



In any battery packs production line, end-of-production quality tests are always important, especially when it comes to battery packs for automotive use. The utilization of batteries in EVs necessitates strict adherence to stringent quality standards for safety and reliability. Defects that might be considered, inconvenient' in other applications become utterly unacceptable in the automotive environment.

Leak testing is a fundamental operation not only in the battery cell manufacturing process, but also during module and pack assembly. The perfect sealing of the battery pack is a very important feature, as water ingress can cause short circuits on high voltage components. The cooling circuits inside the battery pack must also be tested. Leak testing can ensure quality and long-term reliability and prevent the refrigerant gas or liquid from leaking into the battery pack.

BATTERY TRAY AND COVER

The first verification phase concerns the production of the main components of the pack, whose correct sealing conditions must be verified during the production process before they are sent to the next assembly stages. Depending on their design and manufacturing process, battery trays and covers can have various defects that can affect the tightness of the assembled pack: porosity in die-cast components, cracks and fissures in moulded components, defects in welds and bonding.

For the leak testing of these components, the integration of automatic leak testers in the production line is usually recommended in order to carry out fast global tests. **Air testing method** (pressure decay or mass flow) or with **tracer gas in an accumulation chamber** are the preferred solutions to choose from, depending on the characteristics of the part and the test specifications.

Battery tray, cover and cooling plates can be tested also with **helium in hard vacuum chamber** if the requirements in terms of reject limit are challenging to satisfy with other methods. In this case, specific solutions, to avoid part plastic deformation when the component to test is under hard vacuum chamber, are applied in accordance with the part features.

Otherwise, **helium sniffing solutions**, although slower, are widely used in these processes due to their ability to locate leaks. They can also be used to supplement the global test in the event of a negative result, or in the rework area (manual or automatic) to allow the component to be repaired. In some cases, alternative solutions can be evaluated using **organic tracer gases (VOC)**, which also allow the location and value of the leak to be determined, but avoiding the use of expensive tracer gas like helium.

COOLING COMPONENTS

Cooling circuit components, such as cooling plates and radiators, must also be 100% tested before being installed in the battery cooling circuit. In this case, the allowable leakage levels are usually very low and often require the use of very sensitive testing techniques, such as the use of **helium tracer gas in a vacuum chamber**.

Helium Recovery System

All the vacuum chamber applications can be integrated with the helium recovery system to reduce the operating costs. Marposs offers HeSAVER: the standard & modular solutions for trace gas recovery, making your investment fully sustainable.

PACK ASSEMBLY

Leak tests must then be repeated during pack assembly to ensure perfect sealing at critical points of the joints. Once the cooling circuit assembly is complete and before the pack lid is closed, **sniffing** solutions can be used to detect any leaks in the circuit connections. Then, after the lid has been fitted, it is necessary to check that the pack itself is properly sealed. Again, depending on the test specifications and the characteristics of the component (free volume, thermal conditions), different techniques can be selected: **global testing in air** or with **tracer gas in accumulation chamber**, and **helium sniffing tests** to identify the potential leak point. The final test is performed on the cooling circuit, which is completely enclosed within the package. It must be carried out using air techniques (pressure decay or mass flow) without the use of tracer gas.



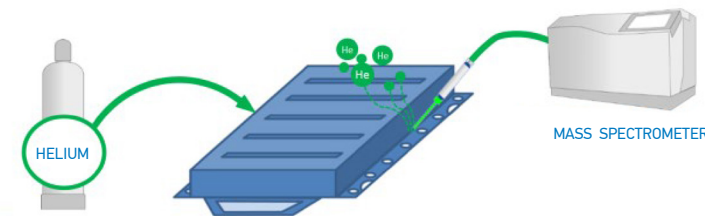
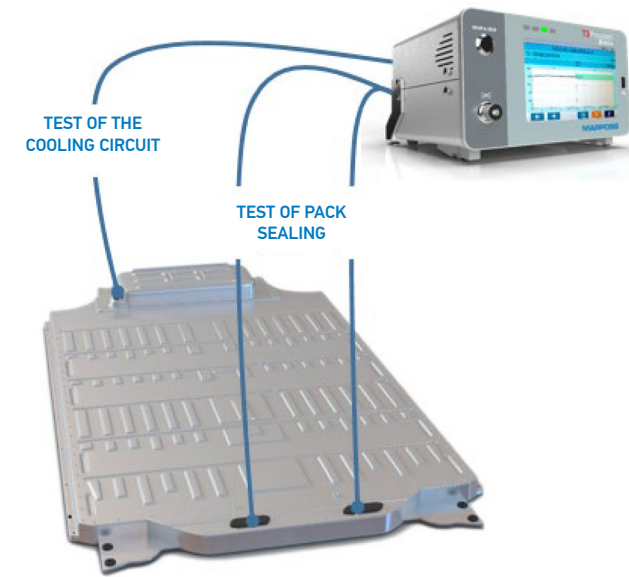
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MARPOSS

LEAK
TEST

IN BATTERY
MODULES &
PACKS
PRODUCTION





AIR LEAK TESTS

Air leak tests assess the total leakage from a component by either pressurising or depressurising it relative to its surroundings. Once the pressure has stabilised, any pressure changes or flow rates are measured over a specified test period.

Marposs Air Leak Detection Systems are capable of detecting leaks with thresholds in the range of -50 mbar and +100 mbar loss from 10 cc/min to 100 cc/min depending on the volume of the piece.

Applicable on:
TRAY & COVER – COOLING COMPONENTS – BATTERY PACK

SNIFFING TESTING WITH ROBOT OR MANUAL

When the component to be tested is sealed, it is filled with a mixture of air and helium, then the critical joints are checked with helium sniffing probe manually or using robotic equipment, and in the event of any leaks, the HMI shows the exact location on the component.

Marposs Helium Sniffing Leak Detection Systems are capable of detecting leaks with thresholds in the range of 10^{-2} - 10^{-4} mbar l/sec.

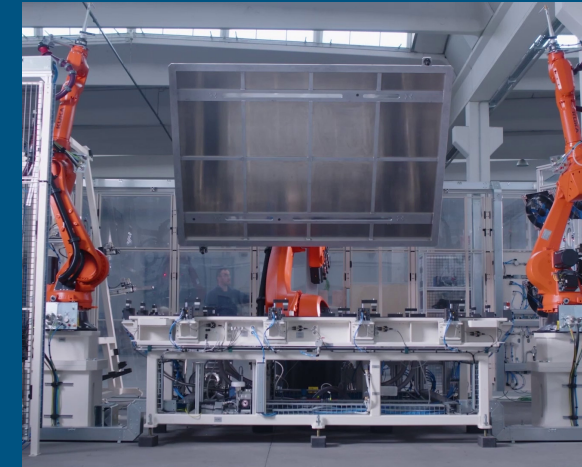
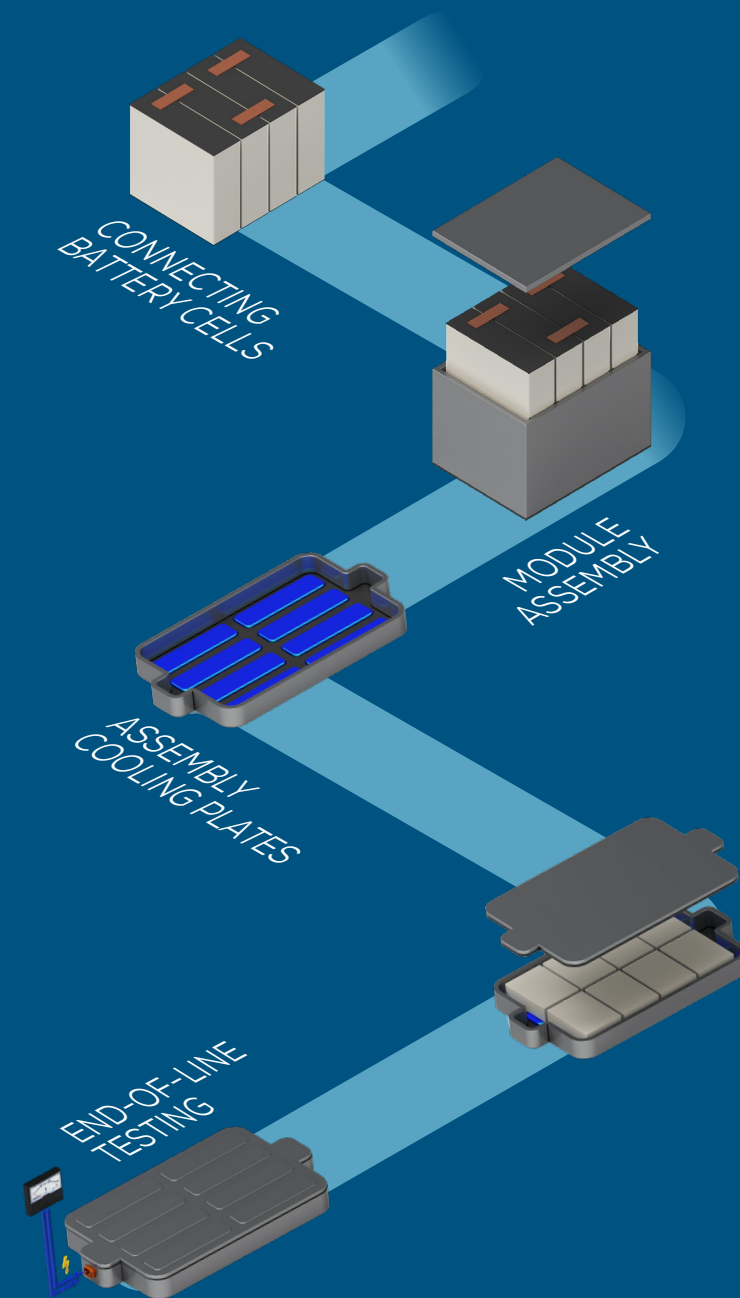
Applicable on:
TRAY & COVER – COOLING COMPONENTS – BATTERY PACK

HELIUM RECOVERY SYSTEM: HeSAVER

A high efficiency helium recovery system connected to the leak test machines, either integrated or as a stand-alone unit, provides a fully integrated process, giving better system reliability with the shortest payback period ever.

- Recovers up to 95% of helium or He/N₂ mixtures
- Wide range of capacities (up to 1000 NU/m) and operating
- Pressures (up to 350 bar)
- Very short payback period

Marposs provides end-to-end testing solutions for EV battery pack production, ensuring optimal performance and safety. Our leak testing systems utilize advanced helium sniffing technology, capable of detecting the smallest leaks, ensuring airtight seals in battery trays, covers, and cooling components. In addition, we offer dedicated electrical testing applications at both beginning-of-line (BoL) and end-of-line (EoL) stages, including **Hi-Pot insulation tests** and **electrical & functional tests**, designed to verify battery integrity and performance. Our solutions are flexible, adaptable to various battery sizes and configurations, and can be fully automated or semi-automatic to seamlessly integrate into your production line.



LEAK TESTING IN THE COMPONENTS PRODUCTION

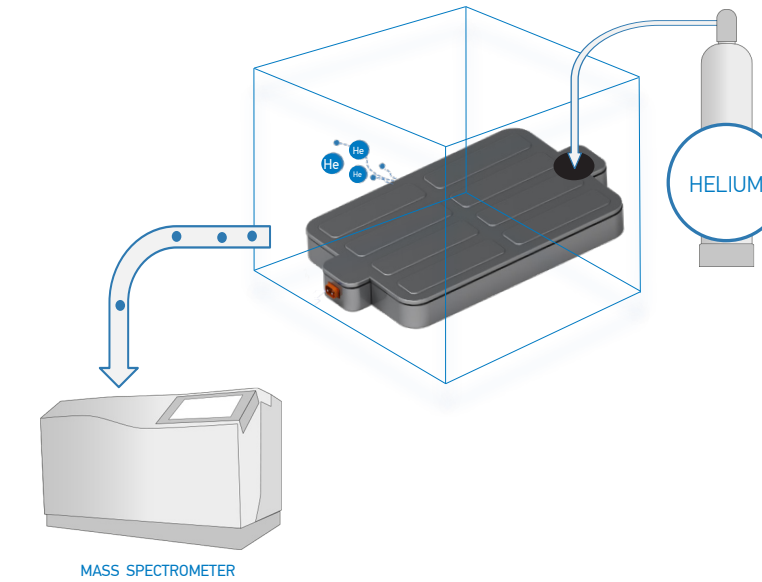
- Battery frame, tray and cover
- Chillers and cooling plates



LEAK TESTING IN THE BATTERY PACK ASSEMBLY LINE

- Sealing check of the cooling circuit
- Test of the external pack enclosure

HOW WE TEST?

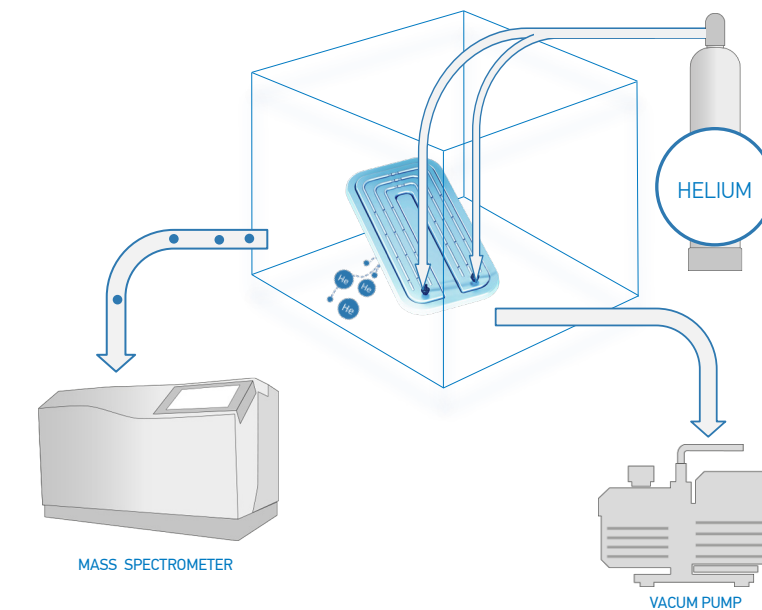


HELIUM IN ACCUMULATION CHAMBER

The Helium in Accumulation chamber is a global test capable of testing for leaks with thresholds in the range of 10^{-2} - 10^{-4} mbar l/sec.

This method involves the introduction of a tracer gas, typically helium, into the part to be tested. The part is then placed in an accumulation chamber. Any helium that escapes through leaks diffuses into the chamber. A mass spectrometer continuously monitors the helium concentration in the accumulation chamber.

Applicable on:
Tray & Cover – Battery Pack



HELIUM IN VACUUM CHAMBER

The vacuum chamber helium leak test is a highly sensitive technique for detecting and quantifying leaks in sealed components or systems. Depending on the part volume and the testing time, it is able to detect extremely small leaks, in the range of 10^{-5} - 10^{-7} mbar l/sec.

By positioning the cooling components in a vacuum chamber, introducing helium into the component and detecting its escape through leaks.

Applicable on:
Cooling Components