

# INSTRUCTION MANUAL

## CVS 4150/4150LE & CVS 4160/4160LE PRESSURE CONTROLLERS



# Instruction Manual

## CVS 4150 / 4150LE and CVS 4160 / 4160LE Pressure Controllers

### Introduction

CVS 4150 and 4160 controllers are designed to provide years of reliable and accurate service.

These instructions cover maintenance, adjustment, and changes in mode of control.

These instructions are intended for the controllers in general. Any instructions that apply to specific controllers will be indicated by model number in the instruction.

Model numbers are stamped on the nameplate located inside the cover of the controller (Key 29, Figure 4).

### Controllers

Inspect the controllers for shipping damage and foreign debris when uncrating.

### Valve

Ensure the pipeline is free of welding slag, chips and other debris by blowing out the line prior to installation.

It is recommended that a strainer be installed upstream of the valve to protect the valve from foreign debris in the line. CVS recommends a standard three-valve maintenance bypass be installed. This allows isolation of the control valve without shutting down the pipeline system.



The valve should be positioned on the line so the flow direction indicator corresponds to the direction of the flow of the pipeline.

If the body is flanged, the bolts should be tightened up evenly to reduce risk of damage to the valve body and the flange.

A good quality thread lubricating compound should be used on all male connections if the body has screwed connections.

### Control Line Connectors

The connections should be made in an area of the pipeline that is free of bends and elbows. Piping connections should be made with 1/4" or 3/8" pipe or tubing.

Tap the pipeline as close to the valve body as possible allowing for these limiting factors.

1. The tap area should be an area that is free from abnormal velocities.
2. The ideal distance away from the body should be 10 x the pipeline diameter.

### **Control Line Connectors cont'd**

The control pressure line is run from the tapped hole in the side or the back of the case to the main pipeline.

Install a lock shield needle valve in the control line to slow down the controlled pressure or to dampen out any pulsations. While the control valve is operational, the needle valve must never be entirely closed.

An air vent is provided on all controllers and works well when air is used as the operating medium. When gas is used the vent can be removed, this allows for an additional 1/4" NPT connection for gas to be piped away.

## **Operation**

Although the output for these controllers are set prior to shipping, upon arrival the following items should be checked.

### **CVS 67 CFR Filter Regulator**

The CVS 67 CFR Filter Regulator is a self-contained filter regulator designed to deliver air or gas to the pilot at a constant pressure. A CVS 67 CFR is designed to handle inlet pressures up to 250 psi. The CVS Series 4150/4160 delivers an outlet pressure of 3 - 15 psi when the regulator is set to 20 and it will deliver 6-30 psi output when the regulator is set to 35 psi.

The filter component ensures that operation is clean and dry.

The relief valve is geared to open when the pressure is reduced to 1 psi above the regulator set point.

Releasing the lock nut and adjusting the adjusting screw located on the top of the regulator can reduce pressure setting for the regulator.

### **Proportional Controllers**

Most of the proportional controls will be used in applications that require a band set to approximately 15%. The following steps are used to test this setting.

1. The air supply should be connected to CVS 67 CFR filter regulator.
2. Zero the pressure setting dial.
3. Set the proportional band adjustment to 15%
4. There should be no pressure sent to the measuring element.
5. For direct or reverse acting controllers the range and output should be set as follows.

| Range    | Output    |
|----------|-----------|
| 3-15 psi | 8-10 psi  |
| 6-30 psi | 16-20 psi |

### **Proportional-Reset Controllers**

1. The reset dial should be set to maximum.
2. The air supply should be connected to CVS 67 CFR filter regulator.
3. Zero the pressure setting dial and proportioned setting dial.
4. There should be no pressure sent to the measuring element.
5. For direct or reverse acting controllers the range and output should be as follows.

| Range    | Output    |
|----------|-----------|
| 3-15 psi | 8-10 psi  |
| 6-30 psi | 16-20 psi |

## **Start Up**

### **Proportional Controllers**

1. The air supply should be connected to CVS 67 CFR filter regulator.
2. Connect the control pressure line and open the lock shield needle valve.
3. Ensure all piping and connections are free from leaks.
4. Set the pressure to the desired control point.
5. Proportional band should be set at 15% of the bandwidth.
6. Open the manual control valves that are upstream and downstream, at the same time close the by-pass valves.
7. Set the controller near the desired control point. When it reaches that point, begin to broaden the proportional band. Broaden the band as little as possible. The narrowest band that will not result in cycling provides the best control. This band adjustment will affect the zero. Re-zero the unit.
8. Test the bandwidth by changing the pressure setting adjustment for a moment. If this causes cycling, then broaden the proportional band and test again. This procedure is to be repeated until stability is reached.

### **Proportional-Reset Controllers**

1. The air supply should be connected to CVS 67 CFR filter regulator.
2. Connect the control pressure line and open the lock shield needle valve.
3. Ensure all piping and connections are free from leaks.
4. Set pressure to the desired control point.

### **Proportional-Reset Controllers cont'd**

5. Proportional band should be set at 100% of bandwidth.
6. Maximize the setting on the reset dial.
7. Open the manual control valves that are upstream and downstream, at the same time close by-pass valves.
8. Set the controller near the desired control point. When it reaches that point, begin to narrow the proportional band until a cycling condition exists. Broaden the band slightly until a stable condition is reached. There is no need to reset the zero in controllers that have reset.
9. Try to obtain the fastest reset time without introducing cycling control carefully by adjusting the reset rate.
10. Test the bandwidth and the reset rate by changing the pressure setting adjustment for a moment. If this causes cycling, then broaden the proportional band and test again. This procedure is to be repeated until stability is reached.

The goal for the controller setting is to have the narrowest proportional band and the fastest reset rate that will not cause cycling.

### **Changing Controller Action**

One advantage of the CVS 4150/4160 is the ease at which you can change from one mode of control to another. There is a connection for both direct and reverse action in all modes of control. There is also a screw (key 5, figure 6) provided to plug the hole opposite of the nozzle. It will be necessary to follow **INITIAL SETTINGS** after any change in mode of control.

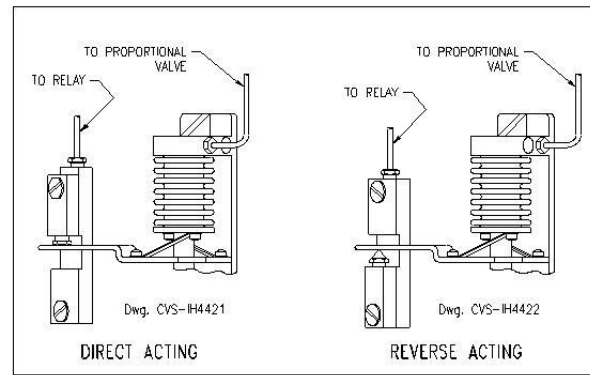
### **Adjustments**

#### **Proportional Band Width Adjustments**

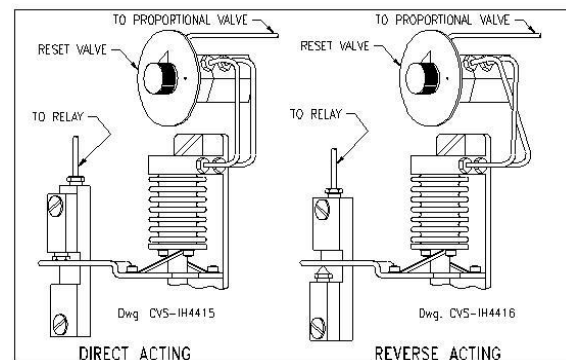
The proportional band width adjustment determines the change in control pressure required to cause the control valve to travel full open or full closed.

**Example:** with the proportional band set @ 1 (10%), using a Bourdon tube of 0-1000 psi that is set @ 500 psi on the pressure dial. The full travel of the valve would occur between 450 psi (3 psi output) and 550 psi (15 psi output) to try to maintain the set point.

Using this theory, an input pressure of 500 would give you an output pressure of 9 psi. The greater the proportional band setting is the slower the reaction.



**Figure 1: Pressure Connections for Proportional Controller**



**Figure 2: Pressure Connections for Proportional-Reset Controller**

### **Reset Rate Adjustment**

By definition the reset rate is the number of minutes that it takes to adjust the controller to adjust the output pressure up or down by the same amount of proportional change output caused by the process change.

The reset rate is calibrated in minute per repeat.

### **Pressure Setting Adjustment**

The CVS 4150 and 4160 come with calibrated set point adjustment. The dial is calibrated for pressure ratings of the measurement element. If start up instructions are followed, the pressure setting dial is correct for any settings on proportional-reset controllers.

## CVS Type 4150 Pressure Controller

The theory of operation can be broken down into steps. Refer to the schematic diagram figure 3.

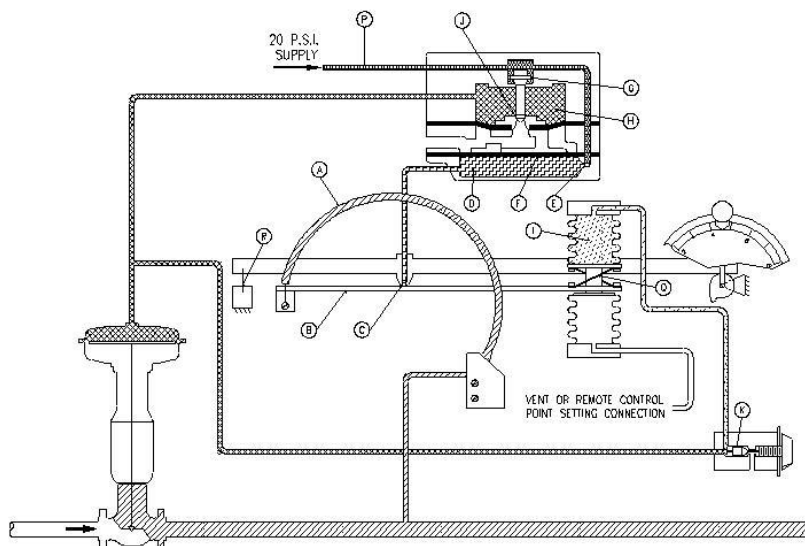
1. The pressure first enters the Bourdon tube. As the pressure increases the Bourdon tube straightens causing the beam (B) attached to the end of the Bourdon tube to move closer to nozzle (C).
2. Closing the nozzle (C) will cause a build up of pressure in chamber (D) from the constant air or gas supply through the orifice (E).
3. The resulting pressure built up in chamber (D) cause the diaphragm (F) to push up and open valve (G).
4. An open Valve (G) will cause the constant air or gas supply to flow into chamber (H).
5. The build up of pressure in chamber (H) causes diaphragm (F) to be pushed back to its original position and therefore closes valve (G).
6. The increase in pressure in chamber (H) sends the supply pressure to flow to the diaphragm of the control valve causing the control valve to start to close.
7. At the same time, the pressure flows through the three-way valve (K) causing an increase in pressure in bellows (I).
8. The increase in the pressure bellows (I) cause the beam (B) to move away from nozzle (C). As a result there will no longer be a build up of pressure in (D). The control valve is now at the desired pressure setting.

If there is a decrease in control pressure the above mentioned steps will proceed in reverse. The control pressure will bleed out through the exhaust vent (J).

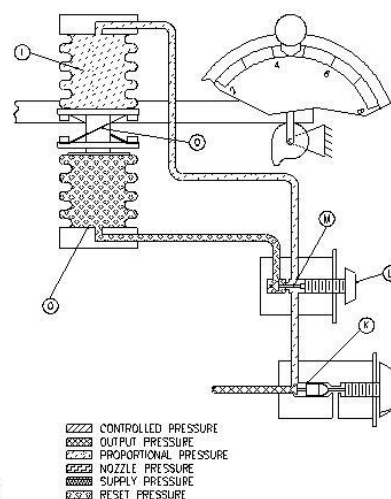
Please note that the changes in pressure are continuous in nature. The process has been explained in steps for ease of explanation.

As seen in the figure 3, schematic illustration of Type 4150, the output pressure from relay chamber (H) goes to both the proportional band adjustment relay three-way valve (K) and the control valve diaphragm. The amount of feedback to the proportional bellows (I) can be adjusted by adjusting the orifice. If valve (K) is fully open, then the total of the diaphragm pressure is sent to the bellows chamber (I).

This causes the beam (B) to move away from nozzle (C) allowing the pressure to be released from chamber (D). The result of this is 100% proportional band based on the rating of the Bourdon tube. Closing the three-way valve (K) will result in a lowering of proportional band response. The proportional band would be approximately 3% when fully closed.



**Figure 3:** Schematic Illustration of CVS Type 4150 Proportional Controller



**Schematic Illustration of CVS Type 4150 Proportional-Reset Controller**

## CVS Type 4160 Pressure Controller

The operation of CVS Type 4160 - proportional-reset controller, is the same as the CVS Type 4150 with the addition of a reset rate adjustment (L). Follow steps 1-6 from operation of the CVS 4150 then proceed with the following:

1. In step No. 7, for the CVS 4160 the pressure will flow through the three-way valve (K), to reset valve (M) where a portion of pressure will be diverted to the bellows (O).
2. The pressure will be built up in bellows (O) pushing beam (B) to nozzle (C) and therefore increased pressure to valve and to bellows (I). This process will continue until control pressure is equal to the set point.
3. The proportional bandwidth determines how much the pressure will deviate from the set point. The reset determines the amount of time the deviation is away from the set point.

## Maintenance

Two steps should be carried out in regular scheduled maintenance. A cleaner button allows you to clean the passages in the relay orifice. This button should be pushed regularly. The second step is using the drain cock that is located on the underside of the drip well in the CVS 67 CFR. This drip well, should be allowed to bleed off to atmosphere to prevent moisture from contaminating the controller.

## Troubleshooting

The following is a list of suggestions on where to start troubleshooting particularly immediately after installation.

1. The control valve continually cycling or hunting.
  - 1.1. The constant cycling of a controller can occur if the reset rate is set too fast or the band setting is set too narrow.
  - 1.2. Ensure that the controller valve plug is not sticking.
  - 1.3. A control valve always operating near its seat will indicate an oversized control valve.
2. Incomplete Pressure Change on the Diaphragm.
  - 2.1. Ensure an accurate reading is being displayed from the diaphragm pressure gauge.
  - 2.2. Verify that lines and connections are free from leaks.

CVS Series 4150/4160 Bourdon Tubes can be replaced. They may be replaced due to changes in pressure regulations or for maintenance.

### Replacing Bourdon Tube

(Refer to figure 6)

1. Detach the connecting link and bearing (Key 37) from the beam.
2. Unscrew the two fixing screws (Key 8) holding the tube. Detach tube from the sub-assembly.
3. Replace the Bourdon tube by removing the connecting link and bearing from the existing tube. Attach the connecting link and bearing on the new Bourdon tube.
4. Zero the pressure dial.
5. Install the Bourdon tube in the sub-assembly. Reconnect the connecting link and bearing to the beam.
6. Ensure that the tube is in a horizontal position and that there is tension in the connecting link. The tension can be adjusted by bending the cross springs (Key 28).
7. Adjust and calibrate for start-up.

### Replacing Bellows

(Refer to figure 6)

1. Detach sub-assembly from controller.
2. Remove the connecting link and bearing (Key 37) from the beam.
3. Remove the bellows unit from the frame (Key 16)
4. Install the bellows in the control assembly. Begin by ensuring that the beam is horizontal and with the pressure setting dial at zero. Then attach the connecting link and the bearing link to bellows and beam. Ensure that there is tension on the connecting link. Tension can be added by bending the cross springs (Key 28).
5. Adjust and calibrate for start up.

### Calibration of Controllers

1. Move the calibration adjuster (Key 30, Figure 6) to the right or the left.
2. Repeat the nozzle adjustment and step 5 for proportional controller or step 6 for proportional-reset controller.
3. To release the calibration adjuster, loosen the two screws, above and below the beam, to the left of the nozzle.

## Calibrate Zero on Proportional Controllers

1. Depending on the controller type the supply pressure will be 20 or 35 psi. Attach a suitable pressure gauge to the output pressure.
2. Connect the pressure source to the pressure block and set the proportional bandwidth to 15% (1.5).
3. Zero the pressure setting dial.
4. Raise or lower the nozzle (Key 34, Figure 6) to get the desired setting of zero as per chart below. Nylon insert will hold the nozzle in place.
5. Allow maximum pressure to the measuring element. Set the pressure dial to maximum. Output pressure should comply with the zero setting column in the following table, if not go to Note 1.

| Control Action | Output Range | Supply Pressure | Zero Setting |
|----------------|--------------|-----------------|--------------|
| Direct         | 3-15 psi     | 20 psi          | 8-10 psi     |
| Direct         | 6-30 psi     | 35 psi          | 16-20 psi    |
| Reverse        | 15-3 psi     | 20 psi          | 8-10 psi     |
| Reverse        | 30-6 psi     | 35 psi          | 16-20 psi    |

## Calibrate Zero on Proportional –Reset Controllers

1. Depending on the controller type the supply pressure will be 20 or 35 psi. Attach a suitable pressure gauge to the output pressure.
2. Connect the pressure source to pressure block and set the proportional bandwidth to zero.
3. Set the reset dial to .005 minutes per repeat.
4. Zero the pressure setting dial.
5. Raise or lower the nozzle (Key 34, Figure 6) to get the desired setting of zero as per chart below. Nylon insert will hold the nozzle in place.
6. Allowing maximum pressure to the measuring element. Set the pressure dial to maximum. Output pressure should comply with the zero setting column in the following table, if not go to Note 1.

**Note 1** - These steps are to be used if the zero setting pressure or output range is not obtained when maximum pressure is applied to the measuring element.

1. Move the calibration adjuster (Key 30, Figure 6) to the right or the left.
2. Repeat the nozzle adjustment and Step 5 for proportional controller, or Step 6 for proportional-reset controller.
3. To release the calibration adjuster, loosen two screws, above and below the beam, to the left of the nozzle.

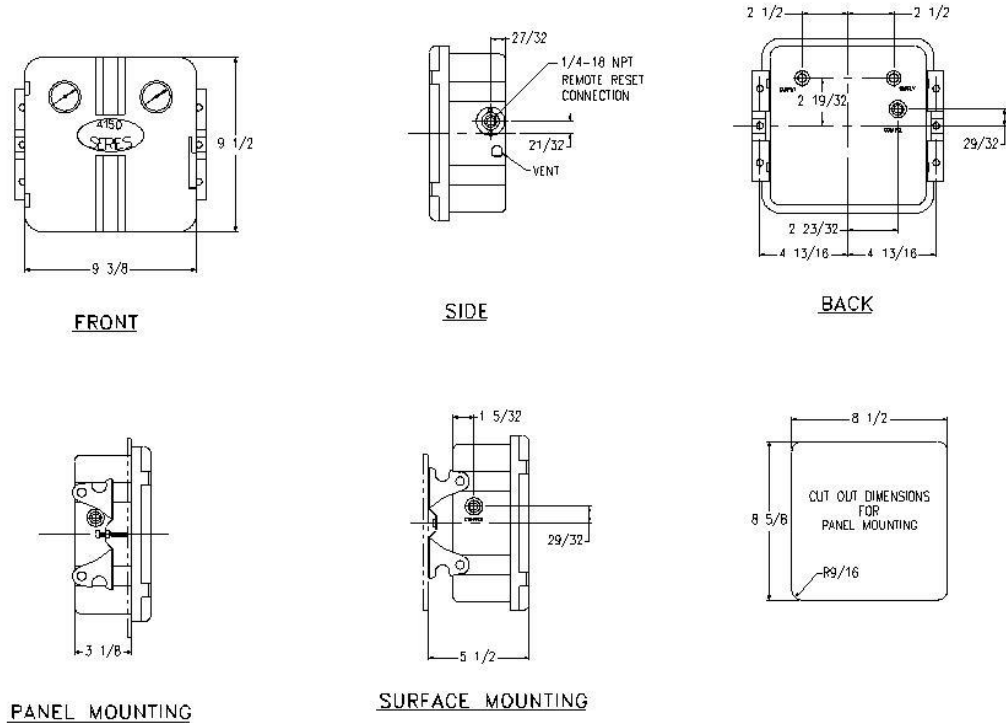
| Control Action | Output Range | Supply Pressure | Zero Setting |
|----------------|--------------|-----------------|--------------|
| Direct         | 3-15 psi     | 20 psi          | 8-10 psi     |
| Direct         | 6-30 psi     | 35 psi          | 16-20 psi    |
| Reverse        | 15-3 psi     | 20 psi          | 8-10 psi     |
| Reverse        | 30-6 psi     | 35 psi          | 16-20 psi    |

## Changing of Controller Output

Controllers having an output range of 3-15 psi, can be converted to having an output range of 6-30 psi. This can be done by changing the two color coded control bellows. The green bellows is for 3-15 range, and yellow bellows for 6-30 psi range.

When the pressure range is changed, it is necessary to change the pressure gauges. This can be completed by unscrewing the old pressure gauges from their boss and screwing in the new gauges.

## Dimensional Data



## Assembly

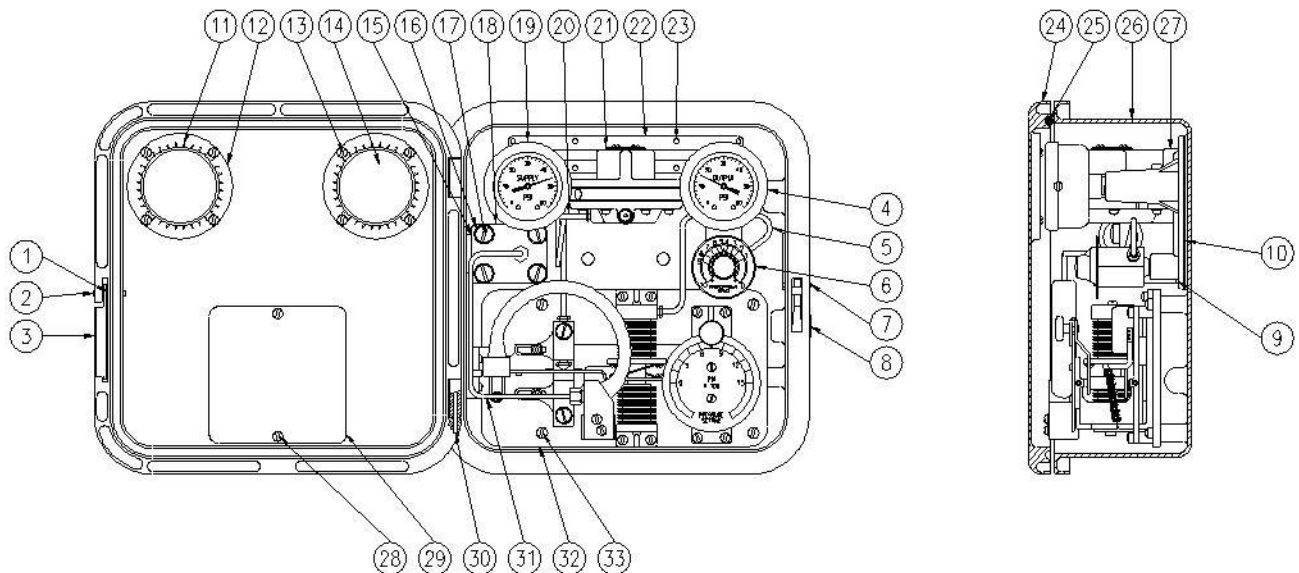
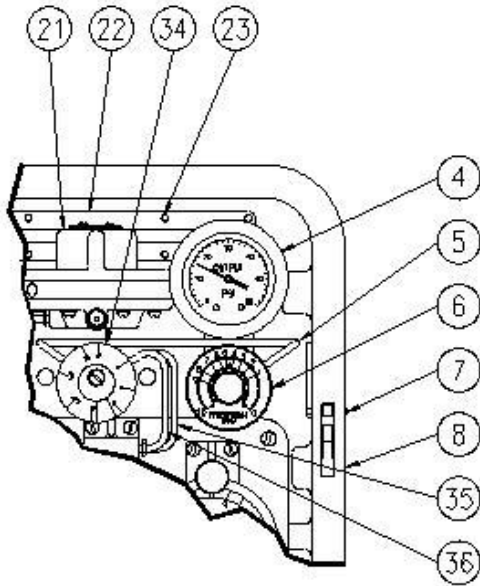


Figure 4: CVS Type 4150 Proportional Pressure Controller with Bourdon Tube Measuring Element

## Parts Reference



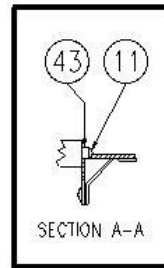
**Figure 5:** Partial view of Type CVS 4160 Pressure Controller Showing the Reset Valve and the Arrangement of Tubing

## Controller Main Assembly (Refer to Figures 4 and 5)

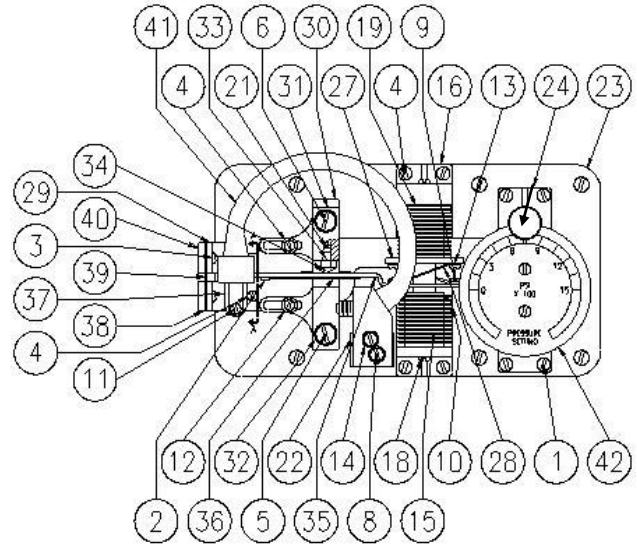
| KEY NO. | PART NUMBER                                      | PART DESCRIPTION                                                                             | MATERIAL                               |
|---------|--------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------|
| 1       | CVS1H2889                                        | Spring Washer                                                                                | Steel Cd. Pl                           |
| 2       | CVS1H2891                                        | Groove Pin                                                                                   | Aluminum                               |
| 3       | CVS1H2886                                        | Cover Latch                                                                                  | Steel Cd. Pl                           |
| 4       | CVS1H2712<br>CVS1H3048                           | Output Pres. Gauge 30 psi.<br>Output Pres. Gauge 60 psi                                      | Sub-Assy<br>Sub-Assy                   |
| 5*      | CVS1H2753<br>CVS1H6864<br>CVS1H2966<br>CVS1H6866 | Compensator Tubing Assy<br>Compensator Tubing Assy<br>Reset Tubing Assy<br>Reset Tubing Assy | Copper<br>304 SST<br>Copper<br>304 SST |
| 6       | CVS367X3                                         | Proportional Band Adj. Assy                                                                  | Sub-Assy                               |
| 7       | CVS1H2890                                        | Groove Pin                                                                                   | Aluminum                               |
| 8       | CVS1C8937                                        | Screen and Elbow Assy                                                                        | Sub-Assy                               |
| 9*      | CVS1C3286                                        | Cont. Pres. Block Gasket                                                                     | Neoprene                               |
| 10*     | CVS1H2887<br>CVS1N8737                           | Relay Base Gasket<br>Relay Base Gasket Hi-Temp                                               | Neoprene<br>Si Rubber                  |
| 11*     | CVS0T0191                                        | Glass Gasket, 2 Req'd                                                                        | Neoprene                               |
| 12      | CVS1A4658                                        | Retaining Ring, 2 Req'd                                                                      | Galv, Steel Cd. Pl.                    |
| 13      | CVS1A5120                                        | Screw, 8 Req'd                                                                               | Steel Cd. Pl                           |
| 14*     | CVS0T0192                                        | Gauge Glass, 2 Req'd                                                                         | Acrylic                                |
| 15*     | CVS1C3762                                        | O-Ring                                                                                       | Buna-N                                 |
| 16      | CVS1C2256                                        | Lockwasher, 4 Req'd                                                                          | Steel Cd. Pl                           |
| 17      | CVS1C3333                                        | Screw, 4 Req'd                                                                               | Steel Cd. Pl                           |
| 18      | CVS1H2698<br>CVS1H2895                           | Cont. Pres. Block<br>Cont Pres. Block                                                        | Steel<br>316 SST                       |
| 19      | CVS1H3435<br>CVS1H3436                           | Supply Pres. Gauge 0-30 psi<br>Supply Pres. Gauge 0-60 psi                                   | Sub-Assy<br>Sub-Assy                   |
| 20*     | CVS1H2759<br>CVS1H6861                           | Relay Tubing Assy<br>Relay Tubing Assy                                                       | Copper<br>304 SST                      |
| 21      | CVS536X47<br>CVS536X84                           | Pilot Relay<br>Pilot Relay Hi-Temp                                                           |                                        |

| KEY NO.                   | PART NUMBER                                      | PART DESCRIPTION                                                                                           | MATERIAL                               |
|---------------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------|
| 22                        | CVS3H2885                                        | Relay Base                                                                                                 | Zinc                                   |
| 23                        | CVS1H5269                                        | Screw, 17 Req'd                                                                                            | Steel Cd. Pl                           |
| 24                        | CVS4H2684                                        | Cover                                                                                                      | Aluminum                               |
| 25*                       | CVS1J24075                                       | Cover Gasket                                                                                               | Sponge Rubber                          |
| 26                        | CVS4H2699                                        | Case                                                                                                       | Aluminum                               |
| 27*                       | CVS1C8974<br>CVS1N8738                           | Relay Gasket<br>Relay Gasket, Hi-Temp                                                                      | Neoprene<br>Silicone Rubber            |
| 28                        | CVS1C9419                                        | Screw, 2 Req'd                                                                                             | Steel Cd. Pl                           |
| 29                        | CVS1H2702                                        | Instruction Plate                                                                                          | Aluminum/SST                           |
| 30                        | CVS1H2888                                        | Roll Pin, 2 Req'd                                                                                          | Steel Cd. Pl                           |
| 31*                       | CVS1H3013<br>CVS1H4528<br>CVS1H3011<br>CVS1H4526 | Cont. Tubing Assy, 4150, 4160<br>Cont. Tubing Assy.<br>Cont. Tubing Assy, 4150, 4160<br>Cont. Tubing Assy. | Copper<br>Copper<br>304 SST<br>304 SST |
| 32                        | CVSML536X<br>CVSML536XH                          | Cont. Sub-Assy. 4150, 4160<br>Cont. Sub-Assy.<br>Hi-Temp, 4150, 4160                                       | Sub-Assy.<br>Sub-Assy.                 |
| 33                        | CVS1A3321                                        | Screw, 6 Req'd                                                                                             | Steel Cd Pl                            |
| 34                        | CVS536X61<br>CVS536X15                           | Reset Valve<br>Reset Valve, Hi-Temp                                                                        |                                        |
| 35*                       | CVS1H2755<br>CVS1H6870                           | Compensator Tubing Assy.<br>Compensator Tubing Assy.                                                       | Copper<br>304 SST                      |
| 36*                       | CVS1H2757<br>CVS1H6870                           | Compensator Tubing Assy.<br>Compensator Tubing Assy.                                                       | Copper<br>304 SST                      |
| 37                        | CVS1H5271                                        | Screw, 2 Req'd                                                                                             | Steel Cd. Pl                           |
| 38                        | CVS1H5270                                        | Screw, 4160                                                                                                | Steel Cd. Pl                           |
| 39                        | CVS1A7675<br>CVS1A7675                           | Pipe Plug<br>Pipe Plug                                                                                     | Steel<br>316 SST                       |
| * Recommended Spare Parts |                                                  |                                                                                                            |                                        |

## Parts Reference



PARTS NOT SHOWN  
7, 17, 20, 25, & 26



**Figure 6** Controller Sub-Assembly for  
Bourdon Tube Controllers  
CVS Type 4150 and 4160

## Controller Sub Assembly (Refer to Figure 6)

| KEY NO. | PART NUMBER | PART DESCRIPTION                | MATERIAL      |
|---------|-------------|---------------------------------|---------------|
| 1       | CVS1C8969   | Screw, 4 Req'd                  | Steel Cd. Pl  |
| 2       | CVS1B2751   | Screw                           | Steel Cd. Pl  |
| 3       | CVS1C8990   | Screw, 4 Req'd                  | Steel Cd. Pl  |
| 4       | CVS1A5733   | Screw, 8 Req'd                  | Steel Cd. Pl  |
| 5*      | CVS1H2674   | Screw                           | Steel Cd. Pl  |
| 6*      | CVS1H2673   | Screw                           | Steel Cd. Pl  |
| 7       | CVS1H2676   | Screw, 2 Req'd                  | Steel Cd. Pl  |
| 8       | CVS1H2677   | Screw, 2 Req'd                  | Steel Cd. Pl  |
| 9*      | CVS1H2678   | Screw, 2 Req'd                  | Steel Cd. Pl  |
| 10*     | CVS1B2776   | Screw, 2 Req'd                  | Steel Cd. Pl  |
| 11*     | CVS1A3319   | Screw, 2 Req'd                  | Steel Cd. Pl  |
| 12      | CVS1E8730   | Washer, 2 Req'd                 | Steel Cd. Pl. |
| 13      | CVS1H2671   | Washer, 4 Req'd                 | Steel Cd. Pl  |
| 14*     | CVS1H2672   | Washer, 4 Req'd                 | Acrylic       |
| 15*     | CVS1H2655   | Bellows Assy. 3-15 psi, 2 Req'd |               |
|         | CVS1H2680   | Bellows Assy. 6-30 psi, 2 Req'd |               |
| 16      | CVS1H2653   | Bellows Frame                   | Aluminum      |
| 17      | CVS1H2654   | Bellows Frame Gasket            | Neoprene      |
|         | CVS1N8735   | Bellows Frame Gasket, Hi-Temp   | Si Rubber     |
| 18      | CVS1D3976   | Bellows Screw, 2 Req'd          | 18-8 SST      |
| 19*     | CVS1D3970   | Bellows Gasket, 2 Req'd         | Neoprene      |
| 20      | CVS1H2658   | Bellows Stud                    | 18-8 SST      |
| 21*     | CVS1E2226   | O-Ring                          | Buna-N        |
|         | CVS1N8387   | O-Ring, Hi-Temp                 | Viton         |
| 22      | CVS1H2650   | Bourdon Tube Mounting Bracket   | Aluminum      |
| 23      | CVS2H2651   | Mounting Plate                  | Steel         |
| 24      | CVS536X4    | Pressure Adj. Assy.             |               |
|         | CVS536X8    | Zero Adj. Assy.                 |               |
| 25      | CVS1H2652   | Adj. Spacer 2 Req'd             | Steel         |
| 26      | CVS1J4234   | Rotary Shaft Spring             | 302 SS        |
| 27      | CVS1H2659   | Spacer                          | Zinc          |
| 28      | CVS1H2660   | Cross Spring, 2 Req'd           | 304 SS        |
| 29      | CVS1H2661   | Pressure Set Arm                | Steel         |
| 31      | CVS1U6392   | Reversing Block Assy.           |               |

| KEY NO. | PART NUMBER | PART DESCRIPTION              | MATERIAL     |
|---------|-------------|-------------------------------|--------------|
| 32*     | CVS1H2664   | O-Ring, 3 Req'd               | Viton        |
| 33      | CVS16A0976  | Nylon Insert                  | Nylon        |
| 34*     | CVS1U6391   | Nozzle                        | 316 SS       |
| 35      | CVS1H2668   | Beam                          | Steel        |
| 36*     | CVS1H2669   | Flapper                       | Spring Steel |
| 37      | CVS1L3796   | Connecting Link               | 316 SS       |
| 38      | CVS1C8977   | Flexure Strip Base            | Steel, Cd Pl |
| 39      | CVS1C8978   | Flexure Base                  | Spring Steel |
| 40      | CVS1C8975   | Flexure Strip Nut, 2 Req'd    | Steel, Cd Pl |
| 41*     | CVS 1R8729  | Bourdon Tube, 0-30 psi        | 316 SS       |
|         | CVS 1R8730  | Bourdon Tube, 0-60 psi        |              |
|         | CVS 1R8731  | Bourdon Tube, 0-100 psi       |              |
|         | CVS 1R8732  | Bourdon Tube, 0-200 psi       |              |
|         | CVS1R8733   | Bourdon Tube, 0-300 psi       |              |
|         | CVS1R8734   | Bourdon Tube, 0-600 psi       |              |
|         | CVS1R8735   | Bourdon Tube, 0-1000 psi      |              |
|         | CVS1R8736   | Bourdon Tube, 0-1500 psi      |              |
|         | CVS1R8737   | Bourdon Tube, 0-3000 psi      |              |
|         | CVS1R8738   | Bourdon Tube, 0-5000 psi      |              |
| 42      | CVS2H2883   | Bourdon Tube, 0-8000 psi      | Aluminum     |
|         | CVS2H2884   | Bourdon Tube, 0-10000 psi     |              |
|         | CVS1H3044   | Press. Adj. Dial, 0-30 psi    |              |
|         | CVS1H3034   | Press. Adj. Dial, 0-60 psi    |              |
|         | CVS1H3035   | Press. Adj. Dial, 0-100 psi   |              |
|         | CVS1J5237   | Press. Adj. Dial, 0-200 psi   |              |
|         | CVS1H3036   | Press. Adj. Dial, 0-300 psi   |              |
|         | CVS1H3037   | Press. Adj. Dial, 0-600 psi   |              |
|         | CVS1H3038   | Press. Adj. Dial, 0-1000 psi  |              |
|         | CVS1H3039   | Press. Adj. Dial, 0-1500 psi  |              |
|         | CVS1H3040   | Press. Adj. Dial, 0-3000 psi  |              |
|         | CVS1H3041   | Press. Adj. Dial, 0-5000 psi  |              |
|         | CVS1H3042   | Press. Adj. Dial, 0-8000 psi  |              |
|         | CVS1H3043   | Press. Adj. Dial, 0-10000 psi |              |

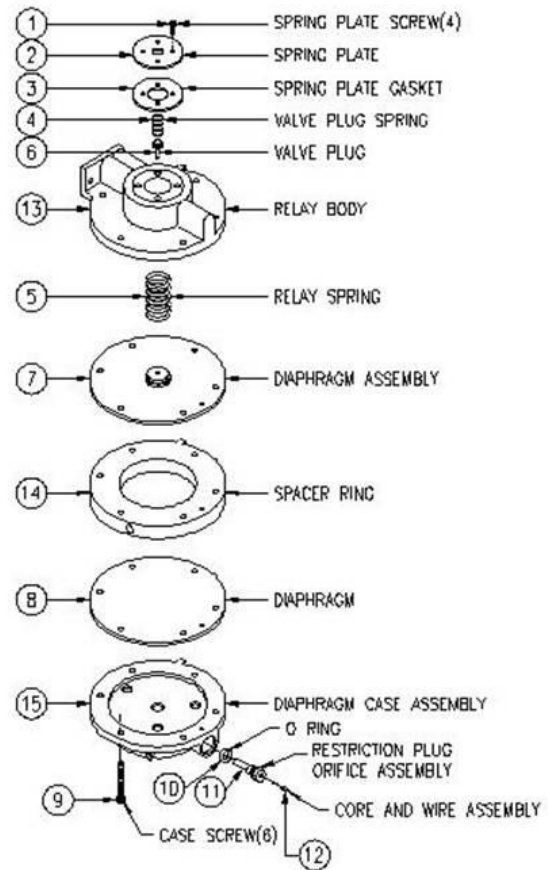
\* Recommended Spare Part

## Parts Reference

### Pilot Relay Assembly

| KEY NO. | PART NUMBER | PART DESCRIPTION                            | MATERIAL    |
|---------|-------------|---------------------------------------------|-------------|
| 1       | CVS1A3319   | Screw, 4 Req'd                              | Steel       |
| 2       | CVS1H2697   | Spring Plate                                | Steel       |
| 3*      | CVS1H2696   | Spring Plate Gasket, Temp. To 150°F         | Neoprene    |
|         | CVS1K7000   | Spring Plate Gasket, Temp. To 150°F-250°F   | Sil. Rubber |
| 4       | CVS0X0836   | Valve Plug Spring                           | Inconel     |
| 5*      | CVS1C8961   | Relay Spring                                | Inconel     |
| 6*      | CVS0Y0617   | Valve Plug                                  | 316 SS      |
|         | CVS0Y0617B  |                                             | Brass       |
| 7       | CVS1C9370   | Dia. Assy. Temp To 150°F                    | Sub Assy.   |
|         | CVS1K6996   | Dia. Assy. Temp 150°-250°F                  |             |
| 8       | CVS1L5556   | Top Dia., Temp 150°F                        | Buna-N      |
| 9*      | CVS1C8969   | Screw Temp to 150°F 6 Req'd                 | Steel       |
|         | CVS1A3294   | Screw 150°F-250°F 6 Req'd                   |             |
| 10*     | CVS1D6875   | O-Ring                                      | Syn. Rubber |
| 11*     | CVS1H8266   | Restriction Plug Orifice Assy.              | Sub Assy.   |
| 12      | CVS1E2303   | Core & Wire Assy.                           | Sub Assy.   |
| 13      | CVS2H2693   | Relay Body                                  | Zinc        |
| 14*     | CVS2K4404   | Spacer Ring                                 | Zinc        |
| 15*     | CVS1C9369   | Diaphragm Case Assy                         | Sub Assy.   |
| 16      | CVS1K7001   | Bottom Gasket (Not Shown) Temp. 150°F-250°F | Sil. Rubber |
|         | CVS1K7002   | Top Gasket, Temp 150°-250°F                 |             |
| 17      | CVS1P8261   | Washer, 6 Req'd (Not Shown)                 | Steel       |

\* Recommended Spare Part



**Figure 7: Exploded View of Pilot Relay used in CVS Type 4150 and 4160 Controllers**

## Supply Pressure Data

| CVS 4150 and CVS 4160                                                                                                                          |                                |                                      |     |                                                              |     |                                                                                                            |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|--------------------------------------|-----|--------------------------------------------------------------|-----|------------------------------------------------------------------------------------------------------------|------------------|
| Output Signal Range                                                                                                                            |                                | Normal Operating Supply Pressure (*) |     | Maximum Allowable Supply Pressure to Prevent Internal Damage |     | Steady State Air Consumption SCFH of Air at 60°F and 14.7PSIA (Normal M³/Hr of Air at 0°C and 1.01325 Bar) |                  |
|                                                                                                                                                |                                |                                      |     |                                                              |     |                                                                                                            |                  |
| Psig                                                                                                                                           | Bar                            | Psig                                 | Bar | Psig                                                         | Bar | Min <sup>A</sup>                                                                                           | Max <sup>B</sup> |
| 3 to 15 or 0 & 20 (on-off)                                                                                                                     | 0.2 to 1.0 or 0 & 20 (on-off)  | 20                                   | 1.4 | 50                                                           | 3.4 | 4.2 (0.12)                                                                                                 | 27 (0.76)        |
| 6 to 30 or 0 & 30 (on-off)                                                                                                                     | 0.4 to 2.0 or 0 & 2.4 (on-off) | 35                                   | 2.4 | 50                                                           | 3.4 | 7 (0.20)                                                                                                   | 42 (1.2)         |
| * Stability and control may be compromised if pressure is exceeded.<br>A Proportional Band setting of 0-10<br>B Proportional Band setting of 5 |                                |                                      |     |                                                              |     |                                                                                                            |                  |
| CVS 4150 LE and CVS 4160 LE – Low Emission Controllers                                                                                         |                                |                                      |     |                                                              |     |                                                                                                            |                  |
| 3 to 15 or 0 & 20 (on-off)                                                                                                                     | 0.2 to 1.0 or 0 & 20 (on-off)  | 20                                   | 1.4 | 50                                                           | 3.4 |                                                                                                            | 2.61 (0.075)     |
| 6 to 30 or 0 & 30 (on-off)                                                                                                                     | 0.4 to 2.0 or 0 & 2.4 (on-off) | 35                                   | 2.4 | 50                                                           | 3.4 |                                                                                                            | 4.20 (0.12)      |

# Specifications

## Supply:

Air or Natural Gas\*

\*natural gas should contain no more than 20ppm of Hydrogen Sulphide

## Supply and Output Connections:

1/4" NPT Female

## Supply Pressure:

-Normal operating pressure for 3 to 15 psig output signal range is 20 psig.

-Normal operating pressure for 6 to 30 psig output signal range is 35 psig.

## Operating Temperature Limits:

-40°F to 200°F (-40°C to 93°C)\*

\*Standard Construction

## Operating Temperature Influence:

-Proportional Control:

Output pressure changes  $\pm 3\%$  of sensing element range for each 50°F (28°C) change in temperature between -40°F and 160°F (-40°C and 71°C) if the controller is set at 100% proportional band.

-Reset Control:

Output pressure changes  $\pm 2\%$  of sensing element range for each 50°F (28°C) change in temperature between -40°F and 160°F (-40°C and 71°C) if the controller is set at 100% proportional band.

## Performance:

-Repeatability:

0.5% of sensing element range

-Deadband:

0.1% of output span

-Frequency response at 100% proportional band:

Output to actuator: 0.7 Hz and 110° phase shift with 113 inches<sup>3</sup> (1850 cm<sup>3</sup>) volume, actuator at mid stroke.

Output to positioner bellows: 9 Hz and 130° phase shift with 3 -15 psig (0.2 to 1.0 bar) output to 2 inches<sup>3</sup> (33cm<sup>3</sup>) bellows.

## Output Signal:

3 to 15 psig (0.2 to 1.0 bar) or 6 to 30 psig (0.4 to 2.0 bar) pneumatic pressure signal.

## Action:

The control action is easily reversible from **direct acting** (increasing sensed pressure produces increasing output signal) to **reverse acting** (increasing sensed pressure produces decreasing output signal) without the need for additional parts.

## Proportional Band Adjustment:

Full output pressure change is adjustable from 3 to 100% for a 3 to 15 psig (0.2 to 1.0 bar), or 6 to 100% for a 6 to 30 psig (0.4 to 2.0 bar) of the sensing element range.

## Reset Adjustment:

Adjustable from 0.01 to 74 minutes per repeat (100 to 0.01 repeats per minute)



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