Installation, Operation and Maintenance Manual - Original Version

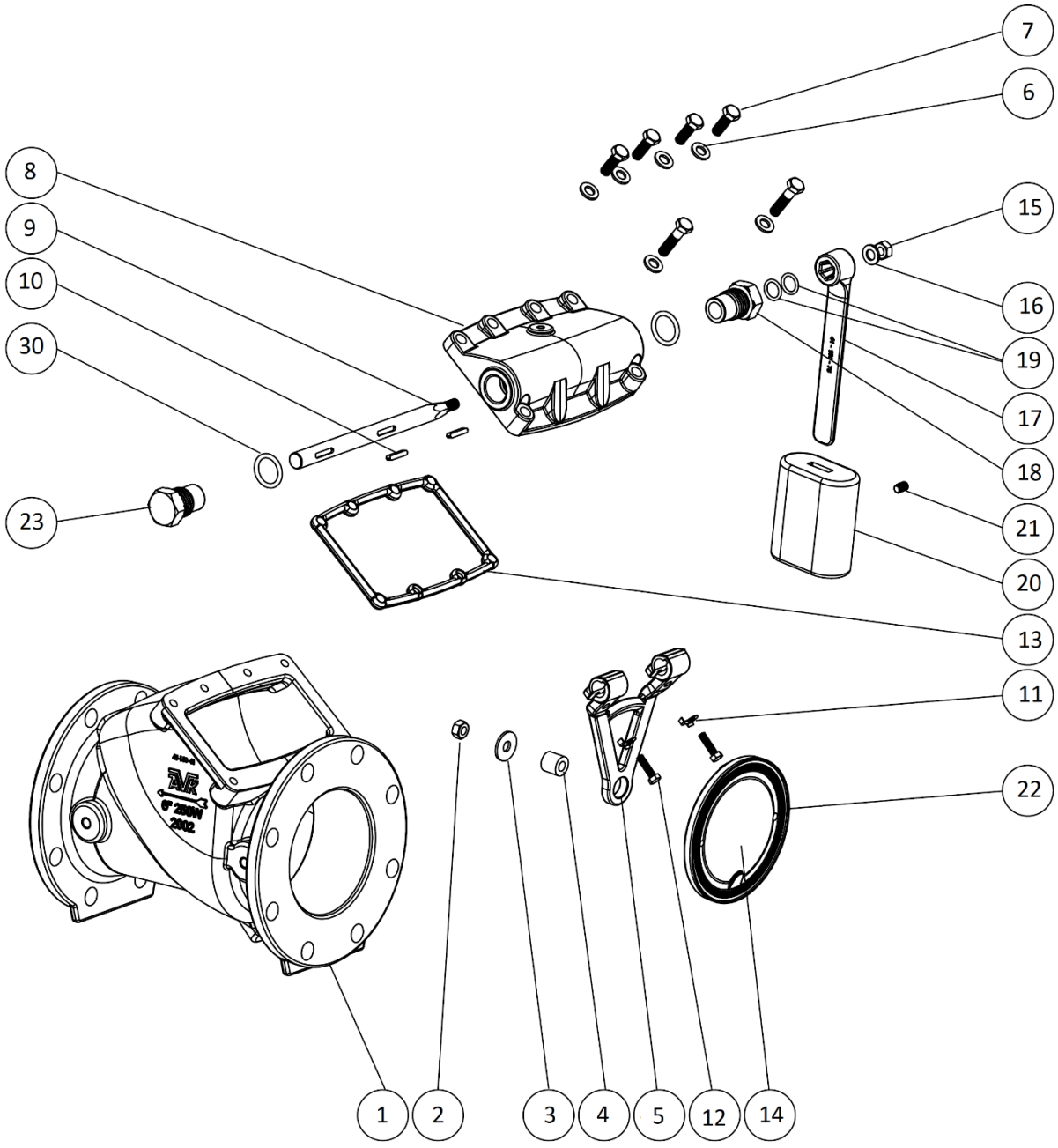
AVK Series 41, Swing Check Valves, DN 50-300

The AVK series 41 swing check valves are installed in water supply and wastewater lines to make water flow in only one direction.

Flow reversal can occur for different reasons, like e.g. pump stop in a plant with large differences in altitude, but with a check valve in the line this can be effectively controlled.

Valves in the size range DN 50-300 come as both resilient and metal seated with the resilient seated having a rubber face pressing against the cast iron seat and the metal seats consisting of copper alloy face- and seat rings.

1. AVK series 41, swing check valves, exploded view



2. AVK series 41, parts list

No.	Item	Material	No	Item	Material
1	Valve Body	Ductile iron	21	Set Screw	Stainless Steel
2	Disc Nut	Stainless steel	22	Rubber Encapsulation	EPDM
3	Disc Washer	Stainless steel	23	Closed Bushing	Copper alloy
4	Disc Bushing	Polyamide	24	Disc Lock Washer	304 Stainless steel
5	Hinge	Stainless steel/ductile iron/bronze	25	Spring	Stainless Steel
6	Washer	Stainless steel	26	Spring Eyebolt	Stainless Steel
7	Bonnet Bolt	Stainless steel	27	Spring Eyebolt Nut	Stainless Steel
8	Bonnet	Ductile iron	28	Spring Eyebolt Washer	Stainless Steel
9	Shaft	Stainless steel	29	Spring Bracket	Carbon Steel
10	Key	Stainless steel	30	O-ring	EPDM
11	Lock Washer	Stainless steel	31	Hinge Connector	Stainless Steel
12	Hinge Bolt	Stainless steel	32	Retaining Washers	Stainless Steel
13	Bonnet Gasket	EPDM	33	Shaft Spacers	Stainless Steel
14	Disc	DN50: Gunmetal	34	Spring Arm Washer	Stainless Steel
		DN65-200: Stainless steel	35	Spring Arm Nut	Stainless Steel
		DN250-300: Ductile iron	36	Spring Arm rod	Stainless Steel
15	Shaft Nut	Stainless steel	37	Spring Bracket Bolt	Stainless Steel
16	Shaft Washer	Stainless steel	38	Spring Arm Spacer	Stainless Steel
17	Lever	Ductile iron	39	Shaft Lock Washer	Stainless Steel
18	Open Bushing	Copper alloy	40	Spring Bracket Mount Washer	Stainless Steel
19	Inner Bushing O-rings	EPDM	41	Seat Ring, Disc Part	Bronze
20	Weight	Cast iron	42	Seat Ring, Body Part	Bronze

Item 31-40 refer to Fig. 10, DN250-300 only

3. Table of contents

4. Principle of operation

The main operating principle is simple and reliable: a hinged disc in the water stream swings open when the flow is forward and shuts off against the valve seat if the flow tends to reverse.

If the reverse water flow shall deliver the force to close the disc there is risk of water hammer and to mitigate this a weighted or spring-loaded lever can be attached to the hinge shaft. This helps force the valve closed before the flow reverses and thus results in quiet operation. The drawback is higher pressure loss when the water is flowing, but correct adjustment of spring tension and weight position can minimise this.

Adding a weight or a spring also makes it possible to operate in vertical installations with downwards flow.

The valve seat is either metal or resilient rubber. The disc is mounted in a flexible rubber bushing allowing it to tilt slightly in all directions and adjust exactly to the valve seat.

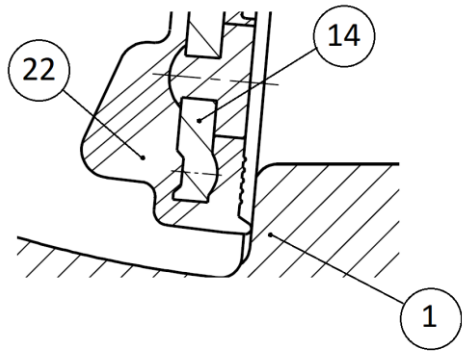


Fig. 1, Rubber seat

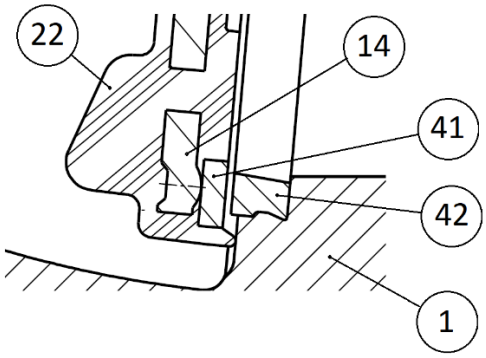


Fig. 2, Metal seat

No	Item	Material
1	Valve Body	Dutile Iron
14	Disc	Gunmetal / Stainless Steel / DI
22	Rubber Encapsulation	EPDM
41	Seat Ring, Disc Part	Copper alloy
42	Seat Ring, Body Part	Copper alloy

5. Health and safety at work

Make sure all relevant Health and Safety issues and regulations are adhered to prior to and during installation or maintenance work carried out on this product. It is the end user's responsibility to ensure that safe working practices are followed at all times.

Whenever AVK's products are installed, operated or maintained the inherent dangers of pressurised liquids and gasses must be addressed. Before work on a valve or other piping component is undertaken, that may involve the release of internal pressure, the valve or line must be fully isolated, depressurised and drained prior to commencing the work. FAILURE TO COMPLY WITH THIS MAY RESULT IN SEVERE INJURY OR DEATH.

All workers handling the product must be aware of the weight of the components or assemblies to be handled and manipulated during installation and maintenance.

It is essential that staff undertaking these operations are adequately trained and it is the responsibility of the end user that only trained and competent staff undertake these duties.

This manual has been designed to assist, but it cannot replace quality training in the workplace. However, the AVK technical staff is always available and ready to answer questions relating to specific problems that may not be covered by this manual.

AVK's products are designed to be fit for purpose and to a high reliability standard. This provides a safe, low risk product when used correctly for the purpose for which it was designed. However, this assumes that the equipment is used and maintained in accordance with this manual, and the user is advised to study it and to make it available to all staff that may need to refer to it.

AVK cannot be held responsible for incidents arising from incorrect installation, operation or maintenance. The responsibility for this rests wholly with the end user.

6. Receiving and storage

Unloading must be carried out carefully. The load must be put gently to the ground without dropping.

Do not lift in the shaft or weight/lever, lift only by means of shackles in the flange bolt holes or slings around the body casting.

If a forklift is used it shall have sufficient capacity to lift the required weight and have a valid inspection certificate.

All workers involved in the unloading shall be able to perform their functions. They shall wear safety boots, safety vest, safety goggles and hard hat.

All slings used for the lifting shall be of sufficient strength. A record shall document that they have been stored under cool, dry conditions away from sunlight and chemical atmosphere, and that they still perform according to their marked strength.

Immediately after unloading the item should be inspected for compliance with specifications and damage in shipment.

Compliance with specification check will typically comprise size, pressure class, flange drilling, face-to-face, accessories (lever, weight, springs, guards, remote sensors, etc.)

Damage in shipment check shall comprise coating, protruding shaft ends, accessories and all other parts that could have been exposed to mishandling during shipment.

Check that the disc and shaft move freely from one end position to the other and make sure to check it in the position in which the valve is to be installed.

Storage shall be under dry, cool conditions, away from direct sunlight and corrosive or otherwise chemically active atmosphere.

7. Installation and commissioning

WARNING: *Prior to installation make sure that all pressurized lines involved in the installation are isolated, depressurized and drained before starting any work. Failure to do so may result in sudden pressure release and subsequent severe injury or death.*

The valve must be installed in a way that gives access to maintenance or inspection. Ample room around the shaft cover should be left to allow for hoisting equipment for taking out the disc and shaft.

The valve and adjacent piping must be supported and aligned to prevent cantilevered stress on the valve.

Shaft and hinge must always be horizontal and never below the disc.

Keep a distance of at least 5-6 pipe diameters to the nearest upstream elbow, tee, control valve or other kind of equipment that can cause turbulence in the water stream.

The valve must be provided with adequate support and the adjoining pipework must not transfer stress to the valve body.

Flange bolts should be tightened gradually in a criss-cross sequence as shown on fig. 3.

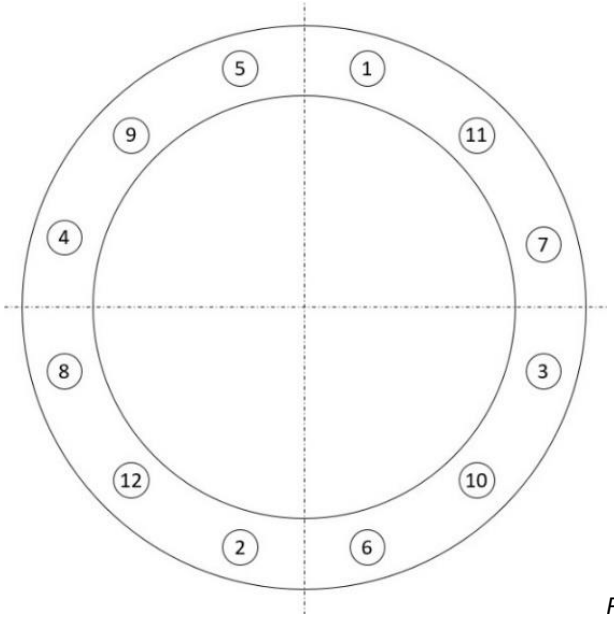


Fig. 3, Example of a tightening sequence, 12-bolts flange

Finally torque the bolts to the value specified by the gasket manufacturer. If this is not available, the values stated in table 1 can be used as a guideline for the maximum torque.

Valve size	Bolt size	Torque
	PN10 / PN16	Nm
DN 80	M16 / M16	100
DN 100	M16 / M16	100
DN 150	M20 / M20	110
DN 200	M20 / M20	110
DN 250	M20 / M24	150
DN 300	M20 / M24	150

Table 1, Flange bolts torque values

7.1 Flow direction

There are three main configurations

1. When installed with horizontal flow the hinge and shaft must also be horizontal and above the disc. Add a lever with spring or weight if necessary. Horizontal flow is the recommended configuration.
2. When installed with vertical rising flow the disc itself will act as a weight that helps close, but a lever with weight or spring might still be necessary depending on the installation.
3. When installed with vertical downwards flow a lever with spring or weight must always be fitted to make sure the valve can close.

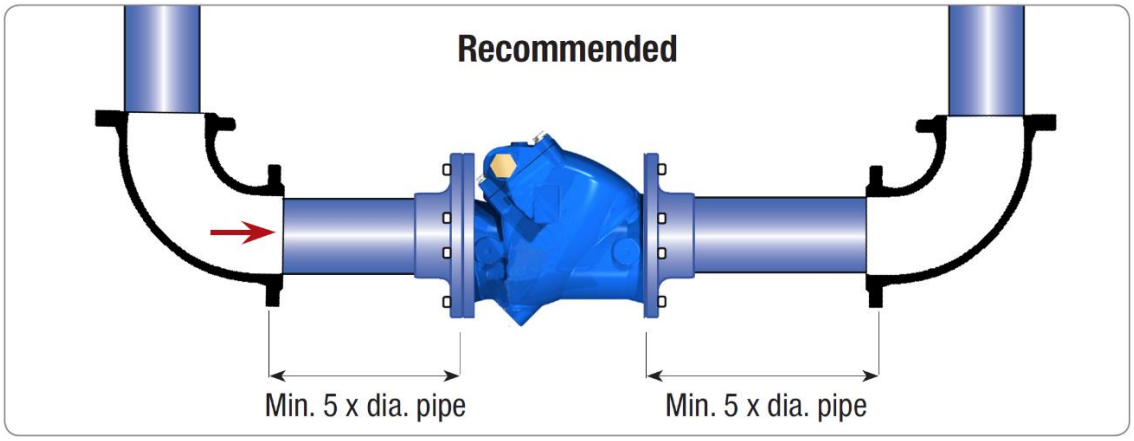


Fig. 4, Recommended configuration

7.2 Lever and weight / spring (optional)

In some applications a pump stop can cause a sudden reverse flow that makes the check valve close violently causing water hammer. This phenomenon is the source of large pressure spikes in the pipe system and can potentially damage components and cause leaks. To mitigate this a lever can be attached to the hinge shaft and with a weight or a spring it can be adjusted to close the valve quickly and quietly by actively stopping the flow before it can reverse.

A side effect is an increased pressure drop across the valve depending how strongly the closing torque is applied, i.e. mass and position of the weight or strength of the spring. To reduce un-necessary energy consumption make sure a good balance is found where the risk of water hammer is effectively reduced at the lowest possible head loss.

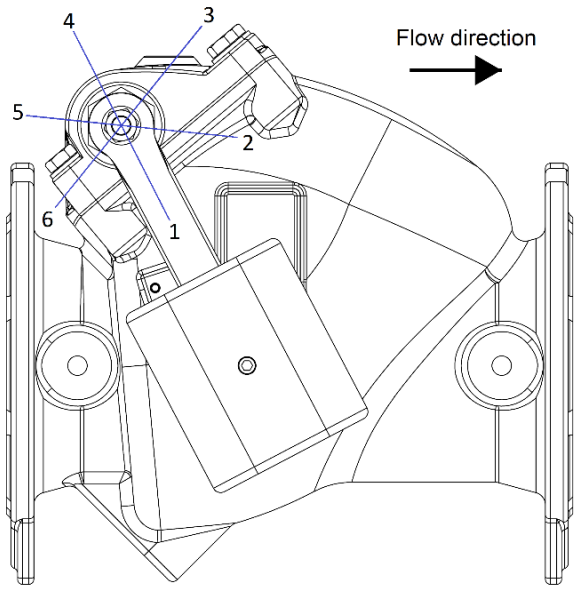
The lever with weight or spring must be adjusted according to the application. If the flow is low the least aggressive position will most often be used, i.e. the one that requires low pressure to open initially, but high pressure to keep wide open.

7.3 Adjusting lever and weight

***Warning**: Do not adjust the weight and lever while the system is operational. The lever can suddenly move with great force and cause injury*

The hexagon end of the shaft allows for 6 different positions of the lever, 60° apart. Select the one that best fits the requirements of the installation.

The lever swings approx. 70-75° from fully closed to fully open, so in the fully open state the lever will be 10-15° further anticlockwise than the next possible closed position shown on fig. 5.



For horizontal flow use 1 or 2

For vertical rising flow use 6 or 1

For vertical downwards flow use 3 (or 4)

Fig 5, Weight positions when closed, 1 to 6

Each of the three main configurations has only two possible positions of the lever/weight:

- The lever close to vertical when closed and close to horizontal when fully open. This characteristic resembles that of a spring with the closing force becoming gradually stronger the more the valve opens. Reaction time is long at low flow and short at high flow.
- A more aggressive position has the lever close to horizontal when closed and close to upwards vertical when fully open. It reacts quickly at low flow, slowly at full flow and requires more pressure to open.
  On some variants the lever in fully open position can pass the vertical point and drop down on the other side leaving the valve inoperable. In that case the aggressive position cannot be used.

Figure 6 shows two different scenarios with position 1:

- In the horizontal configuration it is the standard position with low opening pressure. Turning the lever anticlockwise 60° to pos. 2 selects the more aggressive characteristic.
- With vertical rising flow it is the other way around; position 1 requires high forward pressure to open, is quick to close at low flow and has lower head loss at full flow. To get the less aggressive action turn the lever clockwise 60° to pos. 6.

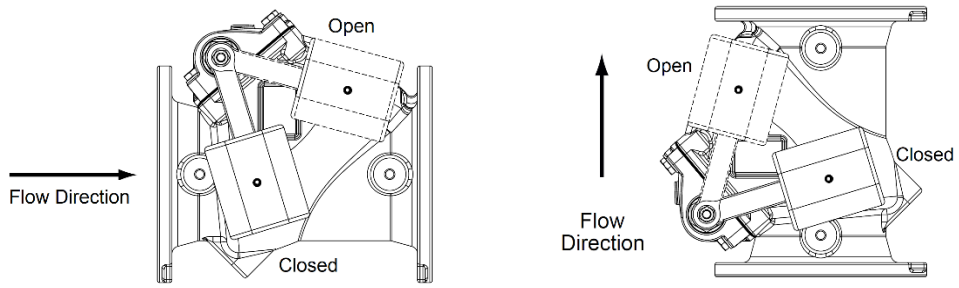


Fig. 6, Lever/weight configurations, pos. 1

Vertical installation with downwards flow is possible, but since the default position of the valve in this configuration is fully open, the use of a lever and weight is essential.
Position 3 as shown in fig. 7, is recommended as the safe choice.
The aggressive position 4 is very close to vertical at fully open. Make sure it does not pass this point and drop down on the other side leaving the valve inoperable. Position 4 must in any case be expected to react very slowly from maximum flow.

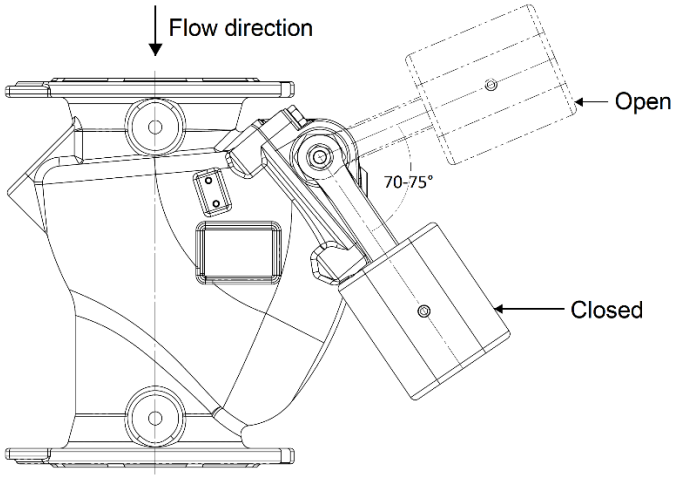


Fig. 7, Downwards flow, pos. 3

7.4 Installation of lever and weight

Secure the lever (17) with the shaft washer (16) and shaft nut (15) and tighten to 40Nm. Attach the weight (20) and tighten the set screw (21) to hold the weight in place.

A medium strength thread locking compound should be used to secure the installation.

To adjust closing speeds for optimum performance the weight can be moved on the lever in order to change the torque applied to the shaft, hinge and disc.

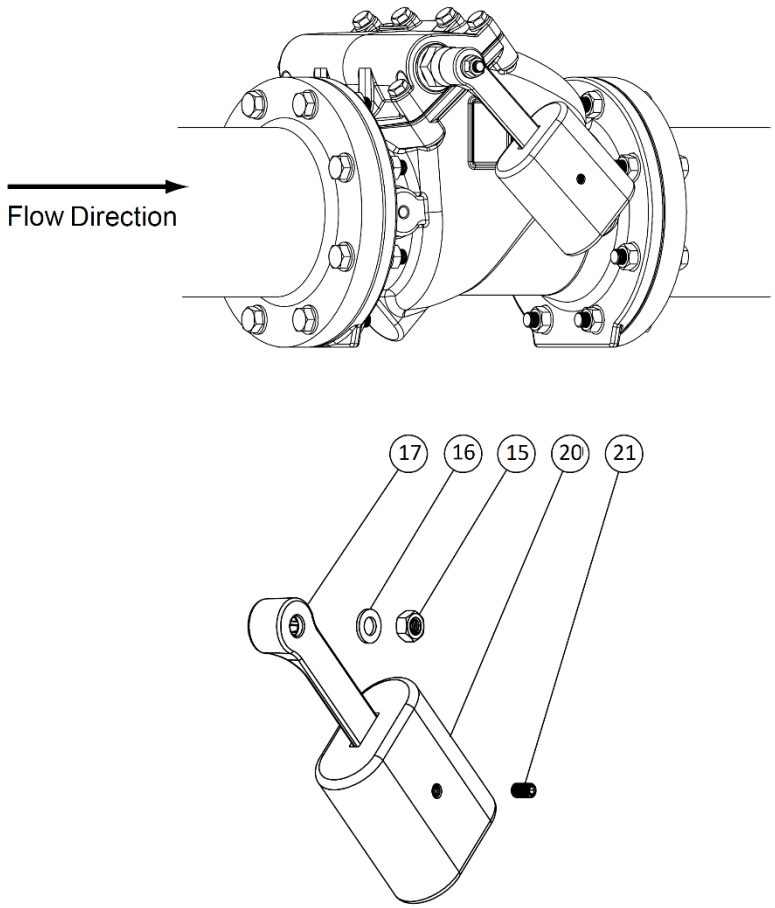


Fig. 8, Weight Components

7.5 Lever and spring, DN200 and below (optional)

Instead of a weight a spring can be fitted to assist in closing the valve. It has the advantage of taking up less space and having less inertia, but adjustments are limited.

A spring bracket (29) is attached to the flange bolts.

Install the spring eyebolt (26) on the spring bracket, securing it with the nuts (27), and washers (28), one washer and nut on each side of the spring bracket (29).

Slide the lever (17) onto the shaft (9) and position as shown in figure 8.

Secure the lever with the shaft washer (16) and shaft nut (15) and tighten to 40Nm.

Attach the spring (25).

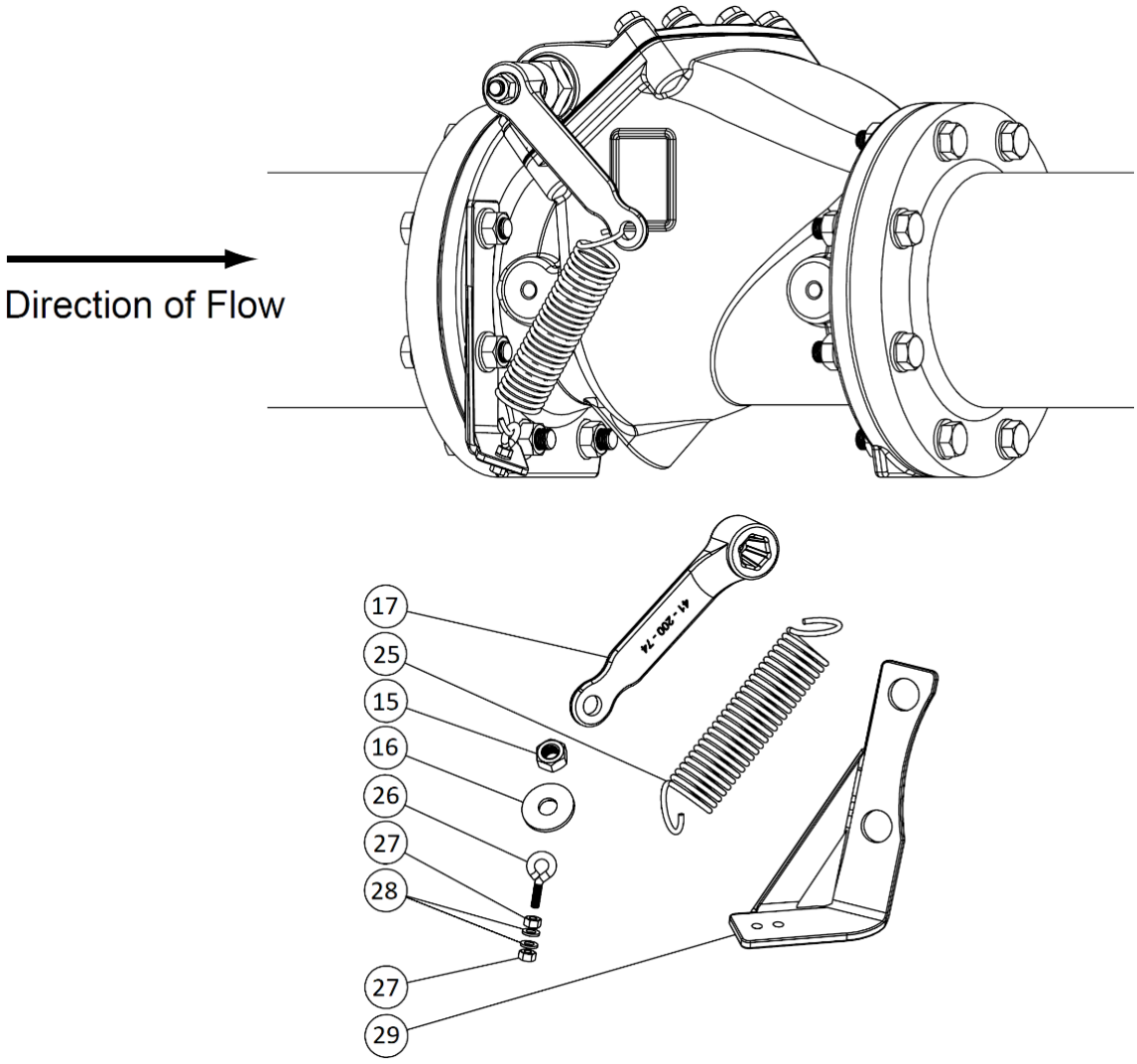


Fig. 9, Spring adjustment, DN≤200

7.6 Lever and spring, DN250-300 (optional)

The large DN250 and DN300 valves will have the lever and spring assembly installed at the factory.

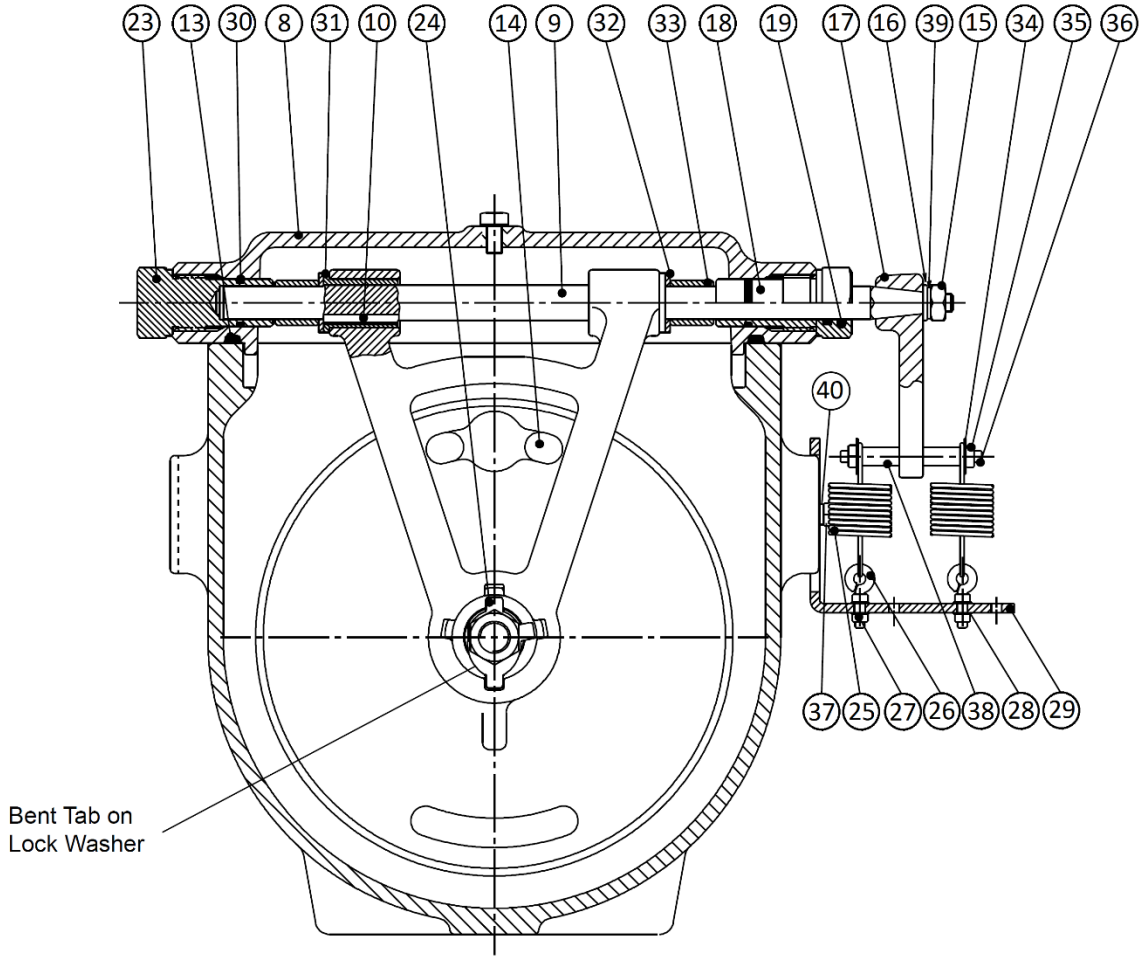


Fig. 10, Lever and spring on DN>200

No	Item	Material	No	Item	Material
8	Bonnet	Ductile iron	27	Spring Eyebolt Nut	Stainless Steel
9	Shaft	Stainless steel	28	Spring Eyebolt Washer	Stainless Steel
10	Key	Stainless steel	29	Spring Bracket	Carbon Steel
13	Bonnet Gasket	EPDM	30	O-ring	EPDM
14	Disc	Ductile iron	31	Hinge Connector	Stainless Steel
15	Shaft Nut	Stainless steel	32	Retaining Washers	Stainless Steel
16	Shaft Washer	Stainless steel	33	Shaft Spacers	Stainless Steel
17	Lever	Ductile iron	34	Spring Arm Washer	Stainless Steel
18	Open Bushing	Copper alloy	35	Spring Arm Nut	Stainless Steel
19	Inner Bushing O-rings	EPDM	36	Spring Arm rod	Stainless Steel
23	Closed Bushing	Copper alloy	37	Spring Bracket Bolt	Stainless Steel
24	Disc Lock Washer	304 Stainless steel	38	Spring Arm Spacer	Stainless Steel
25	Spring	Stainless Steel	39	Shaft Lock Washer	Stainless Steel
26	Spring Eyebolt	Stainless Steel	40	Spring Bracket Mount Washer	Stainless Steel

8. Application hazards

- If the installation is prone to sudden pump stop and flow reversal a lever with weight must be fitted to the shaft to help close the valve quickly
- If fitted with lever and weight check the pressure drop when operating - a balance should be found where the risk of water hammer is sufficiently reduced while still having the lowest possible pressure drop across the valve
- Maximum operating temperature is 70°C (WRAS approval valid to max. 50°C) and maximum flow speed is 4m/s
- Do not install where ambient temperature drops below freezing for the medium unless sufficient insulation or other frost protection is provided
- Keep a distance of at least 5-6 pipe diameters downstream of components creating turbulence, like control valves, elbows, tees, etc.
- Do not install in sewage lines with large pieces of debris that can jam the disc movement
- Installation with vertical downwards flow is possible, but works only with lever and weight or spring to close the valve
- When installing lever/weight make sure to put it in a position that will always turn the shaft towards closing regardless of flow condition, i.e., that it does not pass vertical when moving against fully open
- The metal seated versions cannot be expected to close drop tight and should not be used in applications where this is required
- Do not use with solvents or flammable liquids

9. Operation and maintenance

9.1 Operation

The valve operates automatically.

9.2 Maintenance

WARNING: *Prior to any maintenance work that requires disassembly make sure that the pressurized line involved is isolated, depressurized and drained before starting any disassembly. Failure to do so may result in sudden pressure release and subsequent severe injury or death.*

Very little maintenance is required, but the following parts should be inspected periodically:

- Hinge and disc should be kept clear of debris
- If the valve does not operate frequently and is kept in either open or closed position for long periods of time, it should be exercised regularly depending on the water quality and amount of minerals and debris that could deposit.
- Check shaft and bushings for excessive wear – particularly relevant in installations with fluctuating or low flow
- Clean the sump in the bottom of the valve body
- Clean the surface and check for damage
- Check all seals for leakage
- Check by-pass and priming device for leakage, if installed

If the shaft seals leak in the bushings, check that they are properly tightened. If the leak persists, replace the O-rings.

9.3 Disassembly for inspection and cleaning

The valve body does not need to be removed from the pipeline to remove the bonnet and the inner parts.

1) Depressurize the pipeline completely; not only for safety reasons but also because when loosening the bonnet bolts even a slight overpressure can shoot out the bonnet gasket and damage it
2) Remove lever and spring or weight if installed
3) Note bolt length when he bolts are removed. The bonnet bolts are different lengths with the longer located upstream.
4) Inspect head assembly for worn or damaged parts. If resilient seated, inspect the disc for tears or cracks in the rubber.

9.4 Renewal of shaft and bushings

O-rings (19, 30), bushings (4, 18, 23) and shaft (9) are likely to be worn over time if the valve is operating constantly. Replace as necessary.

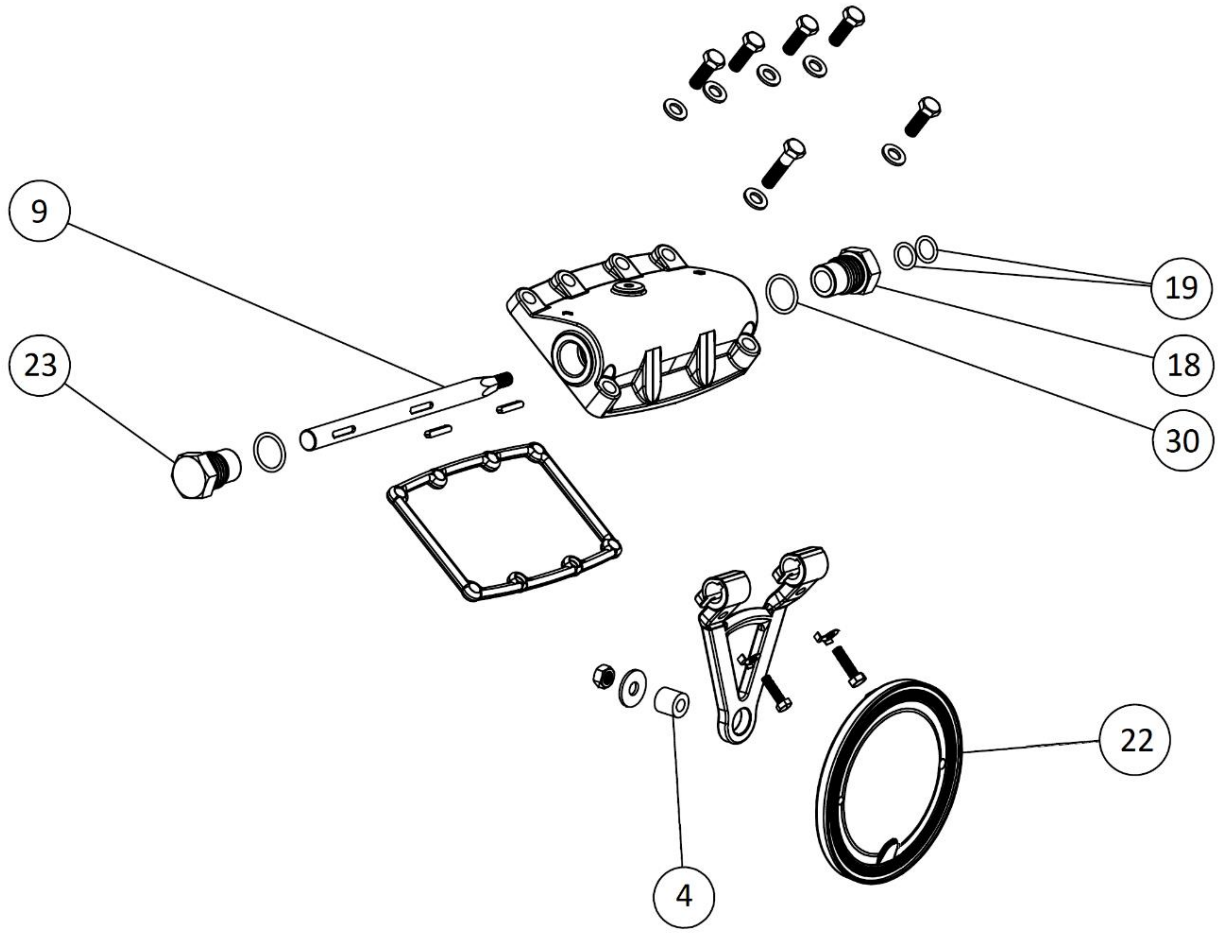


Fig. 11, Shaft and bushings

10. Decommissioning

When decommissioning the valve it should be disposed of according to local regulations and in a way that allows as much recycling of materials as possible.

AVK series 41 check valves do not contain hazardous materials that require special treatment.

11. Trouble shooting

Symptom:	Leakage at the shaft bushings
Cause:	Loose bushing
Cure:	Torque to 60Nm
Symptom:	Leakage at the shaft bushings
Cause:	Worn O-rings
Cure:	Replace O-rings
Symptom:	Leakage at the bonnet
Cause:	Loose bonnet bolts
Cure:	Torque to 60Nm
Symptom:	Leakage at the bonnet
Cause:	Damaged gasket, this can happen if the valve is not completely de-pressurised before loosening the bonnet bolts
Cure:	Replace gasket
Symptom:	Valve leaks slightly when closed, metal seated
Cause:	Design
Cure:	No cure for this; metal seats are not drop tight
Symptom:	Valve leaks when closed
Cause:	Dirty, worn out or damaged seal
Cure:	Clean or replace disc
Symptom:	Valve does not open
Cause:	Low forward pressure
Cure:	Adjust spring or weight
Symptom:	Valve stays open and does not operate
Cause:	Lever mounted on shaft in a wrong angle
Cure:	Check section 7.3 for correct lever angle. When installed with downwards vertical flow in position 4 a high flow situation can cause the weight to tip over vertical to a position where the valve is permanently open.

12. Recommended spare parts

Only genuine AVK spare parts should be used.
AVK cannot accept responsibility for damage caused by failing non-AVK parts.

Following spare parts are recommended to purchase with a ser. 41 valve:

1. O-rings for shaft
2. Bonnet gasket
3. Shaft bushings
4. Complete disc

13. Head Loss

Head loss with cold water in horizontal flow in basic configuration with neither weight nor spring attached is shown below on fig. 12.
With spring or weight installed the pressure loss will be greater and it will vary depending on how lever position, weight position or spring tension are adjusted.

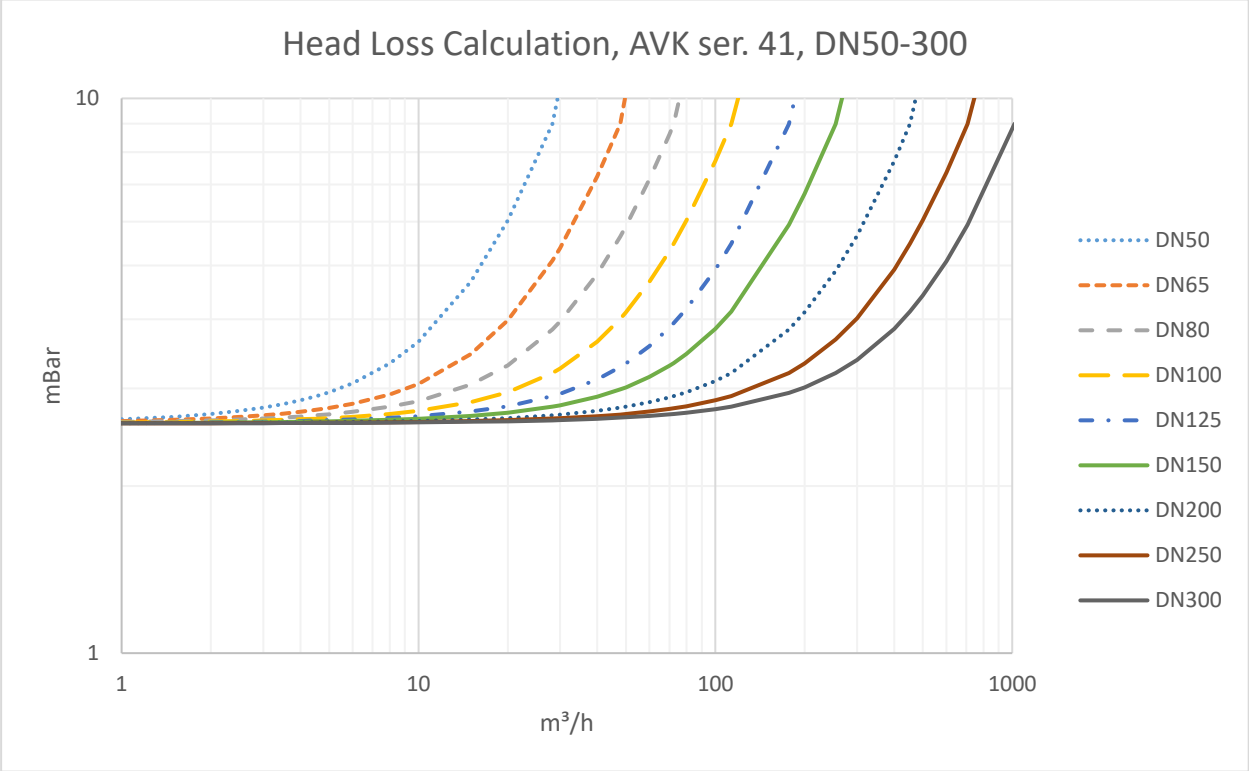


Fig. 12, Head Loss