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).

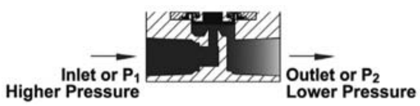
The C_V of any valve flowing liquid media can be determined with the equation shown to the right.

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:

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

For help calculating your C_V, please contact a Gems valve engineer at 800-378-1600 or info@gemssensors.com.

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.

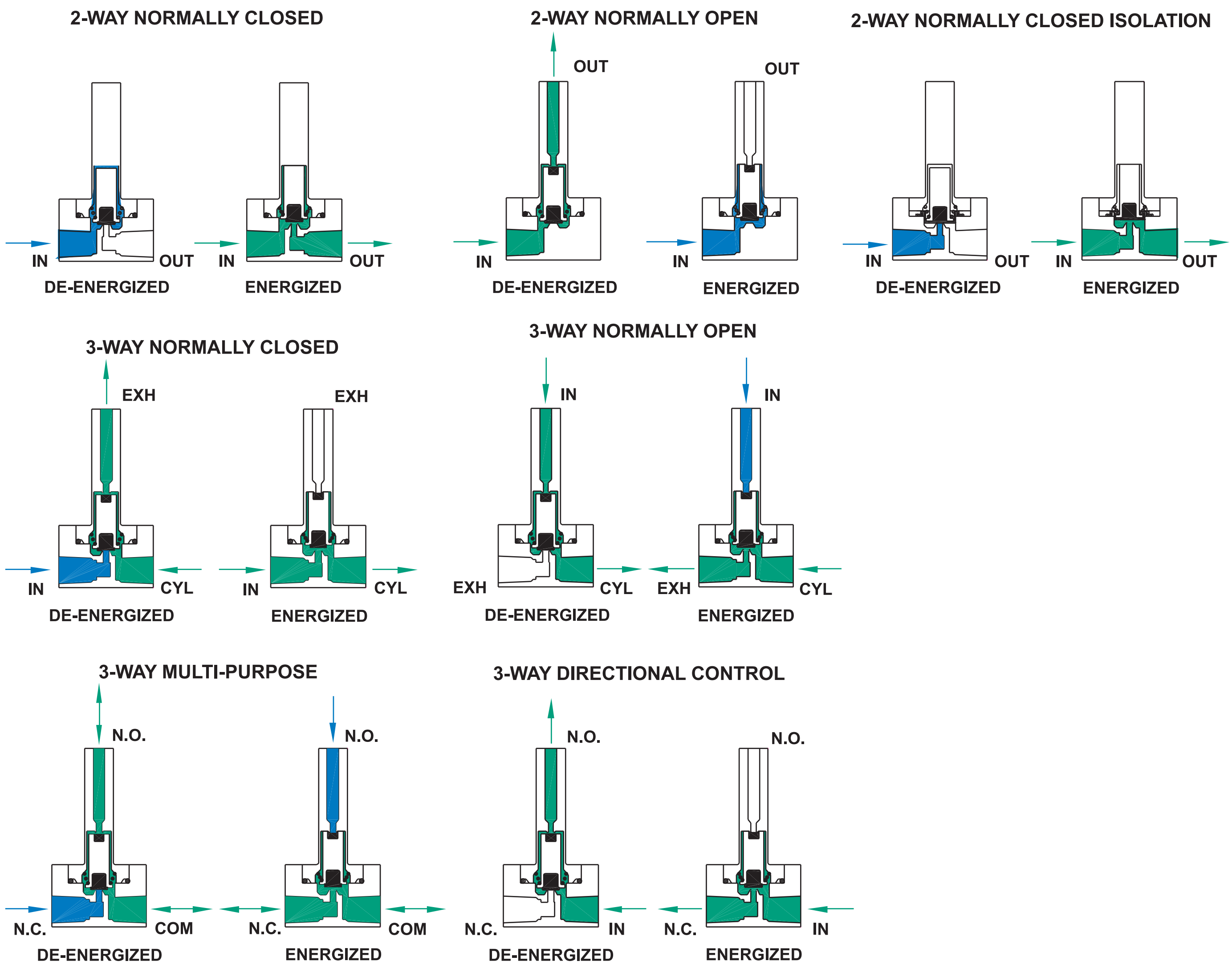
An important note regarding C_V and valve function:

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



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 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.

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.

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

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

*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

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.

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.