

Masoneilan

a Baker Hughes business

72000 Series

Large Mass Flow Energy Management Control Valves

Instruction Manual (Rev. A)



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

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

THESE INSTRUCTIONS DO NOT PURPORT TO COVER ALL DETAILS OR VARIATIONS IN EQUIPMENT NOR TO PROVIDE FOR EVERY POSSIBLE CONTINGENCY TO BE MET IN CONNECTION WITH INSTALLATION, OPERATION OR MAINTENANCE. SHOULD FURTHER INFORMATION BE DESIRED OR SHOULD PARTICULAR PROBLEMS ARISE WHICH ARE NOT COVERED SUFFICIENTLY FOR THE CUSTOMER/OPERATOR'S PURPOSES THE MATTER SHOULD BE REFERRED TO BAKER HUGHES.

THE RIGHTS, OBLIGATIONS AND LIABILITIES OF BAKER HUGHES AND THE CUSTOMER/OPERATOR ARE STRICTLY LIMITED TO THOSE EXPRESSLY PROVIDED IN THE CONTRACT RELATING TO THE SUPPLY OF THE EQUIPMENT. NO ADDITIONAL REPRESENTATIONS OR WARRANTIES BY BAKER HUGHES REGARDING THE EQUIPMENT OR ITS USE ARE GIVEN OR IMPLIED BY THE ISSUE OF THESE INSTRUCTIONS.

THESE INSTRUCTIONS ARE FURNISHED TO THE CUSTOMER/OPERATOR SOLELY TO ASSIST IN THE INSTALLATION, TESTING, OPERATION, AND/OR MAINTENANCE OF THE EQUIPMENT DESCRIBED. THIS DOCUMENT SHALL NOT BE REPRODUCED IN WHOLE OR IN PART WITHOUT THE WRITTEN APPROVAL OF BAKER HUGHES.

Table Of Contents

Safety Information	1
About This Manual.....	1
Warranty	1
72000 Series Numbering System	2
Introduction	3
Scope	3
Serial Plate	3
After Sales Service.....	3
Spare Parts	3
Actuator and Accessories.....	3
Unpacking	3
Installation	3
Piping Cleanliness.....	3
Isolation Bypass Valve.....	3
Heat Insulation	4
Hydrostatic Testing and Line Cleaning	4
Flow Direction.....	4
Welded Connections	4
Pre-Weld Preparation	4
Welding Process.....	4
Post Weld Cleaning and Assembly	4
Actuator Assembly.....	4
Disassembly	4
Valve Actuation	4
Disconnect Instrumentation.....	4
Air-to-Retract Actuators	4
Threaded Connection	4
Split Clamp Connection	4
Air-to-Extend Actuators	4
Actuator Removal.....	4
Valve Disassembly	5
Plug Stem Disassembly	5
Auxiliary Pilot Plug Disassembly	6
Maintenance and Repair	6
Packing Box	6
PTFE Packing	6
Valve with Graphite Packing.....	6
Repair of Parts	7
Guiding Surfaces.....	7
Seating Surfaces.....	7
Gaskets	8
Seal Rings.....	8
Metal Seal	8
Valve Plug.....	8
Conical Springs	8
Valve Reassembly	8
Pinning the Valve Plug	8
Seal Ring Assembly	8
Completing Valve Body Assembly.....	9
Valve Plug and Cage Assembly	9
Valve Plug and Auxiliary Pilot Plug Assembly	9
Bonnet Assembly	9
Tightening Body Nuts	10
Packing Box Assembly.....	10
Bolt Torquing Sequence	10
Parts Reference For 72000 Series Control Valve	12
Actuation	14
Parts Reference Table 51/52/53 Actuators	23

Safety Information

Important - Please read before installation

These instructions contain **DANGER**, **WARNING**, and **CAUTION** labels, where necessary, to alert you to safety related or other important information. Read the instructions carefully before installing and maintaining your control valve. **DANGER** and **WARNING** hazards are related to personal injury. **CAUTION** hazards involve equipment or property damage. Operation of damaged equipment can, under certain operational conditions, result in degraded process system performance that can lead to injury or death. Total compliance with all **DANGER**, **WARNING**, and **CAUTION** notices is required for safe operation.



This is the safety alert symbol. It alerts you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in serious injury.



Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.



When used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, could result in property damage.

Note: Indicates important facts and conditions.

About this Manual

- The information in this manual is subject to change without prior notice.
- The information contained in this manual, in whole or part, shall not be transcribed or copied without Baker Hughes's written permission.
- Please report any errors or questions about the information in this manual to your local supplier.
- These instructions are written specifically for the **Masoneilan™ 72000 Series Energy Management Control Valves**, and do not apply for other valves outside of this product line.
- Changes to specifications, structure, and components used may not lead to the revision of this manual unless such changes affect the function and performance of the product.
- Periodic monitoring of the valve and trim should be performed. Under certain operating conditions, the use of damaged equipment could cause a degradation of the performance of the system which may lead to personal injury or death.

Useful Life

The current estimated useful life period for the Masoneilan 72000 Series is 25+ years. To maximize the useful life of the control valve, it is essential to conduct annual inspections, routine maintenance and ensure proper installation to avoid any unintended stresses on the control valve. The specific operating conditions will also impact the useful life of the valve. Consult the factory for guidance on specific applications if required prior to installation.

Warranty

Items sold by Baker Hughes are warranted to be free from defects in materials and workmanship for a period of one year from the date of shipment provided said items are used according to Baker Hughes recommended usages. Baker Hughes reserves the right to discontinue manufacture of any product or change product materials, design or specifications without notice. This instruction manual applies to the 72000 Series Energy Management Control Valves.

The warranty for this product requires

- The 72000 Series Control Valves must be installed, put into service and maintained by qualified and competent professionals who have undergone suitable training.
- All surrounding pipe lines must be thoroughly flushed to ensure all entrained debris has been removed from the system.

Numbering System



Actuator Type	Body Series	Seal Type	Trim Characteristic	Trim Type	Options
87 Spring-Diaphragm (Air to Close)	72 Fabricated Angle Valve	0 Unbalance	0 Custom Characteristic	0 Undefined	AS Angle Stub
88 Spring-Diaphragm (Air to Open)		2 Polymeric Seal Ring and Soft Seat	1 Linear	1 Single Stage Lo-dB	EB Extension Bonnet
51 Cylinder Double Acting		4 Metal Seal Ring and Metal Seat with Auxiliary Pilot Plug	2 Equal %	2 Double Stage Lo-dB	D Diffuser
52 Cylinder Spring Return (Air to Close)		5 Metal Seal Ring and Metal Seat	4 Modified Linear	8 Partial Stack	
53 Cylinder Spring Return (Air to Open)		6 Polymeric Seal Ring and Metal Seat		9 V-LOG	
		9 Graphite Seal Ring and Metal Seat			

Introduction

Scope

The following instructions are designed to guide the user through the installation and maintenance of the 72000 Series Energy Management Control Valves.

The 72000 Series product is part of Masoneilan's Engineered Product portfolio, and is custom designed to fit our customers' most difficult applications. For this reason, sections of this instruction manual may be replaced with specific drawings and descriptions that apply only to the valves that are specified for use on a given project. For further detailed information on your specific 72000 Series valve design, please contact your local Baker Hughes Sales office.

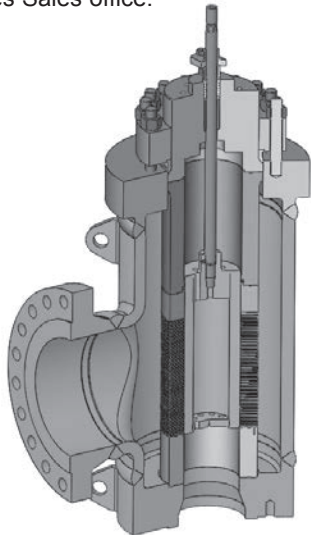


Figure 1 - 72000 Series Energy Management Control Valve

Serial Plate

The serial plate is usually fixed to the side of the actuator yoke. It indicates information about the valve including size and type, pressure class rating, body/bonnet material, and serial number.

⚠ WARNING

Careful attention must be paid to the serial plate prior to pressurizing of the 72000 Series valve. Inlet and outlet connections may be independently designed for the conditions at their point of operation, thus ASME pressure class ratings may differ at each connection.

After Sales Service

Baker Hughes offers After Sales Service comprised of highly qualified technicians to support the installation, operation, maintenance and repair of its equipment. For support contact your local Sales representative.

Spare Parts

Only Masoneilan replacement parts should be used when carrying out maintenance operations. Obtain replacement parts through local Sales representatives or Masoneilan Parts Department.

When ordering spare parts, the MODEL AND SERIAL NUMBERS indicated on the manufacturer's serial plate MUST BE GIVEN. The serial plate is on the side of the actuator yoke.

Actuator and Accessories

Actuators and other valve accessories have their own instruction manuals that provide information and details on the assembly and installation. Refer to the appropriate instruction manual for each unique actuator and accessory.

Unpacking

Care must be exercised when unpacking the valve to prevent damage to the accessories and component parts. Contact the local Baker Hughes Sales Office or Service Center with any issues or problems. Be sure to note the valve model number and serial number in all correspondence.

Installation

The 72000 Series Control Valves are designed to handle large capacity flow rates. Thus, the overall size and weight of these valves are larger than typical control valves. Proper piping supports and hangers must be used to support the weight of the valve, and the removal of the large trim components during periodic maintenance.

Piping Cleanliness

Before installing the valve in the line, clean piping and valve of all foreign material such as welding chips, scale, oil, grease or dirt. Gasket mating surfaces must be thoroughly cleaned to ensure leak-free joints. Sacrificial start-up fixtures are highly recommended for purchase from Baker Hughes to protect the operational trim during the installation and line flushing phases.

⚠ WARNING

If major system or piping modifications (or repairs) are per-formed, thorough flushing and blowdown of the system will be required prior to reinstalling the trim. Sacrificial flushing trim should be installed in this valve to protect the integrity of the flow passages. Failure to follow this warning will violate the valve warranty agreement and could result in control instability, excessive noise levels, and valve leakage.

Isolation Bypass Valve

To allow for in-line inspection, maintenance and removal of the valve without service interruption, provide a manually operated shutoff valve on each side of the control valve and a manually operated throttling valve in the bypass line.

Heat Insulation

In case of a heat-insulated installation, do not insulate the valve bonnet and take protective measures relative to personal safety.

Hydrostatic Testing and Line Cleaning

During this operation, the control valve must not be used as an isolating valve. This means that the valve must always be opened before carrying out pressure tests in the process line, cleaning of pipes, etc. Otherwise equipment damage or failure of the seal rings could result. Flushing and hydrostatic test equipment can be purchased from the Masoneilan factory.

Flow Direction

The valve must be installed so that the process fluid will flow through the valve in the direction indicated by the flow arrow located on the body.

Welded Connections

CAUTION

Carefully review the information in this section prior to welding any valves inline. Refer any additional questions to the local Baker Hughes Sales Office or Service Center.

Pre-Weld Preparation

Carefully follow the installation steps defined in the sections noted below prior to performing weld procedures.

Welding Process

Perform welding process in accordance with the standard requirements for the materials and weld construction of the specific valve. Apply post weld heat treatment if required.

CAUTION

Internal valve components should be removed prior to performing any post weld heat treatment in order to prevent damaging any soft goods (such as teflon® seals). If unable to remove the elastomeric components, then other methods must be employed to prevent the local temperature around the seals from exceeding the maximum material limits (typically 450°F / 232°C for teflon based materials).

Post Weld Cleaning and Assembly

Inspect the body, bonnet, and trim components for cleanliness and surface condition. Remove any foreign materials, such as weld chips, slag or scale. Make sure there are no nicks, scratches, burrs or sharp corners on sealing and sliding surfaces. Clean all gasket interface surfaces and reassemble using new gaskets to ensure sealing integrity.

Actuator Assembly

Assemble the pneumatic actuator onto the control valve using the appropriate instructions for the specific actuator model and type. Connect air pressure lines to the actuator ports to meet intended operating mode (i.e., air-to-extend, air-to-retract, or double-acting).

Disassembly

CAUTION

Prior to performing any maintenance on the valve, isolate the valve and vent the process pressure.

Valve Actuation

Access to the internal components of the valve should be accomplished with the actuator removed. Follow the detailed instructions below and refer to the appropriate actuator instruction manuals.

WARNING

Actuator may be pre-loaded with tension from air pressure or springs. Prior to disconnecting instrumentation read all instructions for the specific actuator.

Disconnect Instrumentation

Disconnect all mechanical connections between the positioner and the other instruments. Disassemble the valve stem and actuator stem coupling as described in the following sections.

Air-to-Retract Actuators

Apply sufficient air pressure to the actuator to retract the stem completely. Disconnect the plug stem from the actuator stem depending on the connection type as described below.

Threaded Connection

Unscrew the plug stem from the actuator stem, making sure the plug never contacts the seating area (liner or seat ring) at any time during disassembly.

CAUTION

Contact between the plug and seating area during this disassembly process may cause damage to the seating surfaces. It may be necessary to disassemble the actuator yoke from the valve bonnet and lifting the actuator off the valve to avoid plug to seating surface contact.

Split Clamp Connection

Remove the screws and disassemble the stem connector from the valve and actuator stem.

Air-to-Extend Actuators

For this actuator configuration, the valve plug is already in the fully retracted position without any air pressure applied. Disconnect the plug stem and actuator stem as described in the threaded connection and stem connector sections above depending on the connection type.

Actuator Removal

Disconnect all electrical and air connections to and from the actuator. Disassemble yoke nut or yoke attachment screws or bolted connections, and lift the actuator off of the valve being careful not to damage the bonnet threads.

CAUTION

Many of the trim components in the valve are both large and heavy. Provisions should be made for special lifting devices to avoid risk of injury during maintenance. It is recommended to remove the valve from line for easy disassembly.

Note: Many of the larger trim components are designed with threaded lifting holes. It is recommended to use eye bolts for ease of lifting during removal and re-assembly.

Valve Disassembly

The valve must always be reassembled with new packing set and gaskets. Before disassembly, make sure the recommended spare parts are available for reassembly.

1. Disconnect the piping to the leak detector connection on the bonnet (if applicable).
2. Remove the packing flange nuts (16) then remove the packing flange (17) and the packing follower (18).
3. Check the exposed part of the valve stem (7) to confirm it is clean enough for ease of removal of the bonnet (2).
4. Remove the body nuts (5).

For valve configurations designed with a two piece bonnet assembly (bonnet and bonnet flange):

5. Disassemble the bonnet flange (3) from the valve body (1).
6. Lift the bonnet (2) and metal seal (6) to remove from the valve body (1). During this operation, the valve stem (7) must be pushed downward to ensure the valve plug (8) remains inside the valve body.

Note: The metal seal (6) may require some force to remove from the bonnet (2). Using a common tool, such as an open-end wrench, lever the seal up at various points to lift out evenly.

7. Remove the body gasket (25) from the top of the valve cage (10) or (if applicable) cage retainer (11). Proceed to step 10.

For valve configurations designed with a single piece bonnet:

8. Lift the bonnet (2) and remove from the valve body (1). During this operation, the valve plug stem (7) must be pushed downward to ensure the valve plug (8) remains inside the valve body (1).
9. Remove the body gasket (25) from the groove on top of the valve body (1).
10. If applicable, remove the conical spring (14) from the groove on top of the valve cage. Some designs for high temperature service may include a conical spring.
11. Remove the valve plug assembly (8) from the valve cage by pulling the valve plug stem (7) upward. In the case of the bell-shaped plug design (see Figure 2), pulling the plug stem (7) will remove both the plug (8) and cage (10) or (if applicable) cage retainer (11) together. For straight plug designs (see Figure 3), after removal of the plug (8) lift the cage (10), and (if applicable) the cage retainer (11) to remove from the valve body (1).

Note: For straight plug designs, as shown in Figure 3, care must be taken to ensure the cage is not lifted out during removal of the plug.

12. Remove the seat ring (13) by lifting the part out of the valve body (1).

Note: The upper seat ring gasket (26) if supplied is located on the top groove of the seat ring.

13. Remove the lower seat ring gasket (26) from the valve body (1).
14. Remove the packing set (19) and the guide bushing (20) from the bonnet (2).

Piping Cleanliness

CAUTION

The valve plug assembly is screwed and pinned, and in some cases tack welded to ensure stability and performance. Due to the critical purpose of the plug assembly and tolerance requirements, Baker Hughes highly recommends avoiding in the field maintenance of this part. The plug assembly should be purchased as a complete assembly. However, if urgent field repair is required, follow the instructions below.

The valve plug stem is screwed, pinned and tack welded into the valve plug (8). To disassemble the stem, the valve plug must be held as shown below in Figure 4, taking care not to damage the guiding surfaces. Remove tack weld if applicable and disassemble the plug stem groove pin (24) from the assembly. By means of flats or using a nut and counter-nut on the end of the stem, unscrew the stem from the plug taking care not to apply a bending movement which could deform it.

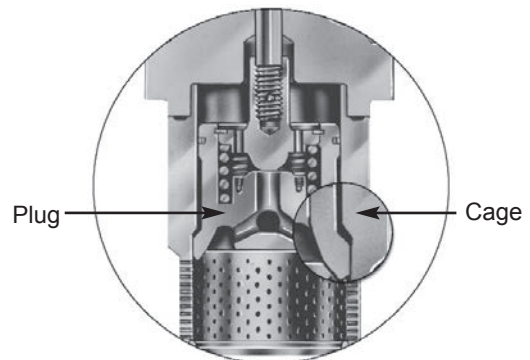


Figure 2 - Bell-Shaped Plug Design

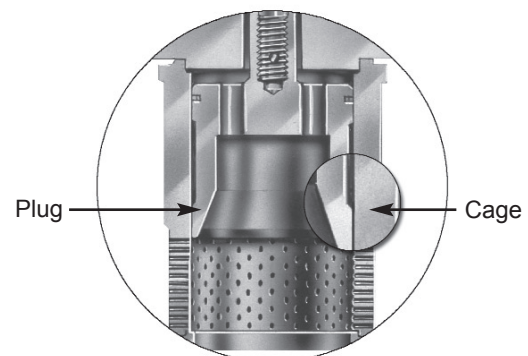


Figure 3 - Straight Plug Design

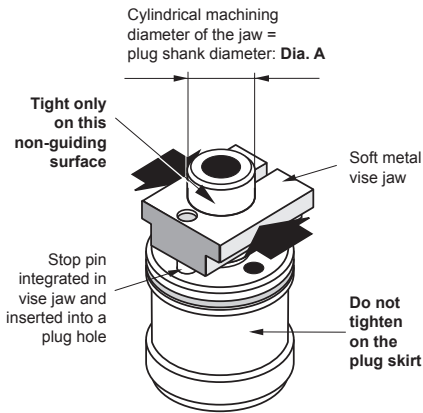


Figure 4 - Valve Plug Stem S/A Disassembly

Auxiliary Pilot Plug Disassembly (Model 724XX)

For size 3" or 4" (80 or 100 mm) valves:

Exert a sufficient force on the auxiliary pilot plug (21) to compress the pilot springs (22). The retaining ring (23) can then be removed, allowing for disassembly of the auxiliary pilot plug and springs.

Some auxiliary pilot plug designs may incorporate a threaded and welded retaining ring. For disassembly machine removal of the weld is required. After removal of the weld, compress the pilot assembly to unthread the retainer.

For size 6" to 16" (150 to 400 mm) plug sizes:

To carry out this operation safely, screws with diameters and lengths indicated in Table 1 must be used. Thread the socket head cap screws through the holes in the auxiliary pilot plug (21). Tighten until the retaining ring (23) can be removed. Loosen the screws gradually, then remove the auxiliary pilot plug and the spring (22).

Valve Size.		Pilot Dismounting Screw Sizes			
		Qty	Length		Diameter
in.	mm		in.	mm	
6	150	2	2.25	57.0	3/8"- 16 UNC 2A
8	20	2	2.5	63.5	
10	250	2	2.75	70.0	
12	300	3	4.00	101.5	
16	400	3	4.00	101.5	

Table 1

Maintenance and Repair

The purpose of this section is to provide recommended maintenance and repair procedures. These procedures assume the availability of standard shop tools and equipment.

Packing Box

Tight sealing within the packing box is obtained by compression of the packing (19). Compression must be achieved by evenly tightening the packing flange nuts (16) on the packing flange (17). Periodic re-tightening of the packing flange nuts may be required to maintain proper sealing.

CAUTION

Be careful not to over tighten the packing as this could prevent proper operation of the valve. If leakage persists after maximum packing compression, then the packing needs to be changed.

PTFE Packing and PTFE V-Ring Packing

Kevlar®/PTFE, carbon/PTFE and pure PTFE packing rings are cut in such a way that they can be replaced without having to separate the valve plug stem from the actuator stem.

Note: V-Ring packing requires smooth, 32 μ inch RMS or finer, finish. Inspect stem and packing box bore to ensure the surfaces have not been damaged. If damage has occurred, the surfaces must be repaired to ensure proper sealing.

1. Unscrew and remove the packing flange nuts (16).
2. Lift the packing flange (17) and packing follower (18) up along the valve stem (7).
3. By means of a puller, remove the packing (19) being careful not to damage the sealing surface of the packing box or the valve plug stem.
4. Replace the packing rings, placing the cut in each ring about 120° apart from the adjacent ring. Press rings in one at a time.
5. Reassemble the packing follower (18) and the packing flange (17).
6. Tighten the packing flange nuts (16) without over compressing the packing rings.

Note: In case of V-ring packing, compress packing flange nuts to finger tight, plus one half additional turn.

7. Put the valve back into service and check for leakage. If packing leaks, tighten packing flange nuts (16) in half turn increments as required.

Valve with Graphite Packing

To replace graphite packing, it is necessary to separate the valve plug stem from the actuator stem.

1. Remove the packing flange nuts (16) from the packing flange studs (15).
2. Lift the packing flange (17) and packing follower (18) up along the valve stem (7).
3. By means of a puller, remove the packing (19) being careful not to damage the sealing surface of the packing box or the valve plug stem.
4. Replace the packing (19). Press a back-up ring (carbon/graphite/Inconel braided ring) into the bonnet (2). Next press the expanded graphite rings into the packing area one at a time. Press an additional back-up ring into packing area.
5. Reassemble the packing follower (18) and the packing flange (17).
6. Tighten the packing flange nuts (16) without over-compressing the packing rings.

7. Open and close the valve several times then retighten the packing as required.
8. Put the valve back into service and check for leakage. Tighten packing flange nuts (16) as required.

Repair of Parts

Prior to reassembly, examine parts carefully for any scratches, unusual wear, or other damage.

Guiding Surfaces

Guiding surfaces of the cage, valve plug, guide bushing, plug stem, and auxiliary pilot plug must be checked. See Figures 5 and 6. If there are only slight wear indications, then gently use a light abrasive, such as Scotchbrite® or fine grit sandpaper, to smooth out guiding surfaces. Parts with significant damage or wear on the guiding surfaces must be replaced.

Seating Surfaces

The seat ring seating surface and valve plug seating surface must be completely free of dents, wear, or scratches. Consult factory should you see any signs of slight deterioration prior to attempting touchup. If a slight defect exists on either the seat ring seating surface and valve plug seating surface, lapping can be applied per the following instructions.

1. Clean body gasket surface areas.
2. Install a new seat ring gasket (26).

Note: *Seat ring gasket (26) is temporarily placed to hold the seat ring during lapping.*

It is imperative to use a new gasket or a test part having the same geometrical characteristics in order to insure the correct position of the seat ring during lapping.

This gasket (or similar part) can be kept after lapping for future lapping use.

The gasket used for lapping must not be reused for the body reassembly.

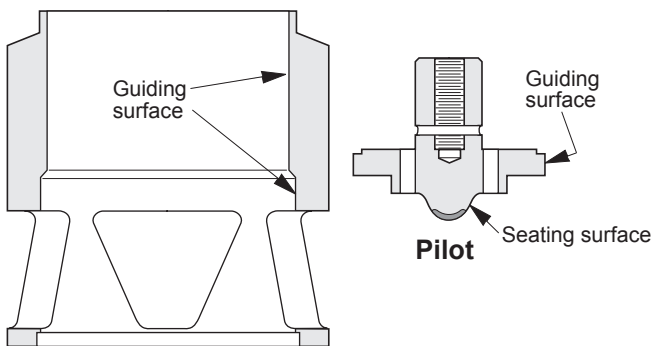


Figure 5 - Guiding Surfaces

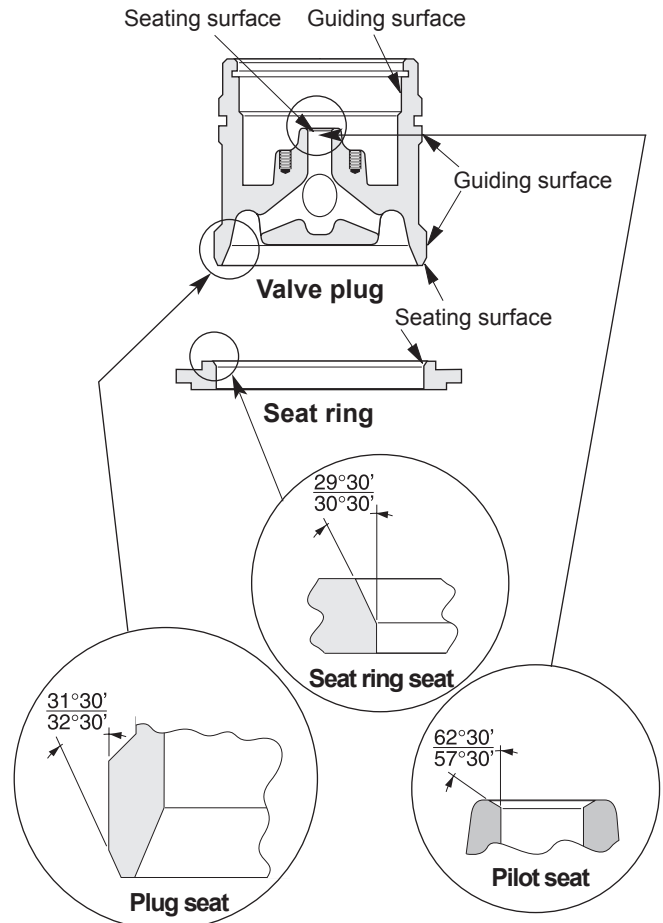


Figure 6 - Typical Seating Angles

3. Place seat ring (13) in the body, noting the seating angle is up.
4. Spread a fine layer of high quality lapping compound (600 grit) on the seating surface.
5. Assemble the cage (10) and (if applicable) cage retainer (11) and the plug assembly (8) into the valve body (1) per the valve plug assembly instructions.
6. Assemble the bonnet (2) and the guide bushing (20) if required.
7. Place an appropriate tool on the valve stem (7) thread to allow for manual rotation.
8. Lap by slightly rotating the valve plug in alternate directions $\pm 15^\circ$ per rotation. After several rotations, lift the valve stem, turn it 90 degrees, and repeat the operation.
9. Lapping can be repeated, but should be limited as much as possible so that the seat remains sufficiently narrow to guarantee tightness.
10. After lapping, disassemble the parts to clean them and then reassemble, making sure the seating angles are within tolerance. See Figure 6.

Note: *For more details on the lapping procedure and seating angles, please consult the factory and provide the valve serial number (found on the serial plate on the actuator).*

Gaskets

Gasket seating surfaces must be free of dents, scratches, corrosion, or other types of damage. Clean mating surfaces as required and replace any non-conforming parts. Spiral wound gaskets (Items 25, 26 & 27) must always be replaced after disassembly.

Seal Rings

Seal rings (9), back-up rings (28), retaining rings (23), and conical springs (14) should be inspected periodically. It is recommended to routinely replace these parts, but they may be re-used if they are free from scratches, erosion, corrosion, or other damage.

Note: Compressed graphite seal rings must be replaced each time the plug is removed from the valve.

Metal Seal

For the two piece bonnet configurations:

Prior to reassembly, the metal seal (6) should be inspected for cracks or signs of wear. The metal seal can be reused if it is free from scratches, erosion, corrosion, or any other type of damage.

If slight wear exists on the metal seal, a new layer of coating should be re-applied to the original condition by the factory or a Masoneilan Authorized Repair Center (MARC™). For emergency repairs in the field, the metal seal may be coated with a molybdenum disulfide based spray on lubricant such as MolyKote®.

Prior to reassembly of the valve, inspect the inside of the valve body around the area where the metal seal seats. It is common to find slight ridges or depressions from where the seal was originally seated. During initial assembly these depressions aid in the sealing of the valve, however these areas can become leak paths during reassembly if the surface is not restored to its original finish as described below.

To prevent this potential leakage, machine the seating angle of the bonnet at 40 degrees by approximately 0.1 inches (2.5 mm) deep, thus causing the metal seal to seat further down inside the valve body (on a new undeformed surface). Refer to Figure 7 for details.

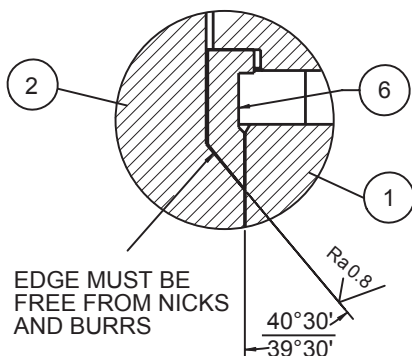


Figure 7 - Bonnet Seating Angle Details (see page 12, detail B)

Conical Springs

For Models that use a conical spring design, always inspect the body bore surface adjacent to where the conical spring (14) is seated. If this surface has been deformed or if there is a groove where the seal seats, the surface should be cleaned and honed prior to reassembling the valve.

If the refinishing procedure is unsuccessful, the factory should be consulted for further instructions.

Valve Reassembly

Pinning the Valve Plug

The valve plug assembly consists of a stem (7) that is threaded into the valve plug (8). To secure this assembly, the stem (7) is then pinned (24) and tack welded to the valve plug (8).

If the valve plug (8) or stem (7) needs to be replaced, an entire assembly should be purchased from the factory to ensure product strength and integrity. Re-machining of these parts in the field can seriously impair the mechanical strength and integrity of the valve plug stem assembly.

Seal Ring Assembly

Model 724XX (Auxiliary Pilot Plug) and 725XX (Metal Seal Ring)

1. To insert the seal ring in the valve plug groove, place it over the conical top of the plug, then push down evenly from all sides until the ring slips into the groove. See Figure 8.

Note: These valves may also be equipped with a secondary metal seal and elastomeric back-up ring located on the lower area of the plug near the seating surface.

2. Install the back-up ring (28) onto the plug using care not to damage the ring on any sharp surfaces. The back-up ring does not require lubrication, however, a light coating of compatible lubricant will help install the seal.
3. Install the seal ring (9) over the back-up ring (28).

Note: When the plug assembly is installed into the cage bore, the lead in angle of the cage will compress the ring into place. If the seal ring is not compressed a ring compression tool may be required for proper installation.

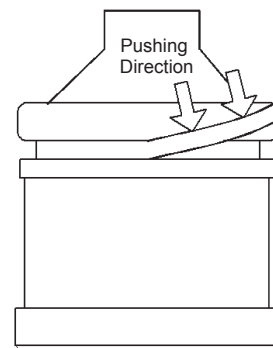


Figure 8 - Installing Seal Ring

Model 722XX and 726XX (Polymeric Seal)

These valves are equipped with an inner elastomeric ring and an outer PTFE ring.

1. Insert the elastomeric back-up ring (28) into the groove.
2. Place the PTFE seal ring (9) in boiling water for a few minutes. Slide the seal ring along the plug until it slips into the groove.
3. For optimum insertion of the ring, a Serflex type ring compressor can be used to compress the ring in the groove for several minutes.

Model 729XX (Graphite Seal Ring)

These valves are also equipped with an inner and outer ring arrangement. The inner metal ring has a straight cut and the outer ring is made of graphite.

1. Replacement graphite seal rings (9) are supplied in a closed ring form, and a notch must be cut before being assembled to the plug.

CAUTION

Graphite seal rings are fragile so the following operations must be carried out very carefully.

2. Using a sharp blade, make a notch in the graphite ring. Hold the ring on either side of the notch between the thumb and index and bend until it breaks.
3. Using a very fine file, adjust each end of the ring so that its external circumference corresponds to the internal circumference of the cage (10) and (if applicable) the cage retainer (11).
4. To adjust the length of the ring correctly, insert the new graphite ring into the cage with the ring against the inner wall of the cage (allowing for minimum play between the two ends of the ring).
5. First assemble the inner metal ring into the cage groove, then assemble the graphite ring over the metal ring. Be careful not to damage the parts.

Note: The breaks on each ring should be placed approximately 180° apart.

Completing Valve Body Assembly

It is recommended to consult the factory for actual assembly cross sectional drawing as some design configurations may vary from the instructions.

Proceeds as follows:

1. After checking all sealing surfaces to ensure they are thoroughly clean, assemble the seat ring gasket (26) in the valve body (1). Make sure the gasket is centered properly in the body.
2. Assemble the seat ring (13) into the valve body on top of the seat ring gasket (26).
3. Install upper seat ring gasket (26) if applicable.

Note: For proper sealing it is important to confirm the gasket is properly engaged in the seat ring gasket groove. If proper alignment can not be achieved, spread a silicone grease, such as Dow Ill, into the gasket groove to retain the gasket during assembly.

Valve Plug and Cage Assembly

For 724XX (Auxiliary Pilot Plug) proceed to Step 6.

4. For valves using a straight plug design (See Figure 3), install the cage (10) and (if applicable) the cage retainer (11) into the valve body by seating it on top of the seat ring. For valves using a bell shaped design (See Figure 2), proceed to Step 7.
5. Insert the valve plug, stem assembly (7) including the seal rings (9) and back-up rings (28) if applicable, into the valve cage taking particular care not to damage the seal rings (9, 28) upon entry. Proceed to Step 8.

Note: Polymeric seal rings should be lightly greased with a silicone based lubricant, such as Dow Ill, prior to installing the plug into the cage.

Valve Plug and Auxiliary Pilot Plug Assembly

6. Assemble either the flat spring washers (sizes 3" and 4") or the coil springs (sizes 6" to 16"), then assemble the valve plug assembly (8), using the same tools as those used for disassembly (see section on disassembly). Compress the springs so that the retaining ring (23) can be installed into the groove in the main plug.

Note: For auxiliary pilot plugs with threaded spring retainers, the retaining ring must be seal welded to the main plug.

For trim configurations designed with a two piece cage (cage and cage retainer):

7. Assemble the cage (10) into valve by seating it on top of the seat ring (13).
8. If applicable, install body gasket (25) on to cage (10).
9. Assemble the cage retainer (11) over the valve plug assembly (8) from the top of the plug stem. Make sure the seal ring (9) in the plug groove stays positioned correctly. Insert the cage and plug assembly into the valve body.
10. If applicable, install the conical spring (14) on top of the cage retainer (11).

For trim configurations designed with a single piece cage:

11. Assemble the cage (10) over the valve plug assembly (8) from the top of the plug stem. Make sure the seal ring (9) stays positioned in the plug groove correctly. Insert the cage and plug assembly into the valve body.
12. If applicable, install the conical spring (14) on top of the cage (10).

Bonnet Assembly

1. Make sure the packing (19) and guide bushing (20) have been removed from the bonnet (2).
2. Position the bonnet (2) above the valve body (1), so the packing flange studs (15) are perpendicular to the inlet of the valve.

For configurations designed with a two piece bonnet (bonnet and bonnet flange):

- Assemble the bonnet (2) over the valve stem (7) and push it down carefully. Be careful not to damage the stem during the assembly process.
- Place the metal seal (6) over the bonnet (2) and press the metal seal down into the groove formed between the body and the bonnet.
- Assemble the bonnet flange (3) over the bonnet (2) and align the bolt holes with the body studs (4). Make sure the bonnet flange is also aligned with the metal seal (6). Proceed to Step 8.

For trim configurations designed with a single piece bonnet:

- Assemble the bonnet (2) over the valve stem (7) and push it down carefully to align the bolt holes with the body studs (4). Be careful not to damage the stem during the assembly process.
- Install body gasket (25) on to the groove on top of the valve body (1).
- Grease the threads of the valve body studs (4) and the bearing surfaces of the body stud nuts (5).
- Assemble the body stud nuts (5) manually. Hand tight-en the nuts evenly so the internal parts are held in place. The face of the bonnet should be parallel to the upper face of the valve body.
- If applicable, slide the guide bushing (20) onto the valve plug stem (7) and let it drop to the bottom of the packing box.

Tightening Body Nuts

In order to achieve perfect alignment of the body and the internal components, it may be beneficial to provide loading to the plug stem assembly (8) during tightening. This may benefit the positioning of various parts in installations where the actuator and trim are installed horizontally.

The force can be applied with the actuator as follows:

Place the actuator on the valve bonnet (2) by means of the yoke nut (29) or bolted connections and connect the valve plug stem (7) to the actuator stem.

CAUTION

During this operation, make sure the plug does not turn when it is seated. If the plug travel is very small and there is a large amount of plug stem inside the actuator, it may be necessary to remove the yoke nut and lift the actuator so that the plug is not touching the seat.

Refer to the appropriate instruction manual for the actuator and each unique accessory.

Tighten the body nuts (5) evenly by applying the torque indicated on the valve assembly drawing (typical torque values are provided as references in Table 2) consult factory for other arrangements not shown on the table. Use the tightening sequence as indicated in Figure 9.

Packing Box Assembly

Assemble the packing box components per the maintenance instructions in the Packing Box maintenance procedure on Page 6.

Bolt Torque Sequence

Figure 8 details the tightening sequence for the bonnet/body bolts torques for a 72000 Series. Evenly apply torque to the amount indicated on the valve assembly drawing (typical torque values for SA193 B7, SA193 B7M, and SA193 B16 bolting materials are provided as references in Table 2).

TORQUE Body/Bonnet Bolting Requirements					
Valve Size		Body Nuts		Assembly Torque	
Nominal size (in)	Pressure rating	Size (in)	Quantity	ft.lb	N.m
3	150/300	3/4 10	8	133	180
	600	3/4 10	8	163	220
	900	1 1/4 8	6	563	760
	1500	1 1/4 8	6	815	1100
4	150/300	7/8 9	8	170	230
	600	7/8 9	8	259	350
	900	1 1/2 8	6	889	1200
	1500	1 1/2 8	6	1370	1850
6	150/300	1 8	8	326	440
	600	1 8	12	237	320
	900	1 3/4 8	8	1370	1850
	1500	1 3/4 8	8	1370	1850
8	150/300	1 1/4 8	8	526	710
	600	1 1/4 8	12	481	650
	900	1 3/4 8	8	1370	1850
	1500	1 3/4 8	8	1778	2400
10	150/300	1 1/2 8	8	852	1150
	600	1 1/2 8	12	852	1150
	900	1 3/4 8	12	1370	1850
	1500	1 3/4 8	12	1630	2200
12	150/300	1 1/2 8	8	926	1250
	600	1 1/2 8	12	852	1150
	900	1 1/2 8	16	926	1250
	1500	1 3/4 8	16	1630	2200
16	150/300	1 1/2 8	12	852	1150
	600	1 1/2 8	16	826	1250
	900	1 1/2 8	20	1111	1500
	1500	1 3/4 8	20	1926	2600

Table 2 - Body/Bonnet Bolting Torque

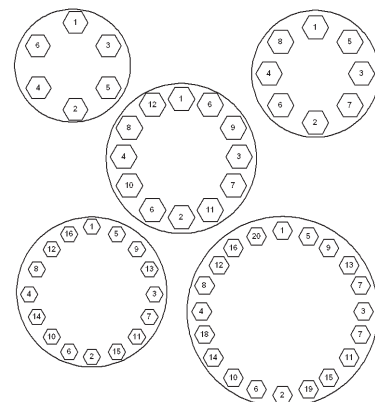


Figure 9 - Bolt Torque Sequence

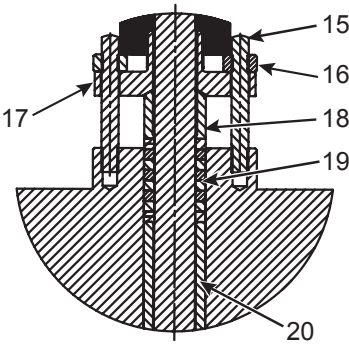
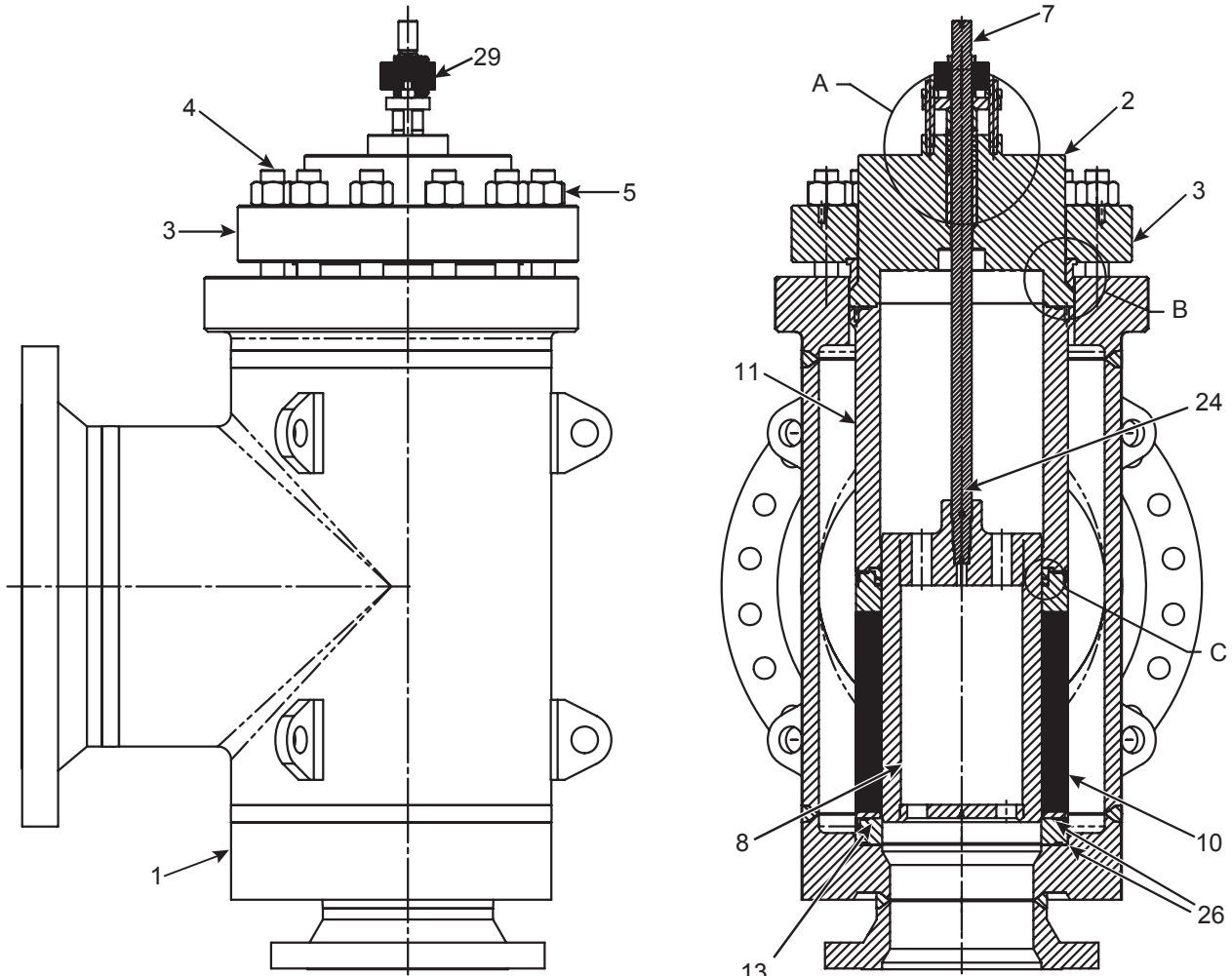
Parts Reference For 72000 Series Control Valve

Item No.	Description
1	Body
2	Bonnet
3	Bonnet Flange
4	Body Stud
5	Body Nut
6	Metal Seal
7	Stem
8	Plug
9	Seal Ring
10	Cage (V-Log or Lo-dB)
11	Cage Retainer
12	Soft Seat Insert
13	Seat Ring
14	Conical Spring
15	Packing Flange Stud
16	16 Packing Flange Nut
17	Packing Flange
18	Packing Follower
• 19	Packing S/A
20	Guide Bushing
21	Auxiliary Pilot Plug
22	Pilot Spring
23	Retaining Ring
24	Groove Pin
• 25	Body Gasket
• 26	Seat Ring Gasket
• 27	Cage Gasket
28	Back-Up Ring
29	Yoke Nut

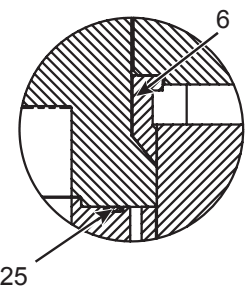
Table 3

Parts may differ according to specific valve supplied.
All parts may not be applicable.

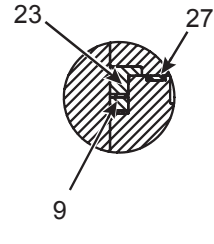
- Recommended Spare Parts (some parts may not be applicable to all designs)



DETAIL A
SCALE 1 : 2



DETAIL B
SCALE 2 : 3



DETAIL C
SCALE 2 : 3

Figure 10 - 72000 Series Cross Section

Actuation

Type 87/88 Multi-Spring Diaphragm Actuators Connecting Type 87 (Air to Extend)

No. 6 Actuator (Figure 11)

1. Tightly assemble the hex nuts (1) onto the plug stem.
2. Push down the actuator, and screw on the yoke nut (33) at the same time. Then assemble the bottom stem connector (2). As soon as it becomes possible, insert the valve stem into the actuator stem (10). The stem must be inserted far enough so that when there is no air in the actuator, the valve plug does not touch the seat.
3. Tighten the yoke nut (33).
4. Supply air to the actuator at the final pressure.
5. Use the pointer (7) to set the travel scale (9) to the valve open position.
6. Supply the actuator with air at a sufficiently high pressure to obtain a travel equal to the nominal travel of the valve.
7. Unscrew the plug stem until the valve plug is in contact with the seat. Do not turn the valve plug on the seat as this could damage the sealing surfaces.
8. Screw the hex nuts (1) as far as they will go and check that operation is correct.

Connecting Type 88 (Air to Retract)

No. 6 Actuator (Figure 11)

1. Tightly assemble the hex nuts (1) onto the plug stem.
2. Push down the actuator, and screw on the yoke nut (33) at the same time. Then assemble the bottom stem connector (2). As soon as it becomes possible, insert the valve stem into the actuator stem (10). The stem must be inserted far enough so that when there is no air in the actuator, the valve plug does not touch the seat.
3. Tighten the yoke nut (33).
4. Unscrew the valve plug stem until the valve plug comes into contact with the seat. Do not turn the valve plug on the seat as this could damage the sealing surfaces.
5. Supply air to the actuator until the stem has travelled at least .40 inches (10 mm).
6. Unscrew the plug stem by the number of turns N1 specified in Table 4.

Note: For model 724XX valves, use the N2 values in Table 4 to ensure seating tightness of the pilot plug.

Plug Stem Diameter	N1 (turn)	N2 844XX (turn)	in	mm
1"	1.25	4.75	0.09	2.3
3/4"	1.25	4.25	0.08	2.0
5/8"	1.5	3.5	0.08	2.0
1/2"	1.5	3	0.075	1.9

Table 4 - Type 88, Air to Retract - valve seating

7. Screw the hex nuts (1) as far as they will go and check that operation is correct.
8. Use the pointer (7) to set the travel scale (9) to the valve closed position.

Connecting Type 87 (Air to Extend) No. 10, 16 and 23 Actuators (Figure 11)

1. Tightly assemble hex nut (1) onto the plug stem.
2. Screw the top stem connector (4) assembly tightly onto the actuator stem (10).
3. Push down the actuator, and screw on the yoke nut (33) at the same time. Then assemble the bottom stem connector (2) assembly by screwing until it comes into contact with the hex nut (1).
4. Push down the actuator and tighten the yoke nut (33).
5. Supply the actuator with air at the initial pressure indicated on the spring scale.
6. Position the stem connector assembly at distance "X" indicated in Table 5.
7. Use the pointer (7) to set the travel scale (9) to the valve open position.
8. Supply the actuator with air at a high enough pressure to obtain a travel equal to the nominal travel of the valve. Note: For model 724XX valves, reduce the travel by Value A indicated in Table 6.
9. With the plug correctly positioned on the seat, unscrew the bottom stem connector (2) assembly until it comes into contact with the top stem connector (4). Tighten the socket head cap screws (5), hex nut (1) and lock nut (32) and check that the operation is correct.

Connecting Type 88 (Air to Retract) No. 10, 16 and 23 Actuator (Figure 11)

1. Supply the actuator with air to retract stem.
2. Unscrew the top stem connector (4) in accordance with dimension "X" in Table 5.
3. Tightly assemble hex nut (1) onto the plug stem.
4. Tightly screw the top stem connector (4) assembly onto the actuator stem (10).
5. Push down the actuator, and screw on the yoke nut (33) at the same time. Then assemble the bottom stem connector (2) assembly by screwing until it comes into contact with the hex nut (1).
6. Push down the actuator and tighten the yoke nut (33).
7. With the plug correctly positioned on the seat, unscrew the bottom stem connector (2) assembly to bring it into contact with the top stem connector (4).
8. Supply air to the actuator until the stem has travelled at least 0.40 inches (10 mm).
9. Unscrew the top stem connector (4) by the number of turns N1 specified in Table 4 then lock manually with hex nut (1).

Note: For model 724XX valves, use N2 values in Table 4 to ensure seating tightness of the pilot plug.

10. Release the pressure in the actuator. Use pointer (7) to set the travel scale (9) to the actuator supply pressure so that the two stem connectors come into contact. Then tighten the socket head cap screws (5), hex nut (1), and lock nut (32).
11. Shut off the closed valve pressure and check that operation is correct.

Actuator Size	Travel		"X" Actuator 87		"X" Actuator 88	
	in	mm	in	mm	in	mm
10	0.8	20	5.12	130.0	4.62	117.3
10	1.5	38	5.44	138.2		
16	0.8	20	8.00	203.2	7.02	178.3
16	1.5	38	8.50	228.6		
16	2.0	51	9.28	235.7		
16	2.5	63.5	9.50	241.3		
23	0.8	20	8.25	209.5		
23	1.5	38	8.62	218.9		
23	2.0	51	9.12	231.6		
23	2.5	63.5	9.59	243.6		

Table 5 - Position of Top Stem Connector

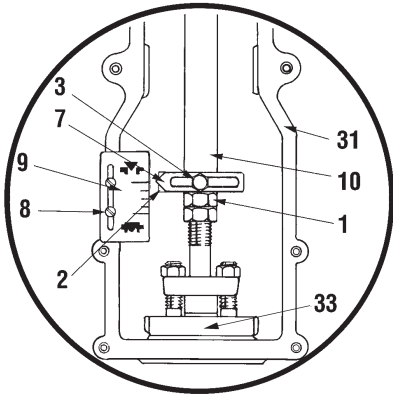
Valve Size (inches)	Pressure Rating	Value A	
		in	mm
2	150, 300 or 600	0.1	2.5
2	900 or 1500	0.08	2
3 and 4	150, 300 or 600 900 or 1500	0.12	3
6		0.2	5
8		0.24	6
10, 12 and 16		0.275	7

Table 6 - Auxiliary Pilot Plug Travel

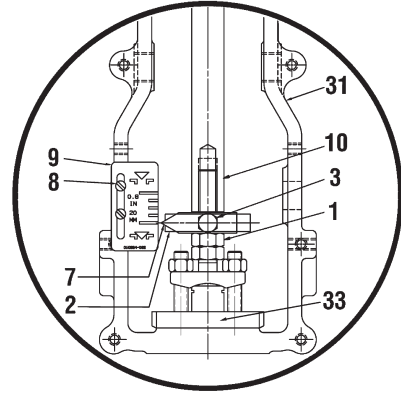
Item No.	Description
1	Hex Nut
2	Stem Connector, Bottom
3	Cap Screw, Hex Head
● 4	Stem Connector, Top
● 5	Cap Screw, Socket Head
● 6	Connector Insert
7	Pointer
8	Screw, Pan Head
9	Scale, Travel
10	Actuator Stem
31	Yoke, Machining
● 32	Lock Nut
33	Yoke Nut

Table 7

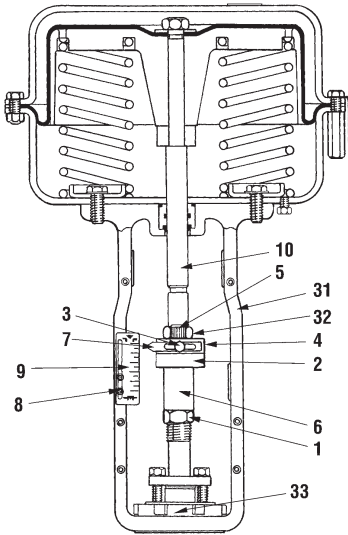
- Not provided for Size 6 Actuator



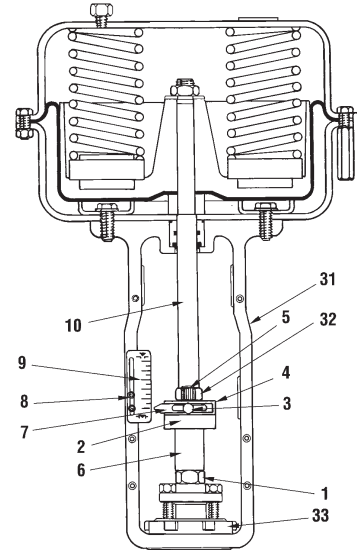
Type 87 Air to Close
No. 6



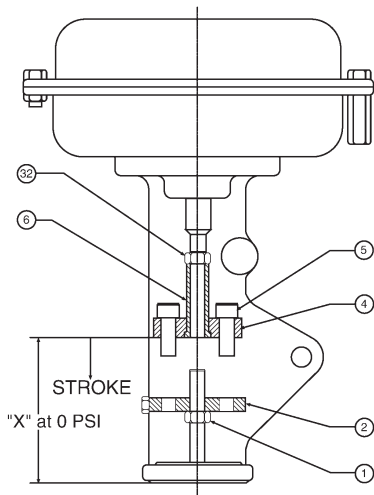
Type 88 Air to Open
No. 6



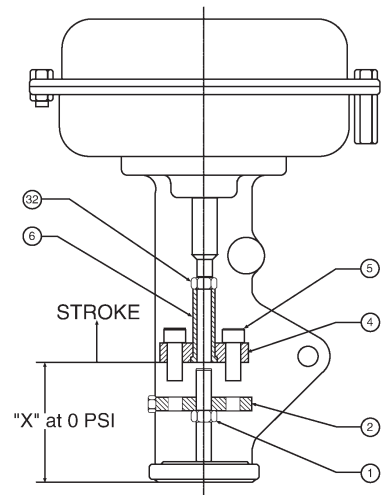
Type 87 Air to Close
No. 10-16-23



Type 88 Air to Open
No. 10-16-23



Model 87 Actuator
Air to Extend (Close)



Model 88 Actuator
Air to Retract (Open)

Figure 11

**Type 51/52/53 Cylinder Actuators
Connecting Double Acting (Model 51)
(Figures 14 & 15)**

1. Install actuator on the valve body with drive nut.
2. Connect manual loading panel tubing to the Top Plate (17).
3. Apply required air pressure through the manual loading panel to completely extend the actuator stem.
4. Reconnect manual loading panel tubing from the Top Plate (17) to the Yoke (1), which is integrated into the bottom plate connection.
5. Retract the actuator stem either pneumatically or with a handwheel approximately .1" (2mm) using the visual stroke scale as shown in Figure 12.

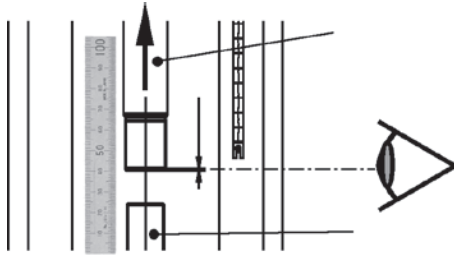


Figure 12

6. Assemble the Split Clamp (22).

Note: If the split clamp does not engage with both stems, then retract the actuator stem until alignment and engagement is achieved.

CAUTION

Make sure the valve is fully extended.

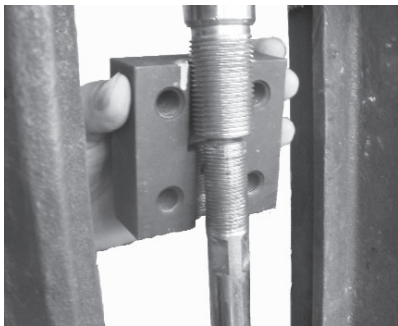


Figure 13

7. Assemble and tighten Indicator Arm (23), Spring Lock Washers (25), and Hexagon Bolts (24).
8. Line up the indicator plate (26), with Indicator arm (23) and check actuator for proper operation.

Connecting Air to Extend (Model 52) (Figure 16)

1. Install actuator on the valve body with drive nut.
2. Connect manual loading panel tubing to the top plate (17).
3. Apply required air pressure through the manual loading panel to completely extend the actuator stem.
4. Extend the actuator stem either pneumatically or with a handwheel approximately .1" (2mm) using the visual stroke scale as shown in Figure 12.
5. Assemble the Split Clamp (22).

Note: If the split clamp does not engage with both stems, then extend the actuator stem until alignment and engagement is achieved.

CAUTION

Make sure the valve is fully extended.

6. Assemble and tighten Indicator Arm (23), Spring Lock Washers (25), and Hexagon Bolts (24).
7. Line up the indicator plate (26), with Indicator arm (23) and check actuator for proper operation.

Connecting Air to Retract (Model 53) (Figure 17)

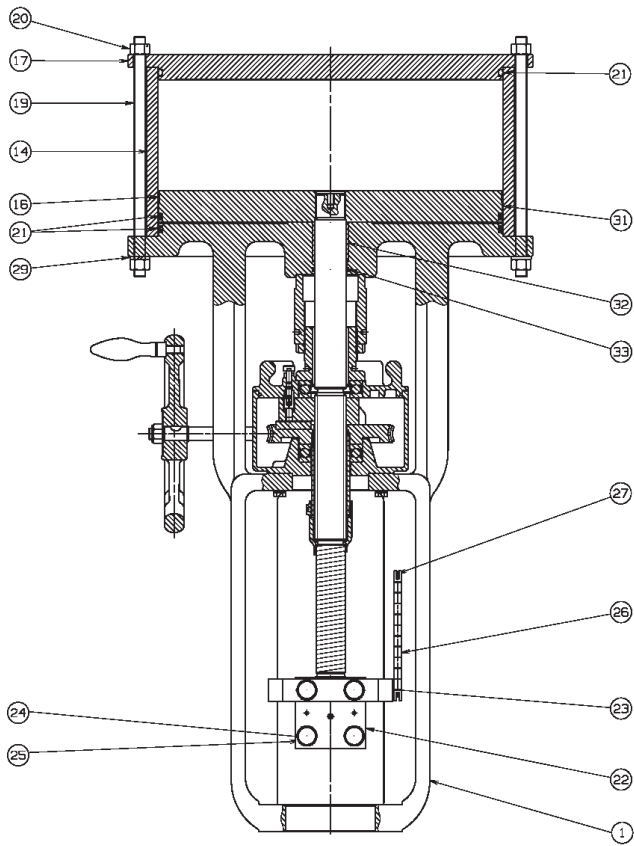
1. Install actuator on the valve body with drive nut.
2. Connect manual loading panel tubing to the yoke (1), which is integrated into the bottom plate connection.
3. Retract the actuator stem either pneumatically or with a handwheel approximately .1" (2mm) using the visual stroke scale as shown in Figure 12.
4. Assemble the Split Clamp (22).

Note: If the split clamp does not engage with both stems, retract the actuator stem until alignment and engagement is achieved.

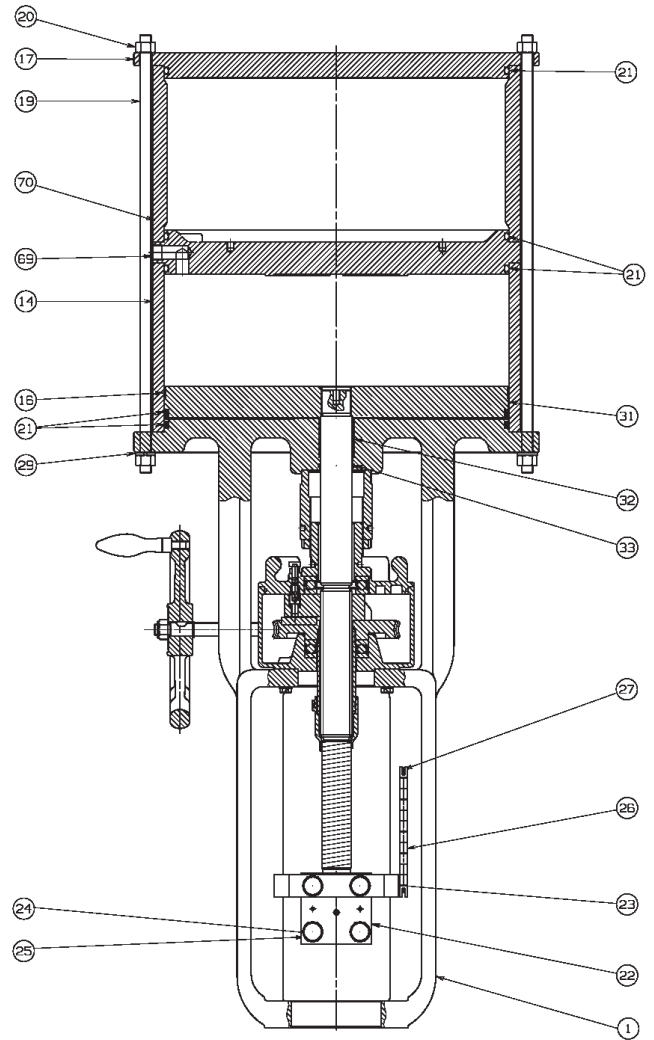
CAUTION

Make sure the valve is fully extended.

5. Assemble and tighten Indicator Arm (23), Spring Lock Washers (25), and Hexagon Bolts (24).
6. Line up the indicator plate (26), with Indicator arm (23) and check actuator for proper operation.

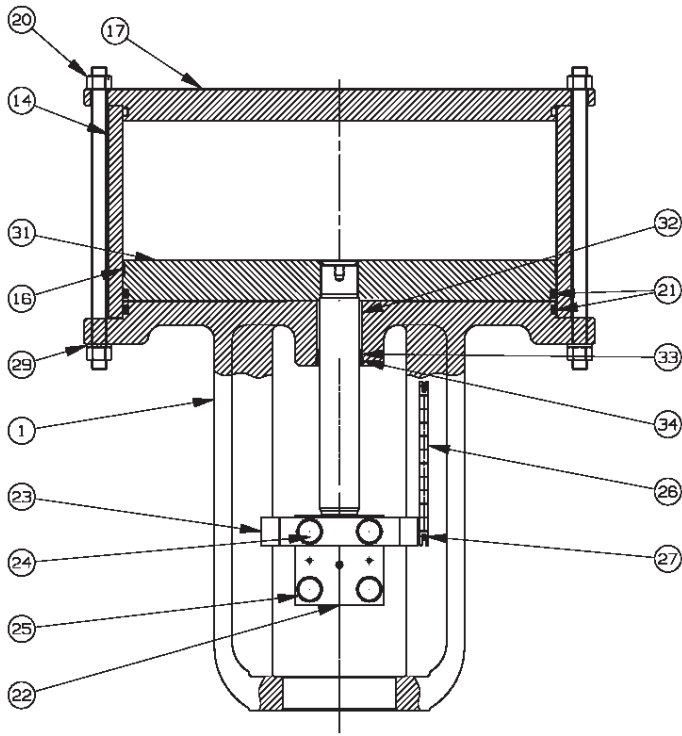


Model 51 Double Acting
With handwheel without volume chamber

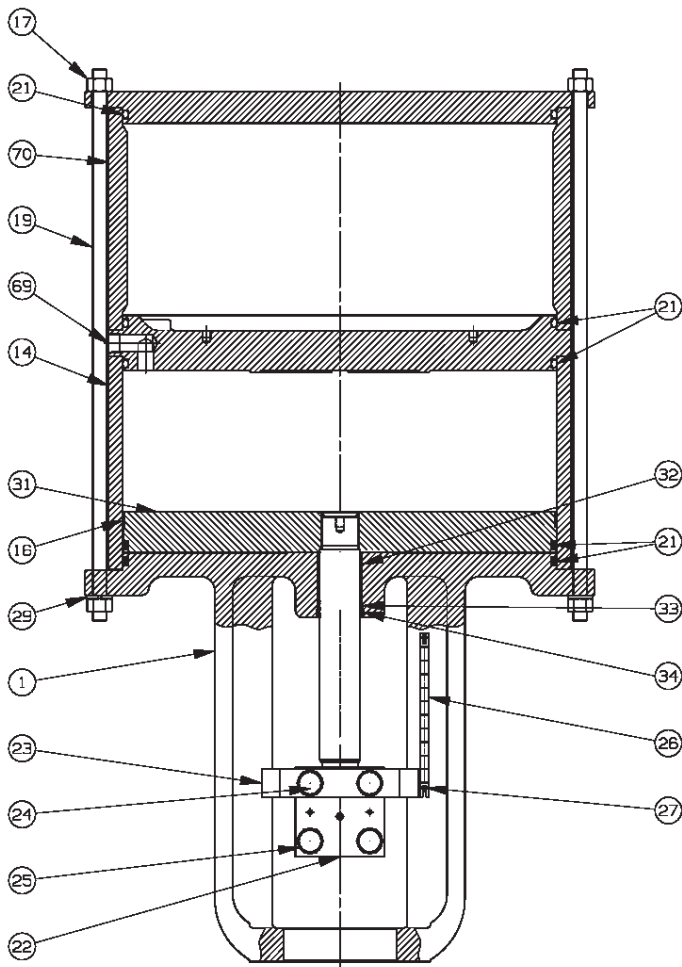


Model 51 Double Acting
With handwheel with volume chamber

Figure 14

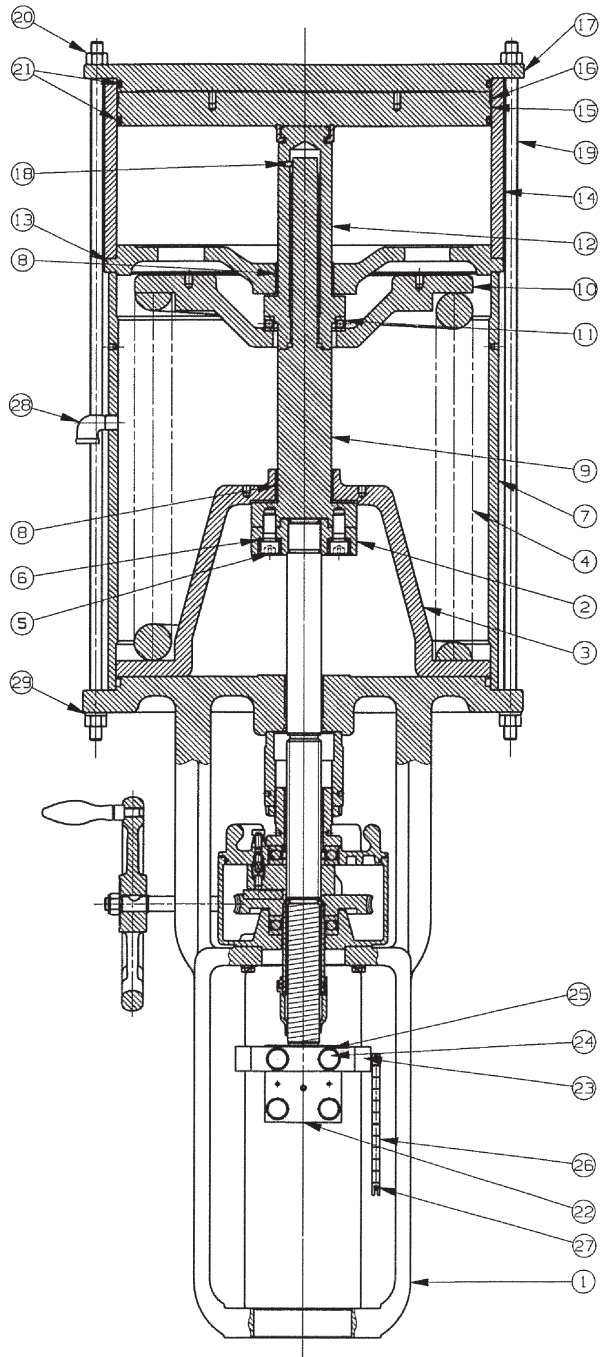


Model 51 Double Acting
Without handwheel without volume chamber

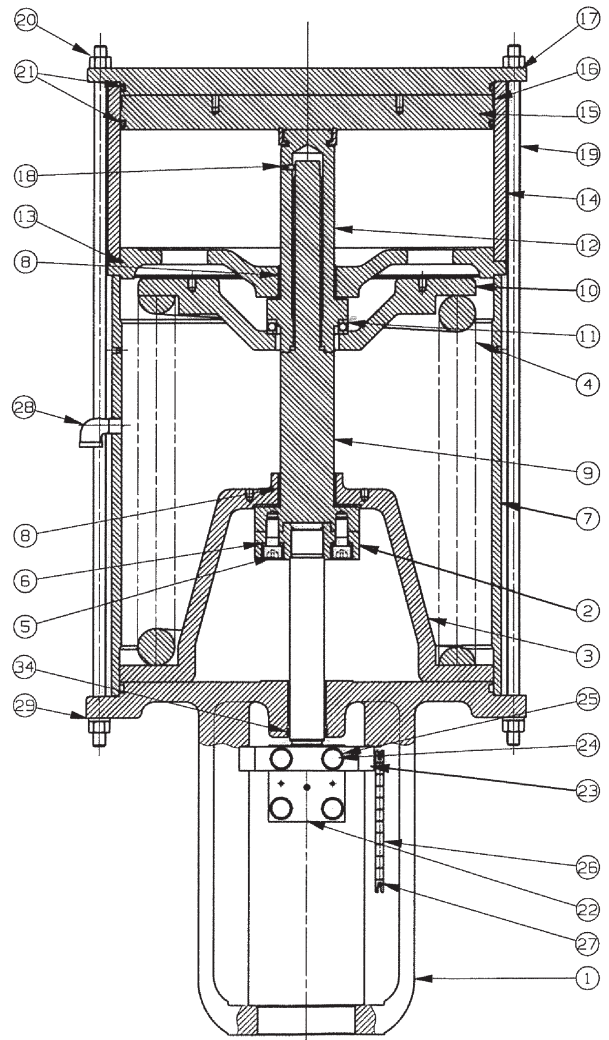


Model 51 Double Acting
Without handwheel with volume chamber

Figure 15

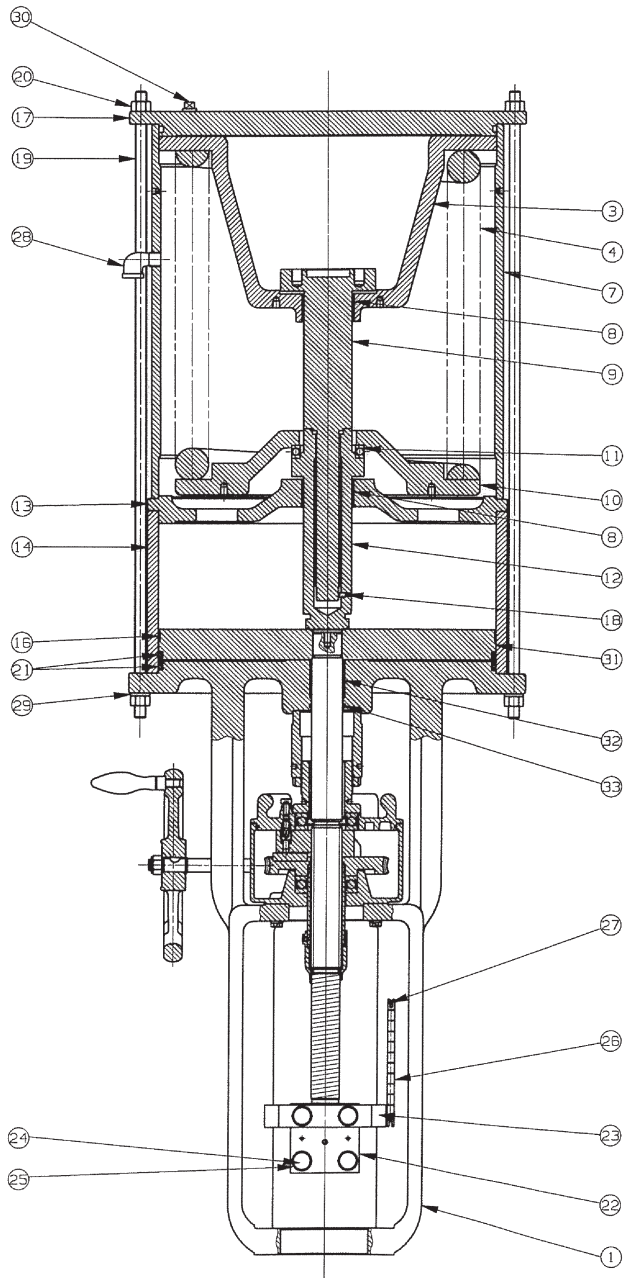


Model 52
Air to extend with handwheel

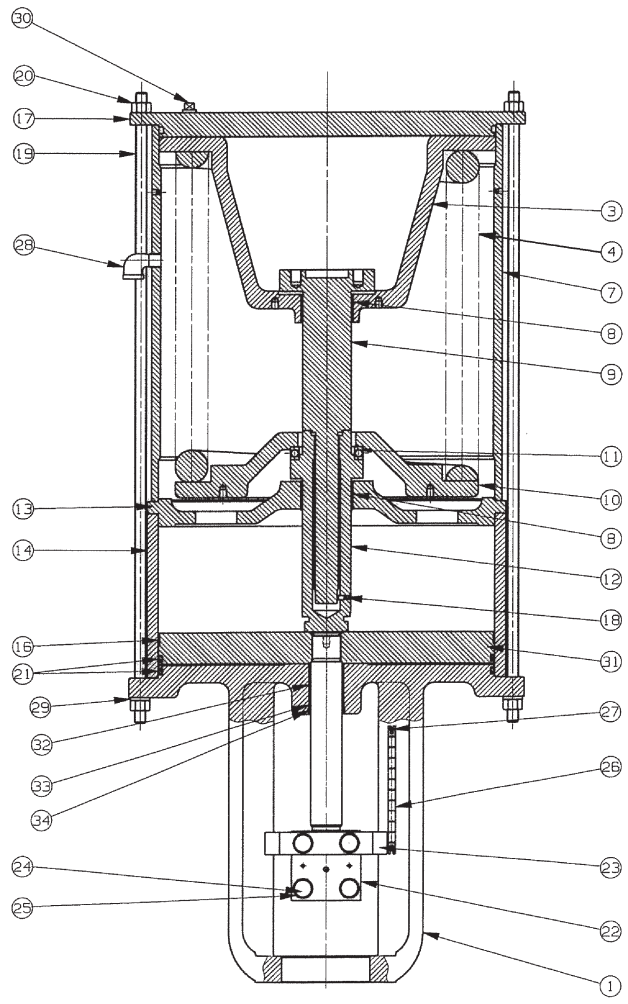


Model 52
Air to retract without handwheel

Figure 16

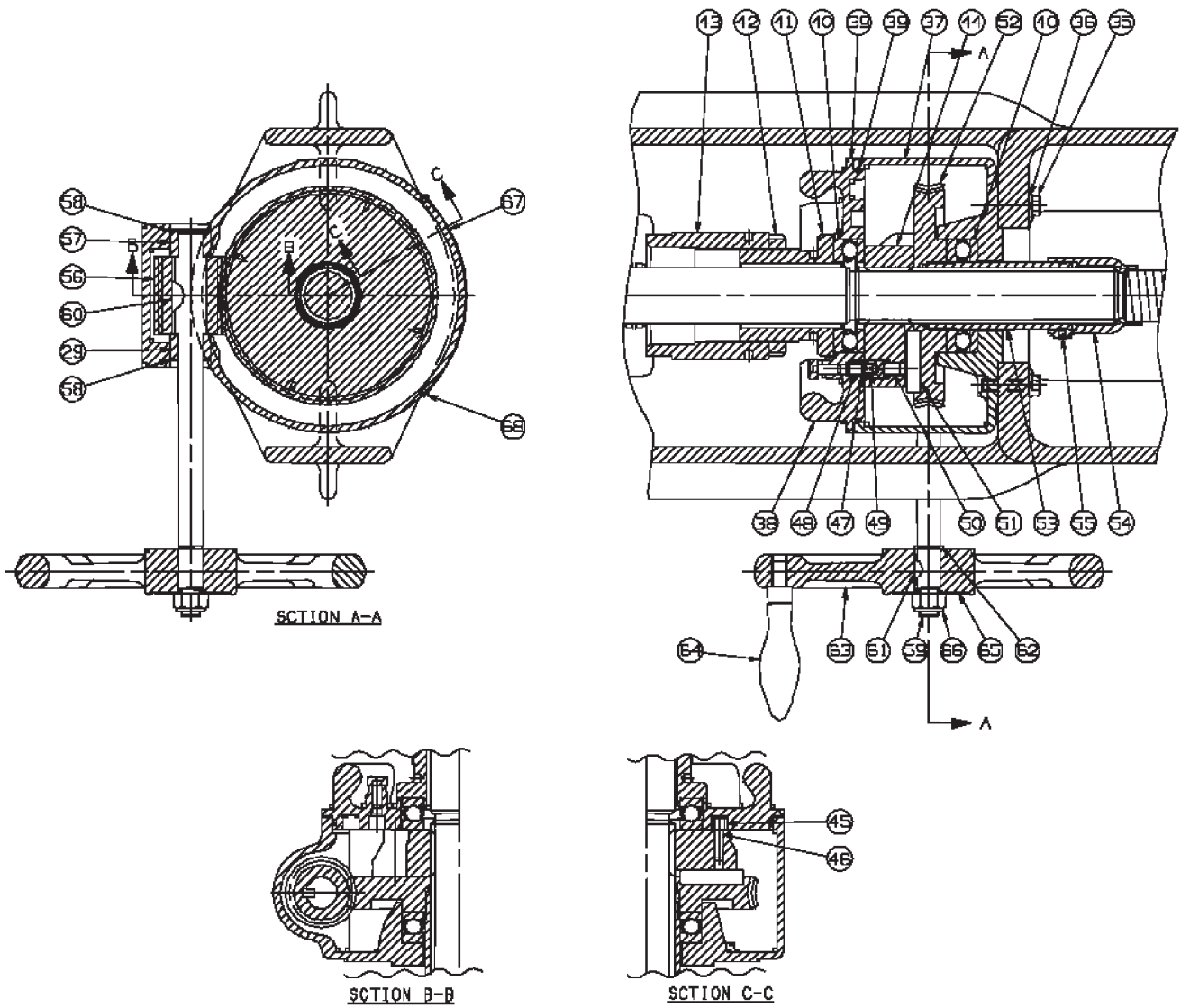


Model 53
Air to extend with handwheel



Model 53
Air to retract without handwheel

Figure 17



CM, DM handwheel
 Typical for Models 51/52/53

Figure 18

Parts Reference Table 51/52/53 Actuators

Ref. #	Description	Ref. #	Description	Ref. #	Description
1	Yoke	24	Hexagon bolt	47	Locking pin case
2	Piston rod S/A	25	Spring lock washer	48	Pin
3	Lower spring button	26	Spring lock washer	49	Spring
4	Spring	27	Cross recessed head screw	50	Hexagon socket set screw
5	Hexagon socket head cap screw	28	Exhaust pipe	51	Guide key
6	Spring lock washer	29	Spring lock washer	52	Worm gear
7	Spring tube	30	Plug	53	Spacer tube
8	Guide bushing	● 31	Piston S/A	54	Adapter
9	Compression bolt	● 32	Guide bushing	55	Set screw
10	Upper spring button	● 33	O-ring (Piston rod)	56	Worm
11	Thrust bearing	● 34	Rod scraper	● 57	Bearing
12	Compression nut	35	Hexagon bolt	58	Retaining ring
13	Separator plate/ Model 52/53	36	Spring lock washer	59	Hand wheel shaft
14	Cylinder tube	37	Gear box	60	Key (Worm)
15	Piston plate S/A	38	Gear box cover S/A	61	Gear box cover S/A
● 16	Guide ring	● 39	O-ring	62	Retaining ring
17	Top plate	● 40	Thrust bearing	63	Handwheel
18	Set screw	41	Adjustment screw	64	Grip
19	Center bolt	42	Locking nut	65	Directional plate
20	Hexagon nut	43	Adjustment nut	66	Self locking nut
● 21	O-ring (Piston, Top plate)	44	Piston rod engagement	67	Operating information plate
22	Split clamp	● 45	Bearing	68	Drive screw
23	Indicator arm	46	Retaining pin	69	Separator plate (Model 51)
				70	Volume chamber tube

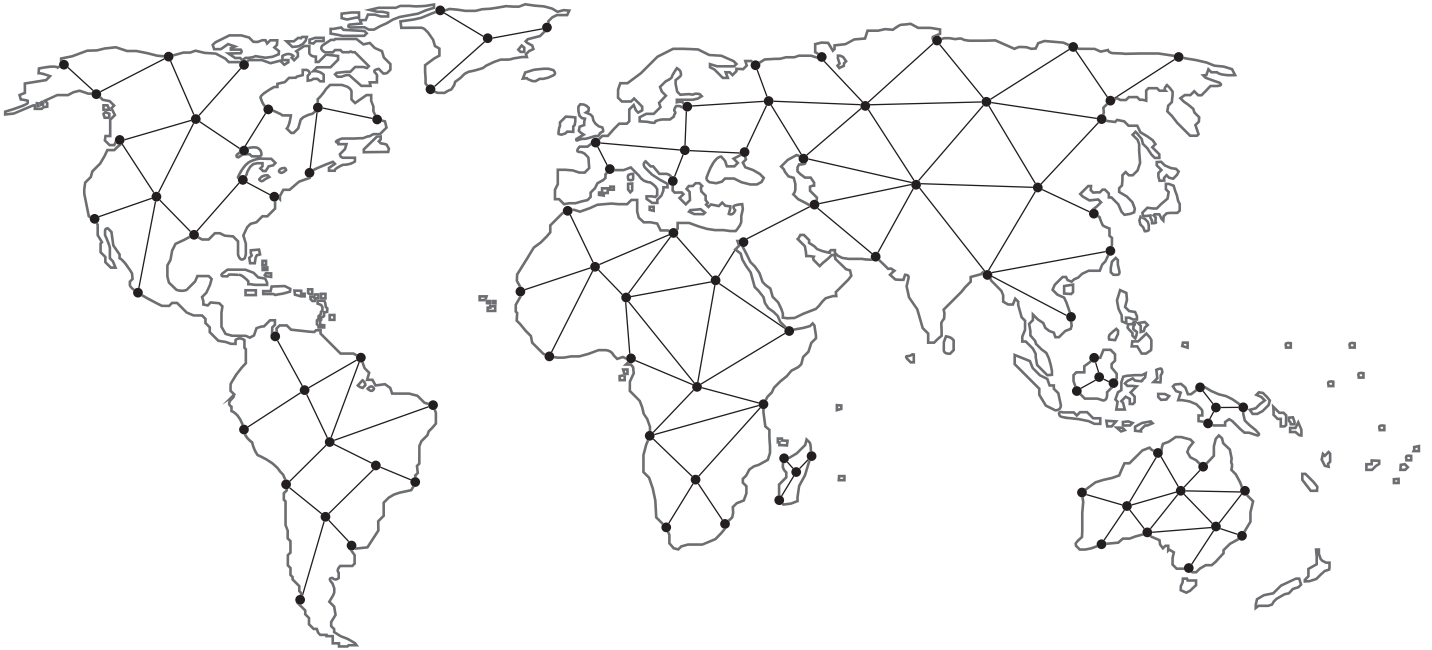
Table 8

● Recommended Spare Parts

Notes

Find the nearest local Channel Partner in your area:

valves.bakerhughes.com/contact-us



Tech Field Support & Warranty:

Phone: +1-866-827-5378

valvesupport@bakerhughes.com

valves.bakerhughes.com

Copyright 2021 Baker Hughes Company. All rights reserved. Baker Hughes provides this information on an "as is" basis for general information purposes. Baker Hughes does not make any representation as to the accuracy or completeness of the information and makes no warranties of any kind, specific, implied or oral, to the fullest extent permissible by law, including those of merchantability and fitness for a particular purpose or use. Baker Hughes hereby disclaims any and all liability for any direct, indirect, consequential or special damages, claims for lost profits, or third party claims arising from the use of the information, whether a claim is asserted in contract, tort, or otherwise. Baker Hughes reserves the right to make changes in specifications and features shown herein, or discontinue the product described at any time without notice or obligation. Contact your Baker Hughes representative for the most current information. The Baker Hughes logo, MARC and Masoneilan are trademarks of Baker Hughes Company. Other company names and product names used in this document are the registered trademarks or trademarks of their respective owners.

Baker Hughes 

bakerhughes.com