Air Release and Vacuum Break Valves

Technical Guide W4.28

Protection of pipelines from damage caused by air.

Applications

- Air release
- Vacuum break

Product Attributes

- Water
- Waste water
- Pump station
- Reticulation lines
- Pipe bridges

Quality

- ISO 9001:2008 Quality Management Standard

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The presence of trapped air in a pressurised pipeline can have serious effects on system operation and efficiency.

As air pockets accumulate at high points, they reduce the effective cross-section of the pipeline in their location, decreasing the water flow, increasing energy consumption required to pump the water through, thus reducing the overall system efficiency.

Pipeline without Air Release Valves

- Increases head loss
- Decreases flow rate
- Increases energy consumption
- Increases surge conditions

When a system is being drained there is a necessity to admit atmospheric air into the pipeline in order to occupy the volume of drained water so to prevent dangerous sub-atmospheric pressure in the pipeline that may cause complete collapse of pipe-sections.

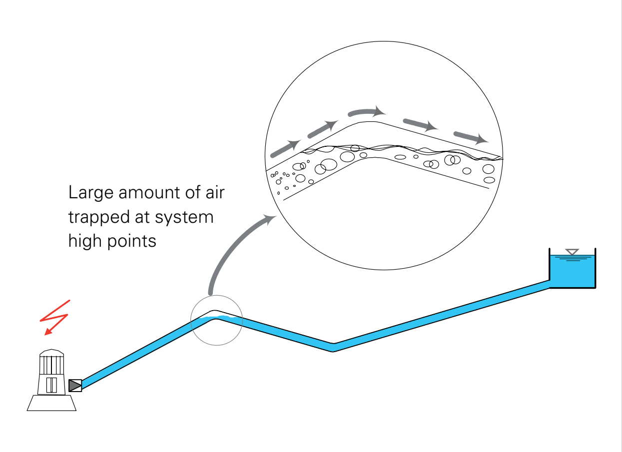


FIG. 1 Pipeline without Air Release Valves

Pipeline without Air Vacuum Valve

- Contaminants can be sucked into the system
- Pipes can collapse
- Vapor pockets can form (as the water boils at such low pressure)
- Collapse or damage pump impellers

Vertical turbine pumps and well pumps lift water from a tank or well into a pipeline. After each pump stoppage, the pump column refills with air because the suction water level is below the pump discharge pipe. If the pump is started without an air valve, the air in the pump column would be pressurised and forced through the check valve into the pipeline, causing surges in the pipe column and the entry of large volumes of air into the pipeline.

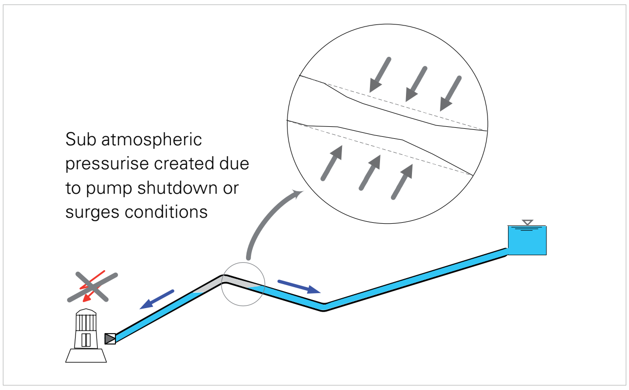


FIG. 2 Pipeline without Kinetic Vacuum Valve

Vertical pump discharge without Air Valve

- Surges in pipe column
- Entry of large volumes of air into the system
- Potential vacuum

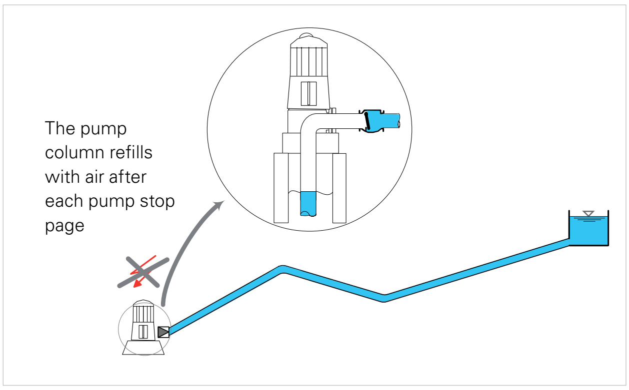


FIG. 3 Vertical pump discharge without Air Valve

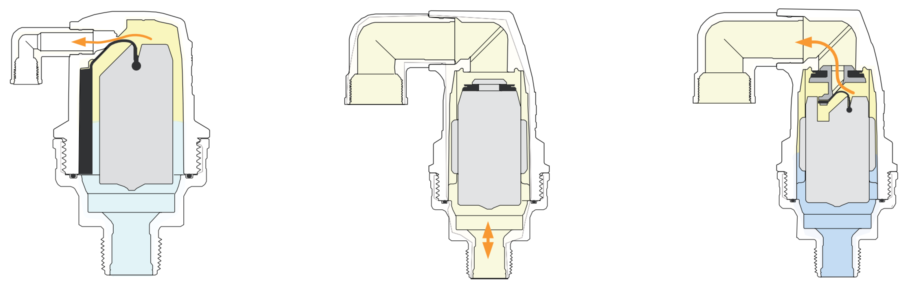


FIG. 4

The types and functions of Air-Valves

- **Automatic Air Release Valves**
  Release small pockets of accumulated air while the pipeline operates under pressure ("Automatic" air-release function)
- **Air / vacuum valve**
  Exhaust large quantities of air from the pipeline when it is filled with water, at low pipeline pressure ("Kinetic" air-release function)
  Admit large quantities of air into the pipe when it is drained or when the internal pressure drops below atmospheric pressure such as in transient conditions ("Kinetic" anti-vacuum function)
- **Combination Air Valves**
  A valve that perform the functions of both the "Kinetic", exhaust/admit large quantities of air from the pipeline at low pressure, and "Automatic", release small pockets of air from the pipeline under pressure.

There are three primary sources of the presence of air in a pipeline

- At startup during filling, the pipeline contains air which must be exhausted. As the pipeline is filled, much of the air will be pushed downstream and released from the system. A large amount of air, however, will become trapped at system high points.
- Water at normal pressure and temperature can contain approximately 2% (by volume) of dissolved air. This dissolved air will come out of solution with a rise in temperature or a drop in pressure. The column of moving water is being subjected to varying pressures and temperatures, due to the terrain slopes, variations in flow velocity caused by changing pipe diameters, partially-open valves, etc. and the dissolved air may be freed from the water mass, accumulating as bubbles, eventually as large pockets of air in the local peaks.
- Air may be drawn into the pipeline at start-up of wellpumps, by the pump-vortex suction and through leaking joints at zones above the hydraulic gradients (negativepressure points). Air can also be admitted into the system by air valves under vacuum conditions.

Air Valve locations along a pipeline

1. High points *(relative to hydraulic gradient line)*.
2. Decrease in an upward slope.
3. Increase in a downward slope.
4. On uniform, long pipe sections: horizontal run, long descents, and long ascents. Air valves should also be located at even spaces of few hundreds of meters *(500 to 1000)*, as determined by collapse-potential of the pipeline under negative pressure.
5. When the flow velocity is very low, air pockets may be accumulated in each local peak, even in small ones, and in steep downhill slopes. It is recommended to eliminate these restrictions by installing air release valves.
6. On the discharge side of deep-well pumps and vertical turbine pumps.
7. Both sides of canal and bridge crossings.
8. Both sides of check-valves, isolating valves and any device that may be closed in the water system, where air may be accumulated on one side while vacuum may be created on the other side.
9. Downstream of a pressure reducing device or temperature raising elements.
10. At any point where the air may accumulate due to local pressure change.
11. At any point where sub-atmospheric conditions may occur during normal or transient conditions.

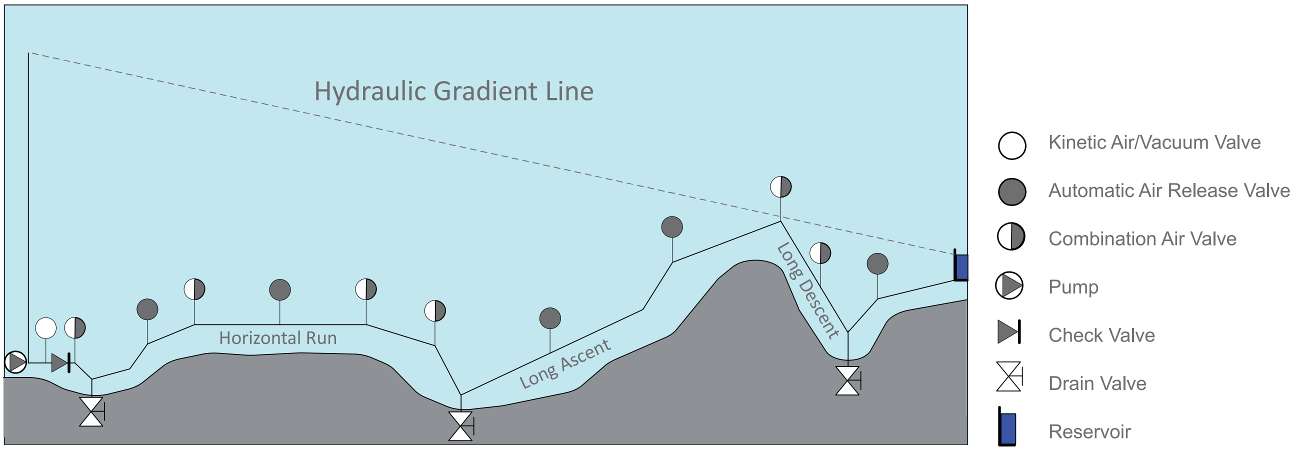


FIG. 5

FIG. 6 Discharge side of pumps

FIG. 7 Increase downward slope

FIG. 8 Discharge side of vertical turbine pumps

FIG. 9 Downstream of a pressure reducing device or temperature raising elements

FIG. 10 Both sides of check-valves, isolating valves and any device that may be closed

FIG. 11 Decrease in an upward slope / Increase in a downward slope

FIG. 12 On uniform, long pipe sections: horizontal run, long descents, and long ascents

Sizing principles

The air volumetric-flow through the air valve is equal to the flow rate of the water filling or emptying the system: For each volume of water entering the pipeline, the same volume of air must me expelled and similarly, for each volume of water drained from the system, the same volume of air should be admitted into the line.

Note: *Air is a compressible media, so its density and volume vary with the pressure. The term "volumetric flow" noted above, refers to that of the air inside the pipeline and is smaller than the calculated 'standard' (atmospheric pressure) air flow when the system is being charged with water and bigger than the 'standard' flow when the system is being drained. The tables and charts presented in this catalogue present the standard air flow under atmospheric pressure.*

The air flow velocity in the valve depends on three factors:

- Rate of water flow, at the valve site
- Orifice diameter of the valve
- Geometry of the specific valve

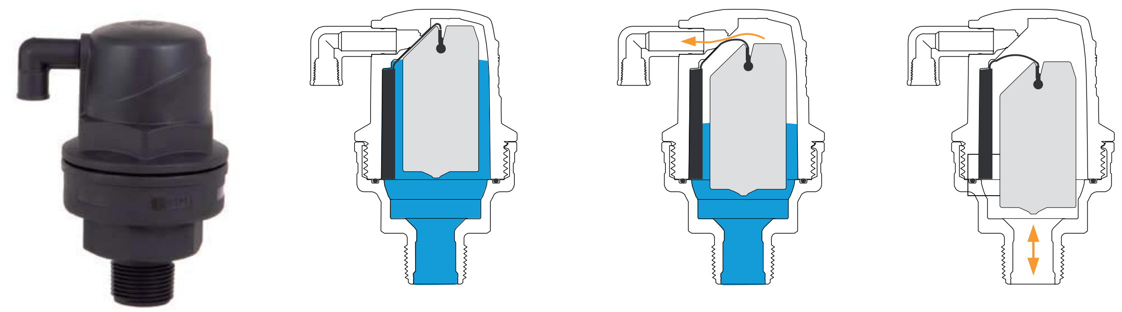
The air flow-velocity through the valve can reach very high values, due to its low density. It is limited only when the velocity reaches the sonic speed, which is practically impossible for the 'Kinetic' valve type, but is the normal situation in the case of the 'Automatic' valve type.

When the system›s internal pressure reaches 0.89 barg, the volumetric air-flow through the orifice becomes constant (critical, sonic-velocity). Increase of the pressure will not result in increased mass-flow, though standvard air-flow will continue to increase due to the increased pressure ratio between the line pressure and the atmospheric pressure. As a rule of thumb, the initial design value for air valves is such that will allow maximal ΔH of 0.1 barg across the valve. i.e. pipeline pressure that does not exceed 0.1 bar gauge-pressure while the pipe is filled, or -0.1 barg when it is drained. However, each system must be inspected to its specific conditions, which the main one is the risk of collapse under sub-atmospheric pressures.

Too small orifice results in high air velocity that may cause:

1. Premature closure, before the water reaches the valve.
2. A mechanical slam of the float to its seating area when the water has reached the valve, local water-hammer and possible breakage in the valve.
3. Insufficient air flow into a drained system that may cause too low sub-atmospheric pressure, which in turn may cause ingress of contaminants into the system or even complete pipe-collapse.

DAV-P-A



Pipe is full of water

Dissolved air is accumulated in the valve, released when the float drops down

Pipe is aerated

FIG. 13

The valve is designed for an efficient release of entrapped air from the pipeline, while the network is at normal working pressure. Due to the relatively large orifice, compare to other Automatic valves in the market, it can also release the air through initial filling of a small-diameter pipe, or admit air into it while it is drained.

Properties

- An automatic air valve, that enables the release of dissolved air that accumulate in the pipeline. The valve will release the air at normal operation pressures of the pipeline.
- The float is made of naturally-buoyant material (specific weight < 1). The float activates a sealing stripe, that closes the outlet when the water will fill the valve body.
- On accumulation of air in the valve, loss of buoyancy causes the float to drop and to pull the strip, thus opening of the air outlet. The Hydraulic sealing of the orifice will provides a driptight closure at a pressure of 2mwc (3psi).

Operation

Releasing entrained air from the pipeline. Small quantities of diluted air accumulate in high peaks of the pipeline and in the peak of the valve. The pressurised air expels the water. The descending water level moves the main float with it. At a certain position the main float pulls down the small seal, that partially opens the nozzle. The pressurised air can escape, the water level rises and the nozzle re-closes.

Technical Specications

- Operating pressure of 0.2 to 16 bars.
- 1/2", 3/4", 1" BSP or NPT threaded base - as per the customer's choice.
- Air flow, even at a critical velocity created by pipeline pressure of 0.9 bar, will not cause premature closure of the valve.
- Structure materials:
  Cover: GRP (UV resistant)
  Base: GRP / Brass
- Internal parts: corrosion resistant, reinforced plastic materials and synthetic rubber.
- The valve allows the discharge of 28m3/h of air at pipe pressure of 1.0 bar, when fully-open.

TABLE 1

Valve	12 mm / 1/2"		18 mm / 3/4"		25 mm / 1"	
Dimension	**SI**	**US**	**SI**	**US**	**SI**	**US**
H – Height	147 mm	53/4"	147 mm	53/4"	147 mm	53/4"
W – Width	86 mm	31/3"	86 mm	31/3"	86 mm	31/3"
D – Thread	1/2" BSP	1/2" NPT	3/4" BSP	3/4" NPT	1" BSP	1" NPT
A – Nozzle Area	12.85 mm2	0.02 in2	12.85 mm2	0.02 in2	12.85 mm2	0.02 in2
L – Total Width	110 mm	41/3"	110 mm	41/3"	110 mm	41/3"
E – Drainage Diameter	1/4" BSP	1/4" BSP	1/4" BSP	1/4" BSP	1/4" BSP	1/4" BSP
Weight	40 g	0.64 lbs.	40 g	0.64 lbs.	40 g	0.64 lbs.

Inflow data (free air flow)

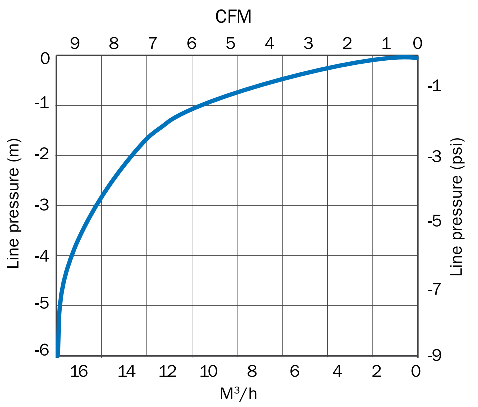


TABLE 2

Discharge data (free air flow)

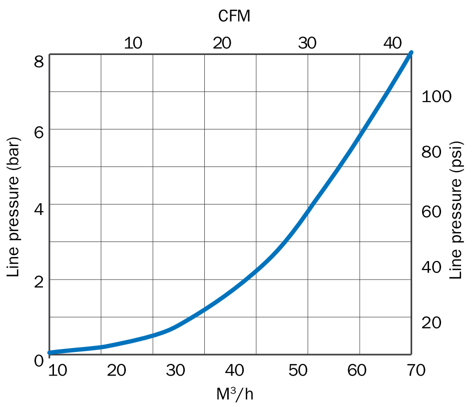


TABLE 3

TABLE 4

Part	Description	Material
1	Base	"Glass Reinforced Nylon, Optional: Brass"
2	Body	Glass Reinforced Nylon
3	Float	Foamed Polypropylene
4	Seal	EPDM Rubber
5	O ring	NBR
6	Drainage Elbow	Polypropylene

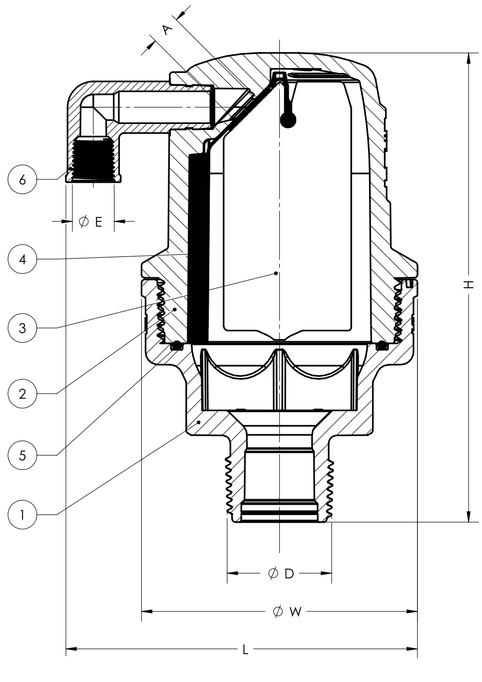
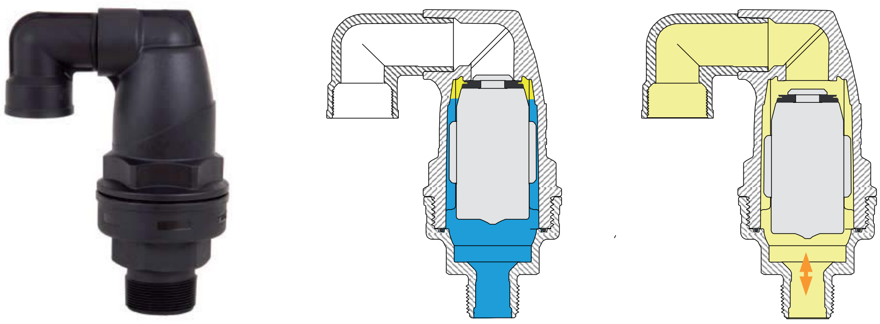


FIG. 14

DAV-P-K



Pipe is full of water *Pipe is aerated*

FIG. 15

This valve has been designed for efficient discharge and intake of air in water transport systems, filtering systems, containers, and other places where confined air could impair the system's operation.

The valve is appropriate for

- Expelling the air at high flow velocity during the initial filling of the system.
- Introducing large quantities of air when the pipe drains, maintaining atmospheric pressures in the pipe and preventing collapse and cavitation damage to the conduits.

Properties

Leak-proof sealing at all conditions, including low system pressure. The aerodynamic design of the float provides air flow at a very high velocity. The float does not close before the water has reached the valve. Threaded outlet elbow allows various possibilities of drain connection. The valve design contains a very limited number of parts, allowing easy dismantling for maintenance.

Operation

The DAV-P-K valve has two modes of operation: Discharge of large quantities of air at a high flow velocity when the conduit is being filled. When the water arrives to the valve, the float rises up and closes the outlet. Introduction of air into the pipeline when the internal pressure is sub-atmospheric. The pressure difference forces the float to drop to "opened" position, allowing large volumes of air to flow into the pipe.

Technical Specications

- Operating pressure of 0.2 to 16 bars
  1", 2" BSP or NPT threaded base - as per the customer's choice
- Air flow, even at a critical velocity created by pipeline pressure of 0.9 bar, will not cause premature closure of the valve
- Structure materials:
  - Body: GRP (UV resistant)
  - Internal parts: corrosion resistant plastic materials and synthetic rubber
- The valve allows the discharge of 700m3/h of air at pipe pressure of 0.5 bar

TABLE 5

Valve	12 mm / 1/2”		18 mm / 3/4”		25 mm / 1”		50 mm / 2”	
H – Height	183 mm	71/4"	183 mm	71/4"	183 mm	71/4"	249 mm	97/8"
W – Width	86 mm	31/3"	86 mm	31/3"	86 mm	31/3"	110 mm	41/3"
D – Thread	1/2" BSP	1/2" NPT	3/4" BSP	3/4" NPT	1" BSP	1" NPT	2" BSP	2" NPT
A – Nozzle Area	12.85 mm²	0.02 in²	12.85 mm²	0.02 in²	12.85 mm²	0.02 in²	12.85 mm²	0.02 in²
K – Kinetic Nozzle Area	314 mm²	0.49 in²	314 mm²	0.49 in²	314 mm²	0.49 in²	908 mm²	1.41 in²
L – Total Width	134 mm	51/4"	134 mm	51/4"	134 mm	51/4"	187 mm	73/8"
E – Drainage Diameter	3/4" BSP	3/4" BSP	3/4" BSP	3/4" BSP	3/4" BSP	3/4" BSP	11/2" BSP	11/2" BSP
Weight	470 g	1.04 lbs.	470 g	1.04 lbs.	470 g	1.04 lbs.	1052 g	2.32 lbs.

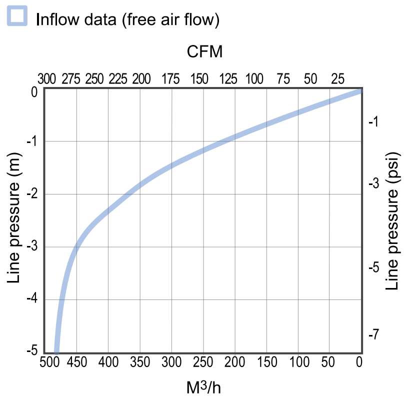


TABLE 6

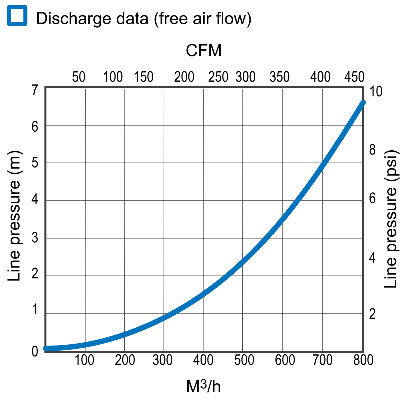


TABLE 7

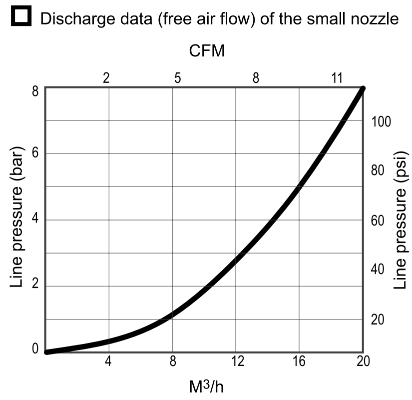


TABLE 8

TABLE 9

Part	Description	Material
1	Body	“Glass Reinforced Nylon Optional: Brass”
2	Bonnet	Glass Reinforced Nylon
3	Float	Foamed Polypropylene
4	Slider	Glass Reinforced Nylon
5	Automatic Seal	EPDM Rubber
6	Kinetic Seal	EPDM Rubber
7	O ring	NBR
8	Drainage Elbow	Polypropylene

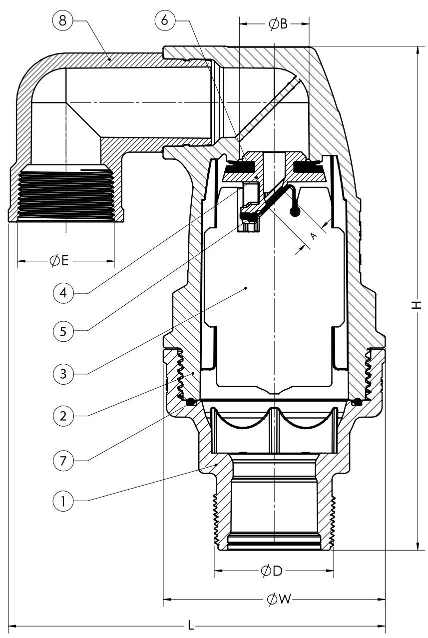
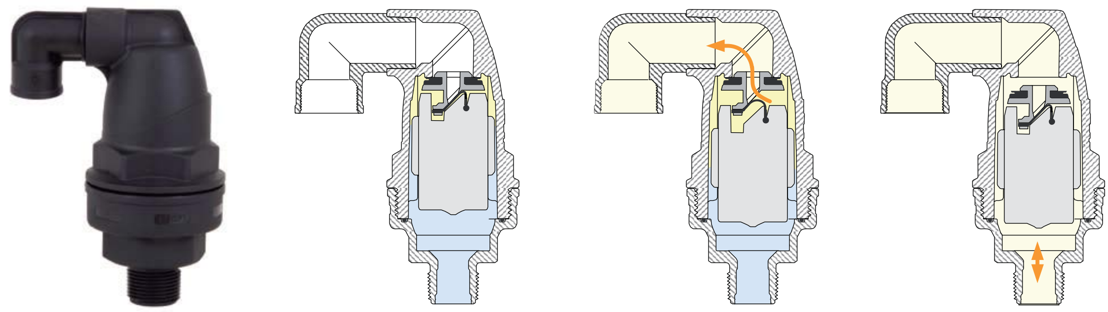


FIG. 16

DAV-P-KA



Pipe is full of water

Dissolved air is accumulated in the valve, released when the float drops down

Pipe is aerated

FIG. 17

This valve has been designed for efficient discharge and intake of air in water transport systems, filtering systems, containers, and other places where confined air could impair the system's operation.

The valve is appropriate for

- Expelling the air at high flow velocity during the initial filling of the systems.
- Introducing large quantities of air when the pipe drains, maintaining atmospheric pressures in the pipe and preventing collapse and cavitation damage to the conduits.
- Relieving the entrained air from the water, while the network is pressurised.

Properties

Leak-proof sealing at all conditions, including low system pressure. The aerodynamic design of the float provides air flow at a very high velocity. The float does not close before the water has reached the valve. Threaded outlet elbow allows various possibilities of drain connection. The valve design contains a very limited number of parts, allowing an easy dismantling for maintenance.

Operation

The DAV-P-2-KA valve has three modes of operation: Discharge of large quantities of air at a high flow velocity when the conduit is being filled. When the water arrives to the valve, the main float rises up and closes the outlet. Introduction of air into the pipeline when the internal pressure is sub- atmospheric. The pressure difference forces the main float to drop to "opened" position, allowing the air to flow into the pipe. Releasing entrained air from the pipeline. Small quantities of diluted air accumulate in high peaks of the pipeline and in the peak of the valve.

The pressurised air expels the water. The descending water level moves the main float with it. At a certain position the main float pulls down the small seal, that partially opens the nozzle. The pressurised air can escape, the water level rises and the nozzle re-closes.

Technical Specications

- Operating pressure of 0.2 to 16 bars
- 1/2", 3/4", 1", 2" BSP or NPT threaded base - as per the customer's choice
- Air flow, even at a critical velocity created by pipeline pressure of 0.9 bar, will not cause premature closure of the valve
- Structure materials:
  - Body: GRP (UV resistant)
  - Internal parts: corrosion resistant plastic materials and synthetic rubber
- The valve allows the discharge of 700m3/h of air at pipe pressure of 0.5 bar, when fully-open

TABLE 10

Valve	12 mm / 1/2"		18 mm / 3/4"		25 mm / 1"		50 mm / 2"	
Dimension	**SI**	**US**	**SI**	**US**	**SI**	**US**	**SI**	**US**
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Weight	470 g	1.04 lbs.	470 g	1.04 lbs.	470 g	1.04 lbs.	1052 g	2.32 lbs.

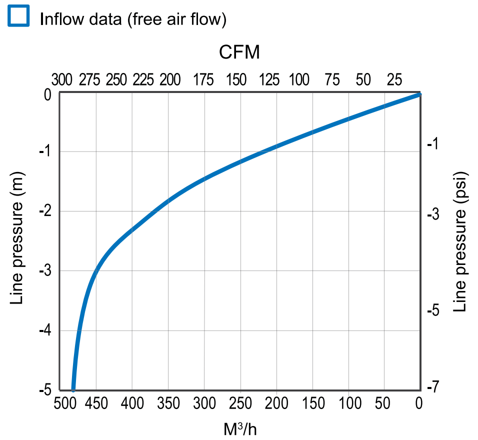

TABLE 11

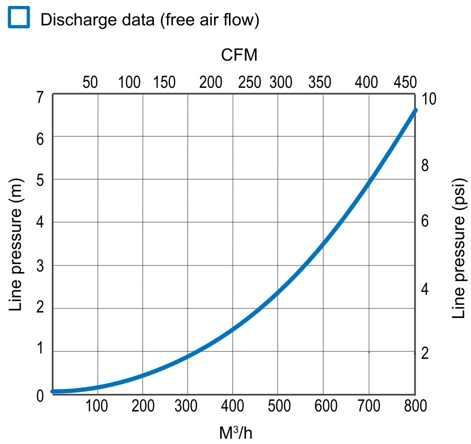

TABLE 12

TABLE 13

Part	Description	Material
1	Body	Glass Reinforced Nylon Optional: Brass
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5	O ring	NBR
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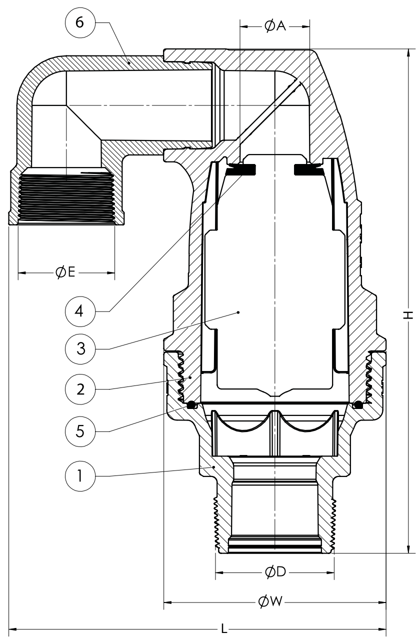

FIG. 18

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