MODELS D and DL
PRESSURE REDUCING REGULATORS

SECTION I

I. DESCRIPTION AND SCOPE

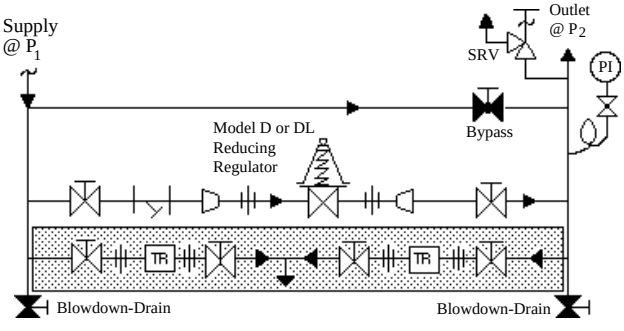
The Model D is a pressure reducing regulator used to control downstream (outlet or P_2) pressure. Sizes are 3/8" (DN10), 1/2" (DN15), 3/4" (DN20) and 1" (DN25). With proper trim utilization, the unit is suitable for liquid, gaseous, or steam service. Refer to Technical Bulletin D-TB for design conditions and selection recommendations.

The Model DL is also a pressure reducing regulator similar to above Model D. Sizes are 1-1/2" (DN40) and 2" (DN50). (Model DL was formerly a Cashco Model D). Refer to Technical Bulletin DL-TB for design conditions and selection recommendations.

SECTION II

II. INSTALLATION

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.



(Shaded portion for steam/condensate systems)

Recommended Piping Schematic
For Pressure Reducing Station

⚠ CAUTION

DO NOT HYDROSTATIC TEST THRU AN INSTALLED UNIT; ISOLATE REGULATOR FROM TEST. The upper range spring pressure level listed on the nameplate or 100 psig (6.9 Barg) minimum is the recommended "upper operative limit" for the sensing diaphragm (see Section IV. Startup, 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.

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 engagement, 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 arrow cast on the body.
9. For best performance, install in well drained horizontal pipe, properly trapped, if a steam service application.

10.A. *Basic Regulator* - (Refer to Figure 3): 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.

10.B. *Model D Cryogenic Regulator* - Option D-5 or D-36 (Refer to Figure 4):

a. Recommended installation is with spring chamber hanging directly below the body in a vertical downwards orientation. Allows water to drain; i.e. rainwater, et cetera.

b. Recommend inert purge gas to spring chamber thru vent hole and out drain hole.

11. Regulators are not to be direct buried underground.

12. For insulated piping systems, recommendation is to not insulate regulator.

13. Spring Chamber Vent Tap - Option D-25 or DL-25: Pipe spring chamber vent opening to remote location. Orient so as not to take on rainwater.

SECTION III

III. PRINCIPLE OF OPERATION

1. Movement occurs as pressure variations register on the diaphragm. The registering pressure is the outlet, P_2, or downstream pressure. The range spring opposes diaphragm movement. As outlet pressure drops, the range spring pushes the diaphragm down, opening the port; as outlet pressure increases, the diaphragm pushes up and the port opening closes.

2. A complete diaphragm failure will cause the regulator to fail open.

SECTION IV

IV. STARTUP

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 the range spring by turning the adjusting screw counter clockwise (CCW) a minimum of three (3) full revolutions. This reduces the outlet (downstream) pressure set point.

3. If it is a “hot” piping system, and equipped with a bypass valve, slowly open the bypass valve to pre-heat 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.*

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 adjusting screw clockwise (CW) 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, and reset the regulator set point by turning the adjusting screw CW to increase outlet pressure, or CCW to reduce outlet pressure.

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 by greater than 10%; i.e. 10-40 psig (.69 - 2.76 Barg) range spring, at low flow the outlet pressure should not exceed 44 psig (3 Barg), if it does, consult factory.

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 shutdown, 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 nonreuseable parts, i.e. gaskets, etc.
3. Refer to Figure 3 for basic regulator. Refer to Figure 4 for cryogenic regulator. For blow-ups of the composition seat trim, refer to Figure 2.

B. Diaphragm Replacement:

1. Securely install the body (1) in a vise with the spring chamber (2) directed upwards.

⚠ WARNING

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

2. Relax range spring (14) by turning adjusting screw (6) CCW until removed from spring chamber (2). ***NOTE:*** *If the D-3 Option handwheel is utilized, the adjusting screw (6) and locknut (7) are replaced respectively by handwheel adjusting screw (20) and locking lever (21). Refer to Figure 1.*
3. Draw or embed a match mark between body casting (1) and spring chamber casting (2) along flanged area.
4. Remove all diaphragm nuts (9) and bolts (8).
5. Remove spring chamber (2), range spring (14), spring button (4), pressure plate (3) and diaphragm(s) (12). ***NOTE:*** *Refer to the quantity of diaphragms (12) incorporated per the bill of materials listing. Depending on outlet pressure level, multiple metal diaphragms may be "stacked".*
6. Remove pusher plate (11) and inspect for a fit which limits its travel to a vertical direction. Wear will show as excessive wobble in pusher plate (11). If apparent, recommend trim removal and inspection; go to Sub-Section C following. Reinstall pusher plate (11).
7. Inspect pressure plate (3) to ensure no deformation due to over-pressurization. If deformed, replace.
8. Clean body (1) and diaphragm flange. ***NOTE:*** *On valves originally supplied as "oxygen clean", Option D-5, D-36, D-55, or DL-55, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1134. On regulators originally supplied as "cleaned for Pharmaceutical and Food applications" Option D-37 or D-37S, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1576.*
9. Place diaphragm gasket (13) on body (1) flange. Position diaphragm(s) (12) into place. Visually center pressure plate (3) onto diaphragm(s) (12), and set range spring (14) onto retainer hub of pressure plate (3). ***NOTE:*** *No diaphragm gasket (13) for composition diaphragm.*

10. Place multi-purpose, high temperature grease into depression of spring button (4) where adjusting screw bears. Set spring button (4) onto range spring (14); ensure spring button (4) is laying flat.

11. Aligning the matchmarks, place spring chamber (2) over the above stacked parts. Install all bolts (8) and nuts (9) by hand tightening. Mechanically tighten bolting (8 & 9) in a cross pattern that allows spring chamber (2) to be pulled down evenly. Recommended torques are as follows:

Model	Regulator Size	Bolt Size	Metal Diaphragm	Comp. Diaphragm
D	3/8" thru 1" (DN10 thru 25)	5/16"-24	20-24 Ft-Lb (27-32 N-m)	16-20 Ft-Lb (22-27 N-m)
DL	1-1/2" (DN40)	7/16"-20	32-36 Ft-Lb (43-49 N-m)	28-32 Ft-Lb (38-43 N-m)
	2" (DN50)	1/2"-20	42-48 Ft-Lb (57-65 N-m)	32-36 Ft-Lb (43-49 N-m)

***NOTE**: Never replace bolting (8 & 9) with just any bolting if lost. Bolt heads and nuts are marked with specification identification markings. Use only proper grades as replacements.*

12. Reinstall adjusting screw (6) with locknut (7).

13. Soap solution test around bolting (8 & 9) and body (1) and spring chamber (2) 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 - 2.76 Barg) range spring, 25 psig (1.72 Barg) test pressure minimum.

C. Trim Replacement:

1. Install body (1) in a vise with the body cap (5) on top and the body (1) flange downwards.

2. Loosen body cap (5) with a hex head wrench with a lever length of at least 15 inches. The wrench should be rapped with a hammer to loosen. Remove body cap (5).

3. Remove piston spring (17), piston (15 or 15.2), cylinder (16 or 15.1) and pusher plate (11). Inspect parts for excessive wear, especially at seat surfaces. Replace if worn, nicked or depressed. (Valves equipped with Opt-4 Stabilizer will have u-cup stabilizer seal (32) removed when piston (15 or 15.2) is removed from body (1). Remove stabilizer seal (32), if installed).

4. Remove the cylinder gasket (18) and clean contacting surface of body.

5. Clean flat mating surfaces of body (1) to body cap (5) shoulder.

6. Clean debris from within body (1) cavity. Clean parts to be reused.
***NOTE:** On regulators originally supplied as "oxygen clean", Option D-5 , D-36, D-55, or DL-55, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1134. On regulators originally supplied as "cleaned for Pharmaceutical and Food applications", Option D-37 or D-37S, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1576. Contact factory for details.*

7. Reinstall a new cylinder gasket (18). Press firmly and evenly into place using the cylinder (16 or 15.1). Do not use "homemade" cylinder gasket. Pipe sealant may be lightly coated to the gasket surfaces prior to installation, except when utilized as Item 6 above.

8. Reinstall the pusher plate (11). Ensure proper position of flat surface being downwards. Ensure centered.

9. If supplied with Opt-4 Stabilizer, install new stabilizer seal (32) properly oriented onto piston (15 or 15.2). See Figures 2 and 5.

10. Reinstall the cylinder (16 or 15.1) concentrically within the body cap (5) opening.

11. Slide the piston (15 or 15.2), including stabilizer seal (32) if supplied, slowly into place, assuring that the piston (15 or 15.2) post slides into the female groove of the pusher plate (11). Use thumbs to ease stabilizer seal (32) into cylinder (16 or 15.1).

12. Place piston spring (17) into piston (15/15.2) cavity.

13. Use pipe thread sealant applied to the body cap (5) threads. Screw body cap (5) into body (1). When body cap (5) is fully down against body (1) at the body cap (5) shoulder, use the wrench with 15" lever handle and a hammer to impact the body cap (5) into the body (1) ***NOTE:** Metal to metal seal between body cap (5) and body (1).*

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

15. Soap solution test around body cap (5) and body (1) for leakage. Test pressure should be a minimum of 100 psig (6.9 Barg) at the inlet. Outlet should be tested to upper value of range spring with a 100 psig (6.9 Barg) minimum.

***NOTE**: When piston (15) assemblies are used with comp seats, Cashco, Inc. does not recommend attempting to remove the comp seat. If composition seat is damaged, replace entire piston assembly.*

SECTION VII

VII. TROUBLE SHOOTING GUIDE

1. Erratic operation; chattering.

Possible Causes	Remedies
A. Oversized regulator.	A1. Check actual flow conditions, resize 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. A4. Before replacing regulator, contact factory.
B. Inadequate rangeability (regulator full capacity approximately 50% utilized).	B1. 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. B2. Install next step higher range spring.
C. Worn piston/cylinder; inadequate guiding.	C. Replace trim.
D. Weakened/broken piston spring.	D. Replace piston spring. Determine if corrosion is causing the failure; if so, then consider alternate trims.
E. Flow induced instability.	E. Replace piston with piston that includes Opt-4 Stabilizer seal.

2. 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, resize regulator; if regulator has inadequate capacity, replace with larger unit.
B. Plugged trim.	B. Remove trim and check for plugged holes in cylinder.
C. Incorrect range spring (screwing in CW of adjusting screw does not allow bringing pressure level up to proper level).	C. Replace range spring with proper higher range.
D. Too much proportional band (droop).	D1. Review P.B. (droop) expected. D2. Contact factory.
E. Restricted diaphragm movement.	E. 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.

3. 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, ensure not subjecting to over-temperature conditions. B4. Downstream (outlet) pressure buildup occuring that overstresses diaphragms. Relocate regulator or protect with safety relief valve.

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 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. Plugged piston balance port.	B. Remove trim and clean balance port.
C. Fluid too viscous.	C. Heat fluid. Contact factory.

SECTION VIII

VIII. PARTS ORDERING INFORMATION

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

METHOD A - USE OF PRODUCT CODE.

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

□□□-□□□7-□□□□□□□□□□

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

Step 2. Identify which kits or parts are desired from the following:
a. The Bill of Materials sheet attached herein, or refer to the cross-sectional drawings.
b. Standard maintenance parts for a basic regulator (no options) are included in the Parts Kit Number table on Page 7. Kit “A” contains seal(s), diaphragm(s) and gasket(s). Kit “B” contains trim replacement parts plus seal(s), diaphragm(s) and gasket(s).

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

METHOD B - NO PRODUCT CODE AVAILABLE - DISASSEMBLED REGULATOR.

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

Step 2. Determine construction of trim.
a. Metal or composition (soft) seat?
b. Is 316 SST needed over standard 416 SST?
c. What material are the gaskets? (Our standard non-asbestos is reddish-brown in color, and TFE is white.)

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

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

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

Step 2. Contact your local Cashco, Inc., Sales Rep with the above information.

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

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

MODEL D PARTS KIT NUMBERS

(Kit Nos. Shaded)

The shaded parts kits numbers below represent an abbreviated identification number for a basic regulator. Opt-4 Stabilizer is NOT included in kits below (no other options included). Order stabilizer seal by numbers below.

Trim Desig. No.	Kit Abbre.	SIZE			
		3/8" & 1/2" (DN10 & 15)	3/4" & 1" (DN20 & 25)	1-1/2" (DN40)	2" (DN50)
BO & B5	A	2B3-AB0K-B	2B5-AB0K-B	2H8-AB0K-A	2H9-AB0K-A
BO	B	2B3-BB0K-B	2B5-BB0K-B	2H8-BB0K-A	2H9-BB0K-A
B2 & S4	A	2B3-AB2K-B	2B5-AB2K-B	2H8-AB2K-A	2H9-AB2K-A
B2	B	2B3-BB2K-B	2B5-BB2K-B	2H8-BB2K-A	2H9-BB2K-A
B5	B	2B3-BB5K-B	2B5-BB5K-B	2H8-BB5K-A	2H9-BB5K-A
S1, S2 & S36	A	2B3-AS1K-B	2B5-AS1K-B	2H8-AS1K-A	2H9-AS1K-A
S1	B	2B3-BS1K-B	2B5-BS1K-B	2H8-BS1K-A	2H9-BS1K-A
S2	B	2B3-BS2K-B	2B5-BS2K-B	2H8-BS2K-A	2H9-BS2K-A
S4	B	2B3-BS4K-B	2B5-BS4K-B	2H8-BS4K-A	2H9-BS4K-A
S36	B	2B3-B36K-B	2B5-B36K-B	—	—
MODEL No.		MODEL D		MODEL DL	
32-Stabilizer Seal		P/N 785-89-5-09014-00	P/N 785-89-5-09018-00	N/A	

*COLOR-CODED SPRING CHART

STEEL PLATED SPRING				
Range Spring psig	Regulator Size			
	3/8" - 1/2"	3/4" - 1"	1-1/2"	2"
2-15	830-69-5-00101-95 (RED)	830-69-5-00107-95 (RED)	830-69-5-00108-95 (RED)	830-69-5-00115-95 (RED)
10-40	830-69-5-00103-95 (BLUE)	830-69-5-00109-95 (BLUE)	830-69-5-00110-95 (BLUE)	830-69-5-00119-95 (WHITE)
30-80	830-69-5-01160-95 (DARK GREEN)	830-69-5-01161-95 (DARK GREEN)	830-69-5-00113-95 DARK GREEN)	830-69-5-01163-95 (LIGHT BLUE)
70-150	830-H2-5-01180-95 (WHITE)	830-H2-5-01181-95 (WHITE)	830-L2-5-00113-95 (WHITE)	830-L2-5-01183-95 (BROWN)
Model No.	Model D		Model DL	

NOTE: *If it becomes necessary to change a regulator's range spring and install a new spring for a different pressure range, a NEW CASHCO, INC. NAMEPLATE MUST BE AFFIXED TO THE REGULATOR. Contact your local Cashco, Inc. Sales Representative, specify the new pressure range and the serial number off the existing name plate. They will contact the factory who will review the unit's original internal construction, determine new operating pressure limits and if additional parts are required, advise. Await the Sales Representative's return contact with the proper part numbers and cost.*

Item No.	Description
2	Spring Chamber
15	Piston - Comp
16	Cylinder-Comp
20	Handwheel Assembly
21	Handwheel Locking Lever
32	Stabilizer Seal

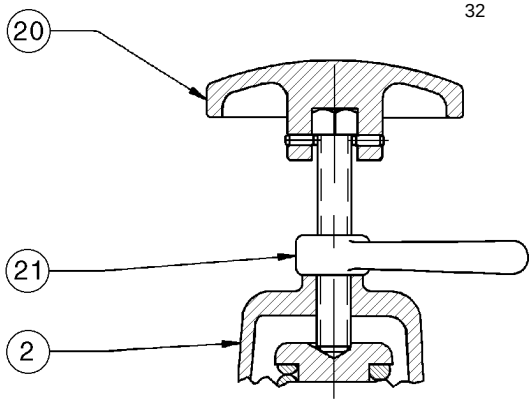


Figure 1: Option D-3 or DL-3 - Handwheel and Locking Lever

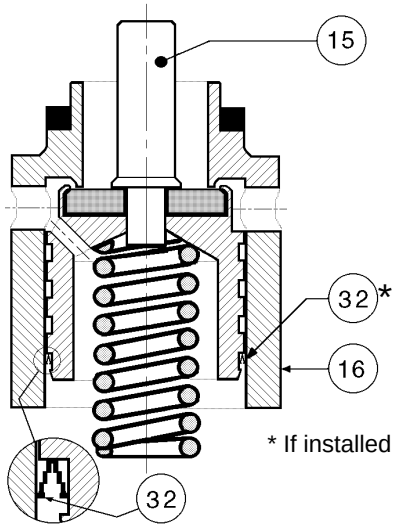


Figure 2: Option-4 - Stabilizer Composition Seat

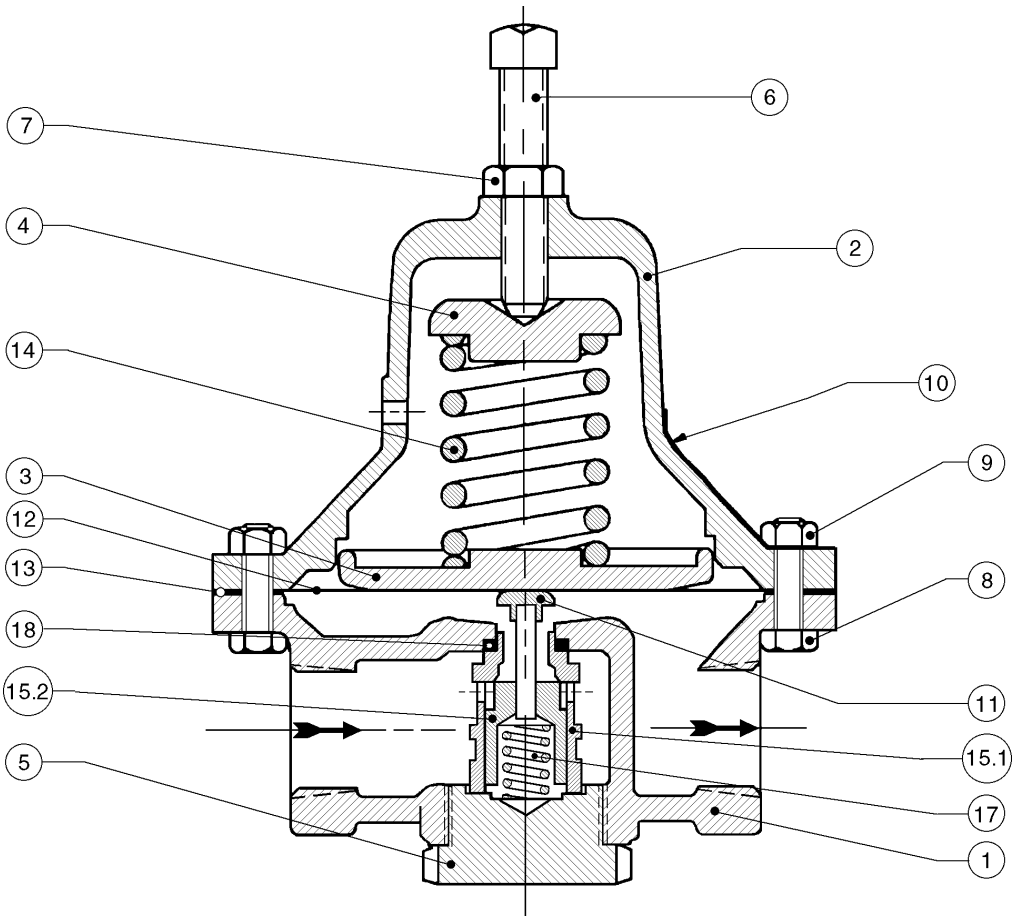


Figure 3: Basic Model D - Metal Seat

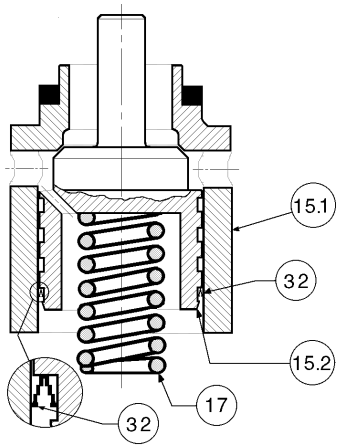


Figure 5: Option-4 Stabilizer Metal Seat Design

Item No.	Description
1	Body
2	Spring Chamber
3	Pressure Plate
4	Spring Button
5	Body Cap
6	Adjusting Screw
7	Nut (hex Jam)
8	Cap Screw (Flange Bolting)
9	Nut (Hex) (Flange Bolting)
10	Name Plate
11	Pusher Plate
12	Diaphragm
13	Diaphragm Gasket
14	Range Spring
15	Piston - Comp
15.1	Cylinder-metal
15.2	Piston-metal
16	Cylinder-Comp
17	Piston Spring
18	Cylinder Gasket
32	Stabilizer Seal

Not Shown:

27	Gauge
28	Bushing

NOTE: *Mount in horizontal line with adjusting screw down (as shown).*

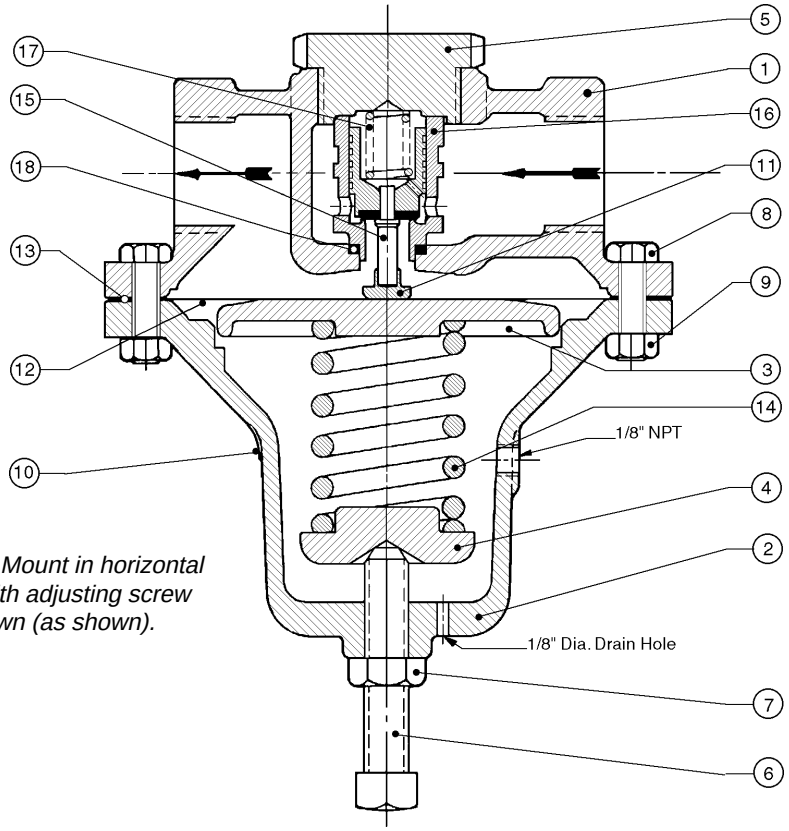


Figure 4: Option D-5 or D-36 Cryogenic Model D Composition Seat Design

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