PRESSURES

- **Maximum allowable pressure (MAP) :** The maximum allowable pressure (MAP) in pipework is the maximum effective pressure (in bar or in Pa) which can be applied to the pipework in a given system (1 bar = 10^2 kPa)
- **Inlet (or upstream) pressure :** fluid pressure at the entrance to the pneumatic component
- **Outlet (or downstream) pressure :** fluid pressure at the exit from the pneumatic component
- **Differential pressure Δ P :** difference in pressure between the inlet (upstream) pressure and the outlet (downstream) pressure.

FLOW COEFFICIENTS

- **Kv** (following standard NF E 29312) :
  The French KV value is an experimental coefficient based on laboratory conditions and expresses the volumetric flow across a valve. The KV coefficient is defined as the flow of water through a fully open valve in litres per minute with a pressure differential ΔP of 1 bar.
- **Cv :** The imperial equivalent of the KV coefficient is the Cv coefficient defined as the flow of water through a valve in US gallon per minute at a differential pressure ΔP of 1 psi across the valve.
  Cv and Kv can be converted as follows : **Kv = 14,3 Cv** and **Cv = 0,07 Kv**
- **C** and **b** (following standard ISO 6358) :
  Coefficients C (sonic conductance) and b (critical pressure ratio) following standard ISO 6358 allow flow calculation under sonic conditions (See spool valves 541 - 543 - sections E and F).

$$C = \frac{q^*_m}{\rho_o \, p_{in}}$$

$$C = \frac{q^*_v}{p_{in}}$$

q^* : mass flow rate q^*_m (kg/s) or volume q^*_v (m^3/s) through a component at sonic flow

p_{in} : inlet pressure (bar)

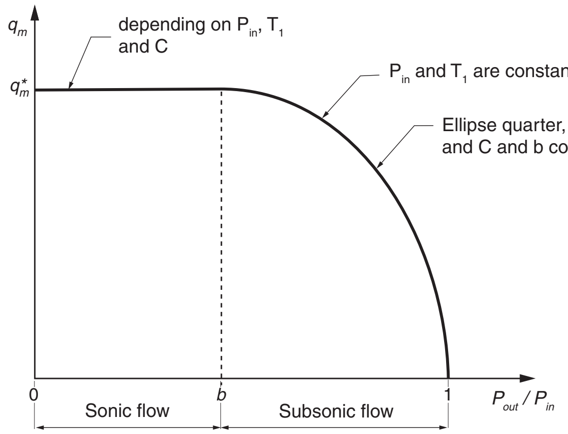
ρ_o = 1,3 kg/m^3 : density under standard conditions (p_0 = 1 bar, T_0 = 293,15 K and 65% relative humidity)

b : pressure ratio below which the flow is sonic:

$$b = \frac{P_{out}}{P_{in}}$$

P_{out} : outlet pressure (bar)

P_{in} : inlet pressure (bar)



T1, temperature (°K) measured when the flow is sonic

CALCULATION OF FLOW (for air and gas)

- **Defining flow at 6 bar :**
  The corresponding leaflets give for each product its mean flow in litres per minute at 6 bar at a standard reference atmosphere (ANR) conforming to ISO 8778 (**with Δ P = 1 bar**)
- **Calculation of flow :**

Δ P < P inlet /2

$$Q = 28{,}16 \times Kv \times \sqrt{\Delta P \times P_{in}}$$

including correction for temperature and density

$$Q = 475 \times Kv \times \sqrt{\frac{(\Delta P \times P_{in})}{(T_a \times d)}}$$

Δ P $\geq$ P inlet /2

(Maximum allowable flow)

$$Q = 14 \times Kv \times P_{out}$$

including correction for temperature and density

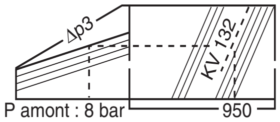
$$Q = 238{,}33 \times Kv \times P_{out} \times \frac{1}{\sqrt{(T_a \times d)}}$$

Q = Flow in l/min
ΔP = Differential pressure, in bar
P_{in} = Absolute inlet pressure, in bar
P_{out} = Absolute outlet pressure, in bar
T_a = Absolute temperature, in Celsius degrees
d = Density compared with air

- **Flow graphs :** (see following page).

HOW TO USE THE GRAPHS

Depending on the supply pressure, use the appropriate graph: either 0 - 2 bar or 0 - 40 bar.
The graph shows the relationship between the flow and the pressure drop Δp, depending upon the upstream pressure and the flow coefficient (Kv in litres per minute).

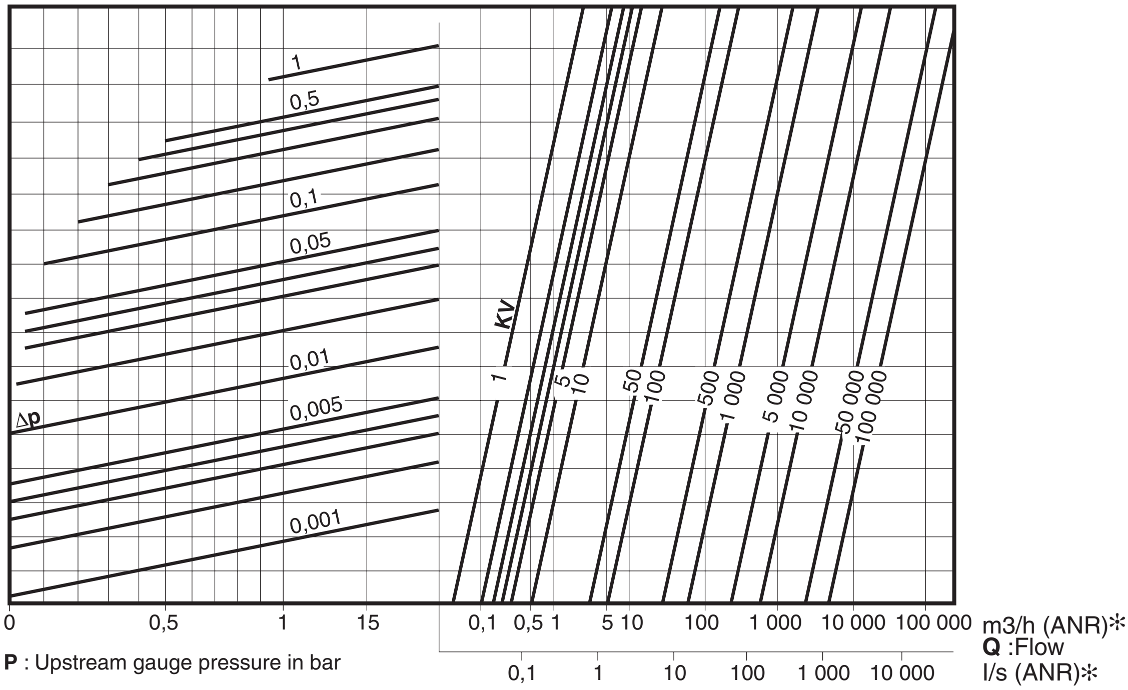


Upstream P : 8 bar

Example : Find the flow of a valve Ø 25 mm, KV = 132, under the following conditions :
– upstream gauge pressure : 8 bar
– pressure drop Δp : 3 bar
Proceed as shown in the diagram to find a flow = 950 m^3/h.
If the pressure drop exceeds the values shown in the graph, the flow is identical to that with "critical pressure drop", so that :

$$\Delta p = \text{absolute downstream pressure} = \frac{\text{absolute upstream pressure}}{2}$$

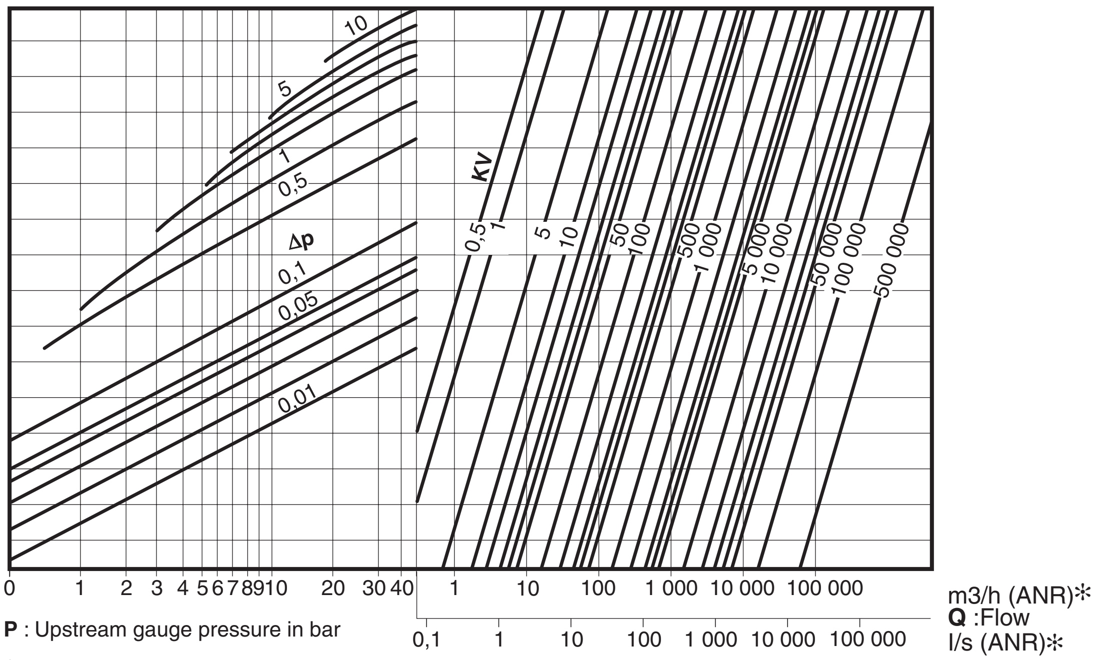
AIR PRESSURE 0 to 2 bar



P : Upstream gauge pressure in bar

✻ ANR : Standard reference atmosphere

AIR PRESSURE 0 to 40 bar



P : Upstream gauge pressure in bar

✻ ANR : Standard reference atmosphere