Gems Sensors & Controls

APPLICATIONS ENGINEERING LTD

Miniature and Subminiature Solenoid Valves

Gems specializes in made-to-order fluidic systems, and a major segment of that activity includes the integration of miniature solenoid valves and manifold assemblies. Our miniature and subminiature solenoid valves are utilized in solutions that serve industries ranging from medical and biotech to automotive and industrial equipment.

Gems solenoid valves are designed to your specifications for each unique application. Each series offers a broad range of construction/performance options to build an endless array of configurations—too many to list in this catalog. From custom coils and manifolds to exotic materials and flow characteristics, there is very little that we cannot accomplish. Whether pneumatic or liquid, cryogenic or high temperature, vacuum or high-pressure, we partner with you to identify, create, and produce the best possible fluidic solution.

General Purpose Valves

A broad range of 2- and 3-way solenoid valves in both miniature and subminiature sizes. A wide selection of configuration options allows easy customization to match specific application requirements.

Isolation Valves

Isolation diaphragms protect media and moving parts alike. Ideal for high-purity and aggressive media applications.

Cryogenic Valves

These valves provide reliable service to media temperatures as low as -320°F (-196°C). Ideal for liquid Nitrogen and Carbon Dioxide use.

4 Steps to Valve Selection

The steps described in this section will help you identify the performance criteria needed to meet your application requirements and select the right valve.

Step 1 – Calculating C_V

Begin by calculating the valve flow coefficient (C_V) using: operating pressure differential; flow rate for your application; Specific Gravity; and in some circumstances, temperature. If you already know your C_V please go directly to Step 2.

C_V combines the effects of all flow restrictions in the valve into a single number. C_V represents the quantity of water, at 68°F and in gallons per minute (GPM) that will flow through your valve with a 1psi pressure differential. C_V can also be calculated for gases.

Specific Gravity (SG) for liquid is the ratio of the density, or specific weight of the liquid, relative to that of water. Similarly, the SG for gas is the ratio of the density, or specific weight of the gas, relative to that of air. The SG of your media is important in calculating C_V because it directly correlates to the flow rate through your valve.

Liquid Flow

Because liquids are incompressible, their flow rate depends only on the difference between the inlet and outlet pressures (P1 - P2 or ΔP, pressure differential. Figure 1).

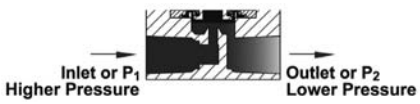
The C_V of any valve flowing liquid media can be determined with the equation shown to the right.

Example: Using Water at 68°F:

V = 3.08 GPM
P1 = 100 PSI
P2 = 40 PSI
SG = 1

$$C_V = \frac{3.08}{\sqrt{\frac{100-40}{1}}} = .398$$

Fig. 1: Press Differential



Pressure differential is the difference between the inlet and outlet pressures.

Gas Flow

Since gases are compressible fluids there are two separate equations for high and low-pressure differential flow.

Example: Using Air:

V = 10 SCFM
P1 = 20 PSIG = 34.7 PSIA (20 + 14.7)
P2 = 0 PSIG = 14.7 PSIA (0 + 14.7)
SG = 1
T = 72° F = 532° Rankine (72 + 460)

Since this is high-pressure differential flow (14.7 ≤ 34.7 / 2), we use the following equation:

$$C_V = \frac{10}{13.61 \cdot 34.7 \sqrt{\frac{1}{(1)\,532}}} = .49$$

Temperature and C_V

Temperature is not included in the C_V calculation for non-compressible fluids (liquids) and is only used in determining SG. Conversely, because gases are compressible, temperature (T) has a greater effect on volume and therefore is included as a separate variable in gas C_V calculations.flow rate through your valve.

Liquid Flow Formula

$$C_V = \frac{V}{\sqrt{\frac{\Delta P}{SG}}}$$

Where:
CV = Valve flow coefficient
V = Flow rate in GPM
ΔP = Pressure differential (PSID)
SG = Specific Gravity

Gas Flow C_V Formula

- Low-pressure differential flow is when $P_2 > \frac{P_1}{2}$ and the following equation is used:

$$C_V = \frac{V}{16.05\sqrt{\frac{(P_1^2 - P_2^2)}{(SG)\,T}}}$$

- High-pressure differential flow is when $P_2 \le \frac{P_1}{2}$ and the following equation is used:

$$C_V = \frac{V}{13.61\,P_1\sqrt{\frac{1}{(SG)\,T}}}$$

Where:
CV = Valve flow coefficient
V = Flow rate in SCFM
P1 = Inlet pressure in PSIA
P2 = Outlet pressure in PSIA
SG = Specific Gravity
T = Temperature of gas in Degree Rankine

16.05 and 13.61 are constants used in gas flow equations

Step 2 – Valve Function

Identify how your valve will function in your application. Pick from the choices below.

An important note regarding C_V and valve function:

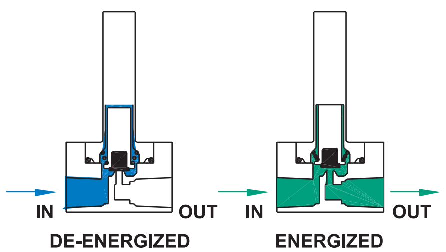
The C_V calculated will apply to either the Body Orifice or the Stop Orifice depending on the valve's function.

For example, the Stop Orifice for a 3-way normally closed valve, when de-energized, is the exhaust port. In other words, C_V is calculated using the specific Inlet Pressure (P1) and Outlet Pressure (P2) for the flow paths described below.

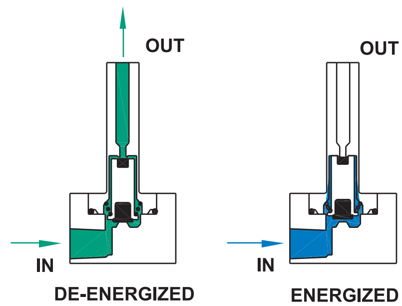
Flow Key

- Blocked Flow
- Free Flow

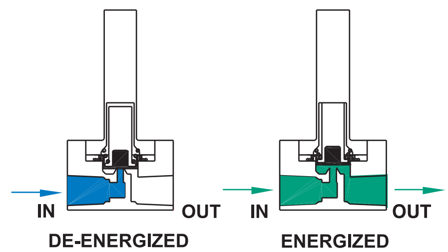
2-WAY NORMALLY CLOSED



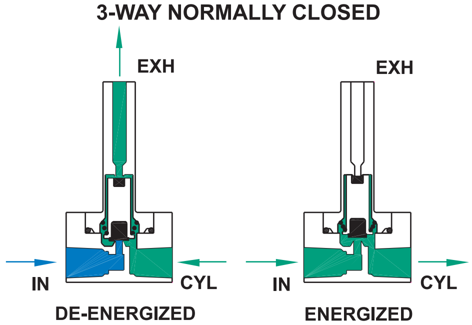
2-WAY NORMALLY OPEN



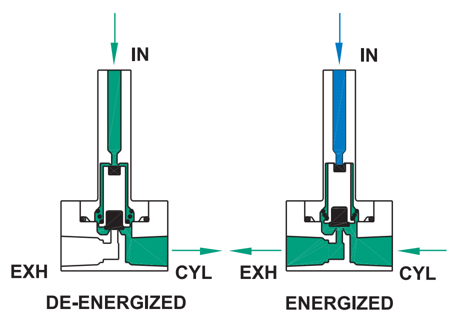
2-WAY NORMALLY CLOSED ISOLATION



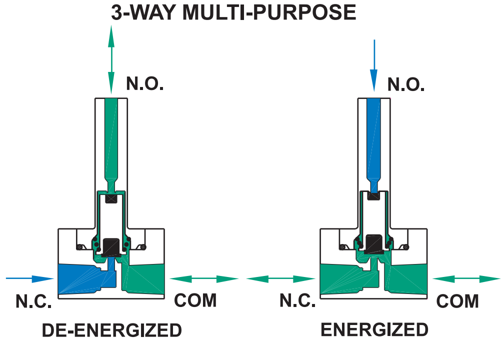
3-WAY NORMALLY CLOSED



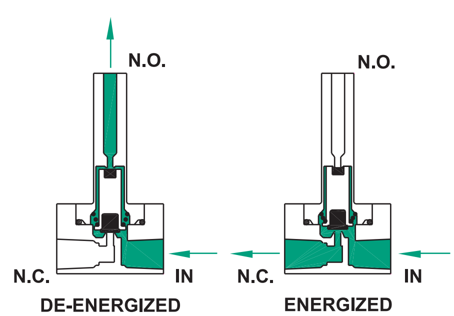
3-WAY NORMALLY OPEN



3-WAY MULTI-PURPOSE



3-WAY DIRECTIONAL CONTROL



Step 3 – Identify Your Valve Series

Select possible valve series candidate using the overview charts below. Begin by choosing the category for your application:

• General Purpose • Isolation • Cryogenic

Using the charts, select maximum operating pressure differential (MOPD), the C_V, function, and additional specifications needed for your application to select possible valve series. The detailed performance specs for each series are located on the corresponding pages listed on the chart.

	General Purpose						
Function	2- & 3-Way						
Media	Gas Only	Gas & Liquid					
Size	Sub-Miniature			Miniature			
C_v Range	0.018 - 0.070			0.019 - 0.430			0.045 - 0.880
Port Configuration	#10-32 Manifold Mount		Barb (1/16, 5/64, 1/8), Manifold or Face-Mount	#10-32, 1/8, 1/4 NPT, Manifold Mount			1/8, 1/4, 3/8 NPT, Manifold Mount
Orifice Dia (in)	0.032 - 0.078		0.031 - 0.052	0.032 - 0.156	0.062 - 0.210		0.047 - 0.375
Power (watt)	0.65, 2		0.5, 1, 2	6	7		10
MOPD (psi)	175	250	100	1000	400		900
Valve Series	**E, EH**	**G, GH**	**M**	**A**	**B**	**C**	**D**
Pages	**J-7, J-8**	**J-9, J-10**	**J-5, J-6**	**J-11, J-12**	**J-13, J-14**	**J-15, J-16**	**J-17, J-18**

	Cryogenic		Isolation		Inert Isolation
Function	2-Way, Normally Closed Only		2-Way, Normally Closed Only		**See page J-24**
Media	Liquid		Gas & Liquid		
Size	Miniature		Miniature		
C_v Range	0.045 - 0.440	0.040 - 0.770	0.020 - 0.300		
Port Configuration	1/8, 1/4 NPT	1/8, 1/4, 3/8 NPT	#10-32, 1/8 NPT, 1/4 NPT, Manifold Mount		
Orifice Dia (in)	0.046 - 0.188	0.046 - 0.250	0.032 - 0.156		
Power (watt)	9	15	4.5, 7		
MOPD (psi)	900	1000*	50 (Plastic Body), 150		
Valve Series	**B-Cryo**	**D-Cryo**	**AS**	**BS**	
Pages	**J-35, J-36**	**J-37, J-38**	**J-19, J-20**	**J-21, J-22**	

*Consult factory for higher MOPD.

Step 4 – Make Your Selection and Configure Your Valve

Complete your valve design by selecting the additional design parameters to build the best possible valve. For example:

- Materials needed for your media (stainless steel, brass, fluoroelastomer, EPDM, etc.)
- Coil construction (lead wire, quick connect spade, grommet, conduit, yoke, etc.)
- Port configuration
- Manifold assembly
- Voltage

We specialize in application specific valves. Our modular valve designs, coupled with our cutting edge 3D modeling and innovative CNC manufacturing capabilities, result in fluidic systems that are truly adaptable to any originally manufactured equipment.