

8. VBB/VBS and VB-2000 Series Ball Valve Assemblies



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Ball Valve Assemblies

VBB/VBS Ball

V B X X N X X

Valve Body Type
 B = Chrome Plated Brass Ball & Nickel Plated Brass Stem
 S = Stainless Steel Ball & Stem

Valve Body Data
 2 = Two-Way
 3 = Three-Way

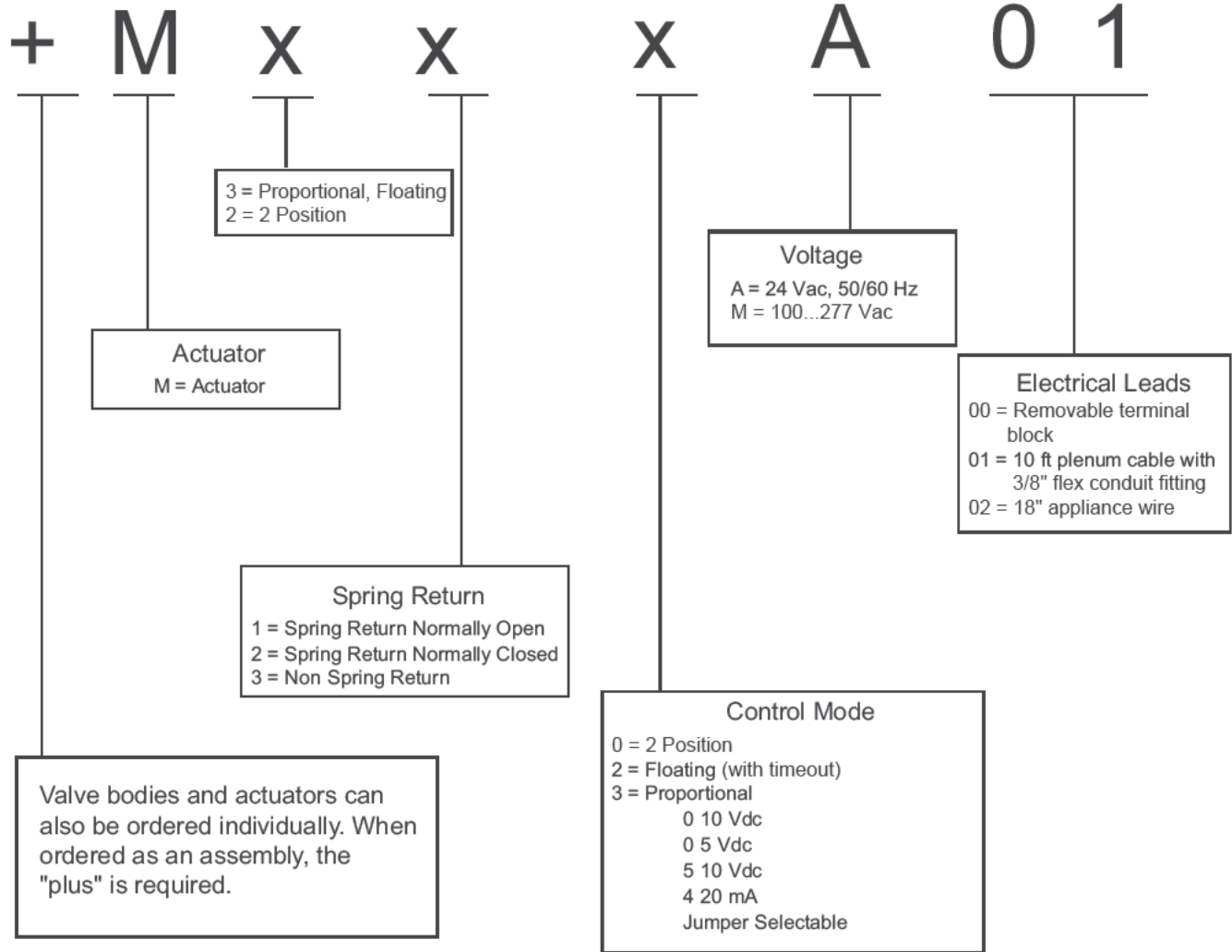
End Fittings
 N = NPT, Female

2-Way			
Size	Port Code	Cv	
1/2"	00	.3	
	01	.7	
	02	1.2	
	03	2.1	
	04	3.5	
	05	4.7	
	06	7.7	
3/4"	07*	10.0	
	10	.3	
	11	.7	
	12	1.2	
	13	2.1	
	14	3.5	
	15	4.7	
	16	7.7	
	17*	10.0	
	3-Way		
	Size	Port Code	Cv
1/2"	00	0.3	
	01	0.6	
	02	1.0	
	03	2.0	
	04	3.0	
	05	4.5	
	06	7.3	
3/4"	07*	10	
	10	0.3	
	11	0.6	
	12	1.0	
	13	2.0	
	14	3.0	
	15	4.5	
	16	7.3	
	17*	10	

* full port

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Valve Assemblies



Application

The VBB and VBS Series valves with SmartX Actuators are 2-Way or 3-Way, 1/2" or 3/4", characterized ball valves. The M3 and M2 SmartX Actuators are direct coupled to the VBB/VBS Series valves and accept two-position, floating or proportional control signals from a DDC system, controller, or thermostat for control of hot or chilled water, or solutions of up to 60% glycol. Typical applications include VAV reheat, fan coil units, hot and chilled water coils in air handling units, heat pumps and unit ventilators.

Features

- Easy product selection — all actuators fit all valve bodies.
- Fast, easy actuator installation — no linkage or tools required.
- Flow characterizing insert provides equal percentage flow characteristic for stable, accurate floating and proportional control.
- ANSI IV seat leakage (0.01%) for both 2-Way and 3-Way valves (A and B port).
- Brass and stainless steel trim models.
- Cvs from 0.3...10.
- Normally open, normally closed, and non-spring return assemblies available.
- Two-position, Floating or Proportional (0...5 Vdc, 0...10 Vdc, 5...10 Vdc, or 4...20 mA dc).
- Proportional actuator is direct or reverse acting.
- RoHS Compliant (VBS Assemblies).
- Reach Compliant.

Applicable Literature

- VBB and VBS Series Two-position Spring-Return Ball Valves Installation Instructions, F-27392.
- VBB and VBS Series Floating Spring Return and Non-spring Return Ball Valves Installation Instructions, F-27393.
- VBB and VBS Series Proportional Spring Return and Non-spring Return Ball Valves Installation Instructions, F-27394.
- VBB and VBS Series Brochure, F-27681.
- EN-205 Water System Guidelines, F-26080.
- EN-206 Guidelines for Powering Multiple Actuators, F-26363.

Application Note for 2-Way and 3-Way Valves

The VBB/VBS Series Ball Valves are Characterized Control Ball Valves. They are designed so that flow thru the A-port exhibits equal percentage flow. Thus, the A-port is the control port.

In a three-way valve, the B-port is the bypass port. Flow thru the B-port is designed to be less than that of the A-port. In most applications, this reduced flow compensates for the pressure drop that is seen by the coil supplied by the A-port.



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Mx1...Mx3 A0x Series Actuator/ Valve Specifications

Specifications

Actuator

Voltage	24 Vac for floating and proportional 100...277 Vac for two position multi-voltage types	
Power Requirements	See Table-1, Table-2, and Table-3.	
Control Signal	2-Position, Floating, or Proportional; half wave rectified power supply	
Timing, Full Open to Full Close	See Table-1, Table-2 and Table-3.	
Manual Operating Lever / Position Indicator	Standard on all models.	
Auxiliary End Switch (optional)	SPST 24 Vac/Vdc, 101 mA...5 A max.	
Materials	Thermoplastic base and cover. Approved for use in air plenums.	
Shipping & Storage Temperature Limit	-40...169 °F (-40...76°C).	
Operating Temperature Limit at max fluid temp.	Floating	32...140 °F (0...60 °C)
	Proportional	32...140 °F (0...60 °C)
	Two-Position	32...169 °F (0...76 °C)
	Humidity	5...95% relative humidity, non-condensing.
Locations	NEMA 2, IEC IP31. Indoor Use Only.	

Valve

Service ^a	Hot and chilled water, up...60% glycol.
System Static Pressure Limit	600 psi (4137 kPa).
Fluid Temperature Limit	20...250°F (-7...121°C).
Cv (Kv)	See Tables 4 through 7.
Close-off Pressure ^b	130 psi 2-Way; 70 psi 3-Way
Differential Pressure	30 psi normal operation 20 psi quiet operation.
Seat Material	PTFE
Characterized Insert	Glass-filled PEEK
Seat Leakage	ANSI class IV (0.01%) at both A and B ports with pressure at inlet.
End Connections	NPT threaded (VBxxNxx)
Rangeability	Greater than 300:1.
Body Material	Forged brass.
Stem Material	Stainless steel anti-blow out stem with dual Viton™ o-rings.
Ball Material	Chrome plated brass (VBB series) or stainless steel (VBS series).

a. Not rated for steam service.

b. Close-off is defined as the maximum allowable pressure drop to which a valve may be subjected while fully closed.

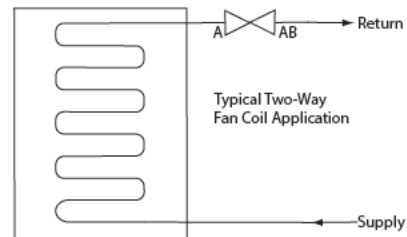
Agency Listings

M2 SmartX actuators	North America: c-UL-us LISTED per UL 873 and C22.2 No.24. European Union: LVD 2006/95/EC and EMC 2004/108/EC directives compliant.
M3 SmartX actuators:	North America: c-UL-us LISTED per UL 60730-1 & -2-14 and CSA E60730-1 & -2-14. FCC part15 classB & ICES-003 classB emissions compliant. European Union: LVD 2014/35/EU and EMC 2014/30/EU directives, per EN 60730-1 & -2-14. EN 61000-6-2 immunity & EN 61000-6-3 emissions compliant.
Australia	This product meets requirements to bear the RCM Mark.
Plenum Rating	Actuators with terminal block or plenum cable leads are plenum rated.
CRN Number	CRN OC0970.9012345678NTY.
RoHS Compliant	VBS valves and M3/M2 actuators comply with European Directive RoHS 2 Directive 2011/65/EU. Please consult factory for part number specific compliance.
REACH Compliant	Compliant as defined in Article 33 of the REACH Regulation (EC)1907/2006.

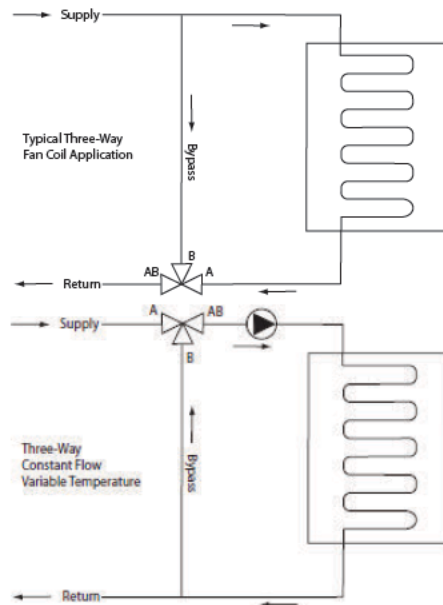
Application Schematics

Typical applications

For simplicity, balancing valves and control devices are not shown.



Mixing applications



Ball Valve Assembly Selection Procedure

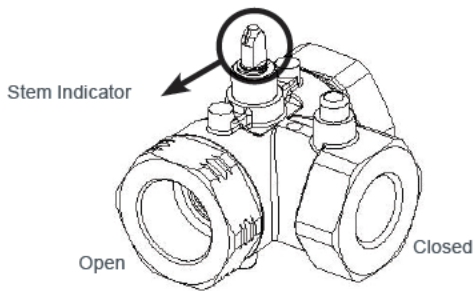
1. Select the actuator. When selecting a ball valve assembly, you must know the control signal type and voltage to first select an actuator. Consult the following tables: Table-1 covers two-position actuator specifications and model numbers, Table-2 covers floating actuator specifications and model numbers and Table-3 covers proportional actuator specifications and model numbers.
2. Select the valve body. The valve body model number is selected based on the line size (1/2" or 3/4"), ball material trim, and flow coefficient (Cv/Kv) required. Consult Table-4 and Table-5 for brass trim valve body specifications and model numbers and Table-6 and Table-7 for stainless steel trim valve body specifications and model numbers. See "Flow Coefficient Selection" for information in determining the flow coefficient.

Other considerations

1. General service conditions: Make sure the actuator is suitable for the anticipated ambient conditions and that the valve body is compatible with the system fluid temperature and pressure requirements.
2. Close-off pressure: Confirm that the VBB/VBS ball valve's close off rating is suitable for the valve control application.
3. Space requirements: If mounting space limitations are a consideration, check the actuator/valve assembly dimensions.
4. Pipe reducers: Refer to Tables for estimating effective Cvs when using pipe reducers.
5. Ordering information. You may order the actuator and valve body separately or as a factory assembly. To order a complete valve and actuator assembly, specify the valve body part number and the actuator part number separated by a "+." Example: To order actuator valve body VBB2N15 and M312A00 as a factory valve/actuator assembly, specify VBB2N15+M312A00.

Flow Direction

A notch cut into the stem indicator at the tip of the valve stem is an external indicator of where the closed portion of the ball sits internally. Check the notch position prior to assembling the actuator to verify the ball is orientated in the correct plane.



In the drawings below, the black mark on the stem indicator represents this stem notch.

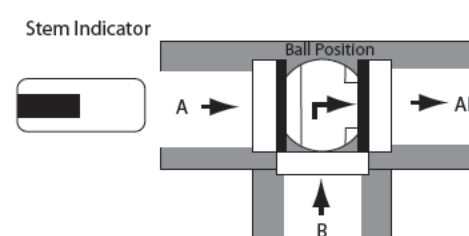
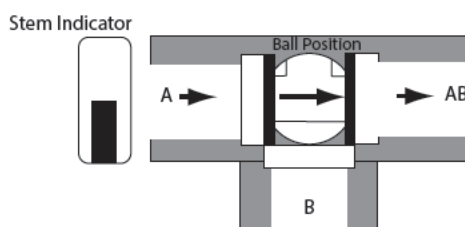
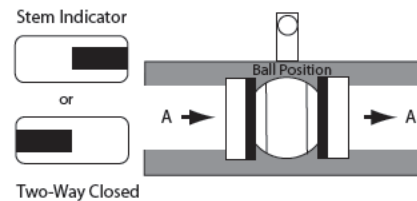
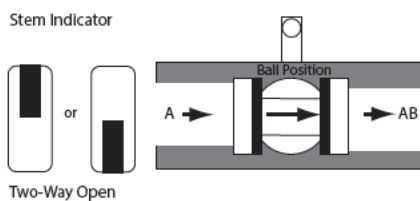


Table-1: Two-Position Actuators

Part Number	Control Signal	Spring Return Action (Valve Normal Position)	VA / Voltage	Leads	Stroke Timing ^g	Spring Return Timing ^g	End Switch
M210A00	Two-Position	Normally Open	3.5/1.8 at 24 Vac/24 Vdc	Removeable Terminal Block ^b	50 sec	35 sec.	
M210A01				10 ft. (3.05 m) Plenum Cable ^c			SPST
M210A11							
M210A02				18 in. (45 cm) Appliance Wire			SPST
M210A12							
M210M02				18 in. (45 cm) Appliance Wire			SPST
M220A00		Normally Closed	3.5/1.8 at 24 Vac/24 Vdc	Removeable Terminal Block ^b	50 sec	35 sec.	
M220A01				10 ft. (3.05 m) Plenum Cable ^c			SPST
M220A11							
M220A02				18 in. (45 cm) Appliance Wire			SPST
M220A12							
M220M02				18 in. (45 cm) Appliance Wire			SPST
M220M12							

Table-2 Floating Actuators

Part Number	Control Signal	Spring Return Action (Valve Normal Position)	VA @ 24 Vac 50/60 Hz	Leads	Stroke Time, sec. 50/60 Hz	Time-out Delay, sec. 50/60 Hz
M332A00	Floating	None	2.3/2.4	Terminal Block ^b	159/135	181 Sec
M332A01				10 ft. (3.05 m) Plenum Cable ^c		
M312A00		Normally Open	3.2/3.3 ^d	Terminal Block ^b		
M312A01				10 ft. (3.05 m) Plenum Cable ^c		
M322A00		Normally Closed	3.2/3.3 ^d	Terminal Block ^b		
M322A01				10 ft. (3.05 m) Plenum Cable ^c		

Table-3 Proportional Actuators

Part Number	Control Signal	Spring Return Action (Valve Normal Position)	VA @ 24 Vac 50/60 Hz	Leads	Stroke Time, sec. 50/60 Hz	Time-out Delay, sec. 50/60 Hz
M333A00	Proportional ^a (Vdc : 0...5, 0...10, 2...10, 5...10, 4...20 mA dc ^e)	None	2.7/2.8	Terminal Block ^b	159/135	200/166
M333A01				10 ft. (3.05 m) Plenum Cable ^c		
M313A00		Normally Open	2.7/2.8 ^d	Terminal Block ^b		
M313A01				10 ft. (3.05 m) Plenum Cable ^c		
M323A00		Normally Closed	2.7/2.8 ^d	Terminal Block ^b		
M323A01				10 ft. (3.05 m) Plenum Cable ^c		

- a. Default configured for 0...10 Vdc input signal, direct acting control.
- b. All terminal block and appliance wire units accept a 1/2" conduit connector fitting (.875" diameter).
- c. All plenum cable units include an integral 3/8" conduit connector fitting.
- d. Size transformer for 10 VA per actuator.
- e. For 4...20 mA control, a separate isolated transformer must be used with each valve.
- g. Nominal.

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Table-4 2-Way Brass Trim Valve Bodies

Size	Part Number	End Connection	Cv (Kv)
1/2"	VBB2N00	NPT	0.3 (0.3)
	VBB2N01		0.7 (0.6)
	VBB2N02		1.2 (1.0)
	VBB2N03		2.1 (1.8)
	VBB2N04		3.5 (3.0)
	VBB2N05		4.7 (4.1)
	VBB2N06		7.7 (6.7)
	VBB2N07 ^b		10 (8.7)
3/4"	VBB2N10		0.3 (0.3)
	VBB2N11		0.7 (0.6)
	VBB2N12		1.2 (1.0)
	VBB2N13		2.1 (1.8)
	VBB2N14		3.5 (3.0)
	VBB2N15		4.7 (4.1)
	VBB2N16		7.7 (6.7)
	VBB2N17 ^b		10 (8.7)

b. Full Port Model without characterized disc.

Table-5 3-Way Brass Trim Valve Bodies

Size	Part Number	End Connection	Cv (Kv) A Port	Cv (Kv) B Port
1/2"	VBB3N00	NPT	0.3 (0.3)	0.3 (0.3)
	VBB3N01		0.6 (0.5)	0.8 (0.7)
	VBB3N02		1.0 (.85)	0.8 (0.7)
	VBB3N03		2.0 (1.7)	1.5 (1.3)
	VBB3N04		3.0 (2.6)	1.5 (1.3)
	VBB3N05		4.5 (3.9)	2.7 (2.3)
	VBB3N06		7.3 (6.3)	4.1 (3.5)
	VBB3N07 ^b		10.0 (8.7)	4.8 (4.1)
3/4"	VBB3N10		0.3 (0.3)	0.3 (0.3)
	VBB3N11		0.6 (0.5)	0.8 (0.7)
	VBB3N12		1.0 (.85)	0.8 (0.7)
	VBB3N13		2.0 (1.7)	1.5 (1.3)
	VBB3N14		3.0 (2.6)	1.5 (1.3)
	VBB3N15		4.5 (3.9)	2.7 (2.3)
	VBB3N16		7.3 (6.3)	4.1 (3.5)
	VBB3N17 ^b		10.0 (8.7)	4.8 (4.1)

b. Full Port Model without characterized disc.

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Table-6 2-Way Stainless Steel Trim Valve Bodies

Size	Part Number	End Connection	Cv (Kv)
1/2"	VBS2N00	NPT	0.3 (0.3)
	VBS2N01		0.7 (0.6)
	VBS2N02		1.2 (1.0)
	VBS2N03		2.1 (1.8)
	VBS2N04		3.5 (3.0)
	VBS2N05		4.7 (4.1)
	VBS2N06		7.7 (6.7)
	VBS2N07 ^b		10 (8.7)
3/4"	VBS2N10		0.3 (0.3)
	VBS2N11		0.7 (0.6)
	VBS2N12		1.2 (1.0)
	VBS2N13		2.1 (1.8)
	VBS2N14		3.5 (3.0)
	VBS2N15		4.7 (4.1)
	VBS2N16		7.7 (6.7)
	VBS2N17 ^b	10 (8.7)	

b. Full Port Model without characterized disc.

Table-7 3-Way Stainless Steel Trim Valve Bodies

Size	Part Number	End Connection	Cv (Kv) A Port	Cv (Kv) B Port
1/2"	VBS3N00	NPT	0.3 (0.3)	0.3 (0.3)
	VBS3N01		0.6 (0.5)	0.8 (0.7)
	VBS3N02		1.0 (.85)	0.8 (0.7)
	VBS3N03		2.0 (1.7)	1.5 (1.3)
	VBS3N04		3.0 (2.6)	1.5 (1.3)
	VBS3N05		4.5 (3.9)	2.7 (2.3)
	VBS3N06		7.3 (6.3)	4.1 (3.5)
	VBS3N07 ^b		10.0 (8.7)	4.8 (4.1)
3/4"	VBS3N10		0.3 (0.3)	0.3 (0.3)
	VBS3N11		0.6 (0.5)	0.8 (0.7)
	VBS3N12		1.0 (.85)	0.8 (0.7)
	VBS3N13		2.0 (1.7)	1.5 (1.3)
	VBS3N14		3.0 (2.6)	1.5 (1.3)
	VBS3N15		4.5 (3.9)	2.7 (2.3)
	VBS3N16		7.3 (6.3)	4.1 (3.5)
	VBS3N17 ^b	10.0 (8.7)	4.8 (4.1)	

b. Full Port Model without characterized disc.

Application Notes

The VBB/VBS Series Ball Valves are valve actuator assemblies designed to make incremental adjustments to flow based on the control signal input. The actuators are not intended for continuous use in zero dead band control systems.

Two-Position Spring Return SmartX Actuators

When powered, the actuator moves to the desired position, winding the spring return system. When power is removed, the spring returns the actuator to the normal position. Two-position spring return actuators can be purchased with an optional built-in auxiliary SPST end switch for interfacing or signaling; for example, zone pump burner control.

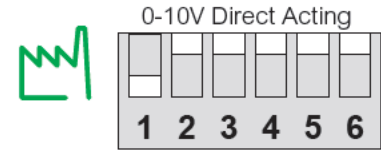
Floating/Proportional Spring Return SmartX Actuators

When power is applied to the actuator, there is a 3-second delay before the solenoid latches and the gear train is engaged. Upon power loss, the solenoid releases after 2 seconds, allowing the actuator to spring return to normal position. This prevents the loss of valve position during brief outages. The spring return feature should not be used for routine, normal operation.

Proportional Spring Return and Non-Spring Return SmartX Actuators

The control signal input and action is selected by means of the input signal dip switch on the actuator circuit board.

All actuators are shipped with the input signal dip switch (SW1) set to ON for a 0...10 Vdc control signal and the remaining dip switches and the control action dip switch set to OFF for direct action (DA; valves opens with increasing control signal, as shown). When using a 4...20 mA dc control signal, a separate isolation transformer must be used with each actuator.



When using switches 1-4, the lowest numbered dip switch set to ON takes priority, e.g. if both SW2 and SW4 are on, SW2 takes precedent. SW1 through SW4 must be OFF (and SW5 ON) for 4-20 mA mode. For more information see Guidelines for Powering Multiple Actuators EN-206 (F-26363).

Multiple actuators may be connected to a single controller. Do not exceed the maximum current draw of the controller or transformer.

Proportional Actuators perform a self-calibration cycle on power-up. The actuator will run to the open direction for approximately 20 seconds and then to the closed direction for approximately 2 1/2 min (60 Hz) or 3 1/2 min (50Hz). See Table-2 for exact timing. Once this cycle is complete, the actuator will then accept and respond to the control signal.

Do not use manual positioning while power is applied to the actuator. Manual positioning of the actuator while power is applied is NOT recommended. If the actuator is manually positioned while power is applied, the calibration cycle will need to be completed again for the actuator to function properly. To recalibrate the actuator, cycle power off for more than 6 seconds.

Floating Spring Return and Non-Spring Return SmartX Actuators

Spring Return and Non-Spring Return actuators with time-out will automatically limit the running time of the actuator. The time-out feature automatically cuts off the control signal to the valve after three minutes (see Table-1) of continuous operation. Upon change in control signal direction, the actuator will resume operation. The controller or thermostat used to operate the Non-Spring Return Floating actuator without timeout must be configured to turn off the control signal after being continuously on for three minutes. Multiple actuators may be connected to a single controller. Do not exceed the maximum current draw of the controller or transformer.

Power/Failure Action

	Control Signal	Position upon loss of power		
		Non-Spring Return Actuator	Spring Return Open Actuator - Fail Open	Spring Return Closed Actuator - Fail Closed
Floating	Power to "Open" terminal will open A to AB	Maintain last position	Will spring A to AB open	Will spring A to AB closed
Proportional	DA Dip Switch selected (SW6 OFF)- Increase in control signal will open A to AB	Maintain last position	Will spring A to AB open	Will spring A to AB closed
	RA Dip Switch selected (SW6 ON)- increase in control signal will close A to AB	Maintain last position	Will spring A to AB open	Will spring A to AB closed
2-Position	Control Signal	Spring Return Open Actuator	Spring Return Closed Actuator	
	Power On	A to AB Closed	A to AB Open	
	Power Off	A to AB Open	A to AB Closed	

Note: 2-Way valve operation described. For a 3-Way valve, A to AB operation is the same. B to AB operation is opposite that of A to AB operation.

8. VBB/VBS and VB-2000 Series Ball Valve Assemblies

Using Pipe Reducers with Ball Valves

This table provides estimated effective Cvs when using pipe reducers with ball valve assemblies. Use these estimated effective Cvs in place of the rated Cvs when reducers or increasers are located within 6 pipe diameters upstream and 3 pipe diameters downstream of the valve.

⚠ WARNING
RISK OF PIPE FAILURE
• Do not use a valve sized less than one half the pipe run size. Erosion or wire draw may cause pipe failure in the reduction area.
Failure to follow this instruction may result in death or serious injury.

2-Way Valves

Valve Size inch	Valve Body NPT Threaded	Cv (Kv)	Estimated Effective Cv (Kv)						
			Pipe Size in Inches						
			1/2	3/4	1	1-1/4	1-1/2		
1/2	VBx2N00	0.3 (0.3)	0.3 (0.3)	0.3 (0.3)	0.3 (0.3)	-	-		
	VBx2N01	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)	0.7 (0.6)				
	VBx2N02	1.2 (1.0)	1.2 (1.0)	1.2 (1.0)	1.2 (1.0)				
	VBx2N03	2.1 (1.8)	2.1 (1.8)	2.1 (1.8)	2.1 (1.8)				
	VBx2N04	3.5 (3.0)	3.5 (3.0)	3.3 (2.8)	3.1 (2.7)				
	VBx2N05	4.7 (4.1)	4.7 (4.1)	4.4 (3.8)	4.1 (3.5)				
	VBx2N06	7.7 (6.7)	7.7 (6.7)	6.6 (5.7)	5.5 (4.8)				
3/4	VBx2N07	10 (8.7)	10 (8.7)	8.5 (7.4)	7.0 (6.0)	-	-		
	VBx2N10	0.3 (0.3)	-	0.3 (0.3)	0.3 (0.3)			0.3 (0.3)	0.3 (0.3)
	VBx2N11	0.7 (0.6)	-	0.7 (0.6)	0.7 (0.6)			0.7 (0.6)	0.7 (0.6)
	VBx2N12	1.2 (1.0)	-	1.2 (1.0)	1.2 (1.0)			1.2 (1.0)	1.2 (1.0)
	VBx2N13	2.1 (1.8)	-	2.1 (1.8)	2.1 (1.8)			2.1 (1.8)	2.1 (1.8)
	VBx2N14	3.5 (3.0)	-	3.5 (3.0)	3.5 (3.0)			3.5 (3.0)	3.5 (3.0)
	VBx2N15	4.7 (4.1)	-	4.7 (4.1)	4.6 (4.0)			4.5 (3.9)	4.4 (3.8)
	VBx2N16	7.7 (6.7)	-	7.7 (6.7)	7.5 (6.5)			7.3 (6.3)	7.2 (6.2)
VBx2N17	10 (8.7)	-	10 (8.7)	9.5 (8.2)	9.0 (7.8)	7.2 (6.2)			

3-Way Valves

Valve Size in	Valve Body NPT Threaded	Cv (Kv)	Estimated Effective Cv (Kv)						
			Pipe Size in Inches						
			1/2	3/4	1	1-1/4	1-1/2		
1/2	VBx3N00	0.3 (0.3)	0.3 (0.3)	0.3 (0.3)	0.3 (0.3)	-	-		
	VBx3N01	0.6 (0.5)	0.6 (0.5)	0.6 (0.5)	0.6 (0.5)				
	VBx3N02	1.0 (.9)	1.0 (.9)	1.0 (.9)	1.0 (.9)				
	VBx3N03	2.0 (1.7)	2.0 (1.7)	2.0 (1.7)	2.0 (1.7)				
	VBx3N04	3.0 (2.6)	3.0 (2.6)	2.9 (2.5)	2.8 (2.4)				
	VBx3N05	4.5 (3.8)	4.5 (3.8)	4.2 (3.6)	3.9 (3.3)				
	VBx3N06	7.3 (6.2)	7.3 (6.2)	6.2 (5.3)	5.1 (4.4)				
3/4	VBx3N07	10.0 (8.5)	10.0 (8.5)	8.5 (7.4)	7.0 (6.0)	-	-		
	VBx3N10	0.3 (0.3)	-	0.3 (0.3)	0.3 (0.3)			0.3 (0.3)	0.3 (0.3)
	VBx3N11	0.6 (0.5)	-	0.6 (0.5)	0.6 (0.5)			0.6 (0.5)	0.6 (0.5)
	VBx3N12	1.0 (.9)	-	1.0 (.85)	1.0 (.85)			1.0 (.9)	1.0 (.9)
	VBx3N13	2.0 (1.7)	-	2.0 (1.7)	2.0 (1.7)			2.0 (1.7)	2.0 (1.7)
	VBx3N14	3.0 (2.6)	-	3.0 (2.6)	3.0 (2.6)			2.9 (2.5)	2.9 (2.5)
	VBx3N15	4.5 (3.8)	-	4.5 (3.8)	4.4 (3.8)			4.3 (3.7)	4.2 (3.6)
	VBx3N16	7.3 (6.2)	-	7.3 (6.2)	7.1 (6.1)			6.9 (5.9)	6.8 (4.1)
VBx3N17	10.0 (8.5)	-	10.0 (8.5)	9.5 (8.2)	9.0 (7.8)	7.2 (6.2)			

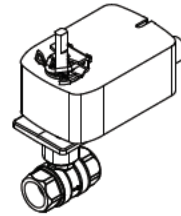
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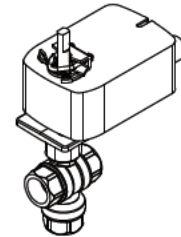
The Schneider Electric VA, VF, and VS-2xx3-xxx-9-xx series Ball Valve Assemblies are complete actuator/valve assemblies that accept two-position, floating, or proportional control signals from a DDC system or a thermostat, for control of hot or chilled water, or solutions of up to 50% glycol. They consist of direct-coupled, SmartX, spring return or non-spring return actuators mounted on 2-way (1/2" to 3") and 3-way (1/2" to 2") ball valve bodies. Typical applications include reheat on VAV boxes, fan coil units, hot and chilled water coils in air handling units, and unit ventilators.

Ball Valve Assemblies with SmartX Actuators

Vx-2xx3-5xx-9-xx series ball valve assemblies are available with either spring return or non-spring return SmartX® Actuators.

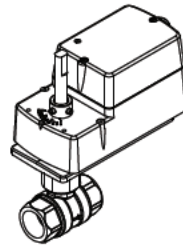


Vx-22x3-5xx-9-xx
2-Way Assembly with
Spring Return Actuator

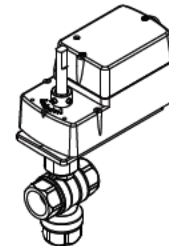


Vx-2313-5xx-9-xx
3-Way Assembly with
Spring Return Actuator

Vx-2xx3-8xx-9-xx Spring return valve assemblies equipped with Mx4D-x0x3 SmartX Actuators, respectively.



Vx-22x3-8xx-9-xx
2-Way Assembly with
Mx4D Series Actuator



Vx-2313-8xx-9-xx
3-Way Assembly with
Mx4D Series Actuator

Ball Valve Body/Linkage Assemblies

Ball valve body/linkage assemblies allow field mounting of SmartX actuators.

Features and Benefits

Feature	Benefit
Close-offs of 40 to 130 psi.	Accommodates most close-off requirements.
Available in full range of line sizes, 1/2 in. to 3 in. for 2-way valves and 1/2 in. to 2 in. for 3-way valves.	Satisfies a wide range of applications.
Cvs from 0.33 to 266.	Permits optimal valve sizing, minimizing the need for pipe reducers.
Flow characterizing insert, made of glass-filled Noryl™.	Provides equal percentage flow characteristic so that the heat output of the coil is linear with respect to valve position.
Available in both spring return and non-spring return models.	Allows power loss mode requirement to be met for any given application.
Utilizes SmartX Actuators with two-position, floating, and proportional control.	Models to fit a wide range of applications.
All models equipped with pigtail leads.	Eases installation. Reduced electrician costs.
Low-friction seals and o-rings.	Allows the use of lower-torque actuators, reducing cost.
Valve body made of forged brass ASTM B283-06.	Rated for static pressure of 360 psi at fluid temperatures of 20 to 250 °F (-7 to 121 °C).
ANSI Class IV (0.01% of Cv) shutoff with 2-way valves.	Allows accurate control, saves energy.
Choices of spring return direction.	Provides Normally Closed or Normally Open spring return.
Thermally isolated mounting plate.	Protects the actuator from excess cold or heat from chilled or hot water passing through the valve. Discourages condensation.
Ball Valve Body/Linkage Assemblies are available separately. They include anti-rotation clips for SmartX Actuators.	Increases flexibility and minimizes inventory.

Ball Valve Assembly Selection Procedure

When selecting a ball valve assembly, you must determine the applicable codes for the control signal type, valve body configuration, end connection, port size, and actuator. Select a ball valve assembly part number as follows:

1. Control Signal Type, Valve Body Configuration, and End Connection
Refer to "Ball Valve Assemblies Using SmartX 5xx Actuators" on page 157 or "Ball Valve Assemblies Using SmartX 8xx Actuators" on page 158, and then select the appropriate codes for these part number fields.
2. Valve Size (Flow Coefficient)
If the required flow coefficient (Cv) has not yet been determined, do so as follows:
 - a. Refer to the "Sizing and Selection" on page 171 to calculate the required Cv.
 - b. Select the nearest available Cv and corresponding valve body port code from "2-Way Ball Valve Assemblies with SmartX Actuators" on page 159 or "3 Way Ball Valve Assemblies with SmartX Actuators" on page 160.
3. Actuator
Select the appropriate actuator and code, according to "Ball Valve Assemblies Using SmartX 5xx Actuators" on page 157 or "Ball Valve Assemblies Using SmartX 8xx Actuators" on page 158, based on the control signal type, required valve normal position, and voltage requirements. For detailed actuator information, refer to the applicable actuator specifications.

NOTE: Ball Valve Assemblies with SmartX Actuators use the basic actuators. However if an actuator with auxiliary switch(es) is required, you may field-assemble a ball valve assembly using a ball valve body/linkage assembly (VB-2x13-500-9-xx). For information on switch-equipped actuators, refer to "Assemblies with Mx40-704x SR SmartX Actuators" on page 167 and "Assemblies with Mx4D-703x/803x SR SmartX Actuators" on page 168, "Assemblies with MF/Ms41-6043/83 NSR SmartX Actuators" on page 166.

4. Close-off Pressure
Confirm in Table-4, Table-5, Table-6, and Table-7 that the selected actuator and valve body combination provides sufficient close-off pressure. If no close off pressure is shown the valve body/actuator combination is not valid.
5. Available Space
If available space is a consideration, check the appropriate dimensional figure (Figure 1 through Figure 8) and its accompanying table for any potential fit problems.

Applicable Literature



MA40-704x, MA4x-707x, MA4x-715x General Instructions	F-26642
MF4x-7xx3, MF4x-7xx3-50x General Instructions	F-26644
MS4x-7xx3, MS4x-7xx3-50x General Instructions	F-26645
MF41-6043, MF41-6083 General Instructions	F-27213
MA4D-xxxx, MF4D-xxxx, MS4D-xxxx General Instructions	F-27170
MS41-6043, MS41-6083 General Instructions	F-27214
Mx40-704x Mounting and Wiring Instruction	F-27003
Mx41-6043 Data Sheet	F-26737
Mx41-6043 Submittal Sheet	F-27216
Vx-2xx3-5xx-9-xx, VB-2xx3-500-9-xx	F-27087
EN205 Water and Steam Systems	F-26080

Ball Valve Assemblies Using SmartX 5xx Actuators

V x - 2 x x 3 - 5 x x - 9 - x x

Control Signal Type
 A = Two Position
 F = Floating
 S = Proportional
 B = Valve Body & Linkage^a (less actuator)

Port Code
 Refer to separate Port Code table

Configuration
 2 = 2 Way
 3 = 3 Way Mixing

Material
 1 = Nickel/Chromium Plated Brass
 5 = Stainless Steel ³

Connection
 3 = Threaded NPT

¹ Normal position for 3 way spring return ball valve assemblies refers to A to AB ports.

³ Stainless steel ball is available only on 2 way versions.

Actuator Code ¹ ²				Valves Used On ³					
Model	Code	Normal Position	Voltage	1/2 to 1"		1-1/4"		1-1/2" to 3"	1-1/2" to 2"
				2-way	3-way	2-way	3-Way	2-Way	3-way
Two-Position									
MA40 7040	522	SR Close	120 Vac	X	X	X	X	X	X
MA40 7040	532	SR Open	120 Vac	X	X	X	X	X	X
MA40 7043	526	SR Close	24 Vac	X	X	X	X	X	X
MA40 7043	536	SR Open	24 Vac	X	X	X	X	X	X
Floating									
MF41 6043	505	NSR	24 Vac	X	X	X	X		
MF41 6083	506	NSR	24 Vac					X	X
MF40 7043	526	SR Close	24 Vac	X	X	X	X	X	X
MF40 7043	536	SR Open	24 Vac	X	X	X	X	X	X
Proportional									
MS41 6043	505	NSR	24 Vac	X	X	X	X		
MS41 6083	506	NSR	24 Vac					X	X
MS40 7043	526	SR Close	24 Vac	X	X	X	X	X	X
MS40 7043	536	SR Open	24 Vac	X	X	X	X	X	X
Valve Body/Linkage Assembly^a				VB-22x3-500-9-xx, VB-2313-500-9-xx					

SR = Spring Return
 NSR = Non Spring Return

^a Includes valve body, linkage, and anti rotation clips for spring return and non spring return SmartX actuators, listed above. Ordered separately.

Note: Not all model configurations are available as factory assemblies. You can purchase the the actuator and a VB 22x3 500 9 xx valve body and linkage separately for field assembly.

Ball Valve Assemblies Using SmartX 8xx Actuators

V x - 2 x x 3 - 8 x x - 9 - x x

Port Code
Refer to separate Port Code table

Control Signal Type
A = Two Position
F = Floating
S = Proportional
B = Valve Body & Linkage^c (less actuator)

Configuration
2 = 2 Way
3 = 3 Way Mixing

Material
1 = Nickel/Chromium Plated Brass
5 = Stainless Steel³

Connection
3 = Threaded NPT

Actuator Code ¹					Valves Used On ³			
Model ^a	Code	Normal Position	Voltage	Type	1/2" to 1"		1-1/4"	1-1/4"
					2-way	3-way	2-way	3-way
Two-Position								
MA4D 7030 000	815	SR Open	120 Vac		X	X		
MA4D 8030 000	817	SR Closed	120 Vac		X	X		
MA4D 7033 100	821	SR Open	24 Vac		X	X		
MA4D 8033 100	831	SR Closed	24 Vac		X	X		
Floating								
MF4D 7033 100	821	SR Open	24 Vac		X	X		
MF4D 8033 100	831	SR Closed	24 Vac		X	X		
MF4D 6083 100	N/A ^b	NSR	24 Vac		X	X	X	X
Proportional								
MS4D 7033 100	821	SR Open	24 Vac	2 10 Vdc	X	X		
MS4D 7033 120	N/A ^b	SR Open	24 Vac	0 3 Vdc	X	X		
MS4D 7033 130	N/A ^b	SR Open	24 Vac	6 9 Vdc	X	X		
MS4D 7033 150	N/A ^b	SR Open	24 Vac	0 10 Vdc	X	X		
MS4D 7033 160	N/A ^b	SR Open	24 Vac	4 20 mA	X	X		
MS4D 8033 100	831	SR Closed	24 Vac	2 10 Vdc	X	X		
MS4D 8033 120	N/A ^b	SR Closed	24 Vac	0 3 Vdc	X	X		
MS4D 8033 130	N/A ^b	SR Closed	24 Vac	6 9 Vdc	X	X		
MS4D 8033 150	N/A ^b	SR Closed	24 Vac	0 10 Vdc	X	X		
MS4D 8033 160	N/A ^b	SR Closed	24 Vac	4 20 mA	X	X		
Valve Body/Linkage Assembly^c					VB-22x3-500-9-xx, VB-2313-500-9-xx			

SR = Spring Return NSR = Non Spring Return

a " 000" models have appliance cables. " 1X0" models have plenum cables.

b Factory assemblies not available. Purchase actuator and valve body separately and field assemble.

c Includes valve body, linkage, and anti rotation clips for spring return and non spring return SmartX actuators, listed above. Ordered separately.

¹ Normal position for 3 way spring return ball valve assemblies refers to A to AB ports.

³ Stainless steel ball is available only on 2 way versions.

8. VBB/VBS and VB-2000 Series Ball Valve Assemblies

Port Codes

2-Way Ball Valve Assemblies with SmartX Actuators

Table-1. 2-Way Ball Valve Assemblies - Sizes, Port Codes, and Cvs.

Size in.	2-Way		
	Port Code	Cv ^a	Kvs ^a
1/2	01	0.38	0.33
	02	0.68	0.59
	03	1.3	1.1
	04	2.6	2.2
	05	4.7	4.1
	06	8.0	6.9
	07	11.7 ^b	10.1
¾	11	0.31	0.27
	12	0.63	0.54
	13	1.2	1.0
	14	2.5	2.2
	15	4.3	3.7
	16	10.1	8.7
	17	14.7 ^b	12.7
1	18	28.6 ^b	24.7
	21	4.4	3.8
	22	9.0	7.8
	23	15.3	13.2
	24	26.1	22.6
	25	28.4 ^b	24.6
	26	43.9 ^b	38.0
1¼	27	54.2 ^b	46.9
	41	4.4	3.8
	42	8.3	7.2
	43	14.9	12.9
	44	36.5	31.6
	45	41.1 ^b	35.6
1½	46	102.3 ^b	88.5
	51	22.8	19.7
	52	41.3	35.7
2	53	73.9 ^b	63.9
	54	171.7 ^b	148.5
	61	41.7	36.1
2	63	71.1	61.5
	65	108 ^b	93.4
	66	210	181.7
	67	266 ^b	230.1

Size in.	2-Way		
	Port Code	Cv ^a	Kvs ^a
2½	71	45	38.9
	72	55	47.6
	73	72.3	62.5
	74	101	87.4
	75	162	140.1
3	76	202 ^b	174.7
	82	63	54.5
	85	145 ^b	125.4

a - $Cv = \frac{gpm}{\sqrt{\Delta P}}$ (where DP is measured in psi) $kvs = \frac{Cv}{1.156}$

$kvs = \frac{m^3/h}{\sqrt{\Delta P}}$ (where DP is measured in bar; 1 bar = 100 kPa)

b - Denotes a full port valve, without the characterized insert.

3-Way Ball Valve Assemblies with SmartX Actuators

Table-2. 3-Way Ball Valve Assemblies - Sizes, Port Codes, and Cvs

Size in.	3-Way		
	Port Code	A Port Cv ^{a,b}	Kvs ^a
1/2	01	0.33	0.28
	02	0.59	0.51
	03	1	0.86
	04	2.4	2.1
	05	4.3	3.7
	06	8.0 ^c	6.9
3/4	11	0.40	0.35
	12	0.66	0.57
	13	1.3	1.1
	14	2.4	2.1
	15	3.8	3.3
	16	11 ^c	9.5
1	21	0.40	0.35
	22	0.65	0.56
	23	1.3	1.1
	24	2.3	2.0
	25	3.5	3.0
	26	4.5	3.9
	27	8.6	7.4
	28	10	8.6
	29	14.9	12.9
	30	22.3 ^c	19.3
	31	30.8 ^c	26.6
1 1/4	41	4.1	3.5
	43	8.7	7.5
	44	12.7	11.0
	45	19.4 ^c	16.8
	46	34.1 ^c	29.5
1 1/2	51	4	3.5
	52	8.3	7.2
	53	13.4	11.6
	54	23.5	20.3
	55	32 ^c	27.7
	56	61.1 ^c	52.8
2	61	23.9	20.7
	62	38.2	33.0
	63	56.7 ^c	49.0
	64	108.5 ^c	93.8

$$a - Cv = \frac{\text{gpm}}{\sqrt{\Delta P}} \text{ (where DP is measured in psi)}$$

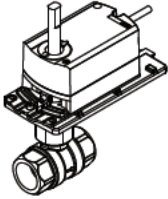
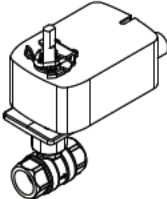
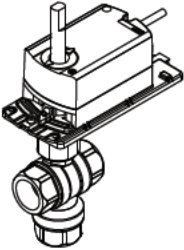
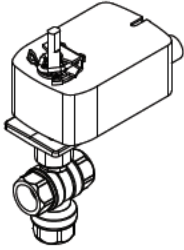
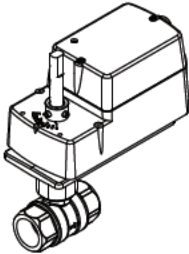
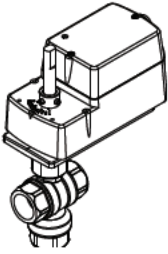
$$kvs = \frac{Cv}{1.156}$$

$$kvs = \frac{\text{m}^3/\text{h}}{\sqrt{\Delta P}} \text{ (where DP is measured in bar; 1 bar = 100 kPa)}$$

b - B port Cv is 80% of A port Cv.

c - Denotes a full port valve, without the characterized insert.

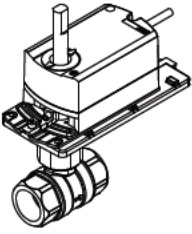
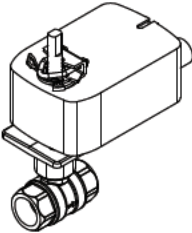
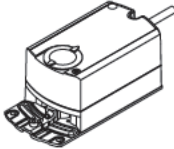
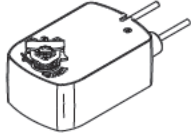
Table-3. Specifications for Ball Valve Assemblies

Valve Assembly Series		2-Way	3-Way Mixing
Ball Valve Assemblies using SmartX Actuators		 <p>Non-Spring Return Vx-22x3-505-9-P Vx-22x3-506-9-P</p>	 <p>Spring Return Vx-22x3-5xx-9-P</p>
		 <p>Non-Spring Return Vx-2313-505-9-P Vx-2313-506-9-P</p>	 <p>Spring Return Vx-2313-5xx-9-P</p>
	 <p>Spring Return Vx-22x3-81x-9-P Vx-22x3-82x-9-P Vx-22x3-83x-9-P</p>	 <p>Spring Return Vx-2313-81x-9-P Vx-2313-82x-9-P Vx-2313-83x-9-P</p>	
Applications		Chilled or Hot Water, up to 50% Glycol Solution	
Type of End Fitting		NPT Screwed	
Size		1/2 in. through 3 in.	1/2 in. through 2 in.
Valve Assembly Series		Vx-22x3-xxx-9-P	Vx-2313-xxx-9-P
Flow Type		Equal Percentage	
Material	Body	Forged Brass (ASTM B283-06)	
	Ball	1 = Nickel/Chromium-Plated Brass 5 = Stainless Steel	Nickel/Chromium-Plated Brass
	Characterizing Insert	Glass-filled Noryl	
	Stem	Stainless Steel	
	Ball Seals	Reinforced Teflon® Seals with EPDM O-Rings	
	Stem Seals	EPDM O-Rings	
	Mounting Plate	Glass-filled Polymer	
Maximum Static Pressure		360 psig (25 bar) at 250 °F (121 °C)	
Maximum Operating Differential Pressure		Same as close-off pressures shown in Table-4 or Table-6. Refer to "Cavitation Limitations on Valve Pressure Drop" on page 173.	Same as close-off pressures shown in Table-5 or Table-7. Refer to "Cavitation Limitations on Valve Pressure Drop" on page 173.
Seat Leakage		ANSI Class IV (0.01% of Cv)	ANSI Class IV (0.01% of Cv), piped coil-side outlet to A only
Fluid (water) Temperature	Minimum	20 °F (-7 °C)	
	Maximum	250 °F (121 °C)	

2-Way Ball Valve Assemblies Using SmartX Actuators

Note: All valve sizes - ANSI Class IV (0.01% of Cv) shut-off.

Table-4. 2-Way Ball Valve Assemblies with SmartX Actuators

2-Way Ball Valve Assemblies with SmartX			Non-Spring Return ^a	Spring Return	
 <p>Vx-22x3-505-9-P</p>  <p>Vx-22x3-5xx-9-P</p>			 		
			Actuator Models (Actuator Codes)		
			24 Vac		
			Floating MF41-6043 (505) Proportional MS41-6043 (505)	Floating MF41-6083 (506) Proportional MS41-6083 (506)	Two-Position MA40-7043 (N.C.) (526) MA40-7043 (N.O.) (536) Floating MF40-7043 (N.C.) (526) MF40-7043 (N.O.) (536) Proportional MS40-7043 (N.C.) (526) MS40-7043 (N.O.) (536)
			120 Vac		
			Two-position MA40-7040 (N.C.) (522) MA40-7040 (N.O.) (532)		
Valve Assembly Part Number	Valve Size (in.)	P Code ^b	Close-Off Pressure, psi (kPa)		
Ball Valve Assembly With SmartX Vx-22x3-5xx-9-P ^c	1/2	1, 2, 3, 4, 5, 6, 7	130 (896) (field assemble)	-	130 (896) (field assemble)
	3/4	11, 12, 13, 14, 15, 16, 17, 18			
	1	21, 22, 23, 24, 25, 26, 27	100 (689)		
Valve/Linkage Assembly VB-22x3-500-9-P	1 1/4	41, 42, 43, 44, 45, 46	70 (482)	70 (482)	70 (482)
	1 1/2	51, 52, 53, 54	-		
	2	61, 63, 65, 66, 67			
	2 1/2	71, 72, 73, 74, 75, 76			
	3	82, 85			

a - VSxx, non-spring return, NO (normally open), 2-way ball valve assemblies are shipped open. For VS-22x3, a control voltage increase will close the valve.

b - To find the corresponding flow coefficients for these port codes, refer to "2-Way Ball Valve Assemblies with SmartX Actuators" on page 159.

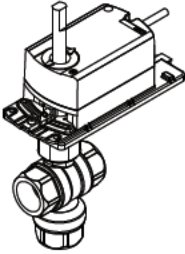
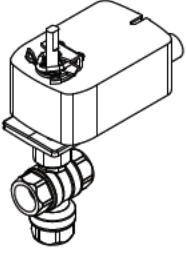
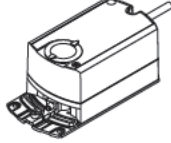
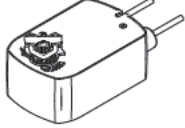
c - To determine a specific part number, identify the actuator's control signal type ("A," "F" or "S"), actuator code, and P code. Refer to "Part Numbering System" on page 157.

Note: Not all model configurations are available as factory assemblies. You can purchase the the actuator and a VB-22x3-500-9-xx valve body and linkage separately for field assembly.

3-Way Mixing Assemblies Using SmartX Actuators

Note: All valve sizes - ANSI Class IV (0.01% of Cv) shut-off piped coil-side outlet to A.

Table-5. 3-Way Mixing Ball Valve Assemblies with SmartX Actuators

3-Way Mixing Ball Valve Assemblies with SmartX ^{ab}			Non-Spring Return	Spring Return	
 <p>Vx-2313-505-9-P Vx-2313-506-9-P</p>  <p>Vx-2313-5xx-9-P</p>					
			Actuator Models (Actuator Codes)		
			24 Vac		
			Floating MF41-6043 (505) Proportional MS41-6043 (505)	Floating MF41-6083 (506) Proportional MS41-6083 (506)	Two-Position MA40-7043 (N.C.) (526) MA40-7043 (N.O.) (536) Floating MF40-7043 (N.C.) (526) MF40-7043 (N.O.) (536) Proportional MS40-7043 (N.C.) (526) MS40-7043 (N.O.) (536)
			120 Vac		
			Two-position MA40-7040 (N.C.) (522) MA40-7040 (N.O.) (532)		
Valve Assembly Part Number	Valve Size (in.)	P Code ^c	Close-Off Pressure, psi (kPa)		
Ball Valve Assembly with SmartX Vx-2313-5xx-9-P ^d	1/2	1, 2, 3, 4, 5, 6	50 (344) (field assemble)	-	50 (344) (field assemble)
	3/4	11, 12, 13, 14, 15, 16			
	1	21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	50 (344)		
Valve/Linkage Assembly VB-2313-500-9-P	1 1/4	41, 43, 44, 45, 46	40 (275)	40 (275)	40 (275)
	1 1/2	51, 52, 53, 54, 55, 56	-		
	2	61, 62, 63, 64	-		

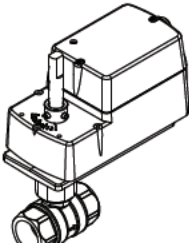
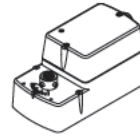
a - Non-spring return 3-way ball valve assemblies are shipped open A to AB. For VS-2313 models, a control voltage increase will close A to AB and open B to AB
 b - Spring return, NC (normally closed), 3-way mixing valves are normally closed, A to AB. For VS-2313 models, a control voltage increase will close A to AB and open B to AB
 c - To find the corresponding flow coefficients for these port codes, refer to "3-Way Ball Valve Assemblies with SmartX Actuators" on page 160.
 d - To determine a specific part number, identify the actuator's control signal type ("A," "F," or "S"), actuator code, and P code. Refer to "Ball Valve Assemblies Using SmartX 8xx Actuators" on page 158.
 Note: Not all model configurations are available as factory assemblies. You can purchase the the actuator and a VB-22x3-500-9-xx valve body and linkage separately for field assembly.

8. VBB/VBS and VB-2000 Series
Ball Valve Assemblies

2-Way Ball Valve Assemblies Using SmartX Actuators

Note: All valve sizes - ANSI Class IV (0.01% of Cv) shut-off.

Table-6. 2-Way Ball Valve Assemblies with SmartX Actuators

2-Way Ball Valve Assemblies with SmartX			Spring Return
 <p>Spring Return Vx-22x3-81x-9-P Vx-22x3-82x-9-P Vx-22x3-83x-9-P</p>			
			Actuator Models (Actuator Codes)
			24 Vac
			Two-Position
			MA4D-7033-100 (N.O.) (821)
			MA4D-8033-100 (N.C.) (831)
			Floating
			MF4D-7033-100 (N.O.) (821)
			MF4D-8033-100 (N.C.) (831)
			Proportional
MS4D-7033-100 (N.O.) (821) to (829)			
MS4D-8033-100 (N.C.) (831) to (839)			
120 Vac			
Two-position			
MA4D-7030-100 (N.O.) (815)			
MA4D-8030 (N.C.) (817)			
230 Vac			
Two-Position			
MA4D-7031-100 (N.O.) (816)			
MA4D-8031-100 (N.C.) (818)			
Valve Assembly Part Number	Valve Size (in.)	P Code ^b	Close-Off Pressure, psi (kPa)
Ball	1/2	1, 2, 3, 4, 5, 6, 7	130 (896)
Valve Assembly with SmartX	3/4	11, 12, 13, 14, 15, 16, 17, 18	130 (896)
	1	21, 22, 23, 24, 25, 26, 27	100 (689)
Valve/Linkage Assembly	Vx-22x3-5xx-9-P ^c	1 1/4	41, 42, 43, 44, 45, 46
		1 1/2	51, 52, 53, 54
		2	61, 63, 65, 66, 67
		2 1/2	71, 72, 73, 74, 75, 76
	VB-22x3-500-9-P	3	82, 85

b - To find the corresponding flow coefficients for these port codes, refer to "3-Way Ball Valve Assemblies with SmartX Actuators" on page 160.

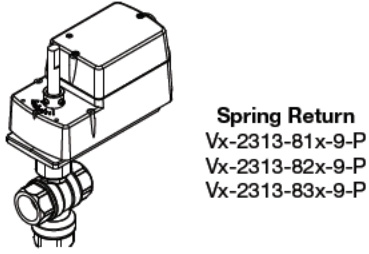
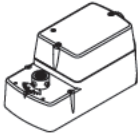
c - To determine a specific part number, identify the actuator's control signal type ("A," "F," or "S"), actuator code, and P code. Refer to "Part Numbering System" on page 158.

Note: Not all model configurations are available as factory assemblies. You can purchase the the actuator and a VB-22x3-500-9-xx valve body and linkage separately for field assembly.

3-Way Mixing Assemblies Using SmartX Actuators

Note: All valve sizes - ANSI Class IV (0.01% of Cv shut-off piped coil-side outlet to A.

Table-7. 3-Way Mixing Ball Valve Assemblies with SmartX Actuators

3-Way Mixing Ball Valve Assemblies with SmartX ^b			Spring Return	
 <p>Spring Return Vx-2313-81x-9-P Vx-2313-82x-9-P Vx-2313-83x-9-P</p>				
			Actuator Models (Actuator Codes)	
			24 Vac	
			Two-Position MA4D-7033-100 (N.O.) (821) MA4D-8033-100 (N.C.) (831)	Two-Position MA4D-7030-100 (N.O.) (815) MA4D-8030-100 (N.C.) (817)
Floating MF4D-7033-100 (N.O.) (821) MF4D-8033-100 (N.C.) (831)				
Proportional MS4D-7033-100 (N.O.) (821) MS4D-8033-100 (N.C.) (831)				
Valve Assembly Part Number	Valve Size (in.)	P Code ^c	Close-Off Pressure, psi (kPa)	
Ball	1/2	1, 2, 3, 4, 5, 6	50 (344)	
Valve Assembly with SmartX	3/4	11, 12, 13, 14, 15, 16		
Vx-2313-8xx-9-P ^d	1	21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31		
Valve/Linkage Assembly	1 1/4	41, 43, 44, 45, 46		
VB-2313-500-9-P	1 1/2	51, 52, 53, 54, 55, 56		
	2	61, 62, 63, 64	-	

b - Spring return, NC (normally closed), 3-way mixing valves are normally A to AB closed. For VS-2313, a control voltage increase will open A to AB and close B to AB

c - To find the corresponding flow coefficients for these port codes, refer to "3-Way Ball Valve Assemblies with SmartX Actuators" on page 160.

d - To determine a specific part number, identify the actuator's control signal type ("A," "F," or "S"), actuator code, and P code. Refer to "Ball Valve Assemblies Using SmartX 8xx Actuators" on page 158.

Note: Not all model configurations are available as factory assemblies. You can purchase the the actuator and a VB-22x3-500-9-xx valve body and linkage separately for field assembly.

8. VBB/VBS and VB-2000 Series
Ball Valve Assemblies

Assemblies with MF/MS41-6043/83 NSR SmartX Actuators

Table-8. Actuator Specifications

Inputs																				
Control Signal	MF41-6043 and MF41-6083: Floating three-position control, 24 Vac.																			
	MS41-6043 and MS41-6083: Proportional, 0 to 10 Vdc; input resistance 100K ohms.																			
	Control signal adjustment available with MS41-6043-520 and MS41-6043-522:																			
	Start point (offset) - Between 0 and 5 Vdc (factory setting = 0 Vdc) Span - 2 to 30 Vdc																			
Power Requirements	All 24 Vac circuits are Class 2.																			
	<table border="1"> <thead> <tr> <th rowspan="2">Part Number</th> <th colspan="4">Power Input @ 50/60 Hz</th> </tr> <tr> <th>Voltage</th> <th>Running VA</th> <th>Holding VA</th> <th>Watts</th> </tr> </thead> <tbody> <tr> <td>MF41-6043 and MF41-6083</td> <td>24 Vac +20/-</td> <td>2.3</td> <td>-</td> <td>2.0</td> </tr> <tr> <td>MS41-6043 and MS41-6083</td> <td>15%</td> <td>3.3</td> <td>1.2</td> <td>3.0</td> </tr> </tbody> </table>	Part Number	Power Input @ 50/60 Hz				Voltage	Running VA	Holding VA	Watts	MF41-6043 and MF41-6083	24 Vac +20/-	2.3	-	2.0	MS41-6043 and MS41-6083	15%	3.3	1.2	3.0
	Part Number		Power Input @ 50/60 Hz																	
		Voltage	Running VA	Holding VA	Watts															
MF41-6043 and MF41-6083	24 Vac +20/-	2.3	-	2.0																
MS41-6043 and MS41-6083	15%	3.3	1.2	3.0																
Connections	3 ft. (0.9 m) long, 18 AWG plenum-rated leads.																			
Motor Type	Synchronous																			
Outputs																				
Electrical	Feedback potentiometer available for MF41-6043/6083-510: 0 to 1000 ohms < 10 mA Position feedback voltage for MS41-6043/6083: 0 to 10 Vdc, 1 mA																			
	Auxiliary Switches: Dual auxiliary switches available with MF41-6043/6083-502, MS41-6043/6083-502, and MS41-6083-522 when these actuators are ordered as separate units. Auxiliary switches are not offered with factory ball valve assemblies.																			
	AC Rating: 24 Vac, 4 A resistive, 2 A inductive	Switch hysteresis: 3° rotation																		
	DC Rating: 12 to 30 Vdc, DC 2 A	Switch Range: Switch A - 0 to 90° range in 5° intervals Recommended range usage - 0 to 45° Factory setting - 5° Switch B - 0 to 90° range in 5° intervals Recommended range usage - 45 to 90° Factory setting - 85°																		
	<table border="1"> <thead> <tr> <th rowspan="2">Timing:</th> <th rowspan="2">Part Number</th> <th colspan="2">90° Timing in Sec.</th> </tr> <tr> <th>At 60 Hz</th> <th>At 50 Hz</th> </tr> </thead> <tbody> <tr> <td></td> <td>MF41-6043 MS41-6043</td> <td>90</td> <td>108</td> </tr> <tr> <td></td> <td>MF41-6083 MS41-6083</td> <td>125</td> <td>150</td> </tr> </tbody> </table>		Timing:	Part Number	90° Timing in Sec.		At 60 Hz	At 50 Hz		MF41-6043 MS41-6043	90	108		MF41-6083 MS41-6083	125	150				
Timing:	Part Number	90° Timing in Sec.																		
		At 60 Hz	At 50 Hz																	
	MF41-6043 MS41-6043	90	108																	
	MF41-6083 MS41-6083	125	150																	
Mechanical	Output torque rating: 44 lb-in. (5 N-m) for Mx41-6043; 88 lb-in. (10 N-m) for Mx41-6083																			
	Stroke: Normal angle of rotation is 90°, limited to a maximum of 95°. Field adjustable to limit travel on either end of stroke.																			
	Position indicator: Adjustable pointer is provided for position indication.																			
	Output shaft setscrew: Tightening torque 55 to 60 lb-in. (6.3 to 6.8 N-m).																			
Environment																				
Temperature Limits	Shipping and storage: -40 to 158 °F (-40 to 70 °C) ambient. Operating: -25 to 130 °F (-32 to 55 °C) ambient. NOTE: Check the valve operating temperature limit. The minimum valve temperature limit is 20 °F (6.7 °C)																			
	Humidity	5 to 95% RH, non-condensing.																		
Locations	NEMA Type 2 (IEC IP54).																			
Agency Listings (Actuator)																				
UL	UL-873, Underwriters Laboratories.																			
cUL	Canadian Standards C22.2 No. 24-93.																			
European Community	EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN50081-2).																			

8. VBB/VBS and VB-2000 Series
Ball Valve Assemblies

Assemblies with Mx40-704x SR SmartX Actuators

Table-11. Actuator Specifications

Inputs									
Control Signal	MA40-704x: ON/OFF SPST control contacts or Triacs (500 mA rated). MS40-7043: Proportional, 2 to 10Vdc or 4 to 20 mAdc with 500 ohm resistor. MS40-7043 MP/MP5: Proportional 6 to 9 Vdc. MF40-7043: Floating point control, 24 Vac.								
Power Requirements	All 24 Vac circuits are Class 2								
	Part Number	Voltage 50/60 Hz	Voltage Vdc	Running				Holding	
				50 Hz		60 Hz		50 Hz	60 Hz
				VA	W	VA	W	W	W
	MA40-7043	24 Vac ± 20%	22 to 30	4.4	2.9	4.4	2.9	0.8	0.8
	MS40-7043			5.6	4.2	5.6	4.2	2.4	2.4
	MF40-7043			5.9	4.4	5.9	4.4	2.9	2.9
MS40-7043-MP	6.9			5.0	6.6	5.0	3.2	3.2	
MS40-7043-MP5*									
MA40-7040*	120 Vac ± 10%	-	6.4	3.8	4.3	3.4	1.6	1.2	
Connections	MA40-704x and MA40-704x-501: 3 ft. (0.9 m) long, appliance cable, 1/2 in. conduit connector. For M20 Metric conduit, use AM-756 adaptor. MF40-7043 and MF40-7043-501, MS40-7043 and MS40-7043-501: 3 ft. (0.9 m) long, plenum rated cable, 1/2 in. conduit connector. For M20 Metric conduit, use AM-756 adaptor.								
Motor Type	MA40-704x: Brush DC. MF40-7043, MS40-7043: Brushless DC.								
Outputs									
Electrical	Auxiliary Switches: Available when actuators are ordered as separate units. Auxiliary switches are not offered with factory ball valve assemblies.								
	Mx40-7043-501 and MS40-7043-MP5: One auxiliary switch available. SPDT 6 A resistive @ 24 Vac, adjustable 0 to 95° (0 to 1 scale). Switch meets VDE requirements for 6 (1.5) A, 24 Vac.					MA40-7040-501: One auxiliary switch available. SPDT 6 A resistive @ 250 Vac, adjustable 0 to 95° (0 to 1 scale). Switch meets VDE requirements for 6 (1.5) A, 250 Vac.			
	Position Feedback Voltage: For 2 to 10 Vdc proportional actuators, the feedback signal is the same voltage range as the input signal. The feedback signal can supply up to 0.5 mA to operate up to four additional slave actuators.								
	Control Mode: Switch provided for selection of direct acting or reverse acting control mode on proportional models. Timing: MA-704x - Approx. 50 sec.; MF- and MS-7043 - Approx. 130 sec. Auxiliary Power Supply: MS40-7043-MP and MS40-7043-MP5 - +20 Vdc @ 25 mA (max.).								
Mechanical	Stroke: Angle of rotation is limited to a maximum of 95°, with mechanical stop.								
	Output torque rating: Mx40-704x - 44 lb-in (5 N-m).								
	Position indicator: Visual scale numbered from 0 to 90°, provided for position indication.								
Environment									
Temperature Limits	Shipping and storage: -40 to 160 °F (-40 to 71 °C) ambient. Operating: -22 to 140 °F (-30 to 60 °C) ambient. NOTE: Check the valve operating temperature limit. The minimum valve temperature limit is 20 °F (6.7 °C)								
Humidity	5 to 95% RH, non-condensing.								
Locations	NEMA 2, UL Type 2 (IEC IP54)								
Agency Listings (Actuator)									
UL	UL 873, Underwriters Laboratories (File #9429 Category Temperature-Indicating and Regulating Equipment).								
cUL	Canadian Standards C22.2 No. 24-93.								
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).								
Australia	This product meets requirements to bear the RCM mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.								

* Not available as an assembly.

Mx4D-703xx/803xx Actuator Specifications

Table-14. Actuator Specifications

Inputs							
Control Signal and Power Requirements	Part Number for Mx4D-703x-xxx Mx4D-803x-xxx	Control Signal	Voltage	Actuator Power Input			
				Running			Holding
				50/60 Hz		DC Amps	50/60 Hz
				VA	W		
	MA4D-x033-100	2-position	24 Vac ±20% or 20 to 30 Vdc	5.1	3.6	0.14	1.3
	MF4D-x033-100	Floating		6.8	4.2	0.15	1.9
	MS4D-x033-100	2 to 10 Vdc ^a Proportional		6.1	3.4	0.12	1.4
	MS4D-x033-120	0 to 3 Vdc Proportional					
	MS4D-x033-130	6 to 9 Vdc Proportional					
	MS4D-x033-150	0 to 10 Vdc Proportional					
	MS4D-x033-160	4 to 20 mAdc Proportional					
a. 4 to 20 mAdc with field-installed 500 W resistor.							
Connections	Mx4D-703x-1x0 and Mx4D-803x-1x0: 10 ft. (3.05 m) long, plenum cable, 1/2 in. (13 mm) conduit connector. For M20 Metric conduit, use AM-756 adaptor.						
Motor Type	Brush DC						
Outputs							
Electrical	Timing:						
	Part Number		Approximate Timing in Sec. @ 70 °F (21 °C) ^a				
			Powered		Spring Return		
					CCW ^b	CW ^b	
	MA4D-7033-100		56		26		-
	MF4D-7033-100		85		21		-
	MS4D-7033-100		56		-		26
	MF4D-8033-100		85		-		21
MS4D-8033-1x0							
a. Timing was measured with no load applied to actuator. b. CCW or CW as viewed from cover side of actuator.							
Position Feedback Voltage: For 0 to 3 Vdc, 0 to 9 Vdc, 2 to 10Vdc, and 0 to 10 Vdc proportional actuators, the feedback signal is the same voltage range as the input signal. The 4 to 20 mA proportional actuators and floating actuators have a 2 to 10 Vdc feedback signal. The feedback signal can supply up to 0.5 mA to operate up to four additional slave actuators.							
Mechanical	Stroke: 93° nominal.						
	Manual override: Allows positioning of valve shaft, using a manual crank..						
	Output torque rating: 30 lb-in (3.4 N-m).						
	RA/DA Jumper (Proportional Models): Permits selection of reverse acting or direct acting control.						
Position indicator: Visual indicator.							

MS4D-x033-120 and MS4D-x033-130 are no longer available and included here for reference purposes.

8. VBB/VBS and VB-2000 Series
Ball Valve Assemblies

Continued

Inputs	
Environment	
Temperature Limits	Shipping and storage: -40 to 160 °F (-40 to 71 °C) ambient. Operating: -22 to 140 °F (-30 to 60 °C) ambient. NOTE: Check the valve operating temperature limit. The minimum valve temperature limit is 20 °F (6.7 °C)
Humidity	15 to 95% RH, non-condensing.
Locations	NEMA 1, NEMA 2, UL Type 2 (IEC IP54) with customer-supplied watertight conduit connectors. Enclosure is air plenum rated.
Agency Listings (Actuator)	
UL	UL 873, Underwriters Laboratories (File #9429 Category Temperature-Indicating and Regulating Equipment). Plenum rated..
cUL	Canadian Standards C22.2 No. 24-93.
European Community	EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC). This product fits into Installation Category (Overvoltage Category) II per EN 61010-1.
Australia	This product meets requirements to bear the RCM mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.

Installation Considerations

Mounting Angle of Valve Assembly

Be sure to allow the necessary clearance around the valve assembly. The valve assembly must be mounted so that the actuator is horizontally even with, or above, the valve. This ensures that any condensate that forms on the valve body will not travel into the actuator, where it may cause corrosion or electrical malfunction. See Vx-2x13-5xx-9-xx Series Ball Valve Assembly Installation Instructions, F-27087 or Mx4D-xxxx Series SmartX Rotary Overshaft Actuators General Instructions, F-27170.

Piping

Figure 9 and Figure 10 illustrate 2-way and 3-way ball valve assembly piping.

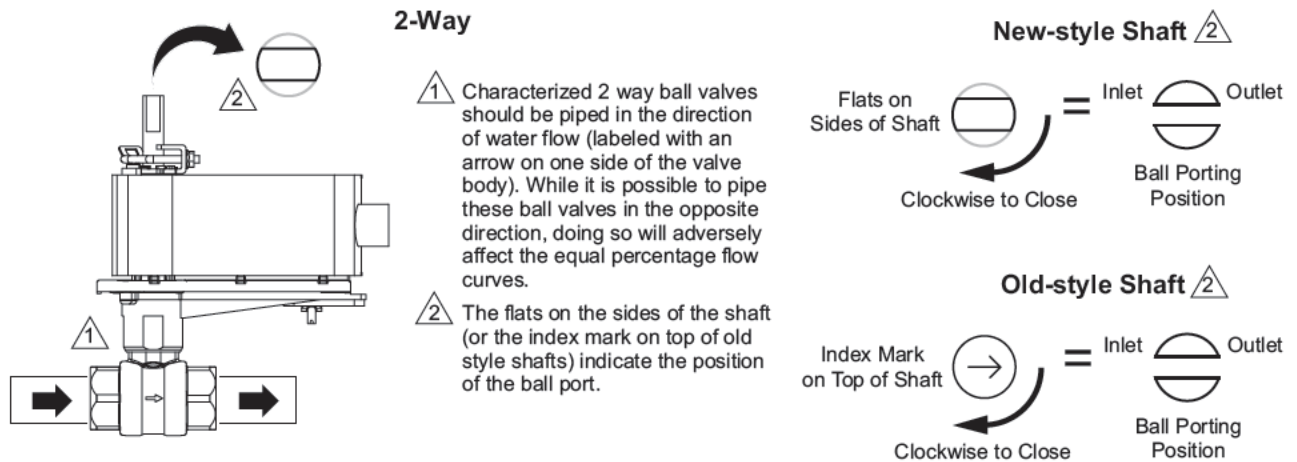
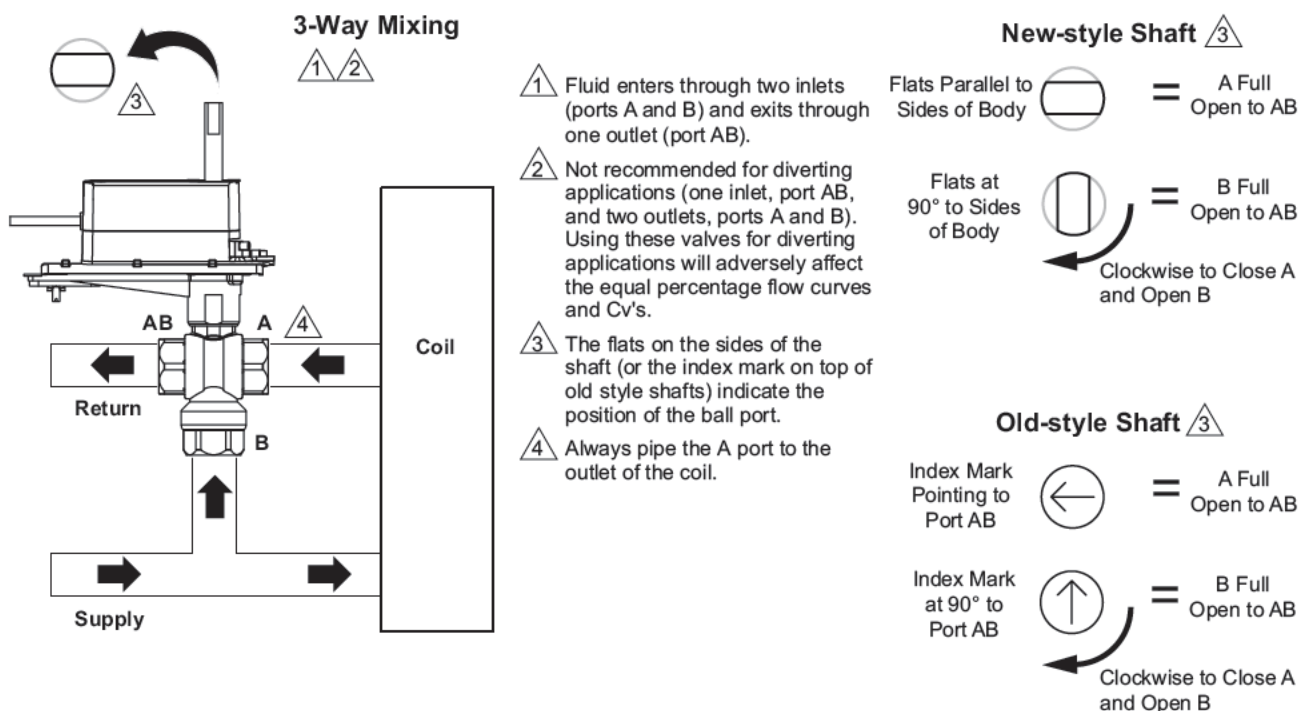


Figure 7. 2-Way Valve Assemblies Piping Diagram.



Insulation of Ball Valve Assembly

The ball valve should be completely insulated to minimize the effect of heat transfer and condensation at the actuator.

Caution: The actuator itself must not be insulated. Doing so can result in excess heat or condensation within the actuator.

Temperature Limits for Ball Valve Assembly

When installing the ball valve assembly, observe the minimum and maximum temperature limits. Refer to the valve and actuator specifications.

Water System Maintenance

All heating and cooling systems are susceptible to valve and system problems caused by improper water treatment and system storage procedures. Durability of valve stems and packings is dependent on maintaining non-damaging water conditions. Inadequate water treatment or filtration, not in accordance with chemical supplier or ASHRAE handbook recommendations, can result in corrosion, scale, and abrasive particle formation. Scale and particulates can cause scratches in the stem and packing, and can adversely affect packing life and other parts of the hydronic system. Consult EN-205, Water System Guidelines Engineering Information, F-26080, for further details.

Sizing and Selection

Flow Coefficient (Cv)

When sizing a valve, you must select a flow coefficient (Cv), which is defined as the flow rate in gallons per minute (GPM) of 60 °F water that will pass through the fully open valve with a 1 psi pressure drop (ΔP). It is calculated according to this formula:

$Cv = \frac{gpm}{\sqrt{\Delta P}}$ where ΔP is measured in psi.

Since the flow rate through the heat exchanger is usually specified, the only variable normally available in sizing a valve is the pressure drop. The following information in this section can be used to determine what pressure drop to use in calculating a valve Cv. Once you have calculated the Cv, consult Table-1 and Table-2 to select the valve body having the nearest available Cv.

NOTE: Metric equivalent

The metric measure of flow coefficient is kvs, which is calculated according to the formula: $kvs = \frac{m^3/h}{\sqrt{\Delta P}}$ (where ΔP is measured in bar; 1 bar = 100 kPa).

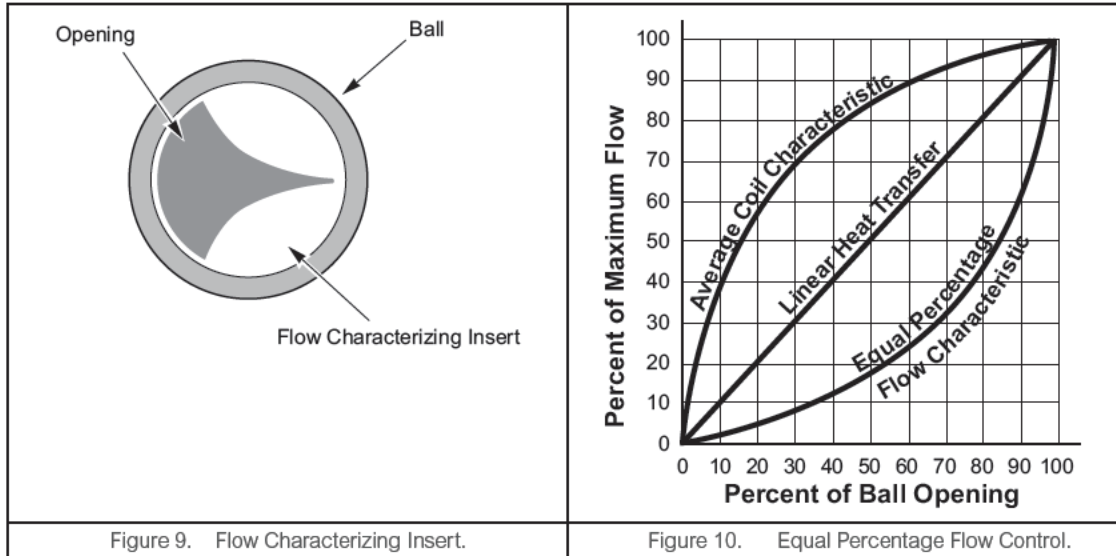
If the Cv is already known, it may be converted directly to its kvs equivalent: $kvs = \frac{Cv}{1.156}$

Two-position Control

Two-position control valves are normally selected "line size" to keep pressure drop at a minimum. If it is desirable to reduce the valve below line size, then 10% of "available pressure" (that is, the pump pressure differential available between supply and return mains, with design flow at the valve location) is normally used to select the valve.

Flow Characterization: Proportional/Floating Control

The Vx-2x13-xxx-9-xx series ball valve assemblies provide equal percentage flow, which is achieved with a flow characterizing insert (Figure-11). The parabolic shape of the orifice allows a gradual change in flow, so that equal movements of the valve stem, at any point of the flow range, change the existing flow an equal percentage, regardless of the flow rate. As shown in the graph in Figure-12, a ball valve equipped with the flow insert mirrors the flow characteristic of the coil, resulting in linear heat transfer.



Proportional control valves are usually selected to take a pressure drop equal to at least 50% of the “available pressure.” As “available pressure” is often difficult to calculate, the normal procedure is to select the valve using a pressure drop at least equal to the drop in the coil or other load being controlled (except where small booster pumps are used) with a minimum recommended pressure drop of 5 psi (34 kPa). When the design temperature drop is less than 60 °F (33 °C) for conventional heating systems, higher pressure drops across the valve are needed for good results.

Table-17. Conventional Heating System.

Design Temperature Load Drop °F (°C)	Recommended Pressure Drop (% of Available Pressure)	Multiplier on Load Drop
60 (33) or More	50%	1 x Load Drop
40 (22)	66%	2 x Load Drop
20 (11)	75%	3 x Load Drop

Secondary Circuits with Small Booster Pumps: 50% of available pressure difference (equal to the drop through load, or 50% of the booster pump head).

3-Way Mixing Valves

3-way mixing valves used in variable flow applications (Figure 10) should be sized using the preceding guidelines. 3-way mixing valves used in constant flow applications, such as boiler bypass, should be sized to use 20% of “available pressure,” or equal to 25% of the pressure drop through the load at full flow.

8. VBB/VBS and VB-2000 Series Ball Valve Assemblies

Cavitation Limitations on Valve Pressure Drop

A valve selected with too high a pressure drop can cause erosion and/or wire drawing of the flow characterizing insert. In addition, cavitation can cause noise, damage to the valve trim (and possibly the body), and choke the flow through the valve.

A valve selected with too high a pressure drop can cause erosion of seals and/or wire drawing of the seat. In addition, can cause noise, damage to the valve trim (and possibly the body), and choke the flow. Do not exceed the maximum differential pressure (pressure drop) for the valve selected. The following formula can be used on higher temperature water systems, where cavitation could be a problem, to estimate the maximum allowable pressure drop across the valve:

$$P_m = 0.5 (P_1 - P_v)$$

Where:

P_m = Maximum allowable pressure drop (psi)

P_1 = Absolute inlet pressure (psia)

P_v = Absolute vapor pressure (psia)

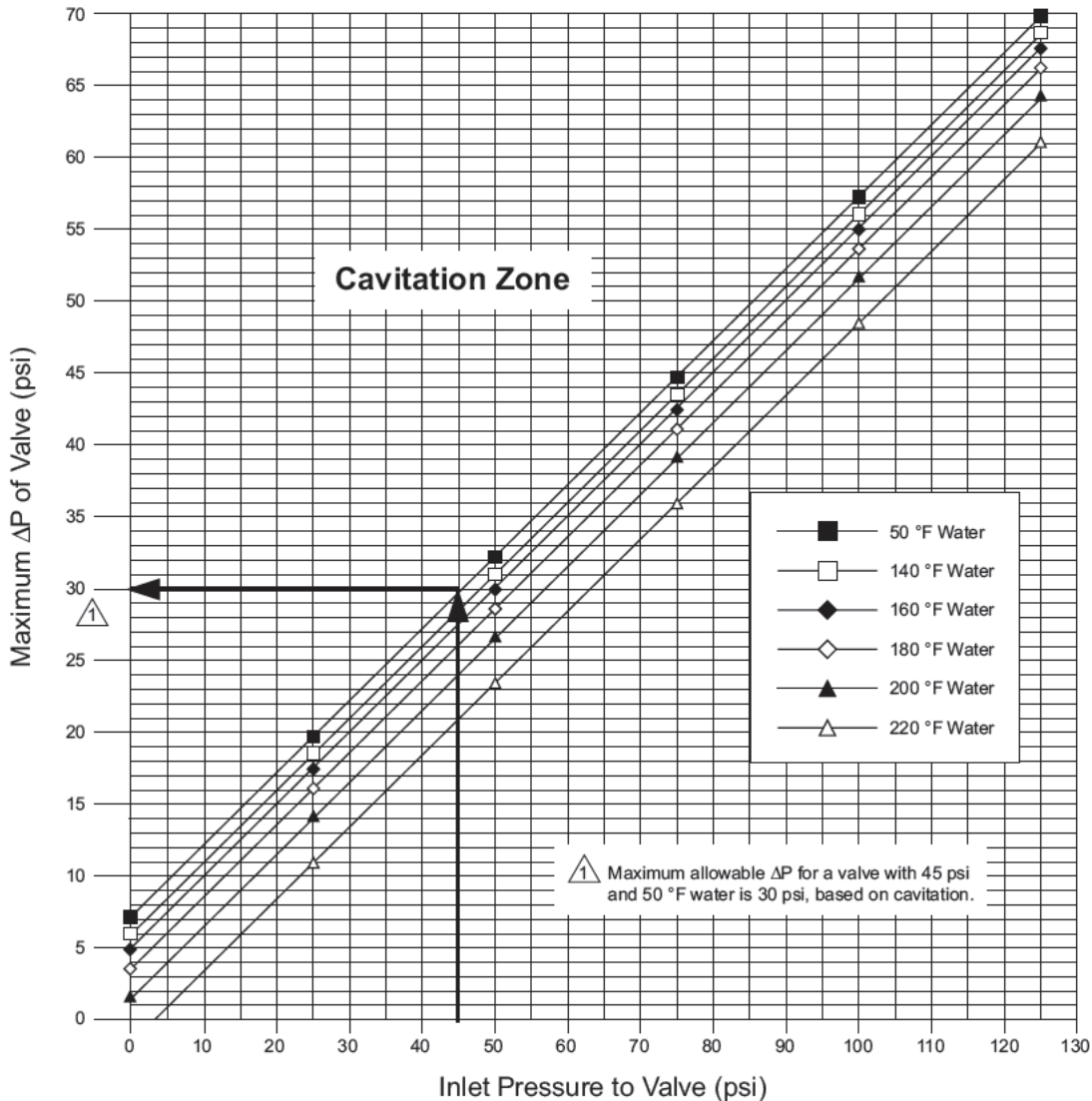
Note: Add 14.7 psi to gauge supply pressure to obtain absolute pressure value.

For example, if a valve is controlling 200°F water at an inlet pressure of 18 psig, the maximum pressure drop allowable would be:

$$P_m = 0.5 [(18 + 14.7) - 11.53] = 10.6 \text{ psi}$$

(Vapor pressure of 200°F water is 11.53 psia)

Systems where cavitation is shown to be a problem can sometimes be adjusted to provide higher downstream back pressures. Valves having harder seat materials should be furnished if velocities are excessive.



Using Pipe Reducers with 2-Way Ball Valve Assemblies

The following table provides estimated effective Cvs when using a 2-way valve assembly on the same or larger pipe size. Use these estimated effective Cvs in place of the rated Cvs along with at least 6 valve size diameters of straight pipe upstream and 3 valve size diameters of straight pipe downstream of the valve body.



WARNING: Do not reduce the valve size to less than one-half the line size, as this may weaken the pipe reduction area. Physical injury can result if the weakened piping fails.

Table-18. Estimated Effective Cv when Using Pipe Reducers with 2-Way Ball Valve Assemblies.

Valve Size in.	P Code	C _v	Estimated Effective Cv (Kvs)									
			Pipe Size - inches (NPT)									
			1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5
1/2	01	0.38	0.38 (0.33)	0.38 (0.33)	0.38 (0.33)	-	-					
	02	0.68	0.68 (0.59)	0.68 (0.59)	0.68 (0.59)							
	03	1.3	1.3 (1.12)	1.3 (1.12)	1.3 (1.12)							
	04	2.6	2.6 (2.24)	2.5 (2.16)	2.5 (2.16)							
	05	4.7	4.7 (4.06)	4.3 (3.71)	4.1 (3.54)							
	06	8.0	8.0 (6.9)	6.5 (5.6)	5.7 (4.9)							
	07	11.7 ^a	11.7 (10.1)	7.9 (6.8)	6.7 (5.8)							
3/4	11	0.31	-	0.31 (0.27)	0.31 (0.27)	0.31 (0.27)	0.31 (0.27)	-				
	12	0.63		0.63 (0.54)	0.63 (0.54)	0.63 (0.54)	0.63 (0.54)					
	13	1.2		1.2 (1.04)	1.2 (1.04)	1.2 (1.04)	1.2 (1.04)					
	14	2.5		2.5 (2.16)	2.5 (2.16)	2.5 (2.16)	2.5 (2.16)					
	15	4.3		4.3 (3.71)	4.3 (3.71)	4.2 (3.63)	4.2 (3.63)					
	16	10.1		10.1 (8.7)	9.6 (8.3)	9.1 (7.9)	8.8 (7.6)					
	17	14.7 ^a		14.7 (12.7)	7.1 (6.1)	6.5 (5.6)	6.2 (5.4)					
	18	28.6 ^a		28.6 (24.7)	21.1 (18.2)	17.1 (14.8)	15.4 (13.3)					

a - Denotes a full port valve, without the characterized insert.

8. VBB/VBS and VB-2000 Series
Ball Valve Assemblies

Estimated Effective Cv con't

Valve Size in.	P Code	C _v	Estimated Effective Cv (Kvs)																		
			Pipe Size - inches (NPT)																		
			1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5									
1	21	4.4			4.4 (3.8)	4.4 (3.8)	4.4 (3.8)	4.4 (3.8)													
	22	9.0			9.0 (7.8)	8.9 (7.4)	8.8 (7.6)	8.7 (7.5)													
	23	15.3			15.3 (13.2)	14.9 (12.9)	14.4 (12.5)	13.8 (11.9)													
	24	26.1			26.1 (22.5)	24.4 (21.1)	22.4 (19.4)	20.3 (17.5)													
	25	28.4 ^a			28.4 (24.6)	26.2 (22.7)	23.8 (20.6)	21.4 (18.5)													
	26	43.9 ^a			43.9 (38.0)	36.8 (31.8)	31.0 (26.8)	26.1 (22.6)													
	27	54.2 ^a			54.2 (46.8)	42.3 (36.6)	34.1 (29.5)	27.9 (24.1)													
1 1/4	41	4.4			4.4 (3.8)	4.4 (3.8)	4.4 (3.8)	4.4 (3.8)													
	42	8.3			8.3 (7.2)	8.3 (7.2)	8.2 (7.1)	8.2 (7.1)													
	43	14.9			14.9 (12.9)	14.8 (12.8)	14.5 (12.5)	14.3 (12.3)													
	44	36.5			36.5 (31.6)	35.0 (30.3)	31.5 (27.2)	29.6 (25.6)													
	45	41.1 ^a			41.1 (35.5)	39.0 (33.7)	34.3 (29.7)	31.9 (27.5)													
	46	102.3 ^a			102.3 (88.1)	79.1 (68.4)	53.3 (46.1)	45.5 (39.3)													
1 1/2	51	22.8					22.8 (19.7)	22.4 (19.4)	22.0 (19.0)	21.8 (18.9)											
	52	41.3					41.3 (35.7)	39.3 (33.9)	37.2 (32.1)	36.0 (31.1)											
	53	73.9 ^a					73.9 (63.9)	63.7 (55.1)	55.9 (48.4)	52.0 (45.0)											
	54	171.7 ^a					171.7 (148.5)	101.2 (87.5)	76.6 (66.3)	67.2 (58.0)											
2	61	41.7						41.7 (36.1)	41.2 (35.6)	40.6 (35.1)	39.7 (34.3)										
	63	71.1						71.1 (61.4)	68.8 (59.5)	65.9 (57.0)	62.4 (53.9)										
	65	108.0 ^a						108.0 (93.4)	100.3 (86.8)	92.0 (79.6)	83.0 (71.8)										
	66	210.0						210.0 (181.7)	165.9 (143.5)	134.6 (116.4)	110.5 (95.6)										
	67	266.0 ^a						266.0 (229.7)	189.7 (164.1)	146.4 (126.6)	116.7 (100.8)										

a - Denotes a full port valve, without the characterized insert.

Valve Size in.	P Code	C _v	Estimated Effective Cv (Kvs)									
			Pipe Size - inches (NPT)									
			1/2	¾	1	1¼	1½	2	2½	3	4	5
2½	71	45.0							45.0 (38.9)	43.6 (37.7)	42.5 (36.8)	42.0 (36.3)
	72	55.0							55.0 (47.5)	52.5 (45.3)	50.6 (43.7)	49.7 (42.9)
	73	72.3							72.3 (62.5)	66.6 (57.6)	63.0 (54.5)	61.2 (52.9)
	74	101.0							101.0 (87.4)	87.5 (75.7)	79.7 (68.9)	76.2 (65.9)
	75	162.0							162.0 (140.0)	119.0 (102.9)	101.3 (87.6)	94.3 (81.6)
	76	202.0 ^a							202.0 (174.4)	132.4 (114.5)	109.3 (94.5)	100.6 (87.0)
3	82	63.0							-	63.0 (54.4)	56.7 (49.0)	55.5 (47.9)
	85	145.0 ^a							-	145.0 (125.2)	96.8 (83.7)	90.6 (78.4)

a - Denotes a full port valve, without the characterized insert.

8. VBB/VBS and VB-2000 Series
Ball Valve Assemblies

Estimated Effective Cv cont

Using Pipe Reducers with 3-Way Ball Valve Assemblies

The following table provides estimated effective Cvs when using a 3-way valve assembly on the same or larger pipe size. Use these estimated effective Cvs in place of the rated Cvs along with at least 6 valve size diameters of straight pipe upstream and 3 valve size diameters of straight pipe downstream of the valve body.


 **WARNING:** Do not reduce the valve size to less than one-half the line size, as this may weaken the pipe reduction area. Physical injury can result if the weakened piping fails.

Table-19. Estimated Effective Cv when Using Pipe Reducers with 3-Way Ball Valve Assemblies.

Valve Size in.	P Code	Cv	Estimated Effective Cv (kvs)						
			Pipe Size - inches (NPT)						
			1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
1/2	01	0.33	0.33 (0.29)	0.33 (0.29)	0.33 (0.29)	-		-	
	02	0.59	0.59 (0.51)	0.59 (0.51)	0.59 (0.51)				
	03	1.0	1.0 (0.86)	1.0 (0.86)	1.0 (0.86)				
	04	2.4	2.4 (2.1)	2.3 (2.0)	2.3 (2.0)				
	05	4.3	4.3 (3.7)	4.0 (3.5)	3.8 (3.3)				
	06	8.0 ^a	8.0 (6.9)	7.9 (6.8)	5.7 (4.9)				
3/4	11	0.40	-		0.40 (0.35)	0.40 (0.35)	0.40 (0.35)	0.40 (0.35)	-
	12	0.66			0.66 (0.57)	0.66 (0.57)	0.66 (0.57)	0.66 (0.57)	
	13	1.3			1.3 (1.12)	1.3 (1.12)	1.3 (1.12)	1.3 (1.12)	
	14	2.4			2.4 (2.1)	2.4 (2.1)	2.4 (2.1)	2.4 (2.1)	
	15	3.8			3.8 (3.3)	3.8 (3.3)	3.74 (3.23)	3.7 (3.2)	
	16	11			11 (9.5)	10.4 (9.0)	9.8 (8.5)	9.4 (8.1)	
1	21	0.40	-		0.40 (0.35)	0.40 (0.35)	0.40 (0.35)	0.40 (0.35)	-
	22	0.65			0.65 (0.56)	0.60 (0.52)	0.60 (0.52)	0.60 (0.52)	
	23	1.3			1.3 (1.1)	1.3 (1.1)	1.3 (1.1)	1.3 (1.1)	
	24	2.3			2.3 (2.0)	2.3 (2.0)	2.3 (2.0)	2.3 (2.0)	
	25	3.5			3.5 (3.0)	3.5 (3.0)	3.5 (3.0)	3.5 (3.0)	
	26	4.5			4.5 (3.9)	4.5 (3.9)	4.5 (3.9)	4.5 (3.9)	
	27	8.6			8.6 (7.4)	8.5 (7.3)	8.4 (7.2)	8.3 (7.2)	
	28	10.0 ^a			10.0 (8.6)	9.9 (8.6)	9.7 (8.4)	9.6 (8.3)	
	29	14.9			14.9 (12.9)	14.6 (12.6)	14.1 (12.2)	13.5 (11.7)	
	30	22.3 ^a			22.3 (19.2)	21.2 (18.3)	19.9 (17.2)	18.4 (15.9)	
	31	30.8 ^a			30.8 (26.6)	28.0 (24.2)	25.2 (21.8)	22.3 (19.3)	

a - Denotes a full port valve, without the characterized insert.

Valve Size in.	P Code	Cv	Estimated Effective Cv (kvs)						
			Pipe Size - inches (NPT)						
			1/2	3/4	1	1 1/4	1 1/2	2	2 1/2
1 1/4	41	4.1				4.1 (3.5)	4.0 (3.5)	4.0 (3.5)	4.0 (3.5)
	43	8.7				8.7 (7.5)	8.6 (7.4)	8.6 (7.4)	8.5 (7.4)
	44	12.7				12.7 (11.0)	12.6 (10.9)	12.4 (10.7)	12.3 (10.6)
	45	19.4 a				19.4 (16.8)	19.2 (16.6)	18.5 (16.0)	18.1 (15.7)
	46	34.1 a				34.1 (29.4)	32.9 (28.4)	29.9 (25.9)	28.3 (24.4)
1 1/2	51	4.0					4.0 (3.5)	4.0 (3.5)	4.0 (3.5)
	52	8.3					8.3 (7.2)	8.2 (7.1)	8.2 (7.1)
	53	13.4					13.4 (11.6)	13.3 (11.5)	13.2 (11.4)
	54	23.5					23.5 (20.3)	23.1 (19.9)	22.7 (19.6)
	55	32.0 ^a					32.0 (27.7)	31.0 (26.8)	30.0 (25.9)
	56	61.1 ^a					61.1 (52.8)	54.9 (47.5)	49.7 (43.0)
2	61	23.9						23.9 (20.7)	23.5 (20.3)
	62	38.2						38.2 (33.0)	37.8 (32.7)
	63	56.7 ^a						56.7 (49.0)	55.5 (47.9)
	64	108.5 ^a						108.5 (93.9)	100.7 (87.1)

a - Denotes a full port valve, without the characterized insert.