ABO valve

08.08.25

Operating instructions for ABO shut-off valves series 500

CE

Summary

1. General information

The following manual provides detailed instructions for the installation, operation and maintenance of ABO Series 500 centric butterfly valves. Failure to follow these instructions may compromise safety and void the manufacturer´s warranty.

Based on many years of experience in the field of shut-off valves, ABO Valve has determined that most operational issues encountered with ABO Series 500 valves are related to improper installation. For this reason, it is very important to follow the instructions in the ABO Valve installation manual.

1.1. Description

The Series 500 centric butterfly valves are designed to shut-off and regulate flow in the piping system as required. Installation is carried out between the flanges of the piping system. The appropriate valve type and material selection should be determined based on the datasheets or the manufacturer's recommendations. The Series 500 butterfly valves fully comply with the CE/97/23 directive.

1.2. Labelling on the butterfly valve

Each Series 500 centric butterfly valve is equipped with an identification label, which lists the attributes used to identify the valve.

2. Safety regulations

Before performing any activities, it is necessary to carefully study and perform activities as listed in the safety regulations. Warranty may be void if adhearance to approved safety regulations is not strictly followed. All work during installation, disassembly, operation and maintenance of the valve must be performed by professionally trained personnel.

Basic safety rules:

- The valve can be operated safely if the pressure and temperature parameters of the media comply with the nominal specifications for the given type of valve.

- The materials of the individual valve components must be suitably selected to withstand the specific media and its operating parameters.
- The valve must not be used for applications for which it was not designed. When changing the media or chemical composition of media, it is necessary to consult with a competent member of the ABO team.
- The inner diameter of the flange must be sized to prevent damage to the disc during opening. An internal diameter that is too small may cause the disc to jam and may damage it. An inner diameter that is too large may prevent the outer seal between the sleeve and the pipe flanges from functioning properly. The recommended radial clearance between the disc and the mating bore is provided in Tab. 2.
- The valve must be opened and closed smoothly to prevent hydraulic hammer, which could damage the piping and possible danger to persons.
- Use only ABO Valve OEM parts for servicing ABO Valves.
- The Series 500 shut-off valve in the **ATEX** version comply with the requirements of standards EN ISO 80079-36:2016, IEC 60079-0:2018. The valve must be conductively connected to the grounded part of the connected equipment, and the measured value of the leakage resistance from the conductive and dissipative parts of the valve must meet the requirements specified in CLC/TR 60079-32-1:2018, Art. 13… ≤ 1 MΩ. The actual maximum temperature does not depend on the product itself, but on its operating conditions, in particular the temperature of the operating media and the ambient temperature.
  The maximum surface temperature of the shut-off valve in relation to the ignition temperature of the explosive atmosphere present must meet the general requirements specified in EN 1127-1:2020, Art. 6.4.2. To determine the maximum surface temperature of the product T in relation to its operating temperature Toperating, the following applies: Toperating ≤ +40 °C: T = 40 °C; +40 °C < Toperating ≤ +200 °C: T = Toperating. To determine the maximum surface temperature of the product T in relation to its marked temperature class, the following applies: T6 …T ≤ +85 °C; T5 …T ≤ +100 °C; T4 …T ≤ +135 °C; T3 …T ≤ +200 °C. T = Toperating.
- Recommendation: The valves must be installed in piping with a stabilized flow. The general rules for stabilizing flow behind a pipe element causing turbulence (e.g., pump, other valves, etc.) must be observed. Generally, calculate a minimum of 6xDN upstream and a minimum of 4xDN downstream (Fig. 1), but this depends on the specific conditions specified by the designer.

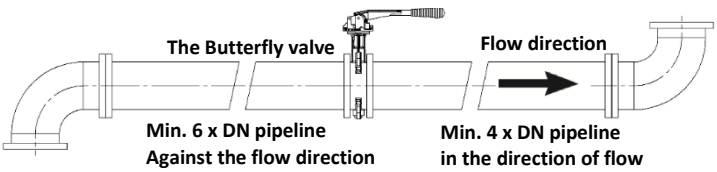


Fig. 1: Valve in the pipeline

- If the temperature of the media in the pipeline or the ambient temperature is higher or lower than the actuator manufacturer´s recommended limits, the actuator must be insulated (protected) from these temperatures in accordance with the actuator manufacturer´s instructions.
- For single-acting pneumatic actuators in NO (normally open) design, the sealing edges of the butterfly valve must be protected during transport and storage. During installation, the valve must be closed manually, or air must be connected to the pneumatic actuator and the valve closed.
- Pneumatic (or hydraulic) actuators must be adjusted so that rapid closure (or opening) does not occur. Unless otherwise specified, a closing time of t [sec]=DN/50 is recommended.
- Double-acting pneumatic actuators are not self-locking, so they must always be under air pressure.
- The electric actuator must be adjusted so that the actuator is switched off by the limit switch, not by the torque switch (see the electric actuator manufacturer's instructions).
- For valves DN300 and larger, a horizontal shaft position is recommended. For valves DN50-250, any installation position is permitted (unless otherwise restricted by the actuator manufacturer).
- Manual operation of the valves should be performed without excessive effort. The use of lever extension or striking tools is not permitted.
- Operation of the actuator mounted on the valve is permitted only when the butterfly valve is connected to the pipeline on both sides. Operating the valve without meeting this condition poses a risk of injury, for which the user is solely responsible. An exception applies to valves with a normally open (NO) actuator, where the disc is

in the open position by default. In this case, it is essential to partially close the disc before installation using air or the actuator controls.

- If the valve is used as an dead-end valve, it must be securely locked in the closed position (locking lever, etc.).
- If it is necessary to open an dead-end valve in a pressurized pipeline, attention must be paid to the escaping media to prevent potential damage or personal injury.
- The valve with actuator must be adjusted before installation in the pipeline, with particular attention to the adjustment of the end positions.
- Valves with actuators used for flow regulation must be designed to prevent cavitation (consult the manufacturer if necessary).
- The operation of the valve with actuator must be thoroughly checked only after installation between the pipeline flanges.
- Before removing the valve from the pipeline (or replacing the shaft seal), the pipeline upstream and downstream of the valve must be depressurized (risk of uncontrolled fluid leakage). The valve must be decontaminated.
- During transport and storage of valves without a lever or actuator, ensure that the valve remains closed to prevent damage to the disc.
- The position of the lever indicates the position of the disc. That is, when the lever is perpendicular to the pipeline, the valve is closed; when the lever is parallel to the pipeline, the valve is open.
- The valves are not self-locking; therefore, the lever or actuator must not be removed while the pipeline is under pressure. If it is necessary to install a valve without an actuator, it must be ensured that the valve is not under pressure.
- The valve must not be used as a support for the pipeline structure.
- Pipeline connections must be made in such a way that external forces or vibrations are not transmitted to the valve during or after installation.
- The valve must be lifted using slings passed through the lifting lugs, or threaded lifting eyes screwed into the T-body or valve neck. Never lift the valve by the actuator or through the internal disc opening.

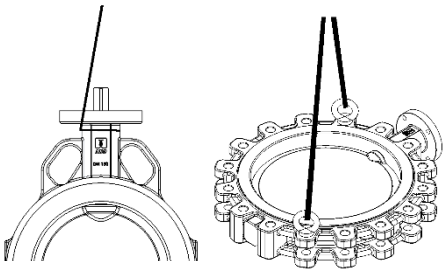


Fig.2: Recommended suspension method for lifting the valve

- Never step on the valves or actuators.
- Valves must never be installed directly on rubber expansion joints, as this may increase the torque, making the valve practically inoperable.
- After disassembling the valves from the pipeline, take care to avoid damage to the sealing surfaces.
- In the event of valve malfunction or damage, contact our claims department (reklamace@abovalve.com) or the sales department.

3. Transport and storage

Basic storage instructions: rubber components – see ISO 2230; plastics – see ČSN 640090.
Proper storage guidelines:

- It is recommended to store valves in closed, dry, dust-free, and temperature-controlled spaces at temperatures between +5 °C and +25 °C, ideally around 15 °C. When storing separate PTFE sleeves, the storage temperature must not fall below -5 °C or exceed 45 °C. Seats must not be exposed to direct sunlight, ozone, solvents, direct contact with heating elements, mechanical damage, vibrations, or deformation. Valves are not recommended to be stored directly on the floor. Long-term storage of rubber and plastic components may reduce their elasticity. Relative humidity should be controlled appropriately.

- Valves should be stored with the disc slightly open, approximately 15°. Never store fully closed. The edges of the disc must be protected against mechanical damage.
- Valves should not be stacked, if possible, as this may damage the seat. If stacking is necessary, each layer must be separated with an appropriate spacer.
- During long-term storage, the disc must be rotated regularly to prevent the moving parts of the valve from seizing and to allow the seat to regain its original shape (the seat tends to deform in contact with the disc). Do not move the disc when stored at temperatures below 0 °C.
- Protective coatings and preservative layers should be inspected at six-month intervals and repaired if necessary.

Proper transportation guidelines:

- When handling larger valves with a crane, they must be lifted only by the body or lifting eyes, never by the actuator or lever.
- Valves supplied without an actuator must be secured and transported in a way that prevents them from opening due to external influences (vibrations) during transport.

4. Installation in the pipeline

Installation of valves into the piping system must be performed by a properly trained and qualified person.

4.1. Prerequisites for installation in pipeline

- Shut-off valves must be installed between necked or flat flanges in accordance with EN 1092-1.
- The sealing surfaces of the valve are formed by the PTFE seat. It is recommended to use type “B” flanges according to EN 1092-1.
- Before installation, it is necessary to verify that the delivered valve corresponds to the required PN, DN, and materials for the intended application, and that no damage occurred during transport (a damaged valve must not be used!).
- Before installing the valve, thoroughly clean the piping system of mechanical impurities, scale, rust, slag, etc. No sharp edges should be present on the components that could damage the seat.
- After storing valves at temperatures below 0 °C, they must be placed for 24 hours in an environment with a temperature of at least 10 °C prior to installation. This allows the valves to warm through completely. Only then may they be installed in the pipeline.
- The pipeline must not be pressurized during valve installation.
- The pipeline flanges must be parallel, and the axes of both pipelines must be coaxial. Misaligned flanges can cause leakage at the valve seat due to uneven pressure on the seat. Flange parallelism tolerances (Tab. 1) are specified according to **EN 558**. **Checking the internal diameter of the pipeline flanges is essential for reliable valve operation!**

Tab. 1: Parallelism tolerance

DN	Tolerance[mm]
32-150	0,6
200-300	0,8
350-500	1,0
600-800	2,0

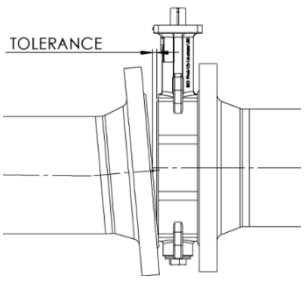
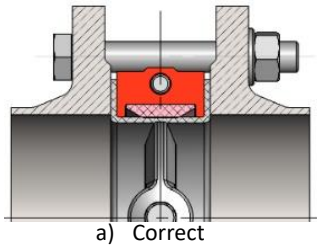
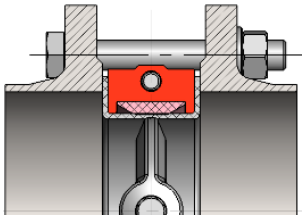


Fig. 3: Flange parallelism

- Due to pipeline stresses, misalignment, flange non-parallelism, or flange spacing exceeding the valve’s face-to-face length, proper tightening of the valve in the flange connection cannot be reliably ensured by torque control alone.
- Check the internal diameter of the mating flanges to ensure proper valve operation (disc rotation). Refer to the information on the disc projection from the valve see in the Tab. 2. Account must be taken of potential flange misalignment, disc clearance, imperfect centering of the valve, and the shape of the seat!!! **An undersized flange bore** can cause the disc to jam, resulting in severe disc damage and valve malfunction. **An oversized flange bore** may prevent proper sealing between the valve and the pipeline flange.
- In general, it is recommended to install the valve in a vertical position within the piping system. However, there are applications where the valve is installed in a horizontal position (Tab. 3).


a) Correct


b) Incorrect
(excessive internal flange diameter)

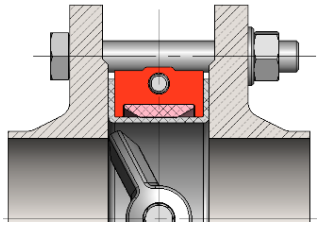
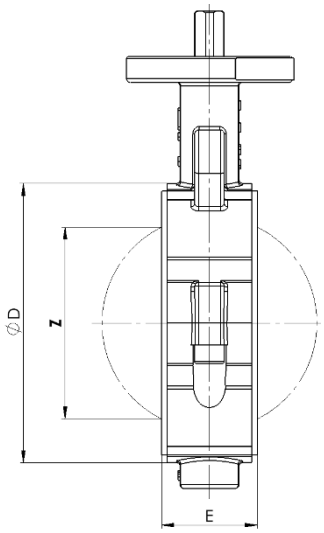

c) Incorrect
(insufficient internal flange diameter)

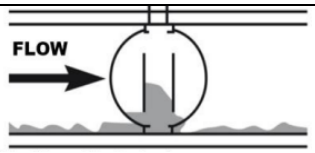
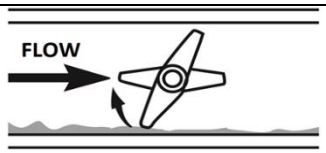
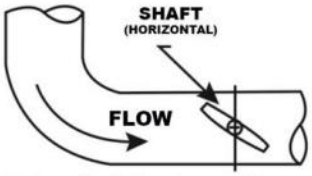
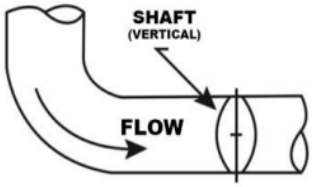
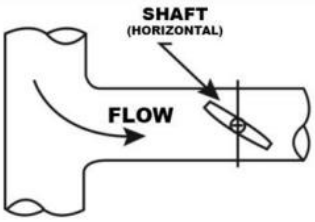
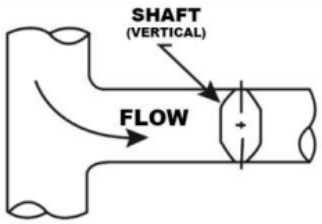
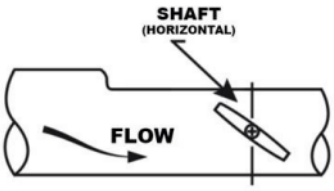
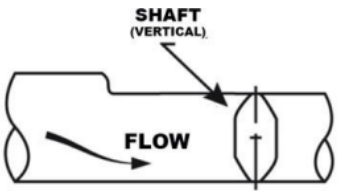
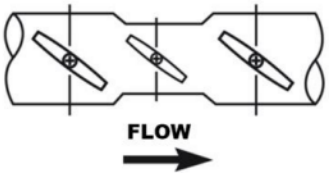
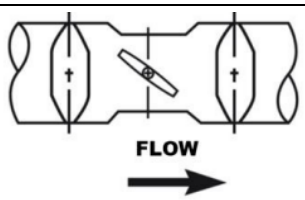
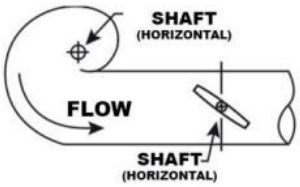
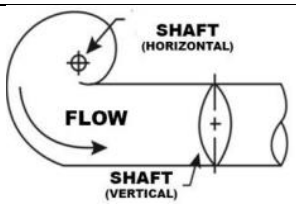
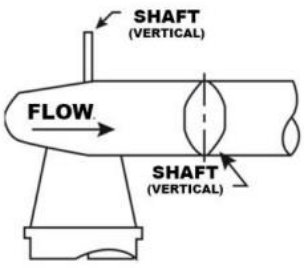
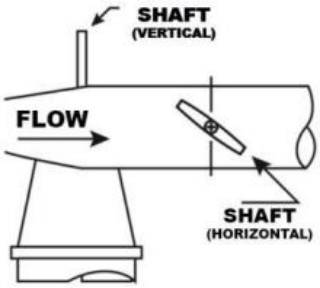
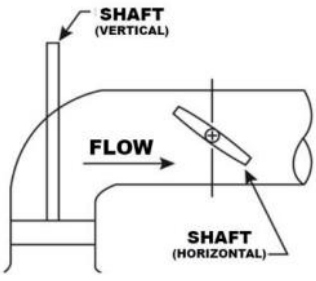
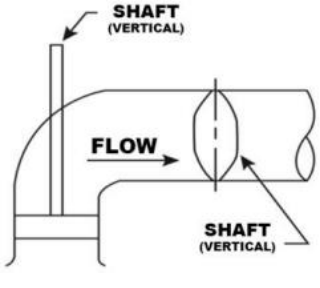
Fig. 4: Installation between flanges

Tab. 2: Dimension of the disc overlap from the valve and inner diameter of the flange

DN	NPS	Overlap of the disc from the valve Z, [mm]	Construction length E, [mm]	Inner diameter of neck flange EN1092-1 type 11 on pipe PN6,10,16, Cl. 150 (GOST PN16), [mm]	Min. inner diameter of the pipe flange, [mm]
50	2“	25,5	43	51,2-54,5 (49)	28,5
65	2 1/2“	46	46	70,3 (66) 62,7 Cl. 150	49
80	3“	65,5	46	82,5 (78)	68,5
100	4“	85,4	52	100,8-107,1 (96)	88,4
125	5“	112	56	125-131,7 (121)	115
150	6“	139,2	56	150-159,3 (146)	142,2
200	8“	191	60	207,3-206,5 (202)	197
250	10“	240	70	254-260,4 (254)	246
300	12“	290,2	76	309,7 (303)	296,2
350	14“	341,2	78	339,6-352 (351)	347,2
400	16“	387	102	390,4-403 (398)	393



Tab. 3: Valve orientation

Incorrect installation	*Correct installation*	*Incorrect installation*	*Correct installation*
Abrasive substances		**Knee**	
 **Vertical shaft, sludge accumulates on the disc**	 **Horizontal shaft, sludge passes under the disc**	 **Valve shaft (horizontal)**	 **Valve shaft (vertical)**
T- piece		**Pipe reduction**	
 **Valve shaft (horizontal)**	 **Valve shaft (vertical)**	 **Valve shaft (horizontal)**	 **Valve shaft (vertical)**
Valve orientation		**Centrifugal pump – shaft orientation**	
 **Increased noise, erosion and vibration**	 **Reduced noise, erosion and vibration**	 **Horizontal pump shaft and horizontal valve shaft**	 **Horizontal pump shaft and vertical valve shaft**
Centrifugal pump - pump shaft vertical and the horizontal valve shaft		**Axial pump – pump shaft vertical and vertical valve shaft**	
 **Vertical pump shaft and vertical valve shaft**	 **Vertical pump shaft and horizontal valve shaft**	 **Vertical pump shaft and horizontal valve shaft**	 **Vertical pump shaft and vertical valve shaft**

4.2. Working steps during installation

- Insert the valve with the disc slightly open (approx. 15°) between the flanges (the disc must not extend beyond the face-to-face length of the valve). Lightly tighten and align the valve using two upper and two lower bolts. **Do not use any additional gaskets between the pipe flanges and the valve. For valves with thicker coatings (C4, C5), exercise increased caution during installation and bolt tightening to prevent cracking of the coating.**
- By opening the valve, verify the correct and unobstructed movement of the disc.
- Tack-weld the flanges to the pipeline at several points.
- Remove the valve and weld the flanges to the pipeline around their entire circumference. After the flanges have cooled, reinstall the valve between the pipeline flanges (with sufficient clearance), align it, and lightly tighten the four bolts. Open the valve again to verify correct operation throughout the full range of disc movement.
- Install the remaining bolts (Fig. 5). Always tighten bolts in a cross pattern. Uneven bolt tightening may result in increased torque on the valve.
- Verify the proper operation of the valve.
- Due to pipeline stresses, misalignment, flange non-parallelism, or flange spacing exceeding the valve's face-to-face length, proper tightening of the valve in the flange connection cannot be reliably ensured by torque control alone.
- For ATEX versions, connect the grounding wire from the valve to the pipeline, which must also be properly grounded.
- Valves with threaded connections can be installed at the end of a pipeline. They may be used as end-of-line valves for long-term operation only if the upstream pressure is less than 6 bar for DN32–200 and less than 3 bar for DN250 and larger. This limitation exists because the PTFE sleeve is not sufficiently evenly compressed between the two flanges. Valves with lifting eyes, through holes, or threaded ends may be operated at full pressure at the end of a pipeline only if they are installed with a mating flange.

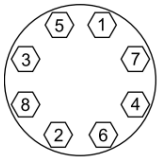


Fig. 5: Cross tightening

Fig. 6: Installing the valve between the flanges using screw

4.3. Tightening torque for flange bolts

When installing centric butterfly valves in a piping system, there are several factors that affect the tightening torques. Below is a list of information that affects tightening torques.

Tab. 4: Factors affecting tightening torques

Valve	Type / Size / Material	**Lubrication**	Aplication / Type
Flange	Type / Size / Surface finishes	**Torque wrench**	Use / Accuracy
Bolt / Stud	Type / Material / Surface conditions	**General factors**	Temperature / Screw tightening speed / Method of tightening (cross-tightening to evenly distribute the tension on the connections)

- Due to the vast number of conditions that the valve is subject to, it is not possible to provide a precise tightening torque.
- The procedure for installing the valve into the piping system, using the tightening torques from Tab. 5, is described in Chapter 4.2.

- ABO Valve provides this manual only as an installation recommendation. This recommendation is based on full compliance of all supplied materials with their respective specifications. Since many components are not manufactured by ABO Valve, the manufacturer cannot assume any liability for damages caused during installation.
- Tightening must be performed gradually in a cross pattern, with incremental torque application of 15 %, 40 %, and 100 % of the specified in Tab. 5.
- The tightening torque values are based on the use of new, lubricated fasteners. When using non-lubricated fasteners, 20 % may be added to the recommended tightening torque values. Any increase of the torque values from Tab. 5 is permissible only in the case of leakage at the flange joint and only after approval by the manufacturer following verification of all the factors mentioned above.
- When installing valves into the pipeline, washers must be placed under the heads of bolts and nuts to distribute pressure within the joint and to reduce friction during tightening.
- For wafer type (Type B) lugless valves, where bolts or threaded rods are not screwed into the body, the recommended bolt tightening torques may, if necessary, be increased up to the maximum values specified by the manufacturer of the selected fasteners.
- For T (lug)/B (wafer) type valves with blind threaded holes in the body, only threaded rods may be used during valve installation into the pipeline, and they must be tightened to the recommended torque values from Tab. 5. The threaded rod must be fully screwed into the blind thread until it bottoms out.
- For T-type (lug) valves with through-threaded holes, bolts or threaded rods must be screwed into the body to a minimum depth of 0.75×D, where D is the nominal diameter of the bolt/threaded rod. When bolts are used, it must be ensured that the bolts do not contact each other inside the body, as this would prevent proper tightening of the flange joint.
- The tightening torques listed in Tab. 5 apply only to soft-seated ABO S500 valves and are not valid for other valve types.

PTFE deforms under pressure, so it is important to follow the tightening torques according to the table below, which provides the recommended approximate maximum tightening torques M_k [Nm] when using lubricated 8.8-grade high-strength bolts:

Tab. 5: Recommended bolt tightening torques M_k [Nm]

DN	Screw/ PN6	M_k [Nm]	Screw/ PN10	M_k [Nm]	Screw/ PN16	M_k [Nm]	Screw/ ANSI CLASS 150	M_k [Nm]
50	M12	50	M16	50	M16	50	5/8“-11 UNC	50
65	M12	50	M16	50	M16	50	5/8“-11 UNC	50
80	M16	52	M16	50	M16	50	5/8“-11 UNC	55
100	M16	60	M16	55	M16	55	5/8“-11 UNC	60
125	M16	56	M16	62	M16	62	3/4“-10 UNC	65
150	M16	65	M20	70	M20	70	3/4“-10 UNC	90
200	M16	70	M20	75	M20	75	3/4“-10 UNC	110
250	M16	110	M20	116	M24	135	7/8“-9 UNC	135
300	M20	127	M20	137	M24	165	7/8“-9 UNC	165
350	M20	132	M20	142	M24	170	1“-8 UNC	190
400	M20	150	M24	160	M27	178	1“-8 UNC	190

4.4. Installation errors

- Insufficient parallelism of the flange – The pressure on the seat will be uneven on both sides. This will cause deformation of the seat and thus leakage between the valve and the flange, or between the seat and the shaft.
- The flanges are too close to each other – The seat may become deformed during installation, leading to rapid damage. If the flanges are far apart, tightening causes high tension in the pipe and valve.
- Deformation of the seat caused by mounting the valve with the disc in the closed position – permanent deformation of the contact surfaces of the seat and disc may occur. This increases the torque of the valve.
- Use of incorrect flanges – The disc may collide with the inner opening of the flange (if the inner diameter is too small), which will prevent the disc from opening freely and cause damage to it.
- Use of an additional seal between the valve and the pipe flange – The seat will be pushed inwards, which will increase the torque of the valve and make the disc opening improper or impossible.
- Welding near the shut-off valve – The seat is damaged due to high temperature.

- Mounting the valve directly on the rubber expansion joint – The torque increases due to the action of the rubber compensator, and the valve becomes virtually impossible to operate.

4.5. Disassembly of flange or pipe behind shut-off valve type T (LUG – eyebolts)

The same safety rules apply as for installation.

- Close the pressure supply to ensure that no overpressure occurs during flange or pipeline disassembly.
- The disc must be in the closed position.
- Check that the pressure upstream of the valve does not exceed 6 bar for DN50 - 200 valves and max. 3 bar for DN 250 and larger valves. The figures below show LUG valves (with threaded holes) mounted between pipe flanges.
- Gradually loosen the screws in a cross pattern on the side behind the valve, then remove the flange and pipe behind the valve.

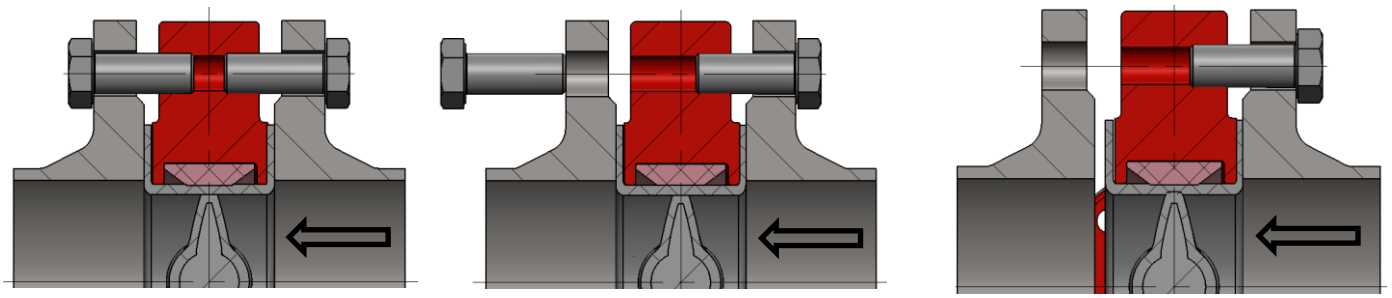


Fig. 7: Removing the flange behind the valve

5. Pipeline pressure test

The valve itself is depressurized by the manufacturer. After installation in the pipeline, it is necessary to pressurize the entire pipeline section with valves. In doing so, the following must be observed:

- The newly installed segment must be thoroughly flushed (cleaned) before mounting valves and all mechanical impurities removed.
- The test pressure with open valves is 1.5 times PS.
- The test pressure with closed valves is 1.1 times PS.

6. Operation and maintenance

- For manual operation of the valve, normal force is sufficient; it is not necessary to extend the lever length.
- When the lever is parallel to the pipeline, the valve is open. When the lever is perpendicular to the pipeline, the valve is closed.
- Lever or worm gear valves close clockwise and open counterclockwise.
- Valves with electric or pneumatic actuators are operated via control signals and are preset by the manufacturer. Do not modify these settings without the manufacturer's approval.
- Opening and closing must be gradual, not abrupt, to prevent hydraulic shock.
- The valves are maintenance-free; during operation, monitor for leakage between the valve and the pipeline flange.
- If the valve remains in the same position for an extended period, it is recommended to operate it (open and close) several times at least four times a year.
- Permissible flow velocities are 4 m/s for liquids and 30 m/s for gases. The flow velocity should be determined based on the valve's application (suction or discharge), installation location, pipe diameter and length, operating pressure, media temperature, pipe material, and other relevant factors.
- In the case of ATEX valve designs, the functionality of the ATEX screw spring must be checked once a year. If it is not functioning properly, the screw must be replaced with a new one.

7. Faults/ Causes of faults/ Troubleshooting

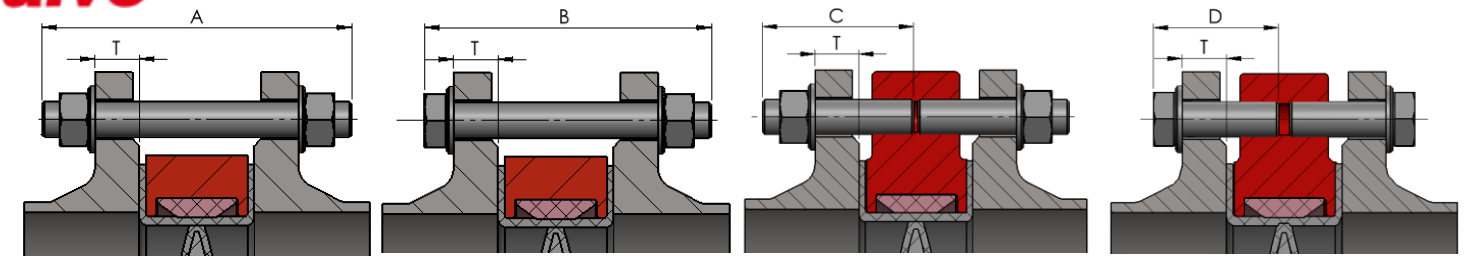
Symptom	Possible cause	Solution
Leakage between valve and pipe flanges	Flange bolts are not tightened	Tighten the bolts
	The valve is not centred	Reinstall the valve into proper position
	Large inner flange diameter	Flange replacement
	Burnt or damaged seat	Replacement of the seat-disc assembly
	The flanges are not parallel	Total repair necessary
	The flanges are damaged by welding or are not completely straight	Total repair necessary
The valve cannot be closed or opened	Solid particles between the seat and the disc	Remove the valve and clean it, or replace damaged parts
	Damaged or porous cuff	Replacement of the seat-disc assembly
	The media pressure is higher	Check the media pressure
	Actuator is blocked	Check the actuator
	The electric actuator is not connected to the mains	Connect the actuator to the mains
The valve in the closed state is leaking	Incorrect close position	Check position adjustment
	Worn disc	Replacement of the seat-disc assembly
	Worn seat	Replacement of the seat-disc assembly
Leakage around the shaft	Worn seat-disc assembly	Replacement of the seat-disc assembly
	The flanges are not parallel, i.e. uneven deformation of the seat	Total repair necessary
	Improper actuator, actuator not installed properly, i.e. excessive pressure on the shaft	Actuator replacement, correct assembly
Bursting function	Dirt caught in the valve	Open and close the valve several times and flush it
	Insufficient air supply to the actuator	Increase pressure or volume of the supplied air
The valve does not rotate	Actuator failure	Replacement or repairs of the actuator
	The valve is clogged with dirt	Flush or clean the valve
The disc cannot be fully opened and closed	Incorrect inner diameter of the flange – the material of the seat is compacted inwards	Total repair necessary
	Incorrect installation of the seat into the body – the media is located between the seat and the body	Proper assembly of the seat
Increased torque and torque on the valve	Dirt on the seat	Clean the seat
	Valve tightened too much between the pipe flanges	Tighten the bolts with lower torque
	Improper installation of the valve in the pipeline	Check the installation of the valve in the pipe
	The actuator is not fastened properly	Tighten the bolts that fasten the actuator
The valve is noisy	Improper mounting position	Change the mounting position
	The valve works outside the designed parameters	Check the project conditions vs the operation conditions

ABO valve

08.08.25

Pipe bolt length
With neck welded
Flanges according to EN1092-1.

Bolt lengths apply for use
With washers under nuts and
under bolt heads.



Tab. 6: Fastener dimensions for PN6

Size		PN6								PN10							
DN	NPS	Bolt size	Number of bolts, thread. Rods A, B	A Thread. Rod Nut Washers	B Bolt Nut Washer	Number of bolts, thread. rods C, D	C Thread. Rod Nut Washer	D Bolt Washer	T	Bolt size	Number of bolts, thread. Rods A, B	A Thread. Rod Nut Washers	B Bolt Nut Washer	Number of bolts, thread. rods C, D	C Thread. Rod Nut Washer	D Bolt Washer	T
50	2	M12	4	110	95	8	55	35	14	M16	4	130	110	8	65	40	18
65	21/2	M12	4	115	95	8	55	35	14	M16	4	130	110	8	65	40	18
80	3	M16	4	130	105	8	65	40	16	M16	8	135	115	16	70	40	20
100	4	M16	4	135	115	8	65	40	16	M16	8	140	120	16	70	45	20
125	5	M16	8	140	120	16	70	45	18	M16	8	150	130	16	75	50	22
150	6	M16	8	140	120	16	70	45	18	M20	8	165	135	16	80	50	22
200	8	M16	8	150	130	16	75	50	20	M20	8	170	145	16	85	55	24
250	10	M16	12	165	145	24	80	55	22	M20	12	185	160	24	95	60	26
300	12	M20	12	185	155	24	90	60	22	M20	12	190	165	24	95	65	26
350	14	M20	12	185	160	24	95	60	22	M20	16	195	165	32	95	65	26
400	16	M20	16	210	180	32	105	70	22	M24	16	225	195	32	115	75	26
Size		**PN16**								**CLASS 150**							
DN	NPS	Bolt size	Number of bolts, thread. Rods A, B	A Thread. Rod Nut Washers	B Bolt Nut Washer	Number of bolts, thread. rods C, D	C Thread. Rod Nut Washer	D Bolt Washer	T	Bolt size	Number of bolts, thread. Rods A, B	A Thread. Rod Nut Washers	B Bolt Nut Washer	Number of bolts, thread. rods C, D	C Thread. Rod Nut Washer	D Bolt Washer	T
50	2	M16	4	130	110	8	65	40	18	5/8“-11 UNC	4	135	115	8	65	40	21,1
65	21/2	M16	4	130	110	8	65	40	18	5/8“-11 UNC	4	145	125	8	70	45	24,3
80	3	M16	8	135	115	16	70	40	20	5/8“-11 UNC	4	150	125	8	75	50	25,9
100	4	M16	8	140	120	16	70	45	20	5/8“-11 UNC	8	155	130	16	75	50	25,9
125	5	M16	8	150	130	16	75	50	22	3/4“-10 UNC	8	170	145	16	85	55	25,9
150	6	M20	8	165	135	16	80	50	22	3/4“-10 UNC	8	175	145	16	85	55	27,4
200	8	M20	12	170	145	24	85	55	24	3/4“-10 UNC	8	185	155	16	90	60	30,6
250	10	M24	12	195	165	24	95	60	26	7/8“-9 UNC	12	205	175	24	105	65	32,2
300	12	M24	12	205	175	24	100	65	28	7/8“- 9 UNC	12	215	185	24	105	70	33,8
350	14	M24	16	210	180	32	105	70	30	1“-8 UNC	12	235	200	24	115	75	37
400	16	M27	16	250	210	32	125	85	32	1“-8 UNC	16	260	225	32	130	90	38,6