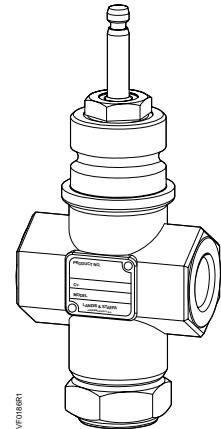


Flowrite™ VF 599 Series

Three-Way Valves

1/2 to 2-inch Bronze Body



Description The Flowrite VF 599 Series ANSI Class 250 three-way valves are designed to work with either a pneumatic or electronic actuator with a 3/4-inch (20 mm) stroke.

- Features**
- Direct coupled universal bonnet
 - Choice of bronze or stainless steel trim
 - ANSI Leakage Class IV (0.01% of Cv)
 - Cartridge type packing

Application A typical application for the Flowrite three-way valve is the mixing of two different temperatures of water supplies.

The valve can also be used for throttling or bypass coil control applications. A pump is recommended on the coil circuit to improve the heat transfer characteristics of the coil and for freeze protection.

Product Numbers See Table 1.

Ordering a Valve Plus Actuator Assembly To order a complete valve plus actuator assembly from the factory, combine the actuator prefix code with the suffix of the valve assembly product number. See *TB 249 Flowrite 599 Series Valve and Actuator Assembly Selection Technical Bulletin* (155-304P25) for selection procedure and ordering codes.

Valve assemblies can be ordered using the numbers in Table 1.



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Specifications

| | | |
|----------------------|--|--|
| Material | Line size | 1/2 to 2 inches (15 to 50 mm) |
| | Capacity | See Tables 2 and 3 and Figure 3 |
| | Body style | Globe style control valve with two connection options; see Table 1 |
| | Seat style | Metal-to-metal |
| | Action | Three-way mixing |
| | Valve body rating | ANSI Class 250; see Table 4 |
| | Stem travel (Stroke) | 3/4-inch (20 mm) |
| | Body | UNS CA 844 bronze |
| | Body trim | See Table 1 |
| | Stem | Stainless steel ASTM A582 Type 303 |
| | Packing | EPDM O-ring |
| Operating | Controlled medium | Water, glycol solutions to 50% |
| | Medium temperature range | 20°F to 250°F (-7°C to 120°C) |
| | Maximum inlet pressure | See Table 4 |
| | Maximum recommended differential pressure for modulating service | |
| | Bronze trim | 25 psi (173 kPa) |
| | Stainless Steel trim | 50 psi (345) kPa) |
| | Rangeability | > 100:1 |
| | Close-off pressures | See Tables 5 and 6 and Figure 4 |
| | Close-off ratings | According to ANSI/FCI 70-2 |
| | Leakage rate | Class IV (0.01% of Cv) |
| Flow characteristics | Equal percentage for NC Linear for NO | |
| Mounting location | NEMA 1 (interior only) | |
| Miscellaneous | Canadian Registration Numbers | 0H7645.5 0C0838.9 |
| | Dimensions | See Tables 7 and 8 and Figure 6 |
| | Valve Weight | See Table 8 |

Accessories

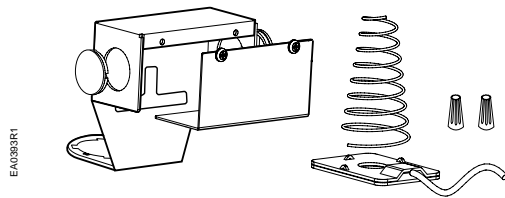


Figure 1. Packing Heating Element for use with SKD and SQX Actuators.

599-00417 Packing heating element.

The heater allows the stem to move freely in valves that control fluids at temperatures below 32°F (0°C). It reduces ice crystal formation on the stem that can damage the packing.

| | |
|-------------------|--------|
| Operating Voltage | 24 Vac |
| Heating Output | 20 W |

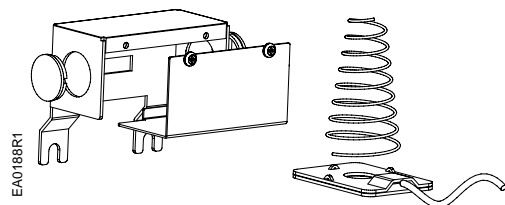


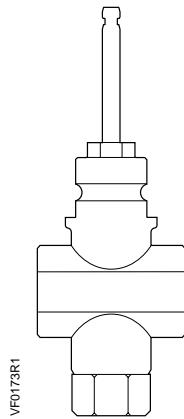
Figure 2. Packing Heating Element for use with SKB/C and 8-inch Actuators.

599-00418: The packing heating element. The heater allows the stem to move freely in valves that control fluids at temperatures below 32°F (0°C). It prevents ice crystal formation on the stem that can damage the packing.

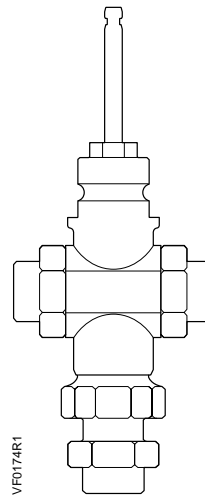
| | |
|-------------------|--------|
| Operating Voltage | 24 Vac |
| Heating Output | 20 W |

Service Kits

| | |
|--|--------------|
| Valve packing kit | 599-03390 |
| Rebuild/repack kits | See Table 10 |
| Sealing rings for union valves (package of 25) | |
| 1/2-inch (15 mm) | 599-03394 |
| 3/4-inch (20 mm) | 599-03395 |
| 1 inch (25 mm) | 599-03396 |
| 1-1/4 inch (32 mm) | 599-03397 |
| 1-1/2 inch (40 mm) | 599-03398 |
| 2 inch (50 mm) | 599-03399 |
| Union Tailpiece kit (one tailpiece, one union nut, one gasket) | |
| 1/2-inch (15 mm) male | 599-09181 |
| 3/4-inch (20 mm) male | 599-09182 |
| 1 inch (25 mm) male | 599-09183 |
| 1-1/4 inch (32 mm) male | 599-09184 |
| 1/2-inch (40 mm) female | 599-09185 |
| 3/4-inch (20 mm) female | 599-09186 |
| 1 inch ((25 mm) female | 599-09187 |
| 1-1/4 inch (32 mm) female | 599-09188 |
| 1-1/2 inch (40 mm) female | 599-09189 |
| 2 inch (50 mm) female | 599-09190 |



**Female NPT x Female
NPT FxF**



**Union Female x Union
Female UFxUF**

Table 1. 3-Way Valves.

| Flow Rate C_v | | Line Size Inch (mm) | | Connection | Stl. Steel Trim | Bronze Trim |
|--------------------|--------|------------------------|------|------------|--------------------|-------------|
| 1 | (0.85) | 1/2 | (15) | FxF | 599-03144 | 599-03198 |
| | | | | UFxUF | 599-03153 | 599-03207 |
| 1.6 | (1.37) | 1/2 | (15) | FxF | 599-03145 | 599-03199 |
| | | | | UFxUF | 599-03154 | 599-03208 |
| 2.5 | (2.15) | 1/2 | (15) | FxF | 599-03146 | 599-03200 |
| | | | | UFxUF | 599-03155 | 599-03209 |
| 4 | (3.44) | 1/2 | (15) | FxF | 599-03147 | 599-03201 |
| | | | | UFxUF | 599-03156 | 599-03210 |
| 6.3 | (5.43) | 3/4 | (20) | FxF | 599-03148 | 599-03202 |
| | | | | UFxUF | 599-03157 | 599-03211 |
| 10 | (8.6) | 1 | (25) | FxF | 599-03149 | 599-03203 |
| | | | | UFxUF | 599-03158 | 599-03212 |
| 16 | (13.8) | 1-1/4 | (32) | FxF | 599-03150 | 599-03204 |
| | | | | UFxUF | 599-03159 | 599-03213 |
| 25 | (21.5) | 1-1/2 | (40) | FxF | 599-03151 | 599-03205 |
| | | | | UFxUF | 599-03160 | 599-03214 |
| 40 | (34.4) | 2 | (50) | FxF | 599-03152 | 599-03206 |
| | | | | UFxUF | 599-03161 | 599-03215 |

Table 2. Maximum Water Capacity - U.S. Gallons per Minute.

| Valve Size in inches | Pressure Differential - psi | | | | | | | | | | | | | | | |
|----------------------|-----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| | Cv/1 | 2 | 3 | 4 | 5 | 6 | 8 | 10 | 15 | 20 | 25 | 30 | 40 | 50 | 60 | 75 |
| 1/2 | 1.0 | 1.4 | 1.7 | 2.0 | 2.2 | 2.5 | 2.8 | 3.2 | 3.9 | 4.5 | 5.0 | 5.5 | 6.3 | 7.1 | 7.8 | 8.7 |
| | 1.6 | 2.3 | 2.8 | 3.2 | 3.6 | 3.9 | 4.5 | 5.1 | 6.2 | 7.2 | 8.0 | 8.8 | 10.1 | 11.3 | 12.4 | 13.9 |
| | 2.5 | 3.5 | 4.3 | 5.0 | 5.6 | 6.1 | 7.1 | 7.9 | 9.7 | 11.2 | 12.5 | 13.7 | 15.8 | 17.7 | 19.4 | 22 |
| | 4 | 5.7 | 7 | 8.0 | 8.9 | 10 | 11.3 | 12.6 | 15.5 | 17.9 | 20.0 | 21.9 | 25 | 28 | 31 | 35 |
| 3/4 | 6 | 8.9 | 10.9 | 12.6 | 14.1 | 15.4 | 17.8 | 20 | 24 | 28 | 32 | 35 | 40 | 45 | 49 | 55 |
| 1 | 10 | 14.1 | 17.3 | 20 | 22 | 24 | 28 | 32 | 39 | 45 | 50 | 55 | 63 | 71 | 77 | 87 |
| 1-1/4 | 16 | 23 | 28 | 32 | 36 | 39 | 45 | 51 | 62 | 72 | 80 | 88 | 101 | 113 | 124 | 139 |
| 1-1/2 | 25 | 35 | 43 | 50 | 56 | 61 | 71 | 79 | 97 | 112 | 125 | 137 | 158 | 177 | 194 | 217 |
| 2 | 40 | 57 | 69 | 80 | 89 | 98 | 113 | 126 | 155 | 179 | 200 | 219 | 253 | 283 | 310 | 346 |

Table 3. Maximum Water Capacity - Cubic Meters per Hour (m³/hr).

| Valve Size in mm | Pressure Differential - kPa | | | | | | | | | | | | | | |
|------------------|-----------------------------|------|------|------|------|------|------|------|---------|------|------|------|------|------|--|
| | 1 | 10 | 20 | 30 | 40 | 50 | 60 | 80 | Kvs/100 | 150 | 200 | 300 | 400 | 500 | |
| 15 | 0.09 | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 | 0.7 | 0.8 | 0.9 | 1.0 | 1.2 | 1.5 | 1.7 | 1.9 | |
| | 0.14 | 0.4 | 0.6 | 0.8 | 0.9 | 1.0 | 1.1 | 1.2 | 1.4 | 1.7 | 1.9 | 2.4 | 2.7 | 3.1 | |
| | 0.2 | 0.7 | 1.0 | 1.2 | 1.4 | 1.5 | 1.7 | 1.9 | 2.2 | 2.6 | 3.0 | 3.7 | 4.3 | 4.8 | |
| | 0.3 | 1.1 | 1.5 | 1.9 | 2.2 | 2.4 | 2.7 | 3.1 | 3.4 | 4.2 | 4.9 | 6.0 | 6.9 | 7.7 | |
| 20 | 0.5 | 1.7 | 2.4 | 3.0 | 3.4 | 3.8 | 4.2 | 4.9 | 5.4 | 6.7 | 7.7 | 9.4 | 10.9 | 12.1 | |
| 25 | 0.9 | 2.7 | 3.8 | 4.7 | 5.4 | 6.1 | 6.7 | 7.7 | 8.6 | 10.5 | 12.2 | 14.9 | 17.2 | 19.2 | |
| 32 | 1.4 | 4.4 | 6.2 | 7.6 | 8.7 | 9.8 | 10.7 | 12.3 | 13.8 | 16.9 | 19.5 | 23.9 | 27.6 | 30.9 | |
| 40 | 2.2 | 6.8 | 9.6 | 11.8 | 13.6 | 15.2 | 16.7 | 19.2 | 22 | 26 | 30 | 37 | 43 | 48 | |
| 50 | 3.4 | 10.9 | 15.4 | 18.8 | 22 | 24 | 27 | 31 | 34 | 42 | 49 | 60 | 69 | 77 | |

Table 4. Body Temperature-Pressure Rating.

| Valve Body | Temperature | | Pressure | |
|------------|-------------|-------------|----------|--------|
| | °F | °C | psig | (kPa) |
| Bronze | -20 to +150 | (-30 to 66) | 400 | (2758) |
| | +200 | (93) | 385 | (2655) |
| | +250 | (121) | 365 | (2586) |
| | +300 | (149) | 335 | (2300) |
| | +350 | (177) | 300 | (2068) |

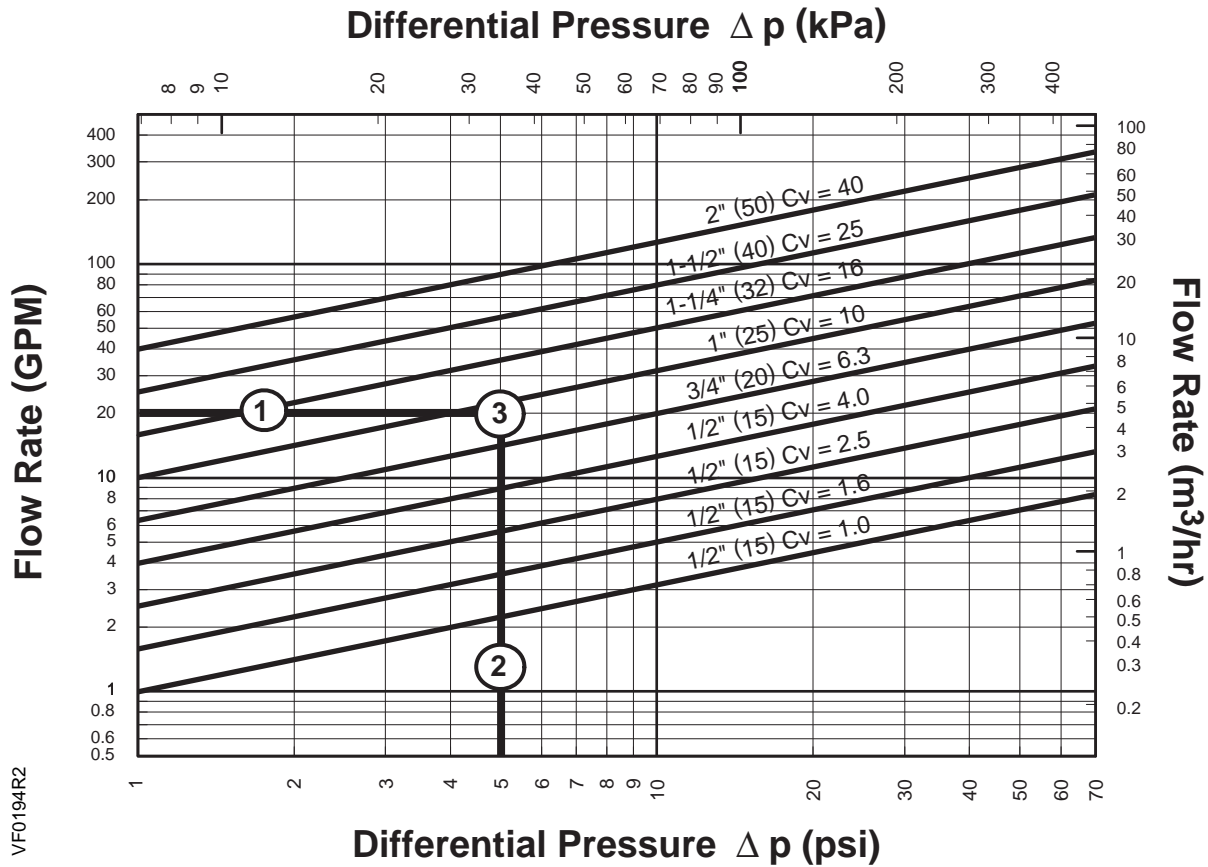


Figure 3. Water Capacity Graph.

Selection Example

Select a valve given:

1. Required flow = 20 gpm.
2. Desired pressure drop = 5 psi.
3. Select a 1 inch (25 mm) valve, Cv 10.

Table 5. Maximum Available Close-off Pressures for Pneumatic Actuators.

| Action | Valve Size Inch (mm) | 10 to 15 psi (69 to 103 kPa) spring range | | |
|---------------------|-------------------------|---|-----------------------------------|-----------------------|
| | | 4" Actuator | 8" Actuator | |
| | | 0 psi (0 kPa) | | |
| NC (Upper port) | 1/2 (15) | 236 (1627) | 250 (1724) | |
| | 3/4 (20) | 155 (1069) | 250 (1724) | |
| | 1 (25) | 91 (627) | 250 (1724) | |
| | 1-1/4 (32) | 52 (359) | 148 (1020) | |
| | 1-1/2 (40) | 32 (331) | 92 (634) | |
| | 2 (50) | 20 (138) | 55 (379) | |
| NO (Bottom port) | Valve Size Inch (mm) | 3 to 8 psi (21 to 55 kPa) spring range | | |
| | | 4" Actuator | 8" Actuator | |
| | | 15 psi (103 kPa) | 15 psi (103 kPa) 30 psi (207 kPa) | |
| | | 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) |
| | | 1-1/4 (32) | 32 (221) | 93 (641) 250 (1724) |
| | | 1-1/2 (40) | 20 (138) | 60 (414) 198 (1365) |
| | | 2 (50) | 12 (83) | 37 (255) 123 (848) |

Table 6. Close-off Pressures for Electronic Actuators.

| Action | Valve Size Inch (mm) | SKB | SKD | SQX | EI/Mech Low Force | Rack & Pinion Valve |
|--------|-------------------------|------------|------------|------------|----------------------|------------------------|
| | | psi (kPa) | psi (kPa) | psi (kPa) | psi (kPa) | psi (kPa) |
| NC | 1/2 (15) | 250 (1724) | 250 (1724) | 250 (1724) | 250 (1724) | 250 (1724) |
| | 3/4 (20) | 250 (1724) | 250 (1724) | 221 (1524) | 238 (1640) | 250 (1724) |
| | 1 (25) | 250 (1724) | 203 (1400) | 130 (896) | 140 (965) | 173 (1193) |
| | 1-1/4 (32) | 250 (1724) | 117 (807) | 75 (517) | 81 (558) | 100 (690) |
| | 1-1/2 (40) | 208 (1334) | 73 (503) | 46 (317) | 50 (345) | 61 (421) |
| | 2 (50) | 126 (869) | 44 (303) | 28 (193) | 31 (214) | 37 (255) |
| NO | 1/2 (15) | 250 (1724) | 250 (1724) | 250 (1724) | 250 (1724) | 250 (1724) |
| | 3/4 (20) | 250 (1724) | 250 (1724) | 173 (1193) | 186 (1282) | 231 (1593) |
| | 1 (25) | 250 (1724) | 201 (1386) | 112 (772) | 121 (834) | 149 (1028) |
| | 1-1/4 (32) | 250 (1724) | 124 (855) | 69 (476) | 75 (517) | 92 (634) |
| | 1-1/2 (40) | 250 (1724) | 80 (552) | 44 (303) | 48 (331) | 59 (407) |
| | 2 (50) | 201 (1386) | 49 (338) | 27 (186) | 30 (207) | 36 (248) |

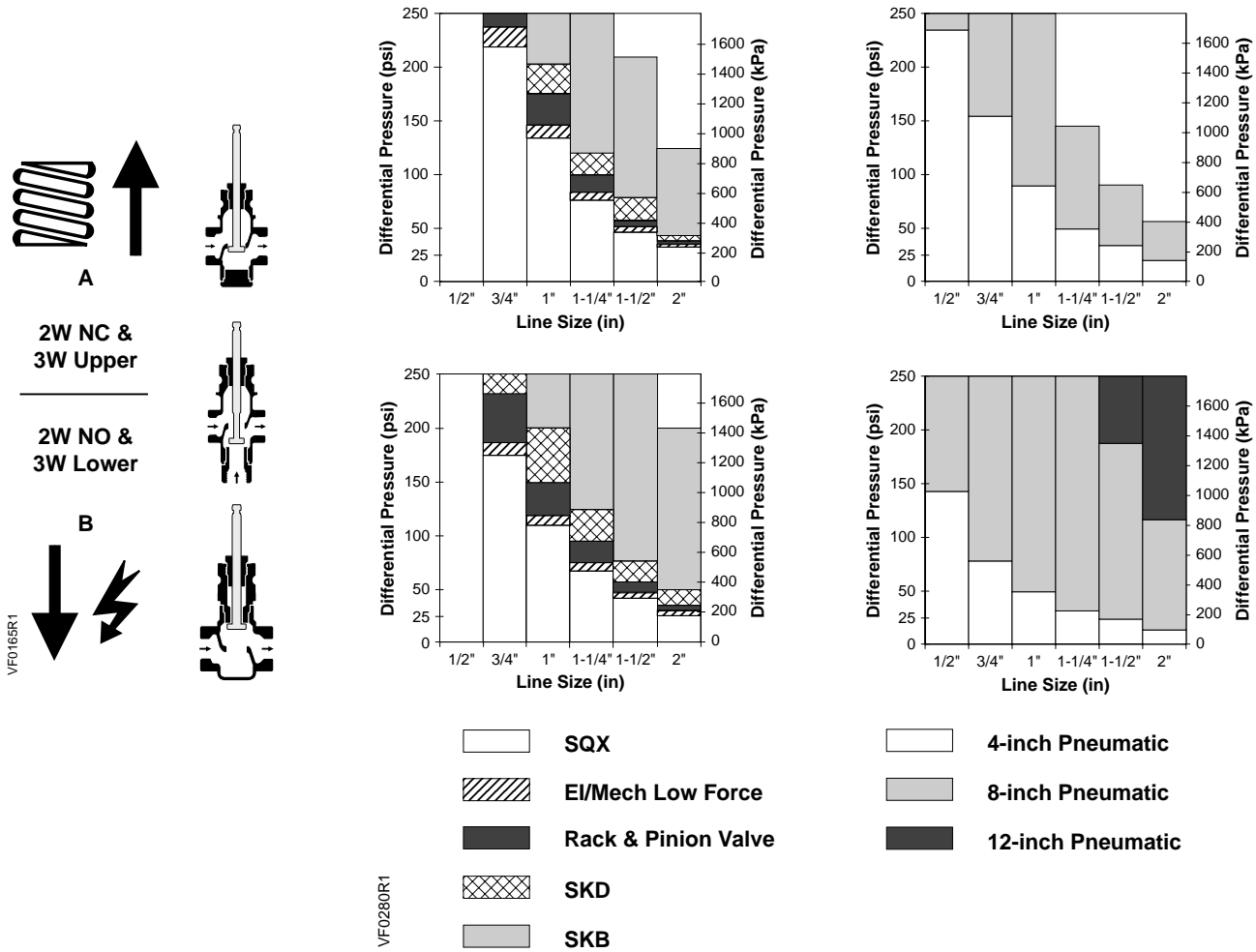


Figure 4. Close-off Pressures.

Operation

As the valve stem moves downward, the flow through the NO port decreases and the flow through the NC port increases. As the valve stem moves upward, the flow through the NO port increases and the flow through the NC port decreases.

In the event of power failure, a spring return actuator returns the valve to its normal position. Non-spring return actuators will hold the last commanded position. See the *Technical Instructions* of the various actuators for additional information.

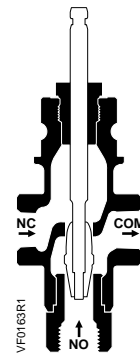


Figure 5.

**Operation,
continued**

If this valve is used in diverting applications, the following conditions apply:

- Diverting service with modulating control can only use the electro-hydraulic actuator, SKB/C. The differential pressure must not exceed 90% of the maximum differential pressure specified for the three-way valve in mixing service.
- Diverting service with a pneumatic actuator can only be used with two-position control. To change over from one port to another there must be no system pressure. The pump is tuned off.

Sizing

The sizing of a valve is important for correct system operation. An undersized valve will not have sufficient capacity at maximum load. An oversized valve can initiate cycling, and the seat and throttling plug can be damaged because of the restricted opening. Correct sizing of the control valve for *actual expected conditions* is considered essential for good control.

Some variables that must be determined are:

- The medium to be controlled, such as water, etc.
- The maximum inlet temperature and pressure of the medium at the valve.
- The pressure differential that will exist across the valve under maximum load demand.
- The maximum capacity the valve must deliver.
- The maximum line pressure differential the valve actuator must close against.
- See the *Control Valve Selection and Sizing (AB-1) section of HVAC Systems/Controls Reference Data (125-1853)* for further recommendations.

See Tables 2 and 3 for valve capacities.

**Mounting and
Installation**

- Install the valve so that the flow follows the direction of the arrow indicated on the valve body.
- For best performance, install the valve assembly with the actuator above the valve body. The valve and actuator can be installed in any position between vertical and horizontal. Siemens Building Technologies does not recommend installing the valve assembly so that the actuator is below horizontal or upside down.
- Allow sufficient space for servicing the valve and actuator. See Table 8 for valve body dimensions. See Figure 6 and Table 7 for dimensions of the service envelope recommended around the actuator.

NOTE: Instructions for field mounting an actuator, wiring diagrams, and start-up are covered in the *Technical Instructions* and *Installation Instructions* for each actuator.

Dimensions

The letters in Figure 6 refer to actuator and service envelope dimensions in Table 7. See Table 8 for valve body dimensions.

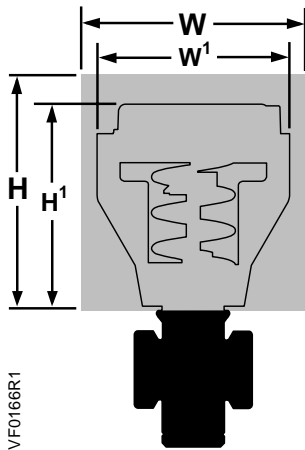
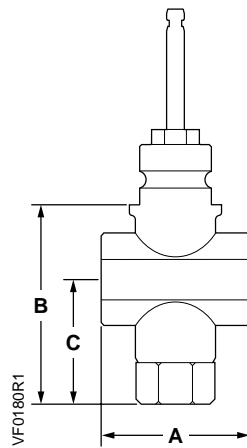


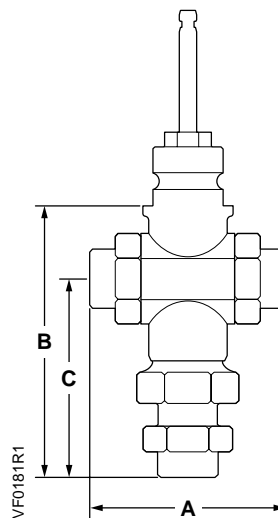
Figure 6.

Table 7. Dimensions of the Actuator and Recommended Service Envelope. Dimensions in Inches (millimeters).

| Actuator | Actuator Prefix Code | Actual Height of Actuator H1 | Service Height H | Actual Width or Diameter of Actuator W1 | Service Width W |
|----------------------|----------------------|------------------------------|------------------|--|-----------------|
| 4" Pneumatic | 268, 269 270 | 5-3/4 (146) | 14 (350) | 5-1/2 (137) dia. | 18 (450) |
| 8" Pneumatic | 277, 278 283, 284 | 14-1/8 (359) | 26 (660) | 8-3/4 (222) dia. | 21 (533) |
| SKD | 274, 275 276 | 11-13/16 (300) | 19-3/4 (500) | 5 (127) Width 6-5/8 (169) Depth | 14-1/2 (360) |
| SQX | 271, 272 273 | 8-7/8 (226) | 17 (430) | 5-17/32 (140) W 4-3/8 (111) Depth | 13-1/2 (340) |
| EI/Mech with linkage | 295, 296 297 | 11 (280) | 22 (559) | 5-3/4 (144) Width x 8-7/8 (225) Depth | 25-3/4 (654) |



Female NPT by Female NPT
FxF



Union Female x Union
Female UFxUF

Table 8. 3-Way Valve Dimensions.

| Valve | Valve Size inch (mm) | Dimensions in inches (mm) | | | | | | Weight lb. (kg) | |
|-------|----------------------------|--------------------------------|-----------------|-----------------|--------------------------------------|------------------|-----------------|-----------------------|-------------|
| | | FxF Female NPT x Female NPT | | | UFxUF Union Female x Union Female | | | FxF | UFxUF |
| | | A | B | C | A | B | C | | |
| 3-Way | 1/2 (15) | 2-7/8 (72) | 4-5/16 (110) | 2-11/16 (68) | 4-11/16 (119) | 6-1/4 (159) | 4-5/8 (117) | 3 (1.4) | 4 (1.8) |
| | 3/4 (20) | 3-3/8 (85) | 4-5/16 (110) | 2-3/4 (69) | 6-3/8 (163) | 6-15/16 (176) | 5-1/4 (134) | 4 (1.8) | 6 (2.7) |
| | 1 (25) | 3-15/16 (100) | 4-1/2 (114) | 2-7/8 (72) | 7-1/16 (180) | 7 (178) | 5-3/8 (136) | 5 (2.3) | 7 (3.2) |
| | 1-1/4 (32) | 4-15/16 (125) | 4-5/8 (116) | 2-15/16 (74) | 7-1/2 (190) | 6-3/4 (170) | 5-1/16 (129) | 7 (3.2) | 11 (5) |
| | 1-1/2 (40) | 5-1/8 (130) | 4-5/8 (117) | 3 (76) | 7-13/16 (199) | 6-15/16 (176) | 5-5/16 (135) | 9 (4.1) | 13 (5.9) |
| | 2 (50) | 6-1/4 (158) | 5-1/8 (130) | 3-3/16 (81) | 9-1/16 (231) | 7-1/2 (191) | 5-9/16 (141) | 13 (5.9) | 19 (8.6) |

Parts List

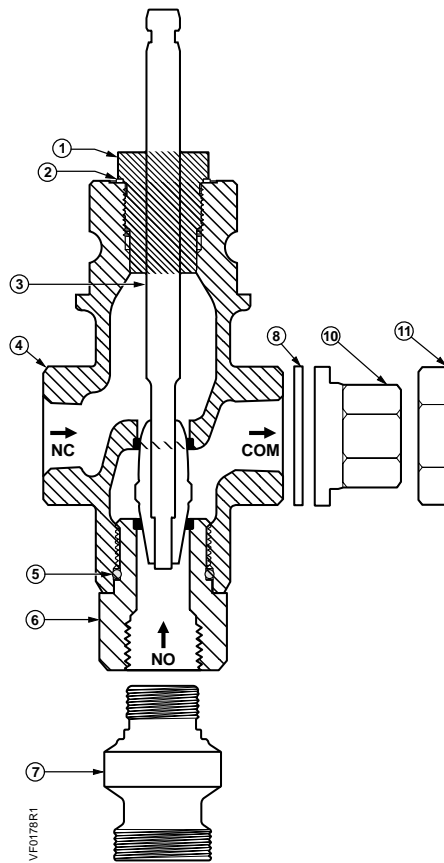


Table 9. Parts List for 3-Way Bronze Valves.

| Item | Part Name | Part No. | Quantity | | Material |
|------|------------------------|---------------|----------|-------|---------------------------|
| | | | FxF | UFxUF | |
| 1 | Packing Cartridge | — | 1 | 1 | — |
| 2 | Gasket | — | 1 | 1 | Copper |
| 3 | Stem and Plug Assembly | — | 1 | 1 | Bronze or Stainless Steel |
| 4 | Valve Body | — | 1 | 1 | Bronze |
| 5 | O-ring | — | 1 | 1 | EPDM |
| 6 | Lower port | — | 1 | — | Bronze |
| 7 | Lower port union | — | — | 1 | Bronze |
| 8 | Gasket | — | — | 3 | Fiber |
| 10 | Female tail piece | — | — | 3 | Brass |
| 11 | Union Nut | — | — | 3 | Brass |
| | Packing Kit | 599-03390 | — | — | Items 1 and 2 |
| | Rebuild/Repack Kit | See Table 10. | — | — | Items 1, 2, 3, and 5 |

Service Kits

To select the service kit, know your valve body assembly number and the type of connection. Read down the *Connection* column until you find the valve body assembly number and then read to the far right to identify the correct kit.

NOTE: The valve body assembly number and model number are stamped on the tag on the valve body.

Table 10. Rebuild/Repack Service Kits Part Numbers. See Table 9 for Items in Kit.

| Connection | | Valve Description | Model 1 Kit No. | Model 2 Kit No. |
|------------|-----------|----------------------------------|--------------------|--------------------|
| FxF | UFxUF | | | |
| 599-03144 | 599-03153 | 1/2" Stainless steel trim 1.0 Cv | 599-03372 | — |
| 599-03145 | 599-03154 | 1/2" Stainless steel trim 1.6 Cv | 599-03373 | — |
| 599-03146 | 599-03155 | 1/2" Stainless steel trim 2.5 Cv | 599-03374 | — |
| 599-03147 | 599-03156 | 1/2" Stainless steel trim 4.0 Cv | 599-03375 | — |
| 599-03148 | 599-03157 | 3/4" Stainless steel trim | 599-03376 | — |
| 599-03149 | 599-03158 | 1" Stainless steel trim | 599-03377 | — |
| 599-03150 | 599-03159 | 1-1/4" Stainless steel trim | 599-03378 | 599-09225 |
| 599-03151 | 599-03160 | 1-1/2" Stainless steel trim | 599-03379 | 599-09226 |
| 599-03152 | 599-03161 | 2" Stainless steel trim | 599-03380 | 599-09227 |
| 599-03198 | 599-03207 | 1/2" Bronze trim 1.0 Cv | 599-03381 | — |
| 599-03199 | 599-03208 | 1/2" Bronze trim 1.6 Cv | 599-03382 | — |
| 599-03200 | 599-03209 | 1/2" Bronze trim 2.5 Cv | 599-03383 | — |
| 599-03201 | 599-03210 | 1/2" Bronze trim 4.0 Cv | 599-03384 | — |
| 599-03202 | 599-03211 | 3/4" Bronze trim | 599-03385 | — |
| 599-03203 | 599-03212 | 1" Bronze trim | 599-03386 | — |
| 599-03204 | 599-03213 | 1-1/4" Bronze trim | 599-03387 | 599-09228 |
| 599-03205 | 599-03214 | 1-1/2" Bronze trim | 599-03388 | 599-09229 |
| 599-03206 | 599-03215 | 2" Bronze trim | 599-03389 | 599-09230 |

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