INFICON

TECHNICAL NOTE

How to Save on Helium Cost with the Protec P3000

WHY HELIUM AS A TRACER GAS

Helium as a tracer gas offers some unique properties which make it the gas most suited to be used as a tracer gas:

- Helium is non-toxic, inert, non-combustible, non-explosive
- Helium has a low and very stable background of 5 ppm in air
- Helium is not used industrially, i.e. it is not released from other industrial processes

USE OF DILUTED HELIUM

Because helium is inert, non-combustible, non-explosive, you do not need to mix it with clean nitrogen but it can easily be mixed with dry air to any concentration desired. The mixing can even take place at your production site.

When designing your specific leak testing procedures, you should determine the optimal mixture rate for your application taking into consideration the trigger level you intend to search for as well as the smallest detectable leak rate of the leak detector you intend to use.

Example

Your threshold value for leak testing is $2*10^{-5}$ mbarl/s, the Protec P3000 offers a smallest detectable leak rate of $1*10^{-7}$ mbarl/s. In an industrial application some tracer gas is always released to the atmosphere, e.g. on connecting fittings to the charging system. So in industrial applications – as a rule of thumb – the lowest trigger level that can be used reliably at a production line is $5*10^{-6}$ mbarl/s.

Divide your threshold value of $2*10^{-5}$ mbarl/s by the lowest usable trigger of $5*10^{-6}$ mbarl/s and get your maximum dilution factor, in this case 4. In other words you could dilute your helium to as low as 25% for your specific application.

MONITORING HELIUM MIXTURES

For very low concentrations of helium in your tracer gas mix, it will become necessary to monitor and control the correct composition of your mixture.

Example

If a mixture, which is supposed to contain 40% helium, contains 1% helium too little, the real concentration will be 39%. So the absolute error is 1% of 40% = 2.5%. So a leak rate which should be $2*10^{-5}$ mbarl/s will be indicated as 2.5% too little, i.e. $1.95*10^{-5}$ mbarl/s.

If a mixture, which is supposed to contain 2% helium, contains 1% helium too little, the real error is 1% of 2% = 50%. So a leak rate which should be $2*10^{-5}$ mbarl/s will be indicated as 50% too little, i.e. $1.0*10^{-5}$ mbarl/s.

Several major gas suppliers offer mixing systems for rent with a monthly charge.

USING A HELIUM RECLAIM SYSTEM

A helium reclaim system is a system which buffers the helium used for leak detection in a tank. Before each leak testing cycle the object under test is first evacuated from air, is then charged with helium from the buffer tank and after leak detection the helium is evacuated from the test object and pumped back to the buffer tank until the test object is back to atmospheric pressure. A helium reclaim system very effectively recovers the helium in your part over

atmospheric pressure (minus some minimal amounts of helium released when connecting and disconnecting the charging connectors). So when using a charge pressure of 10 bar about 90% of the helium are recovered.

The benefit is twofold:

a) only very little helium is consumed by the leak detection process,
b) as almost no helium is released to the atmosphere the helium background in your testing environment is influenced by the charging and discharging process only very little.

USING LESS HELIUM BY RECLAIMING AND MIXING

Helium reclaim systems can obviously also be used in combination with a helium / air mixture. When using a helium mixture it may be beneficial to test at a helium charging pressure higher than the later operating pressure. This is usually feasible if the leak test is performed after a burst test.

The helium leak rate through a part's imperfections is basically a function of total pressure difference (total pressure minus atmospheric pressure) and the helium content in your tracer gas (percentage). It is often possible using increased total pressure, reducing the helium content and achieving the exact same leak rates. Increasing the helium charging pressure will lead to a larger leak rate from a given physical leak. So at the same absolute sensitivity the helium may be diluted even further. On the other hand the total charge of the helium mixture will increase by the same ratio.

Since the reclaim is very efficient at recovering the helium in your part over atmospheric pressure, the loss of helium will be (atmospheric pressure) x (% helium). If the helium percentage is reduced by 50%, the helium consumed will be 50% less.

Using reclaim and mixing can provide 80 to 95% reduction in helium consumed in some cases without decreasing the signal strength.

SAVING HELIUM FROM LEAKS IN CHARGING EQUIPMENT AND SUPPLY LINES

In order to save on helium consumption it is also very advisable to check for leaks in the helium supply lines, the charging equipment itself, the charging connectors and also the reclaim system. This is not only beneficial for the helium consumption; it will also prevent high helium backgrounds in the production environment. The helium consumption due to leakage from charging connectors and valves in the helium supply lines often exceed the real helium consumption due to leak testing, especially when using a reclaim system.

HOW TO SETUP THE PROTEC P3000 FOR HELIUM MIXTURES AND HIGHER HELIUM CHARGING PRESSURE

After determining the appropriate composition of the helium mixture for the specific application, the Protec P3000 offers some easy programming for setting the correct trigger level.

Using helium mixtures with helium leak rates

When using helium mixtures but still using helium leak rates, go to GAS TRIGGER and select a gas number. In the opening submenu go to the NAME line item and press EDIT and select HELIUM.

Three new line items will appear at the bottom of the GAS # page. Scroll to the HE-PERCENTAGE line item and the two line items below will automatically be highlighted, too. Press EDIT and a new submenu will open.

In this submenu in the upper left corner enter the pressure you intend to use as fill pressure for your helium mixture (in absolute pressure) by use of the UP and DOWN buttons. In the upper right corner enter the pressure you intend to use as the fill pressure for the refrigerant in the final product later on (also in absolute pressure, even when still operating in helium leak rates). In the lower left corner now enter the helium content of your helium mixture (in %). Press OK to save these settings and to return to the GAS # submenu.

You can now enter your trigger value as a helium leak rate. Detected leak rate will be displayed in helium leak rates, already taking into account the two different fill pressure as well as the dilution of your helium.

Using helium mixtures with refrigerant equivalent leak rates

When using helium mixtures for testing leak in refrigerant equivalent leak rates with the Protec P3000, in the software menu go to GAS TRIGGER and select a gas number. In the opening submenu go to the NAME line item and press EDIT and select GAS LIBRARY. Choose the refrigerant you intend to use with your product later on and press OKAY.

Three new line items will appear at the bottom of the GAS # page. Scroll to the HE-PERCENTAGE line item

and the two line items below will automatically be highlighted, too. Press EDIT and a new submenu will open.

In this submenu in the upper left corner enter the pressure you intend to use as fill pressure for your helium mixture (in absolute pressure) by use of the UP and DOWN buttons. In the upper right corner enter the pressure you intend to use as the fill pressure for the refrigerant in the final product later on (also in absolute pressure). In the left lower corner now enter the helium content of your helium mixture (in %). Press OK to save these settings and to return to the GAS # submenu.

You can now enter your trigger value in refrigerant equivalent leak rate. Detected leak rate will now also be displayed as refrigerant equivalent leak rates (taking into account the two different fill pressure as well as the dilution of your helium).

Two Technology Place, East Syracuse, NY 13057 USA
Tel: +1.315.434.1100 Fax: +1.315.437.3803 E-mail: reachus@inficon.com

