

# INSTRUCTION MANUAL

for

**MODEL VC-210**

**DIAPHRAGM CONTROL VALVE**



Model No. \_\_\_\_\_

Serial No. \_\_\_\_\_

Robertshaw Order No. \_\_\_\_\_

Note to installer: Before installing, read instructions carefully. After installing, give this manual to operating personnel or see that it is filed for future reference.



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INSTRUCTION MANUAL NUMBER

**P-2202**

Rev. E

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## SPECIFICATIONS

### ACTUATOR ASSEMBLY

**Nominal size:** 10 sq. in.

**Action:** Direct-Acting — Increasing air pressure moves stem downward.

**Nominal Travel:** 3/8" (9.5 mm)

**Spring Range:** 3-15 psi (0.2 - 1.0 bar) standard.

Other ranges available (See Table II).

**Maximum Air Pressure:** 30 psi (2.0 bar)

**Maximum Ambient Temperature:** 180° F. (82° C.)

**Air Connection:** 1/8" NPT, female

### Materials of Construction:

*Diaphragm* — Molded Buna-N 2-ply Dacron Reinforced.

*Housing and Frame* — Die-cast aluminum, iridite finished for corrosion resistance, painted bronzeless gold.

*Spring* — Cadmium plated alloy steel.

### VALVE ASSEMBLY

#### ACTION:

Direct (provides air-to-close action with actuator)

Reverse (provides air-to-open action with actuator)

Three-way (top port normally closed)

#### Valve Body Assembly Ratings:

200 psi for stainless steel bodies @ 350° F. (13.8 bar @ 177° C.)

**End Connections:** Female NPT inlet and outlet.

**Seat Ring:** 316 stainless steel, replaceable in 2-way body; integral stainless seats in 3-way body.

#### Materials of Construction:

*Body* — 316 stainless steel, 2-way and 3-way valves.

*Trim* — 316 stainless steel in 2-way and 3-way valves.

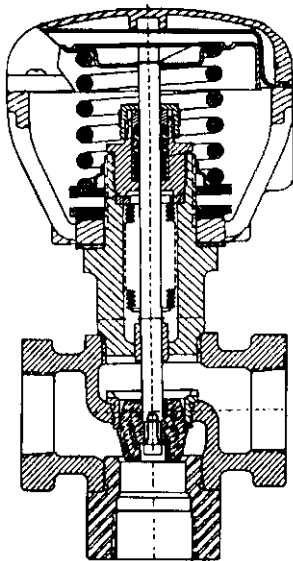
*Primary Packing* — 316 stainless steel bellows in stainless steel bodies.

*Secondary Packing* — Spring-loaded Teflon\* chevrons in stainless steel bodies.

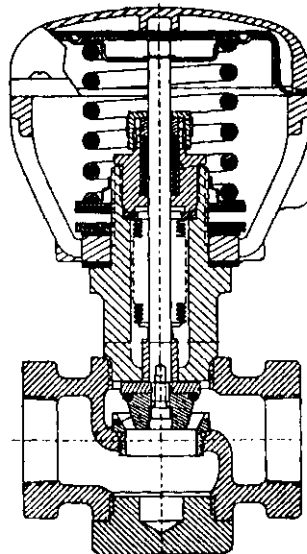
\* Registered TM of DuPont Company

### INNER VALVE CONSTRUCTION

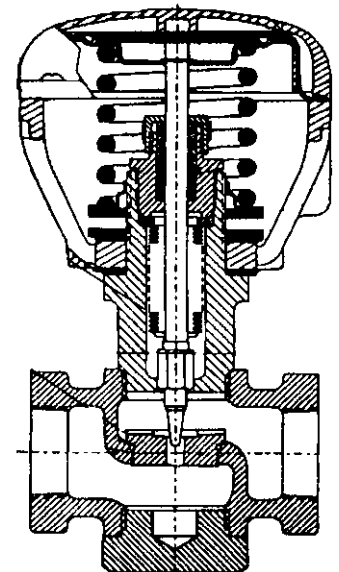
These illustrations represent the 3-way and direct-acting 2-way body styles. The Teflon O-ring construction is also available in reverse-acting styles (See Table I).



**BNS**  
**3-WAY**  
**METAL TO METAL**  
**SEATING**



**BR**  
**DIRECT-ACTING**  
**SOFT SEATING**



**BR**  
**REDUCED TRIM**

**TABLE I**  
**2-Way and 3-Way Valves**

Valve Style		Valve Body Material	Flow Characteristics		Seating Style	Trim Material	Valve Size, In.	C <sub>v</sub> (%)		C <sub>v</sub> (Q.O.)	
Direct Acting	Reverse Acting							DA	RA	DA	RA
BR	BRR	316 St. St.	%	Q.O.	§Teflon O-Ring	316 St. St.	1/2	.3*, .6*, 2.3	2.5	4	4
							3/4	7.3	7.2	8	8
							1	9.5	9.5	10	10
3-Way BNS		St. St.	Linear		St. St. Seat Ring/Plug	316 St. St.	1/2	2.2			
							3/4	4.6			
							1	9.0			

\*Flow Characteristics for .3 and .6 C<sub>v</sub> are linear.

§ Registered TM of DuPont Company

**MAXIMUM ALLOWABLE PRESSURE DROP**

When the control valve is required to close off against the full upstream pressure with 0 psig on the downstream side of the valve, the upstream pressure should be considered as the maximum pressure drop. The tabulated maximum pressure drops are for throttling service only. Where rapid cycling or on-off type service is the

application, the pressure differential across a VC-210 control valve should not exceed 50 psi (3.45 bar). In any case the upstream pressure should not exceed 100 psi (6.89 bar). The tabulated ratings are based on a 3-15 psi (0.2 - 1.0 bar) signal to the diaphragm.

**TABLE II**

Nominal Valve Size	Bench Test Spring Ranges <sup>1</sup>						
	Air-to-Close		Air-to-Open			3-Way	
	3-12 psi* (0.2 - 0.8 bar)	3-7 psi (0.2 - 0.5 bar)	6-15 psi* (0.4 - 1.0 bar)	8-15 psi (0.55 - 1.0 bar)	11-15 psi (0.75 - 1.0 bar)	5-14 psi* (0.3 - 0.9 bar)	9-13 psi (0.6 - 0.9 bar)
	Max. Allowable Pressure Drop						
1/2	90	100	100	100	100	60	100
3/4	50	100	100	100	100	35	80
1	30	90	50	80	100	20	40

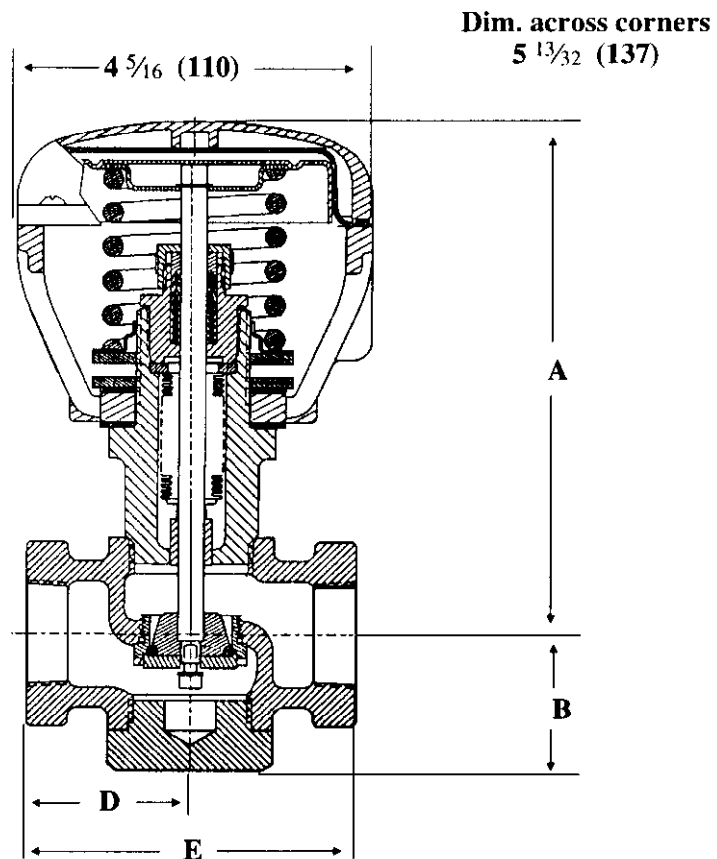
\* Standard springs

<sup>1</sup> Bench test with 0 psi in valve body.

# DIMENSIONS, SHIPPING WEIGHTS

(All dimensions in inches (mm)).

1/8" - NPT  
Female Air  
Connection



**Two-Way BRR  
Shown**

**TABLE III**

Valve	Pattern	Body Material	Dimension	Valve Size, In.			
				1/2"	3/4"	1"	
BR BRR	2-Way	316 Stainless Steel	A	6 3/8 (160)	6 3/8 (160)	6 3/8 (160)	
			B	A.T.C. §	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)
				A.T.O. §	1 3/4 (44)	1 3/4 (44)	1 3/4 (44)
			D	2 (50.8)	2 (50.8)	2 (50.8)	
			E	4 (102)	4 (102)	4 (102)	
BNS	3-Way	316 Stainless Steel	A	6 3/8 (160)	6 3/8 (160)	6 3/8 (160)	
			B	2 3/16 (55)	2 3/16 (55)	2 3/16 (55)	
			D	2 (50.8)	2 (50.8)	2 (50.8)	
			E	4 (102)	4 (102)	4 (102)	
All Styles			Shipping Wt. Lbs. (kg)	6.1 (2.8)	6.1 (2.8)	6.1 (2.8)	

§ A.T.C. — Air to Close, A.T.O. — Air to Open

## OPERATION

Model VC-210 Diaphragm Control Valves are compact, ruggedly constructed and especially designed for the control of water, steam, gas, vacuum, etc. Valves are single seated, bellows sealed to prevent stem leakage, and may be selected to have the valve action, seating materials, and flow characteristics needed for the most critical control applications.

The pneumatic actuator consists of a molded 10 sq. in. Buna-N diaphragm enclosed in a die-cast aluminum housing and frame. The readily accessible spring adjusting nut provides easy field adjustment of the starting point within the selected spring range. Synthane gaskets located between the valve bonnet and the actuator frame reduce heat transfer to the diaphragm.

## INSTALLATION

These instructions apply for all VC-210 series Diaphragm Control Valves. All operate in the same manner and differ only in body style and valve plug construction.

### A. VALVE PIPING

The size of a diaphragm control valve is computed to give full throttling action under certain specific conditions of flow and pressure drop. To ensure obtaining maximum performance, the control valve should not be placed in the main line adjacent to elbows, bends or plug cocks where abnormal velocities may occur. The size of the main line is usually one or two nominal sizes larger than the size of the control valve. When it is desired to use plug cocks for shut-off valves, they should be the same size as the main line and not the size of the control valve.

If it is desirable to have continuous operation when necessary to inspect or replace any of the parts, install a conventional three-valve bypass around the control valve.

When installing the valve in the line, observe the following precautions:

1. Install a pipeline strainer just ahead of the valve.
2. Allow sufficient clearances so that the valve may be easily serviced if necessary.
3. A minimum clearance of 3½" (88.9 mm) must be allowed between the extreme top of the control valve and the nearest obstruction. This permits removal of actuator frame and parts required to replace packing bellows.
4. Use a good grade of pipe compound and apply only above the second or third male threads in moderate amounts.
5. Make sure the flow through the valve body is in the direction indicated by the arrow on the side of the body.

Inspect all parts of the control valve for any foreign material that may have collected during shipment. Clean and blow out all pipe lines to remove pipe scale and chips.

### B. AIR PIPING TO VALVE

Run ¼" or ⅜" tube or pipe from the connection on the diaphragm case to the outlet fitting of the instrument or pilot controller. To avoid excessive delay in response, it is recommended that the distance should be less than 150 ft. (46 meters) from the instrument to valve. If excessive distances are necessary, one or more booster relays, Robertshaw CR 100-A1, may be used to speed the response.

### C. PACKING (Figure 2)

A seamless Sylphon® bellows provides the primary packing.

A secondary Teflon V-ring seal affords protection in the event of rupture of the primary packing bellows.

#### Primary Packing:

*Stainless Steel Bodies* — Type 316 stainless steel seamless Sylphon® bellows.

#### Secondary Packing:

*Stainless Steel Bodies* — Spring-loaded Teflon chevrons.

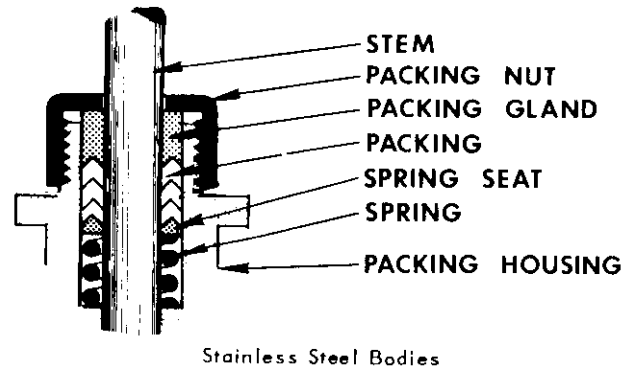


Figure 2

## ADJUSTMENTS

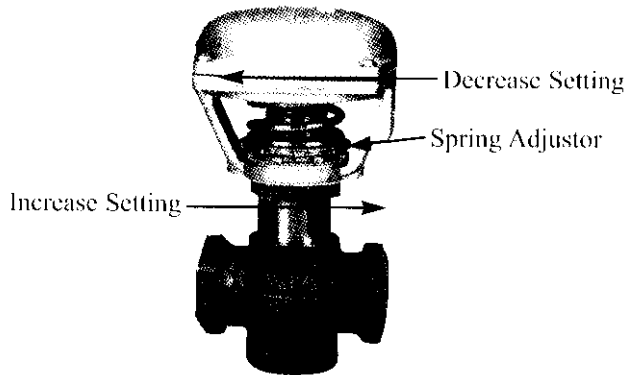


Figure 3 -- Adjustments

Every valve should be checked on or before startup for correct stroke, freedom from friction, correct location, and proper flow direction through the body.

In all cases of trouble, always check first the air lines and fittings for leaks and make sure you have the correct assembly for the desired action.

For successful performance of this equipment, the valve stem must move freely in response to air pressure change on the diaphragm. If this type of action is not being obtained, check the following:

1. *Valve Plug* — Examine the valve guides for “scoring” as a result of foreign material or misalignment.
2. *Diaphragm* — A diaphragm that is no longer pliable or is ruptured must be replaced.

If the above parts are performing correctly, any trouble that may be encountered will likely be found in the controller or instrument.

When the valve is completely installed and connected to the instrument or controller, open the manual downstream valve and close the bypass valve. Slowly open the upstream manual control valve. Allow the controller sufficient time to assume normal operation before checking the controlled pressure.

The size of the diaphragm control valve is computed to give full throttling action.

The diaphragm control valve is shipped from the factory with the spring adjustment properly set for the operating conditions specified on your order.

Under actual service conditions, pressure drops can differ. For this reason, the spring may have to be adjusted in order to compensate for the pressure drop so that full valve travel may be obtained over the diaphragm pressure range. This adjustment is accomplished by turning the spring adjuster to the right to increase spring compression and to the left to decrease spring compression. (See Figure 3).

## MAINTENANCE

### A. GENERAL

The actuator and valve are shipped completely assembled with all adjustments made. However, step-by-step procedures are given in the following paragraphs should it be necessary to disassemble the unit for inspection or maintenance.

### B. REPLACEMENT OF DIAPHRAGM (Figure 4)

1. Remove air pressure.
2. Turn the spring adjuster to the left to relieve spring tension.
3. Remove screws holding upper diaphragm case to the yoke. Lift off the diaphragm case which then allows the diaphragm to be removed.

NOTE: When installing diaphragm be sure the word “UP” is in the UP position.

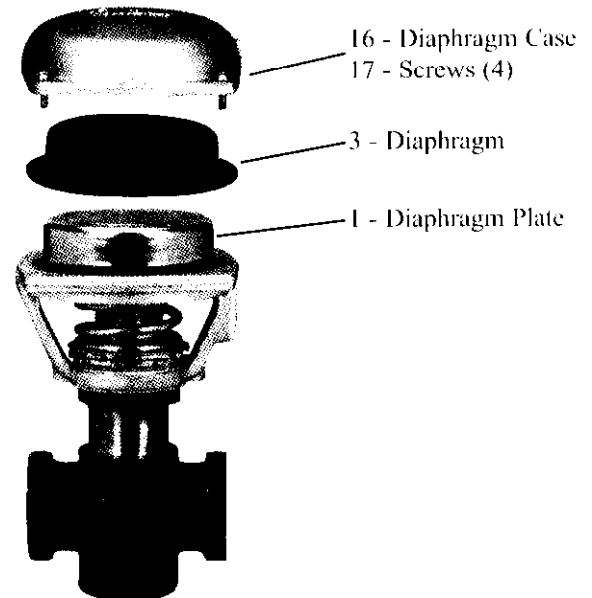


Figure 4 -- Replacement of Diaphragm

### C. REPLACEMENT OF SPRING (Figure 5)

1. Turn spring adjuster to the left to relieve spring tension.
2. Remove screws, diaphragm case, diaphragm and diaphragm plate.
3. Remove E-ring and spring seat.
4. Spring can now be removed and new one installed.
5. Reassemble in reverse order.

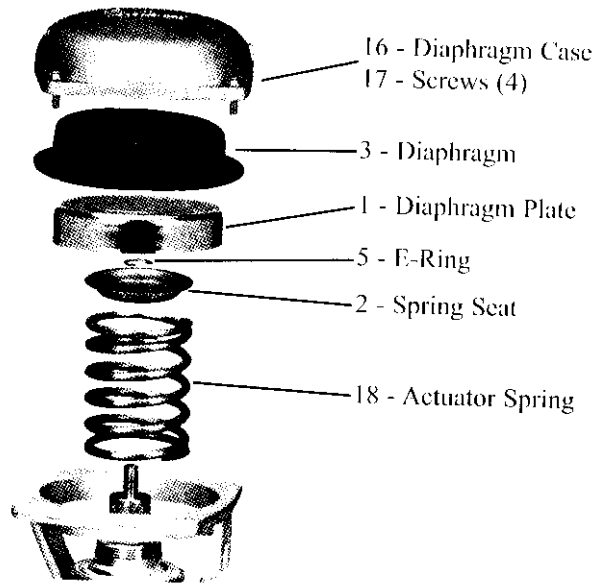


Figure 5 - Replacement of Spring

6. Remove cap screw and remove valve plug from stem and bellows assembly.
7. Reassemble in reverse order, using new Teflon packing, packing gland, spring seat in packing housing, and Teflon O-ring in valve plug and bonnet assembly.
8. Replace spring, spring seat and E-ring.
9. Replace diaphragm plate, diaphragm and diaphragm case.
10. Install four screws to hold diaphragm case to yoke. The diaphragm chamber must be leak-tight, so care must be taken to seat the diaphragm properly in the case groove.
11. Adjust spring adjuster to obtain proper spring load.

### PARTS LIST

#### ORDERING INFORMATION (PARTS)

From the illustrations appearing on the following pages choose the one corresponding to your valve style and identify parts required. Using detail numbers appearing alongside the part name, find the production part numbers for valve size and complete valve assembly number in Parts List Tables.

Please specify:

1. Complete model number.
2. Serial Number
3. Valve size
4. Detail number and part description
5. Production part number and figure number.

### D. REPLACEMENT OF THE BONNET ASSEMBLY, PACKING OR VALVE PLUG.

If valve stem leakage is encountered, the bonnet assembly must be replaced. The bonnet assembly includes a bonnet and a stem/bellows assembly. The stem and bellows assembly is factory sealed to the bonnet and cannot be removed and replaced.

1. Turn spring adjuster to the left to release spring tension.
2. Remove screws, diaphragm case, diaphragm and diaphragm plate.
3. Remove E-ring, spring seat and spring, lower spring seat, both spring adjusters and yoke.
4. Remove packing nut, packing gland, Teflon packing, spring seat, spring packing housing.
5. *Direct-Acting Valve* — Disconnect bonnet from valve body. Valve plug and stem and bellows assembly will be removed with the bonnet as a single unit.  
*Reverse-Acting Valve* — Remove bottom cap.  
*Three-Way Valve* — Remove adapter.



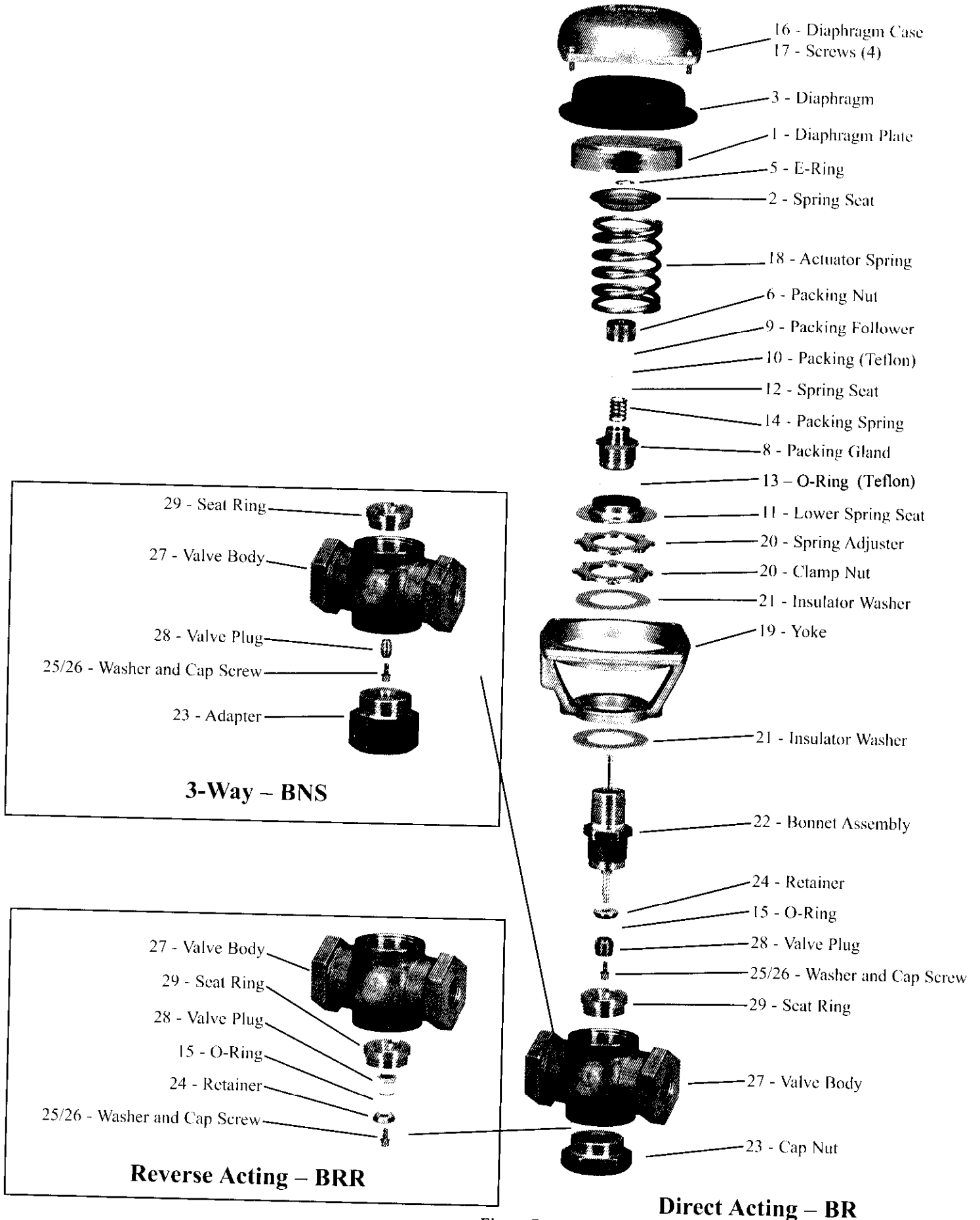


Figure 7

**VC-210 COMMON PARTS FOR  
ALL SIZES**

<b>Item No.</b>	<b>Description</b>	<b>Part Number</b>
1	Screw	33715-A1509
2	Diaphragm Case	25470-A1
3*	Diaphragm	25471-A2
4	Diaphragm Plate	25472-A1
5*	E-ring	36605-N2
6	Upper Spring Seat	25473-A1
7	Actuator Spring	See Table IV
8	Lower Spring Seat	25479-A1
9	Spring Adjuster	25468-A1
10	Clamp Nut	25468-A1
11	Insulator Washer (2)	28923-A1
12	Yoke	25469-C1

**TABLE IV**

<b>Spring Span</b>	<b>Spring Part Number</b>	<b>Bench Test (PSI)</b>		
		<b>Direct</b>	<b>Reverse</b>	<b>3-Way</b>
4	25483-G1	3 – 7	----	4 – 8
4	25483-H1	----	11 – 15	9 – 13
7	25483-L1	----	8 – 15	----
9	25483-M1	3 – 12	6 – 15	5 – 14

Notes:

1. \* Designates recommended spare parts.

**PARTS LIST FOR FIGURE 7**

<b>TWO-WAY VALVE WITH EQUAL PERCENTAGE CHARACTERISTICS</b>							
Item No.	Valve Action/Style	Direct-Acting VC-210-BR			Reverse-Acting VC-210-BRR		
	Size	1/2"	3/4"	1"	1/2"	3/4"	1"
	Assembly Number	81754J010X	81754-J020X	81754-J030X	81754-K010X	81754-K020X	81754-K030X
1	Diaphragm Plate	25472-A1	25472-A1	25472-A1	25472-A1	25472-A1	25472-A1
2	Spring Seat	25473-A1	25473-A1	25473-A1	25473-A1	25473-A1	25473-A1
3	Diaphragm	25471-A2	25471-A2	25471-A2	25471-A2	25471-A2	25471-A2
5	E-Ring	36605-N2	36605-N2	36605-N2	36605-N2	36605-N2	36605-N2
6	Packing Nut	23086	23086	23086	23086	23086	23086
8	Packing Gland	29659-A2	29659-A2	29659-A2	29659-A2	29659-A2	29659-A2
9	Packing Follower	27666-A1	27666-A1	27666-A1	27666-A1	27666-A1	27666-A1
10	Packing (3)	21642	21642	21642	21642	21642	21642
11	Lower Spring Seat	25479-A1	25479-A1	25479-A1	25479-A1	25479-A1	25479-A1
12	Spring Seat	27667-A1	27667-A1	27667-A1	27667-A1	27667-A1	27667-A1
13	O-Ring (Teflon)	36240-W21	36240-W21	36240-W21	36240-W21	36240-W21	36240-W21
14	Packing Spring	25000-A1	25000-A1	25000-A1	25000-A1	25000-A1	25000-A1
15	O-Ring (Teflon)	36240-W111	36240-W115	36240-W211	36240-W111	36240-W115	36240-W211
16	Diaphragm Case	025470-A1	025470-A1	025470-A1	025470-A1	025470-A1	025470-A1
17	Screw (4)	33715-A1509	33715-A1509	33715-A1509	33715-A1509	33715-A1509	33715-A1509
18	Actuator Spring	See Table IV	See Table IV	See Table IV	See Table IV	See Table IV	See Table IV
19	Yoke	25469-C1	25469-C1	25469-C1	25469-C1	25469-C1	25469-C1
20	Spring Adjuster	25468-A1	25468-A1	25468-A1	25468-A1	25468-A1	25468-A1
20	Clamp Nut	25468-A1	25468-A1	25468-A1	25468-A1	25468-A1	25468-A1
21	Insulator Washer (2)	28923-A1	28923-A1	28923-A1	28923-A1	28923-A1	28923-A1
22	Bonnet Assembly	86508-A1	86508-A1	86508-A1	86508-A2	86508-A2	86508-A2
23	Cap Nut	26976-A1	26976-A1	26976-A1	26976-A1	26976-A1	26976-A1
24	Retainer	29634-A1	29634-B1	29634-C1	29634-A1	29634-B1	29634-C1
25	Washer	29648-A1	29648-A1	29648-A1	29648-A1	29648-A1	29648-A1
26	Cap Screw	36713-A1130	36713-A1130	36713-A1130	36713-A1130	36713-A1130	36713-A1130
27	Valve Body	26971-A5	26971-A1	26971-A3	26971-A5	26971-A1	26971-A3
28	Valve Plug	29633-D1	29633-F1	29633-A1	29633-D1	29633-F1	29633-A1
29	Seat Ring	29635-D1	29635-B1	29635-C1	29635-D1	29635-B1	29635-C1

<b>TWO-WAY VALVE WITH QUICK OPENING CHARACTERISTICS</b>							
Item No.	Valve Action/Style	Direct-Acting VC-210-BR			Reverse-Acting VC-210-BRR		
	Size	1/2"	3/4"	1"	1/2"	3/4"	1"
	Assembly Number	81754-J070X	81754-J080X	81754-J090X	81754-K070X	81754-K080X	81754-K090X
28	Valve Plug	29633-G1	29633-H1	29633-J1	29633-G1	29633-H1	29633-J1

All Other Components For Quick Opening Are The Same As For = %

<b>THREE-WAY VALVE WITH LINEAR CHARACTERISTICS</b>				
Item No.	Valve Style	VC-210-BNS		
	Size	1/2"	3/4"	1"
	Assembly Number	81754-L040X	81754-L050X	81754-L060X
15	O-Ring (Teflon)	Omit	Omit	Omit
23	Adapter	26969-C1	26969-C2	26969-C3
24	Retainer	Omit	Omit	Omit
28	Valve Plug	25497-K2	25498-D2	25499-C2

All Other Components For Three Way Valves Are The Same As For Two-Way Valves



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**Printed in U.S.A.**