

299H Series Pressure Reducing Regulators

! WARNING

Failure to follow these instructions or to properly install and maintain this equipment could result in an explosion and/or fire causing property damage and personal injury or death.

Fisher™ regulators must be installed, operated and maintained in accordance with federal, state and local codes, rules and regulations and Emerson Process Management Regulator Technologies, Inc. (Emerson) instructions.

If the regulator vents gas or a leak develops in the system, service to the unit may be required. Failure to correct trouble could result in a hazardous condition.

Call a gas service person to service the unit. Only a qualified person must install or service the regulator.



Figure 1. 299H Series Pressure Reducing Regulator

Introduction

Scope of the Manual

This Instruction Manual provides installation, adjustment and maintenance instructions and parts ordering information for the 299H Series regulators. Instructions and parts list for the 67C Series Instrument Supply Regulators are found in Instruction Manual D102601X012. Instructions and parts list for the P590 Series Filters are found in Instruction Manual D101555X012. Instructions and parts list for the Type VSX2 slam-shut are found in Instruction Manual D103695X012. Instructions and parts list for the Type VSX8 slam-shut are found in Instruction Manual D103127X012.

Description

The 299H Series pressure reducing regulators provide a broad capacity of controlled pressure ranges and capacities in a wide variety of distribution, industrial and commercial applications. A 299H Series regulator has a pilot integrally mounted to the actuator casing. The 299H Series regulators can handle inlet pressures up to 175 psi / 12.1 bar depending on orifice size.

The integral token relief on the Types 299HR and 299HVR regulators is located in the pilot and opens to relieve minor overpressure.

Specifications

Specifications for 299H Series constructions are given below. Some specifications for a given regulator as it originally comes from the factory are stamped on a nameplate located on the actuator upper casing.

Available Constructions

Type 299H: Pilot-operated pressure reducing regulator with a pilot integrally mounted to the actuator casing.

Type 299HR: A Type 299H with a token internal relief valve to relieve minor overpressure caused by thermal expansion.

Type 299HV: Same as the Type 299H with a Type VSX8 slam-shut valve which provides overpressure or overpressure and underpressure protection.

Type 299HVR: Same as the Type 299HV with an internal token relief valve.

Body Size and End Connection Styles

See Table 1

Maximum Operating Inlet Pressure by Orifice Size⁽¹⁾

1/4 x 3/8 in. / 6.4 x 9.5 mm175 psig / 12.1 bar
3/8 in. / 9.5 mm175 psig / 12.1 bar
1/2 in. / 13 mm175 psig / 12.1 bar
3/4 in. / 19 mm150 psig / 10.3 bar
7/8 in. / 22 mm ⁽⁵⁾125 psig / 8.6 bar
1 in. / 25 mm ⁽⁵⁾100 psig / 6.9 bar
1-3/16 in. / 30 mm ⁽⁵⁾	80 psig / 5.5 bar

Maximum Casing and Emergency Outlet Pressure⁽¹⁾

66 psig / 4.5 bar

Outlet (Control) Pressure Ranges⁽¹⁾⁽²⁾

See Table 2

Maximum Set Pressure for Type 299HV⁽¹⁾

16 psig / 1.1 bar

Maximum Set Pressure for Slam-Shut Device⁽¹⁾

See Table 2

Minimum and Maximum Trip Pressure Ranges

See Type VSX8 slam-shut Instruction Manual D103127X012.

Types VSX8 Sensing Line Connection

1/4 NPT

Pressure Control Accuracy (Fixed Factor)(PFM)

±1%⁽³⁾ of absolute control pressure

Minimum Differential Pressure For Full Stroke

1.5 psid / 0.10 bar d

Control Line Connections

3/4 NPT

Temperature Capabilities⁽¹⁾⁽⁶⁾

-20 to 150°F / -29 to 66°C

Approximate Weight

21 lbs / 10 kg

Pressure Registration

Internal, External or Dual Registration

See Figure 2

Fixed Restriction Sizes

0.044 in. / 1.1 mm, Red (standard gain)

0.071 in. / 1.8 mm, Green (low gain)

0.082 in. / 2.1 mm, Blue (lower gain)

Options

- **Filter⁽³⁾:** A P590 Series filter installed in the pilot supply tubing between main body and pilot
- **Filtered pilot supply regulator⁽³⁾⁽⁴⁾:** A Type 67CF supply regulator with integral 5 micron Polyethylene filter
- **Reed switch:** An optional remote notification switch can be installed offering the capability to remotely notify the operator should VSX8 Series shut off occur (Types 299HV and 299HVR only).

1. The pressure/temperature limits in this Instruction Manual and any applicable standard or code limitation should not be exceeded.

2. For optimum performance, a pilot supply regulator may be installed in the pilot supply tubing between the main valve and pilot.

3. A pilot supply regulator or a P590 Series filter (only one may be used, not both) may be ordered with the Type 299H, but not both.

4. For in. w.c., use a pilot supply regulator if actual inlet pressure varies more than ±20 psi / ±1.4 bar and published accuracy is required.

5. This orifice size is not available for Types 299HV and 299HVR.

6. Product has passed Emerson testing for lockup, relief start-to-discharge and reseal down to -40°.

The Type 299HV provide overpressure or overpressure and underpressure protection by completely shutting off the flow of gas to the downstream system. It comes with a Type VSX8 (299HV) slam-shut device which can be configured for Overpressure Shutoff (OPSO) or

Overpressure and Underpressure Shutoff (OPSO/ UPSO). The slam-shut device's actions are independent of the main valve and of variations to the inlet pressure. The Type VSX8 (299HV) slam-shut device has internal or external registration. External registration requires a downstream sensing line.

Table 1. Body Sizes and End Connection Styles

BODY SIZE, IN. / DN	BODY MATERIAL AND END CONNECTION STYLE		
	Cast Iron (For Types 299H and 299HR only)	Ductile Iron	Steel (For Types 299H and 299HR only)
1-1/4 1-1/2	NPT NPT	---- NPT	---- NPT
2 / 50	NPT and CL125 FF ⁽¹⁾ flanged	NPT, CL125 FF and CL250 RF flanged and PN 10/16 flanged	NPT and CL150 RF flanged

1. This flange is available with a face-to-face dimension of 7.5 in. / 190 mm or 10 in. / 254 mm.

Table 2. Outlet Pressure Ranges

OUTLET (CONTROL) PRESSURE RANGE		TYPE		PILOT CONTROL SPRING					
		299H	299HR, 299HV and 299HVR	Part Number	Color	Free Length		Wire Diameter	
In. w.c.	mbar					In.	mm	In.	mm
3.5 to 6 ⁽¹⁾ 5 to 9 ⁽¹⁾ 7 to 20 ⁽¹⁾ 16 to 40 ⁽¹⁾	9 to 15 ⁽¹⁾ 12 to 22 ⁽¹⁾ 17 to 50 ⁽¹⁾ 40 to 99 ⁽¹⁾	X X X X	X X X X	T13707T0012 T13589T0012 1N3112X0012 1B413727222	Black Yellow Unpainted Purple	1.86 2.05 2.18 2.12	47.2 52.1 55.4 53.8	0.055 0.051 0.075 0.092	1.40 1.30 1.90 2.34
1 to 3.25 psig 2.75 to 6 psig 5 to 16 psig 14 to 35 psig 30 to 60 psig	69 mbar to 0.22 bar 0.19 to 0.41 bar 0.34 to 1.1 bar 0.97 to 2.4 bar 2.1 to 4.1 bar	X X X X X	X X X ---- ----	T13593T0012 T13671T0012 T13600T0012 19B0432X012 19B0432X022	Light blue Orange Red Zinc Green	2.12 2.40 2.10 2.15 2.75	53.8 61.0 53.3 54.6 69.8	0.105 0.120 0.142 0.207 0.225	2.67 3.05 3.61 5.26 5.71

1. Use a pilot supply regulator if actual inlet pressure varies more than ± 20 psi / ± 1.4 bar and the published accuracy is required.

Principle of Operation

! WARNING

Since a pilot-operated regulator is constructed of both a pilot and a main valve, do not exceed the maximum inlet pressure shown on the nameplate.

Letter keys in this section refer to Figure 2 unless otherwise noted. Fast response and accuracy are made possible by the amplifying effect of the pilot and by the two-path control system. The function of the pilot is to sense change in the controlled pressure and amplify it into a larger change in the loading pressure. Any changes in outlet pressure act quickly on both the actuator diaphragm and the loading pilot, thus providing the precise pressure control that is characteristic of a two-path control system.

Upstream or inlet pressure is utilized as the operating medium, which is reduced through pilot operation to load the main diaphragm chamber. Tubing connects the inlet pressure to the pilot. Downstream or outlet pressure registers underneath the main diaphragm (E) and on top of pilot diaphragm (F). There are three different versions of pressure registration for the 299H Series.

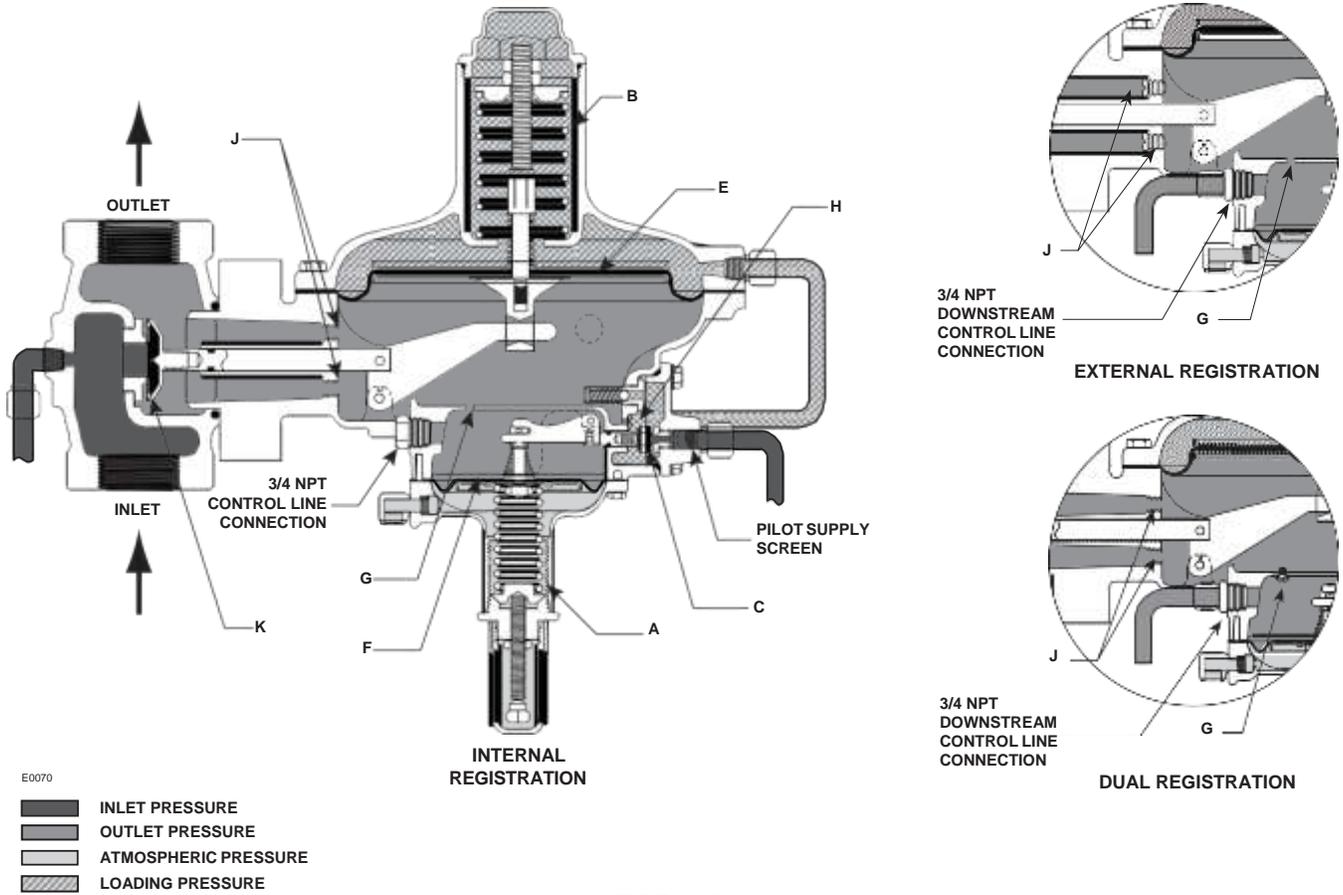
Internal registration—Outlet pressure is registered through the throat (J) to the main diaphragm chamber and then through a small port (G) to the top of the pilot diaphragm.

External registration—The throat (J) is blocked and a downstream control line is connected to the pilot upper diaphragm chamber or the actuator lower diaphragm chamber. A small port (G) connects the two chambers.

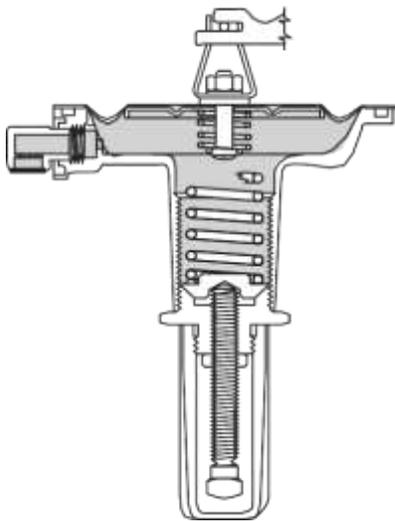
Dual registration—The lower main diaphragm chamber registers outlet pressure through the throat (J) and the upper pilot diaphragm chamber registers downstream pressure by using a downstream control line. The port (G) between the chambers is blocked.

Type 299H

In operation, assume the outlet pressure is less than the setting of the pilot control spring (A). The top side of pilot diaphragm assembly (F) will have a lower pressure than the setting of the control spring (A). The control spring (A) forces the diaphragm assembly upward, opening the pilot orifice (C). Additional loading pressure is supplied from the pilot orifice to the top side of the main diaphragm (E).

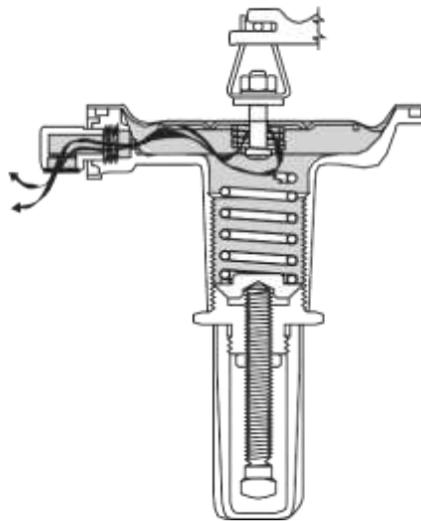


TYPE 299H



A7272

TOKEN RELIEF CLOSED



A7272

TOKEN RELIEF OPEN

TYPE 299HR (TOKEN RELIEF DETAIL)

Figure 2. 299H Series Operational Schematics

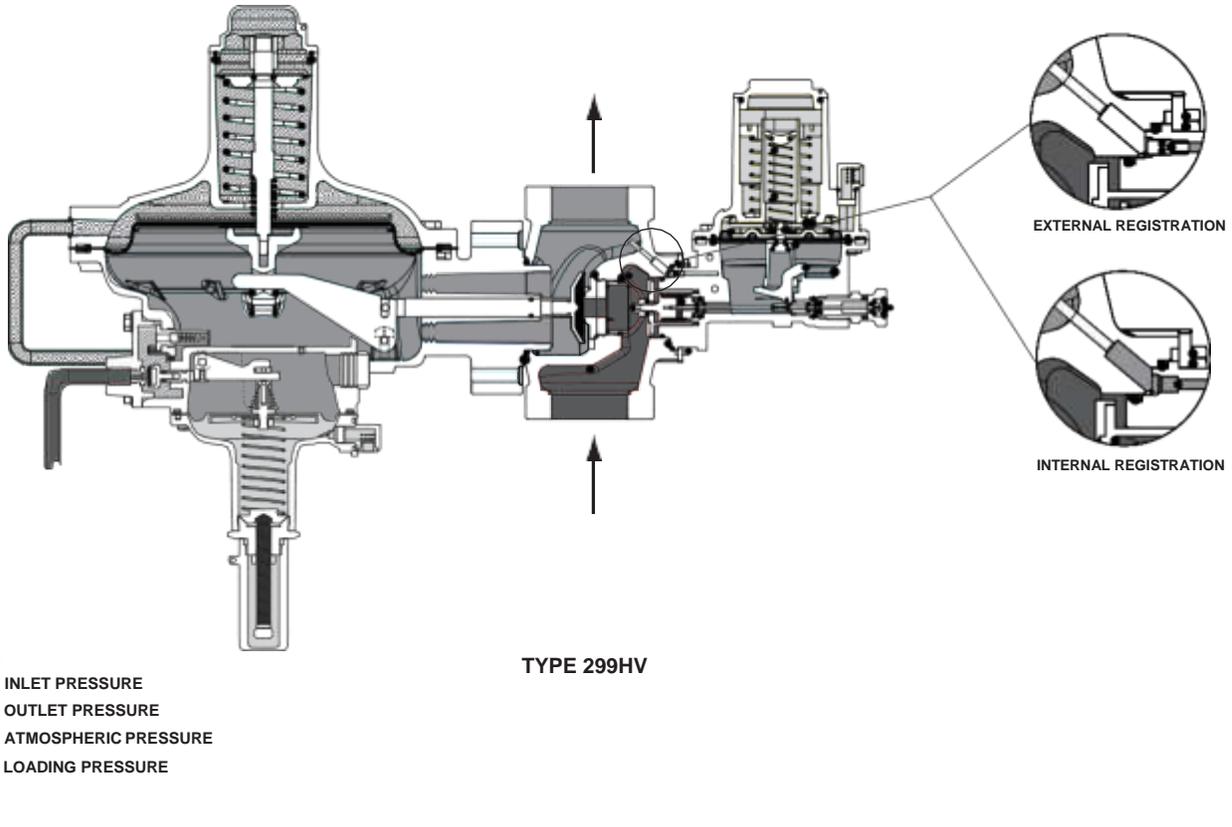


Figure 2. 299H Series Operational Schematics (continued)

This creates a higher pressure on the top side of the main diaphragm (E) than on the bottom side, forcing the diaphragm downward. This motion is transmitted through a lever, which pulls the valve disk (K) open, allowing inlet pressure to flow through the valve.

When the demand in the downstream system has been satisfied, the outlet pressure increases. The increased pressure is transmitted through the downstream control line (for external or dual registration) or through the port (G) (for internal registration) and acts on top of the pilot diaphragm (F). This pressure exceeds the pilot spring setting and forces the diaphragm down, closing the orifice (C). The loading pressure acting on the main diaphragm (E) bleeds to the downstream system through a bleed restriction (H).

With a decrease in loading pressure on top of the main diaphragm (E), the main closing spring (B) exerts an upward force on the diaphragm post which is connected to the main diaphragm (E), pulling it upward. This moves the main valve disk (K) toward its seat, decreasing flow to the downstream system.

Type 299HR

During normal operation the Type 299HR performance is identical to the Type 299H. If an overpressure condition occurs, the pilot diaphragm head will separate from the pilot diaphragm post and travel until it contacts the pilot spring case. The movement of the diaphragm head creates a path and a token or small amount of gas will be released.

When the overpressure condition ceases, the pilot diaphragm head will return to the diaphragm post and the regulator will return to normal operation.

Type 299HV

The Type VSX8 (299HV) slam-shut device on the Type 299HV regulator is a fast acting slam-shut valve which provides overpressure or overpressure and underpressure protection by completely shutting off the flow of gas to the downstream system. The slam-shut module's actions are independent of the Type 299HV main regulator and of the variations to the inlet pressure. The Type VSX8 have internal or external registration. External registration requires a downstream sensing line.

The slam-shut disk is held in the open position (reset position) by an internal latching mechanism that holds the valve stem and disk assembly. If the pressure below the diaphragm increases (or decreases) reaching the Type VSX8 setpoint, the diaphragm will travel upwards (or downwards) operating a lever which in turn releases the valve stem assembly.

Once released, the spring force on the stem will push the stem and disk to the closed position against the seat shutting off all gas flow. The pilot supply pressure is also shut off when the Type VSX8 is closed. The manual reset has an internal bypass to equalize the reset pressure on either side on the slam-shut disk.

In order for the Underpressure Shutoff (UPSO) of any slam shut to be triggered, the downstream pipe pressure must drop below the UPSO setpoint. In the case of a downstream line break, numerous factors can prevent the downstream pipe pressure from decreasing below the slam-shut UPSO setpoint. These factors include the distance of pipe to the break, the diameter of the pipe, size of the break and the number of restrictions, such as valves, elbows and bends, downstream of the regulator and/or slam-shut device. Due to these factors additional protections should be installed to stop flow in the event of a line break.

Overpressure Protection

Like most regulators, the Type 299H has outlet pressure ratings lower than the inlet pressure ratings. Complete downstream overpressure protection is needed if the actual inlet pressure exceeds the outlet pressure rating.

Overpressure protection for internal parts is built into the main and pilot diaphragms by means of a small spring on each post. The springs will allow the diaphragm heads to move farther on the posts avoiding damage to or bending of the valve trim.

Overpressuring any portion of a regulator or associated equipment may cause leakage, parts damage or personal injury due to bursting of pressure-containing parts or explosion of accumulated gas. Regulator operation within ratings does not preclude the possibility of damage from external sources or from debris in the pipeline. A regulator should be inspected for damage periodically and after any overpressure condition.

The pilot vent is provided with a 1/4 NPT tapped connection in the spring case.

Installation

! WARNING

Personal injury, equipment damage or leakage due to escaping gas or bursting of pressure-containing parts might result if this regulator is overpressured or is installed where service conditions could exceed the limits for which the regulator was designed or where conditions exceed any ratings of the adjacent piping or piping connections. To avoid such injury or damage, provide pressure-relieving or pressure-limiting devices (as required by the appropriate code, regulation or standard) to prevent service conditions from exceeding those limits.

A regulator may vent some gas to the atmosphere in hazardous or flammable gas service. Vented gas might accumulate and cause personal injury, death or property damage due to fire or explosion. Vent a regulator in hazardous gas service to a remote, safe location away from air intakes or any hazardous location. Protect the vent line or stack opening against condensation or clogging.

If the regulator is exposed to an overpressure condition, it should be inspected for any damage that may have occurred. Operation below these limits does not preclude the possibility of damage from external sources or from debris in the pipeline.

If the Type VSX8 is exposed to an overpressure condition, it should be inspected for any damage that may have occurred. Operation below these limits does not preclude the possibility of damage from external sources or from debris in the pipeline.

In the case of a downstream line break, numerous factors affect the capability to evacuate gas from the pipeline. These factors include the distance of pipe to the break, the diameter of the pipe, size of the break and the number of restrictions, such as valves, elbows and bends, downstream of the regulator

To convert an external registration regulator to a dual registration regulator, remove the two screws and O-rings (J in Figure 2) from the throat and use a screw and an O-ring to block the port (G in Figure 2) between the lower diaphragm chamber and pilot diaphragm chamber. Remove the 3/4 NPT pipe plug in the pilot lower casing and add a downstream controlline.

Type VSX8 Slam-Shut Device

Refer to the Instruction Manual for Type VSX8 Slam-shut, document D103127X012, for Adjustment and Maintenance of the Slam-shut.

Type VSX8 Installation Startup

Note

The Type VSX8 slam-shut device can be rotated 360° for easy installation and maintenance.

Equipment installed downstream the Type VSX8 slam shut device can be damaged if the following procedure for resetting the Type VSX8 slam shut device is not followed. This equipment includes the integral Type VSX8 regulator configurations.

Before proceeding with the adjustment of the slam-shut device springs, the operator must ensure upstream and downstream valves are closed and adjusting screws are unscrewed.

With proper installation completed and downstream equipment properly adjusted, perform the following procedure while monitoring the pressure with gauges.

1. Very slowly open the upstream block valve.
2. On a Type 299HV, the Type VSX8 is shipped in the tripped position and will need to be reset. If the Type VSX8 is OPSO only, it can be reset before starting the regulator. If the Type VSX8 is OPSO/ UPSO, the regulator will need to be started and the downstream system pressurized before the Type VSX8 can be reset. See the section for Type VSX8 reset.

3. Use the following procedure to reset the Type VSX8:
 - a. To properly reset the Type VSX8 slam shut after it has been tripped to the closed position, a flat-head screwdriver must be inserted into the backside of the reset button.
 - b. The screwdriver should be slowly rotated to gradually pull the reset button away from the Type VSX8 device. This slow movement allows for a slow bleed of the pressure across the Type VSX8 slam shut's disk and seat area. The operator should be able to hear the pressure bleeding through the system.
 - c. When the pressure has equalized and the air bleeding sound has dissipated, the reset button should be pulled completely away from the Type VSX8 slam shut device by hand until the internal shut-off mechanism has been re-latched.
 - d. Once the operator feels the click of the re-latch occurring, the reset button should be pushed completely back into its original position.
4. Slowly open the hand valve (if used) in the control line. The regulator will control downstream pressure at the pilot control spring setting. See the Adjustment section following these numbered steps if changes in the setting are necessary during the start-up procedure.
5. Slowly open the downstream block valve.
6. Slowly close the bypass valve, if used.
7. Check all connections for leaks.

299H Series Adjustment

Keys are referenced in Figure 5. The only adjustment on a 299H Series regulator is the reduced pressure setting of the pilot control spring (key 32). Remove the closing cap (key 29) and turn the adjusting screw (key 36). Turning the adjusting screw clockwise into the spring case increases the controlled or reduced pressure setting. Turning the screw counterclockwise decreases the reduced pressure setting. Always tighten the locknut (key 35) and replace the closing cap after making adjustments.

Note

When assembling the diaphragm assembly (keys 8, 80 and 81), lubricate the actuator diaphragm post (key 10) threads.

8. Loosely reassemble the diaphragm and diaphragm post parts so that the bolt holes in the diaphragm align with the corresponding holes in the lower casing (key 1) when the lever (key 26) is fitted properly into the pusher post. When this orientation is made, tighten the diaphragm post into the pusher post (keys 10 and 11).
9. Reinstall the diaphragm assembly using the reverse order of step 5.
10. Install the upper casing (key 2) and secure it to the lower casing (key 1) with the eight hex head screws (key 23). Tighten the hex head screws evenly using a crisscross pattern to avoid placing an uneven strain on the regulator. Tighten the screws to a final bolt torque of 10 to 13 ft-lbs / 13 to 17 N•m to avoid crushing the diaphragm.

CAUTION

In step 11, the spring seat (key 4) is under spring pressure. Use constant hand pressure to hold the spring down when installing the hex nuts (key 5), see Figure 3.

11. Install the closing spring (key 6) and the spring seat (key 4). Push and hold down on the spring seat, cocking it to one side until the seat catches onto the threads of the diaphragm post (key 10). Then, pull up on the diaphragm post allowing access to the post threads so that the two adjusting hex nuts (key 5) can be installed. Install the adjusting hex nuts as shown in Figure 3. The closing spring must be adjusted down to a depth of 1/2 in. / 13 mm from the top of the upper case opening to the top of the spring seat. When tightening the two hex nuts, use care not to rotate the diaphragm post, which may damage the post.
12. Lightly lubricate the O-ring (key 9) on the closing cap and reinstall the closing cap (key 3).

! WARNING

The wire seal and warning tag (keys 68 and 69) contain important safety information, make sure they are attached when maintenance is completed.

13. Install the wire seal and warning tag (keys 68 and 69).

Main Body Valve Disk and Orifice

Follow this procedure to inspect, clean or replace the main body valve disk or to inspect or replace the orifice. Part key numbers are referenced in Figures 3 and 4.

Note

The regulator body may remain in the pipeline during maintenance procedures.

1. Disconnect the pilot supply tubing (key 21) from the main body (key 17).
2. Remove the two hex head cap screws (key 18) which hold the lower casing (key 1) to the body. Separate the lower casing from the body. Inspect the body O-ring (key 15) and replace if worn or damaged.
3. Examine the valve disk (key 13) and orifice (key 12) for nicks, cuts and other damage. Unscrew the disk holder assembly from the valve stem assembly (key 16) and replace it with a new part if necessary. For the Type 299HV, also examine the insert and O-ring (keys 82 and 83, Figure 6) for any damage. Replace if needed.
4. If the orifice is being replaced with a new or differently sized orifice, change the nameplate (key 63) to state the new size and maximum inlet pressure. Lubricate the threads and flat face of the orifice with a good grade of anti-seize lubricant. Install the orifice using 100 to 120 ft-lbs / 136 to 163 N•m of torque.
5. After replacing all damaged parts, slide the entire assembly into the valve body (key 17) and secure with the two hex head cap screws (key 18).
6. Connect the pilot supply tubing (key 21), then refer to the Startup section for putting the regulator into operation.

Integral Pilot Valve Disk and Orifice

Follow this procedure to inspect, clean or replace the integral pilot valve disk or orifice. Part key numbers are referenced in Figures 3 and 4.

1. Remove or loosen the pilot supply tubing (key 21).
2. Remove the inlet fitting (key 47) and the four machine screws (key 46).
3. Examine the valve disk (key 52) for nicks, cuts and other damage. Unscrew the disk holder assembly from the valve stem (key 48) and replace if necessary.
4. If the seating edge of the orifice (key 50) is nicked or rough, use a thin-walled socket to remove the orifice from the inlet fitting (key 47). Install a new orifice and a lightly lubricated O-ring (key 49) when reassembling the regulator.
5. Inspect the check valve assembly (key 45) and the bleed restriction (key 70) for damage and replace if necessary.
6. The Type 299H has a wire inlet screen (key 51) in the pilot supply inlet fitting (key 47). If clogging is suspected in the pilot supply, remove the elbow fitting (key 19) and clean the wire screen.
7. Lightly lubricate the O-ring (key 54) on the inlet fitting (key 47) and reinstall using the four machine screws (key 46). Torque the machine screws to 30 to 40 in-lbs / 3.4 to 4.5 N•m. Then install and tighten the pilot supply tubing.

Integral Pilot Control Spring and Diaphragm

Follow this procedure to change the pilot control spring or to inspect, clean or replace the diaphragm. Part key numbers are referenced in Figures 3, 4 and 5.

1. Remove the pilot closing cap (key 29) and loosen the hex lock nut (key 35). Turn the adjusting screw (key 36) counterclockwise to ease spring compression.
2. Unscrew the bonnet (key 34).
3. Remove the bonnet (key 34), spring seat (key 33) and control spring (key 32).

4. If only replacing the control spring (key 32), sparingly apply lubricant to the control spring seat (key 33) and reassemble in the reverse order.

Note

When replacing the control spring with a different spring range, be sure to delete the spring range appearing on the nameplate and indicate the new range.

5. Remove the machine screws (key 30) and spring case (key 31) from the lower casing (key 1).
6. Remove the diaphragm assembly (key 28) by tilting them so that the pusher post (key 40) slips off the lever (key 57). To separate the diaphragm from the attached parts, unscrew the hex nut (key 37) and separate the parts: washer (key 38), diaphragm post (key 39), pusher post (key 40), overtravel spring (key 41), machine screw (key 42), spring seat (key 88) (Types 299HR and 299HVR), rivet (key 43) and retaining ring (key 44).
7. To replace the lever assembly (key 57), remove the lever pin (key 25). To replace the valve stem (key 48), also perform Integral Pilot Valve Disk and Orifice maintenance procedure steps 1, 2 and 3 and pull the stem (key 48) out of the lower casing assembly (key 1). Lightly lubricate the replacement stem O-ring (key 53) and install it on the valve stem.
8. Install the valve stem (key 48) into the lower casing assembly (key 1). Be careful not to cut the O-ring (key 53) when sliding the valve stem into the lower casing.
9. Reinstall the diaphragm (key 28) assembly using the reverse order of step 6.
10. Place the spring case (key 31) on the lower casing (key 1) with the vent (key 27) oriented downwards to prevent clogging or entrance or moisture. Install the machine screws (key 30) and tighten in a crisscross pattern using 12 to 18 in-lbs / 1.4 to 2.0 N•m of torque.
11. When all maintenance is complete, refer to the Startup section to put the regulator back into operation and adjust the pressure setting. Tighten the locknut (key 35) and install the closing cap (key 29).

Key	Description	Part Number	Key	Description	Part Number
20	Connector ⁽¹⁾	-----	62	Drive Screw, Steel (2 required)	1E501728982
21	Pilot Supply Tubing, Without filter	-----	63	Nameplate, Aluminum	-----
22	Loading Tubing	-----	68*	Wire Seal	T14088T0012
23	Cap Screw, Steel (8 required)	1C379124052	69	Warning Tag, Aluminum	-----
24	Machine Screw, Steel (2 required)	1B420428982	70	Bleed Restriction, Steel	
25	Lever Pin, Stainless steel (2 required)	1H972935032		0.044 in. / 1.1 mm, Red (standard)	17A2029X012
26	Lever, Steel	T13813T0012		0.071 in. / 1.8 mm, Green	17A2030X012
27	Vent Hood (Type Y602-12 Vent Assembly)	27A5516X012		0.082 in. / 2.1 mm, Blue	17A7277X012
28	Diaphragm Assembly, Nitrile (NBR) diaphragm and steel diaphragm head	T14259T0012	72	Filter Assembly, See P590 Series	
29	Closing Cap, Plastic	24B1301X012		Type P593-1	AJ5004T0012
30	Machine Screw, Steel (8 required)	T14069T0012		Type P594-1	AJ5004000A2
31	Spring Case, Aluminum	T14097T0012	78	Pilot Supply Tubing, Long (for constructions with filter or pilot supply option)	-----
	Spring Case, Aluminum	ERAA10464A1	79	Pilot Supply Tubing, Short (for constructions with filter or pilot supply option)	-----
32	Control Spring	See Table 2	80	Pad, Nitrile (NBR)	T13830T0012
33	Spring Seat, Steel	T13917T0012	81	Diaphragm Head, Steel (2 required)	T13812T0012
34	Bonnet, Steel	T14135T0012	82	Insert (for Types 299HV and 299HVR only, see Figure 6) Aluminum ⁽²⁾	T14013T0012
35	Locknut, Steel	1A352224122	83	O-ring (for Types 299HV and 299HVR only, see Figure 6) Nitrile (NBR) ⁽²⁾	T1072606562
36	Adjusting Screw, Steel	T14133T0012	84	Plate (for Types 299H and 299HR only), Steel ⁽²⁾	T14039T0012
37	Hex Nut, Steel	1E985324142	85	O-ring (for Types 299H and 299HR only), Nitrile (NBR) ⁽²⁾	T13769T0012
38	Washer, Steel	1F230328992	86	O-ring (for Types 299H and 299HR only), Nitrile (NBR) ⁽²⁾	T13772T0012
39	Diaphragm Post, Stainless steel		87	Set Screw (for Types 299H and 299HR only) (4 required) ⁽²⁾	1C629828992
	Types 299H and 299HV	T13915T0012	88	Spring Seat, Type 299HR	T14030T0012
	Types 299HR and 299HVR	T14033T0012	89	Label ⁽³⁾	
40	Pusher Post, Steel	T13914T0012		Type 299H	T1215806032
41	Overtravel Spring, Stainless steel			Type 299HR	T1215906032
	Types 299H and 299HV	T14136T0012	92	Tee, Stainless steel	-----
	Types 299HR and 299HVR	T14031T0012	93	Spring Seat Washer, Delrin [®]	
42	Machine Screw, Steel	1A954828992		(high vibration and engine applications - used with key 4) ⁽³⁾	19B0553X012
43	Rivet, Flat head, Stainless steel	T13916T0012	94	Plastic Plugs ⁽³⁾	T13543T0042
44	Retaining Ring, Steel	16A6977X012			
45	Check Valve Assembly	T14258T0012			
46	Machine Screw, Steel (4 required)	T13920T0012			
47	Inlet Fitting, Aluminum	T13824T0012			
48	Stem Assembly, Aluminum	1H9666T0012			
49*	O-ring, Nitrile (NBR)	T13939T0012			
50	Pilot Orifice, Aluminum	T13825T0012			
51	Inlet Screen, Stainless steel	T13791T0012			
52*	Pilot Disk Assembly, Hydrogenated Nitrile (NBR) and Aluminum disk holder	T13955T0012			
53*	O-ring, Nitrile (NBR)	1D682506992			
54*	O-ring, Nitrile (NBR)	13A2331X022			
56	Screw, Steel (External Registration - 2 required or Dual Registration - 1 required)	1E175828982			
57	Lever, Steel	T14134T0012			
58	Pipe Plug, Steel	1A7715T0012			
59	Pipe Plug, Internal Registration only, Steel				
	3/4 NPT	1A7715T0012			
	1/4 NPT	1A767524662			
61	O-ring, Nitrile (NBR) (External Registration - 2 required or Dual Registration - 1 required)	17A0960X012			

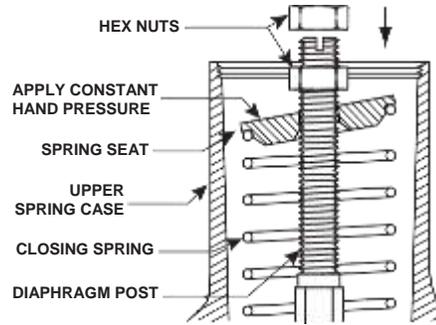
* Recommended spare part

Delrin[®] is a mark owned by E.I. du Pont de Nemours and Co.

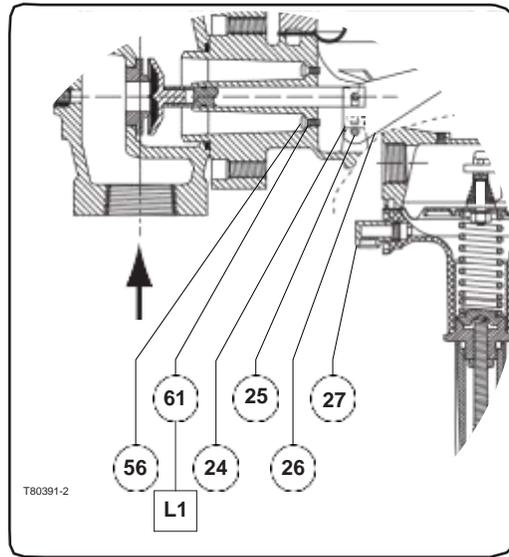
1. Cast iron or steel bodies without filter and pilot supply regulator require 1 connector; all other combinations of filter and/or pilot supply regulator require 3 connectors. Ductile iron bodies without filter and pilot supply regulator require 2 connectors; all other combinations of filter and/or pilot supply regulator require 4 connectors.

2. Ductile iron bodies only.

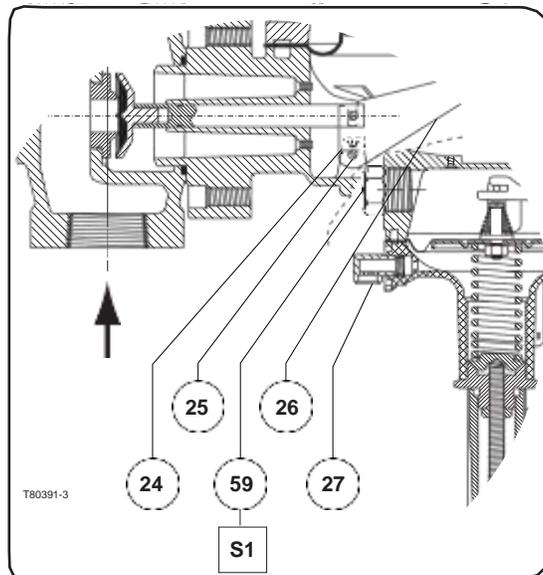
3. Not shown.



LOCKING DOWN THE SPRING SEAT TO FACILITATE INSTALLING THE HEX NUTS



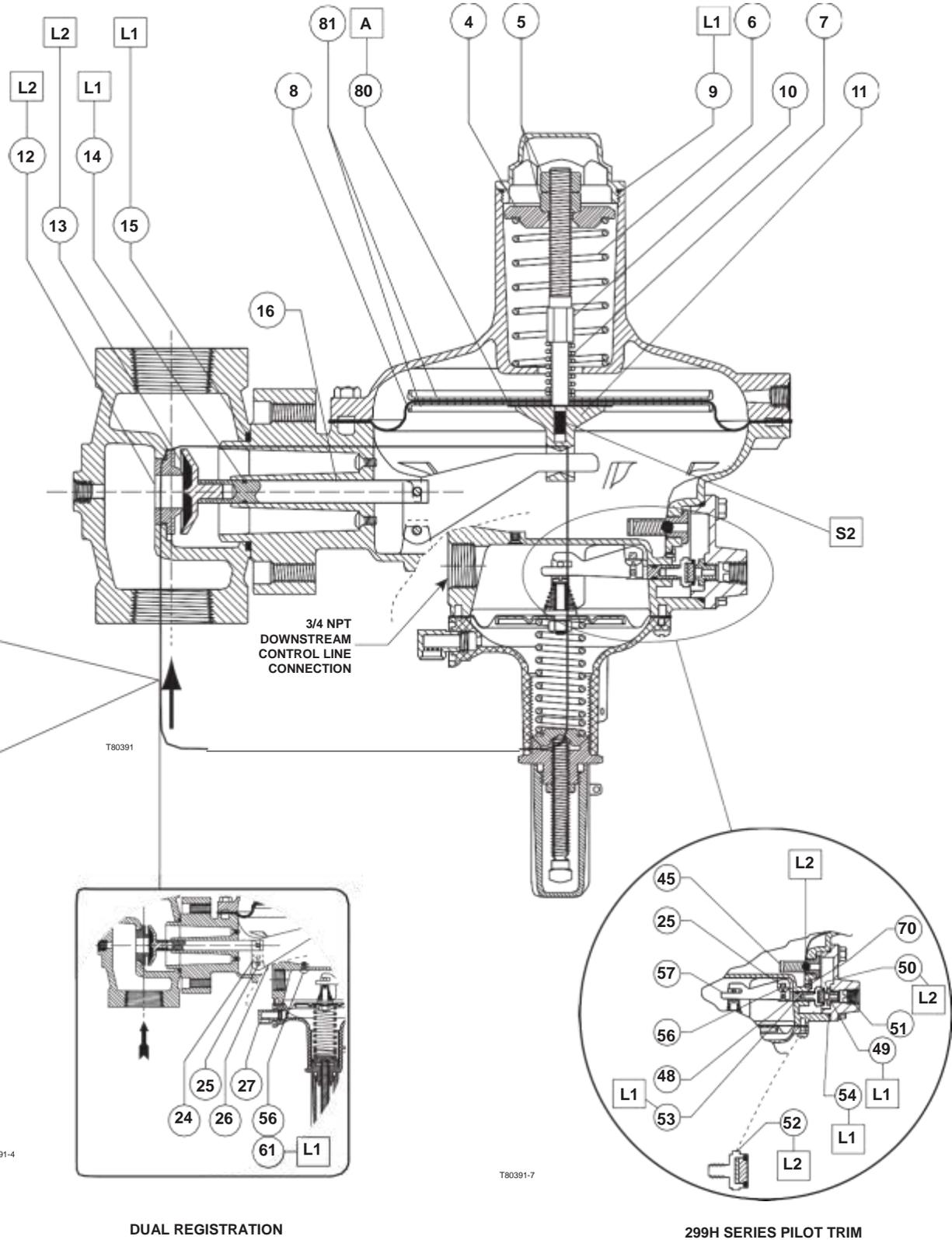
EXTERNAL REGISTRATION



INTERNAL REGISTRATION

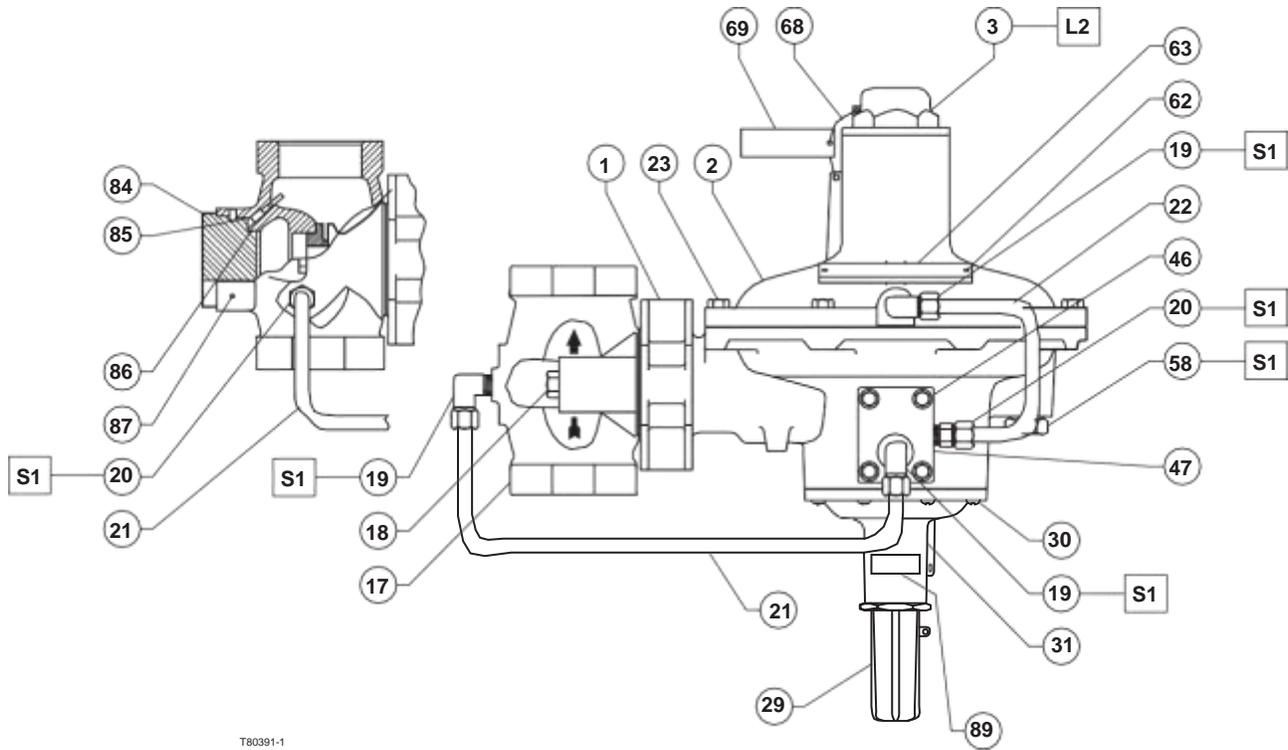
□ APPLY MULTI-PURPOSE LUBRICANT (L1) / MULTI-PURPOSE POLYTETRAFLUOROETHYLENE (PTFE) THREAD SEALANT (S1)

Figure 3. 299H Series Interior Assembly



□ APPLY MULTI-PURPOSE LUBRICANT (L1) / ANTI-SEIZE COMPOUND (L2) / THREAD LOCK SEALANT (S1) / ADHESIVE (A)

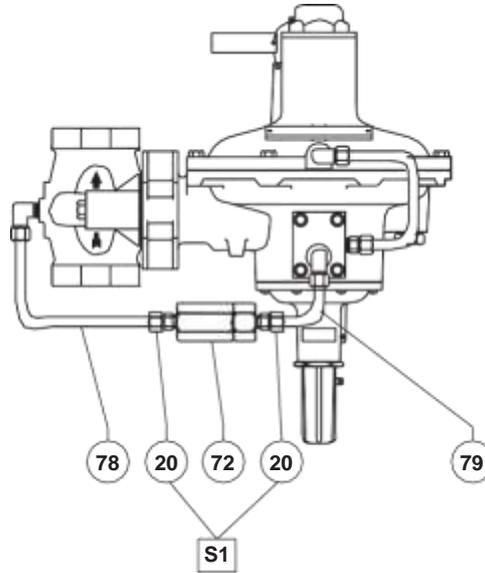
Figure 3. 299H Series Interior Assembly (continued)



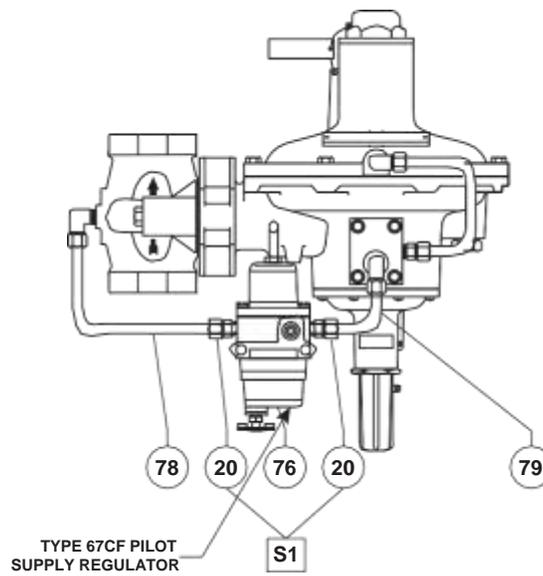
T80391-1

299H SERIES EXTERIOR VIEW

Figure 4. 299H Series Exterior Assembly



**TUBING AND FITTINGS WITH
 OPTIONAL TYPE P590 FILTER**

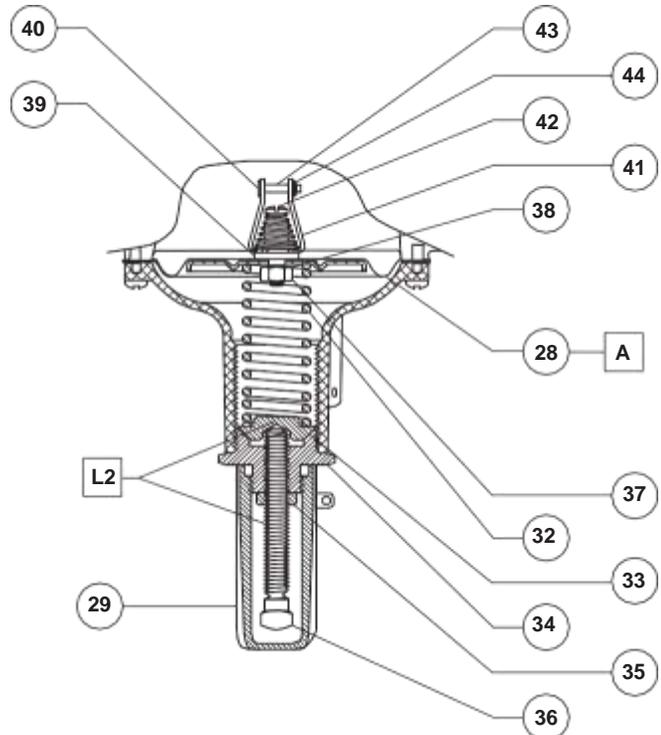


**TYPE 67CF PILOT
 SUPPLY REGULATOR**

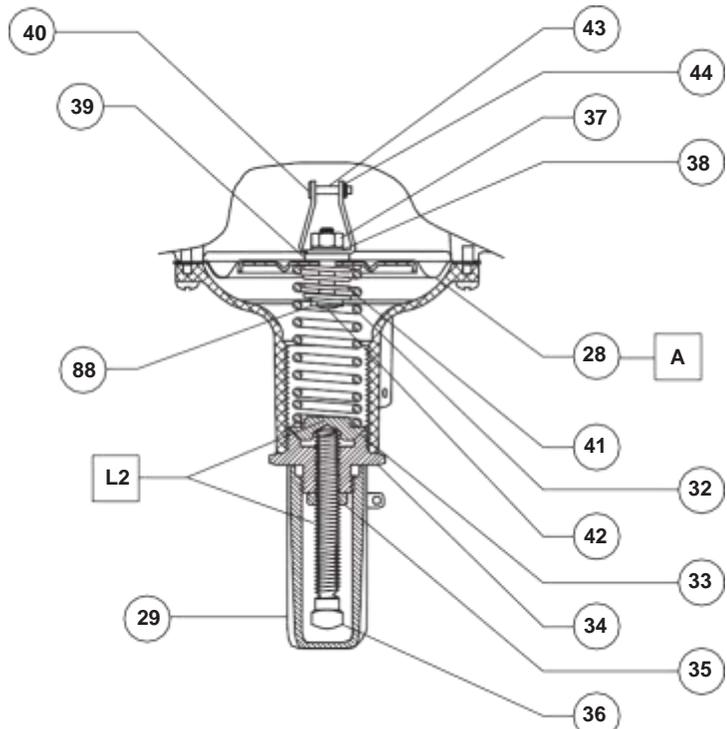
**TUBING AND FITTINGS WITH OPTIONAL
 TYPE 67CF PILOT SUPPLY REGULATOR**

APPLY ANTI-SEIZE COMPOUND (L2) / MULTI-PURPOSE PTFE THREAD SEALANT (S1).

Figure 4. 299H Series Exterior Assembly (continued)



TYPE 299H PILOT WITHOUT RELIEF VALVE



TYPE 299HR PILOT WITH TOKEN RELIEF VALVE

T80391-6

□ APPLY ANTI-SEIZE COMPOUND (L2) / ADHESIVE (A)

Figure 5. 299H Series Pilot Assemblies

