

LEAK TESTING OF COMPONENTS



Fuel tanks / DEF tanks

DESCRIPTION OF TECHNICAL CHALLENGE

Cost pressure in the automobile and supply industries is high. At the same time, the need to reduce emissions is increasing. For example, in the US fuel tanks have to fulfill the requirements of the Low-Emission Vehicle Program - LEV III. Another example is the introduction of the Selective Catalytic Reduction (SCR) technology and the Diesel Exhaust Fluid (DEF) tanks used for this technology. To remain competitive, production and delivery processes must always be optimized.

Automotive fuel tanks are constructed of two materials, metal and plastic. Plastic fuel tanks, as used for passenger vehicles as well as heavy trucks and off-road equipment, typically consist of High Density Polyethylene (HDPE). Metal fuel tanks are comprised of either steel or aluminum. Fuel tanks for two-wheelers are usually made from metal, however, the recent trend of lightweight materials has started its penetration into this segment and is projected to grow significantly over the next five years. Plastic fuel tanks usually have higher requirements for leak testing than metal tanks. Typical leak rate requirements for fuel tanks are in the 10^{-4} .. 10^{-6} mbar-l/s range. DEF tanks are usually made from polyethylene materials as well. Leak rate requirements for DEF tanks are in the 10^{-4} mbar-l/s range.

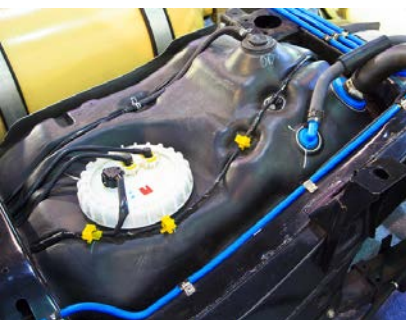
Fuel tanks are often tested in a water bath and sometimes supported by ultrasonic detection of bubbles. However, water bath testing of fuel tanks poses a significant challenge. First, plastic fuel tanks are designed to withstand pressurization to only a few hundred mbar above atmospheric pressure, so the internal pressure that may generate the bubbles is low. In addition, when pushing a fuel tank under water, significant forces apply to the fuel tanks due to its buoyancy caused by the enclosed air. For fuel tank testing in water bath, the fuel tanks usually need to be placed in a supporting cage before being dumped into water. These cages need to be customized to each fuel tank design to offer the best mechanical support. Once the fuel tank has been pushed under water, large amounts of turbulence in the water (bubbles) must clear so conditions can stabilize and bubbles from real leaks can be detected with confidence.

In general, water bath testing is only suited for leak rates down to 10^{-4} mbar l/s at its absolute minimum. It is incapable of finding the smaller leak rate ranges. With increasing requirements for low emissions, the applicability of water bath testing will further degrade.

THE INFICON SOLUTION

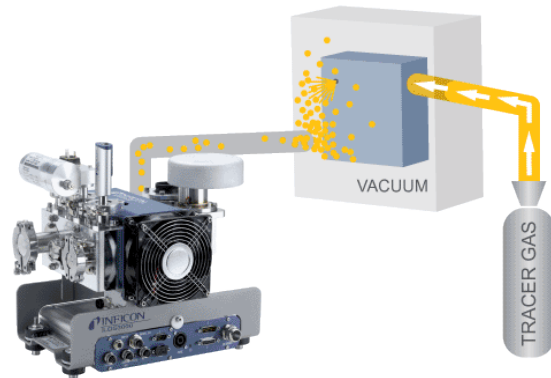
Depending on the size of the tank and the required throughput, two tracer gas solutions are available today:

	Accumulation method	Vacuum leak testing
Throughput	Low to medium	Medium to high
Fuel tank size	Small	Medium to large

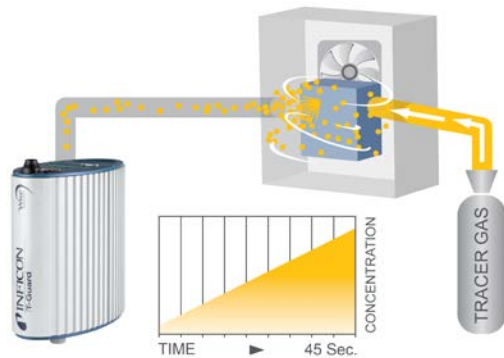


The need to reduce emissions results in stringent leak rate requirements for fuel tanks.

For medium to large tanks (cars and trucks) that need to be tested with medium to high throughput, leak testing with helium in a vacuum chamber is recommended. For this testing process, the tank is placed in the testing chamber and connected to the vacuum system. Once the chamber lid is closed, large vacuum pumps pull a vacuum on the inner volume of the tank as well as on the vacuum chamber. The part and chamber are evacuated simultaneously to avoid too high a pressure load on the tank (this usually does not exceed 200... 300 mbar / 3-4 psi). Subsequently, the part is backfilled with low amounts of helium (again do not exceed the maximum pressure load of the tank). Helium then has the opportunity to migrate outwards and if a leak is present, the INFICON [LDS3000 Helium Leak Detector](#) (connected to the vacuum chamber) detects the helium atoms as they emerge from the tank.



Medium to large tanks can be tested with high throughput by helium vacuum chamber systems.



For small fuel tanks or smaller DEF tanks, leak detection in an accumulation chamber offers an economical solution.

For small fuel tanks (motorcycle) or smaller DEF tanks that need to be tested with low to medium throughput, leak detection with helium or hydrogen in an accumulating chamber under normal pressure (accumulation method) provides an economical solution

In a simple chamber, the tank is filled with small amounts of helium or hydrogen through its test gas connection. As the tanks cannot be evacuated in the surrounding atmospheric pressure (maximum allowable pressure load of the tank is usually only 200... 300 mbar / 3-4 psi), the tank will be filled by pumping through, sucking out air on one side and backfilling with helium from the other side, to ensure filling with close to 100% helium concentration. After filling, the test gas will escape through any leaks into the accumulation chamber. Fans ensure an even distribution of the test gas in the chamber – so, independent of the position of the leak, precise measurement values are guaranteed. The [T-Guard Helium](#) sensor then determines the test gas content in this atmosphere and calculates the leak rate of the part from this value.

BENEFITS OF LEAK TESTING WITH TRACER GAS

- Accurate and repeatable measurements for confident leak testing
- Test result independent of operator intervention
- Also able to detect smaller leaks (10^{-4} .. 10^{-6} mbar l/s range)
- Dry, non-corrosive process
- High throughput

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Due to our continuing program of product improvements, specifications are subject to change without notice.

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