

# Additional information

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# Principles of operation

Solenoid valves are electro-mechanical devices that control fluid flow. This is achieved by opening or closing one or several orifices in the solenoid valve. The (solenoid) coil is the electrical element that converts an electrical signal into a mechanical force which, in turn, shifts the mobile plunger that opens or closes an orifice (nozzle) by means of its seat disc(s).

Solenoid valves are usually constructed from 3 distinct components:

- the body (including the sleeve assembly)
- the coil (or coil housing)
- the housing (or nut/nameplate fixing elements).

These 3 modular components are in many cases interchangeable i.e. a valve body can be used with a number of coil/housing combinations. This catalogue presents the main recommended versions. Your distributor will be pleased to speak to you about other specific versions.

## Direct operated valves (see fig. 1)

The magnetic force is used directly to open or close the passage of fluid at the plunger sealing. The performance is limited by the available performance of the coil (limits of pressure/orifice size.) The pressure rating of the valve starts from zero bar to the maximum value.

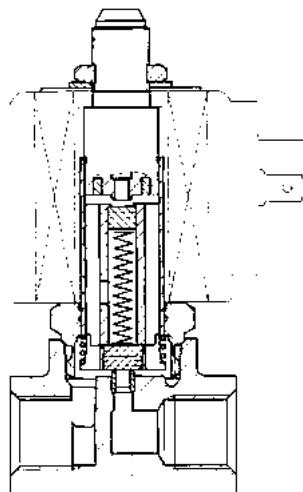


Fig. 1

## Pilot operated valves (see fig. 2 and 3)

In cases where it is necessary to control higher flow/higher pressure it is necessary to use pilot operated valves. The supply pressure enters the direct operated "pilot stage" which directs the flow to a "pilot chamber" which, in turn, applies the pilot pressure over a large area (generally a diaphragm or a piston). Therefore, a large force is generated to move the main sealing elements against higher pressure or over a large orifice. One condition of operation is to have a minimum pressure (indicated in the catalogue table) available to shift the valve. In most applications this presents no particular problems (refer to "Magnalift valves" below). The pressure rating of the valve starts from a minimum value (0.3 or 0.5 bar) up to the maximum value.

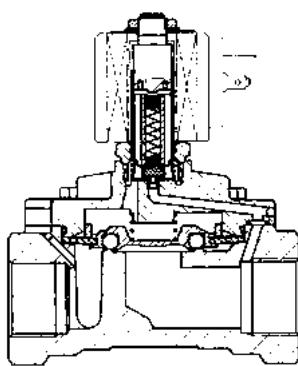


Fig. 2

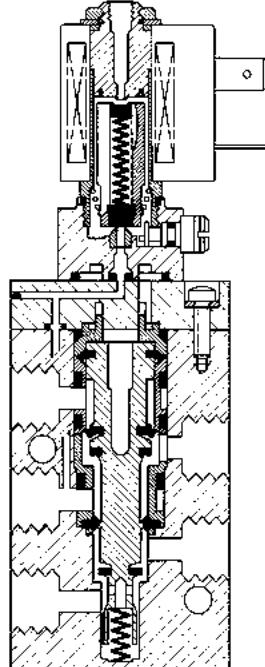


Fig. 3

## Magnalift valves (see fig. 4)

The magnalift valves combine the features of a direct operated and a pilot operated valve. A mechanical link between the plunger and the diaphragm retainer allows the valve to operate as a direct operated valve at low pressures and as a pilot operated valve at higher pressures.

The advantage of this design is that the pressure rating of the valve starts from zero bar to the maximum value. Magnalift valves are specified when the valve controls the emptying/filling of a tank under gravity.

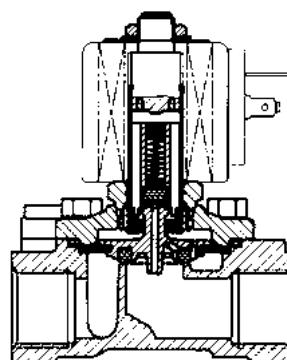


Fig. 4

# Flow rate

## Liquids

The flow through a pipe or a valve is given by:

$$Q = k_v \sqrt{(\Delta p / \gamma)}$$

where  $Q$  = flow (L/min)

$\Delta p$  = pressure drop (bar)

$\gamma$  = density of fluid ( $\text{kg}/\text{dm}^3$ )

$k_v$  = flow factor of the pipe or valve (L/min)

For water  $\gamma = 1 \text{ kg}/\text{dm}^3$

### Flow factor $k_v$

The  $k_v$  flow factor of a valve is defined as the flow rate of water in litres per minute with a pressure drop of 1 bar across the valve. Valve manufacturers use different definitions for  $k_v$  i.e.  $k_v$  may be expressed in L/h or  $\text{m}^3/\text{h}$ , etc. Care should therefore be taken when comparing values.

### Maximum flow rate $Q_{\max}$ .

For particular 2-way valves the maximum flow must be limited for reasons of mechanical resistance and durability. A very high flow velocity may dislocate a poppet sealing or a diaphragm. Maximum flow rates are indicated in the catalogue.

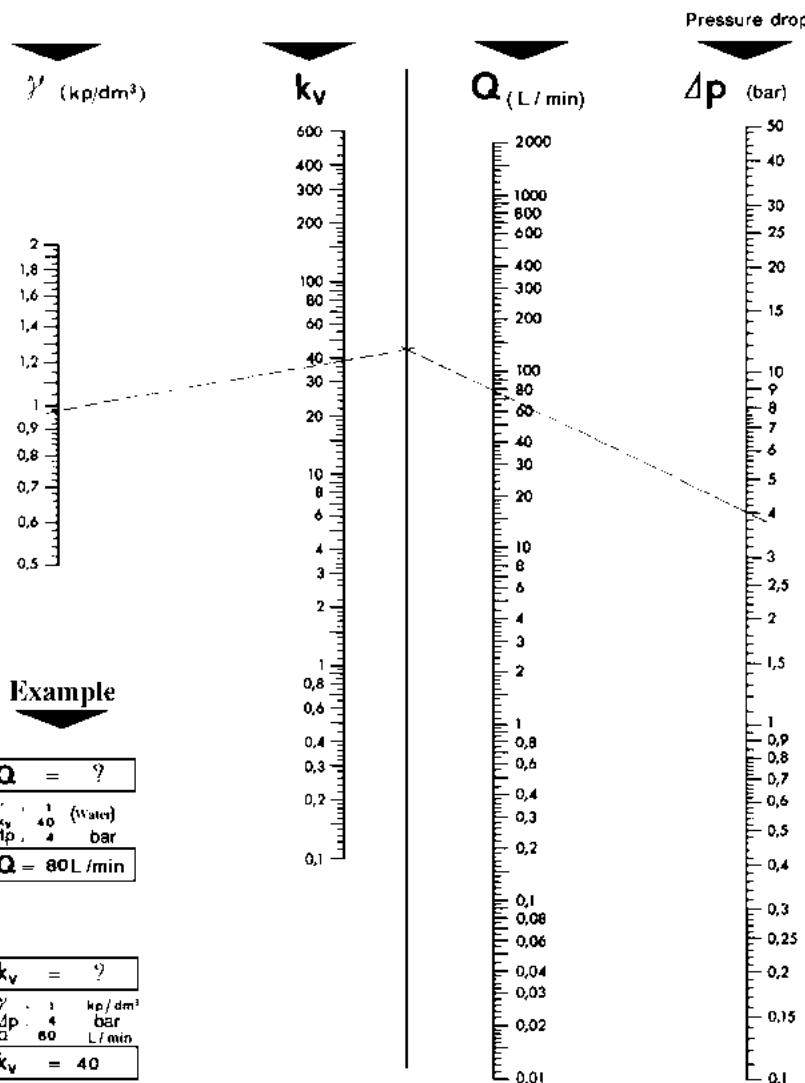
## Gases

### Nominal flow $Q_n$

Calculations can be made with specific flow factors based on the CETOP RP 50P standard. For practical purposes and ease of valve selection the catalogue shows the nominal flow  $Q_n$ . The nominal flow  $Q_n$  is defined as the flow rate (L/min) of air across the valve when the inlet pressure  $p_1 = 6$  bar and the pressure drop  $\Delta p = 1$  bar.

N.B. THE VALUES OF FLOW FACTORS AND FLOW RATES MENTIONED IN CATALOGUES ARE SUBJECT TO  $\pm 15\%$  TOLERANCES.

For detailed technical information please ask for publication 1230/GB



Nomogram for liquid flow calculation

# Unit conversion tables/designation of sealing materials

## Measures

1 inch = 25.4 mm  
 1 mm = 0.039 inch  
 1 U.S. gallon = 3.785 litres  
 1 imperial gallon = 4.546 litres

## Pressure

1 bar = 1.02 kg/cm<sup>2</sup> = 0.98 atm  
 = 10<sup>5</sup> Pa = 100 kPa  
 1 bar = 14.51 psi  
 1 psi = 0.0689 bar = 0.0703 kg/cm<sup>2</sup>

## Flow rate

$k_v$  in L/min/ $\Delta p$  = 1 bar  
 $c_v$  in gpm/ $\Delta p$  = 1 psi  
 1  $c_v$  = 0.07  $k_v$   
 1  $k_v$  = 14.28  $c_v$   
 1 gpm (U.S. gallon) = 3.785 L/min  
 1 L/min = 0.0353 cfm

## Temperature

°F = °C × 9/5 + 32  
 °C = (°F - 32) × 5/9

## Torque

1 in. lb. = 0.113 Nm  
 1 Nm = 8.25 in. lb.

## Size

mm	inches	decimal inches
0.79	1/32	0.031
1.59	1/16	0.063
2.38	3/32	0.094
3.18	1/8	0.125
3.97	5/32	0.156
4.76	3/16	0.188
5.56	7/32	0.219
6.35	1/4	0.250
7.14	9/32	0.281
7.94	5/16	0.313
8.73	11/32	0.344
9.53	3/8	0.375
10.3	13/32	0.406
11.1	7/16	0.438
11.9	15/32	0.469
12.7	1/2	0.500
13.5	17/32	0.531
14.3	9/16	0.563
15.1	19/32	0.594
15.9	5/8	0.625
16.7	21/32	0.656
17.5	11/16	0.688
18.3	23/32	0.719
19.1	3/4	0.750
19.8	25/32	0.781
20.6	13/16	0.813
21.4	27/32	0.844
22.2	7/8	0.875
23.0	29/32	0.906
23.8	15/16	0.938
24.6	31/32	0.969
25.4	1	1.000

## Designation of sealing materials

ASTM Designation	Commercial Designation
NBR	Nitrile rubber, Buna-N., Perbunan
FKM	Fluoroelastomer
EPDM	Ethylene propylene
PCTFE	Kel-F
PTFE	Teflon®
CR	Neoprene
PUR	Polyurethane
PFPM	Kalrez

VALVE FUNCTIONS		2/2 DIRECT OPERATED			2/2 SERVO OPERATED			3/2 DIRECT OPERATED			3/2 SERVO OPERATED			5/2 SERVO OPERATED			
VALVE TYPES																	
BODY MATERIALS																	
FLUIDS	SEALING DISCS OR MEMBRANES	Brass	Brass	St. steel	Brass	Brass	St. steel	Brass	Brass	Brass	Brass	St. steel	St. steel	NBR	EPDM	PCTFE	CRF
Acetone																	
Acetylene, dry*																	
Acid - Boric*																	
Acid - Chrome																	
Acid - Citric																	
Acid - Hydrochloric																	
Acid - Lactic																	
Acid - Nitric*																	
Acid - Phosphoric																	
Acid - Picric																	
Acid - Salicylic																	
Acid - Sulphuric																	
Air, hot																	
Air, unlubricated																	
Alcohol - Amyl alcohol																	
Alcohol - Butyl alcohol (Butanol)																	
Alcohol - Ethyl alcohol (Ethanol)																	
Alcohol - Methyl alcohol (Methanol)																	
Alcohol - Propyl alcohol (Propanol)																	
Ammonia, gas (anhydrous)																	
Aniline*																	
Argon																	
Benzine - leaded and unleaded (motor)																	
Chloroform																	
Cider																	
Coffee																	
Cream																	
Cyclohexane																	
Ethy chloride																	
Ethylene glycol (antifreeze)																	
Exhaust gas																	

## Fluid compatibility of LUCIFER valves



