How To Choose A Helium Leak Detector

J.P. DELUCA

Two basic methods of leak detection are compared.

Regardless of the application, there are fundamentals that must be considered before a choice of an appropriate helium leak detector can be made. There are bewildering varieties of leak detectors to choose from, and anyone not familiar with the various types will find it difficult to make an informed choice. Engineers are often given the task to make this choice, but only limited information is generally available on which to base their decision. To complicate matters further, there are at least two different methods by which helium is used to find leaks. Part one of this article will focus on these methods. Part two, which will appear in the May/June 2005 issue, will focus on choosing the appropriate leak detector.

Even the language of "leak detection" is often misunderstood, which is why it is important to understand the concepts involved. Helium, which is inert and safe, is used as a test gas due to its small molecular size, low molecular weight, and low natural abundance in air (5 ppm). Both a helium source and a leak detector are required to accomplish testing.

Before a selection of leak detection methods can be made, some basic leak specifications must be known.

Figure 1. Inboard leak testing a gas panel, using an Adixen ASM 142.

- The total leak rate permitted, generally specified as Atm.cc/sec.
- For inboard testing, the speed with which leaks need to be found. This bears directly on the size of the vacuum pump.
- If hundreds or thousands of parts must be leak checked, a leak detector must be capable of very fast cycle times otherwise impossibly long test times will be required.
- If on the other hand large vessels need to be checked, large vacuum pumps are required if the inboard method is to be used.

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Leak detectors can further be differentiated as to whether they use oil-sealed vacuum pumps or not. This fact may be important when the parts to be tested need to be ultra clean, as is often the case for medical or semiconductor applications. In some cases, the oil used in the rotary vane pump (roughing/backing pump) to lubricate, could find its way into the parts to be tested due to a physical phenomenon called oil back streaming. In the most critical leak detection applications it may be advisable to purchase a leak detector that contains only oil-free vacuum pumps.

Hard Vacuum Method

The first test method is called the hard vacuum method. This method consists of connecting the part to be tested to a helium leak detector, which contains the vacuum pumps and detection electronics in one integrated package. Vacuum is automatically generated inside the part and once a predetermined vacuum is reached, helium is sprayed around the outside of the part. If the part leaks, helium will find its way inside and the helium leak detector (HLD) will automatically measure and indicate the total leak. As well as the total leak rate, the exact area of the leak can be pinpointed with high reliability making this method very popular. High leak rate sensitivity, coupled with a wide sensitivity range and excellent repeatability are further reasons to use this method.

A further drawback [Outboard Test Method] is that only one leak at a time can be detected.

Outboard Test Method

The other method is known as the outboard test method. It consists of pressurizing a part with helium and passing a wand, also known as a sniffer probe, around the part. If any helium leaks from within the part, it is introduced via the sniffer probe to the helium leak detector where once again it will be detected. In the case of gas industry applications this method has advantages in that parts can be pressurized which is generally the way in which they are used. This method has several disadvantages, namely the smallest detectable helium leak is eliminated by the natural amount of helium, which is present in air of 5 PPM. Furthermore, this method cannot measure the exact value of a leak, as the amount of helium sampled by the sniffer probe will depend on the distance between the leak and the probe. A further drawback is that only one leak at a time can be detected and therefore it cannot determine the total leak present in a part. As can be seen, this method is operator dependant as both the distance from the leaking part and the speed with which the probe is moved influence the amount of helium detected.

Conclusion

Two helium leak test methods are available when leak testing a component. Leak test requirements and/or the capability of the part to withstand vacuum, and/or pressure will determine the best method to meet the test specifications. After examining and understanding these issues, the criteria for the selection of the appropriate type of the helium leak can be evaluated. The topic of selection will be discussed in part two of this article,

Figure 2. Inboard leak testing a mass ow controller, using an Adixen ASM 142.

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Glossary of Terms

Detection limit – The theoretically smallest helium signal that a leak detector can sense in a production environment with a high level of repeatability. The limit is approximately 10^{-10} Atm. cc/sec.

Helium Background – Both the natural concentration (5 parts per million-PPM) of helium in air as well as the increase of helium when used in leak detection.

Leak Rate – The maximum total leakage permitted in the part usually expressed in Atm.cc/sec.

Oil Backstreaming - The passage of pump oil vapors in the direction opposite to the direction of desired gas flow.

Recovery time – The time it takes for the leak detector to return to normal when exposed to a large helium leak

Response time – the time for a leak detector to sense 63% of the total leak rate.

Roughing capacity (Pumpdown time) – The capacity of a vacuum pump to handle gas load which results in the speed with which it can reduce the pressure in a vessel or system from atmospheric to a value where the leak detector can begin to operate.

Choosing a Helium Leak Detector for your Application : Part II

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Determining parameters for inboard and outboard leak detection methods

Introduction

As discussed in part one of this article (March/April 2005 issue), there are two major methods, the inboard and the outboard, which can find leaks using helium as the test gas. The fundamental method by which the helium is detected and quantified is the same in both cases. In order to be in an informed position to make a purchasing decision, the fundamental parameters, which need to be understood and chosen, are discussed for both methods.

A dedicated helium detector (Adixen ASM 102S)

The outboard method requires a leak detector with a sniffing mode and also requires that the part to be tested is pressurized with helium. (It is recommended that the pressure is the same as the operating pressure of the part.) A hand held sniffing probe, which is moved around the atmospheric side of the leaking part and sucks helium (and air) into the leak detector, is also needed. The selection of a sniffing leak detector revolves mainly around the following technical features or requirements:

- The smallest leak that can be detected: This is called the sensitivity of the helium leak detector (HLD) and is especially important as it governs the speed of the movement of the sniffing probe, and in many cases, the speed with which leaks can be found. The highest sensitivity HLD may also be required when the test sequence needs to find leaks quickly, and the distance between the sniffer probe and part to be tested is large.
- The stability of the helium signal of the leak detector: It is important to differentiate between a signal due to a helium leak and electronic noise to avoid false readings, especially in places where electromagnetic emissions are large.
- Measuring range: This refers to the largest and smallest leak that can be detected. The larger the measuring range, the wider the applications the HLD will be able to accommodate.
- Response time: This will impact upon the speed of locating leaks. The faster the response time, the easier it is to locate leaks and the faster the process to locate them becomes.
- Recovery time: Equally important to the response time, recovery time is also negatively influenced by the helium pumping speed. The higher the helium pumping speed, the faster will be the recovery of the leak detector and the sooner the next leak can be found.
- Constant versus adjustable flow rate sniffer probe: Adjustable flow rate probes change the calibration of the HLD as calibration is based on the flow entering the probe. A constant flow will prevent the calibration from changing.

> It is important to differentiate between a signal due to a helium leak and electronic noise to avoid false readings…"

The inboard method (also called the hard vacuum), works by evacuating the object to be tested using the leak detector vacuum system. Helium is then sprayed on the outside of the object, which is sucked into the inside of the object via any cracks or holes and detected by the leak detector. This process can be divided into several steps:

- Pumping down the object (also called the roughing down time) and reaching the crossover pressure. The object is now automatically connected to the detection cell.
- Spraying helium around the object under test and wait-

ing for a response.

- Recovering from a leak (recovery time).

The roughing capacity and the test crossover pressure effect points 1 and 2.

Test Crossover (hard vacuum method only)

In order for helium to be introduced into the leaking part, the part must be low enough in pressure to be connected to the leak detector detection cell. This is done by providing a vacuum pump capable of pumping to this pressure (roughing pump), which is automatically, controlled by the HLD electronics. This phase is called the roughing or pumping down time. The size of this pump must be sufficient to evacuate the part to be tested in a small enough amount of time, which is required by the demands of the application and the number of parts to be tested. (see Figure 1).

Spraying Helium and Waiting for a Response

Once the part is under vacuum and is "connected" to the analyzer cell, helium is sprayed around the item to be tested. In the presence of a leak, some helium molecules reach the inside of the part, and then are transferred to the HLD to be analyzed and a corresponding leak rate is displayed.

The transfer time for helium to go from the inlet of the leak detector to the analyzer is usually quite fast, generally less than one second. Conversely, the time required for the molecules of helium to travel from the leaking part to the inlet of the leak detector can be quite long. This will depend on the helium pumping speed of the leak detector. The greater the helium pumping speed, the faster the response time (see Figure 2).

Recovery Time

Helium pumping speed also effects the disappearance of the helium (see Figure 3). The recovery time after a leak has been found will largely depend on the helium pumping speed. The higher the helium pumping speed, the faster the HLD will recover, in other words, the quicker the next test can be performed.

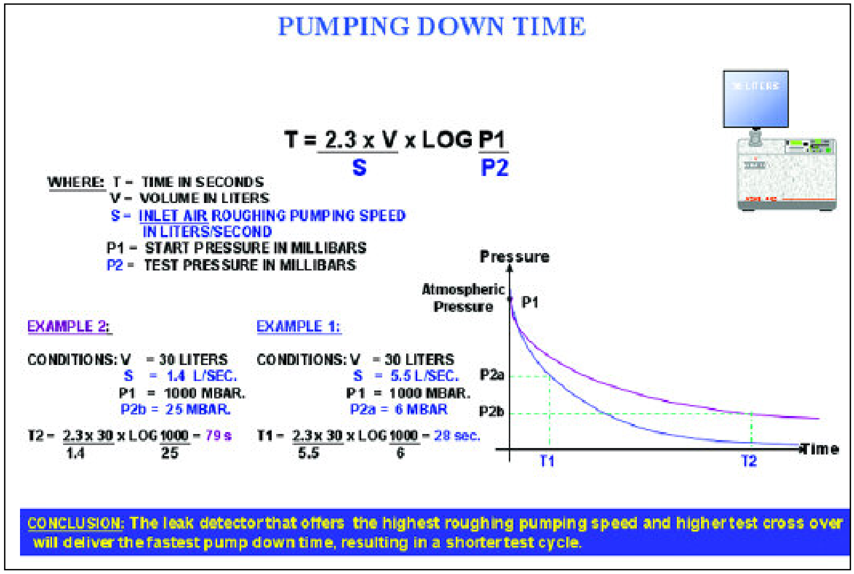

Figure 1. Pumping down time

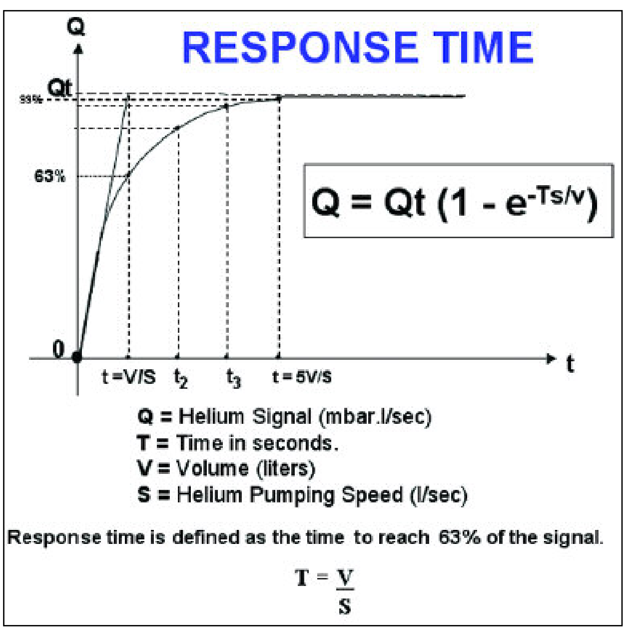

Figure 2. Response time

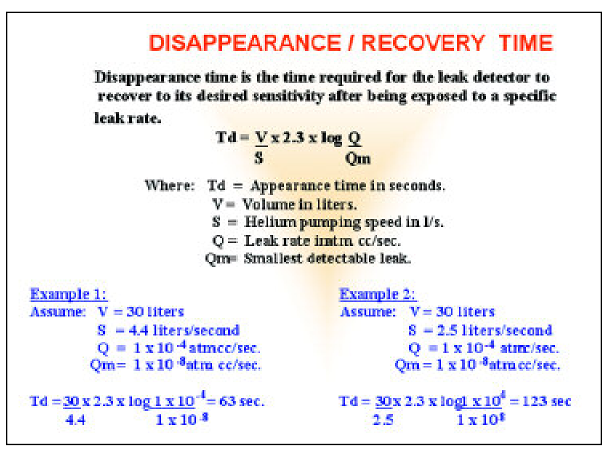

Figure 3. Disappearance/Recovery time

The higher the helium pumping speed...the quicker the next test can be performed.

Conclusion

A leak detector can serve more than one need, for example, production or maintenance providing it has the appropriate features. Regardless of the application or the leak test method, the above criteria should be on the checklist of anyone in search of the right HLD for their needs. Often a demonstration and evaluation of the HLD in the "working environment" is possible to make sure the best unit will be selected.

Should "dry" (oil-free) versus "wet" (oil-sealed) be another consideration? This is further topic that we will cover soon in a future Gases and Technology issue.

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