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.

If at any time, you have a question or simply want to give us your requirements and have Gems Sensor and Controls design your valve or system, please contact us by phone at 800-378-1600 or email us at info@gemssensors.com.

Contents	Page Start

Get Help Quick

An application data sheet (ADS), located on page J-41, will help you select performance criteria and options. Fax it directly to a Gems Valve Engineer at 860-747-4244 or configure your valve online for RFQ at www.gemssensors.com.

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.


SOLENOID VALVES

4 Steps to Valve Selection

The steps described in this section will help you identify and select the right valve.

Step 1 – Calculating Flow Coefficient

C_V – For Imperial Units of Measure

K_V – For Metric Units of Measure

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

The Flow Coefficient combines the effects of all flow restrictions in the valve into a single number, and is used for both liquids and gases (non-compressible and compressible fluids):

> **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.
>
> **K_V** represents the flow of water with temperature ranging between 5°C and 30°C through a valve in cubic meters per hour with a pressure drop of 1 bar.

Temperature Factor

Temperature is not included in the Flow Coefficient calculation for non-compressible fluids (liquids) and is only used in determining SG or Liquid Density. 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/K_V calculations.

Relationship Between C_V and K_V

C_V and K_V may be converted to one another using the formulas below:

$$C_V = 1.56 \cdot K_V$$

$$K_V = 0.853 \cdot C_V$$

Liquid Flow

Because liquids are non-compressible, 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 or K_V of liquid media can be determined with the equations below.

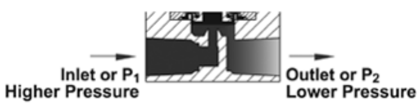
Liquid Flow Formulas

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

Where:

- **C_V** = Valve flow coefficient
- **V** = Flow rate in GPM or m³/h
- **ΔP** = Pressure differential (PSI or bar)
- **SG** = Specific Gravity @ 60°F and 14.7 PSIA
- **ρ** = Density of liquids in kg/m³ (water = 1000)

Fig. 1: Press Differential



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

C_V Example: Using Water at 68°F:

V = 3.08 GPM
P_1 = 100 PSI
P_2 = 40 PSI
SG = 1

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

K_V Example: Using Water at 25°C:

V = 0.45 m³/h
ρ = 1
P_1 = 8.01 ABS bar
P_2 = 3.2 ABS bar
ΔP = 8.01 - 3.20 = 4.81 bar

$$K_V = 0.45\sqrt{\frac{1}{4.81}} = .20$$

Gas Flow

Gases are compressible fluids and there are separate equations for high and low-pressure differential flow.

Gas Flow Coefficient Formulas

- **Low-pressure** differential flow is when $P_2 > \frac{P_1}{2}$. Use the following equations:

$$C_V = \frac{V}{16.05\sqrt{\frac{(P_1^2 - P_2^2)}{(SG)\,T}}} \qquad K_V = \frac{V_G}{519}\sqrt{\frac{\rho_G\, T_1}{\Delta P\, P_2}}$$

- **High-pressure** differential flow is when $P_2 \leq \frac{P_1}{2}$. Use the following equations:

$$C_V = \frac{V}{13.61\, P_1\sqrt{\frac{1}{(SG)\,T}}} \qquad K_V = \frac{V_G}{259.5\, P_1}\sqrt{\rho_G\, T_1}$$

Where:

- **C_V** = Valve flow coefficient
- **V** = Flow rate in SCFM or m³/h
- **P_1** = Inlet pressure in PSIA or bar
- **P_2** = Outlet pressure in PSIA or bar
- **SG** = Specific Gravity @ 60°F and 14.7 PSIA
- **ρ** = Density of gases @ 0°C and 1013 mbar in kg/m³
- **T** = Temperature of gas in Degree Rankine (°F + 460) or Degree Kelvin (°C + 298)

16.05 and 13.61 (519 and 259.5) are constants used in gas flow equations

Examples: Using Air with **High Differential** flow where P:

Since these are high-pressure differential flow examples, we use the following equations:

V = 10 SCFM
P_1 = 20 PSIG = 34.7 PSIA (20 + 14.7)
P_2 = 0 PSIG = 14.7 PSIA (0 + 14.7)
SG = 1
T = 72° F = 532° Rankine (72 + 460)

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

V_G = 16.99 m³/h
P_1 = 2.39 ABS bar
P_2 = 1.01 ABS bar
ρ_G = 1.284 Kg/m³
T_1 = 25°C = 298°K (25 + 273)

$$K_V = \frac{16.99}{519}\sqrt{\frac{1.284\,(298)}{1.38\,(1.01)}} = .54$$

Step 2 – Valve Function

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

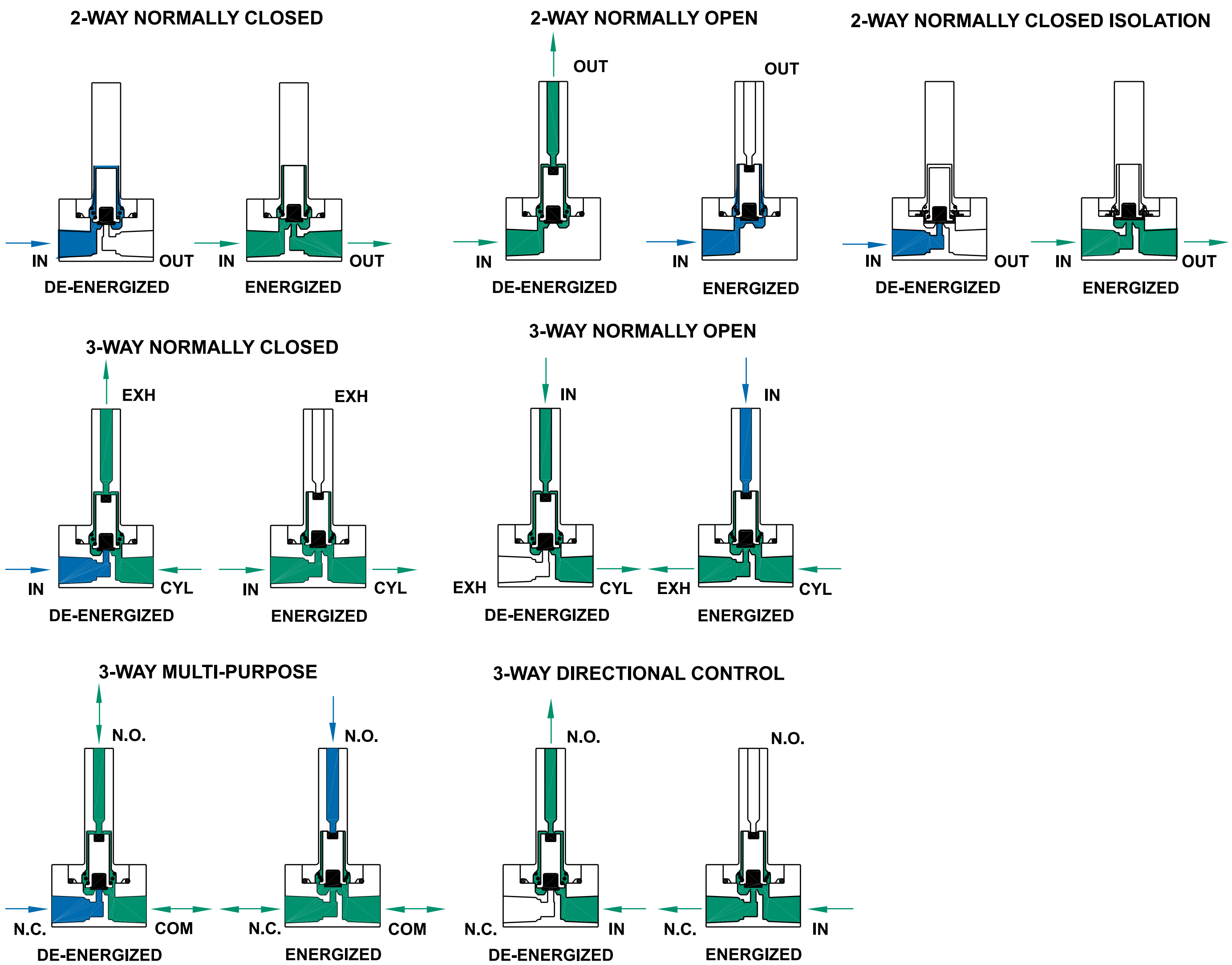
An important note regarding C_V and valve function:

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 (blue)
- Free Flow (green)



Gems specializes in the design and manufacturing of custom solenoid valves and fluidic systems. If you don't see what you're looking for, or have a question, contact us at 800-378-1600 or info@gemssensors.com.

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 specifications needed for your application to target appropriate valve series. The detailed performance specs for each series are located on the corresponding pages listed on the chart.

If you would like assistance with your selection, want to modify a valve, or simply want a sounding board please contact a Gems™ valve engineer at 800-378-1600 or info@gemssensors.com.

	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
K_v Range	0.015 - 0.063			0.016 - 0.357			0.038 - 0.595
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
Orifice Dia (mm)	0.813 - 1.981		0.787 - 1.321	0.813 - 3.962	1.575 - 5.334		1.194 - 9.525
Power (watt)	0.65, 2		0.5, 1, 2	6	7		10
MOPD (psi)	175	250	100	1000	400		900
MOPD (bar)	12.06	17.23	6.89	68.95	27.58		62.05
Valve Series	**E, EH**	**G, GH**	**M**	**A**	**B**	**C**	**D**
Pages	**J-7**	**J-10**	**J-5**	**J-14**	**J-18**	**J-22**	**J-26**

	Isolation		Cryogenic		Latching
Function	2-Way, Normally Closed Only		2-Way, Normally Closed Only		2- & 3-Way
Media	Gas & Liquid		Liquid		Gas & Liquid
Size	Miniature		Miniature		Minature
C_v Range	0.020 - 0.300		0.045 - 0.440	0.040 - 0.770	0.018 - 0.43
K_v Range	0.017 - 0.256		0.038 - 0.374	0.034 - 0.655	
Port Configuration	#10-32, 1/8 NPT, 1/4 NPT, Manifold Mount		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)	0.032 - 0.156		0.046 - 0.188	0.046 - 0.250	0.032 - 0.156
Orifice Dia (mm)					
Power (watt)	4.5, 7		9	15	5 - 9
MOPD (psi)	50 (Plastic Body), 150		900	1000*	100
MOPD (bar)					
Valve Series	**AS**	**BS**	**B-Cryo**	**D-Cryo**	**BL**
Pages	**J-29**	**J-31**	**J-33**	**J-35**	**J-37**

*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, qick 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.

For help selecting the additional options for your valve or if you want to confirm that your selection is the best choice or work with an engineer on integrating a fluidic system into your application, contact us at 800-378-1600 or info@gemssensors.com. We are happy to assist. You can also place orders through these same channels.