VINDUM ENGINEERING

CV Series
High-Pressure Valves

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Chapter 1

1. General Overview

The Vindum Engineering CV High Pressure Valves are available in two configurations; either as a 2-position, on/off valve, or a 3-way, 4-position valve. The CV Valves are air-actuated, constant-volume valves with a switching time of less than .1 second. They are typically used as switching devices in high-pressure fluid flow systems. The valves are designed so that no fluid is displaced when they are opened or closed. This allows them to be useful in systems requiring constant volumes or constant pressures during the switching cycle.

All CV Valves utilize either 316 stainless steel, which is corrosion resistant, or Hastelloy C-276, which is used for brine applications or highly corrosive fluids. Our standard valves have a temperature rating of 180°F (80°C). Valves with our high temperature option have a temperature rating of 320°F (160°C).

1.1 Configuration

Each CV Valve is customized to the needs of the user by utilizing the following options:

The CV Valve can be built as either:

- 2-Way, on/off valve which is supplied with a single solenoid pilot valve
- 3-Way, 4 position valve which is supplied with 2 solenoid pilot valves. The 3-way, 4-position valve contains two independently operated valves that are connected with a tee.

1.2 Main O-Ring Seal Material

The following materials are available for the main o-ring seal. The o-ring seal material needs to agree with the fluid used.

- Aflas
- Buna
- Teflon
- UHMW
- Viton

1.3 Pressure Rating

The CV-Valve can have a pressure rating of either 5,000; 10,000; or 20,000 psi.

1.4 Solenoid Pilot Valve

The solenoid pilot valves for the 85 to 1,000 psi air supply can be operated by either:

- 12 VDC
- 24 VDC

1.5 Valve Temperature Rating

- Standard Ambient Temperature: 180°F (80°C) with push-in type air line fittings.
- Optional High Temperature: 320°F (160°C) with compression type air line fittings

1.6 Wetted Parts

There are two options of materials for the valves wetted parts. (The parts of the valve that will come in contact with the fluid:

- 316 Stainless Steel for inert materials, or
- Hastelloy C-276 for corrosive materials or brine

1.7 Everything is included with your CV Valve

- Valve
- High Pressure Fittings
- Solenoid Pilot Valves
- Pneumatic fittings
- 1/8" air tubing

The following tables show additional Valve information.

CV VALVE MODELS			
Valve Model	**Maximum Pressure Rating [PSI (Bar)]**	**Internal Volume (cc)**	**Approximate Flow Coefficient (CP)**
2-Way On-Off Valves			
CV-210	10,000 (700)	0.11	.06
CV-405	5,000 (350)	0.44	.24
CV-410	10,000 (700)	0,44	.12
CV-420	20,000 (1400)	0.22	.03
3-Way 4 Position Valves			
CV-310	10,000 (700)	0.31	.06
CV-505	5,000 (350)	1.08	.24
CV-510	10,000 (700)	0.74	.12
CV-520	20,000 (1400)	0.62	.03

Table 1-1

Valve Size		
Valve Model	**Fittings (Autoclave Engineers)**	**Valve Dimensions**
2-Way On-Off Valves		
CV-210	W125 - 1/8” Speedbite	2” diameter x 1.695” (5.0 cm diameter x 4.3 cm
CV-405	SW250 - 1/4” Speedbite	2.25” diameter x 1.95” (5.7 cm x 4.9 cm)
CV-410	SW250 - 1/4” Speedbite	2.25” diameter x 1.95” (5.7 cm x 4.9 cm)
CV-420	F250C - 1/4” High Pressure	2.25” diameter x 1.95” (5.7 cm x 4.9 cm)
3-Way 4 Position Valves		
CV-310	W125 - 1/8” Speedbite	2” diameter x 3.645” (5.0 cm x 9.2 cm)
CV-505	SW250 - 1/4” Speedbite	2.25” diameter x 4.435” (57 cm x 11.3 cm)
CV-510	SW250 - 1/4” Speedbite	2.25” diameter x 4.435” (57 cm x 11.3 cm)
CV-520	F250C - 1/4” High Pressure	2.25” diameter x 4.435” (57 cm x 11.3 cm)

Table 1-2

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Chapter 2

2. UNDERSTANDING YOUR VALVE

2.1 Principles of Operation for the 2-Way Valve

Each CV 2-Way Valve **contains** two air supply tubes, which are connected to one solenoid-operated pilot valve. Pressurized air passes from the solenoid pilot valve through one of the air supply tubes into the 2-Way valve's piston assembly. Within the piston assembly is a cone that serves as a "gate", which either opens and allows fluid to flow or closes and stops fluid from flowing.

- Pressurized air passing through air supply tube A moves an internal cone back towards the valve bracket. This causes the valve to open and fluid to flow. This is considered the "open" position.

- Pressurized air passing through air supply tube B moves an internal cone away from the bracket. This causes the valve to close and fluid to stop. This is considered the "closed" position.

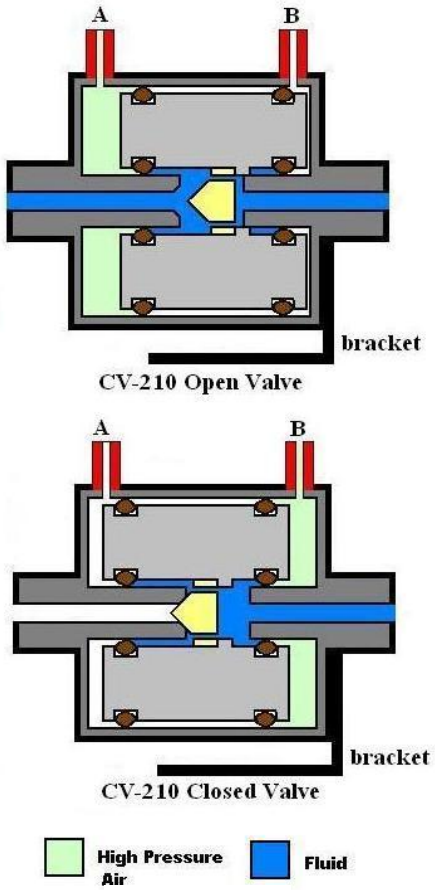

Figure 2.1

2.1.1 Possible Configurations of the 2-Way Valve

The 2-Way CV Valve is an on/off valve. It can be configured in two ways, either normally open or normally closed. In case of a power failure, it can be set to open or to close. (ADD cross Reference) See ...Regarding the Use of the Solenoid Pilot Valves)

2.1.2 Direction of Flow

The fluid can flow through the valve in either direction. The sketch shows the fluid coming in from the right side.

2.2 Principles of Operation for the 3-Way Valve

The CV 3-Way Valve contains two piston assemblies, which are connected by a center fitting (tee), and four air supply tubes. Two air supply tubes run between each piston assembly and solenoid pilot valve. Two solenoid pilot valves are then attached to an air manifold.

2.2.1 Possible Configurations of the 3-Way Valve

Because the three-way CV Valve contains the equivalent of two 2-Way valves, it can be used as two independently operated on-off valves, or as a single 3-way, 4-position switching valve. The 3-way valve can be operated in the following four positions.

2.2.1.1 Open / Closed Position (A1 / B2)

- Air flows into air-inlet port A1, causing the cone inside of valve 1's piston assembly to open.
- Air flows into air-inlet port B2 causing the cone inside of valve 2's piston assembly to close.

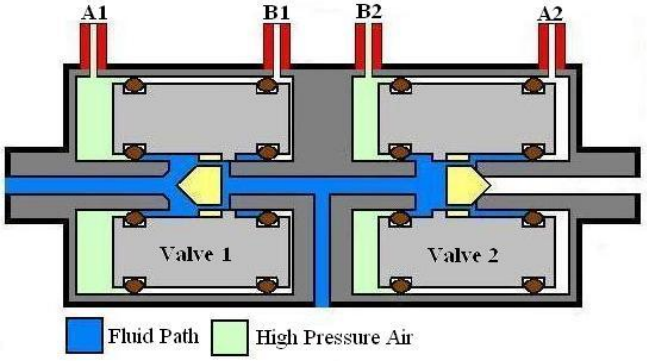

Figure 2.2 Open/Closed Valve

2.2.1.2 Closed / Open Position (B1 / A2)

- Air flows into air-inlet port B1 causing the cone inside of valve 1's piston assembly to close.
- Air flows into air-inlet port A2 causing the cone inside of valve 2's piston assembly to open.

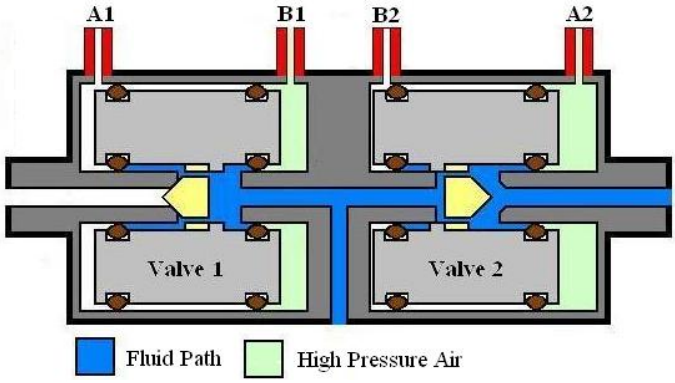

Figure 2.3 Closed/Open Valve

2.2.1.3 Open / Open Position (A1 / A2)

- Air flows into air-inlet port A1 causing the cone inside of valve 1's piston assembly to open.
- Air flows into air-inlet port A2 causing the cone inside of valve 2's piston assembly to open.

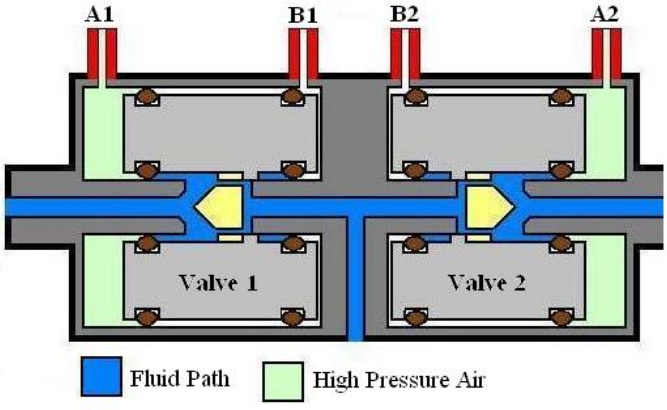

Figure 2.4 Open/Open Valve

2.2.1.4 Closed / Closed Position (B1 / B2)

- Air flows into air inlet port B1 causing the cone inside of valve 1's piston assembly to close.

- Air flows into air inlet port B2 causing the cone inside of valve 2's piston assembly to close.

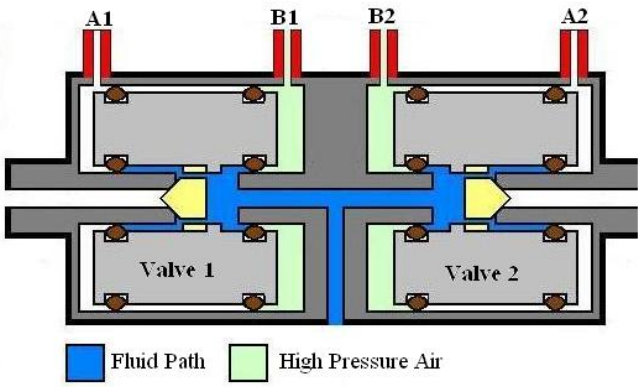

Figure 2.5 Closed/Closed Valve

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Chapter 3

3. Solenoid Pilot Valves and Manifolds

The CV-Series Valves are completely air actuated. Air is taken into the air inlet and distributed to the solenoid pilot manifolds. The solenoid pilots then distribute and control the air flow to the valves.

3.1 Air Supply Requirements

Because the CV Valves are completely air-actuated, 85 to 115 PSIG of filtered air must be connected to the solenoid pilot valves at all times. Failure to maintain sufficient air pressure at the appropriate port on the CV Valves can result in valve malfunction, leakage and subsequent loss of control. Following are the air supply requirements for all CV Valves.

- The air must be clean.
- The air must be dry because moisture in the air supply will cause the solenoid pilot valves to rust and malfunction.
- The air must be oil-free.
- The air must be 85 - 115 PSI (5.95 to 8.05 bar). If air pressure exceeds this, the solenoid pilot valves may stop working.

A standard, filtered laboratory air supply from an air compressor is adequate if it meets the above criteria. The air compressor should be equipped with a dryer because water vapor in the air lines will cause the pilot valves to rust and malfunction. Tanks of compressed air should not be used as a pressurized air source.

3.2 Electrical Power

The solenoid pilot valves require electrical power to re-direct air pressure from one valve port to another. If electrical power is lost, the solenoid pilot valves position themselves to their default; non-energized position and valve control is lost. In this situation the “B” port of the solenoid pilot valve becomes pressured and the “A” port has no pressure on it. For this reason, electrical failure should be taken into consideration and the lines should be connected so that if a power failure does occur, a dangerous situation is not created.

- Figure 3-1, below, shows the correct connections for “normally closed” operation of the CV-210 Valve with a single solenoid pilot valve.

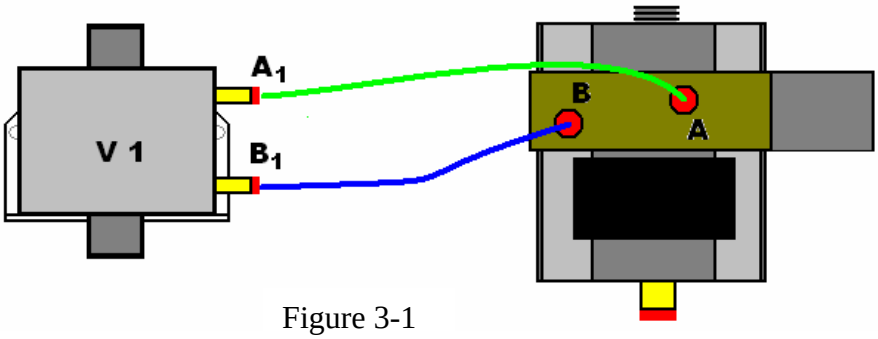

Figure 3-1

- Figure 3-2, below, shows the correct connections for “normally closed” operation for the CV-310 Valve with two solenoid pilot valves. For both valves, fluid can flow in either direction.

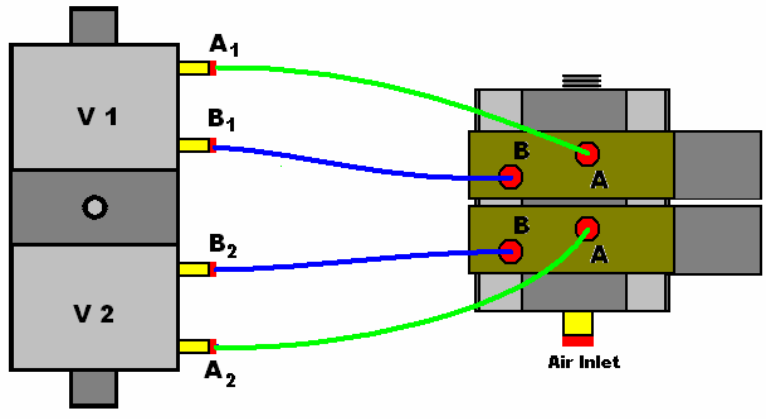

Figure 3-2

3.3 Air Input and Output

As previously mentioned, the CV Valves are air-actuated. Incoming air must be connected at the solenoid pilot valves’ air inlet port, as shown in Figure 3-3. The air inlet at the bottom of the manifold (marked with a “P”) has a ¼ inch quick-disconnect fitting. Into this fitting the user should insert a 1/4 inch air line that is connected to a pressurized air source, regulated at 85 - 115 PSIG. A standard, filtered laboratory air supply from an air compressor is adequate if it is clean, dry and oil-free.

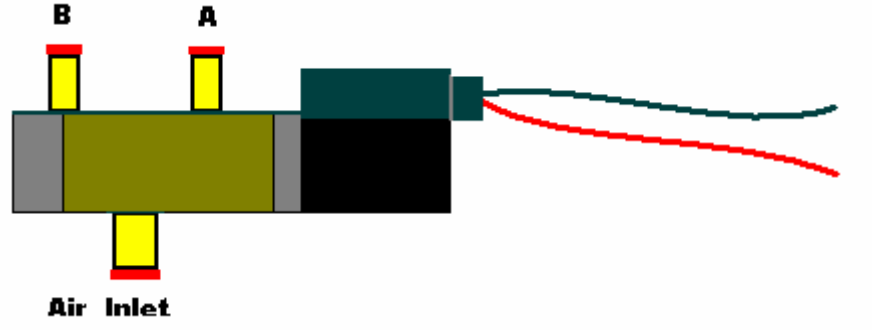

Figure 3-3

NOTE: The air compressor should be equipped with a dryer because water vapor in the air lines will cause the solenoid pilot valves to rust and malfunction.

The air inlet fittings on the CV Valves are plastic “quick disconnects”, the same as the outlet fittings on the solenoid pilot valves. To connect the solenoid pilot valve(s) to the CV Valve, 1/8” nylon tubing should be used on these fittings.

- If normally-open operation is desired for a CV-210 Valve, connect the solenoid pilot valve to the CV-210 Valve as shown in Figure 3-4

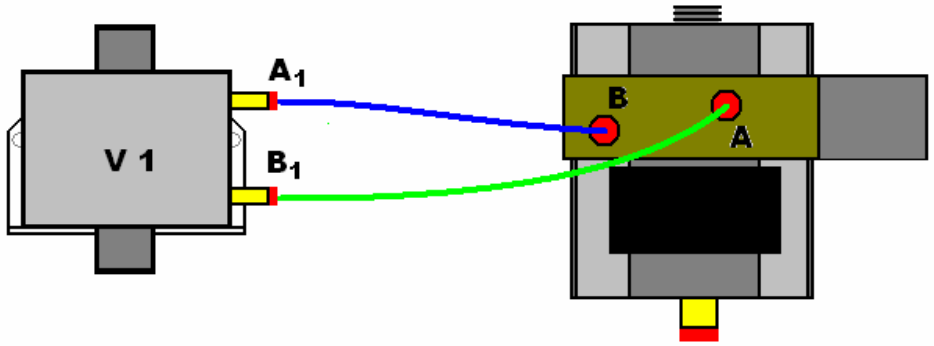

Figure 3-4

- If normally-open operation is desired for a CV-310 Valve, connect the solenoid pilot valves to the CV-310 Valve as shown in Figure 3-5.

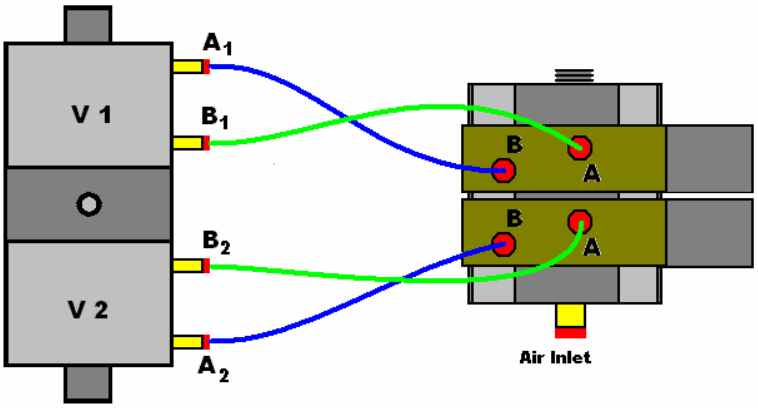

Figure 3-5

NOTE: Before any of the air lines connecting the solenoid pilot valves to the CV Valves are disconnected, for any reason, some type of numbered or color-coded tags should be placed on each air line, each solenoid pilot valve fitting, and each CV Valve fitting to ensure the correct connections are made during reassembly.

3.4 High Temperature CV Valves

If you are connecting a high temperature CV Valve, the following two changes should be made when installing the air lines.

- The 1/8” tubing used for the air connection between the solenoid pilot valve and the CV Valve must be made of Teflon instead of nylon.

- The inlet air line fittings on the CV Valve will be swage-type fittings with metal ferrules. The tubing is slid through the back side of the threaded cap. The metal ferrule is then slid onto the end of the air line, and the threaded cap is firmly tightened onto the fitting, compressing the ferrule onto the air line.

If using CV Valves in an application where they are placed in an oven, the solenoid pilot valves should be placed outside of the oven and the Teflon air lines connecting them to the CV Valves should be as short as possible.

Chapter 4

4. CV-200 Series and CV-400 Series Valve Maintenance

The information contained in Chapter 4 explains how to disassemble, reassemble and service all of the CV-series on-off valves. Chapter 5 will explain how to service the 3-way valves. The piston assemblies and sleeve assemblies in the 3-way valves are relative to those used in the on-off valves, so most of the information in his chapter also pertains to 3-way valves.

Figure 4-1 is an expanded view of the CV-210 Valve. The CV-400 Series valves are similar, except that they are slightly larger in size. Throughout this chapter, refer to Figure 4-1 for component numerical references, which will be shown in brackets. For example, the two 8-32 x 1/2" socket-head cap screws shown as number “1” will be referenced as “[1]”.

4.1 Tools You Will Need

You will need the following tools in order to maintain your valves.

- 1 each - 9/64 inch Allen wrench
- 1 each - 1/2 inch adjustable wrench
- 2 each - 3/4 inch adjustable wrenches
- Q-Tips cotton ended ear swabs

Note: Power needs to be turned off.

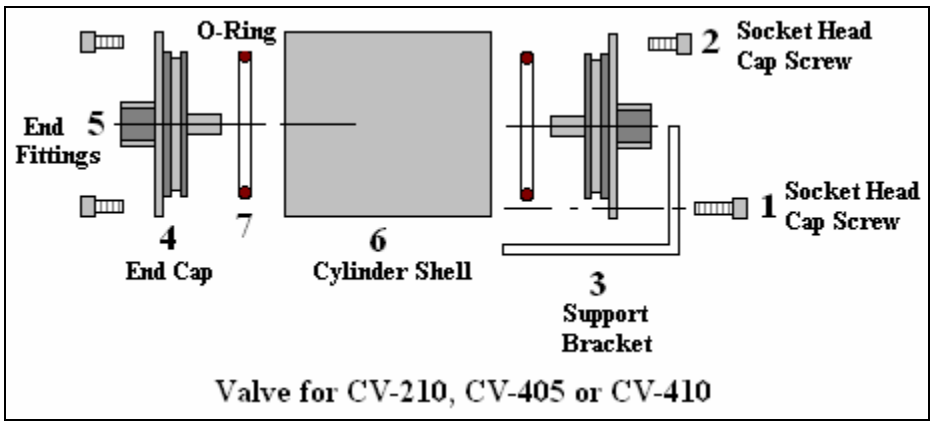

Figure 4-1

4.2 Disassembling the 2-Way Valve

To disassemble the CV-200 Series or the CV-400 Series valve, refer to Figure 4-1, above, while following the instructions below.

1. Use a 9/64” Allen wrench to remove the two 8-32 x 5/8” socket head cap screws [1] securing the valve to the Support Bracket [3].
2. Remove the remaining six 8-32 x 1/2" socket-head cap screws [2] securing both End Caps [4] in place.

3. Grasp the valve in one hand and slide a 1/2” adjustable wrench onto one of the end fittings [5]. Use the wrench to rotate the End Fitting and End Cap in a clockwise direction while simultaneously applying force **away from** the body of the valve. When there is sufficient space between the End Cap and the Cylinder Shell [6], grasp the End Cap by hand and **gently** separate the two parts. As the End Cap begins to separate from the Cylinder Shell, continue to pull “straight back”, with a minimum amount of “rocking back-and-forth”.

NOTE: The End Fitting is permanently attached to the End Cap with “Loctite® 272”.

4. Inspect the polished stem on the End Fitting to make sure that it is free of scratches. If it is scratched, it needs to be polished using 2,000 grid paper. Polishing the stem is easiest if done on a lathe.

5. Repeat step 3 with the other end of the End Cap/End Fitting, and set both pairs of parts aside on a clean work surface.

6. Gently slide the Piston Assembly [8] out of the Cylinder Shell [6], and set the Cylinder Shell aside.

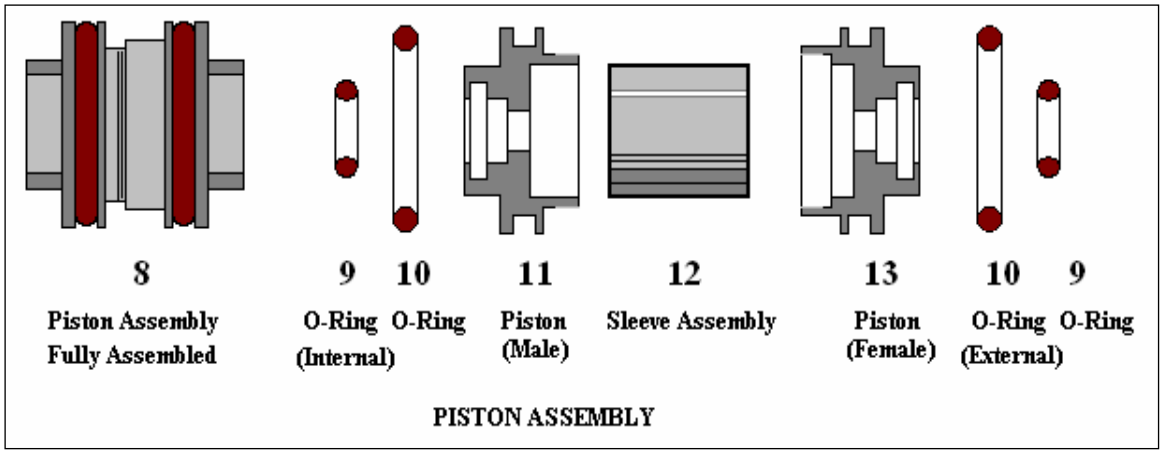

Figure 4-2

4.3 Disassembling the Piston Assembly

Refer to Figure 4-2, above, for the following instructions.

1. Slide two 3/4” adjustable wrenches over the flats on the outside of both the Piston halves [11] and [13].

2. Turn the either one of the Piston halves counter-clockwise, while holding the other Piston stationary with the wrench. After the two halves “break free”, continue to gently unscrew them by hand and set both pieces aside on a clean surface with their threaded sides “up”.
3. Remove the Sleeve Assembly [12] from the Left Piston by hand.

4.4 Disassembling the Sleeve Assembly

Refer to Figures 4-3, 4-4, or 4-5 to Disassemble the Sleeve Assembly for your CV Valve.

1. Grasp the Sleeve Assembly and, using a Q-Tip or other appropriate tool; GENTLY slide it into the inside of one of the PEEK Back-Up Rings [14] on either side of the Sleeve Assembly. Only slide the End Fitting (or tool) in far enough to capture the Peek Back-Up Ring, but not the Teflon Back-up Ring [15] or the O-ring [16].

2. Remove the Peek Back-Up Ring.

3. The objective of this step is to remove the rings one at a time without damaging the inside surface of the Sleeve. Repeat steps 1 and 2 for all remaining back-up and o-rings in the Sleeve Assembly, removing them one at a time.

Note: The sleeve assembly is slightly different for each CV-Valve Model. The figures below show details for the CV-210 / CV-310 Valves, (Figure 4-3), the CV-405 / CV-410 / CV-505 and CV-510 Valves, (Figure 4-4) and the CV-420 / CV-520 Valves, (Figure 4-5).

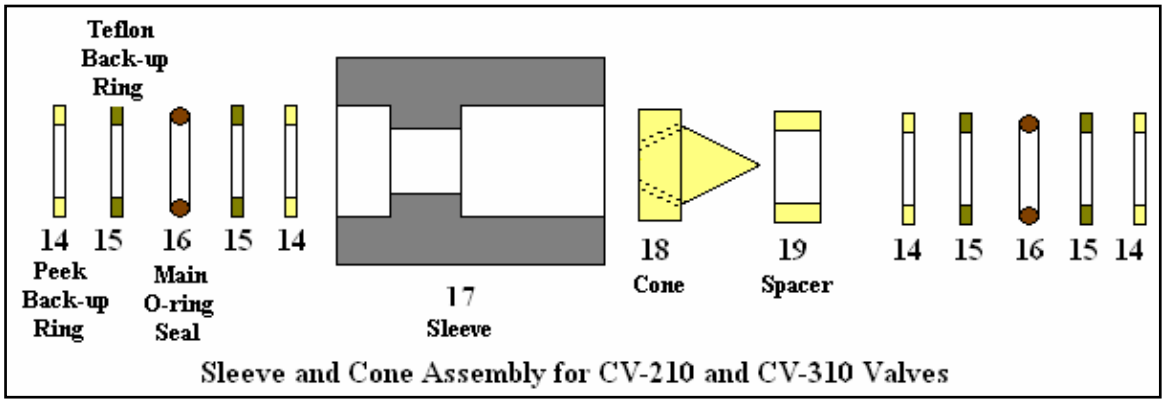

Figure 4-3

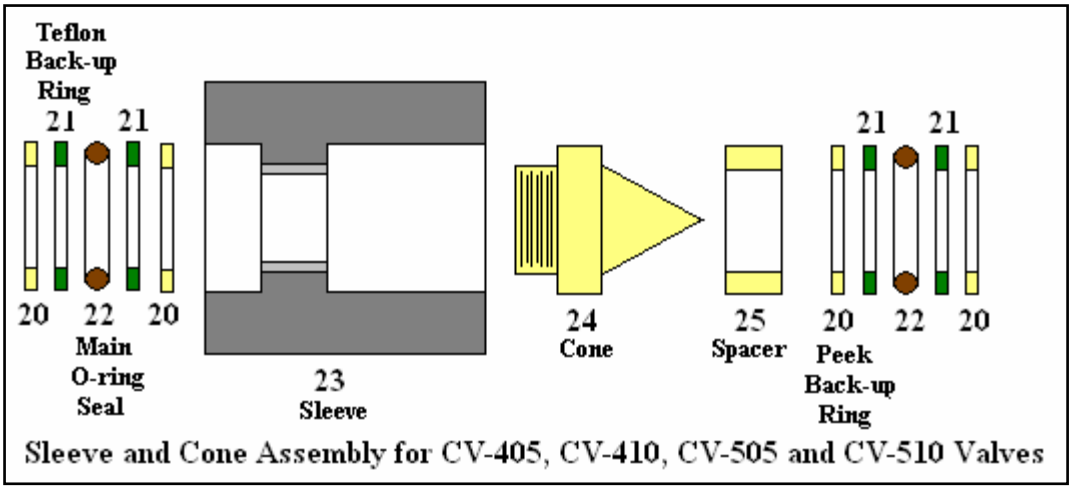

Figure 4-4

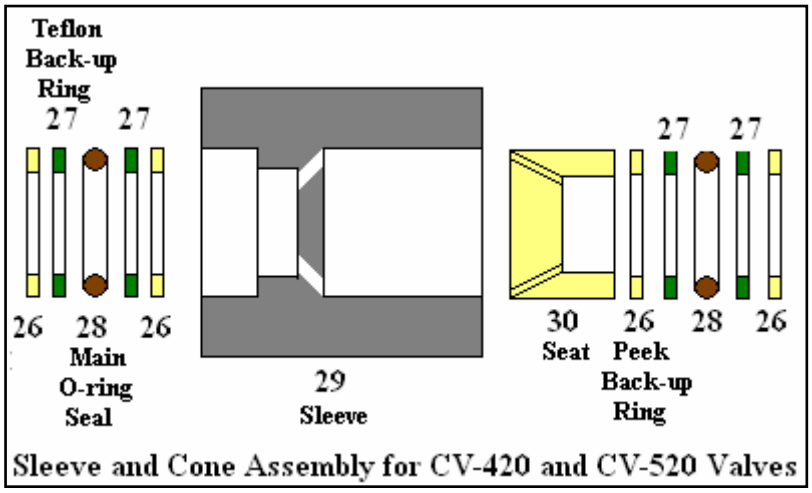

Figure 4-5

4.5 Inspecting the Sleeve and Cone

Now that the outside ring, o-ring and the back-up ring are removed, wipe everything dry with a clean paper towel or a clean cloth.

Look inside of the sleeve. Check to make sure the area inside of the sleeve where the o-ring sits is clean and scratch-free. If there is a build-up, or anything is stuck on the sleeve barrel, remove it. You may use a solvent and rag to clean the sleeve assembly. DO NOT use steel wool. If you see any scratches inside of the sleeve where the o-ring sits, a new o-ring may leak. You may need to polish the scratches out or purchase a replacement sleeve.

Next inspect the cone, which is inside of the sleeve. Check to make sure the cone has no scratches, nicks, cracks or broken-off areas. Make sure the cone does not appear off-

center or have an asymmetrical wear pattern. Proceed only if the cone appears in good condition. If the cone displays any of the above problems, refer to Appendix 1 for information on replacing it.

4.6 Reassembling the Sleeve Assembly

To reassemble the Sleeve Assembly, follow the instructions below.

5. Carefully slide the two PEEK Back-up Rings [14, 20 or 26] into both sides of the Sleeve, on top of the spacer [19 or 25] and one into the other side of the Sleeve. Press these Back-up Rings all the way down so that they are seated flat.

6. Next, carefully slide the two Teflon® Back-up Rings [15, 21 or 27] into both sides of the Sleeve on top of the PEEK Back-up Rings. Again, press these Back-up Rings all the way down so that they are seated flat.

7. Gently insert the Main O-ring [16, 22, or 28] into each end of the Sleeve. Prevent the O-rings from rolling or binding. When fully pressed in, the Main O-ring should be resting flat against the Teflon® Back-up Ring.

8. Carefully slide a second Teflon® Back-up Ring into each side of the Sleeve on top of the Main O-rings. Press the Teflon Back-up Ring all the way down until it is seated flat against the Main O-ring.

9. Slide a second PEEK Back-up Ring into each side of the Sleeve. Make sure it is seated flat and does not protrude outside the outer edge of the sleeve.

4.7 Reassembling the Piston Assembly

Refer to Figure 4-2 to reassemble the Piston Assembly, following the instructions below.

1. The larger half of the Piston Assembly, the Left Piston [11] has male threads. Slide the Sleeve Assembly [12] into this part with the point of the Cone facing out.

2. Gently screw the right Piston into the Left Piston. When the two halves become “snug” use two 3/4” adjustable wrenches to tighten them.

3. As shown in Figure 4-2, each Piston half has two O-rings; one larger, external O-ring [10] and one smaller, internal O-ring [9]. To remove any of these, use a tool such as a small wooden skewer or nylon rod, approximately 1/8” in diameter and tapered at one end. Use care not to scratch or leave particles in the O-ring grooves.

4. Use the tapered end of the tool to gently remove any O-rings. For the larger, external O-rings, gently replace them but do not “roll” them into their respective grooves. When they are in place, they should not be twisted.

4.8 Reassembling the 2-Way Valve

To re-assemble the Valve, follow the instruction below.

1. Replace the O-rings [7] on the End Caps [4], after verifying that there are no foreign particles of wood, or any other materials, on any O-rings and that all O-rings are not twisted.

2. Apply a small amount of high quality grease (not oil) to the external o-rings [10] and the smaller internal O-rings [9]. **Vindum Engineering uses Parker O-Lube® for ambient temperature valves and Dow Corning 55 (M)® for high temperature valves.**

3. Gently slide the Piston Assembly into the Cylinder Shell. **Place a small piece of adhesive tape on the outside of the Cylinder Shell and draw an arrow on the tape pointing in the direction of the "cone point".**

4. The End Fittings [5] and Main O-rings [16, 22 or 28] must be lubricated on the surfaces that will slide into the Piston. Apply a drop of lightweight oil on these surfaces on each End Fitting and spread the oil completely around them. This oil should be compatible with the fluids with which this valve will be used.

5. Using a gentle rotating motion, slide both End Caps **completely** into both sides of the Cylinder Shell.

6. Use the 9/64" Allen wrench to replace the four 8-32 x 1/2" socket-head cap screws on the side of the Cylinder Shell to which the cone is pointing. Tighten all four screws snugly.

7. Use the Allen wrench to replace the two 8-32 x 5/8" screws securing the valve to the Support Bracket, and the other two 8-32 x 1/2" screws into the end Cap on the bracket side.

Chapter 5

5. CV-300 Series and CV-500 Series Valve Maintenance

The information contained in Chapter 5 explains how to disassemble, reassemble and service all of the CV Series 3-way valves.

5.1 Differences Between the CV 2-Way and 3-Way Valves

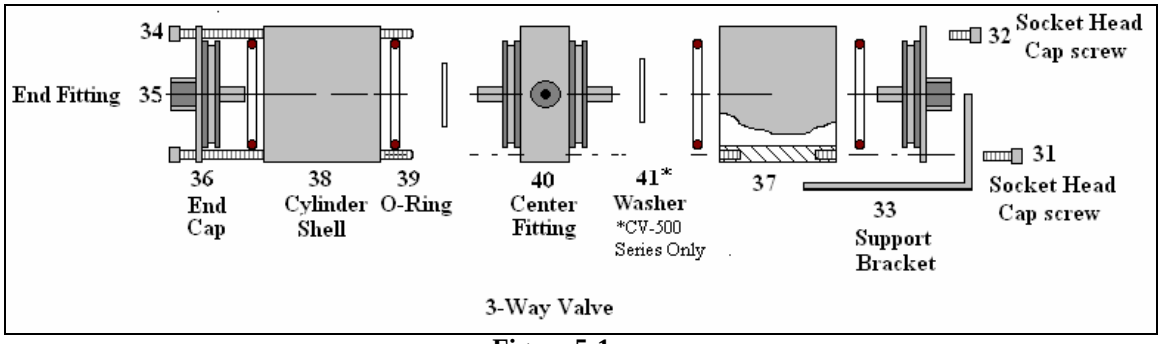

Figure 5-1

The 3-way CV Valve contains all of the same sub-assemblies as the 2-way CV Valve. The 3-way valve is basically two 2-way valves connected in the middle with a Center Fitting [40]. As shown in Figure 5-1, the Center Fitting is a symmetrical part with a "nipple-like" appendage on each side which fits into each of the Piston Assemblies. The Center Fitting also has an O-ring [39] on each side to provide a seal with the two Cylinder Shells. Instead of the Cylinder Shell being threaded on both sides to secure the End Caps, as with the 2-way valve, one Cylinder Shell is bored and one is threaded so that longer (2-1/2") socket-head cap screws can be used to connect the two halves of the valve. The larger CV-500 Series Valves have a Washer [41] located on each side of the Center Fitting [40].

5.2 Disassembling the 3-Way Valve

1. Use a 9/64" Allen wrench to remove all of the 8-32 Socket Head Cap Screws from both ends of the valve. Separate the two "valve halves" by grasping the two Cylinder Shells by hand and **gently** twisting them in opposite directions while pulling them apart.

2. When the two valve halves have been separated, pull the Center Fitting free of the Cylinder Shell it is still attached to, and set it aside.

3. Each half of the valve may now be disassembled as if it were a separate 2-way valve.

4. Grasp either of the halves of the 3-way valve in one hand and slide a 1/2" adjustable wrench onto one of the End fittings [35]. Use the wrench to rotate the End Fitting and End Cap [36] in a clockwise direction while simultaneously applying force away

from the body of the valve. When there is sufficient space between the End Cap and the Cylinder shell [37] [38], grasp the End Cap by hand and gently separate the two parts. As the End Cap begins to separate from the Cylinder Shell, continue to pull "straight back", with a minimum amount of "rocking back-and-forth".

NOTE: The End Fitting is permanently attached to the End Cap with "Loctite® 272".

5. Repeat step 4 with the other End Cap / End Fitting, and set both pairs of parts aside on a clean work surface.

6. Gently slide the Piston Assemblies out of the Cylinder shells and set the Cylinder Shells aside.

5.3 Disassembling the Piston Assembly

Refer to Chapter 4, Section 4.3 Disassembling the Piston Assembly, Page14, for instructions.

5.4 Disassembling the Sleeve Assembly

Refer to Chapter 4, Section 4.4 Disassembling the Sleeve Assembly, Page 15, for instructions.

5.5 Reassembling the Sleeve Assembly

Refer to Chapter 4, Section 4.6 Reassembling the Sleeve Assembly, Page 17, for instructions.

5.6 Reassembling the Piston Assembly

Refer to Chapter 4, Section 4.7 Reassembling the Piston Assembly, Page 17, for instructions.

5.7 Reassembling the 3-Way Valve

To reassemble the valve, follow the instructions below.

1. Verify that there are no foreign particles of wood, or any other materials, on any O-rings. Make sure that all O-rings are not twisted.

2. Replace the O-rings [39] on both End Caps [36].

3. Gently slide the Piston Assembly into the Cylinder shell. **Place a small piece of adhesive tape on the outside of the Cylinder Shell and draw an arrow on the tape pointing in the direction of the "cone point".**

4. On the 3-way valve, lubricate the stems on both sides of the Center Fitting [40]. The stems will slide into the two Piston Assemblies.

5. Lubricate the narrow stems of each End Fitting [35].

6. Lubricate the O-rings [39] on both sides of the Center Fitting. Only lubricate the part that will slide into the Cylinder Shells.

7. Lubricate the other two O-rings [39].

8. Making sure that the “cone points” are each facing **AWAY FROM THE CENTER FITTING**, gently slide each of the Cylinder Shell / Piston Assemblies on to the Center Fitting.

9. Using a gentle rotating motion, gently slide both End Caps completely into both ends of the Cylinder Shells.

10. Use the 3/4" adjustable wrench to rotate each of the End Caps until their four clearance holes are aligned with those on the Cylinder Shells. Look through the clearance holes on each End Cap to see which End Cap is on the bored Cylinder Shell and carefully insert the 8-32 x 2-1/2” cap screws through the End Cap and the bored Cylinder Shell, just until the screws contact the Center Fitting.

11. Hold the Shell stationary, and gently rotate the Center Fitting until the screws can be passed through it.

12. Hold the bored Cylinder Shell and the Center Fitting stationary, and gently rotate the threaded Cylinder Shell until the screws can be easily threaded into it.

13. Make sure that the Fluid Port on the Center Fitting, and the Air Fittings on the Cylinder Shells, are oriented in the correct direction relative to each other.

14. Use the 9/64” Allen wrench to tighten all four screws snugly.

15. On the other End Cap, thread the two 8-32 x 5/8” screws through the Support Bracket [33] and into the Cylinder Shell [37]. Make sure that the Fluid Inlet Port on the valve is facing the desired direction.

16. Use the Allen wrench to replace the remainder of the 8-32” socket-head cap screws. Tighten all screws snugly.

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Chapter 6

6. Maintenance & Troubleshooting

This chapter will help the user solve problems that might be encountered when operating the CV Valve. The following sections are included:

- Air Supply Problems, Section 6.1
- Fluid Supply Problems, Section 6.2
- Valve Does Not Seal, Section 6.3

6.1 Air Supply Problems

CV Valves are air actuated. Filtered air (85 to 115 PSIG) must be connected to the solenoid pilot valves at all times. When encountering air supply problems, the first thing to do is complete the following two checks:

- Solenoid Pilot Valve Visual Check, Section 6.1.1
- Solenoid Pilot Valve Audio Check, Section 6.1.2

Solenoid Pilot Valves are electrically operated to control air flow. They are used to open or close the fluid inlets inside of CV Valves. The solenoid pilot manifold takes in air from the user's air supply and distributes that air to the solenoid pilot valves. There is one solenoid pilot valve for each On/Off Valve and two solenoid pilot valves for each 3-Way Valve.

When encountering air supply problems, the user should perform both the Solenoid Pilot Valve Visual Check and the Solenoid Pilot Valve Audio Check.

6.1.1 Solenoid Pilot Valve Visual Check

The Solenoid Pilot Valve Visual Check confirms that the solenoid pilot valves are operating properly. Some solenoid pilot valves are equipped with a small red indicator light. When a valve is energized, the corresponding solenoid pilot valve indicator light turns ON and when a valve is de-energized, the corresponding solenoid pilot valve indicator light turns OFF. If the solenoid pilot valves on your CV Valve are equipped with indicator lights, perform the Solenoid Pilot Valve Visual Check on the fill and deliver side of each CV Valve in your system.

1. Open and close each CV Valve, using either a computer or manual means, depending on the type of installation the valve are being used.

2. As each CV Valve is opened, confirm the corresponding solenoid pilot light comes on.

3. As each CV Valve is closed, confirm the corresponding solenoid pilot light turns off.

6.1.1.1 If the Light Goes On and Off for a Different Solenoid Pilot Valve

If the light goes on and off for a different solenoid pilot valve than the one you are controlling on the computer, the solenoid pilot cables are switched and must be re-connected properly.

6.1.1.2 If No Light Goes On or Off

If no light goes on or off while conducting the solenoid pilot visual check, do the following:

- Check that the proper voltage and the proper polarity is connected to the solenoid pilot valve(s)

6.1.2 Solenoid Pilot Valve Audio Check

Listen for an "air escaping" sound when the solenoid pilot valve opens and closes. The sound should be easy to hear. It will not be a clicking sound. The clicking sound you may hear is simply the solenoid pilot valve opening or closing. The "air escaping" sound is the same as when you open a can or bottle that is under pressure and you hear an immediate gust of air. It is important that you hear this sound when the solenoid pilot valve opens and closes.

If you do not hear the "air escaping" sound when each valve is opened and closed, then there is not adequate air pressure to operate the valves. Go back and check that your air tubing has been connected properly and that it is securely attached. If your air supply has a switch to turn it on, make sure the switch is turned on.

Perform the Solenoid Pilot Valve Visual Check and Solenoid Pilot Valve Audio Check on all the solenoid pilot valves in your system.

If, after completing the Solenoid Pilot Valve Visual Check and Solenoid Pilot Valve Audio Check, there is still an air supply problem, the following sections may help you in correcting the problem.

- No "Air Escaping Sound When Valves are Opened and Closed, Section 7.1.2

- Constant "Air Escaping" Sound, Section 7.1.3

6.1.2.1 No "Air Escaping" Sound When CV Valves Are Opened & Closed

If you do not hear the "air escaping" sound when each valve is opened and closed, then there is not adequate air pressure to operate the valves.

- Check if there are any kinks in the air tubing which runs between the solenoid pilot valves and the CV Valves.

- Check your air tubing has been connected properly and is securely attached.

- If your air supply has a switch to turn it on, make sure the switch is turned on.

- Make sure the pressurized air supply is a minimum of 85 PSI (5.7 bar).

6.1.2.2 The Air Supply is Not Dry

The air supplied to the CV Valve must be clean and dry. If the air supply is not dry, the solenoid pilot valves may have rusted and stopped switching, which would result in no "air escaping" sound when opening and closing the valves. To check this do the following.

1. Turn off your air supply.

2. Unplug your air line.

3. Check if there is any fluid in the line.

4. If the solenoid pilot valves have rusted and no longer operate, they need to be replaced.

6.1.2.3 The Air Pressure is Too Low

Another cause of no "air escaping" sound when opening and closing a valve is the air pressure is too low to operate the valves. Use a pressure gauge to determine the actual air pressure.

If the air pressure is too low:

- Check that your air tubing has been connected properly.

- If your air supply has a switch to turn it on, make sure the switch is turned on.

6.1.2.4 The Air Pressure is Too High

CV Valves need an air supply between 85 and 115 PSI (5.7 to 7.7 bar) to operate. If the air pressure is too high (more than 115 PSI (7.7 bar)), install an air regulator to limit the air pressure.

6.1.2.5 Constant "Air Escaping" Sound

If you hear a constant "air escaping" sound when the valves are not being operated, then there is an air leak. Check the following areas to determine the cause of the air leak.

- Verify that the plastic washers on all air fittings are present and not damaged.

- Check each air tube to see if it is cracked or damaged. Replace any cracked or damaged air tube.

- Verify that all air tubes are fully inserted into the quick-disconnect or compression fittings. All air tubing should be able to withstand a “slight” tug when properly inserted and the fittings have been tightened.

- Verify that all compression fittings are fully tightened.

- Try using “snoop” (soap and water solution) to detect small leaks.

- If air is escaping from the CV Valve Bleed Port, air is bypassing either the Piston External O-ring [10] or the Piston Internal O-ring [9].

    - Inspect the Piston External O-rings and the Piston Internal O-rings. Make sure they are not damaged and are free of contaminants.

    - Verify that the Piston External O-rings and Piston Internal O-rings are properly inserted. They should be smooth, free of nicks and not twisted.

    - If any problems exist, replace the o-rings.

- If you suspect air is escaping from the solenoid pilot valves, try the following.

    - Sometimes a solenoid pilot valve will get stuck part way open or part way closed and allow air passage. Try opening and closing the valve to get the unstuck and moved to a fully open or fully closed position. Opening and closing a solenoid pilot valve a few times may free up a stuck solenoid pilot. If this does not work, the solenoid pilot valve may have to be replaced so it does not constantly leak air.

    - Verify that all solenoid pilot valves are securely screwed down to their manifold.

    - Verify that the gasket between the solenoid pilot valve and the air manifold is not damaged or cracked. If the gasket is cracked, contact Vindum Engineering for a replacement.

    - If air continues to escape from the area between the solenoid pilot valve and the manifold, apply a light coat of silicone based compound (Dow –Corning Compound 111 Valve Lubricant and Sealant, or equivalent) to the gasket between the solenoid pilot valve and the air manifold.

6.1.2.6 Compressed Air Supply Runs Out Quickly

Tanks of compressed air are not recommended as a pressurized air source. Only a continuous air supply should be used as the air source and air compressors need to be equipped with a dryer.

6.2 Fluid Supply Problems

If the valve leaks, either of the following can occur:

- It can leak to the outside, in which case the fluid will come out the bleed port located between the air inlets.
- The cone will let fluid pass by it.
- Fluid can leak from one of the high pressure fittings.

6.2.1 Fluid Leaks from the CV Valve Bleed Port

If fluid is coming out the Bleed Port, fluid is going by one of the main o-ring seals. To determine where the problem is, follow the steps below.

- On the Piston Assembly, inspect the piston internal o-ring. Make sure it is not damaged and is free of wear. If there are any signs of damage or wear, replace the o-ring. Also make sure the piston internal o-ring is free of contaminants. If contaminants are present, replace the o-ring.
- Inspect the smooth stem of the end fitting for scratches. If a scratch is present the o-ring will not be able to properly seal, therefore the end fitting would need to be replaced or polished with 2000 grid polishing paper.
- Check the inside surface of the sleeve. (The sleeve is part of the Sleeve Assembly, which is located inside of the Piston Assembly.) Make sure there are no scratches on the inside surface of the sleeve. If scratches are present the sleeve must be replaced.
- For the 3-way valves, also check the Center Fitting. Make sure there are no scratches on the stems of the Center Fitting. If scratches are present, the center fitting should be replaced or the stems should be polished with 2000 grid polishing paper.

6.2.2 Fluid Leaks Across a “Closed” Valve

If the fluid is passing through the valve, or it does not hold pressure when it should be closed, this indicates that fluid is leaking by the closing cone.

- Verify the pressurized air source is 85 to 115 PSIG
- Inspect the Sleeve Assembly cone for signs of damage or wear at the sealing point. Replace if damage or wear is visible.

- Inspect the Sleeve Assembly for contaminants blocking the cone. If contaminants are present remove the contaminants making sure that they have not left an indent in the cone, End Fitting or the conical seat in the End Fitting.

6.2.3 Fluid Leaks Into Air Tubes

The most likely cause of fluid leaking from the air tubes is water vapor is present in the pressurized air source.

- Verify that the air compressor is equipped with a dryer and that the dryer is functioning properly.

NOTE: If the air compressor being used is not equipped with a dryer, or if the dryer is not working properly, water vapor will eventually travel to the pilot valves. This will cause the pilot valves to rust and not work properly.

6.2.4 Fluid is Not Traveling Properly

If the fluid is not following the expected path at the expected time, do the following:

- The solenoid pilot valve air tubes are not connected properly. Manually trace each air tube to its destination to determine which tubes go to which valve.

APPENDIX 1

Removal and Replacement of the Cone in the Sleeve Assembly

In the CV-200 and CV-300 Series of valves, the Cone [18] and Spacer [19] are "press-fit" into the Sleeve Assembly. In the CV-400 and CV-500 Series of valves, however, the Cone cannot be pressed out, and it is recommended that the sleeve assembly be replaced with a new cone.

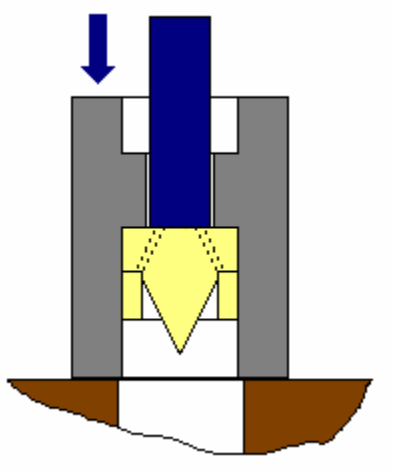

Figure A-1
Removing the Cone and Spacer from the Sleeve Assembly

Removing the Cone and Spacer in the CV-200 and CV-300 Series of Valves

1. To remove the "press-fitted" Cone and Spacer, place the Sleeve Assembly on a metal support plate at least 1-inch thick on an arbor press. The "point" of the Cone should be pointing down. The support plate must have an opening in it so that the Sleeve is supported, but its inside diameter is unobstructed so the Cone and Spacer can be pushed completely through and out of the Sleeve.

2. Use a thin rod of hardwood or plastic with an outside diameter of 3/16" to press from the backside of the Cone as shown below. Use the arbor press and the thin rod to push the Cone and Spacer out of the Sleeve.

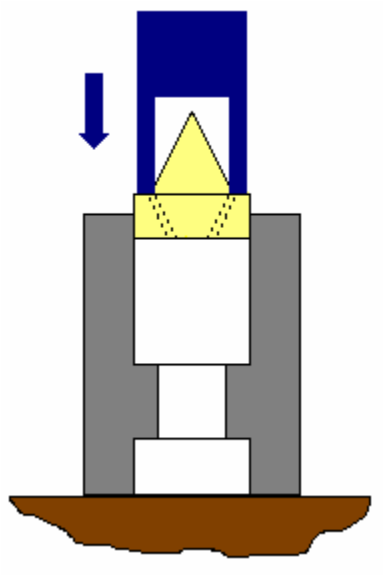

Figure A-2
Reinstalling the Cone and Spacer in the Sleeve Assembly

Reinstalling the Cone and Spacer in the CV-200 and CV-300 Series of Valves
Looking at the inside diameter of the Sleeve [20] from both sides, notice that on one side the inside shoulder is “farther down” or deeper than it is when looking from the other side. Place the sleeve on a flat surface with this “deeper” side up.

Using an arbor press and the tool shown in Figure A-2, below, one at a time carefully press the Cone [18] and the Spacer [19] into the Sleeve. Be sure that the “point” of the Cone is facing “up” towards the outside of the Sleeve, as shown, as the Cone and Spacer are both pressed in all the way to the shoulder.

APPENDIX 2

CV-210 and CV-310 Valve Components

Valve Assy - Refer to Figure 4-1 on page 13 or (Figure 5-1) on page 19.

Figure Number	Description	CV-210 VALVE Quantity / Part Number		CV-310 VALVE Quantity / Part Number	
1 & (31)	Socket Head Cap Screw	2	8-32 x 5/8-SHSS	2	8-32 x 5/8-SHSS
2 & (32)	Socket Head Cap Screw	6	8-32 x 1/2-SHSS	2	8-32 x 1/2-SHSS
(34)	Socket Head Cap Screw			4	8-32 x 2-1/2-SHSS
3	Support Bracket	1	410090		
(33)	Support Bracket			1	440060
4 & (36)	End Cap	2	440070	2	440070
5 & (35)	End Fittings	2	440040	2	440040*
6 & (37)	Cylinder Shell	1	440100-TH	1	440100-TH
(38)	Cylinder Shell			1	440100-BO
7 & (39)	O-Ring	2	2-028	4	2-028
(40)	Center Fitting			1	440050*

Piston Assembly - Refer to Figure 4-2 on page 14.

Figure Number	Description	CV-210 VALVE Quantity / Part Number		CV-310 VALVE Quantity / Part Number	
8	Piston Assembly	1	460190	2	460190*
9	O-Ring (Internal)	2	2-014	4	2-014
10	O-Ring	2	2-125	4	2-125
11	Piston (Male)	1	440110	2	440110
12	Sleeve Assembly	1	460180	2	460180*
13	Piston (Female)	1	440120	2	440120

Sleeve and Cone Assembly - Refer to Figure 4-3 on page 15.

Figure Number	Description	CV-210 VALVE Quantity / Part Number		CV-310 VALVE Quantity / Part Number	
14	Peek Back-up Ring	4	410301	8	410301
15	Teflon Back-up Ring	4	410302	8	410302
16**	Main O-ring Seal	2	2-008	4	2-008
17	Sleeve	1	440010	2	440010*
18	Cone	1	410030	2	410030
19	Spacer	1	410100	2	410100

*Available in stainless steel and Hastelloy.
** Wetted o-ring, Item #16, available in several different materials.
NOTE: O-rings are Viton unless otherwise specified.

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APPENDIX 3

CV-405 and CV-505 Valve Components

Valve Assy - Refer to Figure 4-1 on page 13 or (Figure 5-1) on page 19.

Figure Number	Description	CV-405 VALVE Quantity / Part Number		CV-505 VALVE Quantity / Part Number	
1 & (31)	Socket Head Cap Screw	2	8-32 x 5/8-SHSS	2	8-32 x 5/8-SHSS
2 & (32)	Socket Head Cap Screw	6	8-32 x 1/2-SHSS	2	8-32 x 1/2-SHSS
(34)	Socket Head Cap Screw			4	8-32 x 3-SHSS
3	Support Bracket	1	480060		
(33)	Support Bracket			1	480060
4 & (36)	End Cap	2	480070	2	480070
5 & (35)	End Fittings	2	480046	2	480046*
6 & (37)	Cylinder Shell	1	480100-TH	1	480100-TH
(38)	Cylinder Shell			1	480100-BO
7 & (39)	O-Ring	2	2-030	4	2-030
(40)	Center Fitting			1	480055*
(41)	Washer			2	SS2-48

Piston Assembly - Refer to Figure 4-2 on page 14.

Figure Number	Description	CV-405 VALVE Quantity / Part Number		CV-505 VALVE Quantity / Part Number	
8	Piston Assembly	1	460190	2	460190*
9	O-Ring (Internal)	2	2-014	4	2-014
10	O-Ring	2	2-129	4	2-129
11	Piston (Male)	1	480110	2	480110
12	Sleeve Assembly	1	480185	2	480185*
13	Piston (Female)	1	480120	2	480120

Sleeve and Cone Assembly - Refer to Figure 4-4 on page 16.

Figure Number	Description	CV-405 VALVE Quantity / Part Number		CV-505 VALVE Quantity / Part Number	
20	Peek Back-up Ring	4	480020	8	480020
21	Teflon Back-up Ring	4	480025	8	480025
22**	Main O-ring Seal	2	2-010	4	2-010
23	Sleeve	1	480010	2	480010*
24	Cone	1	480030	2	480030
25	Spacer	1	480105	2	480105

*Available in stainless steel and Hastelloy.
** Wetted o-ring, Item #22, available in several different materials.
NOTE: O-rings are Viton unless otherwise specified.

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APPENDIX 4

CV-410 and CV-510 Valve Components

Valve Assy - Refer to Figure 4-1 on page 13 or (Figure 5-1) on page 19.

Figure Number	Description	CV-410 VALVE Quantity	CV-410 VALVE Part Number	CV-510 VALVE Quantity	CV-510 VALVE Part Number
1 & (31)	Socket Head Cap Screw	2	8-32 x 5/8-SHSS	2	/ 8-32 x 5/8-SHSS
2 & (32)	Socket Head Cap Screw	6	8-32 x 1/2-SHSS	2	8-32 x 1/2-SHSS
(34)	Socket Head Cap Screw			4	8-32 x 3-SHSS
3	Support Bracket	1	480060		
(33)	Support Bracket			1	480060
4 & (36)	End Cap	2	480070	2	480070
5 & (35)	End Fittings	2	480045	2	480045*
6 & (37)	Cylinder Shell	1	480100-TH	1	480100-TH
(38)	Cylinder Shell			1	480100-BO
7 & (39)	O-Ring	2	2-030	4	2-030
(40)	Center Fitting			1	480055*
(41)	Washer			2	SS2-48

Piston Assembly - Refer to Figure 4-2 on page 14.

Figure Number	Description	CV-410 VALVE Quantity	CV-410 VALVE Part Number	CV-510 VALVE Quantity	CV-510 VALVE Part Number
8	Piston Assembly	1	480195	2	480195*
9	O-Ring (Internal)	2	2-014	4	2-014
10	O-Ring	2	2-129	4	2-129
11	Piston (Male)	1	480110	2	480110
12	Sleeve Assembly	1	480185	2	480185*
13	Piston (Female)	1	480120	2	480120

Sleeve and Cone Assembly - Refer to Figure 4-4 on page 16.

Figure Number	Description	CV-410 VALVE Quantity	CV-410 VALVE Part Number	CV-510 VALVE Quantity	CV-510 VALVE Part Number
20	Peek Back-up Ring	4	480020	8	480020
21	Teflon Back-up Ring	4	480025	8	480025
22**	Main O-ring Seal	2	2-010	4	2-010
23	Sleeve	1	480010	2	480010*
24	Cone	1	480030	2	480030
25	Spacer	1	480105	2	480105

*Available in stainless steel and Hastelloy.
** Wetted o-ring, Item #22, available in several different materials.
NOTE: O-rings are Viton unless otherwise specified.

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APPENDIX 5

CV-420 and CV-520 Valve Components

Valve Assy - Refer to Figure 4-1 on page 13 or (Figure 5-1) on page 19.

Figure Number	Description	CV-420 VALVE Quantity	CV-420 VALVE Part Number	CV-520 VALVE Quantity	CV-520 VALVE Part Number
1 & (31)	Socket Head Cap Screw	2	8-32 x 5/8-SHSS	2	8-32 x 5/8-SHSS
2 & (32)	Socket Head Cap Screw	6	8-32 x 1/2-SHSS	2	8-32 x 1/2-SHSS
(34)	Socket Head Cap Screw			4	8-32 x 3-SHSS
3	Support Bracket	1	480060		
(33)	Support Bracket			1	480060
4 & (36)	End Cap	2	480070	2	480070
5 & (35)	End Fittings	2	480130	2	480130*
6 & (37)	Cylinder Shell	1	480100-TH	1	480100-TH
(38)	Cylinder Shell			1	480100-BO
7 & (39)	O-Ring	2	2-030	4	2-030
(40)	Center Fitting			1	480050*
(41)	Washer			2	SS2-48

Piston Assembly - Refer to Figure 4-2 on page 14.

Figure Number	Description	CV-420 VALVE Quantity	CV-420 VALVE Part Number	CV-520 VALVE Quantity	CV-520 VALVE Part Number
8	Piston Assembly	1	480200	2	480200*
9	O-Ring (Internal)	2	2-014	4	2-014
10	O-Ring	2	2-129	4	2-129
11	Piston (Male)	1	480110	2	480110
12	Sleeve Assembly	1	480186	2	480186*
13	Piston (Female)	1	480120	2	480120

Sleeve and Cone Assembly - Refer to Figure 4-5 on page 16.

Figure Number	Description	CV-420 VALVE Quantity	CV-420 VALVE Part Number	CV-520 VALVE Quantity	CV-520 VALVE Part Number
26	Peek Back-up Ring	4	480020	8	480020
27	Teflon Back-up Ring	4	480025	8	480025
28**	Main O-ring Seal	2	2-010	4	2-010
29	Sleeve	1	480011	2	480011*
30	Seat	1	480140	2	480140

*Available in stainless steel and Hastelloy.
** Wetted o-ring, Item #28, available in several different materials.
NOTE: O-rings are Viton unless otherwise specified.

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APPENDIX 6
Commercially Available Parts

FLUID FITTINGS

Description	Manufacturer	Part Number	Notes
Fitting Sleeve* CV210 / CV-310	Autoclave	SSL20 XX	XX is material type: SS for Stainless 316 HC for Hastelloy C-276
Fitting Sleeve* CV-405, CV-410 CV-505, CV-310	Autoclave	SSL40 XX	XX is material type: SS for Stainless 316 HC for Hastelloy C-276
Collar CV-420, CV-520	HIP	60-2H4-SS 17-4	
Fitting Nut CV-210, CV-310	Autoclave	SMN20	
Fitting Nut CV-405, CV-410 CV-505, CV-510	Autoclave	SMN40	
Fitting Nut CV-420, CV-520	HIP	60-2HM4-SS 17-4	
1/8 inch Tubing	Any Supplier	.125” OD x .035” wall	Specify SS-316 or Hastelloy C-276
1/4 inch Tubing (5 – 10 kpsi)	Any Supplier	.250” OD x .065” wall	Specify SS-316 or Hastelloy C-276
1/4 inch Tubing (20 kpsi)	Any Supplier	.250” OD x .083” wall	Specify SS-316 or Hastelloy C-276

* The wetted material for the valves is listed on the warranty card.

PILOT VALVES / AIR MANIFOLD

Description	Manufacturer	Part Number	Notes
Pilot Valve	SMC	NVZ2120-XMOZ-M5	X is 5 for 12 volt, 6 for 24 volt. Verify that number on side of pilot valve is VZ2120 and voltage is correct.
Air Manifold	SMC	NVV5Z2-20-XX 1-OOT	XX is number of stations, 2 to 20. This manifold accepts NVZ2120 pilot valves. Verify pilot valve is VZ2120 before purchasing manifold.
Wire and Electrical Connector for Pilot Valve	SMC	DXT170-80-4A-X	X is length of wire in decimeters. (e.g., X is 3 for 300 mm (12”), 6 for 600 mm (24”), 30 for 3 m (120”). This connector fits in NVZ2120 pilot valves. Verify pilot valve is VZ2120 before purchasing connector.

1/8” Quick-Disconnect Air Fitting for CV Valve and Pilot Valve	SMC	KQH 01-32 or similar	
1/8” Swage-type Air Fitting for High Temperature CV Valve	Beswick	MCB-1018-1 Viton or similar	
¼” Quick Disconnect Air Fitting For Air Manifold Inlet	SMC	KQH 07-34S or similar	The manifold port accepts 1/8” NPT.
Air Manifold Plug	Dynamco	506-5 or similar	The manifold port accepts 1/8’ NPT.
11/8” Nylon Air Tubing for Ambient Temperature Valves	Beswick	MNT 1018 or similar	
1/8” Teflon Air Tubing for High Temperature Valves	Any Supplier	1/8” Teflon Air Tubing 125 psig	
¼” Nylon Air Tubing for Air Manifold Inlet	SMC	TISA 07B-20 or similar	

LUBRICANTS AND ADHESIVES

Description	Manufacturer	Part Number	Notes
Grease for Air Seal O-Rings on Piston for Ambient Temperature Valves	Parker	O-Lube	
Grease for Air Seal O-Rings on Piston for High Temperature Valves	Dow Corning	55 or 55M	
Grease for Pilot Valve Gasket	Dow Corning	111	
Permanent Bond between End Fitting and End Cap.	Loctite	272	

APPENDIX 7
O-Ring Compatibility Chart
(taken from "Parker O-Ring® Handbook")

P = Poor F = Fair G = Good E = Excellent	Abrasion Resistance	Acid Resistance	Chemical Resistance	Cold Resistance	Dynamic Properties	Electrical Properties	Flame Resistance	Heat Resistance	Impermeability	Oil Resistance	Ozone Resistance	Set Resistance	Tear Resistance	Tensile Strength	Water / Steam Resist.	Weather Resistance
Butyl (-75 - 250F)	FG	G	E	G	F	G	P	G	E	P	GE	FG	G	G	G	GE
Chlorinated Polyethylene	G	F	FG	FP	G	G	GE	G		FG	E	F	FG	G	F	E
Chloro-sulfonated Polyethylene	G	G	E	FG	F	F	G	G	G	F	E	F	G	F	F	E
Ethylene Propylene	GE	G	E	GE	GE	G	P	E	G	P	E	GE	GE	GE	E	E
Flourocarbon (Viton) (-515 - 400F)	G	E	E	FP	GE	F	E	E	G	E	E	GE	F	GE	FG	E
Flourosilicone (-100 – 350F)	P	FG	E	GE	P	E	G	E	P	G	E	GE	P	F	F	E
Neoprene (-45 – 250F)	G	FG	FG	FG	F	F	G	G	G	FG	GE	F	FG	G	F	E
Nitrile or Buna N (-30 – 250F)	G	F	FG	G	GE	F	P	G	G	E	P	GE	FG	GE	FG	F
Polyacrylate (-5 to 350F)	G	P	P	P	F	F	P	E	E	E	E	F	FG	F	P	E
Polyurethane (-40 – 180F)	E	P	F	G	E	FG	P	F	G	G	E	F	GE	E	P	E
SBR or Buna S (-70 – 400F)	G	F	FG	G	G	G	P	FG	F	P	P	G	FG	GE	FG	F
Silicone (-70 – 400F)	P	FG	GE	E	P	E	F	E	P	PG	E	GE	P	P	F	E
Teflon Encapsulated (-70 – 400F)	G	E	E	G	G			G		G					G	

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APPENDIX 8
Quote Request / Order Form
For CV Series High Pressure Valves

Required Valve Type and Configuration Information.

		2-Way Valve	3-Way Valve
Select Wetted Material			
316 Stainless Steel		_____	_____
Hastelloy C-276		_____	_____
Expected Fluid Types			
Water (distilled)		_____	_____
Brine		_____	_____
Mineral Oil		_____	_____
Crude Oil		_____	_____
	(Specify)		
Other Oil	_____	_____	_____
Solvents	_____	_____	_____
Acids	_____	_____	_____
Corrosives	_____	_____	_____
Polymers	_____	_____	_____
Other	_____	_____	_____
Expected Operating Temperature			
Less than 60ºF (16ºC)		_____	_____
If less than 60ºF, how low?	_____	_____	_____
Between 60ºF and 150ºF (16º to 65º C)		_____	_____
Between 60ºF and 300ºF (16º to 49º C)?		_____	_____
Greater than 300ºF (149ºC)		_____	_____
If greater than 300ºF, how high?	_____	_____	_____

Customer's Name _____
Company_____
Address_____
Phone Number_____
Fax Number_____
Email Address_____
Purchase Order Number _____

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