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EVS AND BATTERIES

ENSURING WORKER SAFETY IN ELECTRIC VEHICLE AND LITHIUM-ION BATTERY MANUFACTURING

SAFETY BRIEFING

INTRODUCTION

The demand for electric vehicles (EVs) is climbing, with the International Energy Agency (IEA) forecasting accelerated growth over the next decade. As advances in battery technology and mass manufacturing continue to drive down costs, the agency expects EVs to account for more than 30% of the global road vehicle fleet by 2030 [1], a significant escalation from the 10% representation in 2021 [2].

This rapid growth projection is bolstered by ambitious target-setting for the phase-out of internal combustion engine-powered vehicles in many developed regions, along with increased R&D investment from electric vehicle manufacturers and government incentives designed to deliver battery and vehicle production improvements.

Manufacturing both electric vehicles and the batteries required to power them includes several phases during which engineers, technicians, assemblers and other workers are exposed to hazardous materials, components and processes that pose risk, requiring the use of appropriate personal protective equipment (PPE) to minimise the chance of incident or injury.

> **“EVs to account for more than 30% of the global road vehicle fleet by 2030”**

[1] International Energy Agency – “Global EV Outlook 2022” May 2022 p5

[2] International Energy Agency – “Global EV Outlook 2022” May 2022 p4

ELECTRIC VEHICLE BATTERY MANUFACTURE

Production of the lithium-ion EV batteries that power electric and hybrid vehicles is a multi-phased affair, comprising distinct activities that present a range of mechanical, electrical, thermal and chemical risks which require the use of electric vehicle PPE to ensure the worker safety.

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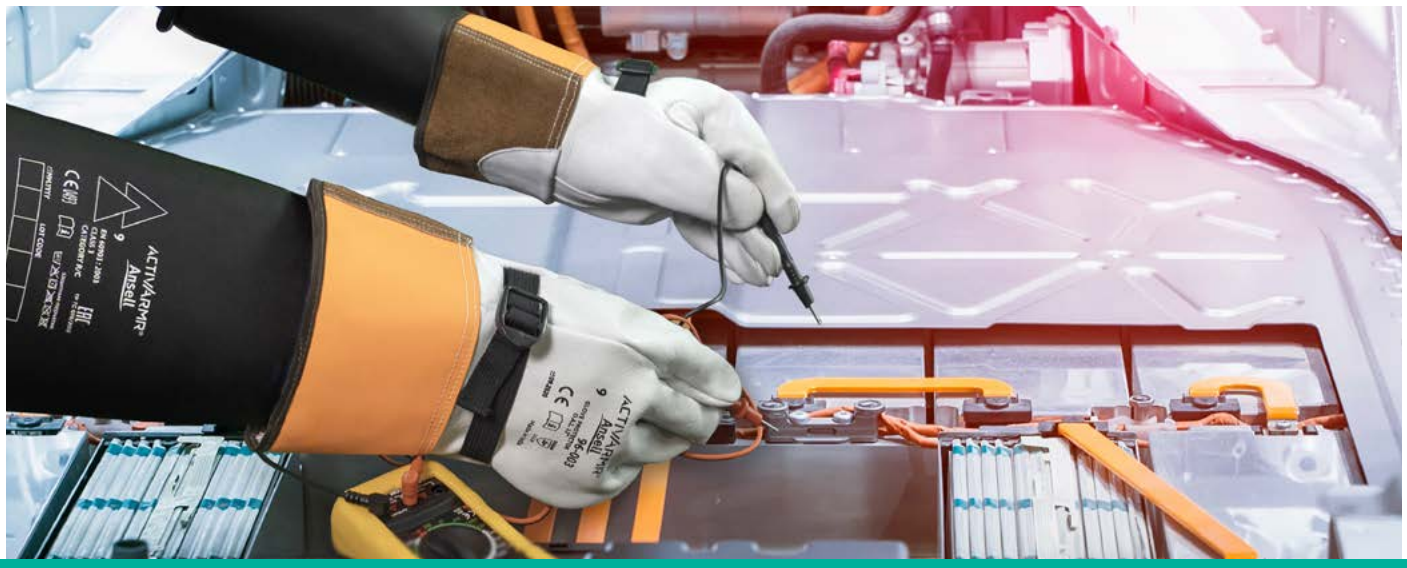
Electric vehicle battery manufacture is complex, incorporating as many as fifty discrete processes that are loosely grouped under the following categories:

1. Electrode manufacturing
2. Cell assembly
3. Cell finishing
4. Battery module assembly
5. Packaging and transport

Due to the inherent safety hazards, the manufacture, testing and transport of lithium-ion batteries is governed by stringent harmonised international standards and is increasingly addressed by specific legislature.

Workers in electric vehicle battery production facilities are exposed to the risk of electric shock from contact with high-voltage components and wiring, arc flash burn and other heat-related injury when operating high temperature conveyors or performing laser welding, fire burns and flying shrapnel or molten metal in the event of an explosion and chemical injury from exposure during electrolyte filling. Mechanical injury threats include abrasion due to hand fatigue and overexertion during handling, cuts or lacerations from handling sharp materials and crush or pinch injuries when loading, unpacking or moving items and materials.



Electrolytes are extremely flammable and likely to catch fire when cells are overheated, exposed to extreme temperatures or otherwise physically damaged. Defects or contamination introduced at the manufacturing phase can also have the same catastrophic effect. Failure of lithium-ion batteries often leads to thermal runaway, in which one or more battery cells explode, releasing toxic and flammable gases that create an intense fire that is challenging to extinguish.

The Electrochemical Safety Research Institute (ESRI) is part of the UL Research Institutes group and conducts scientific research, testing and modelling of energy technology and its components, including lithium-ion batteries. The institute aims to promote knowledge and awareness of the hazards posed by these technologies, with a view to minimising risk and encouraging adoption of manufacturing and testing best practices to improve safety levels.

ESRI recommends [3] a number of precautions against risk in the production of lithium-ion cell and battery manufacturing including the use of cleanroom and dry room production facilities to prevent contamination, process automation to remove the risk of human error and to ensure standardised repeatability and a program of stringent testing including production line sampling and formation testing – the first charge and discharge of a battery cell.

The more rigorous the quality control measures and checks, the less likelihood of manufacturing issues that cause safety breaches and threaten injury to everyone in the supply chain – right through to the end user.

[3] Electrochemical Safety Research Institute - Lithium-ion Manufacturing and Risk Reduction – March 2022

ELECTRIC VEHICLE ASSEMBLY

As with any vehicle manufacture, the production of electric cars incorporates a series of installation and testing tasks at dedicated workstations on the assembly line. It begins with installation of the electric vehicle's complex electronics and attachment of the drive unit to the chassis. The interior fit-out follows, including flooring, seating, carpets and the dashboard. Air conditioning, heating and circulation systems are then installed before the EV battery pack is attached to the chassis, along with the axles which have wheels and tires already fitted.

At this stage, the vehicle is powered up and checked before driving to the remaining workstations where the windshield, door systems and exterior panels are added. The final step in the process includes alignment, any final adjustments required and a comprehensive quality check.

Depending on the practices of the manufacturer, there is potential for risk at the assembly phase as EVs use high voltage battery packs. The vehicles can store electrical energy, exposing workers to electrical injury if they come into contact with the electrical system. Additional dangers include shock or arcing as the wheels are rotated, as some EVs use this motion to generate electricity. These risks can be avoided and or minimised by disconnecting the voltage during the assembly phase and requiring the use of rubber insulating gloves.

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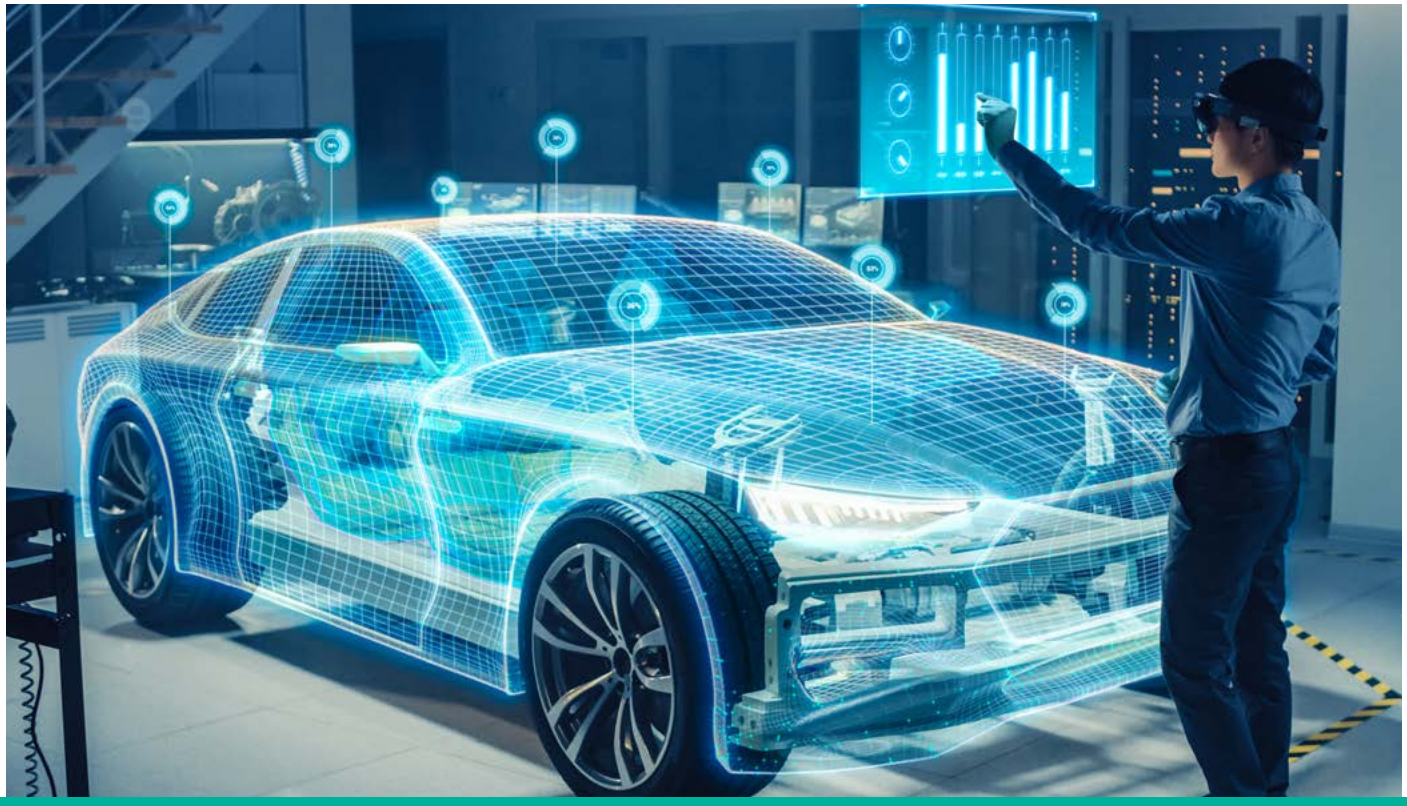

PPE FOR THE ELECTRIC VEHICLE INDUSTRY

The safety risks associated with EV and battery manufacture are not confined to one phase or activity, with multiple protection types usually required across each stage of the process. The following table outlines some typical tasks, the risk they pose and the most suitable electric vehicle PPE choice.

Typical tasks and associated risks	Protection Type	Production Phase/Application					
		Battery Electrode Mfg	Battery Cell Assembly	Battery Cell Finishing	Battery Module Assembly	Battery Packaging & Transport	Vehicle Assembly
Hand fatigue and overexertion due to material and tool handling, placing cells	Abrasion				●	●	●
Exposure to chemicals during loading, mixing, and coating, electrolyte filling, adhesive application	Chemical	●	●	●	●		
Cuts or lacerations when handling sharp material, blade changing	Cut	●	●		●	●	●
Potential for contact with high-voltage components and wiring capable of delivering a fatal electric shock	Electrical				●	●	●
Static discharge when in contact with the battery pack	ESD				●		●
Crush and pinch injury loading or unpacking	Impact	●					●
Exposure to various hazards during equipment operation, material handling, transportation	Single Use	●	●	●	●	●	●
Arc flash and other heat-related injuries when operating high temperature conveyors and performing laser welding	Thermal	●	●		●		●

Table 1 Lithium-ion battery and electric vehicle production phases and the risks

Electric vehicle manufacturers and other sector members including lithium-ion cell and battery pack producers are increasingly subject to safety requirements specific to the goods they produce and test.

The World Forum for Harmonization of Vehicle Regulations is a permanent working party within the United Nations that "is responsible for harmonising global technical requirements and protocols for the homologation of all types of vehicles and components", including input into development of regulations that address safety standards and determine product approvals processes.

As a relatively immature industry in the midst of thriving expansion, electric vehicle and battery manufacture is likely to remain under scrutiny to ensure that appropriate measures and manufacturing best practices deliver levels of safety that remove risk of injury or harm and to guarantee that products developed now will continue to meet the needs of consumers in the longer-term.

Safety and operations managers have a duty of care to assess and identify potential risks, to develop processes and procedures designed to remove or minimise those risks and to provide the appropriate training and PPE to deliver a safe work environment. This can be a challenge in complex industry sectors, where multiple, disparate hazards are often present and tend to vary at each production phases, or by job types or tasks within them.

In complex environments with many safety considerations, it pays to work with a vendor who can offer a thorough assessment of specific applications and processes, allowing for identification of a comprehensive and cost-effective solution that aligns with the broader needs of the organisation while delivering the highest levels of safety

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