

MODEL P7

PISTON SENSING SINGLE STAGE PRESSURE REDUCING REGULATOR


SECTION I

I. DESCRIPTION AND SCOPE

The Model P7 is a 1/2" (DN15) or 3/4" (DN20) pressure reducing regulator used to control downstream (outlet or P_2) pressure. The unit is suitable for gaseous or liquid services. Refer to Technical Bulletin P7-TB for design conditions and selection recommendations.

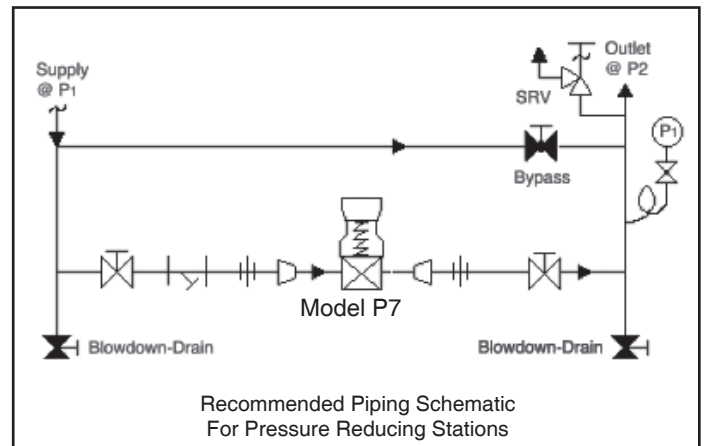
SECTION II

II. INSTALLATION


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.

1. An inlet block valve should always be installed.
2. If service application is continuous such that shutdown is not readily accomplished, it is recommended that an inlet block valve, outlet block valve, and a manual bypass valve be installed.
3. Pipe unions should be installed to allow removal from piping.
4. An outlet pressure gauge should be located approximately ten pipe diameters downstream, and within sight.
5. All installations should include a downstream relief device if the inlet pressure could exceed the pressure rating of any downstream equipment or the maximum outlet pressure rating of the unit.
6. Clean the piping of all foreign material including chips, welding scale, oil, grease and dirt before installing the regulator. Strainers are recommended.
7. In placing thread sealant on pipe ends prior to en-



- gagement, ensure that excess material is removed and not allowed to enter the regulator upon startup.
8. Flow Direction: Install so the flow direction matches the inlet stamp on the main regulator body (1).
9. For best performance, install in well drained horizontal pipe.
10. Regulator may be rotated around the pipe axis 360°. Recommended position is with spring loaded knob (38) or loading dome (2) or ratio loading upper case (44) in vertical upwards position.
11. Regulators are not to be buried underground.
12. For insulated piping systems, recommendation is to not insulate regulator.

SECTION III

III. PRINCIPLE OF OPERATION

1. Movement occurs as pressure variations register on the piston (5). The registering pressure is the outlet, P_2 , or downstream pressure. The range spring (28) or loading pressure (for dome loaded or ratio loaded designs) opposes piston

(5) movement. As outlet pressure drops, the range spring (28) or loading pressure pushes the piston (5) down, opening the port; as outlet pressure increases, the piston (5) pushes up and the port opening closes.

2. A complete piston (5) failure will cause the regulator to fail open.

SECTION IV

IV. STARTUP



CAUTION

For Spring Loaded Design the maximum outlet pressure is indicated on the body as the upper range spring pressure level, and is the recommended “upper operative limit” for the sensing piston (see Section IV. Startup, Step 7).

For Dome & Ratio Loaded Design the max outlet pressure is 1500 psig (103.4 barg).

Max loading pressure for Ratio Loaded Design is 105 psig (7.2 barg).

DO NOT HYDROSTATIC TEST THROUGH AN INSTALLED UNIT; ISOLATE FROM TEST.

1. Start with the block valves closed. A bypass valve may be used to maintain outlet pressure in the downstream system without changing the following steps.
2. Relax range spring (28) by turning the knob (38) counter clockwise (CCW) until rotation comes to a complete stop; or remove the loading pressure for dome loaded or ratio loaded designs.
3. 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. Closely monitor outlet (downstream) 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.
5. Slowly open the inlet (upstream) block valve observing the outlet (downstream) pressure gauge. Determine if the regulator is flowing. If not, slowly rotate the regulator knob (38) clockwise (CW) or increase the loading pressure 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 isn't pressurized. If the outlet (downstream) pressure exceeds the desired pressure, close the block valve and go to Step 2, then return to Step 4.
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. Develop system flow to a level near its expected normal rate, reset the regulator set point by turning the knob (38) (CW) to increase outlet pressure or (CCW) to reduce outlet pressure. Adjust the loading pressure for dome or ratio loaded designs.
10. Reduce system flow to a minimum level and observe set point. Outlet pressure will rise from the set point of Step 9. The maximum rise in outlet pressure on decreasing flow should not exceed the stated upper limit of the range spring (28) by greater than 10%; i.e. 2-100 psig (.14-6.9 Barg) range spring (28).

SECTION V

V. SHUTDOWN

1. 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.

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

SECTION VI

VI. MAINTENANCE



WARNING

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

A. General:

1. Maintenance procedures hereinafter are based upon removal of the regulator unit from the pipeline where installed.
2. Owner should refer to owner's procedures for removal, handling, cleaning and disposal of nonreusable parts, i.e. gaskets, etc.
3. Apply a thin coat of Christo Lube to all o-rings.
4. Refer to Figure 1, Figure 2 or Figure 3 for pertinent design.



CAUTION

To prevent damage to body, use soft jaws when placing body in a vise. Position so that vise closes over the flats on lower end of body.



WARNING

SPRING UNDER COMPRESSION. Prior to removing spring chamber, relieve range spring compression by turning the knob counter clockwise (CCW) until rotation comes to a complete stop. For DOME or RATIO Loaded, remove all loading pressure. Failure to do so may result in flying parts that could cause personal injury.

B. Poppet Seat & Piston Replacement - Spring Loaded Vented Design:

1. Securely install the body (1) in a vise with the spring knob (38) directed upwards.
2. Relax range spring (28) by turning the knob (38) counter clockwise (CCW) until rotation comes to a complete stop. **NOTE:** It is not necessary to remove the knob (38) before removing the spring chamber(2)-(upper assembly) from the body (1). Remove upper assembly by turning spring chamber (2) (CCW). Lift upper assembly off of range spring (28).
3. Remove spring (28), pin (40) and spring follower (26).

4. Grab vent cap (25) by flats and pull up to remove piston (5) and sleeve (3) from body (1). Remove and replace o-ring (4).
5. With thumb, press down on top of vent cap (25) to separate piston (5) from sleeve (3). Remove and replace o-ring (6).
6. Secure piston (5) in a vise using the flats on the sides of piston. Remove vent cap (25) by turning (CCW).
7. Use a pair of needle nose pliers to grasp top of poppet (23). Pull upwards to remove poppet, poppet seat (24) and poppet spring (22).
8. Reinstall poppet spring (22) and poppet (23) in piston (5). Slide new poppet seat / disc (24) over poppet. Install vent cap (25) on piston (5), use (CW) rotation to tighten metal to metal.
9. Insert smallest o.d. of piston (5) into largest i.d. of sleeve (3). Press tightly together for metal to metal contact. Press this assembly into body (1); vent cap (25) oriented upwards.
10. Place spring follower (26) with smallest o.d. next to piston. Install spring (28).
11. Place upper spring chamber assembly on body (1). Turn spring chamber (2) (CW) to secure tight to body. Remove knob cover (39).
12. Rotate vent screw (36) CCW to remove screw and spring (35). Record number of revolutions for removal of screw. _____
13. Lower pin (40) through top / center of adjusting screw (34), pin should rest on top of poppet (23). **NOTE:** insert a small diameter tool through center of adjusting screw and carefully press downward on pin (40) to confirm recoil of the poppet spring (22).
14. Install spring (35) and vent screw (36) - recalling the number of revolutions counted for removal from above. Reinstall knob cover.

C. Piston Replacement - Spring Loaded Non-Vented Design:

1. Instructions are similar to Vented with exception: Assembly does not include pin (40), per B. 3, the poppet, (23) and poppet spring (22). per B.7 & B.8. The poppet seat (24) is replaced by a solid disc.



WARNING

For DOME or RATIO Loaded remove all loading pressure. Failure to do so may result in flying parts that could cause personal injury.

D. Piston Replacement - Dome Loaded Design:

1. Securely install the body (1) in a vise with the loading dome (2) directed upwards.
2. Remove dome (2) by grasping the flats and turning (CCW).
3. Grab piston (5), lift up to remove piston & sleeve (3) from body (1). Remove and replace o-rings (4 & 41).
4. With thumb, press down on top of piston (5) to separate piston from sleeve (3). Remove and replace o-ring (6).
5. Insert smallest o.d. of piston (5) into largest i.d. of sleeve (3). Press tightly together for metal to metal contact. Press this assembly into body.
6. Place dome (2) on body- turning (CW) to secure body (1) and dome (2) firmly together.
7. Refer to Section IV for start up.

E. Piston Replacement - Ratio Loaded Design:

1. Securely install the upper & lower case assembly (43) (44) in a vise with the body(1) directed upwards.
2. Remove body (1) from upper & lower case assembly (43)(44) and bonnet (2) by grasping the flats on the body (1) and turning CCW. **NOTE:** It is not necessary to dis-assemble upper & lower case assembly. Do not remove post (42) from upper & lower case assembly to maintain alignment of post (42) with pressure plate (46).
3. Rotate body assembly end to end 180 degrees and securely install in a vise with piston (5) upwards.
4. Grab piston (5), lift up to remove piston & sleeve (3) from body (1). Remove and replace o-ring (4).
5. With thumb, press down on top of piston (5) to separate piston from sleeve (3). Remove and replace o-ring (6).

6. Insert smallest o.d. of piston (5) into largest i.d. of sleeve (3). Press tightly together for metal to metal contact. Press this assembly into body (1).
7. To re-attach body assembly to upper & lower case assembly, position body (1) on bonnet (2) and rotate body (CW) to secure tight metal to metal seal. **NOTE:** Align post (42) with recess in piston (5).

F. Trim Inspection & Replacement: (All designs)

1. Remove pin (10) and baffle plate assembly (7) (8)(9). **NOTE:** spring pin (9) is pressed into baffle plate (7) flush to top surface. Pitot (8) is threaded tight into bottom side of baffle plate (7).
2. With body securely clamped in vise remove seat (11) turning (CCW). Remove and replace o-ring (27). At re-assembly, tighten seat (11) metal to metal into body (1).
3. Remove body from vise and rotate end to end 180 degrees to reclamp body in vise with body cap (16) upwards.
4. Turn body cap (CCW) to remove and replace o-ring (17). At re-assembly tighten body cap (16) metal to metal to body (1).
5. With a pick type tool, locate leading edge of spiral retaining ring (21) in the body cap (16) and lift upwards slightly. Grab the elevated end with needle-nose pliers and rotate (CCW) to remove. At re-assembly replace with new retaining ring (21).
6. Remove retainer (20). Remove and replace o-ring (19) and backup ring (18).
7. Grasp end of plug (12) and pull upwards to remove. Slide return spring (15) off of plug (12).
8. Secure plug (12) in a vise with vent screw (14) directed upwards. Turn vent screw (CCW) to remove and replace seat disc (13). **NOTE:** chamfer on seat disc (13) faces away from the plug. At re-assembly tighten vented screw (14) into plug per following torque values:

For Cv Size	Torque to in/oz.
0.8	65
2.0	96

9. Clean body (1) and all reusable parts according to owner's procedures. **NOTE:** *On regulators originally supplied as "oxygen clean", Option-M, maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1134. Contact factory for details.*
10. Inspect and replace any necessary parts.
NOTE: *Use only parts manufactured and supplied by Cashco for these products.*
11. Insert plug (12) and spring (15) into body (1).
12. Place backup ring (18) into body cap (16), followed by o-ring (19) and guide bushing (20) - flat side up.
13. Insert spiral retaining ring (21) into groove behind guide bushing (20) to lock parts in place.
14. Thread body cap (16) into the body (1) metal to metal, compressing o-ring (17) into chamfer of body.
15. Remove body from vise and rotate end to end 180 degrees to reclamp body in vise with body cap (16) downwards.
16. Thread seat (11) with o-ring (27) (CW) into body (1) tighten metal to metal.
17. Position baffle plate assembly (7) pin side down into body (1); align spring pin (9) in proper hole in body so pitot (8) is visible in center of outlet threaded connection.
18. Install pin (10) through center of baffle plate (7).
19. Refer to Section VI to re-assemble piston and top works to a specific design.

G. Diaphragm Replacement - Ratio Loaded Design:

1. Securely install the body (1) in a vise with upper & lower case assembly (43) (44) directed upwards.
2. Remove all bolts (48) and nuts (49) from upper & lower case assembly.
3. Remove upper case (44).
4. Remove & replace diaphragm (45).
NOTE: *Ensure that pressure plate (46) is aligned correctly on post (42),*
5. Align bolt holes in upper case (44) with holes in diaphragm (45) & lower case (43). Insert bolts (48) through holes and thread nuts (49) on bolts. Torque bolting and nuts to 35 ft. lbs.

SECTION VII

VII. CALIBRATION OF POPPET VENT - SPRING LOADED MODEL

Refer to Section IV - Startup - to establish system regulating pressure and flow conditions. Pop knob cover off of the knob (38). Rotate vent adjustment screw (36) CW, until a hissing sound is heard - then stop. Then slowly turn the vent adjustment screw CCW until the hissing sound stops. From this point, rotate the vent adjustment screw CCW one more revolution and stop. The vent relieving function of this model is calibrated.

SECTION VIII

VIII. TROUBLE SHOOTING GUIDE

1. Erratic operation; chattering.

Possible Causes	Remedies
A. Oversized regulator; inadequate rangeability.	A1. Check actual flow conditions, re-size regulator for minimum and maximum flow. A2. Increase flow rate. A3. Decrease regulator pressure drop; decrease inlet pressure by placing a throttling orifice in inlet piping union. A5. Before replacing regulator, contact factory.
B. Worn poppet; inadequate guiding. Vented Design	B. Replace trim (possible body replacement).
C. Weakened/broken poppet spring. Vented Design	C. Replace poppet spring. Determine if corrosion is causing the failure.

2. Regulator can not pass sufficient flow.

Possible Causes	Remedies
A. Regulator undersized.	A1. Confirm by opening bypass valve together with regulator. A2. Check actual flow conditions, re-size regulator; if regulator has inadequate capacity, replace with larger unit.
B. Too much droop.	B1. Review droop expected. B2. Contact factory.

3. Sluggish operation.

Possible Causes	Remedies
A. Fluid too viscous.	A. Heat fluid. Contact factory.

4. Excessive pressure downstream.

Possible Causes	Remedies
A. Regulator not closing tightly.	A. Inspect the seating. Clean and lap metal seat surfaces; replace if lapping does not remedy. If composition seats are depressed, nicked or embedded with debris, replace trim.
B. Downstream block..	B. Check system; isolate (block) flow at regulator inlet - not outlet. Relocate regulator if necessary.
C. No pressure relief protection.	C. Install safety relief valve, or rupture disc.
D. Restricted piston movement.	D. Ensure no moisture in spring chamber at temperatures below freeze point.

SECTION IX

IX. ORDERING INFORMATION

NEW REPLACEMENT UNIT vs PARTS "KIT" FOR FIELD REPAIR

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

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NEW REPLACEMENT UNIT:

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

PARTS "KIT" for FIELD REPAIR:

Contact your local Cashco 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".

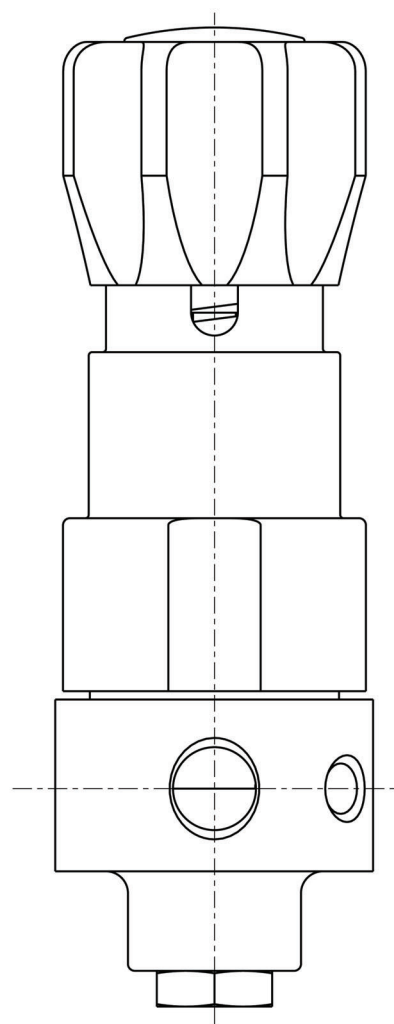
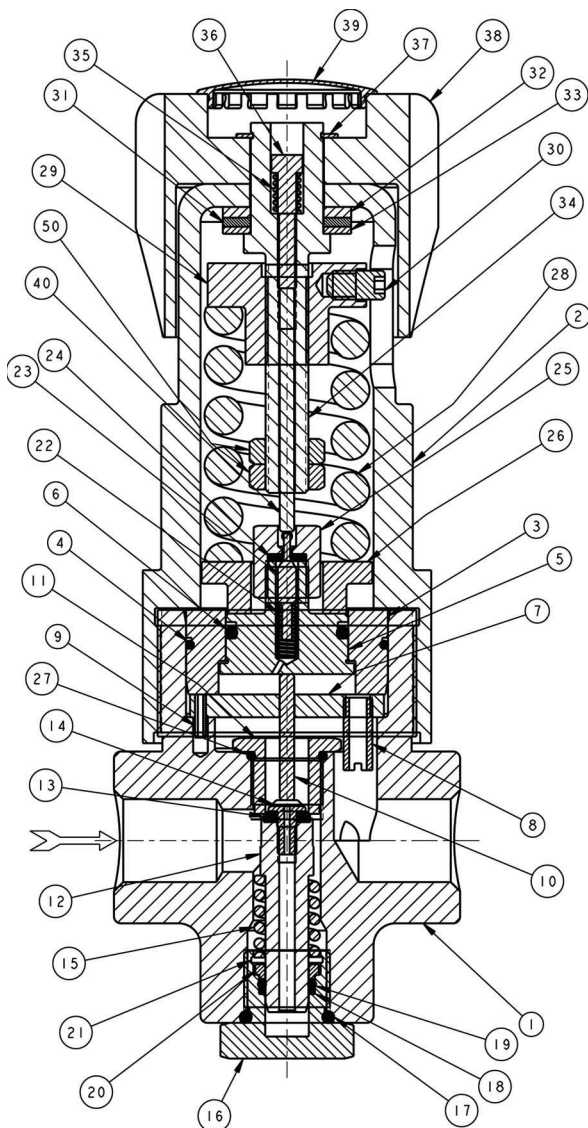
If the "BOM" is not available, refer to the cross-sectional drawings included in this manual for part identification and selection.

A Local Sales Representative will provide quotation for appropriate Kit Number.



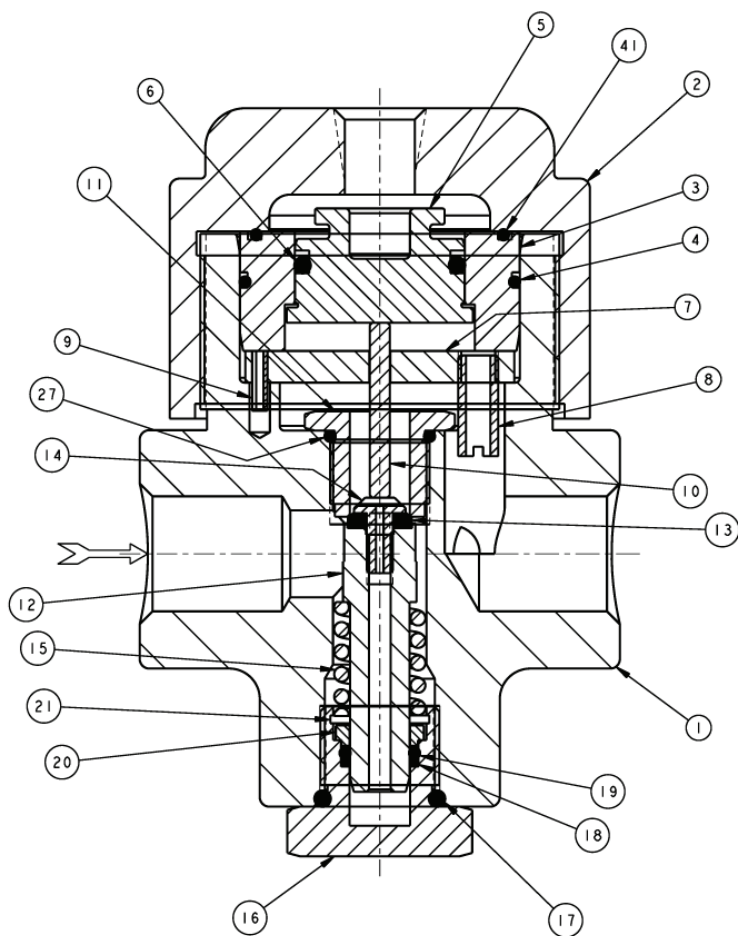
CAUTION

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.



**FIGURE 1
SPRING LOADED**

Item No.	Description	Repair Parts Kit B	Item No.	Description	Repair Parts Kit B
1	Body		22	Vent Poppet Spring	
2	Spring Chamber		23	Vent Poppet	
3	Sleeve		24	Seat.....++	
4	O-Ring.....++		25	Vent Cap	
5	Piston		26	Spring Follower	
6	O-Ring.....++		27	O-ring.....++	
7	Baffle Plate		28	Range Spring	
8	Pilot		29	Spring Button	
9	Spring Pin		30	Set Screw (Spring Button)	
10	Body Pin		31	Thrust Washer	
11	Seat Orifice.....++		32	Thrust Bearing	
12	Plug.....++		33	Thrust Washer	
13	Valve Seat Disc.....++		34	Adjusting Screw	
14	Vent Screw(Valve Seat).....++		35	Adjusting Screw Spring	
15	Return Spring		36	Vent Adjustment Screw	
16	Body Cap		37	Retaining Ring (Snap Ring)	
17	O-Ring.....++		38	Knob	
18	Backup Ring.....++		39	Knob Cover	
19	O-ring.....++		40	Pin	
20	Retainer		50	Nut	
21	Spiral Retaining Ring.....++				



**FIGURE 2
DOME LOADED**

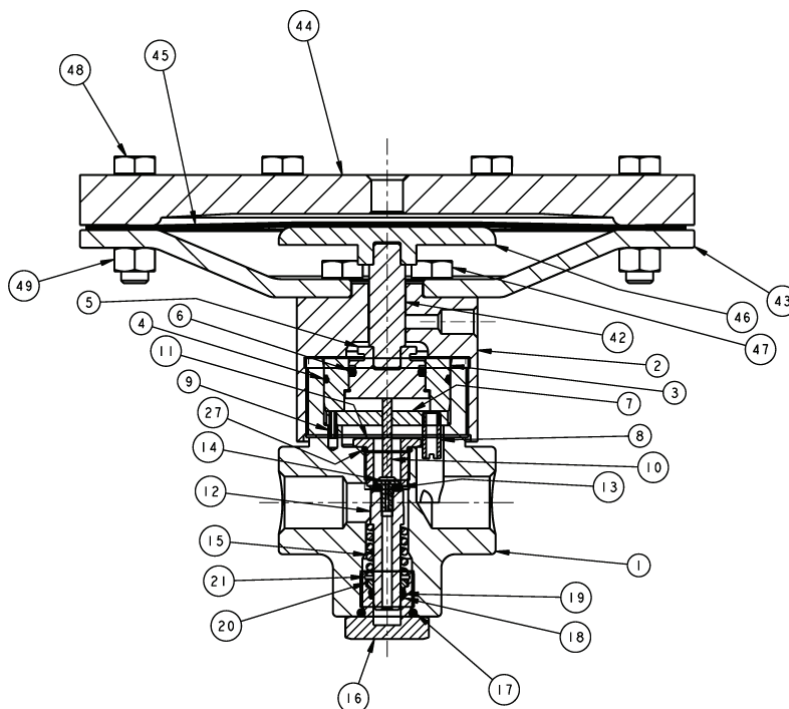
Item No.	Description	Repair Parts Kit B
1	Body	
2	Dome	
3	Sleeve	
4	O-Ring.....++	
5	Piston	
6	O-Ring.....++	
7	Baffle Plate	
8	Pitot	
9	Spring Pin	
10	Body Pin	
11	Seat Orifice.....++	
12	Plug.....++	
13	Valve Seat Disc.....++	
14	Vent Screw.....++	
15	Return Spring	
16	Body Cap	
17	O-Ring.....++	
18	Backup Ring.....++	
19	O-Ring.....++	
20	Retainer	
21	Spiral Retaining Ring.....++	
27	O-Ring.....++	
41	O-Ring.....++	

Item No.

Description

**Repair Parts
Kit B**

42	Post
43	Lower Case
44	Upper Case
45	Diaphragm.....++
46	Diaphragm Pressure Plate
47	Cap Screw
48	Cap Screws
49	Nut



**FIGURE 3
RATIO LOADED**



IOM ADDENDUM:

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

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



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

1. The maximum surface temperature depends entirely on the operating conditions and not the equipment itself. The combination of the maximum ambient and the maximum process medium temperature shall be used to determine the maximum surface temperature and corresponding temperature classification, considering the safety margins described prescribed in EN ISO 80079-36:2016, Clause 8.2. Additionally, the system designer and users must take precautions to prevent rapid system pressurization which may raise the surface temperature of system components and tubing due to adiabatic compression of the system gas. Furthermore, the Joule-Thomson effect may cause process gases to rise in temperature as they expand going through a regulator. This could raise the external surface temperature of the regulator body and the downstream piping creating a potential source of ignition. Whether the Joule-Thomson effect leads to heating or cooling of the process gas depends on the process gas and the inlet and outlet pressures. The system designer is responsible for determining whether the process gas temperature may raise under any operating conditions.
2. Where the process medium is a liquid or semi-solid material with a surface resistance in excess of 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
	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
REGULATORS	
CONTROL VALVES	RANGER, 987, PREMIER
	964, 521, 988, 988-MB, 989
	2296/2296HF
	SCV-30, SCV-S
TANK BLANKETING	8700, 8910, 8920, 8930, 8940
	2100, 2199
	3100, 3200, 3300, 3400, 3500, 3600, 3700
	1078, 1088, 1100, 1049
	5100, 5200, 5400, 5500
	4100, 4200, 4300, 4400, 4500, 4600
MISC	764P/PD, 764-37, 764T

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