MODEL DA8

(Formerly DA8/9)
DIRECT-ACTING, POSITIVE BIAS DIFFERENTIAL BACK PRESSURE REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

The Model DA8 is a differential back pressure regulator used to control differential pressure between the upstream (inlet or P1) pressure and a loading (PLoad) pressure to the spring chamber. Available in sizes 1/2" (DN15), 3/4" (DN20), 1" (DN25), 1-1/4" (DN32), 1-1/2" (DN40), 2" (DN50), 2-1/2" (DN65), 3" (DN80) and 4" (DN100). With proper trim utilization, the unit is suitable for liquid, gaseous, or steam service. Model DA8 is assembled in the "reverse" flow direction arrangement that is balanced (to outlet).

SECTION II

II. REFERENCES

Refer to Technical Bulletin DA8-TB for technical specifications.

ABBREVIATIONS

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

SECTION III

III. INSTALLATION

⚠ 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.

1. Regulator may be rotated around pipe axis 360 degrees. For ease of maintenance, the recommended position is with the spring chamber (4) upwards. In liquid service it is recommended that the spring chamber (4) be oriented downwards, and that a customer supplied and installed vent valve be provided at the external sensing connection to bleed-off trapped gas/air under the diaphragm.
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. An isolation valve on the loading line is not recommended.
4. An inlet pressure gauge should be located approximately ten pipe diameters upstream, and within sight. A loading pressure (or differential pressure) gauge is recommended.
5. Clean the piping of all foreign material including chips, welding scale, oil, grease and dirt before installing the regulator. Strainers are recommended.
6. In placing thread sealant on pipe ends prior to engagement, ensure that excess material is removed and not allowed to enter the regulator upon startup.
7. Flow Direction: Install so the flow direction matches the arrow cast on the body or other markings such as "in" and "out".
8. Precaution for Standard Diaphragm Construction: The loading pressure should be lowered sufficiently prior to shutting off the process fluid supply, to prevent change to the diaphragm. Startup, shutdown, and emergency operating procedures should be reviewed to ensure that the loading pressure is less than 50% of the Diaphragm Proof Rating (See

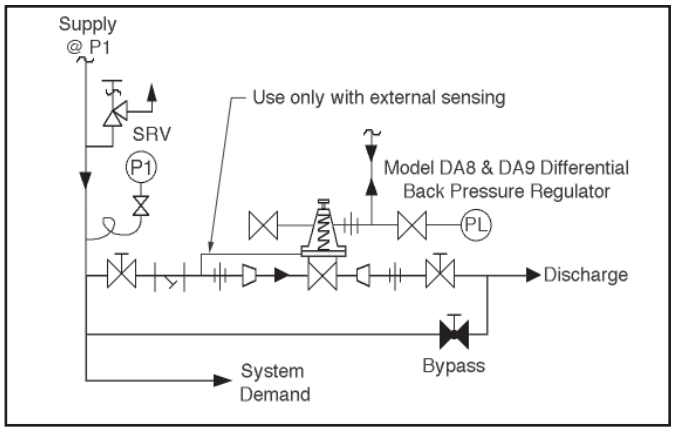
table below) before shutting off the process fluid supply pressure. If the regulator is specified with a fully supported diaphragm, then the diaphragm will withstand a loading pressure equal to the Diaphragm Proof Rating for the fully supported diaphragm.

9. Upstream Sensing Installation Considerations – Internal or External Sensing:
   a. The regulator may be installed with internal or external sensing. Unless otherwise specified, the regulator is supplied by factory with internal sensing. The regulator may be converted in the field to external sensing (see Section VII Maintenance, Paragraph H).
   b. Reference DA8-TB, Table DAG-12 for recommendations for applying external pressure sensing.
   c. For internal sensing, no external line is used. For external sensing, use an external control line. The line is connected from the port (1/4" NPT) on the side of the body diaphragm flange to an upstream pressure tap. The pressure tap should be located a minimum of 10 pipe diameters upstream of the regulator. It is recommended that the upstream pressure tap be located close to the point of use to minimize the adverse affect of variable line losses. A tubing outer diameter of 0.25 inch is adequate for short sensing lines (less than 4 feet). Use 3/8" tubing or 1/4" Sch 40 pipe for sensing lines of 5 to 50 feet.
   d. For condensable vapors (i.e. steam) slope the external sensing line downward 2 to 5 degrees to upstream piping to prevent water pockets, which allows the diaphragm chamber to always be self draining. The external sensing line may be sloped upward for liquids or gases. (i.e., non condensable fluids)

⚠ CAUTION

The proof test pressure must not exceed the diaphragm and body rating for the regulator.

A hydrostatic or pneumatic proof test is allowable under the following conditions for the standard diaphragm construction: Uniformly pressurize the valve body inlet, valve body outlet, and loading chamber to the lesser of the Diaphragm Proof Rating or 1.5 times the Inlet Pressure Rating shown on the nameplate. For example, a 1" DA8 with Cast Iron Body and Spring Chamber, Neoprene Diaphragm (BC) has an Inlet Pressure Rating of 400 psig CWP. The lesser pressure of 1.5X 400 psig = 600 psig and the BC diaphragm proof rating of 750 psig is **600 psig**. Therefore, uniformly pressurizing the DA8 to 600 psig is allowable. Take care to uniformly depressurize at end of test.



Recommended Piping Schematic for Differential Back Pressure Station

TABLE 1 – DIAPHRAGM PROOF RATING IN PSIG (BARG)

Diaphragm Material	Body Sizes – inch (mm)			
	1/2" - 2" (DN15 - 50)		2-1/2" - 4" (DN65 - 100)	
	Standard Diaphragm Construction	OPT-81 Full Diaphragm Support	Standard Diaphragm Construction	OPT-81 Full Diaphragm Support
BC, EPR	750 (51.7)	1200 (82.7)	450 (31.0)	800 (55.2)
HK, NBR, HK+TFE	300 (20.7)	1200 (82.7)	225 (15.5)	600 (41.4)
FK	500 (34.5)	1200 (82.7)	225 (15.5)	600 (41.4)
Elastomeric TFE	125 (8.6)	125 (8.6)	125 (8.6)	125 (8.6)
17-7 PH SST	500 (34.5)	1500 (103)	N/A	N/A
Be-Cu	300 (20.7)	750 (51.7)	N/A	N/A
302 SST	350 (24.1)	800 (55.2)	N/A	N/A
Inconel 718	500 (34.5)	1500 (103)	N/A	N/A

SECTION IV

IV. PRINCIPLE OF OPERATION

1. Valve plug movements modulate the flow across the valve seat to maintain the inlet pressure (P_1) equal to the sum of the differential pressure (ΔP_{DIFF}) and the loading pressure (P_{Load}). The inlet pressure acting on the underside of the diaphragm tends to lift the valve plug off the valve seat. The loading pressure acting on the topside of the diaphragm tends to close the valve plug against the valve seat. The positive differential setting of the range spring for the DA8 tends to close the valve plug against the valve seat.

2. For a DA8 (single diaphragm) design, a complete diaphragm failure will cause the inlet process fluid to mix with the loading fluid.

SECTION V

V. STARTUP

1. Start with the block valves closed.

2. Relax the range spring by turning the adjusting screw CCW (viewed from above) a minimum of three (3) full revolutions. This reduces the ΔP_{DIFF} (differential) pressure set point.

3. If it is a "hot" piping system, and equipped with a bypass valve, partially open the bypass valve to preheat the system piping and to allow slow expansion of the piping. Check for proper steam trap operation if installed. Closely monitor inlet (upstream) pressure via gauge to ensure 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).

4. Crack open the outlet (downstream) block valve.

⚠ CAUTION

Do not walk away and leave a bypassed regulator unattended!

5. Slowly open the inlet (upstream) block valve to about 25% open, observing the inlet (upstream) pressure gauge. Determine if the regulator is flowing. If not, slowly rotate regulator adjusting screw CCW (viewed from above) until flow begins.

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

7. Continue to slowly open the outlet (downstream) block valve, especially when the downstream piping system is not pressurized. If the inlet (upstream) pressure exceeds the desired pressure, close the inlet block valve and go to Step 2. Close bypass valve approximately 25%, and repeat procedure.

8. When flow is established steady enough that the outlet (downstream) block valve is fully open, begin to slowly close the bypass valve if installed.

9. **Under normal operating conditions, set the DA8 regulator set point (ΔP_{DIFF}) by turning the adjusting screw clockwise (CW) to increase inlet pressure or CCW to reduce inlet pressure. The inlet (P_1) pressure under these conditions will approximate the desired differential pressure for the DA8.**

10. Pressurize the source of loading (P_{Load}) pressure and allow to fill the spring chamber cavity. Slightly open the bleeder valve (item 3) to vent any air as the spring chamber is filling with a liquid loading fluid.

11. Develop system flow and pressure and readjust setpoint as required to obtain desired response. Performance should be checked at minimum and maximum flow levels.

12. Install closing cap where applicable. The standard regulator relies on a double o-ring rotary seal (item 34) around the non-rising adjusting screw.

SECTION VI

VI. SHUTDOWN

⚠ CAUTION

Loading Pressure must be reduced before shutting down the system pressure.

1. To prevent force imbalances and possible diaphragm failure, the loading pressure (P_{Load}) should always be shutdown first from its source of pressure. Systems sequencing must ensure this occurs.

2. When the loading pressure (P_{Load}) has been shutdown, the regulator inlet pressure (P_1) should decrease substantially.

3. On systems with a bypass valve, and where system pressure is to be maintained as the regulator 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.

⚠ CAUTION

Do not walk away and leave a bypassed regulator unattended.

4. If the regulator and system are both to be shutdown, slowly close the inlet (upstream) block valve. Close the outlet (downstream) valve only if regulator removal is required.

SECTION VII

VII. MAINTENANCE

A. General:

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

2. Record the nameplate information to requisition spare parts for the regulator. The information should include: Size, Product Code and Serial Number.

3. Refer to Section VIII for recommended spare 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 Cleaning Option-55, -56, or -57, maintenance must include a level of cleanliness equal to Cashco cleaning standards of #S-1134, #S-1542, and #S-1589 respectively. Contact factory for details.

5. The Inner Trim is removed and replaced in the body (23) as an assemblage of parts. The Inner Trim Assembly, hereinafter called **ITA**, consists of the following parts depending on what dynamic sealing system the regulator is using:

Item No.	Dynamic Side 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√
14.4	All	Lower Pusher Plate Gasket
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 Seal w/Metal Energizer
28	All	Seat Disc
29	All	Seat Disc Washer
30	All	Seat Disc Nut

* Possible option is Type NO Dynamic Side Seal for standard flow only..

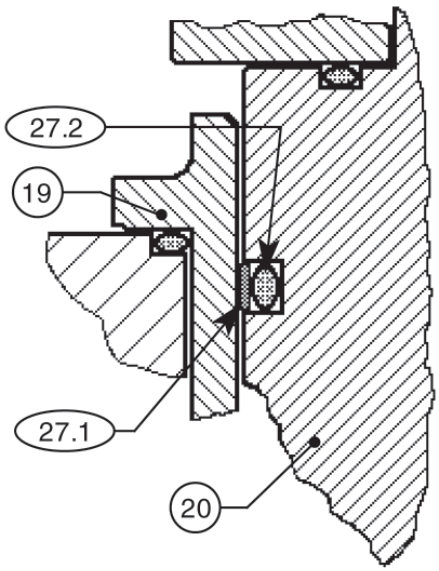
√ 2-1/2" through 4" body sizes only and 1/2" - 1" with U-Cup.

A detailed view of the Dynamic Side Seal parts is shown in Figure 1 on the next page.

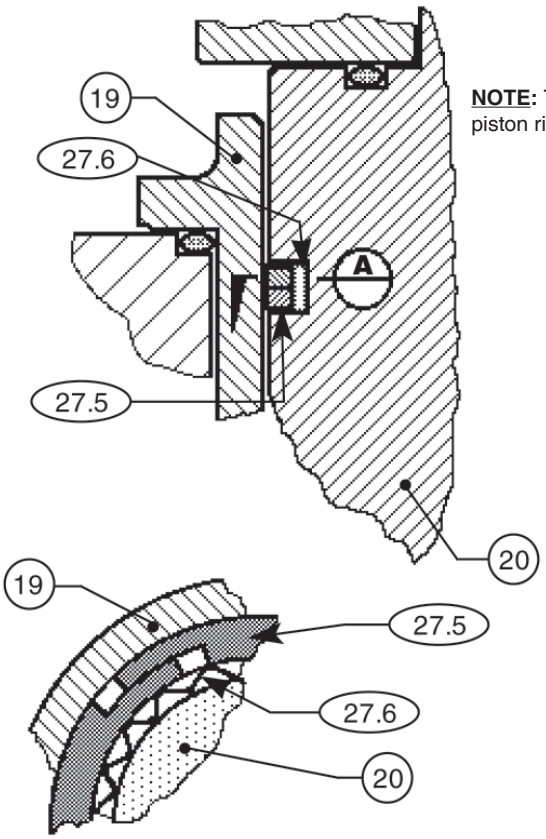
⚠ WARNING

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.*

* Includes external sensing connection if applicable.

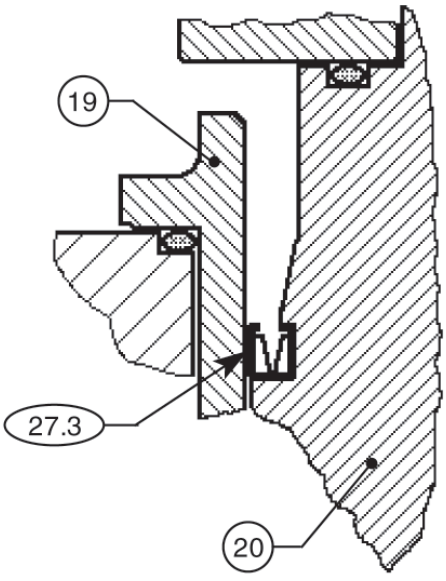


Type CP— TFE Cap Dynamic Seal



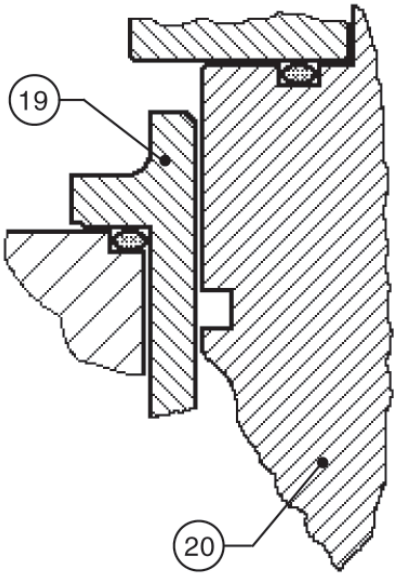
NOTE: Two separate piston rings per assembly.

Type PR — PRA Dynamic Seal



Type UC — U-Cup Dynamic Seal

(1-1/4"-2" Sizes)



Type NO — No Dynamic Seal

(Standard Flow Only)

Figure 1: Dynamic Side Seals

B. Main Valve Disassembly:

⚠ CAUTION

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.

1. Shut down the system in accordance with Section VI.

2. Disconnect the external sensing line, if installed.

3. The quick change trim allows for the disassembly of the regulator while installed in the pipeline. Alternatively the maintenance can be done in a shop area. **NOTE:** It is easier to repair the regulator when mounted upright in a horizontal pipe run compared to a vertical pipe run or a regulator mounted with spring facing down. The description hereafter will assume shop disassembly.

4. Place the valve unit in a vise with the spring chamber (4) upwards.

5. Relax range spring (6) forces by turning adjusting screw (1) CCW (viewed from above) until spring relaxes. The easiest way to check this, is to carefully loosen the locknut (item 2). If the adjusting screw (item 1) sinks into the chamber as the locknuts are loosened, then the spring assembly is still in extension. Turn the adjusting screw CW to remove the extension. Fully remove the locknuts.

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

7. Place matchmarks on body (23) and spring chamber (4) flanges. Completely remove bolting (11,12) Remove the spring chamber (4).

8. Remove spring follower (5) and spring (6.1).

9. Grasp opposite edges of diaphragm (9) and withdraw the ITA from within the cage (19). Set the ITA aside.

10. Evenly loosen the cage cap screws (18) in single revolution increments until fully loosened; remove cage cap screws (18).

11. Pull cage (19) up and out of body to remove o-ring (15).

12. Remove lower cage gasket (21).

13. For metal diaphragm constructions, remove diaphragm gasket (37) from body (23) diaphragm flange.

14. Remove body (23) from vise. Solvent clean all removed metal parts.

C. Disassembly of the ITA:

1. Body Sizes 1/2" – 2". (See Figures 2 through 4):
   a. Obtain two pieces of square-section barstock with a 3/8"-7/16" dimension, approximately 2 inches long.
   b. Place plug (20) into a vise using the bars of a. above positioned on "flats" located on plug (20) to prevent vise jaw marks from direct surface contact with the plug (20). Orient with diaphragms on topside.
   c. Sizes 1/2"-1": Remove diaphragm locknut (7) by rotating CCW.
      Sizes 1-1/4"-2": Remove diaphragm capscrew (7) by rotating CCW.
   d. Remove upper diaphragm pressure plate (8).
   e. Remove diaphragm(s) (9, 9.1, 9.2, 9.9). Examine diaphragm(s) to determine whether failed; determine if operating conditions are exceeding pressure drop or temperature limits.
   f. For composition diaphragm construction, remove upper stem seal (14.1).
   g. For metal diaphragm construction, remove lower pusher plate gasket (14.4).
   h. Remove lower diaphragm pusher plate (10). For 1/2"-1" sizes, remove spacer (13).
   i. Remove middle stem seal (14.2).
   j. Remove plug (20) from vise, rotate end-for-end, and resecure in vise using same metal bars above.
   k. Loosen seat disc nut (30) CCW (viewed from above) approximately two (2) revolutions.
   l. Remove assembly (20, 27, 28, 29, 30) from vise. Complete removal of seat disc nut (30), seat disc washer (29), and seat disc (28).

2. Body Sizes 2-1/2" – 4". (See Figure 6):
   a. Place seat disc nut (30) into a vise with the plug (20) oriented vertically. Do NOT over-tighten nut (30) in vise.
   b. Place closed-end hex wrench onto diaphragm locknut (7). Place socket wrench on 3/4" hex upper end of plug (20). Loosen diaphragm locknut (7) while holding plug (20) from rotating by socket wrench. Remove diaphragm locknut (7) after fully

loosened and socket wrench is removed.

c. Remove upper diaphragm pressure plate (8).
d. Remove diaphragm(s) (9, 9.1, 9.2, 9.9). Examine diaphragm(s) to determine whether failed; determine if operating conditions are exceeding pressure drop or temperature limits.
e. Remove upper stem seal (14.1).
f. Remove lower diaphragm pusher plate (10).
g. Remove middle stem seal (14.2).
h. Remove piston/guide bearing (13) with dynamic side seal (27) in place.
i. Remove lower stem seal (14.3).
j. Place socket wrench on upper end of plug (20) as in Step b. above. Rotate plug (20) CCW (viewed from above) to loosen seat disc nut (30). Once nut (30) is loosened, remove partial assembly (20, 27, 28, 29, 30) from vise. Complete removal of seat disc nut (30), seat disc washer (29) and seat disc (28).

3. Examine the components (27.1, 27.2, 27.3, 27.4, 27.5, 27.6) of the dynamic side seal (27) to determine if significant leakage was occurring. If the dynamic side seal (27) shows signs of significant leakage, determine if operating conditions are exceeding pressure, pressure drop, or temperature limits.

   Remove dynamic side seal (27) components from plug (20) for sizes 1/2" – 2", or from piston/guide bearing (13) for sizes 2-1/2" – 4". Special care should be taken when using "tools" to remove the components to ensure that no scratches are imparted to any portion of the plug (20) or piston/guide bearing (13) groove.

4. Solvent clean all metal parts to be reused.

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, etc.). Metal diaphragms should be replaced. 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 the parts as necessary. Surface conditions that affect the regulator performance are stated below; replace parts that can not be reworked or cleaned.

3. QC Finish & Dimensional Requirements:
   a. Valve plug (20);
      1. No major defects on plug's (20) bottom guide spindle, or at guide area near dynamic seal groove.
   b. Cage (19);
      1. 16 rms finish on cylinder bore. No "ledges" formed due to wear from moving dynamic side seal (27).
      2. 16 rms finish on its seating surface for tight shutoff.
   c. Lower guide bushing (24);
      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.
   e. Piston/Guide Bearing (13)(2-1/2"-4" only);
      1. No defects at guide area near dynamic seal groove.

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

E. Reassembly of the ITA:

1. Position valve plug (20) with seat disc-end upwards. Place new seat disc (28) into recess of lower end of valve plug (20) properly oriented.

2. Position seat disc washer (29) next to seat disc (28).

3. Engage seat disc nut (30) to secure washer (29) and seat disc (28) to valve plug (20). Firmly hand-tighten.

4. Body Sizes 1/2" through 2":
   a. Using the two square-section metal barstock pieces of VII.C.1.a., clamp the plug (20) into a vise with the plug's (20) spindle pointed upwards.
   b. Using a torque wrench, tighten the seat disc nut (30) to 20-35 ft-lbs. by rotating CW.
   c. Remove assembly (20, 28, 29, 30) from vise and rotate end-for-end and resecure in vise using same metal bars.

5. Body Sizes 2-1/2" through 4":
   a. Orient plug (20) with threaded end up-

wards, place into a vise, grasping the seat disc nut (30); tighten the vise lightly, only enough to "hold" the plug (20) from rotating out of the vise. **Caution:** Over-tightening the vise can distort the seat disc nut (30) and give bad final torque values.

b. Place a torque wrench on the 3/4" hex upper end of the plug (20); tighten the seat disc nut (30) to 40-60 ft-lbs by rotating CW.

6. Installation of dynamic side seal (27) (See Figure 1): **NOTE:** Dynamic side seal (27) for sizes 2-1/2"-4" is located on the piston/guide bearing (13). The dynamic side seal can be installed on a work bench without need of a vise.

   a. Type CP:

      1. Stretch o-ring energizer/seal (27.2) over lower circumference of piston-guide bearing (13) or valve plug (20), taking care not to “cut” o-ring energizer/seal (27.4). Using thumbs, work the o-ring energizer/seal (27.4) up and into the groove of the piston-guide bearing (13) or valve plug (20). **NOTE:** A very slight amount of fluid and elastomer compatible o-ring lubricant is recommended as an installation aid.

      2. For metal diaphragm construction, insert camber adjusting washer (17.2) into cage (19) and allow to rest in the bottom of the cage (19).

      3. Position TFE cap seal (27.1) ring with rectangular cross-section at end of piston-guide bearing (13) or valve plug (20). Stretch cap seal (27.1) over lower end of piston-guide bearing (13) or valve plug (20) using thumbs to work the cap seal (27.1) onto the piston-guide bearing (13) or valve plug (20). DO NOT USE A TOOL FOR THIS STEP. Continue pressing cap seal (27.1) upwards towards the groove until the cap seal (27.1) “snaps” into the groove of the piston-guide bearing (13) or valve plug (20).

      4. Position piston-guide bearing (13) or valve plug (20) over and into upper end of cage (19) until the cap seal (27.1) edge touches the upper lip of the cage (19). While gently applying force to press the piston-guide bushing (13) or valve plug (20) into the cage (19), simultaneously use fingers to lightly press the cap seal (27.1) inwards into the groove of the piston-guide bearing (13) or valve plug (20) until the cap seal (27.1) “slips into” the cage (19). DO NOT USE TOOLS, LUBRICANT, OR HEAVY FORCE TO ENGAGE THE CAP SEAL (27.1) INTO THE CAGE (19).

   b. Type PR:

      1. **NOTE:** A piston ring assembly (27.5) consists of one metal corrugated energizer and two piston ring seals. Wrap corrugated metal piston ring energizer into the groove of piston-guide bearing (13) or valve plug (20).

      2. Spread a piston ring seal and slide over lower circumference of piston-guide bearing (13) or valve plug (20). Using thumbs and fingers, work the piston ring seal into the groove of the piston-guide bearing (13) or valve plug (20). Repeat this procedure with a second piston ring seal. Orient the Z-cuts in the piston ring seals 180 degrees apart to minimize leakage by the piston ring assembly.

      3. Position piston-guide bearing (13) or valve plug (20) over and into upper end of cage (19) until the lower piston ring seal touches the upper lip of the cage (19). While gently applying force to press the piston-guide bearing (13) or valve plug (20) into the cage (19), simultaneously use fingers to lightly circumferentially press the piston ring assembly (27.5) inwards into the piston-guide bearing (13) or valve plug (20) groove until the piston ring assembly (27.5) “slips into” the cage (19).

   c. Type UC:

      1. Stretch u-cup seal (27.3) over upper circumference of valve plug (20), taking care not to “cut” u-cup seal (27.3) on the protruding shelf that is part of the valve plug's (20) groove. Ensure that the u-cup seal (27.3) is oriented with the center-open-upwards as shown in Figure 1, as the u-cup seal (27.3) depends upon the P1-Inlet Pressure to pressure activate the seal for proper sealing action.

d. Type NO:
   1. For "standard" flow direction applications, it is not absolutely required that a dynamic side seal (27) be installed. (When included with the dynamic seal (27), better guiding of valve plug (20) results.) Type "NO" dynamic seal (27) means NO dynamic seal.
   2. The more common "Reverse" flow direction always requires a dynamic side seal (27).

7. Place fluid compatible thread anti-seize, Locktite Corp., "Nickel Anti-Seize", or equal on threaded portion of diaphragm cap screw (7), sizes 1-1/4" and 1-1/2"; or, threaded post portion of valve plug (20), sizes 1/2" – 1" and 2-1/2" – 4". (**NOTE:** Valves cleaned for oxygen service should use Fisher Scientific Co., "Fluorolube GR-362", or equal.)

8. Body sizes 1/2"-1", 2-1/2" through 4".
   a. Place o-ring lower stem seal (14.3) over upper-end of plug (20) and into groove in plug (20).
   b. Place properly oriented piston/guide bearing (13) over upper-end of plug (20) and into position on plug (20). Note: Part name for item 13 on 1/2"-1" sizes is "spacer".
   c. Place o-ring middle seal (14.2) over upper-end of plug (20) and into groove of piston/guide bearing (13).

9. Body sizes 1-1/4" through 2".
   Place new o-ring middle stem seal (14.2) into groove of valve plug (20) upper surface.

10. Position lower diaphragm pusher plate (10) on/over upper end of valve plug (20) properly oriented. For composition diaphragm construction the "tongue and groove" "ridge" should be on upper side, "flat" side downwards. For metal diaphragm construction the "rounded" surface of the lower diaphragm pusher plate (10) should be on upper side, "flat" side downwards.

11. For composition diaphragm construction, place new o-ring upper stem seal (14.1) on/over upper end of valve plug (20) and into groove of lower diaphragm pusher plate (10).

12. For metal diaphragm construction, place compatible gasket sealant on both sides and place new lower pusher plate gasket (14.4) on/over upper end of valve plug (20) and onto lower diaphragm pusher plate (10). (Gasket sealant is Federal Process Corp. "Gasoila" , or equal.)

13. Position new diaphragm(s) (9) on/over upper end of valve plug (20). **NOTE:** For multiple diaphragms (9) that include TFE material, the TFE should be on the wetted side; for 6-ply elastomeric TFE diaphragm (9), stackup is TFE-TFE-HK-HK-TFE-TFE, beginning with the lower wetted diaphragm (9) first.

14. Position upper diaphragm pressure plate (8) on/over upper end of valve plug (20) properly oriented. For composition diaphragm construction the "tongue and groove" "ridge" should be on lower side, "flat" side upwards. For metal diaphragm construction the "rounded" surface of the upper diaphragm pressure plate (8) should be on lower side, "flat" side upwards.

15. a. Body sizes 1/2" through 1": Engage diaphragm locknut (7) to threaded post portion of valve plug (20) and torque to 60-70 ft-lbs. by rotating CW.
    b. Body Sizes 1-1/4" through 2": Insert anti-seize coated diaphragm cap screw (7) through stacked parts (8, 9, 10, 14.1, 14.4) and into upper end of valve plug (20). Torque-tighten diaphragm cap screw (7) to 120-130 ft-lbs.
    c. Body Sizes 2-1/2" through 4": Engage diaphragm lock nut (7) to threaded post of valve plug (20) and wrench-tighten firmly. While restraining valve plug (20) from rotating by torque wrench on upper end 3/4" hex, use another wrench to tighten diaphragm locknut (7) to a torque of 180 - 200 ft-lbs.

16. This completes assembly of ITA; remove from vise.

F. Main Reassembly:

1. Place body (23) in a vise.

2. Fit the o-ring cage seal (15) into its body (23) groove.

3. For metal diaphragm construction, place sealant ("Gasoila" or equal) on both sides of diaphragm gasket (37) and position on body (23) diaphragm flange.

4. Position properly oriented lower cage gasket (21) onto lower shelf of cage (19).

5. Insert cage (19) into body (23) recess. Properly align all three cage bolt (18) holes as there is only one circumferential location possible for this alignment. Engage all of the cage bolts (18), then evenly screw in the cage bolts in one-half revolution increments, taking care NOT TO "COCK" THE CAGE (19) IN THE BODY. Torque the cage bolts (18) to 13-15 ft-lbs. For 1/2"-2" full support design, fit support plate (35) into body counter bore.

6. Lubricate and install o-rings (34) into grooves on the adjusting screw (1).

7. Assembly of range spring and spring chamber for DA8:
   a. Lubricate the threads of adjusting screw (1) then thread into the spring follower (5). The spring follower should be threaded up adjusting the screw to within 3/8" of the top threads (see sectional drawing, figure 5.
   b. Insert adjusting screw-spring follower into spring chamber (4). **NOTE:** Milled slots in spring follower must align with ribs in the bore of the spring chamber. The top of the adjusting screw must fit in the center hole of spring chamber. A light rap with a wooden handle of a hammer may be needed to fully install the adjusting screw into the spring chamber.
   c. Aligning match marks and bolt holes, place spring chamber (4) over range spring (6.1). If the spring chamber flange reaches the body flange without a gap, turn adjusting screw (1) CW 2-3 turns. Repeat this procedure until the flanges are approximately 1/8" apart. Be sure that range spring is properly seated into counterbore on spring follower.

8. Assembly of range spring assembly and spring chamber for DA9:
   a. Lubricate the threads of adjusting screw (1), then thread into the range spring assembly (6.2). The adjusting screw should be threaded sufficiently into the range spring assembly to allow easy fitting of the spring chamber (see sectional drawing, figure 6).
   b. Thread the lower end of the range spring assembly to the top of the valve plug. At least three good threads of engagement are required between the range spring assembly and the valve plug. Back off range spring assembly a fraction of the turn to align the milled slots perpendicular to the center line of the valve body. The slots should now be ready to accept the internal ribs of the spring chamber.
   c. Aligning match marks and bolt holes place spring chamber (4) over range spring assembly (6.2). If the spring chamber flange reaches the body flange without the adjusting screw passing through the center hole of the spring chamber, then remove the chamber. Holding the range spring assembly stationary, turn the adjusting screw CW 2-3 turns or as required so the top of the screw will pass through center holes of the spring chamber. After the top of the adjusting screw passes through the center hole of the spring chamber, continue to turn the adjusting screw CW until the adjusting screw is fully fitted into the spring chamber. DO NOT allow the spring chamber to rotate or the range spring assembly may disengage from the valve plug.
   d. Fit the locknut (2) to the top of the adjusting screw. DO NOT over tighten the first locknut. The adjusting screw should turn freely in the spring chamber. Lock the second locknut against the first locknut. Again, check that the adjusting screw turns freely.

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

   NOTE: If a six-ply diaphragm is being used, it is important that the diaphragm (9) is "preformed" – allow formation of a diaphragm (9) convolution. Starting with the body bolts and nuts (11,12) hand tightened, "preforming" can be accomplished by any one of the following techniques:
   a. Relax range spring fully by rotating adjusting screw CCW.
   b. Apply 30 psig (2.1 Barg) pressure to the valve outlet.

      OR

      Block the valve outlet and apply 30 psig (2.1 Barg) under the diaphragm through the 1/4" NPT (plugged) external pressure sensing connection on the valve diaphragm flange.
   c. Leave pressure on through tightening of bolting (11,12).

10. Evenly tighten the body bolting (11,12) in an alternating cross pattern in one revolution increments to the following torque value:

Body Size		Torque	
in	(mm)	ft-lb	(N-m)
1/2" - 2"	(DN15-50)	30-35	(41-47)
2 1/2" - 4"	(DN65-100)	45-50	(61-69)

If supplied, remove pressure of previous Step 14.

G. Units with Supported Diaphragm Designs:

1. With composition diaphragm construction, a supported diaphragm (9) construction is designated as Opt-81 High Inlet Pressure, and comes with the highest range spring selection for sizes 2" and smaller.

H. Converting Internal/External Sensing:

1. Disassemble the regulator and remove the diaphragm(s) (9) according to Steps 1-12 in Part B – Main Regulator Disassembly.

2. To convert from internal to external sensing, remove the drilled pipe plug (32) and install a solid pipe plug. Reverse this step for converting from external to internal sensing.

3. Reassemble the regulator according to Part F – Main Regulator Reassembly.

I. Pressure Testing:

1. If a hydrostatic pressure test is performed, pressure must be applied to all three of spring chamber, inlet and outlet of body at the same level.

2. Inboard Leakage Test (Seat + Dynamic Seal Leakage).
   a. Determine test pressure. If upper value of range spring is less than 55 psig, use test pressure of 5 psig less than upper value of range spring. If upper value of range spring is greater than 55 psig, use test pressure of 50 psig.

⚠ CAUTION

DO NOT HYDROSTATICALLY TEST WITHOUT SPRING CHAMBER PRESSURIZED. NOT ADHERING WILL DO PHYSICAL INTERNALS DAMAGE THAT COULD RENDER THE UNIT INOPERABLE.

   b. While applying GN_2 or air pressurization fluid, engage adjusting screw inwards until valve appears to be closed. Add one additional revolution inwards to adjusting screw.
   c. Tube outlet to a beaker of water to observe number of escaping gas bubbles.

3. Pressure Containment Test.
   (External Leak Test.)
   a. See Section III, last paragraph and Table 1 for restrictions.
   b. Spray leak detection solution over the bolting, diaphragm edge, body, spring chamber and all other pressure boundary areas, during external leak test.

4. Excessive leakage will require disassembly, examination of sealing elements, correction of problem, reassembly and retesting. **NOTE:** This valve is NOT a bubble-tight shutoff device. See DA8-TB, Table DAG-10 for leakage classes.

SECTION VIII

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

Pressure readings should be taken at every location that 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. Load changes are too quick for system.	B. Convert to external sensing (if necessary) and install an orifice or needle valve in external sensing line.
C. Oversized regulator.	C. Check actual flow conditions; resize regulator for minimum and maximum flow; if necessary, replace with smaller regulator.
D. Unstable loading pressure.	D1. Stabilize loading pressure; i.e. pump, control valve, etc. D2. Air in loading piping. Vent spring chamber.

2. Erratic regulation, instability or hunting (liquid service).

Possible Causes	Remedies
A. Air trapped under diaphragm.	A. Install valve on external sensing port and bleed off air. (Install regulator upside down to help prevent reoccurrence.)

3. Upstream pressure too high.

Possible Causes	Remedies
A. Debris in trim preventing movement.	A. Clean unit of debris.
B. Undersized regulator.	B. Check actual flow conditions; resize regulator for minimum and maximum flow; if necessary, replace with larger regulator.
C. Mal-adjusted adjustment screw.	C. Turn adjustment screw CCW.

4. Diaphragm continually breaks (steam service regulators).

Possible Causes	Remedies
A. Stem seals, which protect fluorocarbon elastomer in diaphragm assembly, may have deteriorated.	A. Replace with new stem seals.
B. Diaphragm nut may not be torqued to proper value.	B. Confirm torque value in accordance with Section VII, paragraph E-15.
C. Diaphragm too stiff causing it to crack in service.	C. Follow proper preforming and air pressure to underside of diaphragm techniques during diaphragm installation in accordance with Section VII, paragraph F-9.

5. Diaphragm continually breaks (all regulators).

Possible Causes	Remedies
A. Differential pressure across diaphragm may have exceeded limits.	A. Reference limits as recorded in technical bulletin DA8-TB, as well as where the various pressures are acting.

6. Leakage at diaphragm flange.

Possible Causes	Remedies
A. Body bolts not torqued high enough.	A. Torque to proper value (see Section VI, paragraph F-10).

7. Leakage across seat or dynamic side seal.

Possible Causes	Remedies
A. Contamination (debris) in regulator.	A. Remove internals, clean and if necessary, replace regulator.
B. Oversized regulator.	B. Check actual flow conditions; resize regulator for minimum and maximum flow; if necessary, replace with smaller regulator.

SECTION IX

IX. PARTS ORDERING INFORMATION

There are three methods to obtain parts ordering information/numbers. These methods are listed below, in order of ease of entering. The least expensive method is to utilize parts in kits where possible.

METHOD A - USE OF PRODUCT CODE.

Step 1. If available, obtain the 18 character product code number from:
a. The Bill of Materials (BOM) sheet attached herein.
b. The metal tag attached to the regulator.

□□□-□□□7-□□□□□□□□□

NOTE: Some regulators may not have the product code located on the metal tag.

Step 2. Identify which kits or parts are desired from the following:
a. The BOM, or refer to the cross-sectional drawings.
b. Standard maintenance parts for a basic regulator are identified on the BOM. Kit "A" contains seal(s), diaphragm(s) and gasket(s). Kit "B" contains trim replacement parts plus seal(s), diaphragm(s) and gasket(s).

Step 3. Contact your local KM Sales Representative and specify the product code number along with a description of any parts not included in the kits. Costs of required parts (and kits) can be given by the Sales Representative.

METHOD B - NO PRODUCT CODE AVAILABLE - DISASSEMBLED REGULATOR.

Step 1. Determine all available information from regulator's metal tag.
a. Serial number (5-digit).
b. Regulator "Type" or "Model" number.
c. Size (may have to observe body tap).
d. Spring range.
e. Trim designation number (if available).

Step 2. Determine construction of trim and soft goods.
a. What is fluid?
b. What material is trim?
c. What material are the diaphragms?
d. What material is the seat?
e. What materials are used for static seals and dynamic seals?

Step 3. With the information from Steps 1 and 2 above, contact your local KM Sales Representative for the proper identification numbers to use, and the parts costs.

METHOD C - NO PRODUCT CODE AVAILABLE - ASSEMBLED REGULATOR IN SERVICE.

Step 1. Determine all available information from metal tag using Step 1, Method B.

Step 2. Contact your local KM Sales Rep with the above information.

Step 3. Sales Representative will contact the factory to determine the original internal construction. Factory will relay information to the Sales Representative.

Step 4. Await the Sales Representative's return contact with the proper part numbers and cost.

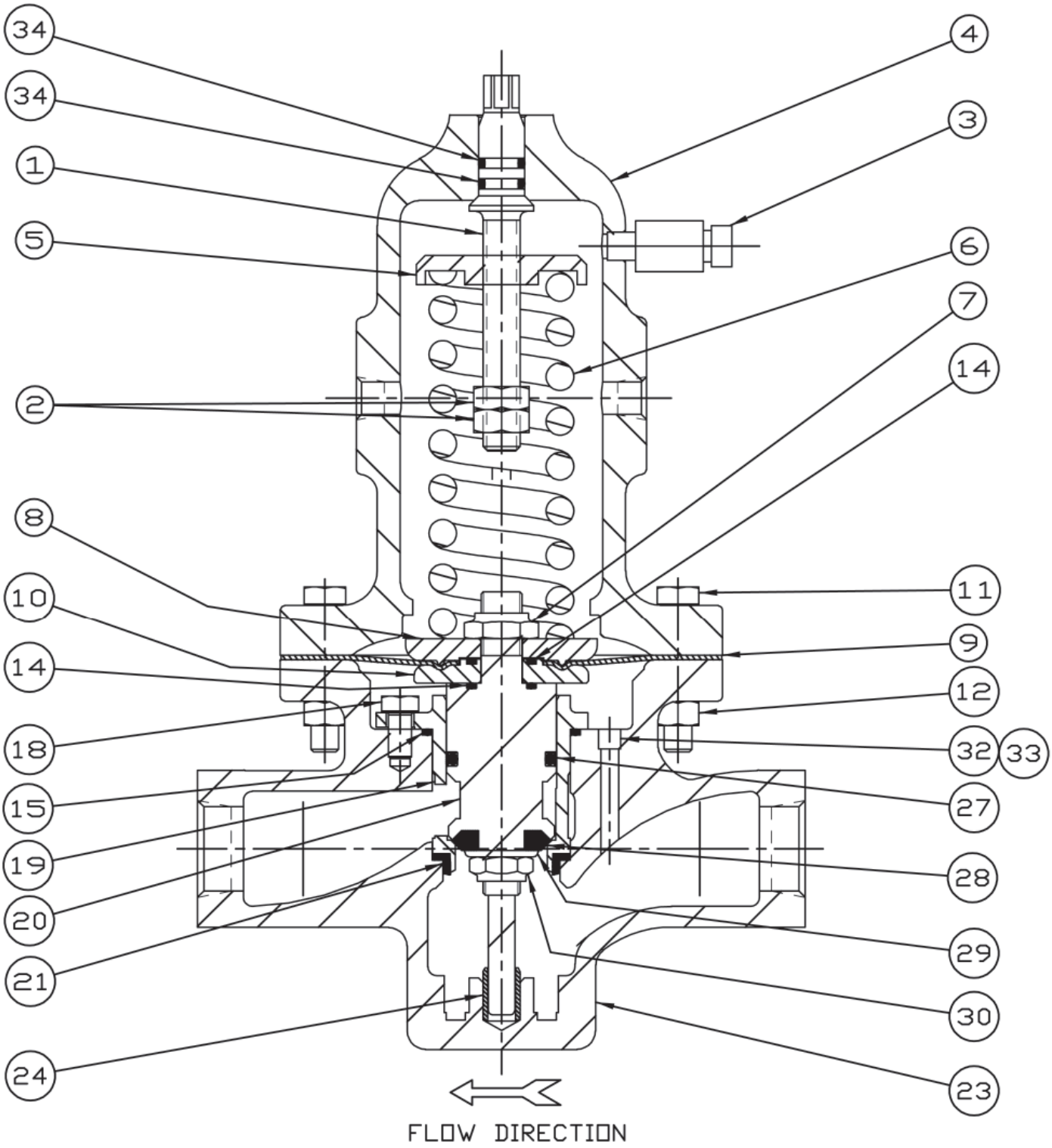


Figure 2
Composition Diaphragm
FTO – Reverse Flow Direction

Item Numbers and Descriptions below apply to Figures 2, 3 and 4.

Item No.	Description
1	Adjusting Screw
2	Adjusting Screw Lock Nut
3	Bleeder Valve Assembly
4	Spring Chamber
5	Spring Follower (Button)
6	Range Spring
7	Diaphragm Cap Screw or Diaphragm Lock Nut
8	Upper Diaphragm Pressure Plate
9 ‡‡	Diaphragm
9.1	Diaphragm (Material #1)
9.2	Diaphragm (Material #2)
9.9	Diaphragm TFE Cover
10	Lower Diaphragm Pusher Plate
11	Flange Bolts
12	Flange Bolting Nuts
14 ‡‡	Stem Seal
14.1	Upper Stem Seal
14.2	Middle Stem Seal
15 ‡‡	Cage Seal
18	Cage Cap Screws
19	Cage
20	Valve Plug
21 ‡‡	Lower Cage Gasket
23	Body
24	Lower Guide Bushing
26	Tap Plug (Not Shown)
27 ‡‡	Dynamic Side Seal
27.1	TFE Cap Seal
27.2	O-ring Energizer/Seal
27.3	U-cup with Metal Energizer
27.5	Piston Ring Seal
27.6	Piston Ring Seal w/Metal Energizer
28 ‡‡	Seat Disc
29	Seat Disc Washer
30	Seat Disc Nut
32	Internal Sensing Plug (External Sensing Only)
33	Internal Sensing Drilled Plug (Internal Sensing Only)
34 ‡‡	Adjusting Screw O-Ring (Qty=2)
99	Nameplate (Not Shown)

‡‡ Recommended Repair Parts

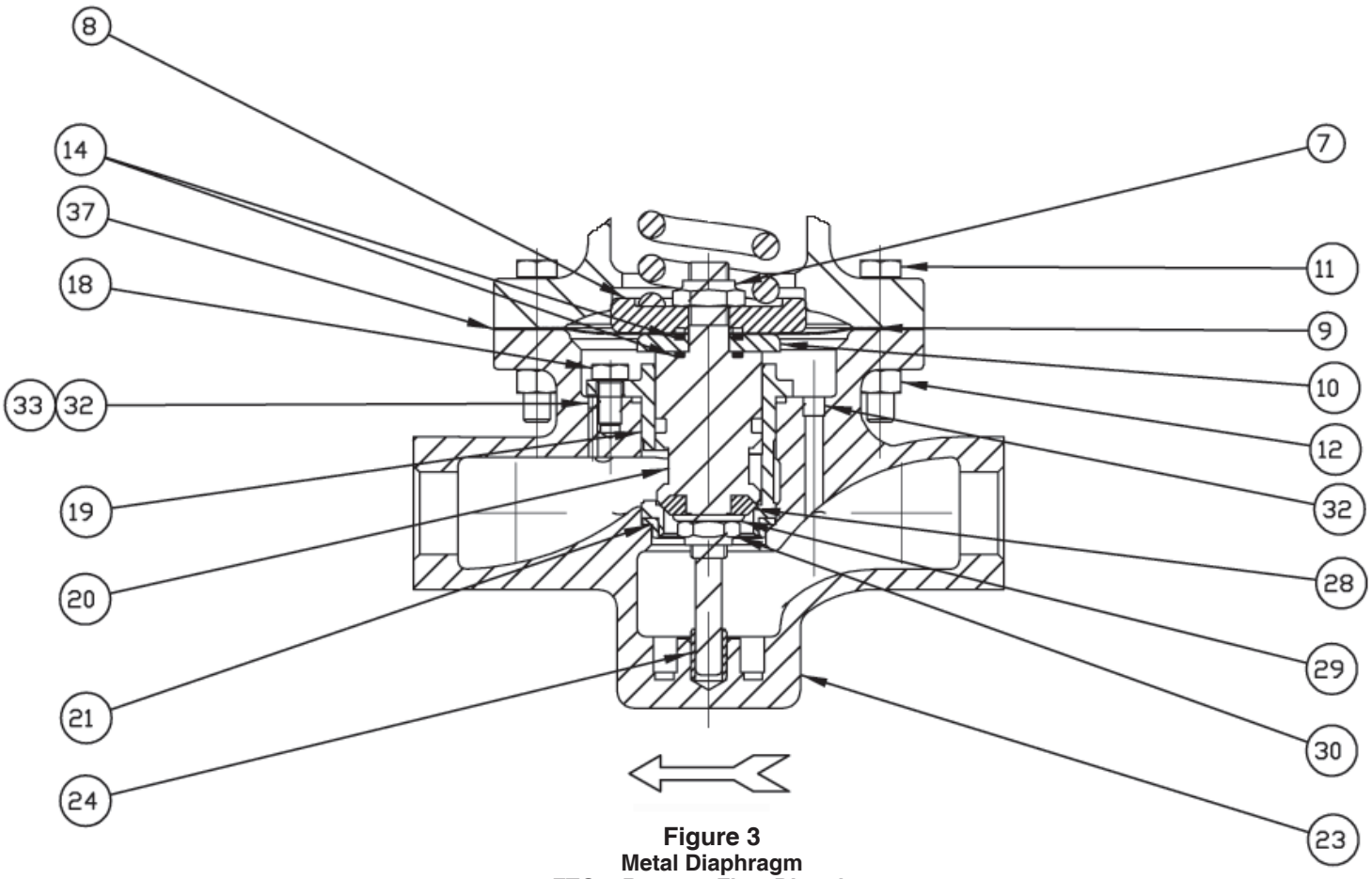
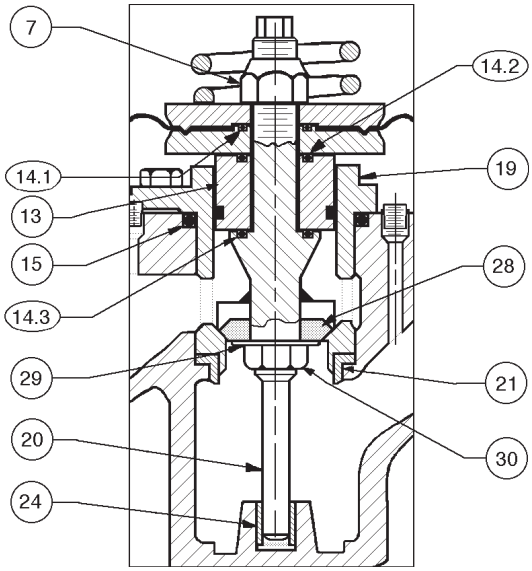


Figure 3
Metal Diaphragm
FTO – Reverse Flow Direction



Item No.	Description
7	Diaphragm Cap Screw
13	Piston/Guide Bearing
14 ‡‡	Stem Seals
14.1	Upper Stem Seal
14.2	Middle Stem Seal
14.3	Lower Stem Seal
15 ‡‡	Cage Seal
19	Cage
20	Valve Plug
21 ‡‡	Lower Cage Gasket
24	Lower Guide Bushing
28 ‡‡	Seat Disk
29	Seat Disk Washer
30	Seat Disk Nut

‡‡ Recommended Repair Parts

Figure 4: Body Sizes
2-1/2" – 4", Composition Diaphragm

ATEX 2014/34/EU: Explosive Atmospheres and Cashco Inc. Products

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. 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:

 II 2 G
Ex h IIB T6... T1 Gb
1000ATEXR1 X

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 1GΩ, 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 <1m/s (<3.3 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
	FL800/FL200
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

Cashco, Inc.
P.O. Box 6
Ellsworth, KS 67439-0006
PH (785) 472-4461
Fax. # (785) 472-3539
www.cashco.com
email: sales@cashco.com
Printed in U.S.A. DA8-IOM

Cashco GmbH
Handwerkerstrasse 15
15366 Hoppegarten, Germany
PH +49 3342 30968 0
Fax. No. +49 3342 30968 29
www.cashco.com
email: germany@cashco.com

Cashco do Brasil, Ltda.
Al.Venus, 340
Indaiatuba - Sao Paulo, Brazil
PH +55 11 99677 7177
Fax. No.
www.cashco.com
email: brazil@cashco.com