Globe and Ball Valves

Selecting Valves: Globe vs. Ball

The control valve is the most important single element in any fluid handling system, because it regulates the flow of fluid to the process. To properly select a control valve, a general knowledge of the process and components is usually necessary. This reference section can help you select and size the control valve that most closely matches the process requirements.

The sizing of a valve is very important if it is to render good service. If it is undersized, it will not have sufficient capacity. If it is oversized, the controlled variable may cycle, and the seat, and disc will be subject to wire drawing because of the restricted opening.

Systems are designed for the most adverse conditions expected (i.e., coldest weather, greatest load, etc.). In addition, system components (boiler, chiller, pumps, coils, etc.) are limited to sizes available and frequently have a greater capacity than system requirements. Correct sizing of the control valve for actual expected conditions is considered essential for good control.

A basic rule of control valve sizing is:

The higher the percentage of drop across the wide open valve in relation to the percentage of pressure drop through the line and process coil, the better the control.

Technical Comparison Between Globe and Ball Valves

Technically, the globe valve has a stem and plug, which strokes linearly, commonly referred to as “stroke” valves. The ball valve has a stem and ball, which turns horizontally, commonly referred to as “rotational” valves.

Early ball valves used a full port opening, allowing large amounts of water to pass through the valve. This gave HVAC controls contractors the ability to select a ball valve two to three pipe sizes smaller than the piping line size. Compared to traditional globe valves that would be only one pipe size smaller than the line size, this was often a more cost-effective device-level solution. In addition, the ball valve could be actuated by a damper actuator, rather than expensive box-style “Mod” motors.

Pricing Comparison

Today, with equivalent pricing between ball and globe valves, the full port ball valve is falling out of favor for most HVAC control applications. This is also due to its poor installed flow characteristic that leads to its inability to maintain proper control. New “flow optimized” or characterized ball valves, specifically designed for modulating applications, have been developed. Characterized ball valves are sized the same way as globe valves. They provide an equal percentage flow characteristic, enabling stable control of fluids. Additionally, there are more cost-effective valve actuators now available for globe valves. Better control and more-competitive pricing now puts globe valves on the same playing field as characterized ball valves.

Most Cost-effective by Application

Let’s look at a cost comparison as it relates to the decision to select ball or globe valves. For terminal unit applications requiring less than 25 GPM, the globe valve is a more cost-effective choice. However, on larger coils the characterized ball valve is the more cost-effective solution.

From a practical standpoint,many jobs will use mostly one type or the other. If the majority of valves on a project tend to be terminal unit valves, then globe valves would offer better control at a lower price. If the majority of the valves are for AHU’s (1-1/4" or larger) characterized Ball Valves are the preferred solution from a pure cost standpoint.

Different tolerances to temperature, pressure and steam should also be considered in the selection process.

Selection Guidelines

Globe Valve

- Lower cost
- Close off of 50 psi or less (typical for most HVAC applications)
- High differential pressure across valve
- Rebuilding of the valve is desired
- Better control performance
- Better low flow (partial load) performance
- Use for steam, water or water/glycol media
- Smaller physical profile than a comparable ball valve

Characterized Ball Valve

- Tight shutoff or high close offs of around 100 psi* are required
- Isolation or two position control**
- Cv ranges from 16 to 250 (equates to line sizes 1-1/4" to 2-1/2")
- Use for water or water/glycol solution only

* This equates to a pump head pressure of approximately 230 ft. Not very common HVAC applications.
** Valve can be line sized to minimize pressure losses; butterfly valves are also used for these applications.

Sizing

Pressure Drop for Water Flow

A pressure drop must exist across a control valve if flow is to occur. The greater the drop, the greater the flow at any fixed opening. The pressure drop across a valve also varies with the disc position–from minimum when fully open, to 100% of the system drop when fully closed.

To size a valve properly, it is necessary to know the full flow pressure drop across it. The pressure drop across a valve is the difference in pressure between the inlet and outlet under flow conditions. When it is specified by the engineer and the required flow is known, the selection of a valve is simplified. When this pressure drop is not known, it must be computed or assumed.

If the pressure drop across the valve when fully open is not a large enough percentage of the total system drop, there will be little change in fluid flow until the valve actually closes, forcing the valve's characteristic toward a quick opening form.

Figure 1 shows flow-lift curves for a linear valve with various percentages of design pressure drop. Note the improved characteristic as pressure drop approaches 100% of system pressure drop at full flow.

It is important to realize that the flow characteristic for any particular valve, such as the linear characteristic shown in Figure 1 is applicable only if the pressure drop remains nearly constant across the valve for full stem travel. In most systems, however, it is impractical to take 100% of the system drop across the valve.

A good working rule is, "at maximum flow, 25 to 50% of the total system pressure drop should be absorbed by the control valve." Although this generally results in larger pump sizes, it should be pointed out that the initial equipment cost is offset by a reduction in control valve size, and results in improved controllability of the system. Reasonably good control can be accomplished with pressure drops of 15 to 30% of total system pressures. A drop of 15% can be used if the variation in flow is small.

Recommended Pressure Drops for Valve Sizing — Water

1. With a differential pressure less than 20 psi, use a pressure drop equal to 5 psi.
2. With a differential pressure greater than 20 psi, use a pressure drop equal to 25% of total system pressure drop (maximum pump head), but not exceeding the maximum rating of the valve.

Pressure Drop for Steam

The same methodology should be applied for selecting a valve for steam with the most important consideration is the pressure drop.

First, the correct maximum capacity of the coil must be determined. Ideally, there should be no safety factor in this determination and it should be based on the actual BTU heating requirements. The valve size must be based on the actual supply pressure at the valve. When the valve is fully open, the outlet pressure will assume a valve such that the valve capacity and coil condensing rate are in balance. If this outlet valve pressure is relatively large (small pressure drop), then as the valve closes, there will be no appreciable reduction in flow until the valve is nearly closed. To achieve better controllability, the smallest valve (largest pressure drop) should be selected. With the valve outlet pressure much less than the inlet pressure, a large pressure drop results. There will now be an immediate reduction in capacity as the valve throttles. For steam valves, generally the largest possible pressure drop should be taken, without exceeding the critical pressure ratio. Therefore, the steam pressure drop should approach 50% of the absolute inlet pressure.

Examining the pressure drops under "Recommended Pressure Drops for Valve Sizing — Steam" , you might be concerned about the steam entering the coil at 0 psi when a large drop is taken across the control valve. Steam flow through the coil will still drop to vacuum pressures due to condensation of the steam. Consequently, a pressure differential will still exist. In this case, proper steam trapping and condensation piping is essential.

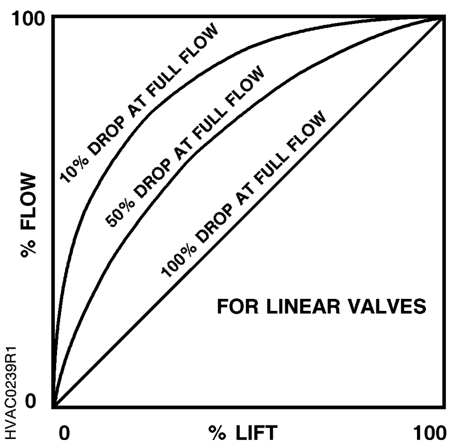


Figure 1.

Recommended Pressure Drops for Valve Sizing — Steam

1. With gravity flow condensate removal and inlet pressure less than 15 psi, use a pressure drop equal to the inlet gauge pressure.
2. With vacuum return system up to 7" Hg vacuum and an inlet pressure less than 2 psi, a pressure drop of 2 psi should be used. With an inlet pressure of 2 to 15 psi, use a pressure drop equal to the inlet gauge pressure.
3. With an inlet pressure greater than 15 psi, use a pressure drop equal to 50% of inlet absolute pressure. Example: Inlet pressure is 20 psi (35 psi). Use a pressure drop of 17.5 psi.
4. When a coil size is selected on the basis that line pressure and temperature is available in the coil of a heating and ventilating application, a very minimum pressure drop is desired. In this case, use the following pressure drop:

Initial Pressure	Pressure Drop
15 psi	5 psi
50 psi	7.5 psi
100 psi	10 psi
Over 100 psi	10% of line pressure

The Most Important Variables to Consider When Sizing a Valve:

1. What medium will the valve control? Water? Air? Steam? What effects will specific gravity and viscosity have on the valve size?
2. What will the inlet pressure be under maximum load demand? What is the inlet temperature?
3. What pressure drop (differential) will exist across the valve under maximum load demand?
4. What maximum capacity should the valve handle?
5. What is the maximum pressure differential the valve top must close against?

When these are known, a valve can be selected by formula (Cv method) or water and steam capacities tables which can be found in the Valves section, pages D-7 through D-10. The valve size should not exceed the line size, and it should preferably be one to two sizes smaller.

Valve Sizing and Selection Example

Select a valve to control a chilled water coil that must have a flow of 35 GPM with a valve differential pressure (△P) of 5 psi.

Determine the valve Cv using the formula for liquids.

$$Cv = Q \sqrt{\frac{S}{P}} = 35\ GPM \sqrt{\frac{1}{5\ psi}} = 15.6$$

Select a valve that is suitable for this application and has a Cv as close as possible to the calculated value.

One choice is 277-03186: a 1-1/4" NC valve with a Cv of 16. Refer to Flowrite Valves Reference section.

Valve Selection Criteria

1. Flow characteristic—Modified Equal Percentage which provides good control for a water coil.
2. Body rating and material—Suitable for water plus a soft disc which provides tight shut-off.
3. Valve type and action—A single seat NC valve with an adjustable spring range which can be sequenced with a NO valve used for heating.
4. Valve actuator—Actuator close-off rating is higher than the system P.
5. Valve line size—Its Cv is close to and slightly larger than the calculated Cv (15.6).
6. For Ball Valves—Select a ball the same size as the line size.

Valve Body Rating

The temperature-pressure ratings for ANSI Classes 125 and 250 valve bodies made of bronze or cast iron are shown below.

Description	Temperature	Pressure	
		ANSI Class 125	ANSI Class 250
Bronze Screwed Bodies Specification #B16.15-1978 ANSI Amer. Std.; USA; ASME	-20 to + 150°F (-30 to + 66°C)	200 psi (1378 kPa)	400 psi (2758 kPa)
	-20 to + 200°F (-30 to + 93°C)	190 psi (1310 kPa)	385 psi (2655 kPa)
	-20 to + 250°F (-30 to + 121°C)	180 psi (1241 kPa)	265 psi (2586 kPa)
	-20 to + 300°F (-30 to + 149°C)	165 psi (1138 kPa)	335 psi (2300 kPa)
	-20 to + 350°F (-30 to + 177°C)	150 psi (1034 kPa)	300 psi (2068 kPa)
	-20 to + 400°F (-30 to + 204°C)	125 psi (862 kPa)	250 psi (1724 kPa)
Cast Iron Flanged Bodies Class A-sizes 1 to 12 Specification #B16.1 1975 ANSI Amer. Std.; USA; ASME	-20 to + 150°F (-30 to + 66°C)	175 psi (1206 kPa)	400 psi (2758 kPa)
	-20 to + 200°F (-30 to + 93°C)	165 psi (1138 kPa)	370 psi (2551 kPa)
	-20 to + 225°F (-30 to + 106°C)	155 psi (1069kPa)	355 psi (2448 kPa)
	-20 to + 250°F (-30 to + 121°C)	150 psi (1034 kPa)	340 psi (2344 kPa)
	-20 to + 275°F (-30 to + 135°C)	145 psi (1000 kPa)	325 psi (2241 kPa)
	-20 to + 300°F (-30 to + 149°C)	140 psi (965 kPa)	310 psi (2137 kPa)
	-20 to + 325°F (-30 to + 163°C)	130 psi (896 kPa)	295 psi (2034 kPa)
	-20 to + 350°F (-30 to + 177°C)	125 psi (862 kPa)	280 psi (1931 kPa)
	-20 to + 375°F (-30 to + 191°C)	—	265 psi (1827 kPa)
	-20 to + 400°F (-30 to + 204°C)	—	250 psi (1734 kPa)

2-Way, Full-Port (no flow optimizer) Ball Valve Part Numbers and Flow Coefficients

Valve Line Size in. (mm)	Ball Size in. (mm)	Valve Part No.	Effective (Installed) Cv (Kvs)										
			Supply Line Size in Inches (mm)										
			1/2 (13)	3/4 (20)	1 (25)	1-1/4 (32)	1-1/2 (38)	2 (51)	2-1/2 (63)	3 (76)	4 (102)	5 (127)	6 (152)
1/2 (15)	1/2 (15)	**599-10208**	10.0 (8.62)	6.94 (5.93)	6.19 (5.29)								
3/4 (20)	3/4 (20)	**599-10210**		25.00 (21.55)	18.66 (15.99)	15.35 (13.12)							
1 (25)	1 (25)	**599-10214**			63.00 (54.31)	39.78 (34.00)	33.56 (28.69)						
1-1/4 (30)	1-1/4 (30)	**599-10217**				100.00 (86.21)	69.19 (5.13)	51.45 (43.98)					
1-1/2 (40)	1-1/4 (30)	**599-10219**					63.00 (54.31)	55.34 (47.30)	51.00 (43.59)				
1-1/2 (40)	1-1/2 (40)	**599-10221**					160.00 (137.93)	93.80 (80.17)	76.34 (65.25)				
2 (50)	1-1/4 (30)	**599-10223**						100.00 (86.21)	94.30 (80.60)	86.12 (73.61)			
2 (50)	2 (50)	**599-10225**						250.00 (215.52)	187.47 (160.23)	140.26 (119.88)			

Key

- Valve may be oversized.
- Optimal valve size.
- Valve may be undersized.

Valve Sizing Formulas

The following definitions apply in the following formulas:

Cv	Valve flow coefficient, U.S. GPM with P = 1 psi
P_1	Inlet pressure at maximum flow, psia (abs.)
P_2	Outlet pressure at maximum flow, psia (abs.)
$\triangle P$	$P_1 — P_2$ at maximum flow, psi
Q	Fluid flow, U.S. GPM
Qa	Air or gas flow, standard cubic feet per hour (SCFH) at 14.7 psi and 60°F
W	Steam flow, pounds per hour (lb./hr.)
S	Specific gravity of fluid relative to water @ 60°F
G	Specific gravity of gas relative to air at 14.7 psi and 60°F
T	Flowing air or gas temperature (°F)
K	1 + (0.0007 x °F superheat), for steam
V_2	Specific volume, cubic feet per pound, at outlet pressure P_2 and absolute temperature (T + 460)
K_r	Viscosity correction factor for fluids (See Page I-4)

Formulas:	Remarks:
1. For liquids (water, oil, etc.): $Cv=Q\sqrt{\frac{S}{\triangle P}}$	Specific gravity correction is negligible for water below 200°F (use S=1.0). Use actual specific gravity S of other liquids at actual flow temperature.
$Cv=K_rQ\sqrt{\frac{S}{\triangle P}}$	Use this for fluids with viscosity correction fact. Use actual specific gravity S for fluids at actual flow temperature.
2. For gases (air, natural gas, propane, etc.): $Cv=\frac{Qa\sqrt{G(T+460)}}{1360\sqrt{\triangle P(P_2)}}$	Use this when P_2 is greater than $1/2P_1$.
$Cv=\frac{Qa\sqrt{G(T+460)}}{660\ P_1}$	Use this when P_2 is *less than* or *equal to* $1/2P_1$.
3. For steam (saturated or superheated): $Cv=\frac{WK}{2.1\sqrt{\triangle P\ (P_1+P_2)}}$	Use this when P_2 is *greater* than $1/2P_1$.
$Cv=\frac{WK}{1.82\ P_1}$	Use this when P2 is *less than* or *equal to* $1/2P_1$.
4. For vapors other than steam: $Cv=\frac{WK}{63.4}\sqrt{\frac{V_2}{\triangle P}}$	When P_2 is less than or equal to $1/2P_1$, use the value of $1/2P_1$ in place of P and use P_2 corresponding to $1/2P_1$ when determining specific volume V_2.

Viscosity Factors

The relationship between kinematic and absolute viscosity:

$$\text{Centistoke} = \frac{\text{Centipoise}}{\text{Specific Gravity}}$$

Saybolt* Univ Seconds (S.S.U.)	Engler Time Seconds	Kinematic Viscosity	Cv Correction Factors (K_r)
46,350	—	10,000	—
37,080	—	8,000	—
27,810	—	6,000	—
18,540	—	4,000	—
13,900	—	3,000	—
11,590	—	2,500	—
9,270	—	2,000	1.93
6,950	10,800	1,500	1.90
4,635	7,100	1,000	1.82
3,708	5,700	800	1.78
2,781	4,250	600	1.74
1,854	2,820	400	1.67
1,390	2,120	300	1.63
1,159	1,760	250	1.61
927	1,400	200	1.57
695	1,050	150	1.43
464	700	100	1.45
371	555	80	1.42
278	420	60	1.37
186	290	40	1.30
141	225	30	1.25
119	191	25	1.22
97.8	157	20	120
77.4	127	15	1.16
58.9	97	10	1.11
52.1	85.5	8	1.08
45.6	76.0	6	1.07
39.1	67.5	4	1.05
36.0	62.5	3	1.03
32.6	58.0	2	—
31.6	55.5	1.5	—
31.3 ← PURE WATER AT 60°F → 1.1			—

Chart Note

*Redwood time (seconds) approximately same as S.S.U.

Specific Gravity of Water

Temp T(°F)	Abs. Pressure	Specific Gravity — S (W=62.4 lb./ft.³ @ 60°F)	$\sqrt{S}$
60	—	1.000	1.000
100	—	0.993	0.999
150	—	0.981	0.985
200	—	0.963	0.981
250	30	0.942	0.971
300	67	0.920	0.959
350	135	0.891	0.944
400	247	0.860	0.927
450	423	0.827	0.910

Sizing Formulas and Tables

Process Formulas

For Heating or Cooling Water:

$$\text{GPM} = \frac{\text{Btu/hr.}}{(\text{°F water temp. rise or drop} \times 500)}$$

$$\text{GPM} = \frac{\text{CFM} \times .009 \times H}{\text{°F water temperature change}}$$

(H = change in enthalpy of air expressed in Btu/lb. of air)

For Heating Water with Steam:

lbs. steam/hr. = 0.50 x GPM x (°F water temp. rise)

For Heating or Cooling Water:

$$\text{GPM}_1 = \text{GPM}_2 \times \frac{(\text{°F water}_2 \text{ temp. rise or drop})}{\text{°F water}_1 \text{ temp. drop}}$$

For Heating Air with Steam Coils:

$$\text{lbs. steam/hr.} = 1.08 \times (\text{°F air temp. rise}) \times \frac{\text{CFM}}{1000}$$

For Heating Air with Water Coils:

$$\text{GPM} = 2.16 \times \frac{\text{CFM} \times (\text{°F air temp. rise})}{1000 \times (\text{°F water}_1 \text{ temp. drop})}$$

For Radiation:

lbs. steam/hr. = 0.24 x ft.² EDR (Low pressure steam)

EDR = Equivalent Direct Radiation

1 EDR (steam) = 240 BTU/Hr. (Coil Temp. = 215°F)

1 EDR (water) = 200 BTU/Hr. (Coil Temp. = 197°F)

$$\text{GPM} = \frac{\text{ft.}^2\ \text{EDR}}{50}$$ (Assume 20°F water TD)

Refer to Conversion Factors on page I-23.

Powermite Globe Close-off Pressures

MZ Series

Valve Size	2-way	3-way
	Electronic	
Normally Open		
1/2", Cv ≤ 1.6	60 psi (414 kPa)	25 psi (172 kPa)
1/2", Cv ≤ 4	35 psi (241 kPa)	15 psi (103 kPa)
3/4 to 1", Cv ≤ 10	30 psi (207 kPa)	10 psi (69 kPa)
Normally Closed		
1/2", Cv ≤ 1.6	70 psi (482 kPa)	70 psi (482 kPa)
1/2", Cv ≤ 4	40 psi (276 kPa)	40 psi (276 kPa)
3/4 to 1" Cv ≤ 10	30 psi (207 kPa)	30 psi (207 kPa)

Table Note: For 3-way valve close-offs, use this chart to determine upper port (NC) and bottom port (NO).

MT Series

2-way Valve Size	Pneumatic			Electronic	
	599-01088			SQS	SSC
	3-8 psi	8-13 psi	10-15 psi		
Normally Open					
1/2", Cv ≤ 1.6	95 psi (655 kPa)	45 psi (310 kPa)	20 psi (138 kPa)	160 psi (1103 kPa)	120 psi (868kPa)
1/2", Cv ≤ 4	45 psi (310 kPa)	25 psi (172 kPa)	15 psi (103 kPa)	85 psi (586 kPa)	65 psi (448 kPa)
3/4 to 1", Cv ≤ 10	35 psi (241 kPa)	10 psi (69 kPa)	—	70 psi (482 kPa)	55 psi (379 kPa)
1-1/4", Cv 16	—	—	—	28 psi (193 kPa)	20 psi (138 kPa)
1-1/2", Cv 25	—	—	—	14 psi (96 kPa)	10 psi (69 kPa)
Normally Closed					
1/2", Cv ≤ 1.6	40 psi (276 kPa)	95 psi (655 kPa)	95 psi (655 kPa)	95 psi (655 kPa)	95 psi (655 kPa)
1/2", Cv ≤ 4	28 psi (193 kPa)	50 psi (345 kPa)	50 psi (345 kPa)	50 psi (345 kPa)	50 psi (345 kPa)
3/4 to 1" Cv ≤ 10	18 psi (124 kPa)	40 psi (276 kPa)	40 psi (276 kPa)	40 psi (276 kPa)	40 psi (276 kPa)
1-1/4", Cv 16	—	—	—	21 psi (145 kPa)	21 psi (145 kPa)
1-1/2", Cv 25	—	—	—	13 psi (90 kPa)	—

3-way Valve Size	Pneumatic			Electronic	
	599-01088			SQS	SSC
	3-8 psi	8-13 psi	10-15 psi		
Normally Open					
1/2", Cv ≤ 1.6	95 psi (655 kPa)	45 psi (310 kPa)	20 psi (138 kPa)	160 psi (1103 kPa)	95 psi (655 kPa)
1/2", Cv ≤ 4	45 psi (310 kPa)	25 psi (172 kPa)	15 psi (103 kPa)	85 psi (586 kPa)	55 psi (379 kPa)
3/4 to 1", Cv ≤ 10	35 psi (241 kPa)	10 psi (69 kPa)	—	70 psi (482 kPa)	40 psi (276 kPa)
1-1/4", Cv 16	—	—	—	10 psi (69 kPa)	10 psi (69 kPa)
1-1/2", Cv 25	—	—	—	7 psi (48 kPa)	—
Normally Closed					
1/2", Cv ≤ 1.6	40 psi (276 kPa)	95 psi (655 kPa)	120 psi (827 kPa)	95 psi (655 kPa)	95 psi (655 kPa)
1/2", Cv ≤ 4	28 psi (193 kPa)	50 psi (345 kPa)	65 psi (448 kPa)	50 psi (345 kPa)	50 psi (345 kPa)
3/4 to 1" Cv ≤ 10	18 psi (124 kPa)	40 psi (276 kPa)	50 psi (345 kPa)	40 psi (276 kPa)	40 psi (276 kPa)
1-1/4", Cv 16	—	—	—	10 psi (69 kPa)	10 psi (69 kPa)
1-1/2", Cv 25	—	—	—	7 psi (48 kPa)	—

Table Notes:

For 3-way valve close-offs, use this chart to determine upper (NC) and bottom port (NO).

Normally open close-off pressures are at 20 psi actuator pressure.

Normally closed close-off pressures are at 0 psi actuator pressure.

Siemens Ball Close-off Pressures

Valve	Line		Close-Off			
Part No.	Size Inches		ΔP in psi (Kvs)			
	in.	(mm)	Cv	(Kvs)	Cv	(Kvs)
599-10203	1/2	(15)	130	(896)	0.4	(0.34)
599-10204	1/2	(15)	130	(896)	0.63	(0.54)
599-10205	1/2	(15)	130	(896)	1.6	(1.4)
599-10206	1/2	(15)	130	(896)	2.5	(2.2)
599-10207	1/2	(15)	130	(896)	4	(3.5)
599-10208*	1/2	(15)	130	(896)	10	(8.6)
599-10209	3/4	(20)	130	(896)	10	(8.6)
599-10210*	3/4	(20)	130	(896)	25	(22)
599-10211	1	(25)	3/4	(689)	10	(8.6)
599-10212	1	(25)	100	(689)	25	(22)
599-10213	1	(25)	100	(689)	16	(14)
599-10214*	1	(25)	100	(689)	63	(54)
599-10215	1-1/4	(30)	100	(689)	16	(14)
599-10216	1-1/4	(30)	100	(689)	40	(35)
599-10217*	1-1/4	(30)	100	(689)	100	(86)
599-10218	1-1/2	(40)	70	(482)	25	(22)
599-10219*	1-1/2	(40)	70	(482)	63	(54)
599-10220	1-1/2	(40)	70	(482)	40	(35)
599-10221*	1-1/2	(40)	70	(482)	160	(138)
599-10222	2	(50)	70	(482)	40	(35)
599-10223*	2	(50)	70	(482)	100	(86)
599-10224	2	(50)	70	(482)	63	(54)
599-10225*	2	(50)	70	(482)	250	(215)

** Denotes a full-port valve with no flow optimizer insert.*

Flowrite Globe Close-off Pressures

Electronic

Valve Size in. (mm)	SQX62 APC 271	SQX82 APC 272, 273	Rack & Pinion APC 298, 299	SKD APC 274, 275, 276	SKB APC 289-291	SKC APC 292-294	El/Mech APC 296	El/Mech APC 295, 297
Normally Open								
1/2 (15)	250 (1724)	250 (1724)	250 (1724)	250 (1724)	250 (1724)	—	250 (1724)	250 (1724)
3/4 (20)	173 (1193)	173 (1193)	231 (1593)	250 (1724)	250 (1724)	—	186 (1282)	186 (1282)
1 (25)	112 (772)	112 (772)	149 (1028)	201 (1386)	250 (1724)	—	121 (834)	121 (834)
1-1/4 (32)	69 (476)	69 (476)	92 (634)	124 (855)	250 (1724)	—	75 (517)	75 (517)
1-1/2 (40)	44 (303)	44 (303)	59 (407)	80 (552)	250 (1724)	—	48 (331)	48(331)
2 (50)	27 (186)	27 (186)	36 (248)	49 (338)	201 (1386)	—	30(207)	30(207)
2-1/2 (65)	25 (172)	25 (172)	25 (172)	38 (262)	153 (518)	—	23 (158)	48 (330)
3 (80)	18 (124)	18 (124)	18 (124)	25 (172)	101 (342)	—	16 (110)	32 (220)
4 (100)	—	—	—	—	—	65 (448)	10 (68)	21 (144)
5 (125)	—	—	—	—	—	42 (289)	—	—
6 (150)	—	—	—	—	—	29 (199)	—	—
Normally Closed								
1/2 (15)	250 (1724)	250 (1724)	250 (1724)	250 (1724)	250 (1724)	—	250 (1724)	250 (1724)
3/4 (20)	221 (1524)	221 (1524)	250 (1724)	250 (1724)	250 (1724)	—	238 (1640)	238 (1640)
1 (25)	130 (896)	130 (896)	173 (1193)	203 (1400)	250 (1724)	—	140 (965)	140 (965)
1-1/4 (32)	75 (517)	75 (517)	100 (690)	117 (807)	250 (1724)	—	81 (558)	81 (558)
1-1/2 (40)	46 (317)	46 (317)	61 (421)	73 (503)	208 (1434)	—	50 (345)	50 (345)
2 (50)	28 (193)	28 (193)	37 (255)	44 (303)	126 (869)	—	31 (214)	31 (214)
2-1/2 (65)	25 (172)	25 (172)	25 (172)	34 (234)	97 (668)	—	24 (165)	50 (344)
3 (80)	18 (124)	18 (124)	18 (124)	22 (152)	63 (434)	—	15 (103)	32 (220)
4 (100)	—	—	—	—	—	39 (268)	10 (68)	20 (137)
5 (125)	—	—	—	—	—	25 (172)	—	—
6 (150)	—	—	—	—	—	17 (117)	—	—

Table Notes:

All valves within table are in psi (kPa) unless otherwise indicated.

For 3-way valve close-offs, use this chart to determine upper port (NC) and bottom port (NO).

Flowrite Globe Close-off Pressures

Pneumatic

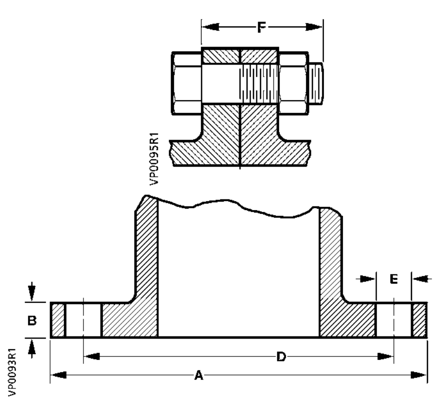
Valve Size in. (mm)	Spring Range: 3 to 8 psi (21 to 55 kPa)					Spring Range: 10 to 15 psi (69 to 103 kPa)		
	4" Actuator	8" Actuator		12" Actuator		4" Actuator	8" Actuator	12" Actuator
	15 psi (103 kPa)	15 psi (103 kPa)	30 psi (207 kPa)	15 psi (103 kPa)	30 psi (207 kPa)	0 psi (0 kPa)	0 psi (0 kPa)	0 psi (0 kPa)
Normally Open								
1/2 (15)	142 (979)	250 (1724)	250 (1724)	—	—	—	—	—
3/4 (20)	80 (552)	231 (1593)	250 (1724)	—	—	—	—	—
1 (25)	52 (359)	150 (1034)	250 (1724)	250 (1724)	250 (1724)	—	—	—
1-1/4 (32)	32 (221)	93 (641)	250 (1724)	250 (1724)	250 (1724)	—	—	—
1-1/2 (40)	20 (138)	60 (414)	198 (1365)	205 (1413)	250 (1724)	—	—	—
2 (50)	12 (83)	37 (255)	123 (848)	130 (896)	250 (1724)	—	—	—
2-1/2 (65)	—	31 (213)	100 (689)	95 (655)	250 (1724)	—	—	—
3 (80)	—	20 (138)	66 (444)	63 (434)	200 (1378)	—	—	—
4 (100)	—	—	—	40 (275)	129 (889)	—	—	—
5 (125)	—	—	—	26 (179)	82 (565)	—	—	—
6 (150)	—	—	—	18 (124)	57 (393)	—	—	—
Normally Closed								
1/2 (15)	—	—	—	—	—	236 (1627)	250 (1724)	—
3/4 (20)	—	—	—	—	—	155 (1069)	250 (1724)	—
1 (25)	—	—	—	—	—	91 (627)	250 (1724)	250 (1724)
1-1/4 (32)	—	—	—	—	—	52 (359)	148 (1020)	250 (1724)
1-1/2 (40)	—	—	—	—	—	32 (331)	92 (634)	250 (1724)
2 (50)	—	—	—	—	—	20 (138)	55 (379)	185 (1275)
2-1/2 (65)	—	—	—	—	—	—	36 (248)	114 (786)
3 (80)	—	—	—	—	—	—	23 (158)	74 (610)
4 (100)	—	—	—	—	—	—	—	46 (317)
5 (125)	—	—	—	—	—	—	—	29 (199)
6 (150)	—	—	—	—	—	—	—	20 (137)

Table Notes:

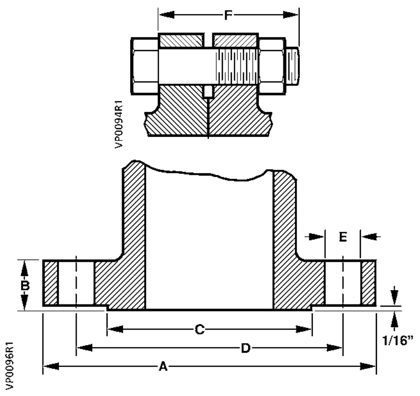
All values within table are in psi (kPa) unless otherwise indicated.

For 3-way valve close-offs, use this chart to determine upper port (NC) and bottom port (NO).

2-1/2 to 8-inch Cast Iron Flange Dimensions (as defined by ANSI standard B16.1)



ANSI Class 125.



ANSI Class 250.

ANSI Class 125

Nominal Pipe Size	Flanges		Drilling		Bolting		Length of Machine Bolts
	Flange Diameter	Flange Thickness	Diameter of Bolt Circle	Diameter of Bolt Holes	Number of Bolts	Diameter of Bolts	
	A	B	D	E			F
2-1/2"	7"	11/16"	5-1/2"	3/4"	4	5/8"	2-1/2"
3"	7-1/2"	3/4"	6"	3/4"	4	5/8"	2-1/2"
4"	9"	15/16"	7-1/2"	3/4"	8	5/8"	3"
5"	10"	15/16"	8-1/2"	7/8"	8	3/4"	3"
6"	11"	1"	9-1/2"	7/8"	8	3/4"	3-1/4"
8"	13-1/2"	1-1/8"	11-3/4"	7/8"	8	7/8"	3-1/2"

ANSI Class 250

Nominal Pipe Size	Flanges			Drilling		Bolting		Length of Machine Bolts
	Flange Diameter	Flange Thickness	Diameter of Raised Face	Diameter of Bolt Circle	Diameter of Bolt Holes	Number of Bolts	Diameter of Bolts	
	A	B	C	D	E			F
2-1/2"	7-1/2"	1"	4-15/16"	5-7/8"	7/8"	8	3/4"	3-1/4"
3"	8-1/4"	1-1/8"	5-11/16"	6-5/8"	7/8"	8	3/4"	3-1/5"
4"	10"	1-1/4"	6-15/16"	7-7/8"	7/8"	8	3/4"	3-3/4"
5"	11"	1-3/8"	8-5/16"	9-1/4"	7/8"	8	3/4"	4"
6"	12-1/2"	1-7/16"	9-11/16"	10-5/8"	7/8"	12	3/4"	4"
8"	15"	1-5/8"	11-15/16"	13"	1"	12	7/8"	4-1/2"

Steam Saturation Pressure – Temperature Table

Vacuum Inches Hg	Absolute Pressure psi	Temperature degrees Fahrenheit
29.74	0.0886	32
29.67	0.1217	40
29.56	0.1780	50
29.40	0.2562	60
29.18	0.3626	70
28.89	0.505	80
28.50	0.696	90
28.00	0.946	100.00
27.88	1	101.83
25.85	2	126.15
23.81	3	141.52
21.78	4	153.01
19.74	5	162.28
17.70	6	170.06
15.67	7	176.85
13.63	8	182.86
11.60	9	188.27
9.56	10	193.22
7.52	11	197.75
5.49	12	201.96
3.45	13	205.87
1.42	14	209.55

Gauge Pressure psi	Absolute Pressure psi	Temperature degrees Fahrenheit
0.0	14.70	212.0
0.3	15	213.0
1.3	16	216.3
2.3	17	219.4
3.3	18	222.4
4.3	19	225.2
5.3	20	228.0
6.3	21	230.6
7.3	22	233.1
8.3	23	235.5
9.3	24	237.8
10.3	25	240.1
11.3	26	242.2
12.3	27	244.4
13.3	28	246.4
14.3	29	248.4
15.3	30	250.3
16.3	31	252.2
17.3	32	254.1
18.3	33	255.8
19.3	34	257.6
20.3	35	259.3
21.3	36	261.0
22.3	37	262.6
23.3	38	264.2
24.3	39	265.8
25.3	40	267.3
26.3	41	268.7
27.3	42	270.2
28.3	43	271.7
29.3	44	273.1

Gauge Pressure psi	Absolute Pressure psi	Temperature degrees Fahrenheit
30.3	45	274.5
31.3	46	275.8
32.3	47	277.2
33.3	48	278.5
34.3	49	279.8
35.3	50	281.0
36.3	51	282.3
37.3	52	283.5
38.3	53	284.7
39.3	54	285.9
40.3	55	287.1
41.3	56	288.2
42.3	57	289.4
43.3	58	290.5
44.3	59	291.6
45.3	60	292.7
46.3	61	293.8
47.3	62	294.9
48.3	63	295.9
49.3	64	297.0
50.3	65	298.0
51.3	66	299.0
52.3	67	300.0
53.3	68	301.0
54.3	69	302.0
55.3	70	302.9
56.3	71	303.9
57.3	72	304.8
58.3	73	305.8
59.3	74	306.7
60.3	75	307.6
61.3	76	308.5
62.3	77	309.4
63.3	78	310.3
64.3	79	311.2
65.3	80	312.0
66.3	81	312.9
67.3	82	313.8
68.3	83	314.6
69.3	84	315.4
70.3	85	316.3
71.6	86	317.1
72.3	87	317.9
73.3	88	318.7
74.3	89	319.5
75.3	90	320.3
76.3	91	321.1
77.3	92	321.8
78.3	93	322.6
79.3	94	323.4
80.3	95	324.1
81.3	96	324.9
82.3	97	325.6
83.3	98	326.4
84.3	99	327.1
85.3	100	327.8
87.3	102	329.3
89.3	104	330.7
91.3	106	332.0
93.3	108	333.4
95.3	110	334.8

Gauge Pressure psi	Absolute Pressure psi	Temperature degrees Fahrenheit
97.3	112	336.1
99.3	114	337.4
101.3	116	338.7
103.3	118	340.0
105.3	120	341.3
107.3	122	342.5
109.3	124	343.8
111.3	126	345.0
113.3	128	346.2
115.3	130	347.4
117.3	132	348.5
119.3	134	349.7
121.3	136	350.8
123.3	138	352.0
125.3	140	353.1
127.3	142	354.2
129.3	144	355.3
131.3	146	356.3
133.3	148	357.4
135.3	150	358.5
137.3	152	359.5
139.3	154	360.5
141.3	156	361.6
143.3	158	362.6
145.3	160	363.6
147.3	162	364.6
149.3	164	365.6
151.3	166	366.5
153.3	168	367.5
155.3	170	368.5
157.3	172	369.4
159.3	174	370.4
161.3	175	371.3
163.3	178	372.2
165.3	180	373.1
167.3	182	374.0
169.3	184	374.9
171.3	186	375.8
173.3	188	376.7
175.3	190	377.6
177.3	192	378.5
179.3	194	379.3
181.3	196	380.2
183.3	198	381.0
185.3	200	381.9
190.3	205	384.0
195.3	210	386.0
200.3	215	388.0
205.3	220	389.9
210.3	225	391.9
215.3	230	393.8
220.3	235	395.6
225.3	240	397.4
230.3	245	399.3
235.3	250	401.1
245.3	260	404.5
255.3	270	407.9
265.3	280	411.2
275.3	290	414.4
285.3	300	417.5