Physikalisch-Technische Bundesanstalt
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Primary standard for the calibration of sniffer test leaks

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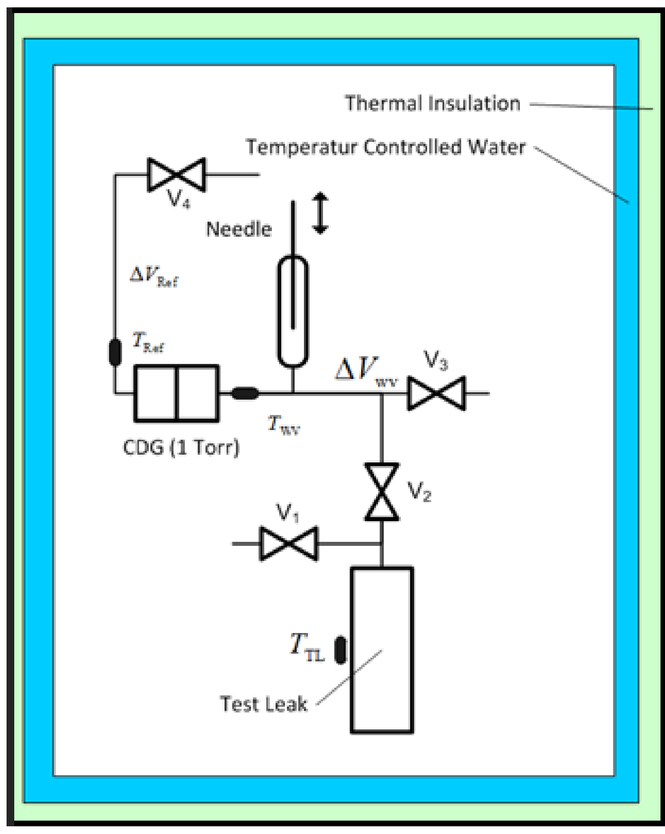
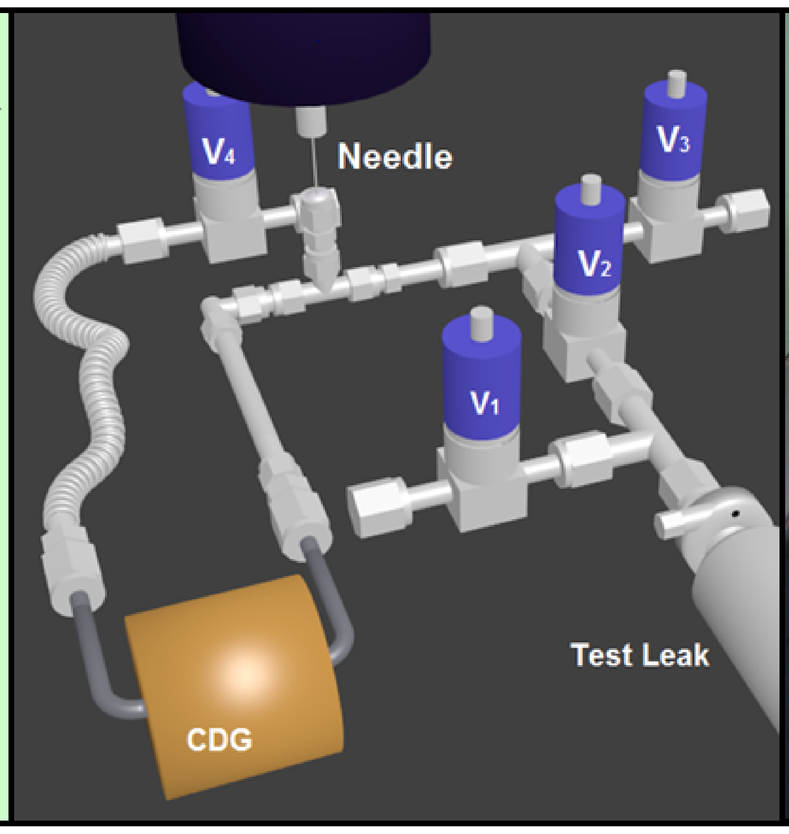
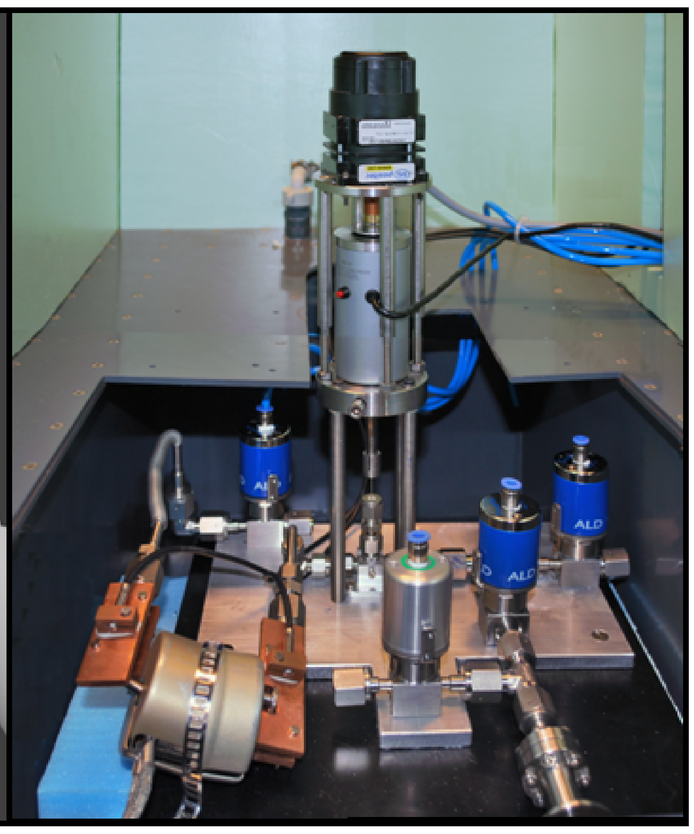






Introduction

Test leaks with a gas flow to atmospheric pressure are often called sniffer test leaks. They are used to calibrate leak detectors for sniffing applications. Sniffer test leaks need calibration by their own. The measurement range of the primary standard is from $4 \cdot 10^{-11}$ mol/s (corresponding to $1 \cdot 10^{-4}$ Pa l/s at 23 °C) to $4 \cdot 10^{-9}$ mol/s ($1 \cdot 10^{-2}$ Pa l/s at 23 °C), which is the most needed range in industry of around 1 g loss per year of the cooling agent R134a. The temperature where the calibration can be carried out may vary from 18 °C to 30 °C.

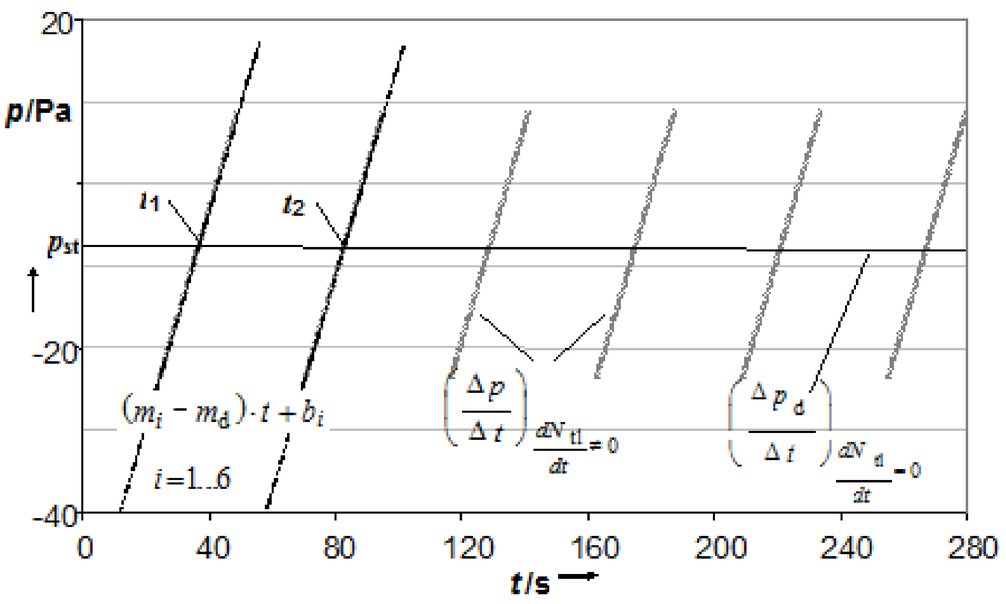
Measurements

We use the fact that an increasing number of molecules in an enclosed volume will increase the pressure in the same volume. Two separated volumes are formed: the working volume V_{WV} and the reference volume V_{ref}. The gas flow from the test leak increases the pressure in V_{WV} continuously. After a defined increase, the volume is increased by ΔV by moving a sealed needle out of V_{WV} in order to reduce the pressure. The flow rate from the leak q_{pV} and q_ν in terms of mol/s is given by:

$$q_{pv} = \frac{\Delta V}{\Delta t} \cdot p_{atm} \qquad \begin{array}{l} p_{atm} - \text{atmospheric pressure} \\ \Delta t \quad - \text{time} \end{array} \qquad (1)$$

$$q_\nu = \frac{q_{pV}}{R \cdot T_{WV}} \qquad \begin{array}{l} R \quad - \text{molar gas constant} \\ T_{WV} - \text{temperature in } V_{WV} \end{array} \qquad (2)$$

This intermittent change of V_{WV} by the needle causes a saw-tooth like variation of the pressure. This is repeated several times in order to obtain a better accuracy for Δt and the mean is taken. Notation of the saw-tooth variation of the differential pressure p including some drift $\frac{p_d}{\Delta t}$ shown on a real measurement curve. p_{st} is the offset from zero mainly caused by the closing of the valves. For clarity only the first time interval $t_2 - t_1$ of in total five time intervals is denoted. The volume is intermittently increased by V_{WV} before each t_i.



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