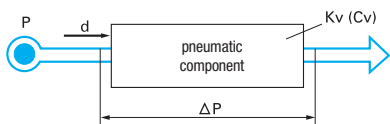


Technical Guidelines

Compressed Air Flow and Pressure Drop

Flow represents the quantity of compressed air passing through a section per unit time. It is expressed in l/min, m³/min or m³/h, at the value expressed in free air, under Standard Reference Atmospheric conditions (ANR) namely: **+20°C, 65 % relative humidity, 1.013 bar**, according to standards NFE 48100 and ISO R554, R558.

When in open position and subject to a supply pressure (**P**), the pneumatic component provides a flow (**d**) which generates a pressure drop at the outlet. The pressure difference therefore between the inlet orifice (upstream pressure) and the outlet orifice (downstream pressure), is called the **pressure drop** and is designated by **Δp** (pressure differential).



The **maximum allowable working pressure** of a component is the effective pressure to which this component may be subjected in a given installation.

The **upstream pressure** is the compressed air pressure at the component inlet.

The **downstream pressure** is the outlet pressure from the component.

The **differential pressure (ΔP)** is the pressure difference between the upstream and downstream pressures.

In order to have simple and usable values available for carrying out calculations and comparing the performances of pneumatic components, we use a flow factor called **Kv**. This experimental factor characterises the flow capacity of a component. It equates to the practical value of the flow of water in litres/minute under a Δp of 1 bar with bore fully open.

The flow factor Kv equates to a coefficient of conductivity - the higher its value, the better the flow provided by the component.

The Kv and pressure drop are linked by the following relationship:

$$Q_v = 26.7 K_v \sqrt{\Delta p \times P_{\text{upstream}}}$$

Q_v = flow in l/min (ANR)

K_v = flow factor

Δp = in bar

P_{upstream}: in bar absolute

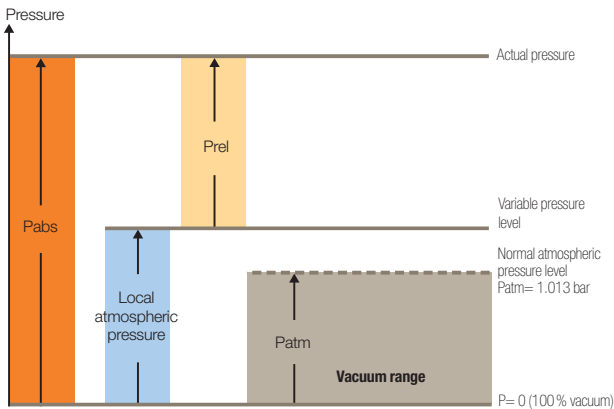
C_v is a flow factor equivalent to Kv, but expressed in US gallons per minute under a Δp of 1 PSI. Kv and Cv are therefore linked by the following relationships:

$$K_v = 14.3 C_v \quad - \quad C_v = 0.07 K_v$$

The flow indicated for certain products in the Parker Legris catalogue is the average flow at 6 bar expressed in NI/min of depressurised air at the Standard Reference Atmosphere (ANR).

Pressure

The normal atmospheric pressure of the air is 1.013 bar at sea level (0 m altitude). It is generally used as a reference for pressure measurements but varies with altitude. For tests and measurements, it is preferable to use absolute bar which relates to an absolute pressure.



$$P_{\text{abs}} = P_{\text{atm}} + P_{\text{rel}}$$

P_{abs} : absolute pressure

P_{rel} : relative pressure

P_{atm} : atmospheric pressure

The pressure is expressed in bar according to industrial practice. It is the result of a force of daN applied to a surface area in cm².

$$1 \text{ bar} = \frac{1 \text{ daN}}{1 \text{ cm}^2} = 10^5 \text{ pascal}$$

Vacuum and Vacuum Levels

Vacuum appears when the atmosphere is rarefied. By removing the air from an enclosed space, a depression (or vacuum) is created relative to atmospheric pressure.

Vacuum therefore relates to the state of a fluid where the pressure is less than atmospheric pressure.

The vacuum level may be expressed as:

depression level = relative pressure value compared to atmospheric pressure

vacuum level in absolute value (defined in comparison with absolute zero)

The common unit of vacuum is the millimetre of mercury (**mm Hg**).

Classification of vacuum

• medium vacuum	1013	to	10 mbar absolute
• primary vacuum	10	to	10 ⁻³ mbar absolute
• secondary vacuum	10 ⁻³	to	10 ⁻⁶ mbar absolute
• molecular vacuum	10 ⁻⁶	to	10 ⁻⁹ mbar absolute
• ultra-vacuum			< 10 ⁻⁹ mbar absolute