TECHNICAL INFORMATION

Valve Sizing

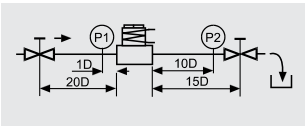
General
It is not recommended to select a solenoid valve according to its pipe connection port or its orifice size. The valve selection depends on the knowledge of the following factors:
pressure range minimum and maximum, differential pressure, minimum and maximum flow rate, the specific gravity of the fluid, temperature, viscosity, etc.

Pressure
The pressure is generally measured above the atmospheric pressure and is expressed in kg/cm² or bars of relative pressure.
The value of pressure terms in this catalog corresponds to the relative pressure.

Pressure drop △P
This is the difference of pressure between the upstream P1 and the downstream P2 of the valve when it is crossed by the fluid.

Differential pressure
Minimum - maximum
This is the minimum or maximum difference of pressure between the upstream P1 and the downstream P2 which secures perfect functioning of the device. Only a pilot operated solenoid valve requires the minimum differential pressure to operate.

Flow - the flow factor Kv (Cv)
The flow of a solenoid valve is the quantity of fluid per time units crossing the valve under certain conditions. It is this factor which determines its size. To obtain a simpler method of calculation and comparison between the various types of valves, all variables permitting the calculation of the flow have been reduced to a common denominator : the flow factor Kv (without units). The Kv factor can be determined by the flow chart or by calculation. When the Kv factor is determined, select the solenoid valve which has the equivalent flow factor. The flow factor values given in this catalog have been set up according to the following method :



Fluid is water, specific gravity 1 kg/dm³ the pressure drop P1, P2 is 1Kg/cm² in a way that the Kv is equal to the flow in liter/min.

$$Q = Kv\sqrt{\frac{\Delta P}{\gamma}} \qquad Kv = Q\sqrt{\frac{\gamma}{\Delta P}}$$

When several valves are mounted in series, the resulting flow factor is equal to :

$$\frac{1}{Kv^2_{Tot}} = \frac{1}{Kv^2_1} + \frac{1}{Kv^2_2} + \frac{1}{Kv^2_3} + \ldots + \frac{1}{Kv^2_n}$$

When several valves are mounted in parallel, the resulting flow factor is equal to :

$$Kv_{Tot} = Kv1 + Kv2 + Kv3 \ldots\ldots + Kvn$$

Unit conversion
Kv = flow factor (decimal units) to convert
CV(USA) = 0.070Kv
f (UK) = 0.0585Kv
Kv = 14.28 Cv (USA)
Kv = 17.11 f (UK)

Viscosity
Practically, the flow Kv is identical for a valve crossed by water or a medium having up to 3ºE viscosity. The flow/pressure characteristic is effected above this limit. It is necessary to consider factor above 3ºE - the flow factor Kv will be :

$$Kv_x = Kv_{water}\, C$$

$$C = \frac{\delta\sqrt{Kv}}{200\ Q} + 1$$

δ = kinematic viscosity (in centistrokes) of the fluid
Q = flow in liter/min
Kv = flow factor given in catalog

This calculation leads to a choice of a valve with a higher flow factor value than the one which would have been chosen for a fluid having a viscosity of 3ºE.

Temperature
The limits of temperature of use of a solenoid valve depend essentially upon the nature of the discs and the desgn of the coil. The temperature developed in a solenoid valve is a function of the electrical characteristics of the coil, the duty cycle, the fluid and ambient temperatures. These parameters determine the "temperature of use".
For each type of solenoid valve, the temperature range is given in the technical data, however these figures are only a general guide. If temperature of use might extend the given limits, please contact our technical sales department.

Response time
The response time of a solenoid valve is the lapse of time between the electric signal and the outlet of fluid signal. The response time is effected by the following parameters:
Valve function, operating mode, orifice size, inlet pressure and pressure differential, fluid, temperature and coil characteristics.
The C.E.T.O.P defines the test of conditions as follows:
Test pressure : air at 6Kg/cm² - 85 PSI
Ambient temperature : 20º C - 68º F

Response time at energizing
Response time at energizing of the solenoid and until the outlet pressure reaches 90% of the test pressure.

Response time at de-energizing
Lapse of time between de-energizing of the solenoid and until the pressure outlet drops to 10% of the test pressure, see schemas of measure method and resulting curves for AC and DC current.
Average response time for GEM-SOL valves can be assumed as follows:
- Direct acting solenoids 16 to 36 ms for complete cycle.
- Large direct acting solenoids 40 to 80 ms for complete cycle.
- Pilot operated valve 20 to 80 ms for complete cycle.

Cycling rate
The cycling rate of a solenoid depends directly on its response time. It is the number of cycles per minutes calculated for continuous operation. The valve should not be reversed at less than 90% or above 10% at discharging of reference pressure.

$$\text{Cycles/Minutes} = \frac{60 \text{ sec}}{R_{T_e} + R_{T_d}}$$

R_{T_e} = response time at energizing (sec)

R_{T_d} = response time at de-energizing (sec)

The cycling rate is the maximum possible cycles per minute of the solenoid valve. It varies when the valve is mounted in a circuit and depends then upon the installation pressure drop.