VB-7211 Series

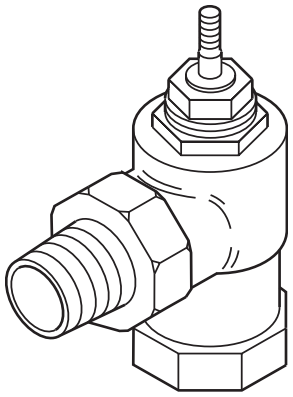
TAC
1354 Clifford Avenue
P. O. Box 2940
Loves Park, IL 61132-2940
www.tac.com

1/2" to 1-1/4" Union End NPT
Stem Up Open, Two-Way Valves
General Instructions

Application

VB-7211 series stem up open, two-way valves control water from 20 to 281°F (-7 to 138°C) or steam to 281°F (138°C) maximum in heating or air conditioning systems. They are used for two-position or proportional control applications. Valve assemblies require an actuator and a valve linkage that must be purchased separately.

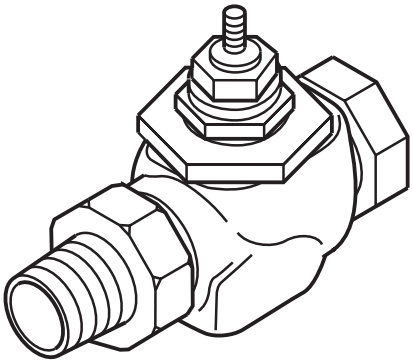
Danger: Do not use for combustible gas applications. The VB-7211 series valve packings are not rated for combustible gas applications, and if used in these applications, gas leaks and explosions could result.



VB-7211-0-3-P

Features

- Valve sizes 1/2" to 1-1/4"
- Equal percentage flow characteristics for two-position or proportional control of water or steam
- 250 psig pressure rating per ANSI Standards (B16.15–1985) for cast bronze bodies
- Spring-loaded TFE packing
- Union end American Standard Taper Pipe Thread (NPT) connections
- Straightway or angle body pattern



VB-7211-0-4-P

Applicable Literature

- TAC Valve Products Catalog, F-27384
- TAC Cross-Reference Guide, F-23638
- TAC Reference Manual, F-21683
- TAC Application Manual, F-21335
- Control Valve Sizing, F-13755
- Valve Selection Chart for Steam, F-11366
- Valve Selection Chart for Water, F-11080
- EN-205 Water System Guidelines, F-26080

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SPECIFICATIONS

Table-1 Specifications/Models.

Specifications			Valve Body Series VB-7211-0-3-P	Valve Body Series VB-7211-0-4-P
Service			Chilled or Hot Water and Steam	
Flow Characteristics (Figure-1)			Equal Percentage	
Action			Stem Up Open	
Sizes			1/2" to 1-1/4"	
Body Pattern			Angle	Straightway
Type of End Fitting			Union NPT	
Valve Materials	**Body**		Bronze	
	Seat		Bronze	
	Stem		Stainless Steel	
	Plug		Brass	
	Packing		Spring-loaded TFE	
	Disc		EPDM	
ANSI Pressure Class (Figure-2)			250 (up to 400 psig below 150°F)[a]	
Maximum Inlet Pressure, Steam			35 psig (241 kPa)	
Allowable Control Media Temperature			20 to 281°F (-7 to 138°C)	
Allowable Differential Pressure for Water[b]			35 psi (241 kPa) Max. for Normal Life (refer to “Cavitation Limitations on Valve Pressure Drop” on page 7)	
Allowable Differential Pressure for Steam[b]			20 psi (138 kPa)	
Valve Size	**C_v Rating**	**k_{vs} Rating[c]**	**Complete Valve Body Part Number**	
1/2"	0.4	0.3	**VB-7211-0-3-1**	**VB-7211-0-4-1**
	1.3	1.1	**VB-7211-0-3-2**	**VB-7211-0-4-2**
	2.2	1.9	**VB-7211-0-3-3**	**VB-7211-0-4-3**
	4.4	3.8	—	**VB-7211-0-4-4**
	5.0	4.3	**VB-7211-0-3-4**	—
3/4"	5.5	4.7	**VB-7211-0-3-5**	**VB-7211-0-4-5**
	7.5	6.5	—	**VB-7211-0-4-6**
	8.5	7.4	**VB-7211-0-3-6**	—
1"	10	8.6	—	**VB-7211-0-4-7**
	14	12	**VB-7211-0-3-7**	**VB-7211-0-4-8**
	16	14	**VB-7211-0-3-8**	—
1-1/4"	20	17	—	**VB-7211-0-4-9**
	22	19	**VB-7211-0-3-9**	—

[a] Do not apply above pressure rating to piping system.

[b] Maximum recommended differential pressure in open position. Do not exceed recommended differential pressure (pressure drop) or integrity of parts may be affected. Exceeding maximum recommended differential pressure voids product warranty.

[c] $k_{vs} = m^3/h$ (ΔP = 100 kPa) $C_v = k_{vs} \times 1.156$

Close-off Pressure Rating

The close-off pressure rating is dependent on the size of the valve, valve linkage, and the actuator. Consult the **TAC Valve Products Catalog, F-27384,** for close-off ratings.

Spring Return Position of Valve Assembly

For a valve assembly (valve, linkage, and actuator) to have a normal (spring return) position, the actuator must be of the spring return type. See Table-2 for spring return position of valve assemblies.

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Table-2 Required Compatible Actuators/Linkages

Actuator Series	Required Valve Linkage	Spring Return Position
MA-5210, MA-5211, MA-5213	AV-7600[a]	Stem Up Normally Open
MF-5413, MF-5513	AV-7600 & AV-601	
MF-22203, MF-22303, MF-22323	Included w/Actuator	None (Non-Spring Return)
MF-63103, MF-63123		
MK-2690	AV-7400	Stem Up Normally Open
MK-4601, MK-4611, MK-4621	AV-401	
MP-5210, MP-5211, MP-5213	AV-7600[a]	
MP-5410, MP-5411, MP-5413	AV-7600 & AV-601	
MP-5511, MP-5513		
MPR-5610, MPR-5611, MPR-5613		
MPR-5713		
MS-22353	Included w/Actuator	None

[a] High ambient temperatures with high media temperatures in the valve may require the use of AV-601 in addition to AV-7600. See General Instructions for AV-7600 (F-26235) and AV-601 (F-19069) for details.

Flow Characteristics

All valves have modified equal percentage flow characteristics. That is, for equal increments of valve stem stroke, the change in flow rate with respect to valve stroke may be expressed as a constant percent of the flow rate at the time of the change. The change of flow rate with respect to valve stroke is relatively small when the valve plug is near the valve seat and relatively high when the valve plug is nearly wide open. See Figure-1 for typical modified equal percentage flow characteristics of VB-7211 series valve bodies.

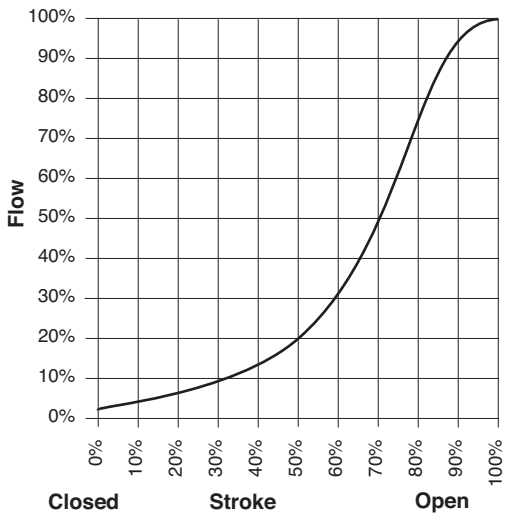


Figure-1 Typical Modified Equal Percentage Flow Characteristics.

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Rangeability

Rangeability is the ratio of rated flow to the minimum controllable flow through a valve. Table-3 lists the rangeability for VB-7211 series of valves.

Table-3 Rangeability

Valve Body Part Number	Nominal Rangeability	Valve Body Part Number	Nominal Rangeability	Valve Body Part Number	Nominal Rangeability
VB-7211-0-X-1	5:1	**VB-7211-0-X-4**	40:1	**VB-7211-0-X-7**	60:1
VB-7211-0-X-2	15:1	**VB-7211-0-X-5**	50:1	**VB-7211-0-X-8**	75:1
VB-7211-0-X-3	25:1	**VB-7211-0-X-6**	60:1	**VB-7211-0-X-9**	75:1

Temperature/Pressure Ratings

See Figure-2 for temperature and pressure ratings. Consult the appropriate valve linkage general instruction sheet for the effect of valve body ambient temperatures on specific actuators. Ratings conform with published values and disclaimer.

VB-7211-0-3-P, VB-7211-0-4-P (Union End Cast Bronze Body)
Standards: Pressure to ANSI B16.15 Class 250 with 400 psig up to 150°F decreasing to 321 psig at 281°F
Materials: ASTM B584

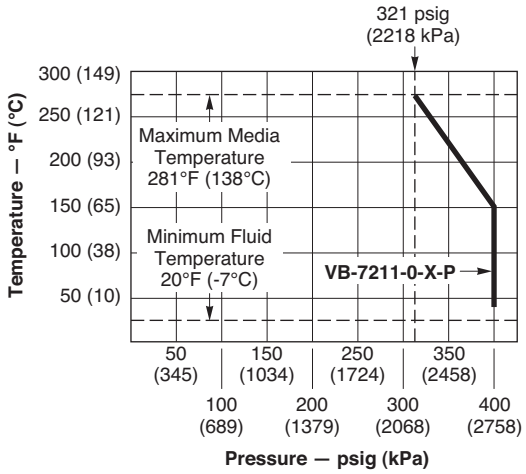


Figure-2 Temperature and Pressure Ratings for VB-7211 Series Valve Bodies.

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VALVE SIZING AND SELECTION

Water

Two-position

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.

Proportional

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-4).

Table-4 Conventional Heating System.

Design Temperature Load Drop °F (°C)	Recommended Pressure Drop[a] (% 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

[a] Recommended minimum pressure drop = 5 psi (34 kPa).

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

Water Capacity

See Table-5 for water capacity of VB-7211 series valves.

Table-5 Water Capacity in Gallons Per Minute for VB-7211 Series.

Valve Body Part Number	C_v Rating	Differential Pressure (ΔP in psi)												
		1	2	3	4	5	6	7	8	9	10	15	20	35
VB-7211-0-X-1	0.4	0.40	0.57	0.69	0.80	0.89	0.98	1.06	1.13	1.20	1.26	1.55	1.79	2.37
VB-7211-0-X-2	1.3	1.30	1.84	2.3	2.6	2.9	3.2	3.4	3.7	3.9	4.1	5.0	5.8	7.7
VB-7211-0-X-3	2.2	2.2	3.1	3.8	4.4	4.9	5.4	5.8	6.2	6.6	7.0	8.5	9.8	13
VB-7211-0-4-4	4.4	4.4	6.2	7.6	8.8	9.8	11	12	12	13	14	17	20	26
VB-7211-0-3-4	5.0	5.0	7.1	8.7	10	11	12	13	14	15	16	19	22	30
VB-7211-0-X-5	5.5	5.5	7.8	9.5	11	12	13	15	16	17	17	21	25	33
VB-7211-0-4-6	7.5	7.5	11	13	15	17	18	20	21	23	24	29	34	44
VB-7211-0-3-6	8.5	8.5	12	15	17	19	21	22	24	26	27	33	38	50
VB-7211-0-4-7	10	10	14	17	20	22	24	26	28	30	32	39	45	59
VB-7211-0-3-7 VB-7211-0-4-8	14	14	20	24	28	31	34	37	40	42	44	54	63	83
VB-7211-0-3-8	16	16	23	28	32	36	39	42	45	48	51	62	72	95
VB-7211-0-4-9	20	20	28	35	40	45	49	53	57	60	63	77	89	118
VB-7211-0-3-9	22	22	31	38	44	49	54	58	62	66	70	85	98	130

C_v Equation

$$C_v = \frac{GPM}{\sqrt{\Delta P}} \qquad \Delta P = \left(\frac{GPM}{C_v}\right)^2 \qquad GPM = C_v\sqrt{\Delta P}$$

Where:
C_v = Coefficient of flow
GPM = U.S. gallons per minute (60°F, 15.6°C)
ΔP = Differential pressure in psi (pressure drop)

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Steam

Two-position

Two-position zone valves and direct radiation valves are normally sized using a minimum of 10% of inlet pressure (psig).

Proportional

Proportional control valves are normally sized using:

- For low pressure (15 psig or less), use ΔP of 80% of gauge inlet pressure.
- For steam pressures greater than 15 psig, use ΔP of 42% of absolute (gauge plus 14.7 psig) inlet pressure.
- When the C_v required is between two valve sizes, select the larger size. Do not size steam valves using a pressure drop greater than 42% of the absolute inlet pressure.

Steam Capacity

See Table-6 for steam capacity of VB-7211 series valves.

Table-6 Steam Capacity in Pounds Per Hour for VB-7211 Series.

Valve Body Part Number	Cv Rating	Differential Pressure (ΔP in psi)[a]															
		2 psig Inlet		5 psig Inlet		10 psig Inlet		15 psig Inlet		20 psig Inlet		25 psig Inlet		30 psig Inlet		35 psig Inlet	
		0.2	1.6	0.5	4	1	8	1.5	12	2	14	2.5	16	3	18	3.5	20
VB-7211-0-X-1	0.4	2.2	5.9	3.7	9.5	5.8	14	7.8	18	9.7	20	12	23	13	26	15	29
VB-7211-0-X-2	1.3	7.1	19	12	31	19	45	25	57	32	66	38	76	44	86	50	95
VB-7211-0-X-3	2.2	12	32	20	52	32	76	43	96	53	112	64	129	74	145	84	161
VB-7211-0-4-4	4.4	24	65	41	105	64	153	86	192	107	225	127	257	148	289	168	322
VB-7211-0-3-4	5.0	27	74	46	119	73	173	98	219	121	255	145	292	168	329	191	366
VB-7211-0-X-5	5.5	30	81	51	131	80	191	107	240	133	281	159	321	185	362	210	402
VB-7211-0-4-6	7.5	41	111	70	178	110	260	146	328	182	383	217	438	252	493	286	548
VB-7211-0-3-6	8.5	46	125	79	202	124	295	166	372	206	434	246	497	285	559	324	621
VB-7211-0-4-7	10	55	147	93	238	146	347	195	437	243	511	289	584	336	658	381	731
VB-7211-0-3-7 VB-7211-0-4-8	14	76	206	130	333	204	485	273	612	340	715	405	818	470	921	534	1024
VB-7211-0-3-8	16	87	236	149	380	234	555	312	699	388	817	463	935	537	1052	610	1170
VB-7211-0-4-9	20	109	295	186	475	292	694	390	874	485	1021	579	1168	671	1315	763	1462
VB-7211-0-3-9	22	120	324	204	523	321	763	429	962	534	1123	636	1285	738	1447	839	1608

[a] Values are for saturated steam (K = 1). Left column under each inlet pressure is for two-position control, and right column is for proportional control

C_v Equation

$$C_v = \frac{QK}{3\sqrt{\Delta P \bullet P2}} \qquad Q = \frac{3C_v\sqrt{\Delta P \bullet P2}}{K}$$

Where:

C_v = Coefficient of flow
Q = Lbs. per hour of steam
ýP = Differential pressure in psi (pressure drop)
P2 = Outlet pressure in psia (absolute) (P2 = Inlet pressure + 14.7 – ΔP)
K = 1 + (0.0007 x °F superheat) (K = 1 for saturated steam)

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Cavitation Limitations on Valve Pressure Drop

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

Do not exceed the maximum differential pressure (pressure drop) for the valve selected.

The following formula can be used on higher temperature water systems, where cavitation could be a problem, to estimate the maximum allowable pressure drop across the valve:

$Pm = 0.5 (P_1 – Pv)$

Where:
Pm = Maximum allowable pressure drop (psi)
P_1 = Absolute inlet pressure (psia)
Pv = Absolute vapor pressure (psia) (refer to Table-6 or Table-7)

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

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

Pm = 0.5 [(18 + 14.7) – 11.53] = 10.6 psi
(Vapor pressure of 200°F water is 11.53 psia)

If the pressure drop for this valve is less than 10.6 psi, cavitation should not be a problem.

Systems where cavitation is shown to be a problem can sometimes be redesigned to provide lower inlet velocities. Valves having harder seat materials should be furnished if inlet velocities cannot be lowered.

Table-7 Vapor Pressure of Water Table.

Water Temp. (°F)	Vapor Pressure (psia)	Water Temp. (°F)	Vapor Pressure (psia)	Water Temp. (°F)	Vapor Pressure (psia)	Water Temp. (°F)	Vapor Pressure (psia)
40	0.12	90	0.70	140	2.89	190	9.34
50	0.18	100	0.95	150	3.72	200	11.53
60	0.26	110	1.28	160	4.74	210	14.12
70	0.36	120	1.69	170	5.99	220	17.19
80	0.51	130	2.22	180	7.51	230	20.78

Additional Valve Sizing Information

For additional valve sizing information, see:

- CA-28 Control Valve Sizing, F-13755
- Valve Selection Chart Water, F-11080
- Valve Selection Chart Steam, F-11366
- Valve Sizing Slide Rule, TOOL-150

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INSTALLATION

Inspection

Inspect the package for damage. If damaged, notify the appropriate carrier immediately. If undamaged, open the package and inspect the device for obvious damage. Return damaged products.

Requirements

- Tools (not provided): Pipe wrenches
- Training: Installer must be a qualified, experienced technician
- Appropriate accessories

Caution:

- Install the valve with the flow in the direction of the flow arrow ("A" port the inlet and "AB" port the outlet).
- Do not exceed the ratings of the device.
- Avoid locations where excessive moisture, corrosive fumes or vibration are present.

Mounting

1. The valve should be mounted in a weather protected area in a location that is within the ambient limits of the actuator. When selecting a location, allow sufficient room for valve linkage, actuator, and other accessories and for service of the product.
2. The preferred mounting position for the valve is with the valve stem vertical above the valve body. Avoid mounting the valve so that the valve stem is below horizontal.
3. For steam applications only, position the valve body so the valve stem and actuator are at least at 45° from vertical.
4. The valves must be piped with the "A" port as the inlet and the "AB" port as the outlet.

Union End NPT Valve Bodies

The VB-7211 series of union valve bodies conform to American Standard Taper Pipe Threads (NPT).

1. Apply pipe dope sparingly to all but the last two threads of a properly threaded, reamed, and cleaned pip1 sure that pipe chips, scale, etc. do not get into the pipe since this material may lodge in the valve seat and prevent proper closing and opening of the valve.
2. Start the joint by hand screwing the pipe into the valve. If the thread engagement feels "right," turn the pipe by hand as far as it will go.
3. Use a pipe wrench to fully tighten the valve to the pipe. Do not over tighten or strip threads. See Table-8 and Figure-3 for the normal engagement length of the threads. Figure-4 shows means of tightening the pipe so that valve is not twisted or crushed.

Table-8 Normal Thread Engagement Between Male Pipe Thread and Valve Body.

Valve Size Inches (NPT)	Normal Engagement
1/2"	1/2"
3/4"	9/16"
1"	11/16"
1-1/4"	11/16"

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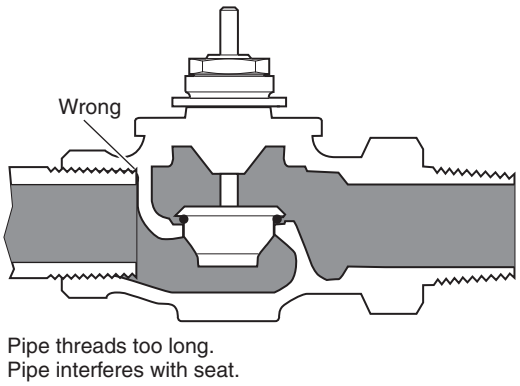
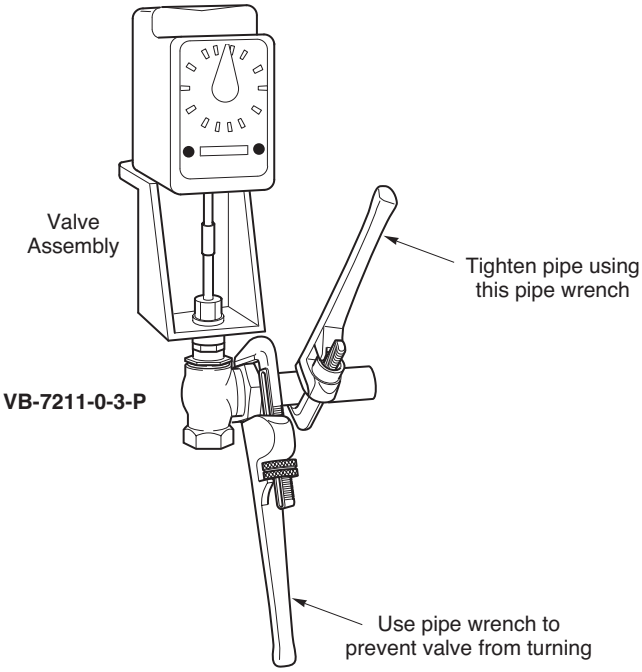


Figure-3 Normal Thread Engagement.



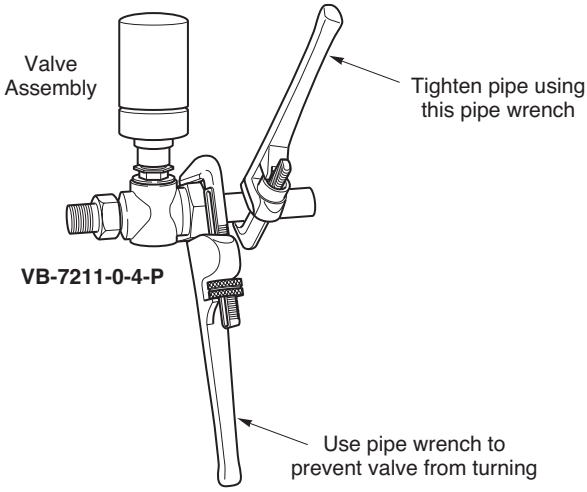


Figure-4 Installation of Union End Valves.

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CHECKOUT

1. Make sure the valve stem operates smoothly before installing the valve linkage and the actuator.
2. If the stem does not operate smoothly, it may indicate that valve was twisted or crushed during installation or that stem was bent by rough handling. These conditions may require that the valve be replaced.
3. After the piping is under pressure, check the valve body and the connections for leaks.
4. After the valve linkage and the actuator are installed, check their operation.
   a. Power the actuator and run the valve to the stem down position. Make sure the linkage and valve stem move freely. At the stem down position, the valve should shut off tightly.
   b. For spring return actuators, allow the actuator to spring return to the stem up position. Again, the valve stem and linkage should operate smoothly. At the stem up position, the valve should be in its full open position.

MAINTENANCE & FIELD REPAIR

Regular maintenance of the total system is recommended to assure sustained performance. See Table-9 for maintenance kit part numbers.

Table-9 Maintenance Kits for VB-7211 Valves.

Valve Body Part Number	Replacement Packing Assembly	Packing Wrench	Valve Repair Kit[a]
VB-7211-0-X-1	YBA-622-1	TOOL-20-1	RYB-721-1
VB-7211-0-X-2			RYB-721-2
VB-7211-0-X-3			RYB-721-3
VB-7211-0-X-4			RYB-721-4
VB-7211-0-X-5			RYB-721-5
VB-7211-0-X-6			RYB-721-6
VB-7211-0-X-7			RYB-721-7
VB-7211-0-3-8			RYB-721-A8
VB-7211-0-4-8			RYB-721-8
VB-7211-0-X-9			RYB-721-9

[a] Kit includes replacement packing and stem & plug assembly.

Water System Maintenance

All heating and cooling systems are susceptible to valve and system problems caused by improper water treatment and system storage procedures. These guidelines are provided to help avoid valve and water system problems resulting from improperly treated water or storage procedures in cooling and hot water systems, and to obtain maximum life from TAC valves.

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/ASHRAE handbook recommendations, can result in corrosion, scale, and abrasive particle formation. Scale and particulates can result in stem and packing scratches and can adversely affect packing life and other parts of the hydronic system.

To maintain non-damaging conditions, follow these guidelines:

- Clean the system prior to start up. Use a nitrite or molybdate-based treatment program.
- Use filtration equipment where needed.
- Properly store off-line systems and monitor water treatment results using corrosion test coupons.
- Follow the advice of a water treatment professional.
- Consult **EN-205, Water System Guidelines Engineering Information, F-26080,** for further details.

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DIMENSIONAL DATA

Table-10 Dimensions for VB-7211-0-3-P Series Angle Valves (Figure-5).

Valve Body Part Number	Valve Size	Dimensions in Inches (mm)				
		A	B	C	D (Stem Down)	E[a] (Stroke)
VB-7211-0-3-1 **VB-7211-0-3-2** **VB-7211-0-3-3** **VB-7211-0-3-4**	1/2"	3-1/8 (79)	1-5/8 (41)	1-5/16 (33)	3/4 (19)	7/16 (11)
VB-7211-0-3-5 **VB-7211-0-3-6**	3/4"	3-5/8 (92)	1-11/16 (43)	1-1/2 (38)		
VB-7211-0-3-7 **VB-7211-0-3-8**	1"	4-1/16 (103)	1-15/16 (49)	2-1/8 (54)		
VB-7211-0-3-9	1-1/4"	4-5/16 (110)	2-3/16 (56)	2-1/4 (57)		

[a] Stroke for rated flow. Add up to 1/16 in. (1.6 mm) for disc seating and compression.

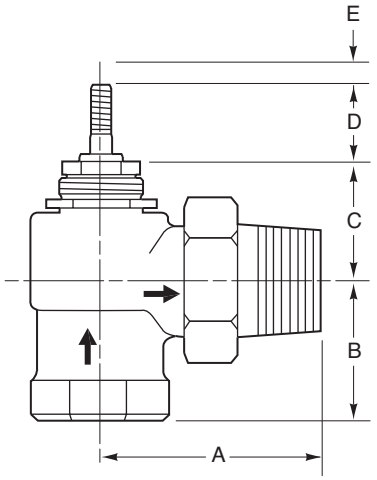


Figure-5 Dimensions for VB-7211-0-3-P Series Angle Valve Bodies.

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Table-11 Dimensions for VB-7211-0-4-P Series Straightway Valves (Figure-6).

Part Number	Valve Size	Dimensions in Inches (mm)				
		A	B	C	D (Stem Down)	E (Stroke)
VB-7211-0-4-1 **VB-7211-0-4-2** **VB-7211-0-4-3** **VB-7211-0-4-4**	1/2"	4-3/16 (106)	1-1/16 (27)	1-11/16 (43)	3/4 (19)	7/16 (11)
VB-7211-0-4-5 **VB-7211-0-4-6**	3/4"	4-15/16 (125)				
VB-7211-0-4-7 **VB-7211-0-4-8**	1"	6 (152)	1-1/8 (29)	2-3/8 (60)		
VB-7211-0-4-9	1-1/4"	6-1/4 (159)	1-3/8 (35)			

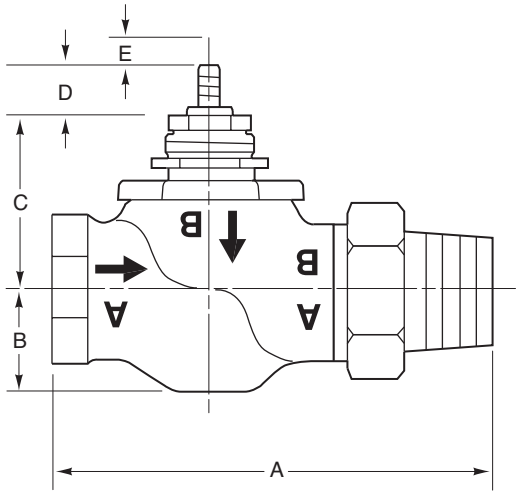


Figure-6 Dimensions for VB-7211-0-4-P Series Straightway Valve Bodies.

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