



## Tip of the month/No.3

### Leak Detection and Water Pressure Test, Part 2

**Question:**

In your last tip you mentioned that humidity is detrimental for the helium leak detector. But this does not have anything to do with our products. We are performing a hydrostatic leak testing. After drying of the object we are applying a helium tracer gas leak test. Recently a customer has claimed a product as leaky, so for what reason are we missing leaks?

**Answer:**

You still have a humidity problem. You have mentioned a hydrostatic leak testing. During this test water penetrates the leak channels. Water molecules are dipoles. So many of these mini-magnets are sticking together and are forming a three-dimensional network. This network can block leak channels which are ten thousand times bigger than the diameter of a single water molecule. For that reason a leak channel might be blocked and you can miss leaks.

However, this does not mean that matter is not transported through these water-filled leak channels. Water will evaporate from the surface on the inner side of the sample. The water molecules then can change the frequency of quartzes, corrode electrical connections, lead to oxidation etc.

**Background:**

Tracer gas methods are among the most sensitive leak detection methods. However, to make full use of the performance of the method the tracer gas needs to find its way through the leak channels. Leak channels can be blocked by process residuals when the product was in use already. But also remaining water after a hydrostatic leak testing can block the leak channels.

Many users of tracer gas methods claim, that only a burst test will open potential leakages by stressing the material. So it seems only logical to perform a leak test only after the burst test. And the leak test should be applied with a test pressure which corresponds to the maximum operational pressure.

Other users believe that water can block leak channels due to intermolecular forces between individual water molecules. So the reliability of tracer leak tests is questionable after hydrostatic leak testing and the sensitivity of the method cannot be used effectively.



It is almost 30 years since leak detection experts in Germany's chemical industry investigated whether a leak test can be applied after a hydrostatic leak testing and which leaks still can be detected after the sample was exposed to massive humidity loads<sup>1</sup>. For the experiments a tubular heat exchanger was prepared with ten leaks in the order between  $< 10^{-4}$  and  $< 10^{-3}$  Pa m<sup>3</sup>/s (corresponding to  $< 10^{-3}$  and  $< 10^{-2}$  mbar l/s or  $< 7.6 \cdot 10^{-4}$  and  $< 7.6 \cdot 10^{-3}$  Torr l/s). The heat exchanger was tested with several test methods from foaming agents to Helium leak detection. With test pressures of more than 0.5 MPa (corresponding to 5 bar or 72.5 psi) relative, all leaks could be detected with all test methods. The leaks could not be detected with optical inspection.

Next a hydrostatic leak testing was performed with a water pressure of 5 MPa (corresponding to 50 bar or 725 psi) relative pressure for a period of 1 hour. The sample was dried by dry air purge for a duration of one hour. Then the leak tests were repeated. Not a single leakage could be detected after this treatment. Only with test pressures of 1 MPa (corresponding to 10 bar or 145 psi) could some leaks observed. The detected leak rates were orders of magnitude smaller than with the dry object.

So a drying process with an air purge over one hour is not at all sufficient for preparation of a moist sample for a tracer gas leak test. Only after vacuum drying at 20 hPa (corresponding to 20 mbar or 0.29 psi) at a temperature of 200 °C over a period of 15 hours the majority of leakages could be detected again – but not all of them!

**So our tip is:**

We strongly recommend to perform a tracer gas leak test prior to a hydrostatic leak testing. It only makes sense to perform a tracer leak test after a burst test if the burst test is likely to induce leak channels. However, the pre-requisite for the leak testing after a burst test is an efficient drying process.

Feel free to repeat the experiments described above in the practical part of our leak detection seminar. The next seminar will take place on November 7th and 8th, 2012, in Asslar. We would be delighted to welcome you to our headquarters for a visit. You can, of course, book the theoretical part of the seminar on November 7th independently of the practical part, and vice versa. And if your problem is too specific for our basic seminar, we will be happy to give you a quote for a seminar tailored to your needs, either on our premises or yours. Our leak detection courses are available in German, French and English language.

To seminar registration:

<http://www.pfeiffer-vacuum.com/service/training/online-registration/container.action>

We would be happy to assist you in optimizing your vacuum solutions for specific applications – go ahead and ask us:

<http://www.pfeiffer-vacuum.com/contact>

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<sup>1</sup> K.-O. Cavalier, Vakuum-Technik, 29. Jahrgang 1980, Heft 7, S 201ff. (in German language; abstracts in English and French)