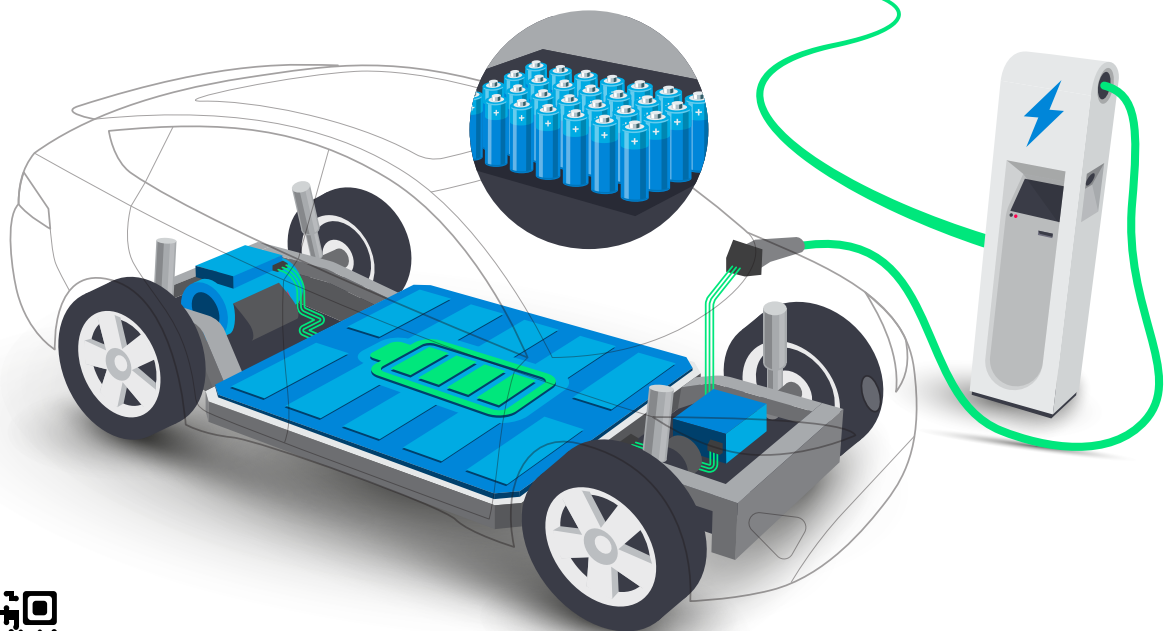


# Agilent Vacuum and Leak Detection Solutions for e-Mobility

An expanded platform assures manufacturing quality



Scan to get your copy of Agilent e-mobility brochure

# Vacuum & leak detection in e-Mobility

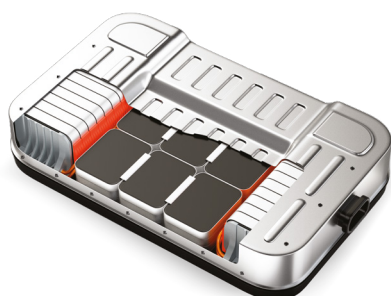
e-Mobility is poised to address today's challenges associated with climate change, fossil fuel dependence, and environmental protection through technological innovation.

Vacuum and leak detection solutions are key elements in advanced industrial processes for the electrification of vehicles.

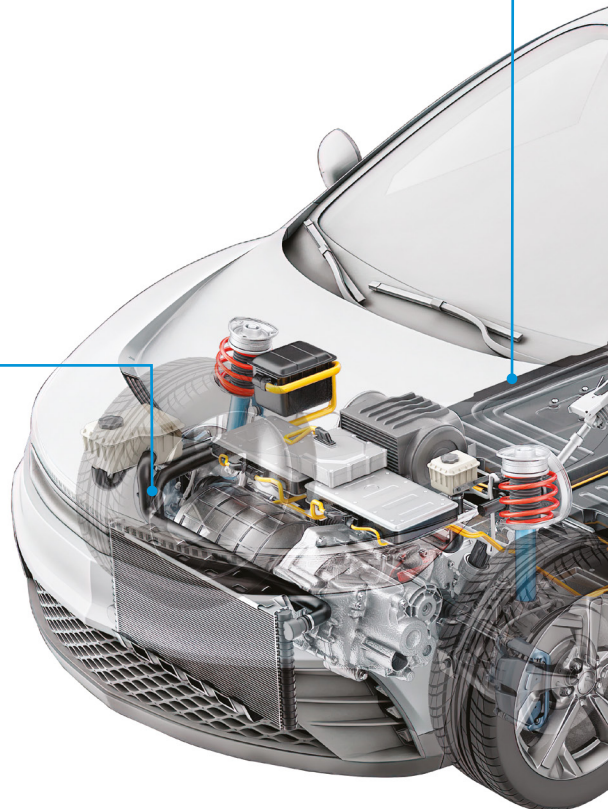
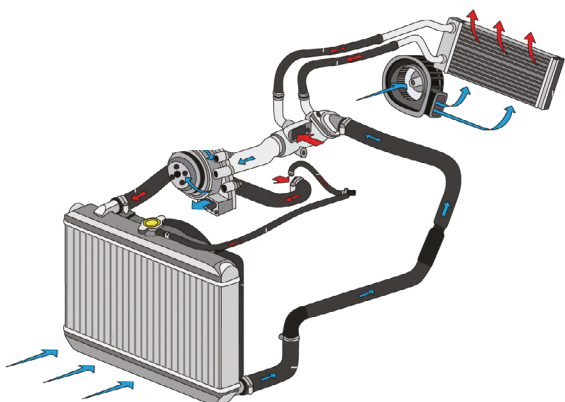
Agilent is committed to providing solutions to help in the transition to sustainable mobility.



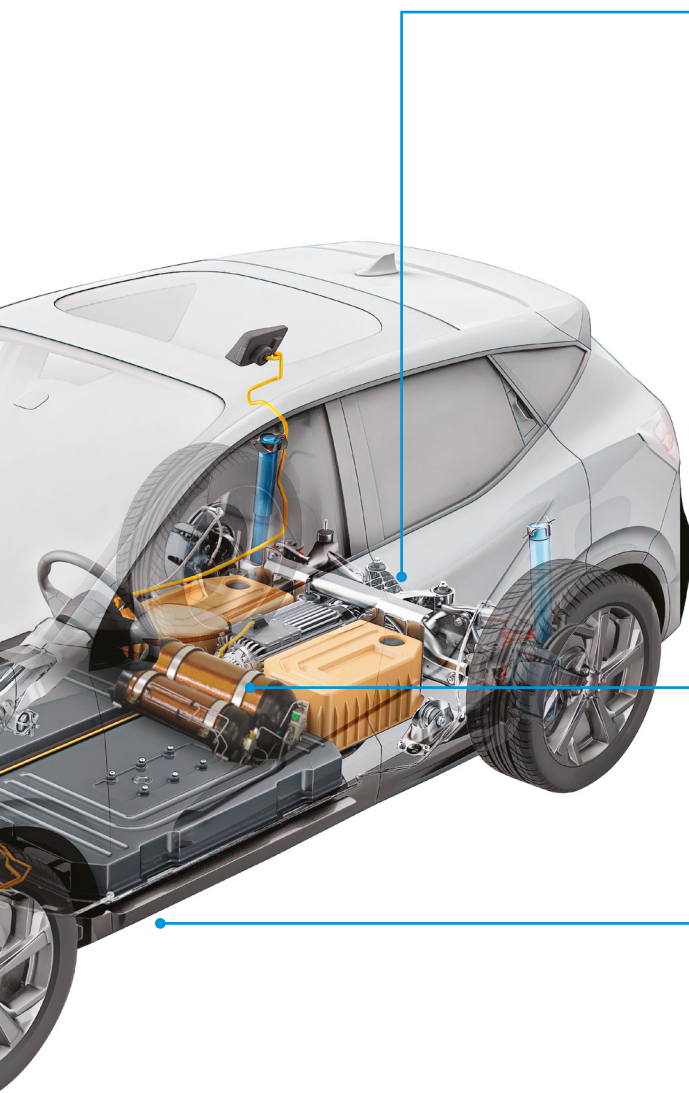
Energy storage



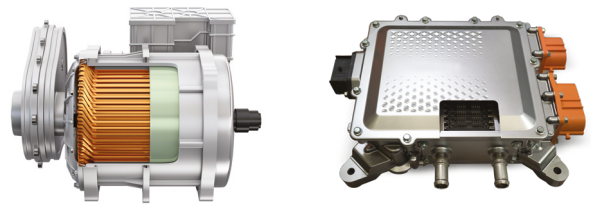
HVAC components and heating pump



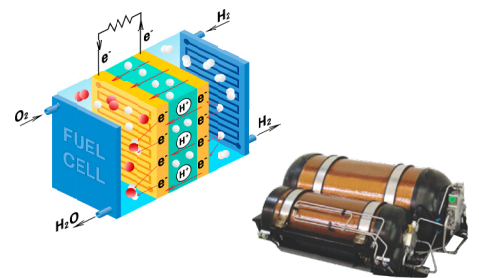
Vehicle electrification requires significant investment in infrastructure, including electric power generation, distribution networks, power storage for handling peak demand (storage batteries, fly-wheels), and battery chargers.



Drivetrain and power electronics



Fuel cell and hydrogen tank

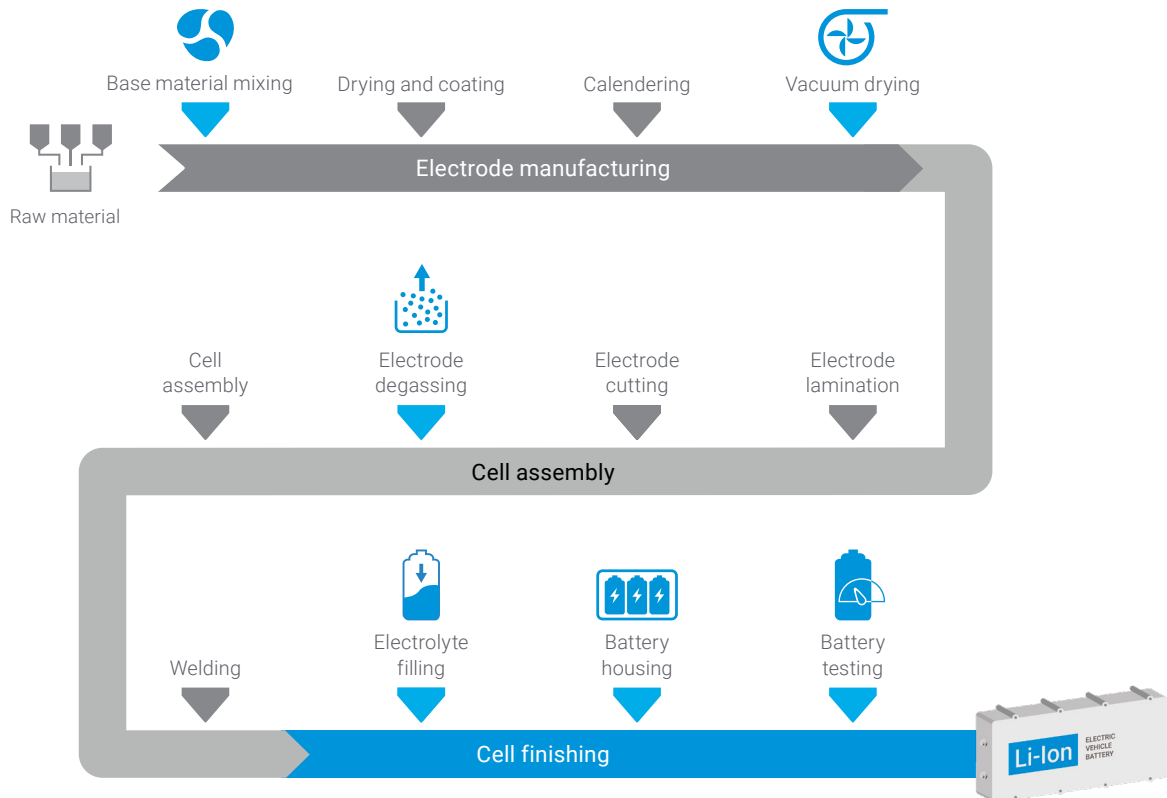


Battery cooling systems



# Battery production

Battery performance, lifetime, and overall quality are all heavily dependent on production process design. Agile solutions and experience can help optimize material use, and save process time while assuring product quality goals are met.

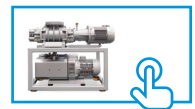


## Base material mixing

Active material, binder, and conductive agents are mixed under vacuum to reach the homogeneity, viscosity, and purity required.

Vacuum helps to eliminate air bubbles, supporting electrical performance.

Agilent Rotary Vane pumps and roots pumps provide efficient vacuum performance, and tolerate gases outgassed from the slurry mixing process.



RVP - Roots pumping system

## Vacuum drying

Laminated lithium-ion electrodes retain moisture, which must be eliminated through a drying process without damaging electrode microstructure.

Vacuum plays a key role in determining the water mass extraction rates.

Due to the high cleaning standards required for electrodes, vacuum pumps need to withstand solvent traces and humidity to guarantee hydrocarbon-free operation.



IDP - Dry Scroll Pumps



## Electrode degassing

The laminated and postdried electrode surface has superficial pockets filled with air that must be removed by vacuum treatment. Dry, hydrocarbon-free vacuum pumps are required in electrode surface degassing, as impurities, residual gas pockets, and oil residues impair electrical performance.

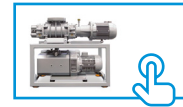


IDP - Dry Scroll Pumps

## Battery electrolyte filling

Filling proceeds under vacuum, to enable a perfect distribution of the electrolyte within the cell, guarantee electrode wetting, and prevent inefficiencies due to trapped gas bubbles.

Vacuum pumps for this process must withstand possible electrolyte residuals. Vacuum plays a key role, as it supports battery efficiency and lifetime.



RVP - Roots pumping system



IDP - Dry Scroll Pumps

## Battery housing

Battery housing plays a central role in e-cars, including crash safety, chassis integration, and a lightweight form factor. Housings represent protection for the battery, and need to be cooled, corrosion-resistant, and electromagnetically shielded. Helium leak detection is used to verify the tightness of the aluminum die-cast battery housing.



Helium Leak Detector

Discover Agilent solutions for leak testing of electric vehicle battery housing



### Battery Housing Leak Station

Leak Limit	$2.6 \cdot 10^{-3}$ mbar · l/s @ 13% He
Pressure	1150 mbar abs
Cycle Time	157 seconds



## Battery testing

Technological advances have led to the introduction of different types of batteries to meet the evolving requirements of vehicle manufacturers. Li-ion battery cells can either be made with a soft cover in the form of a pouch cell, or with a hard cover in cylindrical or square form.

To ensure high quality standards in lifetime, performance, and safety, leak tightness of both the battery module and the final battery assembly are critical.

Agilent leak detectors and dry pumps offer the state-of-the-art performance to identify potential harmful leaks during the battery manufacturing process.

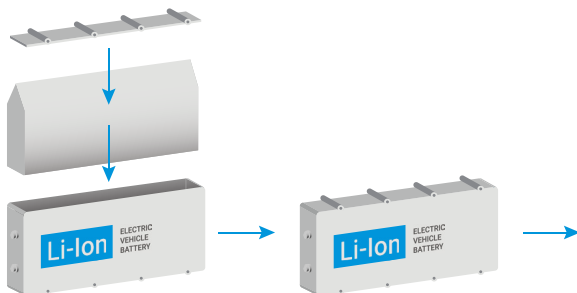


Helium Leak Detector



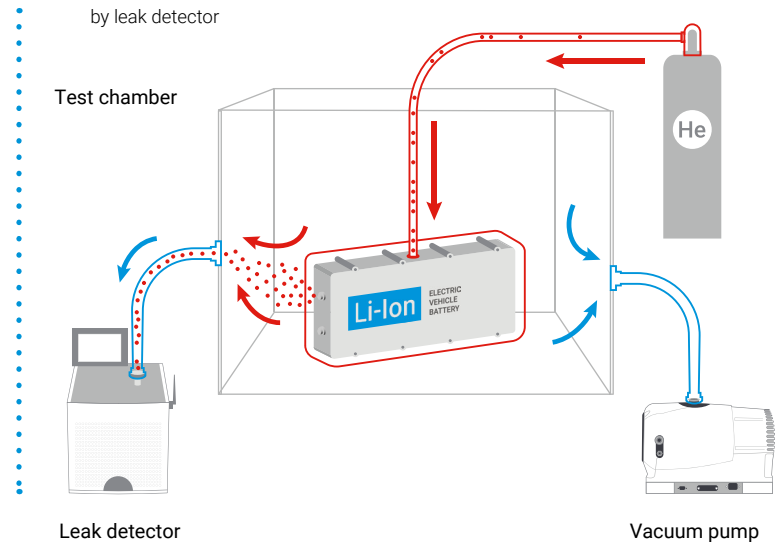
IDP - Dry Scroll Pumps

## Battery assembling



## Battery testing

- Test chamber is evacuated
- Battery pack filled with He
- He released by leaks is detected by leak detector



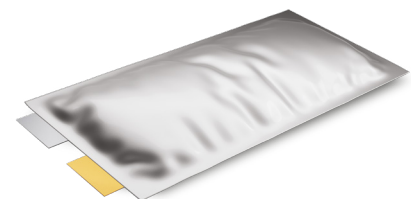
## Battery form factors



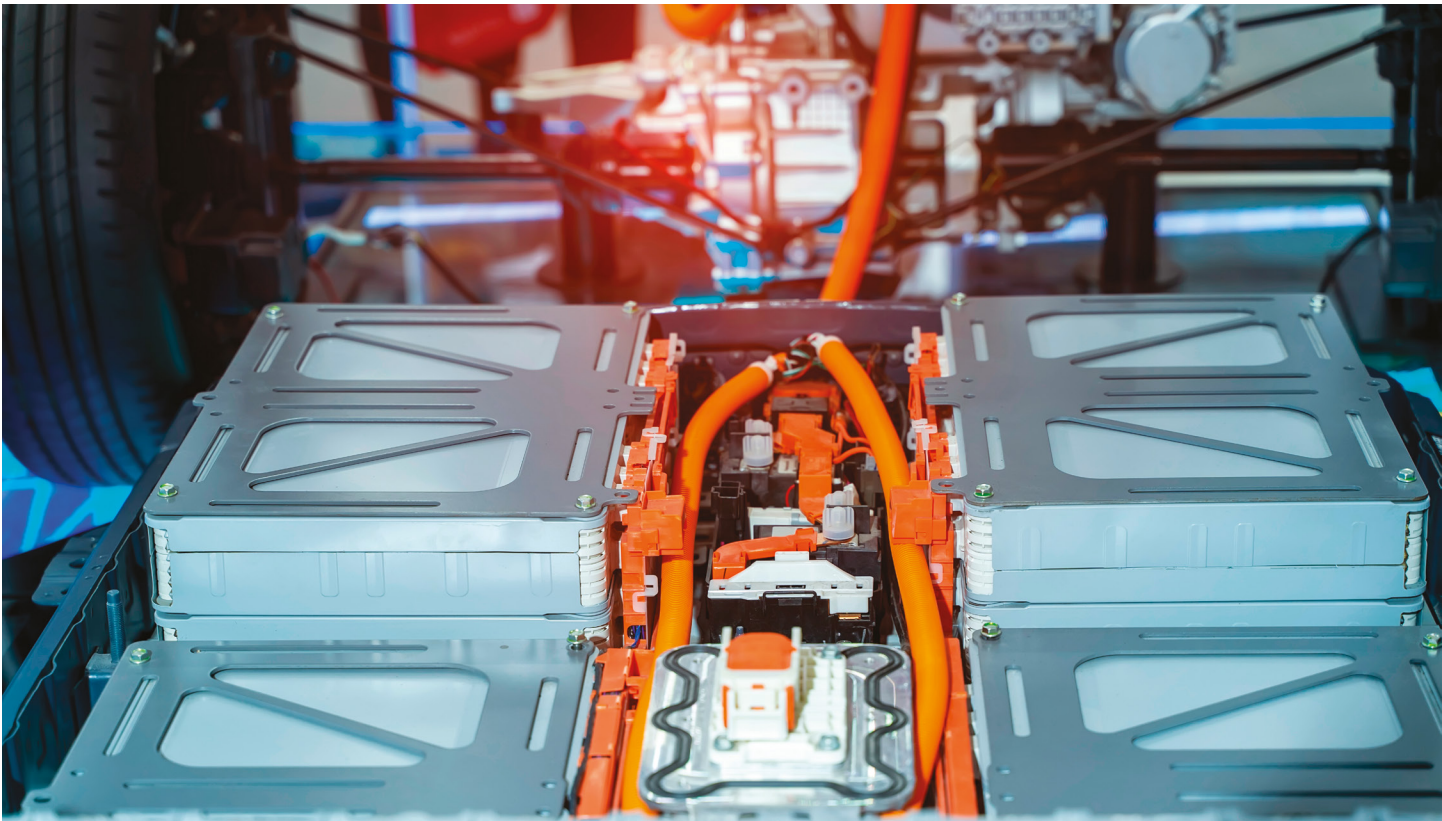
Prismatic lithium battery



Cylindrical lithium battery



Pouch cell lithium battery





# Battery Cooling

As batteries become more efficient and powerful, car manufacturers are forced to design new thermal management systems. Cooling systems must maintain battery temperature in a range of operation between 20 and 40 °C, with a very low temperature differential among different battery modules.

Liquid coolers are considered the most efficient solution for maintaining the battery pack in the correct temperature range, with the required uniformity.

New generations of electric vehicles are equipped with water-glycol battery coolers in one of three designs: intercell serpentine, tab, or large flat cooling surface.

Water leakage in battery coolers is a serious issue, impacting battery durability, as well as battery pack safety. Highly sensitive helium leak detection systems can easily find such leaks.

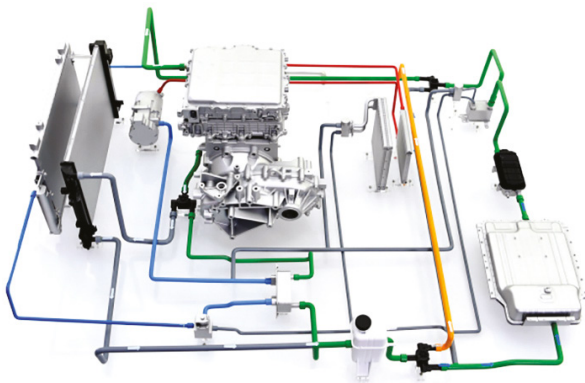
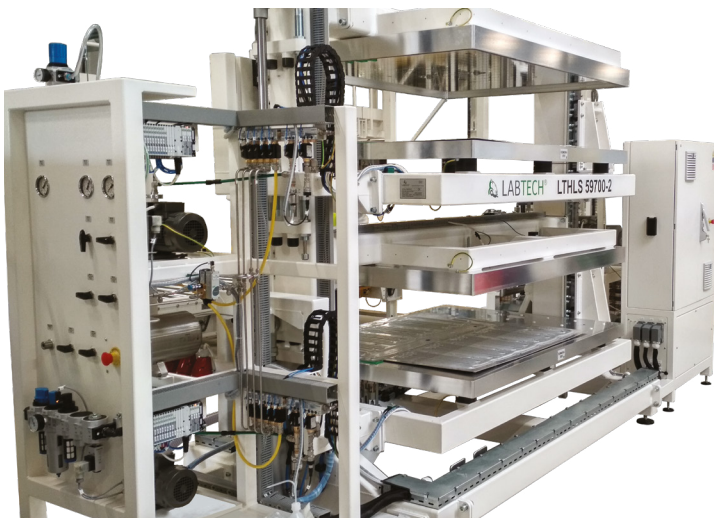
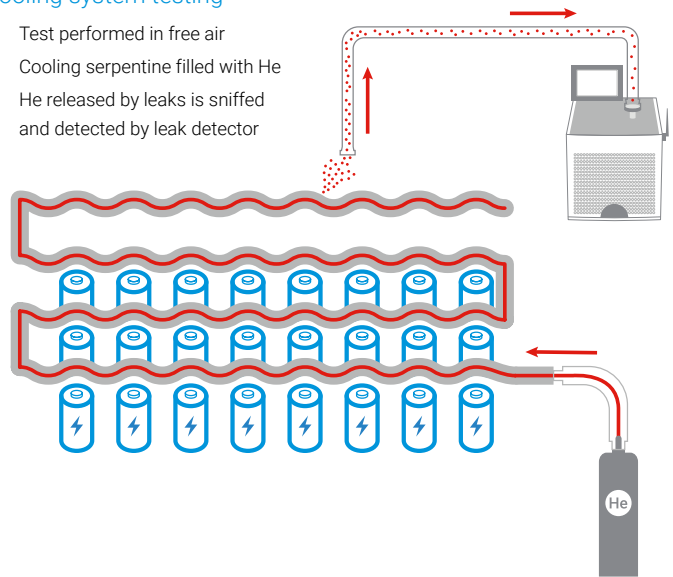


Figure 1. Electric vehicle integrated temperature management system.

## Cooling system testing

- Test performed in free air
- Cooling serpentine filled with He
- He released by leaks is sniffed and detected by leak detector



## Battery Cooling Leak Station

Leak Limit	$7.5 \cdot 10^{-3}$ mbar · l/s @ 13% He
Pressure	3 to 5 bar
Cycle Time	23 seconds



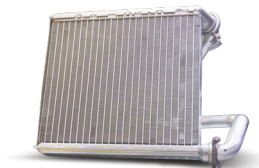
Figure 2. Car HVAC system.

## HVAC systems

### Heating, Ventilation, and Air Conditioning (HVAC) systems

Unlike thermal engines, highly efficient electric motors produce very little heat, so the cabin air temperature must be raised by other means. Early electrical vehicles used simple resistive heaters, while newer vehicles use systems based on heat pumps capable of efficiently transferring outside thermal energy into the cabin.

This technological HVAC evolution requires extensive use of vacuum and leak detection solutions to produce efficient and reliable components.



Heat Exchanger Leak Station 

Leak Limit	$1.7 \cdot 10^{-4}$ mbar · l/s 3g/year, R744
Pressure	200 bar
Cycle Time	27 seconds



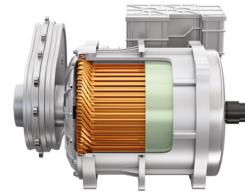
## Electric motor


Electric vehicle producers develop innovative motor/generator technologies to make them modular, lighter, more affordable, quieter, and more efficient than traditional electric motors. In all of these, leak water detection and humidity tightness are absolute priorities, as water is the primary enemy of electric and electronic parts.

Agilent helium leak detectors allow faster and more precise leak location and measurement for electric vehicle motors completely sealed against humidity.

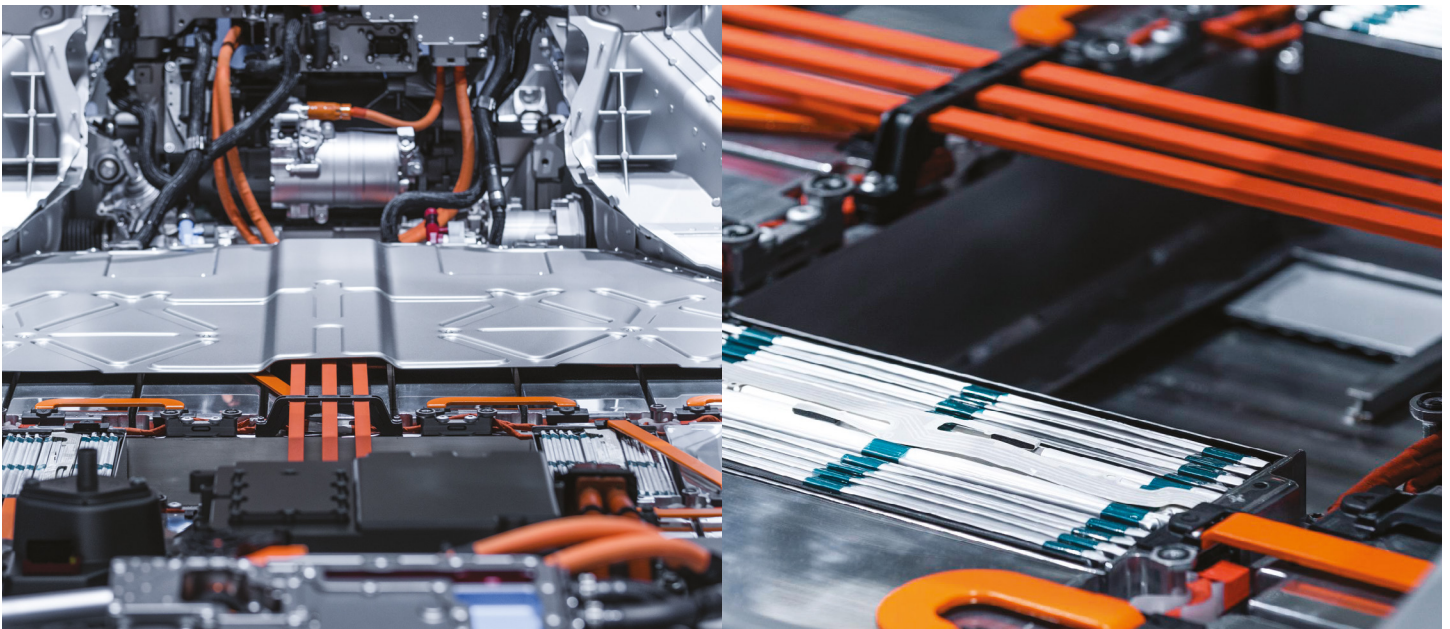


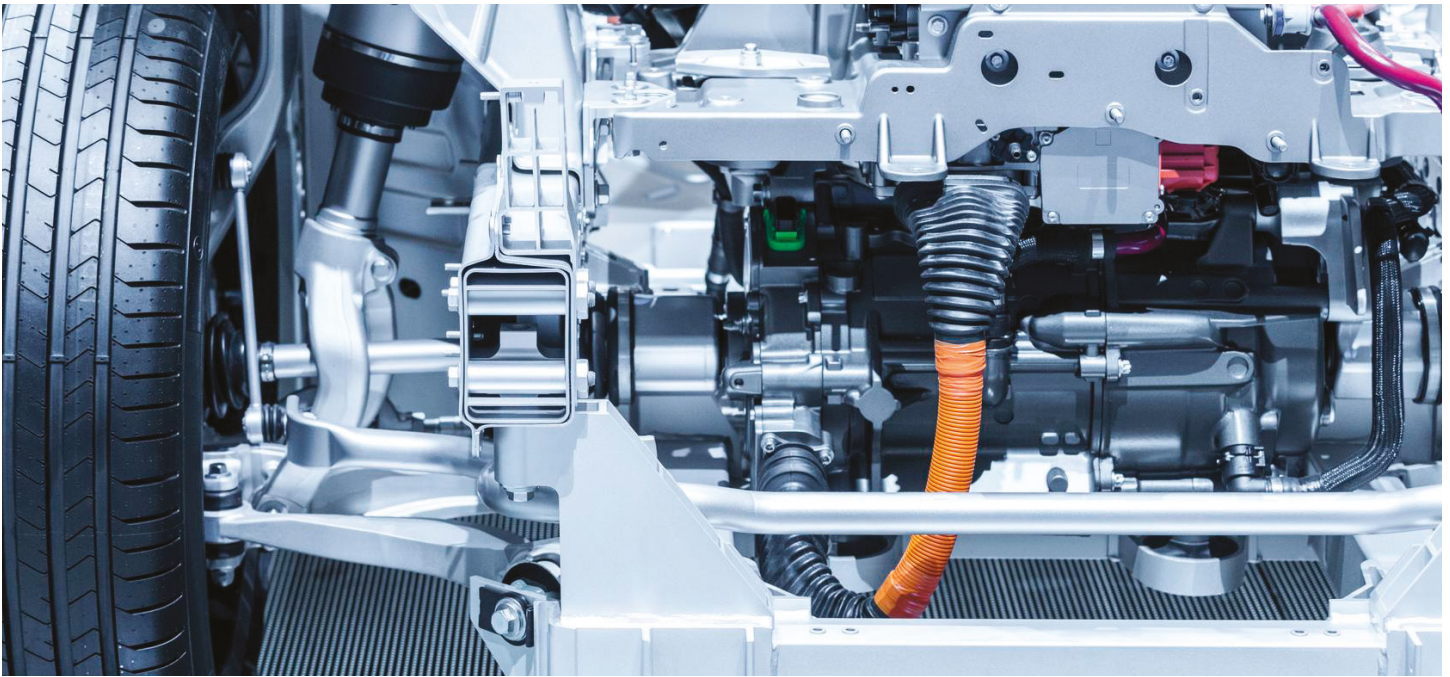
Helium Leak Detector



Electric Motor Leak Station 

Leak Limit	$8 \cdot 10^{-3}$ mbar · l/s
Pressure	3,5 bar rel
Cycle Time	80 seconds





### Electric & electronic components

Electric vehicle operating range is not dependent on battery capacity alone. To improve the efficiency of a car's internal electrical distribution, new materials and processes are implemented to manage higher voltage, temperatures, and insulation challenges.

Inverters, connectors, filters, busbars, and safety devices all play a key role in propulsion-grade power electronics. All of these components require insulating or environmental coatings.

Agilent is pleased to be a supplier of diffusion and turbomolecular pumps for advanced coating equipment.



Diffusion Pumps



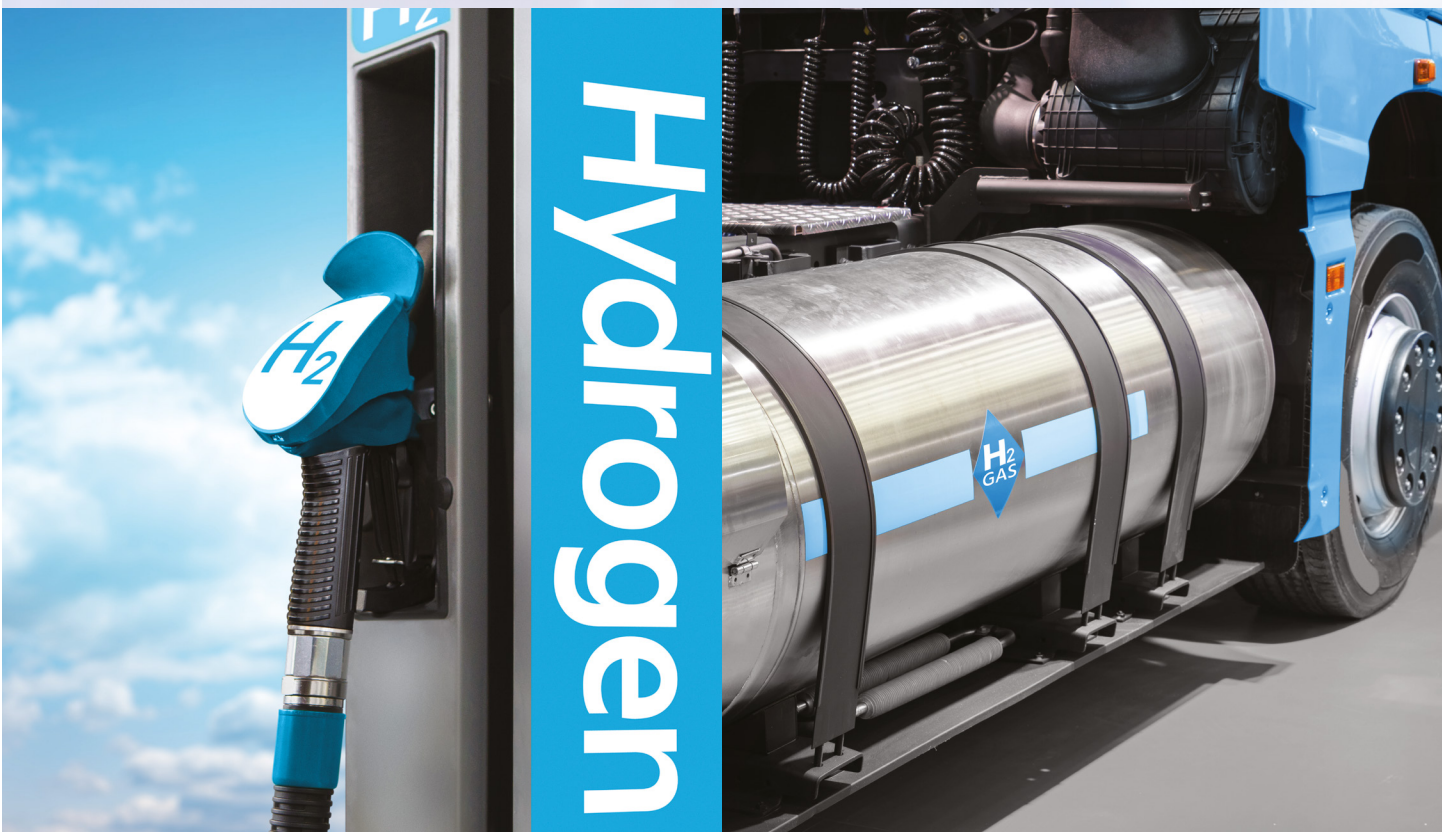
Turbo Pumps



Coating System 







# Fuel cell e-mobility

Fuel cells represent a further zero-emission alternative to combustion engines

The most promising technology is based on hydrogen gas. In fuel cells, hydrogen reacts electrochemically to produce electricity and power the vehicle. Energy recaptured from brakes is stored in a battery to provide extra power during short acceleration events.

Fuel cell generators, gas tanks, and distribution lines must be hermetically sealed to prevent leaks that potentially impact performance and safety.

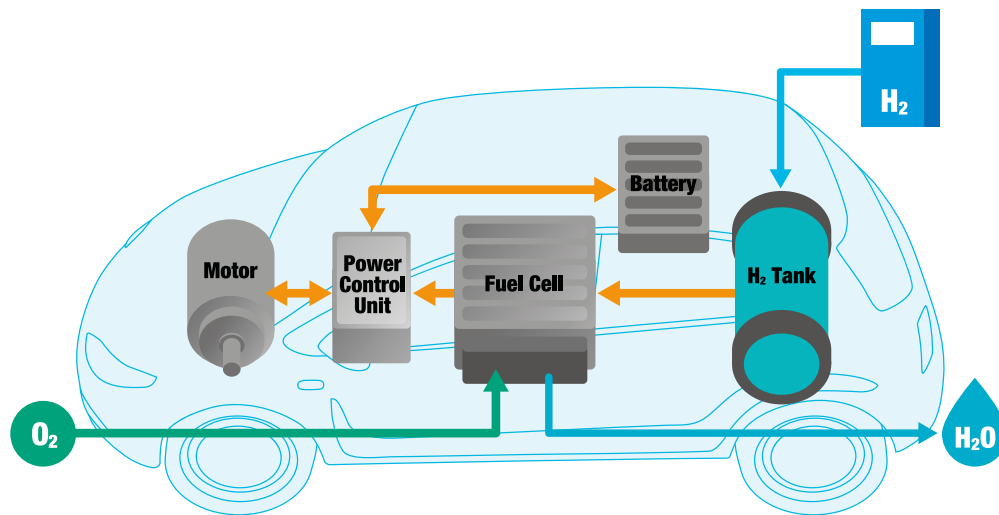
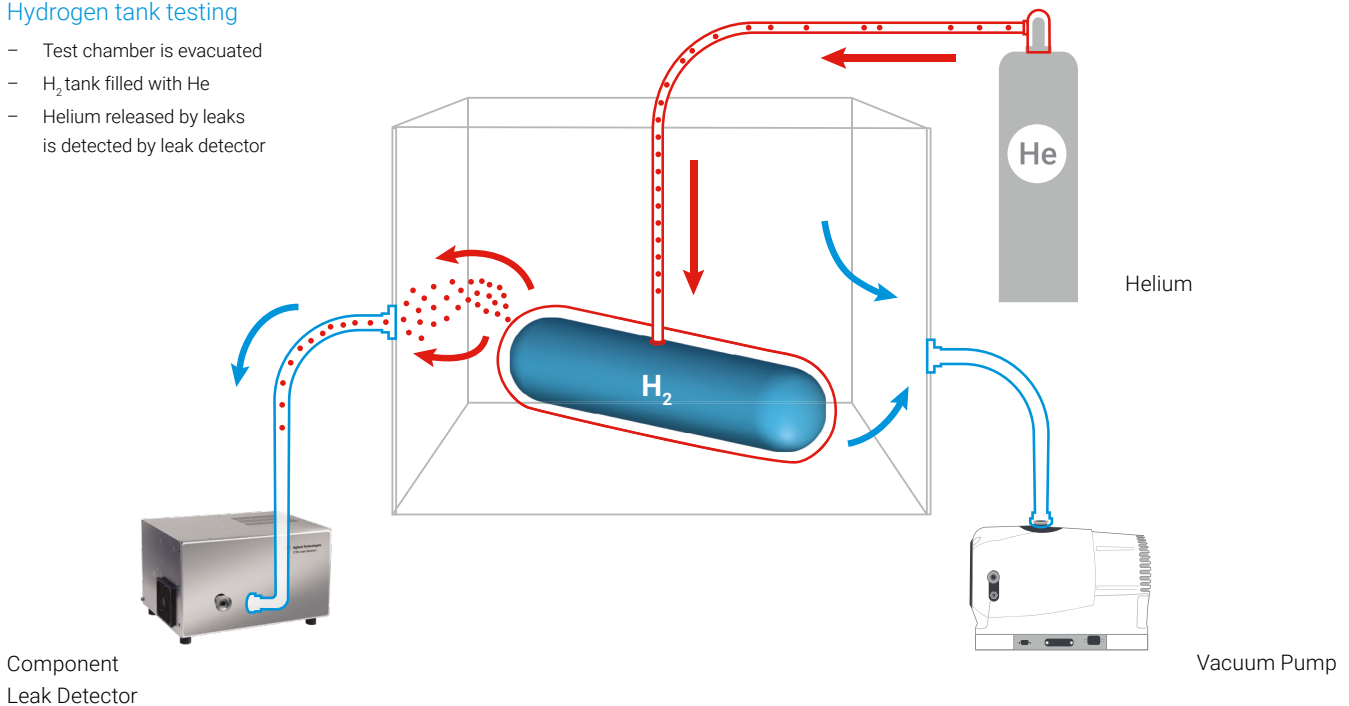


Figure 3. Fuel Cell working scheme.

## Hydrogen tank testing

- Test chamber is evacuated
- H<sub>2</sub> tank filled with He
- Helium released by leaks is detected by leak detector



# Dry vacuum solutions & leak detection for green processes.



## Vacuum Gauges

- Smart pressure measure solutions
- Measurement range from  $6 \times 10^{-12}$  to atmosphere
- Designed for demanding applications, high accuracy, and long-term stability
- Multi-gauge remote control unit or onboard pressure reading



## Dry Vacuum Pumps

- Dry hydrocarbon free scroll pump solution
- Typical size from 3 to 30 m<sup>3</sup>/h
- Inverter driven option
- Low noise and hermetically sealed design



## Turbomolecular Pumps

- Dry high vacuum process pump
- Pumping speed from 70 to 3000 L/s, high gas load
- Reliable, robust, and maintenance free
- Resistant to air in-rush, dust, and process particle
- Rugged integrated IP54 control unit



## Leak Detectors

- State-of-the-art helium detectors for accurate and fast leak measurement
- Wet or dry pumping configurations
- Mass-spec and permeable membrane technologies
- Ease of use, stable, and repeatable measurement.



C15 for integration

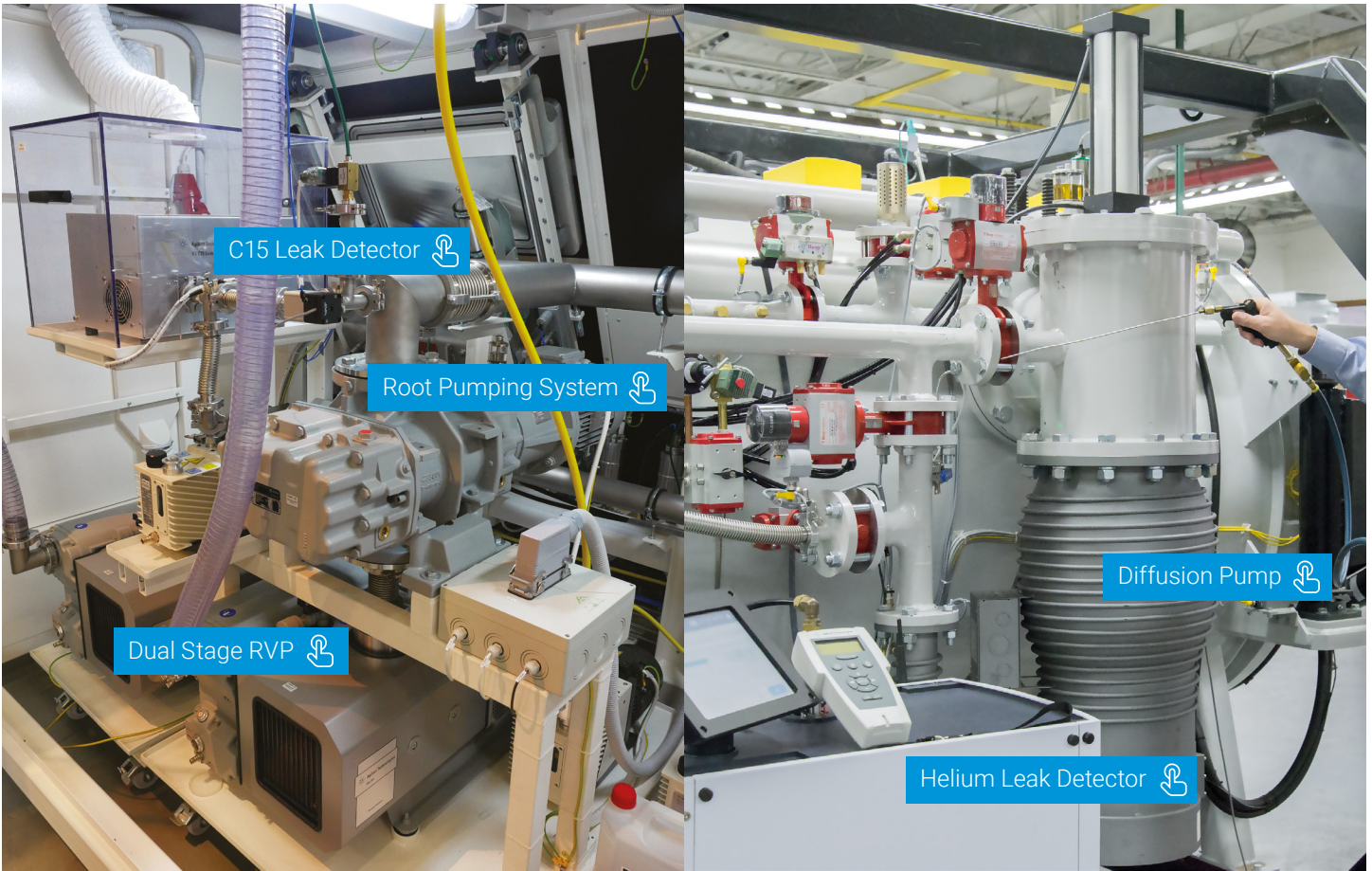


Portable PHD-4



HLD Stand alone





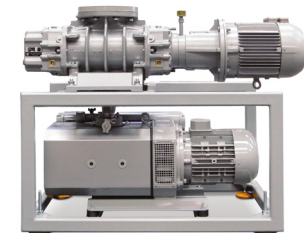
### Diffusion Pumps


- The worldwide benchmark for diffusion pumps
- Pumping speed up to 50,000 L/s
- The highest throughput with minimized back-streaming
- Robust design for a long service life



### High-Capacity pumps

- Rotary Vane and Roots configurations for a wide range of industrial processes
- Rugged mechanical and roots pumps provide wide operating range for demanding industrial applications
- Optimized oil retention and mist separation with minimum maintenance



Discover a complete portfolio of Agilent solutions for e-mobility 

Learn more:

[www.agilent.com/en/product/vacuum-technologies/helium-leak-detectors](http://www.agilent.com/en/product/vacuum-technologies/helium-leak-detectors)

For information on leak detection instruments:

[www.agilent.com/en/product/vacuum-technologies/helium-leak-detection](http://www.agilent.com/en/product/vacuum-technologies/helium-leak-detection)

Get answers to your technical questions and access resources in the Agilent Community:

[community.agilent.com/community/technical/vacuum](http://community.agilent.com/community/technical/vacuum)

Agilent's Online Store:

[www.agilent.com/chem/store](http://www.agilent.com/chem/store)

Contact an Agilent Vacuum Expert:

U.S.

Toll-Free: **1-800-227-9770**

**vpl-customer@agilent.com**

Europe and other countries

Toll-Free: **00800 234 234 00**

**vpt-customer@agilent.com**

China

Landline phone: **800 06 778**

Mobile Phone: **400 06 778**

**contacts.vacuum@agilent.com**

Applications videos and images courtesy of:

LABTECH s.r.o.

[www.helium-leak.eu](http://www.helium-leak.eu)

Arzuffi S.R.L.

[www.arzuffisrl.it/en](http://www.arzuffisrl.it/en)



DE81357925

This information is subject to change without notice.

© Agilent Technologies, Inc. 2022  
Published in Italy, June 15, 2022  
5994-5053EN

