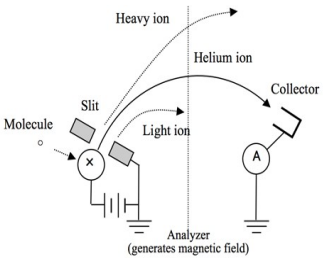
Helium Leak Detector

Why use helium for leak detection?

Helium is the best choice to find leaks because it is non-toxic, inert, non-condensable, non-flammable, present in the atmosphere in trace amounts (5 ppm). Due to its small atomic size, helium passes easily through leaks. The only molecule smaller than helium is hydrogen which is not inert. Helium is lighter than the next inert gas neon, which is more expensive. It is also relatively inexpensive and is available in various size cylinders and also in pure form easily. There are other leak detection methods but none of them is as accurate in terms of localization and quantification, as helium leak detection method.

Principle of helium leak detector (HLD)



The HLD leak detector is based on the principle of field mass spectrometer. The leaked helium gas is ionized by the electron beam from the filament within the ion chamber of the analyzing tube. The ions are accelerated using added voltage and move out through a slit and then pass through the magnetic field generated by the analyzer. Since the circular trajectories of the ions depend on their mass, the collector can catch only the helium ions and detect helium. Using a special detector the ion current is converted into an electric current. This current is accelerated and displayed on the screen using leak detection units. The measured current is in direct proportion to helium concentration and therefore equal to the measured leak.

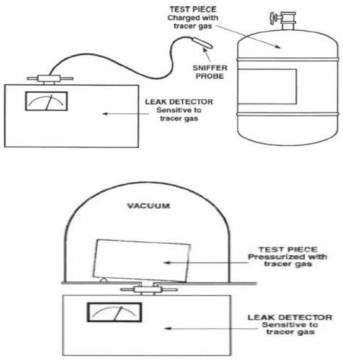
The HLD is a system containing the following modules:

- Helium mass spectrometer leak detector,
- Control system and valves which control individual steps of the measuring cycle, from evacuation to testing to venting,
- Rotary & TMP vacuum pumps to maintain sufficiently low pressure in the spectrometer,
- Vacuum Gauge for measuring the vacuum and
- Fixtures, which connect the unit to be tested with the detector.

Procedure of leak detection in the testing chamber or test piece (TP):

There are two main methods to leak test units using helium: Vacuum Testing (outside-in) and Pressure Testing (Inside-out). The detection method should be selected based on the working conditions of the part to be tested. It is important to maintain the same pressure conditions during the test as will exist during the actual use of the part. Vacuum systems should be tested with a vacuum inside the chamber. A compressed air system should be tested with high pressure inside the system.

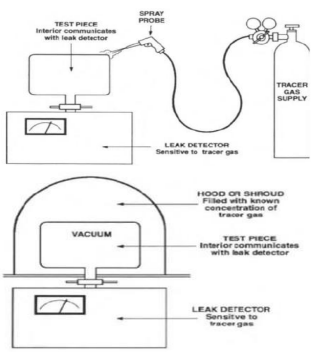
I. Pressure Testing (inside-out) can be carried out in two ways depending on the TP.



(a) In the sniffer-probe mode, the TP is filled with tracer gas and the exterior is scanned with a probe that is attached to the inlet of the leak detector. The probe continuously admits (or "sniffs") some of the air directly surrounding the TP. This air is inducted to the analytical portion of the leak detector, where any of the tracer gas that may be leaking from the TP is detected.

(b) The TP is filled with tracer gas and is placed in a test fixture that is subsequently evacuated. Any of the tracer gas that flows out through a leak is captured in a volume surrounding the TP. The contents of this volume are analyzed by the leak detector as representative of total leakage.

II. Vacuum Testing (outside-in) can be carried out in two ways depending on the TP.



The TP (if it is of smaller volume) is evacuated directly by the leak detector. If the TP is of large volume, it is additionally evacuated by a separate vacuum pump.

(a) In the spray-probe mode, a gas gun (connected to a helium cylinder) is used to discretely spray He gas on suspected leak sites of the TP. Any leaks are evidenced when He gas molecules flows through the leaks of the evacuated TP and is detected by the leak detector.

(b) The TP is placed in a volume containing He gas, which flows through all leaks to the interior of the TP, where it is detected.