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MODEL BGR-1
PILOT OPERATED
BACK PRESSURE REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

Model BGR-1 is a back pressure relief service regulator used to control upstream (inlet or P_1) pressure. Sizes are 1/2" (DN15), 3/4" (DN20), 1" (DN25), 1-1/2" (DN40), 2" (DN50), 3" (DN80) and 4" (DN100). This model is applied primarily in gaseous service.

SECTION II

II. REFERENCES

Refer to Technical Bulletin BGR-1-TB for technical specifications for this regulator.

ABBREVIATIONS

CW	–	Clockwise
CCW	–	Counter Clockwise
ITA	–	Inner Trim Assembly

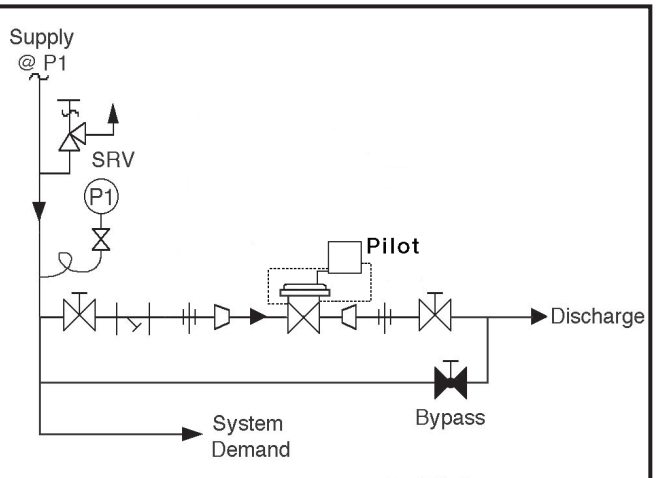
SECTION III

III. INSTALLATION

1. Regulator may be rotated around pipe axis 360 degrees. For ease of maintenance, the recommended position is with the cover dome (25) upwards.
2. Provide space below, above, and around regulator for removal of parts during maintenance.
3. Install block valves and pressure gauges to provide means for adjustment, operation, bypass, or removal of the regulator. A pipeline strainer is recommended before inlet to remove typical pipeline debris from entering valve and damaging internal “soft goods”, primarily the dynamic seal.
4. The BGR-1 is designed to regulate pressure via remote sensing. Use 3/8" or 1/2" (DN10 or DN15) outer diameter tubing to connect the sensing port on the pilot to the piping down stream of the main regulator. If BGR-1 is constructed with self contained feature - tubing and connection in upstream piping is not required.

⚠ 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.



Model BGR-1

SECTION IV

IV. PRINCIPLE OF OPERATION

⚠ CAUTION

DO NOT HYDROSTATIC TEST THROUGH AN INSTALLED UNIT; ISOLATE REGULATOR FROM TEST. The "OUTLET RATING" as printed on the nameplate is the recommended "upper operating limit" for the sensing diaphragm. 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.

1. When a loading pressure – P_{Load} – is applied to the top side of a diaphragm, the outlet controlled pressure – P_1 – will balance at approximately .90 – .98 of the loading pressure - P_L.

2. Movement occurs as pressure variations register on the diaphragm. The registering pressure is the inlet, P1, or upstream pressure. The range spring opposes diaphragm movement. As inlet pressure increases, the diaphragm pushes the range spring up,lifting the valve plug further off the seat; as inlet pressure decreases, the range spring pushes the diaphragm down closing the valve plug toward the seat

3. A diaphragm failure will tend to cause the regulator to fall below setpoint. A loss of loading pressure while inlet pressure is imposed will cause the regulator to fail close.

SECTION V

V. STARTUP

1 Start with the block valves closed.

⚠ CAUTION

Do not walk away and leave a bypassed regulator unattended!

2. Rotate the adjusting screw (113) on the pilot valve CCW so that main regulator is trying to be controlled at 0 psig pressure. **DO NOT** rotate the adjusting screw on the stabilizer, stabilizer was preset and calibrated at the factory. ***NOTE:*** *If an adjustment to the stabilizer is necessary, it is recommended that a gauge be installed in optional port downstream of stabilizer. Once flow is established, if an adjustment is needed, the stabilizer should be set at 8 to 10 PSI above the set point attempting to be controlled.*

3. **DO NOT** rotate knob on metering valve, it was preset at the factory at 2 to 3 full revolutions from closed position. **DO NOT** close metering valve.

4. If it is a "hot" piping system, and equipped with a bypass valve, slowly open the bypass valve to preheat the system piping and to allow slow expansion of the piping.

5. Slowly open the outlet (downstream) block valve to full open.

6. Slowly open the inlet (upstream) block valve to about 25% open. Rotate the adjusting screw (113) on the pilot valve CW to increase setpoint pressure upwards until the main valve flow is shutoff. Observe the inlet pressure gauge to ensure not over pressurizing.

7. Continue to slowly open the inlet (upstream) block valve until fully open.

8. Slowly close the bypass valve if installed.

9. Develop system flow to a level near its expected normal rate, and reset the regulator set point by rotating the adjusting screw (113) on the pilot valve CW to change the setpoint to the desired inlet pressure level. ***NOTE:*** *1/4 turn increments are used due to sensitivity, in some cases the changes to the P_2 are significant.* **DO NOT** rotate knob more than 6 full revolutions from closed position. Metering valve is preset at factory 2 to 3 full revolutions from closed position. **DO NOT** close metering valve.

SECTION VI

VI. SHUTDOWN

1. Shutoff inlet block valve.

2. Allow sufficient time for the line pressure downstream of the inlet block valve to bleed down.

3. Shutoff the outlet block valve.

4. Relieve any trapped upstream and downstream pressure and loading pressure from BGR-1.

5. The regulator may now be removed from the pipeline or disassembled for inspection and preventative maintenance while in-line.

VII. MAINTENANCE

⚠ WARNING

SYSTEM UNDER PRESSURE. Prior to performing any maintenance, isolate the regulator from the system and relieve all pressure. Failure to do so could result in personal injury.

A. General:

1. The main regulator body may be serviced without removing the regulator from pipeline. The regulator is designed with quick-change trim to simplify maintenance.

2. Record the name plate information to requisition repair parts for the regulator. This information should include: size, Serial Number, and Product Code.

3. Refer to Section IX for recommended repair parts. Only use original equipment parts supplied by Cashco for rebuilding or repairing regulators.

4. Owner should refer to owner's procedures for removal, handling, cleaning and disposal of nonreusable parts, i.e. gaskets, etc.
   NOTE: *On regulators originally supplied as "special clean" – Opt-56, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1542.*

5. The Inner Trim is removed and replaced back in the body (23) as an assemblage of parts. The **Inner Trim Assembly**, hereinafter called **ITA**, consists of following parts: (See Figure 1)

   A detailed view of the dynamic side seal parts is shown on page 5.

B. Main Valve Disassembly:

1. Shut down system in accordance Section VI.

2. Disconnect the external sensing line from the pilot valve sensing port.

3. Though it is possible to disassemble the valve unit while installed in a pipeline, it is recommended that all maintenance be done in a shop when possible. The instructions hereafter will assume in shop disassembly. Remove valve from pipeline.

4. Place the main valve unit in a vise with the cover dome (25) upwards.

5. Loosen all fittings and remove tubing that connects the inlet filter to the stabilizer, the cover dome to the metering valve and the outlet of the metering valve to the outlet of the body.

6. Removal of the pilot is dependent on hook-up schematic in use. Refer to Figure 2 on page 14. Loosen all fittings and remove tubing that connects the pilot to the main valve, or loosen bolts that secure the mounting bracket (40.8) and pilot to the cover dome (25). Set pilot assembly aside. Place match marks on the cover dome flange to mark the location for the mounting bracket and two longer bolts if mounting bracket is used.

7. Loosen the diaphragm flange bolts (11) and nuts (12) uniformly and remove.

8. Place matchmarks on body (23) and cover dome (25) flanges. Remove cover dome.

9. With wrench grasp and hold the milled "flats" on top of the valve plug (20) stationary. Rotate diaphragm nut (7) CCW and remove .

10. Remove upper diaphragm plate (8).

Item No.	Dynamic Seal Type	Part Description
7	All	Diaphragm Cap Screw
7	All	Diaphragm Lock Nut
8	All	Upper Diaphragm Pressure Plate
9	All	Diaphragm(s)
10	All	Lower Diaphragm Pusher Plate
13	All	Piston/Guide Bearing√
14	All	Stem Seals
14.1	All	Upper Stem Seal
14.2	All	Middle Stem Seal
14.3	All	Lower Stem Seal√
20	All	Valve Plug
27	All	Dynamic Side Seal *
27.1	CP	TFE Cap Seal
27.2	CP	O-ring Energizer/Seal
27.3	UC	U-Cup Seal w/Metal Energizer
27.5	PR	Piston Ring Seal
27.6	PR	Piston Ring SST Energizer
28	All	Seat Disc
29	All	Seat Disc Washer
30	All	Seat Disc Nut

* Possible option is with NO dynamic side seal.
√ 3" and 4" body sizes only.

11. Remove diaphragm (9) and o-ring upper stem seal (14.1). Examine diaphragm to determine whether failed; determine if operating conditions are exceeding pressure, pressure drop or temperature limits.

12. Remove lower diaphragm pusher plate (10).

13. Rotate the cage bolts (18) CCW evenly in single revolution increments. Regulator contains a lower return spring (22); the ITA should rise up as the cage cap screws are evenly backed out. A downwards holding force should be applied to the top of the guide bearing (13) to prevent the ITA from popping up as the last threads of the cage bolts are backed out.

14. Remove the ITA by pulling up on the valve plug (20). Set ITA aside.

15. Remove the lower return spring (22) from within the body (23) cavity.

16. Remove cage seal (15). It may have been removed when the ITA was lifted out of the body.

17. Remove internal sensing drilled plug (32/33) (if installed) using 5/32" (4 mm) Allen wrench.

18. Remove body (23) from vise. Clean all reusable metal parts according to owner's procedures.

C. Disassembly of the ITA:

1. See Figure 1 for details:
   a. While holding the cage (19) pull the valve plug (20) downwards and through the guide bearing (13) and out the bottom of the cage.
   b. Remove the guide bearing (13) from the upper end of the cage (19).
   c. Remove wiper seal (17) from guide bearing (13).
   d. Examine the component(s) (14.1, 14.2, 14.3) of the dynamic side seal to determine if significant leakage was occurring. If the dynamic side seal shows signs of wear, determine if operating conditions are exceeding pressure, pressure drop, or temperature limits.

      Remove dynamic side seal components. Special care should be taken when using “tools” to remove the components to ensure that no scratches are imparted to any portion of the guide bearing (13) or cage.
   e. Remove o-ring lower stem seal (14.3) from plug (20).
   f. Remove seat (20); examine for signs of leakage. If seat ring shows signs of significant leakage, determine if operating conditions of pressure, pressure drop, or temperature are exceeding limits.

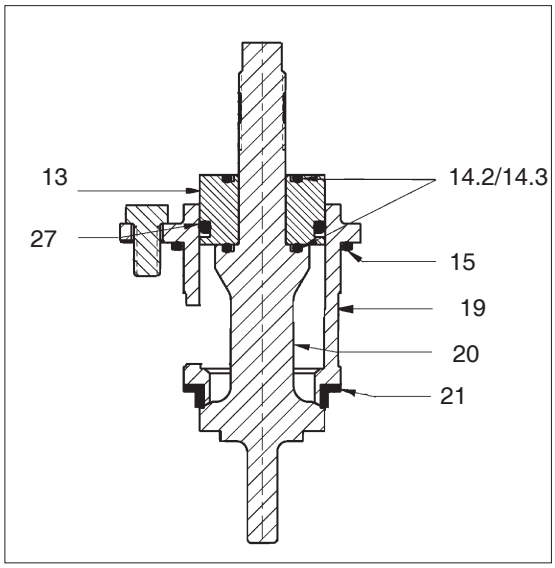


Figure 1: Assembled ITA

D. Inspection of Parts:

1. After inspection remove from the work area and discard the old “soft goods” parts (i.e. o-rings, diaphragms, seals, gaskets, etc.) after inspection. These parts MUST be replaced with factory supplied new parts.

2. Inspect the metal parts that will be reused. The parts should be free of surface contaminants, burrs, oxides, and scale. Rework and clean parts as necessary. Surface conditions that affect the regulator performance are stated below; replace parts that can not be reworked or cleaned.

3. QC Requirements:
   a. Valve plug (20);
      1. 16 rms finish on its seating surface for tight shutoff.
      2. No major defects on bottom guide spindle.
   b. Cage (19);
      1. 16 rms finish on cylinder bore. No “ledges” formed due to wear from moving dynamic side seal (27) or wiper seal (16).
   c. Lower guide bushing (24) (non-replaceable):

1. 16 rms finish on bore.
2. Max 0.015 inch (0.38 mm) clearance between valve plug (20) spindle and lower guide bushing (24).

d. Internal sensing drilled plug (32);
1. Ensure that bore is minimum 0.125 inch (3.20 mm). Drill out as required.

4. Staging Material for Reassembly.
a. Inspect and clean parts, as necessary, from the spare parts kit. (See Article VII A.4. comments for special cleaning.
b. Lay out all the regulator parts and check against the bill of material.

E. Reassembly of the ITA:

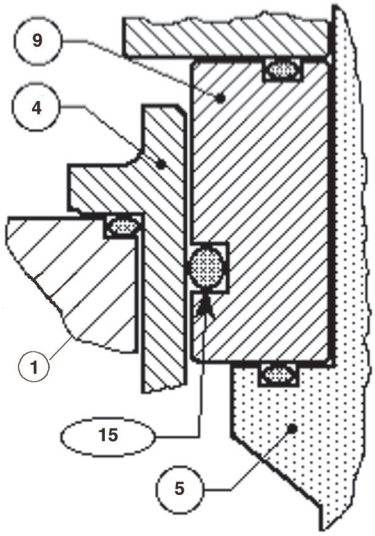
1. Installation of dynamic side seal (15).
a. Type OR:
1. Stretch o-ring seal (15) over lower circumference of guide bearing (13), taking care not to "cut" o-ring seal. Using thumbs, work the o-ring seal up and into the groove of the guide bearing. ***NOTE:*** *A very slight amount of fluid and elastomer compatible lubricant is recommended as an installation aid.*
2. Position guide bearing (13) over top of the upper end of cage (19) properly oriented. Using thumbs, evenly press guide bearing into the cage, ensuring not to "cut" o-ring seal. Continue pressing guide bearing into cage until in approximate final position.

b. Type UC:
1. Stretch u-cup seal (27.3) over lower circumference of guide bearing (13), taking care not to "cut" u-cup seal on the protruding shelf that is part of the guide bearing's groove. Ensure that the u-cup seal is oriented with the center-open-downwards as shown in image below, as the u-cup seal depends upon the P1-Inlet Pressure to pressure activate the seal for proper sealing action.
2. Position guide bearing (9) over top of the upper end of cage (4) properly oriented, until the cup seal edge touches the upper lip of the cage (4). While gently applying force to press the guide bearing (9) into the cage, simultaneously use fingers to lightly press the edges of the u-cup seal inwards into the groove of the guide bearing until the u-cup seal (15.1) "slips into" the cage (19). DO NOT USE TOOLS, LUBRICANT, OR HEAVY FORCE TO ENGAGE THE U-CUP SEAL INTO THE CAGE .

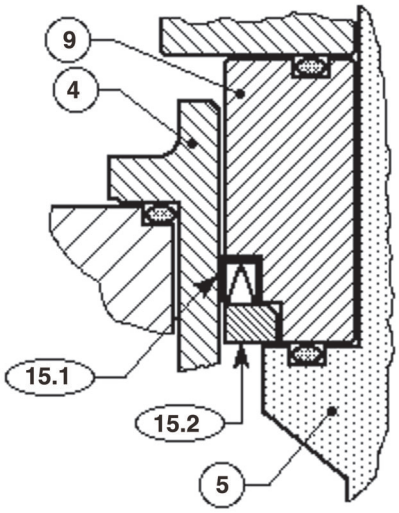
2. Place properly oriented seat (21) onto its shoulder at the lower end of cage (19).

3. Place new o-ring lower stem seal (14.3) into groove of valve plug (20).

4. Insert valve plug (20) upwards through lower end of cage (19) and through the center hole in guide bearing (13). Hold plug and cage together in the closed position.



Type OR — O-Ring Dynamic Seal



Type UC — U-Cup Dynamic Seal

5. Place an oversized nut or stack of washers, the same approximate height of the upper diaphragm plate (8) and the lower diaphragm plate (10), over the upper end of valve plug (20) and temporarily secure with diaphragm nut (7), manually tightened. Do NOT allow valve plug to rotate against seat (21) during tightening.

6. This completes ITA preliminary/partial reassembly.

F. Main Valve Reassembly:

1. Place body (23) in a vise flange face up.

2. Reinstall internal sensing drilled plug (32/33) (if provided) with compatible thread sealant.

3. Insert the lower return spring (22) into the body (23).

4. Fit the cage o-ring seal (15) into the body groove.

5. With the ITA held manually in the closed position, insert ITA into body (23).

6. Properly align bolt holes in the cage with the holes in the body, as there is only one circumferential location possible for this alignment. Apply downward force to the top of the cage (19) until the ITA is lowered sufficiently to engage the cage bolts (18) into the body (23). Engage all of the cage bolts, Rotate the cage bolts in one-half revolution increments to pull down the ITA evenly, taking care NOT TO "ANGLE" the ITA in the body. Torque the cage bolts to 13-15 ft-lbs. (17.6-20.3 N-m).

7. Remove temporarily installed diaphragm nut (7) and spacers of previous Step E.5. this section.

8. Place new o-ring middle stem seal (14.3) into groove of guide bearing (13) upper surface.

9. Position lower diaphragm plate (10) over upper end of plug (20) with tongue and groove "groove" side up.

10. Place new o-ring upper stem seal (14.1) over upper end of valve plug (20).

11. Place diaphragm (9) over end of valve plug (20).

12. Place upper diaphragm plate (8) over upper end of plug (20) with tongue and groove "ridge" side down.

13. Place lubricant on valve plug (20) threaded end. Engage diaphragm nut (7) with upper end of valve stem (20) as far as possible manually. Place a wrench on diaphragm nut and a torque wrench on the upper end of valve plug . Hold torque wrench stationary and rotate diaphragm nut (7) to the following torque values:

Body Size in (DN)	Torque Value Ft-lbs (N-m)
1/2" - 1" (15 - 25)	60 - 70 (81 - 95)
2" (50)	120 - 130 (163 - 176)
3" - 4" (80 - 100)	180 - 200 (244 - 271)

DO NOT allow valve plug (20) to rotate against seat ring (21) during tightening.

14. Aligning matchmarks and bolt holes, place cover dome (25) onto body (23).

15. Reinstall all flange bolts (11) and nuts (12) with nameplate (99) located under one bolt head. Hand-tighten nuts.

16. Evenly tighten the bolting in an alternating cross pattern in one revolution increments to the following torque values:

Body Size in (Dn)	Torque Value Ft-lbs (N-m)
1/2" - 2" (15 - 50)	30 - 35 (41 - 47)
3" - 4" (80 - 100)	45 - 50 (61 - 69)

⚠ WARNING

SYSTEM UNDER PRESSURE. Prior to performing any maintenance, isolate the regulator from the system and relieve all pressure. Failure to do so could result in personal injury.

G. Pilot Valve Disassembly:

1. Shut down system in accordance Section VI.

2. Disconnect the external sensing line, from the pilot valve sensing port.

3. Loosen nipple/adapter connecting main valve to pilot by turning counterclockwise.

4. Remove pilot assembly from main valve.

⚠ CAUTION

To prevent damage to the body, use soft jaws when securing body in a vise. Position body so that vise closes over the inlet and the outlet connections.

5A. **For Spring Range 4" WC - 15 psig**

a. Place the pilot valve body (101) in a vise with the spring bonnet (104) upwards.
b. Relax range spring (115) by first unscrewing the closing cap (105). Then, loosen the jam nut (114) and back off the adjusting screw (113) by rotating CCW several rotations.
c. Paint or embed a match mark between lower case (103) and upper case (102) at flange O.D.
d. Remove all diaphragm flange nuts (109), lockwashers (110), washers (121) and screws (120) around the periphery.
e. Lift upper case (102) and remove bolts (120) and lockwashers (110), holding spring bonnet (104) and upper diaphragm case (102) together. Replace round gasket (122) and reassemble items 102, 104, 110 and 120.
f. Remove the set pressure spring (115), spring button (112), and ring gasket (134), and set to the side.
g. Hold the wrenching washers (128) with a wrench, and loosen and remove the nut (109). Remove the lockwasher (110), lower spring guide washers (111), wrenching washers (128), support plates (106), diaphragm (107), bolt gaskets (126), and spacer (127) and set to the side.
h. Remove the lockwasher (110) and the bolt (120) from the pilot body (101) and lower diaphragm case (103). Remove the seal diaphragm (124), body gasket (125), and the spindle assembly (108). Take the o-ring seat (133) and the bolt gasket (126) off the spindle assembly (108) and replace with new.
i. Reinstall the spindle assembly (108), o-ring (133), and bolt gasket (126) into the pilot body (101). Set new seal diaphragm (124) over the stem of the spindle assembly and a new body gasket (125) on top of the seal diaphragm.
j. Then, reinstall the lower diaphragm case (103) to the pilot body (101) with the lockwasher (110) and the bolt (120).
k. Slide the spacer (127) over the stem of the spindle assembly and place another new bolt gasket (126) on top of the spacer.
l. Place the first support plate (106) on the stem, then the new diaphragm (107), then the bolt gasket (126), and then the final support plate (106).
m. Place the wrenching washers (128), the lower spring guide washers (111), and the lockwasher (110) on the stem.
n. While holding the wrenching washers (128) with a wrench, (and making sure the bolt holes of the diaphragm and diaphragm case align), thread the nut (109) onto the stem and tighten.
o. Place the set pressure spring (115) and the spring button (112) on the spindle assembly (108).
p. Place new ring gasket (134) on top of the diaphragm (107) Then, place the upper diaphragm case (102) on top of the lower diaphragm case (103). Making sure match marks from previous step 7 align
q. Install the washers (121), bolts (120), lockwashers (110), and nuts (109). Tighten to a recommended torque value of 6-8 ft-lbs.
r. Remove the nipple (131) from the pilot body (101).
s. Loosen the jam nut (114). Then, with needle nose pliers, remove the c-ring (119) and unthread the blowdown needle (117).
t. Remove the TFE o-ring (118) Place new TFE o-ring (118) on the blowdown needle (117).
u. Reinstall in reverse order.
v. Thread the blowdown needle (117) completely in, then back out 3 full turns, and lock with the jam nut (114).

5B. **For Spring Range 5 - 300 psig**

a. Securely install the body (80.1) in a vise with the spring chamber (80.2) directed upwards.
b. Relax range spring (80.11) by turning adjusting screw (80.13) CCW until removed from spring chamber (80.2).
c. Draw or embed a match mark between body casting (80.1) and spring chamber casting (80.2) along flanged area.
d. Remove all flange nuts (80.8) and flange bolts (80.7).
e. Remove spring chamber (80.2), range spring (80.11) and spring button (80.12).
f. Remove the diaphragm subassembly consisting of the piston cap screw (80.9), pressure plate (80.10), diaphragm(s) (80.4), piston (80.3) and piston gasket (80.5).
g. To disassemble the diaphragm subassembly, place piston (80.3) in a vise and rotate piston cap screw (80.9) CCW. ***NOTE:*** *Recommend using lead jaws when placing the piston in a vise, so as not to damage the piston grooves.*
h. Separate all parts (80.3, 80.4, 80.5, 80.9 and 80.10) and clean piston gasket (80.5) surface on piston (80.3) if piston is to be reused.
i. Inspect pressure plate (80.10) to ensure no deformation due to over-pressurization. If deformed, replace.
j. Remove diaphragm gasket (80.6) for metal diaphragm.

k. Place diaphragm gasket (80.6) on body (80.1) flange, if required.

l. Reassemble diaphragm subassembly by placing piston (80.3) in a vise (recommend using lead jaws with vise). Assemble parts on piston cap screw (80.9) as follows: pressure plate (80.10), diaphragm(s) (80.4), and piston gasket (80.5), if required. ***NOTE 1:*** *Apply a light coat of gasket sealant to gasket.* ***NOTE 2:*** *Ensure the pressure plate is placed with curved outer rim down next to the diaphragm (80.4) surface.*

m. Using a deep socket with a 24 inch (600mm) lever length, place the socket over the cylinder (80.3) hex surfaces. Rotate CCW to remove the cylinder (80.3).

n. Inspect inside surface of cylinder (80.3) at three points:
   1. Seat ring for erosion/wear on seating surfaces.
   2. At metal-to-metal surface between body and cylinder. If wear exists here, consult factory.
   3. Where the piston ribbed guides bear (guide zone).

   If wear is significant at any of these points, replace the piston/cylinder assembly (80.3).

o. Clean the body (80.1) cavity. Clean all parts to be reused.

p. Use special care cleaning the flat mating surfaces of the body (80.1) and cylinder (80.3) shoulder, as this pressurized joint is metal-to-metal without a gasket.

q. Lubricate the cylinder (80.3) threads lightly with thread sealant, insert the cylinder (80.3) into the body (80.1) and screw CW until tightly seated.

r. Apply thread sealant compound to the threads of the piston cap screw (80.9) and thread into piston (80.3). Rotate piston cap screw (80.9) CW and tighten to the following torques.

DIAPHRAGM TYPE	TORQUE
Metal	15 ft-lb (20 N-m)
Composition	12 ft-lb (16 N-m)

s. Insert the diaphragm subassembly into the body (80.1). Rotate the assembly to ensure that the piston is not binding in the cylinder. If necessary, buff piston with Scotch-Brite® or equivalent.

t. Place range spring (80.11) on the pressure plate (80.10).

u. Place multipurpose, high temperature grease into depression of spring button (80.12) where adjusting screw bears. Set spring button (80.12) onto range spring (80.11); ensure spring button (80.12) is laying flat.

v. Aligning the matchmarks, place spring chamber (80.2) over the above stacked parts. Install all bolts (80.7) and nuts (80.8) by hand tightening. Mechanically tighten bolting (80.7) (80.8) in a cross pattern that allows spring chamber (80.2) to be pulled down evenly. Recommended torques are as follows:

REGULATOR SIZE	BOLT SIZE	METAL DIAPHRAGM	COMP. DIAPHRAGM
ALL	5/16"	15 ft-lb (20 N-m)	12 ft-lb (16 N-m)

NOTE: *Never replace bolting (80.7)(80.8) with just any bolting, if lost. Bolt heads and nuts are marked with specification identification numbers. Use only proper grades as replacements.*

w. Reinstall adjusting screw (80.13) with locknut (80.14).

H. Mounting Pilot Valve to Main Valve:

1. Installation of the pilot to the main valve is dependent on hook-up schematic in use. Refer to Figure 2 on page 14. Re-install adapter in main valve. Re-attach pilot to main valve using adapter, or reinstall bolts using matchmarks made in Section VII, B, point 6. Then, secure the mounting bracket (40.8) to the cover dome (25) if a mounting bracket is used.

2. Re-install tubing and fittings that previously connected the inlet filter to the stabilizer, the cover dome to the metering valve and the outlet of the metering valve to the outlet of the body.

3. Re-connect the external sensing line to the pilot valve sensing port.

I. Disassembly of the Stabilizer:

1. Shut down system in accordance Section VI.

2. Owner should refer to owner's procedures for removal, handling, cleaning and disposal of nonreusable parts, i.e. gaskets, etc.

3. Loosen fitting that connects the stabilizer to the main valve.

4. Secure stabilizer body (60.1) in a vise with the spring chamber (60.2) oriented upwards

⚠ CAUTION

To prevent damage to body, use soft jaws when securing the body in a vise. Position so that vise closes over the inlet and the outlet connections

J. Diaphragm Replacement -

⚠ WARNING

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

1. Loosen adjusting screw nut (60.11) one revolution CCW. Relax range spring (60.17) forces by rotating adjusting screw (60.8) CCW until removed from spring chamber (60.2).

2. Loosen spring chamber (60.2) by placing wrench on "flats" and rotating CCW making sure **not** to use the flat where the vent hole is located.

3. Remove spring chamber (60.2), spring (60.17) and spring button (60.5).

4. Remove the diaphragm subassembly consisting of the pressure plate nut (60.10), lock washer (60.9), pressure plate (60.3), diaphragm (60.13), pusher plate seal (60.15) and pusher plate (60.4).

5. Loosen pusher plate nut (60.10) and separate all parts (60.3, 60.4, 60.9, 60.13 & 60.15) of the diaphragm subassembly.

6. Inspect pressure plate (60.3) to ensure no deformation due to over-pressurization. If deformed, replace.

7. Clean all reusable metal parts according to owner's procedures.

8. Reassemble diaphragm subassembly by placing pusher plate seal (60.15) over threaded post of pusher plate (60.4), placing diaphragm (60.13) and pressure plate (60.3) over the threaded post. Assure the pressure plate (60.3) is placed with curved outer rim down next to the diaphragm (60.13) surface. Place a thread sealant compound on the threads of the pusher plate post (60.4). Apply 15 in-lbs torque to tighten the nut.

9. Place spring (60.17) over the pusher plate nut (60.10) of the diaphragm subassembly.

10. Place multipurpose, high temperature grease into depression of spring button (60.5) where adjusting screw (60.8) makes contact. Set spring button (60.5) onto range spring (60.17); ensure spring button is laying flat on top of spring.

11. Rotate the spring chamber (60.2) CW by hand into the threaded portion of the body (60.1) ensuring not to cross thread. Continue rotating CW until firmly seated against the upper diaphragm. Tighten to 30-35 ft-lbs (41-47 N-m) torque value.

12. Reinstall adjusting screw (60.8) with nut (60.11) into the spring chamber (60.2).

13. Pressurize with air and spray liquid leak detector to test around body and spring chamber for leakage. Ensure that an outlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 20-80 psig (1.4-5.5 Barg) range spring, 50 psig (3.4 Barg) test pressure minimum.

K. TRIM REPLACEMENT :

1. Secure stabilizer body (60.1) in a vise with the body cap (60.6) oriented up and the spring chamber (60.2) downwards.

⚠ CAUTION

To prevent damage to body, use soft jaws when securing the body in a vise. Position so that vise closes over the inlet and the outlet connections.

2. Loosen and remove body cap (60.6).

3. Remove piston spring (60.7), and piston (60.16). Note that the seat and piston guide are integral parts of the body (60.1) casting. Inspect integral seat and guide for excessive wear, especially at seat surfaces. Replace if worn, nicked or depressed. If integral seat is nicked, use seat lapping compound to remove.

   NOTE: *Piston (60.16) assembly is a composition seat, Cashco, Inc. does not recommend attempting to remove the composition seat. If composition seat is damaged, replace entire piston assembly.*

4. Clean flat mating surfaces of body (60.1) to body cap (60.6) shoulder. Be careful not to scratch either surface.

5. Clean debris from within the body (60.1) cavity. Parts to be reused should be cleaned according to owner's procedures.

6. Slide the post end of the piston (60.16), slowly into the body cavity.

7. Place piston spring (60.7) over spring hub of the piston (60.16).

8. Apply pipe thread sealant to the body cap (60.6) threads. Thread body cap into body. When body cap is fully down against body at the body cap shoulder, impact the body cap into the body tight. ***NOTE:*** *When unit is put into service and pressurized, these two parts seal metal-to-metal with no gasket.*

9. Bench test unit for suitable operation. ***NOTE:*** *Regulators are not tight shutoff devices. Even if pressure builds up beyond set point, a regulator may or may not develop bubble tight shutoff. In general, tighter shutoff can be expected with composition seat.*

10. Pressurize with air and spray liquid leak detector to test around body cap (60.6) and body (60.1) for leakage. Test pressure should be a minimum of 100 psig (6.9 Barg) at the inlet.

11. Remove body (60.1) from vise, rotate down side up and secure body in vise with body cap (60.6) down.

12. Reassemble diaphragm subassembly by placing pusher plate seal (60.15) over threaded post of pusher plate (60.4), placing diaphragm (60.13) and pressure plate (60.3) over the threaded post. Assure the pressure plate (60.3) is placed with curved outer rim down next to the diaphragm (60.13) surface. Place a thread sealant compound on the threads of pusher plate post (60.4). Apply 15 in-lbs. torque to tighten the nut.

13. Place spring (60.17) over the pusher plate nut (60.10) of the diaphragm subassembly.

14. Place multipurpose, high temperature grease into depression of spring button (60.5) where adjusting screw (60.8) makes contact. (Also lubricate the threads of the adjusting screw lightly).

15. Set spring button (60.5) onto range spring (60.17); ensure spring button is laying flat on top of spring.

16. Rotate the spring chamber (60.2) CW by hand into the threaded portion of the body (60.1) ensuring not to cross thread. Continue rotating CW until firmly seated against the upper diaphragm. Tighten to 30-35 ft-lbs (41-47 N-m) torque value.

17. Rotate adjusting screw (60.8) CW into the spring chamber (60.2) to where the nut (60.11) comes in contact with the top of the spring chamber. Stabilizer set pressure should approach the set point prior to removal from the piping installation. Retighten nut (60.11).

18. Pressurize with air and spray liquid leak detector to test around body and spring chamber for leakage. Ensure that an inlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 20-80 psig (1.4-5.5 Barg) range spring, 50 psig (3.4 Barg) test pressure minimum.

L. CALIBRATION :

If adjustments are necessary proceed with the following steps:

1. Install a gauge in optional port downstream of stabilizer.

2. Establish flow as close to normal operating conditions as possible.

3. Set stabilizer 8 to 10 PSI above set point (determined at time of order placement).

4. Adjust pilot to obtain desired $P_{1.}$

5. If downstream pressure is unstable, adjust by rotating metering valve in 1/4 turn increments. ***NOTE:*** *It is important that 1/4 turn increments are used due to sensitivity. The P_1 changes can be significant in some cases.*

6. Verify that external sensing is tubed to tap closest to where control of pressure is desired.

SECTION VIII

VIII. TROUBLE SHOOTING GUIDE

When trouble shooting this regulator there are many possibilities as to what may be causing problems. Many times, the regulator itself is not defective, but one or more of the accessories may be. Sometimes the process may be causing difficulties.

The key to efficient trouble shooting is information and communication. The customer should try to be as precise as possible in their explanation of the problem, as well as their understanding of the application and operating conditions.

It is imperative the following information be provided by the customer:

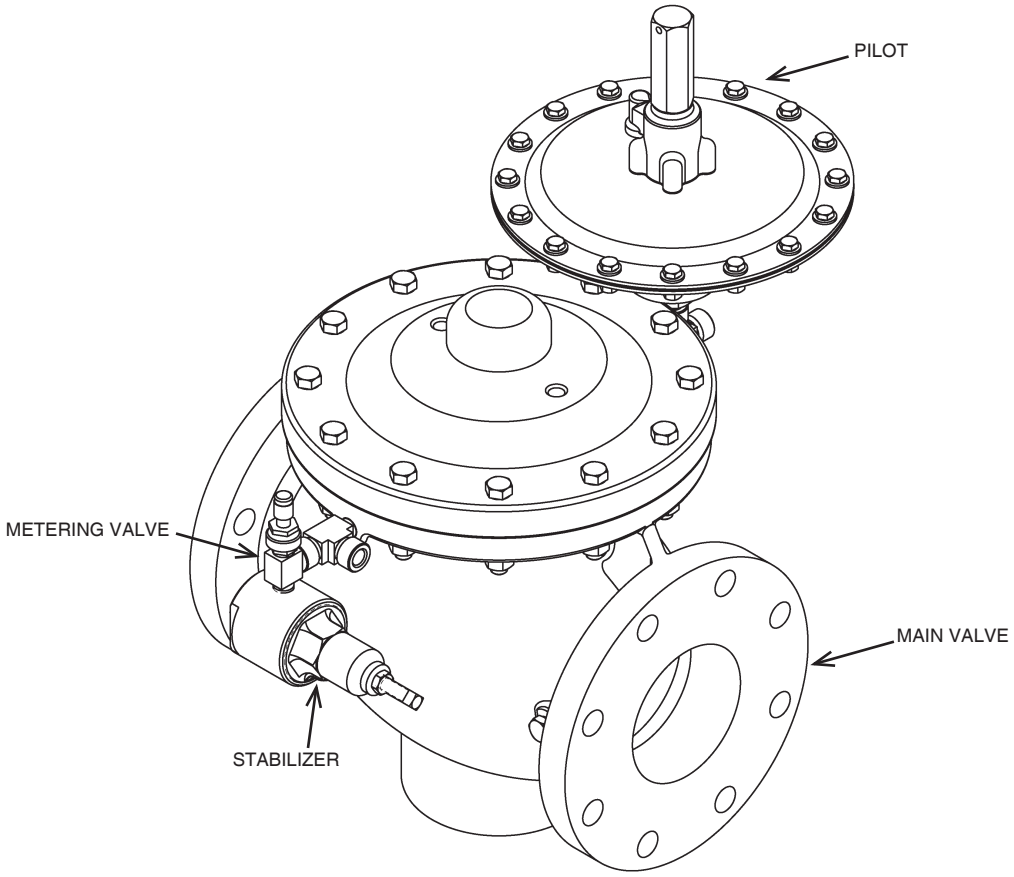
- Type of Service (with fluid properties)
- Range of flow rate
- Range of inlet pressure
- Range of outlet pressure
- Range of temperature
- Range of ambient temperature

Pressure readings should be taken at every location where pressure plays a role - i.e., regulator inlet (as close as possible to inlet port), regulator outlet (as close as possible to outlet port), etc.

Following are some of the more common complaints along with possible causes and remedies.

1. Erratic regulation, instability or hunting.	
Possible Causes	**Remedies**
A. Sticking of internal parts.	A. Remove internals, clean, and if necessary, replace.
B. Oversized regulator.	B. Check actual flow conditions; resize regulator for minimum and maximum flow; if necessary, replace with smaller regulator.
C. Metering Valve may not be adjusted correctly.	C1. Rotate knob on metering valve in 1/4 turn increments to be more or less sensitive to changes in P2 pressure. **DO NOT** fully close the metering valve.
2. Upstream pressure will not reach desired setting.	
Possible Causes	**Remedies**
A. Actuation pressure is down (confirm on pressure gauge.)	A. Increase actuation pressure.
B. Undersized regulator.	B. Check actual flow conditions; resize regulator for minimum and maximum flow; if necessary, replace with larger regulator.
C. Pressure loading system pressure restricted.	C1. Clean filter. C2. Clean pilot valve.
D. Faulty loading pressure control device.	D. Replace/repair loading pressure control device.
3. Diaphragm continually breaks.	
Possible Causes	**Remedies**
A. Stem seals (13) which protect fluorocarbon elastomer in diaphragm assembly may have deteriorated.	A. Replace with new stem seals (13).
B. Diaphragm nut (11) may not be torqued to correct value.	B. Confirm torque value in accordance with Section VII, F-13.
4. Diaphragm continually breaks (all regulators).	
Possible Causes	**Remedies**
A. Differential pressure across diaphragm may have exceeded limits.	A1. Be aware of limits as well as where the various pressures are acting. Install pressure safety equipment as necessary.

5. Leakage at diaphragm flange.	
Possible Causes	**Remedies**
A. Body bolts not torqued properly.	A. Torque to proper value (see Section VII, F-16).
B. Pressures at diaphragm may be too high.	B. Consult factory.
6. Leakage across seat.	
Possible Causes	**Remedies**
A. Contamination (debris) in regulator.	A. Remove internals, clean, and if necessary, replace sealing and seating elements. *
B. Oversized regulator; valve plug operates directly next to seat.	B. Check actual flow conditions; resize regulator for minimum and maximum flow; if necessary, replace with smaller regulator.
* Seat leakage may be diagnosed when a failure of the dynamic side seal has occurred. Inspect both potential internal leak paths.	



Assembled View
Shown with Pilot for Spring
Range 4" WC - 15 psig
Schematic B

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.

⚠ CAUTION

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.

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.

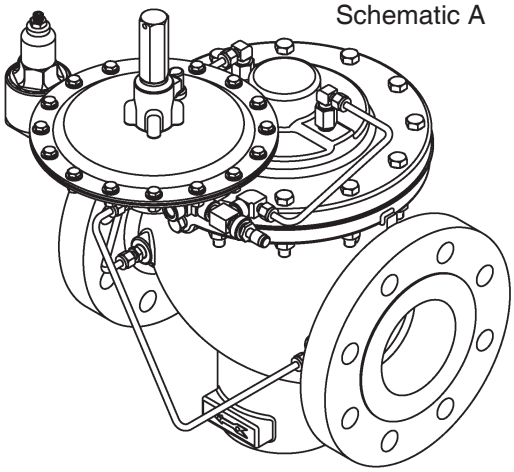
NOTE: *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

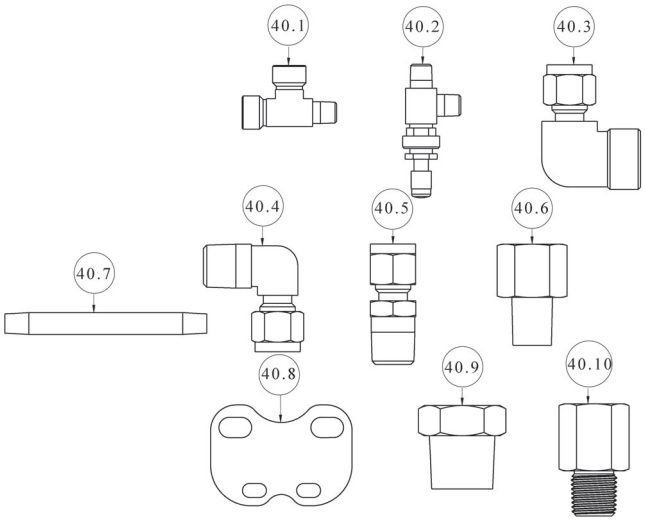
If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

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

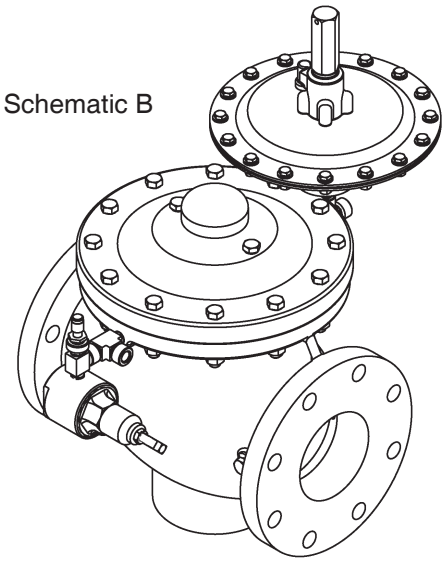
Figure 2
Hook-up Schematics and Fittings

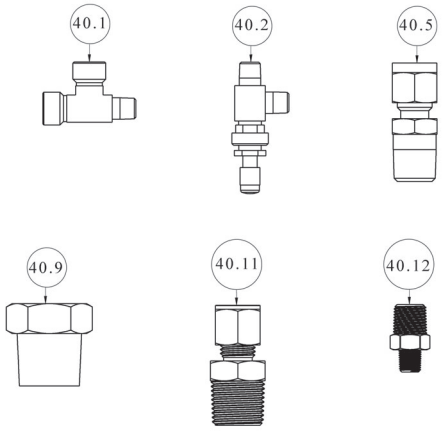
Schematic A





Schematic B

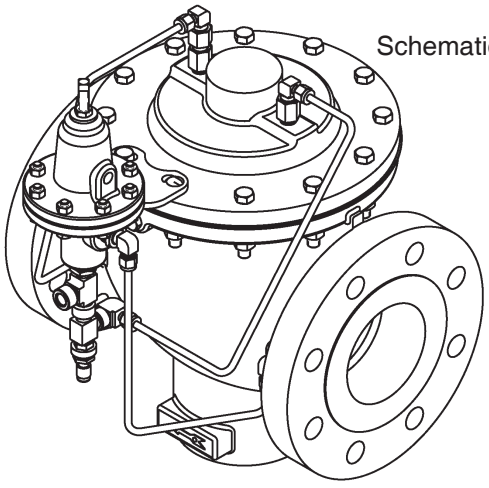


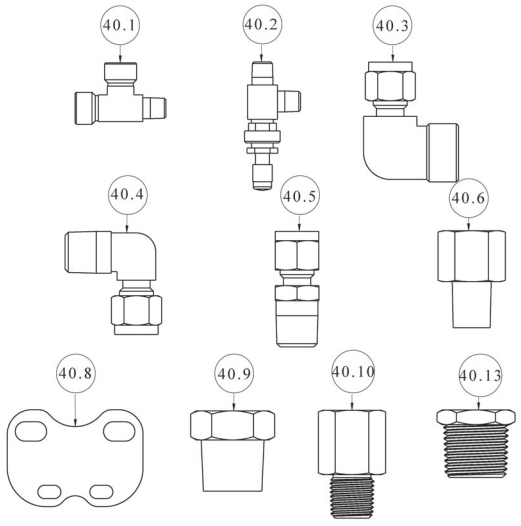


Item No.	Description
40.1	Street Tee
40.2	Meter Valve
40.3	90° Elbow
40.4	90° Elbow
40.5	Straight
40.6	Orifice
40.7	Pipe Nipple
40.8	Pilot Mounting Bracket
40.9	Plug
40.10	M x F Adapter
40.11	Tube Fitting
40.12	Threaded Reducing Nipple
40.13	Threaded Bushing

* Tubing Not Shown

Schematic C





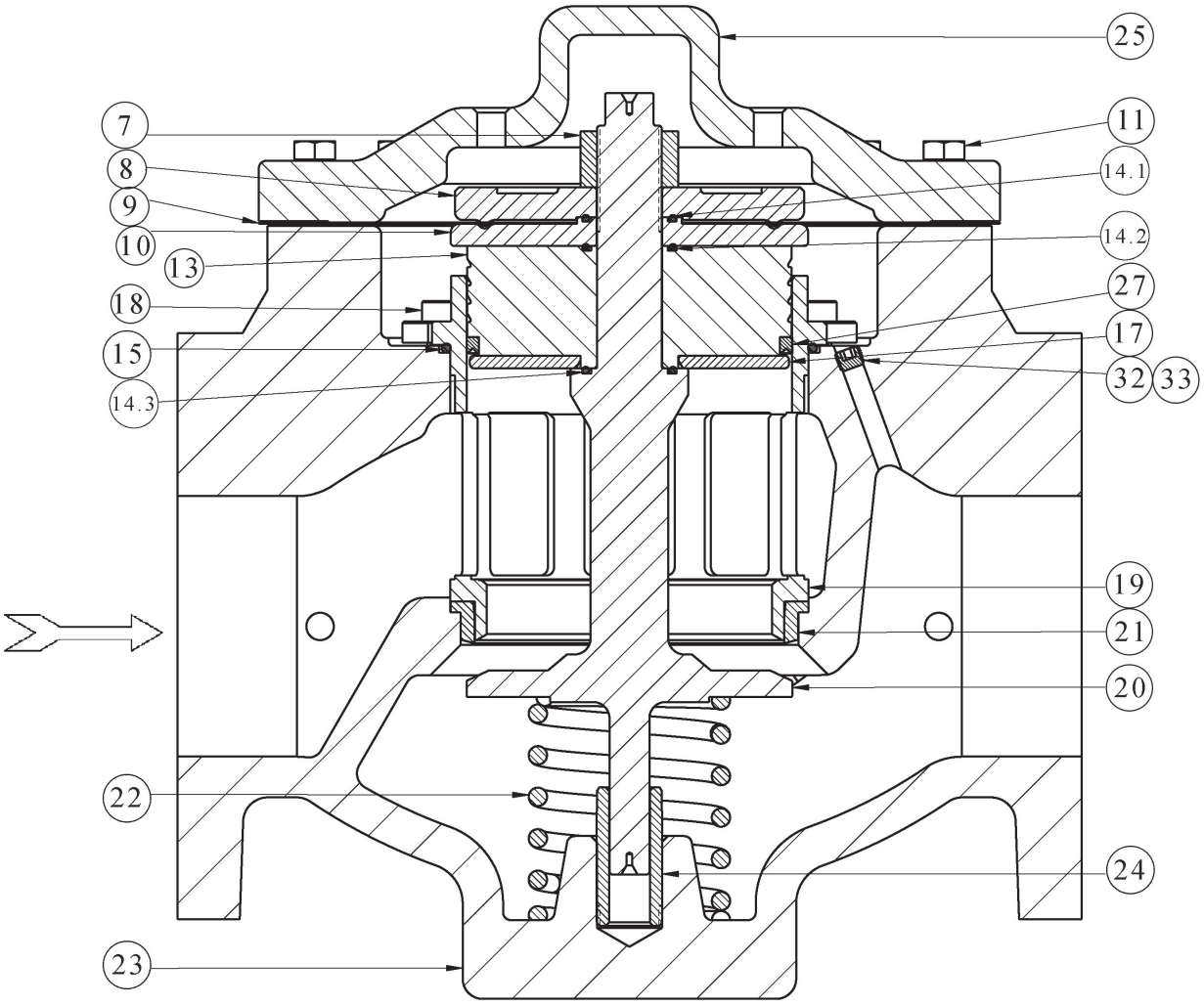


Figure 3
Main Body Assembly

Item No.	Description	Item No.	Description
7	Diaphragm Lock Nut	18	Cage Cap Screws
8	Upper Diaphragm Press. Plate	19	Cage
9 #	Diaphragm	20	Valve Plug
10	Lower Diaphragm Pusher Plate	21 #	Seat Ring
11	Flange Bolts	22	Lower Piston Spring
12	Flange Bolt Nuts	23	Body
13	Piston Guide Bearing	24	Lower Guide Bushing
14	Stem Seals	25	Cover Dome
14.1	Upper Stem Seal	26	Tap Plug (Not Shown)
14.2	Middle Stem Seal	27	Seal U-Cup
14.3	Lower Stem Seal	32 / 33	Solid Internal Sense Plug/ Drilled Internal Sense Plug
15 #	Cage Seal		
17	Wiper Washer	# Recommended Spare Parts	

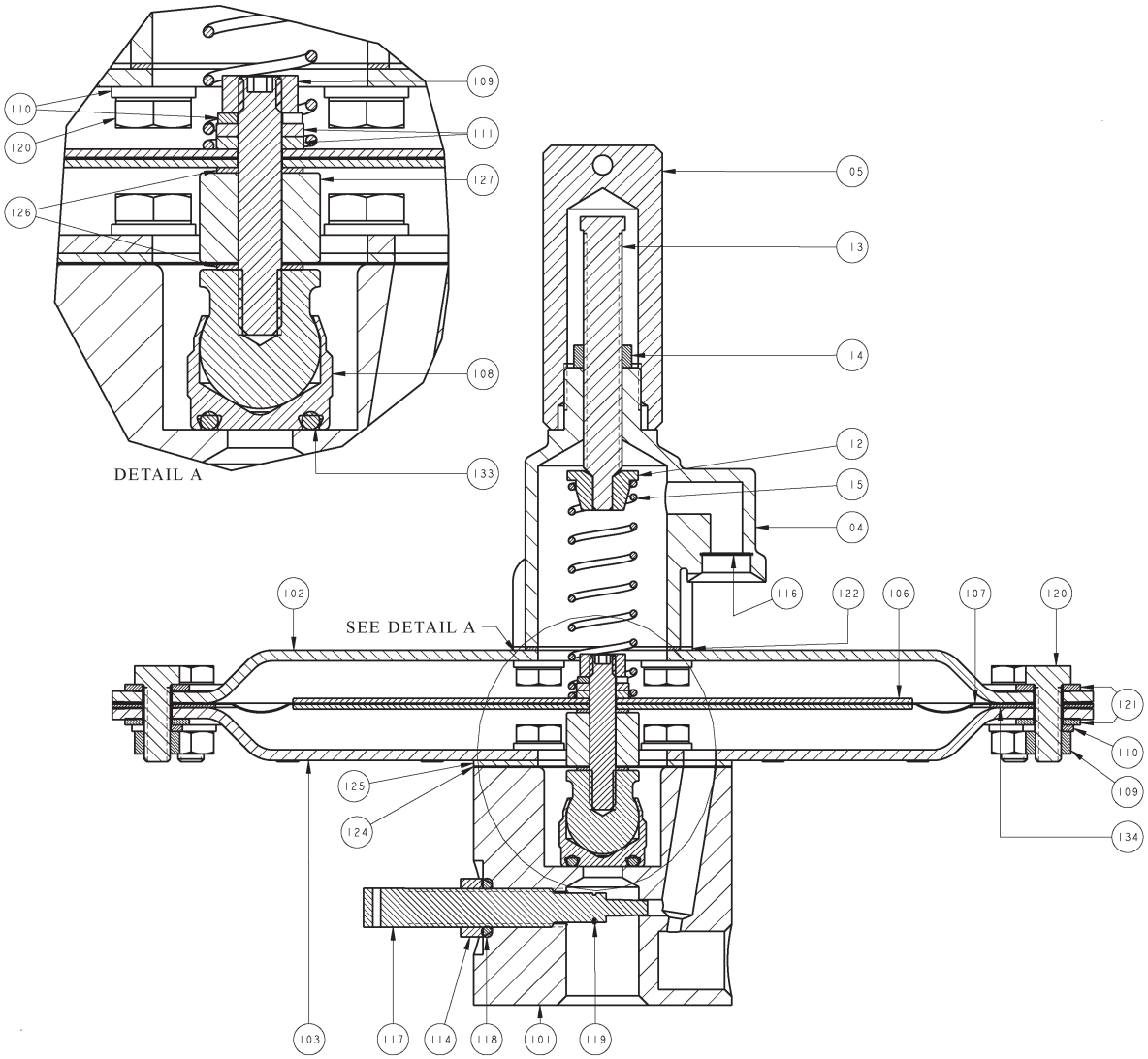


Figure 4
Pilot Assembly
For Spring Range 4" WC - 15 psig

Item No.	Description	Item No.	Description
101	Body	116	Screen
102	Upper Diaphragm Case	117	Blow Down Needle
103	Lower Diaphragm Case	118 #	O-Ring
104	Spring Bonnet	119	Retaining Ring
105	Cap	120	Bolt
106	Support Plate	121	Washer
107 #	Diaphragm	122 #	Round Gasket
108	Spindle Assembly	124 #	Seal Diaphragm
109	Nut	125 #	Body Gasket
110	Lock Washer	126 #	Bolt Gasket
111	Lower Spring Guide Washer	127	Spacer
112	Spring Button	128 *	Wrenching Washer
113	Adjusting Screw	133 #	O-Ring Seat
114	Jam Nut	134 #	Ring Gasket
115	Set Pressure Spring		

Parts are included in soft goods kit.

* Not Shown

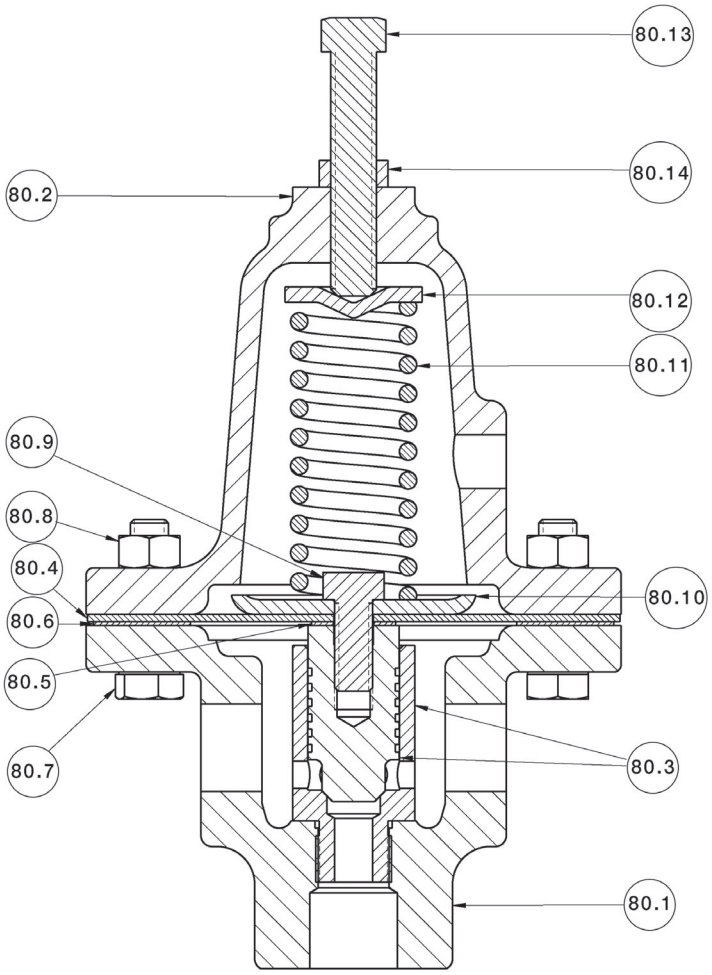


Figure 5
Pilot Assembly
For Spring Range 5 - 300 psig
Item 80

Item No.	Description
80.1	Body
80.2	Spring Chamber
80.3	Trim (Cylinder/Piston/Seat)
80.4	Diaphragm
80.5	Piston Gasket
80.6	Diaphragm Gasket
80.7	Hex. head Cap Screw (Flange Bolting)
80.8	Nut (Flange Bolting)
80.9	Piston Cap Screw
80.10	Pressure Plate
80.11	Range Spring
80.12	Spring Button
80.13	Adjusting Screw
80.14	Adjusting Screw Lock Nut
80.15	Nameplate *

* Not Shown

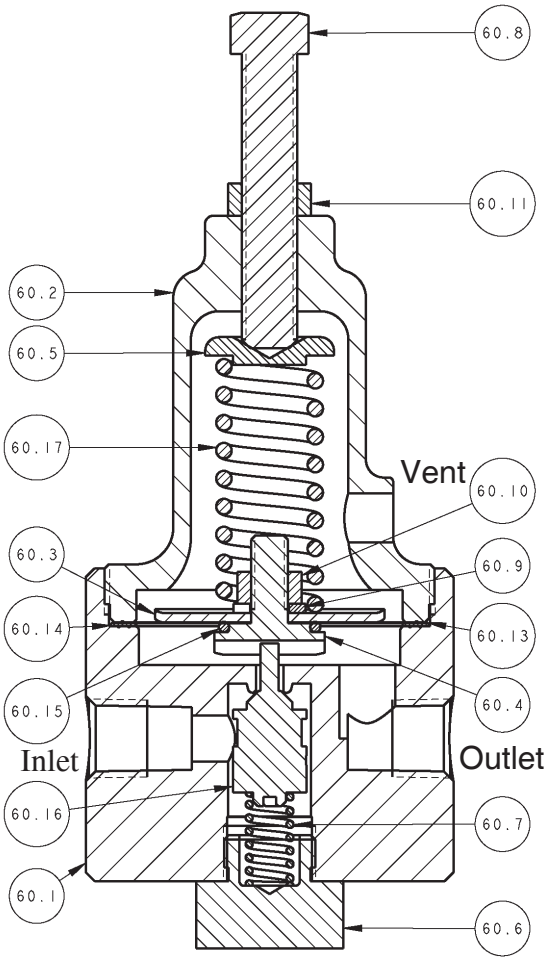


Figure 6
Stabilizer
Item 60

Item No.	Description	
60.1	Body	
60.2	Spring Chamber	
60.3	Pressure Plate	
60.4	Pusher Plate	
60.5	Spring Button	
60.6	Body Cap	
60.7	Piston Spring	
60.8	Adjusting Screw	
60.9	Lock Washer	
60.10	Nut (Pressure Plate)	
60.11	Nut	
60.13	Diaphragm	*
60.14	Diaphragm Gasket	*
60.15	Pusher Plate Seal	*
60.16	Piston	*
60.17	Range Spring	

* Recommended Spare Parts

ATEX 94/9/EC: Explosive Atmospheres and Cashco Inc. Regulators

NOTICE

Only for Product Codes wherein hazard category ATEX has been selected.

These valves satisfy the safety conditions according to EN 13463-1 and EN 13463-5 for equipment group IIG 2 c.

Caution: Because the actual maximum temperature depends not on the equipment itself, but upon the fluid temperature, a single temperature class or temperature cannot be marked by the manufacturer.

Specific Precaution to Installer: Electrical grounding of valve must occur to minimize risk of effective electrical discharges.

Specific Precaution to Installer: Atmosphere vent holes should be plugged to further minimize the risk of explosion.

Specific Precaution to Maintenance: The Valve Body/ Housing must be regularly cleaned to prevent buildup of dust deposits.

Specific Precaution to Maintenance: Conduct periodic Continuity Check between Valve Body/ Housing and Tank to minimize risk of electrical discharges.

Attention: When repairing or altering explosion-protected equipment, national regulations must be adhered to. For maintenance and repairs involving parts, use only manufacturer's original parts.

ATEX requires that all components and equipment be evaluated. Cashco pressure regulators are considered components. Based on the ATEX Directive, Cashco considers the location where the pressure regulators are installed to be classified Equipment-group II, Category 3 because flammable gases would only be present for a short period of time in the event of a leak. It is possible that the location could be classified Equipment-group II, Category 2 if a leak is likely to occur. Please note that the system owner, not Cashco, is responsible for determining the classification of a particular installation.

Product Assessment

Cashco performed a conformity assessment and risk analysis of its pressure regulator and control valve models and their common options, with respect to the Essential Health and Safety Requirements in Annex II of the ATEX directive. The details of the assessment in terms of the individual Essential Health and Safety Requirements, are listed in Table 1. Table 2 lists all of the models and options that were evaluated and along with their evaluation.

Models and options not listed in Table 2 should be assumed to not have been evaluated and therefore should not be selected for use in a potentially explosive environment until they have been evaluated.

Standard default options for each listed model were evaluated even if they were not explicitly listed as a separate option in the table. Not all options listed in the tables are available to all models listed in the tables. Individual TB's must be referenced for actual options.

When specifying a regulator that is to be used in a potentially explosive environment one must review the evaluations in Table 1 and 2 for the specific model and each and every option that is being specified, in order to determine the complete assessment for the unit.

A summary of the models and options found to have an impact on ATEX assessment due to potential ignition sources or other concerns from the ATEX Essential Health and Safety Requirements, are listed below.

1. The plastic knob used as standard on some models, (P1, P2, P3, P4, P5, P7, 3381, 4381, 1171, and 2171) is a potential ignition source due to static electricity. To demonstrate otherwise, the knob must be tested to determine if a transferred charge is below the acceptable values in IEC 60079-0 Section 26.14 (See items 25, 27, and 28 in Appendix A). Until the plastic knob has been shown to be acceptable, then either the metal knob option, or a preset outlet pressure option is required to eliminate this ignition source (See items 45 and 64 in Tables).

2. The pressure gauges offered as options on a few of the regulator models (DA's, P1-7, D, 764, 521), use a plastic polycarbonate window that is a potential ignition source due to static electricity. To demonstrate that the gauges are not a potential source of ignition, the gauges would need to be tested to determine if a transferred charge is below

indicating the gauge is compliant with the ATEX Directive (See items 26, 27, and 28 in Appendix A). Until compliance is determined, regulators should not be ordered with pressure gauges for use in potentially explosive environments.

3. Tied diaphragm regulators with outlet ranges greater than 100 psig should be preset to minimize the risk that improper operation might lead to an outboard leak and a potentially explosive atmosphere (See item 6 in Table 1).

4. 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 regulator with the self- relieving option in a flammable gas system could create an explosive atmosphere in the vicinity of the regulator.

5. Regulators with customer supplied parts are to be assumed to not have been evaluated with regard to ATEX and thus are not to be used in a potentially explosive environment unless a documented evaluation for the specific customer supplied parts in question has been made. Refer to Table 1 for all models and options that have been evaluated.

Product Usage

A summary of ATEX related usage issues that were found in the assessment are listed below.

1. Pressure regulators and control valves must be grounded (earthed) to prevent static charge build-up due to the flowing media. The regulator can be grounded through any mounting holes on the body with metal to metal contact or the system piping can be grounded and electrical continuity verified through the body metal seal connections. Grounding of the regulator should follow the same requirements for the piping system. Also see item 30 in Table 1.

2. The system designer and users must take precautions to prevent rapid system pressurization which may raise surface temperatures of system components and tubing due to adiabatic compression of the system gas.

3. Heating systems installed by the user could possibly increase the surface temperature and must be evaluated by the user for compliance with the ATEX Directive. User installation of heating systems applied to the regulator body or system piping that affects the surface temperature of the pressure regulator is outside the scope of this declaration and is the responsibility of the user.

4. 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 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 rise under any operating conditions. If a process gas temperature rise is possible under operating conditions, then the system designer must investigate whether the regulator body and downstream piping may increase in temperature enough to create a potential source of ignition.

The process gas expansion is typically modeled as a constant enthalpy throttling process for determining the temperature change. A Mollier diagram (Pressure – Enthalpy diagram with constant temperature, density, & entropy contours) or a Temperature – Entropy diagram with constant enthalpy lines, for the process gas, can be used to determine the temperature change. Helium and hydrogen are two gases that typically increase in temperature when expanding across a regulator. Other gases may increase in temperature at sufficiently high pressures.

Product Declaration

If the above issues are addressed by selecting options that do not have potential sources of ignition, avoiding options that have not been assessed, and by taking the proper usage issue precautions, then Cashco regulators can be considered to be a mechanical device that does not have its own source of ignition and thus falls outside the scope of the ATEX directive.

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