Conversion of a leak rate in potential notation into a flow value

Comparison with air under water testing

According to DIN EN 1330, the unit $\frac{Pa*m^3}{s}$ is defined for determining the leak rate.

1 $\frac{Pa*m^3}{s}$ corresponds to a pressure change of one Pa in a closed volume of one m³ within one second.

In practice, however, the units $\frac{mbar*l}{s}$ or $\frac{cm^3}{min}$ are more commonly used.

The conversion from [Pa*m³/s] to [mbar*l/s] is a simple unit conversion:

100 Pa = 1 mbar
1 m³ = 1.000 l

Therefore:

1 $\frac{mbar*l}{s}$ = 0,1 $\frac{Pa*m^3}{s}$

With a leak rate of 1 $\frac{mbar*l}{s}$, the pressure in one liter of volume therefore changes by 1 mbar within one second.

For example, from a volume of 1,000 cm³ under 1,000 mbar pressure, 1 Ncm³ flows out per second. (Ncm³ is 1 cm³ under standard conditions, i.e., at 1013.25 mbar air pressure / 0°C)

Therefore, under manufacturing conditions, it approximately holds:

1$\frac{mbar*l}{s}$ corresponds to 1 $\frac{cm^3}{s}$ oder 60 $\frac{cm^3}{min}$.

A leak rate of 1 x 10^{-3} $\frac{mbar*l}{s}$ therefore corresponds to a volume flow of 0,06 $\frac{cm^3}{min}$.

If this value is now compared with an air-under-water test, the volume of the rising air bubbles must be calculated.
An air bubble with a diameter of 1 mm has a volume of 0.52 mm³ or 0.00052 cm³.

With a leak rate of 10^{-3} $\frac{mbar*l}{s}$ (60 $\frac{mm^3}{min}$), 114 air bubbles with a 1 mm diameter therefore rise per minute in a liquid.

If the diameter of the air bubbles is 2 mm, however, an air bubble has a volume of 4.16 mm³, and their number reduces to 14.4.

It should be noted, however, that due to the water hardnesses and surface tensions common in Germany, the diameter of a "real" air bubble in an air-under-water test is even more likely to be 2.5 to 3 mm.