



ISO Registered Company

# MODELS 8310HP DIFFERENTIAL (1+6 and 1+8 ) PRESSURE REDUCING REGULATORS

## SECTION I

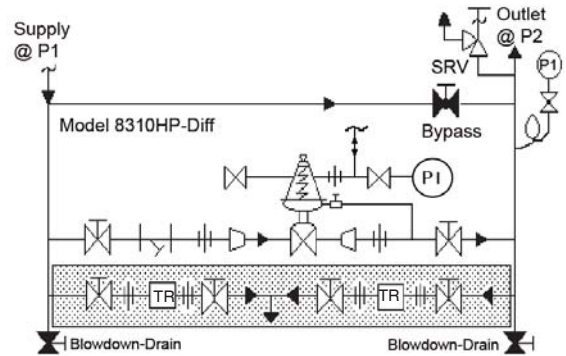
### I. DESCRIPTION AND SCOPE

The Models 8310HP-1+6 and 8310HP-1+8 are differential reducing regulators used to control differential pressure between downstream (outlet or  $P_2$ ) pressure and a loading ( $P_{Load}$ ) pressure to the spring chamber. Available in sizes 1-1/2" (DN40), 2" (DN50), 2-1/2" (DN65), 3" (DN80) and 4" (DN100). Widely applied in steam atomization systems using heavy oil (Nos. 3-6, Bunker C) to fuel burners. Refer to Technical Bulletin 8310HP-DIFF-TB for design conditions and selection recommendations.

## SECTION II

### II. INSTALLATION

1. An inlet block valve should always be installed. An outlet block valve is desirable.
2. A manual bypass valve is recommended for "hot piping" systems to assist in piping warm-up at startup.
3. An isolation valve on the loading line is not recommended. The threaded port in the diaphragm ring (25) for the Model 8310HP 1+8 may be piped to a safe drainage point, but no valve should be installed in the drain line.
4. Pipe unions are recommended for NPT screwed installations to allow removal from piping.
5. An outlet pressure gauge should be located approximately ten pipe diameters downstream, and within sight. A loading pressure (or differential pressure) gauge is recommended.
6. 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.



(Shaded portion for steam/condensate systems)  
Recommended Piping Schematic For  
Pressure Reducing Station

7. Clean the piping of all foreign material including chips, welding scale, oil, grease and dirt before installing the regulator. Strainers are recommended.
8. In placing thread sealant on pipe ends prior to engagement, ensure that excess material is removed and not allowed to enter the regulator upon start-up.
9. Flow Direction: Install so the flow direction matches the arrow cast on the body. Install an external sensing line (1/2" O.D. (DN15) tubing minimum) from the 3/8" (DN10) NPT connection in needle valve (39) to a point downstream, preferably at gauge location.
10. Install oil loading pressure sensing line to spring chamber (13) connection.
11. For long operational life with minimum maintenance, install a strainer in the upstream line. If regulator pipe line is expanding to a larger pipe line, always connect sensing line to the larger pipe line.
12. For best performance, install in well drained horizontal pipe, properly trapped, if a steam service application.



### CAUTION

**DO NOT HYDROSTATIC TEST THRU AN INSTALLED UNIT; ISOLATE REGULATOR FROM TEST. DO NOT HYDROSTATIC TEST THE LOADING PRESSURE WITHOUT PRESSURE IN THE MAIN REGULATOR.**

The upper range spring pressure level listed on the nameplate is the recommended "upper operative limit" for the sensing diaphragm (see Section IV. Start-up, Number 7.) Higher pressures could cause internal damage. In addition, note on the nameplate that the Inlet and Outlet pressure and temperature ratings are at different levels.

- Model 8310HP 1+6 - refer to Figure 1; for 8310HP 1+8 refer to Figure 2. Regulator may be rotated around the pipe axis 360°. Recommended position is with spring chamber vertical upwards. Orient such that the spring chamber vent hole does not collect rainwater or debris.

- Regulators are not to be direct buried underground.
- For insulated piping systems, recommendation is to not insulate regulator.

## SECTION III

### III. PRINCIPLE OF OPERATION

- The Differential Model 8310HP is available in two options: 8310HP-1+6 is single diaphragm construction; 8310HP-1+8 is double diaphragm construction. The double diaphragm construction prevents the loading fluid from direct mixing with the system fluid in case of diaphragm failure.
- Plug movement occurs as pressure variations register on the diaphragm. One pressure is the outlet ( $P_2$ ) or downstream pressure, which registers on the “underneath” side of the diaphragm. The second pressure registered is the loading ( $P_{Load}$ ) pressure in the spring chamber “above” the diaphragm. The range spring determines the differential pressure level ( $P_{Set}$ ). As outlet ( $P_2$ ) pressure drops, the range spring with  $P_{Load}$  pressure pushes the diaphragm down, opening the port; as outlet ( $P_2$ ) pressure increases, the diaphragm

is pushed up and the port closes. As the loading ( $P_{Load}$ ) pressure varies, the outlet ( $P_2$ ) pressure tends to follow. An increase in  $P_{Load}$  ( $\Delta P_{Load}$ ) will increase outlet  $P_2$  pressure by nearly an equal amount ( $\Delta P_{Load} = \Delta P_2$ ); a decrease in  $P_{Load}$  will have a similar effect on outlet  $P_2$  pressure.

- For the 8310HP-1+6 (single diaphragm) design, a complete diaphragm failure will cause the fluids to mix in the spring chamber or loading pressure piping system.
- For the 8310HP-1+8 (double diaphragm) design, a complete diaphragm failure will cause the regulator to fail open, leaking fluid through the annular ring vent hole. **NOTE:** *Composition (soft) diaphragms may be utilized only on -1+6 single diaphragm construction.*

## SECTION IV

### IV. START-UP

- 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.
- Remove the closing cap and relax the range spring by turning the adjusting screw counter clockwise (CCW) (viewed from above) a minimum of three (3) full revolutions. This reduces the outlet (downstream) pressure set point.
- 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 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.*

the regulator is flowing. If not, slowly rotate the regulator adjusting screw clockwise (CW) (viewed from above) until flow begins.

- Continue to slowly open the inlet (upstream) block valve until fully open.
- 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.
- When flow is established steady enough that the outlet (downstream) block valve is fully open, begin to slowly close the bypass valve, if installed. **NOTE:** *The needle valve (39) is shipped in a full open position. If the system is unstable due to pressure fluctuations, slowly close the needle valve (39) until the system becomes stable. This needle valve should never be in a fully closed position.*
- Set the regulator set point ( $P_{Set}$ ) by turning the adjusting screw clockwise (CW) to increase outlet pressure or CCW to reduce outlet pressure. The outlet ( $P_2$ ) pressure under these conditions will approximate the desired differential pressure when loaded with  $P_{Load}$ .



### CAUTION

**Do not walk away and leave a bypassed regulator unattended!**

- Crack open the outlet (downstream) block valve.
- Slowly open the inlet (upstream) block valve observing the outlet (downstream) pressure gauge. Determine if

10. Pressurize the source of loading ( $P_{Load}$ ) pressure and allow to fill the spring chamber cavity. Slightly open the bleeder valve to vent any air as the spring chamber is filling. Close bleeder valve when all air has escaped.
11. Develop system flow to a level near its expected normal rate, and reset the regulator differential set point by turning the adjusting screw CW (viewed from above) to increase outlet pressure, or CCW to reduce outlet pressure.

12. 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 by greater than 10%; i.e. 10-40 psig (.69-2.8 Barg) range spring, at low flow the outlet pressure should not exceed 44 psig (3 Barg). If it does, consult factory.
13. Retighten nut (33) on adjusting screw and install closing cap.

## SECTION V

### V. SHUTDOWN


**CAUTION**


**Loading Pressure must be shut off 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. It is recommended that manual operation not be attempted by a bypass valve during a shutdown.
3. When the loading pressure ( $P_{Load}$ ) has been shutdown, the regulator outlet pressure ( $P_2$ ) should decrease substantially. When this is observed, the inlet (upstream) block valve may be closed. Close downstream block valve.

## 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. If desired, new gaskets may be lubricated with a light oil provided it is compatible with the fluid.

#### B. Diaphragm Replacement:

1. Using an overhead hoist, lift regulator out of the piping installation and on to a flat work surface.


**WARNING**

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

2. Remove closing cap (35). Relax compression on range spring (28) by turning adjusting screw (32) CCW (viewed from above) until removed from spring chamber (13).
3. Draw or embed a match mark between diaphragm case (14), spring chamber casting (13) along flanged area and across body spacer (25) for (1+8).
4. Remove all flange nuts (30) and bolts (29).
5. Remove spring chamber (13), spring button (27), and range spring (28).
6. Draw second match mark on diaphragm case (14) flange in alignment with a match mark on the threaded end of the valve plug assembly (12) to indicate "free vertical movement" position of the valve plug assembly (12).
7. Secure the "flats" above the threaded end of the valve plug assembly (12) with adjustable wrench, remove pressure plate nut (24) by rotating CCW (viewed from above).

**NOTE:** Do not rotate the valve plug assembly (12). The plug (12.1) and seat rings (10 & 11) have been mechanically lapped at the factory per ANSI Class II seat leakage and assembled to provide optimum "free vertical movement".

8. Pry loose pressure plate (22) from diaphragm(s) (20). Inspect pressure plate to ensure no deformation due to over-pressurization. If deformed, replace. Remove o-ring (53).

**NOTES:** a. Not removing the pusher plate (17) or rotating the valve plug assembly (12) will provide performance equal to original factory performance when diaphragm(s) (20) is replaced with a like diaphragm(s) (20). Refer to Section VI.C, steps 12 and 13 for correct diaphragm setting if pusher plate (17) or stem lock nut (19) is removed, or valve plug assembly (12) is rotated.

b. Instructions hereafter will refer to: The -1+6 single diaphragm construction. (The -1+8 diaphragm construction is similar to the 1+6, with the exception of a second set of diaphragms, a body spacer (25) and a diaphragm spacer (26)). Instructions for **composition** soft diaphragm applies only to -1+6 option).

9. Remove diaphragm gasket (21) diaphragms (20) and pusher plate gasket (18). Clean gasket sealing surfaces thoroughly.
10. Apply Federal Process Co. PLS-2 (or equivalent) to both sides of pusher plate gasket (metal diaphragm only). For composition diaphragm, apply a 1/8" continuous bead of Dow/Corning RTV 732 (or equivalent) around the center hole on the underside of diaphragm.
11. Install new diaphragm gasket (21) on diaphragm case (14) flange and new pusher plate gasket (18) on pusher plate. **NOTE:** No gaskets utilized with a composition (soft) diaphragm).
12. Position new diaphragms (20) over threaded end of valve plug assembly (12). Align with bolt holes on diaphragm case (14). Install o-ring (53).
13. Ensuring that the curved outer rim side of the pressure plate (22) rests against the diaphragm (20) directly, place the pressure plate over threaded end of the valve plug assembly (12).
14. Apply Loctite 242 (or equivalent) to threads of pressure plate nut (24) and install pressure plate nut on threaded end of valve plug assembly (12) and tighten to a torque value of 75-80 Ft-lbs (101-108 Nm) for metal diaphragm, or 30-35 Ft-lbs (40-47 Nm) for composition diaphragm. Maintain alignment of match marks on the valve plug assembly (12) with second match mark on diaphragm case (14) flange. **NOTE:** Use two flange bolts (29) to keep multiple diaphragms' (20) bolt holes properly aligned while tightening pressure plate nut (24). **DO NOT USE FINGERS TO HOLD DIAPHRAGMS (20) DURING TIGHTENING OF PRESSURE PLATE NUT.**
15. Set range spring (28) on retainer hub of pressure plate (22).
16. Place multi-purpose, high temperature grease into depression of spring button (27) where adjusting screw (32) bears. Set spring button (27) on to range spring (28); ensure spring button (27) is laying flat.

Model	Diaphragm Material	Torque	Bolt Size
8310HP	ALL	45 ft-lbs (61 Nm)	5/8" Ø
8310LP	ALL	45 ft-lbs (61 Nm)	1/2" Ø

17. Aligning the match marks from B.3, place spring chamber (13) over the above stacked parts. Install all flange bolts (29) and flange nuts (30). Mechanically tighten bolting (29) (30) in a cross pattern that allows spring chamber (13) to be pulled down evenly. Recommended torque values are as follows:

**NOTE:** Never replace bolting (29) (30) with just any bolting, if lost. Bolt heads and nuts are marked with specification identification markings. Use only proper grades as replacements.

18. Reinstall adjusting screw (32) with lock nut (33) and closing cap.
19. To check for external leaks, spray liquid leak detector to test around bolting (29)(30), diaphragm case (14), and spring chamber (13) flanges for leakage. Ensure that an outlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 10-40 psig (.69-2.8 Barg) range spring at 25 psig (1.7 Barg) test pressure minimum.

#### C. Trim Inspection:

1. To inspect the internal trim parts, refer to Section VI.A. and B.1 through 9 for diaphragm replacement and proceed as follows.
2. Secure the "flats" on the threaded end of the valve plug assembly (12) with wrench, rotate the pusher plate (17) CCW to remove pusher plate and lower pressure plate (23). Rotate stem lock nut CCW to remove. **NOTE:** Do not rotate the valve plug assembly (12).
3. Draw or embed a match mark between body (1) and bottom flange (3).
4. Loosen and remove body stud nuts (8) CCW (viewed from bottom) to remove bottom flange (3). Inspect the bottom guide bushing (4) for excessive wear. If worn, both the guide bushing (4) and the bottom flange (3) must be replaced. **NOTE:** DO NOT REMOVE BONNET (2). The bonnet (2) acts as a guide to align the valve plug assembly (12) into the seat rings (10 and 11).
5. Firmly grasp end of the valve plug assembly (12) by hand and pull down and out of the body (1) cavity.
6. Inspect the seating surfaces of the plug (12) for nicks or excessive wear.
7. Using a flashlight or other light source, examine the interior of body (1) cavity. Also, inspect the seating

surfaces of both the upper and lower seat rings (10 and 11) for excessive wear. If either the plug (12) seats or the seat rings (10 and 11) are worn and in need of replacement, contact the factory for authorization to return unit for repair. **NOTE: Overhaul and replacement of trim parts is not easily accomplished by non-factory trained personnel.**

8. Remove the lower body gasket (6) and clean sealing surface thoroughly.
9. Install valve plug assembly (12) up through and into body (1). Place new body gasket (6) onto body.
10. Align match mark of C. 3 and replace bottom flange (3) on body (1). Reinstall flange stud nuts (8). Mechanically tighten nuts using an alternating cross pattern that allows the bottom flange to be pulled up evenly. Recommended torques values are as follows:

Regulator Size	Torque	Bolt Size
1-1/2" - 2" (DN32-50)	50 Ft-lbs (68 Nm)	1/2"
3" - 4" (DN80-100)	100 Ft-lbs (136 Nm)	5/8"

11. Fully thread stem lock nut (19) and pusher plate (17) on end of valve plug assembly (12). Refer to Figure 1 or 2 for correct orientation of the pusher plate (17).
12. Calibrate valve plug assembly (12) setting as follows:
  - a) Lift and hold valve plug assembly (12) up tight against the seats (10 and 11).
  - b) Adjust the pusher plate (17) so that the gasket surface face of the pusher plate (17) is 1/2 rotation below the case flange surface.

**NOTE: Option 1+8** - The gasket surface face of the pusher plate (17) should be flush with the top of the lower case flange surface.

  - c) Secure the "flats" milled on pusher plate and rotate the stem lock nut (19) up tight against the bottom of the pusher plate (17).
13. Grasp threaded end of valve plug assembly (12) by hand and ensure that the assembly moves freely by lifting the valve plug assembly (12) in and out of the seats (10 and 11). If it does not move freely, rotate valve plug assembly (12) CW until new position is found which allows optimum "free vertical movement" in and out of seats.
14. Proceed with diaphragm assembly instructions in accordance with Section IV.B., steps 10 through 19. **NOTE: Do not rotate valve plug assembly (12) from optimum "free vertical movement" position during final assembly.**



## SECTION VII

### VII. 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. Decrease regulator pressure drop; decrease inlet pressure by placing a throttling orifice in inlet piping union; 2-stage pressure drop by using with another regulator in series. A3. Install next step higher range spring. Contact factory. A4. Before replacing regulator, contact factory.
B. Worn plug/stem assembly; inadequate guiding.	B1. Contact factory.

#### 2. Leakage through the spring chamber vent hole.

Possible Causes	Remedies
A. Normal-life diaphragm failure.	A. Replace diaphragm.
B. Abnormal short-life diaphragm failure.	B1. Can be caused by excessive chattering. See No. 1. to remedy chatter. B2. Can be caused by corrosive action. Consider alternate diaphragm material. B3. For composition diaphragms, assure not subjecting to over-temperature conditions. B4. Downstream (outlet) pressure buildup occurring that overstresses diaphragms. Relocate regulator or protect with safety relief valve.

#### 3. Downstream pressure will not reach desired setting.

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. Incorrect range spring (screwing in CW of adjusting screw does not allow bringing pressure level up to proper level).	B. Replace range spring with proper higher range. Contact factory.
C. Too much droop.	C1. Review droop expected. C2. Contact factory.
D. Restricted diaphragm movement.	D. Ensure no moisture in spring chamber at temperatures below freeze point. Ensure no dust or debris entering vent opening. If rainwater or debris can enter, re-orient spring chamber.

#### 4. Excessive pressure downstream.

Possible Causes	Remedies
A. Regulator not closing tightly.	A. Inspect trim and plug alignment.
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 diaphragm movement.	D. Ensure no moisture in spring chamber at temperatures below freeze point. Ensure no dust or debris entering vent opening. If rainwater or debris can enter, re-orient spring chamber.

#### 5. Sluggish operation.

Possible Causes	Remedies
A. Plugged spring chamber vent.	A. Clean vent opening.
B. Fluid too viscous.	B. Heat fluid. Contact factory.

## SECTION VIII

### VIII. 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.

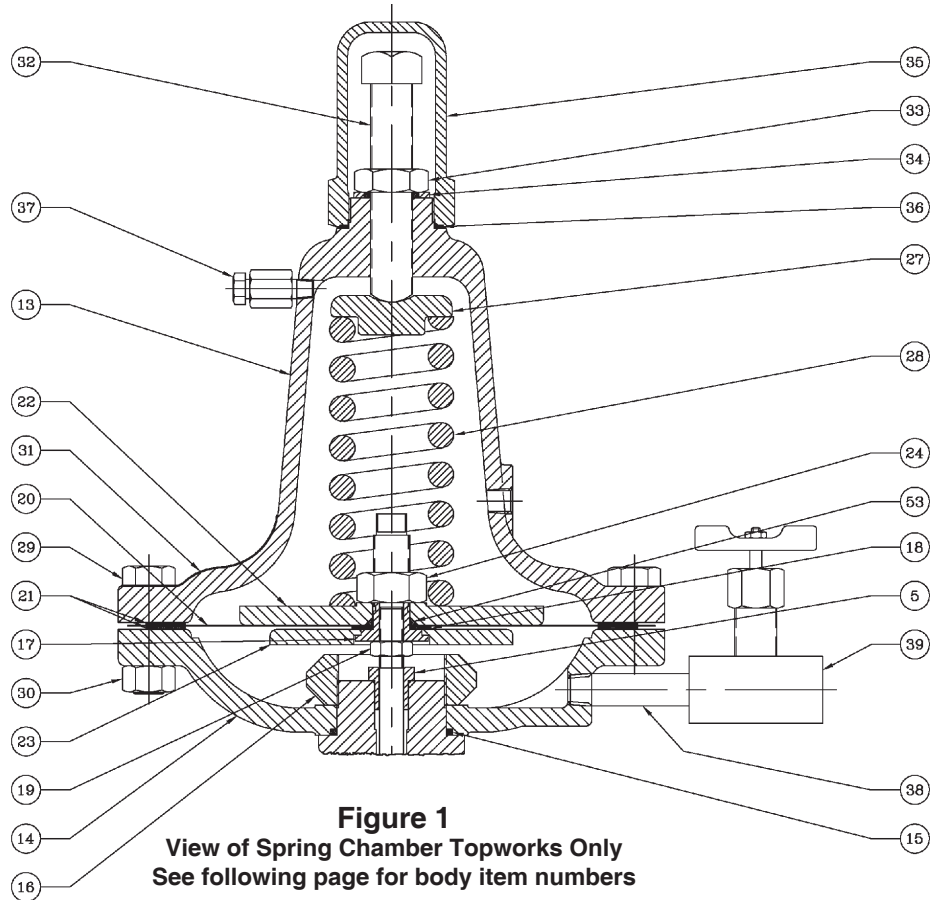
**NOTE:** *Those part numbers that have a quantity indicated under "Spare Parts" in column "A" reflect minimum parts required for inspection and rebuild, - "Soft Goods Kit". Those in column "B" include minimum trim replacement parts needed plus those "Soft Goods" parts from column "A".*

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.

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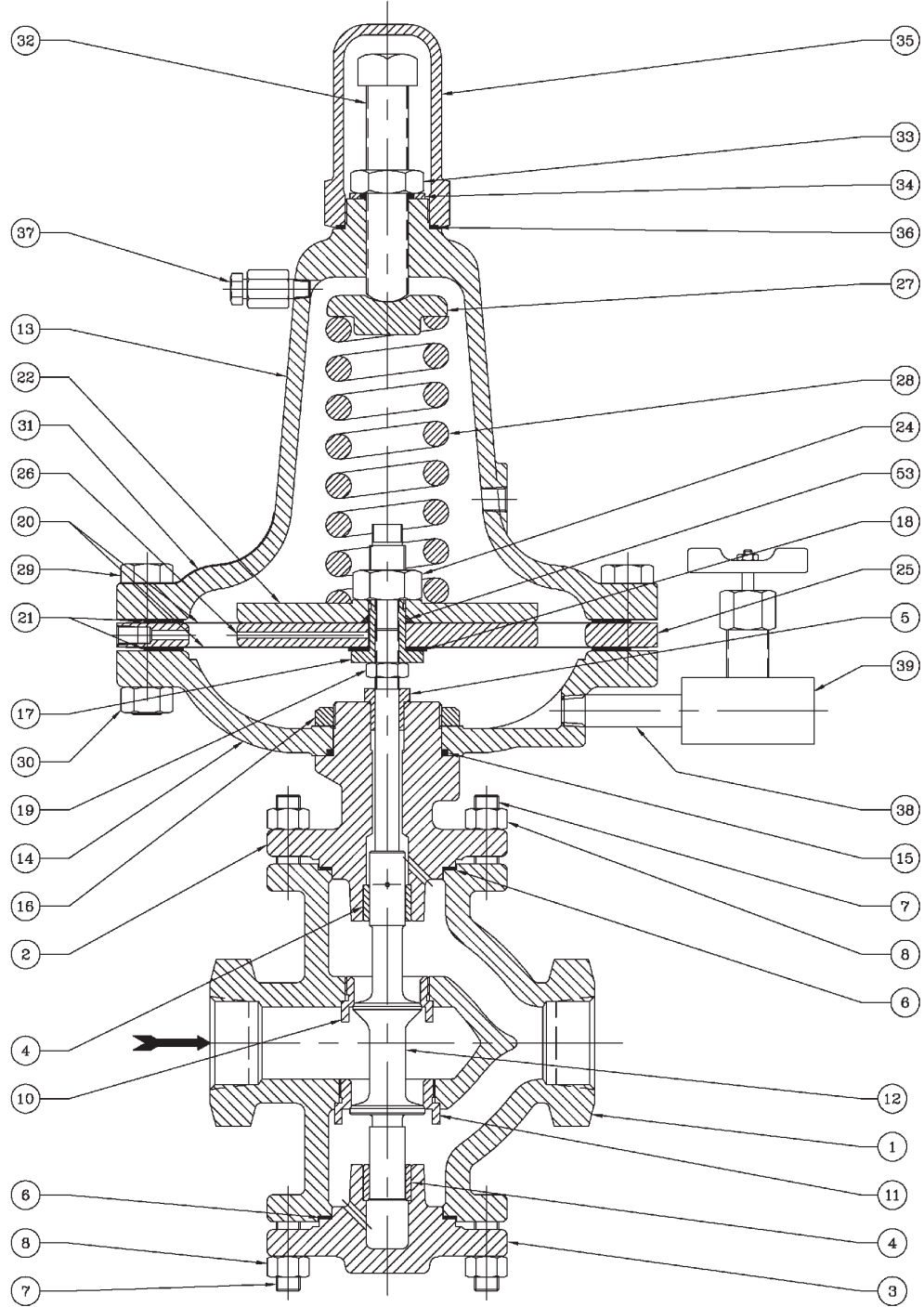
## MODEL 8310HP-1+6 Single Diaphragm Construction



Item No.	Description	Repair Kit A	Item No.	Description	Repair Kit A
1	Body		20	Diaphragm(s) ----- ‡	
2	Bonnet		21	Diaphragm Gasket ----- ‡	
3	Bottom Flange		22	Pressure Plate	
4	Guide Bushing		23	Lower Pressure Plate	
5	Stem Bushing		24	Pressure Plate Nut	
6	Body Gasket----- ‡		25	Body Spacer (8310HP 1+8)	
7	Body Stud		26	Diaphragm Spacer (8310HP 1+8)	
8	Body Stud Nut		27	Spring Button	
10	Upper Seat Ring		28	Range Spring	
11	Lower Seat Ring		29	Flange Bolt	
12	Valve Plug Assembly		30	Flange Nut	
12.1	Plug		31	Nameplate	
12.2	Stem		32	Adjusting Screw	
12.3	Pin (Groove)		33	Adjusting Screw Lock Nut	
13	Spring Chamber		34	Seal Washer	
14	Diaphragm Case		35	Closing Cap	
15	O-Ring ----- ‡		36	Closing Cap Gasket ----- ‡	
16	Bonnet Nut		37	Bleeder Valve	
17	Pusher Plate		38	Pipe Nipple	
18	Pusher Plate Gasket ----- ‡		39	Needle Valve	
19	Stem Lock Nut		53	O-ring	
‡	Recommended Spare Part				



**MODEL 8310HP-1+8**  
**Double Diaphragm Construction**



**Figure 2**

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. IOM-8310HP-Diff

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