



MODEL DA6

DA6 - DIRECT-ACTING, PRESSURE LOADED BACK PRESSURE REGULATOR

SECTION I

I. DESCRIPTION AND SCOPE

The Model DA6 is a pressure loaded back pressure regulator used to control upstream (inlet or P1) pressure. Sizes are 1/2" (DN15), 3/4" (DN20), 1" (DN25), 1 1/4" (DN32), 1 1/2" (DN40), 2" (DN50), 3" (DN80) and 4" (DN100). With proper trim utilization, the unit is suitable for liquid, gaseous, or steam service. Typically installed in a more common "reverse" flow direction arrangement that is balanced (to outlet). Refer to Technical Bulletin DA6-TB for design conditions and selection recommendations. (**NOTE:** This product was formerly identified as a Model D6; a Model DA6 and D6 are one and the same product.)

SECTION II

II. REFERENCES

Refer to Technical Bulletin DA6-TB and DAG-TB for technical specifications of a Model DA6 regulator.

ABBREVIATIONS

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

SECTION III

III. INSTALLATION

1. Install per direction of flow arrow indicated on body, or "IN" and "OUT" markings.
2. Regulator may be rotated around pipe axis 360 degrees. For ease of maintenance, the recommended position is with the cover dome (25) upwards. In liquid service it is recommended that the cover dome (25) 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 during initial startup.
3. Provide space below, above, and around regulator for removal of parts during maintenance.
4. 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 side seal and V-TFE seat when applied.
5. 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, Part H – Converting Internal/ External Sensing.)

- b. Reference DAG-TB, Table DAG-12 for recommendations for applying external pressure sensing.
- c. For internal sensing, no external line is required. For external sensing, use an external control line. The line is connected from the port 1/4" (DN8) NPT tap (Port 5 – See Fig. 5) on the side of the body diaphragm flange to a pressure tap upstream of the regulator. Use 1/4" (6.4 mm) or 3/8" (9.5 mm) outer diameter tubing or 3/8" (DN10) pipe having an inner diameter equivalent to schedule 40 pipe.
- d. For condensable vapors (i.e. steam) slope the external sensing line downward 2 to 5 degrees to inlet piping to prevent water pockets, which allows the diaphragm chamber to always be self draining. The external sensing line may be sloped upward for gas or liquid service; i.e. non-condensibles.

CAUTION

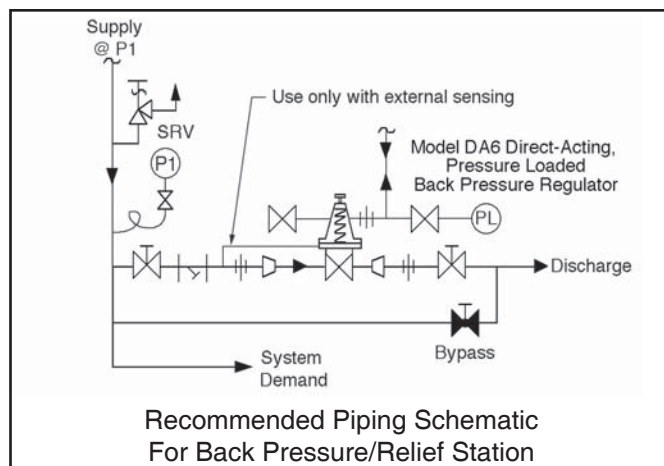
Installation of adequate overpressure protection is recommended to protect the regulator from overpressure and all downstream equipment from damage in the event of regulator failure.

⚠ CAUTION

DO NOT HYDROSTATIC TEST THROUGH AN INSTALLED UNIT; ISOLATE REGULATOR FROM TEST. See Technical Bulletin DA6-TB, Table 1; Maximum P_1 - Inlet Pressure levels for various diaphragm materials by valve body size. Higher pressures could cause internal damage. The nameplate indicates the Inlet and Outlet pressure and temperature ratings.

⚠ 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.



⚠ CAUTION

In the event of diaphragm failure, the process fluid will mix with the loading fluid.

SECTION IV

IV. PRINCIPLE OF OPERATION

1. When a loading pressure – P_{Load} – is applied to the top side of a diaphragm, the inlet controlled pressure – P_1 – will balance at approximately 0.96–0.98 of the loading pressure – P_L – for the standard flow direction, and at 0.98–1.0 of the loading pressure – P_L – for the reverse flow direction. **NOTE:** Fluctuations in the P_2 – Outlet Pressure will cause a deviation in pressure setpoint – P_{SP} – the “crack-open” pressure for the standard flow direction. This deviation is compensated away for the reverse flow direction.
2. Movement occurs as pressure variations register

on the diaphragm. The registering pressure is the inlet, P_1 , or upstream pressure. The loading pressure fluid opposes diaphragm movement. As inlet pressure increases, the diaphragm pushes up, opening the port; as inlet pressure decreases, the loading pressure pushes the diaphragm down and the port opening closes.

3. A complete diaphragm failure will cause the regulator to fail closed if in the standard flow direction variation, and tend to fail closed in the reverse flow direction but with seat leakage.
4. Loss of loading pressure while inlet pressure is imposed will cause valve to fail open.

SECTION V

V. STARTUP

1. Start with the block valves closed.
2. Adjust the loading system pressure control device so that main valve is trying to be controlled at 0 psig pressure.

⚠ CAUTION

Do not walk away and leave a bypassed regulator unattended!

3. Crack open manual bypass valve. Initially pressurize system while simultaneously controlling P_1 pressure through manual actuation of bypass 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. Ensure 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.

5. Open the outlet (downstream) block valve.
6. Slowly open the inlet (upstream) block valve to about 25% open, observing the inlet (upstream) pressure gauge. The regulator should be flowing. Adjust the loading system pressure control device setpoint pressure upwards until the main valve flow is shutoff. Observe the inlet pressure gauge to ensure not over pressurizing.
7. Continue to open inlet block valve until at least 50% open. Set loading system pressure control device upwards to approximate 80% desired main valve pressure level.
8. Fully open inlet block valve.
9. Begin to slowly close the bypass valve if installed.
10. Develop system flow to a level near its expected normal rate, and reset the regulator set point by adjusting the loading system pressure control set point to the desired level.
11. Reduce system flow to a minimum level and observe pressure set point. Inlet pressure will decrease from the set point of Step 10. The maximum build in inlet pressure on increasing flow should not exceed 10%. If it does, consult factory.

SECTION VI

VI. SHUTDOWN

1. Shutoff auxiliary loading pressure source.
2. Shutoff inlet block valve.
3. Shutoff the outlet block valve.
4. Relieve the trapped upstream and downstream pressure and loading pressure.
5. The regulator may now be removed from the pipeline or disassembled for inspection and preventative maintenance while in-line.

SECTION VII

VII. MAINTENANCE

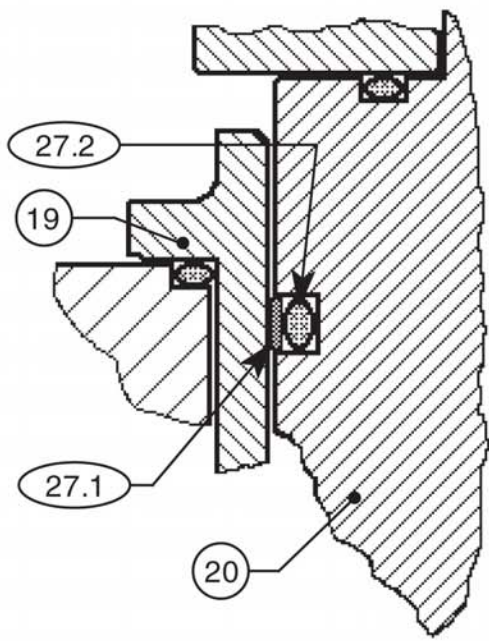
A. General:

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 "oxygen clean" – Opt-55, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1134.
5. The Inner Trim Assembly (ITA) is removed and replaced in the body (23) as an assemblage of parts. The ITA consists of the following parts:

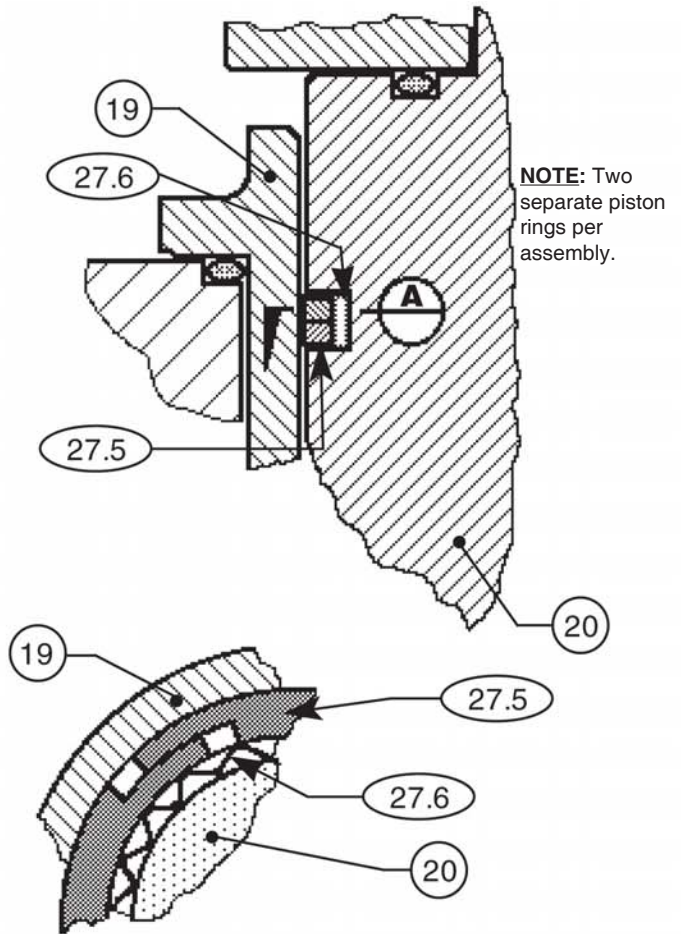
Item No.	Dynamic Side Seal Type	Part Description
7	All	Diaphragm Cap Screw
7	All	Diaphragm Lock Nut
8	All	Upper Diaphragm Pressure Plate
9	All	Diaphragm(s)
10	All	Lower Diaphragm Pusher Plate
13	All	Piston/Guide Bearing✓
14	All	Stem Seals
14.1	All	Upper Stem Seal
14.2	All	Middle Stem Seal
14.3	All	Lower 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 SST Energizer
28	All	Seat Disc
29	All	Seat Disc Washer
30	All	Seat Disc Nut

* Possible option is with NO dynamic side seal.
✓ 2-1/2" thru 4" body sizes only.

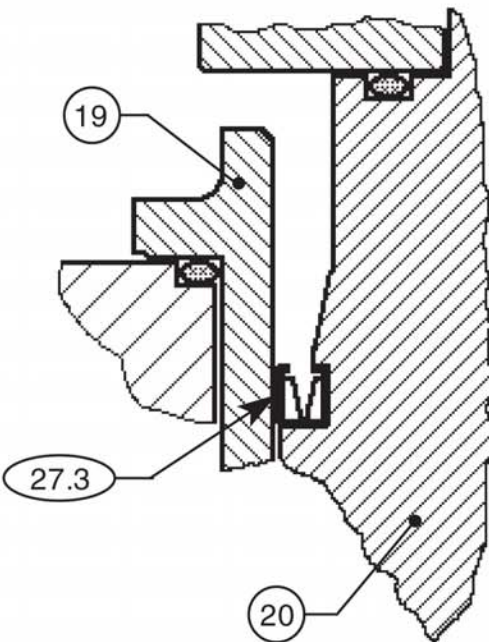
A detailed view of the dynamic side seal parts is shown in Figure 1 on the next page.



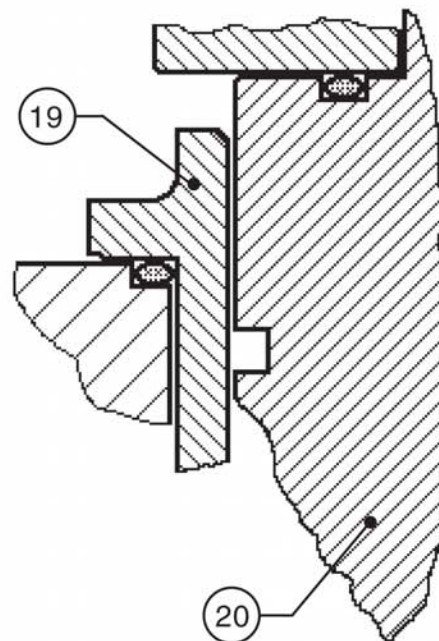
Type CP— TFE Cap Dynamic Seal



Type PR — PRA Dynamic Seal



Type UC — U-Cup Dynamic Seal



Type NO — No Dynamic Seal

Figure 1: Dynamic Side Seals

B. Main Valve Disassembly:

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.

1. Shut down the system in accordance with Section VI.
2. Disconnect the external sensing line, if installed.
3. Though it is possible to disassemble the valve unit while installed in a pipeline, it is recommended that maintenance be done in a shop when possible. The descriptions hereafter will assume shop disassembly. Remove valve from pipeline.
4. Place the valve unit in a vise with the cover dome (25) upwards.
5. Loosen the diaphragm flange bolts (11) and nuts (12) uniformly.
6. Place matchmarks on body (23) and cover dome (25) flanges. Completely remove bolting (11,12). Remove the cover dome (25).
7. Grasp opposite edges of diaphragm (9) and withdraw the ITA from within the cage (19). Set the ITA aside.
8. Evenly loosen the cage cap screws (18) in single revolution increments until fully loosened; remove cage cap screws (18).
9. Pull cage (19) up and out of body.
10. Remove o-ring cage seal (15).
11. Remove lower cage gasket (21).
12. If supplied, remove internal sensing drilled plug (32) using 5/32" (4 mm) Allen key wrench. **NOTE:** Valves with "Large Internal Sensing" will not be equipped with any plug (32,33).
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 thru 5):
 - a. Obtain two pieces of square-section barstock with a 3/8" - 7/16" dimension, approximately 2 inches long.
 - b. Place plug 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 cap screw (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).
 - 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 of a. above.
 - k. Loosen seat 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.

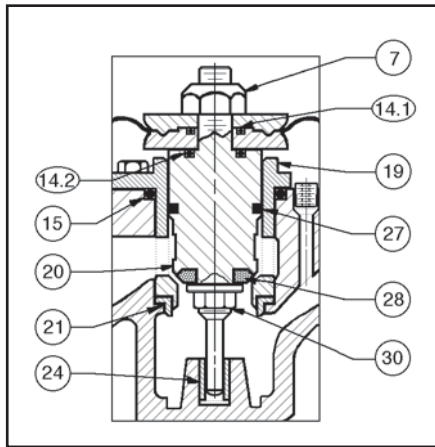


Figure 2: Body Sizes
1/2" – 1", Composition Diaphragm

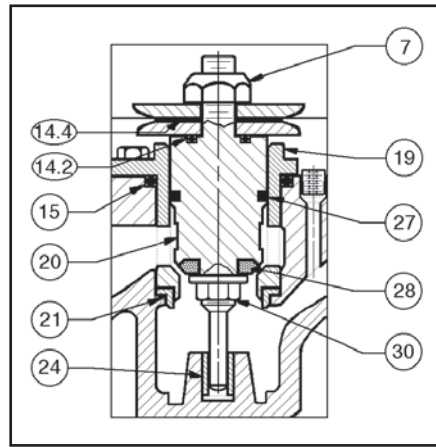


Figure 3: Body Sizes
1/2" – 1", Metal Diaphragm

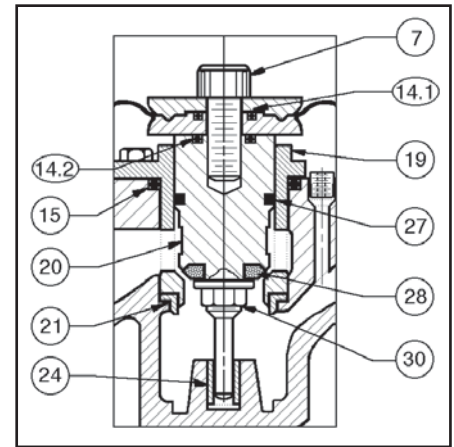


Figure 4: Body Sizes
1-1/4" – 2", Composition Diaphragm

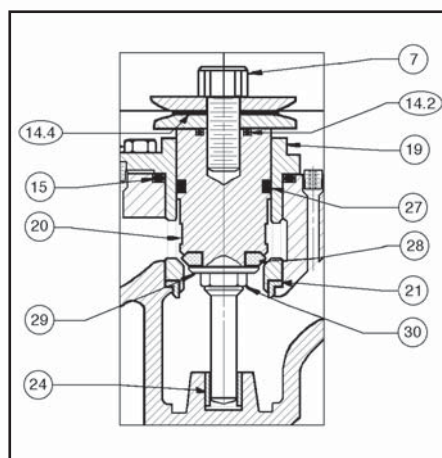


Figure 5: Body Sizes
1-1/4" – 2", Metal Diaphragm

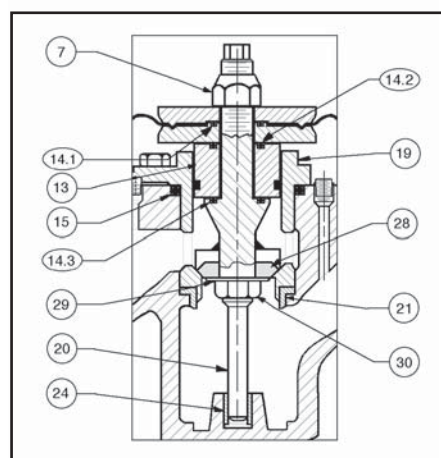


Figure 6: Body Sizes
2-1/2" – 4", Composition Diaphragm

- 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" thru 2":
 - a. Using the two square-section metal bar-stock 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" thru 4":
 - a. Orient plug (20) with upper end upwards, 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 workbench without need of a vise.)
 - a. Type CP:
 1. Stretch o-ring energizer/seal (27.2) over lower circumference of 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 valve plug (20). **NOTE:** A very slight amount of fluid and elastomer compatible lubricant is recommended as an installation aid. DO NOT "ROLL" O-RING.
 2. Position TFE cap seal (27.1) ring with rectangular cross-section at lower end of valve plug (20). Stretch cap seal (27.1) over lower end of valve plug (20) using thumbs to work the cap seal (27.1) onto the 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 valve plug (20).
 - b. Type PR:
 1. Wrap corrugated metal piston ring energizer (27.6) over lower circumference groove of valve plug (20). Using thumbs work the energizer (27.6) into the valve plug (20) groove.
 2. Spread a piston ring seal (27.5) and slide over lower circumference groove of valve plug (20), taking care not to

"cut" piston ring seal (27.5). Using thumbs, work the piston ring seal (27.5) into the groove of the valve plug (20). Repeat this procedure with a second piston ring seal (27.5). Orient/rotate the "splits" in piston ring seals (27.5) 180° across from each other.

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, Loctite 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 2-1/2" thru 4":

- a. Place o-ring lower stem seal (14.3) over upper-end of plug (20) and into groove on plug (20).
- b. Place properly oriented piston/guide bearing (13) over upper-end of plug (20) and into position on plug (20).
- 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 1/2 thru 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. "Gasolite", 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" thru 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" and 1-1/2": 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" thru 4": Engage diaphragm locknut (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. Reinstall internal sensing drilled plug (32) with compatible thread sealant.
3. Fit the o-ring cage seal (15) into its body (23) groove.
4. For metal diaphragm construction, place sealant ("Gasoil" or equal) on both sides of diaphragm gasket (37) and position on body (23) diaphragm flange.
5. Position properly oriented lower cage gasket (21) onto lower shelf of cage (19).
6. Insert cage (19) into body (23) recess. Properly align all 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.

7. Dynamic Side Seals:

- a. Type CP: Position the ITA's valve plug (20) lower end 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 valve plug (20) into the cage (19), simultaneously use hand thumbs to lightly press the cap seal (27.1) inwards into the groove of the 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). Do not press inwards on the cap seal (27.1) too much or the cap seal (27.1) may slide out of its groove.
- b. Type PR: Position the ITA's valve plug (20) lower end over and into upper end of cage (19) until the lower piston ring seal (27.5) touches the upper lip of the cage (19). While gently applying force to press the valve plug (20) into the cage (19), simultaneously use fingers to lightly circumferentially press the first (lower) piston ring seal (27.5) inwards into the

valve plug (20) groove until the first piston ring seal (27.5) "slips into" the cage (19). Repeat for the second piston ring seal (27.5)

- c. Type UC: Position the ITA's valve plug (20) lower end 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 valve plug (20) into the cage (19), simultaneously use hand thumbs to lightly press the u-cup seal (27.3) inwards into the groove of the valve plug (20) until the u-cup seal (27.3) "slips into" the cage (19). DO NOT USE TOOLS, LUBRICANT, OR HEAVY FORCE TO ENGAGE THE U-CUP SEAL (27.3) INTO THE CAGE.
 - d. Type NO: Position the ITA's valve plug (20) lower end over and into the cage (19), allowing plug (20) to enter fully.
8. For composition diaphragm construction, align diaphragm (9) bolt holes with body (23) diaphragm bolt holes.
 9. Aligning matchmarks and bolt holes, place cover dome (25) onto body (23) diaphragm (9) flange.
 10. 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 "pre-formed" – pulled together to remove as much entrapped air as possible and 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. Apply 30-50 psig pressure to the valve inlet and the valve outlet.
OR
 - b. Block the valve inlet and outlet and apply 30-50 psig under the diaphragm through the 1/4" NPT (plugged) external pressure sensing connection on the valve diaphragm flange.
AND
 - c. Leave pressure on through tightening of bolting (11,12).
11. 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 10.

G. Units with Supported Diaphragm Designs:

1. A supported diaphragm (9) construction is designated as Opt-81 High Inlet Pressure. Both upwards and downwards directions are protected against pressure reversal; i.e. pressure on one side of diaphragm (9) with no pressure on other side of diaphragm (9).
2. Body Sizes 2" and Smaller; Composition and Metal Diaphragm. (See Figure 7.)
 - a. Body (23) is specially machined with a shelf to capture a lower diaphragm support ring (35).
 - b. Cover dome (25) is specially machined to provide a surface for the upper diaphragm (9) support. Lower diaphragm support ring (35) is captured by its location. Upon removal of cover dome (25) and diaphragm (9), the lower diaphragm support ring (35) can be lifted upwards and out of the body (23) cavity.
 - c. Reinstallation is a reversal of Step b. above.
3. Body Sizes 2" and Smaller; Metal Diaphragm. (See Figure 8.)
 - a. Body (23) is specially machined with a shelf to capture a lower diaphragm support ring (35) and a groove for lower o-ring diaphragm seal (65).
 - b. Cover dome (25) is specially machined to provide a surface for the upper diaphragm (9) support and a groove for upper o-ring diaphragm seal (65). Lower diaphragm support ring (35) is captured by its location. Upon removal of cover dome (25) and diaphragm (9), the lower diaphragm support ring (35) can be lifted upwards and out of the body (23) cavity.
 - c. Dual o-ring seals (65) replace the diaphragm gasket (37) normally supplied with standard metal diaphragm construction; i.e. non-Opt-81.
 - d. Reinstallation is a reversal of Step b. above.
4. Body Sizes 2-1/2" and Larger; Composition Diaphragm. (See Figure 9.)
 - a. Body (23) is a standard body (23).
 - b. Cover dome (25) is specially machined to provide a surface for the upper diaphragm (9) support.
 - c. When disassembling valve unit, after lower

diaphragm pusher plate (10) is removed, access is provided to extended-length cage cap screws (18). When screws (18) are removed, both the cage (19) and the lower diaphragm support ring (35) are loose, and can be lifted upwards and out of the body (23) cavity.

- d. Upon reassembly of valve unit, after cage (19) is positioned in body (23), lower diaphragm support ring (35) is positioned with cage (19) flange bolt holes (only one orientation possible) prior to engagement and tightening of cage cap screws (18). Torque screws to levels indicated in Sub-Section F.7.i., this Section.

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 cover dome (25), inlet and outlet of body at the same level.
2. Inboard Leakage Test (Seat + Dynamic Seal Leakage).

CAUTION

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

- a. Release all loading pressure in cover dome.
- b. Pressurize inlet to 30 psig with air, GN₂.
- c. Tube outlet to a beaker of water to observe number of escaping gas bubbles.

Inboard leakage path may be via plug/seat or dynamic side seal.

3. Pressure Containment Test.
 - a. Pressurize inlet, outlet and cover dome to 150 psig with air or GN₂.

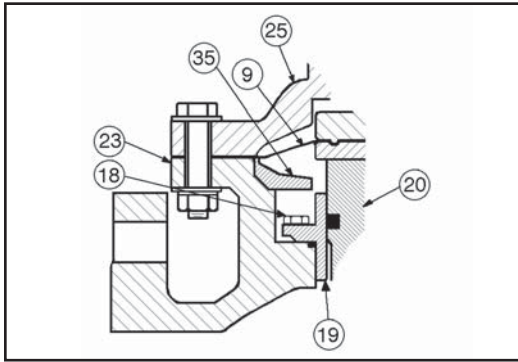


Figure 7: Opt-81 — Composition Diaphragm Construction, 2" and Smaller

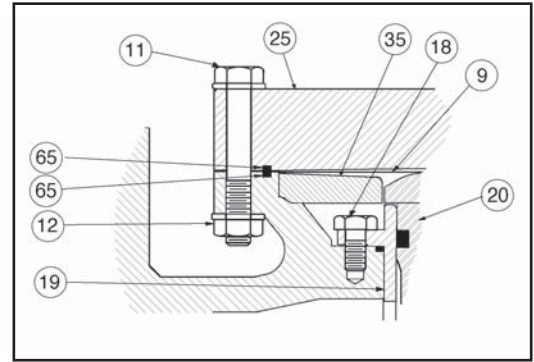


Figure 8: Opt-81 — Metal Diaphragm Construction, 2" and Smaller

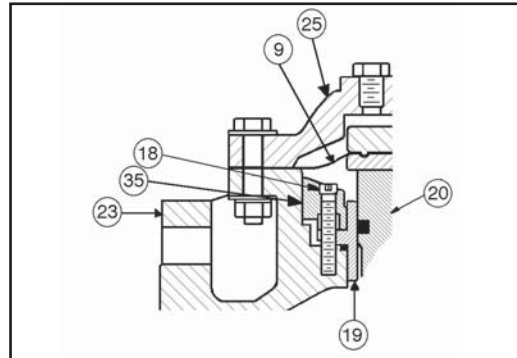


Figure 9: Opt-81 — Composition Diaphragm, 2-1/2" – 4"

- b. Soap solution test all external leak points; plugged connections, diaphragm flange and diaphragm bolting.
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 DAG-TB, Table DAG-10 for leakage classes.

SECTION VIII

VIII.PRESSURE LOADING

1. Loading pressure can be supplied using various schemes. Please reference **LOADING SYSTEMS** for the schematics of these various schemes, including:
 - pressure unloading using BPV
 - pressure loading using PRV
 - pressure loading using I/P transducer

SECTION IX

IX. 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:

- 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.

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. Supply pressure is down (confirm on pressure gauge).	A. Increase supply 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 restriction or bleed orifices. C2. Clean filter(s). C3. Clean loading pressure control device.
D. Faulty loading pressure control device.	D. Replace/repair loading pressure control device.

4. Diaphragm continually breaks (steam service regulators).

Possible Causes	Remedies
A. Stem seals (14) which protect fluorocarbon elastomer in diaphragm assembly may have deteriorated.	A. Replace with new stem seals (14).
B. Diaphragm nut (7) may not be torqued to proper value.	B. Confirm torque value in accordance with Section VII, paragraph E-13.
C. Diaphragm too stiff causing it to crack in service.	C. Follow proper preforming and air evacuation techniques during diaphragm installation in accordance with Section VII, paragraph F-10.

5. Diaphragm continually breaks (all regulators).

Possible Causes	Remedies
A. Differential pressure across diaphragm may have exceeded limits. (See Table 1 in Tech Bulletin DA6-TB.)	A1. Be aware of limits as well as where the various pressures are acting. Install pressure safety equipment as necessary. A2. Consider if full diaphragm support, Opt-81, should be added.

6. Leakage at diaphragm flange.

Possible Causes	Remedies
A. Body bolts not torqued properly.	A. Torque to proper value (see Section VII, paragraph F-11).
B. Pressures at diaphragm may be too high for regulator design.	B. Consult factory.

7. 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.
* Excess seat leakage may be diagnosed when a failure of the dynamic side seal has occurred. Inspect <u>both</u> potential internal leak paths.	

SECTION X

X. 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.

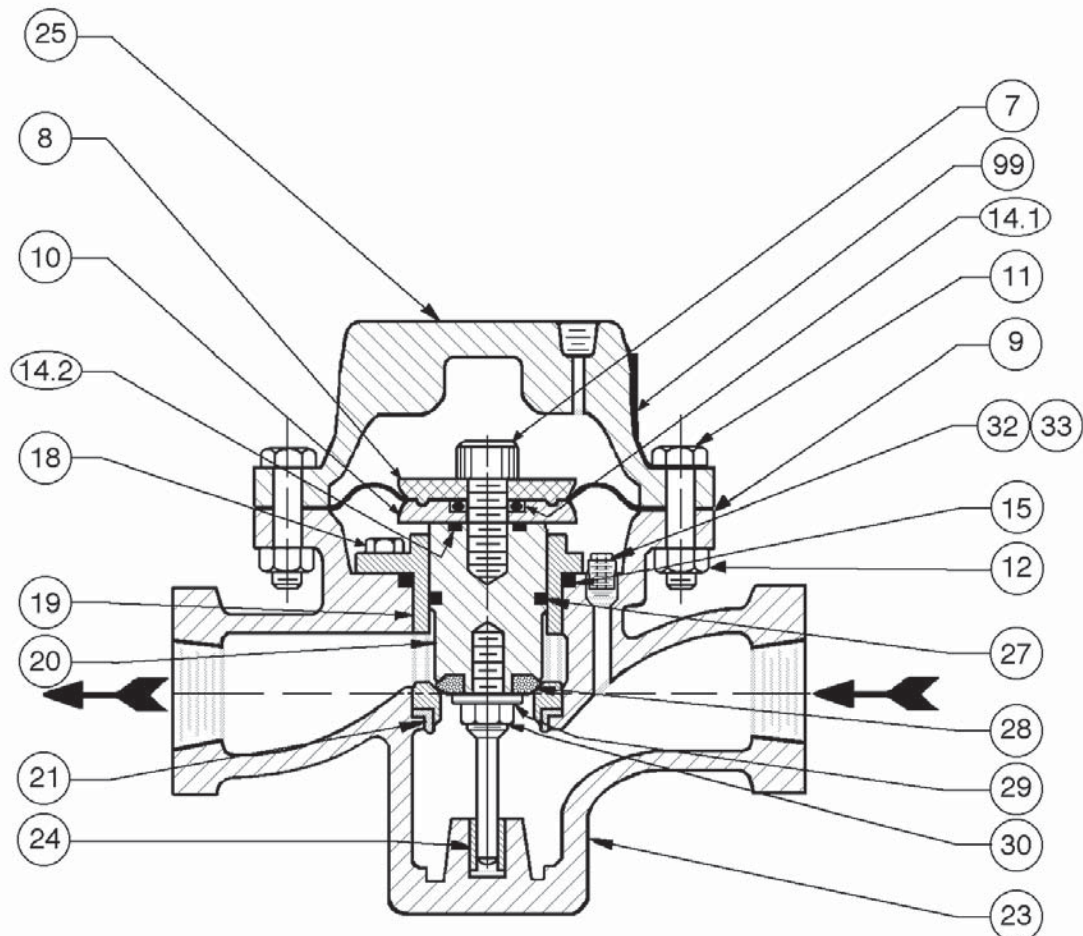
PARTS "KIT" for FIELD REPAIR:

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.



Model DA6
Composition Diaphragm
FTO – Reverse Flow Direction

Item No.	Description	Item No.	Description
7	Diaphragm Cap Screw or Diaphragm Lock Nut	23	Body
8	Upper Diaphragm Pressure Plate	24	Lower Guide Bushing
9 ‡	Diaphragm	25	Cover Dome
9.1	Diaphragm (Material #1)	26	Tap Plug (Not Shown)
9.2	Diaphragm (Material #2)	27 ‡	Dynamic Side Seal
9.9	Diaphragm TFE Cover	27.1	TFE Cap Seal
10	Lower Diaphragm Pusher Plate	27.2	O-ring Energizer/Seal
11	Flange Bolts	27.3	U-cup with Metal Energizer
12 *	Flange Bolting Nuts	27.5	Piston Ring Seal
14 ‡	Stem Seal	27.6	Piston Ring Energizer
14.1	Upper Stem Seal	28 ‡	Seat Disc
14.2	Middle Stem Seal	29	Seat Disc Washer
15 ‡	Cage Seal	30	Seat Disc Nut
18	Cage Cap Screws	32	Internal Sensing Plug (External Sensing Only)
19	Cage	33	Internal Sensing Drilled Plug (Internal Sensing Only)
20	Valve Plug	99	Nameplate
21 ‡	Lower Cage Gasket		

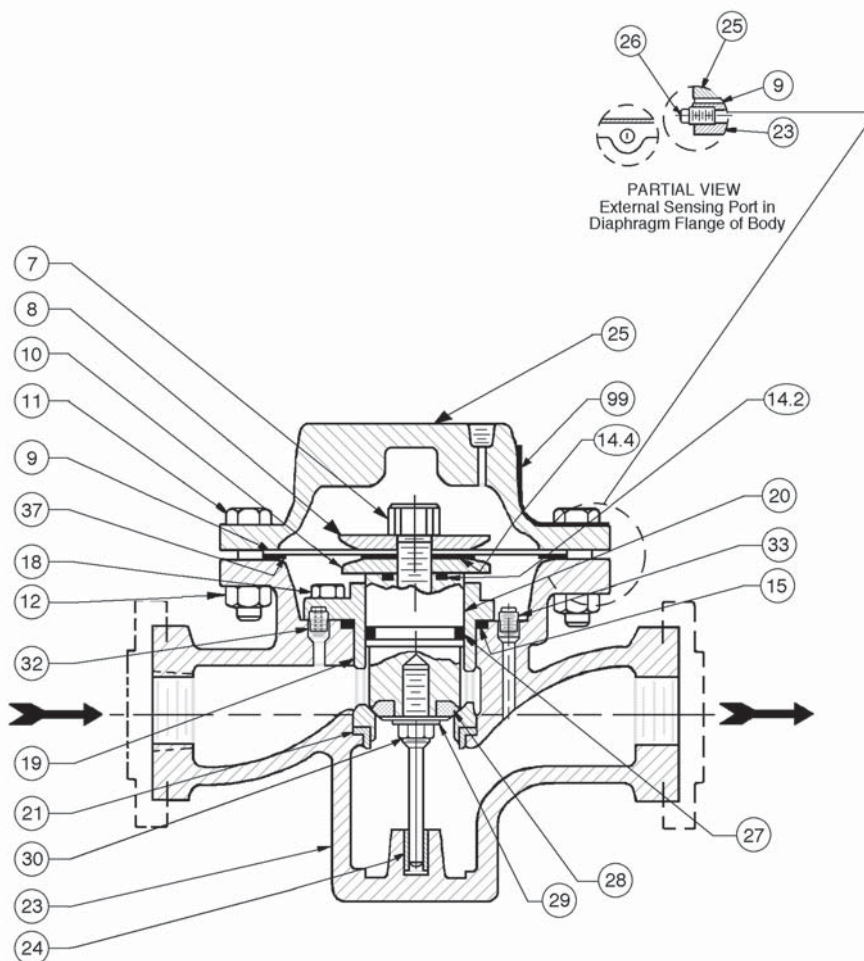
* Not required on 2" CS & SST Body Material.

See Figures 2 – 6 for alternate plug constructions.

‡ Recommended Repair Parts

For sizes 2-1/2" thru 4", see diaphragm/plug construction in Figure 6.

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Model DA6
Metal Diaphragm
FTC – Standard Flow Direction

Item No.	Description	Item No.	Description
7	Diaphragm Lock Nut	24	Lower Guide Bushing
8	Upper Diaphragm Pressure Plate	25	Cover Dome
9 ‡‡	Diaphragm	26	Tap Plug
9.1	Diaphragm (Material #1)	27 ‡‡	Dynamic Side Seal
9.2	Diaphragm (Material #2)	27.1	TFE Cap Seal
9.9	Diaphragm TFE Cover	27.2	O-ring Energizer/Seal
10	Lower Diaphragm Pusher Plate	27.3	U-cup with Metal Energizer
11	Flange Bolts	27.4	O-ring Seal
12 *	Flange Bolting Nuts	27.5	Piston Ring Seal
14 ‡‡	Stem Seal	27.6	Piston Ring Energizer
14.2	Middle Stem Seal	28 ‡‡	Seat Disc
14.4	Lower Pusher Plate Gasket	29	Seat Disc Washer
15 ‡‡	Cage Seal	30	Seat Disc Nut
18	Cage Cap Screws	32	Internal Sensing Plug (External Sensing Only)
19	Cage	33	Internal Sensing Drilled Plug (Internal Sensing Only)
20	Valve Plug	37	Diaphragm Gasket
21 ‡‡	Seat Ring	99	Name Plate
23	Body		

* Not required on 2" CS & SST Body Material.

See Figures 2 – 6 for alternate plug constructions.

‡‡ Recommended Repair Parts

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



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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