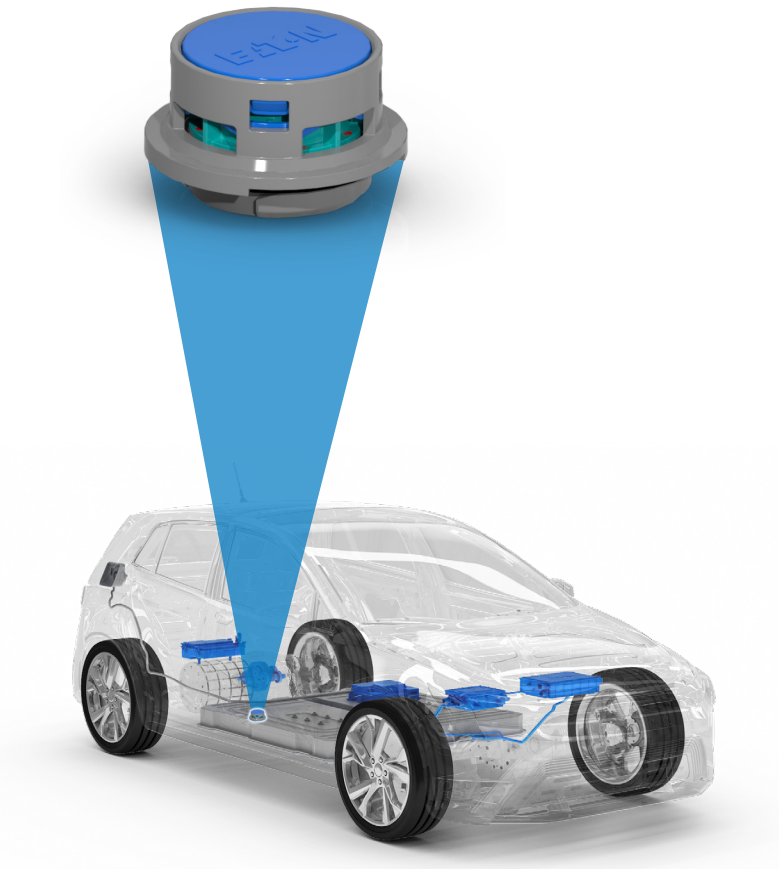
Battery vent valve technology
White paper

Ensuring EV Battery Safety

Powering Business Worldwide

Advanced protection for EV battery packs

Dual stage emergency vent valve



Does your EV battery end of line testing worry you?

For electric vehicle battery engineers, safety is of utmost importance. Your focus is on minimizing the risk of thermal runaway and developing effective cooling systems to maintain optimal operating temperatures of increasingly powerful electrified vehicles (EVs). You also work on improving battery management systems to monitor and prevent potential safety issues. But a particular importance is conducting thorough battery vent valve testing.

As battery packs become progressively more powerful and create more heat, the vent valve plays a crucial role in maintaining the safety of the battery pack. In case of overpressure or excessive gas buildup within the battery, the vent valve allows the release of gases to prevent hazardous situations. Testing ensures that the valve operates correctly, allowing for proper heat dissipation and to prevent overheating.

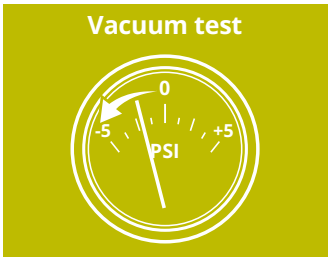
The importance of leak testing

Leak testing is important because it helps to ensure the safety and reliability of electric vehicle batteries. Leaks can allow moisture, dust, or other contaminants to enter the battery, which can cause a variety of problems, including:

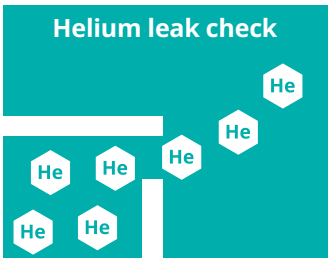
- Reduced battery performance: Moisture can corrode battery components and reduce the battery's capacity.
- Increased risk of thermal event: A leak could also allow the battery to come into contact with a heat source, which could lead to a thermal event.
- Reduced battery life: Dust and other contaminants can block the battery's cooling system, which can lead to overheating and shortened battery life.
- Short circuit: If moisture created a short circuit could render vehicle inoperable.

For these reasons, it is important to perform leak testing on EV battery packs to ensure that they are safe and reliable. Leak testing can be done using a variety of methods, including:

- Pressure testing: The battery pack is pressurized with a gas, and any leaks are detected by the loss of pressure.



- Vacuum testing: The battery pack is placed in a vacuum, and any leaks are detected by the inflow of air.



- Helium leak check: Introduce helium to interior of the battery case and sniff around edges to see if it slips through joints.

Leak testing is an important part of the quality control process for EV battery packs. By ensuring that the battery packs are leak-free, EV battery engineers can help prevent thermal events, reduce the risk of battery failure, and extend the battery's lifespan.

Here are some additional reasons why leak testing is important for EV battery engineers:

- To ensure compliance with safety regulations.
- To meet customer expectations for quality and reliability.
- To reduce the risk of warranty claims.
- To improve the overall performance of the EV battery.

Additionally, leak testing is an important quality control measure that can help to ensure the safety, reliability, and performance of EV battery packs. EV battery engineers should carefully consider the best leak testing method for their specific application and ensure that the battery packs are leak-free before they are released to the market.

To provide peace of mind for global battery engineers, Eaton's Mobility Group now offers a line of EV battery vent valves including a 3-in-1 battery pack vent valve that is capable of three unique functions, including a battery case leak-check mechanism, as well as passive and active venting to supply overpressure relief for a vehicle's battery pack.

3-in-1 Battery pack vent valve

Saves time, more thorough testing

Unlike traditional testing methods where a valve is left off to conduct leak testing and then replaced, Eaton's solution allows testing through the valve, so the entire battery pack is tested fully assembled. Also, some competitive solutions require several breathing valves on the battery pack casing, which must be masked off before testing. Eaton's 3-in-1 battery vent valve meets all flow requirements and overpressure relieve with one valve, so no masking is needed.

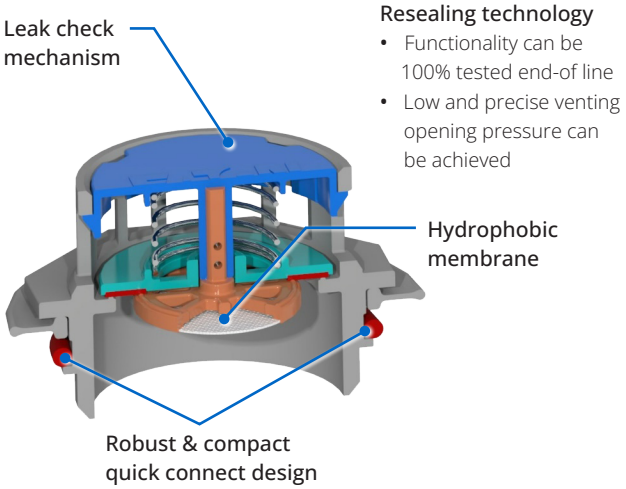
The vent's battery case leak-check feature eliminates the need to install the vent valve as the final step of the battery assembly process, which is the standard in today's EV architectures. Leak testing with Eaton's 3-in-1 battery vent valve is more thorough than traditional methods, as it includes testing the sealing surface of the vent itself when the battery vent valve is already assembled. Eaton has developed a tool for its customers to actuate the leak-check mechanism on their assembly lines, allowing for testing through pressurization or a vacuum, which ensures a proper seal to improve safety.

Passive and active venting

Sealed battery enclosures must compensate for temperature and pressure changes and keep water and dirt outside the battery pack. The vent prevents the enclosure from exceeding a pressure that would cause catastrophic failure during a thermal runaway event, when gases and heat are quickly generated. A battery thermal runaway situation can occur when individual cells inside the unit fail through physical impact or a short circuit. This is where the increasing temperatures and pressures released by cells exceed the venting capability of low flow breathing vents.

Tailored specifications

Eaton's battery vent valve can be precisely and flexibly designed to meet specific opening pressures and optimize venting. The valve's proven resealing technology allows Eaton's customers to specify exceptionally low opening pressures in comparison with conventional burst-valve technology commonly used in the market today. The battery vent valve also features a low flow breathing mode that allows air to move through porous material to normalize pressure during regular operation.



The 3-in-1 battery vent valve can be assembled either through a robust quick-connect feature or by a screwed-on metal-to-metal connection, which provides customers with the freedom to choose their preferred assembly method while also ensuring there is a sturdy connection that stays in place.

Hydrophobic membrane allows free breathing valve, blocks water

Eaton's 3-in-1 battery vent valve has a hydrophobic membrane that always allows the passage of air in and out of the battery case but will not allow liquids or dirt to enter.

Also, the valve is made of materials that meet a UL94 V-0 rating, a standard set by United Laboratories for testing plastics and rubber for flammability. Further, meeting a V-0 rating is the most stringent and means that the materials can withstand a vertical flame test which is required by most customers.

Enables compliance to industry standards

Eaton's 3-in-1 battery vent valve ensures that your batteries comply with global safety requirements and perform reliably.

To keep the interior of the battery case free from atmospheric particles as well as the ingress of water to the battery case, Eaton 3-in-1 valve complies with ISO 20653. The Eaton valve allows free breathing of the battery case by employing a hydrophobic membrane. This porous membrane maintains the pressure within the battery case at atmosphere. To meet this ISO standard, all sealing mechanisms within the valve will not allow the passage of debris or water.

To maintain the ability to contain debris within a battery case in case of thermal runaway, the Eaton 3-in-1 valve may include a metal mesh. This can help to meet compliance with GB 38031-2020: Electric Vehicles Traction Battery Safety requirements.

Trusted vapor management expert

Eaton is a leading automotive fuel vapor management supplier with 100-plus patents in over 12 product families. Our battery vent portfolio leverages more than 35 years of experience managing environmentally critical vapor venting systems and our global engineering team has both prototyping and testing capabilities.

Summary

Eaton's new 3-in-1 battery vent valve can help you ensure the safety, reliability, and performance of your EV battery packs. It allows you to leak test 100% of battery packs quickly and can be tailored to your unique venting requirements.

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Printed in USA
Publication No. EMOB0040
August 2023

Follow us on social media to get the latest product and support information.

Powering Business Worldwide