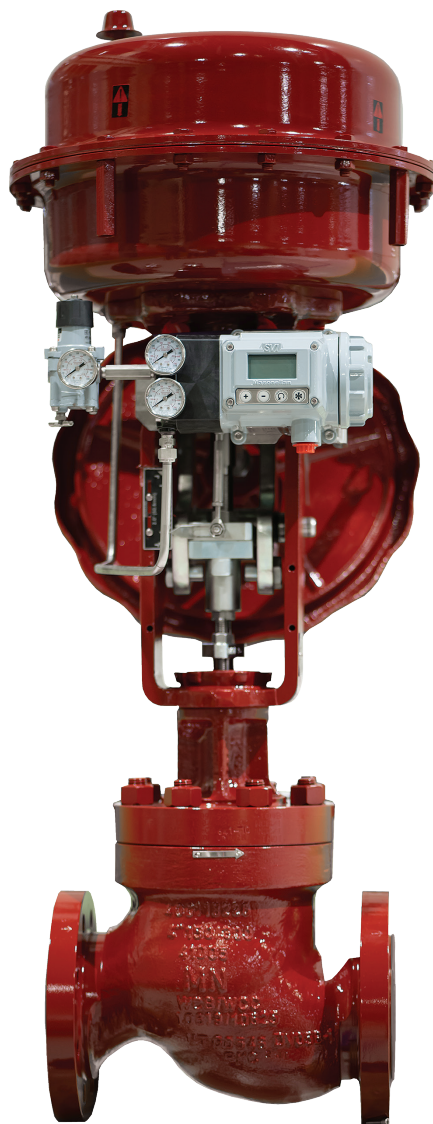


21000 Series

Top Guided Globe Valve

with Lo-dB™, Anti-cavitation and API 6A capabilities

Instruction Manual (Rev. G)



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.

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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 21000 Series control valves, and do not apply for other valves outside of this product line.

Useful Life Period

The current estimated useful life period for the 21000 Series control valves is 25+ years. To maximize the useful life of the product, it is essential to conduct annual inspections, routine maintenance and ensure proper installation to avoid any unintended stresses on the product. The specific operating conditions will also impact the useful life of the product. 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 usage. Baker Hughes reserves the right to discontinue manufacture of any product or change product materials, design or specifications without notice.

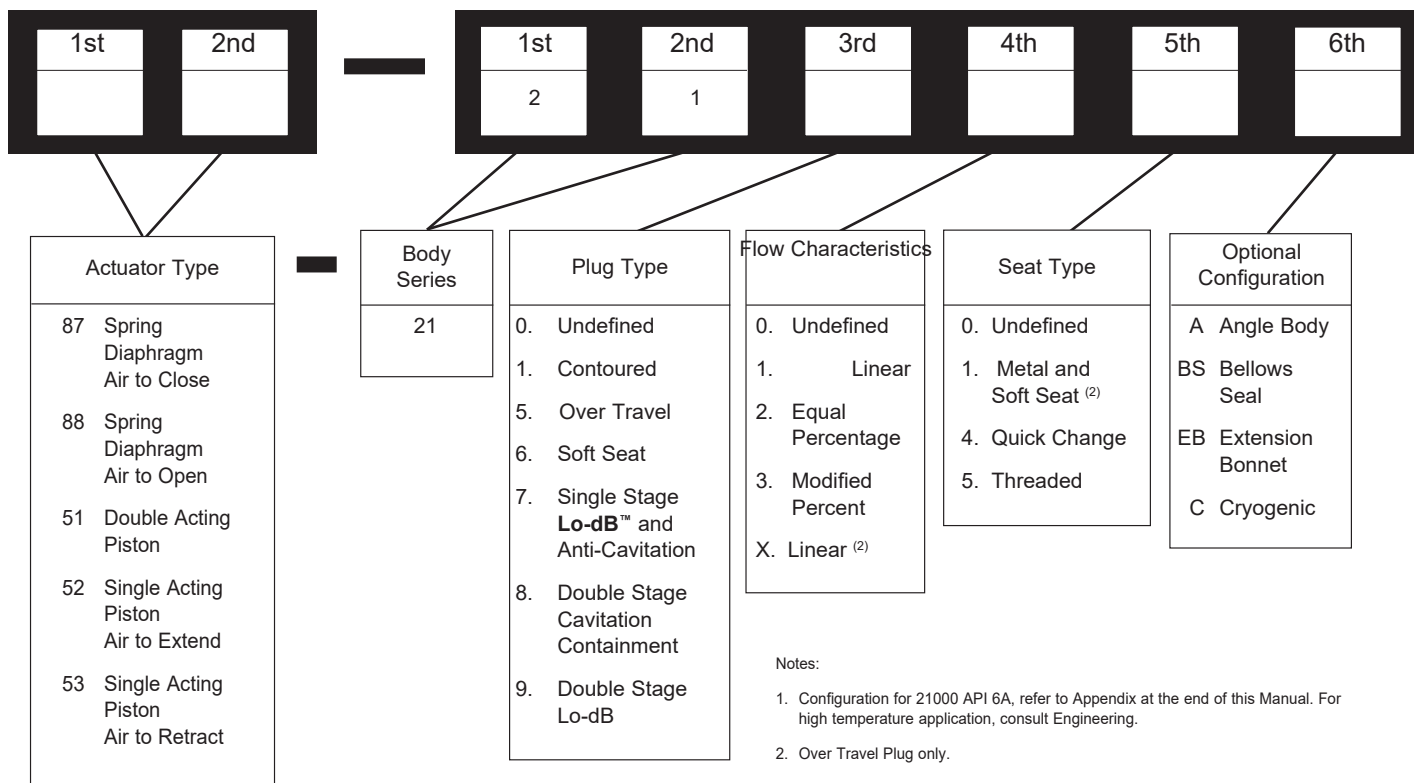
Prior to installation:

- The valve 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.
- 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.
- 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.

! WARNING

1. It is the end user's responsibility to ensure properly loaded and supported piping to avoid undesired stresses on the product which may result in damage to the product, loss of containment, or loss of functionality and resulting unsafe states or conditions.
2. It is the end user's responsibility to correctly identify end locations and place product in areas that may contain explosive atmospheres. The failure of properly following the test, installation, maintenance and disassembly/assembly instructions may result in a compromised product which in turn could result in an uncontrolled or unexpected loss of containment and release of pressure.
3. It is the end user's responsibility to take appropriate actions to ensure that site personnel who are performing installation, commissioning, and maintenance have been trained in proper site procedures for working with and around Baker Hughes supplied equipment, per Safe Site Work Practices.
4. The failure of properly following the test, installation, maintenance and disassembly/assembly instructions may result in a compromised product which in turn could result in an uncontrolled /unexpected loss of containment and release of pressure. It is the responsibility of the person conducting the tasks listed above to take great care in following such procedures.
5. It is the end user's responsibility to:
 - Recognize and safely contain any leak.
 - Ensure proper Personal Protective Equipment is available and used.
 - Follow Proper lifting techniques and procedures, per Safe Site Work Practices.
6. Proper Lockout/Tagout of energy sources prior to maintenance, per Safe Site Work Practices, is the end user's responsibility. This includes any potential control signals or circuits that may have a remote or automated control function over any product. Instructions to properly release spring stored energy are included in this manual.
7. After installation or maintenance, it is the end user's responsibility to ensure the equipment has been properly inspected and returned to proper condition before being returned to service.

Numbering System



1. Introduction

The following instructions should be thoroughly reviewed and understood prior to installing, operating or performing maintenance on this equipment. Throughout the text, safety and/or caution notes will appear and must be strictly adhered to, otherwise, serious injury or equipment malfunction could result.

Baker Hughes has a highly skilled After Sales Department available for start-up, maintenance and repair of our valves and component parts.

Arrangements for this service can be made through your local Baker Hughes's representative or sales department. When performing maintenance use only **Masoneilan™** replacement parts. Parts are obtainable through your local representative or spare parts department. When ordering parts, always include the model and serial number of the unit being repaired.

2. General

These installation and maintenance instructions apply to all sizes and ratings of the 21000 Series control valves regardless of the type of trim used.

21000 Series single ported top guided control valves are designed with built in versatility making them well-suited to handle a wide variety of process applications.

Standard construction offers a contoured plug (21100 Series) with a threaded seat ring or a quick change seat ring. The heavy top plug guiding provides maximum support to ensure plug stability.

A series of reduced area trim is available to provide wide flow range capabilities in all valve sizes.

Tight Shutoff Class IV leakage is standard. Optional constructions (one of which is the 21600 Series soft seat plug) meet IEC 534-4 and ANSI/FCI 70.2 Class V and VI requirements.

An optional Low Emission "Low-E" Packing is available to ensure compliance with fugitive emission containment requirements.

Replacing the conventional plug with the single stage Lo-dB design (21700 Series) provides excellent noise attenuation and anti-cavitation performance.

The 21800 Series double stage anti-cavitation valve is derived from the 21700 single stage anti-cavitation valve through a modification to the cage and plug. Substitution of the standard cage with an anti-cavitation cage permits the pressure drop to be split between the two stages efficiently.

The 21900 Series double stage Lo-dB valve is also derived from the 21700 single stage Lo-dB valve through

a modification to the cage and plug. Substitution of the standard cage, with a Lo- dB cage permits the pressure drop to be split between the two stages efficiently.

In the 21800/21900 Series designs, enlargement of the plug head up to the cage diameter permits simultaneous throttling of the plug C_v and the cage C_v . It also provides optimum allocation of the pressure drop between the two stages along the entire plug travel.

Recommended spare parts required for maintenance are listed in the Parts Reference table on page 26. The model number, size, rating and serial number of the valve are shown on the identification tag located on the actuator. Refer to page 6 for the 21000 series numbering system.

3. 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.

4. Installation

4.1 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 surfaces should be thoroughly cleaned to ensure leak-proof joints.

4.2 Isolation Bypass Valve

To allow for in-line inspection, maintenance or removal of the valve without service interruption, provide a manually operated stop valve on each side of the 21000 Series valve with a manually operated throttling valve mounted in the bypass line - see Figure 1 below.

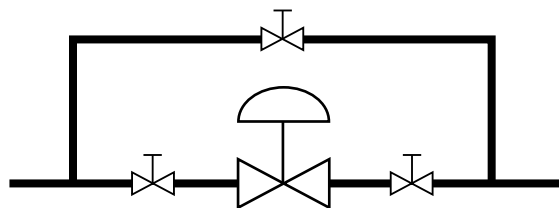


Figure 1 - Typical Installation

4.3 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.

- With contoured plug (21100/21600) or Lo-dB plug (21700/21900) : flow-to-open
- On anti-cavitation design (21700/21800) : flow-to-close

4.4 Heat Insulation

For heat-insulated installation, do not insulate the valve bonnet. Take necessary protective measures related to personal safety.

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 above 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 welding or pre/post weld heat treatment in order to prevent damaging any soft goods (such as PTFE 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 PTFE 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.

5. Air Piping

The actuators are designed to accept 1/4" NPT air supply piping. Use 1/4" OD tubing (4 x 6 mm) or equivalent for all air lines. If the supply air line exceeds 25 feet in length (7 meters) or if the valve is equipped with volume boosters, then 3/8" tubing (6 x 8 mm) is preferred. All connections must be free of leaks.

CAUTION

Do not exceed supply pressure indicated on serial plate located on the yoke of the actuator.

6. Body Disassembly

Access to the internal components of the body can be accomplished with the actuator removed. To remove the actuator from the body, refer to the 87/88 and 51/52/53 Series Actuators Installation, Operation and Maintenance Manuals.

CAUTION

Prior to performing maintenance on the valve, isolate the valve and vent the process pressure. Shut off the supply air line and the pneumatic or electric signal line.

6.1 Threaded Trim

(Figure 7 or 9 on page 19)

After removing the actuator, disassemble the body using the following procedure :

- A. If there is a leak detector connection on the lateral NPT port of the bonnet, disconnect this piping as well.
 - B. Remove body stud nuts (10).
 - C. Remove bonnet (8), and plug stem (1) and plug (16) sub-assembly together as one unit.
- Note: Spiral wound body gaskets (11) are standard in the 21000 Series design and it is imperative that a new gasket be installed each time the valve is disassembled.**
- D. Remove packing flange stud nuts (3), packing flange (4) and packing follower (5).
 - E. Remove plug (16) and plug stem (1) sub-assembly from the bonnet (8).

CAUTION

Care must be taken to avoid damage to the plug and plug guide.

- F. Follow instructions for specific packing type in Section 7.6.1 A, 7.6.2 B or 7.6.3
- G. Bonnet (8), plug (16), bushing (12) and seat ring (14) may now be inspected for wear and service damage. After determining the maintenance required, proceed to the appropriate Section of this instruction manual.

6.2 Quick-Change Trim

(Figure 8 or 10 on page 19)

After removing the actuator, disassemble the body using the following procedure:

- A. If there is a leak detection connection on the lateral NPT port of the bonnet, disconnect this piping as well.
- B. Remove body stud nuts (10).
- C. Remove bonnet (8), and plug stem (1) and plug (16) sub- assembly together as one unit.
- D. Since the cage (13), seat ring (14) and seat ring gasket (15) are held in place by the bonnet, they may now be removed.

Note: Spiral wound gaskets (11 & 15) are standard in the 21000 Series design and it is imperative that new gaskets be installed each time the valve is disassembled.

- E. Remove packing flange stud nuts (3), packing flange (4) and packing follower (5).
- F. Remove plug (16) and plug stem (1) sub-assembly from the bonnet (8).

CAUTION

Care must be taken to avoid damage to the plug and plug guide.

- G. Remove old packing (6) [and optional lantern ring (7) if a leak detection connection has been installed]. Follow instructions for specific packing type in Section 7.6.1 A, 7.6.2 B or 7.6.3.
- H. All components may now be inspected for wear and service damage. After determining the maintenance required, proceed to the appropriate Section of this instruction manual.

7. 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.

7.1 Threaded Seat Ring Removal

(Figure 7 or 9 on page 19)

Threaded seat rings (14) are installed tightly by the manufacturer, and after years of service they may be difficult to remove.

To facilitate removal, seat ring wrenches can be fabricated to engage the seat ring lugs and adapted to a standard wrench. If the seat ring is exceptionally resistant to removal, the application of heat or penetrating oil should be helpful.

CAUTION

When using heating devices, ensure that proper safety practices are observed. Flammability and toxicity of the process fluid must be considered and proper precautions taken.

7.2 Bushing Removal

The bushing (12) is press fit into the bonnet and does not normally require replacement. If necessary, it may be pulled or machined out. When machining the bushing out, care must be taken to maintain proper dimensions and tolerances in the bonnet. These will be furnished upon request.

7.3 Lapping Seats

Lapping is the process of working the valve plug against the seat ring with an abrasive to produce a close fit. If valve leakage is excessive, lapping becomes necessary. The plug and seat ring seating surfaces should be free of large scratches or other defects, and the contact surfaces of the seats should be as narrow as possible. This may require dressing both parts in a lathe. The seating surface angle of the plug is 28 degrees and the seat ring is 30 degrees (relative to the centerline axis). A good grade of fine grinding compound is required for the lapping operation.

The compound should be mixed with a small quantity of lubricant such as graphite. This will slow the cutting rate and prevent tearing of the seating surfaces. The amount of lapping required depends on the materials, condition of seating surfaces, and accuracy of machining. If a short period of lapping does not visibly improve seating, there is usually no advantage in continuing as excessive lapping may result in rough seats. The only remedy is replacement

or re-machining of one or both parts. When lapping new plugs and seat rings, begin with a medium fine (240 grit) and finish with a finer grade (600 grit).

Note: Lapping should produce a line contact area, not the entire surface, due to the difference in seat angles.

CAUTION

Before lapping, the plug and stem sub-assembly must be concentric. (See pinning operation, section 7.5).

7.3.1 Threaded Trim (Figure 7 or 9 on page 19)

1. Clean body gasket surface areas.
2. When seat (14) has been removed, ensure that the sealing surface in the body bridge and the threads are thoroughly cleaned.

Note: A sealant compatible with the process should be applied sparingly to the seat ring threads and sealing shoulder.

3. Install and tighten seat ring (14) using fabricated wrench used for removal.

CAUTION

Do not overtighten. Do not strike seat ring lugs directly. This could distort the seat ring resulting in seat leakage.

4. Apply lapping compound on the plug (16) at several spots equally spaced around the seating area.
5. Insert the stem and plug sub-assembly carefully into the body until it is seated.
6. Place bonnet (8) on the body and fasten the bonnet to the body using four body stud nuts (10) spaced equally apart. Apply slight pressure and tighten evenly.

CAUTION

Do not tighten nuts to final torque specifications at this time. The bonnet is used temporarily for guiding purposes only.

7. Insert two or three pieces of packing (6) into the packing box to assist in guiding the stem and plug during lapping.

8. Screw a drilled and tapped rod with a T-handle onto the plug stem and secure with a locknut - see Figure 3 on page 17.

Note: As an alternative, drill a hole through a flat steel plate and fasten to the plug stem using two locknuts.

9. Apply slight pressure on the stem, and rotate the stem in short oscillating strokes (around 8 to 10 times). Repeat this step as necessary.

Note: The plug should be lifted and turned 90° each time before repeating Step (9). This intermittent lifting is required to keep the plug and seat ring concentric during lapping.

CAUTION

Avoid over-lapping as this can cause damage to the seating surface that can further degrade leakage performance.

10. After completion of the lapping operation, remove bonnet and plug. The seating area of the seat ring and the plug must be cleaned of all lapping compound in preparation for reassembly. Do not remove seat ring.

7.3.2 Quick-Change Trim

(Figure 8 or 10 on page 19)

1. Clean body gasket surface areas.
2. Install a new seat ring gasket (15) and insert seat ring (14) in the body.

Note: Gasket (15) 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 ensure the correct position of the seat ring during lapping. This gasket (or similar part) can be kept after lapping for future use. The gasket used for lapping must not be reused for the body reassembly.

3. Apply lapping compound at several spots equally spaced around the seating area of the seat ring.
4. Insert the cage (13) into the body.
5. Insert the stem and plug sub-assembly carefully into the body until it is seated.
6. Place bonnet (8) on the body.

CAUTION

Ensure that the seat ring (14), cage (13) and bonnet (8) are properly aligned.

7. Fasten the bonnet to the body using four body stud nuts (10) spaced equally apart. Apply slight pressure and tighten evenly.

CAUTION

Do not tighten nuts to final torque specifications at this time. The bonnet is used temporarily for guiding purposes only.

8. Insert two or three pieces of packing into the packing box to assist in guiding the stem and plug during lapping.
9. Screw a drilled and tapped rod with a T-handle onto the plug stem and secure with a locknut - see Figure 3 on page 17.

Note: As an alternative, drill a hole through a flat steel plate and fasten to the plug stem using two locknuts.

10. Apply slight pressure on the stem, and rotate the stem in short oscillating strokes (around 8 to 10 times). Repeat this step as necessary.

Note: The plug should be lifted and turned 90° each time before repeating Step (10). This intermittent lifting is required to keep the plug and seat ring concentric during lapping.

11. After completion of the lapping operation, remove bonnet and internal parts. The seating area of the seat ring and the plug must be cleaned of all lapping compound in preparation for reassembly.

7.4 Lo-dB Plug

(Figure 4 on page 17 and Figure 9 or 10 on page 19)

The procedures used for performing maintenance on a valve equipped with Lo-dB plugs (21700/21800/21900 Series) are the same as those used for Threaded or Quick Change Trim (refer to 6.1 on page 8 and 6.2 on page 9).

CAUTION

Maintenance of the plug should be limited to cleaning of the ports and the procedures defined under Sections 7.3 (Lapping) and 7.5 (Pinning) as required.

7.5 Plug Stem Pinning

Plug stem pinning in the field may be required for the following:

- Replacing existing plug and stem, or
- Replacing existing stem only

Replacing Plug and Stem

If it is necessary to replace the plug, then the plug stem must be replaced at the same time. The original pin hole in an existing stem will not provide the necessary fit, and might seriously impair the strength of the assembly.

A. Reference Marking on the Plug Stem

Measure the depth of the pilot recess in the plug (Dimension X in Figure 5 on page 17), and make a reference mark on the plug stem at the same distance from the thread.

Note: While pinning is being performed, care must be taken not to damage the seating surface or plug guide. Always use a soft metal or plastic vice jaws with cylindrical features to hold the plug guide area - see Figure 5 on page 17.

B. Screwing Stem to Plug

- Hold the plug (with vise jaw assembly) in a vise.
- Lock two nuts against each other on the end of the new plug stem, and screw the stem solidly into the plug using a wrench on the upper nut.

When properly assembled, the reference mark (see Section A above) should be flush with the end of the plug guide.

C. Drilling the New Parts

- **If the plug is already fully drilled** (typical for 440 C hardened stainless steel material or solid Stellite or Equivalent), then drill the stem to the same diameter (Diameter C in Figure 10 on page 19) as the plug shank hole.

- **If the plug guide area has a center mark:**

Place the plug guide on a V-block and use a suitable drill size to either:

- Match the hole size in the plug, or
- Match Diameter C - see Figure 5 on page 17.

Drill through the plug-stem assembly.

- **If the plug guide area does not have any hole or any center mark:**

- Measure Dimension D based on the plug guide diameter and stem diameter - see Figure 5 on page 17.

- Place the plug guide on a V-block, and make a

center mark on the plug guide area using a center punch.

- Drill through the plug-stem assembly using a suitable size drill bit.

In all cases after drilling: Remove any burrs from the plug guide hole by making a slight chamfer.

D. Pinning the Plug-Stem Assembly

1. Select the correct size pin based on the plug guide diameter and stem diameter - see Figure 5 on page 17. Apply a small amount of grease on the pin and hand assemble it into the hole in the plug.
2. Press fit the pin into the hole using a hammer. Complete the pinning operation by taking care to ensure that the pin is recessed by the same amount at both sides - see Figure 5 on page 17.
3. After the plug has been pinned, it should be placed in a lathe to ensure it is concentric with the stem.

If the assembly is not running true, then the stem should be placed in a collet with the plug guide against it and the plug should be adjusted. Alignment of plug stem can be performed by means of a soft faced mallet.

Replacing Existing Stem Only

A. Removing Existing Pin and Stem

1. Place the plug guide on a V-block and use a drift punch to drive out the old pin.

Note: If it is necessary to drill out the pin, use a drill bit slightly smaller than the pin diameter.

2. Hold the plug guide in a vise.
3. Lock one nut against another at the end of the plug stem. Using a wrench on the lower nut, unscrew the stem from the plug. The stem is removed by turning it counter-clockwise.

B. Screwing Stem to Plug

- Hold the plug (with vise jaw assembly) in a vise.
- Lock two nuts against each other on the end of the new plug stem, and screw the stem solidly into the plug using a wrench on the upper nut.

When properly assembled, the reference mark (see Section A above) should be flush with the end of the plug guide.

C. Drilling the New Stem

Place the plug guide on a V-block and use a suitable size drill bit to drill the stem (use the hole in the plug as a guide).

Note: If the hole in the plug guide has been slightly damaged while removing the old pin, choose a drill bit and a pin with a slightly larger diameter than the normal pin.

D. Pinning

Select the correct size pin based on the plug guide diameter and pin hole diameter. Proceed as described in part D of the previous section, taking care not to damage the plug guide area.

Ensure plug stem alignment following the pinning operation.

7.6 Packing Box

Packing box maintenance is one of the principle action items of routine servicing. Tightness of the packing is maintained by packing compression. Compression is achieved by evenly tightening the packing flange nuts (3) against the packing flange (4). Care must be taken not to over tighten as this could prevent smooth operation of the valve. If all compression is used up and the valve leaks, then new packing is required.

CAUTION

Valve must be isolated and the pressure vented before performing packing box maintenance.

7.6.1 Braided PTFE with Carbon or Aramid Core (Standard)

Note: The Braided PTFE/Carbon or Aramid packing rings have a skive cut allowing packing replacement without disconnecting the plug stem from the actuator connector or actuator stem.

- A. By means of a hooked instrument, remove packing rings (6) ensuring not to damage the sealing surfaces of the packing box or plug stem.

Note: On valves equipped with an optional lubricator connection, the lantern ring must also be removed to gain access to lower packing rings. Pay close attention to the order and number of rings extracted with the lantern ring. This will help with reassembly.

- B. Replace packing rings (6).

Note: Assemble and compress rings one at a time into packing box. The skive cut of each packing ring must be placed about 120 degrees apart.

- C. Replace packing follower (5) and packing flange (4).
- D. Replace and tighten packing stud nuts (3).

E. Place valve back in service and only tighten packing as necessary to stop external leakage.

Note: In an emergency, string packing may be used as a temporary repair only. It must be replaced with the correct packing as soon as possible.

7.6.2 Flexible Graphite Rings

Note: Flexible graphite packing rings replacement may require disconnecting the plug stem from the actuator stem and removal of the actuator if rings are not skive cut.

A. By means of a hooked instrument, remove packing (6) ensuring not to damage the sealing surfaces of the packing box or plug stem.

Note: On valves equipped with an optional lubricator connection, the lantern ring must also be removed to gain access to lower packing rings. Pay close attention to the order and number of rings extracted with the lantern ring. This will help with reassembly.

B. Replace new packing set (6): First, assemble a back-up ring (Graphite Filament Yarn braided ring), then the flexible graphite rings (smooth rings), and finally another braided back-up ring.

Note: Assemble and compress rings one at a time into packing box.

C. Assemble packing follower (5) and packing flange (4).

D. Assemble and tighten packing stud nuts (3)

CAUTION

Do not overtighten.

E. Proceed to appropriate instructions for actuator and valve assembly adjustment.

F. Place valve back in service and only tighten packing as necessary to stop external leakage.

7.6.3 Low Emissions Packing

The Masoneilan "Low-E" (Low Emissions) Packing is a high performance packing system capable of containing fugitive emissions well below the specifications of the most severe recommendations. It is also available with a fire proof configuration if required.

The packing is provided as a set of rings consisting of middle rings bound by end rings also referred to as anti-extrusion rings. All of our "Low-E" solutions come with live loading which is imperative to maintain a constant load on the packing and is necessary for thermal cycling

applications.

Applied properly, this packing exhibits below current regulations. Consequently, it can effectively prevent fugitive emissions leaks from a control valve. The "Low-E" packing system can directly replace conventional packing, requiring no modification to the control valve or actuator.

The packing material may vary depending on the specifications and timing when the valve was ordered. It is important to understand the specific packing material that is being replaced.

Installation should be performed by a qualified technician. The following paragraphs will provide guidance but you may also refer to the Masoneilan Valve Packing Manual.

7.6.3.1 Preparation

7.6.3.1.1 Stem

Inspect stem for any nicks or scratches on the surface finish. If any damage is present, the stem must be replaced or it will damage the packing.

Note: A properly etched part number on the stem in the packing area will have no adverse effect on the performance of the packing.

Stem finish should be 3-7 AARH (Ra 0,1/0,2).

7.6.3.1.2 Packing Box

Note: Bonnets that have a lube hole or leak detection port are unacceptable for use with "Low-E" packing.

CAUTION

Packing box should be clean and free of burrs, rust, and any foreign matter. Parts can be cleaned with denatured alcohol.

Note: Packing box finish should be 125 AARH (Ra 3,2) or better.

The packing box may be bored or honed oversize by up to 0.015" (0.38 mm) above the nominal diameter to improve the finish. For instance, a nominal 0.875" (22.22 mm) packing box may be bored or honed up to 0.890" (22.60 mm) and the "Low-E" Packing will still seal properly.

Packing box must be finished to the bottom of the bore.

7.6.3.1.3 Packing

Inspect packing rings. DO NOT use packing if any nicks or scratches on packing are observed. Check packing instructions to ensure that it is in the proper arrangement (different packing materials contain arrangements specific to the design).

7.6.3.2 Packing Installation

- A. Refer to the packing instructions that were provided with the packing for proper installation.
- B. The Masoneilan Valve Packing Manual is available as an additional aid while completing the packing installation.
- C. The packing should be checked for leakage.

Note: All exposed surfaces of the packing set must be covered with the lubricant.

- D. Packing load should be checked after the valve has cycled approximately 500 times. Adjust if necessary. Plant maintenance and operation personnel should periodically inspect valves to spot leakage. Adjust if necessary and per OEM recommendations. If a leak is detected and cannot be resolved, any non-conforming hardware parts must be replaced.

7.6.4 Packing Box Efficiency

The constant supervision of the packing box is one of the main routing operations of the maintenance service. In order to provide a correct operation of the valve, the packing should not be tightened over the compression value necessary to provide the tightness. The packing box efficiency is obtained by the compression of the packing, or by combining it with use of the lubricant. As it wears, gradually re-tighten the packing up to the limits of the possible compression. In order to add packing, it is necessary only to remove the packing follower and flange and introduce one or two split rings.

Note: In case of urgency, the braided packing of suitable size can be inserted without removal of the worn rings. Before this operation, the valve must be put out of service. If the packing is made up of non-split rings, it may be necessary to disassemble the valve, remove the worn packing and reassemble per the instructions.

7.7 Soft Seat Plug

(Figure 2 on page 15)

The soft seat plug used in the 21000 Series valve has a replaceable insert. To remove and replace the insert, proceed as follows.

CAUTION

The shank OD is the plug guide. Extreme care must be taken to prevent scoring or marring this surface. Failure to do so could result in damage to the guide bushing and destruction of the plug. Two flats are provided for holding.

- A. Loosen the set screw until the head of the set screw is flush with the OD of the shank.

Note: On 3/4"- 2" size valves, the plug tip has a machined slot into which a bar can be inserted for removal. On 3"- 6" size valves, the plug tip has two machined holes into which a tool (fabricated with appropriate size pins) can be inserted for removal.

- B. Carefully place the plug sub-assembly into a soft jaw vise, holding the plug by the flats provided on the upper end of the shank.

CAUTION

When using a vise to hold the plug, extreme care must be taken not to damage the plug shank.

- C. Using the appropriate tool, unscrew plug tip (counter-clockwise) from the shank sub-assembly
- D. Remove the insert O-ring (for valve sizes 3"- 8" only) and insert the retainer. Discard the existing insert and O-ring.
- E. Thoroughly clean all remaining metallic components and install new insert and O-ring as follows (according to valve size):

For 3/4"- 2" valves:

- a. Place new insert on shank and insert retainer as shown in Figure 2 on page 15.
- b. Install the plug tip into the shank sub-assembly. Hand tighten and ensure plug tip seats evenly against insert.

For 3" – 8" valves:

- a. Apply a light coat of lubricant to the O-ring and install on the insert retainer.

CAUTION

Ensure any lubricant used is compatible with service conditions.

- b. Install new insert on insert retainer and assemble as shown in Figure 2 below.
- c. Install the plug tip into the insert retainer sub-assembly insuring the plug tip seats evenly on the insert.
- F. Carefully place the plug sub-assembly into a soft jaw vise, holding the plug by the flats provided on the upper end of the shank.

CAUTION

When using a vise to hold the plug, extreme care must be taken not to damage the plug shank.

- G. Using the appropriate tool used during disassembly, firmly tighten the plug tip.

CAUTION

The plug tip must be tightened, allowed to set for approximately 4 hours, re-tightened, allowed to set another 4 hours, then tightened one more time. The purpose of this tightening sequence is to allow the insert material to "cold flow" into place on the plug sub-assembly.

- H. Following the above tightening sequence, securely tighten the set screw down into the plug. The plug is ready for assembly into the valve.

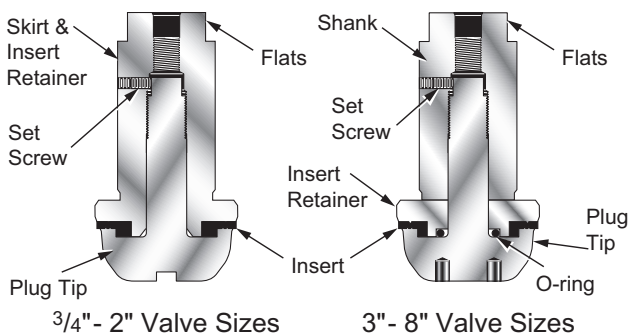


Figure 2 - Soft Seat Plugs (optional)

8. Valve Body Reassembly

After completion of the required maintenance, the valve should be reassembled using the following procedures:

Note: If any of the following steps were completed during maintenance, then proceed to the next step.

8.1 Threaded Trim

(Figure 7 or 9 on page 19)

- A. Clean all gasket mating surfaces.
- B. Apply a small amount of sealant to the seat ring threads and sealing shoulder. Install seat ring into valve body.

Note: A sealant compatible with the process should be applied sparingly.

- C. Install and tighten seat ring using the same wrench used for removal.

CAUTION

Do not overtighten. Do not strike seat ring lugs directly. This could distort the seat ring resulting in unwarranted seat leakage.

- D. Carefully install the plug and stem assembly.

Note: Valve should be lapped before final assembly. See Section 7.3.

- E. Install body gasket (11).

Note: Spiral wound body gaskets (11) are standard in the 21000 Series design. It is imperative that a new gasket be installed each time the valve is disassembled.

- F. Assemble bonnet (8) and body stud nuts (10). Bonnet must be positioned so the packing flange studs are at 90° to the flow center line.

CAUTION

Tighten nuts (10) until metal-to-metal contact is obtained with proper bolt torque. Refer to Figure 6 torque tables on page 18 for proper bolt torque and tightening sequence specifications.

- G. Insert packing (6) [and lantern ring (7) on valve equipped with an optional lubricator connection]. Refer to Section 7.6 for proper packing assembly procedure for standard or optional designs.

- H. Install packing follower (5) and packing flange (4).

- I. Install packing flange stud nuts (3)

CAUTION

**Do not overtighten
(See Section “7.6. Packing Box”).**

- J. If a leak detection connection was installed, connect it on the lateral NPT port in the bonnet. If not, ensure that the 1/4" NPT plug remained in place.
- K. For actuator assembly and plug stem adjustment, refer to the 87/88 and 51/52/53 Series Actuators Installation, Operation and Maintenance Manuals.

8.2 Quick-Change Trim

(Figure 8 or 10 on page 19)

- A. Clean all gasket mating surfaces.
- B. Install seat ring gasket (15) and seat ring (14).

Note: Spiral wound gaskets (11 & 15) are standard in the 21000 Series design. It is imperative that a new gasket be installed each time the valve is disassembled.

- C. Install cage (13).
- D. Carefully install the plug and stem assembly.

Note: Valve should be lapped before final assembly. See Section 7.3.

Note: For 2" valves with Cv 30 Lo-dB / Anti-Cavitation trim only, steps C and D must be reversed such that the plug and stem assembly is installed prior to the cage.

- E. Install body gasket (11).
- F. Assemble bonnet (8) and body stud nuts (10) and tighten. Bonnet must be positioned so the packing flange studs are at 90° to the flow center line.

CAUTION

Care must be taken to ensure that the cage, seat, and bonnet are properly aligned in the body. Cage should be installed with parts at lower end, near seat ring. Tighten nuts (10) until metal-to-metal contact is obtained with proper bolt torque. Refer to Figure 6 and torque tables on page 18 for proper bolt torque and tightening sequence specifications.

- G. Insert packing (6) [and lantern ring (7) on valve equipped with an optional lubricator or leak detection connection]. Refer to Section 7.6 for proper packing assembly procedure for standard or optional designs.

- H. Install packing follower (5) and packing flange (4).

- I. Install packing flange stud nuts (3).

CAUTION

Do not overtighten (See Section “7.6. Packing Box”).

- J. If a leak detection connection was installed, connect it on the lateral NPT port in the bonnet. If not, ensure that the 1/4" NPT plug remained in place.

- K. For actuator assembly and plug stem adjustment, refer to the 87/88 and 51/52/53 Series Actuators Installation, Operation and Maintenance Manuals.

8.3 High Pressure and Angle Design

(Figures 16 and 17 on page 25 and page 26)

Standard trim is used within these optional body configurations. Refer to the applicable sections within this instruction manual.

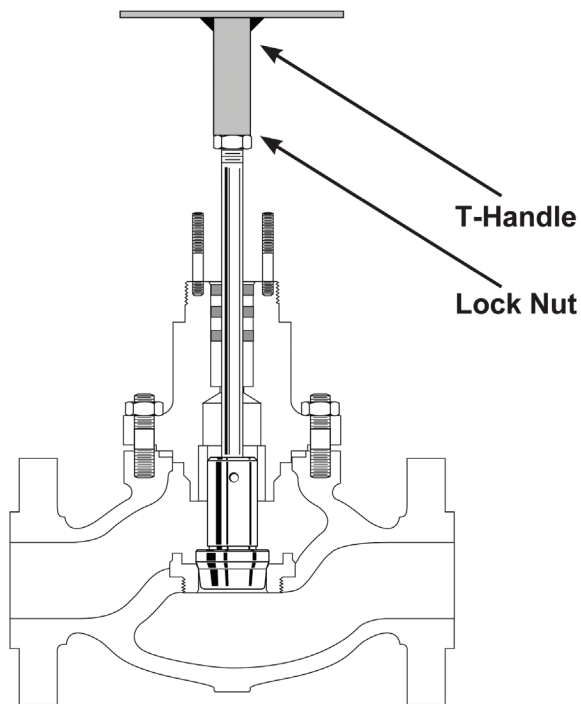


Figure 3 - Seat Lapping Device

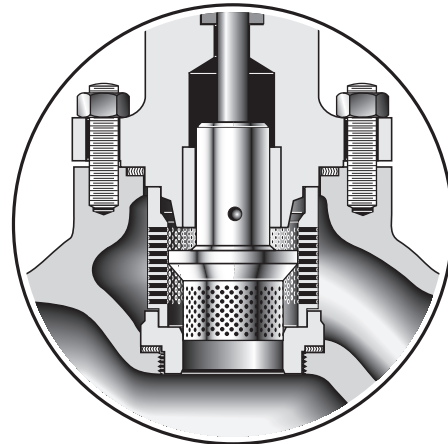


Figure 4 - Lo-dB (Type 21900) and Anti-cavitation (Type 21800) Double Stage Trim (Optional)

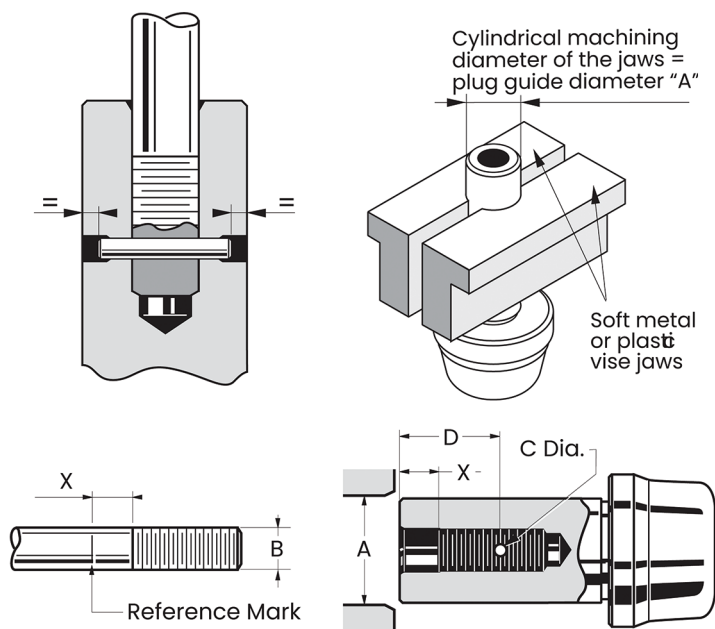


Table 1 - Plug Stem Pinning

Plug Guide Dia. "A"		Plug Stem Dia. "B"		Pin Hole Dia. "C"		"D"		"X"	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
.87	22.22	1/2	12.70	.138	3.50	1.25	32	.50	13
1.50	38.10	1/2	12.70	.138	3.50	1.25	32	.50	13
2.38	60.32	3/4	19.05	.197	5.00	1.88	47.5	.75	19
2.75	69.85	3/4	19.05	.197	5.00	1.88	47.5	.75	19

Figure 5 - Plug Stem Pinning

Assembly Torque Requirements

Table 2 - Assembly Torque Requirements

Valve Size		ANSI Class	Bolting Requirements Minimum		Torque Requirements					
					Minimum		Maximum		Pre-Load	
inch	mm		Qty.	Size (inch)	Lbs.Ft	N.m	Lbs.Ft	N.m	Lbs.Ft	N.m
.75 and 1	20 and 25	150 and 300	4	1/2"-13NC-2A	25	34	66	89	5	7
		600	4	1/2"-13NC-2A	25	34	66	89	5	7
		900 and 1500	4	1"-8NC-2A	125	169	560	759	45	61
		2500	4	1"-8NC-2A	125	169	560	759	45	61
1.5 and 2	40 and 50	150 and 300	8	1/2"-13NC-2A	25	34	66	89	5	7
		600	8	1/2"-13NC-2A	25	34	66	89	5	7
		900 and 1500	8	7/8"-9NC-2A	100	136	300	407	30	41
1.5	40	2500	8	7/8"-9NC-2A	100	136	300	407	30	41
2	50	2500	8	1-1/8"-7NC-2A	160	217	640	868	60	81
3	80	150 and 300	6	5/8"-11NC-2A	45	61	132	179	10	14
		600	8	3/4"-10NC-2A	80	108	230	312	20	27
		900 and 1500	8	1-1/8"-8NC-2A	225	305	830	1125	75	102
4	100	150 and 300	8	5/8"-11NC-2A	45	61	132	179	10	14
		600	8	1"-8NC-2A	125	169	560	759	45	61
		900 and 1500	8	1-1/2"-8NC-2A	400	542	2100	2847	115	156
6	150	150 & 300	12	5/8"-11NC-2A	45	61	132	179	10	14
		600	12	1"-8NC-2A	125	169	560	759	45	61
8	200	150 – 600	12	1-1/4"-8NC-2A	235	319	1200	1627	100	136

Notes:

1. Do not exceed Maximum Torque values listed.
2. Tighten in increments until required torque levels are reached.
3. Reject assembly if metal-to-metal contact is not achieved after reaching Maximum Torque.
4. Torque requirements shown are for standard B7 studs and 2H nuts.

Bellows Bonnet Assembly Torque Requirements

Table 3 - Bellows Bonnet Assembly Torque Requirements

Bolting Requirements		Torque Requirements							
		Minimum		Maximum		Increments		Pre-Load	
Qty.	Size (inch)	Lbs.Ft	N.m	Lbs.Ft	N.m	Lbs.Ft	N.m	Lbs.Ft	N.m
8	1/2"-13NC-2A	20	27	30	41	5	7	5	7
8	5/8"-11NC-2A	25	34	55	75	10	14	5	7

Notes:

1. Do not exceed Maximum Torque values listed.
2. Tighten in increments noted until required torque levels are reached.
3. Torque requirements shown are for standard B7 studs and 2H nuts.

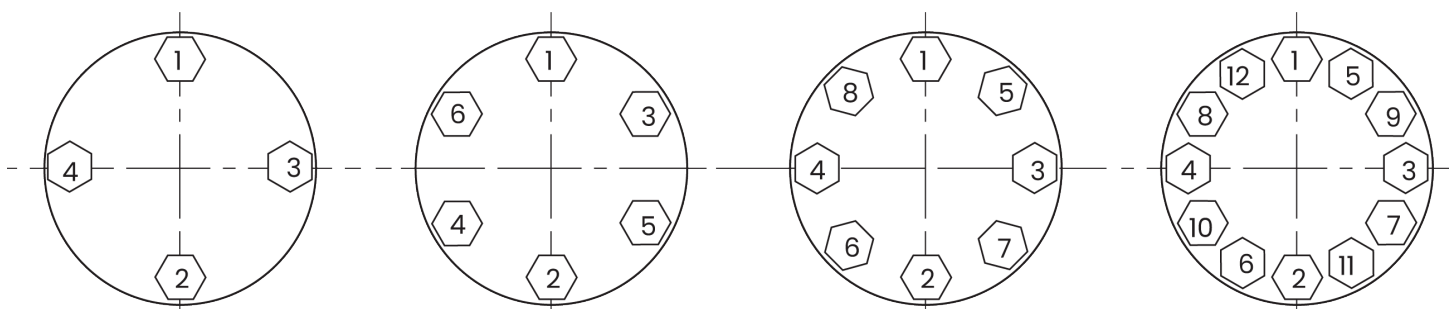
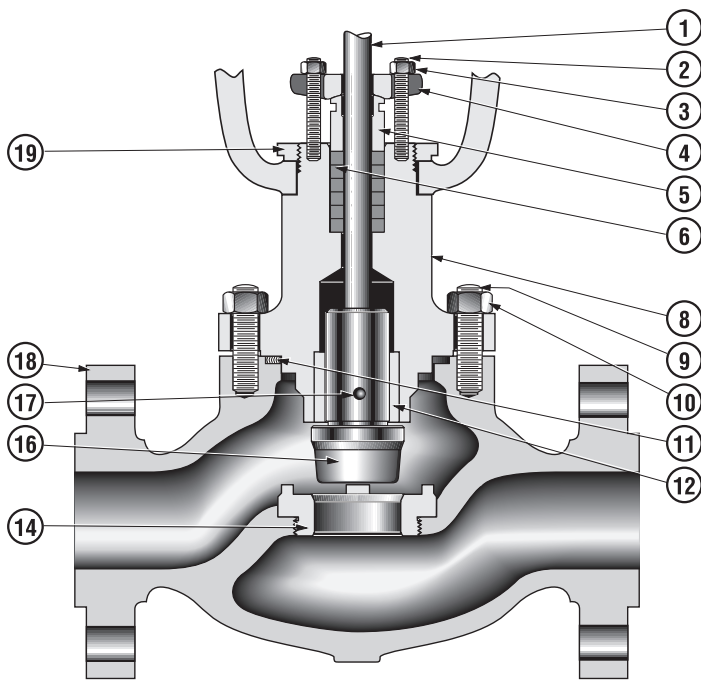
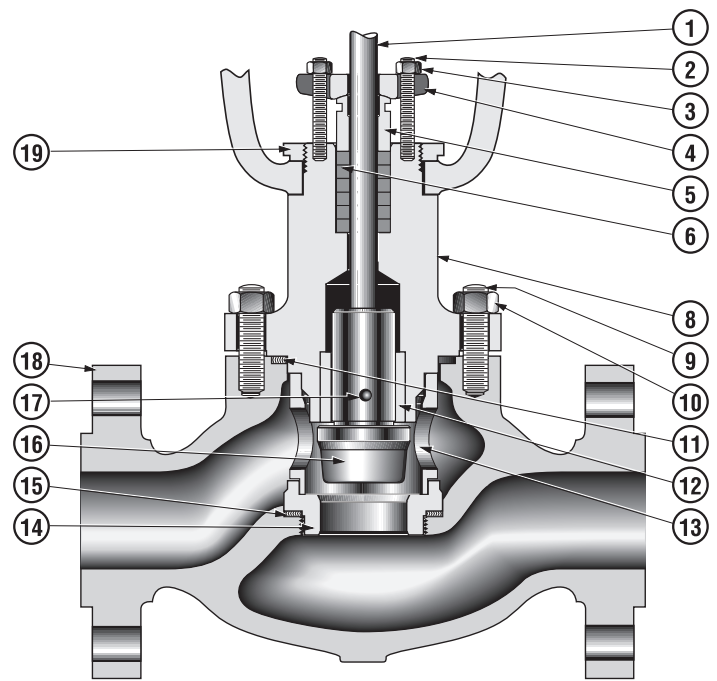


Figure 6 - Bolting Torques and Tightening Sequence



**Figure 7 - Threaded Seat Ring - Contoured Plug
Full Capacity**



**Figure 8 - Quick Change Trim - Contoured Plug
Full Capacity**

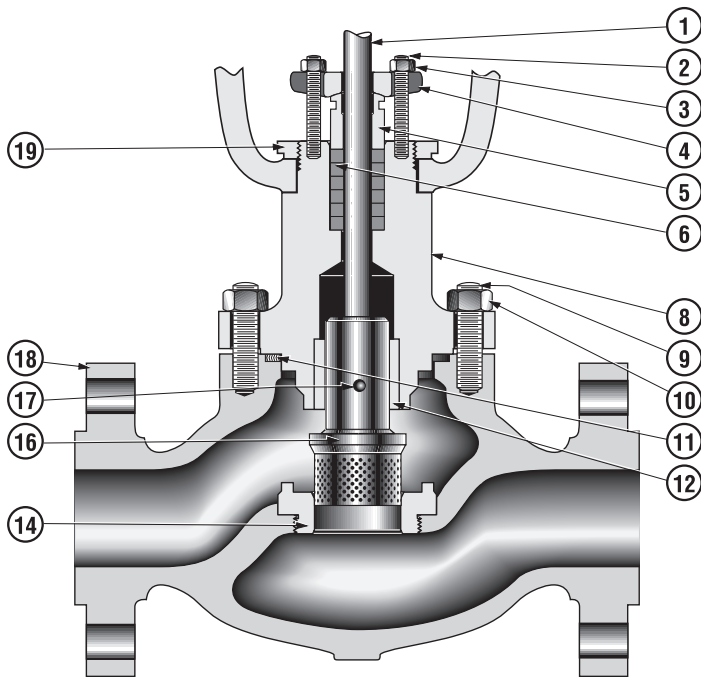


Figure 9 - Threaded Seat Ring - Lo-dB Plug

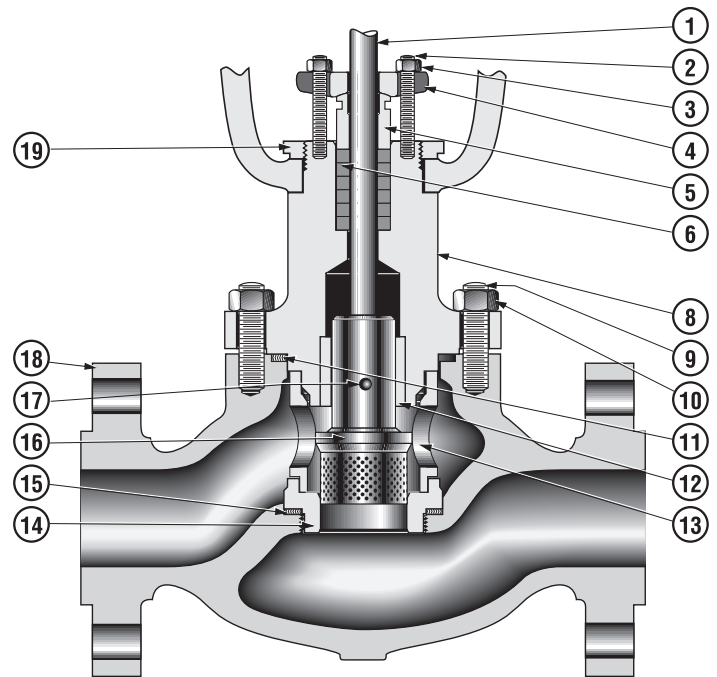


Figure 10 - Quick Change Trim - LodB Plug

Parts Reference

Ref.	Part Name	Ref.	Part Name	Ref.	Part Name
● 1	Plug Stem	9	Body Stud	● 17	Plug Pin
2	Packing Flange Stud	10	Body Stud Nut	18	Body
3	Packing Flange Stud Nut	● 11	Body Gasket	19	Drive Nut
4	Packing Flange	12	Plug Guide Bushing (Incl. w/ref. 8)		
5	Packing Follower	● 13	Cage *		
● 6	Packing	● 14	Seat Ring		
7	Lantern Ring (optional)	● 15	Seat Ring Gasket *		
8	Bonnet	● 16	Plug		

● Recommended spare parts * Only on Quick Change Trim

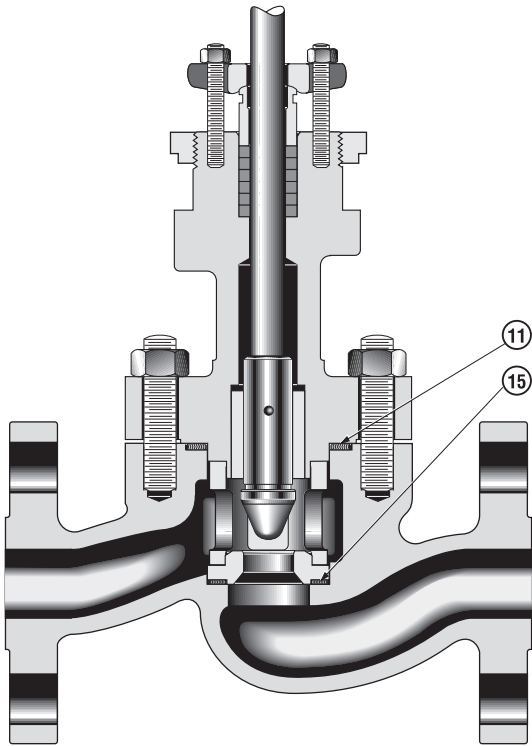


Figure 11 - 21000 Series
3/4" to 2" Valve Sizes ANSI Class 900 to 2500

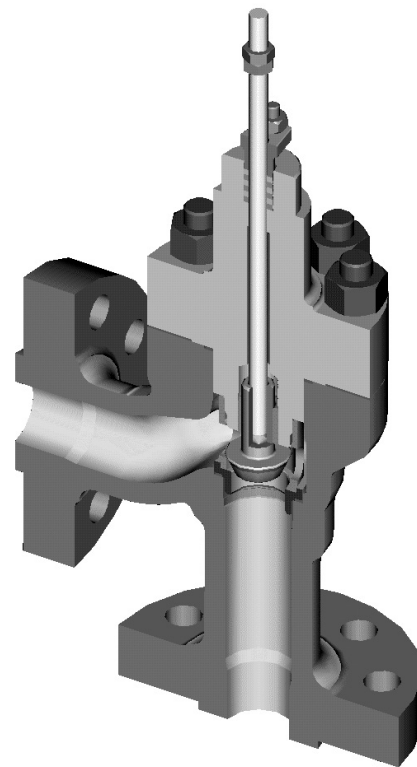


Figure 12 - Angle Body Design
3/4" to 6" Valve Sizes ANSI Class 150 to 600
 3/4" to 2" Valve Sizes ANSI Class 900 to 2500

9. 21000 BS Bellows Seal – Bonnet-less Design

This section is applicable for valve size 0.75 inches up to 4 inches (included).

For size over 4 inches or Bellows Seal design with Bonnet (before mid-2025), refer to Section 10 “Bellows Seal With Bonnet Design” on page 27.

CAUTION

Since this is a sealing bellows, the plug stem should never be turned under any circumstances.

There is a built-in anti-rotation feature, consisting of a double flat surface machined on the plug stem that slides into a rectangular slot machined in the upper bushing (B141b) of the bellows - see Figure 17, view AA on page 26.

CAUTION

IT IS IMPORTANT TO DISCONNECT THE ACTUATOR FROM THE VALVE BEFORE CHANGING THE ACTUATOR ROTATIONAL POSITION.

9.1 Bellows Valve Disassembly

(Figure 17 on page 26)

Note: O-rings are standard in the 21000 BS Series design. It is recommended that new O-rings are installed each time the valve is disassembled.

9.1.1 Threaded Trim

Note: Drive nut should be unscrewed by using the tools shown on the Figure 16 on page 25 coupled to a flat spanner.

After removing the actuator, disassemble the body sub-assembly using the following procedure:

- Disconnect the leak-off circuit from the bonnet (if this option is included).
- Remove packing flange stud nuts (B201), packing flange (B213) and packing follower (B212).
- Remove body stud nuts (B014).

- Remove bonnet extension (B007), stem-bellow sub-assembly (B124) and plug (B112) at the same time.
- Remove the plug pin (B903), then remove the plug (B112) from the plug stem (B120).
- See section 9.2.1.1 on page 23 for unpinning the plug stem.

CAUTION

Be careful during plug disassembly, fluids can be enclosed on the extension bonnet (B007).

- Remove the three hexagonal socket set screw (B914a).
- Untighten and remove bonnet spud (B003) by using tooling shown in Figure 13 on page 22.
- Remove O-ring (B716) in the bonnet spud.
- Remove existing packing (B206) and guide bushing (B203).
- Remove stem-bellow S/A (B124) by the top of the bonnet extension (B007). Use tooling shown in Figure 14 on page 22 to avoid damaging/breaking bellow during disassembly.

CAUTION

Be careful not to damage the seating surfaces of the bellows bushing.

- Remove the body gasket (B015).
- Bonnet extension (B007), plug (B112), guide bushings (B011 and B203) and seat ring (B102) may now be inspected for wear and service damage.

After determining the maintenance required, proceed to the appropriate section of these instructions.

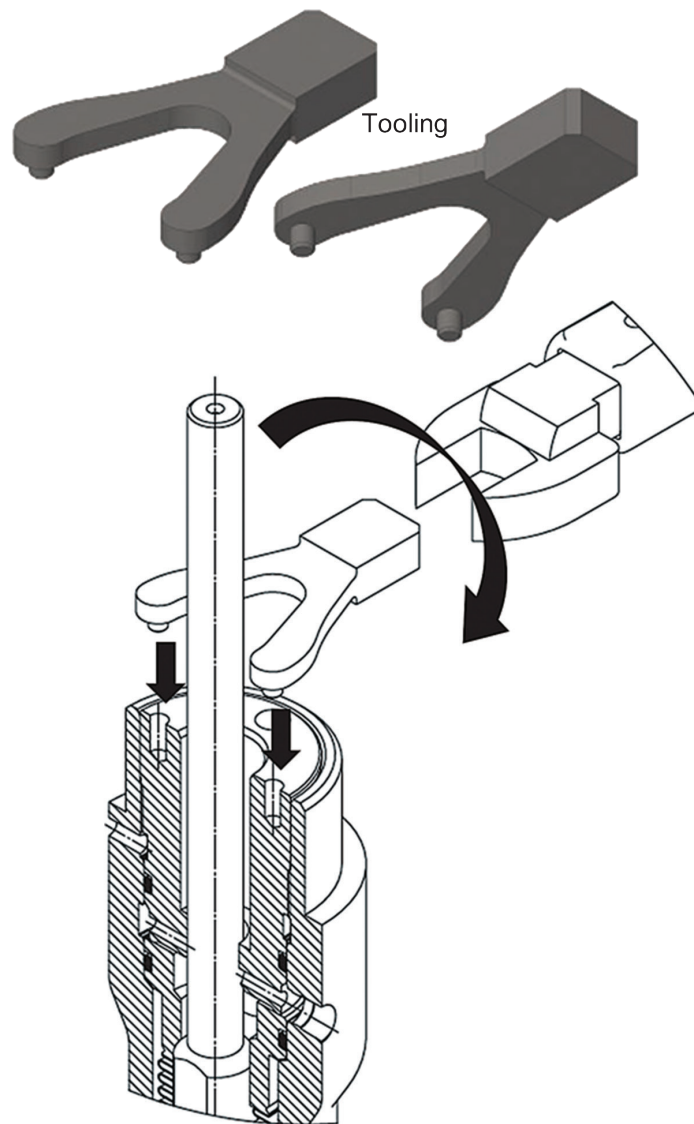


Figure 13 - Bonnet Spud Tightening Tooling

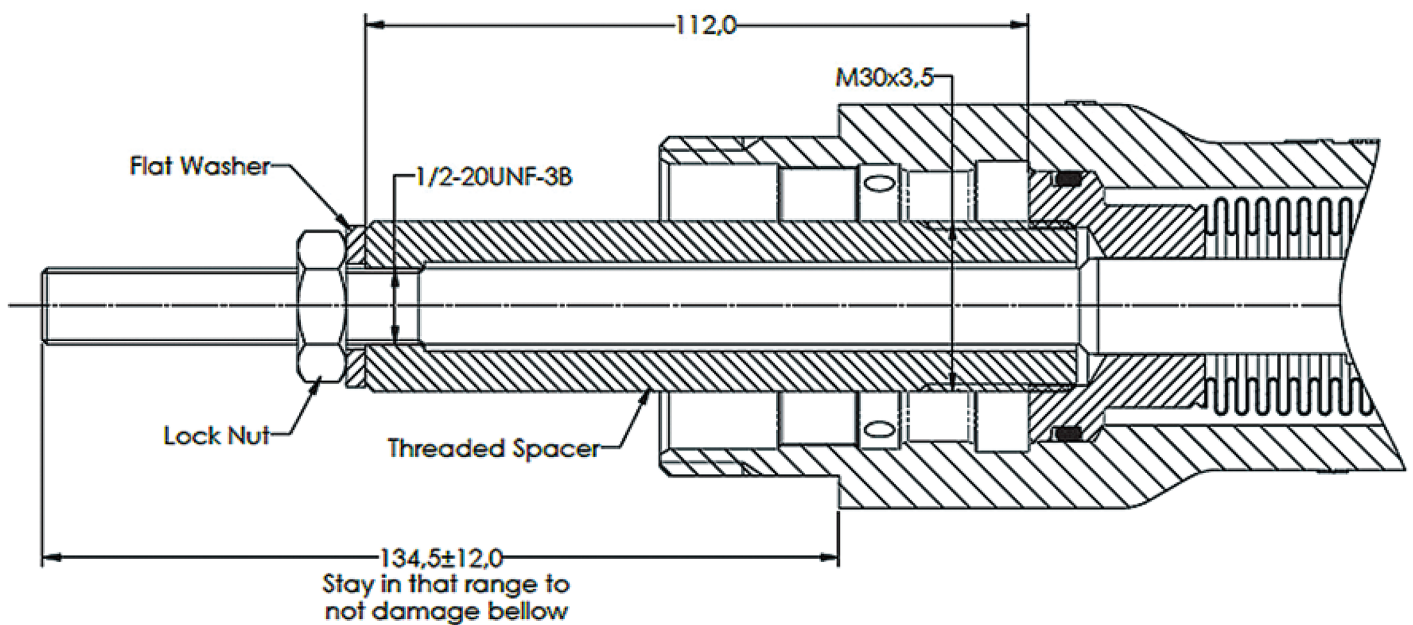


Figure 14 - Bellow and Stem Sub-Assembly Pulling Out Tooling

9.1.2 Quick-Change Trim

Removal of the quick-change trim is accomplished using the same procedure as removal of the threaded trim.

However, after the bonnet extension (B007) has been removed from the body, remove the cage (B107), the seat ring (B102) and the seat ring gasket (B103).

9.2 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.

9.2.1 Plug / Bellow-Stem Sub-Assembly

Plug stem pinning in the field may be required for:

- Replacing existing plug and stem-bellows sub-assembly
- Replacing stem-bellows sub-assembly only

Note: If the plug needs replacing, the stem-bellows sub-assembly should be replaced at the same time.

The original pin hole in a stem which is being reused sometimes prevents a satisfactory result being obtained and can also weaken the plug-stem assembly.

If the stem-bellows sub-assembly is being replaced, the new assembly can be fitted on an existing plug as long as it is in good condition and the removal of the pin has not deformed the hole or damaged it in any other way.

Note: Always use soft metal vise jaws to hold the plug guide surface. Failure to take this precaution could result in damage to the plug guide surface during pinning - see Figure 15 on page 24.

Be careful not to damage the plug seating surface during pin removal and assembly operations.

9.2.1.1 Unpinning the Plug Stem

- Pull and hold the plug (B112) out of the bonnet extension (B007) to allow access to the plug pin (B903). Place the plug guide on a V-block.

Note: A lower mechanical stop has been provided to prevent damage of the bellows during this step.

- Using a drift punch, drive out the existing pin (B903).

Note: If it is necessary to drill out the pin, use a drill bit slightly smaller than the pin diameter. Be careful not to damage the hole of the plug guide.

- Lock two nuts against each other on the end of the plug stem and use a flat spanner on the lower nut to prevent rotation while unscrewing the plug from the stem. The plug is removed by turning it counterclockwise.
- Remove the two nuts from the plug stem. Complete step 9.1.1.

- Inspect the parts and carry out any necessary repairs, then reassemble the stem-bellows sub-assembly (B124) through the upper hole in the bonnet extension (B007) (see section 9.2.1.2).

9.2.1.2 Mounting of the Plug and Stem-Bellows Sub-Assembly into the Bonnet Extension

- Clean all contact surfaces of the bonnet extension (B007) and the stem-bellow sub-assembly (B124).
- Assemble a new O-ring (B716) on the upper adapter (B141b) of the new stem-bellow sub-assembly (B124).
- Insert the new stem-bellows sub-assembly (B124) through the top hole into the bonnet extension (B007). Use tooling shown in Figure 14 on page 22 to avoid damaging/breaking bellow during assembly.
- Pin the plug (B112) on the stem (B120) - see section 9.2.1.3 below.

9.2.1.3 Plug Stem Pinning

Replacing Plug (B112) and Stem-Bellow Sub-Assembly (B124)

A. Screw Plug (B112) on Stem (B120)

- Lock two nuts against each other on the end of the plug stem and use a flat spanner on the upper nut to prevent rotation of the stem-bellows sub-assembly. Screw the plug (B112) onto the lower part of the stem (B120) while inserting the plug shank into the guide bushing (B011) in the bonnet extension (B007).
- Pull and hold the plug (B112) out of the bonnet extension (B007) to allow access to the plug pin (B903).

B. Drilling the New Parts

- **If the plug (B112) is already fully drilled**, (typical for 440C hardened stainless steel material or solid Stellite or equivalent), then drill the stem (B120) to the same diameter (Diameter C in Figure 15 on page 24) as the plug shank hole.
- **If the plug guide area has a center mark**, place the plug guide on a V-block and use a suitable size drill to either:
 - Match the hole size in the plug (B112), or
 - Match Diameter C - see Figure 15 on page 24
 - Drill through the plug-stem assembly.
- **If the plug guide area has no hole or any center mark**:
 - Measure Dimension D based on the plug guide diameter and stem diameter - see Figure 15 on page 24.
 - Place the plug guide on a V-block, and make a center mark on the plug guide area using a center punch.
 - Drill through the plug-stem assembly using a suitable size drill bit.

In all cases after drilling: Remove any burrs from the plug guide hole by making a slight chamfer.

C. Pinning the Plug-Stem Assembly

- Select the correct size pin based on the plug guide diameter and stem diameter - see Figure 15 below. Apply a small amount of grease on the pin (B903) and hand-assemble it into the hole in the plug.
- Press fit the pin (B903) into the hole using a hammer. Complete the pinning operation by ensuring that the pin is recessed by the same amount from both sides - see Figure 15 below.

Replacing Stem-Bellow Sub-Assembly Only (B124)

A. Screw Plug (B112) on Stem (B120)

- Lock two nuts against each other on the end of the plug stem and use a flat spanner on the upper nut to prevent rotation of the stem-bellows sub-assembly. Screw the plug (B112) onto the lower part of the stem (B120) while inserting the plug shank into the guide bushing (B011) in the bonnet extension (B007).
- Pull and hold the plug (B112) out of the bonnet extension (B007) to allow access to the plug pin (B903).

B. Drilling the New Stem

Place the plug guide on a V-block and use a suitable size drill bit to drill the stem (use the hole in the plug as a guide).

Note: If the hole in the plug guide has been slightly damaged while removing of the old pin, choose a drill bit and a pin with a slightly larger diameter than the normal pin.

C. Pinning

- Select the correct size pin based on plug guide diameter and pin hole diameter. Proceed as described in Paragraph C "Pinning the Plug-Stem Assembly" above, taking care not to damage the plug guide area.

9.3 Plug and Seat Ring Seating Surfaces

It is not possible to lap the plug (B112) and seat ring (B102) seating surfaces after the bellows sub-assembly (B125) has been assembled to the stem (B120).

If the seat ring (B102) shows signs of minor wear, it should be turned on a lathe to clean up the worn area.

Table 4 - Plug Guide Diameters

Plug Guide Diameter E		Plug Stem Diameter F		Pin Hole Diameter C		D		L	
in	mm	in	mm	in	mm	in	mm	in	mm
7/8	22.22	1/2	12.70	.138	3.50	1.65	42	.70	18
1-1/2	38.10	1/2	12.70	.138	3.50	2.17	55	1.25	32
2-3/8	60.32	3/4	19.05	.197	5	2.75	70	2	50
2-3/4	69.85	3/4	19.05	.197	5	2.75	70	2	50

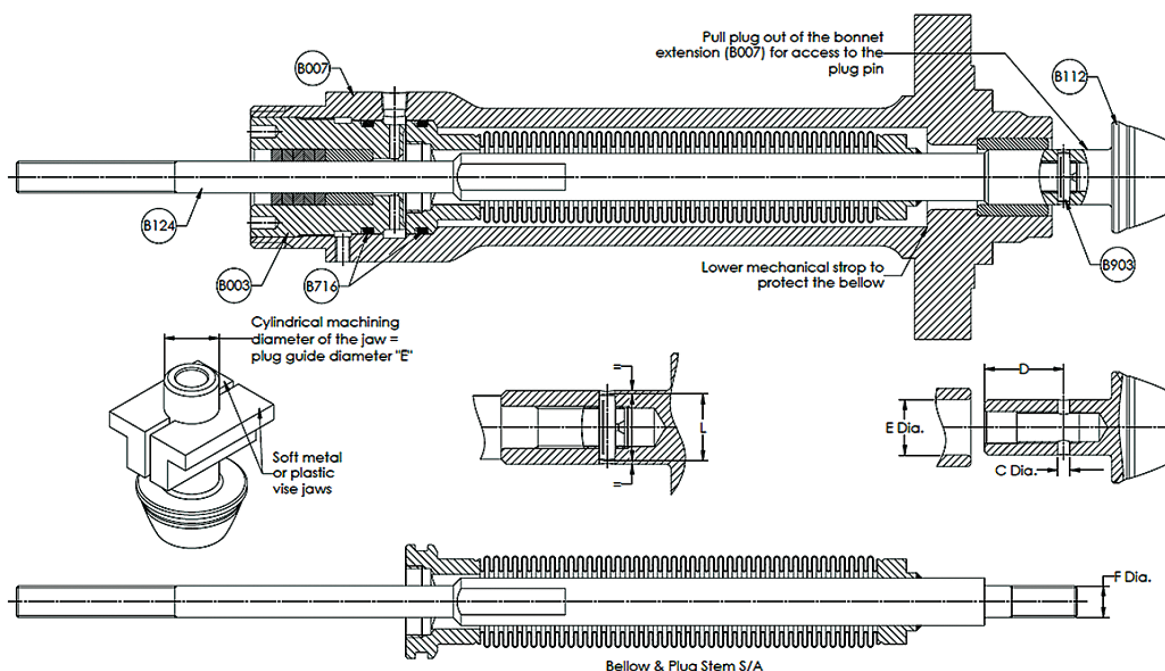


Figure 15 - Unpinning and Pinning of the Plug to the Stem

The seating surface of the seat ring (B102) is 30 degrees from centerline axis. However, no more than 0.010 in. (0.25 mm) of material should be removed.

In cases where the seat ring (B102) cannot be repaired, or if the plug (B112) is also damaged, the only alternative is to replace both parts.

9.4 Bonnet Reassembly

- Place the new O-ring (B716) into the groove of the bonnet spud (B003).
- Add grease on the thread of the bonnet spud (B003)

Tighten the bonnet spud (B003) into the bonnet extension B007 by using tooling shown in Figure 13 on page 22 coupled to a torque wrench. Tightening torque indicated in the table below:

Table 5 - Bonnet Reassembly Torque

Valve Size (in)	ASME Pressure Rating	Tightening Torque ($\pm 10\%$)	
		daN.m	Ft-lbs
0.75 to 4	150/300	55	405.7

Screw the three hexagonal socket set screw (B914a).

9.5 Valve Body Reassembly

Refer to instructions stated in Section 8 on page 15 for the specific trim type involved.

Except for specific instructions relative to 21000 Bellow Seal valves indicated below:

- Before inserting packing (B206), insert guide bushing (B203) into the bonnet spud (B003)

9.6 Actuator to Body Sub-Assembly and Plug Stem Adjustment

Refer to the 87/88 Series and 51/52/53 Actuator Installation, Operation and Maintenance Manual.

Except for specific instructions relative to 21000 Bellow Seal valves indicated below:

- Tighten drive nut by using tools shown in Figure 16. Tightening torque are indicated in the following table:

Table 6 - Plug Stem Adjustment Torque

Valve Size (in)	ASME Pressure Rating	Tightening Torque ($\pm 10\%$)	
		daN.m	Ft-lbs
0.75 to 1	150/300	30	221.3
1.5 to 2	150/300	50	368.8
3	150/300	90	663.8
4	150/300	150	1106.3

! WARNING

Assembly of the No. 6 actuator on a bellows seal valve requires a three-sectioned coupling. Follow coupling instructions as described for the No. 10, 16 and 23 actuators.

CAUTION

The bellows assembly causes a “spring back” effect. Measure this plug spring back before referring to the 87/88 Series Actuator Installation, Operation and Maintenance Manual. Be sure to add this spring back length to the over seat adjustment.

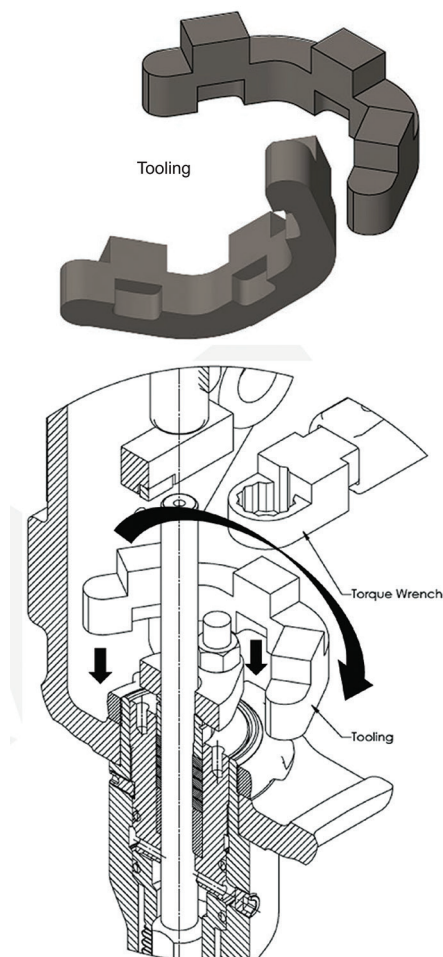


Figure 16 - Drive Nut Tightening Tools

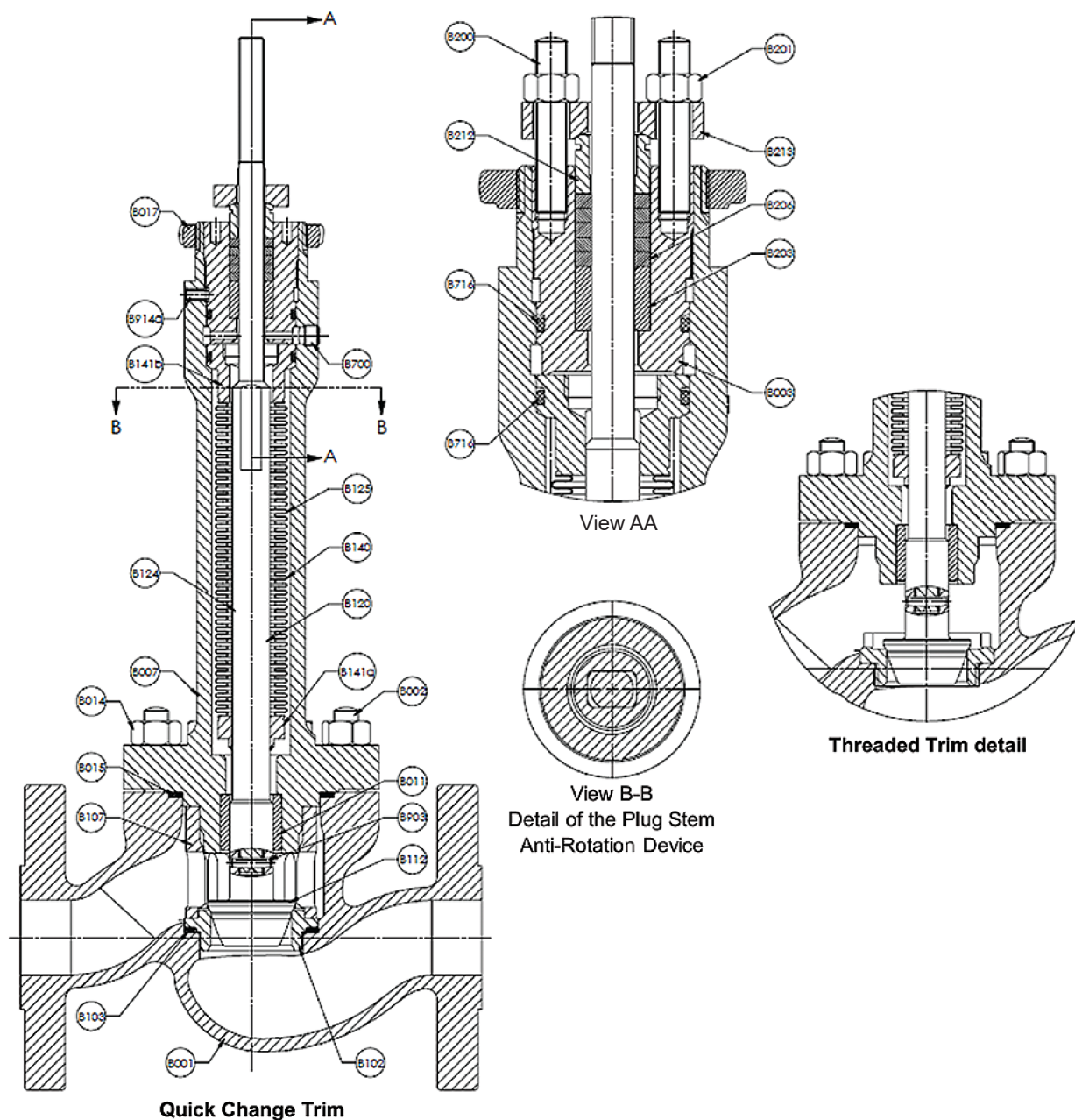


Figure 17 - 21000 BS Series - Bonnet-less Design

Parts Reference

Ref.	Part Name	Ref.	Part Name	Ref.	Part Name
B001	Valve Body	• B107	Cage	B203	Guide Bushing
B002	Body Stud	• B112	Plug	• B206	Packing
B003	Bonnet Spud	• B120	Plug Stem	B212	Packing Follower
B007	Bonnet Extension	B124	Bellow & Plug Stem S/A	B213	Packing Flange
B011	Guide Bushing	* B125	Bellow S/A	B700	1/8" NPT Plug
B014	Body Stud Nut	+ B140	Bellow	• B716	O-ring
B015	Body Gasket	+ B141a	Bellow Lower Adapter	• B903	Plug Pin
B017	Drive Nut	+ B141b	Bellow Upper Adapter	B914a	Hex. Socket Set Screw
• B102	Seat Ring	B200	Packing Flange Stud		
■ B103	Seat Ring Gasket	B201	Packing Flange Nut		

- Recommended Spare Parts ■ Quick Change Trim Only * Parts included in Bellow and Plug Stem sub-assembly
- + Parts included in Bellow sub-assembly

10. 21000 BS Bellows Seal - with Bonnet Design

This section is applicable for Bellows Seal design before mid-2025 and size above 4 inches (not included).

CAUTION

Since this is a sealing bellows, the plug stem should never be turned under any circumstances.

There is a built-in anti-rotation feature, consisting of a double flat surface machined on the plug stem that slides into a rectangular slot machined in the upper bushing (30) of the bellows - see Figure 19, Section-a on page 30.

CAUTION

IT IS IMPORTANT TO DISCONNECT THE ACTUATOR FROM THE VALVE BEFORE CHANGING THE ACTUATOR ROTATIONAL POSITION.

10.1 Bellows Valve Disassembly

(Figure 19 on page 30)

Note: *Spiral wound gaskets are standard in the 21000 BS Series design. It is recommended that new gaskets are installed each time the valve is disassembled.*

10.1.1 Threaded Trim

After removing the actuator, disassemble the body sub-assembly using the following procedure:

- Disconnect the leak-off circuit from the bonnet (if this option is included). Remove nuts (27) and bonnet studs (26) from the bonnet (25).
- Remove packing flange stud nuts (3), packing flange (4) and packing follower (5). Remove bonnet (25).
- Remove existing packing (6).
- Remove body stud nuts (10).
- Remove bonnet extension (29), stem bellows S/A (30) and plug (16) at the same time.
- Remove the plug pin (17), then remove the plug (16) from the plug stem (30). (See section 10.2.1.1 for unpinning the plug stem).
- Remove stem bellows S/A (30) by the top of the bonnet

extension (29). If necessary, disengage the upper bushing of assembly (30) using a screwdriver in the groove provided for this purpose.

CAUTION

Be careful not to damage the seating surfaces of the bellows bushing.

- Remove the bonnet and spacer gaskets (28) and the body gasket (11).
- Bonnet extension (29), plug (16), guide bushings and seat ring (14) may now be inspected for wear and service damage. After determining the maintenance required, proceed to the appropriate section of these instructions.

10.1.2 Quick-Change Trim

Removal of the quick-change trim is accomplished using the same procedures as removal of the threaded trim.

However, after the bonnet extension (29) has been removed from the body, remove the cage (13), the seat ring (14) and the seat ring gasket (15).

10.2 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.

10.2.1 Plug/Stem Bellows/Bonnet Extension Sub-Assembly (S/A)

Plug stem pinning in the field may be required for:

- Replacing existing plug and stem-bellows S/A
- Replacing stem-bellows S/A only

Note: *If the plug needs replacing, the stem-bellows sub-assembly should be replaced at the same time.*

The original pin hole in a stem which is being reused sometimes prevents a satisfactory result being obtained and can also weaken the plug-stem assembly.

If the stem-bellows sub-assembly is being replaced, the new assembly can be fitted on an existing plug as long as it is in good condition and the removal of the pin has not deformed the hole or damaged it in any other way.

Note: *Always use soft metal vise jaws to hold the plug guide surface. Failure to take this precaution could result in damage to the plug guide surface during pinning - see Figure 18 on page 29*

Be careful not to damage the plug seating surface during pin removal and assembly operations.

10.2.1.1 Unpinning the Plug Stem

- Pull and hold the plug (16) out of the bonnet extension (29) to allow access to the plug pin (17). Place the plug guide on a V-block.

Note: A lower mechanical stop has been provided to prevent damage of the bellows during this step.

- Using a drift punch, drive out the existing pin (17).

Note: If it is necessary to drill out the pin, use a drill bit slightly smaller than the pin diameter. Be careful not to damage the hole of the plug guide.

- Lock two nuts against each other on the end of the plug stem, and use a flat spanner on the lower nut to prevent rotation while unscrewing the plug from the stem. The plug is removed by turning it counter-clockwise.
- Remove the two nuts from the plug stem. Complete step 10.1.1.
- Inspect the parts and carry out any necessary repairs, then reassemble the stem-bellows sub-assembly (30) through the upper hole in the bonnet extension (29) (see section 10.2.1.2).

10.2.1.2 Mounting of the Plug-Stem/Bellows Sub-Assembly into the Bonnet Extension

- Clean all contact surfaces of the bonnet extension (29) and the plug-stem/bellows S/A.
- Assemble a new gasket (28) on the upper flange of the bonnet extension.
- Insert the new stem-bellows S/A through the top hole into the bonnet extension (29).
- Pin the plug on the stem (See section 10.2.1.3).

10.2.1.3 Plug Stem Pinning

Replacing Plug and Stem/Bellows Sub-Assembly

A. Screw Stem into Plug

- Lock two nuts against each other on the end of the plug stem and use a flat spanner on the upper nut to prevent rotation of the stem-bellows S/A. Screw the plug onto the lower part of the stem while inserting the plug shank into the guide bushing (12) in the bonnet extension (29).
- Pull and hold the plug (16) out of the bonnet extension (29) to allow access to the plug pin (17).

B. Drilling the New Parts

- If the plug is already fully drilled, (typical for 440C hardened stainless steel material or solid Stellite or equivalent), then drill the stem to the same diameter

(Diameter C in Figure 18 on page 29) as the Plug Shank Hole.

- If the plug guide area has a center mark: place the plug guide on a V-block and use a suitable size drill to either:

- Match the hole size in the plug, or
- Match Diameter C - see Figure 18 on page 29.
- Drill through the plug-stem assembly.

- If the plug guide area has no hole or any center mark:

- Measure Dimension D based on the plug guide diameter and stem diameter - see Figure 18 on page 29.
- Place the plug guide on a V-block, and make a center mark on the plug guide area using a center punch.
- Drill through the plug-stem assembly using a suitable size drill bit.

In all cases after drilling: Remove any burrs from the plug guide hole by making a slight chamfer.

C. Pinning the Plug-Stem Assembly

- Select the correct size pin based on the plug guide diameter and stem diameter - see Figure 18 on page 29. Apply a small amount of grease on the pin and hand-assemble it into the hole in the plug.
- Press fit the pin into the hole using a hammer. Complete the pinning operation by ensuring that the pin is recessed by the same amount from both sides - see Figure 18 on page 29).

Replacing Stem/Bellows Sub-Assembly Only

A. Screw Stem into Plug

- Lock two nuts against each other on the end of the plug stem and use a flat spanner on the upper nut to prevent rotation of the stem-bellows sub-assembly. Screw the plug onto the lower part of the stem while inserting the plug shank into the guide bushing (12) in the bonnet extension (29).
- Pull and hold the plug (16) out of the bonnet extension (29) to allow access to the plug pin (17).

B. Drilling the New Stem

- Place the plug guide on a V-block and use a suitable size drill bit to drill the stem (use the hole in the plug as a guide).

Note: If the hole in the plug guide has been slightly damaged while removing of the old pin, choose a drill bit and a pin with a slightly larger diameter than the normal pin.

Table 7 - Bellows Plug Guide Diameters

Plug Guide Dia. "E"		Plug Stem Dia. "F"		Pin Hole Dia. "C"		"D"		"L"	
in.	mm	in.	mm	in.	mm	in.	mm	in.	mm
7/8	22.22	1/2	12.70	.138	3.50	1.65	42	.70	18
1-1/2	38.10	1/2	12.70	.138	3.50	2.17	55	1.25	32
2-3/8	60.32	3/4	19.05	.197	5	2.75	70	2.00	50
2-3/4	69.85	3/4	19.05	.197	5	2.75	70	2.00	50

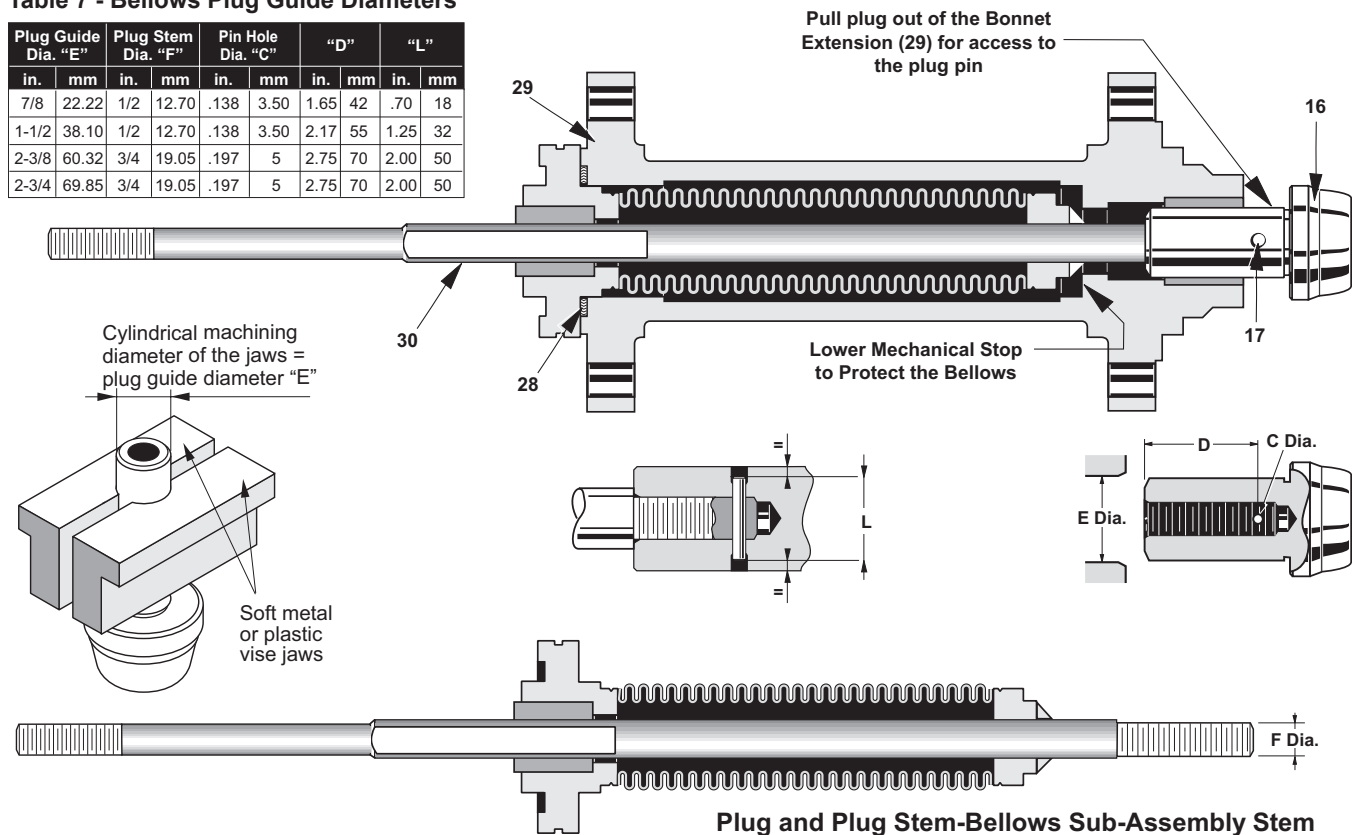


Figure 18 - Unpinning and Pinning of the Plug to Stem

C. Pinning

Select the correct size pin based on plug guide diameter and pin hole diameter. Proceed as described in Paragraph C "Pinning the Plug-Stem Assembly" above, taking care not to damage the plug guide area.

10.3 Plug and Seat Ring Seating Surfaces

It is not possible to lap the plug and seat ring seating surfaces after the bellows has been assembled to the stem.

If the seat ring shows signs of minor wear, it should be turned on a lathe to clean up the worn area. The seating surface of the seat ring is 30 degrees from centerline axis. However, no more than 0.010 in. (0.25 mm) of material should be removed.

In cases where the seat ring cannot be repaired, or if the plug is also damaged, the only alternative is to replace both parts.

10.4 Bonnet Reassembly

Place the new gasket (28) into the groove of the bonnet spacer. Install the bonnet (25) and assemble nuts (27) and studs (26). The bonnet must be positioned so the packing flange studs are at a 90° angle to the flow centerline.

Refer to Figure 6 and torque tables on page 18 for proper bolt torque and tightening sequence.

10.5 Valve Body Reassembly

Refer to instructions stated in Section 8 for the specific trim type involved.

10.6 Actuator to Body Sub-Assembly and Plug Stem Adjustment

Refer to the 87/88 and 51/52/53 Series Actuators Installation, Operation and Maintenance Manuals.

! WARNING

Assembly of the No. 6 actuator on a bellows seal valve requires a three-sectioned coupling. Follow coupling instructions as described for the No. 10, 16 and 23 actuators.

CAUTION

The bellows assembly causes a "spring back" effect. Measure this plug spring back before referring the 87/88 and 51/52/53 Series Actuators Installation, Operation and Maintenance Manuals. Be sure to add this spring back length to the over seat adjustment.

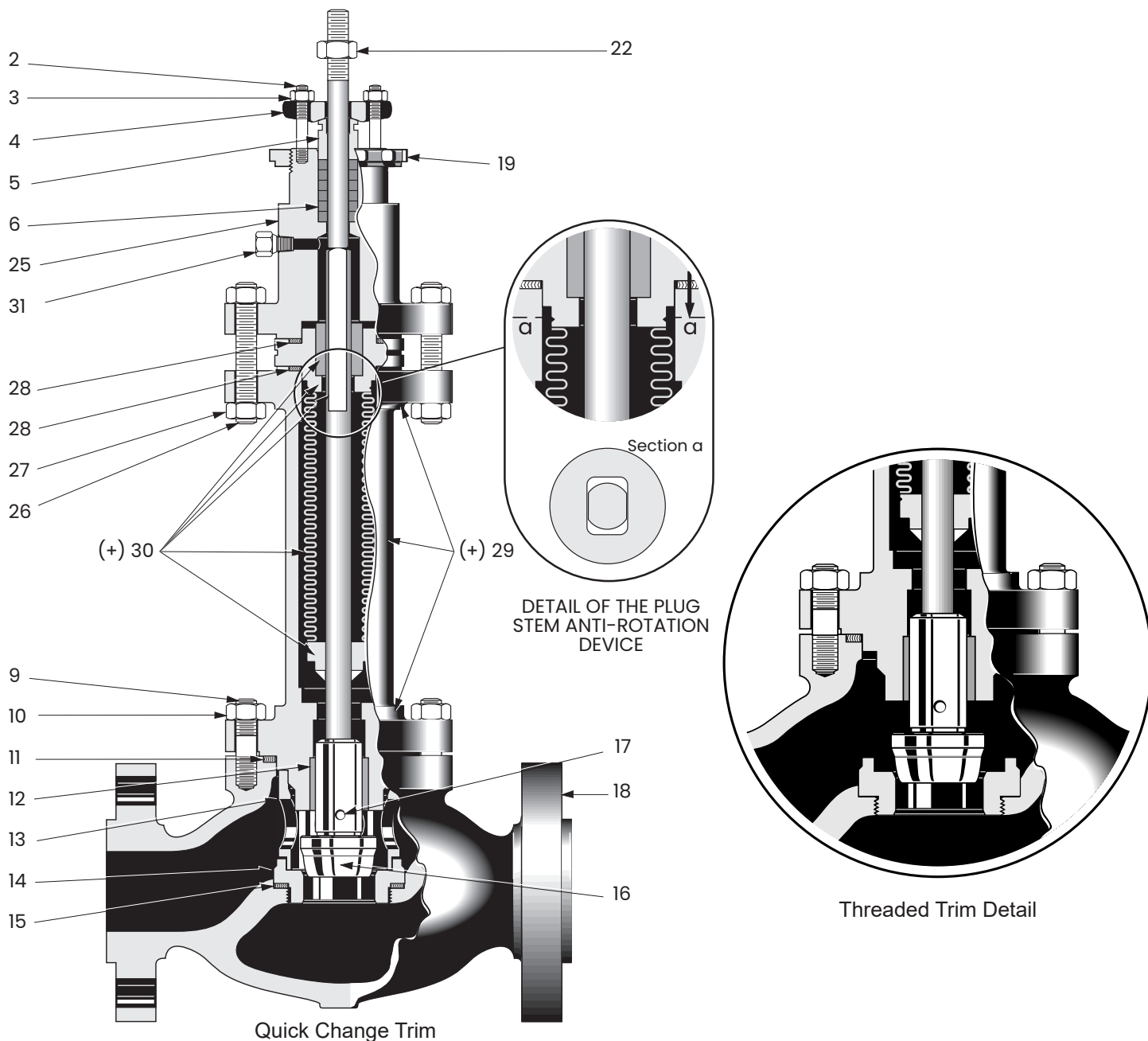


Figure 19 - 21000 BS Series with Bonnet Design

Parts Reference

Ref.	Part Name	Ref.	Part Name	Ref.	Part Name
● 1	Plug Stem	■ 15	Seat Ring Gasket	+	Spacer
2	Packing Flange Stud.	● 16	Plug	+	Lower Flange
3	Packing Flange Nut	● 17	Plug Pin	30	Bellow and Stem Assembly
4	Packing Flange	18	Valve Body	+	Stem
5	Packing Follower	19	Drive Nut		Guide Bushing
● 6	Packing	22	Plug Stem Locknut	+	Bellows
9	Body Stud	25	Valve Bonnet	+	Upper Adapter (Bellows)
10	Body Stud Nut	26	Bonnet Stud	+	Lower Adapter (Bellows)
● 11	Body Gasket	27	Bonnet Stud Nut	31	1/8" NPT Plug
12	Guide Bushing	● 28	Bonnet Spacer Gasket		
■ 13	Cage	29	Bonnet Extension Assembly		
● 14	Seat Ring	+	Upper Flange		

● Recommended Spare Parts + These parts included in welded subassembly ■ Quick change trim only

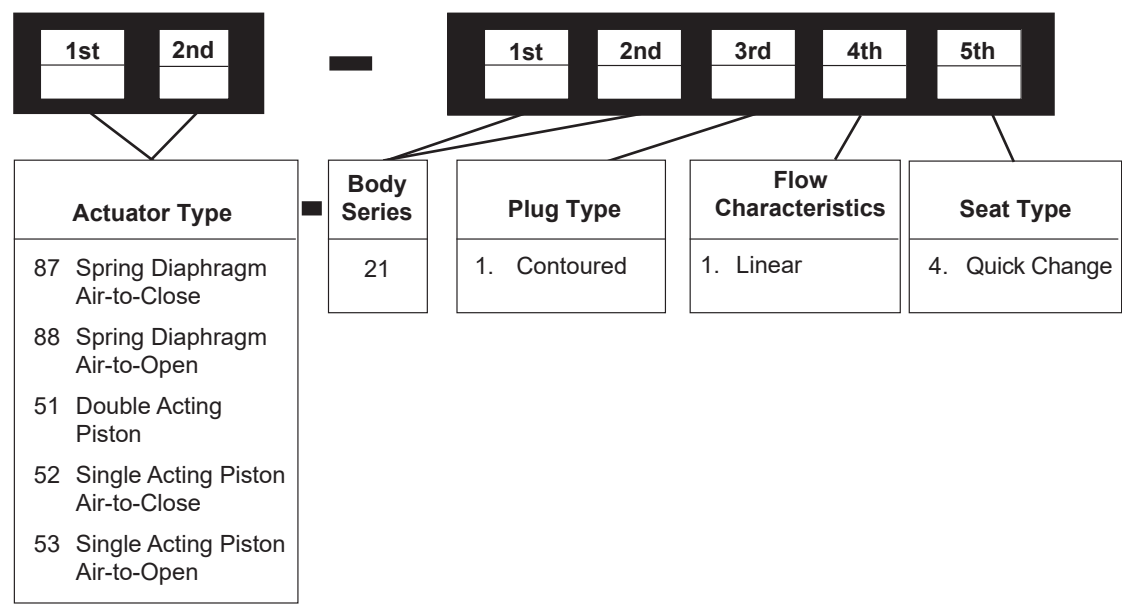
11. Actuation

Refer to the instruction, operation and maintenance manuals for the 51/52/53 Series Pneumatic Piston Actuators and the 87/88 Series Actuators.

Appendix A

High Pressure Valves 21000 API 6A Series

Numbering System



A1. Introduction

The following instructions should be thoroughly reviewed and understood prior to installing, operating or performing maintenance on this equipment. Throughout the text, safety and caution notes will appear and must be strictly adhered to, otherwise, serious injury or equipment malfunction could result.

Baker Hughes has a highly skilled After Sales Department available for start-up, maintenance and repair of our valves and component parts.

Arrangements for this service can be made through your local Baker Hughes's representative or sales department. When performing maintenance use only Masoneilan replacement parts. Parts are obtainable through your local representative or spare parts department. When ordering parts, always include the model and serial number of the unit being repaired.

A2. General

A2.1. Scope

The following instructions are designed to guide the user through the installation and maintenance of the 21000 API 6A Series valves for all sizes and for high working pressures (up to 10K and 15K PSI).

The 21000 API 6A Series single ported, cage guided control valves are designed to meet API 6A standard for high pressure applications.

Leakage class IV & V as per IEC-60534-4 are standard for the 21000 API 6A valves Series.

An optional Low Emission "Low-E" Packing is available to ensure compliance with the fugitive emission containment requirements.

A2.2. Serial Plate

The serial plate is usually fixed to the side of the actuator yoke. It indicates, amongst other things, the type of valve, the working pressure, the material class, temperature class, product specification level, performance requirement used for the pressurized chamber and the air supply pressure of the actuator.

There are two serial plates, one for the valve body sub-assembly and one for the actuator sub-assembly.

A2.3. After Sales Service

Baker Hughes offers After Sales Service performed by highly qualified technicians, for the operation, maintenance, and repair of its equipment. To benefit from this service contact your local representative.

A2.4. Spare Parts

When carrying out maintenance operations, only manufacturer's replacement parts must be used, obtained through local Masoneilan representatives or certified Masoneilan Spare Parts providers.

When ordering spare parts, the model and serial numbers indicated on the manufacturer's serial plate must be given.

The recommended spare parts are indicated in the parts list included in this Appendix on page 36.

A2.5. Actuator and Other Accessories

The valve is equipped with an actuator. Like other valve accessories, actuators have specific instructions regarding the installation, operation and maintenance for the electric and pneumatic connections. For additional information, please refer to the instruction, operation and maintenance manuals for the 51/52/53 Series Pneumatic Piston Actuators and the 87/88 Series Actuators.

A2.6 Warranty

The General Warranty terms outlined on at the beginning of this manual also apply to the 21000 Series API 6A, however please note the following exception:

21000 API 6A should be closed for a short period only. There is a risk of damage for trim parts for long period of closing.

21000 API 6A valves are designed as control valves, not as isolating valves.

If 21000 are used as isolating valve, internal parts damage will not be covered by warranty.

A3. 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.

A4. Installation

A4.1 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 surfaces should be thoroughly cleaned to ensure leak- proof joints.

A4.2 Isolation Bypass Valve

To allow for in-line inspection, maintenance or removal of the valve without service interruption, provide a manually operated stop valve on each side of the 21000 Series valve with a manually operated throttling valve mounted in the bypass line - see Figure 20 on page 35.

A4.3 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.

A4.4 Heat Insulation

For heat-insulated installation, insulate up to the body and actuator interface. Take necessary protective measures for personal safety.

A5. Body Disassembly

Access to the internal components of the body (B001) can be accomplished with the actuator removed. To remove the actuator from the body (B001), refer to the actuator instructions.

CAUTION

Prior to performing maintenance on the valve, isolate the valve and vent the process pressure. Shut off the supply air line and the pneumatic or electric signal line

Note: The valve must always be reassembled with new packing rings and gaskets; before disassembly, make sure that the appropriate parts are available.

After removing the actuator, disassemble the body sub-assembly using the following procedure:

- Remove packing nuts (B221), washers (B921) and studs (B220)
- Remove packing ring (B207) and anti-extrusion rings (B208)
- Remove packing spacer (B202)
- Unscrew trim retainer (B105)
- Remove integral plug/stem (B149)

CAUTION

Care must be taken to avoid damage to the plug and cage.

- All components may now be inspected for wear and service damage. After determining the maintenance required, proceed to the appropriate section of this instruction manual.

A6. 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.

Before reassembly, check parts and materials for conformity to the bill of material call out. Inspect the inside of the body (B001), cages (B102) and integral plug/stem (B149) for cleanliness.

Remove any foreign matter and clean the gasket surfaces. Inspect body (B001), cages (B102), gasket (B103) and plug stems (B149) for nicks, scratches, burrs, sharp corners, etc., on sealing and sliding surfaces including the packing box.

Note: During assembly, care must be exercised to prevent damage to these parts.

Since 21000 API 6A Series are high pressure valves, take care to ensure there is no damage present on the sealing surfaces. The performance of gaskets and seals are strongly linked to surface roughness.

A6.1 Packing Box

Prior to assembling the packing, ensure there are no nicks or scratches on the stem and packing box inside the diameter packing area.

If any of the requirements here above is not met, stem or packing box should be changed.

Tightness of the packing box is obtained by compression of the packing rings (B207) and anti-extrusion rings (B208). Compression must be achieved by evenly tightening the packing flange nuts (B221) on the packing flange (B219). Periodic retightening of the packing flange nuts is required to maintain tightness.

Make sure that the packing is not over tightened as this could prevent smooth operation of the valve.

If a leak persists after the packing has been compressed to a maximum, the packing needs to be changed.

A6.1.1. Replacing PTFE Based Packing

- Unscrew and remove the packing flange nut (B220) and packing flat washer (B921).
- Lift the packing flange (B219) up along the valve stem.
- By means of a puller, remove the packing rings (B207) and anti-extrusion rings (B208), taking care not to damage the sealing surface of the packing box lantern or the valve plug stem.
- Replace the packing rings, with the cut in each ring placed about 120° from the next, pressing them down one at a time indicated in Table A1.

Table A1 - Packing Rings

N.D. mm (in.)	Stem Size	Number of packing rings	Number of anti-extrusion rings
19 (3/4")	19 (3/4")	4	2
25 (1")	25.4 (1")	4	2

A7. Valve Body Reassembly

A7.1 Prior to Assembly the Body

Sub-Assembly

- Check parts and materials for conformity to bill of material call- out.
- Check pressure containing parts for clear and legible heat numbers.
- Inspect inside body (B001), integral seat-ring/cage (B103) and integral plug/stem (B149) for cleanliness.
- Remove any foreign matter and clean gasket surfaces. Inspect body (B001), integral seat-ring/cage (B107) and integral plug/stem (B149) for nicks, scratches, burrs, sharp corners, etc., on sealing and sliding surfaces, including the packing box.

Note: During assembly, care must be exercised to prevent damage to these parts.

Since the 21000 API 6A Series are high pressure valves, take care to ensure there is no damage present on the sealing surfaces. The performance of gaskets and seals are strongly linked to surface roughness.

A7.2 Trim Assembly

A7.2.1. CS Ring (Spring and Pressurised Gasket) mounting

Grease (Gripco NF or equivalent) the groove CS ring into the integral seat-ring/cage (B102), place and center the CS ring (B103) into it.

A7.2.2. Integral Seat-Ring/Cage mounting on the body

Assemble the integral seat-ring/cage (B107) with the CS ring (B103) into the body (B001).

Make sure to not damage the packing box during assembly and that the CS ring is fitted in the cage groove.

A7.2.3. Integral Plug/Stem mounting on the Integral Seat-Ring/Cage

Lower the integral plug/stem (B149) and place on the seating area.

Apply grease (Gripcott NF or equivalent) on thread of the body (B001) and on the trim retainer (B105).

Manually tighten the trim retainer (B105) to compress the CS ring (B103). Apply the appropriate torque as indicated in Table A2 below.

While assembling trim components into the body, the cage window should be oriented along with flow direction - see Figure 20 below.

Table A2 - Torque Value for Trim Retainer

Description	Valve Size (in)	0.75	1
	Max Working Pressure (PSI)	10K/15K	10K/15K
Trim Retainer	Thread Size	1"3/16-12 UNS-2A	1"1/2-12 UNF-2A
	Torque [daN.m]	14	27
	Torque [ft-lb]	103.3	199.2

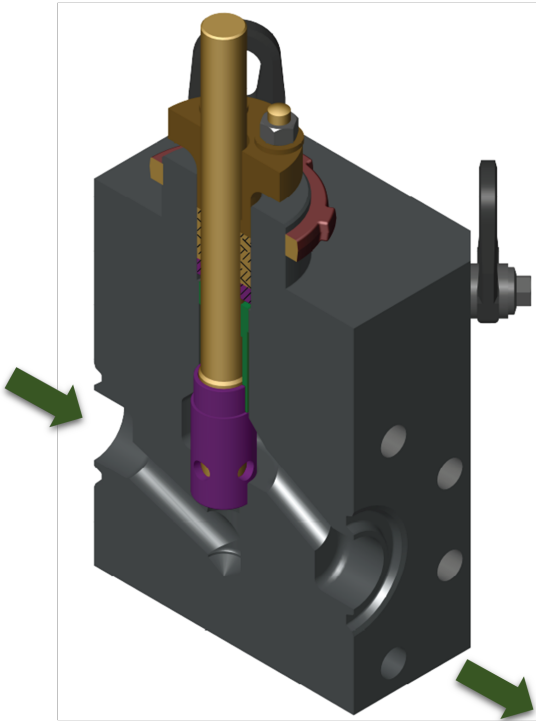
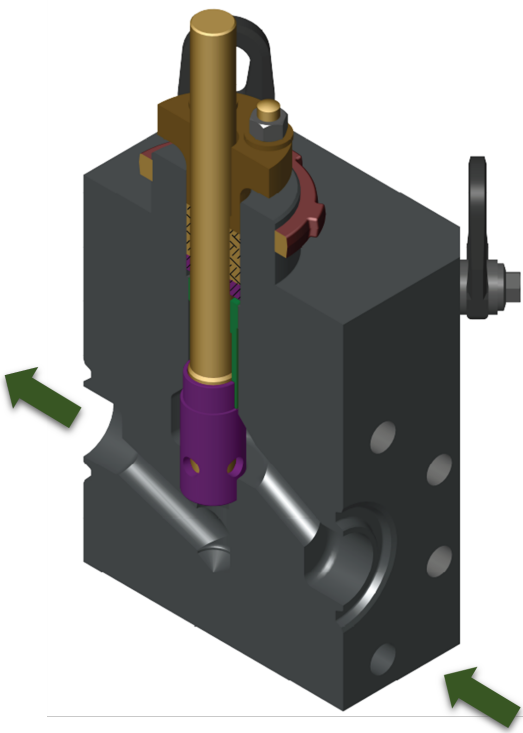


Figure 20 - Cage Orientation - Flow-To-Open (FTO) and Flow-To-Close (FTC)

A7.3 Packing Box Assembly

See packing box detail on Figure 21 on page 36 and Table A1 on page 34.

- Grease (Gripcott NF or equivalent) the packing stud (B220) and thread them in the body (B001)
- Install the packing spacer (B202) in the body (B001)
- Install the packing set (B207 & B208) in the body (B001)
- Install the packing flange/follower (B219) in the packing box of the body (B001)
- Install the packing flat washer (B921)
- Manually tighten by hand the packing flange nut (B221)
- Check that the valve integral plug/stem (B149) moves freely
- Gradually apply torque values as indicated in Table A3 below. Maintain even spacing between the integral plug/ stem (B149) and the packing flange/follower (B219) when torquing. There must be no contact between the integral plug/stem (B149) and the packing flange/follower (B219)

Table A3 - Packing Nuts Torque Value

Description	Stem Size (in)	0.75	1
	Max Working Pressure (PSI)	10K/15K	10K/15K
Packing Nuts	Thread Size	1/2"-13 UNC-2A	1/2"-13 UNC-2A
	No of Bolt	4	4
	Torque [daN.m]	50	82
	Torque [ft-lb]	37	61

A8. API 6A Body Sub-Assembly Cross Section

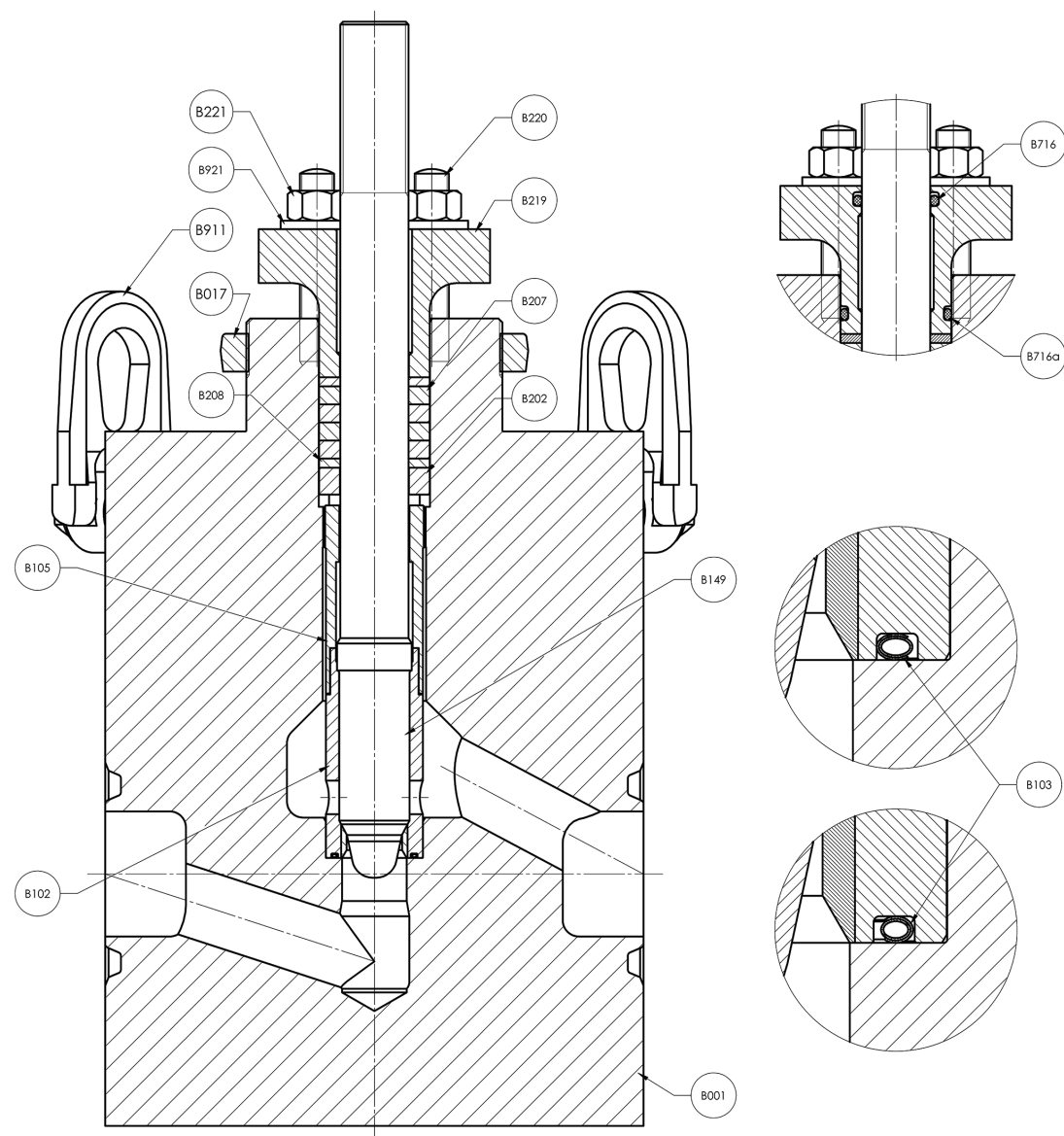


Figure 21 - Cross Sectional View of 21000 API 6A Design

Ref. No.	Spare Part Code	Part Description
B001	N	Valve Body
B017	N	Drive Nut
B102	W	Integral Seat-Ring/Cage
B103	C	CS Ring
B105	W	Trim Retainer
B149	W	Integral Plug/Stem
B202	W	Packing Spacer
B207	C	Packing Ring

Ref. No.	Spare Part Code	Part Description
B208	C	Anti-Extrusion Ring
B219	N	Integral Packing Flange/Follower
B220	N	Packing Flange Stud
B221	N	Packing Flange Nut
B716	C	O-Ring
B716a	C	O-Ring
B911	N	Lifting Lug
B921	W	Flat Washer

Notes:

C = Consumable

W = Wear Parts

N = Not a Spare Part

A9. Actuation

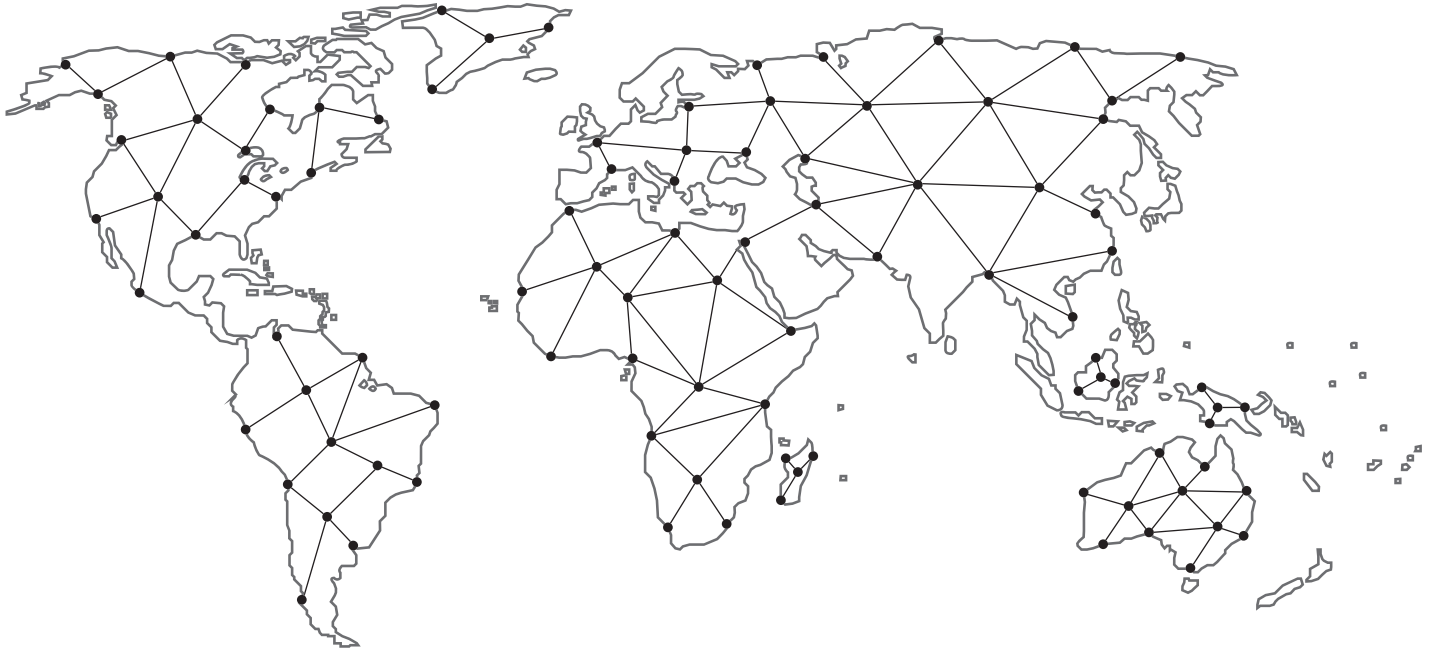
Refer to the instruction, operation and maintenance manuals for the 51/52/53 Series Pneumatic Piston Actuators and the 87/88 Series Actuators.

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