Technical & Sizing Information

Introduction

Sizing and selection of the automatic control valve that will meet all of your system design and performance requirements is critically important. Singer Valve offers the following guidelines and notes to provide a basic understanding of the operating principals and to assist in the selection process.

Full and Reduced Ports

Singer Valve manufactures two distinct model series – 106 Full Port and 206 Reduced Port valves. Model 206 series valves are similar to Model 106 series except that the seats are one standard pipe size smaller than the flange sizes. For example, a 6 in / 150 mm 206-PG valve has a 4 in / 100 mm seat diameter. The Model 206 is often a preferred selection when the flow ranges are suitable. Most sizes are also available in angle (A) pattern and valves larger than 6 in / 150 mm are also available with the Single Rolling Diaphragm (S) technology.

Guidelines for using the flow versus pressure drop curves:

<table>
<thead>
<tr>
<th>Series</th>
<th>Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>106-412</td>
<td>1-06 Series</td>
<td>Full Port, Globe Style Valves</td>
</tr>
<tr>
<td>106-413</td>
<td>A106 Series</td>
<td>Full Port, Angle Style Valves</td>
</tr>
<tr>
<td>206-414</td>
<td>206 Series</td>
<td>Reduced Port, Globe Style Valves</td>
</tr>
<tr>
<td>206-414</td>
<td>A206 Series</td>
<td>Reduced Port, Angle Style Valves</td>
</tr>
</tbody>
</table>

CV and KV Factor & the Straight Line

The flow through a fully open valve may be calculated using the formula:

**Imperial Measure**

\[ Q \text{ (USGPM)} = C_v \text{ (Valve Constant)} \times \sqrt{\Delta P \text{ (psi)}} \]

where the \( C_v \) is the flow in USGPM when there is a 1 psi pressure drop across a fully open valve.

From the Singer performance curves, the straight lines indicate the flow vs. pressure drop through a fully open valve. The Y axis is drawn at the 1 psi pressure drop value. Consequently, the intersection between the flow curve and the Y axis represents the \( C_v \) factor for each valve size.

**Metric Measure**

\[ Q \text{ (L / s)} = K_v \text{ (Valve Constant)} \times \sqrt{\Delta P \text{ (bar)}} \]

where the \( K_v \) is the flow in L / s when there is a 1 bar pressure drop across a fully open valve.

Valves that open fully on low pressure drop require their control chambers (bonnets) to be vented to atmosphere. Commonly, altitude and pump control valves (BPC and DW) are vented to atmosphere and may be selected from the straight line performance curves.
Drooping Portion of the Curves
As mentioned in the previous section, $C_v$ and $K_v$ Factor & the Straight Line, the straight lines represent the pressure drop for fully open valves.

Should the pressure drop across the valve be low (less than 10 psi / 0.7 bar) and the control chamber be connected to downstream, the flow through the valve will be less than when the control chamber is venting to atmosphere and the valve is fully open.

When the bonnet is at the same pressure as the downstream (e.g. the same pressure is on both sides of the diaphragm) there is no resulting opening force from the diaphragm. The force of the main spring and the weight of the inner valve (stem vertical) tend to close the valve.

The opening force results from the pressure drop (between upstream and downstream) acting on the seat area. Flow commences when the pressure drop is sufficient to overcome the force of the spring and the weight of the inner valve assembly. Increasing the pressure drop increases the opening force on the inner valve, permitting greater flow; at approximately 10 psi / 0.7 bar pressure drop the valve is fully open. The drooping portion of the curves represent how the flow increases as the pressure drop increases from zero.

When Actual Flow is Less Than the Value Shown by the Graph
Usually, required flow is less than that shown on the curves—typically, pressure reducing valves. The curves show only the maximum flow available under a given pressure drop. When less than maximum flow is required, the valve will automatically open the required amount.

Operating Ranges
The letters C, I and M are industry standard designations for continuous, intermittent and momentary flows.

- **C** maximum for continuous flow
- **I** maximum for intermittent flow (peak flow for short duration)
- **M** maximum for momentary flow (such as relief valve)
Flow vs. Minimum Pressure Drop – 106 Series (PG, PGX, PT / PTC, PGM)
Full Port, Globe Body, Flat Diaphragm
Curve 106-412 (1/2 in / 15 mm – 8 in / 200 mm)

Straight Lines—Flow For a Fully Open Valve (Bonnet vented to atmosphere)
Curved Lines—Bonnet vented to downstream

Valve Sizes

C = Continuous Service
I = Intermittent Service
M = Momentary Service

20 ft/s / 6 m/s
25 ft/s / 7.5 m/s
45 ft/s / 14 m/s
Flow vs. Minimum Pressure Drop – 106 Series (PG, PGX, PT / PTC, PGM)

Full Port, Globe Body, Rolling Diaphragm
Curve 106-412 (6 in / 150 mm – 36 in / 900 mm)

Straight Lines—Flow For a Fully Open Valve (Bonnet vented to atmosphere)
Curved Lines—Bonnet vented to downstream

C = Continuous Service
I = Intermittent Service
M = Momentary Service

20 ft/s / 6 m/s
25 ft/s / 7.5 m/s
45 ft/s / 14 m/s
Flow vs. Pressure Drop – 106 Series (PG, PGX, PT/PTC, PGM)
Full Port, Angle Body, Flat & Rolling Diaphragm
Curve 106-413 (1 in / 25 mm – 20 in / 500 mm)

Straight Lines—Flow For a Fully Open Valve Bonnet vented to atmosphere
Curved Lines—Bonnet vented to downstream

C = Continuous Service
I = Intermittent Service
M = Momentary Service

20 ft/s / 6 m/s
25 ft/s / 7.5 m/s
45 ft/s / 14 m/s
Flow vs. Pressure Drop – 206 Series (PG, PGX, PT / PTC, PGM)
Reduced Port, Globe & Angle, Flat & Rolling Diaphragm
Bodies Curve 206-414 (3 in / 80 mm – 36 in / 900 mm)

Straight Lines—Flow For a Fully Open Valve (Bonnet vented to atmosphere)
Curved Lines—Bonnet vented to downstream

Minimum Pressure Drop

- C = Continuous Service
- I = Intermittent Service
- M = Momentary Service

C = 20 ft/s / 6 m/s
I = 25 ft/s / 7.5 m/s
M = 45 ft/s / 14 m/s
Dynamic Lifter Sizing Graph Curve: 3 in / 80 mm – 8 in / 200 mm

Traditional relief valves for sewage are typically sized larger than a Singer Dynamic Lifter due to opening forces being lost as the inner valve leaves the seat.

Benefits: Smaller size, smaller footprint and reduced cost

Examples of valve size selection
1) Relief setting 80 psi / 5.5 bar - discharge to atmosphere: Max. flow in main pipeline 1,200 USGPM / 75.7 l / s - Find intersect of 80 psi / 5.5 bar \( \Delta P \) and 1200 USGPM / 75.7 l / s flow. Select next larger size Dynamic Lifter, e.g., 3 in / 80 mm size.
2) Relief setting 55 psi / 3.8 bar - discharge 20 psi / 1.38 bar back pressure: Max. flow in main pipeline 4,000 USGPM / 252.4 l / s

Find intersect of 55 psi – 20 = 35 psi / 2.4 bar \( \Delta P \) and 4000 USGPM / 252.4 l / s flow. Select next larger size Dynamic Lifter, e.g., 6 in / 150 mm size.

Consult Singer Valve for higher pressures.

Examples of valve size selection
1) Relief setting 80 psi / 5.5 bar - discharge to atmosphere: Max. flow in main pipeline 1,200 USGPM / 75.7 l / s - Find intersect of 80 psi / 5.5 bar \( \Delta P \) and 1200 USGPM / 75.7 l / s flow. Select next larger size Dynamic Lifter, e.g., 3 in / 80 mm size.
2) Relief setting 55 psi / 3.8 bar - discharge 20 psi / 1.38 bar back pressure: Max. flow in main pipeline 4,000 USGPM / 252.4 l / s

Find intersect of 55 psi – 20 = 35 psi / 2.4 bar \( \Delta P \) and 4000 USGPM / 252.4 l / s flow. Select next larger size Dynamic Lifter, e.g., 6 in / 150 mm size.

Note:
* If the discharge was to atmosphere, \( \Delta P = 55 \) psi / 3.8 bar and 4 in / 100 mm size would be selected.
* This graph is based on current practice for standard applications. It is intended to be a guide only and no selection guarantee is implied or intended.
Flow vs. Pressure Differential
Model 106 Series (PG-AC, PGX-AC, PT-AC, PGM-AC) – Full Port, Globe Body, Flat / Rolling Diaphragm
Anti-Cavitation Valve Curve 106-415 (1 in / 25 mm – 36 in / 900 mm)

- Solid line and below suitable for continuous service.
- Differential Pressures over 300 psi / 21 bar, check with Singer Valve.

Flow

Pressure Differential

Valve Sizes

36" - 900 mm
24" - 600 mm
20" - 500 mm
16" - 400 mm
12" - 300 mm
10" - 250 mm
8" - 200 mm
6" - 150 mm
4" - 100 mm
3" - 80 mm
2.5" - 65 mm
2" - 50 mm
1.50" - 40 mm
1.25" - 32 mm
1" - 25 mm

l/s USGPM

40 50 60 70 80 90 100 150 200 300 psi

30 40 50 60 70 80 90 100 150 200 250 300 bar
This chart applies to cold water only.

Cavitation Chart (Guide Only)

Sigma (σ) = \( \frac{P_2 - (-P_v)}{\Delta P} \)

Where
- \( P_2 \) = Downstream pressure
- \( \Delta P \) = Differential pressure
- \( P_v = 14.4 \) Psi / 1 Bar / 103 KPa

For Inlet Pressure:
- Consult: 2,758 kpa, 27.58 bar, 400 psi
- Severe: 2,413 kpa, 24.14 bar, 350 psi
- Moderate: 2,068 kpa, 20.7 bar, 300 psi
- No Cavitation: 1,724 kpa, 17.24 bar, 250 psi

For Downstream Pressure:
- 27.58 bar, 2,758 kpa, 400 psi
- 24.14 bar, 2,413 kpa, 350 psi
- 20.7 bar, 2,068 kpa, 300 psi
- 17.24 bar, 1,724 kpa, 250 psi
### Flange Dimensions—Ductile Iron Valves

#### Standard: ANSI B16.42 - 1998 - Class 150 and 300

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>Diameter of Flange</th>
<th>Diameter of Bolt Circle</th>
<th>Number of Bolts</th>
<th>Diameter of Bolt Holes</th>
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<td>4 8</td>
<td>3/4&quot; 3/4&quot;</td>
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<tr>
<td>2.5</td>
<td>7.00 7.50</td>
<td>5.50 5.88</td>
<td>4 8</td>
<td>3/4&quot; 7/8&quot;</td>
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<td>1-1/8&quot; 1-3/8&quot;</td>
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</tbody>
</table>

Note:
ISO flange diameters may vary slightly from the standard, as the flange bolt pattern is drilled on an ANSI valve flange.


<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>Diameter of Flange</th>
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<tr>
<td>40</td>
<td>155 165</td>
<td>155 155</td>
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<td>620 650 660 670</td>
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<td>34 40 49 56</td>
</tr>
</tbody>
</table>

Note:
ISO flange diameters may vary slightly from the standard, as the flange bolt pattern is drilled on an ANSI valve flange.
Engineering Notes

In this section, you will find additional engineering notes for the main valves and also the anti-cavitation valve.

Main Valves Data (US & Metric Units & ISO)

Engineering Notes:
• Drilled as per ANSI B16.42 or threaded as per ANSI B1.20.1
• ANSI flanges drilled to ISO 7005-2 - 1998 / BS54504 PN 10, 16, 25, or 40, or threaded BSPT
• Class 150 machined flat faced / Class 300 machined raised faced.
• Castings are based on ANSI Class 150 or Class 300 standards.
• For conditions where working pressures exceed 300 psi / 20.7 bar, consult with Singer Valve
• Allow 1/8 in / 3 mm for machining tolerance.
• Allow one to three feet for installation and maintenance clearances. Consult Singer Valve for certified dimensions.
• Preferred method of stem installation is vertically; on valves 10 in / 250 mm and larger the vertical installation method is mandatory.
• Add a minimum 6 in / 150 mm on one side, for Pilot System.

Anti-Cavitation Data

106-AC / 206-AC (206 in large valve sizes only)
As a guide, if downstream pressure of an automatic control valve is less than 35% of the inlet pressure, there is a risk of cavitation damage occurring. Use 106-415 to select the valve size.
Cavitation chart on page 290 can also be used to determine if a valve is cavitating. Plot the maximum inlet pressure against the minimum outlet pressure.
• If this plotted point is to the right of the 0.8 line (e.g. you are in the “No Cavitation” zone) then use performance curves from chart 106-412, 106-413 and 106-414 on pages 284 - 287 to select the valve size.
• If this plotted point is to the left of the 0.8 line then use performance curves 106-415 to select the valve size.

Refer to Singer Performance Curves and Cavitation Charts in the Technical & Sizing Information section page 282 or contact Singer Valve.