# Boyle-Mariotte

## The Boyle-Mariotte Law

The Boyle-Mariotte Law, also known as Boyle’s Law, states that the pressure of ideal gases is inversely proportional to their volume at constant temperature and amount of substance. If the pressure on a gas volume is increased, its volume is reduced by the increased pressure. If the pressure is reduced, it expands.

Mathematically, Boyle’s Law is expressed by the formula:
*(Approximate formula without considering temperature)*

$p \cdot V = \text{constant}$

therefore

$p_1 \cdot V_1 = p_2 \cdot V_2$

or

$p_1/p_2 = V_2/ V_1$

where

$p_1$: initial pressure

$V_1$: initial volume

$p_2$: final pressure

$V_2$: final volume

You can learn how this effect can be used to convert the pressure change in a leak test to the leak rate

Based on the above, the formula for converting flow / pressure change is derived:

(without considering temperature):

$p_{start} \bullet V_{start} = p_{end} \bullet V_{end} + p_{leak} \bullet V_{leak}$

Since $V_{start} = V_{end} = V_{DUT} + V_{System} = V_{Test}$
and $p_{leak}$ = 1 bar (ambient pressure), it follows:

$V_{Test} \bullet (p_{start} - p_{end}) = V_{leak} \bullet 1\ bar$

$\Rightarrow V_{leak} = (V_{Test} \bullet \Delta p) / 1\ bar$

# Normalization to flow rate (with test time):

Standardisation to flow rate is achieved by including the test time:

$$Q_{leak} = \frac{V_{test} \bullet \Delta p}{t_{test} \bullet 1000mbar}$$

or reaaranged to $\Delta p$:

$$\Delta p = \frac{Q_{leak} \bullet t_{test} \bullet 1000mbar}{V_{test}}$$

In summary, how this effect can be used to convert the pressure change in a leak test to the leak rate is explained >here<.