MODELS 3381 AND 4381

PRESSURE REDUCING REGULATORS

SECTION I

I. DESCRIPTION AND SCOPE

Models 3381 and 4381 are pressure reducing regulators used to control downstream (outlet or P_2) pressure. Sizes are 1/4" and 3/8" (DN8 and DN10). The 3381 is a bronze bodied unit; the 4381 incorporates a stainless steel body. With proper trim utilization, both units are suitable for liquid, gaseous and steam service (the 4381 can also be used with various chemicals). Refer to Technical Bulletins 3381-TB and 4381-TB for specific design conditions and selection recommendations.

The instructions in this manual will refer to both models, unless otherwise stated.

SECTION II

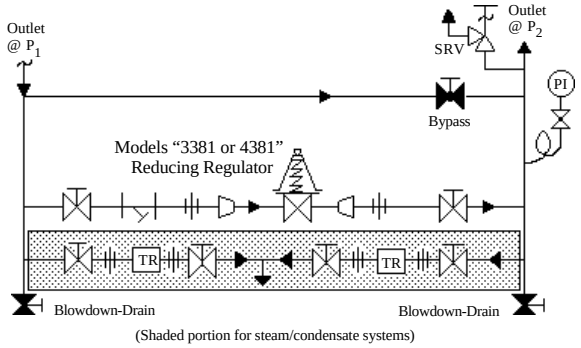
II. INSTALLATION

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.

⚠ WARNING

The maximum outlet pressure is listed on the nameplate as the upper range spring pressure level, and is the recommended "upper operative limit" for the sensing diaphragm (see Section IV. Startup, Number 7). Higher pressures could damage the diaphragm. (Field hydrostatic tests frequently destroy diaphragms. DO NOT HYDROSTATIC TEST THRU AN INSTALLED UNIT; ISOLATE FROM TEST.)

6. Clean the piping of all foreign material including chips, welding scale, oil, grease and dirt before installing the regulator. Strainers are recommended.



Recommended Piping Schematic
For Pressure Reducing Station

7. In placing thread sealant on pipe ends prior to engagement, assure 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 main regulator 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 1, Model 3381 or 4381): 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.

10.B. Cryogenic Regulator - Options 3381-5 and 4381-36 (Refer to Figure 2, Model 3381 or 4381):

a. Recommended installation is with spring chamber hanging directly below the body in a vertical downwards orientation. Allows water to drain; etc.
b. Recommend inert purge gas to spring chamber through 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.

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. Assure proper steam trap operation if installed. Closely monitor outlet (downstream) pressure via gauge to assure 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. 20-80 psig (1.38-5.52 Barg) range spring, at low flow the outlet pressure should not exceed 88 psig (6.07 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 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 nonreuseable parts, i.e. gaskets, etc.
3. Refer to Figure 1, Model 3381 or 4381 for the basic regulator and Figure 2, Model 3381 or 4381 for the cryogenic regulator. Blow-ups of options and the composition seat trim are on either drawing.

B. Diaphragm Replacement - Model 3381:

CAUTION

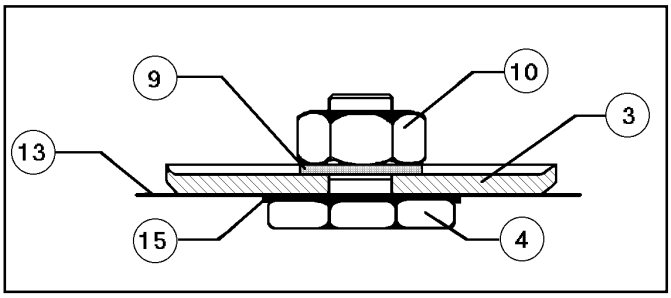
To prevent damage to body, use lead jaws when placing body in a vise. Position so that vise closes over inlet and outlet of the body.

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

WARNING

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

2. Relax range spring (17) by turning adjusting screw(8) CCW until removed from spring chamber (2).
3. Loosen spring chamber (2) by placing wrench on “flats” and rotating CCW making sure **not** to use the flat where the vent hole is located.
4. Remove spring chamber (2), range spring (17), spring button (5) and diaphragm gasket (14), (if metal diaphragms are used, there will be one diaphragm gasket (14) on top and one below the diaphragm(s). If composition diaphragm is used, there will be only one diaphragm gasket (14), above the diaphragm (13).
5. Remove the diaphragm subassembly consisting of the pressure plate nut (10), lock washer (9), pressure plate (3), diaphragm (13), pusher plate gasket (15) and pusher plate (4). ***NOTE:*** *Refer to the quantity of diaphragms (13) incorporated per the bill of materials listing. Depending on outlet pressure level, multiple metal diaphragms may be “stacked”.*



Diaphragm Subassembly

6. Loosen pusher plate nut (10) and separate all parts (3, 4, 9, 13 & 15) of the diaphragm subassembly.
7. Inspect pressure plate (3) to assure no deformation due to over-pressurization. If deformed, replace.
8. Remove diaphragm(s)(13), and diaphragm gasket(s) (14).
9. Clean body (1) and diaphragm flange. Do not scratch diaphragm gasket seating surface. ***NOTE:*** *On regulators originally supplied as “oxygen clean”, Option s 3381-5 & -55, 4381-36 & -55, maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1134. For regulators originally supplied as “cleaned for Pharmaceutical and Food applications” Options 4381-37 and 4381-37S, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1576. Contact factory for details.*
10. Reassemble diaphragm subassembly by placing pusher plate gasket (15) over threaded post of pusher plate (4), placing diaphragm(s)(13) and pressure plate (3) over the threaded post. Assure the pressure plate (3) is placed with curved outer rim down next to the diaphragm (13) surface. Place a thread sealant compound on the threads of the

pusher plate post (4) prior to tightening the pusher plate nut (10) to the following torques:

Sizes	Diaphragm	Torque
ALL	Metal	60 in/#
	Composition	15 in/#

11. For metal diaphragm(s)(13), place lower diaphragm gasket (14) into body (1) recess (none required for composition diaphragm (14)). Insert diaphragm subassembly into the body (1). Place upper diaphragm gasket (14) into recess of body (1).

12. Place the range spring (17) over the pusher plate nut (10) of the diaphragm subassembly.

13. Place multi-purpose, high temperature grease into depression of spring button (5) where adjusting screw bears. Set spring button (5) onto range spring (17); assure spring button is laying flat.

14. Rotate the spring chamber (2) CW by hand into the threaded portion of the body (1) assuring not to cross thread. Continue hand rotating CW until firmly seated against the upper diaphragm gasket (14). Wrench tighten to 30-35 ft-lbs torque.

15. Reinstall adjusting screw (8) with locknut (11) into the spring chamber.

16. Pressurize with air and soap solution test around body (1) and spring chamber (2) for leakage. Assure that an outlet pressure is maintained during this leak test of at least mid-range spring level; i.e. 20-80 psig range spring, 50 psig test pressure minimum.

C. Diaphragm Replacement - Model 4381:

1. Procedures are the same as Model 3381, except that the 3381's lower diaphragm flat gasket (14) is replaced with an O-ring type gasket. The O-ring diaphragm gasket is used with both metal and composition diaphragms.

2. For SST body (1) and SST spring chamber (2), place thread lubricant to minimize potential of seizing threads.

D. Special Instructions for Diaphragm Removal:

1. If the TFE coated diaphragm is utilized on the Model 4381, the TFE coating is the wetted side of the diaphragm.

2. If the Option-2 handwheel is utilized, the adjusting screw (8) and locknut (11) are replaced with a knob (18) and lock nut (11). With the Option-22 panel mounting w/handwheel, the adjusting screw and lock nut are replaced with a knob (18), lock nut (11) and a panel mounting nut (19).

3. Use only those gaskets manufactured and supplied by Cashco, Inc. for these products.

E. Trim Replacement:

CAUTION

To prevent damage to body, use lead jaws when placing body in a vise. Position so that vise closes over inlet and outlet of the body.

1. Install body (1) in a vise with the body cap (6) on top and the spring chamber (2) downwards.

2. Loosen body cap (6) 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.

3. Remove piston spring (7), and piston (16). Note that the seat and piston (16) guide are integral parts of the body casting. Inspect integral seat and parts for excessive wear, especially at seat surfaces. Replace if worn, nicked or depressed. If integral seat is nicked, use seat lapping compound to remove.

4. Clean flat mating surfaces of body (1) to body cap (6) shoulder. Be careful not to scratch either surface.

5. Clean debris from within the body (1) cavity. Clean parts to be reused. ***NOTE:*** *On valves originally supplied as "oxygen clean", Options 3381-5 & -55, 4381-36 & 55 maintenance must include a level of cleanliness equal to Cashco's cleaning standard #S-1134. For regulators originally supplied as "cleaned for Pharmaceutical and Food applications" Options 4381-37 and 4381-37S, maintenance must include a level of cleanliness equal to Cashco cleaning standard #S-1576. Contact factory for details.*

6. Place the piston (16), stem first, into the body cap (6) cavity.

7. Place piston spring (7) over spring hub of the piston (16).

8. Apply pipe thread sealant to the body cap (6) threads. Screw body cap (6) into body (1). When body cap is fully down against body (1) at the body cap (6) shoulder, use a wrench

with 15" lever handle and a hammer to impact the body cap (6) into the body (1).

9. 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.

10. Pressurize with air and soap solution test around body cap (6) and body (1) for leakage. Test pressure should be a minimum of 100 psig at the inlet.

CAUTION

When piston (16) assemblies are used with composition seats, Cashco, Inc. does not recommend attempting to remove the composition seat, as it is retained by the piston's post being force pressed into the lower cylinder section, and the outer (OD) edge of the composition seat is retained by the piston's thinned wall being forcefully crimped into the composition seat material (bent over and into).

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. Increase flow rate. A3. Decrease regulator pressure drop; decrease inlet pressure by placing a throttling orifice in inlet piping union. A4. Install next step higher range spring. A5. Before replacing regulator, contact factory.
B. Worn piston; inadequate guiding.	B. Replace trim (possible body replacement).
C. Weakened/broken piston spring.	C. Replace piston spring. Determine if corrosion is causing the failure.

2. Regulator can't 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. 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.
C. Too much droop.	C1. Review droop expected. C2. Contact factory.

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

4. Sluggish operation.

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

5. 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. Assure no moisture in spring chamber at temperatures below freeze point. Assure no dust or debris entering vent opening. If rainwater or debris can enter, re-orient regulator.

SECTION VIII

VII. 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. Models 3381 and 4381 require only one kit - Kit B, which consists of diaphragms, gaskets and piston.

Step 3. Contact your local Cashco, Inc. Sales Representative and specify the product code number, Kit "B" designation/number, and any part numbers not included in Kit B. Costs of required parts 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.
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. Metal or composition (soft) diaphragm?
c. Is a TFE coated SST diaphragm utilized?
d. What material are the gaskets? (Our standard non asbestos is light gray in color, asbestos is a very dark gray, 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 regulator 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.

PARTS KIT NUMBERS
(KIT NOS. SHADED)

The shaded parts kits numbers below represent an abbreviated identification number for a basic regulator (no options) with the most commonly used trims.

Model	Trim Desig.No.	Kit Abbr.	Size 1/4" & 3/8" (DN8 & DN10)
3381	B0	**B**	**6B2-BB0K-A**
	B2	**B**	**6B2-BB2K-A**
	B5	**B**	**6B2-BB5K-A**
4381	S1	**B**	**MB2-BS1K-A**
	S36	**B**	**MB2-B36K-A**

MODELS 3381/4381
COLOR-CODED SPRING CHART

Size	Standard Unit Steel Plated Spring	
	Range Spring psig	Part Number/Color
ALL	5-30	830-69-5-01350-95 (Green)
	20-80	830-69-5-01351-95 (Dark Green)
	70-140	830-69-5-01352-95 (Brown)
	130-200	830-H2-5-01353-95 (Navy)
	190-300	830-M5-5-01354-95 (Maroon)
	[1]270-400	830-69-5-01361-95 (Turquoise)
	[1]360-500	830-69-5-01362-95 (Purple)

[1]Utilize on Model 4381 only.

***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 and specify the new pressure range and the serial number off the existing nameplate. They will contact the factory who will review unit's original internal construction and determine new operating pressure limits. Await the Sales Representative's return contact with the proper part numbers.*

MODEL 3381

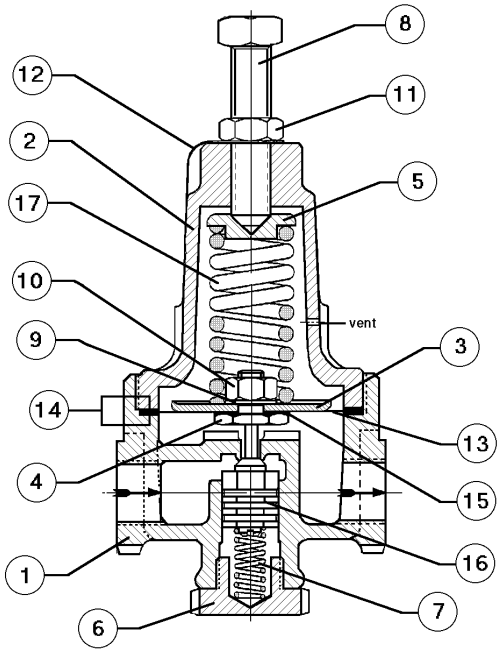
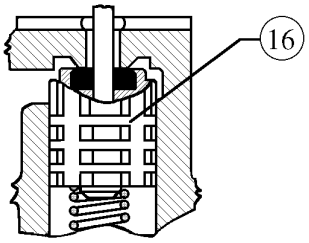
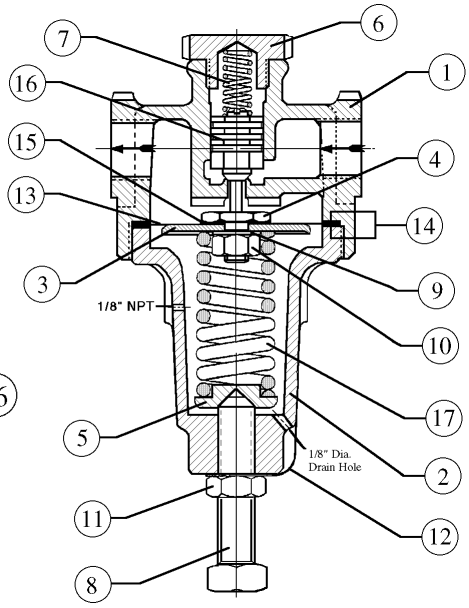


Figure 1: Basic Model 3381 with Metal Seat Design

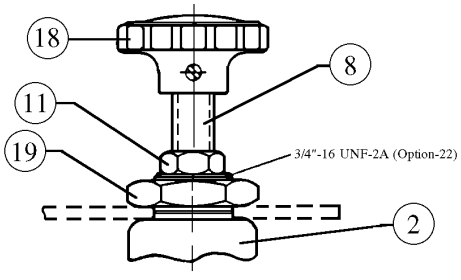


Composition Seat Design

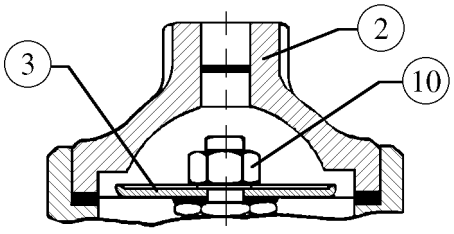


*(**NOTE:** Mount in Horizontal line with Adjusting Screw down as shown.)*

Figure 2: Option-5 Cryogenic Model 3381, Metal Seat Design



Option-22 Panel Mounting (handwheel portion is same for Option-2 Handwheel)



Option-20, Dome Loaded

Item No.	Description
1	Body
2	Spring Chamber
3	Pressure Plate
4	Pusher Plate
5	Spring Button
6	Body Cap
7	Piston Spring
8	Adjusting Screw or Handwheel Assy.
9	Lock Washer
10	Pressure Plate Nut
11	Adjusting Screw Locknut
12	Nameplate
13	Diaphragm
14	Diaphragm Gasket(s)
15	Pusher Plate Gasket
16	Piston & Piston Subassembly
17	Range Spring
18	Knob
19	Mounting Nut

MODEL 4381

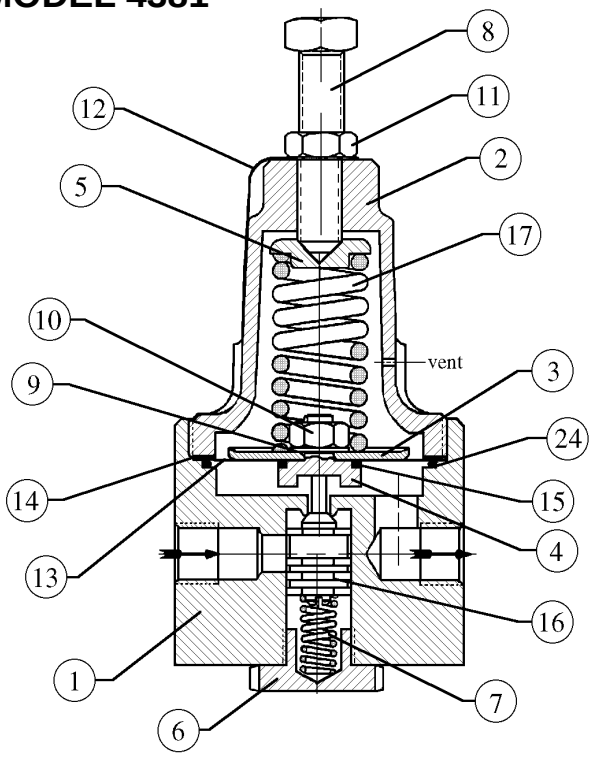
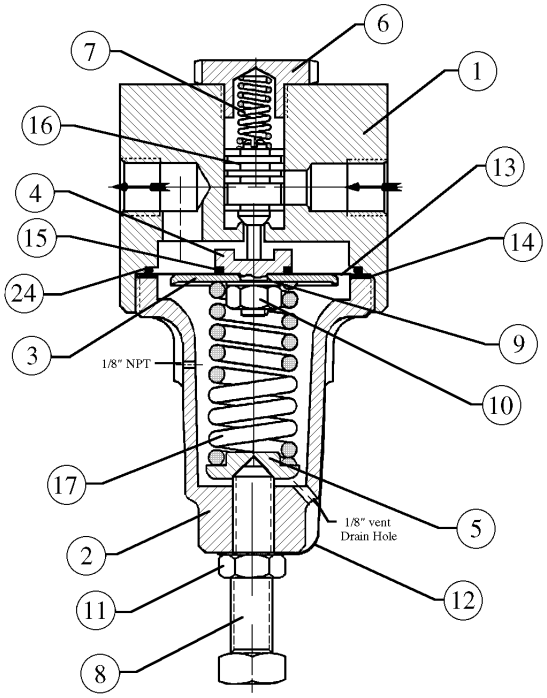


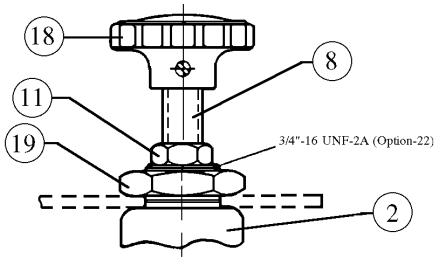
Figure 1: Basic Model 4381, Metal Seat Design



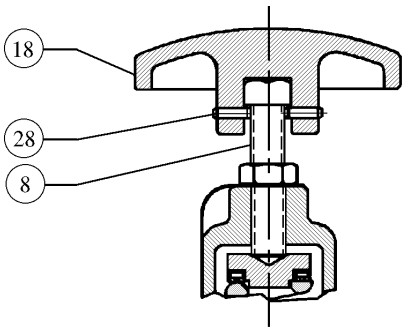
***(NOTE:** Mount in Horizontal line with Adjusting Screw down as shown.)*

Figure 2: Option -36 Cryogenic Model 4381, Metal Seat Design

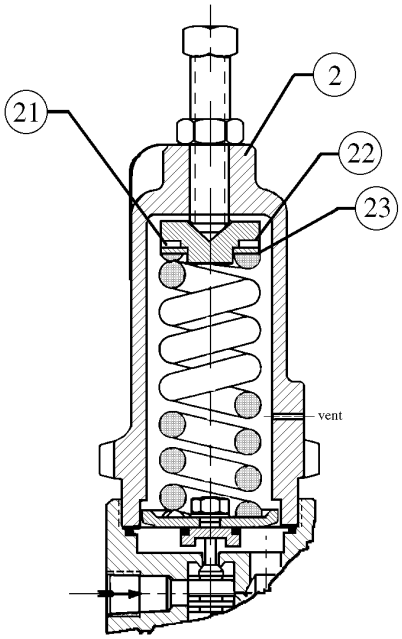
Item No.	Description
1	Body
2	Spring Chamber
3	Pressure Plate
4	Pusher Plate
5	Spring Button
6	Body Cap
7	Piston Spring
8	Adjusting Screw or Handwheel Assy.
9	Lock Washer
10	Pressure Plate Nut
11	Adjusting Screw Locknut
12	Nameplate
13	Diaphragm
14	Diaphragm Gasket
15	Pusher Plate Gasket
16	Piston & Piston Subassembly
17	Range Spring
18	Handwheel
19	Mounting Nut
21	Thrust Bearing
22	Upper Bearing Washer
23	Lower Bearing Washer
24	Diaphragm O-ring
28	Spring Pin



Option-22 Panel Mounting (handwheel portion is same for Option-2 Handwheel). Option-22 **NOT** available with Option-80.



Option-2+80 Handwheel
(**NOT** available with Option-22)



Option-80, High Pressure Spring Chamber Construction

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