CHAPTER VII: ACCESSORY ORGANS – VALVES

In any water supply or distribution network, there is a range of essential accessories vital for the system to function properly. The installation of these accessories varies depending on the specific situation, and their importance can range from essential to optional, based on their role in maintaining safety and optimizing performance.

Each drinking water network may include:

- Gate valves
- Strainers
- Regulators
- Air vents
- Air release valves
- Fire hydrants
- Hydraulic control valves
- Check valves

VI.1. Gate Valves

A distinction is made between wedge gate valves and butterfly valves. Wedge gate valves function as shut-off mechanisms that require full opening or closing. Compared to butterfly valves, their dimensions are quite significant. The body of the gate valve is made of cast iron, with its screw and nut.

Butterfly valves have the ability to both section and regulate flow. They have a compact size, are lightweight, and require low operating torque.

For gate valves of both types, once a certain diameter is reached (between 200 and 300 mm), motorization is generally implemented.

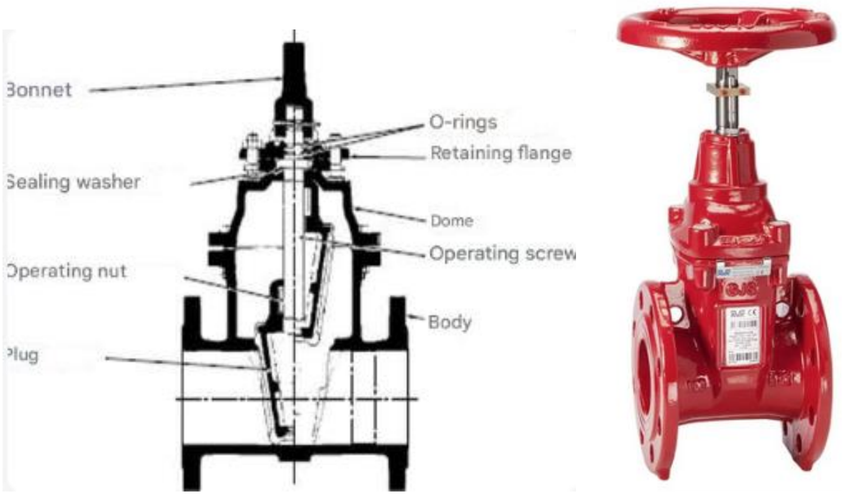

Figure VII. 1. Schematic of a wedge gate valve (https://www.avk.fr)

Among its drawbacks, we can mention:

• Simple shut-off

• Not recommended for flow control due to potential issues.

• During the final shutdown cycles, there may be a sudden flow restriction, and the initial opening cycles may experience a sudden flow increase.

• In cases where the valve is partially closed, degradation and cavitation can lead to rapid water flow under the wedge of the valve, resulting in undesirable consequences such as strong turbulence and high pressure losses.

• To avoid this, it is advisable to open and close the valve slowly during the first and last turns, respectively, to prevent water hammer.

VI.1.1. Wedge Gate Valve

Wedge gate valves are available in various sizes, ranging from DN 40 to 300, and sometimes up to DN 600. For larger DN sizes, a By-pass is installed to address pressure imbalances when the downstream pipeline is empty, preventing valve opening. The By-pass function reduces the imbalance by filling the downstream pipeline. Gate valves are used to isolate sections for repairs, diagnose leaks, and manage networks in cases of water shortage or pollution. They play a crucial role in ensuring the optimal system operation.

VI.1.2. Butterfly Valve

The use of a butterfly valve involves stopping pressurized fluids. This is achieved using a disc or lens-shaped closure element, commonly known as a butterfly, which rotates around an axis perpendicular to the fluid flow axis. The standard operation mode of the valve is full opening or closing. Additionally, butterfly valves can exceptionally be used as drain valves for tanks. It is important to note that, similar to gate valves, butterfly valves are not suitable for regulation purposes as they cause only a single pressure drop and are not designed for this task. There are specialized devices specifically designed for pressure and flow regulation.

Figure VII. 2. Butterfly Valve (https://geniehydraulique.com)

VI.2. Check Valves

Check valves are commonly used in pipeline networks to prevent backflow. A check valve is a one-way valve, meaning that fluid flows only in one direction. When the flow direction changes, the valve closes to protect pipelines, valves, pumps, and other equipment. Without a check valve, backflow can lead to a sudden increase in pressure, causing water hammer that can damage pipes and fittings.

Check valves are employed in various applications. They are often placed at the outlet of a pump to safeguard it from reverse flow. Since centrifugal pumps, the most common type of pump, are not self-priming, having check valves is essential.

Figure VII. 3. Butterfly Valve (https://www.gflow.fr)

VI.2.1. Ball Check Valve

A ball check valve operates through the movement of a ball that moves up and down inside the valve. The ball is guided by a cone-shaped cavity, which in turn stops the flow. If the valve is inadequate, opting for a lighter ball is a viable option. Conversely, water hammer occurs when the pump stops working, and this can be resolved by selecting a heavier ball. Ball check valves are commonly used in pumping stations with minimal supervision, as they require limited maintenance.

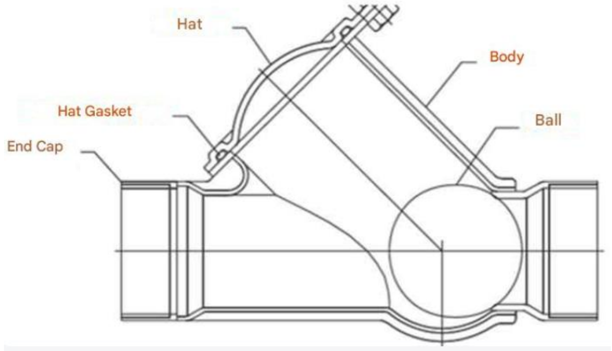

Figure VII. 4. Diagram of a ball check valve (https://www.gmi-robinetterie.com)

VI.3. Regulator

Achieving optimal operation of a network involves maintaining flows and pressures within reasonable limits. To facilitate this, various regulators, stabilizers, unloaders, and limiters have been meticulously implemented. By utilizing a common base type, these different functions can be achieved by adding the appropriate accessories.

a) The downstream pressure reducer-stabilizer and upstream pressure maintainer-reliever, along with the upstream and downstream stabilizer, operate based on calibrated spring pilots, allowing adjustments in pressure ranges from 0.1 to 21 bar.
b) The flow limiter is equipped with a diaphragm that adjusts according to the flow rate.
c) Tank valves include a high and low float level regulator that operates within a water height range of 0.5 to 2 m, a constant float level regulator, and an altimetric level controller located at the base of the tank.

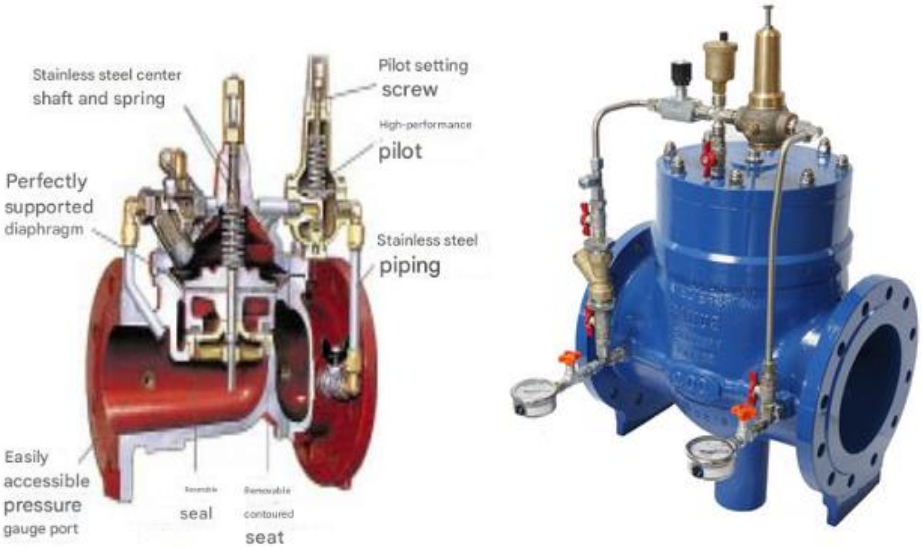

Figure VII. 5. Diagram of a Flow Regulator (https://www.ramus-industrie.com)

VI.4. Air Vents

The installation of air vents and automatic air release valves helps protect pipes against deleterious effects that may result from air accumulation at high points or singular points in the network. These effects can include total or partial flow interruption due to the presence of an air pocket at the top of the network. Water hammer resulting from the expansion or movement of the air pocket in the pipes can lead to pump and siphon priming.
To address these concerns, air vents are used to remove the air that has accumulated at high points in the pipelines during operation, at a low pressure of 0.3 bar. These air vents are suitable

for four different types of connectivity, namely flanged, non-flanged, with valve, and without any specific requirement.

VI.5. Air Vent

Air accumulation can occur at high points in a pipeline, leading to disturbances that should be avoided to prevent reduction in section, complete flow stoppage, pressure drop, and water hammer. To eliminate air pockets, a vent, which can be manual or automatic, is used. A manual vent is a simple valve that is periodically operated. On the other hand, automatic vents are components that release air as soon as a visible pocket forms. All these vents should be placed visibly, and their proper functioning should be assessed periodically. The main role of vents is to facilitate air entry and exit. This is achieved by performing various functions such as deaeration, degassing, and ventilation. During the filling process, vents help remove air to prevent blockages caused by unreleased air pockets. Additionally, the degassing process is carried out by purging air during operation. In case of vacuum, vents fill with air to prevent joint suction and plastic tube collapse.

Figure VII. 6. Diagram of an Automatic Air Vent (http://www.cowalca.be/catalogue-produit)

In addition, air vents have a triple function. Firstly,

- They facilitate the high-flow air evacuation when water pipes are filled.
- They allow high-flow air entry during pipe draining to protect the network against depressurization in case of pipe rupture.
- Air vents also aid in low-flow degassing during operation.

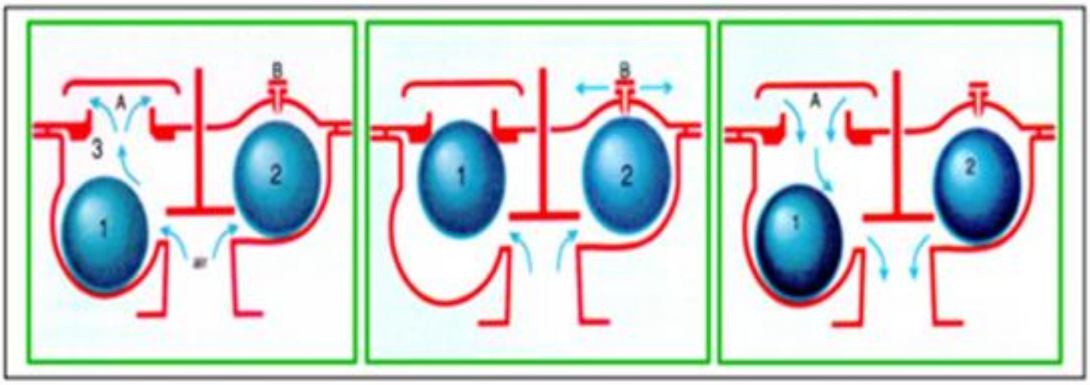

Figure VII. 7. Operation of a Triple Function Air Vent

VI.6. Installation of Air Vents

High points require the use of PN 16 triple-function air vents, which must have sufficient dimensions for the device to pass through and be positioned at accessible angles. If the inspection hole is not directly above the air vent, it is imperative to include a keyhole in the cover of the chamber precisely above the shut-off valve.

During the filling and draining processes, the air flow that needs to be evacuated or drawn in can potentially reach very high levels. It is of utmost importance to ensure that a properly designed pipe or orifice is integrated into the chamber to facilitate communication with free air having a section at least equal to that of the pipe. Additionally, a drain connected to a suitable discharge must also be provided.

VI.7. Strainer

- Filters are essential for protecting equipment sensitive to sand and other elements in networks. Hydraulic regulation valves require the use of filters. They are widely used in water supply and distribution networks. A filter is a metal or plastic piece perforated with holes. It is made of perforated sheet metal and is used to prevent foreign bodies from entering the suction pipe of a pump or gravity drain. The filter is the main component of water management equipment. Positioned after the solid casing, facing part or all of the aquifer formation, filters must meet the following requirements:
- Allow maximum production of clear water without sand,
- Resist corrosion caused by aggressive waters,
- Withstand the crushing pressure exerted by the aquifer formation.

Figure VII.8. Photograph of a Strainer (www.Puits-et-Forages.com)

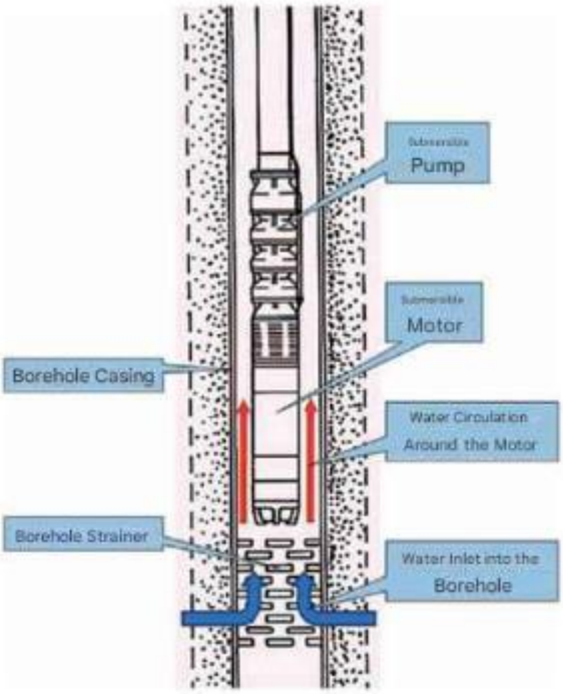

Figure VII. 9. Design of Water Intakes for a Well. (SNECOREP, 2010)

The selection of a filter for a pump is based on several criteria:

- Pressure resistance: The ability to withstand hydraulic pressure, influenced by the ground pressure, is a critical factor in filter selection. Geological conditions and well depth are taken into account to determine the filter type.
- Corrosion resistance: The choice of filter material depends on the aggressiveness and corrosiveness of the groundwater. Materials like PVC, polyethylene, or stainless steel are commonly used for filter production.

- Geometry of openings: The filter's geometry plays a vital role in maximizing water flow and filtering out sand and particles. Striking a balance between the risk of clogging in small spaces and the risk of allowing sand and gravel to pass through is crucial. Manufacturers offer a variety of openings suitable for all geological formations.

The definition of the openings of filters and the filter pack requires knowledge of the soil granulometry. Therefore, various empirical techniques are used to find an ideal balance between reducing the influx of fines and the performance of the structure in terms of head losses.

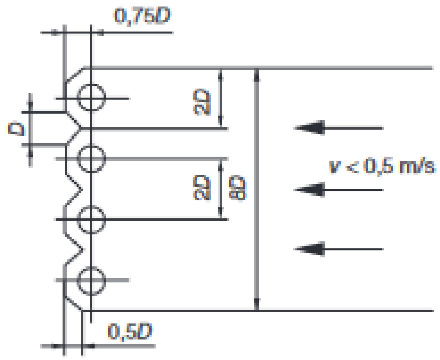

Figure VII. 10. Pipe Spacing from Walls in Suction Lines.

(https://elementsindustriels.fr/le-snecorep-le-syndicat-des-professionnels-des-stations-de-pompage/)

VI.8. Fire Hydrant

A fire hydrant is a plumbing device connected to an underground or protected pressurized water system, enabling the connection at ground level for mobile firefighting equipment. A fire hydrant post is a similar installation to a fire hydrant, but with outlets positioned above ground level.

Fire hydrants and posts can be supplied by either a public water distribution network or a private pressurized water system.

VI.8.1. The 100 mm Fire Hydrant (B.I.)

Typically connected to an underground pipeline equal to or larger than 100 mm in diameter, it should be capable of supplying a standardized 60 m3/h fire engine.

Figure VII. 11. 100 mm Fire Hydrant (B.I.)

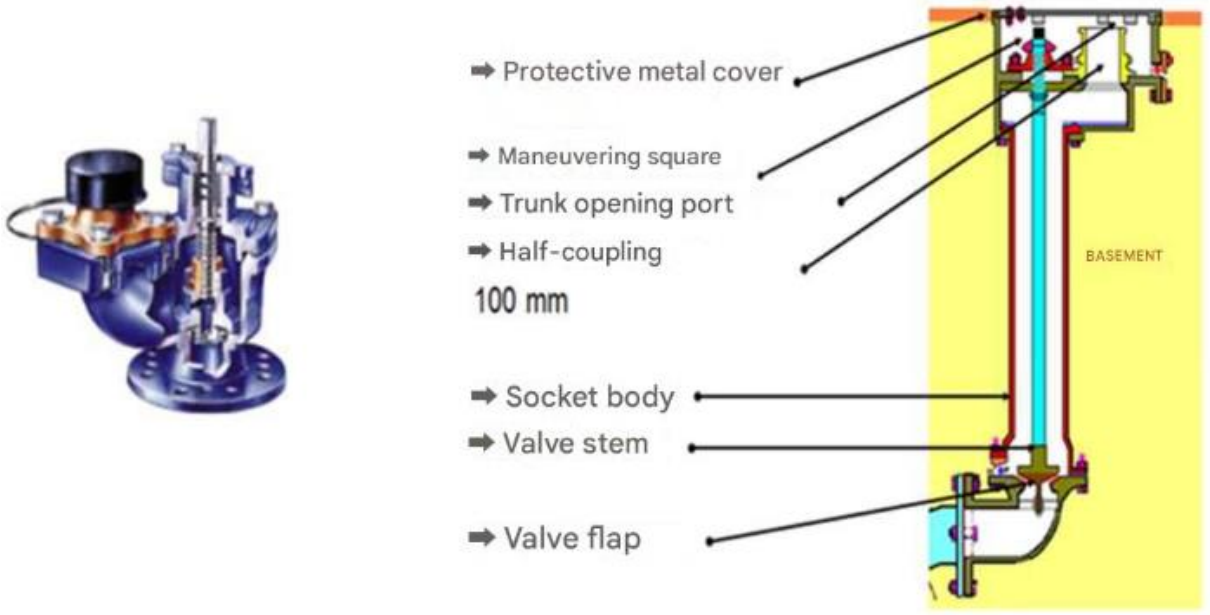

Figure VII. 12. Connection Method of a 100 mm Fire Hydrant (B.I.) to a Pressurized Water System

VI.8.2. The 100 mm Fire Hydrant Post (P.I.)

Same installation requirement as the B.I., it is preferably used where a B.I. could be. It includes a 100 mm outlet with a 1/2 A.R. fitting and two 70 mm outlets (1/2 symmetrical connection of 65 mm).

(a) **(b)**

Figure VII. 13. The 100 mm Fire Hydrant Post (P.I.): (a) BAYARD Model (b) Pont A MOUSSON Model (https://www.smmi-borne-incendie.fr/poteau-incendie/)

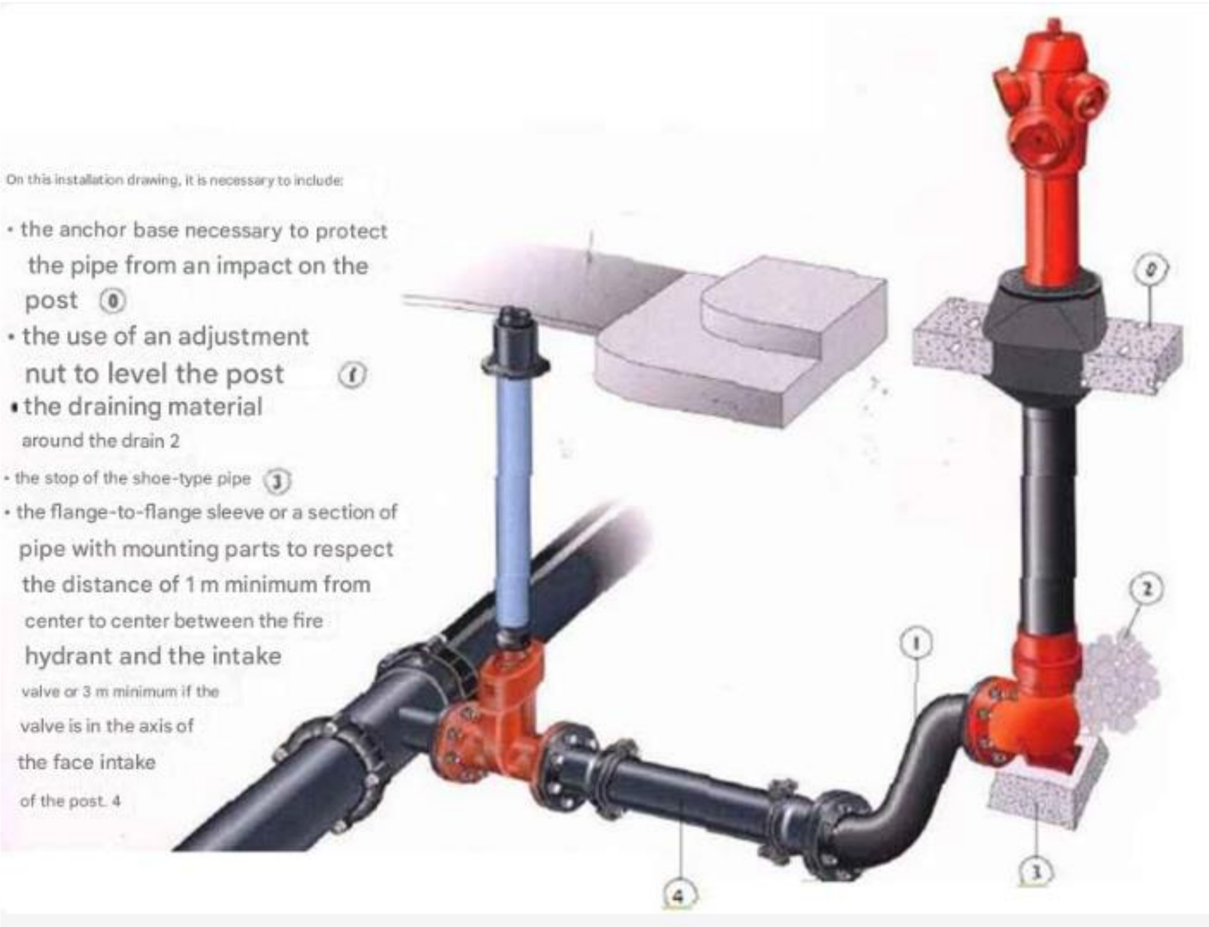

Figure VII. 14. Installation of the Fire Hydrant (https://www.smmi-borne-incendie.fr/poteau-incendie/