Information

How to use flow charts

TESCOM EUROPE flow charts are the graphic representation of test results which show the change in outlet pressure (P_2) with a varying flow rate. All curves are based on using air or water at ambient conditions as a media. Inlet pressures (P_1) are shown on the right end of each curve.

To use these charts, select the curve to fit the following:

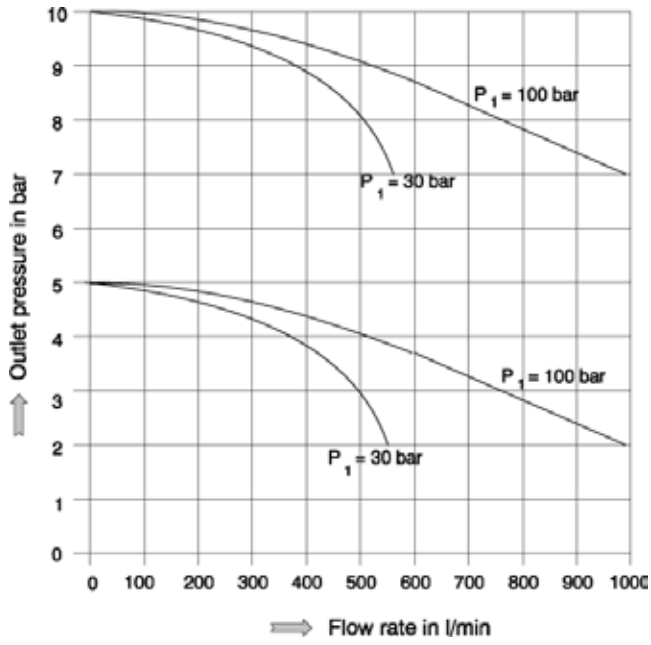
- Regulator model
- Inlet pressure range (P_1)
- Outlet pressure range (P_2)

Determine the maximum dead-ended (zero flow) P_2 pressure permitted by your system. Locate this pressure on the P_2 (vertical) axis. If no curve is plotted for that exact pressure, extrapolate a new curve between the two closest existing curves and follow from the zero flow point to the intersection of the new curve and the vertical coordinate of the desired flow. Read horizontally to locate the corresponding P_2 pressure.

Example:

Using the flow chart above, determine the droop (P_2 at the 500 l/min condition). Given conditions:
P_1= 100 bar , P_2= 10 bar max, Q= 500 l/min.

1) Locate maximum outlet pressure (10 bar) on P_2 axis with zero (0) flow.
2) Follow the discharge curve until it crosses the vertical line corresponding to 500 l/min.
3) Follow the intersecting point horizontally to the vertical P_2 axis and read the corresponding pressure of 9.1 bar. Hence droop is 0.9 bar.



DEFINITIONS:

C_V: Flow coefficient for regulators and valves that expresses flow capabilities of a unit at full open condition.

For gases $K_V = \frac{C_V}{1.17}$

S_L: Specific gravity of liquids relative to water, both at standard temperature of 15 °C. (Specific gravity of water = 1.0 @ 15 °C).

S_g: Specific gravity of a gas relative to air; equals the ratio of the molecular weight of the gas to that of air. (Specific gravity of air = 1.0 @ 15 °C).

P_1: Inlet pressure expressed in barg

P_2: Outlet pressure expressed in barg

ΔP: Differential pressure (P_1 - P_2).

Q_L: Liquid flow in liter per minute (l/min).

Q_g: Gas flow in liter per minute (l/min). (At standard conditions of 15 °C and 1.01 bar).

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FORMULAS

1. Liquid C_V formula

$$C_V = \frac{(Q_L/3.78) \times \sqrt{S_L}}{\sqrt{\Delta P \times 14{,}5}}$$

2. Gas C_V formulas

a) When P_1 is greater than or equal to 2 x P_2

$$C_V = \frac{(2 \times Q_g) / 28.3}{(P_1 \times 14.5) + 14.7} \times \sqrt{S_g}$$

b) When P_1 is less than 2 x P_2

$$C_V = \frac{Q_g}{28.3} \times \sqrt{\frac{S_g}{\Delta P \times 14.5 [(P_2 \times 14.5) + 14.7]}}$$

P in bar, $\Delta P = (P_1 - P_2)$, Q in l/min. Calculations with C_V require always a cross-check with flow diagrams.
Please consider always that normally a regulator operates not at its max. Cv. So calculated Cv should be increased by minimum 30% when selecting a regulator.

TABLES

1. Approximate specific gravities (S_g) for various gases and multipliers to convert the flow rate of a certain gas to the air flow:

Gas	Multiplier	Formula	gravity	Specific to convert to air flow
Air			1.00	1.00
Ammonia	NH_3		0.60	0.77
Argon	Ar		1.38	1.17
Arsine	AsH_3		2.69	1.64
Butane	C_4H_{10}		2.10	1.45
Carbon dioxide	CO_2		1.53	1.24
Carbon monoxid	CO		0.97	0.98
Chorine	Cl_2		2.47	1.57
Ethane	C_2H_6		1.05	1.02
Ethylene	C_2H_4		0.98	0.99
Helium	He		0.14	0.37
Hydrogen	H_2		0.07	0.26
Methane	CH_4		0.56	0.75
Nitrogen	N_2		0.97	0.98
Oxygen	O_2		1.11	1.05
Propane	C_3H_8		1.55	1.24
Silane	SiH_4		1.11	1.05
Xenon	Xe		4.55	2.13

2. Approximate specific gravities (S_L) for various liquids and multipliers to convert the flow rate of a certain liquid to the flow of water:

Liquid	Specific gravity	Multiplier to convert to flow of water
Crude oil	0.81 - 0.97	0.99 - 1.03
Gasoline	0.75	0.87
Hydraulic oil-water glycol base	1.05	1.02
Hydraulik oil-phosphate ester base	1.10	1.05
Hydraulik oil-standard mil 5606	0.83	0.91
Hydraulik oil-mineral base	0.80	0.90
Kerosene	0.82	0.91
Water	1.00	1.00

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1228-07-02 Subject to technical changes

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