

Operation & Maintenance Manual

8" IDP DeltaPValve®



Revised: July 2019

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Operating Notes and Warnings

WARNING!	WARNING!
<p>Spring Preload:</p> <p>The DeltaPValve® is assembled with a preload on the piston spring. If, for any reason, the piston cover is to be removed, use caution when removing the bolts (both to avoid injury, and to avoid losing the spring and other internal components).</p> 	<p>System Hydrotest:</p> <p>When hydrostatic testing a system in which a DeltaPValve® is installed, make certain that the DeltaPValve® is in the wide open position, or internal damage to the valve may occur.</p> 

WARNING!
<p>Back Flow:</p> <p>DeltaPValves will be damaged if subjected to reverse pressure when in the closed position. If back-flushing of the system is required, the valve should be fully open.</p> 

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Principle of Operation | DeltaPValve®

The DeltaPValve® is a high-performance modulating two-way hydronic control valve. The DeltaPValve® is completely pressure independent meaning that the flow rate remains constant independent of pressure fluctuations in the system.

The principle of operation involves two sections of the valve body; the Cv section and the pressure regulation section (ref Figure 1). The Cv section controls the flow rate through the valve according to the stem position. The stem may be rotated either manually or with an electric/pneumatic actuator. The Cv section is similar to any two-way modulating valve. The pressure regulation section of the valve has a spring-balanced piston, which acts to maintain a constant differential pressure across the control surfaces in the Cv section, using only the internal fluid pressures in the valve. Thus, the flow rate through the Cv section is unaffected by pressure changes upstream or downstream of the valve.

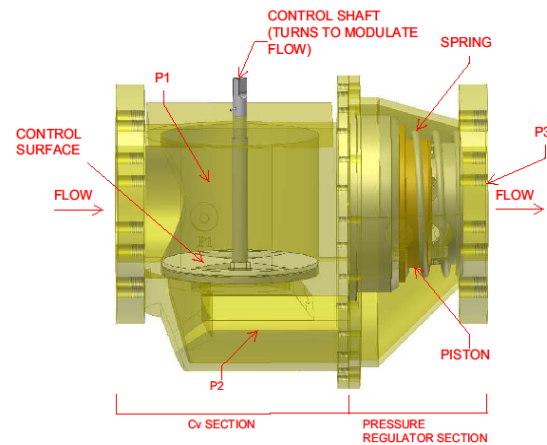
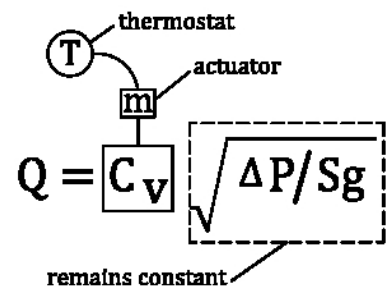


Figure 1: DeltaPValve

Flow through a control valve is calculated by the formula shown in Figure 2. Flow rate "Q" is affected by the Cv of the valve, the ΔP across the valve, and the specific gravity of the fluid, which remains constant. In the DeltaPValve®, the ΔP across the Cv section control surfaces also remains constant, so the DeltaPValve® flow rate is only affected by a change in the Cv (rotation of the valve stem) and not by pressure fluctuations in the system.

When the system pressure changes, the flow through a normal modulating control valve will increase or decrease accordingly. The flow rate will move away from the set point of the controller, further changing the pressures in the system. The controller will attempt to compensate and eventually bring the flow back to the desired rate. This creates flow and pressure fluctuation in the system which often continues indefinitely as the other valves in the system attempt to compensate.



$$Q = C_v \sqrt{\frac{\Delta P}{S_g}}$$

remains constant

Figure 2: Flow Equation

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The DeltaPValve® operates in a pressure independent manner through the range of the spring in the differential pressure section. The standard range is 5 - 70 psi (35 - 480 kPa) differential pressure across the entire valve (P1-P3). An optional range of 10 - 90 psid (69 - 621 kPa) is also available at higher flow rates.

The flow curves for a typical DeltaPValve® are shown in Fig 3. At differential pressures below 5 psi (35 kPa), the DeltaPValve® acts as a normal modulating control valve (i.e. the flow through the valve increases as the differential pressure across the valve increases). Above 5 psi (35 kPa), the flow through the DeltaPValve® does NOT increase with an increase in the differential pressure. The various curves shown in Fig. 3 represent the flow at different settings of the DeltaPValve® (set by rotating the valve stem).

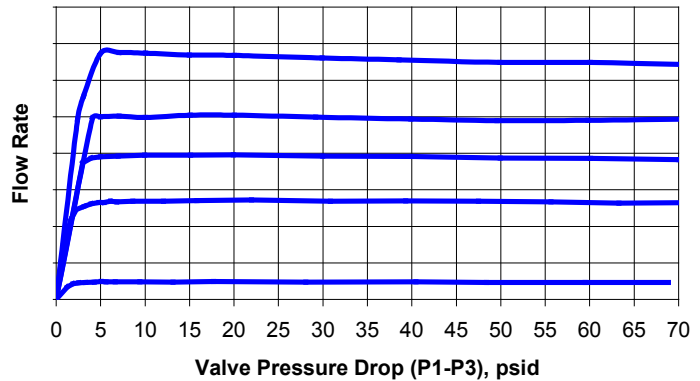


Figure 3: Flow Rate vs. Differential Pressure

The DeltaPValve® eliminates these fluctuations (see example below).

Example:

Assume the DeltaPValve® is set at a stem rotation of 10° for a flow rate of 15 gpm. Assume $P_1 = 50$ psig (345 kPa) and $P_3 = 10$ psig (69 kPa). P_2 is set internally by the pressure regulating section of the valve at about 47 psig (310 kPa). The ΔP across the control surface is then about 3 psid (35 kPa).

Case 1	Case 2
$P_1 = 50$ psig	$P_1 = 20$ psig
$P_2 = 47$ psig	$P_2 = 17$ psig
$P_3 = 10$ psig	$P_3 = 10$ psig
Flow = 15 gpm	Flow = 15 gpm

Now assume that the upstream pressure falls to 20 psig (138 kPa). When $P_1 = 20$ psig (138 kPa) and $P_3 = 10$ psig (69 kPa), P_2 is internally reset by the pressure regulator section in the valve to 17 psig (103 kPa). The ΔP across the control surfaces is maintained at around 3 psid (35 kPa).

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Valve Installation Procedures



DO NOT install balancing valves or similar flow limiting valves in series with DeltaPValves

New Construction: See Figure 4 & Figure 5 for typical valve installation details.

NOTE: Balancing valves may be used within coil arrays, if desired.

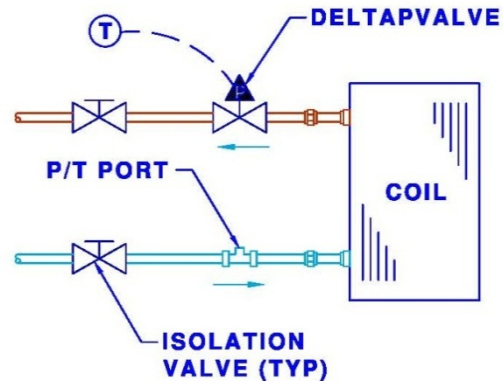


Figure 4: Single Coil Standard Detail

Retrofits: If balancing valves have been previously installed, they should be adjusted, modified, or removed as required, so that they do not cause any restriction to flow.

1. Confirm that the valve tag corresponds to the proper installation location. Install valve so that the flow is in the proper direction. A flow arrow is cast in the valve housing. Valve may be mounted in any position, except it is recommended that valves with actuators in horizontal pipe NOT be mounted with the stem in any position below horizontal, to reduce the chances of condensation (drips) from entering the actuator mechanisms. Installation with the piston in the up position is preferred when possible. Refer to Figure 6. There are no restrictions regarding length of straight pipe at the inlet or outlet of the valve.

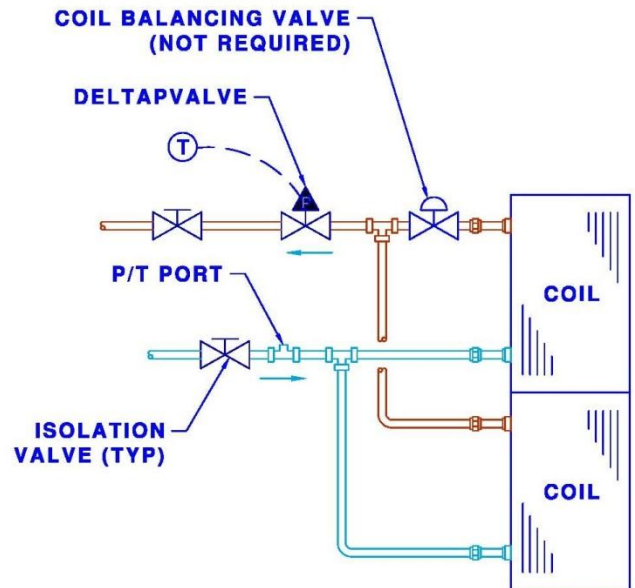


Figure 5: Multiple Coil Standard Detail

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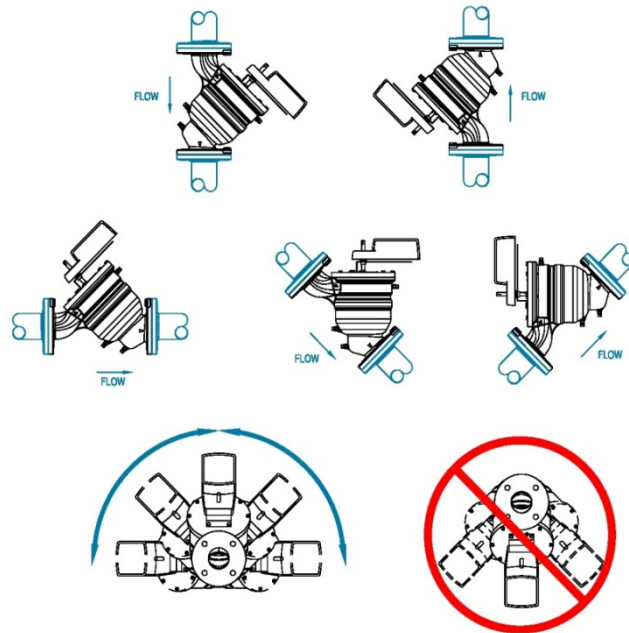


Figure 6: Installation Orientation

- The valve should be mounted to allow unrestricted access to the P/T taps; install the three P/T plugs (if shipped loose) into the valve body taps (ref Figure 6). Plug extensions are available from factory to allow for access through insulation.

NOTE: Valves should be installed with as much working clearance and access as possible. Maintain a minimum of 4" [102mm] clearance from P/T ports to allow access for commissioning. Consult DeltaP Valve submittal sheet for clearance required for actuator service and removal.

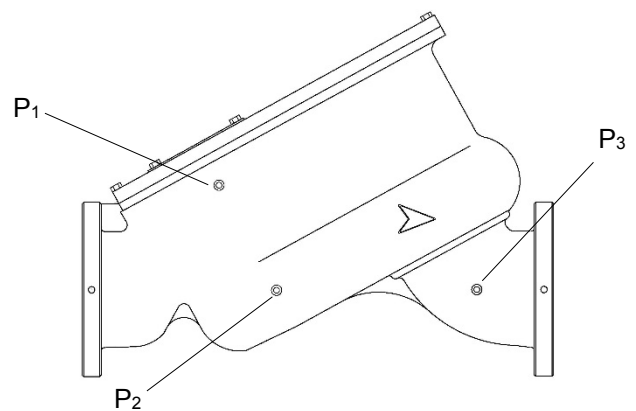


Figure 7: P/T Port Locations

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- DeltaPValves may be installed in indoor or outdoor locations. Actuator enclosures must be selected to match the installation location requirements. Proper insulation of the valve body is recommended to avoid excessive fluid heat gain or loss in exposed locations.
- If mounting electric or pneumatic actuator, mount so that it strokes to give the control sequence required. The direction of rotation of the valve stem can be either clockwise or counter-clockwise. See Fig. 8.

8" IDP MODEL

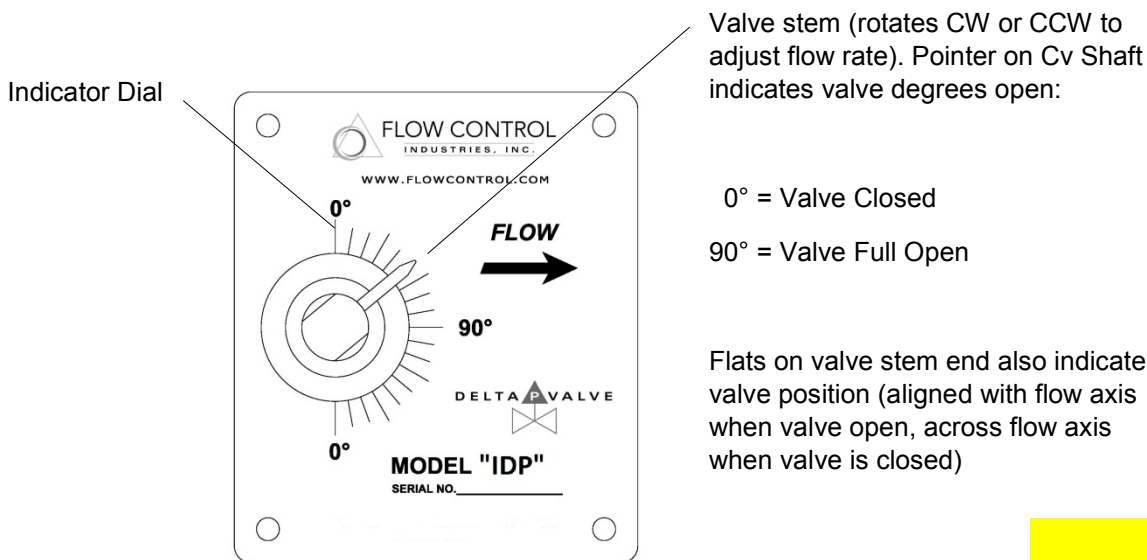


Figure 8: DeltaPValve Nameplate (8" IDP)



Nameplate must remain visible. DO NOT insulate over the DeltaPValve® nameplate

If installing a manual locking quadrant handle, attach directly to the valve stem.

- The 8" IDP (200mm) size valves are furnished with a flow performance tag (see Example "A", Fig. 8, for flow tag in "gpm", and Example "B" for metric flow tag in liters per second). Using the nylon tie provided, attach the metal flow performance tag for the specific valve serial number through the hole provided in the actuator mounting bracket, or around the valve stem. Each valve is individually flow tested at the factory and has its own unique tag.

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SALES ORDER: 22765	
SERIAL NO: 8-20222	
MODEL: 8" IDP-1750-10	
Degrees Open	Design: 1738.0
	Test GPM
0	0.0
10	200.0
20	480.0
30	640.0
40	900.0
50	1130.0
60	1350.0
70	1560.0
80	1720.0
90	1760.0
TAG: PLOT NO 107-109	
Example A	

SALES ORDER: 22994	
SERIAL NO: 8-20222	
MODEL: 8" IDP-1750-10	
Degrees Open	Design: 109.67
	Test LPS
0	0.00
10	12.62
20	30.29
30	40.38
40	56.79
50	71.30
60	85.19
70	98.44
80	108.53
90	109.67
TAG: PLOT NO 107-109	
Example B	

Figure 9: DeltaPValve Flow Tags

- The flow performance tag has the model number listed (e.g. 8" IDP-700-5). The "700" in the model number is the maximum rated flow for this particular valve. The "-5" indicates that this particular valve is rated for 5-70 psig operation (versus 10-90 psi operation). See the Flow Control Industries, Inc. DeltaPValve® catalog for more information.
- Model HDP DeltaPValves are furnished standard with a 5-70 psid (35-480 kPa) range (minimum 5 psi / 35 kPa ΔP) over which the valve will operate in a pressure-independent manner. This ΔP can be measured between P/T Plugs P₁ and P₃ - see the Figure 6. Optionally, the valve may be provided with a 10-90 psi range (minimum 10 psi / 620 kPa ΔP).
- After installation, complete the DeltaPValve® Commissioning Checklist (a copy is appended to this manual).

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8" IDP DeltaPValve® Maximum Operating Torque

The 8" IDP model HDP DeltaPValve® requires the torque shown in Table 1 to open from the closed position with the indicated differential pressure across the valve (P_1-P_3). Once the valve is open, the torque requirements are substantially lower. Contact factory if the torque is greater than shown.

Table 1: Actuator Torque for Shutoff

Valve Size	Torque ft-lb (N-m)	At Valve Pressure Drop psid (kPa)
8" (200mm) Model IDP	175 (242)	150 (1034)

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8" IDP DeltaPValve® Valve Calibration

If the flow calibration tag is missing or damaged, the flow may be approximated using the valve calibration information in Table 2. The flow rate from the calculation should match the flow on the valve tag approximately. For standard 5 -70 psi spring:

Table 2: Reference Cv Values

8" IDP							
700 GPM		900 GPM		1130 GPM		1320 GPM	
Degrees Open	Valve Cv	Degrees Open	Valve Cv	Degrees Open	Valve Cv	Degrees Open	Valve Cv
45	187	45	240	45	302	45	352
90	374	90	481	90	604	90	705

Calibration:

1. Formulas:

$$Q = C_v \sqrt{\frac{\Delta P}{S_g}}$$

Q = flow (gpm)

$\Delta P = (P_1 - P_2)$ (psi)

$$Q = (1.44) C_v \sqrt{\frac{\Delta P}{S_g}}$$

Q = flow (lpm)

$\Delta P = (P_1 - P_2)$ (kPa)

S_g = Specific gravity (=1.0 for water)

2. Notes:

- A DeltaPValve® with the standard flow range of 5 - 70 psi (35 - 483 kPa) MUST have a minimum of 5 psi / 35 kPa (maximum 70 psi / 483 kPa) ΔP across the valve (pressure ports P_1 - P_3) to provide the flow rates indicated on the flow tag provided with the valve.
- A DeltaPValve® with the optional flow range of 10 - 90 psi (69 - 621 kPa) MUST have a minimum of 10 psi / 69 kPa (maximum 90 psi / 621 kPa) ΔP across the valve (pressure ports P_1 - P_3) to provide the flow rates indicated on the flow tag provided with the valve.

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- c. To determine flow rate (approximate), measure the ΔP across pressure ports P_1 - P_2 , and calculate flow using the C_v indicated in the tables above. If valve cannot be set at 30°, 60° or 90° open, the C_v can be interpolated from the tables for the actual degrees open. Do not interpolate below 45° open.
- d. If valve is operating correctly, and the ΔP across the valve is in the correct range for the flow rating as described above, then the DP across P_1 - P_2 should be about 2 - 3 psi (14 - 21 kPa) for the 5 - 70 psi (35 - 483 kPa) flow range.

3. Sample Calculations:

DeltaPValve® model 8" IDP-700-05, flowing water at 70° open, with 3.5 psi (24.3 kPa) across P_1 - P_2 . From Calibration Chart on page 9, interpolate C_v at 70° open for size "Dash700" – $C_v \approx 291$



Calculate approximate flow rate:


$\Delta P = 3.5$ psi	$\Delta P = 24.3$ kPa
$C_v = 291$	$C_v = 291$
$Q = 544$ gpm	$Q = 784$ lpm

This calculated flow should be approximately equal to that shown on the flow tag for the valve. Because of slight differences in the C_v of individual valves, and with the variables associated with interpolating the C_v value from the tables, and reading the ΔP and the degrees open, an error of about $\pm 10\%$ between the above calculation and the flow tag number will indicate that the valve is operating satisfactorily.

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Operating Notes and Warnings

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DeltaPValve® Commissioning Checklist

DeltaPValves do not need to be balanced; however, it is prudent after installation to commission the valves to ensure proper operation. This checklist does not apply to DeltaPValves installed in the central plant to control flow.

- _____ note the date (mm/dd/year)
- _____ note the DeltaPValve® serial number (on flow tag)
- _____ verify valve is installed in the proper location (match flow tag to unit)
- _____ verify valve is installed in the proper direction of flow (see arrow on casting)
- _____ verify that balancing valves are not installed (preferred)
- _____ verify isolation valves to the circuit are open
- _____ when the valve is flowing, verify that minimum differential pressure is available measured across ports P1 and P3 (built into the valve) *

8"-IDP-700-**05**-L
 ↑
* minimum differential pressure (psid) REQUIRED during operation
- _____ apply compatible control signal to the actuator (typically from air temperature thermostat) and verify that the actuator strokes through the full range of flow

Notes:

- Direct proportional/integral control (no derivative) is recommended for best performance
- With a pneumatic actuator the stroke is set by the linkage (typically at the factory)
- With an electronic actuator the stroke may be limited in the field by setting the span of the actuator control signal
- Full stroke will take between 60 seconds and 8 minutes depending on the actuator.

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DeltaPValve® Troubleshooting Checklist

Collect from DeltaPValve® flow tag ➡	Sales Order	Serial Number	Valve Tag ID	Design Flow

Yes /No

- _____ Is the DeltaPValve® installed in the correct flow direction? *Verify orientation with flow arrow on valve body.*
- _____ Are circuit and system isolation valves open?
- _____ Are coil balancing valves and circuit setters removed or fully open?
- _____ Is the DeltaPValve® installed in the correct location? *Verify valve tag corresponds to the unit number.*
- _____ Is the actuator operating correctly? *Please verify, below.*

Actuator Brand ➡		
Actuator Model ➡		
(Check One)		
Normal Valve Position ➡	<input type="checkbox"/> Open	<input type="checkbox"/> Closed
Fail Action ➡	<input type="checkbox"/> Fail-Safe	<input type="checkbox"/> Fail-In-Place
Actuator Control Signal & Control Range ➡	<input type="checkbox"/> 2-10 VDC <input type="checkbox"/> 0-10 VDC <input type="checkbox"/> 4-20 mA	<input type="checkbox"/> 8-13 PSI <input type="checkbox"/> Other

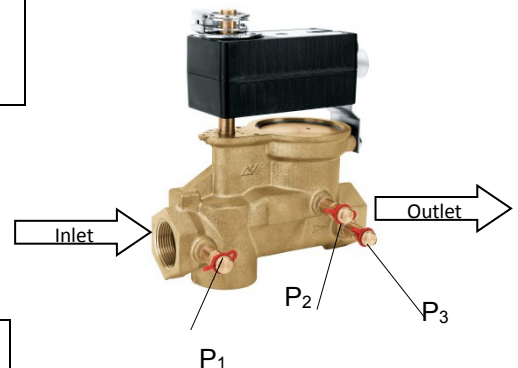
List the controller output signal at:
 _____ 0% design (closed)
 _____ 100% design flow

Note:

100% design flow may not correspond to 90° open. Verify on flow tag.

Yes/No

- _____ Does the valve stem rotate with the actuator?
- _____ Does the stem pointer align with 0° when closed?
- _____ Has the actuator range been field adjusted?
- _____ Is there at least 5 PSID across the valve? *Please measure, below.*



At 0% Design Flow Valve Position: _____ ° Open	P1:		P2:		P3:	
At 50% Design Flow Valve Position: _____ ° Open	P1:		P2:		P3:	
At 100% Design Flow Valve Position: _____ ° Open	P1:		P2:		P3:	

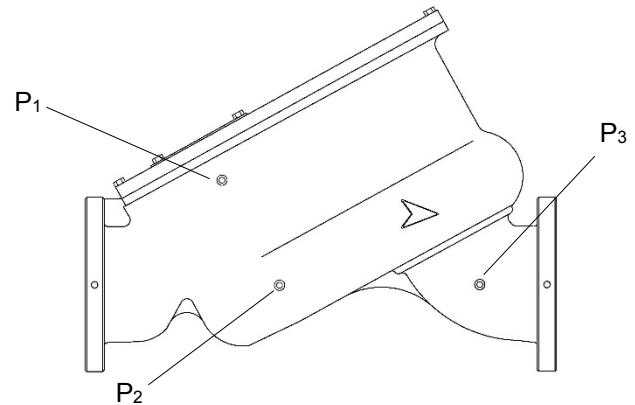
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Troubleshooting Improper Valve Performance

For reference:

- P1 = Inlet pressure
- P2 = Intermediate pressure
- P3 = Outlet pressure

With the valve at the desired position/rotation:



Confirm Proper Differential Range

- Confirm P1-P3 is ≥ 5 PSID [0.34 bar] and ≤ 70 PSID [4.83 bar]
 - This is the minimum differential pressure for proper pressure independent operation

Confirm Pressure Independence

- Confirm P1-P2 is between 2-4 PSID [0.13-0.28 bar] (valve must be open)
 - This indicates the pressure regulator is functioning correctly, and will vary slightly depending on the valve position and valve size
- If both differential pressures are verified within the proper ranges, read the factory flow tag to find the current flow rate at the given position
- Note that the Design Flow position may not be at full rotation (90 deg), and can be confirmed on the flow tag

Confirm Shutoff

- Confirm P2=P3 with the valve in the closed position
 - This indicates all pressure drop is across the control surface and the valve is shutoff

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Troubleshooting Improper Valve Performance

Symptom	Cause	Remedy
Valve does not shut off flow.	Debris on Cv seat or Cv seat is worn or damaged.	Clean or replace Cv seat.
	Diaphragm seal worn or damaged.	Replace diaphragm seal.
	Actuator is not driving Cv stem to fully closed.	Drive actuator to closed position. Verify position of pointer on Cv shaft. Make adjustments if necessary.
	Valve was installed backwards and has caused damage to Cv disk and seal.	Replace Cv disk and Cv seat.
Valve not controlling flow independent of pressure. (Pressures $P_2 = P_3$)	Diaphragm seal has failed.	Replace diaphragm seal.
	Debris causing piston to stick.	Open Valve and remove/clean debris
Valve leaking externally at valve stem.	Valve stem seal worn.	Replace valve stem seal.
Valve hard to operate due to high torque.	Valve inlet surface dirty or jammed with debris.	Remove valve stem and remove/clean.
	Damaged valve stem inlet seal.	Replace stem seal.
	Diaphragm seal has failed.	Replace diaphragm seal.
	Valve was installed backwards and has caused damage to Cv disk and seal.	Replace Cv disk and Cv seat.

Recommended Spare Parts:

- 8" IDP Shaft Seal Kit | Quantity = 1 | Includes: Cv cover seal, Cv shaft seal
- 8" IDP Valve Seal Kit | Quantity = 1 | Includes: Shaft Seal Kit and diaphragm seal, case mating seal

Contact Information:

Please call our factory in Woodinville, Washington at 866.454.1288 if you need additional help. You can also send an e-mail to sales@flowcontrol.com.

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LIMITED WARRANTY

Flow Control Industries, Inc. (FCI) warrants its ½" to 8" (15mm to 200mm) pressure independent valves to be free of defects in material and workmanship for a period of ten (10) years from the shipment to the original purchaser, assuming proper installation, proper maintenance, normal operating conditions, and competent supervision. FCI's obligation under this warranty shall be limited to repairing at its factory any part or parts thereof that, upon examination, shall appear to FCI's satisfaction to have been defective. All transportation charges are to be paid by the customer. Correction of such defects by repair or replacement shall constitute fulfillment of all obligations to purchaser under this warranty. The actuator warranty is subject to terms and conditions of its respective manufacturer. There is no other express warranty. The duration of any implied warranty is limited to the duration of the express warranty specified above. Some states do not allow limitation on how long an implied warranty lasts, so the above limitations may not be applicable. FCI shall not be liable for incidental, consequential, or special damages arising out of or in connection with the product use or performance. Some states do not allow the exclusion of incidental or consequential damages, so the above limitation may not apply. FCI assumes no liability of expenses of repairs outside of its factory, except by express written contract. No liability whatsoever shall attach to FCI until said products have been paid for in full by customer. FCI's limited warranty gives specified legal rights and supersedes all prior warranties.

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8" IDP Valve Drawing

