined, easy to install and configure, high accuracy tightening system that offers improved operator ergonomics.

High-quality sealing of the battery tray is needed to avoid rework and material waste. However, because battery tray design is complex and the geometries of the included parts vary extensively, manufacturers are faced with the challenge of consistently and precisely achieving optimal material distribution without wasting material.

The **E-Swirl 2 AdX** automated applicator system from Atlas Copco **SCA** dispensing range provides an advanced solution to this challenge. Featuring an adjustable swirl pattern and flexible application programming, **E-Swirl 2 AdX** enables changes in part geometry or application needs to be easily addressed. The applicator system offers a continuous optimal application despite changes in bead width and constriction. **E-Swirl 2 AdX** offers a flexible solution that perfectly fits the geometry of the individual component or part to enhance productivity and the utilisation of sealing material.

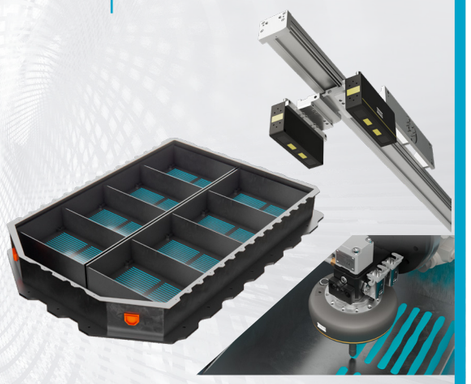
The cooling system of an EV battery plays an integral role in managing the temperature of the battery. This makes the reliable joining of different materials during the production phase cycle time a crucial factor, along with flexibility and ensuring minimal contamination at the joint

Atlas Copco´s **K-Flow** drill technology is the ideal mechanical fastening solution to meet these requirements. **K-Flow** utilises a fastener which is rotated at high speed, applying pressure to warm up the material. This allows the fastener to pierce the material stack,

cutting the thread in a single process to provide efficient and flexible hybrid joining of multi-material stacks. Requiring one-sided access only, the **K-Flow** process provides reliable high-quality joints that when compared to welding include fewer process steps and therefore improved operational efficiency.

Featuring an innovative helix design, the **K-Flow HLX 70** magazine, mounted on the **K-Flow** joining system, is a fast and sustainable fastener supply with a unique magazine technology featuring a hoseless design. **HLX 70** can reduce cycle times by up to a third and also offers a significant reduction in contamination at the joint which is particularly important in the sensitive EV battery assembly process. Compared to a feeding solution that uses compressed air, the hoseless design can save up to the equivalent of 181 metric tons of CO2 emissions each year.

6 Thermal Management



EV batteries deliver maximum performance within a defined temperature range. Managing and controlling the heat created by charging and discharging is crucial for both safety and maintaining long-term battery capacity. The process for achieving this is challenging but when correctly applied the rewards in terms of weight reduction, cost and CO2 footprint can be considerable.

The battery represents approximately 30% of the total cost of an EV. One essential way to secure that investment is through efficient thermal management. This is achieved by applying a thermal compound material with heat transfer properties in the EV battery tray. However, applying this material (also called gap filler) is a challenge due to its high density and weight characteristics and the high cost of the material. The key is therefore to precisely apply the right amount of material in an optimised pattern to achieve the heat transfer properties while avoiding excess material use to minimise weight and cost.

The solution is Atlas Copco's innovative **Smart.Adjust** technology which combines vision and dispensing systems for the optimum application of the thermal compound material. The fully aligned system measures, calculates, adjusts, applies and controls the application process. **Smart.Adjust** sensors scan the EV battery tray for any irregularities after which a smart algorithm calculates the required material volume. The result is sent to the dispensing system that adjusts the volume and applies the gap filler in an optimal pattern.

Smart.Adjust provides evident and measurable advantages by saving up to two kilograms of material weight and 20% of the material cost in each cycle. This not only reduces the CO2 emissions associated with the application process but also increases the battery range due to weight reduction.

The Atlas Copco thermal management offering also presents advantages in terms of improvements to the material supply system and the processes related to changing the gap filler supply barrels in particular.

Due to the high density of the gap filler, the barrels are frequently only half-filled which increases the number of barrel changes required. In addition, conventional pumps can often not fully empty a barrel and need to be ventilated and purged manually after a change. This is a complex process that takes time and results in expensive thermal compound material being wasted. As with all manual processes, difficulties can also occur when it comes to ensuring a consistent level of quality throughout the dispensing process.

7 Assembly of Modules

Atlas Copco's **Plus.Supply** pump technology addresses these issues by introducing unique and automated barrel change and ventilation capabilities to the equation. Utilising an optimised flat follower plate in combination with a vacuum pump, **Plus.Supply** virtually eliminates material waste and introduces less complexity and improved safety into the barrel change process. **Plus.Supply** reduces the number of barrel changes by up to 70% and waste material costs can be substantially decreased. Overall, these factors combine to increase productivity and quality while also reducing CO2 footprint of the material supply process by up to 50%.

Atlas Copco's **Smart.Adjust** and **Plus.Supply** solutions offer substantial measurable advantages in managing the thermal challenges in EV batteries. From scanning the EV battery tray, to finally dispensing the thermal compound material in optimised patterns and changing material supply barrels, Atlas Copco enables more efficient use of materials, increased productivity, quality and security along with the opportunity to make a real difference in reducing CO2 emissions in the production process.

Once assembled, EV battery modules need to be mounted on top of a liquid gap filler paste in the battery tray. This can be achieved with tightening, but in order not to compromise thermal transfer, the process needs to be fully controllable. Automation and robot guidance provides the answer to meeting this.

The soft joint behaviour of the gap filler presents a challenge in the assembly of battery modules due to the tendency of gap filler adhesive to squeeze out between the module and tray which can result in air remaining trapped within the battery module. A fully controllable tightening strategy is required to guarantee even distribution and full contact between the battery modules and the thermal compound (gap filler).

With a portfolio ranging from the **PF6 FlexSystem** controller system, the **PowerPICK3D** detection sensor, to the **MONO3D** robotic guidance system, Atlas Copco can offer an integrated, fully automated and controlled module assembly process solution that answers these demands.

Atlas Copco's industry-leading nut-runners provide a multi-spindle, electronically-controlled solution via the **PF6 FlexSystem** to ensure a continuous tightening process, quality assurance and traceability via data collection and visualisation. By working synchronously in the final tightening process, the assembly cycle time is reduced and each module is fixed evenly in the tray. Optimal contact to ensure thermal transfer is achieved by employing a programmed tightening strategy with a precise tightening sequence.

The compact size of the multi-spindle **FlexSystem** can save up to 97% floor space and 90% cable length and also saves energy due to low standby energy consumption.

Fully automated battery assembly lines also require machine vision technology to guarantee a collision-free assembly process. The Atlas Copco **PowerPICK3D** system ensures a consistently high and reliable level of inspection quality based on 3D images that recognize very small parts, irrespective of their geometry or material. When foreign objects are detected, the assembly process is stopped to avoid damage in the battery assembly process. With a measurement time of under 500ms, the **PowerPICK3D** scanner offers ultra-fast process control.

Precise positioning of the applicator unit is important for ensuring

the assembly process performs to the highest quality standards. Atlas Copco's **MONO3D** is a precise robot guidance solution for multi-spindle systems. **MONO3D** enables unsorted components to be automatically picked from a pallet or component carrier, making a time and cost-efficient contribution to the battery module assembly process. The system determines the position of an object in all six degrees of freedom in less than a second, after which the information on the component´s exact position is then used for precise robot path planning. **Mono3D** is a highly flexible system that is easy to configure to specific requirements and can be ready for use with any robot in a matter of hours.

8 Tightening of Electrical Components

Battery modules for EVs need to be interconnected and other electrical components assembled. In addition, multiple tasks in the process increase the level of complexity and live battery components require special safety procedures, equipment and tools.

Addressing the challenges of electrical component assembly requires battery tools with an integrated controller. This enables a precise assembly process to be achieved while isolated sockets tighten the connection between the individual modules. In addition, wireless bolt level positioning secures the correct tightening on the correct fastener and process control software guides the operator clearly to increase battery quality. Utilising an integrated solution also offers the flexibility of wireless freedom, reduces the cost of operator training and ultimately the energy consumed in rework.

As with so many stages in the EV battery assembly process, there is no room for error when assembling the electrical components. Atlas Copco's **QA Platform 4.0** answers this challenge with a flexible and modular solution for quality assurance. With Tool, Joint, Visual and Dimensional Check performed by a single platform, **QA Platform 4.0** reduces the need for multiple quality checking devices. Compliant with quality standards, **QA Platform 4.0** optimises operational costs by reducing defects, reworks and product recalls.

Operator safety must be prioritised throughout the electrical component assembly process. The International Standard IEC 60900 applies to insulated, insulating and hybrid hand tools used for working on live or close to live parts at nominal voltages up to 1,000 V AC and 1,500 V DC. Atlas Copco's isolated sockets, quick change adapters and insulating tool covers improve operator safety in accordance with IEC 60900.

9 Fire Protection

Passengers should only need a few minutes to leave the vehicle if the battery cells of an EV get inflamed. The answer to achieving this critical requirement is to secure the battery cover from burn-through by applying a fire protective material. Fire protection is all about saving lives, but getting the process right can offer additional health advantages as well as material savings

Applying fire resistant materials to the battery cover is a complicated and challenging process that demands the material is applied precisely and seamlessly. Any gaps in the material will jeopardise the ability to provide fire protection, while applying too much material can cause issues later in vehicle assembly due to tight design requirements. Throughout the EV battery assembly process it pays to get each step right from the beginning, but in no instance is this more valid than for fire protection.

When applying the fire-resistant material, it is important for safety reasons to ensure a certain thickness of the material layer across the entire surface of the battery cover. Various solutions are available for applying the material, such as airless **spr**ay or wide flat stream application.

Atlas Copco recommends the use of a flat stream applicator when applying the fire-resistant material. In contrast to a **spr**ay applicator, workers are not exposed to hazardous airborne Epoxy particles. In addition, the 2C (two-component) material can be applied allowing for optimal fire protection capabilities within physical design tolerances without wasting valuable material.

Quality assurance is key, and it all starts with an Atlas Copco integrated vision solution utilising automated sensors that scan the battery cover after applying the fire-resistant material to detect any inconsistencies in application quality.

10 Cover Sealing

Finally, when all of the internal EV battery components are in position, the time has come to seal off the battery tray. Battery cover sealing is necessary to avoid leakages that can reduce the performance of the battery, or present a health hazard. The challenge is to ensure the cover is tightly sealed, but also ensure the serviceability of the battery tray in the future.

Humidity and moisture entering the battery tray can damage the EV battery system and cause the performance of the battery to deteriorate dramatically, leading to corrosion. In addition, hazardous toxic gases are produced within the battery that can be harmful if they enter the passenger compartment. This requires the battery cover to be tightly sealed to prevent anything getting in or out of the battery during its lifetime. The seal must also be reversible so that the battery can be serviced if necessary.

Atlas Copco's **SCA** dispensing product line enables sealant to be applied on either the battery cover or tray. Because the battery cannot be exposed to heat, a 1C (one-component) hot butyl material is commonly used for the cover sealing application. Thanks to its reversible characteristics, future maintenance and service of the battery is also possible. Other material options are 2C (two-component) polyurethane or 2C silicone, all of which do not require oven curing.

Regardless of the material, the application needs to be uniform, and it is particularly important that the beginning and end of the bead are precisely placed to ensure a tight seal.

Hot butyl needs to be heated up to 160 degrees Celsius which requires a fully heated dispensing system for the highly viscous material to be applied correctly. This is a complex operation for which Atlas Copco has the expertise and technology needed to offer a solution. **SCA** dispensing systems enable reliable material tempering from the pump, to the meter and to the applicator which allows hot butyl to be applied with the right viscosity and pressure. In addition, **SCA** dispensing enables uniform bead application with a precise start and finish.

The addition of an integrated vision system to the cover sealing process enables the inline monitoring, inspection, measurement and online rework to be easily undertaken, while the level of quality throughout the cover sealing process can also be monitored. This in turn helps to reduce scrap and also increases process stability.

The result of the dispensing system combined with an integrated vision system is a perfect and tight cover sealing process that prevents humidity and moisture ingress and gas evaporation. At the same time,the serviceability of the battery is ensured, reducing the amount of waste and minimising the risk of rework by increasing the stability of the cover sealing process from start to finish.

Conclusion

The rapid pace of the transformation towards electromobility has created several new challenges for manufacturers including the need to reduce weight to make EV's travel further, the need to reduce time to market and the need to reduce the cost to make EV's more affordable. All of these challenges relate to the EV battery pack and the processes used to manufacture them.

As joining experts, Atlas Copco continues to develop innovative ways of handling all types of joining at every stage in the EV production process. These combine leading edge, fully connected assembly technologies like tightening, self-pierce riveting, adhesive dispensing and flow drill fastening, that create smart connected assembly solutions that support the full digitisation of the manufacturing process.

With a wealth of innovation expertise, competence and unrivalled assembly knowledge, Atlas Copco can support manufacturers through the entire EV battery assembly process as a long term strategic partner.

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