	Installation and Operation Manual **Triple Eccentric Butterfly Valve** **AJ Cryogenic**	985/011-000, 985/021-000, 985/031-000, 985/041-000, 985/051-000

The technical data are non-committal and do not assure you of any properties. Please refer to our general sales conditions.
Modifications without notice.

PRODUCT SAFETY SIGN AND LABEL SYSTEM

1. **DANGER – Immediate hazards which WILL result in personal injury or death.**
2. **WARNING – Hazards or unsafe practices which COULD result in personal injury or death.**
3. **CAUTION – Hazards or unsafe practices which COULD result in minor personal injury.**
4. **ATTENTION – Hazards or unsafe practices, which COULD result in product or property, damage**

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

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

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

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

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1. Safety Notice

Proper installation, operation, and maintenance are essential to the safe and reliable operation of all valve products. The procedures recommended by AVK and described in this manual are effective methods for performing the required tasks.

This manual contains various safety messages which must be carefully read in order to minimise the risk of personal injury and to avoid improper procedures that may damage the AVK product or render it unsafe. These safety messages are not exhaustive. AVK cannot possibly know, evaluate, or advise customers of all conceivable ways in which tasks might be performed, or of the possible hazardous consequences of each method. Therefore, anyone using procedures and/or tools not recommended by AVK, or deviating from AVK recommendations, must ensure that neither personal safety nor valve safety will be jeopardised by the selected methods or tools. If there is any doubt, AVK should be contacted for clarification regarding tools or methods.

If the products are used in radioactive environments, appropriate health physics procedures shall be consulted and followed prior to starting any operation, where applicable.

Installation, operation, and maintenance of valves and/or valve products may involve proximity to fluids at extremely high pressure and/or temperature. All necessary precautions must therefore be taken to prevent injury to personnel during any operation. These precautions include, but are not limited to, hearing protection, eye protection, and the use of appropriate protective clothing (e.g. gloves) when personnel are working in or around the valve area. Due to the wide range of operating conditions and potential hazards, AVK cannot evaluate all circumstances that may result in injury to personnel or damage to equipment. The safety precautions listed in this manual are provided for customer information only.

The purchaser or user of AVK valves and equipment is responsible for ensuring that all personnel working with the products are adequately trained. Prior to performing any work, personnel must become thoroughly familiar with the contents of this manual.

1.1. Safety Precautions

- Do NOT attempt to remove the packing gland nuts while the valve is under pressure.
- Do NOT attempt to eliminate seal leakage from the bottom cover by tightening the bottom cover bolts while the valve is under pressure.
- The bottom cover shall NEVER be removed while the valve is under pressure.
- Do NOT attempt to replace the packing while the valve is under pressure.
- No alteration and/or modification shall be made to any AVK valve.
- NEVER install or attempt to use a valve that is not properly identified with respect to material and pressure class.

1.2. Introduction

This manual covers the following range and design of Triple Eccentric Butterfly Valves in Cryogenic configuration

- AJ Series, Double Flanged Body Style.
- AJ Series, Lug Body Style.
- AJ Series, Wafer Body Style.
- AJ Series, Buttweld ends.

AVK Triple Eccentric Butterfly Valves are engineered to high standards of precision and accuracy and are subjected to rigorous inspection before leaving the factory. To ensure optimal performance and long service life, it is essential that these valves are correctly installed, operated, and maintained.

This manual is intended to provide guidance to installation crews, maintenance personnel, and operators on the fundamental procedures and best practices related to these valves. The manual shall be readily available to all personnel involved, in order to ensure continued familiarity with the valve characteristics, specifications, and handling requirements.

All valves are shipped from the AVK factory in verified good condition. However, AVK cannot be held responsible for damage resulting from improper installation, incorrect operation, or other conditions beyond its control.

2. Verifications on receipt and storage before installation

Upon receipt of the goods at the job site, it is strongly recommended to carry out the following checks and precautions:

- Verify the integrity of the packaging.
- Open the packaging carefully and check for any damage incurred during transportation.
- Do not open the barrier bag (if present).
- Confirm the contents against the packing list.

Storage Guidelines

- Store the valves preferably in their original packaging, provided it is undamaged, and place them in a closed, clean, and dry indoor storage area.

- Temporary outdoor storage is allowed only if the valves are packed appropriately (e.g., in crates lined with tarred paper and sealed in a barrier bag). In all cases:

    - Do not place packaging directly on the ground.
    - Avoid direct exposure to sunlight or harsh weather conditions.
    - Inspect packaging at least every two months.
    - Replace dehumidifying salts every six months (except when barrier bags are used).

For actuated valves, in addition to the above, refer also to the specific instructions and safety warnings provided in the actuator’s manual.

3. Handling (ref. enclosure fig 1)

When handling and/or lifting the valve, appropriate lifting equipment (such as fasteners, hooks, slings, etc.) shall be selected and sized according to the valve weight indicated in the packing list and/or delivery note. Lifting and handling operations shall be carried out only by qualified personnel. Fasteners shall be protected with plastic covers, particularly in areas with sharp edges. During handling operations, all necessary precautions shall be taken to ensure that the valve or lifting equipment does not pass over personnel or over areas where a potential fall could result in injury or damage.
All handling and lifting activities shall be performed in full compliance with applicable local safety regulations.

Do not use damaged slings, with insufficient or unknown load capacity

- **Valves Packed in Crates**
  Lifting and handling must be performed using a forklift truck equipped with suitable fork attachments**.**
- **Valves Packed in Cases**
  Lifting must be performed using the designated lifting points and following the center of gravity markings indicated on the packaging. All transportation must be carried out in accordance with local safety regulations to ensure safe handling**.**
- **Unpacked Valves**
  These valves should be handled using pallets, with particular care taken to protect machined surfaces from any potential damage**.**
- **Lifting of Valves**
  Valves must be lifted using slings, following the method illustrated in Figure 1.
  If lifting lugs are present on the valve body, they may be used for lifting as specified.

4. Installation

If the valve is supplied with a bare shaft, the disc is unsecured and free to move. This condition may cause injury to personnel and/or damage to the valve. The disc may unexpectedly become unseated due to valve movement or vibrations.

The recommended installation configuration is with the shaft in the vertical plane, as illustrated in Fig. 2. This installation orientation is strongly recommended by AVK for cryogenic service.

AVK Triple Offset Valves (TOV) are designed to withstand the design differential pressure in both flow directions. However, for optimal performance, installation in accordance with the preferential flow direction indicated on the identification plate affixed to the flange is recommended.

AVK does not recommend installing TOV valves as end-of-line valves. As a safety practice, end-of-line installations shall always include either two valves in series or one valve combined with a blind flange.

AVK recommends not install TOV valve as end pipeline valve, safety practice required in all instance at the end of pipe 2 valves or one valve plus blind flange.

Immediately before installing the valve into the pipeline, the following checks shall be performed:

- Remove all end and flange protective covers.
- Verify that upstream and downstream piping is clean and free from foreign objects; if necessary, clean using appropriate equipment (e.g. vacuum cleaner).
- Verify the correct flow direction.
- Inspect the seal ring to ensure it has not been damaged during handling. This is particularly important for valves shipped with the disc in the open position and with *fail-open* actuators.
- Confirm that the materials of construction indicated on the valve nameplate are suitable for the intended service and comply with specifications.
- Ensure that the packing gland adjusting nuts against the packing gland flange cannot be rotated by hand

Flanged, Lug, Wafer valves

Place the valve between the two flanges of the pipe and put the seal gasket between flange of valve and flange of pipe, make sure that it is correctly positioned. Then assemble the valve to the pipe by the bolts which will be tightened crossing. Progressively reach the requested torque value indicated by the Engineering Company that designed the plant.

Buttweld valves

Place the valve and check the alignment with the pipe, then proceed with welding, in accordance with the appropriate WPS given by the Engineering Company that designed the plant.

Generally, the first lay by TIG and the next ones with electrodes (material compatible with valve body).

During welding, shelter your eyes by appropriate mask.

When the pipe is lined, be careful that the disc does not come into contact with the lining during its stroke, especially in Lug and Wafer body styles. This verification is very important to avoid any damage to the valve.

General notes

- If one end of the valve remains unconnected to the pipeline for more than half a day, the open end shall be properly closed and sealed to prevent the ingress of dirt and foreign materials.
- After valve installation and prior to plant testing, it is strongly recommended to thoroughly clean the piping system in order to remove dirt and foreign objects that could compromise the tightness between seat and disc and adversely affect valve operation.

- Unless otherwise specified, the valve should be installed with the disc in the closed position to prevent damage to the seal ring during installation. Particular attention shall be paid to valves equipped with fail-open actuators.
- Hydrostatic testing of the valve is not recommended, as residual moisture may lead to ice formation inside the valve, potentially impairing correct operation.
- If a hydrostatic test is unavoidable, the valve shall be completely drained and thoroughly dried. The packing set shall be replaced after the test.

Do not use process valves as stop valves for flushing.

5. Checking before start-up

Before pressurizing the line, the following checks shall be performed:

- Verify that the pipeline has been thoroughly cleaned using appropriate washing methods.
- Ensure that the packing gland bolting is properly tightened.
- Remove any protective devices from the valve stem.
- Verify that all electrical, pneumatic, or hydraulic connections to motor operators are correctly completed.
- Tighten the packing only enough to prevent stem leakage. Over-tightening shall be avoided, as it may reduce packing life and increase operating torque.
- Check valve operation by stroking it to the *full open* and *full close* positions. To verify correct valve orientation, the disc position indicator mark on the shaft shall rotate between the cast bosses on the top flange of the valve body (for valves with top circular flanges). The valve disc rotates clockwise to close.
- During the normal open-to-close cycle, the disc position indicator mark on the shaft shall rotate clockwise from a position in line with the pipeline to a position parallel to the pipe flanges (see figure).
- During plant start-up, immediately check the tightness of the gland packing. If leakage is detected, tighten the gland bolts alternately.

A wrong electric connection of actuators without phase discriminator may cause danger and heavily damage the valve.
Actuators which have been removed or placed in another position on the valve, whose calibration has not been verified, may cause danger and heavily damage the valve.
When mounting the actuator, care must be taken to connect the actuator drive bushing with the valve shaft in the correct position. If this requirement is not observed, the disc will not be free to move in the right direction, causing leaking.

6. Routine maintenance

Due to their simple design, AVK Triple Offset Valves (TOV) require virtually no routine maintenance. However, the following checks may be required depending on the specific operating conditions.

6.1. Normal check

- **Monthly** verify that there is no leakage from packing.
- In case of leakage tighten the appropriate gland bolts and nuts according to the procedures described in the assembling paragraph.
- For actuated valves, in addition to the above, please refer also to the warnings in the manual of the actuator.

Do not over-tighten packing gland nuts. Over-tightening will increase the torque required to operate the valve. When tightening the gland nut, use half-turn increments until leakage has stopped.

6.2. Preventive

- **Every 3 months** verify the tightness of gland bolts.
- **Every 12 months** check the travel of the gland follower, setting a new packing when the end of the travel is approaching.
- **Every 4 years**. Substitute the packing.
- For the actuator, proceed as indicated in its maintenance book.

For your own safety, before starting any maintenance, it is absolutely necessary to verify that:

- there is no pressure in the line;
- the valve is not in temperature;
- there is no electrical connection.

7. Possible damage and relevant solutions

The damages listed here below are the most frequent ones that may occur.

7.1. Leakage from the packing

- Loose gland flange nuts. → Tighten gland flange nuts
- Packing damage or got stiff → Replace the packing
- Gland is at the end of its travel → Packing must be substituted

7.2. Leakage between seat and disc

- Valve is not in close position → Check if the valve is in close position
- Operator mechanical stops improperly set → Reset the stop properly
- Foreign material trapped in the valve → Flush the valve in open position
- Seal ring damaged → Replace seal ring

7.3. Jamming of valve along the stroke

- Packing is too tight → Loosen the gland nuts
- Valve packed with debris → Flush the valve to remove debris
- Stem key has sheared → Determine cause of shearing and replace key
- Debris between bearing and shaft → Flush the valve to remove debris
- Actuator failed → Check actuator and repair it

7.4. Leakage from bottom flange

- Bottom flange bolting loose → Tighten bottom flange bolting
- Spiral wound gasket damage → Replace gasket

7.5. Problems relevant to motor operators

- Packing is too tight → Loosen the gland nuts, cycle valve then retightens
- Air supply inadequate → Increase air supply pressure and/or volume
- Actuator/stem adapter misaligned → Remove actuator mounting and realign

7.6. Leakage from bonnet flange

- Bonnet flange bolting loose → Tighten bonnet flange bolting
- Spiral wound gasket damage → Replace gasket

In addition, check the actuator instruction book.

8. Maintenance

For your own safety, before starting any maintenance, ensure that:

- There is no pressure in the line.
- The valve is at ambient temperature.
- There is no electrical connection.
- Actuator is disconnected from any energy source (where applicable).

This procedure applies to **Flanged, Lug, Wafer, and Butt-weld valves**.

8.1. Packing maintenance (ref. enclosure fig 3)

- Remove the gear/actuator and relevant connecting keys (046A). Note the actuator position in relation to the valve position for reassembly.
- Remove nuts (049A) to detach bracket (019B) from the valve.
- Remove gland nuts (018A) and, if applicable, Belleville springs (take note of their configuration). Also, remove the gland flange (050D) and gland bushing (015B).
- Remove all packing rings (017T) from the stuffing box using a flexible screw hook. If the valve has a lantern ring, remove it as well.
- Inspect the shaft, stuffing box, and gland bushing. The surfaces of these components should be free of scratches. If any damage is found, polish the surface. If the damage is extensive, the components must be replaced.
- Clean the stuffing box with a specific lubricant (see Annex 6 for Lubricant selection).
- Insert new packing rings and, if the valve has a lantern ring, insert it as well, in the same sequence as they were removed.
- Reassemble the gland bushing (015B) and gland flange (050D). If Belleville springs were present, reassemble them in the same configuration as noted earlier. Apply a thin layer of lubricant (see Annex 6 for Lubricant selection) on the gland stud bolts (012A) threads and reassemble the gland nuts by hand, without tightening.
- Reassemble the bracket and nuts (049A), tightening them according to the torque specifications in ANNEX 1.
- Reassemble the keys (046A) on the upper stem end.
- Reassemble the gear/actuator and close the valve.

- Do **not** force the actuator on the stem; it should be a free-moving fit.
- Tighten gland nuts with torque values in **ANNEX 2**.
- Cycle the valve 2–3 times.
- Pressurize the line.
- If leakage is detected, tighten gland nuts slowly and evenly until leakage stops

8.2. Sealing Elements Maintenance (ref. enclosure fig 4)

- Remove the operator from the valve, then remove the valve from the line with disc in the close position.
- Loose the gland nuts (018A) in order to move easily the disc in fully open position (90°).
- Remove the screw (364A) and security washer (127R) and carefully remove the retainer seal ring (363A).
- Remove the seal ring (361A) and the spiral wound gasket (362A).
- Inspect the body seat and cleaned it with a fine abrasive cloth (P800), then cleaning with solvent.
- The disc seal ring area shall be inspected and cleaned. No foreign particles shall be present where spiral wound gasket shall be placed.
- Apply a thin film of lubricant (see Annex 6 for Lubricant selection) to the area where the seal ring will be positioned.
- Assemble the new spiral wound gasket (362A) in the disc groove, taking care not to damage it.
- Seal ring (361A) shall be replaced take care to check this point:
- align the internal slot of the seal ring (361A) to the reference pin (0157R)
- the reference mark (C) on the seal ring (361A) must be in the upper side

Before assembly the retainer seal ring (363A) check that the serration surfaces shall be cleaned such that no foreign particles are present.

- The seal retainer ring (363A) should be assembled after ensuring that the hole in the retainer ring aligns with the corresponding marks on the seal ring (361A).
- Hand-tighten all fastening screws (364A) with the appropriate lock washers (127R), after applying Loctite® 270 to the underside of the threads. Ensure that the threads are thoroughly cleaned with solvent before applying Loctite®. Then, verify that the seal ring can be moved freely by hand without rotation
  - Apply a thin film of dry lubricant (see Annex 6 for Lubricant selection) to the body seat and the external edge (sealing conical surface) of the seal ring.
  - seat and unseat the valve twice. Ensure that the seal and seat make uniform contact around the entire circumference. No light should be visible around the seal.
  - Keep the valve in the closed position without applying torque, then tighten all retaining ring screws (364A) in the sequence shown in Figure 5, using the torque specifications listed in ANNEX 3.
  - Apply bolt torque in increments of 25% of the final torque to ensure even compression of the gasket.
  - Repeat the application of 100% bolt torque to equalize the load

8.3. Bottom Flange Gasket Maintenance (ref. enclosure fig 6)

The following procedure should be followed to replace the bottom spiral wound gasket:

- Loosen the bottom screws and remove the bottom flange.
- Remove the spiral wound gasket.
- Inspect and clean the groove of the spiral wound gasket in both the body and the bottom flange.
- Apply a thin film of lubricant (see Annex 6 for Lubricant selection) to the new spiral wound gasket (6c).
- Insert the gasket into the bottom flange (6a), ensuring it is centered and properly positioned within the body bore.
- Rotate the bottom flange to align it correctly and center it with the threaded holes in the body.
- Apply a thin film of lubricant (see Annex 6 for Lubricant selection) to the threads of the screws (6b), then insert and tighten them using the torque value specified in ANNEX 5.

9. Preservation on line

For a correct preservation of the valves in the line, after the line cleaning, comply with the following requirements.

- Open the valve partially.
- Verify that stem is covered by a grease film.
- For long storage fill the valve with inert gas (nitrogen) at 2 bar.
- In addition to the requirements for handwheel operated valves, check the actuator manufacturer in its maintenance book.

10. Service life

The valve is designed to provide a minimum service life as specified in the contract. Where no specific service life is defined, a minimum service life of **10 years** is guaranteed.
This service life is contingent upon correct use of the valve within the project parameters and on the implementation of appropriate maintenance and inspection procedures.

11. Spare part list

There are two main types of spare part kits available: commissioning kits and 2-year kits. AVK guarantees the supply of a specific kit type as outlined in the contract with the customer. Please review the contract to see what is included in the scope of supply.

CLASSIFICATION OF RECOMMENDED SPARE PARTS

Classification	Item No.	Description
Commissioning Spare Part Kit	477D 362A 017T 477C	Bonnet gasket Seal ring gasket Gland packing Bottom flange gasket
2Years Spare Part Kit	477D 362A 017T 477C 361A	Bonnet gasket Seal ring gasket Gland packing Bottom flange gasket Seal ring

NOTE

- No single components are foreseen as spares for the gearbox.
- For actuator see the actuator manual.

ATTACHMENTS

Fig 0 Exploded valve

Fig 1 Handling

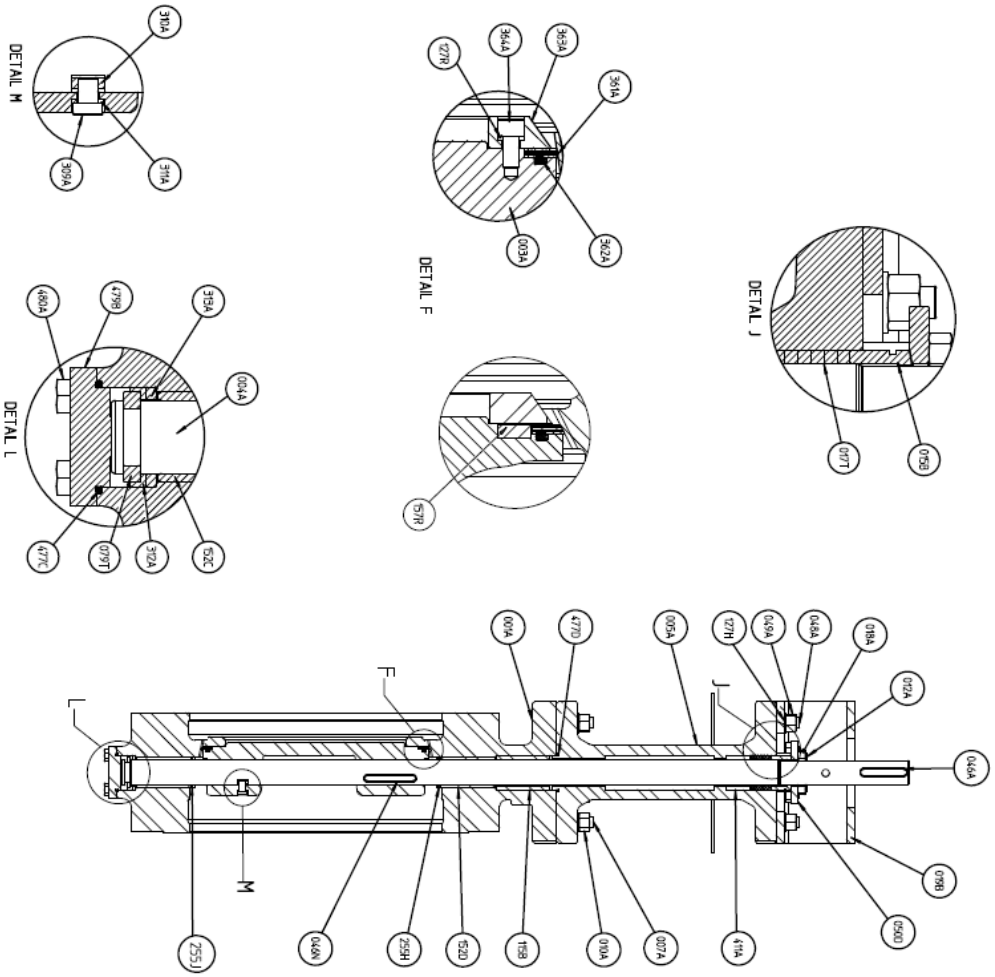
Fig 2 Installation

Fig 3 Packing maintenance

Fig 4 Seal ring maintenance

Fig 5 Screw tightening sequence

Fig 6 Bottom flange maintenance



Item	Description	Material	Sugg. spare part
001A	Body	A351 CF3 + Stellite® Gr 21	
003A	Disc	A351 CF3	
004A	Shaft	A479 GrXM19	
005A	Bonnet	A351 CF3 or A182 F304+A240 Gr304	
007A	Body-bonnet bolts	A320 B8M Cl.2	
010A	Body-bonnet nuts	A194 Gr8M	
012A	Gland rod	A193 B8M Cl2	
015B	Gland ring	A479 Gr 316	
* 017T	Packing	Graphite	
018A	Gland nut	A194 Gr 8M	
019B	Bracket	A516 Gr70	
046A	Stem key	C45	
046N	Stem disc key	A479 XM19	
048A	Body-bracket bolts	A193 B8M Cl2	
049A	Body-bracket nuts	A194 Gr8M	
050D	Gland flange	A240 Gr 316 or A479 Gr316	
079T	Segment ring	A479 Gr 316 Hard faced	
115B	Filling ring	A479 Gr316	
127H	Body-bracket washer	Stainless steel	
127R	Washer screw disc flange	Stainless steel	
152C/D	Radial bearing	A479 Gr 316 Hard faced	
157R	Reference pin	A479 Gr 316	
255H/J	Protector	Graphite	
309A	Bolts locking nut	A193 B8M	
310A	Locking nut	A479 Gr 316	
311A	Washer locking nut	Stainless steel	
312A	Axial bearing washer	A479 Gr 316 Hard faced	
313A	Axial bearing	A479 Gr 316 Hard faced	
* 361A	Seal ring	S31803+Graphite	
* 362A	Disc gasket	S31600 + Graphite	
363A	Disc flange	A240 Gr316 or A479 Gr316	
364A	Flange seal screw	A193 B8M Cl1	
411A	Up axial bearing	A479 Gr316 Hardened	
* 477C	Bottom seal gasket	S31600 + Graphite	
477D	Primary cover body gasket	S31600 + Graphite	
479B	Bottom cover	A240 Gr316 or A479 Gr316	
480A	Bottom flange screw	A316 B8M Cl2	

Fig 0 Exploded valve

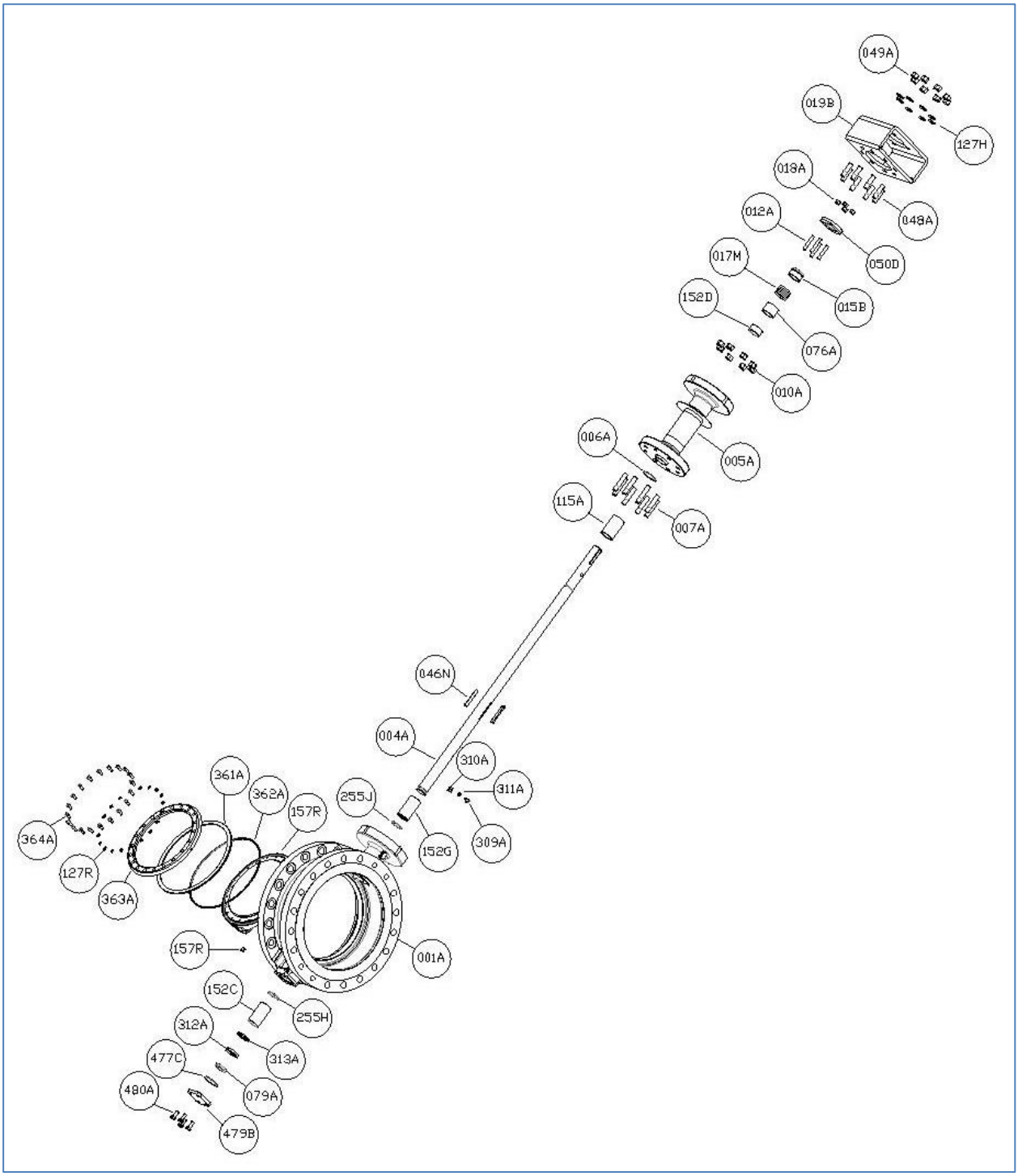


Fig 1 Handling

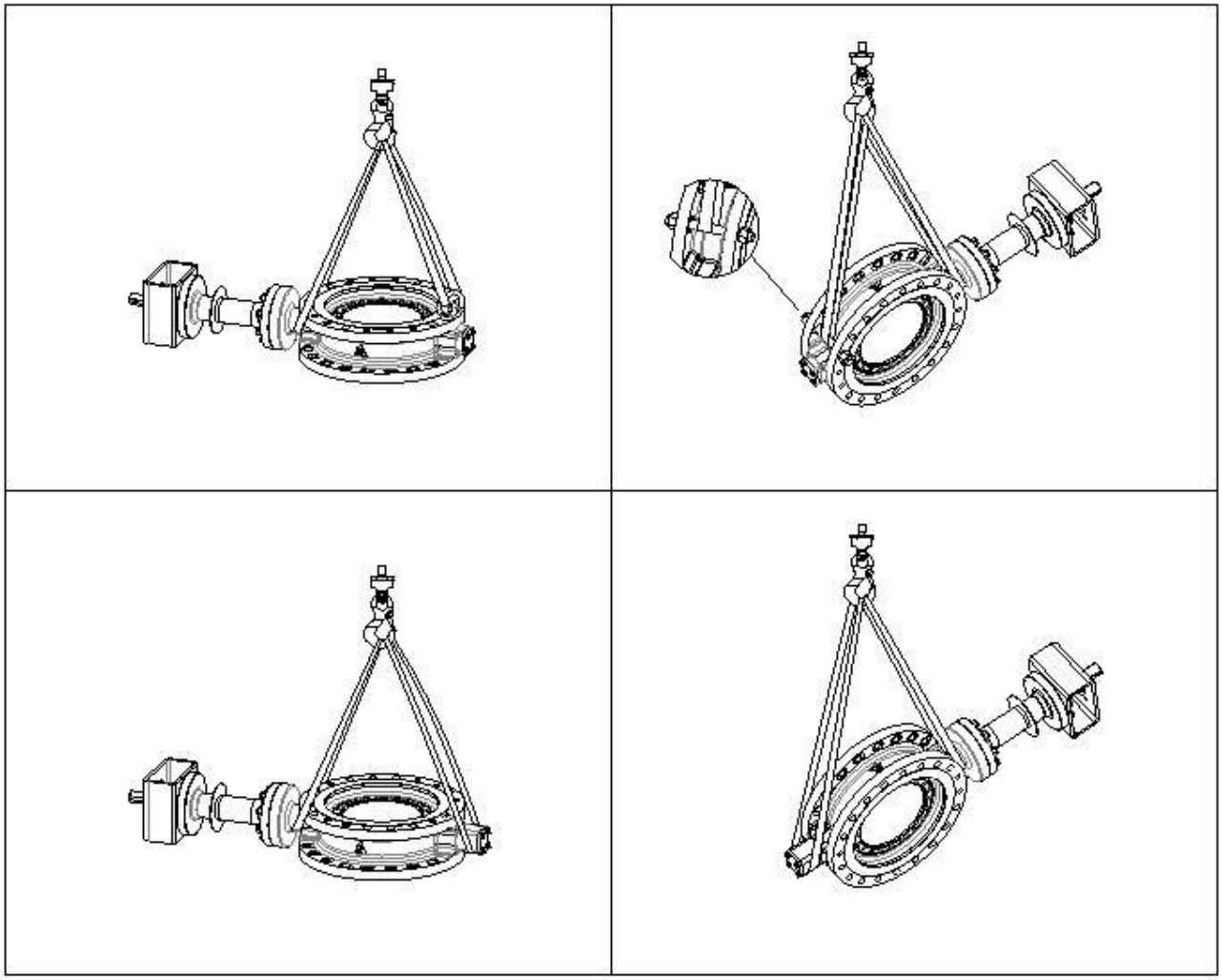


Fig 2 Installation

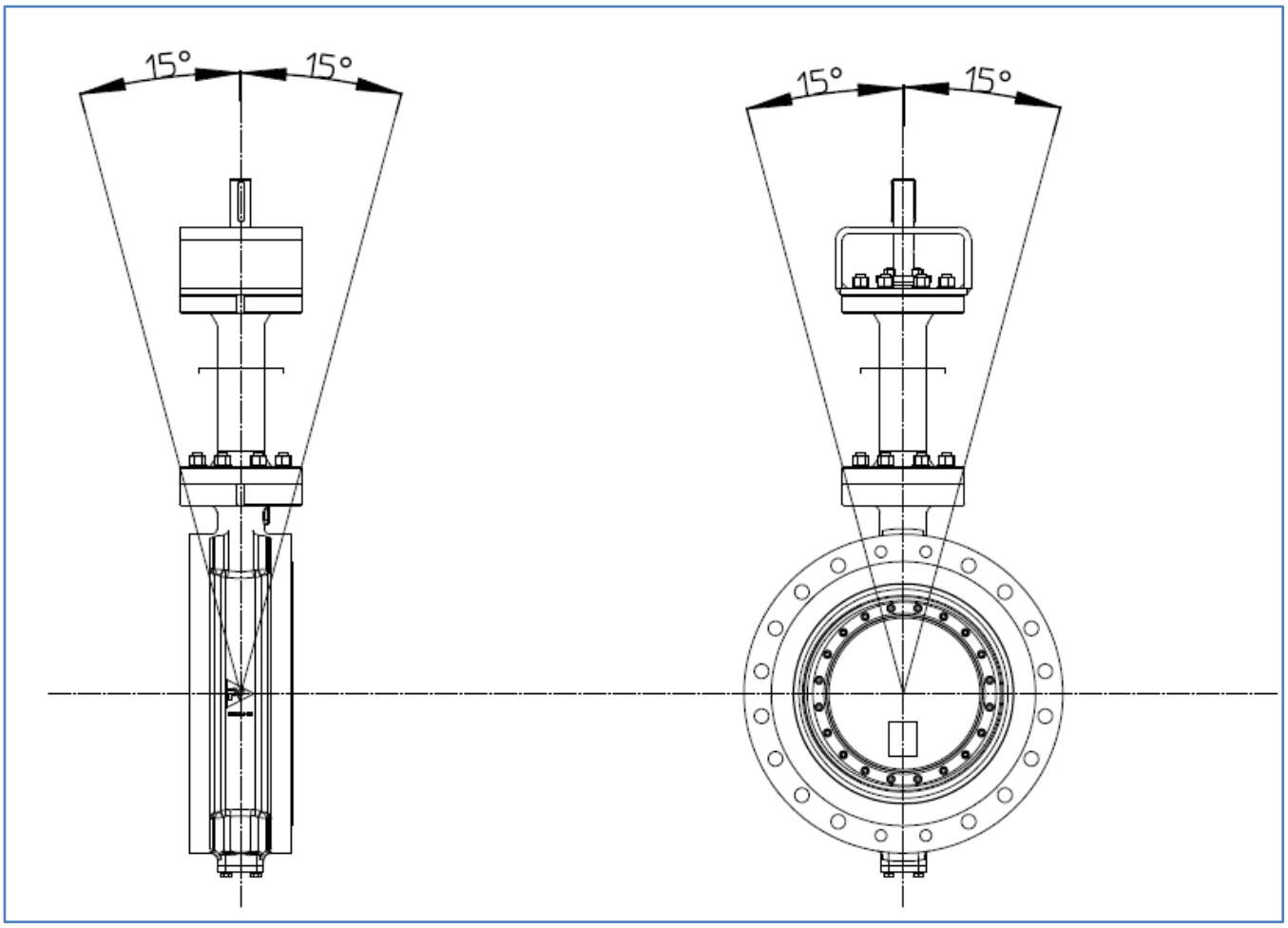


Fig 3 Packing maintenance

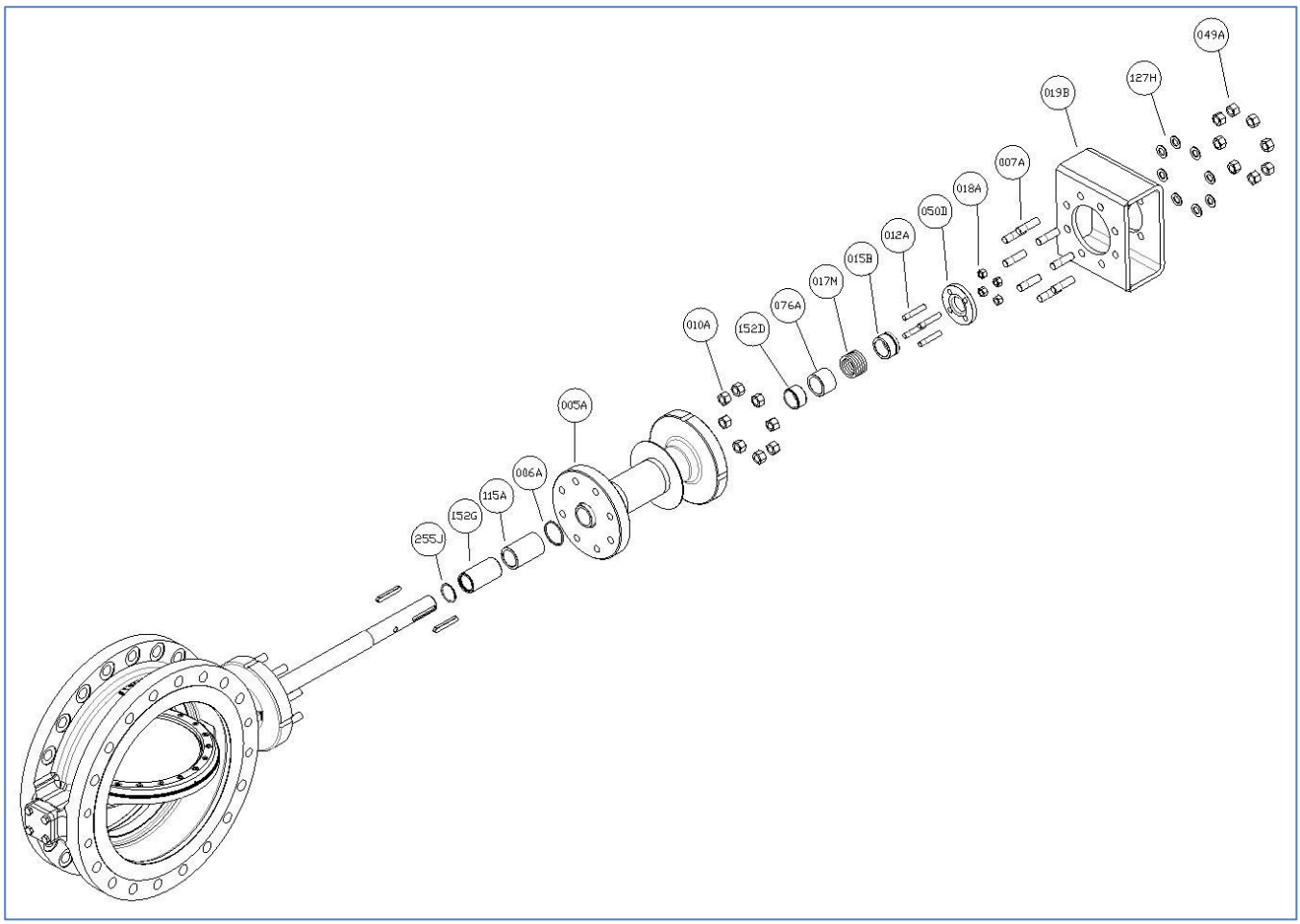


Fig 4 Seal ring maintenance

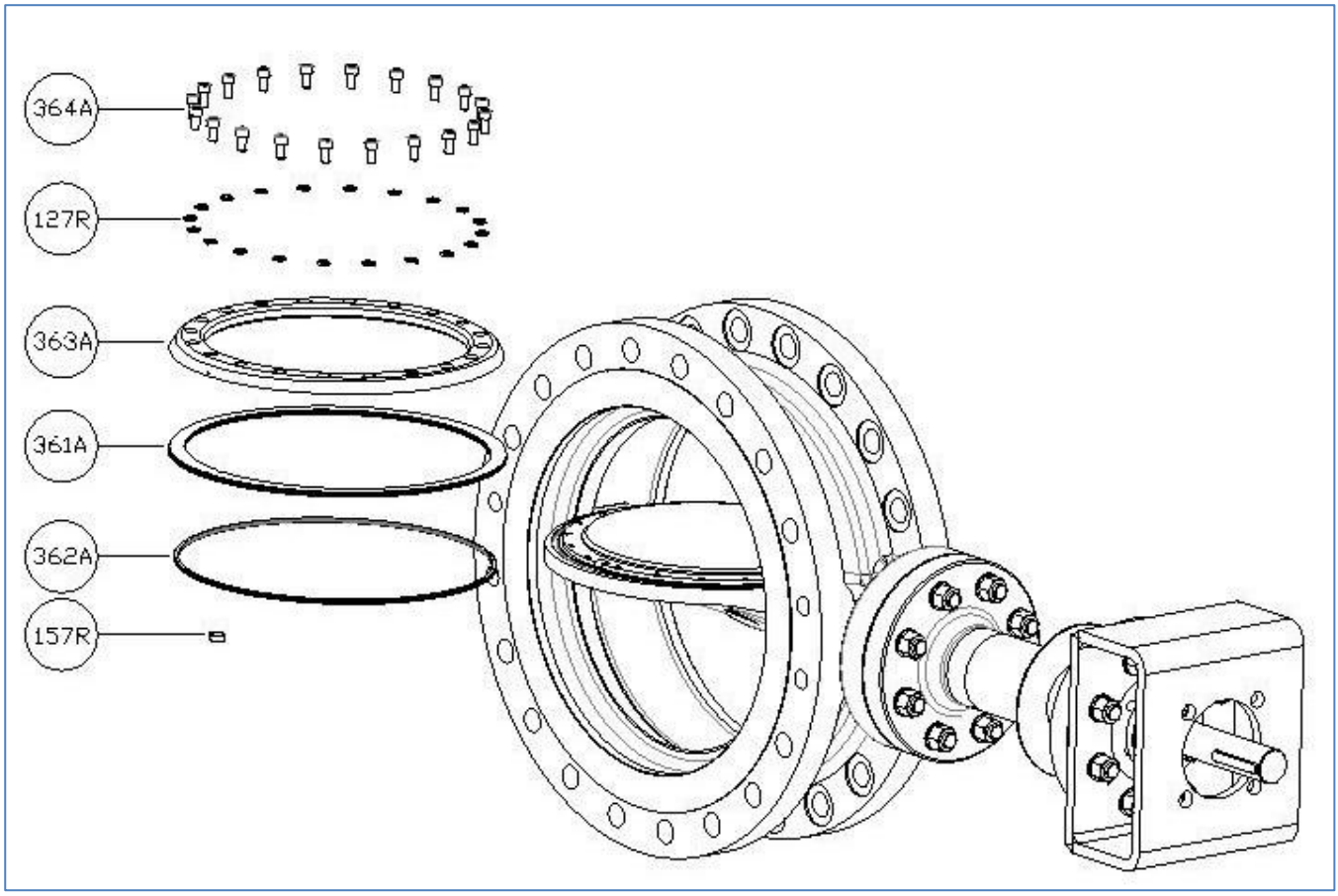


Fig. 5 Screw tightening sequence

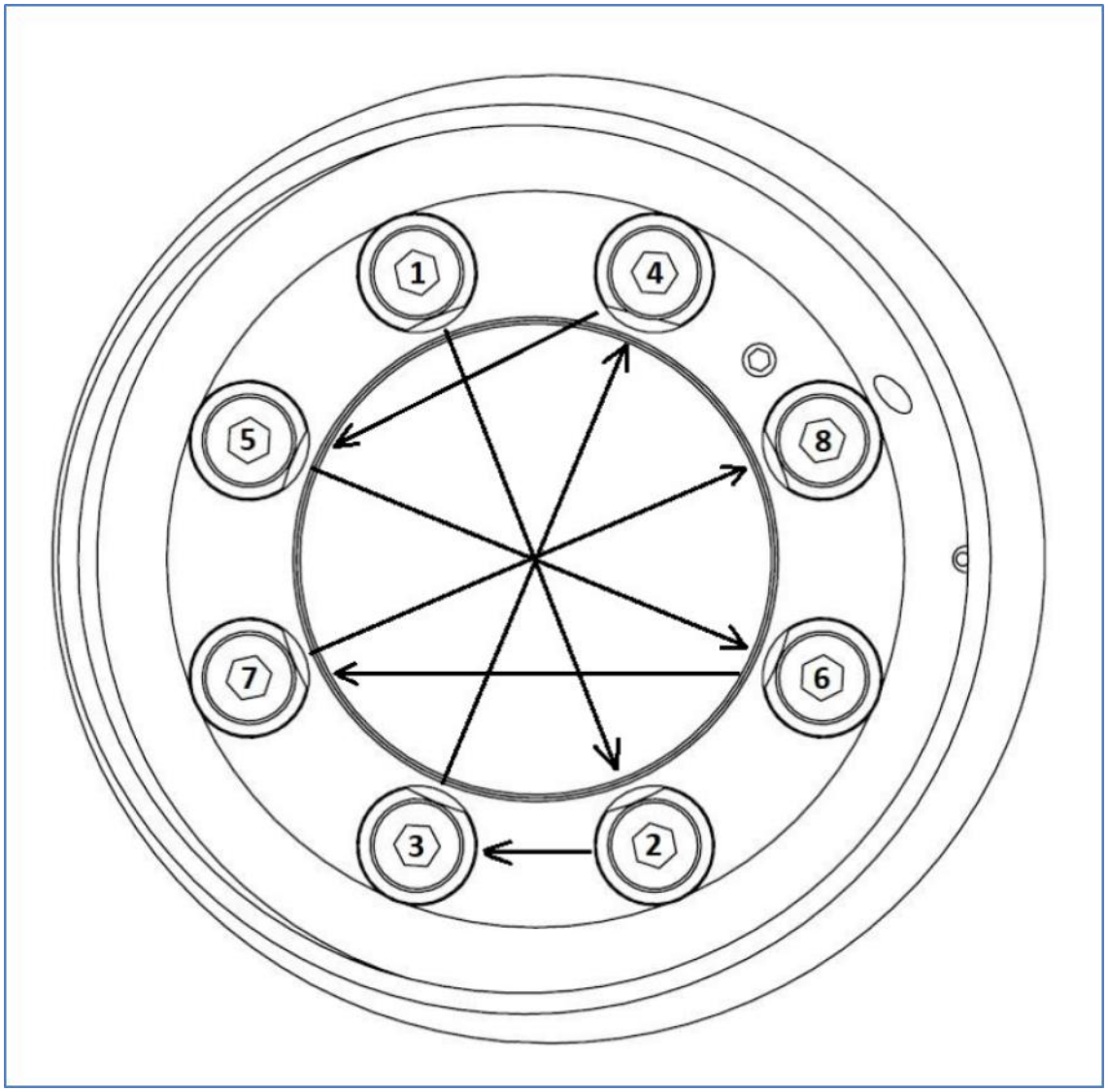


Fig 6 Bottom flange maintenance