2019 Scope of Work

Valve Tag	11LBG30AA010 (Valve Serial No. 38172.019)
Description	Aux. Steam CRH Pressure Control Valve
Valve Type	Valtek Control Valve (Megastream 2-ST Survivor type) with Valtek pneumatic actuator
Size	6"
Pressure Class	600

S.No.	Required Activities
1	Review and follow ITP and given procedure.
2	Disengage valve stem and actuator.
3	Remove actuator and disassemble the valve bonnet.
4	Remove valve trim including seat retainer, seat ring, cage, plug and stem.
5	Assess the condition of all internal components such as valve trim, record with photos.
6	Refurbish, machine or replace all components such as seat, plug, cage and stem as required.
7	Machining may be required on the valve body to remove steam cuts and to maintain stack height.
8	Replace all soft goods such as gaskets and stem packing for the valve.
9	Assemble the valve as per given GA drawing.
10	Overhaul the actuator and replace all soft goods.
11	All spares to be free-issued by TWPS.
12	Assemble the valve and actuator.
13	Inspect and overhaul all ancillary components such solenoid valves, filter /regulator etc.
14	Function test and reprofile the valve and actuator assembly.
15	Leave the valve and actuator assembly in the as-found position.
16	
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Attachments	
1	GA drawing and catalogue
2	Actuator IOM
3	Valve IOM
4	
5	

Prepared by: Nitin Aggarwal	Checked and approved by: Frank Young	Date: 05/01/2019

FLOWSERVE™

Valtek MegaStream

Control Valves

Valtek MegaStream

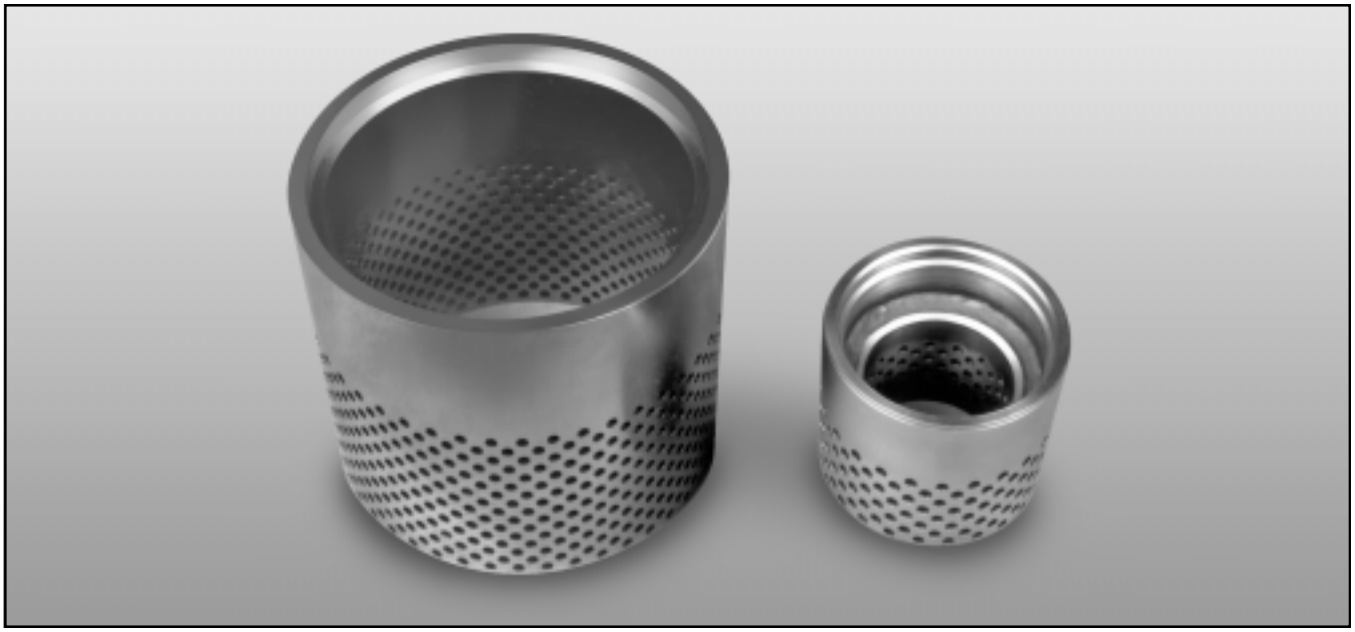


Figure 1: MegaStream Trim

The Valtek® MegaStream™ valve trim effectively attenuates gaseous noise in control valves. MegaStream trim is available in two styles: an economical, interchangeable one and the two-stage retainer for noise reduction up to 15 dBA, and a three- to seven-stage retainer for noise reduction approaching 30 dBA.

The MegaStream concept and principle, explained in detail on the following pages, are the result of extensive research and engineering study. These principles have been incorporated into the trim design, allowing MegaStream to be used in a wide variety of applications: chemical/petroleum plants, refineries, gas transmission and production, power plants, process industries, nuclear industries, and wherever a highly successful noise reduction valve is required.

Some of the built-in design features of MegaStream noise control valves are:

1. Staged pressure reduction through a series of carefully designed drilled-hole cylinders called “stages.”
2. Velocity control.
3. Turbulence control.
4. Acoustic impedance.

MegaStream’s design simplicity has reduced the cost of noise reduction valves by using many standard parts.

The concepts of noise generation have been explored in detail at the Flowserve gaseous noise test facility. With advanced computer programs, the anticipated noise generated by any control valve can be easily determined.

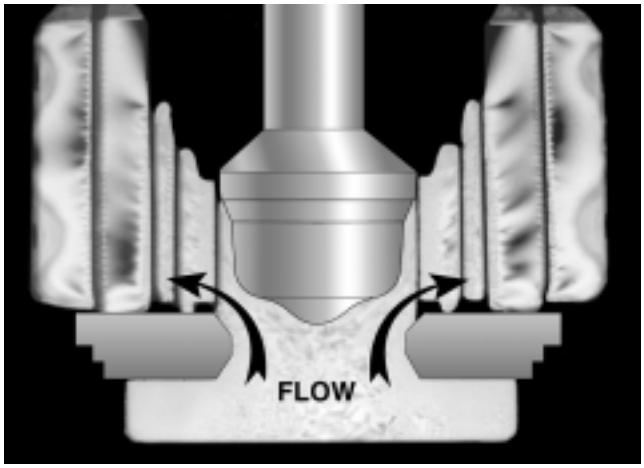


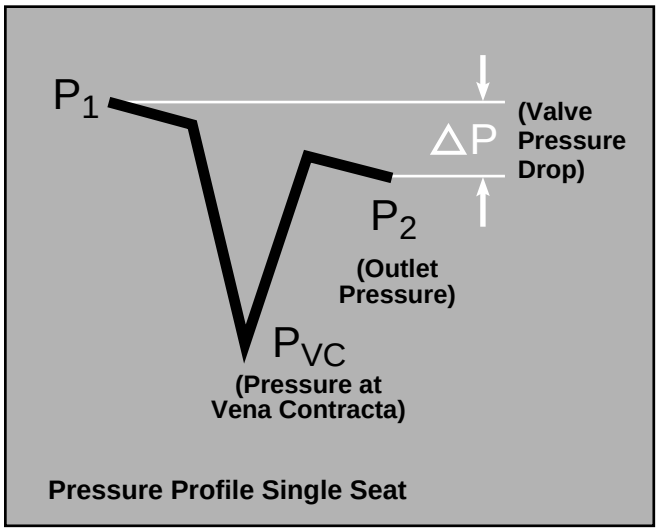
Figure 2: MegaStream Polariscope Display

A basic principle of MegaStream noise control valves is the restructuring of noise generating turbulence. This principle is illustrated in this polariscope display (Figure 2) of MegaStream trim with birefringent fluid. Note the turbulence generated in the fluid as it passes through the seat and how this turbulence decreases as the flow continues

Valtek MegaStream

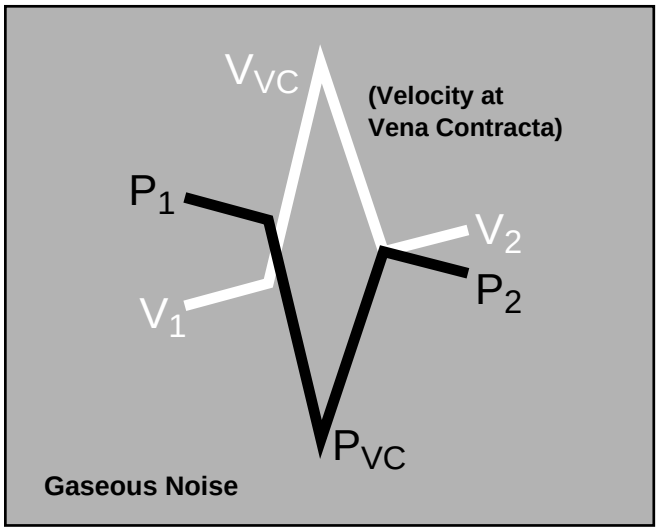
The Basic Principles

In conventional single-throttling-point globe control valves, a vena contracta (point of greatest flow constriction) occurs immediately downstream of the throttling point. A simplified pressure profile of the fluid as it passes through the valve shows slight pressure losses in the inlet and outlet passages, and a substantial reduction of pressure at the vena contracta. Note that the overall pressure drop between the inlet and the outlet does not reveal how far the pressure may have dropped within the valve itself.



The Problem with Gases

The problem becomes apparent by superimposing a velocity profile on the pressure profile, discussed above. For single-throttling-point control valves, with the sharp pressure reduction, the velocity will be greatly increased at the vena contracta. While considerable noise can be generated as velocities in the valve approach sonic levels, substantial noise can be generated even where inlet and outlet velocities are significantly less than sonic.



The Solution

The solution to the problem is to reduce the pressure from inlet to outlet gradually without allowing a sharp pressure drop at the vena contracta. Thus, gaseous velocities are maintained at reasonable values throughout the valve and high noise levels are simply not generated. Also, by breaking the flow into many small flow streams, turbulent energy is reduced and dissipated. In addition, noise generated upstream is substantially blocked by successive stages.

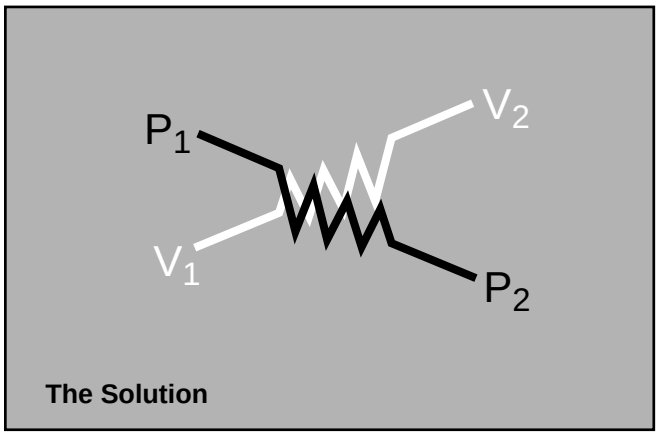


Figure 3: Pressure / Velocity Graphs

Valtek MegaStream

MegaStream – The Effective Solution

Valtek MegaStream trim eliminates the problem of control valve noise by dealing effectively with gaseous pressure reduction, and by controlling turbulence carried into the downstream piping.

Pressure Reduction

The pressure drop in MegaStream trim is distributed so that it occurs not only at the throttling point between the plug and seat, but also at each stage, from the inside of the retainer to the outside. This pressure drop occurs largely as a result of the sudden expansions and contractions that take place as the flow passes through the MegaStream trim. Each stage is designed to take a small pressure drop, avoiding the high velocities present in single-throttling-point trims. This gradual pressure reduction is achieved by designing sufficient stages to keep the velocity low.

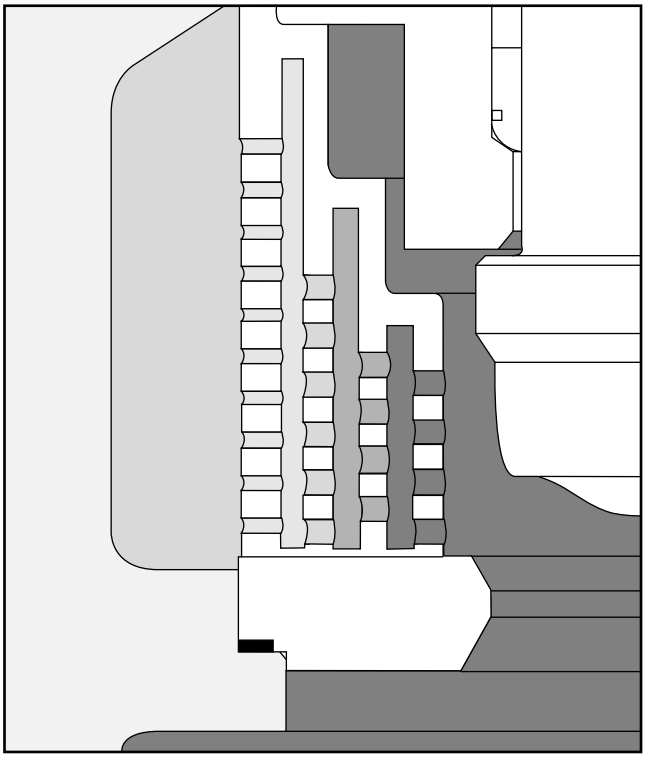


Figure 4: MegaStream Stages

Each retainer stage of MegaStream trim handles a portion of the pressure drop, significantly reducing the high velocity and the turbulence generated by the single throttling point.

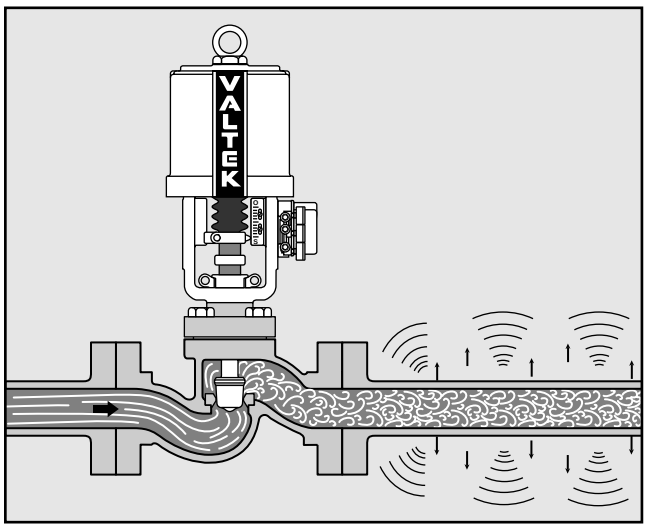


Figure 5: Downstream Piping Noise with Standard Valve

Turbulence Generation

Control valve noise is largely a result of turbulence generated within the valve. This turbulence is carried into the downstream piping where the localized pressure changes resulting from the turbulence vibrate the relatively thin pipe wall which radiates noise to the surroundings. Valtek MegaStream control valves are designed to control this turbulence. Each stage is designed with a large number of holes or orifices. Each successive stage has additional holes or orifices, permitting increased flow area to handle the increased gas volume resulting from the pressure drop.

The turbulence present in the fluid as it leaves the final stage of the MegaStream trim is limited by controlling the physical size of the individual fluid streams. The smaller fluid stream size exiting the final stage of the MegaStream trim limits the amount of turbulence energy present. Further, the smaller turbulent eddies are more easily dissipated. The result is a fluid stream leaving the valve that contains no large-scale turbulent eddies sufficient to cause substantial noise generation in the downstream piping. The stages also effectively limit much of the sound vibration generated at the throttling area. This attenuating effect is made possible by the acoustic impedance characteristics of the material and design, which provide resistance to further transmission of incident sound energy. The acoustic impedance described is a principal factor permitting the control of noise when the valve plug is throttled close to the seat.

Valtek MegaStream

Velocities

One of the fundamental design considerations with MegaStream control valves is maintaining reasonable and acceptable velocities at every point as the flow passes through the valve. This requires careful attention to flow areas and area ratios at the various stages in the retainer, as well as elsewhere in the valve.

With gases, it is commonly understood that as the velocity approaches the speed of sound the valve will be noisy. Control valve noise often becomes excessive for velocities much less than sonic. The MegaStream design engineer carefully assesses velocities for the most critical flowing conditions at the following points (refer to Figure 6):

1. The inlet passageway to the valve.
2. The internal flow area of the MegaStream retainer at various plug positions.
3. The gallery flow area formed between the outside diameter of the retainer and the inside diameter of the valve body.
4. The valve outlet passage flow area. For proper noise control, the downstream piping must be equal to or larger than the valve outlet size.

Heavy-duty Top-stem Guiding

MegaStream valves utilize heavy-duty, top-stem guiding for several reasons:

- In most cases the flow characteristics of the MegaStream valve is determined by the shape of the plug. It is a relatively simple matter of changing the plug to provide equal percentage, linear or quick-open trim.
- Heavy-duty, double, top-stem guiding keeps the plug stem concentrec to the bonnet bore even in high vibration applications. This prolongs packing and trim life.

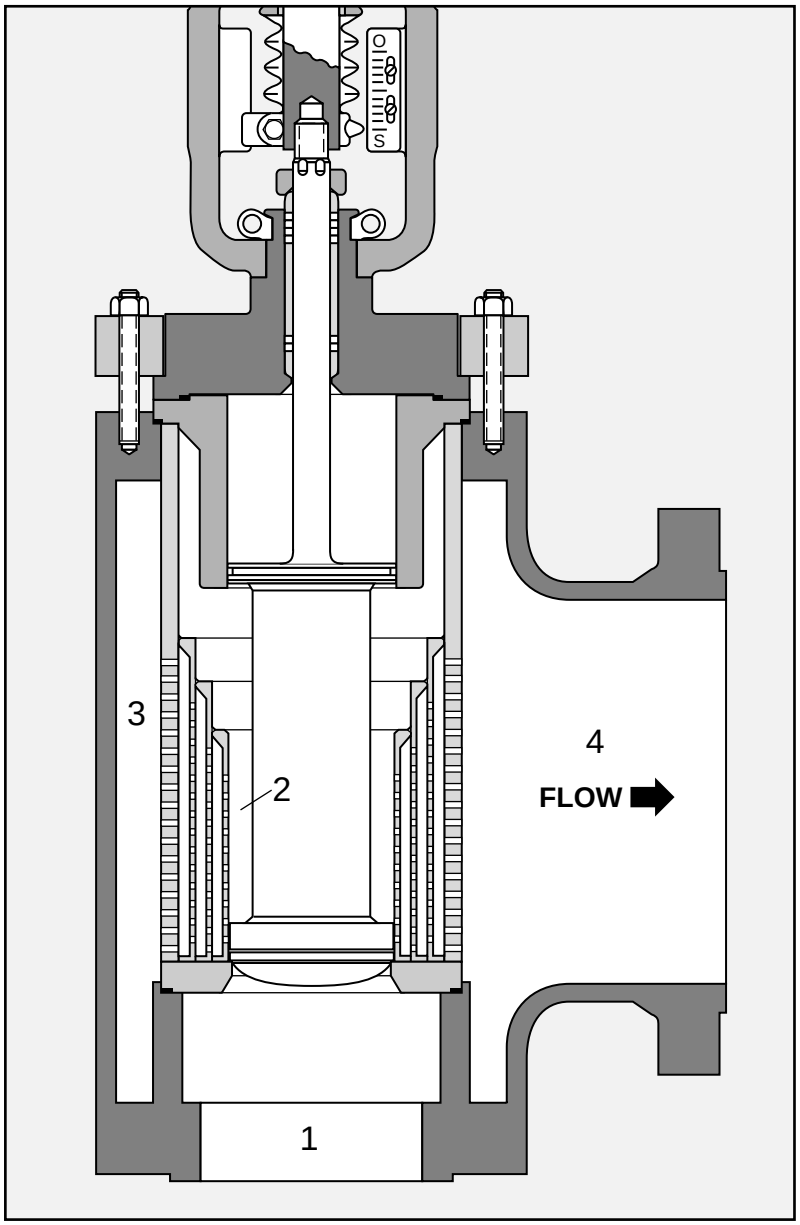


Figure 6: Velocity Checkpoints

WARNING: High acoustic noise levels are accompanied by high mechanical vibration levels. These vibration levels can cause failure of the valve, piping or associated equipment resulting in property damage and/or personal injury. Acoustic noise and mechanical vibration levels are greatly compounded (up to 50 times) when the frequency of the excitation matches acoustic and/or mechanical natural frequencies of the system. Noise control trim (source treatment) should always be considered in any high energy (high pressure and high flow) and/or resonant noise/vibration applications.

Valtek MegaStream

Flow Characteristics

Three flow characteristics are available in MegaStream control valves.

"Equal percentage" is the most common characteristic in process control. Here, the change in flow per unit of valve stroke is directly proportional to the flow occurring before the change is made.

"Linear" characteristic produces an equal change of flow per unit of valve stroke. This characteristic is generally used on those systems where pressure drop is relatively constant or the valve pressure drop is a major portion of the total system drop.

"Quick-open" characteristic is used for on-off service. This characteristic is designed to provide maximum flow quickly and, when used with the MegaStream retainer, effectively reduces noise.

MegaStream Noise Reduction Possibilities

Flowserve has developed and made available the *Performance!* software program for use on IBM® and compatible personal computers running Windows® 95 or NT. This program quickly determines anticipated noise generation levels for conventional valves and, at the same time, verify the noise reduction capabilities of a MegaStream valve for the same application.

MegaStream quotations include guaranteed maximum noise levels (±5 dBA) as required to meet your specifications and OSHA standards.

Valve Size Estimation

To estimate the required MegaStream valve size, use the following procedure:

1. Estimate required flow capacity. For one and two-stage retainer designs, use the sizing equations for conventional globe valves (see the Valtek Sizing & Selection Manual, Section 3). Since three through seven-stage retainers are designed not to choke, the sizing equations must be adjusted by setting $X_T = 1$.
2. Calculate the pressure drop ratio, P_1/P_2, for the maximum C_V condition.
3. Using the standard MegaStream data in Table I, locate the valve size that accommodates both the required C_V and the pressure ratio calculated in step 2. The pressure ratio must not exceed the maximum P_1/P_2 limit indicated for the size and C_V selected.
4. The discharge mach number should be 0.33 or less, except for valves venting to atmosphere which require a mach number of 0.1 or less.

NOTE: *These calculations indicate an* ***estimated*** *valve size and C_V which must be confirmed by Valtek design engineers. (Other design considerations may also influence the final size selection).*

Ordering Information

The following information must be provided when ordering a MegaStream valve:

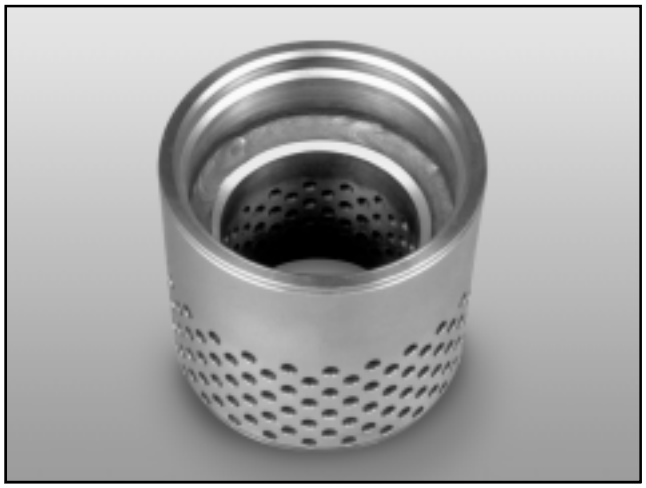
1. Size and type: globe or angle
2. Start-up and operating conditions: inlet and outlet pressures, temperature, flow rate, fluid's specific gravity or molecular weight, vapor pressure or gas compressibility
3. Maximum operating temperatures and pressures
4. Maximum allowable sound pressure levels
5. Body pressure rating and end connections
6. Materials required: trim, body and packing
7. Actuator requirements: type (pneumatic or manual), failure position, size and minimum air supply
8. Positioner signal requirements
9. Accessories required

Valtek MegaStream

One and Two-stage Retainers

MegaStream valves equipped with one or two-stage retainers represent an economical and innovative approach to low noise applications by permitting up to 15 dBA noise reduction. A standard retainer is constructed from heavy-duty, 316 stainless steel, drilled-hole cylinders.

Since one standard design exists for each valve size, special engineering is not required. This results in lower prices and quicker deliveries. Because of parts interchangeability with standard seat retainers, one and two-stage retainers can be fitted into conventional Mark One valves without special parts. The simplicity of design also permits easy removal and cleaning.

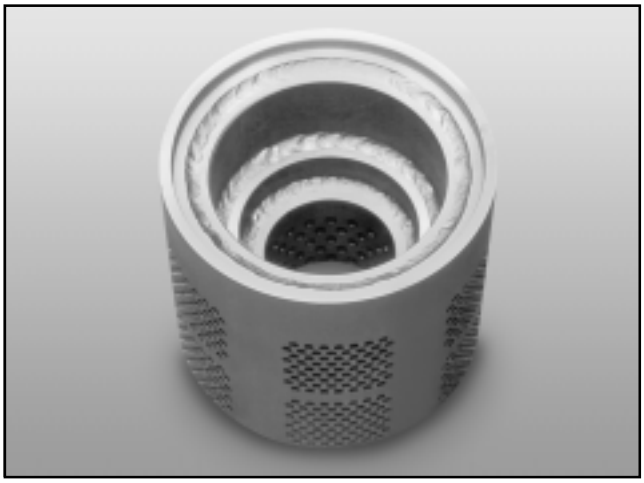


Two-stage, drilled hole retainer.

Table I: Actuator Assembly Materials of Construction

Cylinder and Piston	Anodized aluminum
Yoke	Ductile iron
O-rings	Buna-N, Viton
Stem Bushings	Oilite bronze
Stem Nut	Zinc-plated steel
Cylinder Retaining Ring	Zinc-plated steel, Dichromate dipped
Stem Clamp	Stainless steel, carbon steel
Actuator Stem	416 stainless steel
Spring	Carbon steel
Spring Button	Painted steel
Stroke Plates	Aluminum

NOTE: *Contact factory for other materials that are available.*



Multistage retainer.

Multistage Retainers

For larger noise reduction levels (up to 30 dBA), multistage retainers incorporate from three to seven stages. Each stage is welded in place. The outer stage allows proper gasket compression to be applied to the bonnet and seat gasket.

Refer to Figure 7 for standard attenuation data.

Table II: Body Assembly Materials of Construction

Body and Bonnet	Steel, stainless steel, alloys as required
Plug and Seat Ring	316 stainless steel or 316 S.S. with Stellite, 400 Series hardened stainless steel, Inconel, alloys as required
MegaStream Retainer	Nickel-plated carbon steel, 316 stainless steel, Inconel
Guides	Bronze, Grafoil lined S.S., Stellite, Teflon-lined S.S
Packing	Teflon, Teflon AFP, Glass-filled Teflon, Graphite/AFP, Graphite/ AFP w/Inconel wire, Graphite
Packing Spacer	316 stainless steel, other alloys
Gaskets	Spiral-wound stainless steel and Graphite; Teflon, Metal O-ring, Spiral-wound Inconel and Graphite
Bonnet Flange Bolting	B7-2H, Stainless steel, other materials as requested
Gland Flange	Stainless steel, painted carbon
Gland Flange Bolting	Zinc-plated steel, stainless steel
Yoke Clamp	Stainless steel
Yoke Clamp Bolting	Zinc-plated steel, stainless steel

Valtek MegaStream
Trim Data

Table III: MegaStream Class 150-600 Standard Trim Data

Body Size	Trim No.	Stages	Stroke	Unbalanced		Pressure Balanced	
				Linear	Equal %	Linear	Equal %
1	0.81	1	0.75	10.3	10.0	NA	NA
	0.50	2	0.75	5.1	5.0	NA	NA
1.5	1.25	1	1.00	23.7	23.0	23.7	23.0
	1.00	2	0.75	15.7	15.3	15.7	15.3
2	1.62	1	1.50	41.4	40.2	41.4	40.2
	1.00	2	0.75	20.5	19.9	20.5	19.9
3	2.62	1	2.00	98	95	98	95
	2.00	2	1.50	63	61	63	61
	1.25	3	1.00	32	31	32	31
4	3.50	1	2.50	174	169	174	169
	2.62	2	2.00	110	107	110	107
	1.62	3	1.50	55	53	55	53
6	5.00	1	3.00	380	370	380	370
	3.50	2	2.50	220	215	220	215
	3.00	3	2.00	157	152	157	152
	2.25	4	2.00	97	94	97	94
8	6.25	1	4.00	630	610	630	610
	5.00	2	3.00	415	405	415	405
	4.00	3	2.50	275	265	275	265
	3.00	4	2.50	170	165	170	165
	2.62	5	2.00	123	119	123	119
	2.00	6	1.50	77	75	77	75
10	8.00	1	6.00	1010	980	1010	980
	6.00	2	4.00	630	610	630	610
	4.50	3	3.00	385	375	385	375
	3.50	4	2.50	245	240	245	240
	3.00	5	2.50	176	170	176	170
	2.62	6	2.00	127	123	127	123
12	9.50	1	6.00	1440	1400	1440	1400
	7.38	2	4.00	930	900	930	900
	6.00	3	4.00	620	600	620	600
	5.00	4	4.00	425	415	425	415
	4.00	5	2.50	280	275	280	275
	3.00	6	2.50	174	169	174	169
	2.62	7	2.00	125	121	125	121
14	10.00	1	6.00	1500	1450	1500	1450
	8.00	2	6.00	1000	970	1000	970
	6.50	3	4.00	720	700	720	700
	5.00	4	3.00	470	460	470	460
	4.00	5	2.50	315	305	315	305
	3.50	6	2.50	230	220	230	220
	2.62	7	2.00	142	137	142	137

Body Size	Trim No.	Stages	Stroke	Unbalanced		Pressure Balanced	
				Linear	Equal %	Linear	Equal %
16	12.00	1	6.00	2050	2000	2050	2000
	9.00	2	6.00	1320	1280	1320	1280
	7.25	3	4.00	920	890	920	890
	6.00	4	4.00	640	620	640	620
	5.00	5	3.00	445	430	445	430
	4.00	6	2.50	295	285	295	285
	3.25	7	2.50	199	193	199	193
18	13.25	1	8.00	2500	2450	2500	2450
	10.00	2	6.00	1600	1550	1600	1550
	8.25	3	6.00	1150	1120	1150	1120
	6.75	4	4.00	800	780	800	780
	5.50	5	3.00	550	530	550	530
	4.50	6	3.00	370	360	370	360
	3.75	7	2.50	255	245	255	245
20	14.75	1	8.00	3100	3000	3100	3000
	11.00	2	6.00	1950	1890	1950	1890
	9.00	3	6.00	1400	1350	1400	1350
	7.50	4	4.00	980	950	980	950
	6.00	5	4.00	660	640	660	640
	5.00	6	3.00	460	440	460	440
	4.25	7	2.50	320	310	320	310
24	17.75	1	8.00	4500	4300	4500	4300
	13.25	2	8.00	2850	2750	2850	2750
	11.00	3	6.00	2050	1990	2050	1990
	9.00	4	6.00	1430	1380	1430	1380
	7.25	5	4.00	960	930	960	930
	6.00	6	4.00	660	640	660	640
	5.00	7	3.00	450	440	450	440
30	20.00	1	8.00	6250	6100	6250	6100
	16.50	2	8.00	4400	4250	4400	4250
	13.50	3	8.00	3150	3050	3150	3050
	11.00	4	6.00	2150	2100	2150	2100
	9.00	5	6.00	1490	1440	1490	1440
	7.50	6	4.00	1030	990	1030	990
	6.25	7	4.00	700	680	700	680
36	26.50	1	8.00	10100	9800	10100	9800
	20.00	2	8.00	6400	6200	6400	6200
	16.25	3	8.00	4550	4400	4550	4400
	13.25	4	8.00	3150	3050	3150	3050
	11.00	5	6.00	2200	2150	2200	2150
	9.00	6	6.00	1500	1450	1500	1450
	7.50	7	4.00	1020	990	1020	990

This standard MegaStream data table is intended to indicate available designs. Consult Valtek engineers to determine the suitable designs and options for particular applications.

Valtek MegaStream
Attenuation Curves

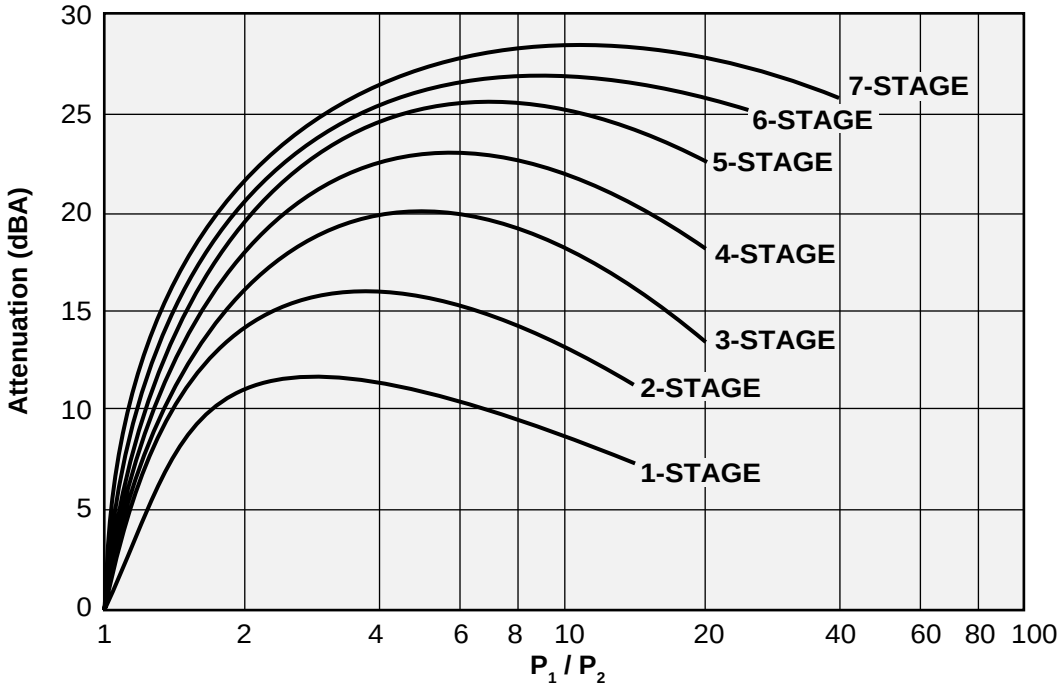


Figure 7: One and Multistage MegaStream Noise Attenuation Curves

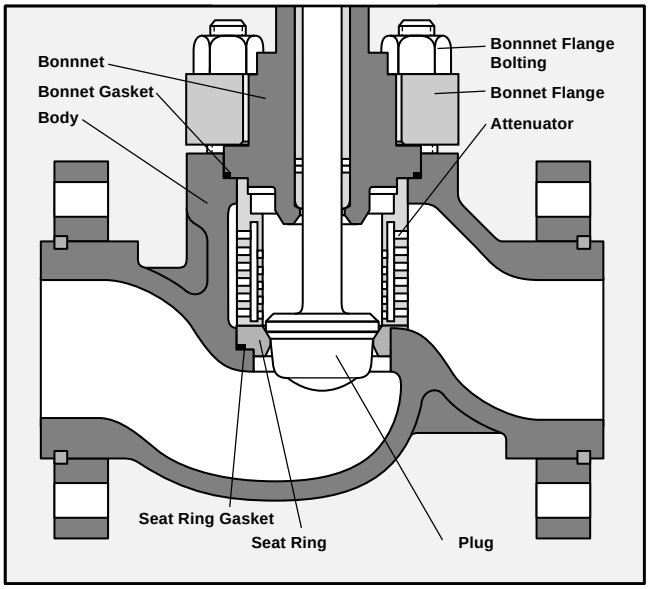


Figure 8: Standard, Two-stage MegaStream

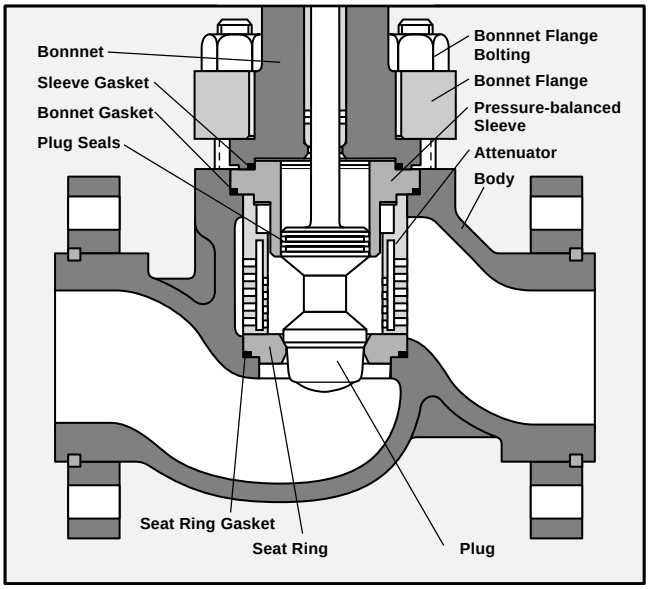


Figure 9: Pressure-balanced, Two-stage MegaStream

MegaStream valves equipped with one and two-stage retainers are interchangeable with standard Mark One seat retainers. Both one and two-stage MegaStream valves are available in either unbalanced or pressure-balanced designs. The pressure-balanced design uses a standard retainer along with a special pressure-balanced sleeve and plug.

Valtek MegaStream

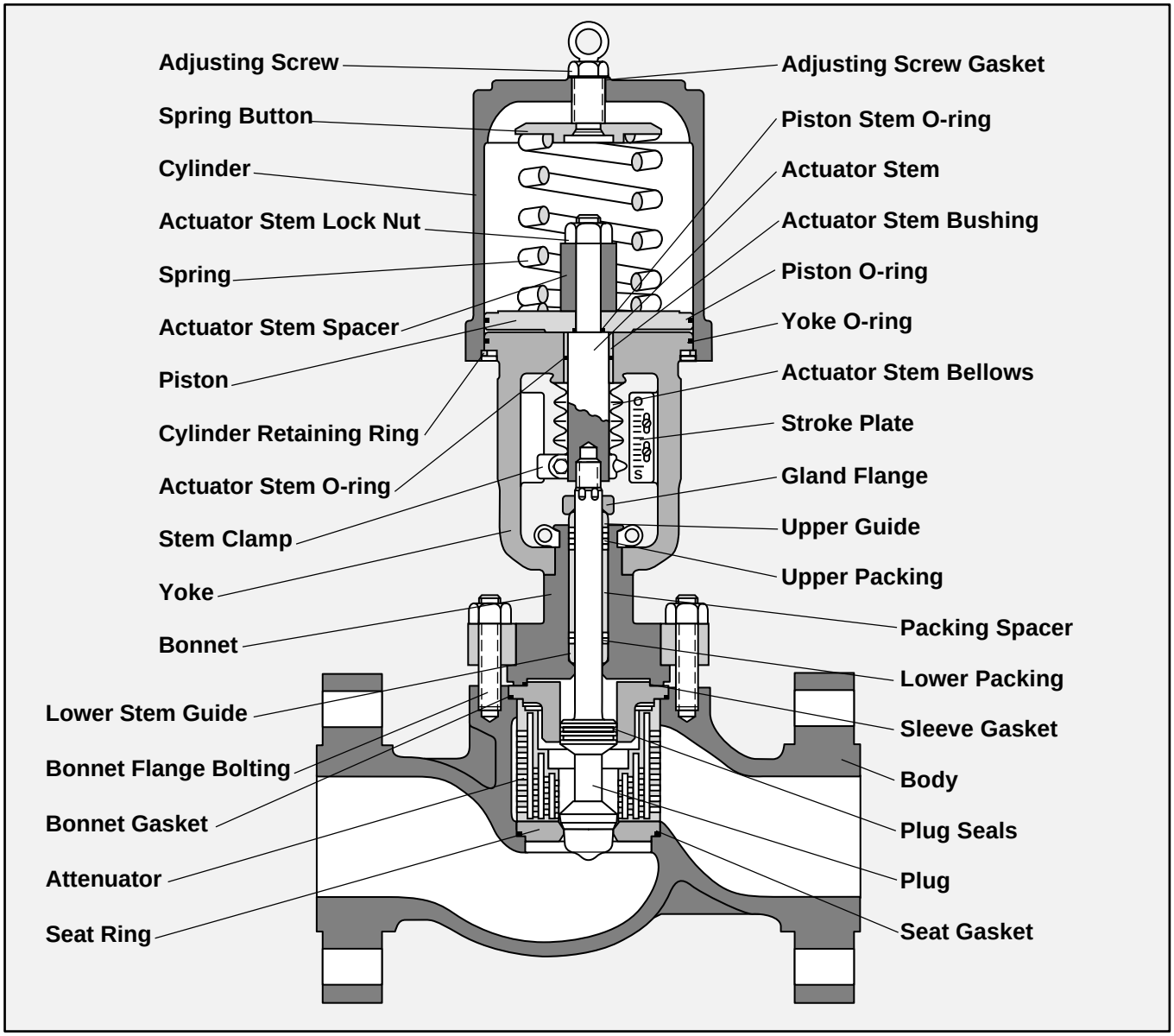


Figure 10: Cast Globe Body Construction with Pressure-balanced, Multistage MegaStream Retainer

Multistage MegaStream valves (three stages and above) are manufactured in sizes 1 through 14-inch utilizing conventional and interchangeable Mark One globe bodies. Except for the multistage MegaStream retainer, all other parts of these valves are interchangeable with the Mark One control valve. Therefore, for additional design features and accessories, refer to the Valtek Mark One Control Valves and Linear Actuator brochures.

MegaStream sizes 16 through 36-inch are customarily fabricated in an angle body configuration with the inlet on the bottom and the outlet on the side. Because these bodies are fabricated, it is possible to construct a small inlet with a large outlet – an arrangement ideal for velocity control. As a cost-saving measure, if the downstream side of the valve is protected by a safety valve or is discharged to atmosphere, the body and outlet can be constructed with a lower pressure rating than the inlet.

Valtek MegaStream
Dimensions

Refer to the Valtek Mark One Control Valve sales bulletin for dimensional information of MegaStream valve sizes 1 through 14-inch. Face-to-face and actuator dimensional information will be identical.

Typical fabricated angle body dimensions are shown below. This information is for estimation only. If required, contact Valtek Engineering for specific certified dimensional drawings.

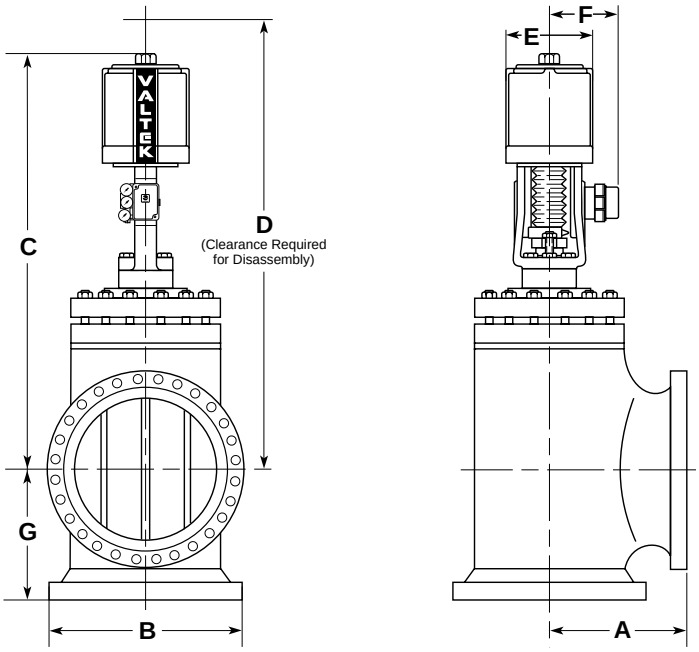


Table IV: Fabricated Angle Body Dimensions (inches/mm)

Valve Size	Class	A		B		E*		F*		J*		K*	
16	150	17.0	432	17.0	432	24.0	610	55.0	1397	12.0	305	10.5	267
	300	17.8	451	17.8	451	24.0	610	55.5	1410	12.0	305	10.5	267
	600	19.3	489	19.3	489	24.0	610	57.0	1448	12.0	305	10.5	267
18	150	19.0	483	19.0	483	24.0	610	56.0	1422	12.0	305	10.5	267
	300	19.8	502	19.8	502	24.0	610	57.0	1448	12.0	305	10.5	267
	600	21.0	533	21.0	533	24.0	610	58.0	1473	12.0	305	10.5	267
20	150	20.7	526	20.7	526	24.0	610	58.5	1486	12.0	305	10.5	267
	300	21.4	543	21.4	543	24.0	610	59.5	1511	12.0	305	10.5	267
	600	22.8	578	22.8	578	24.0	610	60.5	1537	12.0	305	10.5	267
24	150	23.0	584	23.0	584	24.0	610	65.0	1651	12.0	305	10.5	267
	300	23.6	600	23.6	600	24.0	610	65.0	1651	12.0	305	10.5	267
	600	25.3	641	25.3	641	24.0	610	66.0	1676	12.0	305	10.5	267
30	150	27.1	689	27.1	689	24.0	610	75.0	1905	12.0	305	10.5	267
	300	30.3	768	30.3	768	24.0	610	75.0	1905	12.0	305	10.5	267
	600	32.0	813	32.0	813	24.0	610	76.0	1930	12.0	305	10.5	267
36	150	31.9	809	31.9	809	24.0	610	80.0	2032	12.0	305	10.5	267
	300	36.0	914	36.0	914	24.0	610	82.0	2083	12.0	305	10.5	267
	600	37.9	962	37.9	962	24.0	610	84.0	2134	12.0	305	10.5	267

NOTE: *Various inlet sizes are available for fabricated angle body valves. Contact factory for specific sizes required. *Size 100 Cylinder assumed.*

Valtek MegaStream

Flowserve Corporation has established industry leadership in the design and manufacture of its products. When properly selected, this Flowserve product is designed to perform its intended function safely during its useful life. However, the purchaser or user of Flowserve products should be aware that Flowserve products might be used in numerous applications under a wide variety of industrial service conditions. Although Flowserve can (and often does) provide general guidelines, it cannot provide specific data and warnings for all possible applications. The purchaser/user must therefore assume the ultimate responsibility for the proper sizing and selection, installation, operation and maintenance of Flowserve products. The purchaser/user should read and understand the Installation Operation Maintenance (IOM) instructions included with the product, and train its employees and contractors in the safe use of Flowserve products in connection with the specific application.

While the information and specifications presented in this literature are believed to be accurate, they are supplied for informative purposes only and should not be considered certified or as a guarantee of satisfactory results by reliance thereon. Nothing contained herein is to be construed as a warranty or guarantee, express or implied, regarding any matter with respect to this product. Because Flowserve is continually improving and upgrading its product design, the specifications, dimensions and information contained herein are subject to change without notice. Should any question arise concerning these provisions, the purchaser/user should contact Flowserve Corporation at any of its worldwide operations or offices.

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Valtek Spring Cylinder Linear Actuators

GENERAL INFORMATION

The following instructions are designed to assist in installing, troubleshooting and servicing Valtek spring cylinder actuators. Product users and maintenance personnel should thoroughly review this bulletin prior to installing, operating or disassembling the actuator. Separate installation, operation and maintenance instructions cover additional features (such as handwheels, limit stops, fail-safe systems or limit switches).

This publication does not contain information on Flowserve positioners. Refer to the appropriate installation operation and maintenance instructions for installing, maintaining, troubleshooting, calibrating and operating Flowserve positioners.

To avoid possible injury to personnel or damage to valve parts, WARNING and CAUTION notes must be strictly followed. Modifying this product, substituting non-factory or inferior parts or using maintenance procedures other than outlined could drastically affect performance, void product warranties and be hazardous to personnel and equipment.

WARNING: Standard industry safety practices must be followed when working on this or any process control product. Specifically, personal protection and lifting devices must be used as warranted.

Unpacking

While unpacking the actuator, check packing list against materials received. Lists describing the actuator and accessories are included in each shipping container.

1. Position the lifting straps and hoist to avoid damage to the tubing and mounted accessories when lifting the actuator from the shipping container.

   WARNING: When lifting an actuator with lifting straps through the yoke legs, be aware the center of gravity may be above the lifting point. Therefore, support must be given to prevent the actuator from rotating or causing serious injury to personnel or damage to nearby equipment.

2. Contact your shipper immediately in the event of shipping damage.
3. Contact your Flowserve representative for any problems.

Installation

Prior to installation, make sure adequate overhead clearance for the actuator is provided to allow for proper removal from the valve body and for proper maintenance. Refer to Table 1.

NOTE: *If the actuator is attached to a valve body assembly, see Installation, Operation, Maintenance Instructions 1 for overhead clearances.*

Table 1:
Overhead Clearance for Disassembly

Actuator Size	Minimum Clearance
25	6 inches
50	8 inches
100,200,300 400,500,600	9 inches

1. Connect the air supply and instrument signal air lines to the two appropriately marked connections on the positioner. Since both the cylinder and positioner are suitable for 150 psi air supply, an air regulator should not be used unless the supply exceeds 150 psi.

   NOTE: *In some cases, air supply must be limited to 100 psi rather than 150 psi; this will be indicated by a sticker found near the upper air port on the cylinder.*

   WARNING: To avoid personal injury or equipment damage, do not exceed recommended supply pressure.
2. Installation of an air filter on the supply line is recommended.
3. Use a soap solution to make sure all air connections are leak free.

MAINTENANCE

At least once every six months, check for proper operation by following the preventative maintenance steps outlined below. These steps can be performed while the actuator is in service and, in some cases, without interrupting service. If an internal problem is suspected with the actuator, refer to the "Disassembly and Reassembly" section.

1. Examine the actuator for damage caused by corrosive fumes and process drippings.
2. Clean the actuator and repaint any areas of severe oxidation.
3. If possible, stroke the actuator and check for smooth, full-stroke operation.

   WARNING: To avoid serious injury, keep hands, hair and clothing away from all moving parts while operating the actuator.
4. Make sure positioner mounting bolts, linkage and stem clamp are securely fastened.
5. Ensure all accessories, brackets and associated bolting are securely fastened.
6. If possible, remove air supply and observe actuator for correct fail-safe action.
7. Check rubber bellows for wear.
8. Spray soap solution around the cylinder retaining ring, the adjusting screw and the lower actuator stem bushing to check for air leaks through the O-rings and gasket.
9. Clean any dirt or foreign material from the actuator stem.
10. If an air filter is supplied, check and replace cartridge as necessary.

DISASSEMBLY AND REASSEMBLY

Disassembling the Actuator

Refer to Figures 1 through 5 to disassemble the cylinder actuator.

1. Shut off air supply. If actuator is installed on a Flowserve valve, remove the valve per Installation Operation, Maintenance Instructions 1.

   WARNING: To avoid serious injury, depressurize the line to atmospheric pressure and drain all fluids before working on the actuator.
2. Disconnect all tubing. Remove stem clamp and stem bellows from the actuator stem.
3. Relieve spring compression completely by removing the adjusting screw. Remove adjusting screw gasket from adjusting screw.

   CAUTION: Do not use a screwdriver or bar to turn the adjusting screw; instead, use a wrench on the flats of the screw.

   WARNING: To avoid serious personal injury, relieve the spring compression before further disassembly. The cylinder could possibly fly off the yoke when removing the cylinder retaining ring.
4. Remove the cylinder retaining ring from the groove at the base of the cylinder by using two screwdrivers. Insert one screwdriver in slot found in the ring and pry the ring from the groove. Use the other screwdriver to help work the ring out of the cylinder groove.
5. Pull the cylinder off the yoke and piston; some O-ring resistance may be felt.

   WARNING: To avoid serious personal injury, do not use air pressure to remove the cylinder. The cylinder could possibly fly off the yoke.
6. For heavy-duty spring designs using a spring cap (see Figure 4), remove the spring cap and cap O-ring from the cylinder.
7. For air-to-retract configurations, remove the spring(s) and spring button for cleaning and inspection (see Figures 1, 3 and 5). Remove the actuator stem locknut and slide the piston and stem spacer off the actuator stem. The spring guide should be removed when using heavy-duty spring designs.

   NOTE: *The dual, heavy-duty spring configuration (Figure 3) has two springs, one inside the other. Remove both springs during this step.*

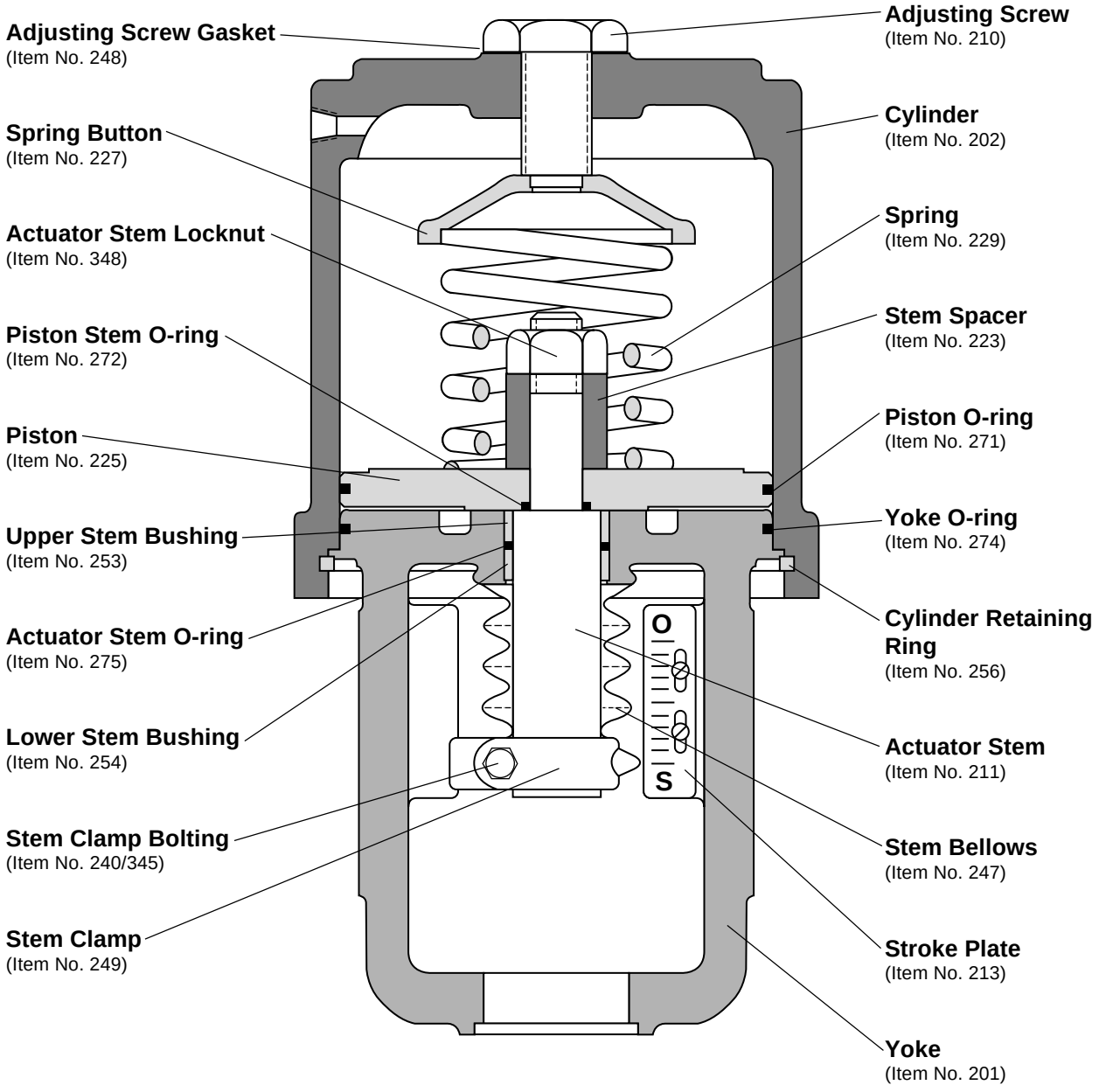

Figure 1: Air-to-retract Cylinder Actuator

NOTE: *Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.*

For air-to-extend configurations, slowly loosen and remove the actuator stem locknut. Be certain the piston follows the stem locknut up the actuator stem and does not bind on the actuator stem. Remove the actuator stem locknut, spring button, piston, spring and stem spacer.

WARNING: To avoid personal injury, be certain the spring force is completely relieved before removing actuator stem locknut.

8. Remove the piston O-ring, piston stem O-ring and yoke O-ring.
9. Remove the actuator stem O-ring.

   NOTE: *The upper and lower stem bushings are pressed into the yoke. Removal of the bushings to replace the actuator stem O-ring is unnecessary.*
10. Use appropriately sized press to push worn or damaged bushings out of yoke.

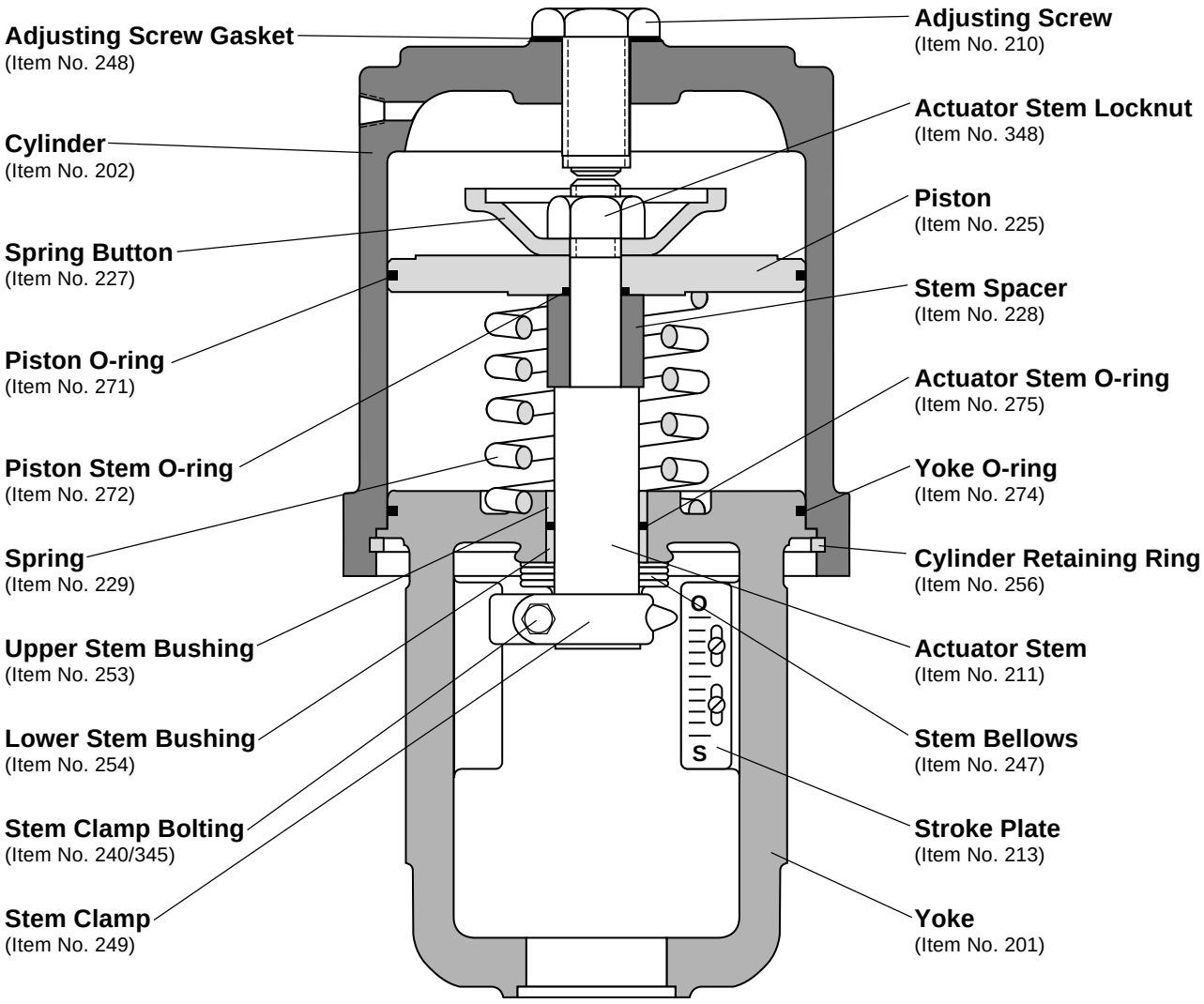

Figure 2: Air-to-extend Cylinder Actuator

NOTE: *Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.*

Reassembling the Actuator

To reassemble the cylinder actuator, refer to Figures 1 through 5:

1. All O-rings should be replaced. New O-rings should be lubricated with a silicone lubricant (Dow Corning 55M or equivalent). Silicone O-rings must be lubricated with Magnalube-G lubricant or equivalent. Do not use silicone lubricant on silicone O-rings.
2. Thoroughly clean all internal parts before beginning assembly. Lubricate cylinder wall with silicone lubricant.
3. Lubricate the outside of the replacement bushings if the stem bushings have been removed. Press a new lower stem bushing into the actuator stem bore in the yoke until it bottoms out. Press the upper stem bushing into the bore until it is flush with the top of the yoke (refer to Figures 1 or 2).
4. Replace the actuator stem O-ring and yoke O-ring.
5. Reassemble the piston, piston stem O-ring and stem spacer on the actuator stem according to the proper air-action (refer to either Figure 1 or 2). Replace the piston O-ring. Air-to-extend configurations require the spring button to be stored under actuator stem locknut. Tighten the locknut firmly.

   NOTE: *When reassembling heavy-duty, spring-design actuators, the spring guide must be first inserted under the actuator stem locknut (see Figures 3 and 4).*

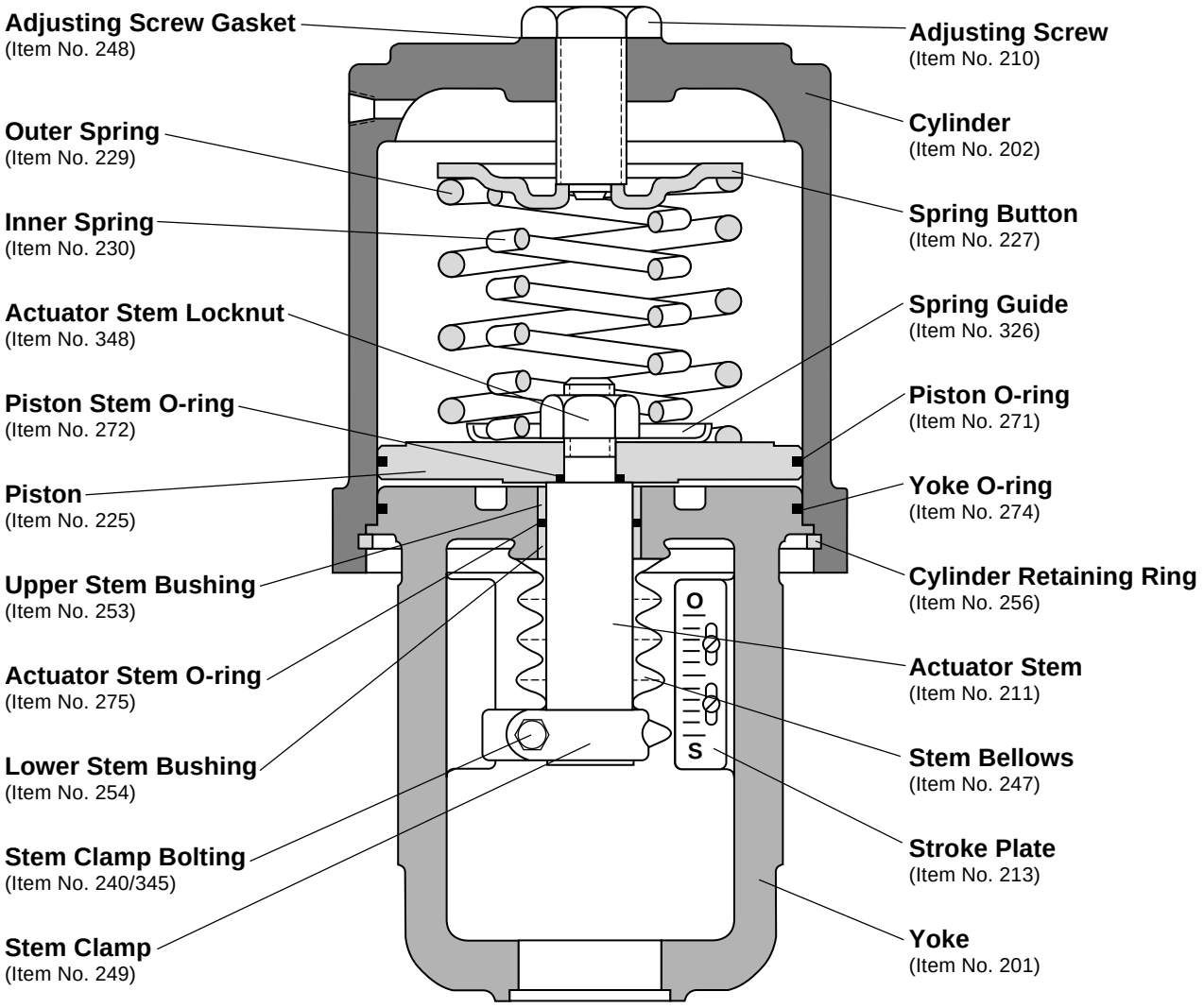

Figure 3: Dual-spring Cylinder Actuator

NOTE: *Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.*

6. For air-to-extend configurations, place the spring under the piston and insert the actuator stem through the yoke, being careful not to pinch the actuator stem O-ring or gall the stem and stem bushings. For air-to-retract configurations, insert the actuator stem through the yoke and place the spring(s) and spring button above the piston.
7. Replace the cap O-ring and install the spring cap in the cylinder when using heavy-duty spring designs using spring caps (see Figure 4).
8. Install the cylinder, making sure the yoke is pushed deeply enough into the cylinder to allow the cylinder retaining ring to be installed. Care should be taken not to scar or cut the piston and yoke O-rings.
9. Reinsert the cylinder retaining ring by until it snaps in place. Use a hammer and drift punch to lightly tap the retaining ring in the groove.

   WARNING: To avoid personal injury, the cylinder retaining ring must be solidly in place. The cylinder could possibly fly off when pressurized. Be careful not to pinch or cut fingers on the square edges of the retaining ring during installation.
10. Reinstall the adjusting screw using a new adjusting screw gasket.

    NOTE: *Be certain the hole in the spring button is directly centered under the adjusting screw hole in the cylinder on air-to-retract configurations.*

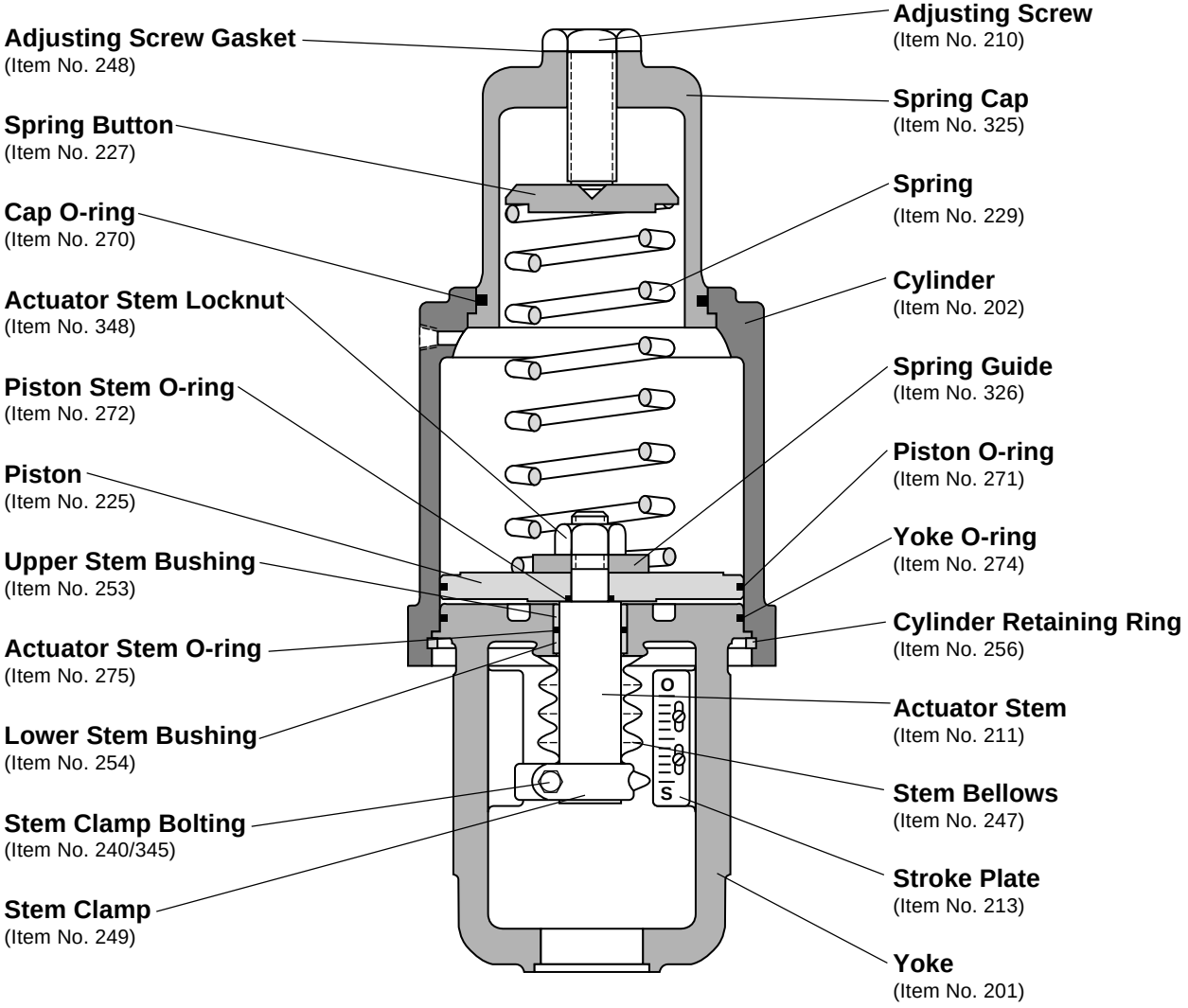

Figure 4: Cap-spring Cylinder Actuator

NOTE: *Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.*

11. Tighten the adjusting screw enough to provide an air seal with the gasket. Do not overtighten.
12. Reinstall the stem bellows and stem clamp.

    NOTE: *To ensure maximum clamping strength when installing the stem clamp, make sure the stem clamp bolting is perpendicular to one of the slots machined into the actuator stem.*
13. Apply air over the piston. Tighten the stem clamp bolting with the stem clamp adjusted to point at the closed position of the stroke indicator plate.

    NOTE: *If the actuator is installed on a Flowserve valve, refer to Installation, Operaton, Maintenance Instructions 1 for correct plug stem thread engagement.*
14. Reconnect tubing, supply and signal lines.

Reversing the Air-action

To change the air action from air-to-retract to air-to extend, or vice versa, refer to Figures 1, 2 or 5:

NOTE: *Heavy-duty spring actuators are not reversible.*

1. Disassemble the actuator according to the “Disassembling the Actuator” section.
2. For air-to-retract action, reassemble the actuator with stem spacer and spring button over the piston.
3. For air-to-extend action, reassemble with spring and stem spacer below the piston and with the spring button stored above the piston.
4. Reassemble the actuator according to the “Reassembling the Actuator” section.
5. The positioner must also be reversed. See the appropriate positioner maintenance instructions.

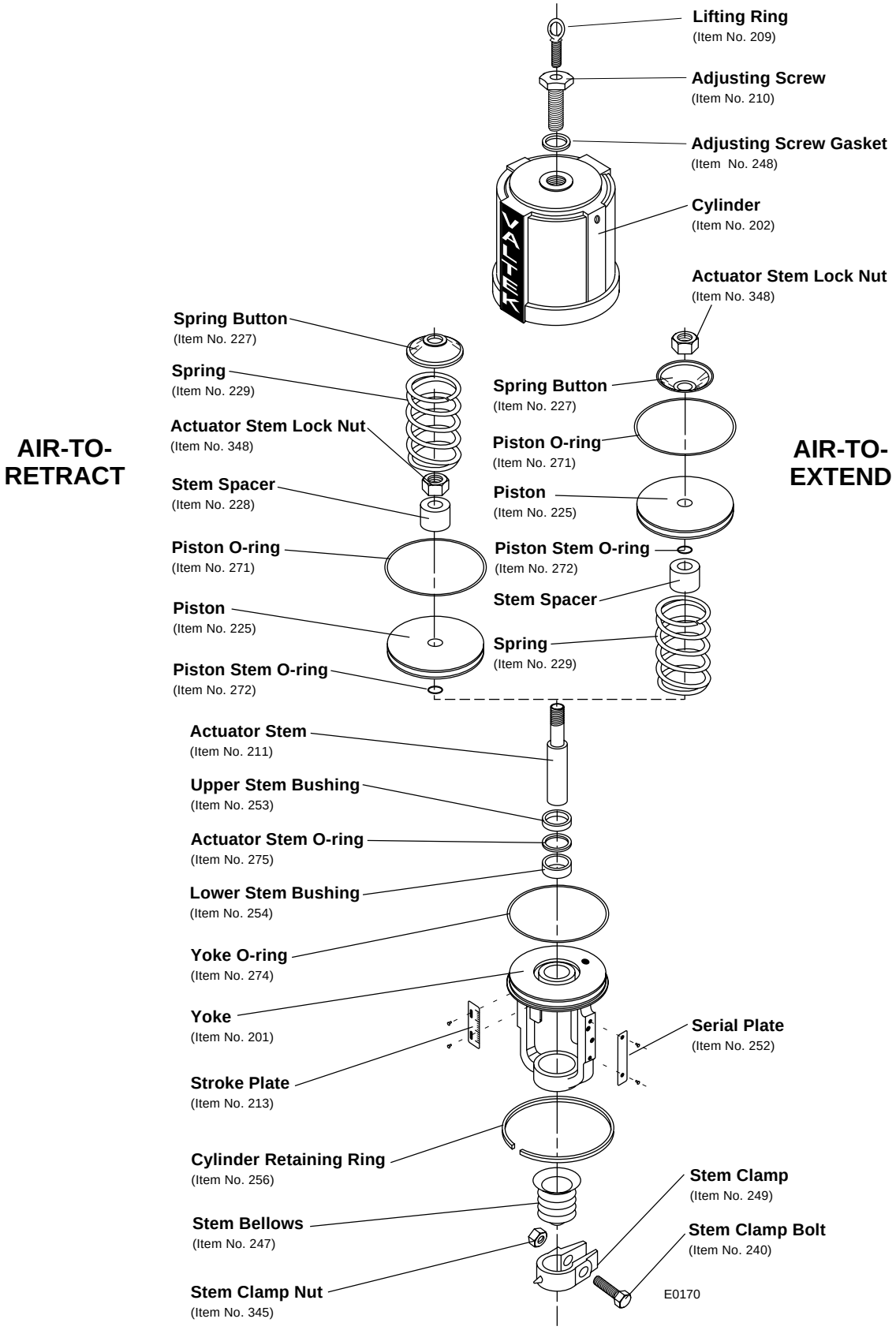

Figure 5: Exploded View, Spring Cylinder Actuator

NOTE: *Item numbers correspond directly to actuator's bill of material. Refer to it for specific part numbers.*

Troubleshooting

Problem	Probable Cause	Corrective Action
High air consumption or leakage	1. Leaks in the air supply or instrument signal system 2. Malfunctioning positioner 3. Leaks through O-rings or adjusting screw gasket	1. Tighten connections and replace any leaking lines 2. Refer to appropriate positioner maintenance bulletin 3. Replace O-rings or gasket
Actuator does not move to fail position upon loss of air supply pressure	1. Air pressure in cylinder not venting because of faulty positioner 2. Spring failure 3. Internal valve problem	1. Refer to appropriate positioner maintenance bulletin 2. Replace spring 3. Refer to valve's maintenance bulletin
Jerky or sticking stem travel	1. Insufficient air supply pressure 2. Unlubricated cylinder wall 3. Worn or damaged stem bushings 4. Improperly assembled spring 5. Internal valve problem	1. Check air supply and any filters or regulators; check for leaking O-rings 2. Lubricate cylinder wall with silicone lubricant 3. Check actuator stem for damage; replace actuator stem, O-ring, and stem bushings, if necessary 4. Disassemble actuator and check cylinder and piston for damage; reassemble actuator correctly 5. Refer to valve's maintenance instructions

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Valtek Mark One and Mark Two Control Valves

GENERAL INFORMATION

The following instructions are designed to assist in unpacking, installing and performing maintenance as required on Valtek® Mark One and Mark Two control valves. Product users and maintenance personnel should thoroughly review this bulletin prior to installing, operating or performing any maintenance on the valve. Separate installation, operation, maintenance instructions cover additional features (such as special trim, diaphragm actuator, handwheel and extension bonnets).

This publication does not contain information on Valtek positioners. Refer to the appropriate Installation, Operation, Maintenance Instructions for installing, maintaining, troubleshooting, calibrating and operating Valtek positioners.

To avoid possible injury to personnel or damage to valve parts, WARNING and CAUTION notes must be strictly followed. Modifying this product, substituting non-factory parts or using maintenance procedures other than outlined could drastically affect performance and be hazardous to personnel and equipment and may void existing warranties.

WARNING: Standard industry safety practices must be adhered to when working on this or any other process control product. Specifically, personal protective and lifting devices must be used as warranted.

NOTE: *Selecting the proper fastener material is the responsibility of the customer. Typically, the supplier does not know what the valve service conditions or environment may be. Flowserve's standard body bolting material is B7/2H. B8 (stainless steel) is optional for applications more than 800° F / 425° C and with stainless steel or alloy body valves. The customer therefore must consider the material's resistance to stress corrosion cracking in addition to general corrosion. As with any mechanical equipment,* ***periodic inspection and maintenance is required****. For more information about fastener materials, contact your Flowserve representative.*

Unpacking

1. While unpacking the valve, check the packing list against materials received. Lists describing valve and accessories are in each shipping container.
2. When lifting the valve from shipping container, position the lifting straps through the yoke legs to avoid damage to the tubing and mounted accessories.

   WARNING: When lifting an actuator with lifting straps through the yoke legs, be aware that the center of gravity may be above the lifting point. Therefore, support must be given to prevent the actuator from rotating. Failure to do so can cause serious injury to personnel, damage to the valve or nearby equipment.

3. Contact your shipper immediately if there is shipping damage.
4. Should any problem arise, call your representative.

Installation

1. Before installing the valve, clean the line of dirt, welding chips, scale or other foreign material.
2. Whenever possible, the valve should be installed in an upright position. Vertical installation permits easier valve maintenance. This is also important for cryogenic applications to keep the packing isolated from the flowing medium, permitting the packing temperature to remain close to ambient temperature.

   CAUTION: Do not insulate extension bonnets that are provided for hot or cold services.

Table I: Overhead Clearance Requirement

Valve Size (inches)	Clearance (inches)	Valve Size (inches)	Clearance (inches)
1/2, 3/4, 1	3 / 76	6	10 / 254
1 1/2, 2	5 / 127	8	13 / 330
3	6 / 152	10	14 / 356
4	8 / 203	12	15 / 381

3. Be sure to provide proper overhead clearance for the actuator to allow for disassembly of the plug from the valve body. Refer to Table I for the necessary clearance needed for valve disassembly.
4. Double-check flow direction to be sure the valve is installed correctly. Flow direction is shown by the arrow attached to the body flange. Standard air-to-open valves close on air failure and should be installed so the flow tends to close the valve, except in rare circumstances that will be clearly indicated. Standard air-to-close valves open on air failure and should be installed with the flow tending to open the valve.
5. If welding the valve into the line, use extreme care to avoid excess heat buildup in the valve.
6. If the valve has separable end flanges, the half rings must be installed on the valve body before bolting the valve into the line to ensure a tight connection.

   WARNING: Failure to install half rings on the valve body can cause serious personal injury.
7. Connect air supply and instrument signal (air or mA) lines. Throttling control valves are equipped with a valve positioner. Two connections are marked: one for the air supply and the other for the instrument signal. Both the actuator and the positioner are suitable for 150 psi / 10.3 Bar air supply. An air regulator is not required unless the supply pressure exceeds 150 psi / 10.3 Bar. An air filter should be installed before the positioner unless supply air is clean and dry. All connections must be free of leaks.

   CAUTION: On valves equipped with air filters, the air filter must point down to perform properly.

   NOTE: *In some rare cases, the air supply must be limited to less than 150 psi / 10.3 Bar. This is indicated on a sticker found near the upper air port on the actuator cylinder. An air regulator should be installed to ensure the supply pressure does not exceed the line pressure indicated on the sticker.*

Table II: Common Lubricants

Lubricant	Manufacturer	Temperature Range	Description Applications
Krytox 206	E.I. DuPont	-5° to 550° F / -20° to 285° C	Fluorinated general purpose grease; handles common liquids and gases; good lubricity in harsh mediums; nonflammable, chemically inert; will not harm plastic or metal parts
GP 460	Graphite Products Co.	32° to 1000° F / 0° to 540° C	Graphite in petrolatum; high pressures; anti-galling, graphite remains above 600° F / 316° C
Aeroshell Grease 7	Shell Oil Co.	-100° to 300° F / -75° to 150° C	Synthetic oil based; low temperature applications
Garlock Luball	Garlock Inc.	32° to 500° F / 0° to 260° C	General purpose molybdenum disulfide lubricant economical; good in water, steam and common chemicals; not good in harsh mediums where Krytox 206 is recommended

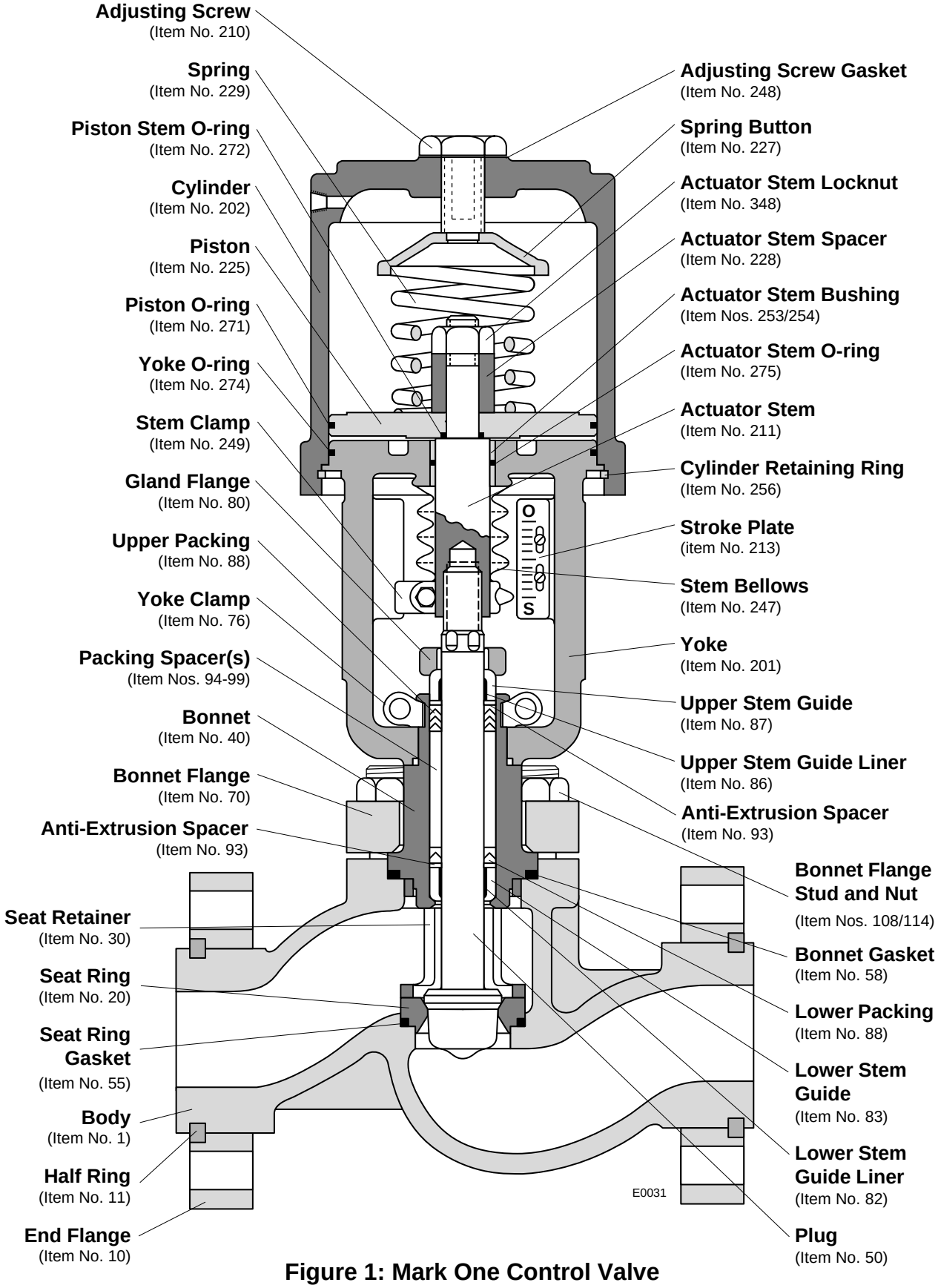


Figure 1: Mark One Control Valve

NOTE: *Item numbers correspond directly to the valve's bill of material. Refer to it for specific part numbers.*

Quick-check

Prior to start-up, check the control valve by following these steps:

1. Stroke the valve and observe the plug position indicator on the stem clamp compared to the stroke indicator plate. The plug should change position in a smooth, linear fashion.
2. Check for full stroke by making appropriate instrument signal change: 3-15, 3-9, 9-15 psi / 0-1, 0-0.6, 0.6-1 Bar or associated split ranges for pneumatic positioners, 4-20 or 10-50 mA for electro-pneumatic positioners).
3. Check all air connections for leaks.
4. Adjust the packing nuts to slightly over finger-tight.

   CAUTION: Do not overtighten packing. This can cause excessive packing wear and high stem friction that may impede plug movement.
5. Make sure the valve fails in the correct direction in case of air failure. This is done by shutting off the air supply and observing the failure direction.
6. After temperature excursion has occurred, bonnet flange bolting should be retightened to ensure bonnet gaskets do not leak. See Table III.

VALVE MAINTENANCE

At least once every six months, check for proper operation by following the preventative maintenance steps outlined below. These steps can be performed while the valve is in-line and, in some cases, without interrupting service. If an internal problem is suspected, refer to the "Valve Disassembly and Reassembly" section.

1. Look for signs of gasket leakage through the end flanges and bonnet. Tighten flange and bonnet bolting (if required). See Table III.
2. Check for fluid leakage to the atmosphere through the pressure-balance sleeve, metal bellows seal and body drain plug.
3. Examine the valve for damage caused by corrosive fumes or process drippings.
4. Clean valve and repaint areas of severe oxidation.
5. Check packing box bolting for proper tightness. Packing nuts should be slightly over finger-tight; however, tighten only as necessary to prevent stem leakage.

   CAUTION: Do not overtighten packing. This can cause excessive packing wear and high stem friction that may impede stem movement.
6. If the valve is supplied with a lubricator fitting, check lubricant supply and add lubricant if necessary. See Table II for common lubricants.
7. If possible, stroke the valve and check for smooth, full-stroke operation. Unsteady stem movement could indicate an internal valve problem.

   NOTE: *Jerky stem motion is normal whenever graphite packing is used.*

   WARNING: Keep hands, hair and clothing away from all moving parts when operating the valve. Failure to do so can cause serious injury.
8. Make sure positioner linkage and stem clamp are securely fastened. If the stem clamp is loose, check plug thread engagement (refer to the "Reassembling the Actuator" section for the correct procedure on aligning the plug with the seat.)
9. Ensure all accessories, brackets and bolting are securely fastened.
10. If possible, remove air supply and observe actuator for correct fail-safe action.
11. Check rubber bellows for wear.
12. Spray a soap solution around the cylinder actuator retaining ring, adjusting screw and actuator stem guide to check for air leaks through the O-rings.
13. Clean any dirt and other foreign material from the plug stem.
14. If an air filter is supplied, check and replace cartridge if necessary.

VALVE DISASSEMBLY AND REASSEMBLY

Disassembling the Body

To disassemble the valve body, refer to Figures 1 and 4 then proceed as follows:

WARNING: Depressurize line to atmospheric pressure and drain all fluids before working on the valve. Failure to do so can cause serious injury.

1. If valve is air-to-open, apply air under the piston to lift the plug off the seat before taking the valve apart. If valve is air-to-close, proceed to step 2.
2. Remove the bonnet flange bolting and lift actuator, bonnet and plug out of the valve.

   CAUTION: Heavy actuators may require a hoist. Lift the valve with the yoke legs using a lifting strap and a hoist. Great care should be taken to lift the actuator and plug straight out of the body to avoid damage to the plug and seat.
3. Lift retainer, seat ring and gaskets free of the body.
4. Check to see the seating surfaces on both the seat ring and plug are free of damage to ensure tight shutoff. Make sure the gasket surfaces on the seat ring, bonnet and body are clean and undamaged.
5. To inspect the plug, remove by loosening the stem clamp and gland flange and by taking off the yoke clamps.

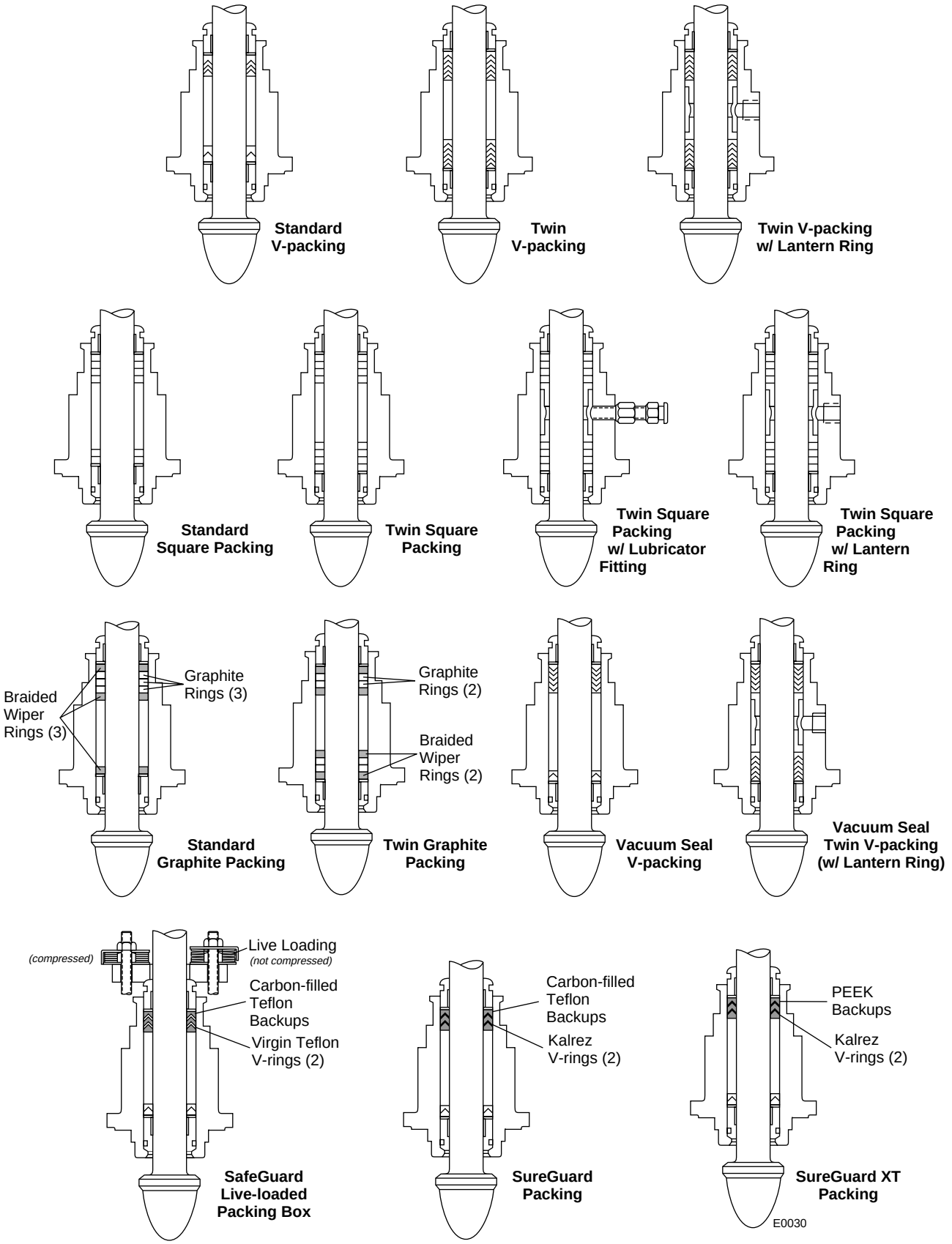


Figure 2: Typical Packing Configurations

NOTE: *See step 1 in "Reasembling the Body" section.*

NOTE: *With air-to-close, fail-open valves, it may be necessary to apply a small amount of air to the top of the actuator to move the plug away from the bonnet. Otherwise, plug galling may occur.*

Turn the actuator off the plug and bonnet without allowing the plug to rotate within the bonnet. Pull the plug carefully through the packing box.

CAUTION: To avoid scoring guides and plug stem, follow the above procedure exactly.

6. If the seat surfaces need remachining, both surfaces on plug and seat ring must be reworked. The seat angle on the plug is 30 degrees (36 degrees for CavControl and Channel Stream valves); the seat ring, 33 degrees. Lapping is not necessary if proper assembly procedures are followed.

   CAUTION: If remachining, protect the stem while turning. Ensure concentricity of the seat surface with the plug stem (or outside diameter of the seat ring, if machining the seat).

7. To replace packing or change the packing box configuration, from underneath the bonnet push out packing, spacer and guides with a dowel of the same approximate size as the plug stem.

   WARNING: For valves equipped with separable end flanges, do not machine body gasket surfaces. Machining could cause failure of the separable flange lip causing end gasket leakage and valve failure.

8. If separable end flanges need to be removed, file off tack welds or pull rivets behind the flanges.

   CAUTION: When using separable end flanges and spiral wound gaskets, use gaskets with outer backup rings. Failure to do so could result in excess stress in some applications.

   NOTE: *To prevent flanges from dropping off during shipping, a tack weld or stainless steel rivet has been installed behind the end flanges.*

Reassembling the Body

To reassemble the valve body, refer to Figures 1, 2 and 4 then proceed as follows:

1. If the packing has been removed, refer to Figure 2 and reinstall new packing exactly as shown. Make sure at least 1/8-inch is left at the top of packing box for the top guide to enter. Different spacer lengths permit a wide variety of packing configurations, such as twin seal and vacuum-pressure packing.

   WARNING: Valves with extended bonnets or metal bellows seals must not have lower packing installed. Instead, lower packing rings should be installed with the upper set. Lower packing installed in extended bonnets or metal bellows seal valves will diminish the integrity of the packing assembly.

   The graphite guide liners should be replaced each time the valve packing is replaced. Do not rebuild the valve without graphite liners in the guides.

2. Reinsert the plug stem into the packing box, being careful not to score the stem or the guides.

3. Turn actuator back onto the plug, without turning the plug inside the bonnet. Make sure the gland flange and bonnet flange are in place before engaging the plug stem and actuator stem threads.

   NOTE: *Do not allow the gland flange to contact and gall the polished plug stem.*

   Leave approximately three to four plug stem threads exposed. Attach yoke clamp and gland flange bolting. For valves with a 2-inch spud, be sure the half rings are in place between the yoke and bonnet. Firmly tighten yoke clamp bolting. The packing box nuts should be just over finger tight.

4. Install new bonnet and seat gaskets with the beveled edge up for Teflon gaskets.

5. Insert the seat ring into the body with the step side down. Place the seat retainer into the body with the thin end of the cathedral window down.

   NOTE: *For ANSI Class 900 and above valves with valve sizes 1/2- through 1 1/2-inch, the seat retainer window should be placed in the body with the window facing toward the valve ports. With valves 2-inches and larger, the retainer's bar should face toward the valve ports.*

6. Place air under the actuator piston on air-to-open valves to retract the plug.

7. Lower the plug and bonnet squarely into the body. Be careful not to scratch or gall the plug as it enters the body.

8. To properly align the seat ring and plug, first bring the bonnet bolting to finger-tightness.

   a. With pneumatic actuators, apply air pressure above the piston to seat the plug in the seat ring. Proceed to step 9.

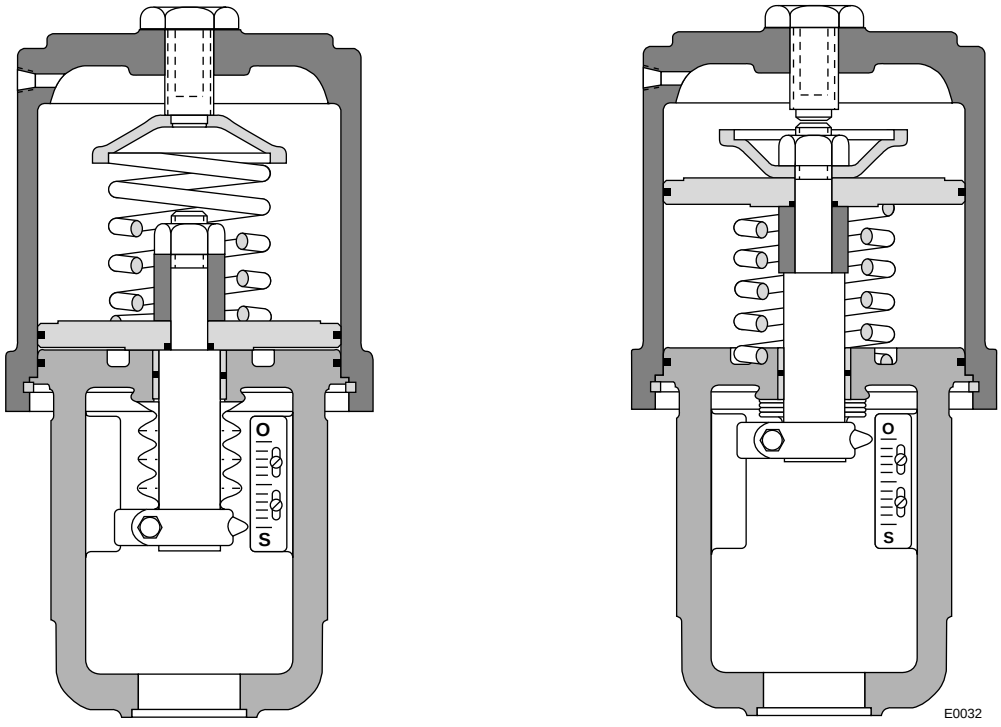
   b. With electric or hydraulic actuators, move the actuator stem down until it is completely extended. Next, retract the actuator stem 1/8 inch / 3.175 mm. Install the stem clamp onto the plug stem / actuator stem and tighten the associated bolting. Move the actuator stem completely down. Adjust actuator limit switches according to the actuator's operating manual.

NOTE: *Step 9 applies only to valves with pneumatic actuators. If an electric or hydraulic actuator is used, return the plug to the midstroke position and proceed to tighten.*

CAUTION: Failure to return the plug to a midstroke position (electric or hydraulic operators only) will cause damage to the actuator and / or the valve during the bonnet tightening sequence. This is due to the inability of most electric / hydraulic actuators to accommodate the $^{1}/_{16}$ inch / 1.60 mm back-drive during the tightening sequence.

9. For air-to-close valves, skip this step and go to step 10. For air-to-open valves, check for proper plug seating as follows: When proper seating occurs, the bonnet flange will be forced up against the finger-tight body bolting with such force that it will be impossible to move the flange. If proper seating does not occur, the bonnet flange can be wiggled with light hand force. Should this occur, place air under the actuator piston and retract the actuator to approximate midstroke position. Turn the plug out of the actuator plug stem one additional thread and repeat above seating procedure. When the bonnet flange becomes tight against the finger-tight body bolting, the plug is properly seated. If necessary, repeat above procedure until proper seating occurs.
10. Move the plug to the extended (or closed) position for pneumatic actuators and to the midstroke position for electric, hydraulic or mechanical actuators. Begin tightening the bonnet flange bolting in a manner that will keep the bonnet flange square / parallel with the body. Tighten the first bolt $^{1}/_{6}$ turn, then tighten the bolt directly opposite $^{1}/_{6}$ turn and so on around the flange. Firmly tighten all bolts evenly and completely to compress the bonnet gasket and to seat the bonnet. Torque the bonnet bolts to the suggested torque values in Table III.
11. Apply air over the piston to seat the plug. For all throttling valves, adjust the stem clamp so that with full instrument signal to the positioner the full signal scribe line on the positioner cam points to the center of the cam roller bearing.

    NOTE: *For on / off valves, the bottom of the stem clamp should simply be lined up with the bottom of actuator stem (plus or minus $^{1}/_{16}$ inch / 1.60 mm).*



Air-to-Open **Air-to-Close**

Figure 3: Air-action Configurations

Tighten the stem clamp bolting. Proper tightness is important since this adjustment secures the actuator stem to the plug stem. Adjust the stroke plate so the stem clamp points to the “closed” position.

12. If the valve has been taken out of the line, make sure the flow arrow indicates proper flow direction upon reinstallation.

Table III: Suggested Bonnet Bolting Torque Values (ft-lbs / Nm, ±10 percent)

Bolt Size (inches)	Bolt/Stud Material	
	Carbon Steel	Stainless Steel
5/8	80 / 108	50 / 68
3/4	140 / 190	90 / 122
7/8	230 / 312	150 / 203
1	350 / 475	220 / 298
1 1/8	510 / 690	330 / 447
1 1/4	730 / 990	460 / 624
1 3/8	990 / 1342	630 / 854
1 1/2	1320 / 1790	840 / 1140
1 5/8	1710 / 2318	1080 / 1484
1 3/4	2170 / 2942	1400 / 1898
1 7/8	2700 / 3660	1700 / 2305
2	3350 / 4542	2100 / 2847

Disassembling the Actuator

With air-to-open valves, the actuator may be disassembled while on the valve. With air-to-close valves, the actuator must be removed from the valve prior to disassembly. To disassemble the actuator, refer to Figures 1, 3 and 5 then proceed as follows:

NOTE: *Steps 1 through 4 apply to removing the actuator from the valve. If disassembly is to take place with the actuator still attached to the valve, go on to step 5.*

1. Make sure the plug is neither seated on the seat ring nor back-seated against the bonnet by attaching an air hose on the appropriate side of the cylinder and release the pressure on the opposite side.

   CAUTION: Galling of critical surfaces may result if the plug is not positioned correctly between the seat ring and bonnet.

2. Loosen the stem clamp.
3. Remove packing box bolting and yoke clamps.
4. Completely turn the actuator off the plug and bonnet without rotating the plug inside the bonnet.

   CAUTION: Do not allow the plug to drop and impact against the seat after turning the actuator off the plug threads.

5. Disconnect tubing.
6. Remove the adjusting screw to relieve the spring compression.

   WARNING: The spring compression must be relieved before further disassembly; otherwise, serious personal injury can occur during disassembly.

7. Remove the retaining ring from the groove at the base of the cylinder by using two screwdrivers, inserting them in the ring’s slot and prying the ring from the groove.
8. Pull the cylinder off of yoke and piston. Some O-ring resistance may be felt. Remove spring for cleaning and inspection (air-to-open configuration only).

   WARNING: Do not use air pressure to remove cylinder. Serious personal injury can occur.

9. To remove the spring on air-to-close configurations, remove the piston retaining nut and slide piston off of the actuator stem. The spring may now be removed.

   NOTE: *Step 10 can only be performed if the actuator has been removed from the valve.*

10. To inspect the actuator stem O-ring, remove the stem clamp and bellows. Push the actuator stem through the yoke, being careful not to gall the stem. The O-ring may now be removed for replacement.

    NOTE: *The actuator stem bushings are pressed into the yoke; it is not necessary to remove the bushing to replace the actuator stem O-ring.*

Reassembling the Actuator

To reassemble the actuator, refer to Figures 1, 3 and 5 then proceed as follows:

1. All O-rings should be replaced and the new ones lubricated with a silicone lubricant (Dow Corning 55M or equivalent). Silicone O-rings must be lubricated with Magnalube-G lubricant or equivalent. Do not use a silicone lubricant on silicone O-rings.
2. Make sure all internal parts are thoroughly cleaned and lubricated before beginning reassembly.
3. If the actuator stem has been removed, replace the piston stem O-ring and reassemble the piston and actuator spacer on the actuator stem according to the proper air-action (refer to Figures 3 and 5.) Air-to-close configurations require the spring button to be inserted under the actuator stem retaining nut. Tighten the retaining nut firmly.
4. For air-to-close configurations, place the spring under the piston and insert the actuator stem through the yoke, being careful to not gall the stem

or the bushings. Make sure the spring is retained in the groove provided in the top of the yoke. For air-to-open configurations, insert the actuator stem through the yoke and place the spring and spring button above the piston.

5. Install the cylinder, making sure the yoke is pushed deep enough into the cylinder to allow the retaining ring to be installed.
6. Reinsert the retaining ring by feeding it into the groove a little at a time until it snaps in place. Replace the stem bellows and stem clamp.
7. Using a new adjusting screw gasket, reinstall the gasket and adjusting screw. Tighten the adjusting screw only enough to provide an air seal with the gasket. Do not over tighten.

   NOTE: *On air-to-open configurations, make sure the hole in the spring button is directly centered under the adjusting screw hole.*
8. Apply air over the piston and place the actuator subassembly onto the valve, making sure the gland flange and bonnet flange are in place. For valves with a 2-inch spud, be sure the half rings are in place between the yoke and bonnet. Engage the plug stem and actuator stem threads. Carefully turn the actuator clockwise until the plug stem is engaged (three to four turns).

   CAUTION: To avoid possible stem and / or seat galling, do not allow the plug to turn on the seat.
9. Apply sufficient air under the piston (for air-to-open valves) or over the piston (for air-to-close valves) to prevent the plug head from touching either the seat or the bonnet. Continue turning the plug stem into the actuator stem until two to three plug stem threads remain exposed.

   CAUTION: Do not allow the gland flange to contact or gall the polished plug stem.

   CAUTION: To avoid possible stem and / or seat galling, do not allow the plug to turn on the seat.
10. Apply air over the piston. This will drive the plug into the seat and lift the yoke off the bonnet approximately $^{1}/_{16}$ inch / 1.60 mm. If the space is not $^{1}/_{16}$ inch / 1.60 mm, apply air under the piston to retract the actuator stem and screw the plug in or out as needed. Repeat this step until the $^{1}/_{16}$ inch / 1.60 mm space is created.
11. Apply air under the piston and attach the yoke clamps and packing box bolting. Tighten the yoke clamp bolting firmly. The packing box nuts should be just over finger-tight.

    CAUTION: Do not overtighten packing. This can cause excessive packing wear and high stem friction that may impede plug movement.
12. Apply air over the piston to seat the plug. For all throttling valves, adjust the stem clamp so that with full instrument signal to the positioner the full signal scribe line on the positioner cam points to the center of the cam roller bearing.

    NOTE: *For on / off valves, the bottom of the stem clamp should simply be lined up with the bottom of the actuator stem (± $^{1}/_{16}$ inch / 1.60 mm).*

    Tighten the stem clamp bolting. Proper tightness is important since this adjustment secures the actuator stem to the plug stem. Adjust the stroke plate so the stem clamp points to the “closed” position.
13. Reconnect the actuator / positioner tubing, supply and signal lines.

REVERSING THE AIR-ACTION

Changing to Air-to-Open

To change the air-action from air-to-close to air-to-open, refer to Figures 3 and 5 then proceed as follows:

1. Follow the instructions for disassembling the actuator (see “Disassembling the Actuator” section).
2. Reassemble the actuator with the spring, actuator stem spacer and spring button over the piston. For proper alignment, the center hole in the spring button should engage the end of the adjusting screw.
3. The positioner must also be changed. To do this, refer to the appropriate positioner Installation, Operation, Maintenance Instructions.

Changing to Air-to-Close

To change the air action from air-to-open to air-to-close, refer to Figures 3 and 5 then proceed as follows:

1. Follow the instructions for disassembling the actuator (see “Disassembling the Actuator” section).
2. Reassemble the actuator with spring and actuator stem spacer below the piston. The spring should sit in the spring groove on top of the yoke. The spring button is not used on air-to-extend configurations and is stored above the piston (the actuator stem retaining nut holds the spring button in place.)
3. The positioner must also be changed. To do this, refer to the appropriate positioner Installation, Operation, Maintenance Instructions.

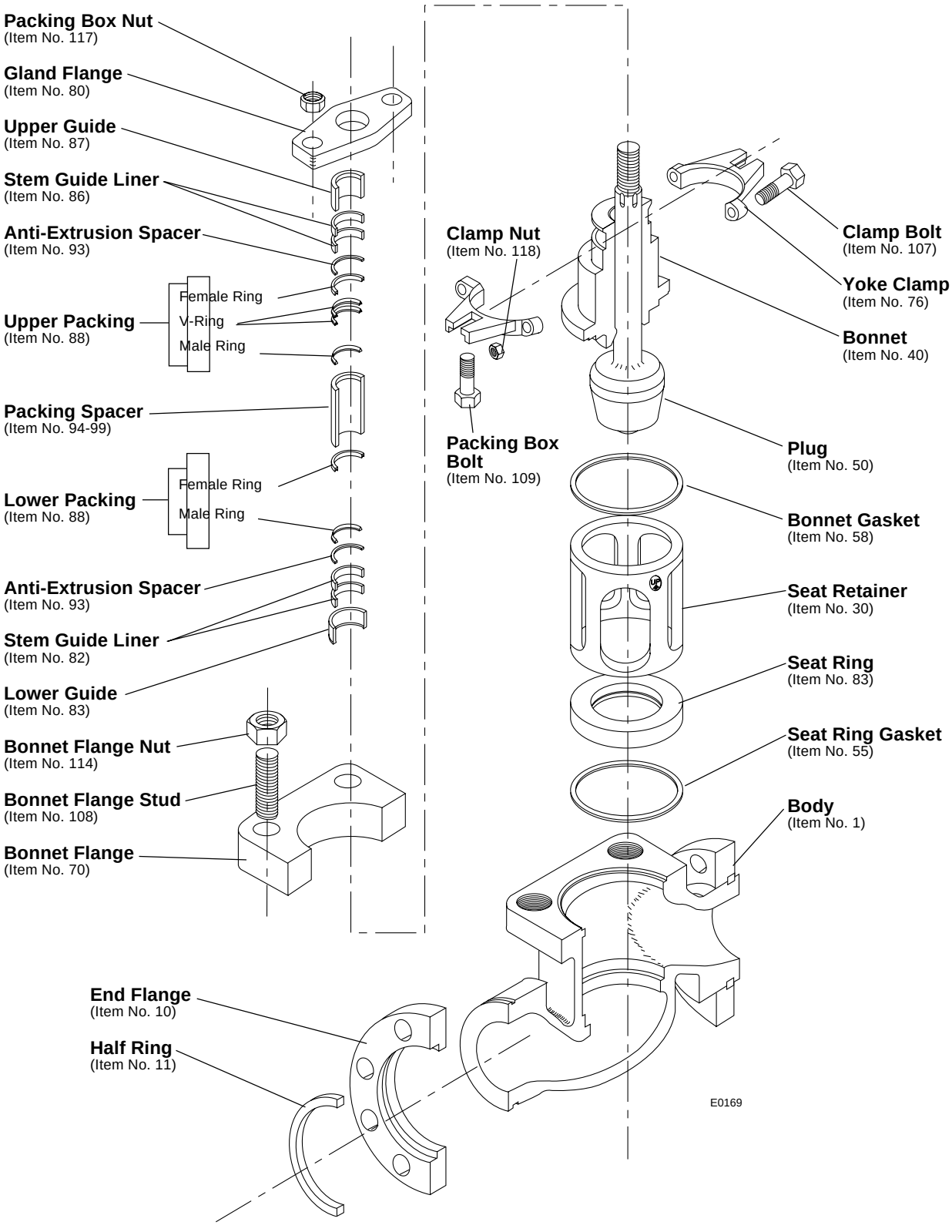


Figure 4: Exploded View – Body Assembly

NOTE: *Item numbers correspond directly to the valve's bill of material. Refer to it for specific part numbers.*

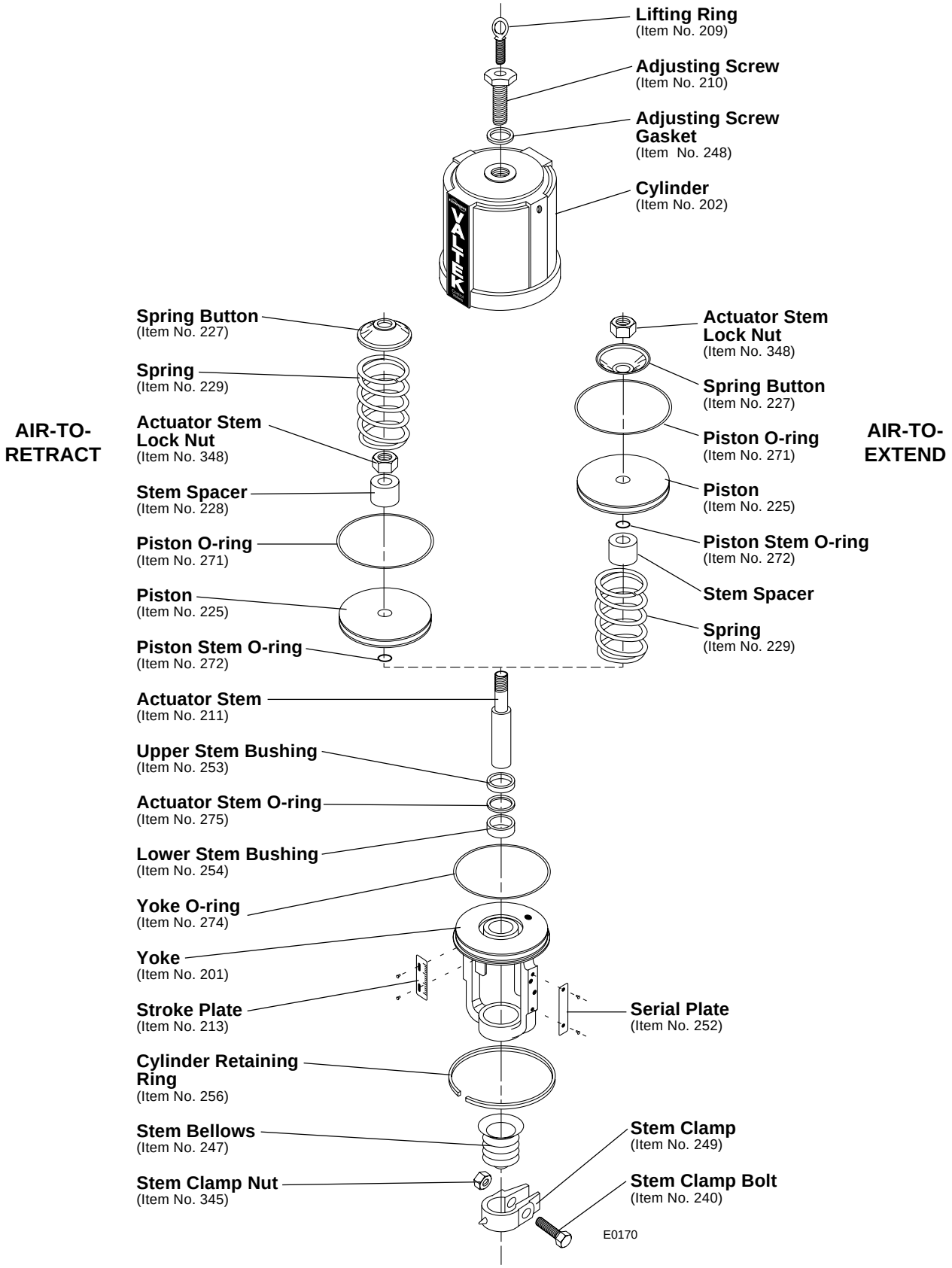


Figure 5: Exploded View – Actuator Assembly

NOTE: *Item numbers correspond directly to the valve's bill of material. Refer to it for specific part numbers.*

Troubleshooting Chart

Problem	Probable Cause	Corrective Action
Stem motion impeded	1. Overtightened packing 2. Service temperature is beyond operating limits of trim design 3. Inadequate air supply 4. Malfunctioning positioner	1. Adjust packing box nuts to slightly over finger-tight 2. Reconfirm service conditions and contact factory 3. Check for leaks in air supply or instrument signal system; tighten loose connections and replace leaky lines 4. Refer to positioner maintenance instructions
Excessive leakage	1. Improperly tightened bonnet flange bolting 2. Worn or damaged seat ring 3. Worn or damaged seat or bonnet gasket 4. Inadequate actuator thrust 5. Incorrectly adjusted plug 6. Improper flow direction 7. Improper handwheel adjustment acting as a limit-stop	1. Refer to step 3 of “Reassembling the Body” section for correct tightening procedure 2. Disassemble valve and replace or repair seat ring 3. Disassemble and replace gaskets 4. Check for adequate air supply to actuator; if air supply is adequate, reconfirm service conditions and contact factory 5. Refer to steps 8 - 10 of “Reassembling the Body” section for correct plug adjustment 6. Refer to original specifications or contact factory 7. Adjust handwheel until plug seats properly
Inadequate flow	1. Improper plug adjustment, limiting stroke 2. Malfunctioning positioner 3. Service conditions exceed trim design capacity	1. Refer to steps 8 - 10 of “Reassembling the Body” section for correct plug adjustment 2. Refer to positioner maintenance instructions 3. Verify service conditions and consult factory
Plug slams	1. Incorrect plug adjustment allowing improper cushion of air between actuator piston and yoke 2. Inadequate air supply 3. Trim sized too large for flow rate	1. Refer to steps 8 - 10 of “Reassembling the Body” section for correct plug adjustment 2. Check air supply to actuator; repair leaks and remove any restrictions in supply line 3. Install reduced trim
Valve does not fail in correct position	1. Incorrect flow direction	1. Reconfirm direction and, if necessary, correct flow direction through valve

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