

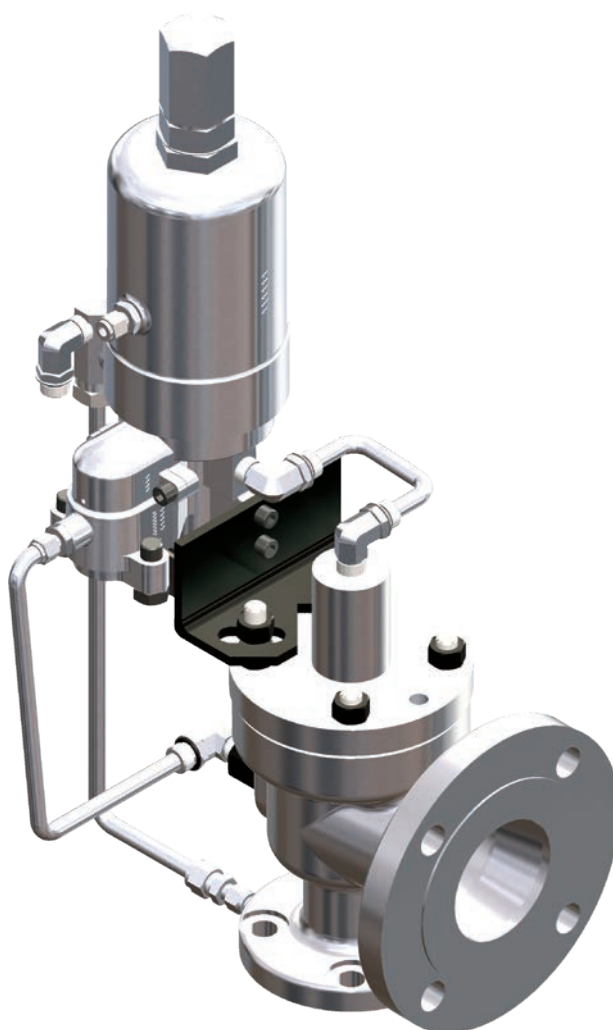
Consolidated

a Baker Hughes business

2900 Series Generation II

Pilot-Operated Safety Relief Valves

Instruction Manual (Rev. J)



THESE INSTRUCTIONS PROVIDE THE CUSTOMER/OPERATOR WITH IMPORTANT PROJECT-SPECIFIC REFERENCE INFORMATION IN ADDITION TO THE CUSTOMER/OPERATOR'S NORMAL OPERATION AND MAINTENANCE PROCEDURES. SINCE OPERATION AND MAINTENANCE PHILOSOPHIES VARY, BAKER HUGHES (AND ITS SUBSIDIARIES AND AFFILIATES) DOES NOT ATTEMPT TO DICTATE SPECIFIC PROCEDURES, BUT TO PROVIDE BASIC LIMITATIONS AND REQUIREMENTS CREATED BY THE TYPE OF EQUIPMENT PROVIDED.

THESE INSTRUCTIONS ASSUME THAT OPERATORS ALREADY HAVE A GENERAL UNDERSTANDING OF THE REQUIREMENTS FOR SAFE OPERATION OF MECHANICAL AND ELECTRICAL EQUIPMENT IN POTENTIALLY HAZARDOUS ENVIRONMENTS. THEREFORE, THESE INSTRUCTIONS SHOULD BE INTERPRETED AND APPLIED IN CONJUNCTION WITH THE SAFETY RULES AND REGULATIONS APPLICABLE AT THE SITE AND THE PARTICULAR REQUIREMENTS FOR OPERATION OF OTHER EQUIPMENT AT THE SITE.

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Conversion Table

All the United States Customary System (USCS) units are converted to metric units using the following conversion factors:		
USCS Unit	Conversion Factor	Metric Unit
in.	25.4	mm
lb.	0.4535924	kg
in ²	6.4516	cm ²
ft ³ /min	0.02831685	m ³ /min
gal/min	3.785412	L/min
lb/hr	0.4535924	kg/hr
psig	0.06894757	barg
ft lb	1.3558181	Nm
°F	5/9 (°F-32)	°C

Note: Multiply USCS unit with conversion factor to get metric value.

NOTICE
For valve configurations not listed in this manual, please contact your local Green Tag™ Center (GTC) for assistance.

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I. Product Safety Sign and Label System

If and when required, appropriate safety labels have been included in the rectangular margin blocks throughout this manual. Safety labels are vertically oriented rectangles as shown in the *representative examples* (below), consisting of three panels encircled by a narrow border. The panels can contain four messages which communicate:

- The level of hazard seriousness
- The nature of the hazard
- The consequence of human, or product, interaction with the hazard.
- The instructions, if necessary, on how to avoid the hazard.

The top panel of the format contains a signal word (**DANGER**, **WARNING**, **CAUTION** or **ATTENTION**) which communicates the level of hazard seriousness.

The center panel contains a pictorial which communicates the nature of the hazard, and the possible consequence of human or product interaction with the hazard. In some instances of human hazards the pictorial may, instead, depict what preventive measures to take, such as wearing protective equipment.

The bottom panel may contain an instruction message on how to avoid the hazard. In the case of human hazard, this message may also contain a more precise definition of the hazard, and the consequences of human interaction with the hazard, than can be communicated solely by the pictorial.

①

DANGER — Immediate hazards which **WILL** result in severe personal injury or death.

②

WARNING — Hazards or unsafe practices which **COULD** result in severe personal injury or death.

③

CAUTION — Hazards or unsafe practices which **COULD** result in minor personal injury.

④

ATTENTION — Hazards or unsafe practices which **COULD** result in product or property damage.

①



②



③



④



⚠ WARNING



Improper use or repair of pressurized media or steam device may result in severe personal injury or death.

⚠ WARNING



Heed all container label warnings.

⚠ WARNING



Provide and use guarding to prevent contact with heated and/or pressurized parts.

⚠ WARNING



Do not work with valves while under the influence of intoxicants or narcotics.

⚠ WARNING



All potential hazards may not be covered in this manual.

⚠ WARNING



Improper tools or improper use of right tools could result in personal injury or product damage.

II. Safety Precautions

Read – Understand – Practice

- WARNING:** Allow the system to cool to room temperature before cleaning servicing or repairing the system. Hot components or fluids can cause severe personal injury or death.
- WARNING:** Always read and comply with safety labels on all containers. Do not remove or deface the container. Do not remove or deface the container labels. Improper handling or misuse could result in severe personal injury or death.
- WARNING:** Never use pressurized fluids/gas/air to clean clothing or body parts. Never use body parts to check for leakage or discharge rates of areas. Pressurized fluids/gas/air injected into or near the body can cause severe personal injury or death.
- WARNING:** It is the responsibility of the owner to specify and provide guarding to protect persons from pressurized or heated parts. Contact with pressurized or heated parts. Contact with pressurized or heated parts can result in severe personal injury or death.
- WARNING:** Do not allow anyone under the influence or intoxicants or narcotics to work on or around pressurized systems. Workers under the influence intoxicants or narcotics are a hazard both to themselves and other employees and can cause severe personal injury or death to themselves or others.
- WARNING:** Incorrect service and repair could result in product or property damage or severe personal injury or death.
- WARNING:** This valve product line is not intended for radioactive nuclear applications. Some valve products Manufactured by Baker Hughes may be used in radioactive environments. Consequently, prior to starting any operation in a radioactive environment, the proper “health physics” procedures should be followed, if applicable.
- WARNING:** Use of improper tools or improper use of right tools could result in personal injury or product or property damage.
- WARNING:** These WARNINGS are as complete as possible but not all-inclusive. Baker Hughes cannot know all conceivable service methods nor evaluate all potential hazards.

II. Safety Precautions (Cont.)

Cautions Concerning Product Warning Labels

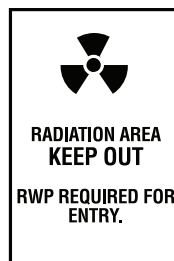
1. **CAUTION:** Heed all service manual warnings. Read installation instructions before installing valve(s).
2. **CAUTION:** Wear hearing protection when testing or operating valves.
3. **CAUTION:** Wear appropriate eye and clothing protection.
4. **CAUTION:** Wear protective breathing apparatus to protect against toxic media.

Note: *Any Service questions not covered in this manual should be referred to your local Green Tag™ Center (GTC).*

Restoring Safety

Appropriate service and repair are important to safe, reliable operation of all valve products. Restoration to original quality and manufacturing specifications will accomplish the desired results. Procedures developed by Baker Hughes as described in the applicable installation and Maintenance Manual, when correctly applied, will be effective.

⚠ WARNING



Know nuclear "health physics" procedures, if applicable, to avoid possible severe personal injury or death.

⚠ CAUTION



Heed all service manual warnings. Read installation instructions before installing valve(s).

⚠ CAUTION



Wear necessary protective equipment to prevent possible injury.

⚠ CAUTION



Always use appropriate restoration procedures.

III. Safety Notice



Proper installation and start-up is essential to the safe and reliable operation of all valve products. The relevant procedures recommended by Baker Hughes, and described in these instructions, are effective methods of performing the required tasks.

It is important to note that these instructions contain various “safety messages” which should be carefully read in order to minimize the risk of personal injury, or the possibility that improper procedures will be followed which may damage the involved Baker Hughes **Consolidated™** product, or render it unsafe. It is also important to understand that these “safety messages” are not exhaustive. Baker Hughes can not possibly know, evaluate, and advise any customer of all of the conceivable ways in which tasks might be performed, or of the possible hazardous consequences of each way. Consequently, Baker Hughes has not undertaken any such broad evaluation and, thus, anyone who uses a procedure and/or tool, which is not recommended by Baker Hughes, or deviates from Baker Hughes recommendations, must be thoroughly satisfied that neither personal safety, nor valve safety, will be jeopardized by the method and/or tools selected. Contact your local Green Tag Center (GTC) if there are any questions relative to tools/methods.

The installation and start-up of valves and/or valve products may involve proximity to fluids at extremely high pressure and/or temperature. Consequently, every precaution should be taken to prevent injury to personnel during the performance of any procedure. These precautions should consist of, but are not limited to, ear drum protection, eye protection, and the use of protective clothing, (i.e., gloves, etc.) when personnel are in, or around, a valve work area. Due to the various circumstances and conditions in which these operations may be performed on Consolidated products, and the possible hazardous consequences of each way, Baker Hughes can not possibly evaluate all conditions that might injure personnel or equipment. Nevertheless, Baker Hughes does offer certain Safety Precautions for customer information only.

It is the responsibility of the purchaser or user of Baker Hughes's Consolidated valves/equipment to adequately train all personnel who will be working with the involved valves/equipment. For more information on training schedules, call your local Green Tag Center (GTC). Further, prior to working with the involved valves/equipment, personnel who are to perform such work should become thoroughly familiar with the contents of these instructions.

IV. Warranty Information

Warranty Statement

Warranty Statement¹- Baker Hughes warrants that its products and work will meet all applicable specifications and other specific product and work requirements (including those of performance), if any, and will be free from defects in material and workmanship.

CAUTION: Defective and nonconforming items must be held for Baker Hughes's inspection and returned to the original F.O.B. point upon request.

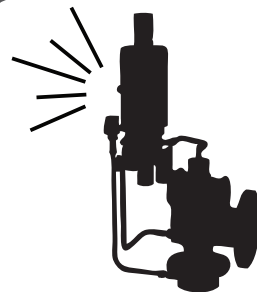
Incorrect Selection or Misapplication of Products – Baker Hughes cannot be responsible for customer's incorrect selection or misapplication of our products.

Unauthorized Repair Work – Baker Hughes has not authorized any non-Baker Hughes affiliated repair companies, contractors or individuals to perform warranty repair service on new products or field repaired products of its manufacture. Therefore, customers contracting or performing such repair service from unauthorized sources do so at their own risk.

Unauthorized Removal of Seals – All new valves and valves repaired in the field by Baker Hughes Field Service are sealed to assure the customer of our guarantee against defective workmanship. Unauthorized removal and/or breakage of this seal will negate our warranty.

1: Refer to Baker Hughes's Standard Terms of Sale for complete details on warranty and limitation of remedy and liability.

⚠ CAUTION



Defective and nonconforming items must be inspected by Baker Hughes

⚠ CAUTION



Removal and/or breakage of seal will negate our warranty.

V. Terminology for Pilot Operated Safety Relief Valves

- **Accumulation:** The pressure increase over the maximum allowable working pressure of the vessel during discharge through the POSRV, expressed as a percentage of that pressure or in actual pressure units.
- **Backpressure:** The pressure on the discharge side of the POSRV:
 - **Built-up Backpressure:** Pressure that develops at the valve outlet as a result of flow, after the POSRV has been opened.
 - **Superimposed Backpressure:** Pressure in the discharge header before the POSRV opens.
 - **Constant Backpressure:** Superimposed backpressure that is constant with time.
 - **Variable Backpressure:** Superimposed backpressure that will vary with time.
- **Blowdown:** The difference between set pressure and reseating pressure of the POSRV, expressed as a percentage of the set pressure or in actual pressure units.
- **Cold Differential Set Pressure:** The pressure at which the valve is adjusted to open on the test stand. This pressure corrects for backpressure when a pop action pilot's vent is piped to the main valve outlet.
- **Differential Between Operating and Set Pressures:** Valves in process service will generally give best results if the operating pressure does not exceed 90% of the set pressure. However, on pump and compressor discharge lines, the differential required between the operating and set pressures may be greater because of pressure pulsations coming from a reciprocating piston. The valve should be set as far above the operating pressure as possible.
- **Lift:** The actual travel of the disc away from the closed position when a valve is relieving.
- **Maximum Allowable Working Pressure:** The maximum gauge pressure permissible in a vessel at a designated temperature. A vessel may not be operated above this pressure or its equivalent at any metal temperature other than that used in its design. Consequently, for that metal temperature, it is the highest pressure at which the primary pressure POSRV is set to open.
- **Operating Pressure:** The gauge pressure to which the vessel is normally subjected in service. A suitable margin is provided between operating pressure and maximum allowable working pressure. For assured safe operation, the operating pressure should be at least 10% under the maximum allowable working pressure or 5 psig (0.34 bar), whichever is greater.
- **Overpressure:** A pressure increase over the set pressure of the primary relieving device. Overpressure is similar to accumulation when the relieving device is set at the maximum allowable working pressure of the vessel. Normally, overpressure is expressed as a percentage of set pressure.
- **Pilot Operated Safety Relief Valve (POSRV):** A pressure relief valve in which the major relieving device is combined with, and is controlled by, a self-actuated auxiliary pressure relief valve.
- **Rated Capacity:** The percentage of measured flow at an authorized percent overpressure permitted by the applicable code. Rated capacity is generally expressed in pounds per hour (lb/hr) or kg/hr for vapors, standard cubic feet per minute (SCFM) or m³/min for gases, and in gallons per minute (GPM) or Liter/min (L/min) for liquids.
- **Safety Relief Valve (SRV):** An automatic pressure-relieving device used as either a safety or relief valve, depending upon application. The SRV is used to protect personnel and equipment by preventing excessive overpressure.
- **Set Pressure:** The gauge pressure at the valve inlet, for which the relief valve has been adjusted to open under service conditions. In liquid service, the inlet pressure at which the valve starts to discharge determines set pressure. In gas or vapor service, the inlet pressure at which the valve pops determines the set pressure.

VI. Handling and Storage

⚠ CAUTION



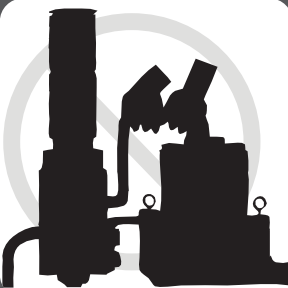
Always keep valve in an upright position when handling or storing.

⚠ CAUTION



Do not subject valves to sharp impact.

⚠ CAUTION



Never attempt to lift the valve by anything other than the eyebolts.

Handling

Always keep the inlet flange down on a crated or uncrated flange valve to prevent misalignment and damage to valve internals.

Pilot Operated Safety Relief Valves should be handled carefully. The internal parts of a pilot operated safety relief valve are precision machined and fitted together to maintain perfect alignment. Rough handling may damage the external tubing, pilot, and main valve seats or may cause misalignment sufficient to incur leakage or erratic operation. POSRVs are shipped with a protective covering over the inlet and the outlet flanges. This is to prevent damage to the flanged surfaces and to prevent entry of foreign material into the valve.

ATTENTION!

Never lift the full weight of the valve by the pilot assembly, external devices or tubing.

ATTENTION!

Do not rotate the valve horizontally or lift/carry using the pilot assembly.

ATTENTION!

Only lift the valve by the eyebolts inserted into the cover plate.

ATTENTION!

Handle carefully. Do not drop or strike the valve.

Storage

Store POSRVs in a dry environment and protect them from the weather. Do not remove the valve from the skids or crates until immediately before installation. Do not remove flange protectors and seating plugs until the valve is ready to be bolted into place during the installation, i.e., both inlet and outlet.

VII. Pre-Installation and Installation Instructions

Pre-Installation and Installation

CAUTION: After the valve is uncrated and protective devices removed, exercise care to prevent dirt and other foreign matter from entering either the inlet or the outlet port.

Mounting Instructions

CAUTION: Pressure relief valves should be mounted in a vertical, upright position. Installing a valve in any other position will adversely affect its operation in varying degrees as a result of induced misalignment of parts.

No stop valve should be placed between the pressure vessel and its relief valve except as permitted by Code regulations. If a stop valve is located between the pressure vessel and pressure relief valve, its port area should equal or exceed the nominal internal area of the piping from the vessel to the relief valve must not exceed 3% of the valve set pressure when it is flowing at full capacity.

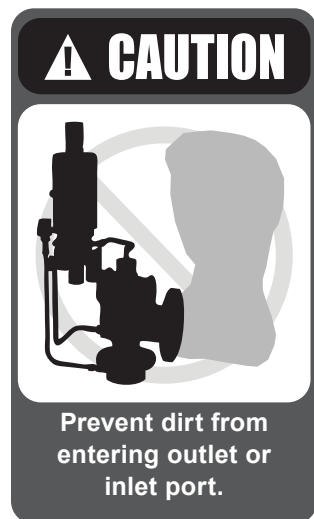
Flanges and gasket surfaces must be free from dirt and debris when valves are installed. The length, size and maximum change in height of the remote sensing line should be verified through analysis, taking into account the requirement to re-charge the dome through the pilot valve. On request, Baker Hughes will assist in the analysis to determine the appropriate length, size and maximum change in height for the sensing line and to determine the correct capacity of the pressure relief valve. Before start-up, be sure all threaded joints are tight and secure.

Hydrostatic Testing

Prior to hydrostatic test of the pressure vessel system, the pilot-operated safety relief valve should be removed and the mounting flange for the valve blocked.

Service Considerations

For best performance, pressure relief valves should be serviced annually unless maintenance history dictates otherwise. They should be located for easy access and removal for service.



VII. Pre-Installation and Installation Instructions (Cont.)

Integral Sensing

The integral sense configuration is the default and recommended pressure sensing option when remote sense is not required due to high inlet line loss. With the integral sense option, the pilot valve pressure can be picked up through the integral sense ring located around the base of the full through nozzle.

The Generation II 2900 Series with the integral sense option does not affect the centerline-to-face dimensions of the main valve because the integral sense ring wraps around the nozzle rather than sitting beneath. This unique design ensures that the integrally sensed Generation II 2900 Series will match all API 526 Direct Spring PRV centerline-to-face dimensions, including the Consolidated 1900 Series.

Remote Sensing

If the pressure drop between the source of pressure in the equipment to be protected and the pressure at the relief valve inlet exceeds 3%, the sensing line to the pilot valve should be connected directly to the equipment being protected. The optional sensing ring should not be installed. For remote sensing, .375" (9.53 mm) diameter tubing is adequate for distances up to 10 feet, (3.048 m).

For block valve and other special installation features consult API 520 or the factory.

Ramp Rate

As with all pilot operated relief valves, the ramp rate should be carefully controlled in order to minimize the adverse effects of extreme pressure surges. With many years of operational experience along with research and development, the importance of proper ramp rate has been established as one of the primary contributors to many avoidable valve problems. Based on testing and operating experience, a ramp rate of about 2% of valve set pressure per second or the equivalent of a consistent increase in pressure over a one minute interval was shown to have no adverse effects due to water hammer during the pressurization. This has been shown to provide the best balance between quick start up procedures while eliminating the chance of avoidable valve damage. For applications where pressurization rates are expected to be high, a Nitrogen bottle (connected to the field test connector) pre-charged up to 97% of set pressure may be used.

Pre-fill

During pre-fill of the economizer before pressurization, the prefill pressure is recommended not to exceed 15-25 psi (1-1.5 bar). For pressures exceeding this limit, a Nitrogen bottle (connected to the field test connector) precharged up to 97% of set pressure may be used.

VIII. Introduction

A. General Introduction

A pilot operated pressure relief valve is a pressure relief valve in which the major relieving device is combined with and is controlled by a self actuated auxiliary pressure relief valve.¹

1. Source ASME Code, Section XIII, Paragraph 3.1.2.

The Consolidated Modular Pilot Valve (MPV) is designed to provide reliable performance characteristics and stable operation within a pressure range of 15 to 6250 psig (10.34 to 430.92 barg).

B. Main Valve Introduction

The Consolidated Pilot Operated Safety Relief Valve (POS RV) cast bodies are designed to meet the often specified inlet and outlet connection combinations. Sizes range from 1" - 12" (25.4 mm - 304.80 mm); pressure ratings from 150 - 2500 class. The standard metal seat is the same design that has been successfully utilized in the Consolidated SRV for over 50 years.

Capacities are certified by National Board of Boiler and Pressure Vessel Inspectors and published in their NB18 entitled "Pressure Relief Device Certifications".

Main Valve Features

- Orifice controlled capacity
- Superior tightness
- Removable nozzles for replacement or remachining
- Standard O-Ring sizes: readily available, easily replaced
- Meets ASME Section XIII (UV Designator)
- Meets ASME B & PVC, Section I (Liquid Service)
- National Board certified capacities
- Uses many parts standard on 1900 Series SRV

Service and Applications

Main valve pressure and temperature limitations are combined in pressure class categories according to ANSI Standards. Conversely, the pressure and temperature limits of the Pilot Valve are presented separately.

Note: *When replacing or repairing the main valve and pilot valve assembly, pay particular attention to the pressures and temperature limitations for both the main valve and pilot valve to ensure compatibility.*

C. Pilot Valve Introduction

Standard pilot construction consists of 316SS parts with Nitrile O-Rings with Teflon® based seals throughout. Standard Steam and High Temperature Pilot Construction consists of 316SS parts with Teflon® O-Rings and seals. Alternate materials can be provided by contacting the factory.

Pilot Valve Features

- One pilot fits all main valves
- Standard O-Ring seals
- Superior seat tightness
- Accurate adjustment of blowdown and set point
- Positive closure after blowdown
- Reduces icing and clogging
- Field test connection
- Remote Sensing
- Integral Sensing
- External blowdown adjustments

Table 1: Service and Applications

Model	Service	Pressure Range				Temperature Range			
		min.		max.		min.		max.	
		psig	barg	psig	barg	°F	°C	°F	°C
39PV07, GS, SS, or LA	Gas, Air, Steam or Liquid	15	1.03	750	51.71	-40	-40.0	505	262.8
39MV07 GS or SS	Gas, Air or Steam	15	1.03	750	51.71	-40	-40.0	505	262.8
39MV07 LS	Liquid	15	1.03	750	51.71	-40	-40.0	505	262.8
39PV37 GS, SS, or LA	Gas, Air, Steam or Liquid	751	51.78	3750	258.55	-40	-40.0	505	262.8
39MV22 GS or SS	Gas, Air or Steam	751	51.78	3750	258.55	-40	-40.0	505	262.8
39MV22 LA	Liquid	751	51.78	3750	258.55	-40	-40.0	505	262.8
39MV72 GS, SS or LA	Gas, Air, Steam or Liquid	3751	258.62	6250	430.92	-40	-40.0	505	262.8

Note: *With the installation of the heat exchanger, temperature range may be expanded to -450°F to 1200°F. (-267.8°C to 648.9°C)*

IX. 2900 Series Pilot Operated Safety Relief Valves

A. Metal Seat Valve

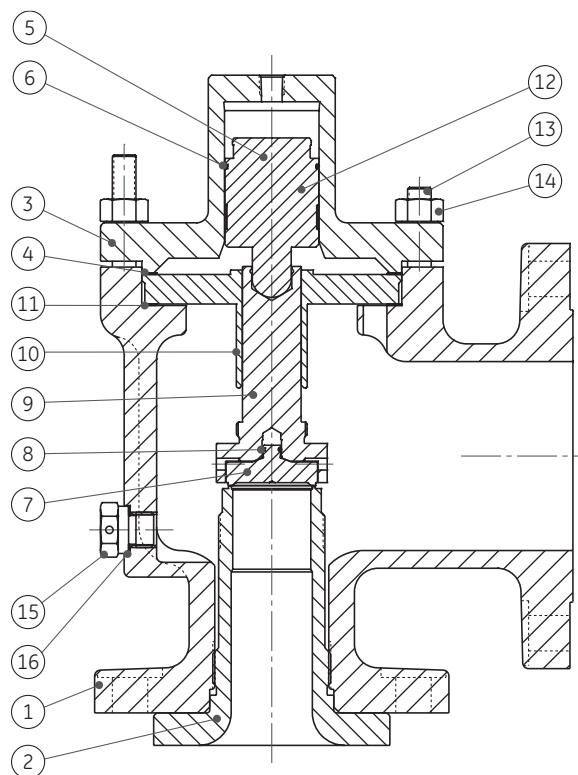


Figure 1: Main Valve Construction - Metal

B. Soft Seat Valve

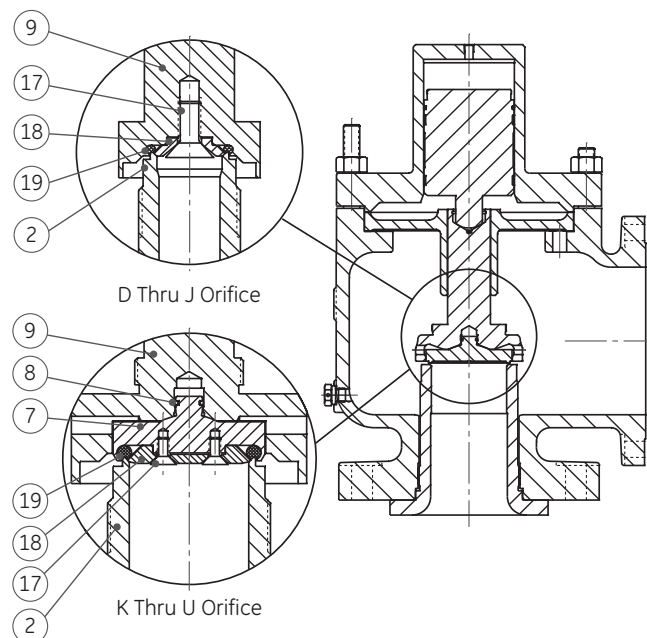


Figure 2: Main Valve Construction - Soft Seat

Part No.	Nomenclature
1	Base
2	Nozzle
3	Coverplate
4	Coverplate Gasket
5	Main Valve Piston
6	Main Valve Piston O-Ring
7	Disc
8	Disc Retainer
9	Disc Holder
10	Guide
11	Guide Gasket
12	Guide Ring(s)
13	Stud (Base)
14	Nut (Base)
15	Plug Adaptor
16	Plug Adaptor Gasket
17	O-Ring Retainer Lock Screw
18	O-Ring Retainer
19	O-Ring Seat Seal
20	Integral Sensing Ring
21	Integral Sensing Gasket
22	Integral Sensing Tube

C. Integral Sense

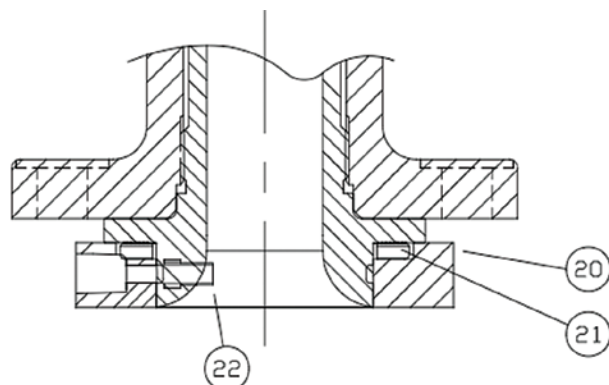
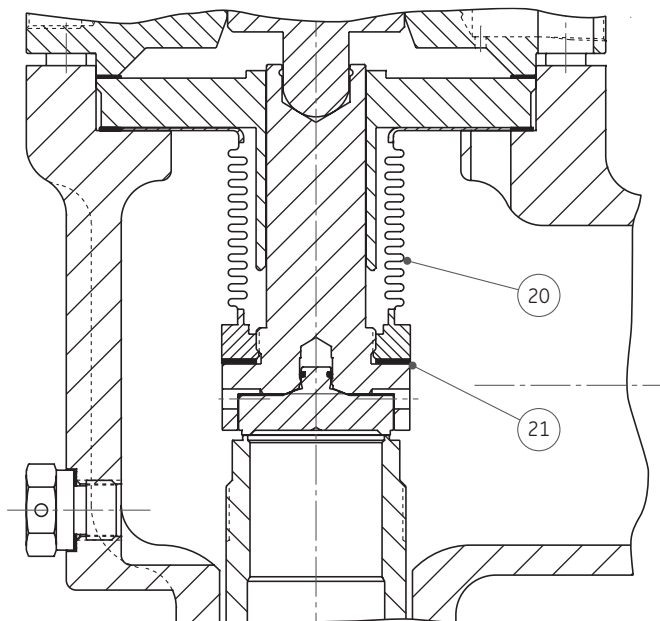


Figure 3: Main Valve Construction - Integral Sense

IX. 2900 Series Pilot Operated Safety Relief Valves (Cont.)

D. D-U Orifice (with Bellows)



Part No.	Nomenclature
20	Bellows Assembly
21	Bellows Gasket
8A	Disc Retainer Screws
8B	Retainer Screw Lock Washer
9	Disc Holder Assembly
20	Bellows Assembly
21	Bellows Gasket
22	Bellows Bolts
23	Bellows Bolts Lock Washers
24	Guide Ring (Guide)
25	Bug Screen (not shown)

Figure 4: Main Valve Construction - Bellows (D-U orifices)

E. V & W Orifice (with Bellows)

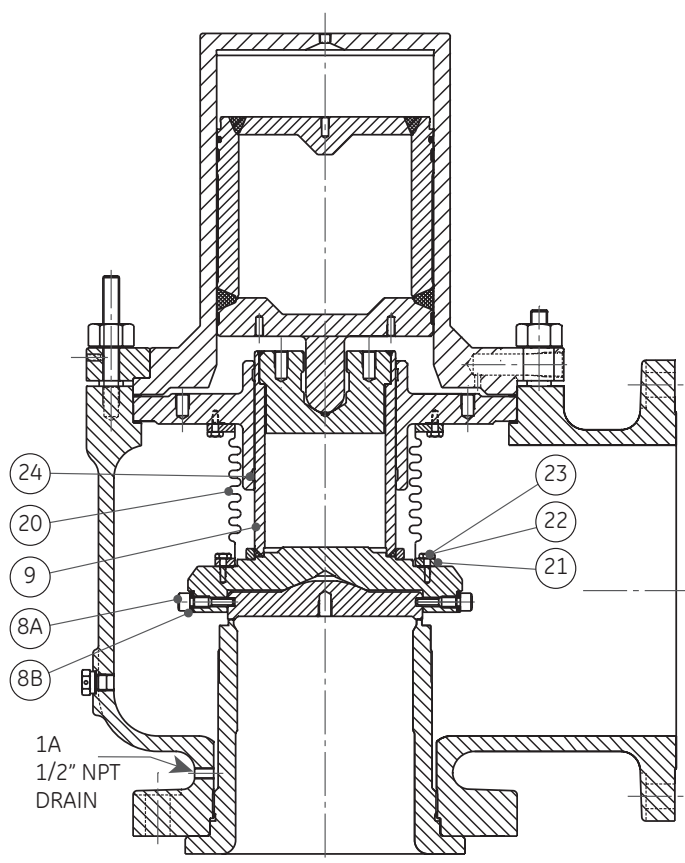
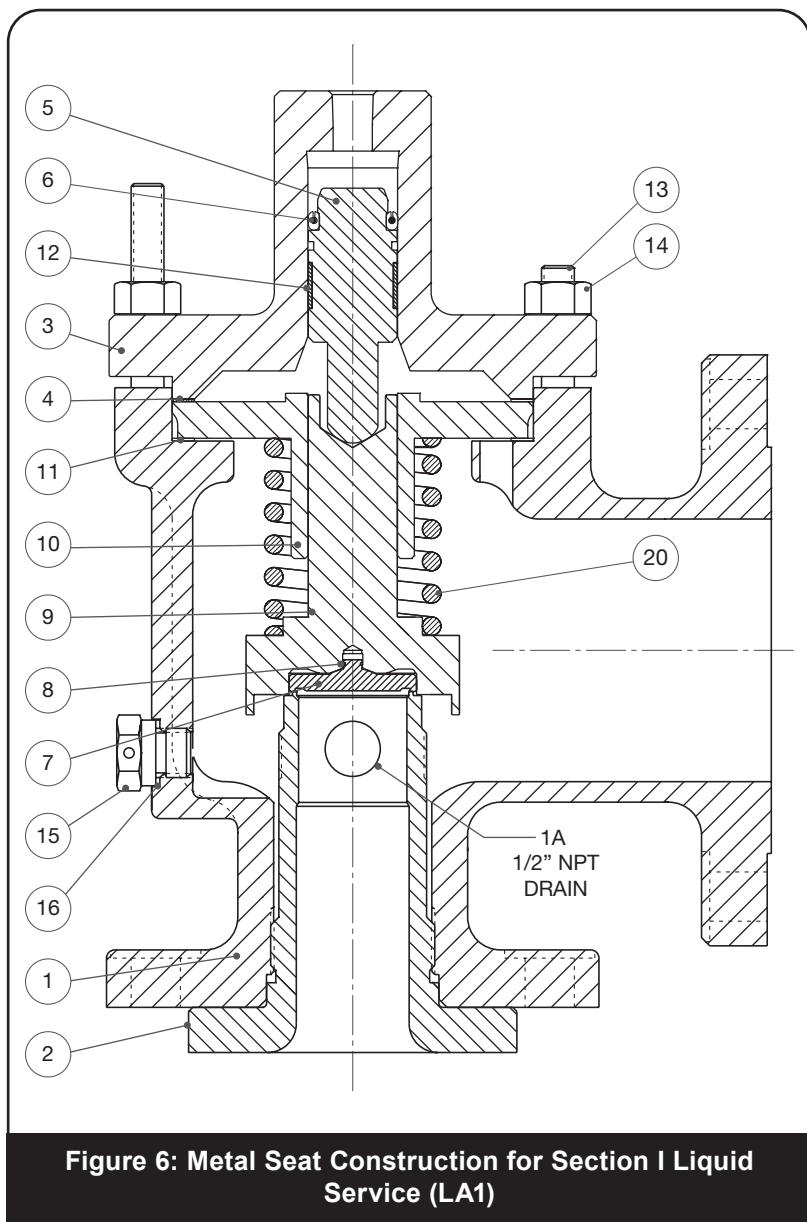


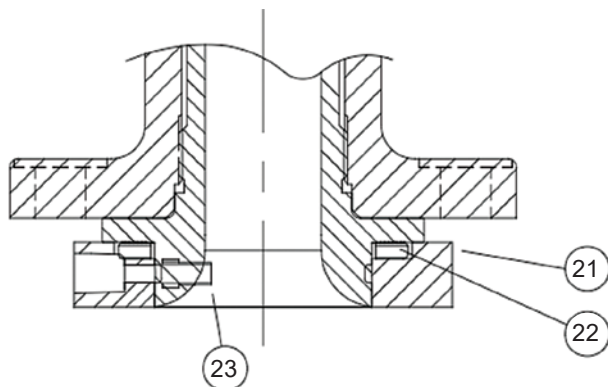
Figure 5: Main Valve Construction - Bellows (V&W orifices)

IX. 2900 Series Pilot Operated Safety Relief Valves (Cont.)

F. Metal Seat Valve for Section I Liquid Service (LA1)



Part No.	Nomenclature
1	Base
2	Nozzle
3	Coverplate
4	Coverplate Gasket
5	Main Valve Piston
6	Main Valve Piston Spring Energized Seal
7	Disc
8	Disc Retainer
9	Disc Holder
10	Guide
11	Guide Gasket
12	Guide Ring
13	Stud (Base)
14	Nut (Base)
15	Plug/Adaptor
16	Plug/Adaptor Gasket
20	Spring
21	Integral Sensing Ring
22	Integral Sensing Gasket
23	Integral Sensing Tube



IX. 2900 Series Pilot Operated Safety Relief Valves (Cont.)

G. Soft Seat Valve for Section I Liquid Service (LA1)

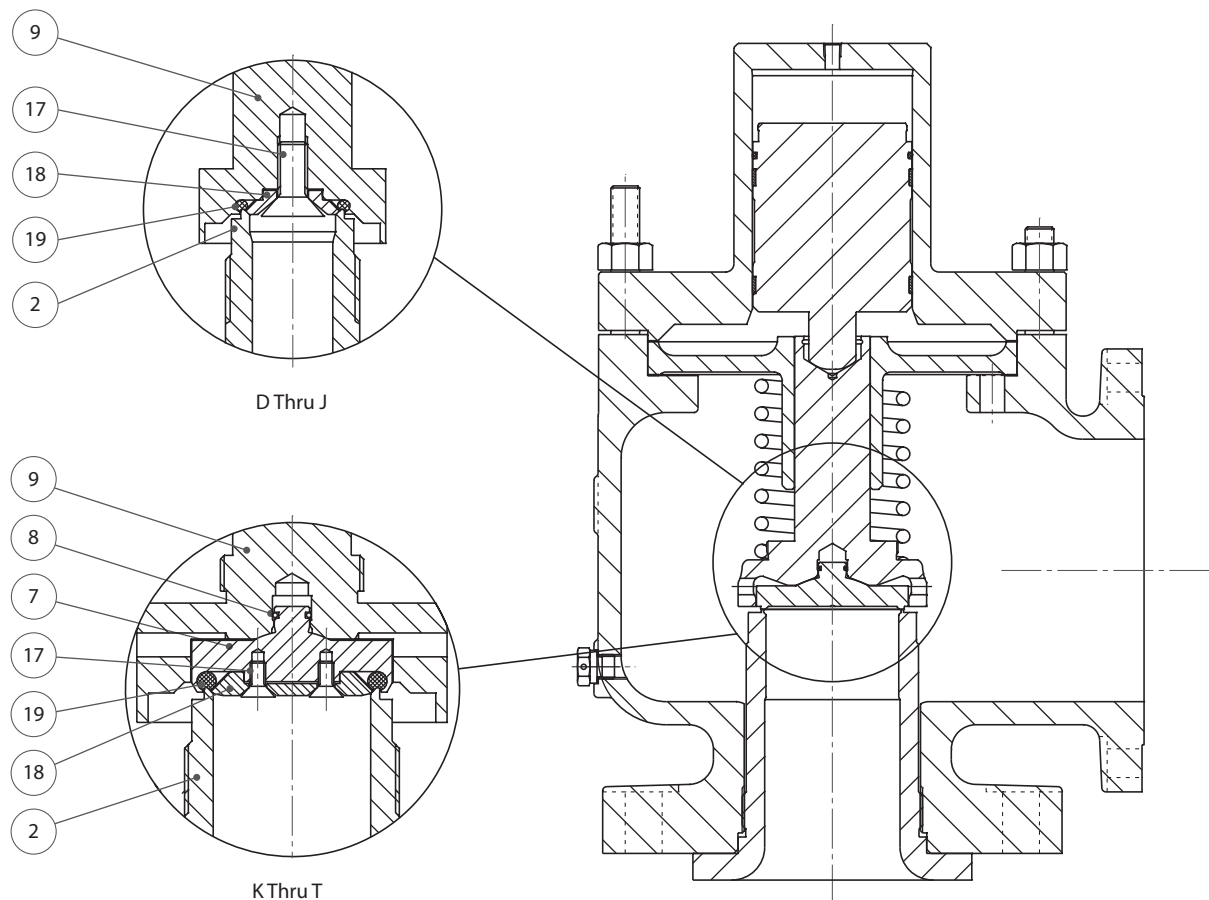
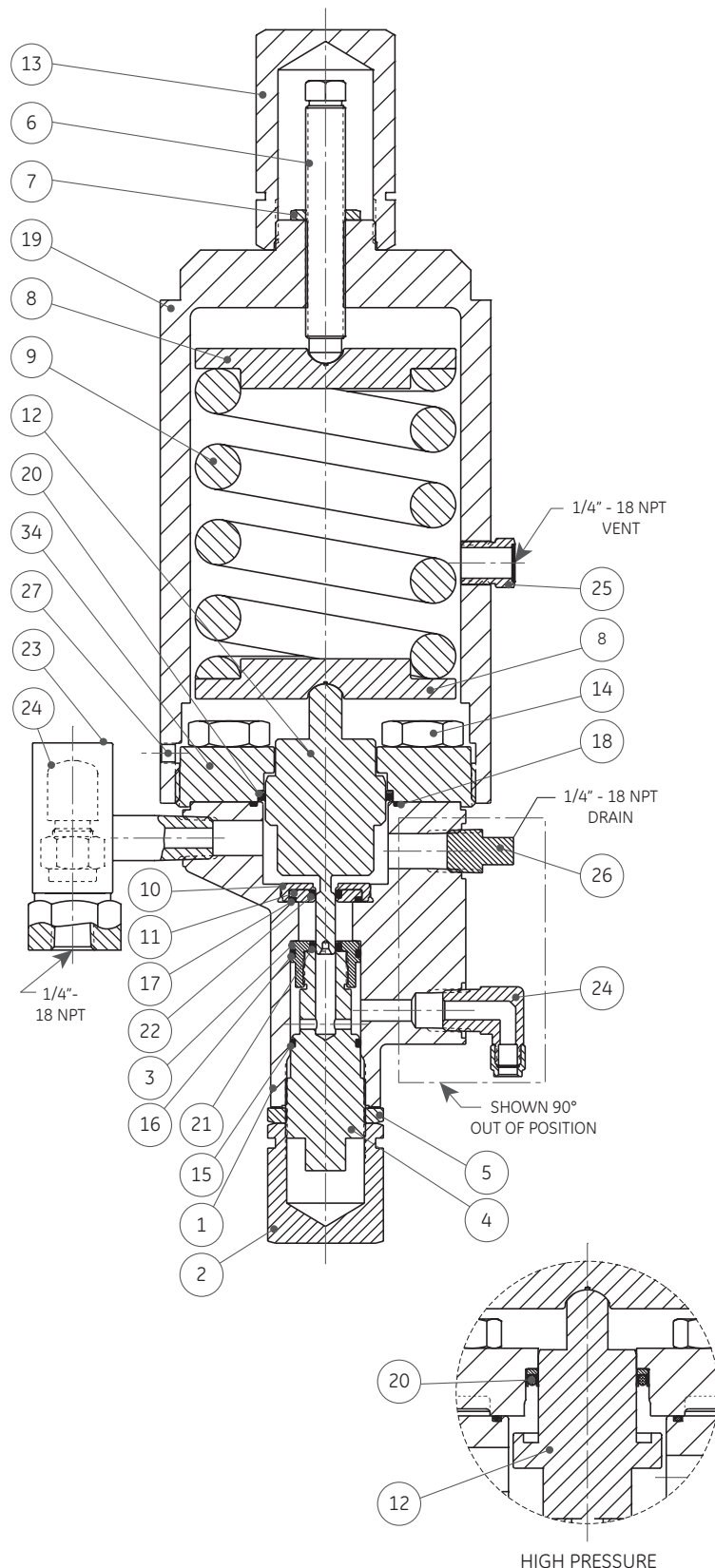


Figure 8: Soft Seat Construction for Section I Liquid Service (LA1)

Part No.	Nomenclature
2	Nozzle
7	Disc
8	Disc Retainer
9	Disc Holder
10	Guide
17	O-Ring Retainer Lock Screw
18	O-Ring Retainer
19	O-Ring Seat Seal

IX. 2900 Series Pilot Operated Safety Relief Valves (Cont.)

H. 39PV07/37 Pilot Valves (Standard Service)



Part No.	Nomenclature
1	Main Base
2	Adjuster Cap
3	Adjuster Top
4	Adjuster Bottom
5	Adjuster Lock Nut
6	Compression Screw
7	Compression Screw Lock Nut
8	Spring Washer
9	Spring
10	Insert Top
11	Insert Bottom
12	Main Piston
13	Cap (Compression Screw)
14	Cap Screw (Top Plate)
15	O-Ring (Adjuster Bottom)
16	O-Ring (Adjuster Top)
17	O-Ring (Insert)
18	O-Ring (Top Plate)
19	Bonnet
20	Spring Seal (Main Piston)
21	Spring Seal (Adjuster Top)
22	Spring Seal (Insert)
23	Field Test Connector
24	Vent Assembly/Bug Screen (Field Test Connection)
25	Vent Assembly (Bonnet Vent) ⁽¹⁾
26	Pipe Plug (Pilot Valve)
27	Set Screw (Bonnet)
34	Top Plate
35	Plug Filter (Used in Sensing Tube When Equipped) (not shown)

1. Standard material is a filter plug. For special materials, vent assembly is supplied.

Figure 9: 39PV07/37 Pilot Valve Construction

IX. 2900 Series Pilot Operated Safety Relief Valves (Cont.)

I. 39MV07 Pilot Valve (Standard Service)

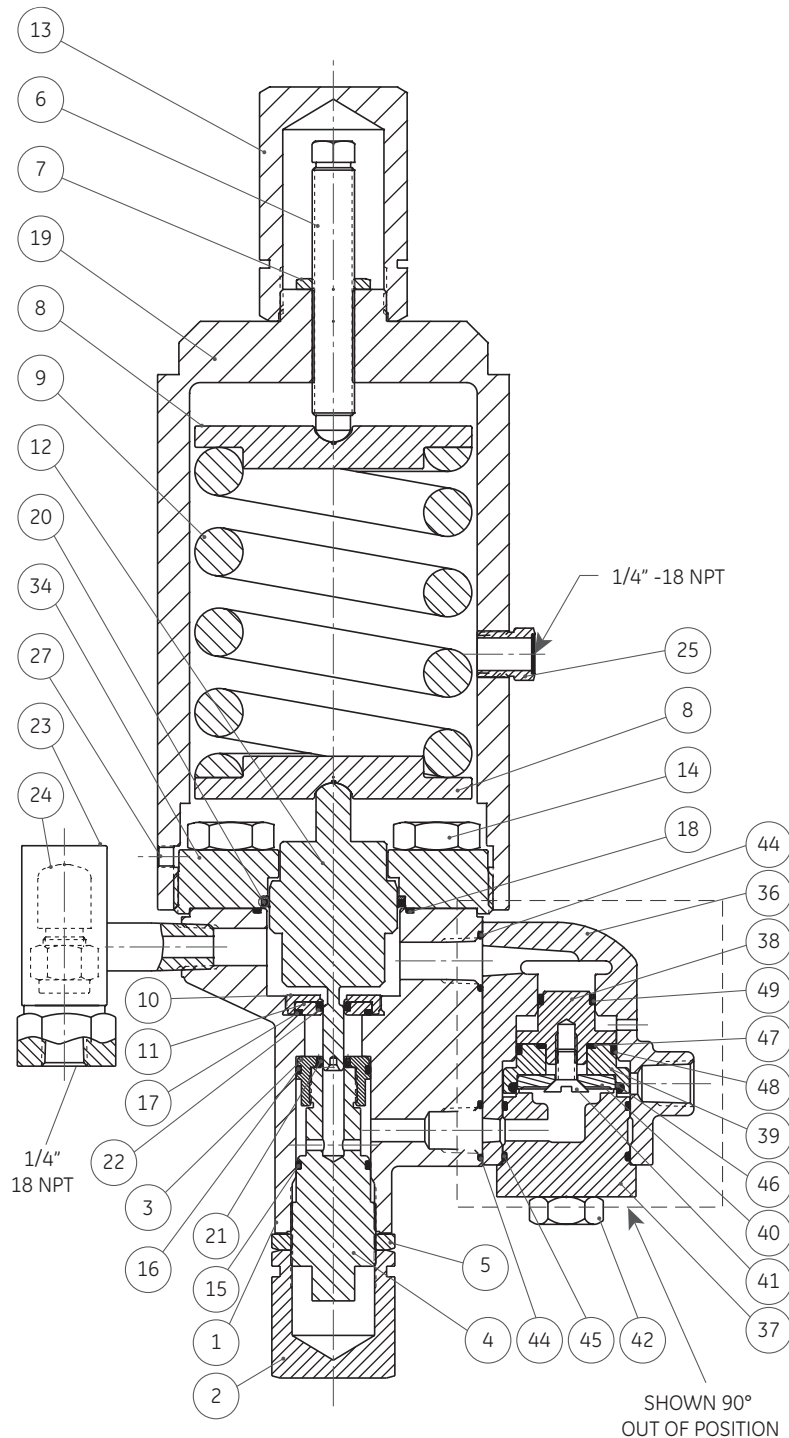


Figure 10: 39MV07 Pilot Valve Construction

Part No.	Nomenclature
1	Main Base
2	Adjuster Cap
3	Adjuster Top
4	Adjuster Bottom
5	Adjuster Lock Nut
6	Compression Screw
7	Compression Screw Lock Nut
8	Spring Washer
9	Spring
10	Insert Top
11	Insert Bottom
12	Main Piston
13	Cap (Compression Screw)
14	Cap Screw (Top Plate)
15	O-Ring (Adjuster Bottom)
16	O-Ring (Adjuster Top)
17	O-Ring (Insert)
18	O-Ring (Top Plate)
19	Bonnet
20	Spring Seal (Main Piston)
21	Spring Seal (Adjuster Top)
22	Spring Seal (Insert)
23	Field Test Connector
24	Vent Assembly/Bug Screen (Field Test Connection)
25	Vent Assembly (Bonnet Vent) ¹
27	Set Screw (Bonnet)
34	Top Plate
35	Plug Filter (Used in Sensing Tube When Equipped) (not shown)
36	Modulator Base
37	Modulator Stop
38	Modulator Piston Top
39	Modulator Piston Bottom
40	O-Ring Retainer
41	Lock Screw (Retainer)
42	Cap Screw (Modulator)
43	Socket Head Cap Screw (Modulator)
44	O-Ring (Modulator Base)
45	O-Ring (Modulator Stop)
46	O-Ring (Modulator Seat)
47	O-Ring (Modulator Piston Bottom)
48	Spring Seal (Piston Bottom)
49	Spring Seal (Piston Top)

1: Standard material is a filter plug. For special materials, vent assembly is supplied.

IX. 2900 Series Pilot Operated Safety Relief Valves (Cont.)

J. 39MV22/72 Pilot Valve (Standard Service)

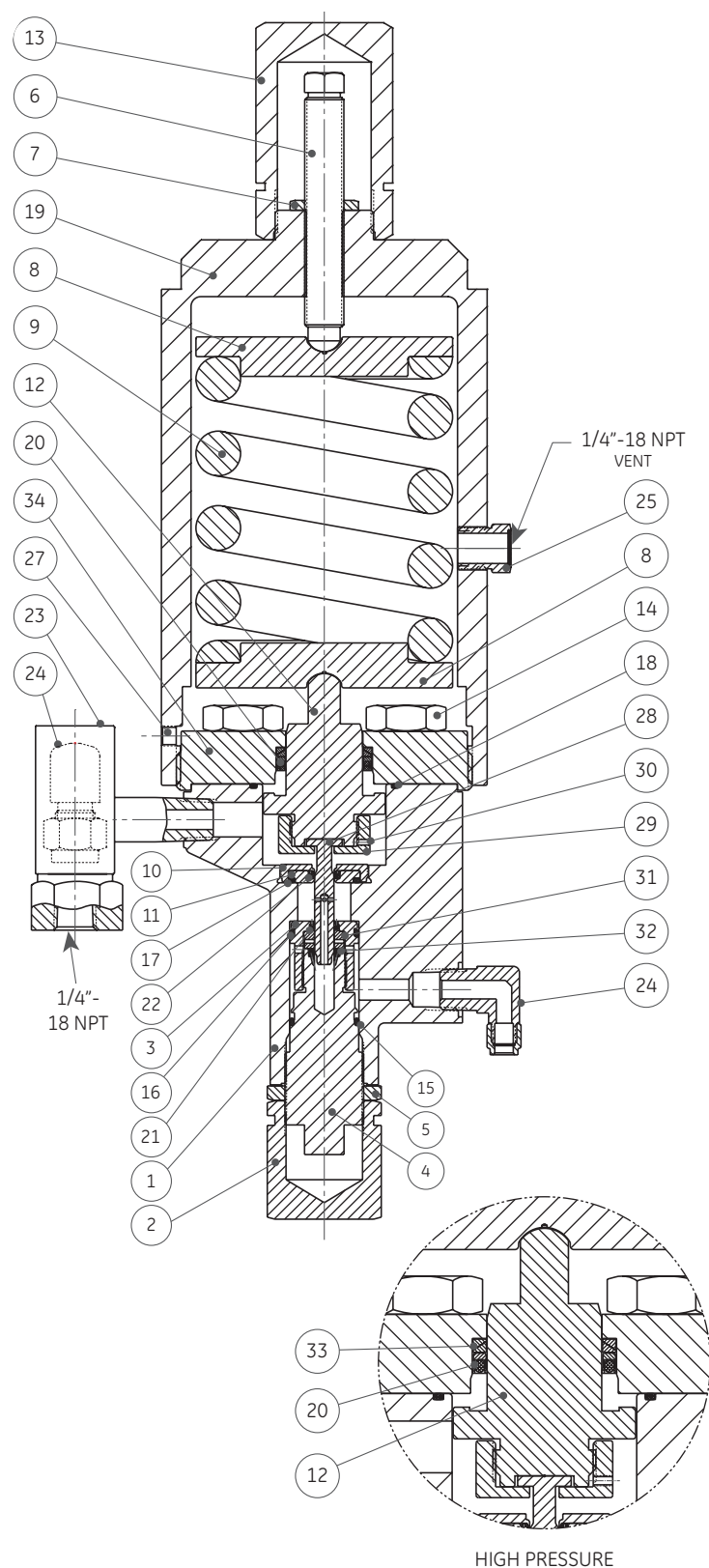


Figure 11: 39MV22/72 Pilot Valve Construction

Part No.	Nomenclature
1	Main Base
2	Adjuster Cap
3	Adjuster Top
4	Adjuster Bottom
5	Adjuster Lock Nut
6	Compression Screw
7	Compression Screw Lock Nut
8	Spring Washer
9	Spring
10	Insert Top
11	Insert Bottom
12	Main Piston
13	Cap (Compression Screw)
14	Cap Screw (Top Plate)
15	O-Ring (Adjuster Bottom)
16	O-Ring (Adjuster Top)
17	O-Ring (Insert)
18	O-Ring (Top Plate)
19	Bonnet
20	Spring Seal (Main Piston)
21	Spring Seal (Adjuster Top)
22	Spring Seal (Insert)
23	Field Test Connector
24	Vent Assembly/Bug Screen (Field Test Connection)
25	Vent Assembly (Bonnet Vent) ¹
27	Set Screw (Bonnet)
28	Piston Nose
29	Piston Retainer Nut
30	Set Screw (Piston)
31	Vent Seal (Adaptor)
32	Spring Seal (Vent Seal Adaptor)
33	Back-up Ring (39MV72 Only)
34	Top Plate
35	Plug Filter (Used in Sensing Tube When Equipped) (not shown)

1: Standard material is a filter plug. For special materials, vent assembly is supplied.

X. Operating Principles

A. 2900 Series with Type 39PV (Pop) Pilot Operational Descriptions

PV Valve Closed (Normal Position)

System pressure from the main valve inlet is fed to the dome by the pilot through interconnecting tubing. This equalizes the pressure on the top of the piston with inlet pressure on the seating surface (bottom) of the disc. Since the area of the top of the piston is larger than the area of the seating surface, the differential area results in a net downward force keeping the main valve tightly closed.

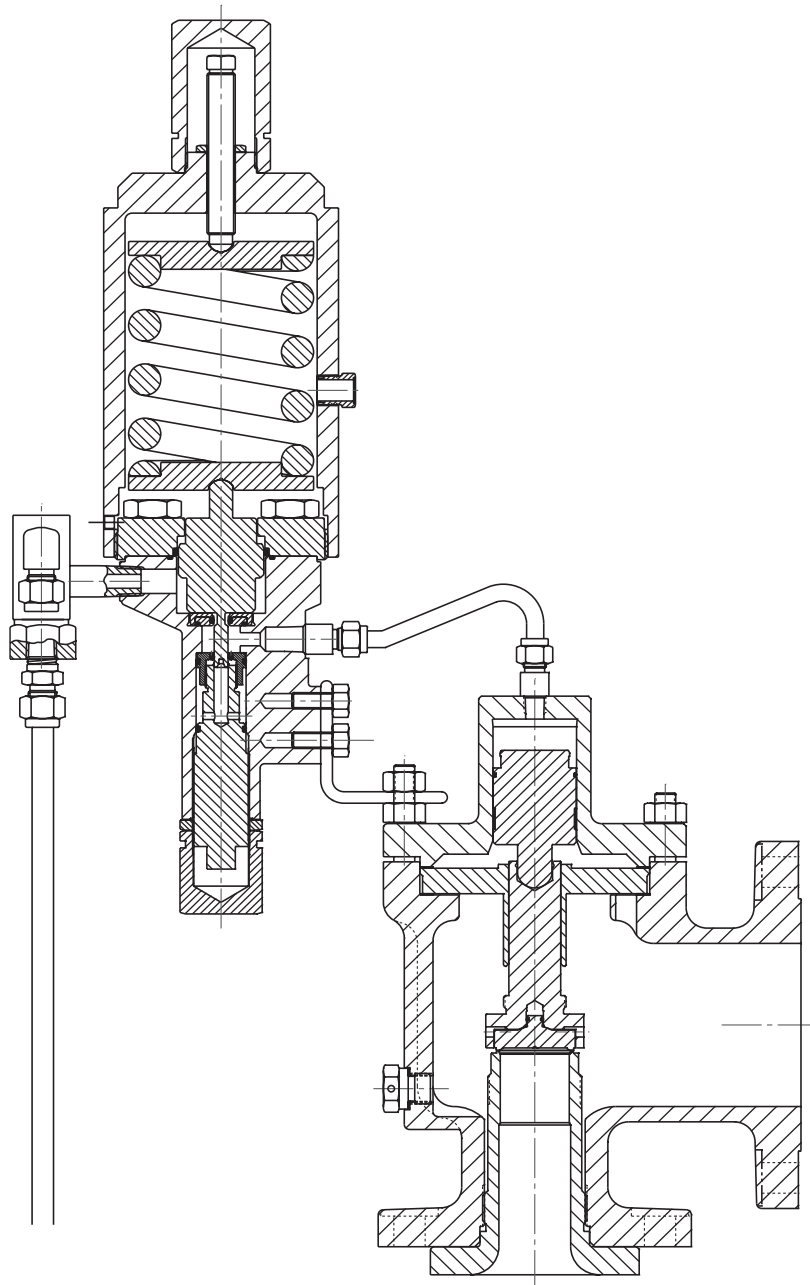


Figure 12: PV Valve Closed (Normal Position)

X. Operating Principles (Cont.)

A. 2900 Series with Type 39PV (Pop) Pilot Operational Descriptions (Cont.)

PV Valve OPEN (Relieving Position)

As inlet pressure increases, the pilot piston strokes and seals off the main valve inlet pressure from the dome pressure. The pilot simultaneously opens the vent seal to relieve the dome pressure to atmospheric pressure. The main valve disc is allowed to lift off the seat as the fluid force overcomes the now removed pressure load above the main valve piston. The valve discharges to relieve system pressure.

When the discharging main valve reduces the inlet pressure to the preset blowdown pressure of the pilot, the pilot piston closes the vent seal. Simultaneously, the inlet seal is reopened in the pilot. The main valve inlet pressure is again allowed to enter the dome above the main valve piston. As the dome pressure equalizes with the inlet pressure, the downward force created by the differential areas of the piston and disc closes the main valve.

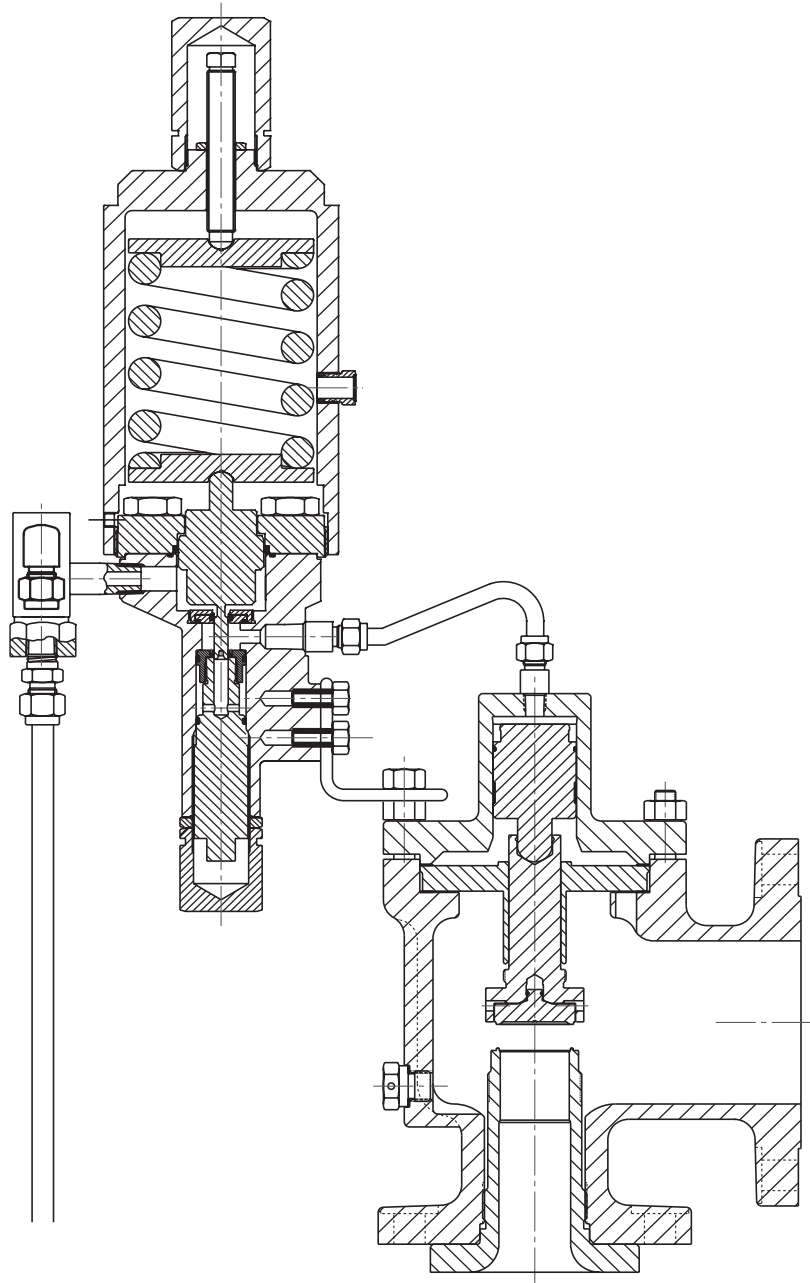


Figure 13: PV Valve OPEN (Relieving Position)

X. Operating Principles (Cont.)

B. 2900 Series 39MV07 (Modulating) Pilot – Operational Description

MV07 Valve Closed (Normal Position)

System pressure from the main valve inlet is fed to the dome by the pilot through interconnecting tubing. This equalizes the pressure on the top of the piston with inlet pressure on the seating surface (bottom) of the disc. Since the area of the top of the piston is larger than the area of the seating surface, the differential area results in a net downward force keeping the main valve tightly closed.

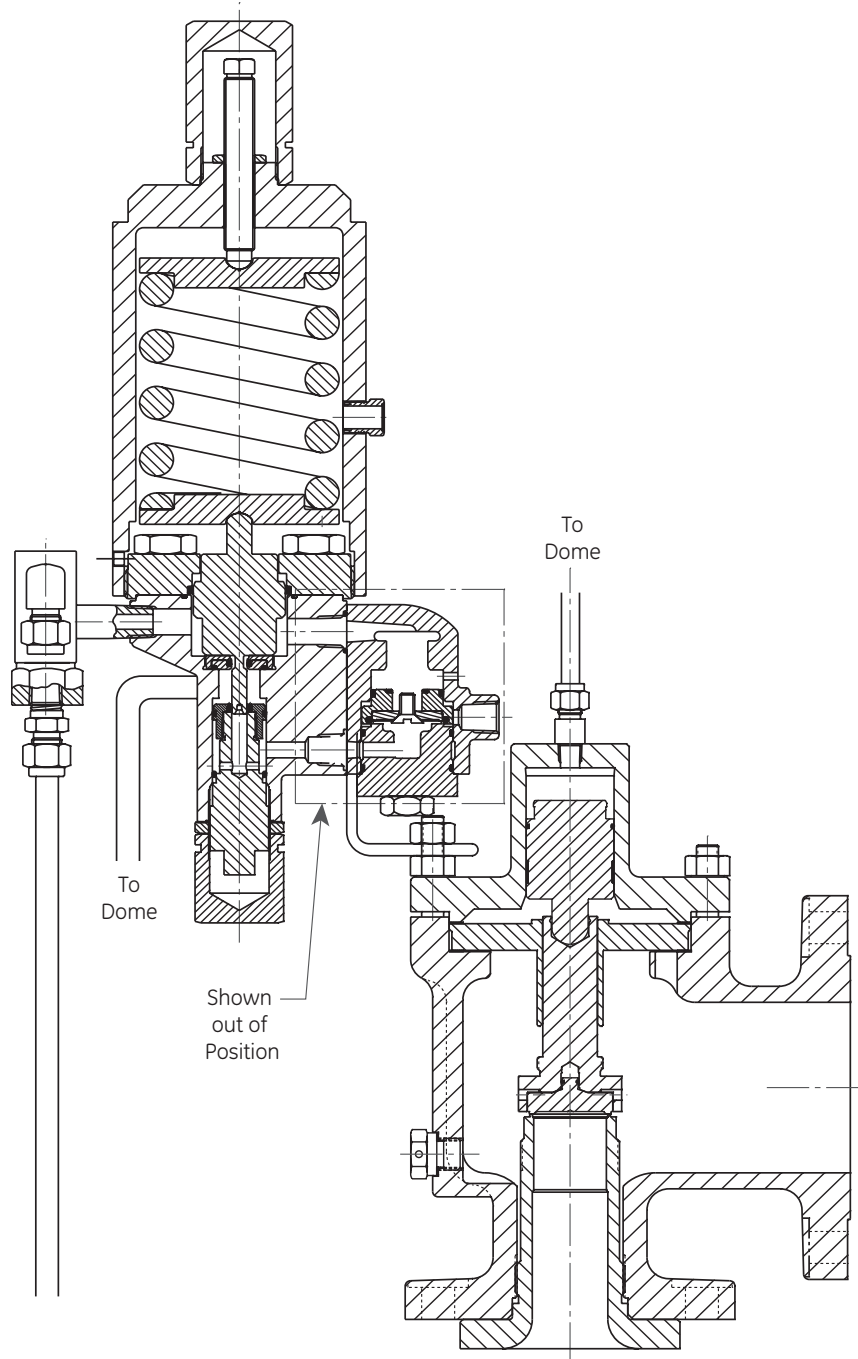


Figure 14: MV07 Valve Closed (Normal Position)

X. Operating Principles (Cont.)

B. 2900 Series 39MV07 (Modulating) Pilot – Operational Description (Cont.)

MV07 Valve Modulating (Partial Relieving Position)

As inlet pressure increases, the pilot piston strokes and seals off the main valve inlet pressure from the dome pressure. The pilot simultaneously opens the vent seal to relieve the dome pressure to the bottom of the modulator piston. The modulator piston has a differential area with the smaller area being on top of the modulator piston. The top of this piston always sees the main valve inlet pressure. When the dome pressure is applied to the bottom of the modulator piston, there is a net upward force. This is due to both pressures being equal (at this point), and the lower area being larger than the upper area. The modulator relieves the pressure from the dome to the atmosphere until force from the inlet pressure on top of the modulator piston is sufficient to move it to the closed position. A certain amount of pressure remains in the dome. This pressure is controlled by the differential area in the modulator. Since the dome pressure has not been dropped to atmospheric pressure, the main valve only partially opens at the set point. The modulator piston will remain closed until the main valve disc is forced into higher lift by increasing inlet pressure. As this occurs, the modulator piston may relieve further pressure from the dome as necessary to achieve the required main disc lift within 10% overpressure.

MV07 Fully Open (Full Relieving Position)

As the inlet pressure increases further, the net upward force on the main valve disc increases, allowing the main valve to relieve more pressure. The disc obtains full lift (full capacity) within 10% of set pressure. When the discharging valve reduces the inlet pressure to the preset blowdown pressure of the pilot, the pilot piston closes the vent seal. Simultaneously, the inlet seal is reopened in the pilot. The main valve inlet pressure is again allowed to enter the dome above the main valve piston. As the dome pressure equalizes with the inlet pressure, the downward force created by the differential areas of the piston and disc closes the main valve.

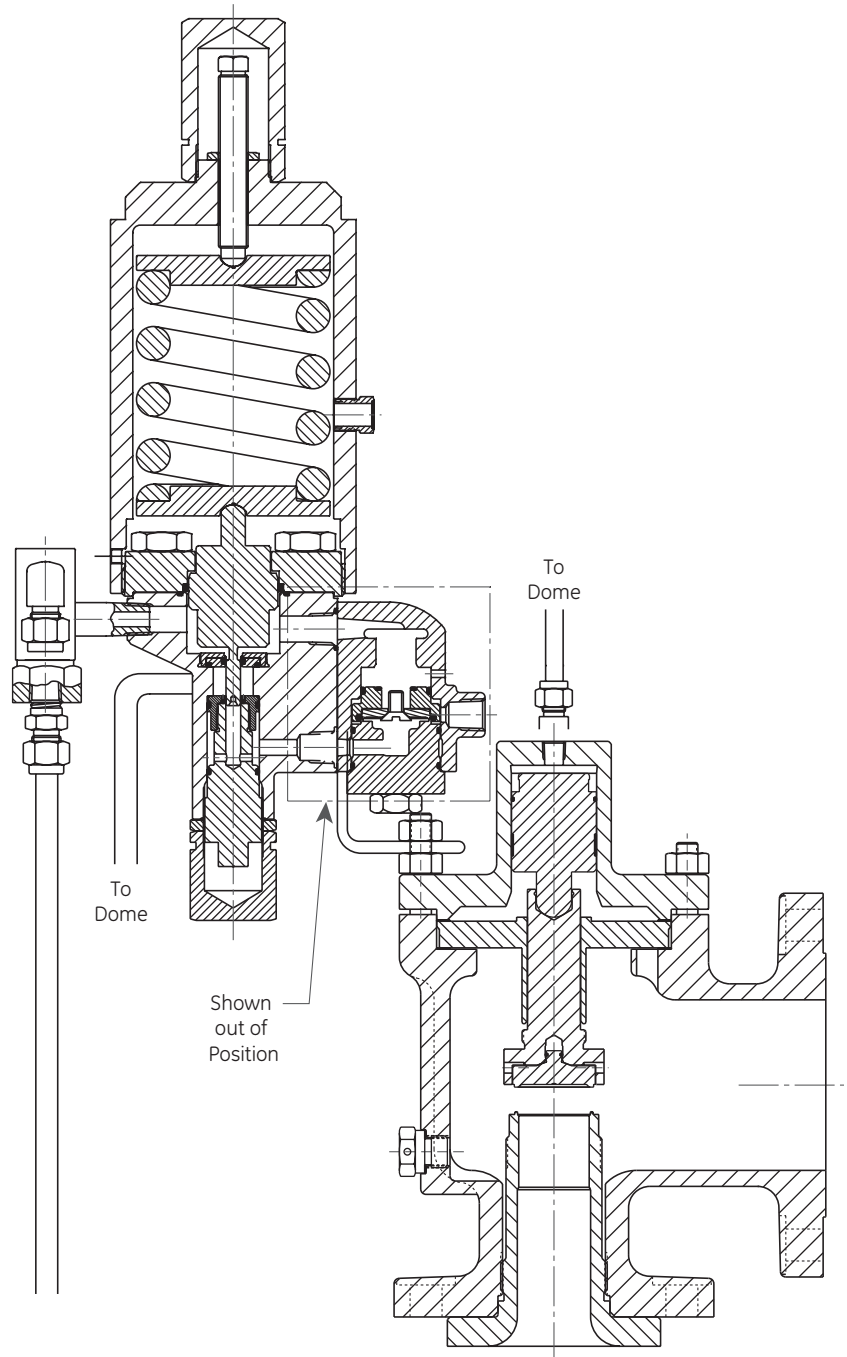


Figure 15: MV07 Valve Modulating (Partial Relieving Position)

XI. General Planning for Maintenance

A 12-month maintenance interval is recommended for general service conditions. For severe service applications, a 3 to 6 month inspection and test interim may be more appropriate. The specific plant's operating and service history will better determine this frequency. Baker Hughes encourages preventive maintenance.

The 2900 series Pilot Operated Safety Relief Valve (POSRV) is easily maintained. Normal maintenance usually involves:

- Removal of pilot valve from main valve
- Disassembly of both the pilot and main valve
- Cleaning
- Component Inspection
- Parts Replacement as Needed
- Reassembly
- Setting, Testing and Resealing the Valve

Occasionally, remachining the nozzle may be necessary to extend the service life of the valve. Keep all parts for each valve separated to ensure replacement in the same valve.

Note: *Insure there is no pressure in the inlet of the valve before attempting to remove it from the piping system.*

XII. Recommended Installation Practices

A. Mounting Position

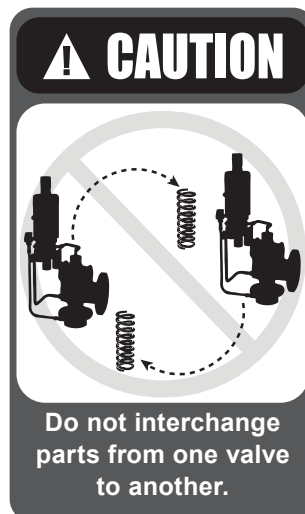
The POSRVs should be mounted in a vertical upright position (in accordance with API RP 520). Installing a pilot operated safety relief valve in any position other than vertical (± 1 degree) will adversely affect its operation as a result of induced misalignment of moving parts.

A stop valve may be placed between the pressure vessel and its relief valve only as permitted by code regulations. If a stop valve is located between the pressure vessel and POSRV, the stop valve port area should equal or exceed the nominal internal area associated with the pipe size of the POSRV inlet. The pressure drop from the vessel to the POSRV shall not exceed 3% of the valve's set pressure, when flowing at full capacity.

Ensure the flanges and sealing faces of the valve and connective piping are free from dirt, sediment, and scale.

Ensure all flange bolts are drawn evenly to prevent distortion of the valve body and the inlet nozzle.

Position the POSRVs for easy access and/or removal so that servicing can be properly performed. Ensure sufficient working space is provided around and above the valve.



XII. Recommended Installation Practices (Cont.)

B. Inlet Piping

The inlet piping (Figure 16) to the valve should be short and direct from the vessel, or equipment, being protected. The radius of the connection to the vessel should permit smooth flow to the valve. Avoid sharp corners. If this is not practical, then the inlet should be at least one additional pipe diameter larger. The pressure drop from the vessel to the valve shall not exceed 3% of valve set pressure when the valve is allowing full capacity flow. The inlet piping should never be smaller in diameter than the inlet connection of the valve. Excessive pressure drop in gas, vapor, or flashing- liquid service at the inlet of the POSRV will cause extremely rapid opening and closing of the valve, which is known as “chattering”. Chattering will result in lowered capacity and damage to the seating surfaces. The most desirable installation is that in which the nominal size of the inlet piping is the same as, or greater than, the nominal size of the valve inlet flange; and in which the length does not exceed the face-to-face dimensions of a standard tee of the required pressure class.

Do not locate POSRV inlets where excessive turbulence is present, such as near elbows, tees, bends, orifice plates or throttling valves.

Section VIII of the ASME Boiler and Pressure Vessel Code requires the inlet connection design to consider stress conditions during valve operation, caused by external loading, vibration, and loads due to thermal expansion of the discharge piping.

The determination of reaction forces during valve discharge is the responsibility of the vessel and/or piping designer. Baker Hughes publishes certain technical information about reaction forces under various fluid flow conditions, but assumes no liability for the calculations and design of the inlet piping.

External loading, by poorly designed discharge piping and support systems, and forced alignment of discharge piping can cause excessive stresses and distortions in the valve as well as the inlet piping.

The stresses in the valve may cause a malfunction or leak. Therefore, discharge piping must be independently supported and carefully aligned.

Vibrations in the inlet piping systems may cause valve seat leakage and/or fatigue failure. These vibrations may cause the disc seat to slide back and forth across the nozzle seat and may result in damage to the seating surfaces. Also, vibration may cause separation of the seating surfaces and premature wear to valve parts. High-frequency vibrations are more detrimental to POSRV tightness than low-frequency vibrations. This effect can be minimized by providing a larger difference between the operating pressure of the system and the set pressure of the valve, particularly under high frequency conditions.

Temperature changes in the discharge piping may be caused by fluid flowing from the discharge of the valve or by prolonged exposure to the sun or heat radiated from nearby equipment. A change in the discharge piping temperature will cause a change in the length of the piping, which may cause stresses to be transmitted to the POSRV and its inlet piping. Proper support, anchoring or provision for flexibility of the discharge piping can prevent stresses caused by thermal changes. Do not use fixed supports.

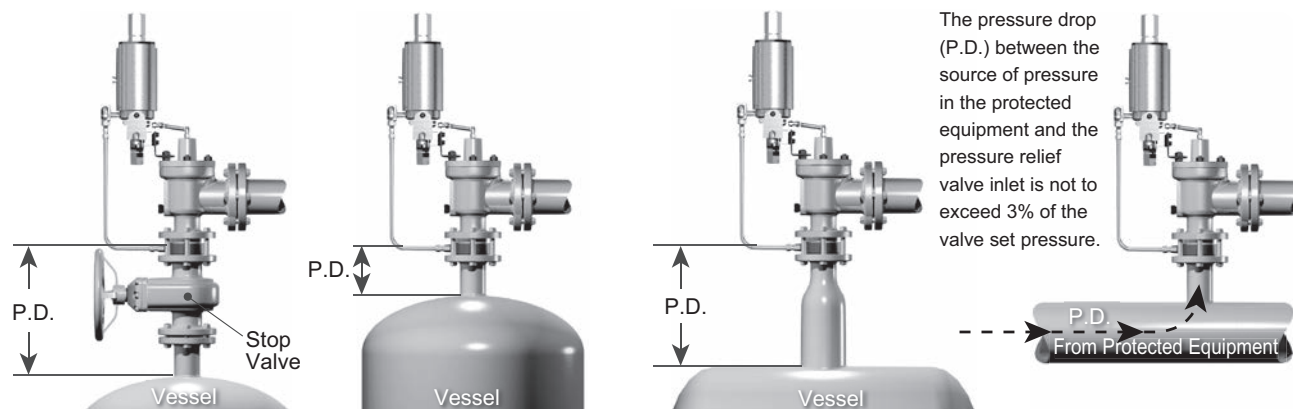


Figure 16: Pressure Drop on the Inlet Piping

XII. Recommended Installation Practices (Cont.)

C. Outlet Piping

Alignment of the internal parts of the POSRV is important to ensure proper operation (see Figure 19). Although the valve body will withstand a considerable mechanical load, unsupported discharge piping consisting of more than a companion flange long-radius elbow, and a short vertical pipe is not recommended. Use spring supports to connect outlet piping to prevent thermal expansion from creating strains on the valve. The discharge piping should be designed to allow for vessel expansion as well as expansion of the discharge pipe itself. This is particularly important on long distance lines.

A continual oscillation of the discharge piping (wind loads) may induce stress distortion in the valve body. The resultant movement of the valve's internal parts may cause leakage.

Where possible, use properly supported drainage piping to prevent the collection of water or corrosive liquid in the valve body.

In every case, the nominal discharge pipe size should be at least as large as the nominal size of the POSRV outlet flange. In the case of long discharge piping, the nominal discharge pipe size must sometimes be much larger.

D. Integral Sensing

The 2900 Series Gen II with standard integral sensing ring will be delivered complete with tubing that is disconnected from the main valve inlet to prevent damage during shipment and handling. There is one location for a tubing connection point. The tubing union location is illustrated in Figure 17.

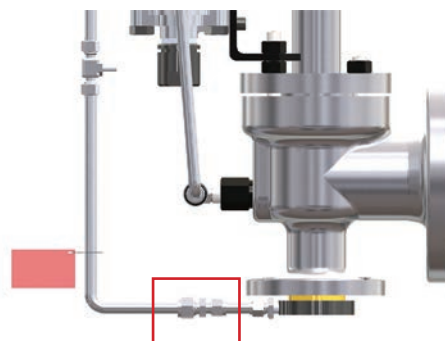


Figure 17: Integral Sensing Tubing Union and Tag

It is recommended to install the integral sensing ring and gaskets on the inlet flange before lifting the valve into place for installation and reconnecting the tubing before final tightening of the flange bolting.

Every 2900 Series Gen II with integral sense will have an installation warning tag wired at the 1/4" to 3/8" tubing union (as shown in Figure 18).

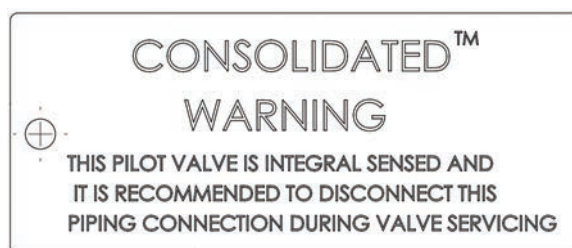


Figure 18: Integral Sensing Warning Tag

It is recommended to detach tubing union connection prior to lifting the valve off the inlet piping to prevent damage to tubing. The warning tag part number is 7723101.

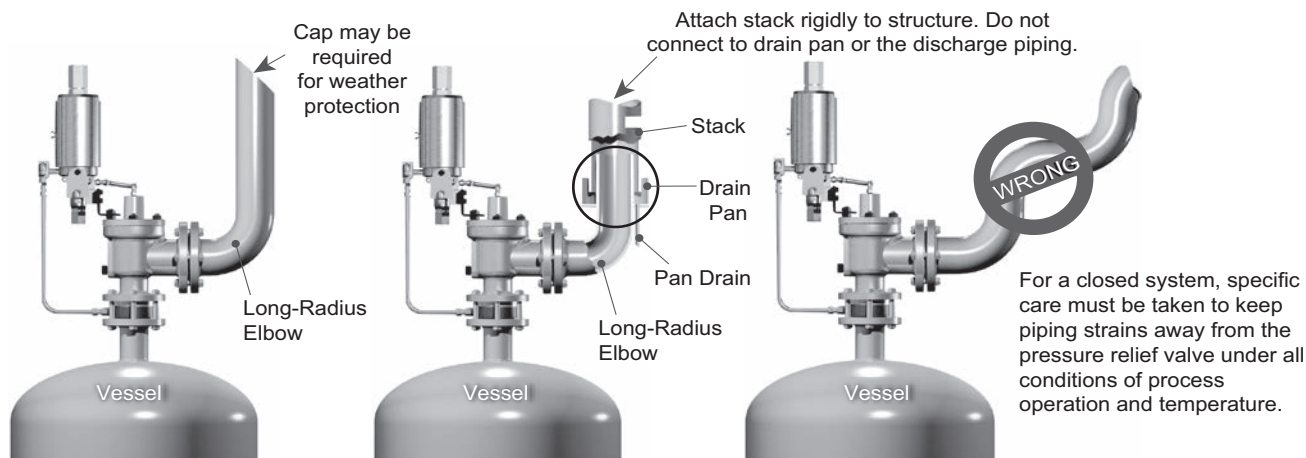


Figure 19: POSRV Parts Alignment

XII. Recommended Installation Practices (Cont.)

E. Remote Sensing

If the pressure drop between the source of pressure in the equipment to be protected and the pressure at the relief valve inlet exceeds 3%, the sensing line to the pilot valve should be connected directly to the equipment being protected. The optional sensing ring should not be installed. For remote sensing, .375" (9.53 mm) diameter tubing is adequate for distances up to 10 feet, (3.048 m). If distance is longer than 10 feet (3.048 m), please contact Baker Hughes Application Engineering.

ATTENTION!

Change in elevation between relief valve and source of sensing line may cause set pressure changes.

For block valve and other special installation features consult API 520 or the factory.

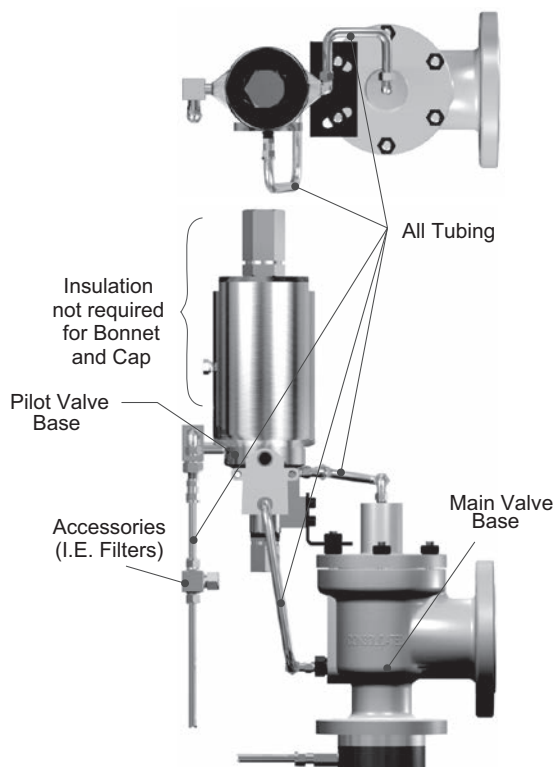


Figure 20: Pilot Operated Safety Relief Valve

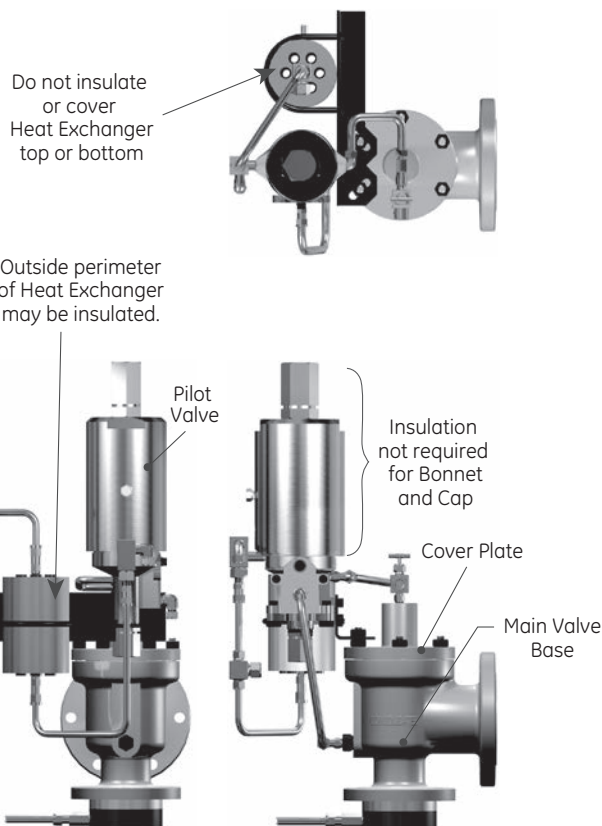


Figure 21: POSRV with Heat Exchanger

F. Freeze Protection

Type of Applications:

1. Applications where the process media, in the liquid state, has a freezing point between the ambient temperature limits of the local region.
2. Steam service applications where the pilot operated valve is exposed to the climate, extreme cold ambient temperatures.

Example: the condensed steam in the pilot and tubing may become frozen.

3. Applications where the process media is temperature sensitive to thick formations.

Example: Hydrocarbon applications where the possibility of hydrate formation may occur.

Reasons for Freeze Protection:

1. If the pilot sensing line becomes clogged or frozen, then system pressure can be isolated from the pilot valve. This will not allow the pilot to detect system pressure, open and relieve the overpressure situation.
2. Recommendations for insulating and heat tracing pilot operated safety relief valve:
 1. **Types of freeze protection:**
 - a. Insulation by fiberglass blankets or wrap.
 - b. Heat tracing with electrical heat tape.
 - c. Radiant heat sources, such as a heat lamp.

For applications where heat tracing or radiant heaters are used, the temperature should be limited to approximately 200°F (93.3°C) so that the elastomers are not damaged. Higher temperatures may be allowed upon review of the application.

Valve illustrations showing acceptable locations for insulation are shown in Figures 20 and 21. Figure 20 shows a standard pilot operated relief valve. Figure 21 shows a pilot operated relief valve equipped with a heat exchanger.

XIII. Disassembly of the 2900 POSRV

A. Removal of Pilot Valve from Main Valve

1. Make sure there is no media pressure in the vessel, in the valve inlet, in the main valve, or in the pilot valve.
2. Disconnect the Sensing Tube, Dome Tube and Discharge Line from the Pilot Valve.
3. All other external attachments should be removed to free the Pilot Valve for Disassembly.
4. Loosen and remove the two cap bolts holding the pilot valve to the mounting bracket.
5. Place parts in the order they are disassembled to facilitate reassembly.

B. Disassembly of Main Valve

Note: If the pilot valve has not been removed, then refer to Section XIII.A.

1. If applicable, remove sensing tube fitting from Sensing Tube
2. Remove and discard Plug Filter from Sensing Tube (if applicable).
3. Loosen and remove the Stud Nuts on the Cover Plate.
4. Remove the Bracket.
5. Install 1/4" MNPT pipe plug into Cover Plate where dome line is installed. Pipe plug will prevent Main Valve Piston from falling out of Cover Plate when the assembly is removed.
6. Remove Cover Plate and Main Valve Piston assembly from Base.

ATTENTION!

If Main Valve Piston O-Ring or Spring Energize Seal is damaged, then Main Valve Piston may fall out of Cover Plate during disassembly.

7. Remove pipe plug from Cover Plate.
8. Remove the Main Valve Piston from the Cover Plate using a dowel pressed through the center hole in the top of the Cover Plate.

⚠ DANGER



Lower pressure and stand clear of discharge when working on valve to avoid severe personal injury or death.

⚠ CAUTION



Wear necessary protective equipment to prevent possible injury

⚠ DANGER



Do not remove bolts if pressure in line, as this will result in severe personal injury or death

⚠ WARNING



Know all valve exhaust/leakage points to avoid possible severe personal injury or death

XIII. Disassembly of the 2900 POSRV (Cont.)

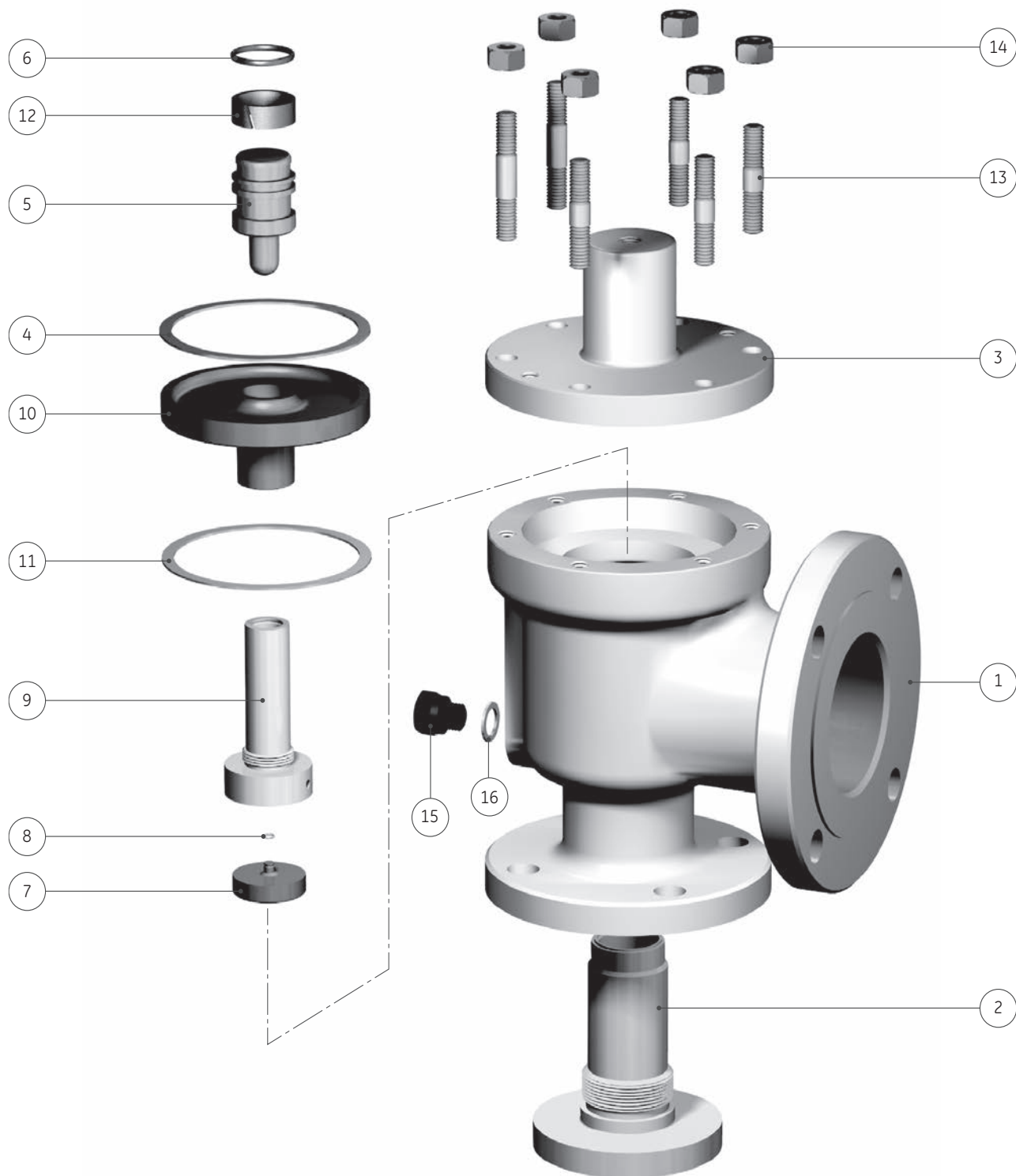


Figure 22: Conventional Metal Seat Valve Disassembly

XIII. Disassembly of the 2900 POSRV (Cont.)

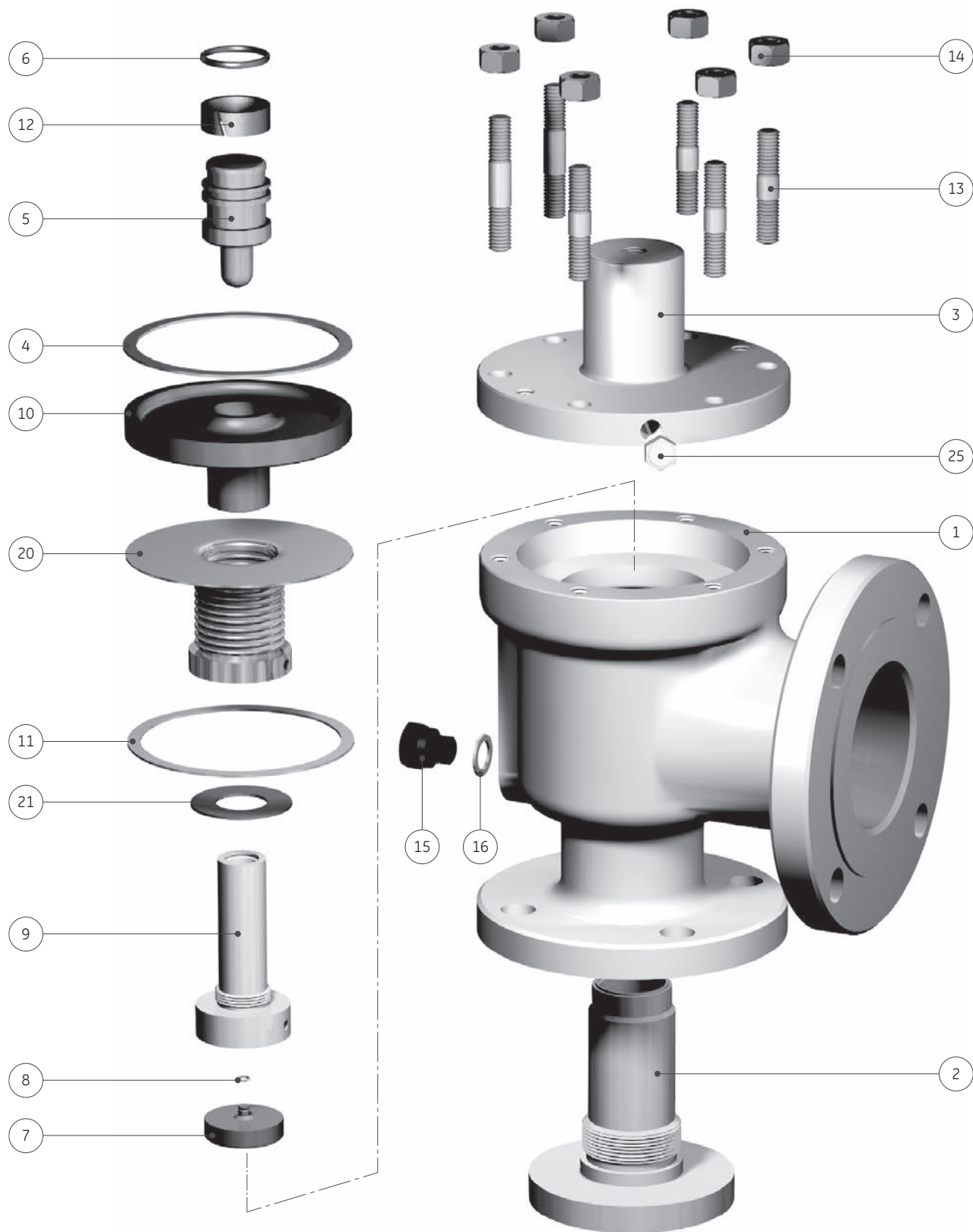


Figure 23: Bellows Metal Seat Valve Disassembly

XIII. Disassembly of the 2900 POSRV (Cont.)

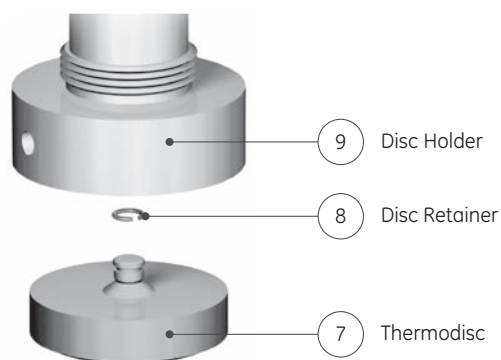


Figure 24: Thermodisc

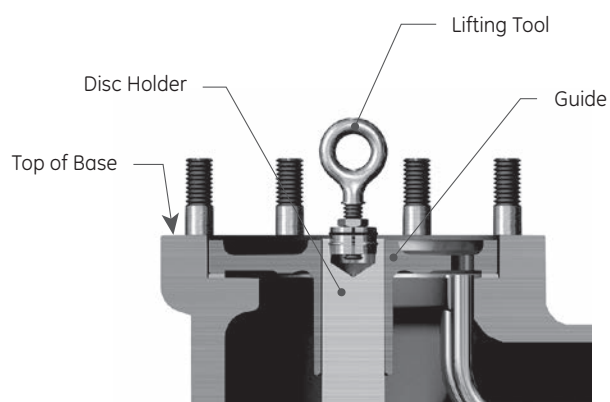


Figure 27: Disc Holder Removal Tool (P-U)

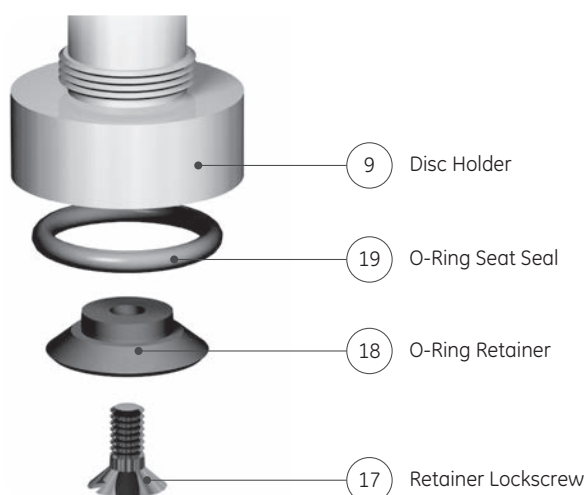


Figure 25: O-Ring Seat (D-J Orifices)

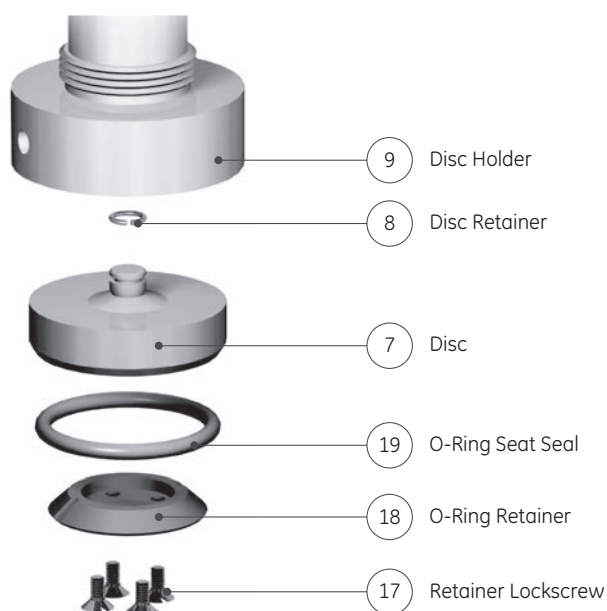


Figure 26: O-Ring Seat (K-W Orifices)

9. Remove the Cover Plate Gasket.
10. For “D” through “N” orifice, removed Disc Holder and Guide.

For “P” through “U” orifices, install the Disc Holder Removal Tool (Baker Hughes P/N 4464604) in the top of the Disc Holder as shown in Figure 27. Lift out and remove the Guide and Disc Holder. Remove the Lifting Tool from the top of the Disc Holder.

On “V” and “W” orifice valves thread two 5/8-11 NC Standard Eye Bolts into the top of the Disc Holder as shown in Figure 28. Lift out and remove the Guide and Disc Holder. Remove the Eye Bolts from the top of the Disc Holder.

11. Lift the Guide off the Disc Holder. If the valve has a Bellows avoid damage to the gasket seating surfaces, and if present the convolutions or the flange section of the Bellows.

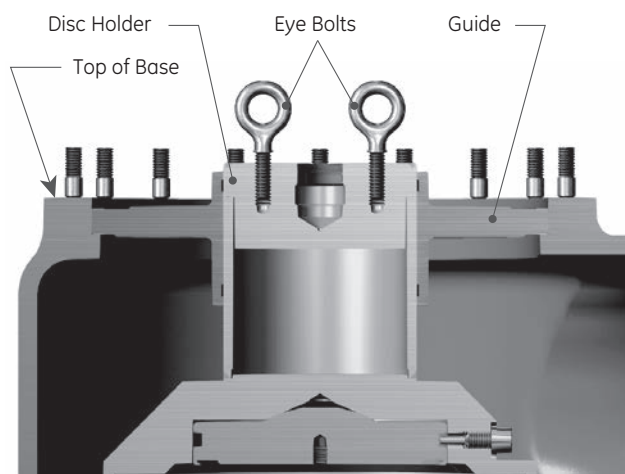


Figure 28: Disc Holder Removal Tool (V & W)

XIII. Disassembly of the 2900 POSRV (Cont.)

12. For D through U orifice bellows valves, the bellows is attached to the disc holder by right-hand threads. Use a special spanner wrench on the bellows ring to remove it by turning counterclockwise (Figure 29).

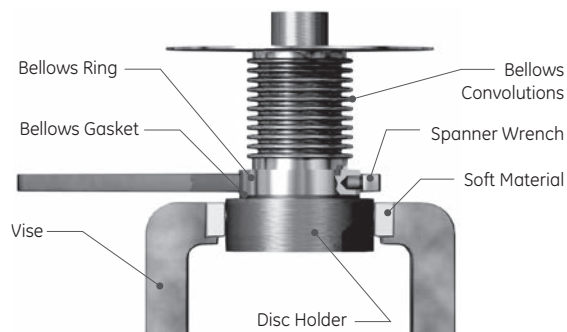


Figure 29: Removal of Bellows Ring

For V and W orifice bellows valves, the bellows is bolted to the disc holder. Remove these bolts to disassemble the bellows from the disc holder.

ATTENTION!

The bellows convolutions are very thin and fragile. Take care to protect them from damage.

13. Remove the bellows gasket.
14. Follow the procedure appropriate to the orifice valve type:
- For D through U orifice valves, remove the disc from the disc holder as follows:

- Clamp the stem portion of the disc holder, disc end up, firmly between two wooden V-blocks in a vise.
- Start inserting special drift pins into the holes in the disc holder (Figure 28) with the tapered portion of the pins working against the top of the disc, as indicated. See Figure 93 and Table 21 in the Maintenance Tools and Supplies section for drift pin size.
- Use a light machinist hammer to tap each pin alternately until the disc snaps out of the recess in the disc holder.
- For V and W orifice valves, remove the disc from the disc holder as follows:
- Turn the disc holder on its side.
- Remove the retaining bolts.
- Attach the lifting lug to the disc and lift out.

15. For O-Ring seat seal valves only, remove the

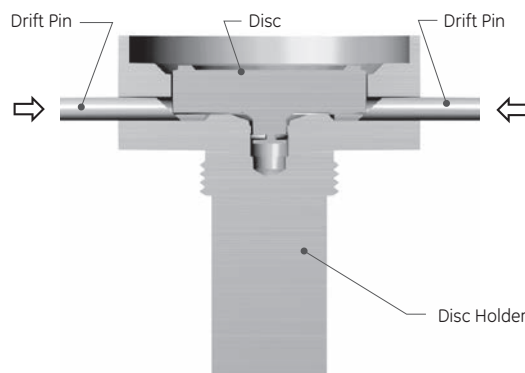


Figure 30: Removing the Disc with Drift Pins

Retainer Lock Screw(s), O-Ring Retainer, and O-Ring Seat Seal.

B.1 Nozzle Removal

B.1.1 Remote Sense Nozzle

- The nozzle is threaded onto the base and is removed by turning it counterclockwise (from right to left). Before removing the nozzle, soak the threaded joint with a suitable penetrating liquid or solvent. If the nozzle is frozen to the base, apply dry ice or other cooling medium to the inside of the nozzle and heat the base from the outside with a blowtorch in the area of the nozzle threads.

ATTENTION!

Should heat be applied, use care to prevent cracking of cast parts.

- Using a three- or four-jaw chuck welded vertically to a stand bolted to a concrete floor, clamp the nozzle into the chuck and break the body loose with a heavy rod or pipe (Figure 30).

ATTENTION!

Exercise care when inserting a rod or pipe in the outlet. Ensure the valve nozzle is not damaged during the operation.

- Use a large pipe wrench on the nozzle flange to remove the nozzle from the base (Figure 31).

ATTENTION!

The nozzle is normally removed for routine maintenance and service.

XIII. Disassembly of the 2900 POSRV (Cont.)

4. Remove the Nozzle from the Valve Base as suggested in Figure 31, or by using a Hex wrench or a pipe wrench on the flange as indicated in Figure 32.

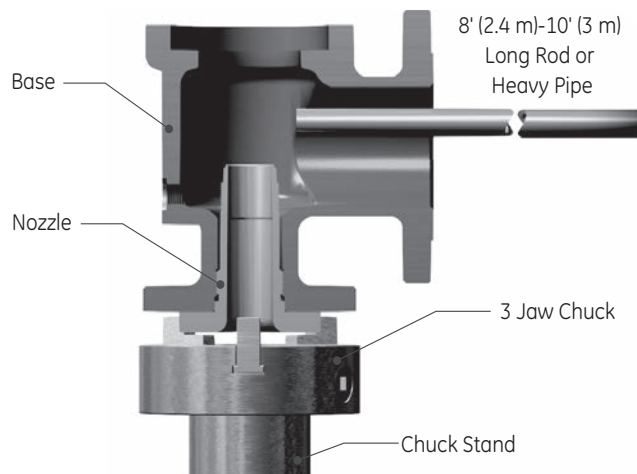


Figure 31: Loosening the Nozzle from the Base

5. The Main valve is ready for cleaning, inspection and refurbishing.
6. Discard all O-Rings, guide rings, and seals.

View From Top



View From Side

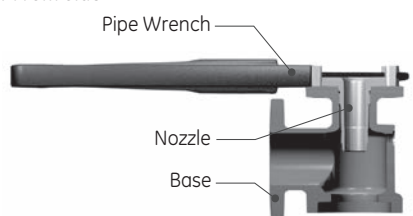


Figure 32: Removing the Nozzle from the Base

B.1.2.1 Integral Sensing Ring Disassembly

1. The 1/4" to 3/8" tubing reducer should be disconnected from the sensing ring before disassembly
2. Remove sensing ring and gasket from nozzle.

B.1.2.2 Integral Sense Nozzle Removal

1. The nozzle is threaded into the base and is removed by turning it counterclockwise (from right to left). Before removing the nozzle, soak the threaded joint with a suitable penetrating liquid or solvent. If the nozzle is frozen to the base, apply dry ice or other cooling medium to the inside of the nozzle and heat the base from the outside with a blowtorch in the area of the nozzle threads.

ATTENTION!

Should heat be applied, use care to prevent cracking of cast parts.

2. For nozzles with hex flanges, use method A or B. Nozzles with round flanges, use method B:
 - a. With a wrench/socket loosen the nozzle at the wrench location in Figure 33.
 - b. Using of a three or four-jaw chuck welded vertically to a stand bolted to a concrete floor or the 1900/2900 Nozzle Assembly Tool with the correct 2900 Integral Sense Torquing Tool Insert per the drawing in Section XXIII, loosen the nozzle at the Special Tools Only location in Figure 33.

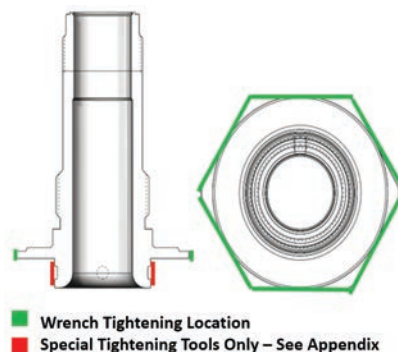


Figure 33: IS Nozzle Tightening Locations

3. Remove the Nozzle from the Valve Base as suggested in Figure 31, or by using a Hex wrench or a pipe wrench on the flange as indicated in Figure 32.
4. The Main valve is ready for cleaning, inspection and refurbishing.
5. Discard all O-Rings, guide rings, and seals.

C. Cleaning

1. Clean parts to remove all rust, burrs, scale, organic matter, and loose particles. Parts are to be free of any oil or grease except for lubrication as specified in this instruction.
2. Cleaning agents used shall be such that effective cleaning is assured without injuring the surface finishes or material properties of the part.
3. Acceptable cleaning agents include demineralized water, nonphosphate detergent, acetone, and isopropyl alcohol. Parts must be blown dry or wiped dry after cleaning.
4. If you are using cleaning solvents, take precautions to protect yourself from potential danger from breathing fumes, chemical burns, or explosion. See the solvent's Material Safety Data Sheet for safe handling recommendations and equipment.
5. Do not "sand blast" internal parts as it can reduce the dimensions of the parts.



XIV. Maintenance Instructions

A. General Maintenance Information

After the valve has been disassembled, a close inspection should be made of the seating surfaces. In a majority of cases, a simple lapping of seats is all that is necessary to put the valve in first class working order. If an inspection of the parts shows the valve seating surfaces to be badly damaged, machining will be required before lapping. O-Ring seat seal valve nozzles can only be reconditioned by machining, not lapping. (For specific information concerning the machining of nozzle and disc seating surfaces, see The Re-Machining Nozzle Seats and Bores and Re-Machining the Disc Seat sections.)

The seating surfaces of the metal seated Consolidated Safety Relief Valve are flat. The nozzle seat is relieved by a 5° angle on the outside of the flat seat. The disc seat is wider than the nozzle seat; thus, the control of seat width is the nozzle seat (see Figure 34).

Reconditioning of the seating surfaces of the nozzle and disc is accomplished by lapping with a cast iron lap, and lapping compound.

Anytime the V or W orifice valve is disassembled, be sure to inspect the Guide Rings for wear. If worn, replace before reassembly.

B. O-Ring Seat

The nozzle must not have any defects to prohibit the O-Ring from sealing properly, especially the OD of the seat where the surface must maintain a minimum of 32 RMS finish. See Figure 34 and Table 2 for reworking O-Ring Nozzle.

The O-Ring Retainer must also maintain a flat surface for it to sit on the Nozzle. Only polishing of surface can be done since material removal from this surface will cause the Nozzle to over engage O-Ring. Polishing paper or some other light abrasive can only be used since the part cannot function properly if its overall dimensions are changed significantly. If significant corrosion or damage has occurred on O-Ring retainer, discard and replace.

ATTENTION!

In order to establish leak free valve seats, the nozzle seating surface and the disc seating surface must be lapped flat..

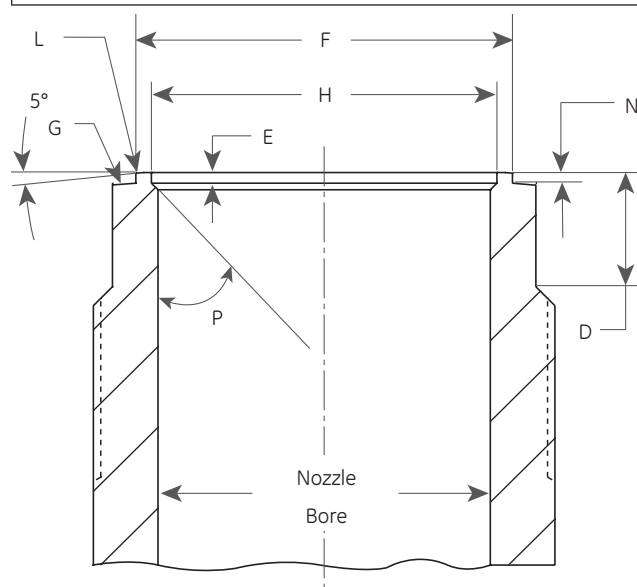


Figure 34a: Metal Seat Nozzle

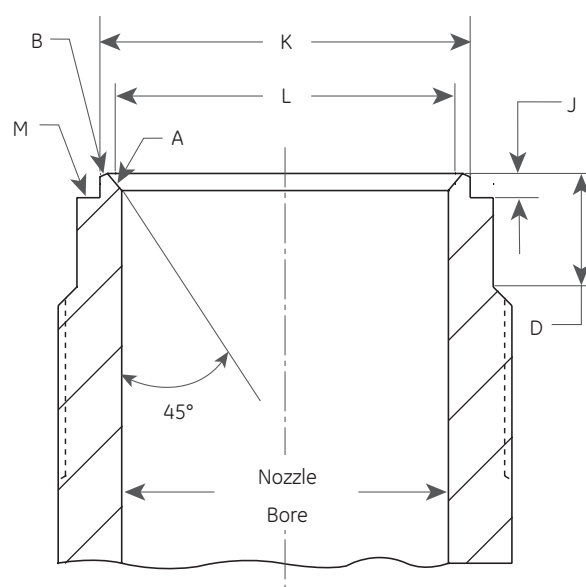


Figure 34b: Soft Seat Nozzle

Figure 34: Main Valve Nozzle Critical Dimensions

XIV. Maintenance Instructions (Cont.)

Table 2: Nozzle Critical Dimensions

Orifice	Nozzle Bore				D min.1		E ± .005” (0.13 mm)		F		H	
	min.		max.									
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm.	in.	mm.
D	.402	10.21	.409	10.39	.313	7.95	.030	0.76	.954 ± .001	24.23 ± 0.03	.831 ± .001	21.11 ± 0.03
E	.539	13.69	.544	13.82	.313	7.95	.030	0.76	.954 ± .001	24.23 ± 0.03	.831 ± .001	21.11 ± 0.03
F	.674	17.12	.679	17.25	.313	7.95	.030	0.76	.954 ± .001	24.23 ± 0.03	.831 ± .001	21.11 ± 0.03
G	.864	21.95	.869	22.07	.313	7.95	.035	0.89	1.093 ± .001	27.76 ± 0.03	.953 ± .001	24.21 ± 0.03
H	1.078	27.38	1.083	27.51	.250	6.35	.035	0.89	1.224 ± .001	31.09 ± 0.03	1.123 ± .001	28.52 ± 0.03
J	1.380	35.05	1.385	35.18	.375	9.53	.035	0.89	1.545 ± .001	39.24 ± 0.03	1.435 ± .001	36.45 ± 0.03
K	1.650	41.91	1.655	42.04	.438	11.13	.063	1.60	1.836 ± .002	46.63 ± 0.05	1.711 ± .002	43.46 ± 0.05
L	2.055	52.20	2.060	52.32	.438	11.13	.063	1.60	2.257 ± .002	57.33 ± 0.05	2.133 ± .002	54.18 ± 0.05
M	2.309	58.65	2.314	58.78	.438	11.13	.063	1.60	2.525 ± .002	64.14 ± 0.05	2.400 ± .002	60.96 ± 0.05
N	2.535	64.39	2.540	64.52	.500	12.70	.063	1.60	2.777 ± .002	70.54 ± 0.05	2.627 ± .002	66.73 ± 0.05
P	3.073	78.05	3.078	78.18	.625	15.88	.093	2.36	3.332 ± .002	84.63 ± 0.05	3.182 ± .002	80.82 ± 0.05
Q	4.045	102.74	4.050	102.87	.875	22.23	.093	2.36	4.335 ± .003	110.11 ± 0.08	4.185 ± .003	106.30 ± 0.08
R	4.867	123.62	4.872	123.75	1.000	25.40	.093	2.36	5.110 ± .003	129.79 ± 0.08	4.960 ± .003	125.98 ± 0.08
T	6.202	157.53	6.208	157.68	.750	19.05	.093	2.36	6.510 ± .003	165.35 ± 0.08	6.315 ± .003	160.40 ± 0.08
U	6.685	169.80	6.691	169.95	.750	19.05	.093	2.36	6.993 ± .003	177.62 ± 0.08	6.798 ± .003	172.67 ± 0.08
V	8.000	203.20	8.005	203.33	1.250	31.75	.250	6.35	8.816 ± .005	223.93 ± 0.13	8.336 ± .005	211.73 ± 0.13
W	10.029	254.74	10.034	254.86	1.750	44.45	.350	8.89	11.058 ± .005	280.87 ± 0.13	10.458 ± .005	265.63 ± 0.13

Note: Do not remachine threaded areas of the nozzle to reestablish "D" Dimension. Once "D" minimum is reached, replacement of nozzle is necessary.

Table 2: Nozzle Critical Dimensions (Cont.)

Orifice	N		P ±0.5°	Radius B ± .001" (0.03 mm)		J ± .005" (0.13 mm)		K		L	
	in.	mm		in.	mm	in.	mm	in.	mm	in.	mm
D	.038 ^{+.002} - .003	0.97 ^{+.05} - 0.08	30°	.016	0.41	.079	2.01	0.867 ± .001	22.02 ± 0.03	.813 ± .001	20.65 ± 0.03
E	.038 ^{+.002} - .003	0.97 ^{+.05} - 0.08	30°	.016	0.41	.079	2.01	0.867 ± .001	22.02 ± 0.03	.813 ± .001	20.65 ± 0.03
F	.038 ^{+.002} - .003	0.97 ^{+.05} - 0.08	30°	.016	0.41	.079	2.01	0.867 ± .001	22.02 ± 0.03	.813 ± .001	20.65 ± 0.03
G	.038 ^{+.002} - .003	0.97 ^{+.05} - 0.08	30°	.022	0.56	.090	2.29	1.058 ^{+.002} - .001	26.87 ^{+.05} - 0.03	.998 ± .001	25.35 ± 0.03
H	.035 ^{+.002} - .003	0.89 ^{+.05} - 0.08	45°	.022	0.56	.060	1.52	1.214 ^{+.002} - .001	30.84 ^{+.05} - 0.03	1.165 ^{+.002} - .001	29.59 ^{+.05} - 0.03
J	.035 ± .005	0.89 ± 0.13	45°	.022	0.56	.074	1.88	1.532 ^{+.002} - .001	38.91 ^{+.05} - 0.03	1.479 ^{+.002} - .001	37.57 ^{+.05} - 0.03
K	.063 ± .005	1.60 ± 0.13	45°	.022	0.56	.126	3.20	1.836 ± .002	46.63 ± 0.05	1.780 ^{+.001} - .002	45.21 ^{+.03} - 0.05
L	.063 ± .005	1.60 ± 0.13	45°	.017	0.43	.126	3.20	2.206 ± .002	56.03 ± 0.05	2.156 ± .002	54.76 ± 0.05
M	.063 ± .005	1.60 ± 0.13	45°	.022	0.56	.126	3.20	2.534 ± .002	64.36 ± 0.05	2.478 ± .002	62.94 ± 0.05
N	.063 ± .005	1.60 ± 0.13	45°	.022	0.56	.101	2.57	2.706 ± .002	68.73 ± 0.05	2.650 ± .002	67.31 ± 0.05
P	.093 ± .005	2.36 ± 0.13	45°	.022	0.56	.150	3.81	3.332 ± .002	84.63 ± 0.05	3.277 ^{+.002} - .003	83.24 ^{+.05} - 0.08
Q	.093 ± .005	2.36 ± 0.13	45°	.022	0.56	.188	4.78	4.335 ± .003	110.11 ± 0.08	4.281 ± .003	108.74 ± 0.08
R	.093 ± .005	2.36 ± 0.13	45°	.022	0.56	.215	5.46	5.092 ± .003	129.34 ± 0.08	5.033 ± .003	127.84 ± 0.08
T	.093 ± .005	2.36 ± 0.13	45°	.022	0.56	.142	3.61	6.510 ^{+.003} - .004	165.35 ^{+.08} - 0.10	6.420 ^{+.004} - .003	163.07 ^{+.10} - 0.08
U	.093 ± .005	2.36 ± 0.13	45°	.022	0.56	.142	3.61	6.992 ± .003	177.60 ± 0.08	6.902 ± .003	175.31 ± 0.08
V	.275 ± .005	6.99 ± 0.13	30°	.020	0.51	.275	6.99	9.125 ± .005	231.78 ± 0.13	8.336 ± .003	211.73 ± 0.08
W	.353 ± .005	8.97 ± 0.13	30°	.020 ± .005	0.51 ± 0.13	.353	8.97	11.125 ± .005	282.58 ± 0.13	10.458 ± .005	265.63 ± 0.13

XIV. Maintenance Instructions (Cont.)

C. Lapping Nozzle Seats (Metal Seat, Non-O-Ring Styles)

ATTENTION!

Nozzle laps as illustrated in Figure 35 are available from Baker Hughes. Do not use these laps if the valve nozzle can be removed and machined to the seat dimensions described in Table 3 and Table 4.

Lap the 5° angle of the nozzle first (Figure 35, View A). Then, invert the nozzle lap and use the flat side as a “starter” lap to ensure the seat is square (Figure 35, View B). Use a ring lap in a circular motion to finish lapping (See Figure 35, View C and Reconditioning of Laps). Keep the lap squarely on the flat surface and avoid rocking the lap, which will cause rounding of the seat.

D. Lapped Nozzle Seat Widths

A wide nozzle seat will induce leakage, especially in the smaller-orifice, lower-pressure valves. For this reason, the seat of valves other than O-Ring valves should be as narrow as practical. Since the seat must be wide enough to carry the bearing load imposed upon it by the pressure force, the higher pressure valves must have wider seats than the lower pressure valves. The nozzle seat width should conform to the measurements in Table 3 and Table 4. To measure the seat width, use a Model S1-34-35-37 Bausch and Lomb Optical Co. measuring magnifier or an equivalent seven-power glass with a 3/4" (19.05 mm) scale showing graduations of 0.005" (0.13 mm). Figure 36a and 36b illustrate the use of this tool in measuring the nozzle seat width.

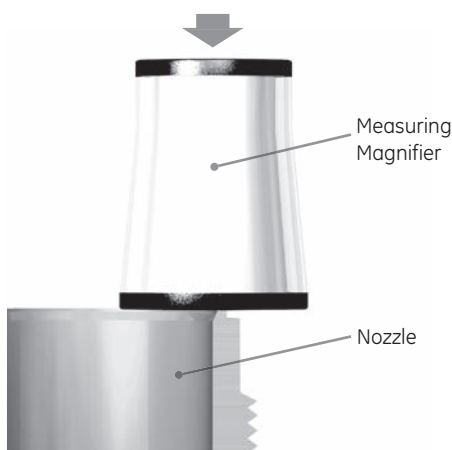


Figure 36a: Measuring Magnifier

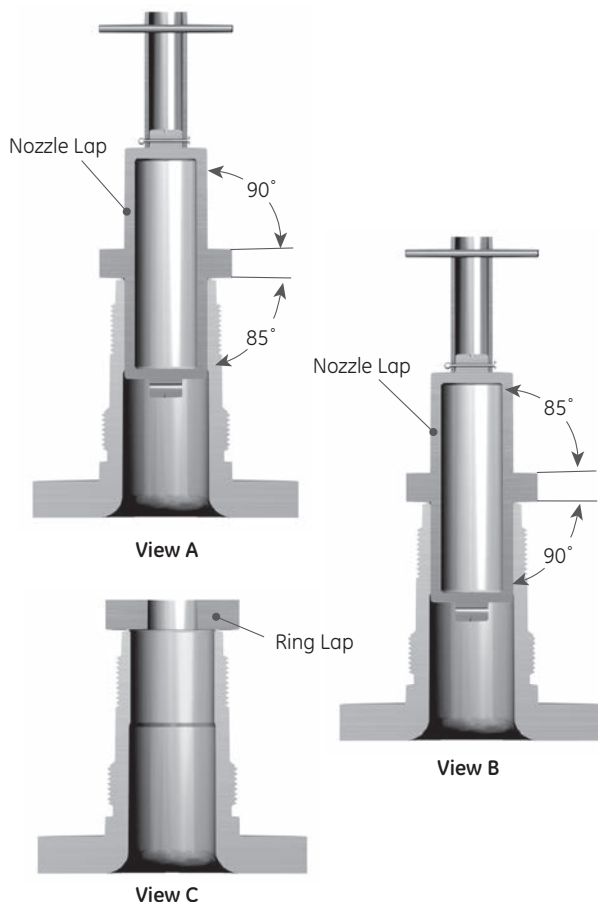


Figure 35: Lapping Nozzle Seats

If additional lighting is required for measuring, use a gooseneck flashlight similar to the Type A Lamp Assembly (Standard Molding Corp.), or equivalent.

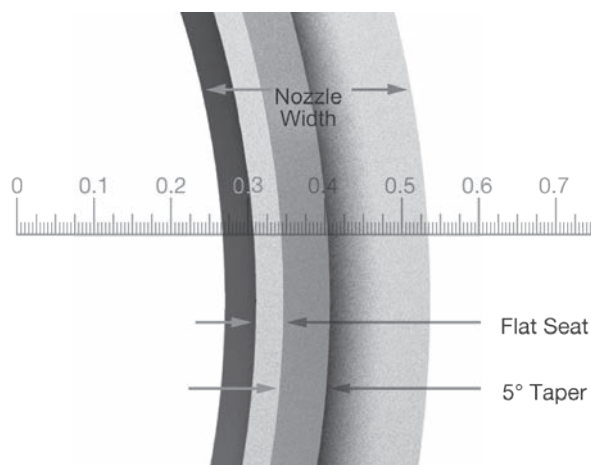


Figure 36b: Magnifier Details

Figure 36: Measuring Magnifier

XIV. Maintenance Instructions (Cont.)

**Table 3: Approximate Nozzle Seat Width
(Std. Metal Seat Designs)**

Orifice	Set Pressure Range ¹				Lapped Seat Width			
	min.		max.		min.		max.	
	psig	barg	psig	barg	in.	mm	in.	mm
D - G	1	0.07	50	3.45	.012	0.30	.015	0.38
	51	3.52	100	6.89	.015	0.38	.022	0.56
	101	6.96	250	17.24	.022	0.56	.028	0.71
	251	17.31	400	27.58	.028	0.71	.035	0.89
	401	27.65	800	55.16	.035	0.89	.042	1.07
	801	55.23	Above		Note 2		Note 2	
H - J	1	0.07	50	3.45	.019	0.48	.022	0.56
	51	3.52	100	6.89	.022	0.56	.027	0.69
	101	6.96	250	17.24	.027	0.69	.031	0.79
	251	17.31	400	27.58	.031	0.79	.035	0.89
	401	27.65	800	55.16	.035	0.89	.040	1.02
	801	55.23	Above		Note 3		Note 3	
K - N	1	0.07	50	3.45	.025	0.64	.028	0.71
	51	3.52	100	6.89	.028	0.71	.033	0.84
	101	6.96	250	17.24	.033	0.84	.038	0.97
	251	17.31	400	27.58	.038	0.97	.043	1.09
	401	27.65	800	55.16	.043	1.09	.048	1.22
	801	55.23	Above		Note 4		Note 4	
P - R	1	0.07	50	3.45	.030	0.76	.034	0.86
	51	3.52	100	6.89	.034	0.86	.041	1.04
	101	6.96	251	17.31	.041	1.04	.049	1.24
	251	17.31	400	27.58	.049	1.24	.056	1.42
	401	27.65	800	55.16	.056	1.42	.062	1.57
	801	55.23	Above		.062	1.57	.064	1.63
T	1	0.07	50	3.45	.040	1.02	.043	1.09
	51	3.52	100	6.89	.043	1.09	.049	1.24
	101	6.96	250	17.24	.049	1.24	.057	1.45
	251	17.31	300	20.68	.057	1.45	.060	1.52
U	1	0.07	50	3.45	.040	1.02	.043	1.09
	51	3.52	100	6.89	.043	1.09	.049	1.24
	101	6.96	250	17.24	.049	1.24	.057	1.45
	251	17.31	300	20.68	.057	1.45	.060	1.52
V	1	0.07	50	3.45	.075	1.91	.083	2.11
	51	3.52	100	6.89	.083	2.11	.103	2.62
	101	6.96	250	17.24	.103	2.62	.123	3.12
	251	17.31	300	20.68	.123	3.12	.130	3.30
W	1	0.07	50	3.45	.100	2.54	.110	2.79
	51	3.52	100	6.89	.110	2.79	.130	3.30
	101	6.96	250	17.24	.130	3.30	.150	3.81
	251	17.31	300	20.68	.150	3.81	.160	4.06

- 1: Seat widths for set pressures below 15 psig (1.03 barg) should be approximately the same as those shown for 15 psig (1.03 barg).
- 2: .042" + .005" (1.07 + 0.13 mm) per 100 psig (6.89 barg).
Not to exceed .070 ± .005" (1.78±0.13 mm).
- 3: .040" + .005" (1.02 + 0.13 mm) per 100 psig (6.89 barg).
Not to exceed .070 ± .005" (1.78±0.13 mm).
- 4: .048" + .005" (1.22 + 0.13 mm) per 100 psig (6.89 barg).
Not to exceed .070 ± .005" (1.78±0.13 mm).

**Table 4: Approx. Nozzle Seat Width
(Thermodisc, Cryodisc Designs)**

Orifice	Set Pressure Range ¹				Lapped Seat Width			
	min.		max.		min.		max.	
	psig	barg	psig	barg	in.	mm	in.	mm
D - F	1	0.07	100	6.89	.020	0.51	.035	0.89
	101	6.96	300	20.68	.035	0.89	.045	1.14
	301	20.75	800	55.16	.045	1.14	.055	1.40
	801	55.23	Above		Full Width ²			
G - J	1	0.07	100	6.89	.025	0.64	.035	0.89
	101	6.96	300	20.68	.035	0.89	.045	1.14
	301	20.75	800	55.16	.045	1.14	.055	1.40
	801	55.23	Above		Full Width ²			
K - N	1	0.07	100	6.89	.035	0.89	.045	1.14
	101	6.96	300	20.68	.045	1.14	.055	1.40
	301	20.75	800	55.16	.055	1.40	.065	1.65
	801	55.23	Above		Full Width ²			
P - R	1	0.07	100	6.89	.040	1.02	.050	1.27
	101	6.96	130	8.96	.050	1.27	.060	1.52
	131	9.03	800	55.16	.060	1.52	.070	1.78
	801	55.23	Above		Full Width ²			
T	1	0.07	100	6.89	.050	1.27	.060	1.52
	101	6.96	300	20.68	.060	1.52	.075	1.91
U	1	0.07	100	6.89	.050	1.27	.060	1.52
	101	6.96	300	20.68	.060	1.52	.075	1.91
V	1	0.07	100	6.89	.075	1.91	.100	2.54
	101	6.96	300	20.68	.100	2.54	.130	3.30
W	1	0.07	100	6.89	.100	2.54	.125	3.18
	101	6.96	300	20.68	.125	3.18	.160	4.06

- 1: Seat widths for set pressures below 15 psig (1.03 barg) should be approximately the same as those shown for 15 psig (1.03 barg).
- 2: Not to exceed .070 ± .005" (1.78±0.13 mm).

XIV. Maintenance Instructions (Cont.)

E. Lapping Disc Seats

Use a ring lap or lapping plate to lap the disc in a circular motion, applying uniform pressure and slowly rotating the disc or lap.

- Apply 1000 lapping compound (see Table 18 in Lapping Tools Section XXIII.C. Lap disc to a polish finish.
- Remove lapping compound completely from Disc and Disc Holder.

F. Precautions and Hints for Lapping Seats

To ensure a quality lapping process, observe the following precautions and guidelines:

Keep work materials clean. Always use a fresh lap. If signs of wear (out of flatness) are evident, recondition the lap.

Apply a very thin layer of lapping compound to the lap to prevent rounding off the edges of the seat.

Keep the lap squarely on the flat surface, and avoid rocking the lap, which causes rounding of the seat.

When lapping, keep a firm grip on the lapped part to prevent dropping it and damaging the seat.

Lap in a circular motion while applying a uniform pressure. Slowly rotate the lap to evenly distribute the lapping compound. Wipe off the old compound and replace it with new compound frequently. Apply more pressure to speed the cutting action of the compound. To check the seating surfaces, remove all compound from the seat and the lap. Then, shine the seat with the same lap using the lapping method as described above. Low sections on the seating surface show up as shadow in contrast to the shiny portion. If shadows are present, further lapping is necessary. Only laps known to be flat can be used. It should take only a few minutes to remove the shadows.

When lapping is complete, any lines appearing as cross-scratches can be removed by rotating the lap on its axis (which has been wiped clean of compound) on the seat. Thoroughly clean the lapped seat using lint free cloth and a cleansing fluid.

G. Reconditioning of Laps

Ring laps are reconditioned by lapping them on a flat lapping plate in a figure-eight motion (Figure 37). To ensure the best results, recondition the ring laps after each use. Use an optical flat to check the quality of the lap.

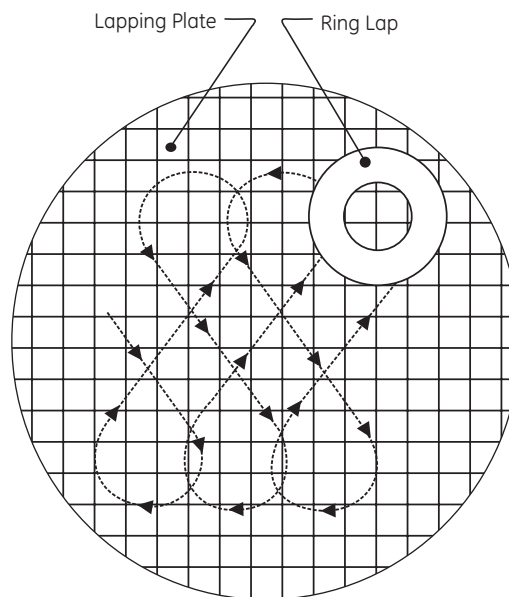


Figure 37: Lapping Pattern

Nozzle laps must be re-machined to recondition the lapping surfaces. Place the nozzle lap in a lathe between centers (Figure 38). The surfaces marked A and B must be running concentric.

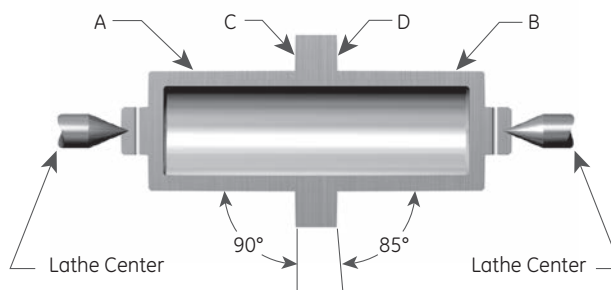


Figure 38: Nozzle Lap in a Lathe

ATTENTION!

Before assembly, grind the contact surfaces of the nozzle and O-Ring retainer to provide metal-to-metal seat tightness in the event of O-Ring failure.

XIV. Maintenance Instructions (Cont.)

H. Re-Machining Nozzle Seats

1. Remove the nozzle from the valve to be remachined. If it cannot be removed from the base, re-machine it inside the base.
2. Take the following steps to setup the lathe and nozzle:
 - a. Grip the nozzle in a four-jaw independent chuck (or collet, if appropriate), using a piece of soft material such as copper or fiber between the jaws and the nozzle as shown at A (Figure 39).
 - b. True up the nozzle so that the surfaces marked B and C run true within .001" (0.03 mm) on indicator (Figure 39).
3. Take the following steps to re-machine the metal-to-metal nozzle (Figure 34a and Table 2):
 - a. Make light cuts across the surface L at 5° until the damaged areas are removed. Turn to the smoothest possible finish.
 - b. The nozzle is now ready for lapping.
 - c. When the minimum dimension H is reached, discard the nozzle.
4. Take the following steps to re-machine the O-Ring seat seal (Figure 34b and Table 2):
 - a. Make light cuts across surface A (45°) until the damaged areas are removed. Turn to the smoothest possible finish.

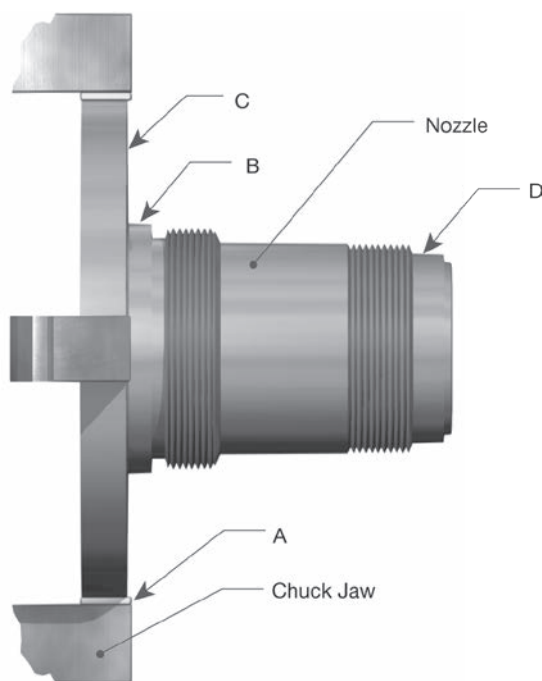


Figure 39: Nozzle Positioned in a Jaw

- b. Re-machine radius R.
- c. The nozzle is now ready for lapping.
- d. When the minimum dimension H is reached, discard the nozzle.

I. Re-Machining the Disc Seat

Take the following steps to machine the standard disc seating surface (Figure 40):

1. Grip the disc in a four-jaw independent chuck (or collet, if appropriate), using a piece of soft material such as copper or fiber between the jaws and the disc as shown at A.
2. True up the disc so that the surface marked B and C run true within .001" (0.03 mm), TIR.
3. Make light cuts across the seating surface L until damaged areas are removed. Turn to the smoothest possible finish.
4. The disc is now ready for lapping.
5. Discard the disc if the minimum dimension N or T (Figure 41, Table 5) is reached. Do not reestablish surface C.

ATTENTION!

Do not remachine a *Thermodisc™* or O-Ring Retainer.

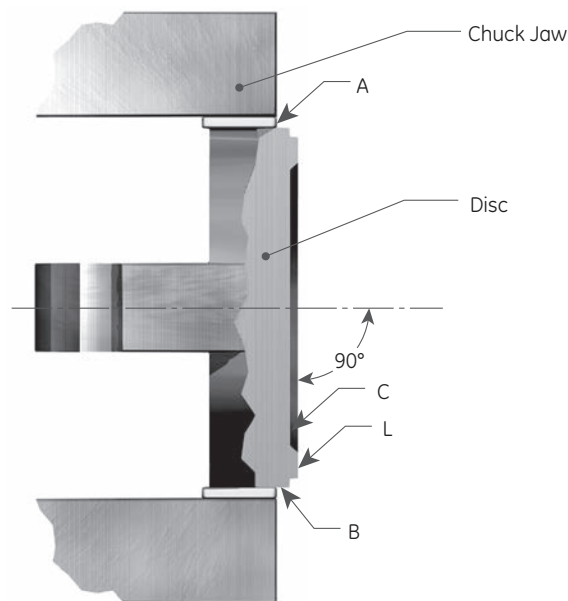


Figure 40: Standard Disc Seating Surface

XIV. Maintenance Instructions (Cont.)

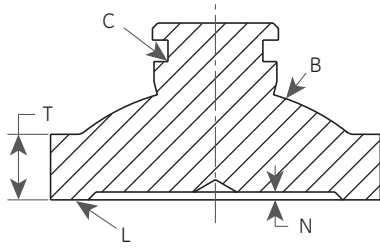


Figure 41a: Type 1
D - H Orifice

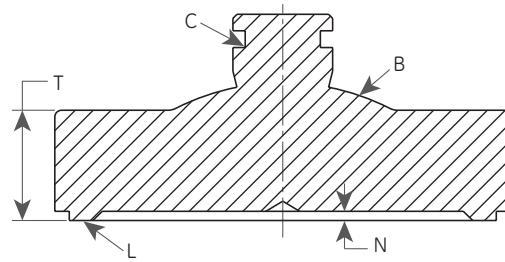


Figure 41b: Type 2
J - U Orifice

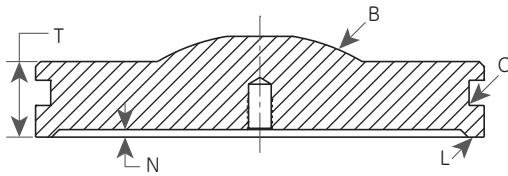


Figure 41c: Type 3
V&W Orifice

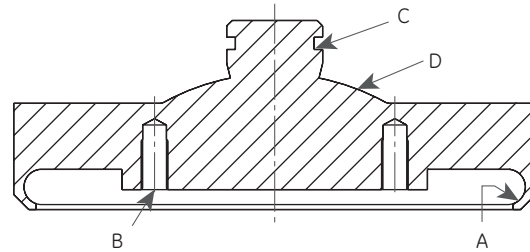


Figure 41d:
Disc O-Ring Soft Seat (K-U Orifices Only)

Figure 41: Metal and Soft Seat Disc Inspection Areas

Table 5: Metal Seat Disc Machining Dimensions					
Disc Type	Orifice Size	T min.		N min.	
		in.	mm	in.	mm
Type 1	D	.174	4.42	.010	0.25
	E	.174	4.42	.010	0.25
	F	.174	4.42	.010	0.25
	G	.174	4.42	.010	0.25
	H	.335	8.51	.010	0.25
Type 2	J	.369	9.37	.010	0.25
	K	.432	10.97	.038	0.97
	L	.467	11.86	.038	0.97
	M	.467	11.86	.038	0.97
	N	.495	12.57	.038	0.97
	P	.620	15.75	.068	1.73
	Q	.620	15.75	.068	1.73
	R	.620	15.75	.068	1.73
	T	.832	21.13	.068	1.73
	U	.833	21.16	.068	1.73
Type 3	V	1.230	31.24	.120	3.05
	W	1.855	47.12	.168	4.27

XV. Inspection and Part Replacement

1. Guide Replacement Criteria:

2900 Series Guide should be replaced:

- If the sliding surface is galled, pitted or scratched or the machined gasket surfaces are damaged.
- The "A" dimension (See Figures 37 and 38) exceeds A max. in Table 6.

Table 6: Guide Critical Dimension

Orifice	A max.		Orifice	A max.	
	in.	mm		in.	mm
D	.455	11.56	N	1.876	47.65
E	.455	11.56	P	2.314	58.78
F	.455	11.56	Q	2.314	58.78
G	.500	12.70	R	2.314	58.78
H	.688	17.48	T	2.313	58.75
J	1.001	25.43	U	2.313	58.75
K	1.251	31.78	V	6.446	163.73
L	1.376	34.95	W	8.446	214.53
M	1.751	44.48			

- Base: Inspect general condition for cracks or holes. Look for any corrosion issues.

- Bellows: Inspect general condition for cracks, holes or deformation of convolutions. Check for any corrosion or pitting.
- Cover Plate: Cover Plate Should be reused if:
 - The sliding surface in the dome area is not galled, scratched, corroded or pitted.
 - The Gasket surface is not scratched, corroded or pitted.
- O-Ring Retainer: Inspect surface that sits on the disc for any corrosion or defects that might cause the disc not to sit flush with nozzle.

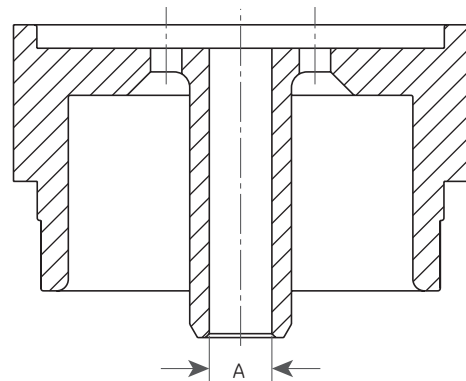


Figure 43a: D-G Orifice

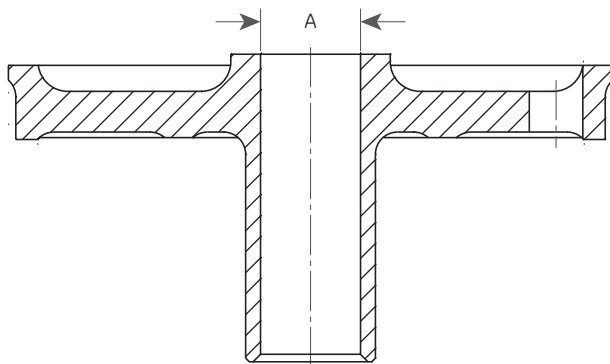


Figure 42a: D-U Orifice

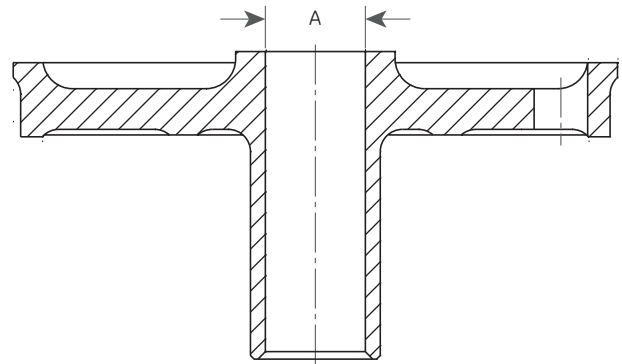


Figure 43b: H-U Orifice

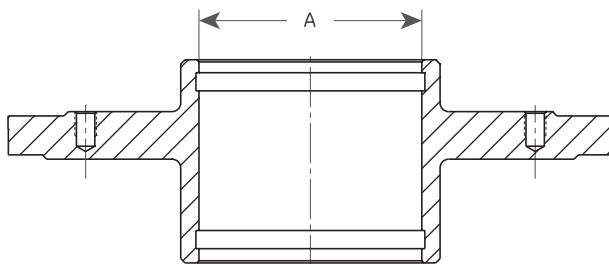


Figure 42b: V & W Orifice

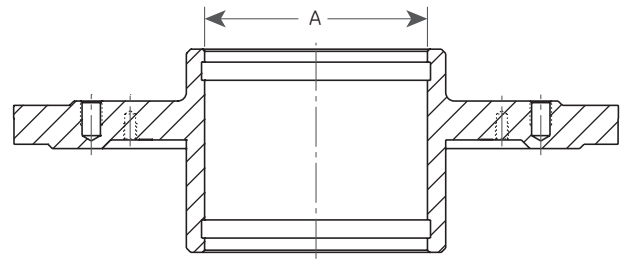


Figure 43c: V&W Orifice

**Figure 42: Guide Critical Dimensions
(Metal Seat)**

**Figure 43: Guide Critical Dimensions
(Bellows)**

XV. Inspection and Part Replacement (Cont.)

1. Nozzle: Nozzle should be replaced if:
 - a. The seat width requires adjustment, and the Dimension from the seat to the first thread is less than “D” minimum on Table 2.
 - b. Thread sections are damaged from pitting and/or corrosion.
 - c. Top of the nozzle flange and intersecting surface are damaged from galling and/or tearing.
 - d. The nozzle flange thickness can change center to face Dimensions. The minimum dimension for orifices “D” through “P” is .672” (16.50 mm) and “Q” through “W” orifices is .797” (20.20 mm).

Nozzle Seat Width: Using a measuring magnifying glass, (see Lapped Nozzle Seat Widths), determine whether the finish lapped seat surface must be machined before lapping. If the seat can be lapped flat without exceeding the required seat width, as indicated in Table 3 or 4, it does not require machining.

To reduce the seat width, the 5° angle surface must be machined. The nozzle must be replaced if the D min is reduced below the minimum as indicated in Table 2.

2. Spring: Check for any corrosion or pitting.
3. **Standard Metal Seated Disc:** This disc (Figure 41) can be machined until the T dimension is reduced to the minimum, as listed in Table 5. The “N” minimum dimension must be maintained as well.
4. **Thermodisc and Cryodisc Metal Seated Disc:** This disc (Figure 44) cannot be machined. It can be lapped as long as the “A” minimum dimension has been maintained. If lapping does not fix damaged area, part must be discarded.

The Thermodisc must be replaced if:

- a. Seat defects and damage cannot be lapped out without reducing the “A” dimension in Figure 44 that is listed in Table 7.
- b. If the dimension cannot be measured, replace the Thermodisc.

Table 7: Thermodisc Replacement Criteria

Orifice	A min.	
	in.	mm
D	.006	0.15
E	.006	0.15
F	.006	0.15
G	.006	0.15
H	.006	0.15
J	.013	0.33
K	.014	0.36
L	.014	0.36
M	.014	0.36
N	.014	0.36
P	.017	0.43
Q	.015	0.38
R	.015	0.38
T	.025	0.64
U	.025	0.64
V	.035	0.89
W	.035	0.89

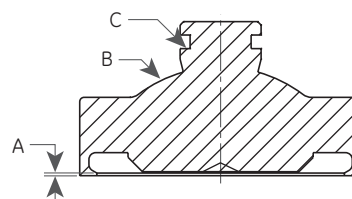


Figure 44a: D-H Orifices

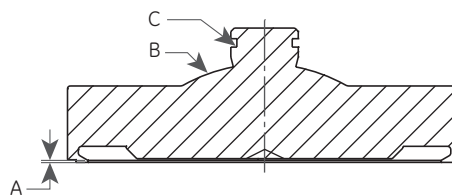


Figure 44b: J-U Orifices

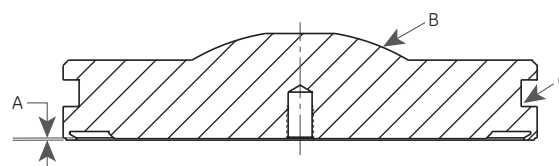


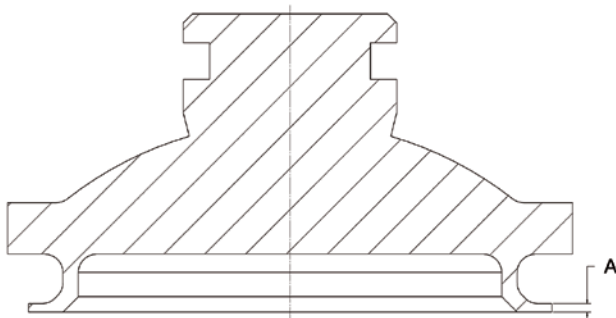
Figure 44c: V&W Orifices

Figure 44: Thermodisc Design

XV. Inspection and Part Replacement (Cont.)

**Table 8 : Minimum A Dimensions
(UM Cryogenic Disc)**

Orifice	A min.	
	in.	mm
D	0.008	0.19
E	0.008	0.19
F	0.008	0.19
G	0.009	0.23
H	0.011	0.27
J	0.019	0.48
K	0.023	0.58
L	0.026	0.67
M	0.034	0.86
N	0.037	0.94
P	0.046	1.17
Q	0.051	1.29
R	0.061	1.55
T-4	0.094	2.39
U	0.101	2.57



**Figure 45: Cryogenic Disc Design
(D-U Orifices)**

8. Main Valve Piston Replacement Criteria:

The Piston should be re-used if:

- There is no indication of galling, scratched, corroded or pitted on any surface of the piston.
- The "B" & "E" dimensions (See Figure 46) are less than "B" minimum and "E" minimum, indicated in Table 9.

Replace all parts as needed. If any damage listed above is present, the part should be replaced or repaired per instruction. Other valve parts may be acceptable with light corrosion, pitting, or minor damage of other types if it can be determined that it will not affect product performance. All o-rings and seals should be replaced each time the valve is disassembled.

Refer to Tables 25 for a list of recommended spare parts and Table 26 for a list of O-Ring repair kits.

- O-Ring Seated Disc:** The O-Ring Retainer cannot be machined. It can be lapped for minor scratches. If lapping does not fix damaged area, part must be discarded.
- Disc Holder:** Disc Holder should be replaced if the sliding surface of the Holder is galled, pitted, or scratched.
- Solid Metal Gaskets:** Solid Metal Gaskets can be reused unless they are corroded, pitted, or crimped.

XV. Inspection and Part Replacement (Cont.)

Table 9: Piston Critical Dimensions				
Orifice	B min.		E min.	
	in.	mm	in.	mm
D	.989	25.12	.748	19.00
E	.989	25.12	.748	19.00
F	.989	25.12	.748	19.00
G	1.114	28.30	.873	22.17
H	1.365	34.67	.998	25.35
J	1.677	42.60	1.310	33.27
K	1.990	50.55	1.623	41.22
L	2.490	63.25	2.123	53.92
M	2.867	72.82	2.498	63.45
N	3.117	79.17	2.748	69.80
P	3.741	95.02	3.372	85.65
Q	4.861	123.47	4.498	114.25
R	5.735	145.67	5.372	136.45
T	7.360	186.94	6.997	177.72
U	8.110	205.99	7.747	196.77
V	9.662	245.41	9.500	241.30
W	Contact Engineering Department.			

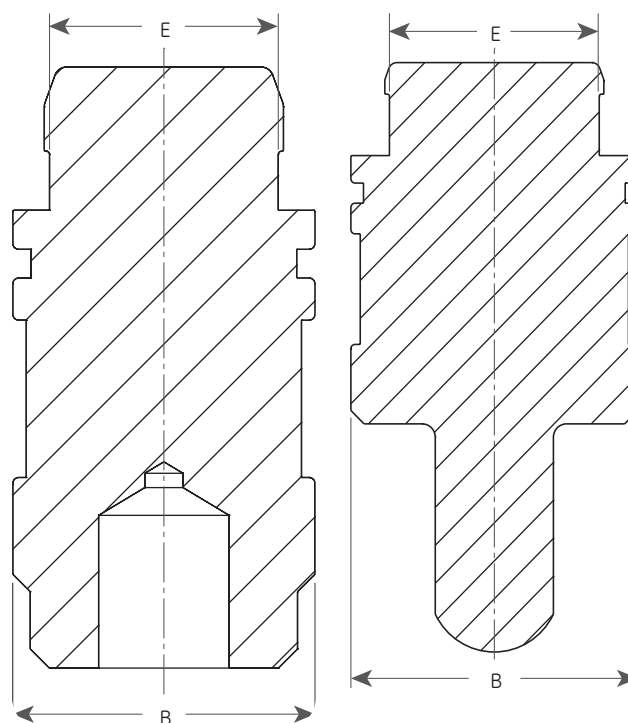


Figure 46a:
D-G Orifice
(Bellows)

Figure 46b:
H-W Orifice (Bellows),
D-W Orifice
(Conventional)

Figure 46: Main Valve Piston

XVI. Reassembly of the 2900 Main Valve

A. Lubricants and Sealants

- Operating temperatures between -20°F and +505°F (-28.9°C and +262.7°C)
 - Lubricate all o-rings, except silicone, spring energized seals, and back-up rings sparingly with silicone grease (P/N SP505).
 - Seal all pipe threads with Teflon tape or pipe sealant (Baker Hughes P/N SP364-AB).
 - Lubricate standard threads and bearing points with nickel graphite N5000 (P/N 4114507) or Jet-Lube 550, Baker Hughes non-metallic (P/N 4114511).
- Operating temperatures above +505°F (+262.7°C)
 - Lubricate all o-rings, except silicone, spring energized seals, and back-up rings sparingly with silicone grease (P/N SP505).
 - Seal all pipe threads with Teflon tape or pipe sealant (Baker Hughes P/N SP364-AB).
 - Lubricate standard threads with nickel graphite N5000 (P/N 4114507) or Jet-Lube 550, Baker Hughes nonmetallic (P/N 4114511).
- Operating temperatures between -21°F and -100°F (-29°C and -73°C)
 - Lubricate bearing points, all o-rings, except silicone, spring energized seals, and back-up rings sparingly with silicone grease (P/N SP505).
 - Seal all pipe threads with Teflon tape or pipe sealant (Baker Hughes P/N SP364-AB).
 - Lubricate standard threads with nickel graphite N5000 (P/N 4114507) or Jet-Lube 550, Baker Hughes nonmetallic (P/N 4114511).

4. Operating temperatures between -101°F and -450°F (-74°C and -268°C)
 - a. Lubricate all o-rings, except silicone, spring energized seals, and back-up rings sparingly with silicone grease (P/N SP505).
 - b. Seal all pipe threads with Teflon tape or pipe sealant (Baker Hughes P/N SP364-AB).
 - c. Lubricate standard threads with nickel graphite N5000 (P/N 4114507) or Jet-Lube 550, Baker Hughes nonmetallic (P/N 4114511).
 - d. Lubricate bearing points with molykote D-321R (P/N 4114514 or 4114515).

Table 10: Nozzle Torque Values +10% - 0%

Orifice	Required Torque	
	ft-lbs	Nm
D, E & F	165	224
G	145	197
H	165	224
J	335	454
K	430	583
L	550	746
M	550	746
N	640	868
P	1020	1383
Q	1400	1898
R	1070	1451
T	1920	2603
U	1920	2603
V	1960	2657
W	2000	2712

Note: DO NOT USE impact wrench on “D” through “K” orifice Nozzles.

Table 11: Disc Holder Torque Values

Orifice	No. of Bolts	Bolt Size	Torque			
			in-lbs		N-m	
D, E, F	1	1/4-28UNF	75	± 3	8.5	± 0.3
G	1	1/4-28UNF	75	± 3	8.5	± 0.3
H	1	1/4-28UNF	75	± 3	8.5	± 0.3
J	3	#10-32UNF	30	± 2	3.4	± 0.2
K	3	#8-32NC	18	± 1	2.0	± 0.1
L	3	#8-32NC	18	± 1	2.0	± 0.1
M	4	#8-32NC	18	± 1	2.0	± 0.1
N	4	#8-32NC	18	± 1	2.0	± 0.1
P	4	1/4-28UNF	75	± 3	8.5	± 0.3
Q	4	1/4-28UNF	75	± 3	8.5	± 0.3
R	4	1/4-28UNF	75	± 3	8.5	± 0.3
T	4	1/4-28UNF	75	± 3	8.5	± 0.3
U	4	1/4-28UNF	75	± 3	8.5	± 0.3
V	-	-	-	-	-	-
W	-	-	-	-	-	-

B. Assembly Procedure with Metal Seats

B.1 Remote Sense Nozzle Assembly

If the valve Nozzle was removed, apply thread lubricant to the nozzle threads before reinstalling in the Base. Insert it into the inlet flange of the Base, and torque to the correct value listed in Table 10.

B.2 Integral Sense Nozzle Assembly

1. Insert Integral Sensing Tube into nozzle from the exterior of flange until hand tight. Tighten until the slot in the tube is pointing to the inlet side of the nozzle within a 180 degree window shown in Figure 47.

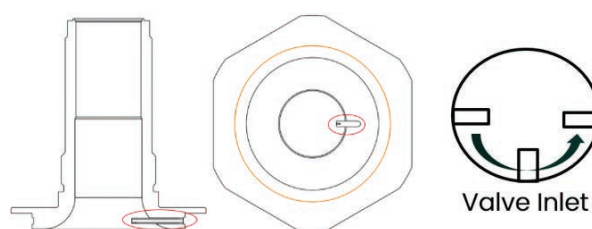


Figure 47: Integral Sense Nozzle Assembly

2. Using a torque wrench, apply a 5 in-lbs preload to the sensing tube, if the slot in the tube is pointing to the inlet side of the nozzle within +/-90 degrees the sensing tube is installed.
3. If the sensing tube is not installed correctly per step 2, set the torque wrench to 15 in-lbs and tighten the sensing tube until the slot in the tube is pointing to the inlet side of the nozzle within +/-90 degrees. Do not exceed the 15 in-lbs torque setting.
4. Using a small amount of lubricant, lubricate lower threads and base guide diameter of nozzle.
5. Screw the nozzle into the base, hand tight. For nozzles with hex flanges, use method A or B. Nozzles with round flanges, use method B:
 - a. Tighten with wrench/socket to a maximum torque not to exceed that value listed in Table 10 at the wrench tightening location in Figure 48.
 - b. Tighten to a maximum torque not to exceed that value listed in Table 10 with the use of the 2900 IS Torqueing Tool Insert per the drawing in Section XXIII. at the Special

XVI. Reassembly of the 2900 Main Valve (Cont.)

Tightening Tools Only location in Figure 48.

6. Using a small amount of lubricant, lubricate lower threads and base guide diameter of nozzle.
7. Screw the nozzle into the base, hand tight. For nozzles with hex flanges, use method A or B. Nozzles with round flanges, use method B:
 - a. Tighten with wrench/socket to a maximum torque not to exceed that value listed in Table 10 at the wrench tightening location in Figure 48.
 - b. Tighten to a maximum torque not to exceed that value listed in Table 10 with the use of the 2900 IS Torqueing Tool Insert per the drawing in Section XXIII. at the Special Tightening Tools Only location in Figure 48.

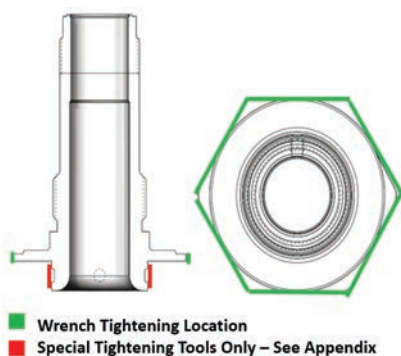


Figure 48: IS Nozzle Tightening Locations

B.2.1 Integral Sensing Ring Assembly

1. Attach NPT fitting to Integral Sensing Ring.
2. The included tubing and union fitting shall be used to connect the Integral Sensing Ring to the 3/8" tubing going to the inlet of the pilot valve.
3. The 1/4" to 3/8" tubing reducer should be installed to allow the shortest length of 1/4" tubing required, however, the tubing shall be long enough to have the fitting outside the Inlet Flange diameter.

B.3 Disc/Disc Holder Assembly

1. Assemble the disc/disc holder as follows:
 - a. Prior to assembly of the Disc into the Disc Holder, remove the Disc Retainer from the back of the Disc. Use 1000 grit grinding compound on the bearing surface to grind the Disc into the Disc Holder to properly establish the bearing surface.
 - b. For "D" through "U" orifice valves, place the Disc Retainer into the groove in the disc. The Disc with the Disc Retainer should "snap" into the Disc Holder pocket with moderate finger or hand force. Do not use excessive force to assemble these parts. Be sure that the Disc is free to "wobble" after it is in place. For V and W orifice discs, place Disc into Disc Holder and secure Disc Retaining Bolts.

C. Assembly Procedure with O-Ring Seats

1. If the valve Nozzle was removed, apply thread lubricant to the nozzle threads before reinstalling in the Base. Insert it into the inlet flange of the Base, and torque to the correct value listed in Table 10.
2. Assemble the disc/disc holder as follows:
 - a. For disc sizes "D" thru "J", reassemble the Disc Holder using a new O-Ring, O-Ring Retainer, and new Lock Screw(s). Refer to Table 11 for the proper torque. These Disc Holders are ready for the next step.
 - b. For disc sizes "K" thru "W", reassemble the Disc using a new O-Ring, O-Ring Retainer, and new Lock Screws. Refer to Table 11 for the proper torque.
 - i. Prior to assembly of the Disc into the Disc Holder, remove the Disc Retainer from the back of the Disc. Use 1000 grit grinding compound on the bearing

XVI. Reassembly of the 2900 Main Valve (Cont.)

surface to grind the Disc into the Disc Holder to properly establish the bearing surface.

- ii. Place the Disc Retainer into the groove in the disc. The Disc with the Disc Retainer should “snap” into the Disc Holder pocket with moderate finger or hand force. Do not use excessive force to assemble these parts. Be sure that the Disc is free to “wobble” after it is in place. For V and W orifice discs, place Disc into Disc Holder and secure Disc Retaining Bolts.
3. Set the Disc Holder (disc side down), on the work surface. Place a small amount of 1000 grit grinding compound onto the ball end of the Main Valve Piston and place it in the disc holder pocket. Turn the Main Valve Piston clockwise, and then counter clockwise, to seat the Main Valve Piston. Clean all grinding compound from parts.

For bellows valves "D" through "U"

- c. Place a new Bellows Gasket on the Disc Holder. Thread the Bellows, finger-tight, down to the Gasket on the Disc Holder. Use a pin spanner wrench, or special cable type wrench to turn the Bellows Ring down until a pressure tight joint is obtained.
- d. For bellows valves “V” and “W”, place a new Bellows Gasket on the Disc Holder. Bolt down using proper torque as found in the assembly instructions.
- e. For Spring Assist valves, place the Spring down onto the Disc Holder.

For D through U orifice valves:

- f. Place the Guide over the Disc Holder. (DO NOT DROP.) If Bellows is present, the weight of the Guide will slightly compress the Bellows.
- g. For V and W orifice valves:
4. Install guide rings into the grooves located inside the guide ID. Make sure the space where the upper and lower guide ring ends meet is positioned 180° apart. Mark both the guide and disc holder at the point where the bottom guide ring ends meet. This mark must be faced 180° away from the outlet when the assembly is placed into the valve. Gently lower the guide down onto the disc holder ensuring that guide rings remain

in their respective groove.

5. Place the Guide Gasket in the Base.
6. Install disc guide assembly. Use the same lifting tools (see Figure 25 and Figure 26) as used during disassembly, then carefully lower it into the Base.
7. On “V” and “W” sizes, use the same lifting lugs as were used during disassembly.
8. Using a small amount of Silicone Grease supplied with soft goods replacement kit, rub a small amount on the seals and O-rings prior to assembly.
9. Take the Main Valve Piston and measure and cut diagonally the proper length of Guide Ring material to fit in the groove of the Main Valve Piston. Allow 1/16 of an inch gap between the ends for proper fit.
10. For Teflon seals, make sure of the integrity of the Teflon seal and seal spring. Install Main Valve Piston Seal on Main Valve Piston outside diameter on the opposite end of the main valve piston seat as shown in Figure 49.
11. If an O-Ring seal is used, it is installed in the groove between where the Guide Ring is installed and where a Spring Energized Seal would be installed (Figure 22).
12. Install the Guide Ring(s) onto the Main Valve Piston. If there is more than one Guide Ring, stagger the cut locations 180° apart.
13. To prevent seal damage during assembly, check the chamfer on the bottom of the Cover Plate for burrs. If any sharp edges exist, polish the chamfer.
14. Insert Main Valve Piston (energize seal/o-ring side first) into bottom of Cover Plate. Continue pushing Main Valve Piston into Cover Plate, being careful not to pinch the guide rings. Push Main Valve Piston in until bottom of Main Valve Piston is even with the bottom of the Cover Plate.
15. Install 1/4" MNPT pipe plug into Cover Plate where dome line connects.
16. Install Cover Plate Gasket. Install Cover Plate on top of Base such that the pilot will be aligned for proper tubing connections. Make note of the length of the studs. The two longer ones will

XVI. Reassembly of the 2900 Main Valve (Cont.)

straddle the vertical line of the inlet sensing port on the Main Base of the pilot valve. Install the bracket between the Cover Plate and the Nut or Cap Screw. Be sure that the bracket is aligned so that the two smaller pilot attachment holes are above the horizontal plane of the Cover Plate.

17. Remove pipe plug from Cover Plate.
18. Torque to the values found in Table 12 using the torque patterns in Figure 50 and Table 13.
19. Once the Main Valve is assembled before any tubing is connected reach through the hole in the center of the Cover Plate and force the Main Valve Piston down until it contacts the Disc Holder. Failure to complete this procedure will prevent the Main Valve from loading and closing, when pressure is applied to the valve.
20. The Main Valve is ready to receive the pilot and finished assembly.

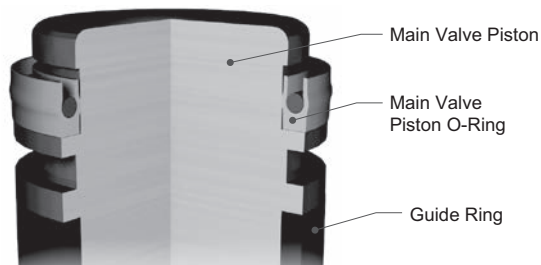


Figure 49: Main Valve Piston

XVI. Reassembly of the 2900 Main Valve (Cont.)

Table 12: Cover Plate Nut Torque

Orifice	2905		2906		2910		2912		2914		2916		2918	
	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm
D	55	75	55	75	55	75	60	81	60	81	60	81	120	163
E	55	75	55	75	55	75	60	81	60	81	60	81	120	163
F	55	75	55	75	55	75	60	81	70	95	70	95	115	156
G	55	75	55	75	55	75	60	81	70	95	70	95	75	102
H	90	122	90	122	60	81	75	102	65	88	65	88	—	—
J	60	81	60	81	75	102	100	136	100	136	100	136	—	—
K	65	88	65	88	60	81	60	81	135	183	145	197	—	—
L	75	102	75	102	90	122	90	122	140	190	140	190	—	—
M	95	129	95	129	110	149	95	129	95	129	—	—	—	—
N	105	142	105	142	130	176	85	115	85	115	—	—	—	—
P	120	163	120	163	145	197	125	169	125	169	—	—	—	—
Q	105	142	105	142	125	169	150	203	—	—	—	—	—	—
R	115	156	115	156	115	156	135	183	—	—	—	—	—	—
T	95	129	95	129	95	129	125	169	—	—	—	—	—	—
U	95	129	95	129	95	129	125	169	—	—	—	—	—	—
V	130	176	130	176	130	176	—	—	—	—	—	—	—	—
W	130	176	130	176	130	176	—	—	—	—	—	—	—	—

Table 12: Cover Plate Nut Torque (Cont.)

Orifice	2920		2922		2923		2924		2926		2928	
	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm	ft lb	Nm
D	55	75	55	75	—	—	60	81	60	81	115	156
E	55	75	55	75	—	—	60	81	60	81	115	156
F	55	75	55	75	—	—	70	95	70	95	115	156
G	55	75	60	81	—	—	70	95	70	95	75	102
H	60	81	60	81	—	—	75	102	85	115	—	—
J	75	102	75	102	—	—	100	136	100	136	—	—
K	60	81	60	81	—	—	60	81	140	190	—	—
L	90	122	90	122	—	—	140	190	140	190	—	—
M	90	122	95	129	—	—	95	129	—	—	—	—
N	130	176	85	115	—	—	85	115	—	—	—	—
P	145	197	—	—	125	169	125	169	—	—	—	—
Q	105	142	150	203	—	—	—	—	—	—	—	—
R	115	156	135	183	—	—	—	—	—	—	—	—
T	125	169	—	—	—	—	—	—	—	—	—	—
U	125	169	—	—	—	—	—	—	—	—	—	—
V	130	176	—	—	—	—	—	—	—	—	—	—
W	130	176	—	—	—	—	—	—	—	—	—	—

XVI. Reassembly of the 2900 Main Valve (Cont.)

Table 13: Torque Required for Each Round of Pattern	
Round	Percentage of Required Torque
1	Wrench Tight
2	25
3	60
4	100
5	100

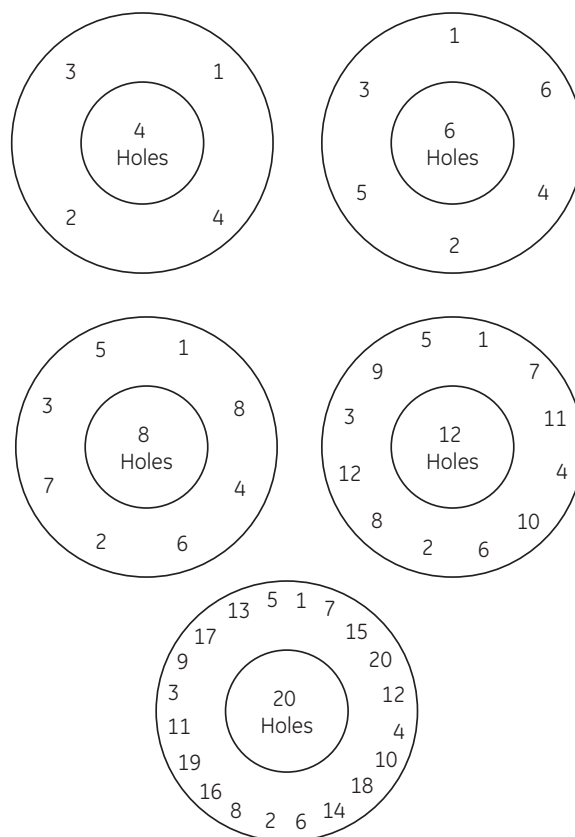


Figure 50: Bolt Tightening Patterns

XVII. Disassembly of Pilot Valve

A. 39PV07/37 Disassembly

Figures 51 and 52

1. Remove and discard the aluminum seals and sealing wire.
2. Remove Cap (Compression Screw) by turning counterclockwise.
3. If a lifting lever is installed, also use Figure 52 to remove the Lifting Lever assembly. Then return to Figure 51 to continue disassembly.

The Lifting Lever Assembly consists of:

- 1 – Lever
- 1 – Drive Pin
- 1 – Cam Shaft
- 1 – Bushing

4. Remove Lifting Lever Assembly by turning Bushing counterclockwise.
5. Turn Cap (Compression Screw) counterclockwise.
6. Measure distance from Release Lock Nut to the top of the Lifting Stem for reassembly later.
7. Remove the Release Lock Nut and Release Nut by turning counterclockwise.
8. Measure and record Compression Screw height for later use when resetting.
9. Turn Compression Screw Lock Nut counterclockwise to loosen.
10. Turn Compression Screw counterclockwise to remove the load on the Spring.
11. Turn Set Screw counterclockwise to loosen.
12. Bonnet can now be removed by turning counterclockwise.
13. Spring and Spring Washers can now be removed.

Note: If Lifting Lever option is equipped, there is no need to remove Drive Pin from Bottom Spring Washer assembly.

14. Remove the four Cap Screws (Top Plate) holding the Top Plate to the Pilot Base. Remove and discard the Spring Seal (Main Piston) and O-Ring (Top Plate).
15. Remove Main Piston from Pilot Base.

Note: For Dome Assist Option, please refer to “Dome Assist Option” (Section XXII.B) for disassembly instructions.

Removing the Insert Assembly.

The Insert Assembly consists of:

- 1 - Insert Top
- 1 - Insert Bottom
- 1 - Spring Seal (Insert)
- 1 - O-Ring (Insert)

1. Remove Insert Assembly from the top of the Pilot Base with tool #4995401 as shown in Figure 93. Remove and discard the O-Ring (Insert) on the bottom of the Insert Assembly. Disassemble Insert Assembly by removing the Insert Bottom from the Insert Top. Discard Spring Seal (Insert).
2. Remove Adjuster Cap from the bottom of the Pilot Base by turning counterclockwise.
3. Loosen Adjuster Lock Nut by turning counterclockwise.

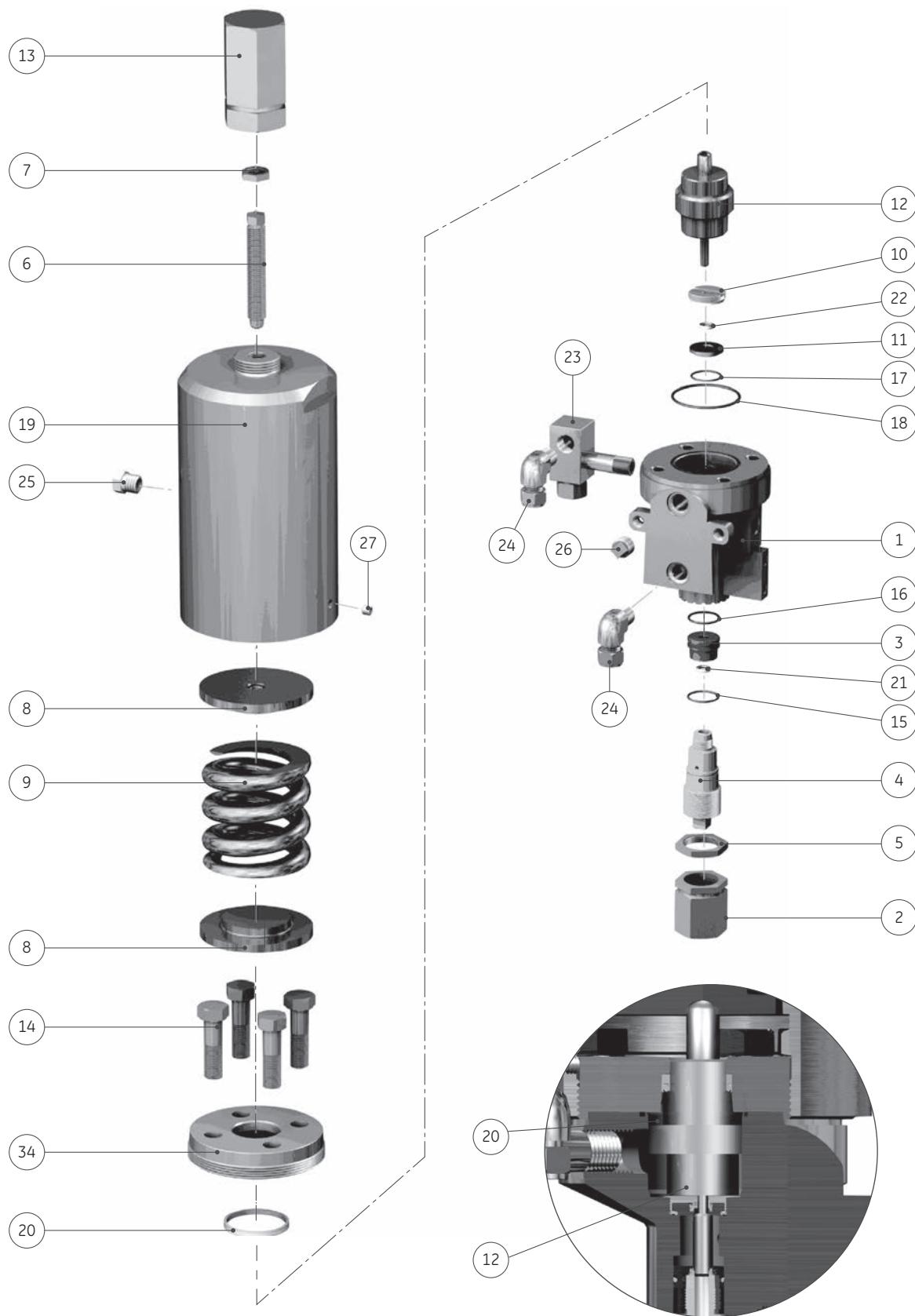
Removing the Adjuster Assembly:

The Adjuster Assembly consists of:

- 1 – Adjuster Top
- 1 – Adjuster Bottom
- 1 – O-Ring (Adjuster Top)
- 1 – O-Ring (Adjuster Bottom)
- 1 – Spring Seal (Adjuster Top)

1. Turn Adjuster Assembly clockwise counting the number of flats until assembly stops. Record number of flats for reassembly.
2. Remove Adjuster Assembly from the Pilot Base by turning counterclockwise. Remove O-Ring (Adjuster Top) and O-Ring (Adjuster Bottom) from adjuster assembly and discard. Disassemble Adjuster Top from the Adjuster Bottom by turning Adjuster Top counterclockwise. Remove Spring Seal (Adjuster Top) from Adjuster Top and discard.
3. Refer to Field Test Connection / Backflow Preventer Option (Section XXII.A) for disassembly of Field Test Connection

XVII. Disassembly of Pilot Valve (Cont.)



39PV37

Figure 51: 39PV07/37 Disassembly

XVII. Disassembly of Pilot Valve (Cont.)

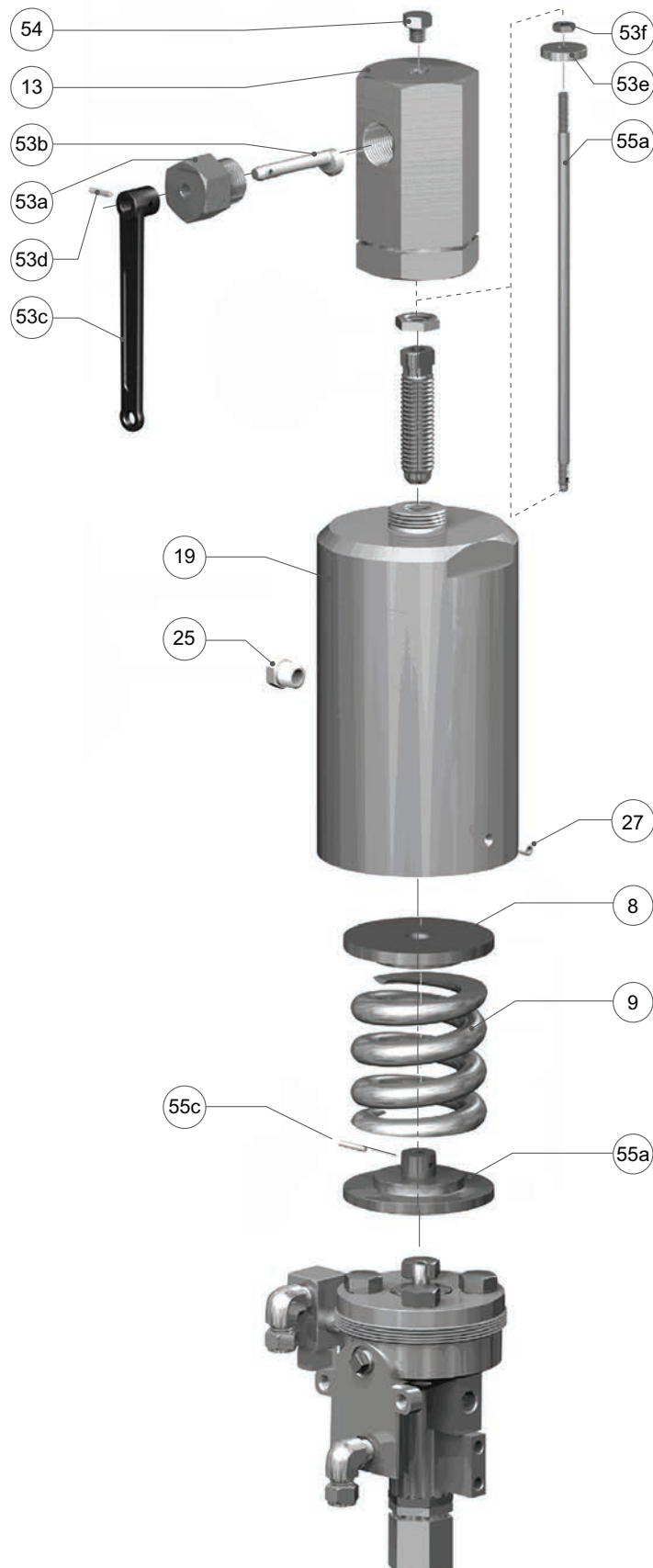


Figure 52: Lifting Lever Disassembly

Part No.	Nomenclature
1	Main Base
2	Adjuster Cap
3	Adjuster Top
4	Adjuster Bottom
5	Adjuster Lock Nut
6	Compression Screw
7	Compression Screw Lock Nut
8	Spring Washer
9	Spring
10	Insert Top
11	Insert Bottom
12	Main Piston
13	Cap (Compression Screw)
14	Cap Screw (Top Plate)
15	O-Ring (Adjuster Bottom)
16	O-Ring (Adjuster Top)
17	O-Ring (Insert)
18	O-Ring (Top Plate)
19	Bonnet
20	Spring Seal (Main Piston)
21	Spring Seal (Adjuster Top)
22	Spring Seal (Insert)
23	Field Test Connector
24	Vent Assembly/Bug Screen (Field Test Connection)
25	Vent Assembly (Bonnet Vent) ¹
27	Set Screw (Bonnet)
34	Top Plate
53	Lifting Lever Assembly
53a	Cam Bushing
53b	Cam Shaft
53c	Lifting Lever
53d	Drive Pin
53e	Release Nut
53f	Release Locknut
54	Gag Bolt
55	Lower Spring Washer Assembly
55a	Lower Spring Washer
55b	Lifting Stem
55c	Drive Pin

1: Standard material is a filter plug. For special materials, vent assembly is supplied.

XVII. Disassembly of Pilot Valve (Cont.)

B. 39MV07 Disassembly

Figures 52 and 53

1. Remove and discard the aluminum seals and sealing wire.
2. Remove Cap (Compression Screw) by turning counterclockwise.
3. If a lifting lever is installed, also use Figure 52 to remove the Lifting Lever assembly. Then return to Figure 53 to continue disassembly.

The Lifting Lever Assembly consists of:

- 1 – Lever
- 1 – Drive Pin
- 1 – Cam Shaft
- 1 – Bushing

4. Remove Lifting Lever Assembly by turning Bushing counterclockwise.
5. Turn Cap (Compression Screw) counterclockwise.
6. Measure distance from Release Lock Nut to the top of the Lifting Stem for reassembly later.
7. Remove the Release Lock Nut and Release Nut by turning counterclockwise.
8. Measure and record Compression Screw height for later use when resetting.
9. Turn Compression Screw Lock Nut counterclockwise to loosen.
10. Turn Compression Screw counterclockwise to remove the load on the Spring.
11. Turn Set Screw counterclockwise to loosen.
12. Bonnet can now be removed by turning counterclockwise.
13. Spring and Spring Washers can now be removed.

Note: If Lifting Lever option is equipped, there is no need to remove Drive Pin from Bottom Spring Washer assembly.

14. Remove the four Cap Screws (Top Plate) holding the Top Plate to the Pilot Base. Remove and discard the Spring Seal (Main Piston) and O-Ring (Top Plate).

1. Remove Main Piston from Pilot Base.

Note: For Dome Assist Option, please refer to Dome Assist Option (Section XXII.B) for disassembly instructions.

Removing the Insert Assembly.

The Insert Assembly consists of:

- 1 - Insert Top
- 1 - Insert Bottom
- 1 - Spring Seal (Insert)
- 1 - O-Ring (Insert)

2. Remove Insert Assembly from the top of the Pilot Base with tool #4995401 as shown in Figure 93. Remove and discard the O-Ring (Insert) on the bottom of the Insert Assembly. Disassemble Insert Assembly by removing the Insert Bottom from the Insert Top. Discard Spring Seal (Insert).
3. Remove Adjuster Cap from the bottom of the Pilot Base by turning counterclockwise.
4. Loosen Adjuster Lock Nut by turning counterclockwise.

Removing the Adjuster Assembly:

The Adjuster Assembly consists of:

- 1 – Adjuster Top
- 1 – Adjuster Bottom
- 1 – O-Ring (Adjuster Top)
- 1 – O-Ring (Adjuster Bottom)
- 1 – Spring Seal (Adjuster Top)

1. Turn Adjuster Assembly clockwise counting the number of flats until assembly stops. Record number of flats for reassembly.
2. Remove Adjuster Assembly from the Pilot Base by turning counterclockwise. Remove O-Ring (Adjuster Top) and O-Ring (Adjuster Bottom) from adjuster assembly and discard. Disassemble Adjuster Top from the Adjuster Bottom by turning Adjuster Top counterclockwise. Remove Spring Seal (Adjuster Top) from Adjuster Top and discard.
3. Refer to Field Test Connection / Backflow Preventer Option (Section XXII.A) for disassembly of Field Test Connection.

XVII. Disassembly of Pilot Valve (Cont.)

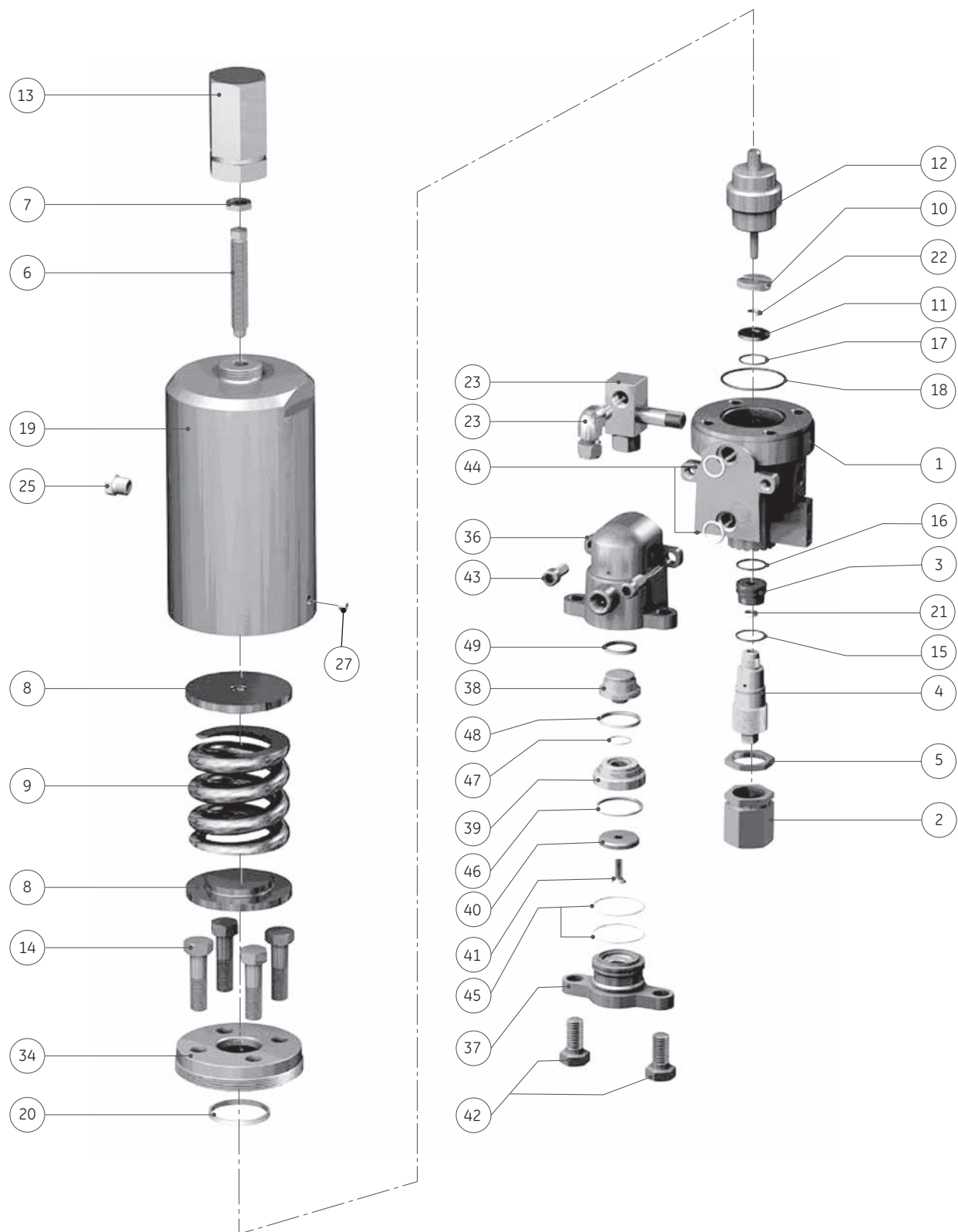


Figure 53: 39MV07 Disassembly

XVII. Disassembly of Pilot Valve (Cont.)

Part No.	Nomenclature
1	Main Base
2	Adjuster Cap
3	Adjuster Top
4	Adjuster Bottom
5	Adjuster Lock Nut
6	Compression Screw
7	Compression Screw Lock Nut
8	Spring Washer
9	Spring
10	Insert Top
11	Insert Bottom
12	Main Piston
13	Cap (Compression Screw)
14	Cap Screw (Top Plate)
15	O-Ring (Adjuster Bottom)
16	O-Ring (Adjuster Top)
17	O-Ring (Insert)
18	O-Ring (Top Plate)
19	Bonnet
20	Spring Seal (Main Piston)
21	Spring Seal (Adjuster Top)
22	Spring Seal (Insert)
23	Field Test Connector
24	Vent Assembly/Bug Screen (Field Test Connection)
25	Vent Assembly (Bonnet Vent) ¹
27	Set Screw (Bonnet)
34	Top Plate
36	Modulator Base
37	Modulator Stop
38	Modulator Piston Top
39	Modulator Piston Bottom
40	O-Ring Retainer
41	Lock Screw (Retainer)
42	Cap Screw (Modulator)
43	Socket Head Cap Screw (Modulator)
44	O-Ring (Modulator Base)
45	O-Ring (Modulator Stop)
46	O-Ring (Modulator Seat)
47	O-Ring (Modulator Piston Bottom)
48	Spring Seal (Piston Bottom)
49	Spring Seal (Piston Top)

1: Standard material is a filter plug. For special materials, vent assembly is supplied.

1. Remove Socket Head Cap Screw (2 Nos.) to remove Modulator Assembly from Pilot Base. Remove and discard both O-Rings (Modulator Base).

The Modulator Assembly consists of:

- 1 – Modulator Base
- 1 – Modulator Stop
- 1 – Modulator Piston Assembly

The Modulator Piston Assembly consists of:

- 1 – Modulator Piston Top
- 1 – Modulator Piston Bottom
- 1 – O-Ring Retainer
- 1 – Lock Screw
- 1 – O-Ring Modulator Piston Bottom
- 1 – Spring Seal (Piston Top)
- 1 – Spring Seal (Piston Bottom)
- 1 – O-Ring (Modulator Seat)

2. Remove Cap Screws (Modulator) holding Modulator Stop to Modulator Base.
3. Modulator Base can now be removed by rotating the Modulator Stop enough to be able to push against the ears on the Modulator Base to remove the Modulator Stop.
4. Remove both O-Rings (Modulator Stop) and discard.
5. Disassemble the Modulator Piston Assembly by removing the Lock Screw.
6. Remove and discard O-Ring (Modulator Piston Bottom) and O-Ring (Modulator Seat). Be careful not to bend the lip enclosing the O-Ring (Modulator Seat) during its removal.
7. Discard Spring Seal (Piston Bottom) and Spring Seal (Piston Top).

XVII. Disassembly of Pilot Valve (Cont.)

C. 39MV22/72 Disassembly

Figures 54, 55 and 52

1. Remove and discard the aluminum seals and sealing wire.
2. Remove Cap (Compression Screw) by turning counterclockwise.
3. If a lifting lever is installed, also use Figure 52 to remove the Lifting Lever assembly. Then return to Figure 54 or 55 to continue disassembly.

The Lifting Lever Assembly consists of:

- 1 – Lever
 - 1 – Drive Pin
 - 1 – Cam Shaft
 - 1 – Bushing
4. Remove Lifting Lever Assembly by turning Bushing counterclockwise.
 5. Turn Cap (Compression Screw) counterclockwise.
 6. Measure distance from Release Lock Nut to the top of the Lifting Stem for reassembly later.
 7. Remove the Release Lock Nut and Release Nut by turning counterclockwise.
 8. Measure and record Compression Screw height for later use when resetting.
 9. Turn Compression Screw Lock Nut counterclockwise to loosen.
 10. Turn Compression Screw counterclockwise to remove the load on the Spring.
 11. Turn Set Screw counterclockwise to loosen.
 12. Bonnet can now be removed by turning counterclockwise.
 13. Spring and Spring Washers can now be removed.

Note: If Lifting Lever option is equipped, there is no need to remove Drive Pin from Bottom Spring Washer assembly.

14. Remove the four Cap Screws (Top Plate) holding the Top Plate to the Pilot Base. Remove and discard the Spring Seal (Main Piston), O-Ring (Top Plate) and back-up rings (if applicable).
15. Remove Main Piston Assembly from Pilot Base.

Main Piston Assembly consists of:

- 1 – Main Piston
 - 1 – Piston Nose
 - 1 – Piston Retainer Nut
 - 1 – Set Screw
16. Remove Set Screw. Turn Piston Retainer Nut counterclockwise to remove. Remove Piston Nose.

Note: For Dome Assist Option, please refer to “Dome Assist Option” (Section XXII.B) for disassembly instructions.

17. Remove Spring Seal (Main Piston) and Backup Ring (if applicable) and discard.

Removing the Insert Assembly:

The Insert Assembly consists of:

- 1 - Insert Top
 - 1 - Insert Bottom
 - 1 - Spring Seal (Insert)
 - 1 - O-Ring (Insert)
1. Remove Insert Assembly from the top of the Pilot Base with tool #4995401 as shown in Figure 93. Remove and discard the O-Ring (Insert) on the bottom of the Insert Assembly. Disassemble Insert Assembly by removing the Insert Bottom from the Insert Top. Discard Spring Seal (Insert).
 2. Remove Adjuster Cap from the bottom of the Pilot Base by turning counterclockwise.
 3. Loosen Adjuster Lock Nut by turning counterclockwise.

Removing the Adjuster Assembly.

The Adjuster Assembly consists of:

- 1 – Adjuster Top
 - 1 – Adjuster Bottom
 - 1 – Vent Seal Adaptor
 - 1 – O-Ring (Adjuster Top)
 - 1 – O-Ring (Adjuster Bottom)
 - 1 – Spring Seal (Adjuster Top)
 - 1 – Spring Seal (Adjuster Bottom)
1. Turn Adjuster Assembly clockwise counting the number of flats until assembly stops. Record number of flats for reassembly.

XVII. Disassembly of Pilot Valve (Cont.)

2. Remove Adjuster Assembly from the Pilot Base by turning counterclockwise. Remove O-Ring (Adjuster Top) and O-Ring (Adjuster Bottom) from adjuster assembly and discard. Disassemble Adjuster Top from the Adjuster Bottom by turning Adjuster Top counterclockwise. Remove the Vent Seal Adaptor from the Adjuster Top. Remove and discard the Spring Seal (Adjuster Top) and Spring Seal (Adjuster Bottom).
3. Refer to Field Test Connection / Backflow Preventer Option (Section XXII.A) for disassembly of Field Test Connection.

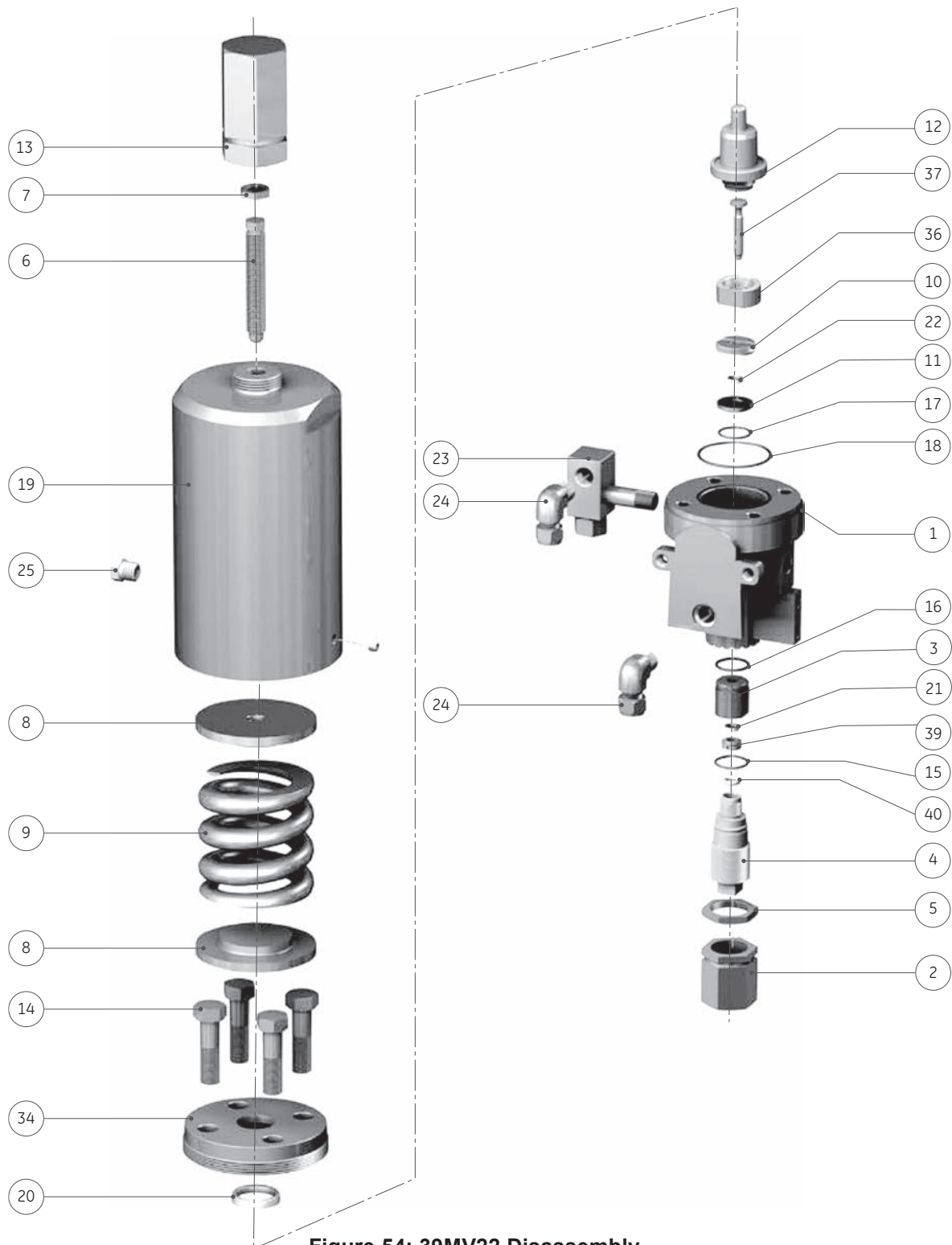


Figure 54: 39MV22 Disassembly

XVII. Disassembly of Pilot Valve (Cont.)

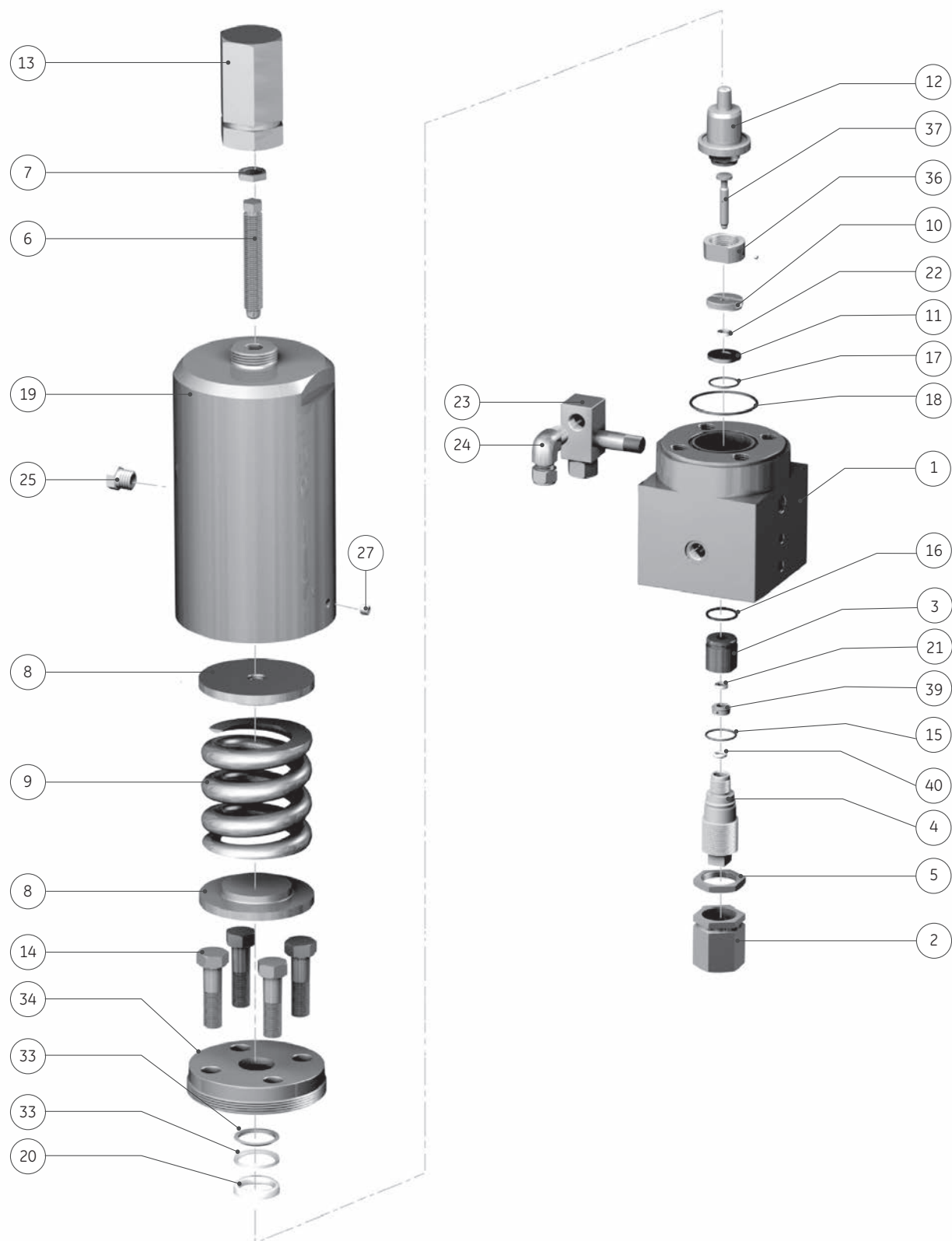


Figure 55: 39MV72 Disassembly

XVII. Disassembly of Pilot Valve (Cont.)

Part No.	Nomenclature
1	Main Base
2	Adjuster Cap
3	Adjuster Top
4	Adjuster Bottom
5	Adjuster Lock Nut
6	Compression Screw
7	Compression Screw Lock Nut
8	Spring Washer
9	Spring
10	Insert Top
11	Insert Bottom
12	Main Piston
13	Cap (Compression Screw)
14	Cap Screw (Top Plate)
15	O-Ring (Adjuster Bottom)
16	O-Ring (Adjuster Top)
17	O-Ring (Insert)
18	O-Ring (Top Plate)
19	Bonnet
20	Spring Seal (Main Piston)
21	Spring Seal (Adjuster Top)
22	Spring Seal (Insert)
23	Field Test Connector
24	Vent Assembly/Bug Screen (Field Test Connection)
25	Vent Assembly (Bonnet Vent) ¹
27	Set Screw (Bonnet)
28	Piston Nose
29	Piston Retainer Nut
30	Set Screw (Piston)
31	Vent Seal (Adaptor)
32	Spring Seal (Vent Seal Adaptor)
33	Back-up Ring (39MV72 Only)
34	Top Plate

1: Standard material is a filter plug. For special materials, vent assembly is supplied.

D. Cleaning

1. Clean parts to remove all rust, burrs, scale, organic matter, and loose particles. Parts are to be free of any oil or grease except for lubrication as specified in this instruction.
2. Cleaning agents used shall be such that effective cleaning is assured without injuring the surface finishes or material properties of the part.
3. Acceptable cleaning agents include demineralized water, nonphosphate detergent, acetone, and isopropyl alcohol. Parts must be blown dry or wiped dry after cleaning.
4. If you are using cleaning solvents, take precautions to protect yourself from potential danger from breathing fumes, chemical burns, or explosion. See the solvent's Material Safety Data Sheet for safe handling recommendations and equipment.
5. Do not "sand blast" internal parts as it can reduce the dimensions of the parts.



XVIII. Part Inspection of Pilot Valve

After the valve has been disassembled, all parts should be given a visual inspection. Some key areas to check with the boundaries for reworking parts are listed below.

A. 39PV07/37

1. **Main Piston:** Galling or excessive wear on the small diameter end where it engages the spring seals or on the spherical bearing surface. Any corrosion or pitting that appears detrimental to the function of the valve. The part can be polished as long as the outside diameter of the stem remains at $.243 \pm .001"$ (6.18 ± 0.03 mm). The stem itself must have a T.I.R of $.001"$ (0.03 mm) along its length. The upper diameter where the Spring Seal (Main Piston) rides must be $1.495 \pm .001$ (37.97 ± 0.03 mm) on 39PV07 model or $.970 \pm .001"$ (24.64 ± 0.03 mm) on 39PV37. A surface finish of 8 RMS must be maintained for proper sealing on these surfaces.
2. **Insert Top:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
3. **Insert Bottom:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting.
4. **Adjuster Top:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
5. **Adjuster Bottom:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
6. **Top Plate:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
7. **Bonnet:** Check for any corrosion or pitting. Also, check for galling of threads for the compression screw and where it attaches to the Pilot Base.
8. **Compression Screw:** Galling at the spherical bearing surface or in the thread. Check for any corrosion or pitting.
9. **Spring Washer(s):** Galling at the spherical bearing surface. Check for any corrosion or pitting.
10. **Pilot Base:** Check for any corrosion or pitting. Also, check for galling of threads.
11. **Spring:** Check for any corrosion or pitting.

B. 39MV07

1. **Main Piston:** Galling or excessive wear on the small diameter end where it engages the spring seals or on the spherical bearing surface. Any corrosion or pitting that appears detrimental to the function of the valve. The part can be polished as long as the outside diameter of the stem remains at $.243 \pm .001"$ (6.17 ± 0.03 mm). The stem itself must have a T.I.R of $.001"$ (0.03 mm) along its length. The upper diameter where the Spring Seal (Main Piston) rides must be $1.495 \pm .001$ (37.97 ± 0.03 mm) on 39PV07 model or $.970 \pm .001"$ (24.64 ± 0.03 mm) on 39PV37. A surface finish of 8 RMS must be maintained for proper sealing on these surfaces.
2. **Insert Top:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
3. **Insert Bottom:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting.
4. **Adjuster Top:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
5. **Adjuster Bottom:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
6. **Top Plate:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
7. **Bonnet:** Check for any corrosion or pitting. Also, check for galling of threads for the compression screw and where it attaches to the Pilot Base.
8. **Compression Screw:** Galling at the spherical bearing surface or in the thread. Check for any corrosion or pitting.
9. **Spring Washer(s):** Galling at the spherical bearing surface. Check for any corrosion or pitting.
10. **Pilot Base:** Check for any corrosion or pitting. Also, check for galling of threads.
11. **Spring:** Check for any corrosion or pitting.

XVIII. Part Inspection of Pilot Valve (Cont.)

12. **Modulator Stop:** Top seating surface for cuts or deformities. The surface can be lapped if the distance from the seat to the outside shoulder does not reduce to less than .086" (2.18 mm).
13. **O-Ring Retainer:** Seating surface for cuts or deformities. The surface can be lapped if the overall height of the part does not reduce to less than .160" (4.06 mm). Also, check the outside diameter for any scratches that might prevent the O-Ring (Modulator Seat) from sealing.
14. **Modulator Piston Bottom:** Galling or excessive wear on the outside diameter that rubs against the Modulator Base. Make sure that the lip holding the O-Ring (Modulator Seat) is not deformed. Also, check the outside diameter of the O-Ring groove for scratches that might cause the O-Ring (Modulator Seat) not to seal. Check for any corrosion or pitting.
15. **Modulator Base:** Galling or excessive wear on any inside diameter. Any corrosion or pitting.
6. **Adjuster Bottom:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
7. **Vent Seal Adaptor:** Check for any corrosion or pitting.
8. **Top Plate:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
9. **Bonnet:** Check for any corrosion or pitting. Also, check for galling of threads for the compression screw and where it attaches to the Pilot Base.
10. **Compression Screw:** Galling at the spherical bearing surface or in the thread. Check for any corrosion or pitting.
11. **Spring Washer(s):** Galling at the spherical bearing surface. Check for any corrosion or pitting.
12. **Pilot Base:** Check for any corrosion or pitting. Also, check for galling of threads.

C. 39MV22/72

1. **Main Piston:** Galling or excessive wear on the diameter where the Spring Seal (Main Piston) engages or on the spherical bearing surface. Any corrosion or pitting that appears detrimental to the function of the valve. The part can be polished as long as the outside diameter of the where the Spring Seal (Main Piston) rides must be $.970 \pm .001$ " (24.64 ± 0.03 mm) on 39MV22 model or $.812 \pm .001$ " (20.63 ± 0.03 mm) on 39MV72. A surface finish of 8 RMS must be maintained for proper sealing on these surfaces.
2. **Piston Nose:** Galling or excessive wear on the diameter where the spring seals engage. Any corrosion or pitting that appears detrimental to the function of the valve. The part can be polished as long as the outside diameter of the stem remains at $.243 \pm .001$ " (6.17 ± 0.03 mm). The stem itself must have a T.I.R of .001" (0.03 mm) along its length.
3. **Insert Top:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.
4. **Insert Bottom:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting.
5. **Adjuster Top:** Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.

13. **Spring:** Check for any corrosion or pitting.

If any damage listed above is present, the part should be replaced or repaired per instruction. Other valve parts may be acceptable with light corrosion, pitting, or minor damage of other types if it can be determined that it will not affect product performance. All O-Rings and spring seals should be replaced each time the valve is disassembled.

Refer to Tables 27 and 28 for O-Ring/Spring Seal repair kits. Recommended spare parts are listed in Table 25.

XIX. Reassembly of Pilot Valve

A. Lubricants and Sealants

1. Lubricate all O-Rings, except those made from silicone, and spring seals sparingly with silicone grease (Baker Hughes P/N SP505).
2. Seal all pipe threads with Teflon tape or pipe sealant (Baker Hughes P/N SP364-AB).
3. Lubricate standard threads and bearing points with Flourolube GR362 (Baker Hughes P/N 4668601) or equivalent.

B. Assembly of 39PV07/37

1. Making the Main Pilot.
2. Making the Adjuster Assembly,

This assembly consists of:

- 1 – Adjuster Bottom
 - 1 – Adjuster Top
 - 1 – Spring Seal (Adjuster Top)
 - 1 – O-Ring (Adjuster Top)
 - 1 – O-Ring (Adjuster Bottom)
- a. Check the Adjuster Top for burrs at the spring seal lead in chamfer. Remove any burrs using a polishing cloth.
 - b. Install Spring Seal (Adjuster Top) into Adjuster Top using insertion tool as shown in Figure 93.
 - i. Lubricate Spring Seal (Adjuster Top) with silicone grease.
 - ii. Install Spring Seal (Adjuster Top) onto Plunger Cylinder with spring facing away from Plunger Cylinder.
 - iii. Insert Plunger into Plunger Cylinder until Plunger lightly contacts Spring Seal (Adjuster Top).
 - iv. Insert Funnel Tube, chamfer side first, over the Plunger and Spring Seal (Adjuster Top). Stop when Spring Seal (Adjuster Top) is about half way inside the Funnel Tube as shown in Figure 56.

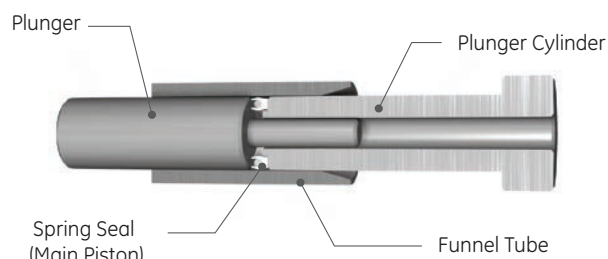


Figure 56: Funnel Tube

- v. Remove Plunger. Insert Funnel Tube Assembly into Adjuster Top until Funnel Tube contacts Spring Seal (Adjuster Top) gland.
- vi. Push down on Plunger cylinder to insert Spring Seal (Adjuster Top) into Adjuster Top as shown in Figure 57.
- vii. Remove Funnel Tube Assembly.
- viii. Inspect Adjuster Top to make sure that Spring Seal (Adjuster Top) did not flare out during installation and that the Spring Seal (Adjuster Top) is oriented as shown in Figure 58.

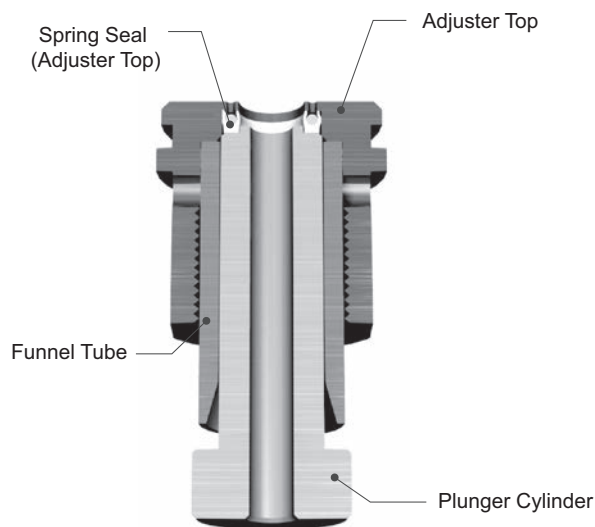


Figure 57: Plunger Cylinder

- c. Thread Adjuster Top clockwise onto Adjuster bottom and torque to 27 ± 2 ft-lbs (37 ± 2.7 N-m).
- d. Lubricate Main Piston stem and cycle Main Piston through Spring Seal (Adjuster Top) five times.

Note: Do not install adjuster assembly into Pilot Base with O-Rings installed without wrench tightening Adjuster Top to Adjuster Bottom together. Adjuster Top can get stuck in Pilot Base if the Adjuster Top is not tighten properly.

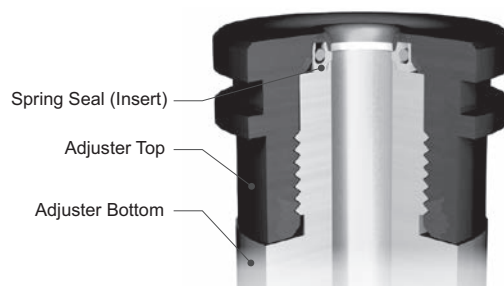


Figure 58: Adjuster Top Assembly

XIX. Reassembly of Pilot Valve (Cont.)

- e. Install O-Ring (Adjuster Top) into groove on Adjuster Top.
- f. Install O-Ring (Adjuster Bottom) into groove on Adjuster Bottom. Install from the opposite end of the square wrenching flats.
- g. Lightly lubricate both external O-Rings on Adjuster Assembly. Install Adjuster Assembly into Pilot Base with the Adjuster Top going in first. Rotate the assembly clockwise during installation until the threads are engaged. This helps the O-Rings get by chamfers and holes.
- h. Continue to turn Adjuster Assembly clockwise into Pilot Base until it stops.
- i. Turn Adjuster Assembly counterclockwise the number of flats that was recorded in Disassembly Instructions (Section XVII.A), step 16.
- j. Thread the Adjuster Lock Nut clockwise onto the Adjuster Assembly hand tight.
- k. Thread Adjuster Cap clockwise onto Adjuster Assembly hand tight.

Note: Make sure Adjuster Cap and Adjuster Lock Nut threads freely on Adjuster Bottom. Adjuster Assembly may be inadvertently rotated if these two parts do not fit loosely.

3. The Insert Assembly of the pilot consists of:

- 1 – Insert Top
- 1 – Insert Bottom
- 1 – Spring Seal (Insert)
- 1 – O-Ring (Insert)

- a. Press Spring Seal (Insert) into groove on the Insert Bottom. Make sure spring is facing upwards.
- b. Install Insert Top over Insert Bottom with the spring seal side going in first.
- c. Lightly lubricate O-Ring groove now formed by the two insert parts. This lubrication is used to hold the O-Ring in place when it is being inserted into Pilot Base.
- d. Place O-Ring (Insert) into groove.
- e. Final Insert Assembly is shown in Figure 59.
- f. Turn Insert Assembly over and thread into Pilot Base with T-handle groove wrench (Part #4995401 Figure 93). Tighten wrench tight. Make sure milled slot is facing up.
- g. Lubricate Main Piston stem and cycle Main Piston through Spring Seal (Insert) five times.

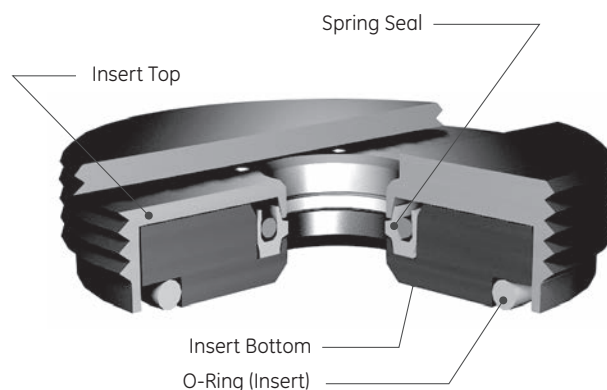


Figure 59: Insert Assembly

Note: For Dome Assist Option, please refer to assembly instructions included in the Dome Assist Option section (Section XXII.B.4).

4. Install O-Ring (Top Plate) into groove on top of Pilot Base.

Note: For Dome Assist Option, O-Ring (Top Plate) is installed into groove on top of the Dome Assist Insert.

- a. Lubricate the Spring Seal (Main Piston) and Top Plate gland. Install the Spring Seal (Main Piston) into Top Plate. The spring should be oriented as shown in Figures 50 or 51.
- b. Lubricate Main Piston before installing. Install the Main Piston into the Top Plate with the Spring Washer bearing point going in first. Be careful not to damage the Spring Seal (Main Piston).

5. Install Main Piston / Top Plate Assembly into Pilot Base by inserting small diameter end of Main Piston through Insert Assembly.

Note: For Dome Assist Option, install Main Piston /Top Plate Assembly into Dome Assist Insert instead of Pilot Base.

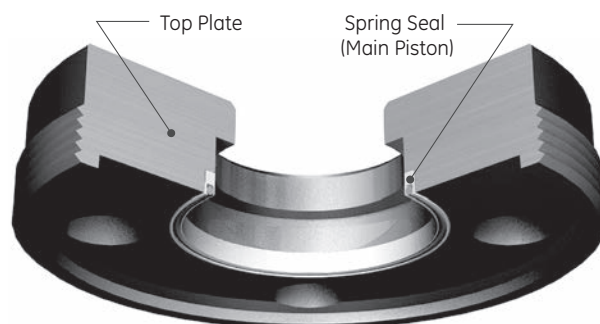


Figure 60: Top Plate (39PV07)

XIX. Reassembly of Pilot Valve (Cont.)

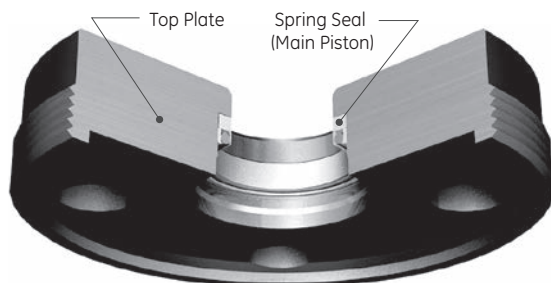


Figure 61: Top Plate (39PV37)

6. Insert the four Cap Screws (Top Plate) through the Top Plate and thread into the Pilot Base. Tighten to 25 ± 2 ft-lbs (34 ± 2.7 N-m).
 - a. If removed, thread Compression Screw Lock Nut clockwise onto Compression Screw.
7. Thread Compression Screw into top of Bonnet until the bearing point begins to protrude through Bonnet.
8. Place Spring Washers on the ends of the Spring. There is not a top or bottom Spring Washer unless the Lifting Lever option is installed.
9. If pilot has Lifting Lever Option:
 - a. Place Spring over Lifting Stem and place on Bottom Spring Washer.
 - b. Place Top Spring Washer on top of Spring and then place the entire assembly on top of Pilot Base assembly ensuring that the spherical radius located on the Bottom Spring Washer engages with spherical nose on Main Piston.
10. Install the Bonnet over the Spring and Spring Washer Assembly. Thread the Bonnet onto the Top Plate. Tighten wrench tight. Install and tighten Set Screw.
11. Turn Compression Screw clockwise until dimension has been reached that was noted during disassembly.
12. Tighten Compression Screw Lock Nut wrench tight.
13. For Lifting Lever Option, reinstall Release Nut and Release Lock Nut onto Lifting Stem. Turn clockwise until it matches the dimension noted during disassembly.
14. Install Filter Plug into Bonnet vent hole (if removed).
15. Install Pipe Plug (Pilot Valve) in port above vent hole (if removed).

16. Refer to Field Test Connection / Backflow Preventer Option (Section XXII.A) for reassembly of Field Test Connection.

C. Assembly of 39MV07

1. Making the Main Pilot.
2. Making the Adjuster Assembly,

This assembly consists of:

- 1 – Adjuster Bottom
 - 1 – Adjuster Top
 - 1 – Spring Seal (Adjuster Top)
 - 1 – O-Ring (Adjuster Top)
 - 1 – O-Ring (Adjuster Bottom)
- a. Check the Adjuster Top for burrs at the spring seal lead in chamfer. Remove any burrs using a polishing cloth.
 - b. Install Spring Seal (Adjuster Top) into Adjuster Top using insertion tool as shown in Figure 92.
 - i. Lubricate Spring Seal (Adjuster Top) with silicone grease.
 - ii. Install Spring Seal (Adjuster Top) onto Plunger Cylinder with spring facing away from Plunger Cylinder.
 - iii. Insert Plunger into Plunger Cylinder until Plunger lightly contacts Spring Seal (Adjuster Top).
 - iv. Insert Funnel Tube, chamfer side first, over the Plunger and Spring Seal (Adjuster Top). Stop when Spring Seal (Adjuster Top) is about half way inside the Funnel Tube as shown in Figure 56.
 - v. Remove Plunger.
 - vi. Insert Funnel Tube Assembly into Adjuster Top until Funnel Tube contacts Spring Seal (Adjuster Top) gland.
 - vii. Push down on Plunger cylinder to insert Spring Seal (Adjuster Top) into Adjuster Top as shown in Figure 57.
 - viii. Remove Funnel Tube Assembly.
 - ix. Inspect Adjuster Top to make sure that Spring Seal (Adjuster Top) did not flare out during installation and that the Spring Seal (Adjuster Top) is oriented as shown in Figure 58.
 - c. Thread Adjuster Top clockwise onto Adjuster bottom and torque to 27 ± 2 ft-lbs (37 ± 2.7 N-m).
 - d. Lubricate Main Piston stem and cycle Main Piston through Spring Seal (Adjuster Top) five times.

XIX. Reassembly of Pilot Valve (Cont.)

Note: Do not install adjuster assembly into Pilot Base with O-Rings installed without wrench tightening Adjuster Top to Adjuster Bottom together. Adjuster Top can get stuck in Pilot Base if Adjuster Top is not tighten properly.

- e. Install O-Ring (Adjuster Top) into groove on Adjuster Top.
- f. Install O-Ring (Adjuster Bottom) into groove on Adjuster Bottom. Install from the opposite end of the square wrenching flats.
- g. Lightly lubricate both external O-Rings on Adjuster Assembly. Install Adjuster Assembly into Pilot Base with the Adjuster Top going in first. Rotate the assembly clockwise during installation until the threads are engaged. This helps the O-Rings get by chamfers and holes.
- h. Continue to turn Adjuster Assembly clockwise into Pilot Base until it stops.
- i. Turn Adjuster Assembly counterclockwise the number of flats that was recorded in Disassembly Instructions (Section XVII.B), step 16.
- j. Thread the Adjuster Lock Nut clockwise onto the Adjuster Assembly hand tight.
- k. Thread Adjuster Cap clockwise onto Adjuster Assembly hand tight.

Note: Make sure Adjuster Cap and Adjuster Lock Nut threads freely on Adjuster Bottom. Adjuster Assembly may be inadvertently rotated if these two parts do not fit loosely.

3. The Insert Assembly of the pilot consists of:
 - 1 – Insert Top
 - 1 – Insert Bottom
 - 1 – Spring Seal (Insert)
 - 1 – O-Ring (Insert)
- a. Press Spring Seal (Insert) into groove on the Insert Bottom. Make sure spring is facing upwards.
- b. Install Insert Top over Insert Bottom with the spring seal side going in first.
- c. Lightly lubricate O-Ring groove now formed by the two insert parts. This lubrication is used to hold the O-Ring in place when it is being inserted into Pilot Base.
- d. Place O-Ring (Insert) into groove.
- e. Final Insert Assembly is shown in Figure 59.

- f. Turn Insert Assembly over and thread into Pilot Base with T-handle groove wrench (Part #4995401, Figure 93). Tighten wrench tight. Make sure milled slot is facing up.
- g. Lubricate Main Piston stem and cycle Main Piston through Spring Seal (Insert) five times.

Note: For Dome Assist Option, please refer to assembly instructions included in the Dome Assist Option section.

4. Install O-Ring (Top Plate) into groove on top of Pilot Base.

Note: For Dome Assist Option, O-Ring (Top Plate) is installed into groove on top of the Dome Assist Insert.

- a. Lubricate the Spring Seal (Main Piston) and Top Plate gland. Install the Spring Seal (Main Piston) into Top Plate. The spring should be oriented as shown in Figure 60.
 - b. Lubricate Main Piston before installing. Install the Main Piston into the Top Plate with the Spring Washer bearing point going in first. Be careful not to damage the Spring Seal (Main Piston).
5. Install Main Piston / Top Plate Assembly into Pilot Base by inserting small diameter end of Main Piston through Insert Assembly.

Note: For Dome Assist Option, install Main Piston /Top Plate Assembly into Dome Assist Insert instead of Pilot Base.

6. Insert the four Cap Screws (Top Plate) through the Top Plate and thread into the Pilot Base. Tighten to 25 ± 2 ft-lbs (34 ± 2.7 N-m).

Note: If removed, thread Compression Screw Lock Nut clockwise onto Compression Screw.

7. Thread Compression Screw Lock Nut clockwise onto Compression Screw.
8. Thread Compression Screw into top of Bonnet until the bearing point begins to protrude through Bonnet.
9. Place Spring Washers on the ends of the Spring. There is not a top or bottom Spring Washer unless the Lifting Lever option is installed.
10. If pilot has Lifting Lever Option:
 - a. Place Spring over Lifting Stem and place on Bottom Spring Washer.

XIX. Reassembly of Pilot Valve (Cont.)

- b. Place Top Spring Washer on top of Spring and then place the entire assembly on top of Pilot Base assembly ensuring that the spherical radius located on the Bottom Spring Washer engages with spherical nose on Main Piston.
11. Install the Bonnet over the Spring and Spring Washer Assembly. Thread the Bonnet onto the Top Plate. Tighten wrench tight. Install and tighten Set Screw.
12. Turn Compression Screw clockwise until dimension has been reached that was noted during disassembly.
13. Tighten Compression Screw Lock Nut wrench tight.
14. For Lifting Lever Option, reinstall Release Nut and Release Lock Nut onto Lifting Stem. Turn clockwise until it matches the dimension noted during disassembly.
 - a. Install Filter Plug into Bonnet vent hole (if removed).
15. Install Pipe Plug (Pilot Valve) in port above vent hole.
16. Refer to Field Test Connection / Backflow Preventer Option for reassembly of Field Test Connection
17. Making The Modulator Piston Assembly:
 - a. Install Spring Seal (Piston Top) into groove on Modulator Piston Top. Be sure to have the spring in the seal facing up.
 - b. Install O-Ring (Modulator Seat) into groove on Modulator Piston Bottom.
 - c. Turn Modulator Piston Bottom over and place O-Ring (Modulator Piston Bottom) into inner groove.
 - d. Install Spring Seal (Piston Bottom) onto Modulator Piston Bottom in outer groove. Make sure spring is facing down.
 - e. Insert Modulator Piston Top into Modulator Piston Bottom through the side with the O-Ring (Modulator Piston Bottom) and the Spring Seal (Piston Bottom).
 - f. Turn assembly over and install O-Ring Retainer. The chamfered outside diameter goes in first.
 - g. Thread Lock Screw through the O-Ring Retainer into Modulator Piston Top. Tighten 40 ± 5 in-lbs (4.5 ± 0.6 N-m).
 - h. Final Modulator Piston Assembly is shown in Figure 62.

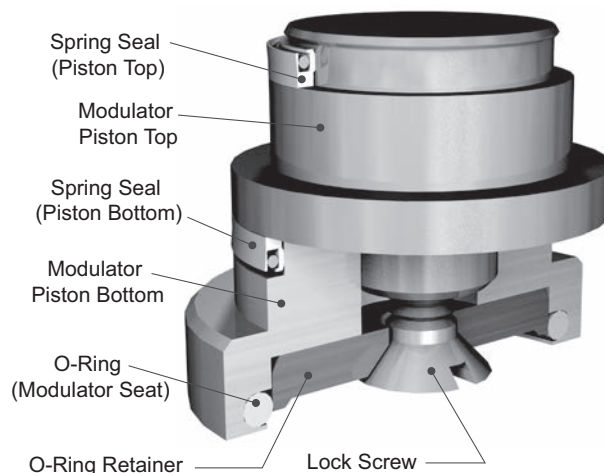


Figure 62: Modulator Piston Assembly

18. Lubricate Spring Seals before inserting into Modulator Base.
19. Insert Modulator Piston Assembly into Modulator Base with the Modulator Piston Top going in first. Push piston in with thumbs until it stops. There will be some resistance due to the Spring Seals compressing to fit into the bore of the Modulator Base. If necessary for installation, insert the proper wrench into the Lock Screw. Lightly tapping the wrench with a hammer will force the Modulator Piston Assembly into the Modulator base.
20. Install both O-Rings (Modulator Stop) into grooves on Modulator Piston Stop.
21. 18. Insert Modulator Stop into Modulator Base with the seat going in first. Make sure the side hole in the Modulator Stop is facing towards the flat side of the Modulator Base.
22. Thread the Cap Screws (Modulator) through the Modulator Stop into the Modulator Base. Tighten to 365 ± 30 in-lbs (41.2 ± 3.4 N-m).
23. Do not install Modulator Assembly at this time.

D. Assembly of 39MV22/72

Making the Main Pilot.

1. Making the Main Piston Assembly
 - a. Insert the Piston Nose into the recess at the threaded end of the Piston Top.
 - b. Slide the Piston Nut over the Piston Nose and thread it onto the Piston Top. Place the assembly in a vice with soft jaws and torque the Piston Nut to 30 ± 3 ft-lbs (40.6 ± 4 N-m).
 - c. Install the Set Screw into the threaded hole of the Piston Nut and hand tighten.

XIX. Reassembly of Pilot Valve (Cont.)

2. Making the Adjuster Assembly,

This assembly consists of:

- 1 – Adjuster Bottom
 - 1 – Adjuster Top
 - 1 – Vent Seal Adaptor
 - 1 – Spring Seal (Adjuster Top)
 - 1 – Spring Seal (Adjuster Bottom)
 - 1 – O-Ring (Adjuster Top)
 - 1 – O-Ring (Adjuster Bottom)
- a. Check the Adjuster Top for burrs at the spring seal lead in chamfer. Remove any burrs using a polishing cloth.
 - b. Install Spring Seal (Adjuster Top) into Adjuster Top using insertion tool as shown in Figure 92.
 - i. Lubricate Spring Seal (Adjuster Top) with silicone grease.
 - ii. Install Spring Seal (Adjuster Top) onto Plunger Cylinder with spring facing away from Plunger Cylinder.
 - iii. Insert Plunger into Plunger Cylinder until Plunger lightly contacts Spring Seal (Adjuster Top).
 - iv. Insert Funnel Tube, chamfer side first, over the Plunger and Spring Seal (Adjuster Top). Stop when Spring Seal (Adjuster Top) is about half way inside the Funnel Tube as shown in Figure 56.
 - v. Remove Plunger.
 - vi. Insert Funnel Tube Assembly into Adjuster Top until Funnel Tube contacts Spring Seal (Adjuster Top) gland.
 - vii. Push down on Plunger cylinder to insert Spring Seal (Adjuster Top) into Adjuster Top as shown in Figure 57.
 - viii. Remove Funnel Tube Assembly.
 - ix. Inspect Adjuster Top to make sure that Spring Seal (Adjuster Top) did not flare out during installation and that the Spring Seal (Adjuster Top) is oriented as shown in Figure 58.
 - c. Install the Spring Seal (Adjuster Bottom) onto the Adjuster Bottom with spring side down as shown in Figure 58.
 - d. Place the Vent Seal Adaptor onto the Spring Seal (Adjuster Bottom) with flat side up.
 - e. Thread Adjuster Top clockwise onto Adjuster bottom and torque to 27 ± 2 ft-lbs (37 ± 2.7 N-m).
 - f. Lubricate Main Piston stem and cycle Main

Piston through Spring Seal (Adjuster Top) and Spring Seal (Vent Seal Adaptor) five times.

Note: Do not install adjuster assembly into Pilot Base with O-Rings installed without wrench tightening Adjuster Top to Adjuster Bottom together. Adjuster Top can get stuck in Pilot Base if Adjuster Top is not tightened properly.

- g. Install O-Ring (Adjuster Top) into groove on Adjuster Top.
- h. Install O-Ring (Adjuster Bottom) into groove on Adjuster Bottom. Install from the opposite end of the square.
- i. Lightly lubricate both external O-Rings on Adjuster Assembly. Install Adjuster Assembly into Pilot Base with the Adjuster Top going in first. Rotate the assembly clockwise during installation until the threads are engaged. This helps the O-Rings get by chamfers and holes.
- j. Continue to turn Adjuster Assembly clockwise into Pilot Base until it stops.
- k. Turn Adjuster Assembly counterclockwise the number of flats that was recorded in Disassembly Instructions (Section XVII.C), step 16.
- l. Thread the Adjuster Lock Nut clockwise onto the Adjuster Assembly hand tight.
- m. Thread Adjuster Cap clockwise onto Adjuster Assembly hand tight.

Note: Make sure Adjuster Cap and Adjuster Lock Nut threads freely on Adjuster Bottom. Adjuster Assembly may be inadvertently rotated if these two parts do not fit loosely.

3. The Insert Assembly of the pilot consists of:

- 1 – Insert Top
 - 1 – Insert Bottom
 - 1 – Spring Seal (Insert)
 - 1 – O-Ring (Insert)
- a. Press Spring Seal (Insert) into groove on the Insert Bottom. Make sure spring is facing upwards.
 - b. Install Insert Top over Insert Bottom with the spring seal side going in first.
 - c. Lightly lubricate O-Ring groove now formed by the two insert parts. This lubrication is used to hold the O-Ring in place when it is being inserted into Pilot Base.
 - d. Place O-Ring (Insert) into groove.
 - e. Final Insert Assembly is shown in Figure 59.

XIX. Reassembly of Pilot Valve (Cont.)

- f. Turn Insert Assembly over and thread into Pilot Base with T-handle groove wrench (Part #4995401 Figure 93). Tighten wrench tight. Make sure milled slot is facing up.
- g. Lubricate Main Piston stem and cycle Main Piston through Spring Seal (Insert) five times.

Note: For Dome Assist Option, please refer to Dome Assist Option in section XXII.B for assembly instructions.

- 4. Install O-Ring (Top Plate) into groove on top of Pilot Base.

Note: For Dome Assist Option, O-Ring (Top Plate) is installed into groove on top of the Dome Assist Insert.

- a. 39MV22
 - i. Lubricate the Spring Seal (Main Piston) and Top Plate gland. Install the Spring Seal (Main Piston) into Top Plate. The spring should be oriented as shown in Figure 61.
 - ii. Lubricate Main Piston before installing. Install the Main Piston into the Top Plate with the Spring Washer bearing point going in first. Be careful not to damage the Spring Seal (Main Piston).
- b. 39MV72
 - i. Lubricate the backup rings. Back-up Ring (Upper) should be installed first with angle surface facing you when installed.
 - ii. Back-up Ring (Lower) should be installed second with angle facing away from you when installed.
 - iii. Lubricate Spring Seal (Main Piston) and Top Plate gland. Install Spring Seal (Main Piston) into the Top Plate. The spring and back-up rings should be oriented as shown in Figure 61.
 - iv. Lubricate Main Piston Assembly before installing. Install Main Piston into the Top Plate with Spring Washer bearing point going in first. Be careful not to damage Spring Seal (Main Piston).

- 5. Install Main Piston / Top Plate Assembly into Pilot Base by inserting small diameter end of Main Piston through Insert Assembly.

Note: For Dome Assist Option, install Main Piston /Top Plate Assembly into Dome Assist Insert instead of Pilot Base.

- 6. Insert the four Cap Screws (Top Plate) through the Top Plate and thread into the Pilot Base. Tighten to 25 ± 2 ft-lbs (34 ± 2.7 N-m).
- 7. If removed, thread Compression Screw Lock Nut clockwise onto Compression Screw.
- 8. Thread Compression Screw into top of Bonnet until the bearing point begins to protrude through Bonnet.
- 9. Place Spring Washers on the ends of the Spring. There is not a top or bottom Spring Washer unless the Lifting Lever option is installed.
- 10. If pilot has Lifting Lever Option:
 - a. Place Spring over Lifting Stem and place on Bottom Spring Washer.
 - b. Place Top Spring Washer on top of Spring and then place the entire assembly on top of Pilot Base assembly ensuring that the spherical radius located on the Bottom Spring Washer engages with spherical nose on Main Piston.
- 11. Install the Bonnet over the Spring and Spring Washer Assembly. Thread the Bonnet onto the Top Plate. Tighten wrench tight. Install and tighten Set Screw.
- 12. Turn Compression Screw clockwise until dimension has been reached that was noted during disassembly.
- 13. Tighten Compression Screw Lock Nut wrench tight.
- 14. For Lifting Lever Option, reinstall Release Nut and Release Lock Nut onto Lifting Stem. Turn clockwise until it matches the dimension noted during disassembly.
- 15. Install Filter Plug into Bonnet vent hole (if removed).
- 16. Install Pipe Plug (Pilot Valve) in port above vent hole (if removed).
- 17. Refer to Field Test Connection / Backflow Preventer Option (Section XXII.A) for reassembly of Field Test Connection.

XX. Setting and Testing

A. General Information

1. Before putting the reconditioned valve in service, it must be set to open at the required set pressure. Although the valve can be set on the service installation, it is more convenient to set the valve and check seat tightness on a test stand.

2. Test Equipment:

The test stand used for testing POSRVs normally consists of a pressure source supply line with a throttle valve and receiver that have the following features:

- a. Outlet for attaching the valve to be tested
- b. Pressure gauge with a shutoff valve
- c. Drain line with a shutoff valve
- d. Adequate receiver volume for the valve to be tested and to achieve proper operation

3. Test Media:

For best results, valves shall be tested by type, as follows:

- a. Steam valves are tested on saturated steam.
- b. Air or gas valves are tested on air or gas at ambient temperature.
- c. Liquid valves are tested on water at ambient temperature.

B. With Standard Options

Note: Seal all pipe threads with a non-organic sealant or Teflon® tape.

B.1 39PV07/37

1. Attach pilot to main valve using two Socket Head Cap Screws (Bracket).
2. Install the 3/8" O.D. tubes (Refer to Table 15 for sizing of tubing) into the fittings for the inlet and dome ports. Make sure the tube ends are fully inserted before torquing. Begin torquing the fitting, about midway down; verify that Swagelok Gap Inspection Gauge (Swagelok P/N MS-IG-468) will go. Continue to torque down fitting until Swagelok Gap Inspection Gauge will not go.

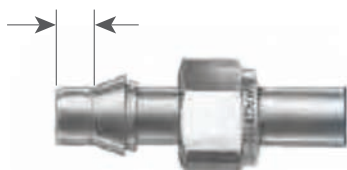


Figure 63: Tubing Dimensions

After torquing, remove to assure the ferrule is in good contact with the tubing. Refer to Table 14 and Figure 63 to determine if ferrule has seated itself properly. Reinstall the tubing.

Table 14: Ferrule Wall Thickness

Pressure Class	Wall Thickness (min.)	
	in.	mm
150# to 900#	.035	0.89
1500#	.049	1.24
2500#	.065	1.65

Table 15: Tubing Dimensions

Tubing Diameter		Tubing Length (A)	
in.	mm	in.	mm
.250	6.35	.190	4.83
.375	9.53	.250	6.35
.500	12.70	.340	8.64

3. The vent port of the pilot valve is vented to atmosphere in standard configuration.
4. Final standard configuration for a 39PV07 or 39PV37 without any options is shown in Figure 64.



Figure 64: 39PV07/37

XX. Setting and Testing (Cont.)

B.2 39MV07, 39MV22 AND 39MV72

1. Attach Pilot to Main Valve using two Socket Head Cap Screws (Bracket).
2. Install the tubes into the fittings for the inlet and dome ports. Make sure the tube ends are fully inserted before torquing. Begin torquing the fitting, about midway down, verify that Swagelok Gap Inspection Gauge (Swagelok P/N MS-IG-468) will go. Continue to torque down fitting until Swagelok Gap Inspection Gauge will not go. After torquing, remove to assure the ferrule is in good contact with the tubing. Reinstall the tubing.
3. Install tubing to connect the vent port of the Pilot to the outlet of the Main Valve in the standard configuration.
4. Final standard configuration for the modulation pilot valves without any options is shown in Figures 65 through 67.

C. Integral Sensing Ring (Figure 65)

Integral sensing is the standard pressure connection to the pilot valve used on the 2900 Gen II Pilot Operated Safety Relief Valve. With the Integral Sensing Ring, the pilot valve pressure can be picked up just before the inlet of the main valve. Before testing or startup, ensure that the tubing is reconnected to the integral sensing ring. For pressure testing on a shop test stand; additional gaskets can be ordered to complete testing of the valve.

Note: *One gasket supplied with the integral sense kit is intended for end user installations.*

The flange gaskets which are supplied by the customer are to be inserted between the Valve Nozzle and the Sensing Ring and between the Sensing Ring and the test system flange.

Reasons for failure:

1. Any leakage from Pilot at 4% below valve set pressure or 2 psig (0.14 psig), whichever is greater. The 39MV22 and 39MV72 may have 50 bubbles per minute at 5% below the set pressures at or above 2251 psig (155.2 barg) and none at pressures below 2250 psig (155.1 barg).
2. Main Valve equipped with soft seats.
 - a. For Main Valve equipped with 39MV22 and 39MV72, no leakage (0 bpm) is acceptable at 5% below valve set pressure or 2 psig (0.14 barg), whichever is greater. For set pressures 2250 psig (155.1 barg) and above, 50 bpm is acceptable for both Pilot and Main Valve.
 - b. For all other valve types, no leakage (0 bpm) is acceptable at 4% below valve set pressure or 2 psig (0.14 barg), whichever is greater.
 - c. (i) Paragraph 2.b(ii) refers to testing valves with Teflon O-rings specified for elevated temperatures above 200°F (93 °C).
 - d. (ii) Check the unit ticket for the temperature and verify that it is above 200°F (93°C). Test air/gas valves on room temperature air and check for leakage. If the valve is tight, testing is complete. If not, check the valve leakage on elevated temperature air between 201-500°F (94-260°C).

Note: *No need to pop the valve on elevated temperature air.*



Figure 65: 39MV07



Figure 66: 39MV22



Figure 67: 39MV72

XX. Setting and Testing (Cont.)

- e. (iii) Test liquid valves on room temperature water and check for leakage. If the valve is tight, testing is complete. If not, check the valve leakage on elevated temperature water between 201°F - 500°F (94°C - 260°C).

Note: No need to pop the valve on elevated temperature water.

1. Main Valve equipped with metal seats and air as test media.
 - a. An initial leakage test of the Main Valve shall be made using a piece of wet paper placed over the outlet of the valve for one minute with pressure held at 4% below valve set pressure or 2 psig (0.14 barg), whichever is greater.
 - b. If leakage from Main Valve is indicated by a bulging of the wet paper, the standard test fixture (as described in 3.c shall be installed on the outlet flange to determine the extent of the leakage. The test fixture is to be connected to the valve outlet in such a manner that no leakage may occur in the connection.
 - c. Per API standard 527 (ANSI B147.1-72) a standard test fixture consists of a piece of tubing 5/16" OD (8 mm) x .032" (0.8 mm) wall, where one end is joined to an adaptor on the valve outlet and other end is immersed .500" (12.7 mm) below the surface of a reservoir of water.



Figure 68: with Optional Line Filter

D. Troubleshooting Leakage

1. To isolate leakage that may be coming from the pilot, disconnect the pilot vent line (if applicable) from the main base outlet and plug the main valve outlet connection. If wet paper still bulges, then leakage is occurring from main valve.
2. Leakage from main valve can come from either the main valve seat, nozzle seal or dome seal. To determine if the leakage is from either the main valve seat or nozzle seal, the outlet must be filled to above the seat line and checked for bubbles. If no bubbles are present, then leakage is either coming from the dome seal.
3. The leakage rate shall be determined with the valve mounted vertically and using a standard test fixture as described in 3.c in Section XX.C. The leakage rate in bubbles per minute shall be determined with pressure held at 4% below valve set pressure or 2 psig (0.14 barg), whichever is greater. The test pressure shall be applied for 1 minute for valves of inlet sizes through 2" (50.8 mm); 2 minutes for sizes 2.5" (63.5 mm), 3" (76.2 mm) & 4" (101.6 mm); 5 minutes for sizes 6" (152.4 mm) and 8" (203.2 mm).
4. The leakage rate in bubbles per minute shall not exceed the values in Table 16.

Table 16: Leakage Rate					
Set Pressure at 60°F (15.6°C)		Effective Orifice Sizes ≤ 0.307 in2 (1.981 cm2) D & E Orifice Only		Effective Orifice Sizes > 0.307 in2 (1.981 cm2) F Orifice & Larger	
		Approximate Leakage per 24 Hours		Approximate Leakage per 24 Hours	
		Bubbles per minute	Standard Cubic Feet	Bubbles per minute	Standard Cubic Feet
15-1000	1.03-68.95	40	0.60	20	0.30
1500	103.42	60	0.90	30	0.45
2000	137.90	80	1.20	40	0.60
2500	172.37	100	1.50	50	0.75
3000	206.84	100	1.50	60	0.90
4000	275.79	100	1.50	80	1.20
5000	344.74	100	1.50	100	1.50
6000	413.69	100	1.50	100	1.50

XX. Setting and Testing (Cont.)

5. Main Valve equipped with metal seats and water as the test media.
 - a. No leakage shall be detected by sight or feel for one minute, when pressure is held at 4% below valve set pressure or 2 psig (0.14 barg), whichever is greater.
 6. Media valve equipped with metal seats and steam as the test media.
 - a. Leak tightness shall be checked visually using a black background. There shall be no visual or audible leakage after the interior or the valve is allowed to dry after popping. The leak test pressure shall be when pressure is held at 4% below valve set pressure or 2 psig (0.14 barg), whichever is greater.
 7. Blowdown is long (only consider if system is capable of flowing valve at 10% overpressure).
 8. Set point cannot be adjusted to consistently release at $\pm 2\%$ of unit ticket set pressure or 2 psig (0.14 barg), whichever is greater.
 9. Repeat set point verification tests 3 times.
 - a. Inlet pressure ramp guidelines.
 - (i) When set pressure is below or equal to 750 psig (51.7 barg), the inlet pressure ramp should not exceed 0.5 psig (0.03 barg), per second, when test pressure is within 90% of set pressure.
 - (ii) When set pressure is above 750 psig (51.7 barg), the inlet pressure ramp should not exceed 1.0 psig (0.07 barg) per second, when test pressure is within 90% of set pressure.
 - b. For the 39MV22 and 39MV72 pilots, venting will and must begin before the set point. The 39MV22 begins venting at 98% of set pressure and the 39MV72 begins venting at 97% of set pressure.
 - c. Drop system to 90% of set pressure between cycles.
 - d. The 3 tests should be within $\pm 2\%$ of unit ticket set pressure or 2 psig (0.14 barg), whichever is greater.
 - e. If blowdown is being checked, the following guidelines are to be followed.
 - i. 39PV model (gas/steam): less than or equal to 5% or 3 psig (0.20 barg), whichever is greater.
 - ii. 39PV model (liquid): between 7% and 4%. If set pressure is less than 30 psig (2.1 barg), 3 psig (0.20 barg), or less.
 - iii. 39MV model (gas/steam): less than or equal to 4% or 2 psig (0.14 barg), whichever is greater.
 - iv. 39MV model (liquid): between 7% and 4%. If set pressure is less than 30 psig (2.1 barg), 3 psig (0.20 barg), or less.
- Note: Customer requirements may note a variation to the standard blowdown. Customer request takes priority.**
- f. If adjustments are necessary, adjust Compression Screw or Adjuster and retighten corresponding lock nut. Retest beginning at step 9.
 - g. Increase pressure from 90% of set pressure to 4% below set pressure or 2 psig (0.14 barg), whichever is greater, and check all ports and connections for leakage on Pilot and Main Valve.
10. Back pressure testing for leakage
 - a. Backpressure is the pressure measured at the valve outlet, in pounds per square inch gauge (psig or barg).
 - b. Backpressure tests are to be performed after adjustment of set pressure and blowdown on each valve designed for use in a closed system having an inlet size greater than 1" (25.4 mm) NPS.
 - c. The pressure, at which the valve is to be backpressure tested, shall be 30 psig (2.1 barg) (minimum) or system backpressure, whichever is higher. Air or nitrogen shall be used as the test medium for applying backpressure.
 - d. Backpressure tests are to be performed by applying pressure with air or nitrogen to the valve outlet. Leakage may be detected by application of soap solution, or equivalent, at points of possible leakage. Pressure is to be held constant at the test pressure while the valve is being examined for leakage.
 - e. The following points shall be examined for leakage during backpressure testing.
 - i. Cover Plate, inlet and outlet joints.
 - ii. All tube fittings and connections.
 - iii. Possible point of leakage on the pilot valve.

Note: Blowdown can be set and checked on the main valve only if the system can achieve 10% over pressure.

XX. Setting and Testing (Cont.)

11. Repair of valves which show leaks in backpressure testing may be attempted by tightening the joint involved to normal tightness, while the valve is in the testing area. The valve is to be examined for cause of failure, the cause corrected, and the test repeated.

E. Conversions between Conventional and Bellows Type

Table 17 shows the requirements to convert between Conventional configurations and a Bellows configurations.

Table 17: Conventional to Bellows Conversion				
Valve	New Parts To Convert From			
Orifice Size	Conventional to Bellows Valve		Bellows to Conventional Valve	
ALL Ori-fices	1	Bellows Assembly Standard Material, AISI 316L Stainless Steel	1	Set of gaskets for conventional valve
	2	Set of gaskets for bellows valve	2	Pipe Plug
	3	Disc holder for bellows valve		
	4	Cover Plate ¹		

1. Conventional Cover Plate may be modified to work on a bellows valve.

XX. Setting and Testing (Cont.)

F. Field Testing of POSRV Assembly

IMPORTANT - Read First:

- A. These procedures shall not be used unless in the presence of a qualified Consolidated technician
- B. These procedures are specialized and shall not be incorporated into any of the customer's SOP's
- C. In no case shall the auxiliary pressure be raised more than 115% of MAWP.
 - i. The auxiliary system providing pressure must contain proper control to regulate flow into pilot.
- D. The necessary tubing, gauges, and fittings to perform this test must have a minimum pressure rating of 2x the maximum desired set point.
- E. In the cases when the auxiliary pressure is higher than the set pressure of the valve, these procedures may interfere with normal valve operation and the valve may not perform its intended function. The process system pressure shall be monitored at all times during the performance of these tests. If system pressure increases past 95% of desired set pressure, the auxiliary pressure source shall be removed and the vent valve downstream of the exhaust gauge shall be opened. This will allow the PRV to function as intended.
- F. In cases where there is a large pressure gap between the bottle/source pressure and desired dome pressure, it is recommended multiple regulators be installed to maintain the ability to fine tune the pressure setting in the pilot dome.

F.1 Field Test Connection

A 1/4" FNPT field test connection (Figure 70) is standard on all Consolidated pilot valve types, 39PV series and 39MV series. The field test connection along with an auxiliary pressure source can be used to provide a stable and constant pressure to the pilot valve and dome of the main valve. An internal check valve is present in the field test connection isolating the inlet media from the auxiliary pressure source media and at the same time, allowing the valve to open normally in the event of a system over pressurization while using the field test connection. Figures 69 and 71 represent the recommended schematic for supplying auxiliary pressure to the POSRV. The "Connection to Valve Test Plug" mates with the 1/4" FNPT of the Field Test Connection.

Below are some common usages for the field test connection:

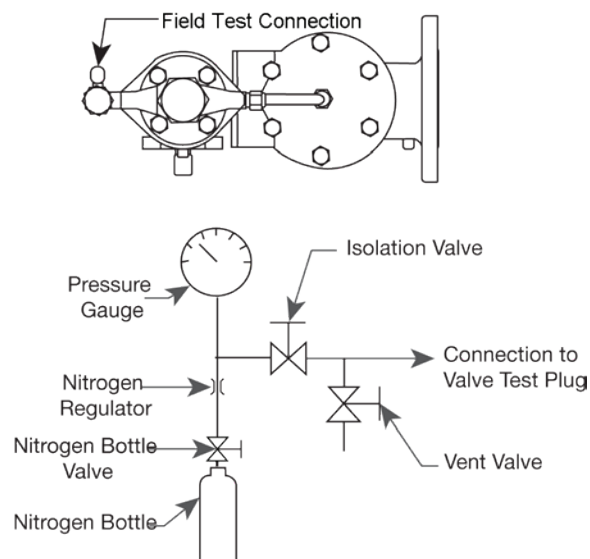


Figure 69: Typical Field Test Arrangement



XX. Setting and Testing (Cont.)

- Mitigation of main valve instability during startup** - During system start-up, it is common for a POSRV to experience instability due to pressure fluctuations and differentials present between the main valve and the pilot. Instability may take the form of rapid opening and closing of the system called chatter or a transient relieving condition until pressure within the pilot stabilizes with the main valve pressure. Proper POSRV start-up procedures can be practiced to mitigate these issues using the already installed Field Test Connector on the POSRV.
- Artificial actuation of pilot and main valve** - Per ASME Section I and Section XIII (UV), all pilot-operated pressure relief valves used in the respective services shall be provided with either a lifting device or means for connecting and applying pressure to the pilot adequate to verify that the moving parts critical to proper operation are free to move. The field test connection fulfills the latter.

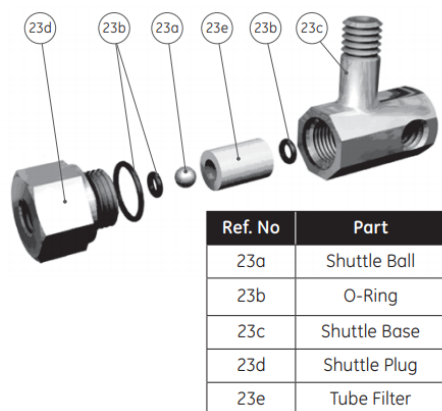


Figure 70: POSRV Check Valve Assembly

F.1.1 Mitigation of Main Valve Instability During Startup

Below are the recommended steps for charging the pilot in preparation for startup:

- Close all valves and regulator.
- Connect **Field Test Arrangement** to Field Test Connection (Figure 71).
- Open the **Isolation Valve #1**.
- Slowly open the **Nitrogen Bottle Valve** to its fully open position.
- Slowly adjust the **Nitrogen Regulator** (pressure increase should not exceed 10 psig/sec) till the downstream pressure is equal to 90% of the set pressure as indicated by **Pressure Gauge #1**. Should the pressure input exceed the set pressure, follow these steps:
 - Close the **Isolation Valve #1**.
 - Reduce the output pressure of the **Nitrogen Regulator** to 90% of set pressure.
 - Slowly open **Vent Valve #1** until all pressure in the pilot is below 90% of set pressure.
 - Close **Vent Valve #1**.
 - Open **Isolation Valve #1**.
- With the pilot pressurized to 90% of set pressure, system startup may begin.
- After startup, close **Nitrogen Bottle Valve**

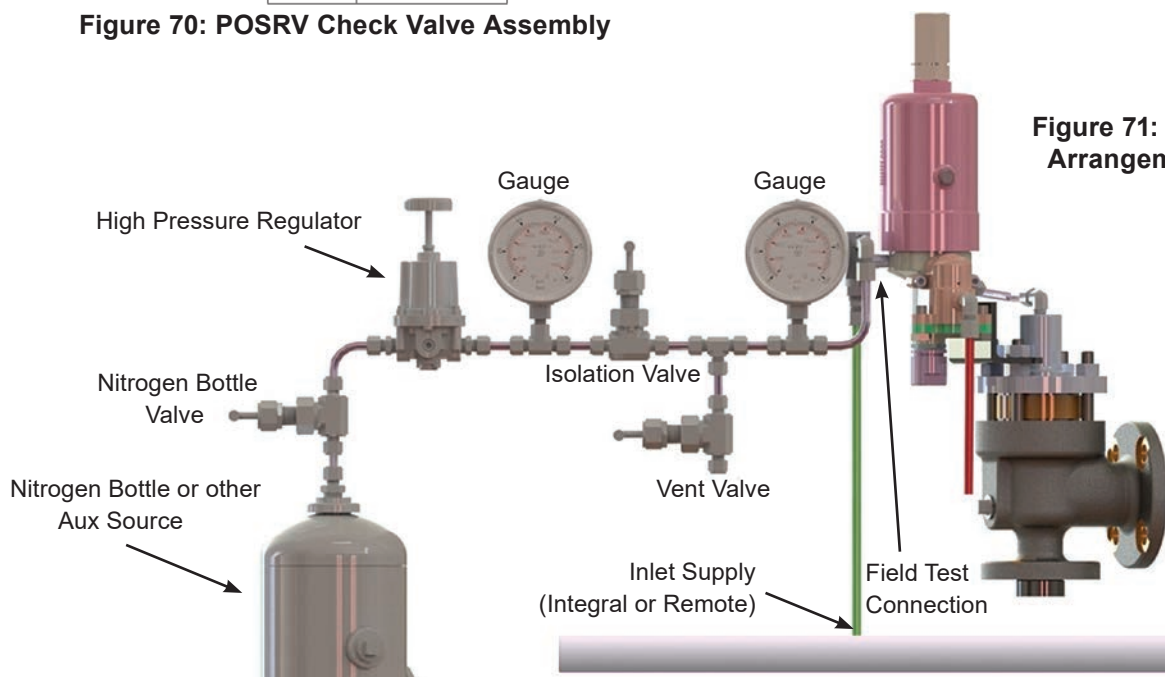


Figure 71: Typical Installation Arrangement with Auxiliary Supply

XX. Setting and Testing (Cont.)

8. Fully open **Vent Valve #1** until **Pressure Gauge #1** reads 0 psig.
9. Disconnect **Field Test Arrangement** from the **Field Test Connection**.
10. Ensure **Field Test Connection** is not plugged.

It is still possible that pressure excursions may actuate the valve, therefore it is recommended to minimize system pressure ramp rate.

F.1.2 Artificial Actuation of Pilot and Main Valve

1. Close all valves and regulator.
2. Connect **Field Test Arrangement** to **Field Test Connection**.
3. Open **Isolation Valve #1**.
4. Slowly open **Nitrogen Bottle Valve** to its fully open position.
5. Slowly adjust **Nitrogen Regulator** (pressure increase should not exceed 10 psig/sec) till the downstream pressure is equal to 90% of the set pressure as indicated by the **Pressure Gauge #1**.
6. After 90% of set pressure is achieved, lower the auxiliary pressure ramp rate to 2 psig/sec. Record set pressure by the audible discharge (gas) or steady stream (water) of the main valve.
7. Continue the pressure ramp up until the valve set point is exceeded in order to ensure the disc is not sticking.

Note: *When the auxiliary test pressure reaches the accumulation pressure of 103% or 110%, the pressure relief valve will be relieving its rated capacity. Proper safety precautions, including process controls, administrative controls and PPE controls should be taken to ensure the safety of the test personnel who can be in close vicinity of the relieving pressure relief valve.*

8. Close **Isolation Valve #1** and open **Vent Valve #1** to begin to drop pressure at a rate of 2 psi/sec until the main valve closes. Record the reseal pressure when the valve stops relieving. Continue to drop pressure until 80% of set pressure.
9. Close **Nitrogen Bottle Valve**.

10. Fully open **Vent Valve #1** and **Isolation Valve #1** until **Pressure Gauge #1** reads 0 psig.
11. Disconnect **Field Test Arrangement** from the **Field Test Connection**.
12. Ensure **Field Test Connection** is not plugged.

F.2 Pilot Valve Tester

The pilot valve test indicator is available for the modulating and pop action pilot valves. The valve test indicator measures the set pressure of the pilot, while maintaining pressure on the main valve dome area; thereby, allowing only the pilot to actuate. The system shown in Figure 72 is available for remote or local testing.



Figure 72: Pilot Valve Tester

XX. Setting and Testing (Cont.)

F.2.1 Artificial Actuation of Pilot Only

1. Remove OEM exhaust tubing connected to pilot exhaust port and outlet neck (confirm there is no exhaust leakage prior to removal of tubing)
2. Connect a pressure gauge to outlet of pilot followed by an isolation/vent valve to prevent exhaust to atmosphere.
3. With system pressure operating at <90% of set pressure, connect **Field Test Arrangement** to **Field Test Connection**.
4. Close all valves and regulators.
5. Slowly open **Nitrogen Bottle Valve** to its fully open position.
6. Slowly adjust **Nitrogen Regulator** (pressure increase should not exceed 10 psig/sec) till the downstream pressure is equal to 90% of the set pressure as indicated by **Pressure Gauge #1**.
7. After 90% of set pressure is achieved, lower the pressure ramp rate to 2 psig/sec.
8. Increase auxiliary pressure until **Pressure Gauge #2** indicates a pressure increase; the value of **Pressure Gauge #1** at this point is

the set point of the valve. Perform set point adjustment as required by adjusting the compression screw. Reclose isolation valve and vent valve. Retest.

9. Close **Isolation Valve #1** and use **Vent Valve #1** to begin to drop pressure at a rate of 2 psi/sec until **Pressure Gauge #1** reads 80% of set pressure.

Note: Accurate blowdown settings cannot be determined by this test procedure. Actual main valve operation is required to measure blowdown values.

10. Open **Vent Valve #2** to remove pressure in exhaust port.
11. Close **Nitrogen Bottle Valve**.
12. Fully open **Vent Valve #1** and **Isolation Valve #1** until **Pressure Gauge #1** reads 0 psig.
13. Disconnect **Field Test Arrangement** from the **Field Test Connection**.
14. Ensure **Field Test Connection** is not plugged.

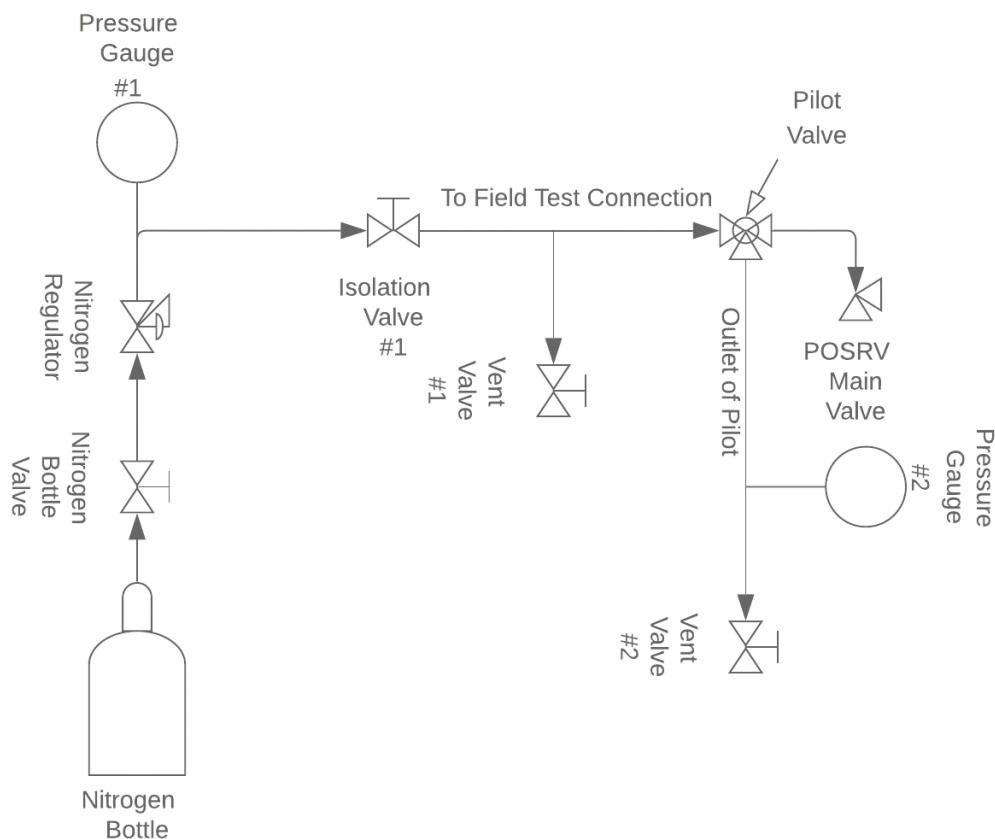


Figure 73: Typical Installation Arrangement with Auxiliary Supply for Artificial Actuation of Pilot Only

XXI. Troubleshooting

Table 18: Troubleshooting 2900 Series POSRV's

Problem	Possible Cause		Corrective Action	
Blowdown incorrect	A.	Incorrect Adjuster Assembly setting	A.	Re-set Adjuster Assembly (See Pilot Valve Setting)
Leakage around fittings	A.	Fittings are not tightened or are cross threaded.	A.	Re-install fittings correctly
	B.	Did not install Teflon tape or pipe sealant.	B.	Re-install fittings with Teflon tape or pipe sealant.
Leakage under the Cover Plate when valve is open.	A.	Guide or Cover Plate Gasket/O-ring is damaged.	A.	Disassemble valve and replace Cover Plate Gasket/O-ring.
	B.	Cap Screws or Stud Nuts on Cover Plate are loose.	B.	Tighten as required.
Main Valve leaks through the Seat	A.	Damaged Seat O-Ring	A.	Disassemble valve and replace Seat O-Ring.
	B.	Damaged Metal Seat	B.	Disassemble valve and lap Metal Disc and/or Nozzle.
	C.	Metal Seat is not lapped in properly to Disc Holder	C.	Disassemble Disc and Disc Holder to lap two together properly
	D.	Seat too wide	D.	Recheck Tables 3 and 4
Main Valve leaks under the Nozzle Seat	A.	Damaged Nozzle O-Ring	A.	Disassemble Main Valve and replace damaged Nozzle O-Ring.
Pilot Valve is not opening at set pressure and Main Valve will not open	A.	Wrong set pressure	A.	Readjust the set pressure of the valve.
Main Valve does not close upon start up. P2 chamber does not load with system pressure.	A.	Start-up procedures pressurize the valve too rapidly.	A.	Slowly increase the inlet pressure.
	B.	Sensing Tube is installed upside down.	B.	Re-install Sensing Tube correctly.
	C.	Closed Filter	C.	Clear or replace Filter.
	D.	Main Valve Piston is not resting on nozzle.	D.	Push the Main Valve Piston down to nozzle through the compression fitting on top of the Cover Plate.
Leakage through the Pilot Valve	A.	Operating pressure too high	A.	Adjust operating pressure
	B.	O-Ring or Spring Seal degradation	B.	Disassemble and replace O-Ring or Spring Seals
Main Valve opens and allows the discharge media to flow back into the pressure vessel	A.	Back pressure is greater than set pressure and forces the Main Disc up, and the media flows backward into the vessel.	A.	Install Backflow Preventer
	B.	Discharging into a closed container or not enough capacity in the discharge system.	B.	Install Backflow Preventer.

XXII. 2900 Series POSRV Options

A. Backflow Preventer

When the pilot operated safety relief valve is not vented directly to atmosphere, it is possible to build up backpressure in the discharge line. This is typical in situations where several valves manifold into a common discharge header. Should the discharge line pressure exceed the valve inlet pressure, it could cause the disc to lift and allow reverse flow through the main valve. This situation can be eliminated through the use of the Backflow Preventer.

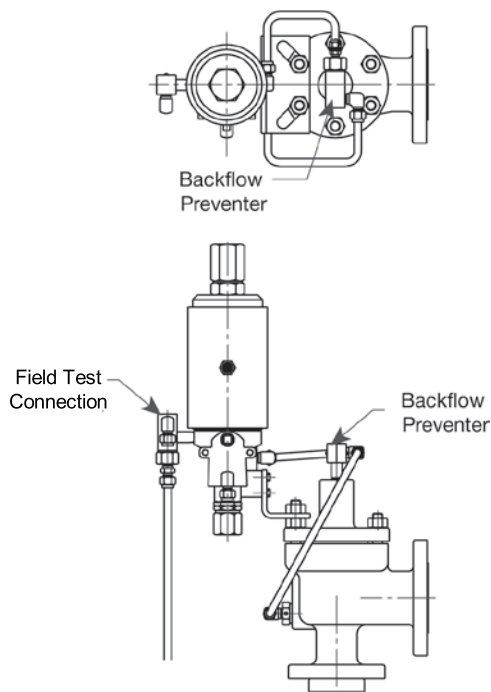


Figure 74: Field Test Connection / Backflow Preventer Option

A.1 Disassembly Instructions

1. Remove Shuttle Plug from Shuttle Base by unscrewing counterclockwise.
2. Remove Shuttle Ball, Tube Filter, and O-Rings and discard.

A.2 Cleaning

1. If required, clean parts to remove all rust, burrs, scale, organic matter, and loose particles. Parts are to be free of any oil or grease except for lubrication as specified in this instruction.
2. Cleaning agents used shall be such that effective cleaning is assured without injuring the surface finishes or material properties of the part.

3. Acceptable cleaning agents include demineralized water, nonphosphate detergent, acetone, and isopropyl alcohol. Parts must be blown dry or wiped dry after cleaning.
4. If you are using cleaning solvents, take precautions to protect yourself from potential danger from breathing fumes, chemical burns, or explosion. See the solvent's Material Safety Data Sheet for safe handling recommendations and equipment.
5. It is not recommended to "sand blast" internal parts as it can reduce the dimensions of the parts.

A.3 Parts Inspection

1. Shuttle Base: Galling or excessive wear on the threads. Check for any corrosion or pitting.
2. Shuttle Plug: Galling or excessive wear on the threads. Check for any corrosion or pitting.

A.4 Reassembly Instructions

Lubricate O-Rings with silicone grease Baker Hughes P/N SP505.

1. Assembly of Field Test Connection / Backflow Preventer Assembly.
 - a. Insert one of the Small O-Rings into the Shuttle Base counter bore.
 - b. Insert the Tube Filter into the Shuttle Base.
 - c. Insert Shuttle Ball inside of Tube Filter.
 - d. Insert the other Small O-Ring into the Shuttle Plug counter bore. Install Larger O-Ring into groove located on OD of Shuttle Plug.
 - e. Thread Shuttle Plug into Shuttle Base, wrench tighten.

XXII. 2900 Series POSRV Options (Cont.)

B. Dome Assist Option

Severe dirty service, precipitation, viscous fluid, and dome load problems can be solved using the dome assist option offered on the 3900 POSRV. A dome assist option can be added to the standard pilot valve. The kit contains a 316 SS chamber, an isolation seal and an extended pilot piston. The

module is positioned at the top of the pilot valve body and below the pilot valve bonnet. Crucial valve components such as the modulator, dome assembly, vent, and inlet seals never come in contact with the process media. The process media pressure still controls the set pressure and blowdown of the POSRV.

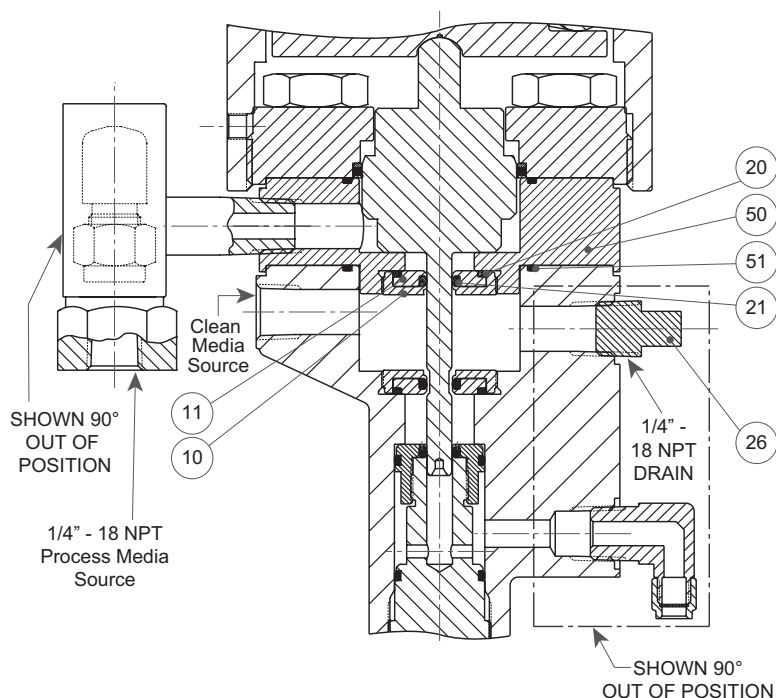


Figure 75: 39PV07/37 Dome Assist

Part No.	Nomenclature
1	Main Base
2	Adjuster Cap
3	Adjuster Top
10	Insert Top
11	Insert Bottom
12	Main Piston
14	Cap Screw (Top Plate)
16	O-Ring (Adjuster Top)
17	O-Ring (Insert)
18	O-Ring (Top Plate)
20	Spring Seal (Main Piston)
21	Spring Seal (Adjuster Top)
22	Spring Seal (Insert)
26	Pipe Plug (Pilot Valve)
29	Piston Retainer Nut
30	Set Screw (Piston)
31	Vent Seal (Adaptor)
32	Spring Seal (Vent Seal Adaptor)
50	Dome Assist Insert
51	Omni Plug
52	Breather Filer Vent

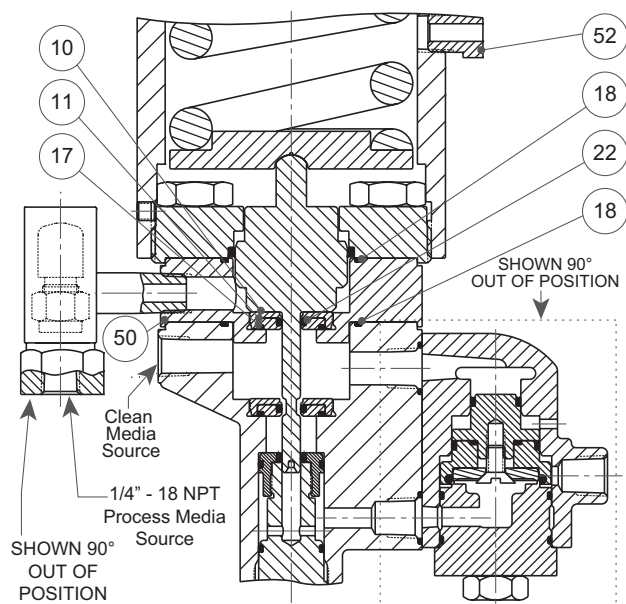


Figure 76: 39MV07 Dome Assist

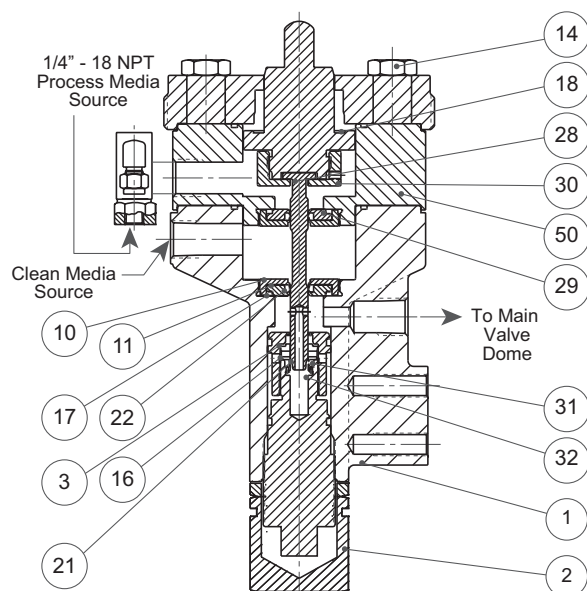


Figure 77: 39MV22/72 Dome Assist

XXII. 2900 Series POSRV Options (Cont.)

B. Dome Assist Option (Cont.)

B.1 Disassembly Instructions

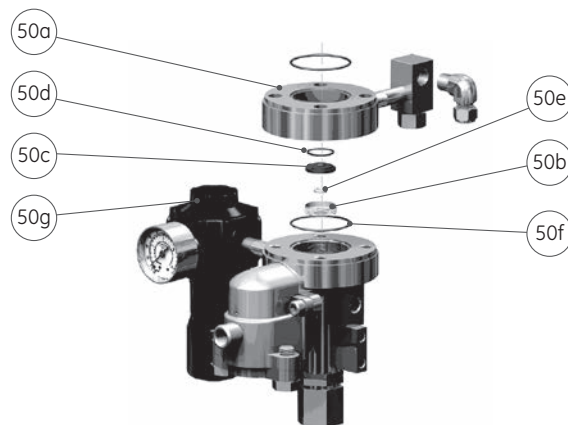
1. The Dome Assist Option consists of:
 - 1 – Insert Assembly
 - 1 – Dome Assist Insert
 - 1 – O-Ring (Dome Assist Insert)
 - 1 – Regulator
2. The Insert Assembly consists of:
 - 1 – Insert Top
 - 1 – Insert Bottom
 - 1 – Spring Seal (Insert)
 - 1 – O-Ring (Insert)
3. Remove Dome Assist Insert and discard O-Ring (Dome Assist Insert).
4. Remove Insert Assembly from the Dome Assist Insert with tool #4995401. Remove and discard the O-Ring (Insert) on the bottom of the Insert Assembly. Disassemble Insert Assembly by removing the Insert Bottom from the Insert Top. Discard Spring Seal (Insert).
5. Return to Disassembly Instructions for pilot (Section XVII).

B.2 Cleaning

1. Clean parts to remove all rust, burrs, scale, organic matter, and loose particles. Parts are to be free of any oil or grease except for lubrication as specified in this instruction.
2. Cleaning agents used shall be such that effective cleaning is assured without injuring the surface finishes or material properties of the part.
3. Acceptable cleaning agents include demineralized water, nonphosphate detergent, acetone, and isopropyl alcohol. Parts must be blown dry or wiped dry after cleaning.
4. If you are using cleaning solvents, take precautions to protect yourself from potential danger from breathing fumes, chemical burns, or explosion. See the solvent's Material Safety Data Sheet for safe handling recommendations and equipment.
5. Do not "sand blast" internal parts as it can reduce the dimensions of the parts.

B.3 Parts Inspection

1. Insert Top: Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting. Also, check for galling of threads.



Ref. No.	Part
50a	Dome Assist Insert
50b	Insert Top
50c	Insert Bottom
50d	O-Ring (Insert)
50e	Spring Seal (Insert)
50f	O-Ring (Dome Assist Insert)
50g	Regulator

Figure 78: Dome Assist Parts

2. Insert Bottom: Galling or excessive wear on the inside diameter that guides the Main Piston. Check for any corrosion or pitting.

B.4 Reassembly Instructions

Making the Insert Assembly for Dome Assist Option:

1. Press Spring Seal (Insert) into groove on the Insert Bottom. Make sure spring is facing upwards.
2. Install Insert Top over Insert Bottom with the seal side going in first.
3. Lightly lubricate O-Ring groove now formed by the two insert parts. This lubrication is used to hold the O-Ring (Insert) in place when it is being inserted into Dome Assist Insert.
4. Place O-Ring (Insert) into groove.
5. The Insert Assembly is threaded into the Dome Assist Insert. Tighten assembly wrench tight. Make sure milled slot is facing up.
6. Install O-Ring (Top-Plate) onto groove in Pilot Base.

XXII. 2900 Pilot Valve Options (Cont.)

7. Install Dome Assist Insert Assembly on top of Pilot Base with inlet port facing opposite of vent port on Pilot Base. Then install Main Piston / Top Plate Assembly onto Base/Dome Assist Insert by inserting small diameter end of Main Piston through Insert Assemblies.

C. Dual Pilots

A dual pilot arrangement (Figure 79) is available for applications in which the pilot valve soft goods require monitoring and/or maintenance more often than the main valve. In this installation, the pilot valves may be alternated for maintenance, without bringing the system down.



Figure 79: Dual Pilots

ATTENTION!

When servicing dual pilots, procedures need to be in place to perform a tag out / lock out of pilots under pressure if they are in service.

D. Field Test Connection

A field test connection is standard on all pilot valve types. This allows the stroking of the valve with an auxiliary media, e.g. air or nitrogen. An internal check valve is present in the field test connection isolating the inlet media from the test media and at the same time, allowing the valve to open normally in the event of a system over pressurization during a field test. The test port connection is a .375" (9.53 mm) tube fitting equipped with a bug screen.

For all applications on air, water over 140°F (60°C), or steam service, ASME Section XIII (UV) requires each pressure relief valve to have a lifting device such as a field test connection or a means of connecting or applying pressure to the pilot to verify that the moving parts essential to good operation are free to move. (Reference 3.2.7(a/b)). The lifting lever or field test connection may be omitted under Code Case 2203. All orders for pressure relief valves without levers or field test connection for steam, air and water over 140°F (60°C) must state specifically that the valves are being purchased per Code Case 2203. The purchaser is responsible for obtaining jurisdictional authorization for use of Code Case 2203.

E. Sensing Line Filter (Standard)

Consolidated 2900 Pilot Operated Relief valves come configured directly from the factory with specially designed filters to ensure long term operation. These filters should be maintained based on the service conditions and cleanliness of the media the valve will be exposed to. Depending on the amount of contamination expected to be introduced to the valve, these filters need to be regularly inspected and replaced to ensure proper flow through the valve is maintained. Regular maintenance intervals should be established based on inspection of the filter at the time of service. Heavy accumulation at the filter is an indication that more frequent maintenance is needed. In applications that call for exposure to a significant amount of contaminants, our high capacity filters should be installed that allow regular maintenance to be performed easily. Please consult your factory authorized representatives for details on how to obtain this configuration. The high capacity filter configuration can be installed with independent filters that allow the maintenance to be performed while the valve remains in service.

Note: See Tables 27 to 30 for replacement filter parts information.

XXII. 2900 Pilot Valve Options (Cont.)

F. Single, Dual and High Capacity Filters (Optional)

Filter options are available for dirty applications. These filters are installed in the pilot inlet sensing line. For the 39PV and 39MV, an optional sensing line filter is available (Figure 80). This filter has a 316 stainless steel body, Teflon® seals, and a 40-50 micron stainless steel filter element. Other high capacity filter options (Figure 81) include:

1. A carbon steel filter body with a 35 micron stainless steel element; and
2. An entirely stainless steel filter arrangement. These filters may be equipped with a manually operated needle valve which allows for purging the filtered material while the valve is in operation. All filter elements are stainless steel, and all filters, including carbon steel, conform to NACE Standard MR0103 and MR0175. A dual filter arrangement (Figure 82) is available for applications in which the customer is unsure of the filter maintenance requirements. In these cases, a preventive maintenance program may be developed by monitoring the filters, without taking the valve off line.

ATTENTION!

When servicing dual filters, procedures need to be in place to perform a tag out / lock out of pilots under pressure if they are in service.

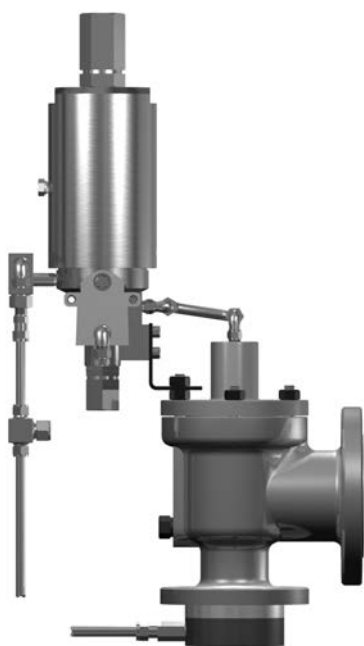


Figure 80: Sensing Line Filter



Figure 81: High Capacity Filter

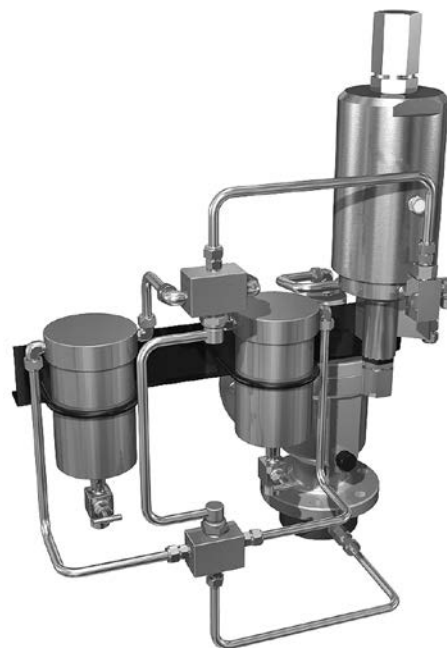


Figure 82: Dual Filter

XXII. 2900 Pilot Valve Options (Cont.)

G. Gag

A manual method of locking a pilot operated relief valve in the closed position for system hydrostatic test. 39MV72 limited to 4800 psig (330.9 barg) with gag option (Figure 83).



Figure 83: Gag

H. Heat Exchanger

This allows the temperature range for the 3900 POSRV with metal seats to be extended to -320°F to 650°F (-195.5°C to 343.3°C). Not available above 3750 psig (258.5 barg). When the heat exchanger is selected, the POSRV shall be piped so that the media enters the heat exchanger first to condition the media's temperature. Option(s) such as line filter, canister filter, 5-way manifold valve, pressure differential switch, pressure spike snubber, etc. shall be piped downstream of the heat exchanger (Figures 84 and 85).



Figure 84: Heat Exchanger - Hot Service



Figure 85: Heat Exchanger - Cold Service

XXII. 2900 Pilot Valve Options (Cont.)

I. Lifting Lever

This is an external, physical means of allowing the pilot valve to relieve dome pressure so that the main valve can open.

J. Manual, Electrical, or Pneumatic Blowdown Valve

(Figures 86 & 87)

An optional manual blowdown valve is available for relieving the pilot operated safety relief valve. Consult factory for applications requiring a pneumatic or electrical solenoid blowdown valve which may be connected to a distant location, such as an operator station, for remote actuation. The blowdown valve is ported directly to the main dome area, so that the media in the dome is vented when the blowdown valve is actuated, thus allowing the main valve to open.



Figure 86: Manual Blowdown Valve



Figure 87: Electrical Blowdown Valve

K. Pressure Differential Switch

Electrical: A pressure differential switch (Figure 88) is available which may be wired to an operator station or some other remote location. The switch will provide a signal that indicates when the main valve is opening. The standard pressure differential switch is a single pole, double throw, rated at 5 amps and 30 volts DC with a NEMA 4 enclosure. (For other configurations, consult the factory.)

Pneumatic: For applications that do not permit an electrical differential switch, an option is available to provide pneumatic signal to indicate when the main valve opens.

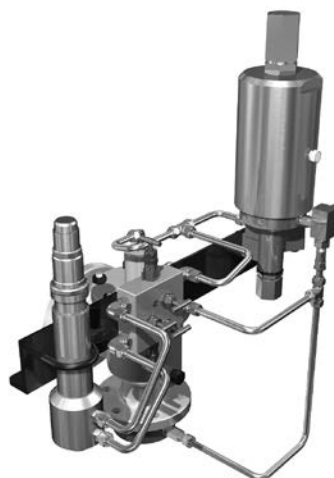


Figure 88: Pressure Differential Switch

L. Pressure Spike Snubber

Baker Hughes recommends the use of a pressure spike snubber (Figure 89) for all applications which may have high frequency pressure spikes. The pressure spike snubber is designed to dampen the pressure spikes which could cause unnecessary parts wear or premature valve opening.



Figure 89: Pressure Spike Snubber

XXII. 2900 Pilot Valve Options (Cont.)

M. Remote Pilot Mounting

The 39PV and 39MV pilots can be mounted separately from the main valve. Remote pilot mounting will allow heating or cooling the pilot in case ambient conditions are outside the scope of the pilot. It will also enable the user to group several pilots together for control of ambient conditions in a smaller space. In addition, this promotes easier maintenance.

N. Remote Sensing

The pilot valve inlet may be piped to a location remote from the main valve. In this application, the customer may pipe the inlet sensing line to some location other than where the main valve is located and where the pressure will be relieved (for tubing size and maximum length, consult factory for recommendations).

O. Sensing Ring Options

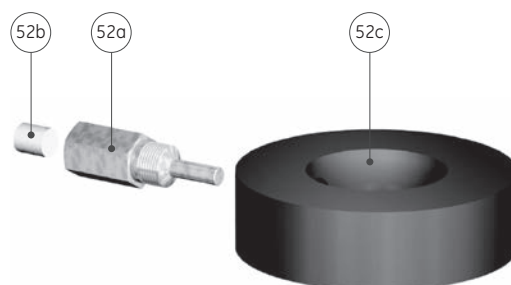
Integral sensing rings allow the pilot valve inlet to be piped to a location just below the inlet flange of the main valve base.

The 2900 Gen II "IS" (Figure 90) option is the standard and recommended configuration for integral sense when the remote sense option is not selected. This integral sensing ring is a drop-in solution that doesn't require piping modifications due to center-to-face dimensional differences. Therefore it can be used to replace existing API 526 Spring loaded PRVs.

The "SR" option (Figure 91) is also available for existing 2900 installations only when the SR sensing ring was used. Using this sensing ring to replace API 526 Spring Loaded PRVs will result in center-to-face dimensional differences.



Figure 90: Integral Sensing Ring



Ref. No.	Part
52a	Sensing Tube
52b	Plug Filter
52c	Sensing Ring

Figure 91: Sensing Ring

XXIII. Maintenance Tools and Supplies

A. Adjuster Top Seal Insertion Tool

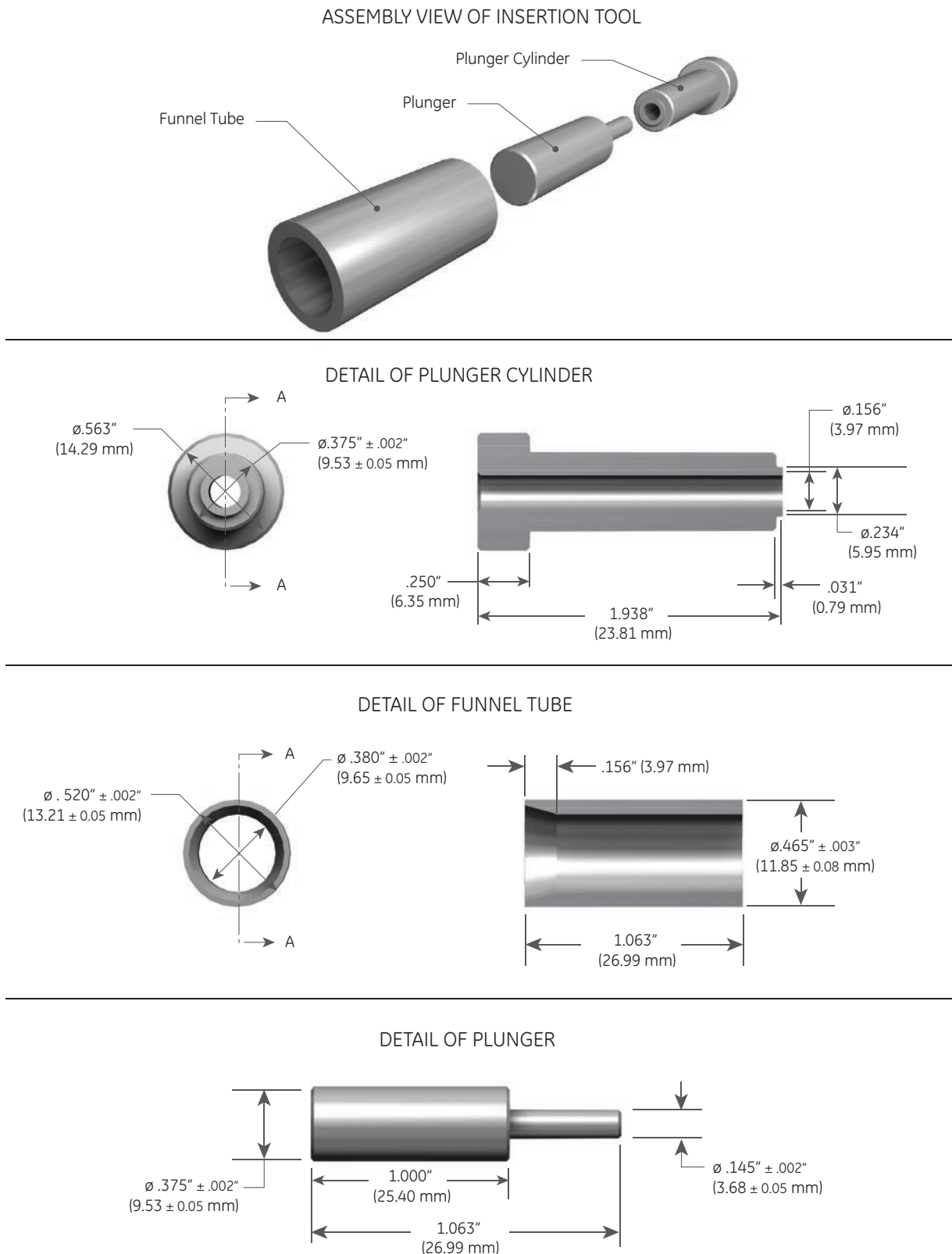


Figure 92: Adjuster Top Seal Insertion Tool

XXIII. Maintenance Tools and Supplies (Cont.)

B. Insert Installation Tool

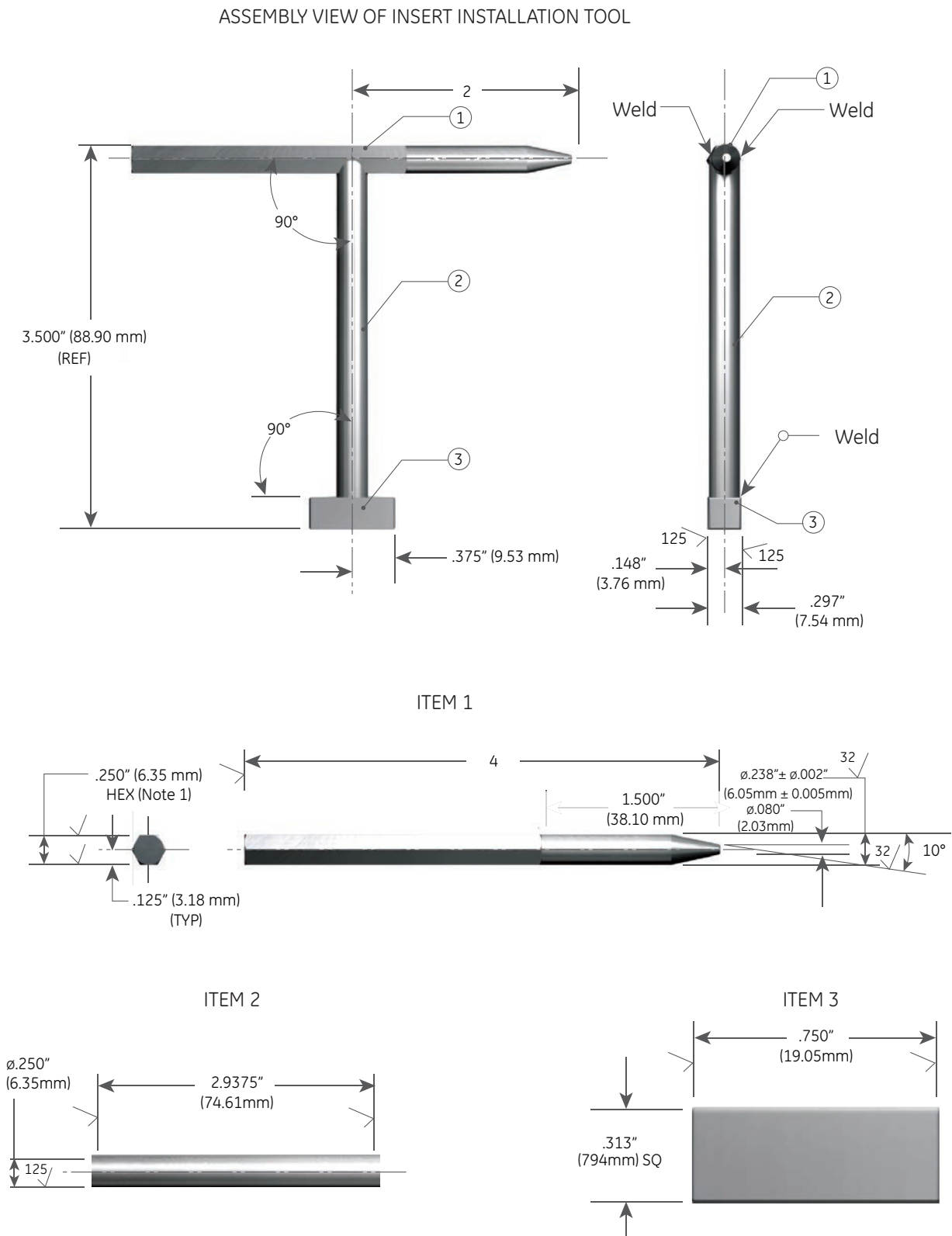


Figure 93: Insert Installation Tool

XXIII. Maintenance Tools and Supplies (Cont.)

C. Lapping Tools

The following tools are required for proper maintenance of Pilot Operated Safety Relief Valve metal seats, and may be purchased from Baker Hughes.

1. Ring Lap: The ring lap is used for lapping the disc seat and finish lapping of the nozzle seat.
2. Lapping Plate: The lapping plate is used for reconditioning the ring lap. It may also be used for lapping the disc. One 11" (279.40 mm) diameter plate is required for the entire line of valves (Part No. 0439004).
3. Lapping Compound: Lapping compound is used as a cutting medium when lapping the valve seats, as specified in Table 19.
4. Drift Pins: Two drift pins are required for the removal of the disc from the disc holder. Refer Figure 94 and Table 21 for Drift Pin specifications.

5. Nozzle Lap: The nozzle lap is used for lapping the nozzle seat and has one flat side and one side with a 5° angle. This lap guides in the bore of the nozzle; therefore, a different size lap is required for each valve orifice (Table 20).
6. Lifting Tools: Lifting tools are used for the removal of upper internal parts of larger valves, as specified in Table 22.

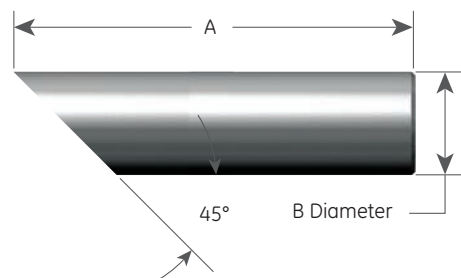


Figure 94: Drift Pin Specifications

Table 19: Lapping Compound Types

Brand	Grade	Grit	Lapping Function	Size Container	Part No.
Clover	1A	320	General	4 oz	199-3
Clover	3A	500	Finishing	4 oz	199-4
Kwik-Ak-Shun	-	1000	Polishing	1 lb	199-11
				2 lb	199-12

Table 21: Drift Pin Types

Orifice	A		B		Part No.
	in.	mm	in.	mm	
D, E, F, G, H, J, K	1.75	44.5	.219	5.55	430401
L, M, N, P	2.50	63.5	.375	9.53	430402
Q, R	3.00	76.2	.625	15.88	430403
T, U	3.50	88.9	.875	22.23	430404

Table 20: Nozzle Lap Dimensions

Orifice	Nozzle Bore				Nozzle Lap	Nozzle Lap Handle	Ring Lap ¹
	min.		max.				
	in	mm	in	mm			
D	.404	10.26	.409	10.39	4451501	544603	1672805
E	.539	13.69	.544	13.82	4451502	544601	1672805
F	.674	17.12	.679	17.25	4451503	544601	1672805
G	.863	21.92	.868	22.05	4451504	544601	1672805
H	1.078	27.38	1.083	27.51	4451505	544601	1672805
J	1.380	35.05	1.385	35.18	4451506	544601	1672805
K	1.650	41.91	1.655	42.04	4451507	544601	1672807
M	2.309	58.65	2.314	58.78	4451602	544601	1672809
N	2.535	64.39	2.540	64.52	4451603	544601	1672809
P	3.073	78.05	3.078	78.18	4451604	544602	1672810
Q	4.045	102.74	4.050	102.87	4451605	544602	1672812
R	4.867	123.62	4.872	123.75	4451606	544602	1672812
T	6.037	153.34	6.043	153.49	4451607	544602	1672813
U	6.685	169.80	6.891	175.03	None	None	1672813
V	8.000	203.20	8.005	203.33	None	None	6267201
W	10.029	254.74	10.034	254.86	None	None	4875201

- 1: Ring Laps: One set of three (3) ring laps is recommended for each orifice to assure ample flat laps are available at all times.

XXIII. Maintenance Tools and Supplies (Cont.)

Table 22: Wrench Types											
Valve Orifice	Description of Wrench				Pin Spanner Wrench No.	Valve Orifice	Description of Wrench				Pin Spanner Wrench No.
	Wrench Radius		Pin				Wrench Radius		Pin		
	in	mm	in	mm			in	mm	in	mm	
F	.750	19.05	.219	5.56	4451801	N	1.875	47.63	.359	9.13	4451607
G	.750	19.05	.219	5.56	4451801	P	1.875	47.63	.359	9.13	4451607
H	.875	22.23	.266	6.75	4451802	Q	2.500	63.50	.438	11.11	4451808
J	1.125	28.58	.266	6.75	4451803	R	3.000	76.20	.500	12.70	4451809
K	1.250	31.75	.281	7.14	4451804	T	3.750	95.25	.500	12.70	4451810
L	1.375	34.93	.297	7.54	4451805	U	3.750	95.25	.500	12.70	4451810
M	1.675	42.55	.328	8.33	4451806	-	-	-	-	-	-

D. Disc Holder and Guide Removal and Assembly Tool

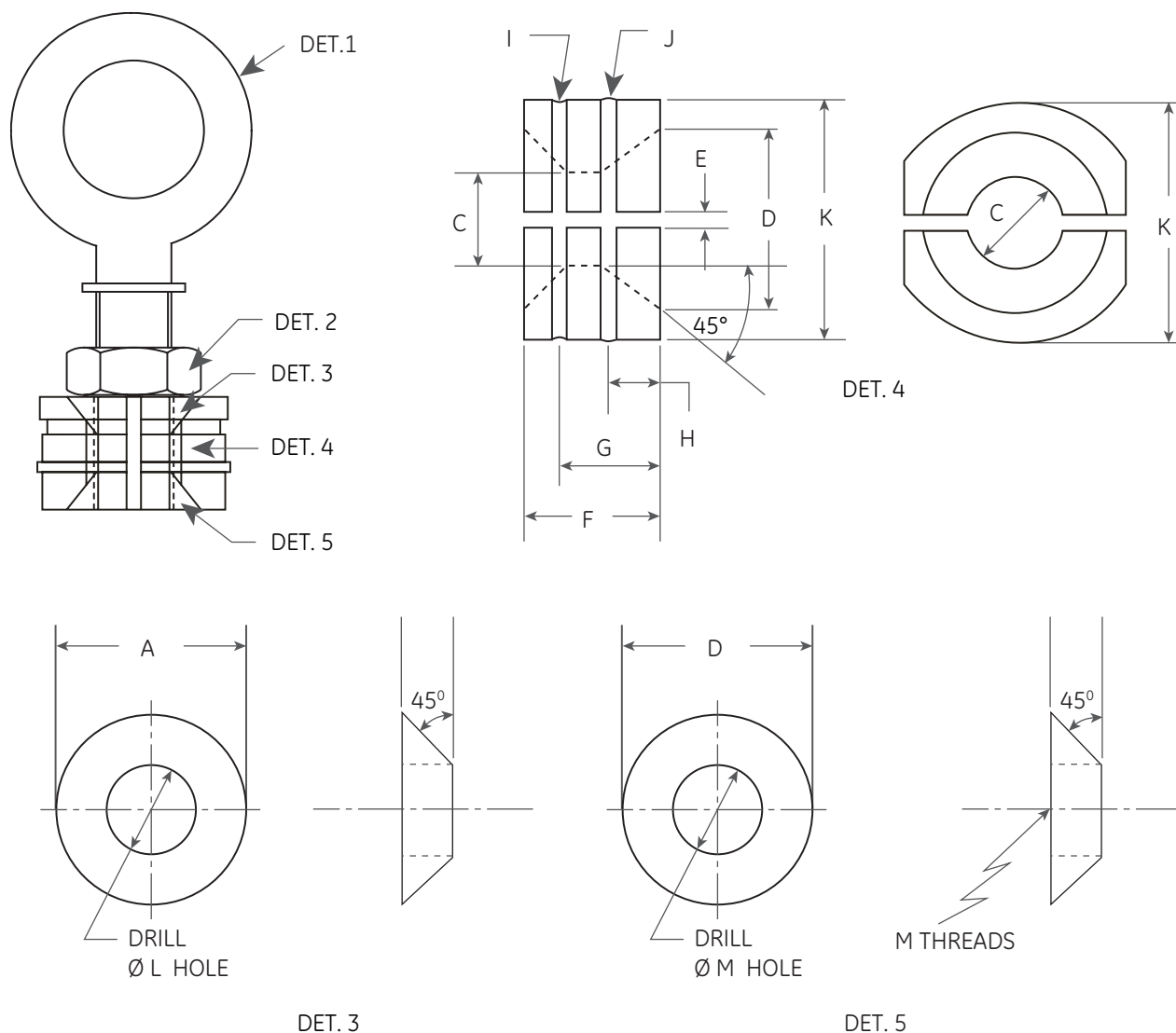


Figure 95: Disc Holder and Guide Removal and Assembly Tool

XXIII. Maintenance Tools and Supplies (Cont.)

Table 23: Disassembly Tool Dimensions

Orifices Sizes	"Eye Bolt (Notes)"	"Jam Nut (Notes)"	Ø A		Ø B		Ø C		Ø D		Ø E		Ø F		Ø G	
			in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
D,E,F,G,H,J	#1	#5	.703	17.86	.250	6.35	.437	11.10	.730	18.54	.094	2.39	.750	19.05	.406	10.31
K,L	#2	#6	.828	21.03	.250	6.35	.437	11.10	.847	21.51	.125	3.18	.750	19.05	.438	11.13
M,N	#3	#7	.828	21.03	.250	6.35	.437	11.10	.828	21.03	.125	3.18	.750	19.05	.438	11.13
P, Q, R, T	#4	#8	1.375	34.93	.376	9.55	.750	19.05	1.375	34.93	.125	3.18	1.000	25.40	.750	19.05

Table 23: Disassembly Tool Dimensions (Cont.)

Orifices Sizes	Ø H		I Radius		J Radius		Ø K		Ø L		Ø M Drill Size		M NC Tap Size	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
D,E,F,G,H,J	.156	3.96	.047	1.19	.034	0.86	.798	20.27	.375	9.53	Note 7		.250 - 20 thd.	6.35 - 20 thd.
K,L	.188	4.78	.062	1.57	.040	1.02	.927	23.55	.375	9.53	.313	7.94	.375 - 16 thd.	9.53 - 16 thd.
M,N	.188	4.78	.062	1.57	.047	1.19	1.126	28.60	.500	12.70	.313	7.94	.375 - 16 thd.	9.53 - 16 thd.
P, Q, R, T	.375	9.53	.094	2.39	.055	1.40	1.834	46.58	.750	19.05	.531	13.49	.625 - 11 thd.	15.88 - 11 thd.

Notes:

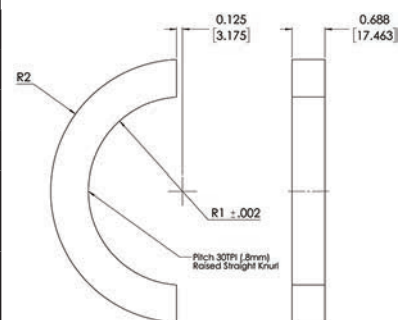
1. Use a Standard Eye-Bolt – .250" (6.35 mm) - 20 thd. x 3.5" (88.90 mm) Long
2. Use a Standard Eye-Bolt – .375" (9.53 mm) - 16 thd. x 4.5" (114.30 mm) Long
3. Use a Standard Eye-Bolt – .375" (9.53 mm)-16 thd. x 4.5" (114.30 mm) Long
4. Use a Standard Eye-Bolt – .625" (15.88 mm)-11 thd. x 4.5" (114.30 mm) Long
5. Use a Standard Nut – .250" (6.35 mm) - 20 thd.
6. Use a Standard Nut – .375" (9.53 mm) - 16 thd.
7. Use a Standard Nut – .375" (9.53 mm) - 16 thd.
8. Use a Standard Nut – .625" (15.88 mm) - 11 thd.

Additional: Use an appropriate sized O-Ring in groove "I", to hold the parts together.

E. 2900 IS Torquing Tool Insert

Table 24 - Torquing Tool

Tool#	R1	R2	Nozzle Use	Qty
1	0.594	1.250	Nozzle 2905/06/10/12D/E Integral Sense	2
2	0.771	1.500	Nozzle 2918D/E/F Integral Sense	2
3	0.901	1.500	Nozzle 2905/06f/H 2910/12F 2914/16D/E/F Integral Sense	2
4	1.020	1.625	Nozzle 2905 06/10/12/14G Integral Sense	2
5	1.146	2.000	Nozzle 2916/18G Ingetral Sense	2
6	1.337	2.125	Nozzle 2905 06J 2910/12/14/16H Integral Sense	2
7	1.964	2.750	Nozzle 2910 12/14/16J 2905/06/10/12/14/16K 2905/06L Integral Sense	2
8	2.428	3.438	Nozzle 2910 12/14/16L/2905/06/10/12/14M/N/P Integral Sense	2
9	3.300	4.375	Nozzle 2905/06/10/12Q/R Integral Sense	2
10	4.526	5.312	Nozzle 2905/06/10/12T/U Integral Sense	2



XXIV. Replacement Parts Planning

A. Basic Guidelines

The following guidelines should be of assistance in developing a meaningful replacement parts plan.

1. The total number of valves in service should be classified by size, type and temperature class.
2. The parts inventory should be classified by the tendency to require replacement.
 - a. Class I – Most frequently replaced
 - b. Class II – Less frequently replaced but critical in an emergency
3. Parts for the valve types covered by this manual are classified on Tables 23. “Qty. parts” is the number of parts or sets which is recommended to achieve a desired need-probability, as it relates to the total number of valves in service by size and type. For example, a “Qty. parts” of 1 for “Valves in service” of 5 means that 1 part should be stocked for each 5 valves of the same type and size in service.
4. When ordering replacement parts, please specify in accordance with applicable nomenclature (see Figures 1 to 7). Be sure to state the size, type and serial number of the valve for which parts are required. When ordering pilot parts please state specific pilot type (39PV07, 37 etc.)

For ease of maintenance O-Ring kits are available for each main valve and pilot type. A stock of these kits should be kept on hand for maximum operating efficiency. See Tables 25, 26 and 27 in Section XXVI.

B. Identification and Ordering Essentials

Identification and Ordering Essentials When ordering service parts, please furnish the following information to ensure receiving the correct replacement parts.

Identify valve by the following nameplate data (Refer Figures 96, 97 and 98):

1. Size
2. Type
3. Pressure/Temperature Class Rating
4. Serial Numbers from both main valve and pilot valve

Example:

Main Valve: 2910R-00-1-CC-MS-B-RF-GS-RS, TL12345-M

Pilot Valve: 39PV07-2-CC-B-GS-60, TL12346-P

How to verify Materials of O-Rings and Seals:

Kit coding indicates O-Ring and seals material.

Examples:

MORK-70T006

PSGK - 31B

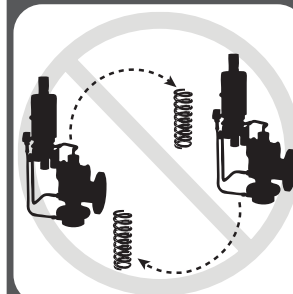
T	Teflon
B	Buna N
E	Ethylene / Propylene
V	Viton
K	Kalrez

⚠ CAUTION



Always use appropriate restoration procedures.

⚠ CAUTION



Do not interchange parts from one valve to another.

XXIV. Replacement Parts Planning (Cont.)

C. Positive Identification of Main Valve and Pilot Valve Combinations

POSRV's shipped direct from the factory to the end-user probably have main valves and pilot valves with identical serial numbers (S/N's). Those shipped unconnected to the Baker Hughes Green Tag Center (GTC) network may have main valves and pilot valves with different S/N's. During service and repair, the following inspection steps will ensure the proper match of main valves to pilot valves.

1. Record main valve and pilot valve S/N's of original POSRV's in plant records.
2. Inspect S/N's for agreement with Step 1, after any disassembly involving removal of pilot valve from main valve.
3. Make sure the set pressures of the main valve and pilot valve are identical.
4. Check O-Ring and Seals Kit material code to ensure they are the same for main valve and pilot valve. Any discrepancies should be promptly report to the appropriate plant authority.

Specify parts required by:

1. Part Name (See Nomenclature, Figures 1-9)
2. Part Number (if known)
3. Quantity

In addition, the main valve serial number is stamped on the top edge of the outlet flange. Be sure to include the one or two letters preceding the figures in the serial number. Typical valve nameplates are shown in Figures 96, 97 and 98.

CONSOLIDATED™		
SIZE		
CRN		
SERIAL NO		
+	SET PRESS	COTP
		V +
TYPE		
MANUF	CODE CASE	LIFT
CAP		
AT		
ASME CERT NO		

Figure 96: Nameplates for Main Valve

THIS VALVE CONTAINS	
TEFLON® SEALS AND AN	
○	○
SEAT SEAL	
O-RING	
PART NO.	

Figure 97: Nameplates for Main Valve

CONSOLIDATED™	
ASME CERT NO	
←	PILOT VALVE
MANUF	
MODEL NO	
SERIAL NO	SET PRESS
O RING	PRESS UNITS

Figure 98: Nameplate for Pilot Valve

XXV. Genuine Consolidated Parts

The next time replacement parts are needed, keep these points in mind:

- Baker Hughes designed the parts
- Baker Hughes guarantees the parts
- Consolidated valve products have been in use since 1879
- Baker Hughes has worldwide service
- Baker Hughes has fast response availability for parts

XXVI. Recommended Spare Parts

Table 25: Recommended Spare Parts for 2900 Series POSRV¹

	Class	Part Name	
<p>Class I Parts should be stocked at the rate of one (1) per valve. Maintaining this level of spare parts will provide replacement parts for 70% of possible maintenance requirements</p>	I	Pilot Valve	O-Ring Kit Plug Filter
		Main Valve	O-Ring Kit / Gasket Kit Metal Disc Nozzle Bellows (if required) Disc Retainer
<p>Class II parts should be stocked at the rate of one (1) part per each five (5) valves in the population. Class II parts will provide replacement parts for an additional 15% of possible maintenance requirements.</p>	II	Pilot Valve	Main Piston Tube Fittings (2) Modulator Stop O-Ring Retainer Backflow Preventer Seal Kit Piston Nose
		Main Valve	Disc Holder O-Ring Retainer (if required) Guide Main Valve Piston 1 set of Nuts and Studs Tube Fittings (2)

1: A combination of Class I and II parts will satisfy maintenance requirements 85% of the time.

XXVI.Recommended Spare Parts (Cont.)

Table 26: Main Valve O-Ring Kits			
Material: Buna-N 90 Durometer (Nitrile 90)			
Orifice	Valve Type	Part No.	
		Conventional Valves (-00)	Bellows Valves (-30)
D, E, F	2905, 06, 10, 20, 22	M0RK29001B008	M0RK29027B008
D, E, F	2912	M0RK29016B008	M0RK29042B008
D, E, F	2914,16,24,26	M0RK29020B008	M0RK29046B008
D, E, F	2918, 28	M0RK29025B008	M0RK29051B008
G	2905, 06, 10, 20, 22	M0RK29002B008	M0RK29028B008
G	2912	M0RK29017B008	M0RK29043B008
G	2914,16,18, 24,26, 28	M0RK29021B008	M0RK29047B008
H	2905, 06, 10, 12, 20, 22	M0RK29003B008	M0RK29029B008
H	2914,16, 24,26	M0RK29022B008	M0RK29048B008
J	22905,06,10,20,22	M0RK29004B008	M0RK29030B008
J	2912,14,16,24,26	M0RK29018B008	M0RK29044B008
K	2905,06,10,12,20,22,24	M0RK29005B008	M0RK29031B008
K	2914,16	M0RK29023B008	M0RK29049B008
K	2926,28	M0RK29026B008	M0RK29052B008
L	2905,06,10,12,20,22	M0RK29006B008	M0RK29032B008
L	2914,16,24,26	M0RK29024B008	M0RK29050B008
M	2905,06,10,12,14,20,22,24	M0RK29007B008	M0RK29033B008
N	2905,06,10,12,14,20,22,24	M0RK29008B008	M0RK29034B008
P	2905,06,10,20	M0RK29009B008	M0RK29035B008
P	2912,14	M0RK29019B008	M0RK29045B008
Q	2905,06,10,12,20,22	M0RK29010B008	M0RK29036B008
R	2905,06,10,12,20,22	M0RK29011B008	M0RK29037B008
T	2905,06,10,12,20,22	M0RK29012B008	M0RK29038B008

XXVI.Recommended Spare Parts (Cont.)

Table 26: Main Valve O-Ring Kits (Cont.)			
Material: Buna-N 70 Durometer (Nitrile 70)			
Orifice	Valve Type	Part No.	
		Conventional Valves (-00)	Bellows Valves (-30)
D, E, F	2905, 06, 10, 20, 22	M0RK29001B018	M0RK29027B018
D, E, F	2912	M0RK29016B018	M0RK29042B018
D, E, F	2914,16,24,26	M0RK29020B018	M0RK29046B018
D, E, F	2918, 28	M0RK29025B018	M0RK29051B018
G	2905, 06, 10, 20, 22	M0RK29002B018	M0RK29028B018
G	2912	M0RK29017B018	M0RK29043B018
G	2914,16,18, 24,26, 28	M0RK29021B018	M0RK29047B018
H	2905, 06, 10, 12, 20, 22	M0RK29003B018	M0RK29029B018
H	2914,16, 24,26	M0RK29022B018	M0RK29048B018
J	22905,06,10,20,22	M0RK29004B018	M0RK29030B018
J	2912,14,16,24,26	M0RK29018B018	M0RK29044B018
K	2905,06,10,12,20,22,24	M0RK29005B018	M0RK29031B018
K	2914,16	M0RK29023B018	M0RK29049B018
K	2926,28	M0RK29026B018	M0RK29052B018
L	2905,06,10,12,20,22	M0RK29006B018	M0RK29032B018
L	2914,16,24,26	M0RK29024B018	M0RK29050B018
M	2905,06,10,12,14,20,22,24	M0RK29007B018	M0RK29033B018
N	2905,06,10,12,14,20,22,24	M0RK29008B018	M0RK29034B018
P	2905,06,10,20	M0RK29009B018	M0RK29035B018
P	2912,14	M0RK29019B018	M0RK29045B018
Q	2905,06,10,12,20,22	M0RK29010B018	M0RK29036B018
R	2905,06,10,12,20,22	M0RK29011B018	M0RK29037B018
T	2905,06,10,12,20,22	M0RK29012B018	M0RK29038B018

XXVI.Recommended Spare Parts (Cont.)

Table 26: Main Valve O-Ring Kits (Cont.)			
Material: Teflon®			
Orifice	Valve Type	Part No.	
		Conventional Valves (-00)	Bellows Valves (-30)
D, E, F	2905, 06, 10, 20, 22	M0RK29001T006	M0RK29027T006
D, E, F	2912	M0RK29016T006	M0RK29042T006
D, E, F	2914,16,24,26	M0RK29020T006	M0RK29046T006
D, E, F	2918, 28	M0RK29025T006	M0RK29051T006
G	2905, 06, 10, 20, 22	M0RK29002T006	M0RK29028T006
G	2912	M0RK29017T006	M0RK29043T006
G	2914,16,18, 24,26, 28	M0RK29021T006	M0RK29047T006
H	2905, 06, 10, 12, 20, 22	M0RK29003T006	M0RK29029T006
H	2914,16, 24,26	M0RK29022T006	M0RK29048T006
J	22905,06,10,20,22	M0RK29004T006	M0RK29030T006
J	2912,14,16,24,26	M0RK29018T006	M0RK29044T006
K	2905,06,10,12,20,22,24	M0RK29005T006	M0RK29031T006
K	2914,16	M0RK29023T006	M0RK29049T006
K	2926,28	M0RK29026T006	M0RK29052T006
L	2905,06,10,12,20,22	M0RK29006T006	M0RK29032T006
L	2914,16,24,26	M0RK29024T006	M0RK29050T006
M	2905,06,10,12,14,20,22,24	M0RK29007T006	M0RK29033T006
N	2905,06,10,12,14,20,22,24	M0RK29008T006	M0RK29034T006
P	2905,06,10,20	M0RK29009T006	M0RK29035T006
P	2912,14	M0RK29019T006	M0RK29045T006
Q	2905,06,10,12,20,22	M0RK29010T006	M0RK29036T006
R	2905,06,10,12,20,22	M0RK29011T006	M0RK29037T006
T	2905,06,10,12,20,22	M0RK29012T006	M0RK29038T006

XXVI. Recommended Spare Parts (Cont.)

Table 26: Main Valve O-Ring Kits (Cont.)			
Material: Ethylene Propylene (EPR EPDM 90 Durometer)			
Orifice	Valve Type	Part No.	
		Conventional Valves (-00)	Bellows Valves (-30)
D, E, F	2905, 06, 10, 20, 22	M0RK29001E002	M0RK29027E002
D, E, F	2912	M0RK29016E002	M0RK29042E002
D, E, F	2914,16,24,26	M0RK29020E002	M0RK29046E002
D, E, F	2918, 28	M0RK29025E002	M0RK29051E002
G	2905, 06, 10, 20, 22	M0RK29002E002	M0RK29028E002
G	2912	M0RK29017E002	M0RK29043E002
G	2914,16,18, 24,26, 28	M0RK29021E002	M0RK29047E002
H	2905, 06, 10, 12, 20, 22	M0RK29003E002	M0RK29029E002
H	2914,16, 24,26	M0RK29022E002	M0RK29048E002
J	22905,06,10,20,22	M0RK29004E002	M0RK29030E002
J	2912,14,16,24,26	M0RK29018E002	M0RK29044E002
K	2905,06,10,12,20,22,24	M0RK29005E002	M0RK29031E002
K	2914,16	M0RK29023E002	M0RK29049E002
K	2926,28	M0RK29026E002	M0RK29052E002
L	2905,06,10,12,20,22	M0RK29006E002	M0RK29032E002
L	2914,16,24,26	M0RK29024E002	M0RK29050E002
M	2905,06,10,12,14,20,22,24	M0RK29007E002	M0RK29033E002
N	2905,06,10,12,14,20,22,24	M0RK29008E002	M0RK29034E002
P	2905,06,10,20	M0RK29009E002	M0RK29035E002
P	2912,14	M0RK29019E002	M0RK29045E002
Q	2905,06,10,12,20,22	M0RK29010E002	M0RK29036E002
R	2905,06,10,12,20,22	M0RK29011E002	M0RK29037E002
T	2905,06,10,12,20,22	M0RK29012E002	M0RK29038E002

XXVI.Recommended Spare Parts (Cont.)

Table 26: Main Valve O-Ring Kits (Cont.)			
Material: Ethylene Propylene (EPR 70 Durometer)			
Orifice	Valve Type	Part No.	
		Conventional Valves (-00)	Bellows Valves (-30)
D, E, F	2905, 06, 10, 20, 22	M0RK29001E019	M0RK29027E019
D, E, F	2912	M0RK29016E019	M0RK29042E019
D, E, F	2914,16,24,26	M0RK29020E019	M0RK29046E019
D, E, F	2918, 28	M0RK29025E019	M0RK29051E019
G	2905, 06, 10, 20, 22	M0RK29002E019	M0RK29028E019
G	2912	M0RK29017E019	M0RK29043E019
G	2914,16,18, 24,26, 28	M0RK29021E019	M0RK29047E019
H	2905, 06, 10, 12, 20, 22	M0RK29003E019	M0RK29029E019
H	2914,16, 24,26	M0RK29022E019	M0RK29048E019
J	22905,06,10,20,22	M0RK29004E019	M0RK29030E019
J	2912,14,16,24,26	M0RK29018E019	M0RK29044E019
K	2905,06,10,12,20,22,24	M0RK29005E019	M0RK29031E019
K	2914,16	M0RK29023E019	M0RK29049E019
K	2926,28	M0RK29026E019	M0RK29052E019
L	2905,06,10,12,20,22	M0RK29006E019	M0RK29032E019
L	2914,16,24,26	M0RK29024E019	M0RK29050E019
M	2905,06,10,12,14,20,22,24	M0RK29007E019	M0RK29033E019
N	2905,06,10,12,14,20,22,24	M0RK29008E019	M0RK29034E019
P	2905,06,10,20	M0RK29009E019	M0RK29035E019
P	2912,14	M0RK29019E019	M0RK29045E019
Q	2905,06,10,12,20,22	M0RK29010E019	M0RK29036E019
R	2905,06,10,12,20,22	M0RK29011E019	M0RK29037E019
T	2905,06,10,12,20,22	M0RK29012E019	M0RK29038E019

XXVI.Recommended Spare Parts (Cont.)

Table 26: Main Valve O-Ring Kits (Cont.)			
Material: Viton® Fluorocarbon (90 Durometer)			
Orifice	Valve Type	Part No.	
		Conventional Valves (-00)	Bellows Valves (-30)
D, E, F	2905, 06, 10, 20, 22	M0RK29001V005	M0RK29027V005
D, E, F	2912	M0RK29016V005	M0RK29042V005
D, E, F	2914,16,24,26	M0RK29020V005	M0RK29046V005
D, E, F	2918, 28	M0RK29025V005	M0RK29051V005
G	2905, 06, 10, 20, 22	M0RK29002V005	M0RK29028V005
G	2912	M0RK29017V005	M0RK29043V005
G	2914,16,18, 24,26, 28	M0RK29021V005	M0RK29047V005
H	2905, 06, 10, 12, 20, 22	M0RK29003V005	M0RK29029V005
H	2914,16, 24,26	M0RK29022V005	M0RK29048V005
J	22905,06,10,20,22	M0RK29004V005	M0RK29030V005
J	2912,14,16,24,26	M0RK29018V005	M0RK29044V005
K	2905,06,10,12,20,22,24	M0RK29005V005	M0RK29031V005
K	2914,16	M0RK29023V005	M0RK29049V005
K	2926,28	M0RK29026V005	M0RK29052V005
L	2905,06,10,12,20,22	M0RK29006V005	M0RK29032V005
L	2914,16,24,26	M0RK29024V005	M0RK29050V005
M	2905,06,10,12,14,20,22,24	M0RK29007V005	M0RK29033V005
N	2905,06,10,12,14,20,22,24	M0RK29008V005	M0RK29034V005
P	2905,06,10,20	M0RK29009V005	M0RK29035V005
P	2912,14	M0RK29019V005	M0RK29045V005
Q	2905,06,10,12,20,22	M0RK29010V005	M0RK29036V005
R	2905,06,10,12,20,22	M0RK29011V005	M0RK29037V005
T	2905,06,10,12,20,22	M0RK29012V005	M0RK29038V005

XXVI.Recommended Spare Parts (Cont.)

Table 26: Main Valve O-Ring Kits (Cont.)			
Material: Viton® Fluorocarbon (75 Durometer)			
Orifice	Valve Type	Part No.	
		Conventional Valves (-00)	Bellows Valves (-30)
D, E, F	2905, 06, 10, 20, 22	M0RK29001V022	M0RK29027V022
D, E, F	2912	M0RK29016V022	M0RK29042V022
D, E, F	2914,16,24,26	M0RK29020V022	M0RK29046V022
D, E, F	2918, 28	M0RK29025V022	M0RK29051V022
G	2905, 06, 10, 20, 22	M0RK29002V022	M0RK29028V022
G	2912	M0RK29017V022	M0RK29043V022
G	2914,16,18, 24,26, 28	M0RK29021V022	M0RK29047V022
H	2905, 06, 10, 12, 20, 22	M0RK29003V022	M0RK29029V022
H	2914,16, 24,26	M0RK29022V022	M0RK29048V022
J	22905,06,10,20,22	M0RK29004V022	M0RK29030V022
J	2912,14,16,24,26	M0RK29018V022	M0RK29044V022
K	2905,06,10,12,20,22,24	M0RK29005V022	M0RK29031V022
K	2914,16	M0RK29023V022	M0RK29049V022
K	2926,28	M0RK29026V022	M0RK29052V022
L	2905,06,10,12,20,22	M0RK29006V022	M0RK29032V022
L	2914,16,24,26	M0RK29024V022	M0RK29050V022
M	2905,06,10,12,14,20,22,24	M0RK29007V022	M0RK29033V022
N	2905,06,10,12,14,20,22,24	M0RK29008V022	M0RK29034V022
P	2905,06,10,20	M0RK29009V022	M0RK29035V022
P	2912,14	M0RK29019V022	M0RK29045V022
Q	2905,06,10,12,20,22	M0RK29010V022	M0RK29036V022
R	2905,06,10,12,20,22	M0RK29011V022	M0RK29037V022
T	2905,06,10,12,20,22	M0RK29012V022	M0RK29038V022

XXVI. Recommended Spare Parts (Cont.)

Table 27: Pilot Valve O-Ring Kit

Pilot Type	Buna-N	Ethylene/ Propylene	Viton	Teflon
39PV01-1-GS & LS	PSGKF - 31B	PSGKF - 31E	PSGKF - 31V	N/A
39PV07-1-GS & LS	PSGKF - 33B	PSGKF - 33E	PSGKF - 33V	N/A
39PV07-2-GS & LA	PSGK - 38B018	PSGK - 38E019	PSGK - 38V022	Note 2
39PV07-2-SS	N/A	PSGK - 38E0021	N/A	PSGK - 38T006
39PV37-1-GS & LS	PSGK - 35B018	PSGK - 35E019	PSGK - 35V022	N/A
39PV37-2-GS & LA	PSGK - 35B018	PSGK - 35E019	PSGK - 35V022	Note 2
39PV37-2-SS	N/A	N/A	N/A	PSGK - 35T006
39MV01, 07 & 37-GS3	PSGK - 32B018	PSGK - 32E019	PSGK - 32V022	Note 2
39MV01, 07 & 37-LS3	PSGK - 34B018	PSGK - 34E019	PSGK - 34V022	Note 2
39MV, 07 & 37-SS3	N/A	PSGK - 34E002	N/A	PSGK - 34T006
39MV22-LA & GS	PSGK - 46B018	PSGK - 46E019	PSGK - 46V022	PSGK - 46T006
39MV72-LA & GS	PSGK - 47B008	PSGK - 47E002	PSGK - 47V005	PSGK - 47T006

- For steam service at pressures below 50 psig (3.45 barg) the 39PV07-2-SS or 39MV07-2-SS with EPR O-Rings should be used (E962-90).
- For services other than steam consult applications engineering.
- This kit contains modulator o rings only. In addition to this psbk kit, the Comparable PV PSGK kit is also required. Example: A 39MV07-2-LS with Viton O-Rings would require a PSGK-34V022 and a PSGK-38V022.

Table 28: Pilot Valve O-Ring Kit Options¹

Options	Buna-N	Ethylene/ Propylene	Viton	Teflon
Field Test Connector		PSGK - 37E019		
Backflow Preventer Seal Kit	PSGK - 37B018	PSGK - 37E0022	PSGK - 37V022	PSGK - 37T006
Line Filter Seal Kit				SP540-JKIT

- Contact factory for kit number for Dome Assist Option.
- For steam service at pressures below 50 psig (3.45 barg) the 39PV07-2-SS or 39MV07-2-SS with EPR O-Rings should be used (E962-90).

Table 29: Line Filter Assembly

Seal Material	Part No.
Teflon®	SP540-J
Line Filter Kit (For Repair Of Line Filter Assembly)	
Seal Material	Part No.
Teflon®	SP540-J Kit

Line filter kit consists of filter element and two Teflon® O-Rings only

Table 30: High Capacity Filter/CC

Seal Material	Part No.
Teflon®	9465-1851
High Capacity Filter/S4	
Seal Material	Part No.
Teflon®	9465-18191

Table 31: High Capacity Filter Replacement Parts

Description	Part No.	No. Required Per Valve
Filter Element	6027301	1
O-Rings	31006131	2

Table 32: Standard Filter

Description	Part No.
Sensing tube filter element	SP-540-V

Note: The sensing tube filter element cannot be cleaned and must be replaced when clogged.

XXVI. Recommended Spare Parts (Cont.)

Table 33: Miscellaneous Parts¹

Description	Size	Part Number
Manual Blowdown Valve	.250" (6.35 mm) MNPT	SP348-E
Male Connector	.375" (9.53 mm) T x .250" (6.35 mm) MNPT	6000609
Male Elbow	.375" (9.53 mm) T x .250" (6.35 mm) MNPT	6000608
Nut and Ferrule Set	.375" (9.53 mm) T	6000669
Plug Filter	N/A	4818801
Union Tee	.375" (9.53 mm) T x .375" (9.53 mm) T x .375" (9.53 mm) T	6000615

1. The above part numbers are 316 stainless steel material. For other material options, please contact factory.

XXVII. Field Service, Repair and Training Program

A. Field Service

Baker Hughes maintains the largest and most competent field service staff in the Industry. Service technicians are located at strategic points throughout the United State to respond to customer's requirements for service. Each Service technician is factory trained and long experienced in servicing Safety Valves.

It is highly recommended that the professional expertise of a Consolidated Field Service technician be employed to make final field adjustments during the initial setting of all Consolidated safety valves.

For further information, please contact your local Green Tag Center (GTC).

B. Repair Facilities

The Baker Hughes Consolidated Repair Department, in conjunction with the manufacturing facilities, is equipped to perform specialized repairs and product modifications, e.g. butt-weld, bushing replacements, code welding, pilot replacement, etc.

For further information, please contact your local Green Tag Center (GTC).

C. Maintenance Training

Rising costs of maintenance and repair in the Utility and Process Industries indicate the need for trained maintenance personnel. Baker Hughes conducts service seminars that can help your maintenance and engineering personnel to reduce these costs.

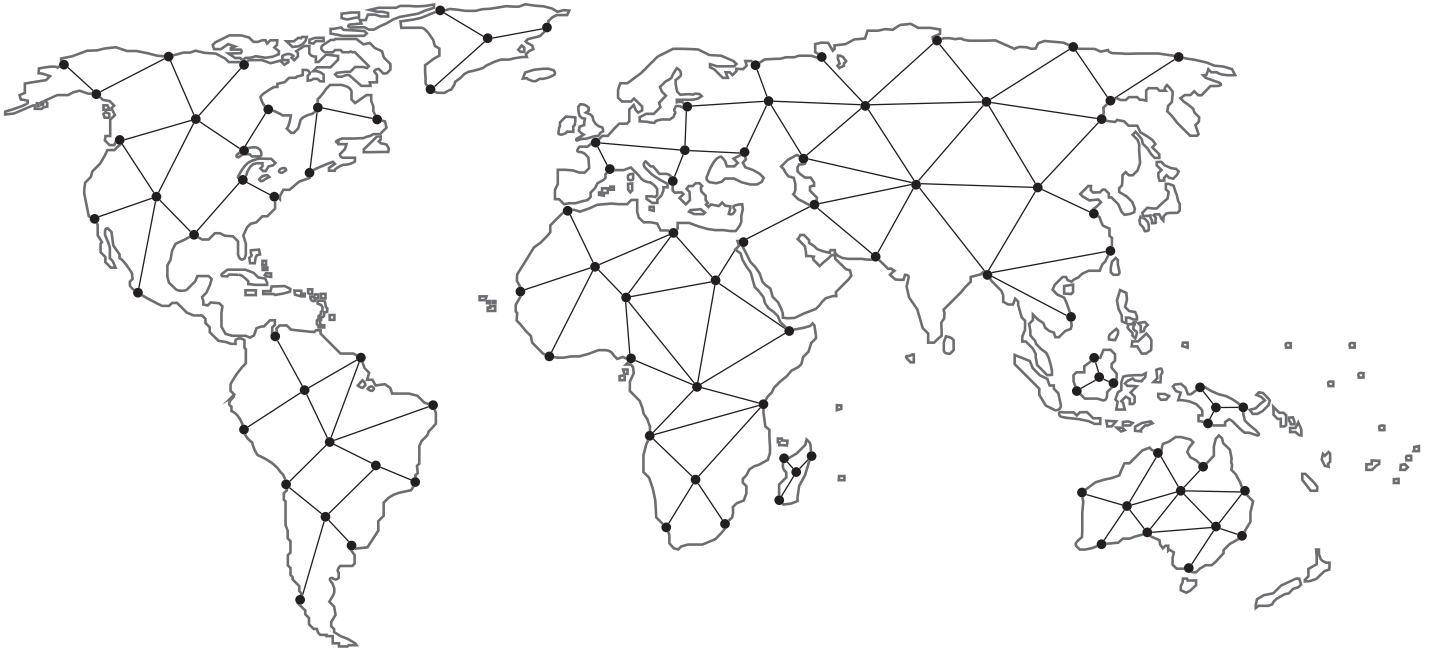
Seminars, conducted either at your site, or at our manufacturing plant, provide participants with an introduction to the basics of preventive maintenance necessary to minimize downtime, reduce unplanned repairs and increase valve safety. While these seminars do not make "instant" experts, they do provide the participants with "Hands-On" experience with Consolidated Valves. The seminar also includes valve terminology, trouble shooting, setting and testing, with emphasis on the ASME Boiler and Pressure Vessel Code.

For further information, please contact your local Green Tag Center (GTC).

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