



ISO Registered Company

MODEL POSR-1 PILOT OPERATED PRESSURE REDUCING REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

The POSR-1 is a pilot operated pressure reducing regulator used to control downstream (P_2) pressure. The POSR-1-20 is a pressure loaded (no pilot) option. Sizes are 1/2", 3/4" and 1" (DN15, 20 and 25). The unit is suitable for steam service only. Refer to Technical Bulletin POSR-1-TB for design conditions and selection recommendations. **NOT RECOMMENDED FOR DEAD END SERVICE!**

SECTION II

II. INSTALLATION

A. General:



WARNING

Do not dead end (no flow demand) downstream of POSR-1 if P_1 - Inlet Pressure is greater than maximum allowable outlet design pressure.

Spring Range	Max. Allowable Outlet Pressure
5-15 psig (0.34-1.03 Barg)	100 psig (6.9 Barg)
10-40 psig (0.69-2.8 Barg)	200 psig (13.8 Barg)
30-80 psig (2.1-5.5 Barg)	200 psig (13.8 Barg)
70-150 psig (4.8-10.3 Barg)	200 psig (13.8 Barg)

B. Piping the Valve:

1. An inlet block valve should always be installed.
2. If service application is continuous such that shut down is not readily accomplished, it is recommended that an inlet block valve, outlet block valve, and a manual bypass valve be installed.
3. Pipe unions are recommended for NPT screwed installations to allow removal from piping.
4. An outlet pressure gauge should be located approximately ten pipe diameters downstream, and within sight.

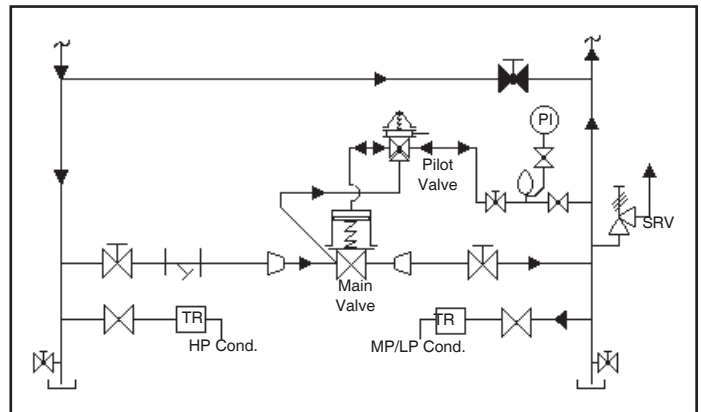


FIGURE 1

Recommended Piping Schematic for POSR-1

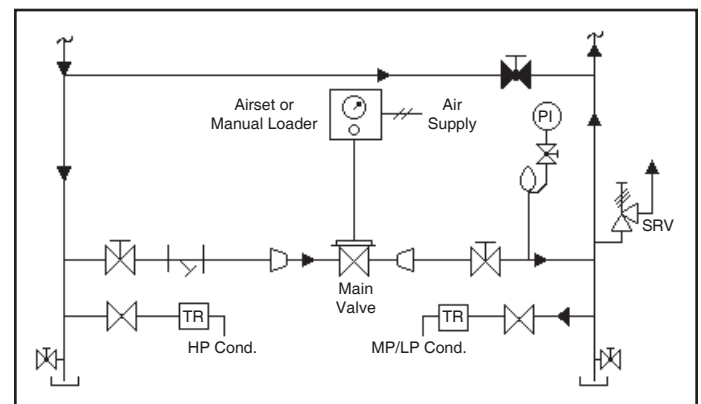


FIGURE 2

Recommended Piping Schematic for POSR-1-20




CAUTION

Installation of adequate overpressure protection is recommended to protect the regulator from overpressure and all downstream equipment from damage in the event of regulator failure.

5. All installations should include a downstream relief device if the inlet pressure could exceed the pressure rating of any downstream equipment or the maximum allowable outlet pressure rating of the unit.
6. Clean the piping of all foreign material including chips, welding scale, oil, grease and dirt before installing the regulator. Strainers are recommended.


to a point downstream at gauge location; use 1/4" OD metal tubing for distances 4 ft (1.2 m) or less, and 3/8" OD metal tubing (requires 1/4" x 3/8" tubing adapter) for distances greater than 4 ft. (1.2 m). The sensing line should always be sloped downward so that condensation will drain away from the pilot. If regulator pipe line is expanding to a larger pipe line, always connect sensing line to the larger pipe line. **NOTE: The POSR-1-20 does not require a sensing line.**


CAUTION

DO NOT HYDROSTATIC TEST THROUGH AN INSTALLED UNIT, INCLUDING PILOT; ISOLATE BOTH PILOT AND MAIN VALVE FROM TEST. The upper range spring pressure level listed on the nameplate is the recommended "upper operative limit" for the sensing diaphragm(s) in the pilot. Higher pressures could cause internal damage. In addition, note on the nameplate that the Inlet and Outlet pressure and temperature ratings are at different levels.

7. In placing thread sealant on pipe ends prior to engagement, assure that excess material is removed and not allowed to enter the regulator upon start-up.
8. Flow Direction. Install so the flow direction matches the arrow cast on the body.
9. The POSR-1 comes factory piped between the pilot supply and pilot loading. Install an external sensing line from the 1/4" NPT connection opposite the factory piped pilot loading port

10. For best performance Cashco recommends installing regulator in a well drained horizontal pipe, properly trapped.
11. Recommended installation is with pilot valve spring chamber vertical upwards. Orient such that the spring chamber vent hole does not collect rainwater or debris.
12. Regulators are not to be buried underground.
13. For insulated piping systems, recommendation is to not insulate regulator.


CAUTION

For welded installations, all internal trim parts, seals and diaphragm(s) must be removed from regulator body prior to welding into pipeline. The heat of fusion welding will damage non-metallic parts if not removed. NOTE: This does not apply to units equipped with extended pipe nipples.

SECTION III

III. PRINCIPLE OF OPERATION

A. General:

1. The POSR-1 pilot obtains its operating medium from the main valve body inlet. Downstream pressure (P_2) registers on the underside of the main valve's diaphragm and the pilot valve's diaphragm(s).
2. The loading pressure on the top side of the main valve's diaphragm is an intermediate pressure higher than the downstream (P_2) pressure by the sum of the pressures required to overcome the main valve's plug unbalance force and the piston spring's force.
3. The pilot has a bleed orifice that continuously bleeds part of the loading medium downstream. In operation, the pilot valve's plug can flow more medium than is bleeding downstream.

This increases the loading pressure on the main valve's plug and opens valve. Partially closing the pilot valve's plug will reduce its flow to less than the amount bleeding downstream, and allows the loading pressure on the main valve's diaphragm to decay, allowing partial closing of the main valve's plug. This continues until steady-state is developed.

4. The pilot valve's diaphragm(s) senses the downstream (P_2) pressure and compares the force generated to the force developed by the pilot's range spring.
5. If, during operation, the downstream (P_2) pressure falls below the pilot valve's setpoint, the main valve's diaphragm senses the reduced pressure on its underside and instantly moves down, increasing the flow through the main valve. At the same time, the pilot valve

senses the reduced pressure and the pilot valve's plug increases its opening, elevating the loading pressure on the upper side of the main valve's diaphragm. The combined actions increase flow enough to restore the downstream (P_2) pressure to the setpoint.

- If the downstream (P_2) pressure rises above the setpoint, the force developed by the increased pressure on the underside of the diaphragm instantly moves it upward and partially closes the main valve's plug. Simultaneously, the pilot valve's plug partially closes and allows

the loading pressure to decay through the bleed orifice. The reduced loading pressure on the upper side of the diaphragm closes the main valve's plug enough to restore the downstream (P_2) pressure to the setpoint.

- Pressure setpoint is adjusted by changing the compression of the pilot's range spring by turning the adjusting screw either clockwise (CW) or counter-clockwise (CCW). Turning the adjusting screw clockwise (CW) will increase the downstream (P_2) pressure. Turning the adjusting screw counter-clockwise (CCW) will decrease the downstream (P_2) pressure.

SECTION IV

IV. START-UP

A. General

- Start with the block valves closed.
- Ensure that the needle valve(s) on the sensing line is opened and downstream (P_2) pressure is indicating on pressure gauge.
- Relax the pilot valve range spring by turning the adjusting screw counter clockwise (CCW) (viewed from above) a minimum of three (3) full revolutions. This reduces the outlet (downstream) pressure setpoint.

For POSR-1-20 use manual loading valve to set minimum loading pressure.

Outlet Pressure - P_2 psig (Barg)	Loading Pressure - P_3 , psig (Barg)	
	@ P_1 Minimum	@ P_1 Maximum
5 (0.34)	15 (1.03)	25 (1.7)
50 (3.45)	60 (4.1)	70 (4.8)
100 (6.90)	110 (7.6)	120 (8.3)
130 (8.97)	145 (10.0)	150 (10.3)
135 (9.31)	150 (10.3)	- (-)

- Slowly open the bypass valve to preheat the system piping and to allow slow expansion of the piping. Assure proper steam trap operation. Closely monitor outlet (downstream) pressure via gauge to assure not over-pressurizing. **NOTE:** *If no bypass valve is installed, extra caution should be used in starting up a cold system; i.e. do everything slowly.*
- Slowly open the outlet (downstream) block valve until fully open. Slightly close the bypass valve at same time.



CAUTION

Do not walk away and leave a bypassed regulator unattended when on manual bypass!

- Slowly open the inlet (upstream) block valve observing the outlet (downstream) pressure gauge. Determine if the regulator is flowing. If not, slightly close bypass valve, and then slowly rotate the pilot valve adjusting screw clockwise (CW) (viewed from above) until flow begins.

For POSR-1-20 increase loading pressure until flow begins.



CAUTION

Do not exceed Maximum Loading Pressure limits for P_2 set point.

- Continue to alternate slowly closing the bypass valve and then slowly opening the inlet (upstream) block valve, especially when the downstream piping system isn't pressurized. If the outlet (downstream) pressure exceeds the desired pressure, close the bypass valve until fully closed. If outlet pressure still remains above desired level, rotate pilot's adjusting screw CCW (viewed from above) in 1/2 revolution increments until outlet pressure reaches desired level. If outlet pressure is below desired level, rotate pilot's adjusting screw CW (viewed from above) until desired level is reached.

For POSR-1-20 adjust manual loading valve to either increase or decrease loading pressure until desired set point is reached. Do not exceed limits.

- When flow is established steady enough that the inlet (upstream) block valve is fully open, begin to slowly close the bypass valve and continue until fully closed.
- Develop system flow to a level near its expected normal rate, and reset the regulator setpoint by turning the pilot valve adjusting screw

CW (viewed from above) to increase outlet pressure, or CCW to reduce outlet pressure.

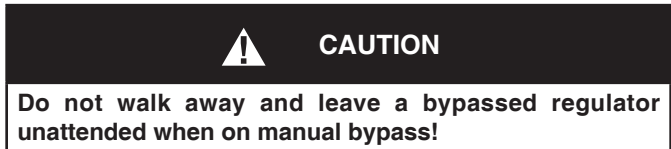
- Reduce system flow to a minimum level and observe setpoint. Outlet pressure will rise from the setpoint of Step 9. There should be no more than a 10% variation in outlet pressure over the maximum to minimum flow range.

SECTION V

V. SHUTDOWN

A. General

- On systems with a bypass valve, and where system pressure is to be maintained as the POSR-1 is shut down, slowly open the bypass valve while closing the inlet (upstream) block valve. Fully close the inlet (upstream) block valve. (When on bypass, the system pressure must be constantly observed and manually regulated.) Close the outlet (downstream) block valve. Close the needle valve on the pilot valve's sensing line.

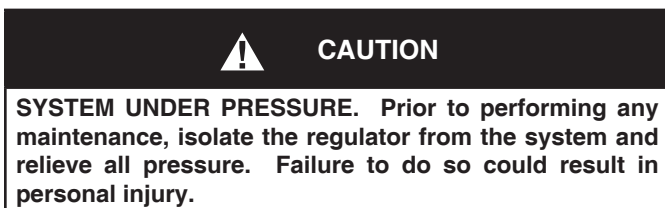


- If the regulator and system are to both be shutdown, slowly close the inlet (upstream) block valve. Close the outlet (downstream) valve only if regulator removal is required. Close the needle valve on the pilot valve's sensing line.

For POSR-1-20 close manual loading valve and relieve loading pressure.

SECTION VI

VI. MAINTENANCE



A. General:

- Maintenance procedures hereinafter are based upon removal of the regulator unit from the pipeline where installed.
- Owner should refer to owner's procedures for removal, handling, cleaning and disposal of nonreusable parts, i.e. gaskets, etc. Cashco recommends not reusing any gaskets, but replacing with only new and factory supplied gaskets.
- This regulator is supplied from the factory using a gasket sealing aid, Federal Process Company, PLS2, or equal. Such compatible sealing aids may be utilized by the Owner, if desired.

- All indicated item numbers that are with respect to the Pilot Valve will be in parenthesis and underscored, i.e. (14), (PV). All item numbers that are with respect to the Main Valve will **NOT** be underscored, i.e. (1), (MV).
- Refer to Figures 3 and 4 for item number callouts.
- Most pilot-operated valve operation problems center around the pilot valve (PV). Cashco always recommends full maintenance on any POSR-1 pilot valve (PV) once a POSR-1 is removed from the pipeline.

B. Separation:

- Observe position of pilot valve (PV) with respect to main valve (MV) before disassembling.
- Place main valve body (1) into a vise, oriented to allow rotation of pilot valve (PV) together with interconnecting pipe nipple (19).
- Remove loading tubing (21) at both end fittings (20) by rotating nut CCW (viewed from tube-end).

4. Place pipe wrench on interconnecting pipe nipple (19) and rotate CCW (viewed from pilot valve (PV) end) to removal. Remove main valve (MV) from vise and set aside.
5. Place pilot valve body (1) in vise. Remove pipe nipple (19) by rotating CCW (viewed from end of nipple) by pipe wrench.
6. Inspect the inside of the inter-connecting pipe nipple (19) for corrosion, scaling, debris, or filming. Problems here will be an indication of improper condensate corrosion control which can affect the overall operation of the POSR-1. Install an upstream strainer if scale or debris appears at this point.
7. Remove pilot valve (PV) from vise and set aside.



WARNING

SPRING UNDER COMPRESSION. Prior to removing body flange bolts, relieve spring compression by backing out the adjusting screw. Failure to do so may result in flying parts that could cause personal injury.

C. Pilot Valve (PV):

1. Securely install the pilot valve body (1) in a vise with the spring chamber (2) directed upwards.
2. Loosen locknut (20) by rotating CCW (viewed from above) ONLY two revolutions. Relax range spring (15) by turning adjusting screw (19) CCW (viewed from above) until removed from spring chamber (2). Set adjusting screw (19) with locknut (20) aside.
3. Draw or embed a match mark between body casting (1) and spring chamber casting (2) along flanged area.
4. Remove all diaphragm flange nuts (18) and bolts (17).
5. Remove spring chamber (2) by lifting upwards. Remove range spring (15) and spring button (16).
6. Remove pressure plate (14). Inspect to ensure that the pressure plate (14) has not been deformed by overpressure by placing a thin, straight bar or ruler across the side that touches the diaphragm (12). If the pressure plate (14) does not touch the bar at its center (i.e. a depression in center), the pressure plate (14) is deformed and must be replaced.

NOTE: Pilot valves (PV) supplied with a 5–15 psig (0.34–1.03 Barg) range spring (15) have only one diaphragm (12) supplied; all other spring ranges use two diaphragms (12).

7. Using a putty knife or similar tool, remove diaphragm(s) (12) and diaphragm gasket (13). Inspect diaphragm(s) (12) for cracks or deformation. Radial creases and cracks indicate overpressure. Cracks circumferentially indicate high cycles, and may be due to normal cycling, or pulsing or chattering if premature. Discard both diaphragm(s) (12) and gasket (13).
8. Using a 7/8" deep well socket, remove bellows (11) by rotating CCW (viewed from above). Count and record the number of revolutions required to remove the bellows (11) in the box below:

Number of revolutions required to remove bellows (11): _____.

Inspect the bellows (11) for a crack or joint failure where leakage is occurring. Replace bellows (11) if leaking.

9. Remove protruding stem extension (10).
 10. Using a flat, sharp-edged tool, clean body (1) flange where diaphragm gasket (13) seals.
 11. Using a wire gauge tool, clean the 0.068" (1.73 mm) diameter bleed orifice located in the body cavity (smaller of two holes) of any film or other buildup material that might be restricting flow.
- NOTE:** Any significant blockage of the bleed orifice will downgrade a POSR-1's performance. If a buildup is forming, attempt to determine the cause and remove the source.
12. Remove body (1) from vise and reorient with body cap (9) on top; resecure body (1) in vise.
 13. Remove body cap (9) by rotating CCW (viewed from above) with hex-end wrench. Hammer-rapping the wrench may be necessary, as the body cap (9) has a metal-to-metal shoulder joint with the body (1). **NOTE:** Plug (4.2) and plug spring (7) may come out with body cap (9) removal.
 14. Remove plug spring (7) and plug (4.2) from body (1) recess.

15. Using needle nose pliers, carefully remove the screen (6) from the body (1) recess.
16. Inspect body cap (9), screen (6), plug spring (7), and plug (4.2) for buildup or filming. If parts are "sticking" together, then improper condensate corrosion treatment is likely. If scale or other debris is present, then an upstream strainer is recommended.
17. Using a 5/8" deepwell socket, rotate valve seat (4.1) CCW (viewed from above) to removal.
18. Remove seat gasket (8) using a tool with a bent sharp end. Discard the seat gasket (8).
19. Using a sharp edged tool, clean all gasket surfaces, and metal-to-metal contact surfaces of body (1), valve seat (4.1) and body cap (9).
20. Lap plug (4.2) with valve seat (4.1) using a suitable lapping compound. Do for new replacement plug (4.2) and seat (4.1) also.
21. Solvent clean all loose internal parts of pilot valve (PV). Inspect the valve seat (4.1) and plug (4.2) for wear. Replace the valve seat (4.1) and plug (4.2) together, even if only one piece shows significant wear. Solvent clean body (1).
22. Place body (1) into vise with body cap (9) opening upwards.
23. Place seat gasket (8) into recess.
24. Put thread lubricant onto valve seat (4.1), and rotate valve seat (4.1) into threaded recess by rotating CW (viewed from above) until seat (4.1) shoulders against body (1).
25. **NOTE:** Replace screen (6) only if necessary. Using a 3/4" (19 mm) round bar, form and interlock the flat screen (6) similar to the removed screen (6) being replaced. Slide formed screen (6) off of bar. Insert the screen into the body recess and over the hex points of the valve seat (4.1). Ensure concentricity of positioned screen (6).
26. Place plug spring (7) into recess of plug (4.2), and position plug's (4.2) stem-end through the valve seat (4.1).
27. Place thread lubricant on threads of body cap (9). Capture protruding plug (4.2) end and plug spring (7) with body cap (9) recess. Rotate body cap (9) CW (viewed from above) until shouldering on body (1). Hammer rap wrench handle to ensure tightness.
28. Remove body (1) from vise and reposition with diaphragm flange oriented on top.
29. Place thread sealant/lubricant onto threads of bellows (11). Insert flat-end of stem extension (10) into the center of the bellows (11); chamfered end of stem extension (10) should be protruding bellows (11). Invert bellows (11) with stem extension (10) into body (1) recess. Allow stem extension (10) to "fall" into threaded opening for bellows (11). Align threaded portion of bellows (11); rotate CW (viewed from above) the same number of engaged revolutions recorded in article 8. previous, this sub-section.
30. Place diaphragm gasket (13) onto body's (1) flange aligning cutouts of gasket (13) with bolt hole openings.
31. Place diaphragm(s) (12) onto body (1) positioned concentrically. **NOTE:** Reassemble pilot valve (PV) ONLY with the number of diaphragms (12) disassembled with; the 5–15 psig (0.34–1.03 Barg) spring range uses only one diaphragm (12).
32. Concentrically position pressure plate (14) onto diaphragm(s) (12).
33. Set range spring (15) over hub of pressure plate (14).
34. Place multi-purpose, high temperature grease into recess of spring button (16) where adjusting screw (19) bears. Place spring button (16) over top-end of range spring (15) with greased recess on top side.
35. Clean threads of diaphragm bolting (17) (18). Place thread lubricant on bolts (17). Engage two sets of bolting (17) (18) for ease in rotation; disengage.
36. Place the two bolts (17) of above, approximately 180° across through body (1) diaphragm flange from underneath side. Hold bolts (17) with fingers of one hand to keep from falling downwards.
37. Set spring chamber (2) down over the two protruding bolts (17), aligning the matchmarks of article 3. previous, this sub-section.
38. Place the two nuts (18) onto bolts (17) of above, and finger-tighten.
39. Place remaining bolts (17) through spring chamber (2) bolt hole openings. Engage all

nuts (18) onto bolts (17) along underneath side of body (1) flange and finger-tighten.

40. Remove the two upside-down bolts (17) and nuts (18) and rotate to position of other bolts (17). Place nameplate tag (21) over one of the bolts (17) before replacing into bolt hole. Finger-tighten nuts (18).
41. Observe through opening in top of spring chamber (2) to ensure the concentricity of the recess in the spring button (16) with the top opening. It may be necessary to use an awl or similar tool to realign the spring button (16) as much as possible. The spring chamber (2) is not tightened down, and may be temporarily "shifted" to help ensure alignment for the adjusting screw (19) engagement.
42. Place lubricant onto the upper exposed threads of the spring chamber's (2) adjusting screw (19) opening. Place lubricant onto the adjusting screw (19) lower-end threads. Engage adjusting screw (19) back into spring chamber (2) by rotating CW (viewed from above). Engage only until resistance is made with the range spring (15) via the spring button (16).
43. Realign the spring chamber (2) flange with the body (1) flange, and wrench-tighten bolting (17, 18) in an alternating, crossing pattern. Final tightening should be done with a torque wrench to 15 ft.-lbs. (20 N-M).



WARNING

Never replace bolting (17, 18) with just any bolting if lost. Bolt heads and nuts are marked with specification identification markings. Use only proper grades as replacements.

44. Continue CW rotation (viewed from above) of adjusting screw (19) until locknut (20) touches spring chamber (2). Back adjusting screw (19) out by rotating CCW (viewed from above) two revolutions. This position will approximate the pressure setpoint prior to disassembly if the locknut (20) is only loosened two revolutions as directed in article 2. previous, this sub-section.
45. Pressure leak test pilot valve (PV) assembly when rejoined with the main valve (MV) assembly including interconnecting nipple (19), tubing (21), and tubing fittings (20).

D. Main Valve (MV):

1. Securely install the body (1) in a vise with the loading chamber (2) directed upwards.
2. Draw or embed a match mark between body (1) casting and spring chamber (2) casting along flanged area.
3. Remove all cap screws (14) and nuts (15).
4. Remove loading chamber (2), diaphragms (12), diaphragm gaskets (13) and pusher plate (11). Clean body (1) and diaphragm (12) flange surface.
5. Rotate cap screws (10) CCW to remove, lift shield plate (9) out of body (1) cavity.
6. Remove body (1) from vise, rotate body (1) with body cap (4) directed upwards and re-secure body (1) in vise.
7. Loosen and remove body cap (4) using a hex head wrench with a lever length of at least 15" inches. The wrench should be rapped with a hammer to loosen.
8. Remove piston spring (6), piston (3.2) and cylinder (3.1). Inspect parts for excessive wear, especially at seat surfaces. Replace if worn.
9. Remove the cylinder gasket (8) and clean contacting surface in body (1).
10. Clean flat mating surfaces of body (1) to body cap (4) shoulder.
11. Clean debris from within body (1) cavity and all parts to be reused.
12. Reinstall a new cylinder gasket (8). Use the cylinder (3.1) to firmly and evenly press the gasket (8) into place. Gasket surfaces maybe lightly coated with pipe sealant prior to installation.
13. Ensure cylinder (3.1) is concentric within the body (1) opening. Slide the piston (3.2) into the cylinder (3.1).
14. Place piston spring (6) into piston cavity.
15. Apply pipe thread sealant to body cap (4) threads and screw into body (1). When body cap (4) shoulder is resting fully down against body (1), use a wrench with 15" lever handle and a hammer to impact the body cap (4) tight

into the body (1). **NOTE:** *Metal to metal seal between body cap (4) and body (1).*

16. Remove body (1) from vise, rotate body (1) with body cap (4) directed downwards and resecure body (1) in vise.
17. Reposition shield plate (9) in body (1). Align hole for cap screw (10) with threaded hole in body cavity. Insert and tighten cap screw (10).
18. Reinstall the pusher plate (11). Ensure piston (3.2) post slides into the hole of the pusher plate (11).
19. Place new diaphragm gasket (13), two diaphragms (12) and last diaphragm gasket (13) in that order on body (1) flange. Visually align these parts on body (1) diaphragm flange.
20. Place loading chamber (2) over the above stacked parts. Install all cap screws (14) and nuts (15) and hand tighten. Mechanically tighten bolting (14 & 15) in a cross pattern that allows loading chamber (2) to be pulled down evenly. Recommended torques 15 to 20 ft/lbs.

NOTE: *Never replace bolting (14 & 15) with just any bolting if lost. Bolt heads and nuts are marked with specification identification markings. Use only proper grades as replacements.*

SECTION VII

VII. LEAK TESTING

A. General:

1. A POSR-1 is a metal-to-metal seated design with standard hardened trim in main valve (MV) and pilot valve (PV).
2. The pilot valve (PV) can be seat leakage tested without extensive setup.
3. There are two design pressures for a POSR-1; one for the higher inlet pressure zone, and another for the lower outlet pressure zone.

Recommended Test Pressures –

Inlet: 100 psig (7.0 Barg).

Outlet: 15 psig (1.03 Barg) for Pilot with 5–15 psig (0.34–1.03 Barg) spring range.

40 psig (2.7 Barg) for Pilots with 15–150 psig (1.03–10.3 Barg) spring ranges.

E. Reconnecting Pilot Valve (PV) to Main Valve (MN)

1. Place main valve body (1) into vise, oriented to allow rotation of pilot valve (PV) together with interconnecting pipe nipple (19).
2. Place thread sealant on both threaded ends of interconnecting pipe nipple (19).
3. Insert nipple (19) in main valve body (1). Hand tighten. Rotate CW (viewed from nipple open end) to tighten.
4. Rotate pilot valve (PV) CW (viewed from above pilot valve) into open end of interconnecting pipe nipple (19). Using a pipe wrench, tighten the pilot valve (PV) to the main valve (MV) by turning the pilot valve (PV) until tight and in proper orientation with respect to each other.
5. Reinstall interconnecting tubing (21) between main valve (MV) loading chamber (2) and pilot valve (PV) body (1).
6. Leak test the combined unit per Section VII.

B. Seat Leakage – Pilot Valve (PV):

1. Disconnect tubing (21) that connects the pilot valve (PV) body (1) to the main valve (MV) loading chamber (2).
2. Disconnect pipe nipple (19) from main valve (MV) body (1) and pilot valve (PV) body (1).
3. Remove tube fitting (20) from pilot valve (PV) body (1) by rotating CCW (viewed from fitting end).
4. Place temporary pipe plug into 1/4" – NPT connection (P_{in}) after removal of fitting (20).
5. Install a hose fitting into the 1/2" FNPT port of pilot valve (PV) body (1). Connect a length of rubber hose to fitting. Place the open end of the hose at the bottom of a jar with approximately 1/8" (3 mm) of water depth at about the same elevation of the pilot valve (PV).

- Relax the range spring (15) by rotating the adjusting screw (19) CCW (viewed from above) until fully loose. Keep track of the number of revolutions in the box below:

No. of Revolutions adjusting screw rotated: _____.

- Connect temporary air supply with in-line adjustable airset regulator to P₂ outlet of pilot. Slowly pressurize the pilot valve (PV) while observing the jar with water. Bring pressure to 50 psig (3.4 Barg). Wait a minimum of five minutes. Observe for leakage of bubbles in the water jar. If the number of bubbles is greater than one (1) per minute, the leakage is at the point where trim replacement is recommended. (Recommend pressure integrity test per Sub-Section D. herein.)
- Remove leak test apparatus. Reinstall brass fittings (20) using suitable thread sealant. Reinstall all tubing (21).

C. Seat Leakage – Main Valve (MV):

Seat leakage rate for main valve cylinder (3.1) and piston (3.2) should be equivalent to ANSI/FCI 70-2, Class IV (approaches 0.1% of rated valve capacity).

D. Pressure Integrity Leak Test:

- Test pilot valve (PV) and main valve (MV) assembled together with all interconnecting pipe (19), tubing (21) and fittings (20).
- Insert tapped pipe plugs with hose fittings to both inlet and outlet body (1) connections.
- Install temporary hoses with tight shutoff instrument needle valves at outlet connection of main valve (MV) and of the pilot valve (PV).
- Connect temporary air supply with in-line adjustable airset regulator to inlet connection of main valve (MV).

- Close needle valve at outlet connection of main valve (MV). Crack open the needle valve at the pilot valve (PV) outlet.
- Rotate adjusting screw (19) of pilot valve (PV) CW (viewed from above) until a point of high resistance occurs; this should correspond to the diaphragm (12) pushing against the body's (1) down travel stops. Record the number of revolutions the adjusting screw was rotated in the box below:

No. of revolutions the adjusting screw was rotated _____.

- Slowly pressurize the inlet of the main valve (MV) and pilot valve (PV) to 100 psig (6.9 Barg).

NOTE: If the pilot valve (PV) has any other range spring (15) above 5–15 psig (.34–1.03 Barg), the test pressure can be raised to 200 psig (13.8 Barg).

- Using a solution of leak detection fluid and water, apply a liberal amount of the solution to cover each external joint, including the threaded fittings (20), tubing (21) and the interconnecting pipe nipple (19) threaded connections. Wait a minimum of five minutes to allow sufficient time for a leak to form bubbles. Repeat this procedure with a second five minute wait.
- Identify and mark any observed leakage. Disassemble down to the point of leakage and determine the cause of the leak. Repair and reassemble per instructions in Section VI. Retest per Section VII.
- Shut off pressure to inlet connection of main valve (MV) and remove all leak testing equipment. Reset the adjusting screw (19) back to its normal setpoint by rotating the screw (19) CCW (viewed from above) the same number of revolutions recorded in Article 6. previous, this sub-section.

SECTION VIII

VIII. TROUBLE SHOOTING GUIDE

1. Erratic or Noisy Operation.

Possible Causes	Remedies
A. Wet steam or condensate at the inlet.	A. Install a steam trap on the inlet side of the regulator.
B. Clogged pilot valve screen.	B. Clean or replace. Blowdown inlet drip leg. Install upstream strainer, if severe.
C. Regulator oversized for flow conditions.	C. Install correct size.
D. Insufficiently sloped line.	D. Move tap from top of pipe to side; or, increase sensing tube to 3/8" OD.

2. Regulator won't maintain downstream set pressure.

Possible Causes	Remedies
A. Valve undersized.	A. Resize based on actual service conditions.
B. Incorrect range spring.	B. Replace range spring. Replace range spring.
C. Failed bellows.	C. Replace bellows assembly.
D. Pressure drop less than required 15 psid (1 Bard).	D. Contact your Cashco Representative.
E. Insufficiently sloped line.	E. Move tap from top of pipe to side; or, increase sensing tube to 3/8" OD.

3. Leakage through the pilot spring chamber vent hole.

Possible Causes	Remedies
A. Defective diaphragm.	A. Replace diaphragm.

4. Excessive pressure downstream.

Possible Causes	Remedies
A. Main valve or pilot plug not closing.	A. Inspect the seating of the main valve and then the pilot plug seating. Clean or replace. Check seat gaskets; replace.

SECTION IX

IX. ORDERING INFORMATION

NEW REPLACEMENT UNIT vs PARTS "KIT" FOR FIELD REPAIR

To obtain a quotation or place an order, please retrieve the Serial Number and Product Code that was stamped on the metal name plate and attached to the unit. This information can also be found on the Bill of Material ("BOM"), a parts list that was provided when unit was originally shipped. (Serial Number typically 6 digits). Product Code typical format as follows: (last digit is alpha character that reflects revision level for the product).

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NEW REPLACEMENT UNIT:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. With this information they can provide a quotation for a new unit including a complete description, price and availability.

PARTS "KIT" for FIELD REPAIR:

Contact your local Cashco, Inc., Sales Representative with the Serial Number and Product code. Identify the parts and the quantity required to repair the unit from the "BOM" sheet that was provided when unit was originally shipped.

NOTE: Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".

If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

A Local Sales Representative will provide quotation for appropriate Kit Number, Price and Availability.

 CAUTION
<p>Do not attempt to alter the original construction of any unit without assistance and approval from the factory. All purposed changes will require a new name plate with appropriate ratings and new product code to accommodate the recommended part(s) changes.</p>

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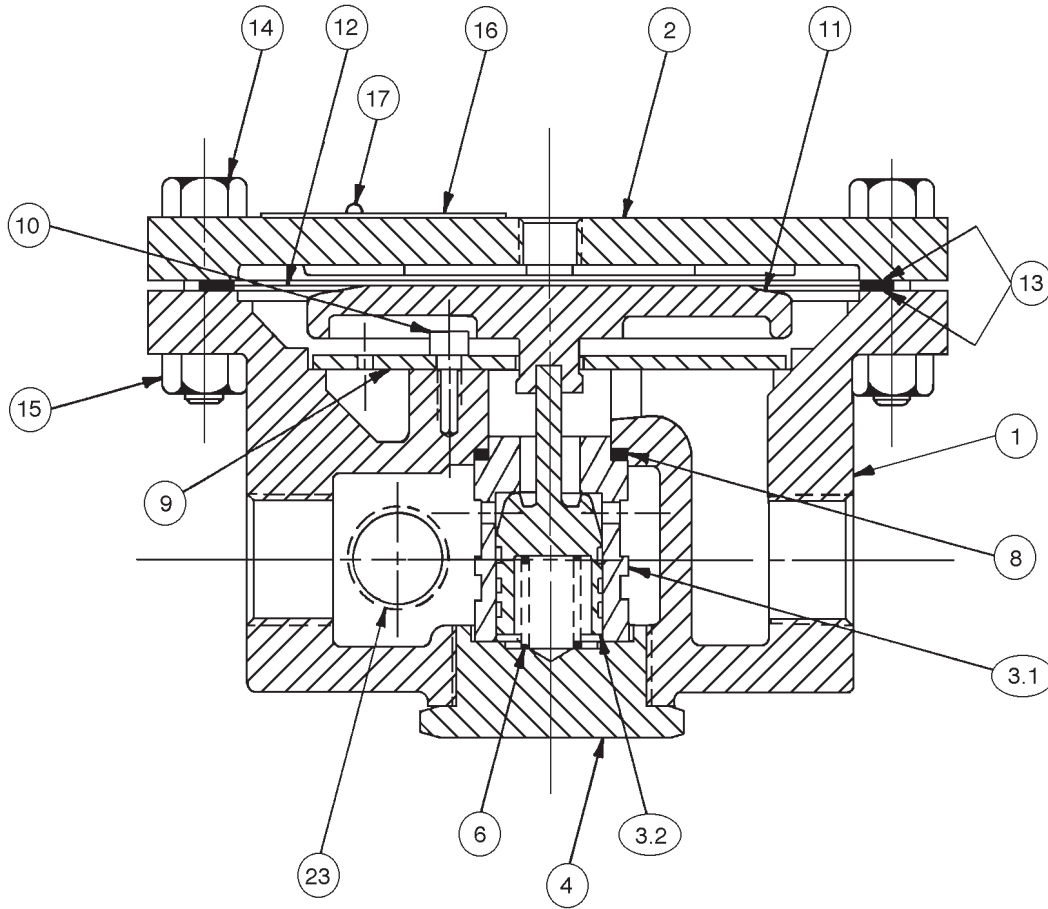
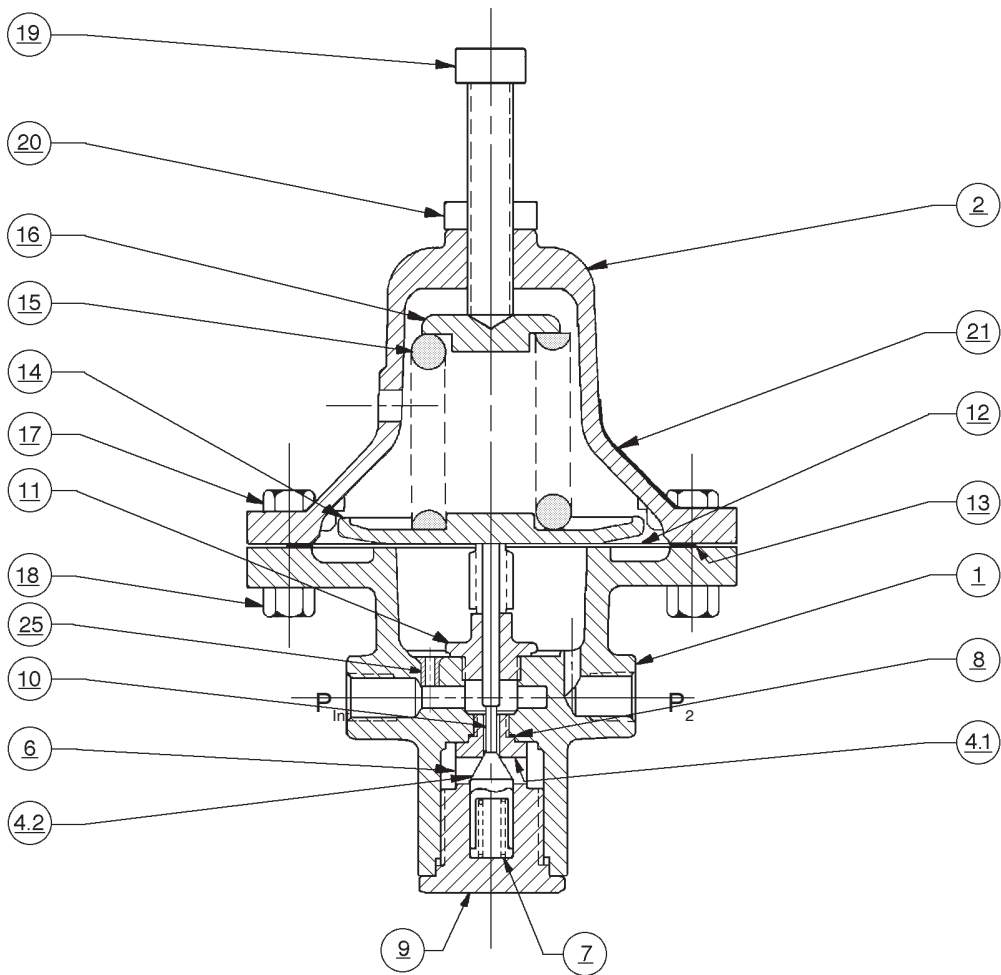


FIGURE 3
MV – MAIN VALVE
POSR-1 & POSR-1-20

<u>ITEM NO.</u>	<u>DESCRIPTION</u>	<u>ITEM NO.</u>	<u>DESCRIPTION</u>
1	Body	13	Diaphragm Gasket
2	Loading Chamber	14	Cap Screw
3	Cylinder/Piston Subassembly	15	Nut
3.1	Cylinder	16	Nameplate
3.2	Piston	17	Drive Screw
4	Body Cap	23	Pipe Plug
6	Spring		
8	Cylinder Gasket		
9	Shield		
10	Socket Head Cap Screw		
11	Pusher Plate		
12	Diaphragm		
			<u>Not Shown on Drawing</u>
		19	Pipe Nipple
		20	Tube Fitting
		21	Tubing



**FIGURE 4
PV – PILOT VALVE**

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
<u>1</u>	Body	<u>11</u>	Bellows Subassembly
<u>2</u>	Spring Chamber	<u>12</u>	Diaphragm
<u>4</u>	Plug & Seat Assembly	<u>13</u>	Diaphragm Gasket
<u>4.1</u>	Valve Seat	<u>14</u>	Pressure Plate
<u>4.2</u>	Valve Plug	<u>15</u>	Range Spring
<u>6</u>	Screen	<u>16</u>	Spring Button
<u>7</u>	Spring	<u>17</u>	Cap Screw
<u>8</u>	Valve Seat Gasket	<u>18</u>	Hex. Nut
<u>9</u>	Body Cap	<u>19</u>	Adjusting Screw
<u>10</u>	Stem	<u>20</u>	Adjusting Screw Lock Nut
		<u>21</u>	Nameplate
		<u>25</u>	Bleed Orifice
		ITEMS NOT SHOWN	
		<u>22</u>	Handwheel
		<u>23</u>	Locking Lever
		<u>24</u>	Spring Pin



IOM ADDENDUM:

ATEX DIRECTIVE 2014/34/EU and THE EQUIPMENT AND PROTECTIVE SYSTEMS INTENDED FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES REGULATIONS 2016

Cashco, Inc. declares that the products listed in the table below has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II of the ATEX Directive 2014/34/EU and given in Schedule 1 of The Equipment and Protective Systems Indented for Use in Potentially Explosive Atmospheres Regulations 2016. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN ISO 80079-36:2016 and EN ISO 80079-37:2016. The product will be marked as follows:



The 'X' placed after the technical file number indicates that the product is subject to specific conditions of use as follows:

1. The maximum surface temperature depends entirely on the operating conditions and not the equipment itself. The combination of the maximum ambient and the maximum process medium temperature shall be used to determine the maximum surface temperature and corresponding temperature classification, considering the safety margins described prescribed in EN ISO 80079-36:2016, Clause 8.2. Additionally, the system designer and users must take precautions to prevent rapid system pressurization which may raise the surface temperature of system components and tubing due to adiabatic compression of the system gas. Furthermore, the Joule-Thomson effect may cause process gases to rise in temperature as they expand going through a regulator. This could raise the external surface temperature of the regulator body and the downstream piping creating a potential source of ignition. Whether the Joule-Thomson effect leads to heating or cooling of the process gas depends on the process gas and the inlet and outlet pressures. The system designer is responsible for determining whether the process gas temperature may raise under any operating conditions.
2. Where the process medium is a liquid or semi-solid material with a surface resistance in excess of $1G\Omega$, special precautions shall be taken to ensure the process does not generate electrostatic discharge.
3. Special consideration shall be made regarding the filtration of the process medium if there is a potential for the process medium to contain solid particles. Where particles are present, the process flow shall be $<1\text{m/s}$ ($<3.3\text{ft/s}$) in order to prevent friction between the process medium and internal surfaces.
4. Effective earthing (grounding) of the product shall be ensured during installation.
5. The valve body/housing shall be regularly cleaned to prevent build up of dust deposits.
6. Regulators must be ordered with the non-relieving option (instead of the self-relieving option) if the process gas they are to be used with is hazardous (flammable, toxic, etc.). The self-relieving option vents process gas through the regulator cap directly into the atmosphere while the non-relieving option does not. Using regulators with the self-relieving option in a flammable gas system could create an explosive atmosphere in the vicinity of the regulator.
7. Tied diaphragm regulators with outlet ranges greater than 7 barg (100 psig) should be preset to minimize the risk that improper operation might lead to an outboard leak and a potentially explosive atmosphere.
8. All equipment must only be fitted with manufacturer's original spare parts.
9. Ensure that only non-sparking tools are used, as per EN 1127-1, Annex A.

	PRODUCT
REGULATORS	31-B, 31-N
	1164, 1164(OPT-45)
	1171, 1171(OPT-45), 1171(CRYO)
	2171, 2171(OPT-45), 2171(CRYO), 3171
	1465, 3381, 3381(OPT-45), 3381(OPT-40)
	4381, 4381(OPT-37), 4381(CRYO), 4381(OPT-45), 5381
	MPRV-H, MPRV-L
	PBE, PBE-L, PBE-H
	CA-1, CA-2
	CA1, SA1, CA4, SA4, CA5, SA5
	DA2, DA4, DA5, DA6, DA8
	DA0, DA1, DAP, SAP
	SLR-1, SLR-2, PTR-1
	ALR-1, ULR-1, PGR-1
	BQ, BQ(OPT-45), BQ(CRYO)
	123, 123(CRYO), 123(OPT-45), 123(OPT-46G)
	123-1+6, 123-1+6(OPT-45), 123-1+6(OPT-46G), 123-1+6+S, 123-1+6+S(OPT-40)
	1000HP, 1000HP(OPT-37), 1000HP(OPT-45), 1000HP(OPT-45G), 1000HP(CRYO)
	1000HP-1+6, 1000HP-1+8, 1000LP, 1000LP(OPT-45), 1000LP(OPT-46G)
	6987
	8310HP, 8310HP-1+6, 8310HP-1+8, 8310LP, 8311HP, 8311LP
	345, 345(OPT-45)
	BA1/BL1, PA1/PL1
	C-BPV, C-PRV, C-CS
	D, D(CRYO), D(OPT-37), D(OPT-20), D(OPT-45)
	DL, DL(LCC), DL(OPT-45)
	BR, BR(CRYO)
	HP, HP(LCC), HP(OPT-45), HP(OPT46G), HP-1+6+S(OPT-40), HP-1+6+S
	P1, P2, P3, P4, P5, P7
	B2, B7
	POSR-1, POSR-2
	5200P, 5300P
135	
NW-PL, NW-SO	
CG-PILOT	
FG1	
CONTROL VALVES	RANGER, 987, PREMIER
	964, 521, 988, 988-MB, 989
	2296/2296HF
	SCV-30, SCV-S
TANK BLANKETING	8700, 8910, 8920, 8930, 8940
	2100, 2199
	3100, 3200, 3300, 3400, 3500, 3600, 3700
	1078, 1088, 1100, 1049
	5100, 5200, 5400, 5500
	4100, 4200, 4300, 4400, 4500, 4600
MISC	764P/PD, 764-37, 764T

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