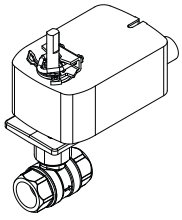
Ball Valve Assemblies with SmartX Actuators

Selection Guide

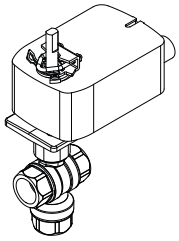
The Schneider Electric VA, VF, and VS-2xx3-xxx-9-xx series Ball Valve Assemblies are complete actuator/valve assemblies that accept two-position, floating, or proportional control signals from a DDC system or a thermostat, for control of hot or chilled water, or solutions of up to 50% glycol. They consist 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.

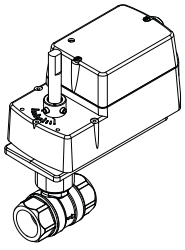


Vx-22x3-5xx-9-xx
2-Way Assembly with
Spring Return Actuator

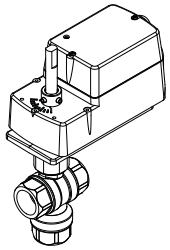


Vx-2313-5xx-9-xx
3-Way Assembly with
Spring Return Actuator

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

Contents

Ball Valve Assemblies with SmartX Actuators. 1
Ball Valve Body/Linkage Assemblies. 2
Features and Benefits 2
Ball Valve Assembly Selection Procedure 3
Applicable Literature. 3
Part Numbering System. 4
Ball Valve Assemblies Using SmartX 5xx Actuators 4
Ball Valve Assemblies Using SmartX 8xx Actuators 5
Port Codes. 6
2-Way Ball Valve Assemblies with SmartX Actuators 6
3-Way Ball Valve Assemblies with SmartX Actuators 7
Ball Valve Specifications. 8
Valve/Actuator Combinations. 9
2-Way Ball Valve Assemblies Using SmartX Actuators 9
3-Way Mixing Assemblies Using SmartX Actuators 10
2-Way Ball Valve Assemblies Using SmartX Actuators 11
3-Way Mixing Assemblies Using SmartX Actuators 12
Actuator Specs and Valve Assembly Mounting Dimensions. 13
Assemblies with MF/Ms41-6043/83 NSR SmartX Actuators 13
Assemblies with MF/MS 4D-6083 NSR SmartX Actuators 16
Assemblies with Mx40-704x SR SmartX Actuators 19
Assemblies with Mx4D-7033/8033 SR SmartX Actuators 22
Assemblies with Mx4D-7033/8033 SR SmartX Actuators 23
Installation Considerations. 26
Mounting Angle of Valve Assembly 26
Piping 26
Water System Maintenance 27
Sizing and Selection 27
Two-position Control 27
Flow Characterization: Proportional/Floating Control 28
3-Way Mixing Valves 28
Cavitation Limitations on Valve Pressure Drop 29
Using Pipe Reducers with 2-Way Ball Valve Assemblies 30
Using Pipe Reducers with 3-Way Ball Valve Assemblies 33

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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.

Document Number: F-27086-11

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.
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

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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

Actuator Code △1 △2				Valves Used On △3					
				1/2 to 1"		1-1/4"		1-1/2" to 3"	1-1/2" to 2"
Model	Code	Normal Position	Voltage	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

△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.

[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.

Document Number: F-27086-11

Ball Valve Assemblies Using SmartX 8xx Actuators

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

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 Steel 3

Connection
3 = Threaded NPT

Port Code
Refer to separate Port Code table

Actuator Code 1 2					Valves Used On 3			
					1/2" to 1"		1-1/4" to 3"	1-1/4" to 2"
Model[a]	**Code**	**Normal Position**	**Voltage**	**Type**	**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**							

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.

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.

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
	18	28.6[b]	24.7
1	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
	27	54.2[b]	46.9
1-1/4	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
	46	102.3[b]	88.5
1-1/2	51	22.8	19.7
	52	41.3	35.7
	53	73.9[b]	63.9
	54	171.7[b]	148.5
2	61	41.7	36.1
	63	71.1	61.5
	65	108[b]	93.4
	66	210	181.7
	67	266[b]	230.1
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.

Document Number: F-27086-11

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

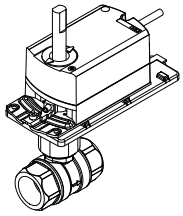
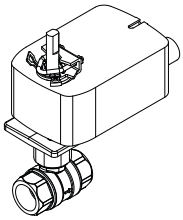
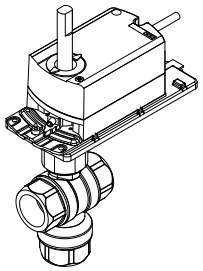
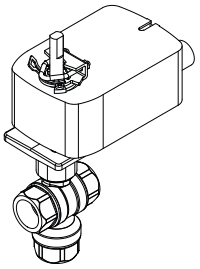
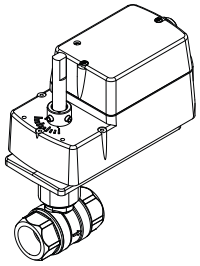
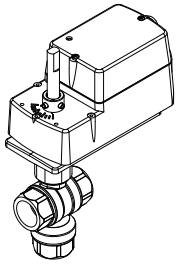
$kvs = \frac{m^3/h}{\sqrt{\Delta P}}$ (where ΔP is measured in bar; 1 bar = 100 kPa)

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)	

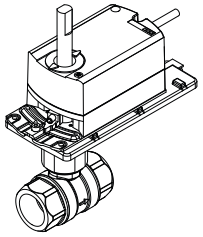
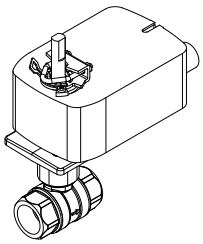
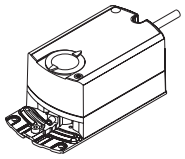
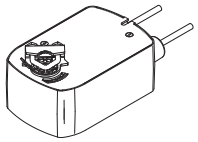
Document Number: F-27086-11

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
 Vx-22x3-505-9-P  Vx-22x3-5xx-9-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] 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.

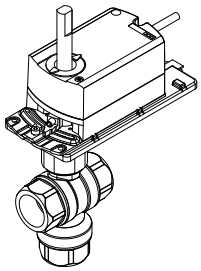
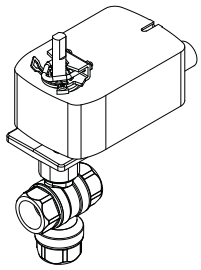
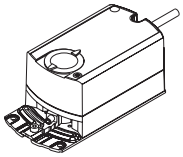
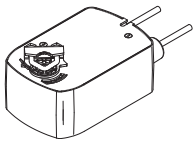
c) To determine a specific part number, identify the actuator's control signal type ("A," "F," or "S"), actuator code, and P code. Refer to "Part Numbering System" on page 4.

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 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
 Vx-2313-505-9-P Vx-2313-506-9-P  Vx-2313-5xx-9-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] 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.

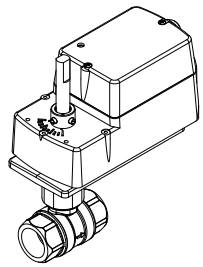
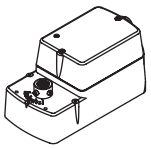
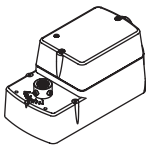
Note: Not all model configurations are available as factory assemblies. You can purchase the the actuator and a VB-22x3-500-9-xx valve body and linkage separately for field assembly.

Document Number: F-27086-11

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
 **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				
			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] Valve/Linkage Assembly VB-22x3-500-9-P	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)
	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.

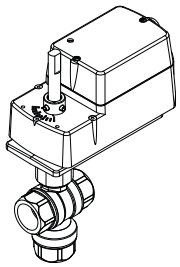
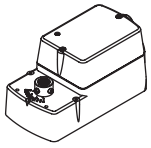
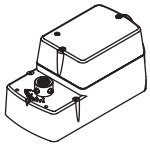
c) To determine a specific part number, identify the actuator’s control signal type (“A,” “F,” or “S”), actuator code, and P code. Refer to “Part Numbering System” on page 4.

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 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	
 **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					
			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) MS4D-8033-100 (N.C.) (831)	Two-Position MA4D-7030-100 (N.O.) (815) MA4D-8030-100 (N.C.) (817)
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] Valve/Linkage Assembly VB-2313-500-9-P	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)	
	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.

Document Number: F-27086-11

Actuator Specs and Valve Assembly Mounting Dimensions

Assemblies with MF/Ms41-6043/83 NSR SmartX Actuators

Table-8. Actuator Specifications

<table>
<tr><td colspan="2">Inputs</td><td></td></tr>
<tr><td></td><td>Control Signal</td><td>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</td></tr>
<tr><td></td><td>Power Requirements</td><td>All 24 Vac circuits are Class 2.
<table>
<tr><td rowspan="2">Part Number</td><td colspan="4">Power Input @ 50/60 Hz</td></tr>
<tr><td>Voltage</td><td>Running VA</td><td>Holding VA</td><td>Watts</td></tr>
<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>
</table></td></tr>
<tr><td></td><td>Connections</td><td>3 ft. (0.9 m) long, 18 AWG plenum-rated leads.</td></tr>
<tr><td colspan="2">Motor Type</td><td>Synchronous</td></tr>
<tr><td colspan="2">Outputs</td><td></td></tr>
<tr><td></td><td>Electrical</td><td>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
DC Rating: 12 to 30 Vdc, DC 2 A
Switch hysteresis: 3° rotation
<table>
<tr><td rowspan="3">Timing:</td><td rowspan="2">Part Number</td><td colspan="2">90° Timing in Sec.</td></tr>
<tr><td>At 60 Hz</td><td>At 50 Hz</td></tr>
<tr><td>MF41-6043
MS41-6043</td><td>90</td><td>108</td></tr>
<tr><td>MF41-6083
MS41-6083</td><td>125</td><td>150</td></tr>
</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°</td></tr>
<tr><td></td><td>Mechanical</td><td>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).</td></tr>
<tr><td colspan="2">Environment</td><td></td></tr>
<tr><td></td><td>Temperature Limits</td><td>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)</td></tr>
<tr><td></td><td>Humidity</td><td>5 to 95% RH, non-condensing.</td></tr>
<tr><td></td><td>Locations</td><td>NEMA Type 2 (IEC IP54).</td></tr>
<tr><td colspan="2">Agency Listings (Actuator)</td><td></td></tr>
<tr><td></td><td>UL</td><td>UL-873, Underwriters Laboratories.</td></tr>
<tr><td></td><td>cUL</td><td>Canadian Standards C22.2 No. 24-93.</td></tr>
<tr><td></td><td>European Community</td><td>EMC Directive (89/336/EEC). Emissions (EN50081-1). Immunity (EN50081-2).</td></tr>
</table>

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.

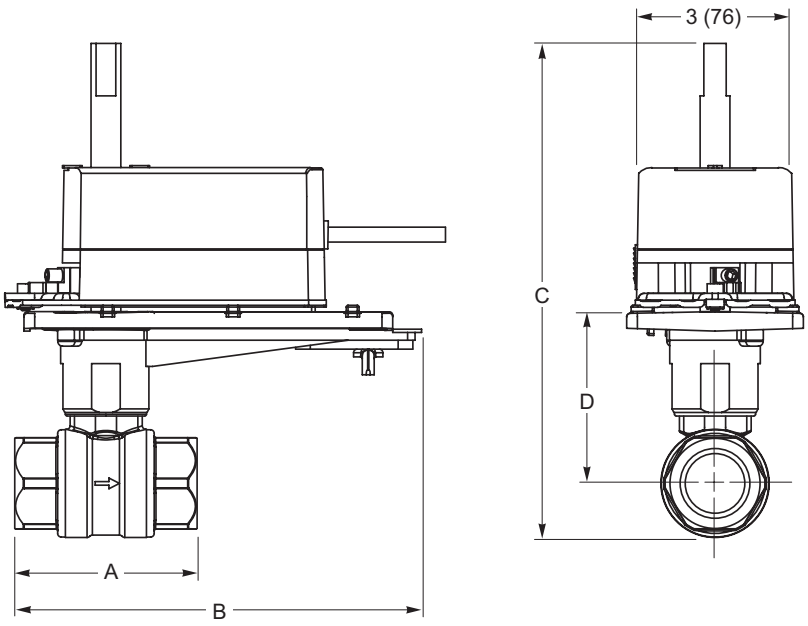


Figure 1. Mx41-6043 or Mx41-6083 with 2-Way Ball Valve.

Document Number: F-27086-11

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)
		27, 30	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.

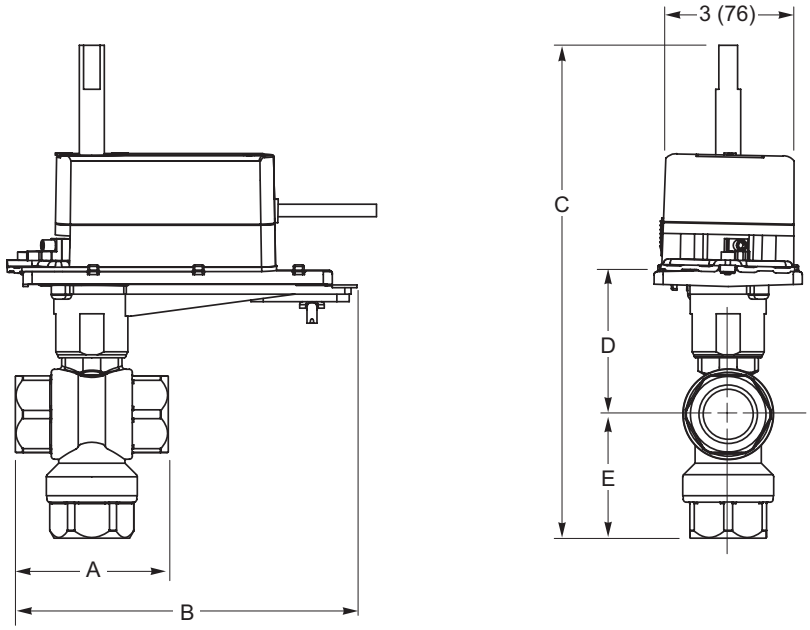


Figure 2. Mx41-6043 or Mx41-6083 with 3-Way Ball Valve.

Assemblies with MF/MS 4D-6083 NSR SmartX Actuators

Table-11. Actuator Specifications

<table>
<tr><td colspan="8">Inputs</td></tr>
<tr><td colspan="2" rowspan="8">Control Signal
and
Power Requirements</td><td rowspan="3">Part Number</td><td rowspan="3">Control Signal</td><td rowspan="3">Voltage</td><td colspan="4">Actuator Power Input</td></tr>
<tr><td colspan="3">Running</td><td>Holding</td></tr>
<tr><td colspan="2">50/60 Hz</td><td rowspan="2">DC Amps</td><td>50/60 Hz</td></tr>
<tr><td>VA</td><td>W</td><td>W</td></tr>
<tr><td>MF4D-6083-100</td><td>Floating</td><td rowspan="6">24 Vac ±20%
or
20 to 30 Vdc</td><td>5.9</td><td>3.6</td><td>0.13</td><td>1.6</td></tr>
<tr><td>MS4D-6083-100</td><td>2 to 10 Vdc Proportional</td><td rowspan="5">5.2</td><td rowspan="5">2.7</td><td rowspan="5">0.10</td><td rowspan="5">1.4</td></tr>
<tr><td>MS4D-6083-120</td><td>0 to 3 Vdc Proportional</td></tr>
<tr><td>MS4D-6083-130</td><td>6 to 9 Vdc Proportional</td></tr>
<tr><td>MS4D-6083-150</td><td>0 to 10 Vdc Proportional</td></tr>
<tr><td>MS4D-6083-160</td><td>4 to 20 mAdc Proportional</td></tr>
<tr><td colspan="2">Connections</td><td colspan="6">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.</td></tr>
<tr><td colspan="2">Motor Type</td><td colspan="6">Brush DC</td></tr>
<tr><td colspan="8">Outputs</td></tr>
<tr><td rowspan="2">Electrical</td><td colspan="7">Timing: Approx. 85 sec. at 70 °F (21 °C), measured with no load applied to actuator.</td></tr>
<tr><td colspan="7">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.</td></tr>
<tr><td rowspan="4">Mechanical</td><td colspan="7">Stroke: 93° nominal.</td></tr>
<tr><td colspan="7">Manual override: Allows positioning of valve shaft, using a manual crank..</td></tr>
<tr><td colspan="7">Output torque rating: 70 lb-in (8 N-m).</td></tr>
<tr><td colspan="7">RA/DA Jumper (Proportional Models): Permits selection of reverse acting or direct acting control.</td></tr>
<tr><td colspan="2">Position indicator: Visual indicator.</td><td colspan="6"></td></tr>
<tr><td colspan="8">Environment</td></tr>
<tr><td colspan="2">Temperature Limits</td><td colspan="6">Shipping and storage: -40 to 158 °F (-40 to 70 °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)</td></tr>
<tr><td colspan="2">Humidity</td><td colspan="6">15 to 95% RH, non-condensing.</td></tr>
<tr><td colspan="2">Locations</td><td colspan="6">NEMA 1. NEMA 2, UL Type 2 (IEC IP54) with customer-supplied watertight conduit connectors. Enclosure is air plenum rated.</td></tr>
<tr><td colspan="8">Agency Listings (Actuator)</td></tr>
<tr><td colspan="2">UL</td><td colspan="6">UL 873, Underwriters Laboratories (File #9429 Category Temperature-Indicating and Regulating Equipment). Plenum rated..</td></tr>
<tr><td colspan="2">cUL</td><td colspan="6">Canadian Standards C22.2 No. 24-93.</td></tr>
<tr><td colspan="2">European Community</td><td colspan="6">EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC). This product fits into Installation Category (Over-voltage Category) II per EN 61010-1.</td></tr>
<tr><td colspan="2">Australia</td><td colspan="6">This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.</td></tr>
</table>

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)
	3	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..

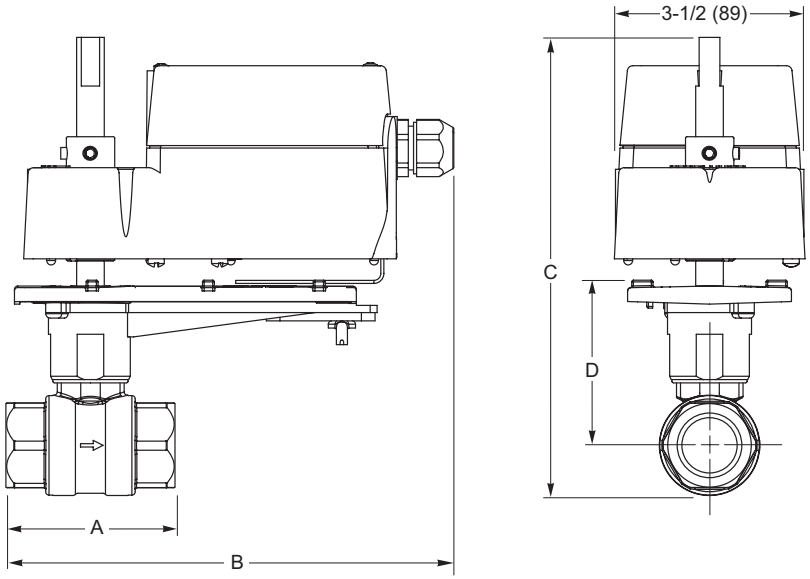


Figure 3. MF4D-6083-100, MS4D-6083-100 with 2-Way Ball Valve.

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)
		27, 30	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.

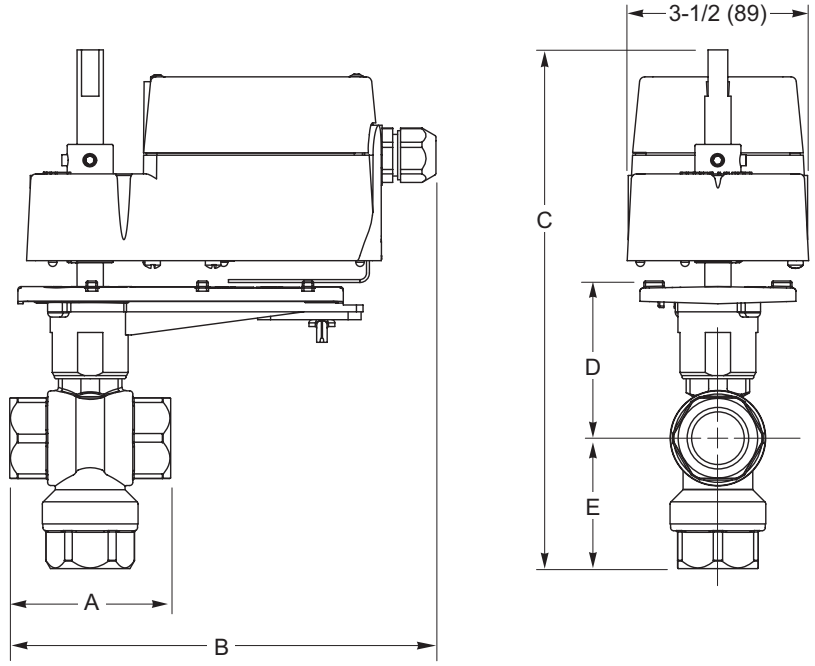


Figure 4. MF4D-6083-100, MS4D-6083-100 with 3-Way Ball Valve.

Assemblies with Mx40-704x SR SmartX Actuators

Table-14. Actuator Specifications

<table>
<tr><td colspan="2">Inputs</td><td colspan="8"></td></tr>
<tr><td></td><td>Control Signal</td><td colspan="8">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.</td></tr>
<tr><td rowspan="11"></td><td rowspan="11">Power Requirements</td><td colspan="8">All 24 Vac circuits are Class 2</td></tr>
<tr><td rowspan="3">Part Number</td><td rowspan="3">Voltage 50/60 Hz</td><td rowspan="3">Voltage Vdc</td><td colspan="4">Running</td><td colspan="2">Holding</td></tr>
<tr><td colspan="2">50 Hz</td><td colspan="2">60 Hz</td><td>50 Hz</td><td>60 Hz</td></tr>
<tr><td>VA</td><td>W</td><td>VA</td><td>W</td><td>W</td><td>W</td></tr>
<tr><td>MA40-7043</td><td rowspan="5">24 Vac ± 20%</td><td rowspan="5">22 to 30</td><td>4.4</td><td>2.9</td><td>4.4</td><td>2.9</td><td>0.8</td><td>0.8</td></tr>
<tr><td>MS40-7043</td><td>5.6</td><td>4.2</td><td>5.6</td><td>4.2</td><td>2.4</td><td>2.4</td></tr>
<tr><td>MF40-7043</td><td>5.9</td><td>4.4</td><td>5.9</td><td>4.4</td><td>2.9</td><td>2.9</td></tr>
<tr><td>MS40-7043-MP</td><td rowspan="2">6.9</td><td rowspan="2">5.0</td><td rowspan="2">6.6</td><td rowspan="2">5.0</td><td rowspan="2">3.2</td><td rowspan="2">3.2</td></tr>
<tr><td>MS40-7043-MP5</td></tr>
<tr><td>MA40-7040</td><td>120 Vac ± 10%</td><td>—</td><td>6.4</td><td>3.8</td><td>4.3</td><td>3.4</td><td>1.6</td><td>1.2</td></tr>
<tr><td></td><td>Connections</td><td colspan="8">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..</td></tr>
<tr><td colspan="2">Motor Type</td><td colspan="8">MA40-704x: Brush DC.
MF40-7043, MS40-7043: Brushless DC.</td></tr>
<tr><td colspan="2">Outputs</td><td colspan="8"></td></tr>
<tr><td rowspan="5"></td><td>Electrical</td><td colspan="8">Auxiliary Switches: Available when actuators are ordered as separate units. Auxiliary switches are not offered with factory ball valve assemblies.</td></tr>
<tr><td colspan="4">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.</td><td colspan="4">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.</td></tr>
<tr><td colspan="8">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.).</td></tr>
<tr><td>Mechanical</td><td colspan="8">Stroke: Angle of rotation is limited to a maximum of 95°, with mechanical stop.</td></tr>
<tr><td colspan="8">Output torque rating: Mx40-704x — 35 lb-in (4 N-m).</td></tr>
<tr><td colspan="8">Position indicator: Visual scale numbered from 0 to 90°, provided for position indication.</td></tr>
<tr><td colspan="2">Environment</td><td colspan="8"></td></tr>
<tr><td rowspan="3"></td><td>Temperature Limits</td><td colspan="8">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)</td></tr>
<tr><td>Humidity</td><td colspan="8">5 to 95% RH, non-condensing.</td></tr>
<tr><td>Locations</td><td colspan="8">NEMA 2, UL Type 2 (IEC IP54)</td></tr>
<tr><td colspan="2">Agency Listings (Actuator)</td><td colspan="8"></td></tr>
<tr><td rowspan="4"></td><td>UL</td><td colspan="8">UL 873, Underwriters Laboratories (File #9429 Category Temperature-Indicating and Regulating Equipment).</td></tr>
<tr><td>cUL</td><td colspan="8">Canadian Standards C22.2 No. 24-93.</td></tr>
<tr><td>European Community</td><td colspan="8">EMC Directive (89/336/EEC). Low Voltage Directive (72/23/EEC).</td></tr>
<tr><td>Australia</td><td colspan="8">This product meets requirements to bear the C-Tick Mark according to the terms specified by the Communications Authority under the Radiocommunications Act 1992.</td></tr>
</table>

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)	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.

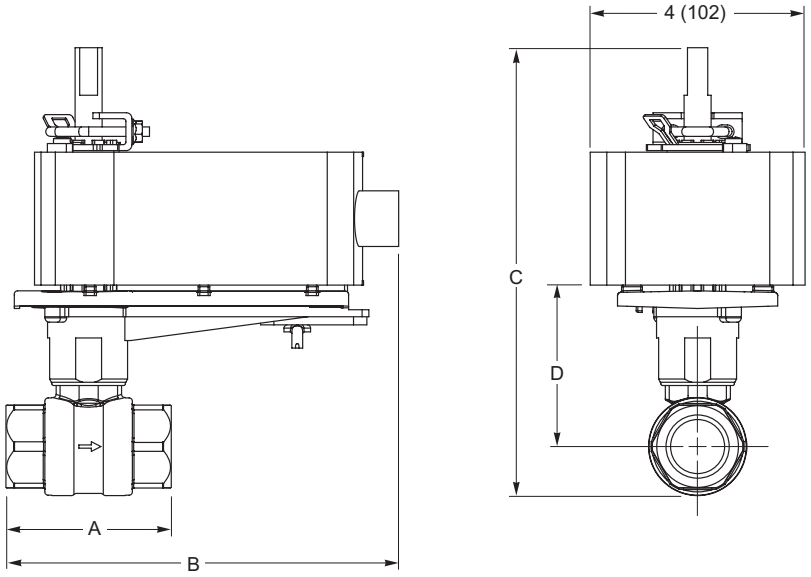


Figure 5. Mx40-704x with 2-Way Ball Valve.

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)
		26, 29, 31	4-1/4 (108)	8-1/8 (206)	11-1/2 (292)	3-1/2 (89)	3-1/8 (79)
	1-1/4	45	3 (76)	7-3/8 (187)	10-5/8 (270)	3-5/8 (92)	2-3/8 (60)
		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.

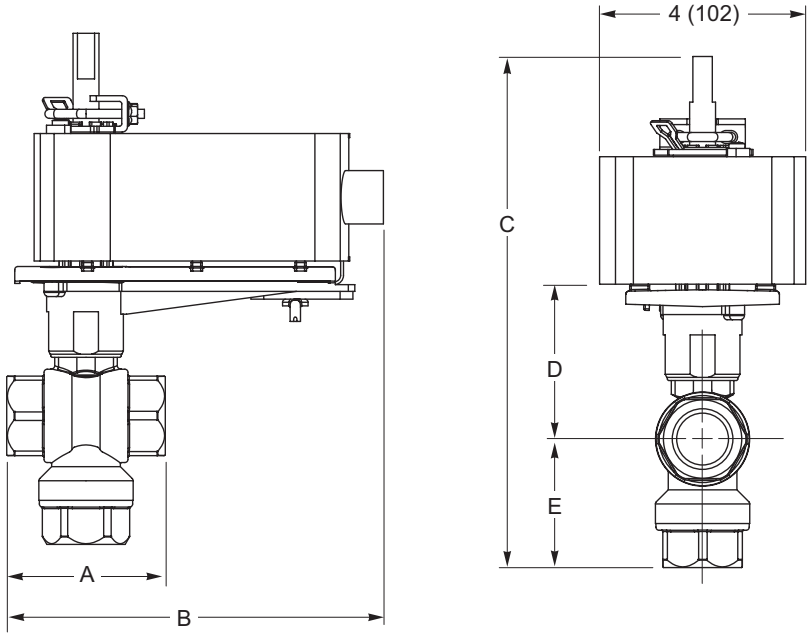


Figure 6. Mx40-704x with 3-Way Ball Valve.

Assemblies with Mx4D-7033/8033 SR SmartX Actuators

Table-17. Actuator Specifications

<table>
<tr><td colspan="7">Inputs</td></tr>
<tr><td rowspan="11">Control Signal and Power Requirements</td><td rowspan="3">Part Number for Mx4D-703x-xxx Mx4D-803x-xxx</td><td rowspan="3">Control Signal</td><td rowspan="3">Voltage</td><td colspan="3">Actuator Power Input</td></tr>
<tr><td colspan="2">Running</td><td>Holding</td></tr>
<tr><td colspan="2">50/60 Hz</td><td rowspan="2">DC Amps</td><td rowspan="2">50/60 Hz</td></tr>
<tr><td>VA</td><td>W</td><td>W</td></tr>
<tr><td>MA4D-x033-100</td><td>2-position</td><td rowspan="7">24 Vac ±20% or 20 to 30 Vdc</td><td>5.1</td><td>3.6</td><td>0.14</td><td>1.3</td></tr>
<tr><td>MF4D-x033-100</td><td>Floating</td><td>6.8</td><td>4.2</td><td>0.15</td><td>1.9</td></tr>
<tr><td>MS4D-x033-100</td><td>2 to 10 Vdc[a] Proportional</td><td rowspan="6">6.1</td><td rowspan="6">3.4</td><td rowspan="6">0.12</td><td rowspan="6">1.4</td></tr>
<tr><td>MS4D-x033-120</td><td>0 to 3 Vdc Proportional</td></tr>
<tr><td>MS4D-x033-130</td><td>6 to 9 Vdc Proportional</td></tr>
<tr><td>MS4D-x033-150</td><td>0 to 10 Vdc Proportional</td></tr>
<tr><td>MS4D-x033-160</td><td>4 to 20 mAdc Proportional</td></tr>
<tr><td colspan="7">a. 4 to 20 mAdc with field-installed 500 W resistor.</td></tr>
<tr><td>Connections</td><td colspan="6">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.</td></tr>
<tr><td>Motor Type</td><td colspan="6">Brush DC</td></tr>
<tr><td colspan="7">Outputs</td></tr>
<tr><td rowspan="5">Electrical</td><td colspan="6">Timing:
<table>
<tr><td>Part Number</td><td colspan="3">Approximate Timing in Sec. @ 70 °F (21 °C)[a]</td></tr>
<tr><td></td><td>Powered</td><td colspan="2">Spring Return</td></tr>
<tr><td></td><td></td><td>CCW[b]</td><td>CW[b]</td></tr>
<tr><td>MA4D-7033-100</td><td>56</td><td>26</td><td>—</td></tr>
<tr><td>MF4D-7033-100
MS4D-7033-100</td><td>85</td><td>21</td><td>—</td></tr>
<tr><td>MA4D-8033-100</td><td>56</td><td>—</td><td>26</td></tr>
<tr><td>MF4D-8033-100
MS4D-8033-1x0</td><td>85</td><td>—</td><td>21</td></tr>
</table>
a. Timing was measured with no load applied to actuator.
b. CCW or CW as viewed from cover side of actuator.</td></tr>
<tr><td colspan="6">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.</td></tr>
<tr><td rowspan="3">Mechanical</td><td colspan="6">Stroke: 93° nominal.</td></tr>
<tr><td colspan="6">Manual override: Allows positioning of valve shaft, using a manual crank..</td></tr>
<tr><td colspan="6">Output torque rating: 30 lb-in (3.4 N-m).</td></tr>
</table>

Assemblies with Mx4D-7033/8033 SR SmartX Actuators

Continued

Inputs		
		RA/DA Jumper (Proportional Models): Permits selection of reverse acting or direct acting control.
		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 VF-22x3-821-9-P VF-22x3-831-9-P VS-22x3-821-9-P VS-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)
	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)

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

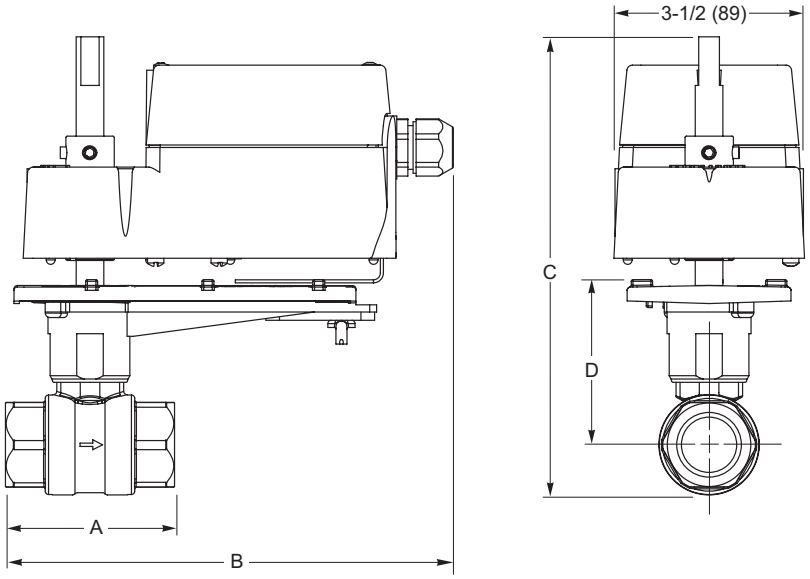


Figure 7. MA4D-7033, MF4D-7033, MS4D-7033, MA4D-8033, MF4D-8033, or MS4D-8033 with 2-Way Ball Valve.

Document Number: F-27086-11

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 VA-2313-817-9-P VA-2313-821-9-P VA-2313-831-9-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)
VF-2313-821-9-P VF-2313-831-9-P		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.

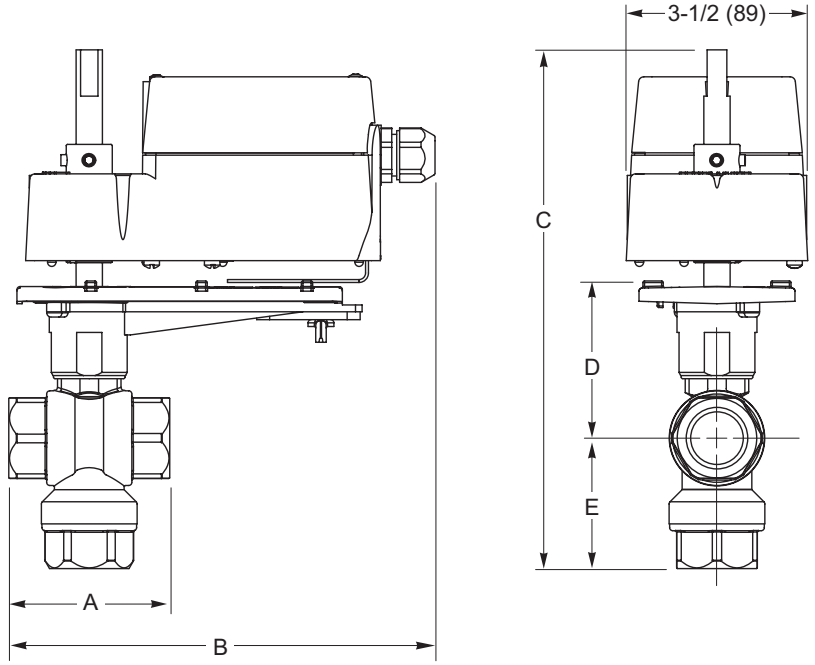


Figure 8. MA4D-7033, MF4D-7033, MS4D-7033, MA4D-8033, MF4D-8033, or MS4D-8033 with 3-Way Ball Valve.

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.

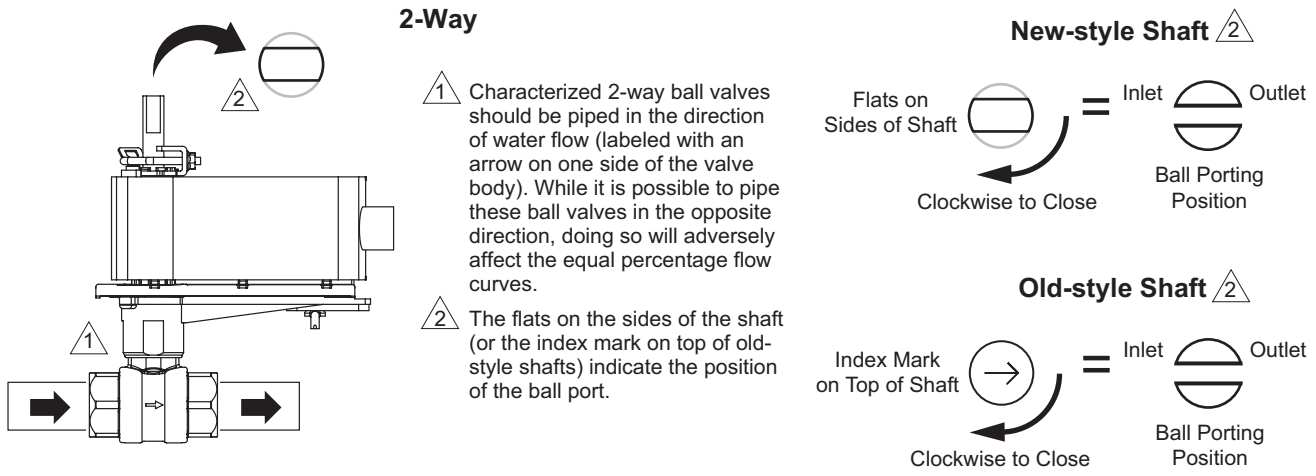


Figure 9. 2-Way Valve Assemblies Piping Diagram.

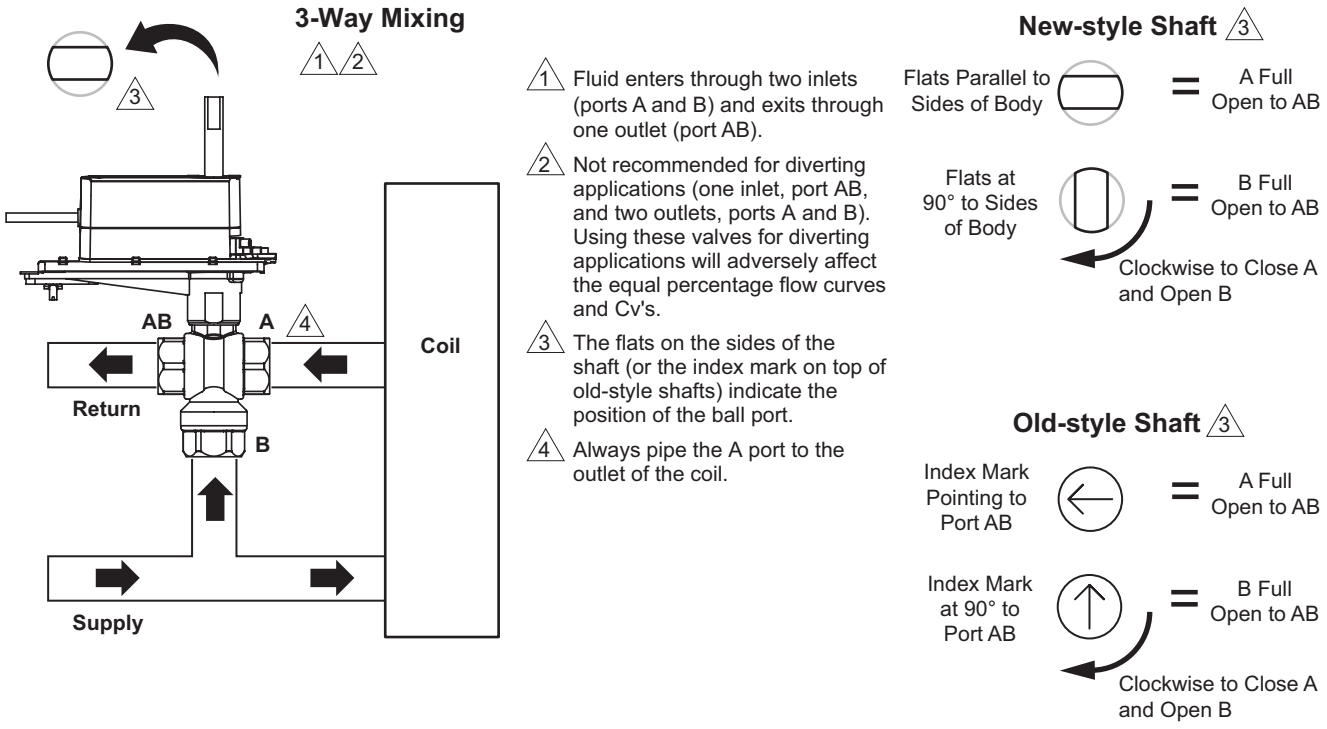


Figure 10. 3-Way Mixing Valve Assemblies Piping Diagram.

Document Number: F-27086-11

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 futher 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.

Document Number: F-27086-11
May, 2016 tc

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.

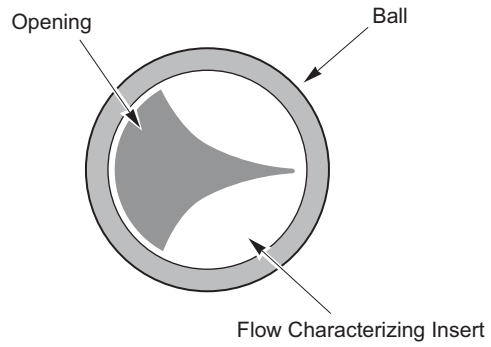


Figure 11. Flow Characterizing Insert.

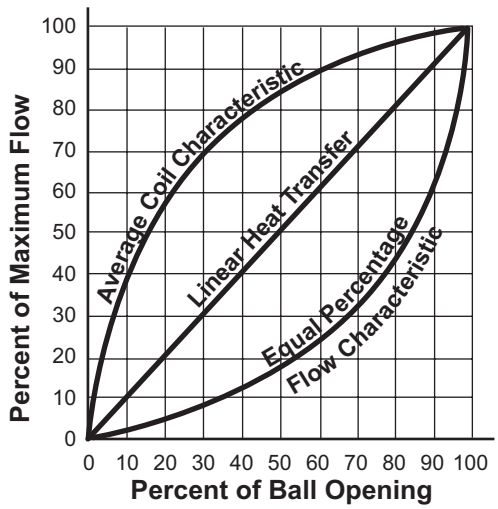


Figure 12. Equal Percentage Flow Control.

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.

Document Number: F-27086-11

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.

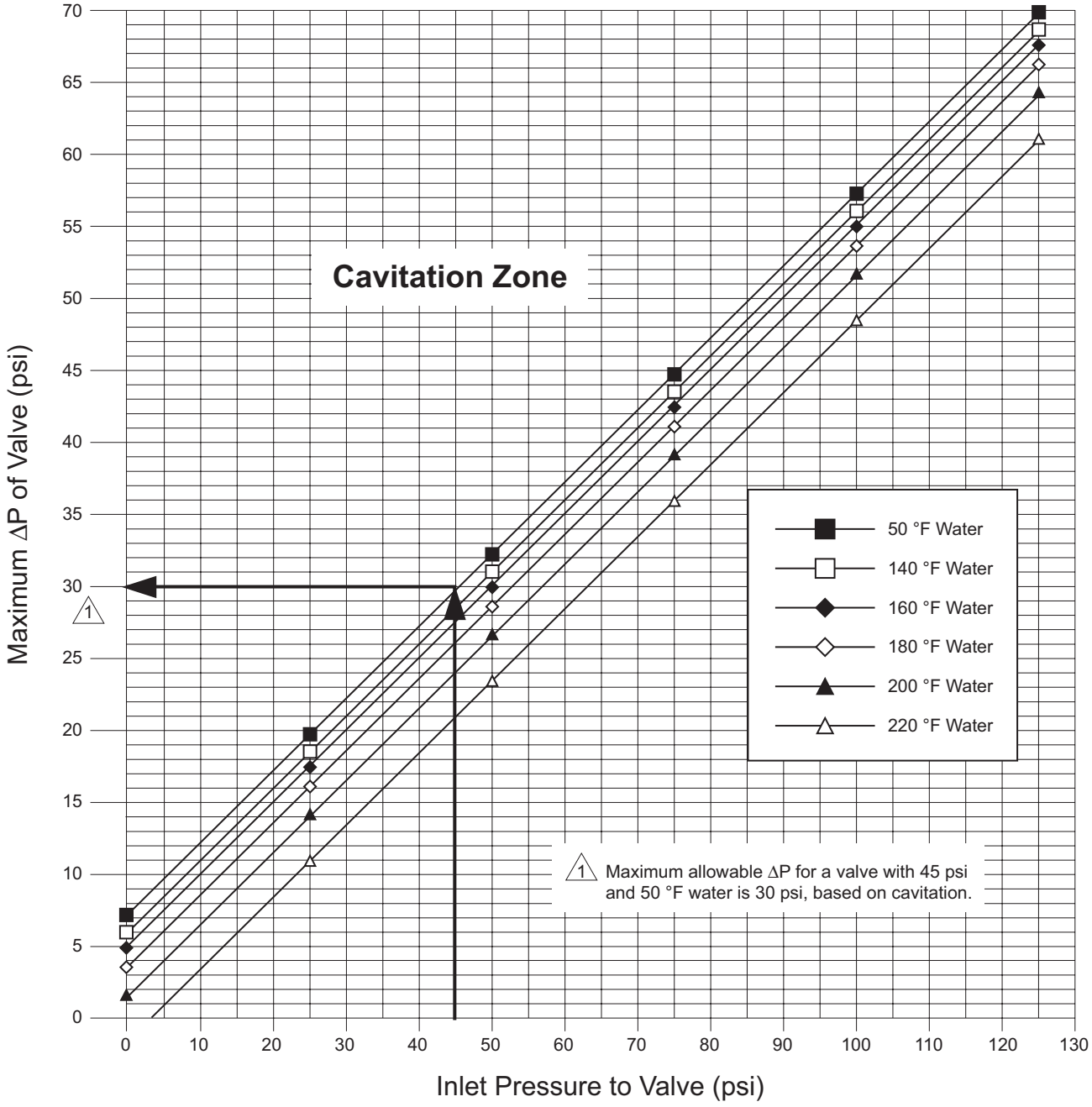


Figure 13. Maximum Allowable Differential Pressure (ΔP) for Water Valves.

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 lager 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 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
1-1/4	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

TThe following table provides estimated effective Cvs when using a 3-way valve assembly on the same or lager 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)

Document Number: F-27086-11

Estimated Effective Cv con't

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
1-1/2	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.

Document Number: F-27086-11