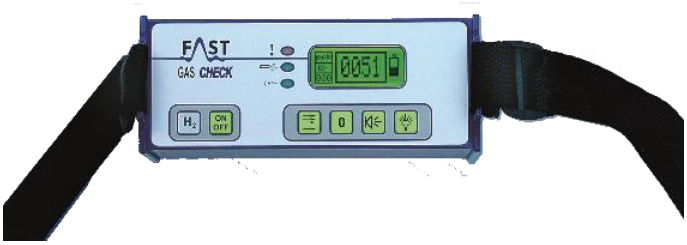
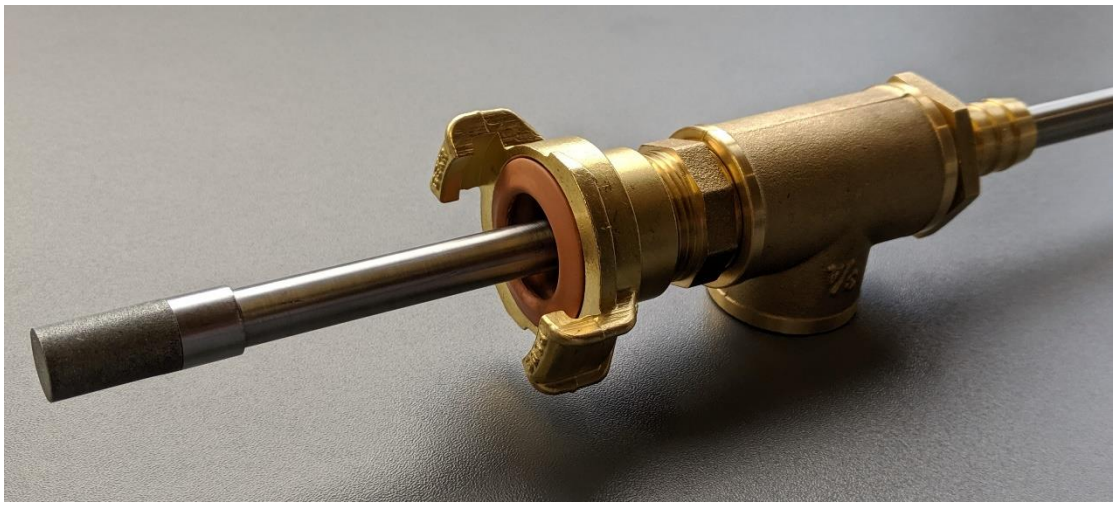
Tracer Gas method – technical description

For the leak detection in water Pipes still under operation, we use a special developed technology in combination with our **Aqua M300 H2 bell probe or GasCheck device.** The new system is made to use the proven tracer gas technology without the need of interrupt or discharge the pipeline. The gas gets directly inserted into the water of the operated pipeline through a special water lock and mixing hose (called "bubble creator", see picture below). The gas gets well mixed with the water and will escape with the water through the leakage. When the water-gas mixture experiences a pressure drop after escaping through the leak, the gas will be released and will come up to the surface, where it can be detected by the Aqua M300 H2 bell probe or GasCheck. Another advantage of not interrupting the supply is the reduction in quantity of the needed tracer gas by approximate 100 times.





Using tracer gas for leak location is based on the proven method of locating leakages in marsh gas pipelines with electronic gas tracing instruments. Our **Aqua M 300 with H2 bell probe** or **GasCheck** is very well suited, with its precise and quick response, for minute location of leakages. Tracer Gas used for detecting leakages in water pipelines is a mixture of H2 (Hydrogen 5%) and N2 (Nitrogen 95%) and is totally safe to use (please refer to the attached Safety Data Sheet of "Formier 5" gas). Due to its low molecular weight and smallest structure, H2 has the ability to quickly diffuse through all materials (concrete, tiles, tar, asphalt etc.) and to ascend vertically, where it can be traced with the **Aqua M 300 with H2 bell probe or GasCheck** consequently.

The Concentration of the Tracer gas is the following:

5% Hydrogen 95% Nitrogen

It is usually traded under the name "Formier 5" and gets used for welding. The cost for that gas is low and please make sure, that you do purchase it as "industrial" gas and not as "medicine" gas (When purchasing Tracer gas as

"medicine" gas, it will be an exact mixture of 95,000000000% Nitrogen and 5,000000000% Hydrogen – this is not needed for our purpose and way to expansive!)

See here the formula for the use of tracer gas by filling an empty pipe.

Determination of required gas quantities:

Formula: **G** = **VL** x **L** x **D**

G = gas quantity in relation to the check pressure (L)
VL = volume in litres required for one metre of pipe length (L)
L = pipe length (m)
D = check pressure (bar)

Volume table for the calculation of the gas quantities for different pipe diameters, when empty:

Pipe diameter in mm	**VL** =Volume of gas in litres required for one meter of pipe length at 1 bar
40	1.26
50	1.96
60	2.83
80	5.02
100	7.85
125	12.27
150	17.66
200	31.40
250	49.06
300	70.65
400	125.66
500	196.35
600	282.74
700	384.85
800	502.65
900	636.15
1000	785.40
1200	1130.97

Example for an empty pipe:
A DN 125 pipe with a length of 300 m has to be filled with gas pressurized to about 5 bar. Volume per metre x length = 12.27 litres x 300 metres = 3.681 litres at a pressure of 1 bar. At a pressure of 5 bars, 3.681 litres x 5 bar = 18. 405 litres have to be pumped in. As one 50 litre canister contains 10.000 litres of gas at 1 bar, the operator would need two such canisters for the job. It should be kept in mind that there may be a certain reserve quantity needed for the gas evading at the leakage spot.

Due to the fact, that with the bubble creator we mix the water with tiny gas bubbles only a 100 fold or even less of the gas is needed, which makes the technology much more economic.

Determination of Hydrogen:

Hydrogen is actually the lightest element in the universe and hydrogen gas is the lightest of all gases. Hydrogen molecules move with a much higher velocity than any other molecule and therefore escape through leaks quicker than other gases. Hydrogen gas does also dissipate quicker than other gases thereby minimizing the risk for build-up background interference during leak testing.
If you worry about increased background concentrations, try 5% hydrogen as a tracer gas. This is also the least expensive tracer gas you can buy.
Some leaks are so big that you can see them or hear them. Other leaks are so small that you need a vacuum system to detect them. Most leaks are in the range between these extremes and can be easily detected with hydrogen tracer gas.

Hydrogen has some unique properties making it a superb tracer gas for leak testing:

- Lightest molecule
- Low background in air (0.5 ppm)

- Environmentally friendly and a renewable natural resource
- Inexpensive
- Non-flammable (when purchased ready mixed 5% Hydrogen in Nitrogen)
- Non-toxic and non-corrosive

Never use pure hydrogen for leak testing. We recommend using a standard industrial gas mixture consisting of 5% hydrogen in nitrogen, available from almost all gas suppliers (often called Formier Gas). It is a widespread misconception that the flammability of Hydrogen would make it impossible to benefit from its advantageous properties in leak testing. In fact, Hydrogen is only flammable in the concentration range 4% - 75% in air or oxygen and can only detonate in the range 18% - 60% in air or oxygen.

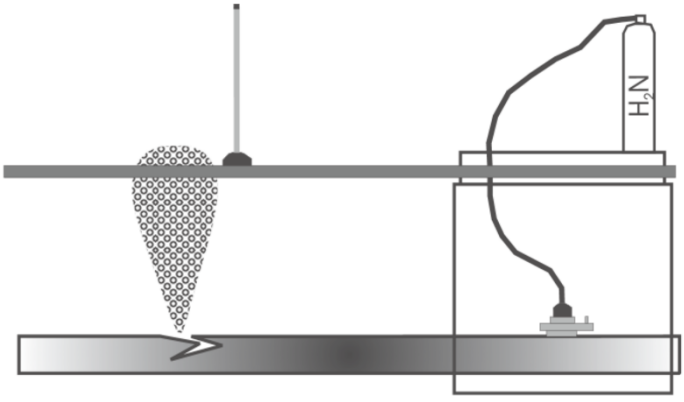
By using pre-diluted Hydrogen one can avoid the flammable concentration range altogether. Standard Hydrogen/Nitrogen mixtures are for example commonly used as shielding gases for welding purposes.
Hydrogen can therefore safely be employed for leak testing if used at the right concentration. A suitable concentration to use is the standard 5% Hydrogen / 95% Nitrogen mixture which is available in industrial grade from most gas suppliers. The price is only a fraction for example of the price for helium.

The 5% mixture is classified as non-flammable according to international standard ISO 10156. This standard not only describes how flammability limits of gas mixtures are to be determined, but also states that Hydrogen/Nitrogen mixtures containing less than 5.7% Hydrogen are non-flammable, irrespective of how this mixture, in turn, is mixed with air. Hydrogen is a naturally occurring gas which is totally non-toxic and has no adverse effects on the environment. Hydrogen can be found naturally or produced with very simple methods. In fact, we all have some hydrogen being produced in our stomachs! You can test that with the H2 sensor of the Aqua M300 by blowing into the bell probe. The normal background level of Hydrogen in air is as low as 0.5 ppm and therefore not detectable with the Aqua M300 H2 sensor, which detects concentrations higher than 1 ppm.

Other tracer gases either comes from finite sources, are expensive to produce or are potentially toxic. Therefore, Hydrogen is the most environmentally friendly choice to make when considering Leak Testing with a tracer gas.

Follow this procedure for the tracer gas method:

1. Install the bubble creator on a nearby valve, washout, air valve or hot tap (hydrant could also work, but often the bubble creator does not fit through the hydrant´s spindle). Before that, it is recommended to measure the actual water pressure inside the pipe.
2. Connect the end of the hose from the bubble creator to the gas cylinder/bottle.
3. Open the valve, washout, air valve or hot tap and insert the sinter filter towards the bottom of the pipe. Push it the whole way to the bottom!
4. Open the gas bottle and push the gas with maximum 0,1-0,2 bar more than the actual water pressure in the pipe. You can listen to the valve on the gas bottle and it should be a constant small noise there. If you can hear it streaming out to loud, it is to much. No noise the pressure should be increased again.



5. Heat up the sensor of your gas detector in gas free area (calibrate it in non-gas polluted air)
6. Slowly walk above the pipeline in about 1m steps. For each step keep the gas sensor about 4-8 seconds on the ground.
7. Once the detector shows a higher reading (more than 50ppm) try to find the position of the maximum concentration (“circling in”).
8. Mark the area to indicate the position of the found highest concentration.