GE Oil & Gas

VRP-SB-GAP

Pneumatic On-Off Pressure Controller

Maintenance and Operation Manual

GE Data Classification : Public

Table of Contents

Technical Specifications

Control Pressure Range
1 inch of water column - 1500 psig

Power Gas Requirements

Use clean, dry filtered (25 micron) gas.
Discharge to Atmosphere: 150 psig max.

Output Signal

Pneumatic pressure as required by the actuator up to full supply pressure.

Port Connections

All Ports: ¼" NPT

Action

Direct and Reverse Acting: Field-reversible by changing the output tubing connection.

Performance

Resolution: 0.2 percent

Steady State Consumption

Zero

Power Gas Requirement

Use clean, dry filtered (100 micron) gas.

Operative Temperature

-20 to 160 °F (-28 to 70°C).

Housing

Meets NEMA 3 classification (weather tight).

Installation Orientation

Must be installed in the vertical position.

Approximate Weight

15 pounds.

Construction Materials

External Parts: Anodized 2024 Aluminum
Internal Parts: 316 Stainless Steel and 2024 (Stainless Steel Available) Anodized Aluminum
Diaphragms: Buna-N with Nylon Reinforcement
Seats and O-Rings: Buna-N
Tubing: 316 Stainless Steel
Fittings: 316 Stainless Steel
Gauges: 2 ½-inch Dial Liquid Stainless Steel Connection with Stainless Steel Case

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Introduction

The Becker VRP-SB-GAP gap controller from GE represents a breakthrough in pilot and pressure control technology for the natural gas industry. Built to exacting specifications and offering highly accurate control, the unit is easy to operate and requires minimal maintenance while exhibiting excellent control characteristics in a broad range of operating environments. Additionally, the gap controller design allows the bleed gas to be routed to a lower pressure fuel gas system or downstream. This eliminates atmospheric bleed gas completely.

Your Becker VRP-SB-GAP gap controller will come factory-adjusted to suit your particular application. This manual provides instructions for any maintenance, i.e., soft goods replacement or rebuild.

Scope of Manual

This manual provides installation, operation, adjustment, and maintenance information for the Becker VRP-SB-GAP gap controller. Refer to individual product manuals for information on other components of your Becker product from GE (valve, actuator, and accessories).

NOTE: Only personnel qualified through training or experience should install, operate, and maintain the VRP-SB-GAP gap controller. If there are any questions concerning these instructions, contact your GE sales representative or sales office before proceeding.

Description

The Becker Model VRP-SB-GAP single-acting gap controller provides gap control (on-off) when used with pneumatically actuated valves. The VRP-SB-GAP gap controller measures the process-sensing pressure and closes the actuated valve upon pressure rising to the high pressure setpoint.

Conversely, the VRP-SB-GAP gap controller will re-open the actuated valve upon pressure falling to the low pressure setpoint. The action of the gap controller may be reversed to open an actuated valve upon rising pressure while closing on falling pressure.
The VRP-SB-GAP gap controller may be utilized for gap control applications with setpoints ranging from 1.0 psig to 1500 psig (6.9 kPa - 10342 kPa). The VRP-SB-GAP controller features zero steady state bleed; simple adjustment; and may incorporate Becker's unique BPS™ Bleed to Pressure System capability to completely eliminate atmospheric emissions.

Applications and Configuration

VRP-SB-GAP Gap Controller Applications

- Tube Switching
- Overpressure Protection
- Backpressure Protection
- Underpressure Protection
- Slam Shut (High Speed) Overpressure Protection

Application 1: Valve will close on rising pressure.
Application 2: Valve will open on falling pressure at specified difference from the set point.

Standard Configuration

a. Power Gas: 150 psig max.
b. Supply & exhaust orifices: Not used.
c. Installation should be installed together with a directional valve.

Accessories

- Setpoint Change Pump
- Remote Setpoint Change:
  a. pneumatic loading
  b. electrical motor, 24 V / 120 V/4 - 20 mA
- Atmospheric Bleed Control (AB) to maintain minimum differential across the cylinder, required to provide the necessary output to operate the control valve under all design conditions

Model Number

The model number is an alpha-numeric combination that characterizes your unit. It is marked on the name tag located on the spring cartridge.

Example: VRP-1000-SB-GAP

VRP = Valve Regulator Pilot
1000 = Maximum allowable control pressure, in psig
SB = Single-Acting
GAP = Gap Controller

Each unit has a stainless steel tag fastened under one of the bolts of the spring cartridge. The control spring range along with the shipping date and part number of the assembly are stamped on the tag.

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Principles of Operation

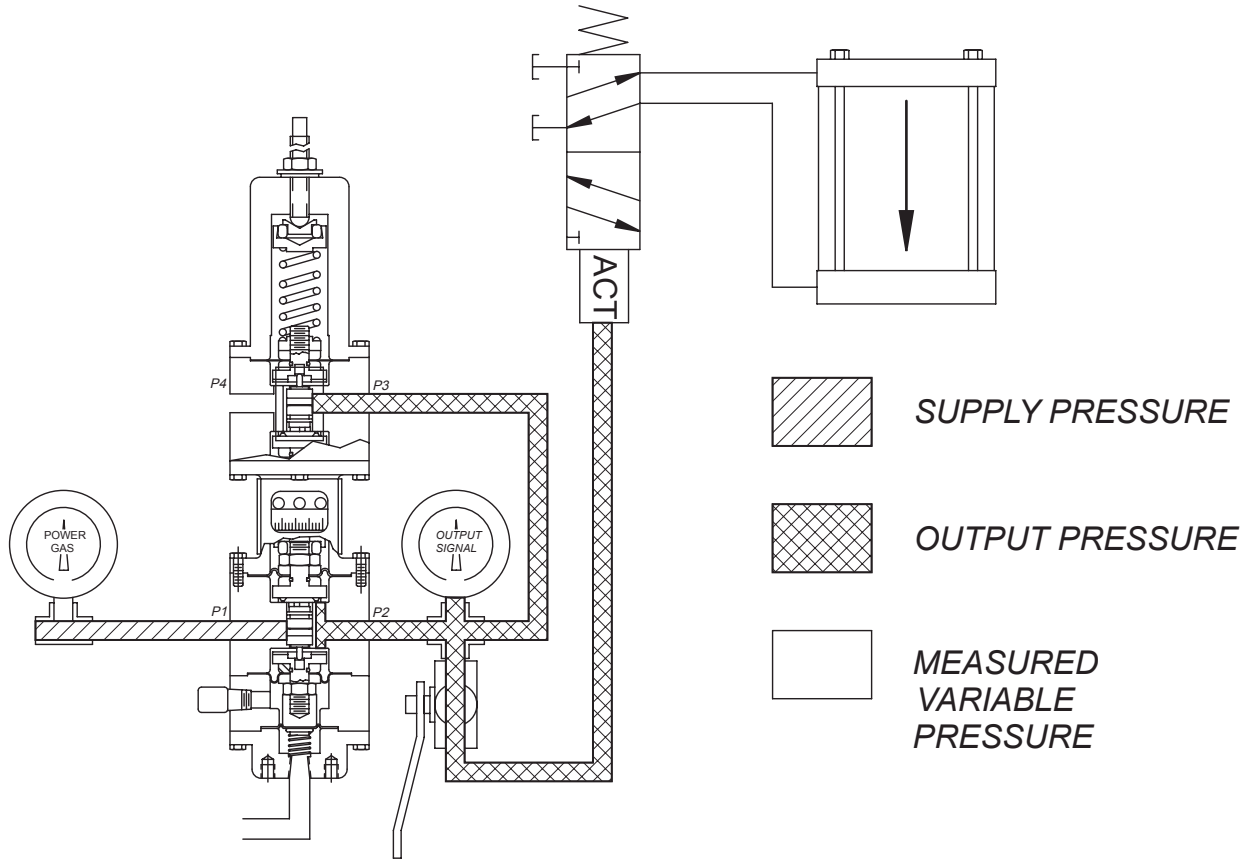

Figure 1 - Principle of Operation

Above figure shows a direct acting controller setup. When the measured variable is between the high setpoint, and low setpoint both balance valves are closed and output pressure will be at the last value (zero or full output). The control valve remains stationary and there is no "bleed gas". As the measured variable rises above the high setpoint, the supply balance valve will open while the exhaust balance valve stays closed. Output pressure will increase and trip the directional valve. At low setpoint the exhaust balance valve will open while the supply balance valve closes, and the output pressure will drop to zero. At zero output the valve will open, and it will close at full output. Reverse action is achieved by tubing supply to P3, output to P4, and exhaust to P2.

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Adjustment Procedure

Initial adjustment procedures must be followed after original installation, when changing operating conditions, or after disassembly-reassembly.

To change the setpoint or the response of the controller, skip to the procedure for Fine Tuning Adjustment.

Initial Adjustment

Step 1: Adjust power gas to designated pressure

Step 2: Close valve on measured variable line. Then adjust measured variable pressure to desired value using false signal valves.

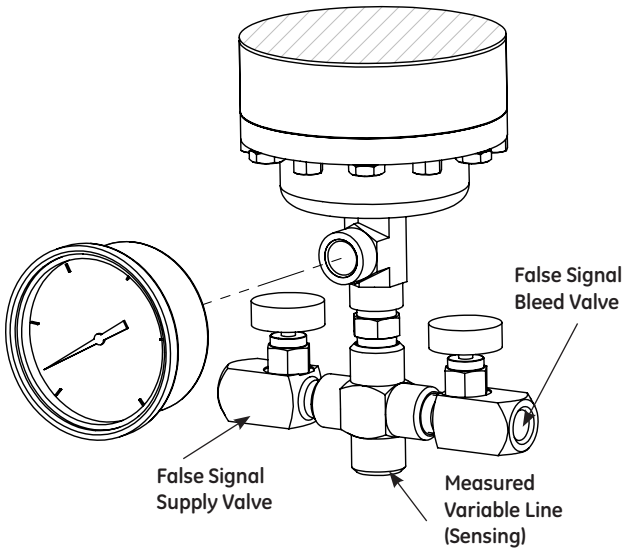

Figure 2 - Sensing Chamber Lines

Step 3: Close output block valve.

Step 4: Turn the adjusting screw counterclockwise until the control spring is fully unloaded. You will feel the screw becoming much easier to turn. If you accidentally disengage the screw from the spring cartridge simply screw it back into the spring cartridge until it just begins to engage the spring.

Step 5: Turn adjusting drum to the right as far as it will turn (in direction of increasing numbers). Then turn the drum one (1) complete rotation to the left (use the numbers as a guide)

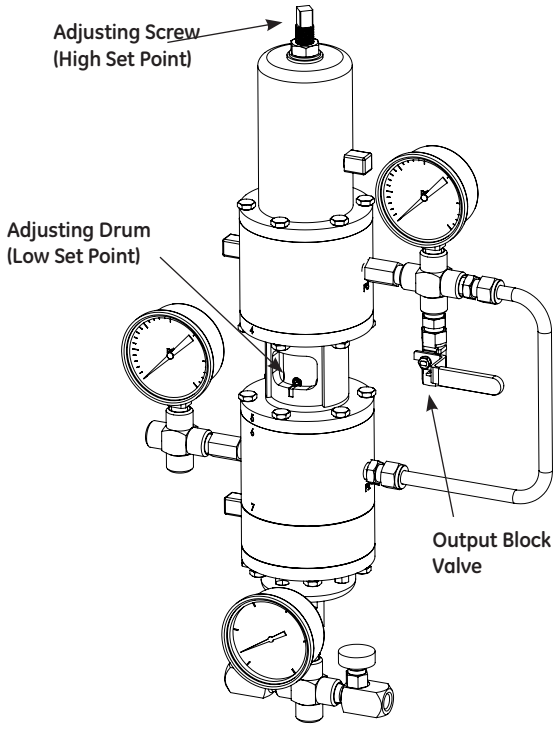

Figure 3 - Direct Acting Controller

For direct-acting controller ONLY (Supply Gas to P1)

Step 6a: Turn the adjusting screw clockwise until the output gauge just drops off.

Step 6b: Go to step 7

For reverse-acting controller ONLY (Supply Gas to P3)

Step 6a: Turn the adjusting screw clockwise until the output gauge just rises.

Step 6b: Go to step 7

For both direct- and reverse-acting controllers

Step 7: If the controller vents gas, turn the adjusting drum to the left until the controller stops venting gas. If controller does not vent gas, turn the adjusting drum to the right until the controller starts venting gas, then bock off slightly to the left to stop the gas from venting.

Step 8: Adjust controller at the set point by turning the adjusting screw.

NOTE: The controller is at set point when the output pressure is stationary and not at the maximum or minimum value.

Step 9: If controller vents gas turn the drum more to the left until it stops venting and then go back to step 8.

Step 10: When controller is at setpoint and there is no vent gas, check if dead band is too large. Change the measured variable pressure above and below the setpoint about 1 percent of its value. The output pressure must reach its extreme values in about 5-10 seconds.

Step 11: Open the block valve and measured variable line. Put gap controller in control.

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Controller Adjustment

Step 1: Adjust the VRP-SB-GAP gap controller with minimum dead bond as outlined in the initial adjustment procedures (pages 4 and 5), at maximum desired setpoint.

Step 2: Turn the drum to the left (in direction of decreasing numbers) to widen the "gap". Then check the high and low setpoint by raising and lowering the control pressure while observing the shifting of the directional valve.

Step 3: Some iteration will be required between setpoint adjustment (adjusting screw) and gap adjustment (adjusting drum) to achieve the proper high and low setpoint requirement.(Use the adjusting screw to set the high setpoint and the adjusting drum for the low setpoint).

Step 4: Refer to the gap range available for each VRP-SB-GAP gap controller in the spring range Table 1.

Table 1 - Spring Adjustment Ranges

Controller	Range (psig)	Spring Color	Part Number	psig/turn	Gap (psig)
VRP-30-SB-GAP	inch of water column - 6	Green	20-2592	0.46	0 - 0.5
	3 - 30	Red	25-1037	3	0.5 - 4
VRP-200-SB-GAP	5 - 40	Green	20-2592	2.8	1 - 3.5
	10 - 70	Silver	25-1038	5.3	1 - 7
	25 - 140	Blue	25-1036	16	1 - 20
	50 - 200	Red	25-1037	18	2 - 25
VRP-600-SB-GAP	135- 300	Orange	25-1052	33	3 - 40
	175 - 600	Yellow	25-1306	85	5 - 100
VRP-1000-SB-GAP	200 - 675	Black	25-1053	76	5 - 90
	300 - 1000	Yellow	25-1306	143	10 - 175
VRP-1500-SB-GAP	300-1300	Gray	25-1562	226	10 - 275
	500 - 1500	Violet	25-8073	276	12 - 335

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Inspection Procedure

As with all precision equipment, it is necessary to periodically test the VRP-SB-GAP gap controller to ensure optimum performance. We recommend performing the following procedure once a year.

Step 1: Close the output block valve in order to prevent the control valve from moving. Close the valve on the Measured Variable line.

Step 2: Balance Valve and Seat Inspection

Change the control pressure at least 5 percent above and below the setpoint by using the "false signal" valves found on the bottom of the controller. Soap test the exhaust port.

For Direct-Acting Controller

Exhaust port is P4.

a. When the control pressure is above the setpoint, the supply balance valve is open and the exhaust balance valve (top block) is closed. Gas exhausting from port P4 indicates wear or contaminants in the exhaust balance valve assembly (top block).

b. When the control pressure is below the setpoint the supply balance valve is closed and the exhaust balance valve is open. Gas exhausting from port P4 indicates wear or contaminants in the supply balance valve assembly (bottom block).

For Reverse-Acting Controller

Exhaust port is P2.

a. The supply and exhaust balance valves are opposite to direct acting case above.

Note: If a leak is found through one balance valve only, it is not necessary to take apart both top and bottom blocks. Only the block with the damaged balance valve assembly requires disassembly.

Step 3: Soap test around all diaphragms, vents and orifice assembly. Unless a leak is found it is not necessary to take the controller apart. If any leaks are found around the diaphragms, all rubber goods must be replaced. Take the controller apart, replace all rubber goods, and reassemble the controller.

Step 4: Apply a "false signal" pressure in the sensing chamber. Observe operation of the gauges. If any gauges are defective, replace them.

Step 5: Perform internal friction test.

Step 6: Readjust the Becker VRP-SB-GAP gap controller if necessary.

Internal Friction Test

Friction may occur due to any one or a combination of the following reasons:

a. The diaphragms are not centered properly.

b. The control spring is not seated properly over the spring nut, or defective.

c. Dirt or ice has built up inside the controller.

Step 1: Adjust the Controller using Initial Adjustment procedure. Keep Controller at setpoint and close output block valve.

Step 2: Eliminate the dead-band by turning the drum to the right about one to two divisions (turn in direction of increasing numbers). The VRP-SB-GAP gap controller must have slight continuous bleed gas. Turn the adjusting screw back and forth. Observe the output gauge response.

If response of the output gauge hesitates or the pressure moves in the opposite direction of the adjusting screw rotation, the VRP-SB-GAP gap controller has internal friction. For example if the VRP-SB-GAP gap controller is direct-acting, as the adjusting screw is rotated clockwise the output gauge should go down without hesitation. If the gage goes up or hesitates before going down, internal friction is present.

Step 3: If internal friction is found, take the VRP-SB-GAP gap controller apart and reassemble it.

The above test procedure precisely indicates the mechanical and pneumatic condition of the Becker VRP-SB-GAP gap controller. Should you require any additional information or assistance, please feel free to contact GE using our toll free number 1-800-323-8844.

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Assembly Procedure

NOTE: During assembly, moisten all O-rings, threads, thrust bearing, and the recess in the spring seat with lightweight silicone grease.

Step 1: Using a 7/16-inch socket, press seat assembly (E) with rubber seat facing downward into bottom body (F).

Step 1a: Insert spacer (D) together with strainer (D1).

Step 1b: Insert balanced valve assembly (C) with the stem facing downward.

Step 1c: Secure the assembly in bottom body (F) with seat cover (B) and two Phillips head machine screws (A).

Step 2: Repeat the process by inserting the second seat assembly (E) into top body (G).

Step 2b: Insert the second spacer.

Step 2c: Insert second balanced valve assembly (C).

Step 2d: Secure the assembly in top body (G) with seat cover (B) and two machine screws (A).

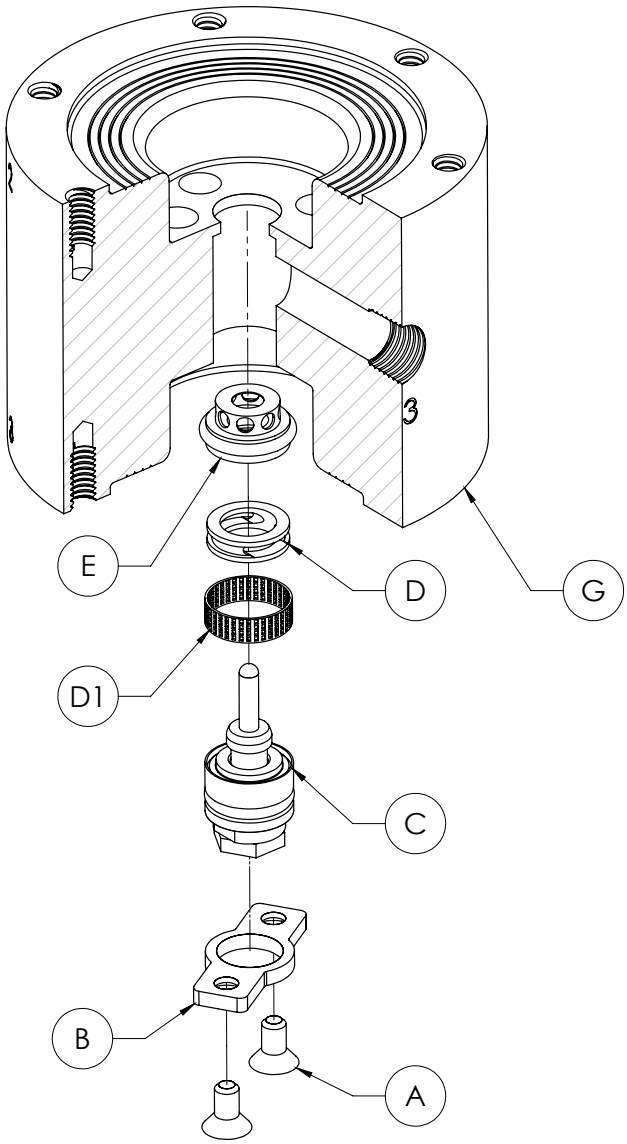

Figure 4 - Top Body

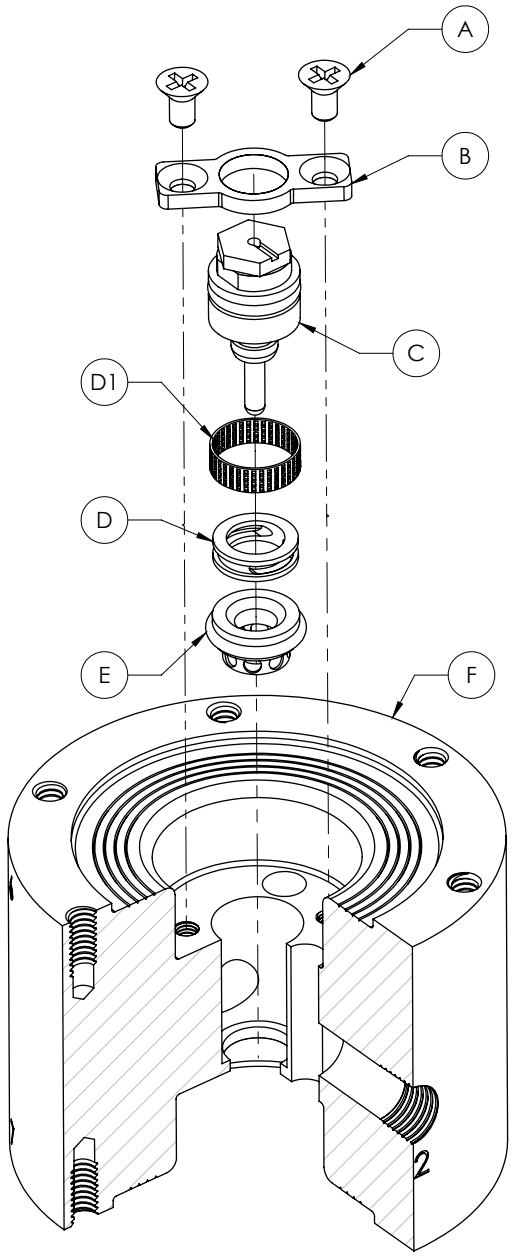

Figure 5 - Bottom Body

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Step 3: With the balanced valve assemblies now installed, perform a leak test of top and bottom valve bodies by doing the following:

Step 3b: Apply approximately 100 psig air to the supply ports of

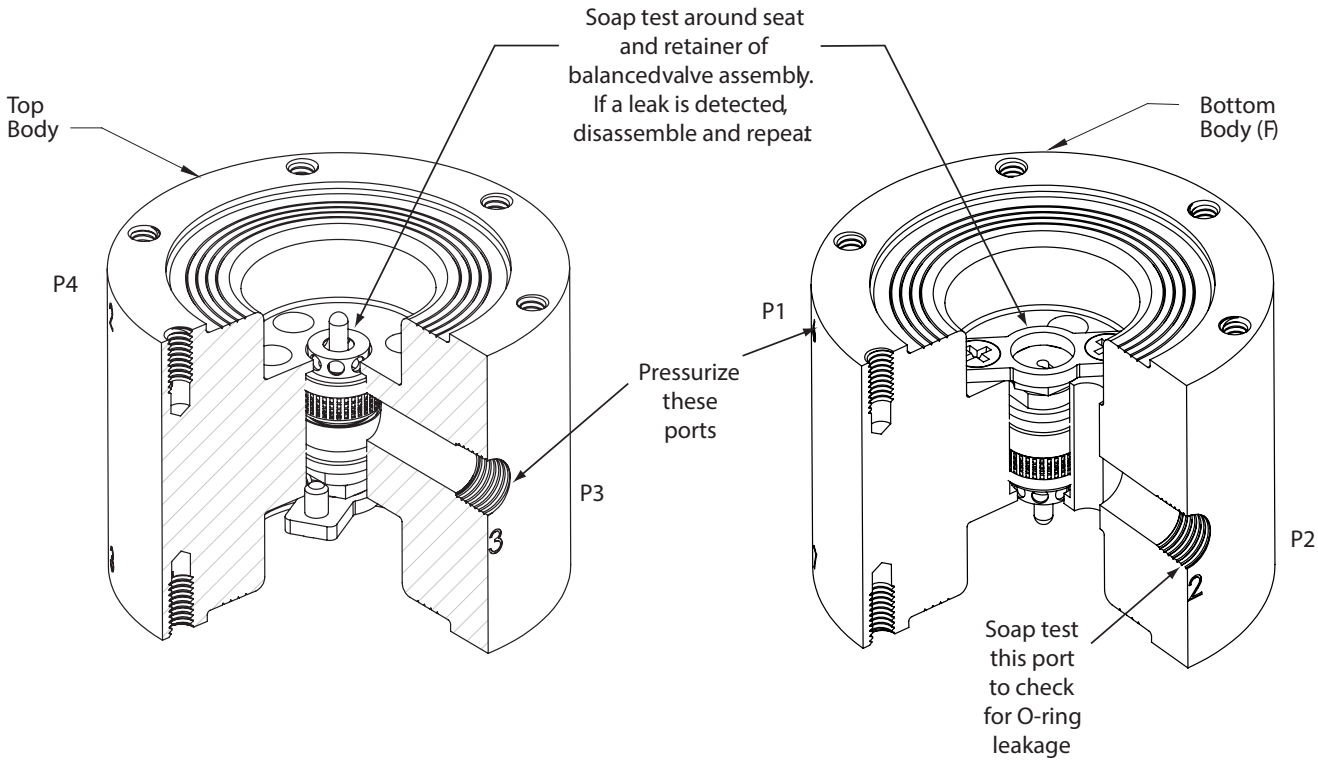

Figure 6 - Soap Test Procedure

the bottom and top valve bodies, marked 'P1' and 'P3' respectively. Soap around the valve seat (found on the stem side of the valve), the back end of retainer, and ports 'P2' and 'P4'. If a leak is found, check the O-ring integrity and contamination between the balance valve and the seat.

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Step 4: Install –012 O-rings (J) onto the groove on each piston and –010 O-ring (N) onto the stem of the top body inside piston (L).

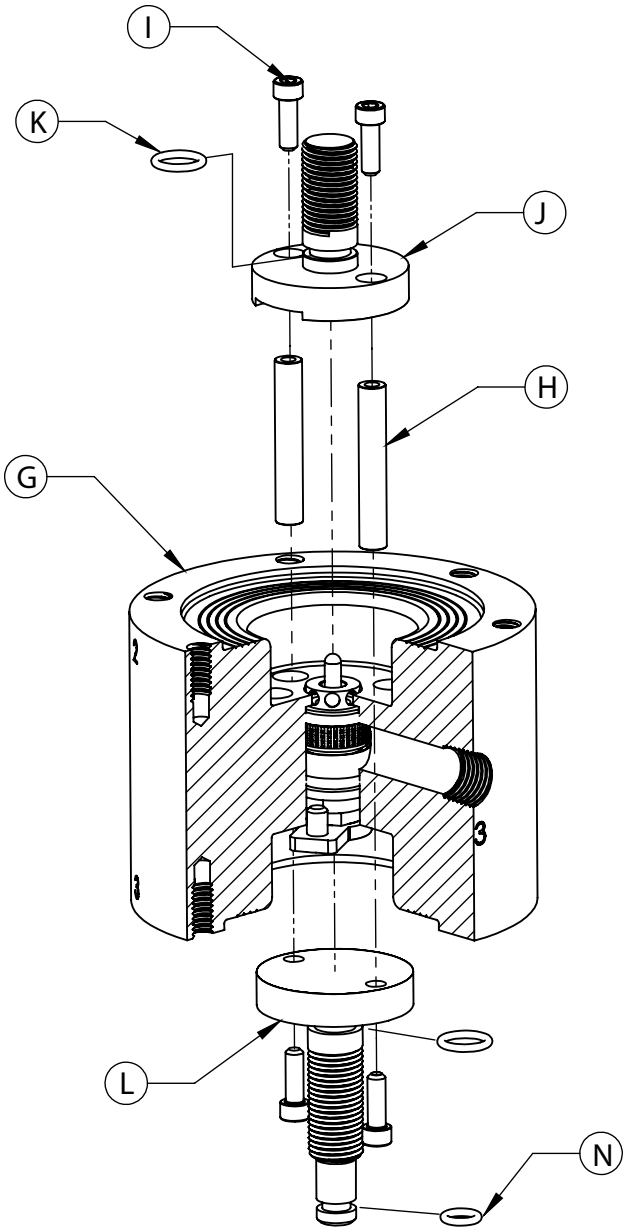

Figure 7 - Top Body Post Assembly

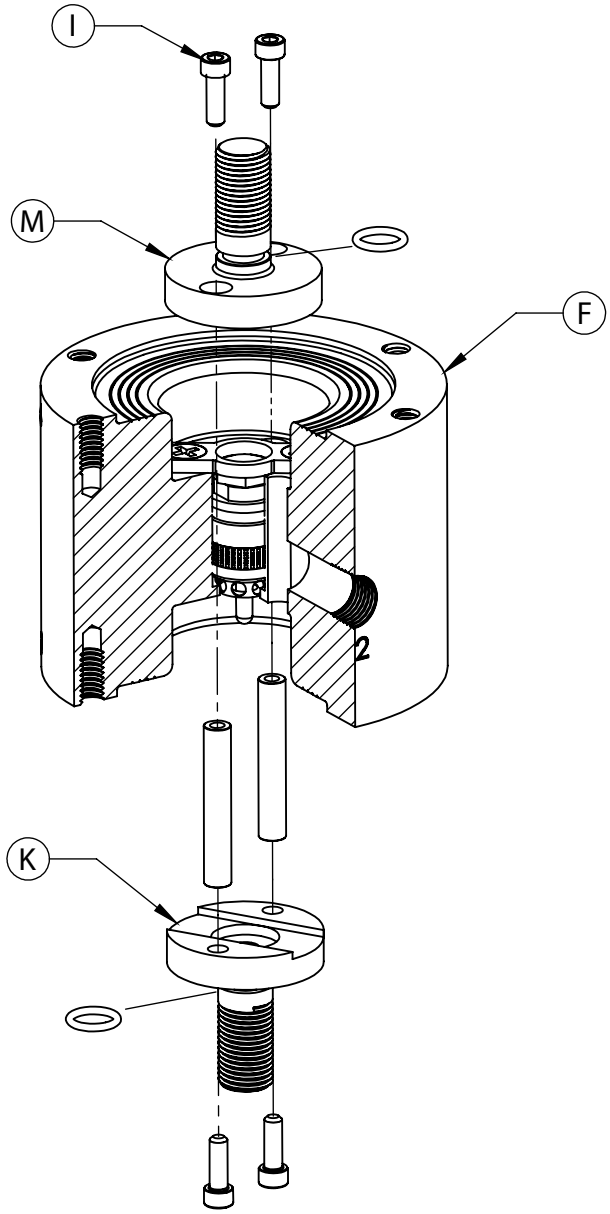

Figure 8 - Bottom Body Post Assembly

Step 4a: Attach posts (H) to outside pistons (K) with 8-32 x 1/2-inch SHCS (I).

Step 4b: Slide the posts and outside piston assemblies through the bodies and attach them to inside pistons (L and M) with 8-32 x 1/2-inch SHCS (I).

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Step 5: Slide one grooved washer (O) onto each piston with the grooves facing away from the body.

Step 5a: Install convolute diaphragms (R) onto washers (O) as shown (see note).

Step 5b: Install another washer (O) onto each piston with grooves facing the diaphragms.

Step 5c: Secure the diaphragm assemblies by threading 1/2-20 hex jam nuts (S) onto the inside the piston of top body (G) and the outside piston of bottom body (F).

Step 5d: Install special flat nut (Q) onto the inside piston of bottom valve body (F) and special spring nut (P) onto the outside piston of a top valve body (G). Torque all nuts (S,Q,P) to 95-100 in-lbs.

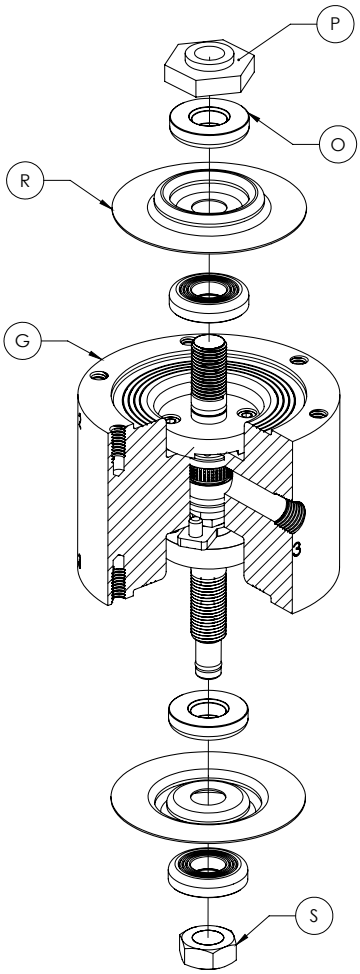

Figure 9 - Top Body Diaphragm Assembly

Step 6a: Press fit thrust-bearing (U) into the adjusting drum with the stamped letters size first (this will place the bearing case inside the drum with the bearing surface freely rotating)

Step 6b: Install the adjusting drum to inside piston (L) of top body (G) by threading the drum until it touches the ½-20 hex jam nut.

Step 7: Center the posts assemblies in bodies (F and G) by:

1. Rotating the diaphragm assemblies (from step 5) counter clockwise until they stop (1).

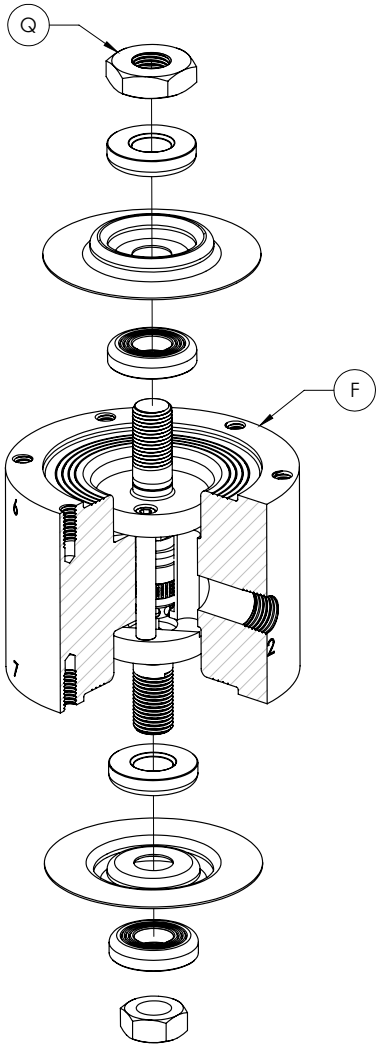

Figure 10 - Bottom Body Diaphragm Assembly

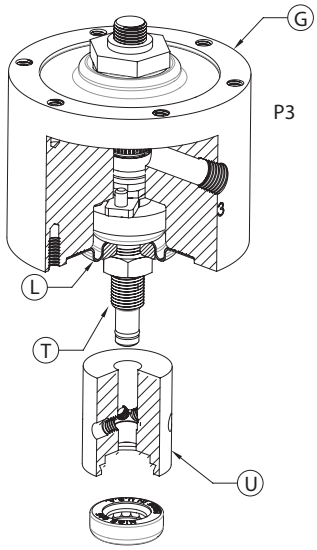

Figure 11 - Bottom Body Thrust Bearing Assembly

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2. Marking the diaphragms and bodies (F and G) with a single line (2).
3. Rotating the diaphragm assemblies clockwise until they stop (3).
4. Marking bodies (F and G) with extensions from the lines on the diaphragms.
5. Centering the line on the diaphragm between the two lines on each body (2).

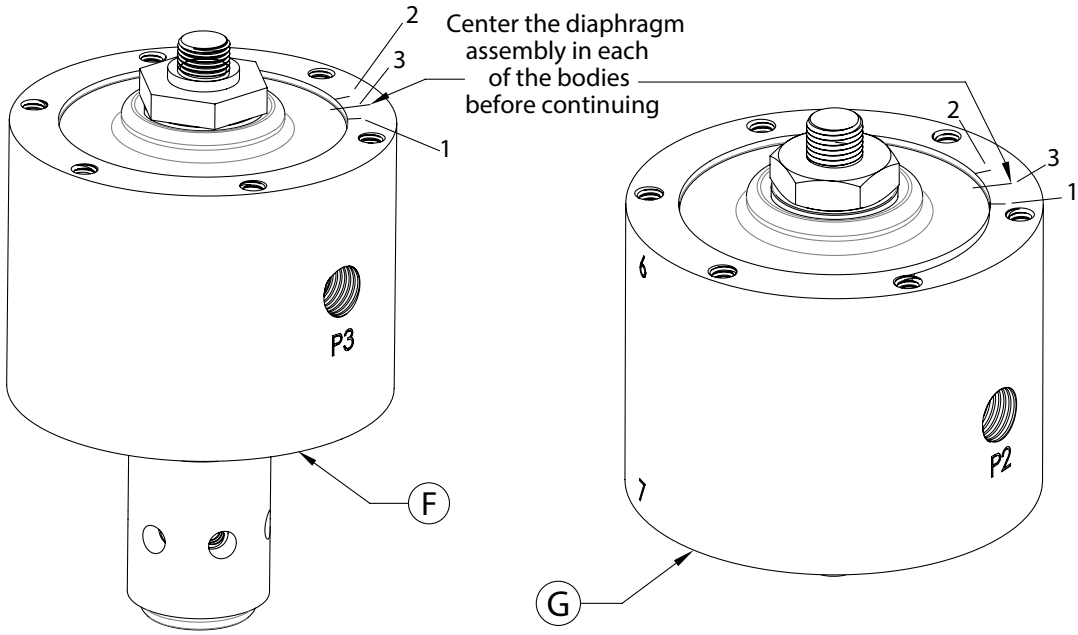

Figure 12 - Centering the Diaphragm

Step 8: Keeping the diaphragm securely in the center, between the inscribed lines, fasten the sensitivity spacer (V) to top and bottom bodies (F & G) with twelve 1/4 - 20 x 3/4 HHCS (W). This will secure the diaphragm and prevent it from moving it further.

NOTE: Align numbers stamped on the pilot parts in numerical order.

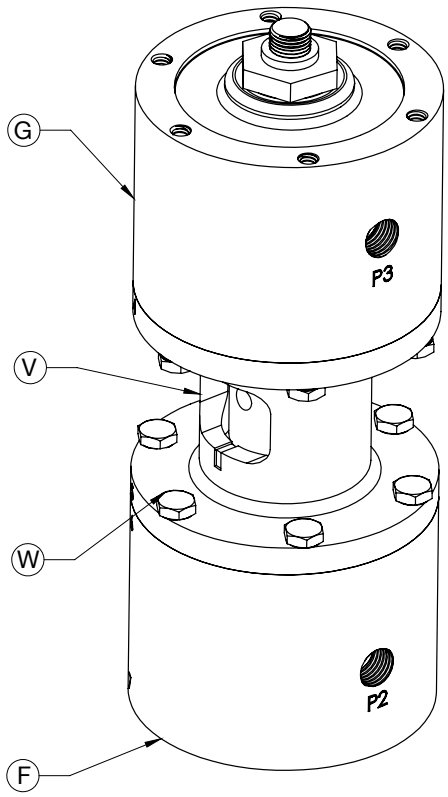

Figure 13 - Top and Bottom Body Assembly

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For VRP-30-SB-GAP, VRP-100-SB-GAP, and VRP-200-SB-GAP Gap Controllers

Step 9a: Bolt flange (AA) to the bottom body with six 1/4 - 20 x 3/4-inch HHCS (JJ). Torque to 95-100 in-lbs.

Step 9b: Install spacer (LL) and thread bottom piston (X) onto the bottom body's outside piston assembly until it stops.

Step 9c: Place diaphragm (CC) over bottom piston (X), so convolute will slip into the gap between it and spacer (LL).

Step 9d: Install spring (Y) onto spring seat (DD) and place assembly onto the center of diaphragm (CC).

Step 9e: Install pressure cartridge (Z) and secure it with six 1/4 - 20 x 1- 1/2-inch HHCS (BB). Torque to 95-100 in-lbs. Install vent (MM) into bottom spacer (AA).

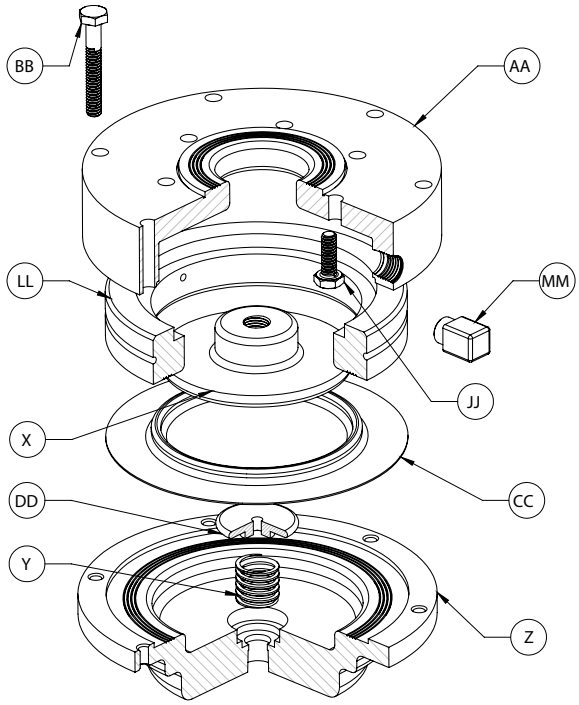

Figure 14 - Sensing Chamber Assembly

For VRP-200-SB-GAP and VRP-600-SB-GAP Gap Controller

Step 9a: Slide –012 O-ring (J) over the bottom inside piston (X).

Step 9b: Install convoluted diaphragm (R) onto bottom inside piston (X).

Step 9c: Install washer (O) onto bottom inside piston (X) with grooves facing forward.

Step 9d: Fasten the assembly with 1/2 - 20 jam nuts. Torque to 95 – 100 in-lbs.

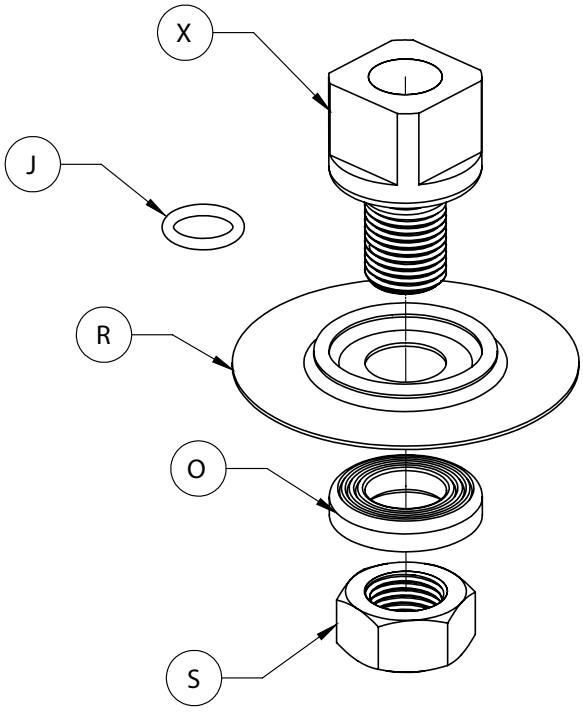

Figure 15 - Diaphragm Assembly

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For VRP-200-SB-GAP and VRP-600-SB-GAP Gap Controller (continued)

Step 9e: Thread bottom inside piston (X) with secured diaphragm onto the outside piston of bottom body (F)

Step 9f: Install spacer (AA) onto body (F), adjust the position of the diaphragm to make it flat against the spacer surface, slide spring (Y) onto the stem of bottom inside piston (X), and attach pressure cartridge (Z) and secure it with six 1/4 - 20 x 2- 1/4 HHCS (BB).

Step 9g: Install vent (MM) into bottom spacer (AA).

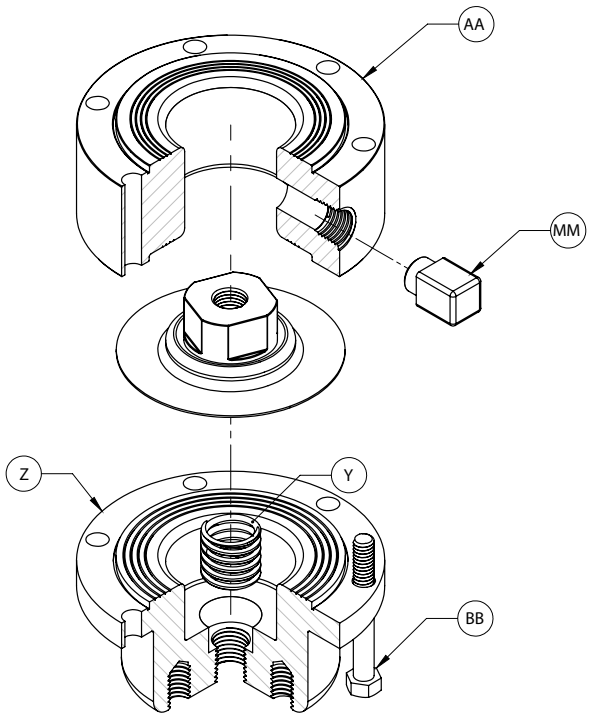

Figure 16 - Sensing Assembly

For VRP-1000-SB-GAP and VRP-1500-SB-GAP Gap Controller

Step 9a: Thread bottom piston (X) onto the bottom body's outside piston assembly until it stops.

Step 9b: Install bottom spacer (AA) and line up bolt holes.

Step 9c: Place diaphragm (CC) over bottom piston (X), so convolute will slip into the gap between it and spacer (AA).

Step 9d: Install spring (y) onto spring seat (DD) and place assembly onto the center of diaphragm (CC).

Step 9e: Install pressure cartridge (Z) and secure it with six 1/4 - 20 x 2-inch HHCS (BB) and six 1/4 - 20 x3/4 " HHCS (BBB). Torque to 95 – 100 in-lbs.

Step 9f: Install vent (MM) into bottom spacer (AA).

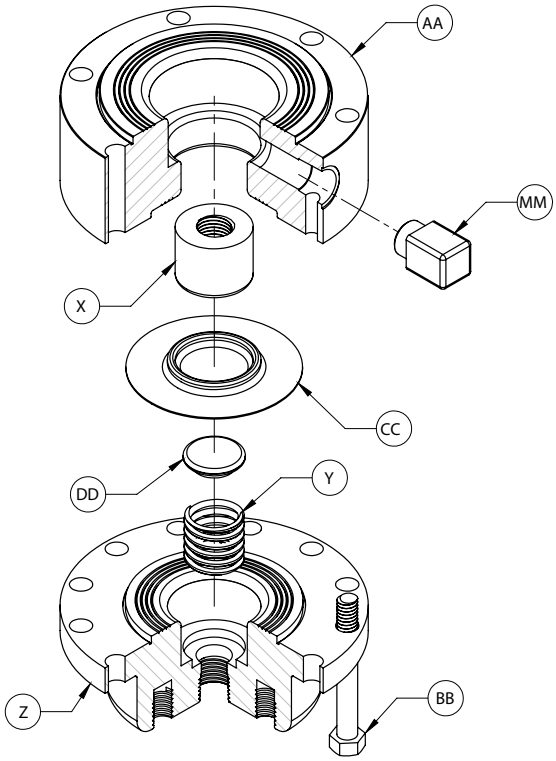

Figure 17 - Sensing Chamber

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For All Spring Ranges

Step 10a: With the pilot in the vertical position, place the control spring (EE) so it sits flat on the spring nut.

Step 10b: Place the thrust bearing (U) into the bearing case (FF).

Step 10c: Place bearing case (FF) on top of the spring, seating it in the center.

Step10d: Place spring seat (GG) inside the thrust bearing.

Step 10e: Mount spring cartridge (HH) onto top block (G) with six 1/4 - 20 x ¾-inch HHCS (JJ). Torque to 95-100 in-lbs.

Step 10f: Insert the vent into spring cartridge (HH).

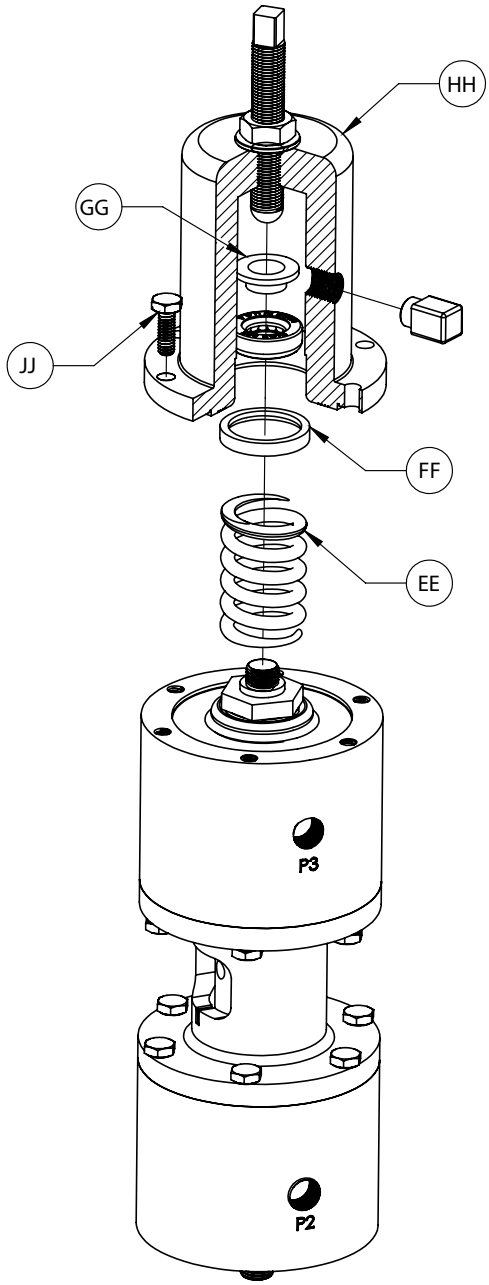

Figure 18 - Control Spring Assembly

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