

Ball Valve Assemblies with SmartX Actuators

Selection Guide

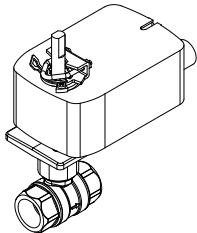
Ball Valve Assemblies

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.

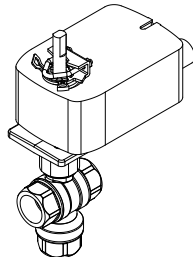
Typical applications include reheat on VAV boxes, fan coil units, hot and chilled water coils in air handling units, and unit ventilators.

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.

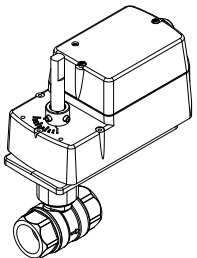


Vx-22x3-5xx-9-xx
2-Way Assembly with
Spring Return Actuator

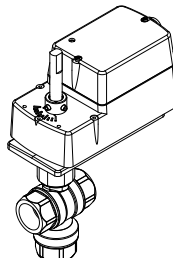


Vx-2313-5xx-9-xx
3-Way Assembly with
Spring Return Actuator

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

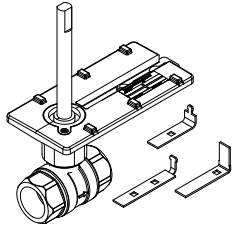
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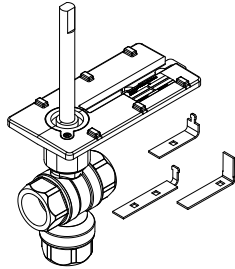
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Ball Valve Body/Linkage Assemblies

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



VB-22x3-500-9-xx
Body/Linkage Assembly
with 2-Way Ball Valve



VB-2313-500-9-xx
Body/Linkage Assembly
with 3-Way Ball Valve

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 4 or “Ball Valve Assemblies Using SmartX 8xx Actuators” on page 5 , and then select the appropriate codes for these part number fields.

BALL VALVE ASSEMBLY SELECTION PROCEDURE

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 27 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 6 or “3-Way Ball Valve Assemblies with SmartX Actuators” on page 7.

3. Actuator

Select the appropriate actuator and code, according to “Ball Valve Assemblies Using SmartX 5xx Actuators” on page 4 or “Ball Valve Assemblies Using SmartX 8xx Actuators” on page 5, based on the control signal type, required valve normal position, and voltage requirements. For detailed actuator information, refer to the applicable actuator specifications on page 13, page 16, page 19, and page 22.

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 “Valve Assemblies with Mx40-704x Spring Return SmartX Actuators” on page 19 and “Valve Assemblies with Mx4D-7033 and Mx4D-8033 Spring Return SmartX Actuators” on page 23 “Valve Assemblies with MF41-6043, MF41-6083, MS41-6043, and MS41-6083 Non-Spring Return SmartX Actuators” on page 13.

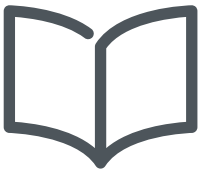
4. Close-off Pressure

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
Schneider Electric Valves Catalog	F-27414

Part Numbering System

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)

Configuration
 2 = 2-Way
 3 = 3-Way Mixing

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

Connection
 3 = Threaded NPT

Port Code
 Refer to separate Port Code table

Model	Actuator Code ¹ ²			Valves Used On ³					
	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					

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

² Only the listed 35 lb-in. and 70 lb-in. SmartX actuators are compatible with ball valve body/linkage assemblies.

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

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 ²					Valves Used On ³			
Model ^a	Code	Normal Position	Voltage	Type	1/2" to 1"		1-1/4" to 3"	1-1/4" to 2"
					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	—	—
MS4D-6083-100	841	NSR	24 Vac	2-10 Vdc	X	X	X	X
MS4D-6083-120	N/A ^b	NSR	24 Vac	0-3 Vdc	X	X	X	X
MS4D-6083-130	N/A ^b	NSR	24 Vac	6-9 Vdc	X	X	X	X
MS4D-6083-150	N/A ^b	NSR	24 Vac	0-10 Vdc	X	X	X	X
MS4D-6083-160	N/A ^b	NSR	24 Vac	4-20 mA	X	X	X	X
Valve Body/Linkage Assembly^c					VB-22x3-500-9-xx, VB-2313-500-9-xx			

- ¹ Normal position for 3-way spring return ball valve assemblies refers to A to AB ports.
- ² Only the listed 30 lb-in. and 70 lb-in. SmartX actuators are compatible with ball valve body/linkage assemblies.
- ³ Stainless steel ball is available only on 2-way versions.

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.

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
3/4	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
1-1/4	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
1-1/2	46	102.3 ^b	88.5
	51	22.8	19.7
	52	41.3	35.7
	53	73.9 ^b	63.9
2	54	171.7 ^b	148.5
	61	41.7	36.1
	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
2-1/2	71	45	38.9
	72	55	47.6
	73	72.3	62.5
	74	101	87.4
	75	162	140.1
	76	202 ^b	174.7
3	82	63	54.5
	85	145 ^b	125.4

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

$kvs = \frac{m^3/h}{\sqrt{\Delta P}}$ (where ΔP 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

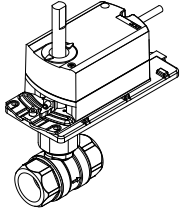
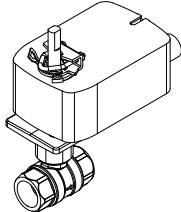
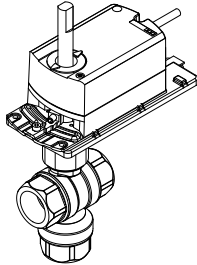
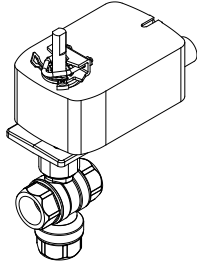
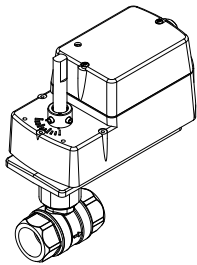
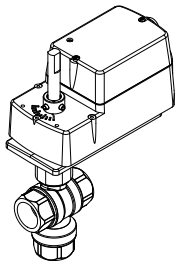
a) $Cv = \frac{gpm}{\sqrt{\Delta P}}$ (where ΔP is measured in psi) $kvs = \frac{Cv}{1.156}$

$kvs = \frac{m^3/h}{\sqrt{\Delta P}}$ (where ΔP 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.

Ball Valve Specifications

Table-3. Specifications for Ball Valve Assemblies

Valve Assembly Series		2-Way		3-Way Mixing	
Ball Valve Assemblies using SmartX Actuators					
	Non-Spring Return Vx-22x3-505-9-P Vx-22x3-506-9-P	Spring Return Vx-22x3-5xx-9-P	Non-Spring Return Vx-2313-505-9-P Vx-2313-506-9-P	Spring Return Vx-2313-5xx-9-P	
		Spring Return Vx-22x3-81x-9-P Vx-22x3-82x-9-P Vx-22x3-83x-9-P Non-Spring Return Vx-22x3-841-9-P		Spring Return Vx-2313-81x-9-P Vx-2313-82x-9-P Vx-2313-83x-9-P Non-Spring Return Vx-2313-841-9-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 29.		Same as close-off pressures shown in Table-5 or Table-7. Refer to "Cavitation Limitations on Valve Pressure Drop" on page 29.	
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)			

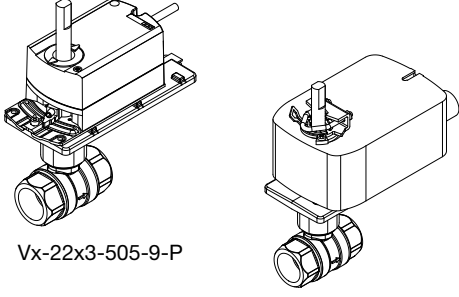
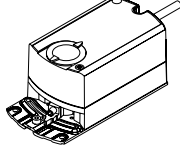
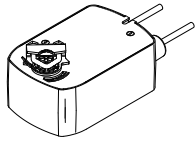
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Valve/Actuator Combinations

2-WAY BALL VALVE ASSEMBLIES USING SMARTX ACTUATORS

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

Table-4. Selection Chart—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			<p>Floating MF41-6043 (505) Proportional MS41-6043 (505)</p>	<p>Floating MF41-6083 (506) Proportional MS41-6083 (506)</p>	<p>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)</p>
			—			—	<p>120 Vac</p> <p>Two-position MA40-7040 (N.C.) (522) MA40-7040 (N.O.) (532)</p>	
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 Valve/Linkage Assembly VB-22x3-500-9-P	1/2	1, 2, 3, 4, 5, 6, 7	130 (896) (field assemble ^d)	—	130 (896) (field assemble ^d)			
	3/4	11, 12, 13, 14, 15, 16, 17, 18	130 (896) (field assemble ^d)	—	130 (896) (field assemble ^d)			
	1	21, 22, 23, 24, 25, 26, 27	100 (689)	—	100 (689) (field assemble ^d)			
	1-1/4	41, 42, 43, 44, 45, 46	70 (482)	—	70 (482)			
	1-1/2	51, 52, 53, 54	—	70 (482)	70 (482)			
	2	61, 63, 65, 66, 67	—	70 (482)	70 (482)			
	2-1/2	71, 72, 73, 74, 75, 76	—	70 (482)	70 (482)			
3	82, 85	—	70 (482)	70 (482)				

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 6.

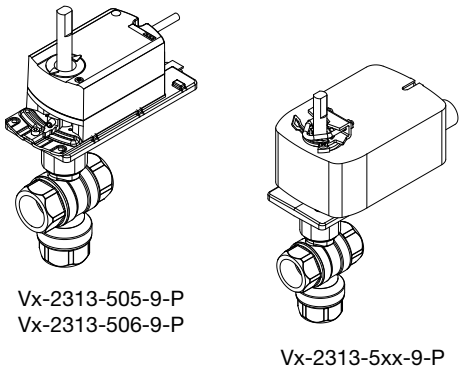
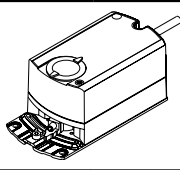
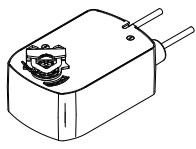
c) To determine a specific part number, identify the actuator’s control signal type (“A,” “F,” or “S”), actuator code, and P code. Refer to “Part Numbering System” on page 4.

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 BALL VALVE 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. Selection Chart—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		
						<p>Floating MF41-6043 (505) Proportional MS41-6043 (505)</p>	<p>Floating MF41-6083 (506) Proportional MS41-6083 (506)</p>	<p>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)</p>
			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 Valve/Linkage Assembly VB-2313-500-9-P	1/2	1, 2, 3, 4, 5, 6	50 (344) (field assemble ^e)	—	50 (344) (field assemble ^e)			
	3/4	11, 12, 13, 14, 15, 16	50 (344) (field assemble ^e)	—	50 (344) (field assemble ^e)			
	1	21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	50 (344)	—	50 (344) (field assemble ^e)			
	1-1/4	41, 43, 44, 45, 46	40 (275)	—	40 (275))			
	1-1/2	51, 52, 53, 54, 55, 56	—	40 (275)	40 (275)			
	2	61, 62, 63, 64	—	40 (275)	40 (275)			

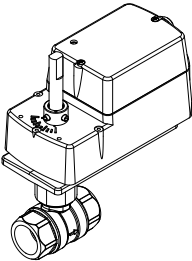
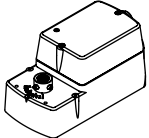
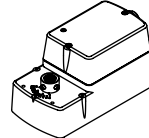
- a) Non-spring return 3-way ball valve assemblies are shipped open A to AB. For VS-2313 models, a control voltage increase will close A to AB and open B to AB
- b) Spring return, NC (normally closed), 3-way mixing valves are normally closed, A to AB. For VS-2313 models, a control voltage increase will 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 7.
- 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 5.

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.

2-WAY BALL VALVE ASSEMBLIES USING SMARTX ACTUATORS

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

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

2-Way Ball Valve Assemblies with SmartX			Non-Spring Return ^a	Spring Return
 <p>Spring Return Vx-22x3-81x-9-P Vx-22x3-82x-9-P Vx-22x3-83x-9-P</p> <p>Non-Spring Return Vx-22x3-841-9-P</p>				
			Actuator Models (Actuator Codes)	
			24 Vac	
			Floating MF4D-6083-100 (field assembly only) Proportional MS4D-6083-100 (841)	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 Valve Assembly with SmartX Vx-22x3-5xx-9-P ^c	1/2	1, 2, 3, 4, 5, 6, 7	130 (896)	130 (896)
	3/4	11, 12, 13, 14, 15, 16, 17, 18	130 (896)	130 (896)
	1	21, 22, 23, 24, 25, 26, 27	100 (689)	100 (689)
Valve/Linkage Assembly VB-22x3-500-9-P	1-1/4	41, 42, 43, 44, 45, 46	70 (482)	—
	1-1/2	51, 52, 53, 54	70 (482)	—
	2	61, 63, 65, 66, 67	70 (482)	—
	2-1/2	71, 72, 73, 74, 75, 76	70 (482)	—
	3	82, 85	70 (482)	—

a) Non-spring return 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 Assembly Dimensions" on page 24.

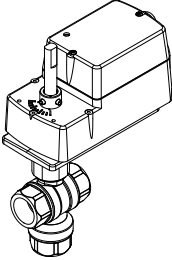
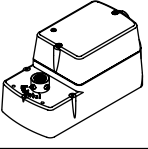
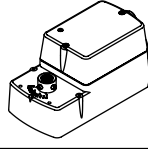
c) To determine a specific part number, identify the actuator's control signal type ("A," "F," or "S"), actuator code, and P code. Refer to "Part Numbering System" on page 4.

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 BALL VALVE 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. Selection Chart—3-Way Mixing Ball Valve Assemblies with SmartX Actuators

3-Way Mixing Ball Valve Assemblies with SmartX ^{ab}			Non-Spring Return	Spring Return
 <p>Spring Return Vx-2313-81x-9-P Vx-2313-82x-9-P Vx-2313-83x-9-P</p> <p>Non-Spring Return Vx-2313-841-9-P</p>				
			Actuator Models (Actuator Codes)	
			24 Vac	
			<p>Floating MF4D-6083-100 (field assembly only)</p> <p>Proportional MS4D-6083-100 (841)</p>	<p>Two-Position MA4D-7033-100 (N.O.) (821) MA4D-8033-100 (N.C.) (831)</p> <p>Floating MF4D-7033-100 (N.O.) (821) MF4D-8033-100 (N.C.) (831)</p> <p>Proportional MS4D-7033-100 (N.O.) (821) MS4D-8033-100 (N.C.) (831)</p>
Valve Assembly Part Number	Valve Size (in.)	P Code ^c	Close-Off Pressure, psi (kPa)	
Ball Valve Assembly with SmartX Vx-2313-8xx-9-P ^d	1/2	1, 2, 3, 4, 5, 6	50 (344)	50 (344)
	3/4	11, 12, 13, 14, 15, 16	50 (344)	50 (344)
	1	21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	50 (344)	50 (344)
Valve/Linkage Assembly VB-2313-500-9-P	1-1/4	41, 43, 44, 45, 46	40 (275)	—
	1-1/2	51, 52, 53, 54, 55, 56	40 (275)	—
	2	61, 62, 63, 64	40 (275)	—

- a) Non-spring return, NO (normally open), 3-way ball valve assemblies are shipped open A to AB. For VS-2313, 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 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 7.
- 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 5.

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.

Actuator Specifications and Valve Assembly Mounting Dimensions

VALVE ASSEMBLIES WITH MF41-6043, MF41-6083, MS41-6043, AND MS41-6083 NON-SPRING RETURN 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 rowspan="2">24 Vac +20/-15%</td> <td>2.3</td> <td>—</td> <td>2.0</td> </tr> <tr> <td>MS41-6043 and MS41-6083</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/-15%	2.3	—	2.0	MS41-6043 and MS41-6083	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/-15%	2.3	—	2.0															
MS41-6043 and MS41-6083		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 <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> 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°	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: 35 lb-in. (4 N-m) for Mx41-6043; 70 lb-in. (8 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).																		

2-Way Ball Valve Assembly Dimensions

Table-9. 2-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 1			
			A	B	C	D
2-Way VF-22x3-505-9-P VF-22x3-506-9-P VS-22x3-505-9-P VS-22x3-506-9-P	1/2	1, 2, 3, 4, 5, 7	2-3/8 (60)	7 (178)	8-1/4 (210)	3-1/8 (79)
		6	2-5/8 (67)	7 (178)	8-1/2 (216)	3-3/8 (86)
	3/4	11, 12, 13, 14, 15, 17	2-7/16 (62)	7 (178)	8-1/4 (210)	3-1/4 (83)
		16, 18	2-3/4 (70)	7 (178)	8-1/2 (216)	3-3/8 (86)
	1	21, 23	3-1/16 (78)	7 (178)	8-7/8 (225)	3-5/8 (92)
		22, 25	2-3/4 (70)	7 (178)	8-1/2 (216)	3-3/8 (86)
		24, 26	4-1/2 (114)	7-3/8 (187)	9-3/8 (238)	3-7/8 (98)
		27	3 (76)	7 (178)	8-7/8 (225)	3-5/8 (92)
	1-1/4	41, 42, 43, 45	3 (76)	7 (178)	8-7/8 (225)	3-5/8 (92)
		44, 46	3-5/8 (92)	7-1/8 (181)	9-3/8 (238)	3-3/4 (95)
	1-1/2	51, 53	3-7/16 (87)	7-1/8 (181)	9-3/8 (238)	3-3/4 (95)
		52, 54	4-1/16 (103)	7-1/4 (184)	9-7/8 (251)	4-1/16 (103)
	2	61, 65	3-15/16 (100)	7-1/4 (184)	9-7/8 (251)	4 (102)
		63, 66, 67	4-15/16 (125)	7-3/4 (197)	10-1/2 (267)	4-7/16 (113)
	2-1/2	71, 72, 76, 73, 74, 75	5-3/8 (137)	8 (203)	10-3/4 (273)	4-1/2 (114)
	3	82, 85	5-11/16 (144)	8-1/8 (206)	10-11/16 (271)	4-1/4 (108)

a) To find the corresponding flow coefficients for these port codes, refer to "2-Way Ball Valve Assemblies with SmartX Actuators" on page 6.

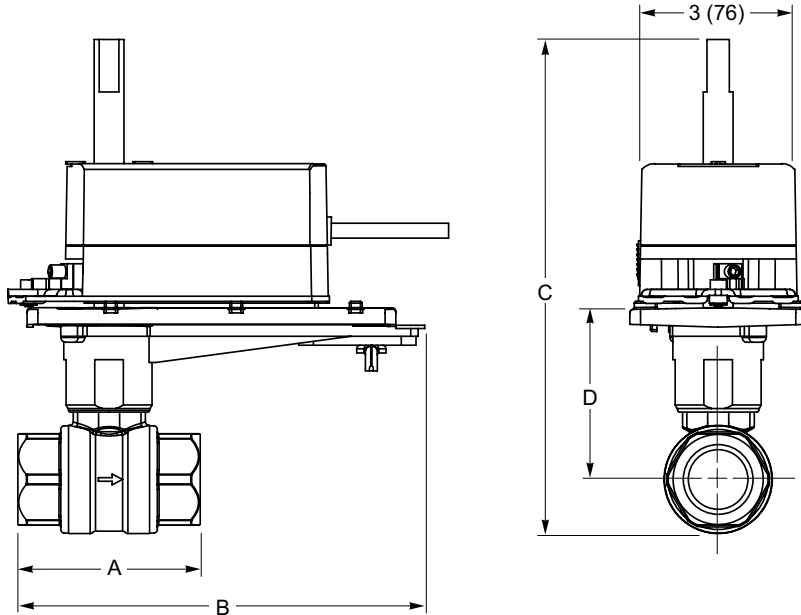


Figure 1. Mx41-6043 or Mx41-6083 with 2-Way Ball Valve.

3-Way Mixing Ball Valve Assembly Dimensions

Table-10. 3-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 2				
			A	B	C	D	E
3-Way VF-2313-505-9-P VF-2313-506-9-P VS-2313-505-9-P VS-2313-506-9-P	1/2	1, 2, 3, 4, 5, 6	2-5/8 (67)	7 (178)	9-3/4 (248)	3-5/16 (84)	2 (51)
	3/4	11, 12, 13, 14, 15, 16	2-3/4 (70)	7 (178)	9-3/4 (248)	3-1/4 (83)	2 (51)
	1	21, 22, 23, 24, 25, 28	2-3/4 (70)	7 (178)	9-13/16 (249)	3-1/4 (83)	2-1/8 (54)
			4-1/4 (108)	7-3/8 (187)	11-5/8 (295)	3-5/8 (92)	3-1/16 (78)
		26, 29, 31	4-1/4 (108)	7-1/2 (191)	11-1/2 (292)	3-1/2 (89)	3-1/8 (79)
	1-1/4	45	3 (76)	7 (178)	10-5/8 (270)	3-5/8 (92)	2-3/8 (60)
		41, 43, 44, 46	3-5/8 (92)	7-1/8 (181)	10-7/8 (276)	3-1/2 (89)	2-3/4 (70)
	1-1/2	51, 52, 53, 55	3-5/8 (92)	7-1/8 (181)	10-7/8 (276)	3-5/8 (92)	2-3/4 (70)
		54	4 (102)	7-1/4 (184)	11-3/4 (298)	4 (102)	3-1/4 (83)
		56	4 (102)	7-3/4 (197)	11-3/4 (298)	4 (102)	3-1/4 (83)
	2	61, 63	3-15/16 (100)	7-1/4 (184)	11-3/4 (298)	3-7/8 (98)	3-1/16 (78)
		62, 64	4-7/8 (124)	7-3/4 (197)	12-11/16 (322)	4-1/2 (114)	3-7/8 (98)

a) To find the corresponding flow coefficients for these port codes, refer to "3-Way Ball Valve Assemblies with SmartX Actuators" on page 7.

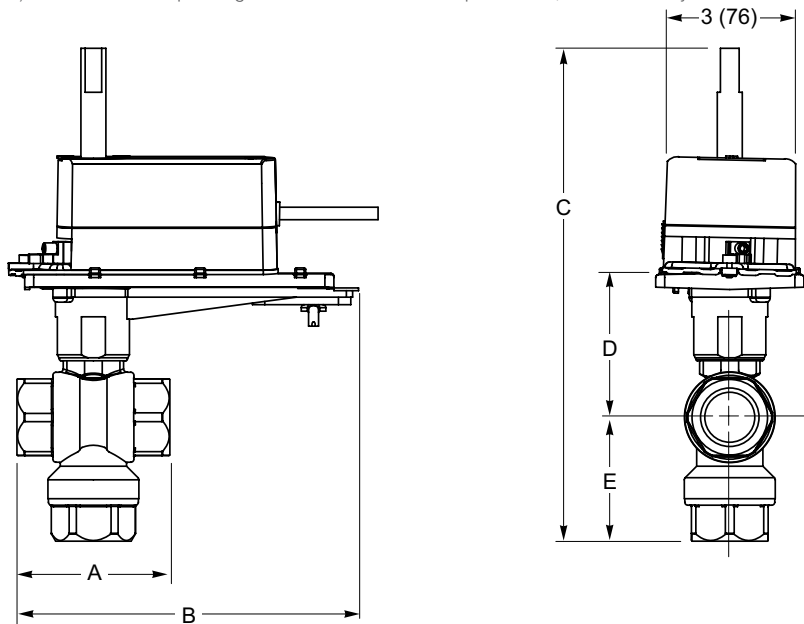


Figure 2. Mx41-6043 or Mx41-6083 with 3-Way Ball Valve.

VALVE ASSEMBLIES WITH MF4D-6083 AND MS4D-6083 NON-SPRING RETURN SMARTX ACTUATORS

Table-11. Actuator Specifications

Inputs							
Control Signal and Power Requirements	Part Number	Control Signal	Voltage	Actuator Power Input			
				Running			Holding
				50/60 Hz		DC Amps	50/60 Hz
				VA	W		W
				MF4D-6083-100	Floating	24 Vac ±20% or 20 to 30 Vdc	5.9
MS4D-6083-100	2 to 10 Vdc Proportional	5.2	2.7	0.10	1.4		
MS4D-6083-120	0 to 3 Vdc Proportional						
MS4D-6083-130	6 to 9 Vdc Proportional						
MS4D-6083-150	0 to 10 Vdc Proportional						
MS4D-6083-160	4 to 20 mAdc Proportional						
Connections		Mx4D-6083-1x0: 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		<p>Timing: Approx. 85 sec. at 70 °F (21 °C), measured with no load applied to actuator.</p> <p>Position Feedback Voltage: For 0 to 3 Vdc, 6 to 9 Vdc, 0 to 10 Vdc, and 2 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.</p>					
Mechanical		<p>Stroke: 93° nominal.</p> <p>Manual override: Allows positioning of valve shaft, using a manual crank..</p> <p>Output torque rating: 70 lb-in (8 N-m).</p> <p>RA/DA Jumper (Proportional Models): Permits selection of reverse acting or direct acting control.</p> <p>Position indicator: Visual indicator.</p>					
Environment							
Temperature Limits		<p>Shipping and storage: -40 to 158 °F (-40 to 70 °C) ambient.</p> <p>Operating: -22 to 140 °F (-30 to 60 °C) ambient.</p> <p>NOTE: Check the valve operating temperature limit. The minimum valve temperature limit is 20 °F (6.7 °C)</p>					
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 C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.					

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2-Way Ball Valve Assembly Dimensions

Table-12. 2-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 3			
			A	B	C	D
2-Way VF-22x3-841-9-P VS-22x3-841-9-P	1/2	1, 2, 3, 4, 5, 7	2-3/8 (60)	8-1/4 (210)	8-1/4 (210)	3-1/8 (79)
		6	2-5/8 (67)	8-1/4 (210)	8-1/2 (216)	3-3/8 (86)
	3/4	11, 12, 13, 14, 15, 17	2-7/16 (62)	8-1/4 (210)	8-1/4 (210)	3-1/4 (83)
		16, 18	2-3/4 (70)	8-1/4 (210)	8-1/2 (216)	3-3/8 (86)
	1	21, 23	3-1/16 (78)	8-1/4 (210)	8-7/8 (225)	3-5/8 (92)
		22, 25	2-3/4 (70)	8-1/4 (210)	8-1/2 (216)	3-3/8 (86)
		24, 26	4-1/2 (114)	8-7/8 (225)	9-3/8 (238)	3-7/8 (98)
		27	3 (76)	8-1/4 (210)	8-7/8 (225)	3-5/8 (92)
	1-1/4	41, 42, 43, 45	3 (76)	8-1/4 (210)	8-7/8 (225)	3-5/8 (92)
		44, 46	3-5/8 (92)	8-5/8 (219)	9-3/8 (238)	3-3/4 (95)
	1-1/2	51, 53	3-7/16 (87)	8-5/8 (219)	9-3/8 (238)	3-3/4 (95)
		52, 54	4-1/16 (103)	8-3/4 (222)	9-7/8 (251)	4-1/16 (103)
	2	61, 65	3-15/16 (100)	8-3/4 (222)	9-7/8 (251)	4 (102)
		63, 66, 67	4-15/16 (125)	9-1/4 (235)	10-1/2 (267)	4-7/16 (113)
	2-1/2	71, 72, 76, 73, 74, 75	5-3/8 (137)	9-1/2 (241)	10-3/4 (273)	4-1/2 (114)
		82, 85	5-11/16 (144)	9-5/8 (244)	10-11/16 (271)	4-1/4 (108)

a) To find the corresponding flow coefficients for these port codes, refer to "2-Way Ball Valve Assemblies with SmartX Actuators" on page 6..

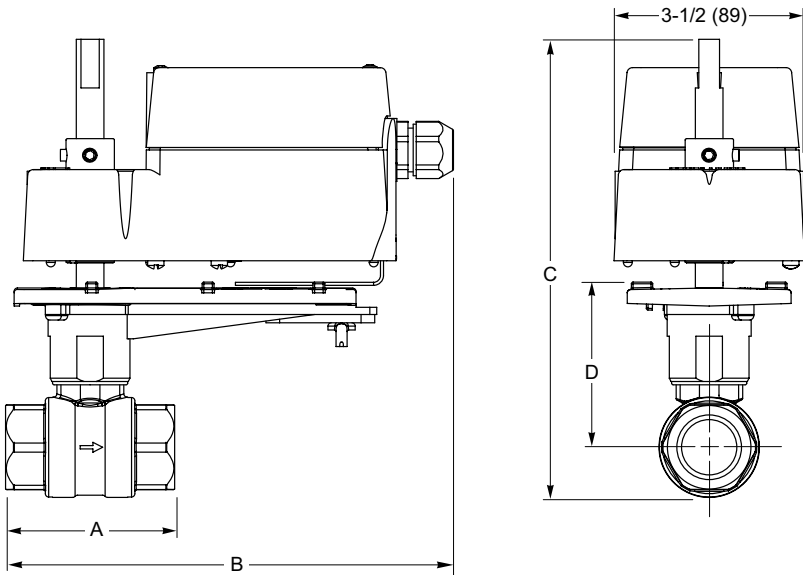


Figure 3. MF4D-6083-100, MS4D-6083-100 with 2-Way Ball Valve.

3-Way Mixing Ball Valve Assembly Dimensions

Table-13. 3-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 4				
			A	B	C	D	E
3-Way VF-2313-841-9-P VS-2313-841-9-P	1/2	1, 2, 3, 4, 5, 6	2-5/8 (67)	8-1/2 (216)	9-3/4 (248)	3-5/16 (84)	2 (51)
	3/4	11, 12, 13, 14, 15, 16	2-3/4 (70)	8-1/2 (216)	9-3/4 (248)	3-1/4 (83)	2 (51)
	1	21, 22, 23, 24, 25, 28	2-3/4 (70)	8-1/2 (216)	9-13/16 (249)	3-1/4 (83)	2-1/8 (54)
			4-1/4 (108)	8-7/8 (225)	11-5/8 (295)	3-5/8 (92)	3-1/16 (78)
		26, 29, 31	4-1/4 (108)	9 (229)	11-1/2 (292)	3-1/2 (89)	3-1/8 (79)
	1-1/4	45	3 (76)	8-1/2 (216)	10-5/8 (270)	3-5/8 (92)	2-3/8 (60)
		41, 43, 44, 46	3-5/8 (92)	8-5/8 (219)	10-7/8 (276)	3-1/2 (89)	2-3/4 (70)
	1-1/2	51, 52, 53, 55	3-5/8 (92)	8-5/8 (219)	10-7/8 (276)	3-5/8 (92)	2-3/4 (70)
		54	4 (102)	8-3/4 (222)	11-3/4 (298)	4 (102)	3-1/4 (83)
		56	4 (102)	9-1/4 (235)	11-3/4 (298)	4 (102)	3-1/4 (83)
	2	61, 63	3-15/16 (100)	8-3/4 (222)	11-3/4 (298)	3-7/8 (98)	3-1/16 (78)
		62, 64	4-7/8 (124)	9-1/4 (235)	12-11/16 (322)	4-1/2 (114)	3-7/8 (98)

a) To find the corresponding flow coefficients for these port codes, refer to "3-Way Ball Valve Assemblies with SmartX Actuators" on page 7.

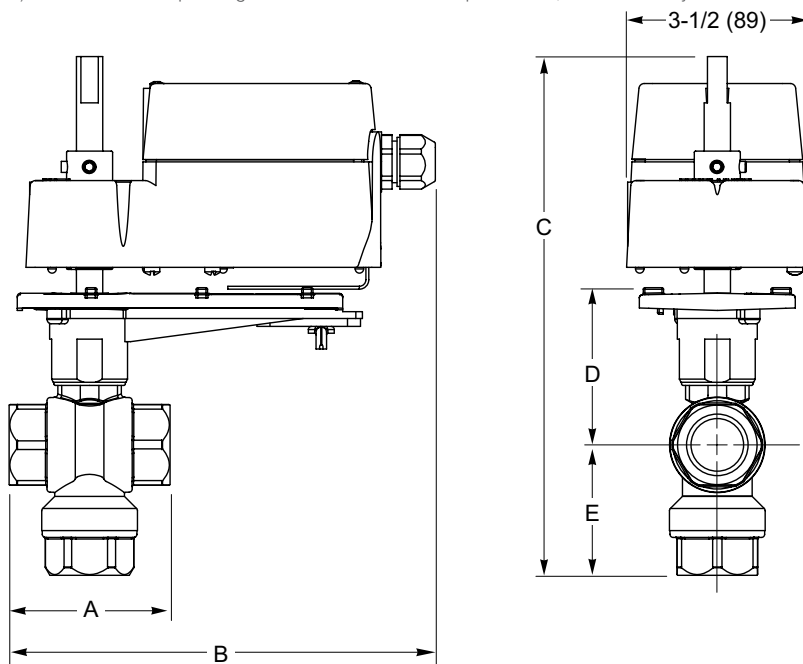


Figure 4. MF4D-6083-100, MS4D-6083-100 with 3-Way Ball Valve.

VALVE ASSEMBLIES WITH MX40-704X SPRING RETURN SMARTX ACTUATORS

Table-14. 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.			
Mechanical	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.).								
	Stroke: Angle of rotation is limited to a maximum of 95°, with mechanical stop.								
	Output torque rating: Mx40-704x — 35 lb-in (4 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 C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.								

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2-Way Ball Valve Assembly Dimensions

Table-15. 2-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 5			
			A	B	C	D
2-Way VA-22x3-522-9-P VA-22x3-526-9-P VA-22x3-532-9-P VA-22x3-536-9-P VF-22x3-526-9-P VF-22x3-536-9-P VS-22x3-526-9-P VS-22x3-536-9-P	1/2	1, 2, 3, 4, 5, 7	2-3/8 (60)	7-3/8 (187)	8-1/4 (210)	3-1/8 (79)
		6	2-5/8 (67)	7-3/8 (187)	8-1/2 (216)	3-3/8 (86)
	3/4	11, 12, 13, 14, 15, 17	2-7/16 (62)	7-3/8 (187)	8-1/4 (210)	3-1/4 (83)
		16, 18	2-3/4 (70)	7-3/8 (187)	8-1/2 (216)	3-3/8 (86)
	1	21, 23	3-1/16 (78)	7-3/8 (187)	8-7/8 (225)	3-5/8 (92)
		22, 25	2-3/4 (70)	7-3/8 (187)	8-1/2 (216)	3-3/8 (86)
		24, 26	4-1/2 (114)	8 (203)	9-3/8 (238)	3-7/8 (98)
		27	3 (76)	7-3/8 (187)	8-7/8 (225)	3-5/8 (92)
	1-1/4	41, 42, 43, 45	3 (76)	7-3/8 (187)	8-7/8 (225)	3-5/8 (92)
		44, 46	3-5/8 (92)	7-3/4 (197)	9-3/8 (238)	3-3/4 (95)
	1-1/2	51, 53	3-7/16 (87)	7-3/4 (197)	9-3/8 (238)	3-3/4 (95)
		52, 54	4-1/16 (103)	7-7/8 (200)	9-7/8 (251)	4-1/16 (103)
	2	61, 65	3-15/16 (100)	7-7/8 (200)	9-7/8 (251)	4 (102)
		63, 66, 67	4-15/16 (125)	8-3/8 (123)	10-1/2 (267)	4-7/16 (113)
	2-1/2	71, 72, 76, 73, 74, 75	5-3/8 (137)	8-5/8 (219)	10-3/4 (273)	4-1/2 (114)
		3	82, 85	5-11/16 (144)	8-3/4 (222)	10-11/16 (271)

a) To find the corresponding flow coefficients for these port codes, refer to "2-Way Ball Valve Assemblies with SmartX Actuators" on page 6.

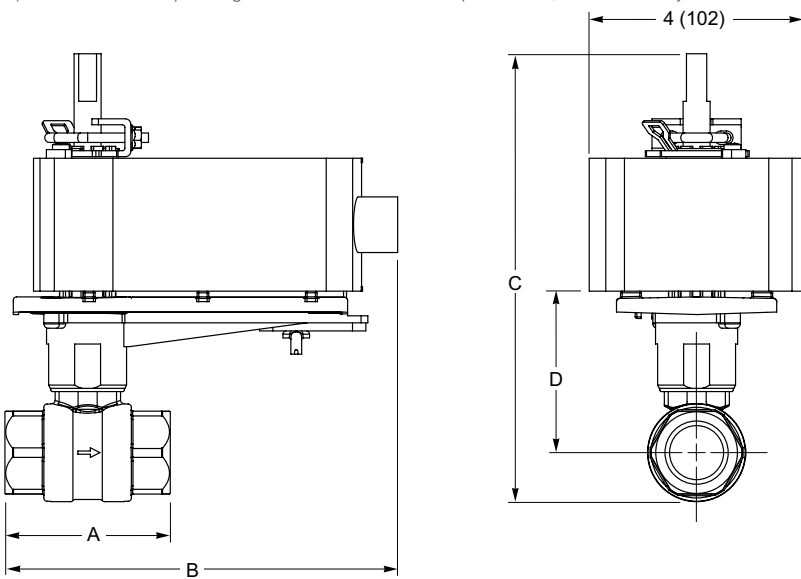


Figure 5. Mx40-704x with 2-Way Ball Valve.

3-Way Mixing Ball Valve Assembly Dimensions

Table-16. 3-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 6					
			A	B	C	D	E	
3-Way VA-2313-526-9-P VA-2313-536-9-P VF-2313-526-9-P VF-2313-536-9-P VS-2313-526-9-P VS-2313-536-9-P	1/2	1, 2, 3, 4, 5, 6	2-5/8 (67)	7-3/8 (187)	9-3/4 (248)	3-5/16 (84)	2 (51)	
	3/4	11, 12, 13, 14, 15, 16	2-3/4 (70)	7-3/8 (187)	9-3/4 (248)	3-1/4 (83)	2 (51)	
	1	21, 22, 23, 24, 25, 28	2-3/4 (70)	7-3/8 (187)	9-13/16 (249)	3-1/4 (83)	2-1/8 (54)	
			27, 30	4-1/4 (108)	8 (203)	11-5/8 (295)	3-5/8 (92)	3-1/16 (78)
	1-1/4	45	4-1/4 (108)	8-1/8 (206)	11-1/2 (292)	3-1/2 (89)	3-1/8 (79)	
			41, 43, 44, 46	3-5/8 (92)	7-3/4 (197)	10-7/8 (276)	3-1/2 (89)	2-3/4 (70)
	1-1/2	51, 52, 53, 55	3-5/8 (92)	7-3/4 (197)	10-7/8 (276)	3-5/8 (92)	2-3/4 (70)	
			54	4 (102)	7-7/8 (200)	11-3/4 (298)	4 (102)	3-1/4 (83)
			56	4 (102)	8-3/8 (213)	11-3/4 (298)	4 (102)	3-1/4 (83)
	2	61, 63	3-15/16 (100)	7-7/8 (200)	11-3/4 (298)	3-7/8 (98)	3-1/16 (78)	
			62, 64	4-7/8 (124)	8-3/8 (213)	12-11/16 (322)	4-1/2 (114)	3-7/8 (98)

a) To find the corresponding flow coefficients for these port codes, refer to "3-Way Ball Valve Assemblies with SmartX Actuators" on page 7.

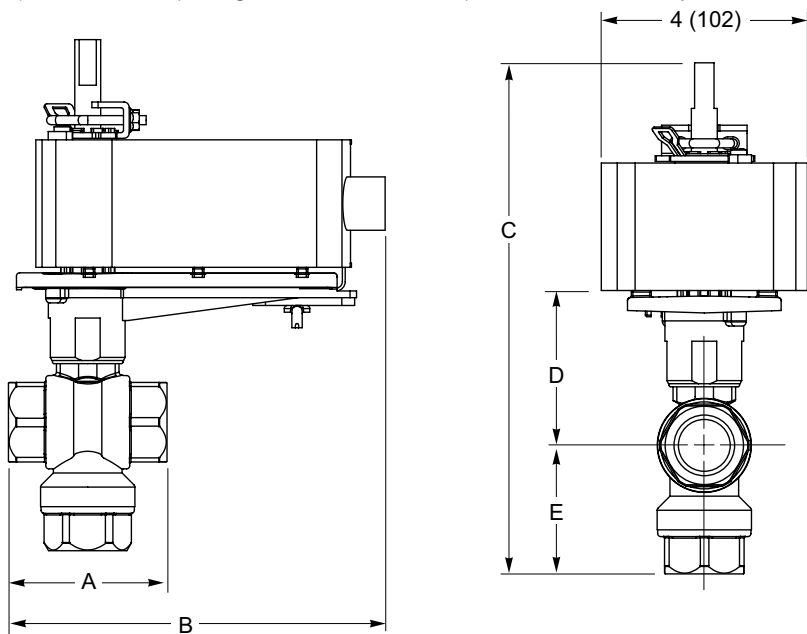


Figure 6. Mx40-704x with 3-Way Ball Valve.

VALVE ASSEMBLIES WITH MX4D-7033 AND MX4D-8033 SPRING RETURN SMARTX ACTUATORS

Table-17. 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		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							
	MA4D-8033-100		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.						

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VALVE ASSEMBLIES WITH MX4D-7033 AND MX4D-8033 SPRING RETURN SMARTX ACTUATORS

Continued

Inputs	
	Position indicator: Visual indicator.
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 C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.

2-Way Ball Valve Assembly Dimensions

Table-18. 2-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 7			
			A	B	C	D
2-Way VA-22x3-815-9-P VA-22x3-817-9-P VA-22x3-821-9-P VA-22x3-831-9-P	1/2	1, 2, 3, 4, 5, 7	2-3/8 (60)	8-1/4 (210)	8-1/4 (210)	3-1/8 (79)
		6	2-5/8 (67)	8-1/4 (210)	8-1/2 (216)	3-3/8 (86)
	3/4	11, 12, 13, 14, 15, 17	2-7/16 (62)	8-1/4 (210)	8-1/4 (210)	3-1/4 (83)
		16, 18	2-3/4 (70)	8-1/4 (210)	8-1/2 (216)	3-3/8 (86)
VF-22x3-821-9-P VF-22x3-831-9-P	1	21, 23	3-1/16 (78)	8-1/4 (210)	8-7/8 (225)	3-5/8 (92)
		22, 25	2-3/4 (70)	8-1/4 (210)	8-1/2 (216)	3-3/8 (86)
VS-22x3-821-9-P VS-22x3-831-9-P	1	24, 26	4-1/2 (114)	8-7/8 (225)	9-3/8 (238)	3-7/8 (98)
		27	3 (76)	8-1/4 (210)	8-7/8 (225)	3-5/8 (92)

a) To find the corresponding flow coefficients for these port codes, refer to "2-Way Ball Valve Assemblies with SmartX Actuators" on page 6..

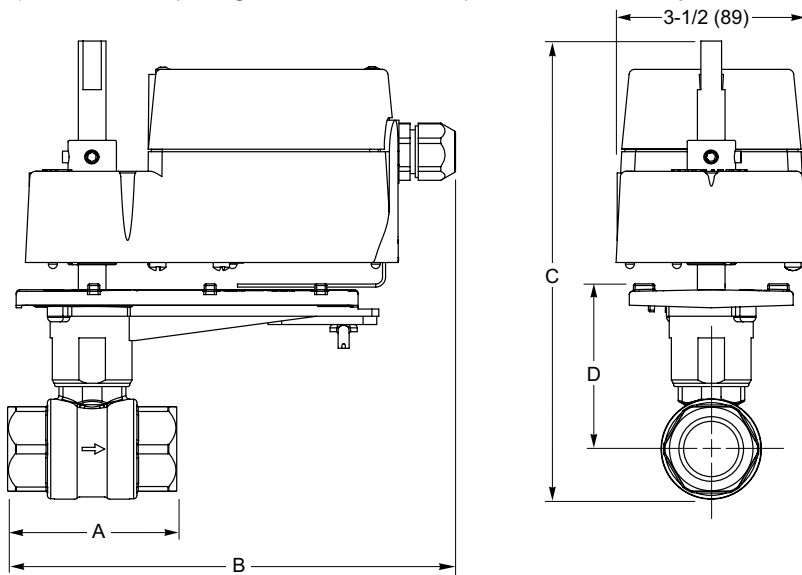


Figure 7. MA4D-7033, MF4D-7033, MS4D-7033, MA4D-8033, MF4D-8033, or MS4D-8033 with 2-Way Ball Valve.

3-Way Mixing Ball Valve Assembly Dimensions

Table-19. 3-Way Ball Valve Assembly Dimensions

Valve Assembly Part Number	Valve Size in.	P Code ^a	Valve Dimensions in inches (millimetres) Refer to Figure 8				
			A	B	C	D	E
3-Way VA-2313-815-9-P	1/2	1, 2, 3, 4, 5, 6	2-5/8 (67)	8-1/2 (216)	9-3/4 (248)	3-5/16 (84)	2 (51)
VA-2313-817-9-P VA-2313-821-9-P VA-2313-831-9-P	3/4	11, 12, 13, 14, 15, 16	2-3/4 (70)	8-1/2 (216)	9-3/4 (248)	3-1/4 (83)	2 (51)
VF-2313-821-9-P VF-2313-831-9-P	1	21, 22, 23, 24, 25, 28	2-3/4 (70)	8-1/2 (216)	9-13/16 (249)	3-1/4 (83)	2-1/8 (54)
		27, 30	4-1/4 (108)	8-7/8 (225)	11-5/8 (295)	3-5/8 (92)	3-1/16 (78)
VS-2313-821-9-P VS-2313-831-9-P		26, 29, 31	4-1/4 (108)	9 (229)	11-1/2 (292)	3-1/2 (89)	3-1/8 (79)

a) To find the corresponding flow coefficients for these port codes, refer to "3-Way Ball Valve Assemblies with SmartX Actuators" on page 7.

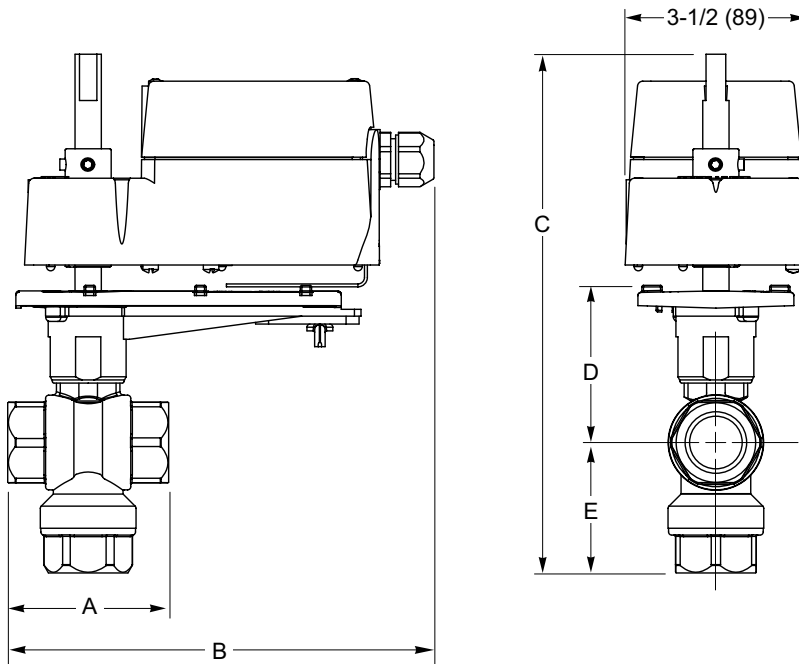


Figure 8. MA4D-7033, MF4D-7033, MS4D-7033, MA4D-8033, MF4D-8033, or MS4D-8033 with 3-Way Ball Valve.

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-xxxxSeries SmartX Rotary Overshaft Actuators General Instructions*, F-27170.

PIPING

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

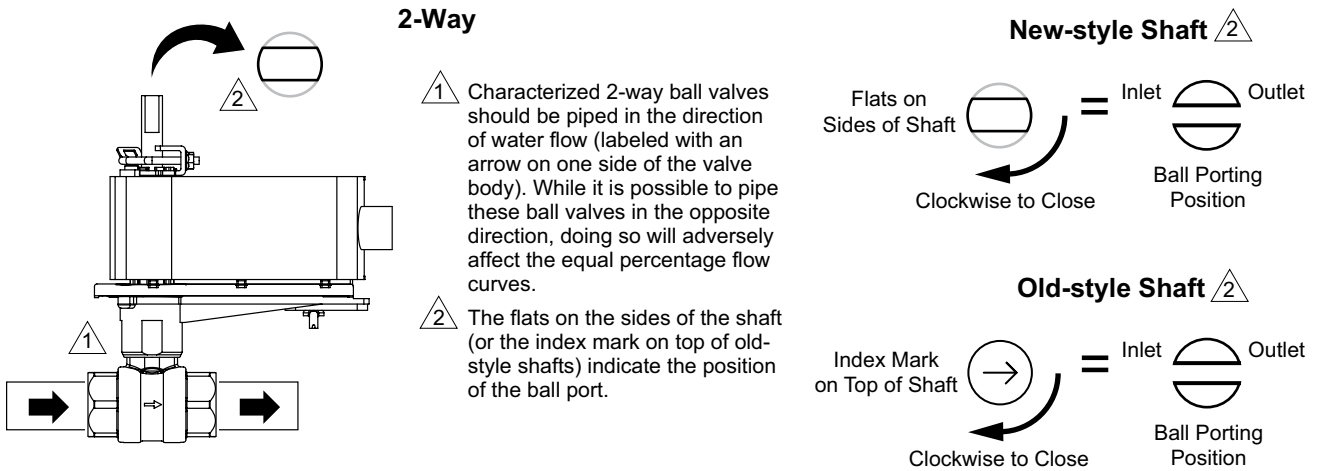


Figure 9. 2-Way Valve Assemblies Piping Diagram.

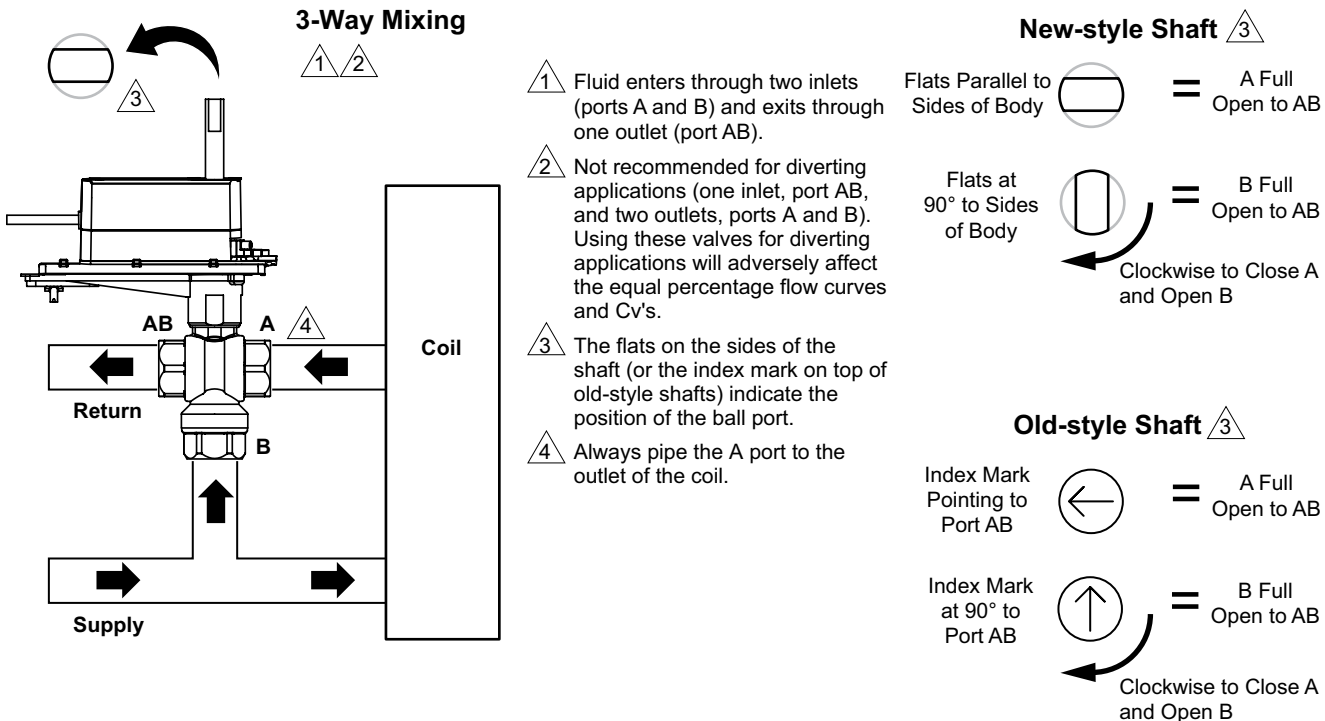


Figure 10. 3-Way Mixing Valve Assemblies Piping Diagram.

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 on page 8, page 13, page 16, page 19, and page 22.

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:

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

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).

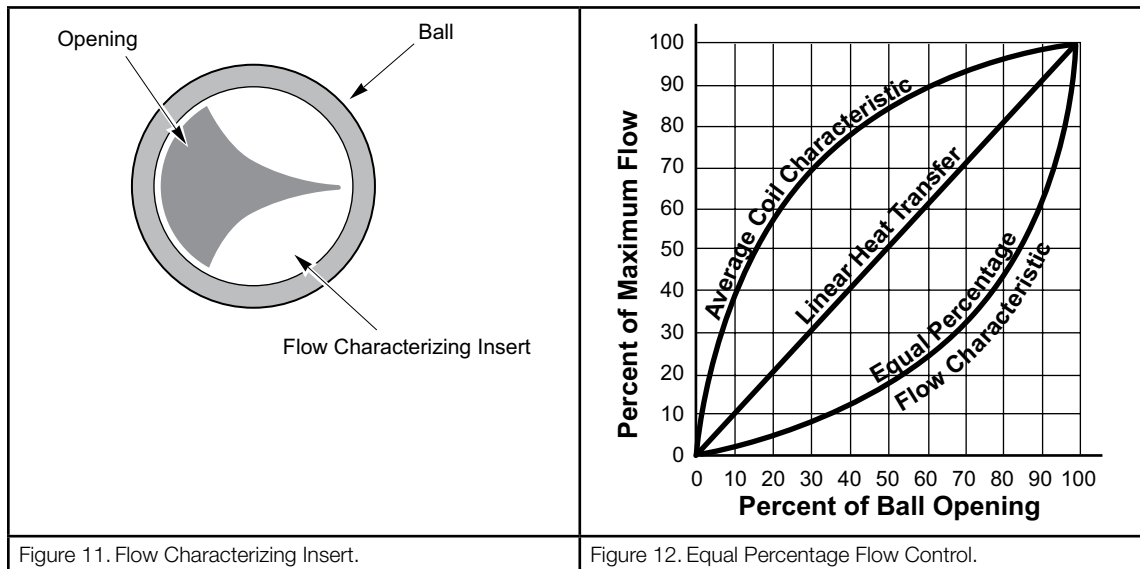
If the Cv is already known, it may be converted directly to its kvs equivalent: $kvs = \frac{Cv}{1.156}$

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 FOR PROPORTIONAL AND 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-20. 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.

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.

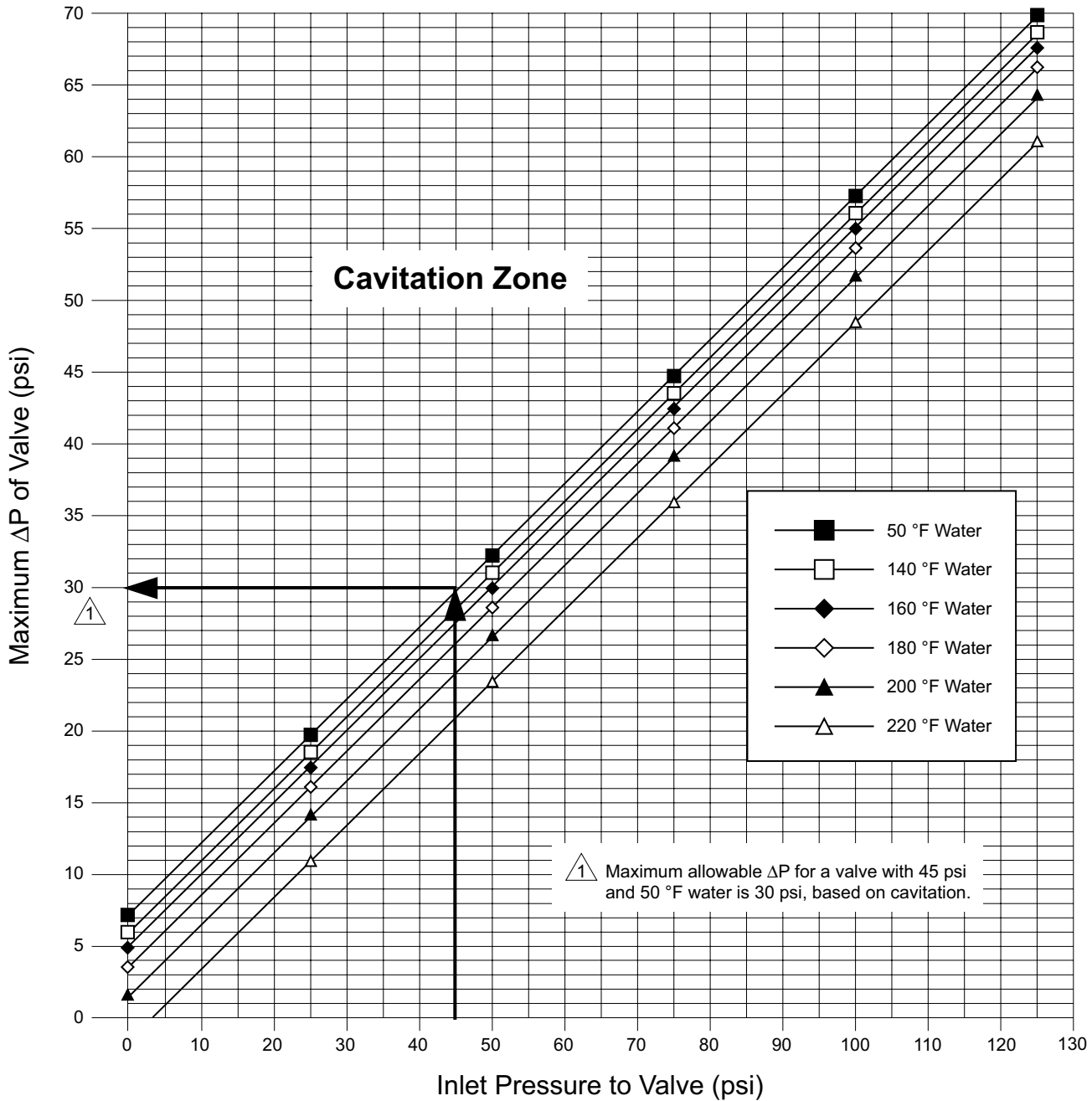


Figure 13. Maximum Allowable Differential Pressure (ΔP) for Water Valves.

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-21. 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)	—	—	—	—	—
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)	—	—	—	—

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

Estimated Effective Cv When Using Pipe Reducers with 2-Way Ball Valve Assemblies continued.

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	3	4	5
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)	—
2-1/2	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.

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-22. 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)	—
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)

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

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

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
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.

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