PFEIFFER VACUUM

THE MASS SPECTROMETER INSIDE THE LEAK DETECTOR

Functionality and benefits

Helium leak detection has established itself for many years as a method for testing the tightness in various fields of application. Its high degree of sensitivity, the reliability of its measurements as well as its easy reproducibility are the most convincing advantages compared to other tightness test methods.

For detecting test gases, Pfeiffer Vacuum offers leak detectors based on mass spectrometers. Mass spectrometers ionize a gas mixture and isolate the desired tracer gas on the basis of their mass-to-charge ratio. Due to the low detection limit of the mass spectrometer, the high degree of sensitivity for the Pfeiffer Vacuum leak detector is guaranteed.

Mass spectrometer is the centerpiece of the leak detector

The so-called "spectrometer cell "is the centerpiece of the helium leak detector. From the inlet of the leak detector, the gases are guided into the spectrometer cell. Here, the electrically loaded gas particles are bombarded with an electron beam at high energies (figure 1, violet). This beam is generated by a filament at high temperatures. If an electron is hit in the shell of a neutral gas particle, it emerges from the electron shell. Consequently, a positively loaded gas particle – an ion – remains. A large part of the introduced gas particles is ionized by these collisions between electrons.

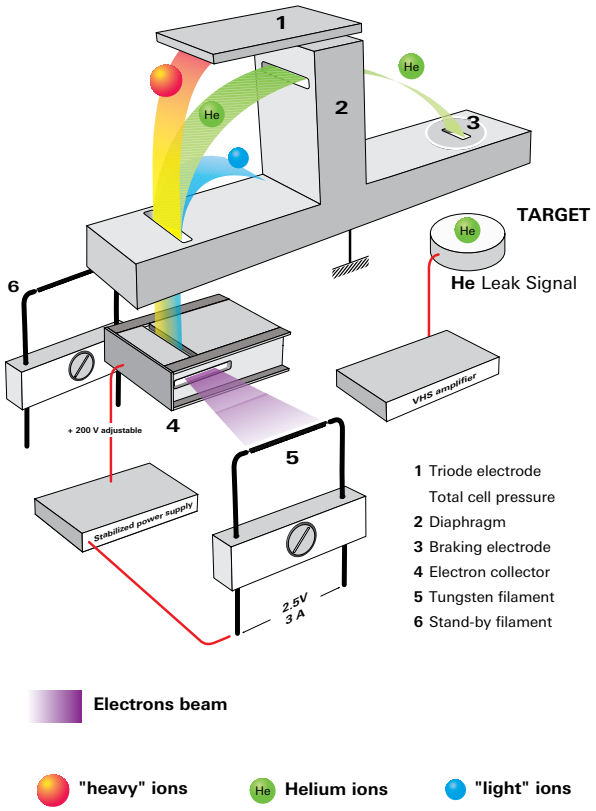

Figure 1: Function of a sector field mass spectrometer

The positively loaded gas particles which are still present in the mixture are now accelerated in an electrical field (figure 1, upward rainbow ray).

Splitting the gas mixture in a magnetic field

The complete analyzer cell is positioned inside a magnetic field. The arrow in figure 1 indicates the direction of this magnetic field. Here, the loaded gas particles are separated according to their mass-charge ratio. In most cases, only one electron was removed. The separation depends only on the mass in a first approach. The different mass of the gas mixture of air and the test gas helium leads to a separation of the mixture into single rays. Light gases describe a tight orbit while the orbit of heavy gases has a greater radius. Hydrogen (as an atom mass 1, as a molecule mass 2) thus describes the tightest orbit (figure 1, blue ray). The heavy gas particles of the air – most of all water (mass 18), nitrogen (mass 28), oxygen (mass 32), carbon dioxide (mass 44), argon (mass 40) – describe the widest orbit and smash against the disk labelled as "1" in figure 1.

The magnetic field around the spectrometer cell is constant. The abovementioned accelerating voltage for the rainbow ray is now set in a way that makes the particles of the test gas helium (figure 1, green ray) fly through different orifices before they hit a signal amplifier. The energy of the helium ion is an indicator for the partial pressure of the test gas inside the vacuum system and therewith also for the leak rate of the test object.

A vacuum system is needed to allow the helium ions to fly from their origin to the detector. At atmospheric pressure, a helium ion is able to fly around 0.2 µm before it collides with other gas particles. At a maximum pressure in the spectrometer cell of 10^{-4} mbar, the helium ion is able to fly around two meters. Only by the aid of the evacuated spectrometer cell, it can be assured that the test gas reaches the detector unimpededly. The spectrometer cell can be adjusted to hydrogen as well.

Leak detection solutions by Pfeiffer Vacuum

With its broad leak detector portfolio, Pfeiffer Vacuum offers the optimal solution for every application. No leak is too small or too big to be found. From portable to universal high performance leak detectors, Pfeiffer Vacuum offers the right product for every application and requirement.
Advantages at a glance:

- Easy operation
- High performance and reliability
- High sensitivity
- For international use

Are you looking for a perfect vacuum solution? Please contact us:

Pfeiffer Vacuum GmbH
Headquarters · Germany
T +49 6441 802-0
info@pfeiffer-vacuum.de
www.pfeiffer-vacuum.com