

The Advantages of the D-070 Dynamic Air Valve

May 2, 2010 Dan Cohen

Controlled release of air is critical for the safe operation of pipeline systems. This paper will try to summarize the advantages in surge suppression of the Dynamic diaphragm-operated non-slam air valve with its new working configuration, compared to the existing concept of surge suppression by two-stage and three-stage non slam air valves.

Two-stage non-slam air valve:

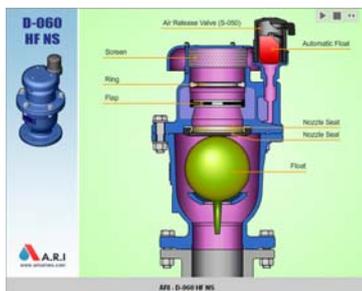


Two-stage non-slam air valves are actually a vacuum breaker with a smaller (automatic) air release orifice and larger air intake orifice. The discharge orifice is held in place by a spring so that it is normally closed. Thus, the air valve can only release air through the small orifice. When a vacuum condition occurs in the pipeline (water is draining out of the pipe, at water column separation), the check valve disc opens, allowing for the intake of air through the larger orifice.

Two-stage non-slam air valves are actually spring-loaded check valves with automatic air release. They require a complex check valve mechanism to control flow through two different regions and allow for a large orifice for air intake only and a small orifice for air release. By limiting the discharge, the speed of the water column filling the pipeline is restrained and the velocity of the water column moving towards the orifice is slowed down.

The disadvantage of the two-stage non-slam valve is that air stays in pipelines for a longer period of time.

Three-stage non-slam air valves:



The three-stage non-slam air valve is equipped with an additional disc that has a small orifice (but much larger than the automatic orifice). The air valve is normally open with a large active orifice. The large discharge

orifice switches over to the smaller discharge orifice (disc) when the air discharge pressure exceeds a preset value. The non-slam effect is achieved by the ability to slowdown the water column before all the air is expelled from the pipeline.

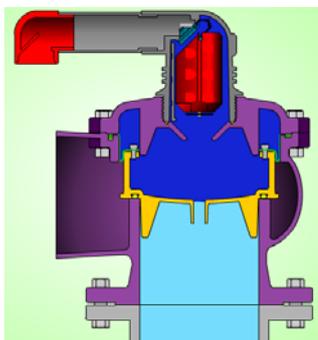
Advantages over the two-stage air valve:

- Discharge at low air pressure will release large quantities of air quickly.
- The switch over to the smaller orifice (disc), when the air discharge pressure exceeds a preset value, occurs while air is still in the line and this reduces the air slam pressure. The residual air provides a cushioning effect for the initial pressure slam (generated during the switchover from the larger to the smaller orifice).

Disadvantages of the three stage air valves:

- Air discharge pressures are usually very small during bulk evacuation of air (10 to 50cm). When discharging small quantities of air (total air volume), pressures may not reach the switch value
- When the switchover to the smaller orifice does NOT take place, then the valve loses its NONSLAM capability.
- All air goes out through large orifice, leading to air slam conditions.
- There are also differences between the different manufacturers in the switching pressure. The lower the switching point, the better is the reaction of the air valve and its ability to lock enough air in the pipeline. The ARI switch point is 0.02 bar compared to Dorot and Vent-O-Mat 0.07.
- In the situation of water column separation, it is critical to have large enough air intake to create a sufficient air pocket in the pipeline with the necessary volume to slow down the colliding water columns. If the length of time of the vacuum condition is smaller than a few seconds, then the air pocket will be too small to activate the slowing down of the colliding columns and will not be able to prevent the surge.

The Dynamic non-slam air valve:



The Dynamic air valve operates in a totally different manner. It discharges all the air in the pipeline through the large orifice when the water column arrives and closes the air valve slow enough to prevent an abrupt change of velocity. This action prevents surge and water hammer. The unique

rolling diaphragm sealing mechanism reduces changes in velocity (in equation $\Delta H = (c/g) \Delta V$), therefore reduces the slam effect.

Advantages:

- The Dynamic air valve always ensures water flow after ALL the air is out of pipeline, unlike three-stage non-slam air valves where the non-slam effect is lost if the switch does NOT take place.
- Water flow starts immediately after air flow stops – it continues to maintain SOME flow velocity (prevents sudden deceleration)
- When water flow stops – there is a gradual closure (just like closing a discharging valve). There is no need for building an air pocket in the pipeline.