

Comeval®

Comeval Valve Systems



Air vented anti surge tank

A.V.A.S.T.

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*Flowing innovation
.... since 1974*



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During the research and realisation of new products, CSA has always focused his efforts on:

- Listening to the customer's needs and finding the best solution both at the design and operational phases.
- Guiding our R&D department to develop ranges of modern, reliable and complementary products.
- Adopting production techniques that, even while complying with the severest quality standards, would allow us to reduce delivery times.
- Guaranteeing complete technical support for our customers and prompt after-sales assistance.

This philosophy characterizes us not only as a valve manufacturer but also as a reliable partner whom you can always depend on for consulting and solutions.

The production cycle, aimed at the constant improvement of our products and complete customer satisfaction, ensures predetermined margins of tolerance by establishing production standards, which guarantee that the semi finished products reach the next production stage with the required specifications. All our valves are made of ductile cast iron GJS 450-10 or 500-7 in absolute compliance with European standards, and are suitable for PN 25-40 bar.

The manufacturing process is carried out exclusively by means of numerically controlled lathes, mills, and horizontal machining units. Subsequent step-by-step controls are based on strict quality procedures.

Painting, pretreated by sand blasting grade SA 2.5, is carried out inside a fluidized bed containing epoxy powder, which guarantees maximum surface protection. All our products are tested under water pressure and certified.

Air vented anti surge tank A.V.A.S.T.

The innovative antisurge tank A.V.A.S.T. has been designed to contain the devastating effects of water hammer, more precisely the transients coming from the sudden pump failure both for water and sewer systems. The device, fully automatic, proved to be an innovative and reliable solution thanks to the absence of air compressors, electricity, panels, bladders, precharges. A.V.A.S.T. is the ideal solution to avoid damages sometimes fatal for our systems as a consequence of uncontrolled overpressures and negative pressure waves.



Technical features and benefits

- Designed for treated water and wastewater.
- Available from 300 up to 25000 liters PN6/10/16.
- Innovative system, pat. pending, to avoid bladders and compressors.
- Low maintenance and reduced volumes compared to air vessels, bladders and tanks working with precharges.
- Anti-hammer device to control air outflow yet ensuring the maximum inflow during negative pressure conditions.
- Produced in different materials, welding in compliance with EN / ASME standards.
- Supported by CSA transient analysis and calculation software.

Applications

- To protect pumping station from negative and positive pressure conditions caused by pump failure and used in:
 - Wastewater pressurized main lines.
 - Irrigation.
 - Water mains and distributions systems.

Water hammer

The term water hammer is commonly used as a synonymous of unsteady flow, suggesting noise and fast changing pressure variations sometimes related to devastating effects on the system.

Pipelines, both for water and sewage, are vital for our modern civilization and their safety and protection should be one of the top priorities. During the studying and assessment of the pipeline network their behaviour under transient conditions will reveal the potential for damages. This involves numerical simulations carried out to reproduce events, planned or accidental, with consequences on the system.

The main causes of transients are :

- sudden changes in demand
- pump start up
- pump failure
- rapid closing and opening of isolation devices
- rapid filling of pipe line and fire fighting installations
- opening and closing fire hydrants
- pipe flushing and draining operations
- feed tanks draining

Water hammer can also be described as a propagation of energy, as in the transmission of sound, and from basic physics as a wave motion the energy is associated with the elastic deformation of the medium.

The celerity of sound waves a in rigid pipes is given by

$$a = \sqrt{\frac{\frac{K}{\rho}}{1 + K \cdot \frac{D}{E \cdot e}}}$$

Where E is the modulus of elasticity;

D is the pipe diameter;

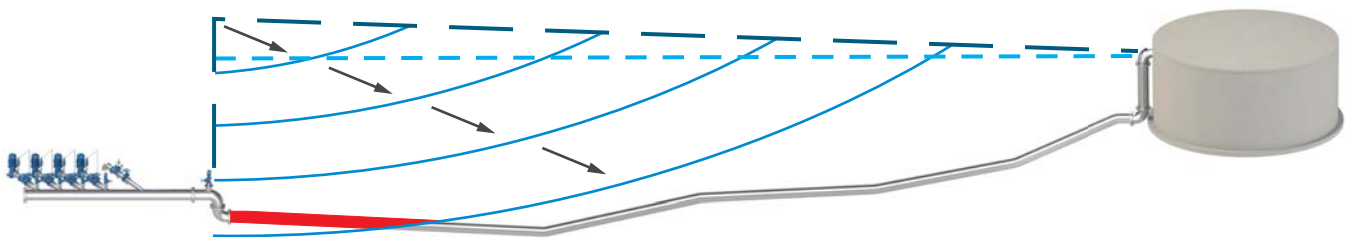
e is the wall thickness;

K is the bulk modulus;

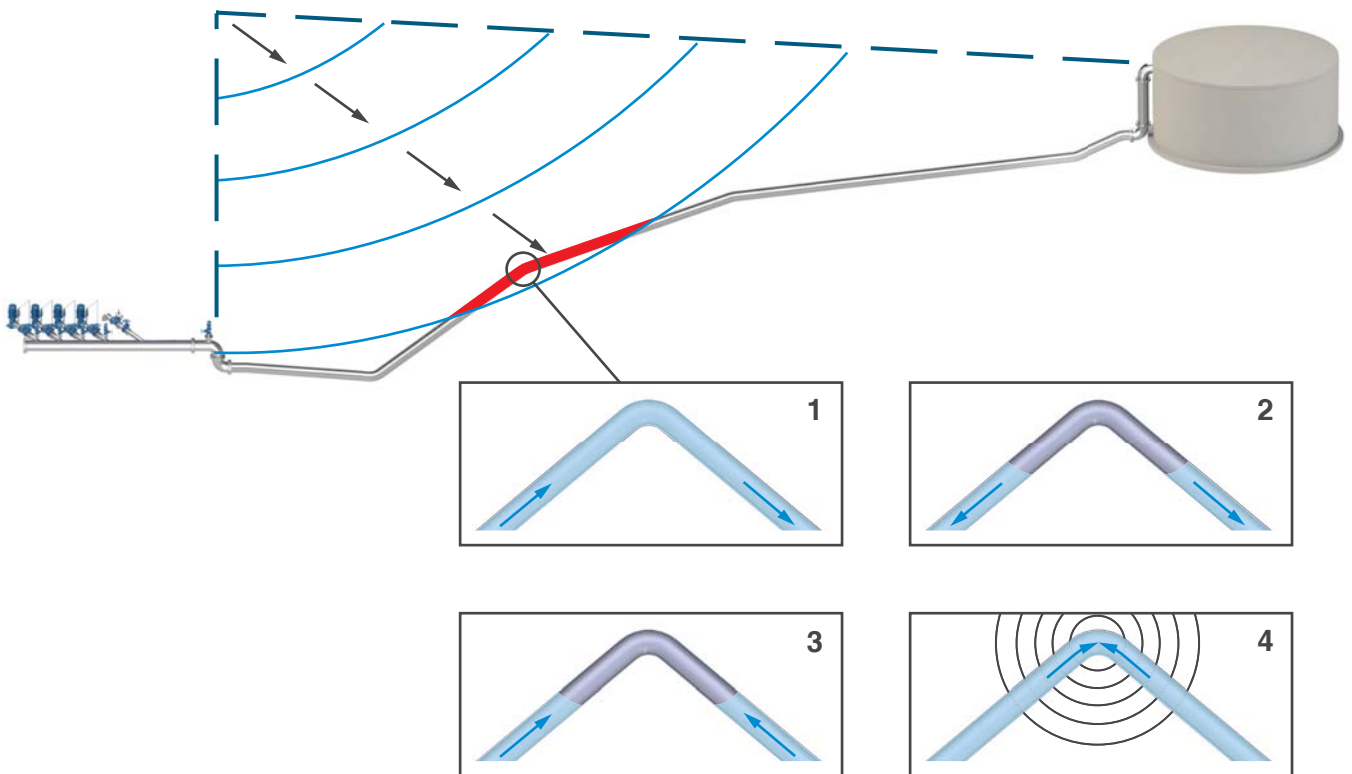
ρ is the density of the fluid medium.

Pump failure

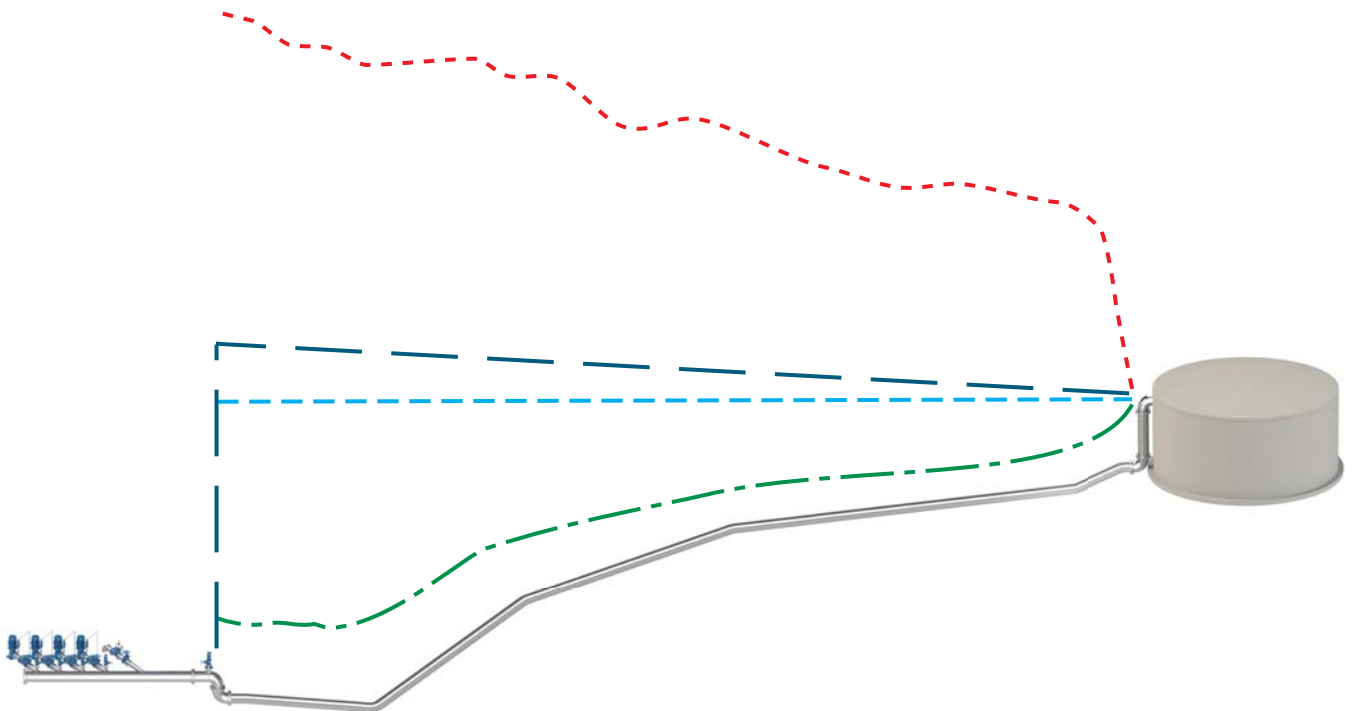
One of the most critical occurrence in water and wastewater system is the pump failure also called pump trip. This definition means actually a full blackout, interrupting the pump's head and causing a deceleration with consequent negative pressure variation propagating with a speed whose value depends on the fluid and pipe properties. Negative pressure is always a problem for possible pipe deformation, collapse, gaskets movements and entrance of contaminated water and pollution through points of leakage. If the hydraulic grade line, during the pump failure, drops to a negative value corresponding to the vapour pressure there is the risk of column separation, generated by the formation and collapse of vapour pockets producing serious and unexpected high frequency rises in pressure, sometimes fatal for the system.



The plot above shows a pipeline profile, with pumps and downstream tank as boundary conditions, where the dark blue dotted line represents the HGL and the light blue dotted line is the static. The picture represents the negative pressure wave propagating downstream as an effect of pump failure, where the red segment depicts the area exposed to negative during the initial phase of the event.



The plot above shows the negative pressure wave propagating downstream, as an effect of pump failure. The red segment depicts the area exposed to severe negative pressure. The change in slope represents a location at risk of column separation, caused by vapour pockets forming and then collapsing creating unwanted water hammer as explained on the 4 pictures.



The results of pump failure can be summarized in a plot showing the envelope of the maximum and minimum pressure values reached during the simulation, in the picture above displayed in green and red. It is evident how the system reaches a full vacuum on the entire profile and an extreme rise in pressure due to the column separation, occurred at the change in slope.

How can transients be prevented?

In order to prevent transients and unwanted damages on the pipeline systems we basically have to reduce the variations in velocity of the fluid and, when this happens, try to proceed as slow as possible.

It will therefore be mandatory to:

- operate slowly during valve closing, especially on the last 20% of the stroke. Vice versa for the valve's opening.
- control the pipe filling to remain or use anti-hammer combination air valves, example the CSA RFP model.
- introduce air or water into the pipeline, at the locations where negative pressure conditions are likely to occur.

One of the best and most reliable solutions to the problem, and working as a standalone or in combination with other devices like anti hammer air valves and pressure relief valves, is the CSA air vented anti surge tank also called A.V.A.S.T.

This type of anti surge device can be installed in derivation from the main line or directly on top of it, and simply provided with an isolation device to allow for maintenance. No additional check valves, by pass or restrictions are needed. Compared to other solutions A.V.A.S.T. doesn't need any kind of compressor, bladder or external source of energy. This means a reduced maintenance, higher reliability and more important a lower volume needed to provide the same degree of protection, in comparison with bladder tanks or air vessels.



Operating principle - First phase of transient after pump failure

As a consequence of power failure A.V.A.S.T. will avoid negative pressure conditions, using the fluid and its storage capacity, by means of the force obtained thanks to the effect of the stand pipe and the automatic air compression around it.



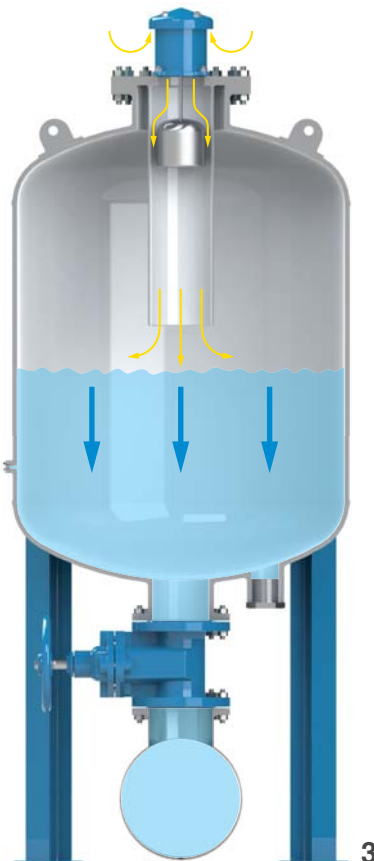
First phase 1

In case of pump failure AVAST will supply liquid to the pipe, avoiding negative pressure conditions. The liquid level will therefore drop inside of it according to the variation in pressure.



First phase 2

When the liquid drops also inside the stand pipe the air valve system, located on top, will allow the entrance of large volumes of air avoiding negative pressure inside the A.V.A.S.T.



First phase 3

When the liquid drops below the stand pipe lowest point the air inflow will recharge the air pockets, previously expanded due to the variation in pressure.



First phase 4

Thanks to its innovative operating principle A.V.A.S.T. will allow the drop in the liquid level to the bottom of it, or even further, therefore using the entire storage capacity. The protection capacity of the air valve located on top against negative will always be ensured.

Operating principle - Second phase of transient after pump failure

On the second phase of transient caused by pump failure water column will come back pushing air and water towards the pump station, and the A.V.A.S.T. anti surge device. Even in this case the latter features a technology able to cope with the transient event, to minimize the risk of water hammer.



Second phase 1

On the second phase of transient water will come back pushing the liquid level upwards, air will start flowing out of the AS air valve system on top (pat. pending) controlling the velocity and avoiding unexpected rises in pressure.



Second phase 2

The more water pressure is packing up the more the fluid level will raise. As long as it is maintained below the pipe's stand pipe, air will be discharge through the air valve system.



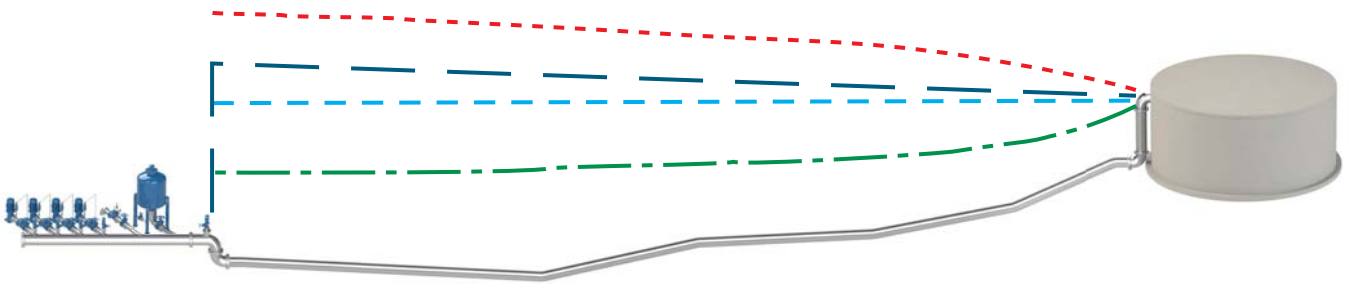
Second phase 3

As the liquid level rises above the dipping tube lowest point air is compressed around it, while the outflow through the air valve will continue with water filling the stand pipe.

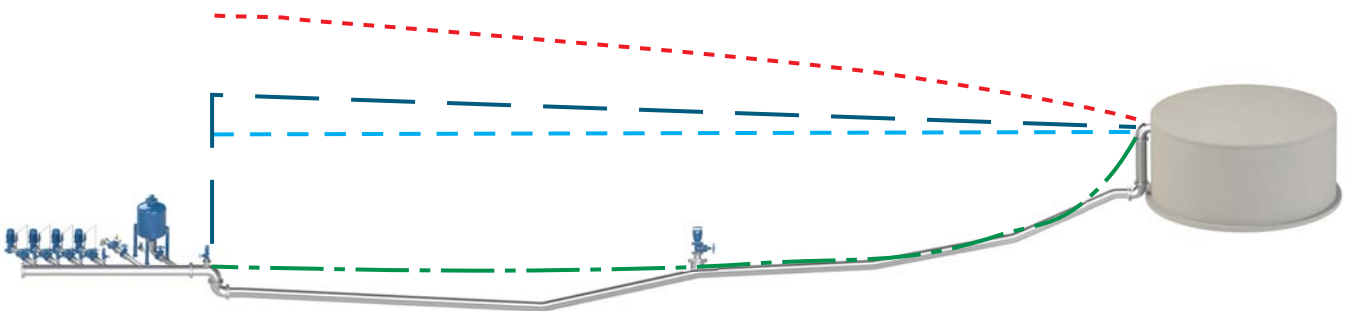


Second phase 4

At the end of the transient, once pressure has stabilized, the liquid will fill the stand pipe closing the AS air valve. At the same time air will compress around it pushing the level upwards, to a value depending on the steady state conditions of the system.

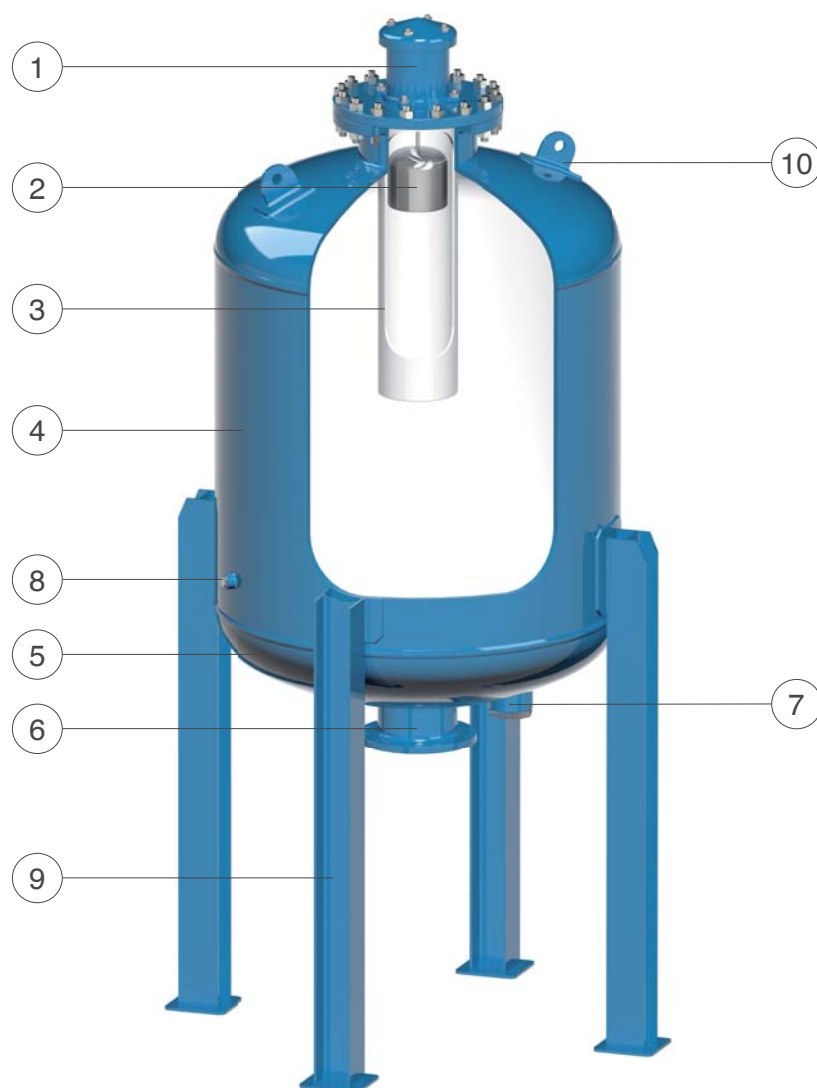


The plot above shows the pressure envelope of the transient event caused by pump failure on a pipeline with A.V.A.S.T. installed as a protection. The red and green are the maximum and minimum pressure values reached during the simulation, it is clearly visible the beneficial effect in terms of negative pressure and consequently water hammer reduction.



The plot above shows the pressure envelope of the transient event caused by pump failure on a pipeline with A.V.A.S.T. installed as a protection, in combination with anti-hammer air valves (CSA AS series). In this case the effect of the air valve will help reducing the volume of A.V.A.S.T., containing budget and design requirements. The red and green are the maximum and minimum pressure values reached during the simulation. A.V.A.S.T. can be placed at the pumping station and/or along the profile and calculated to perform with air valves and pressure relief valves, CSA VRCA series, if required.

Technical details



N.	Component	Standard material	Optional
1	Air valve CSA anti hammer type	in different executions for treated and wastewater	
2	Float	stainless steel AISI 316	
3	Dipping tube	painted steel Fe 360	
4	Shell	painted steel P 355 NH	
5	Base plate	painted steel P 355 NH	
6	Flanged outlet	painted steel P 245 GH	
7	Drain outlet	painted steel P 355 NH	DN 2-3" or flanged DN 50-150
8	Pressure outlet for gauge	painted steel P 355 NH	DN 1/2-2"
9	Legs	painted steel P 355 NH	
10	Lifting plates	painted steel P 355 NH	

The list of materials and components is subject to changes without notice.

Working conditions

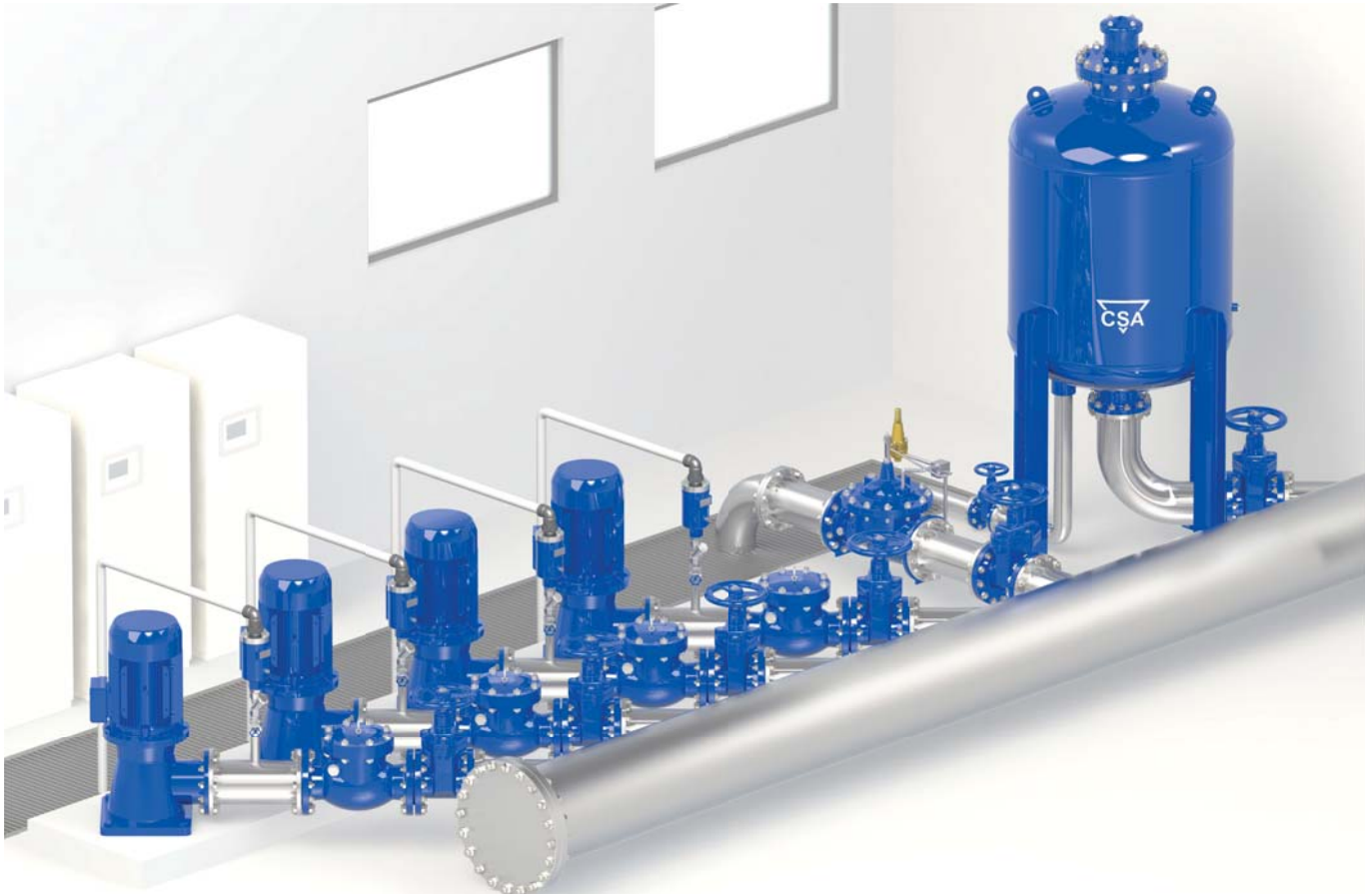
Treated water / Waste water 70° C max.;
Maximum pressure 16 bar;
Minimum pressure 0,3 bar on the top.

Standard

Calculation CND in compliance with PED and ASME VIII.
Welding according to ASME VIII Div.1, EN regulation.
Painting according to project requirements.
Outlet flanges according to EN 1092/2 or ANSI;
variations on flanges details available on request.

Installation layout for water applications

Anti surge tanks represent one of the most versatile means of providing protection at pumping stations. This is because they allow the introduction of flow limiting the rate of acceleration/deceleration that occurs in case of pump failure. The illustration below shows the use of CSA anti surge tank A.V.A.S.T., in a common water pumping station, without the need of any check valves, by-passes and restriction otherwise necessities for air vessels and other solutions. In addition to A.V.A.S.T. a series of CSA equipments are also present for the proper protection of the system. In case of pump failure the consequence of rapid negative and positive pressure variations shall be evaluated, therefore the introduction of relief valves along with the A.V.A.S.T..



The picture on the left shows the particular of CSA anti slam water air valves installed at the pump, just upstream of the check valve. The air valve is needed to avoid at any time the onset of negative pressure, yet assuring a controlled air venting when pump is operated. This is achieved by means of CSA anti-slam device and is extremely important to avoid water hammer events, likely to be generated by conventional air valves during abrupt closures. The anti hammer combination model will also perform air release, to eliminate air pockets generated by the pumps during operating conditions and start up cycles.

Installation layout for wastewater applications

Anti surge tanks represent one of the most versatile means of providing protection at pumping stations. This is because they allow the introduction of flow limiting the rate of deceleration/acceleration that occurs in case of pump failure. The illustration below shows the use of CSA anti surge tank A.V.A.S.T, in a common wastewater pumping station, without the need of any check valves, by-passes and restriction otherwise necessities for air vessels and other solutions. In addition to A.V.A.S.T. a CSA wastewater anti-hammer air valve Mod. SCA is also present and located on the main line. CSA expertise in the field of water hammer analysis will provide the right solution, through a sizing and assessment of the devices needed to ensure the proper protection of the system.



The picture on the left shows the particular of CSA anti slam wastewater air valves installed on the pump riser, just upstream of the check valve. When the pump is idle the riser will be filled with air, down to the water level in the sump. The air valve is needed to avoid at any time the onset of negative pressure, yet assuring a controlled air venting when pump is operated. This is achieved by means of CSA anti slam device and is extremely important to avoid water hammer events, likely to be generated by conventional air valves during abrupt closures.



Advanced testing facilities

Designed to reproduce real conditions of modern water distribution systems the CSA testing facility is able to assess the dynamic performances of automatic control valves, direct acting pressure control valves, air valves and anti water hammer valves.

Provided with a high capacity booster pumps station, and linked to an advanced high frequency pressure transducers and flow meters, the testing rig allows for a real time visualization of pressure and flow evolutions. Water hammer events can also be simulated and recorded to prove the efficacy of CSA fast acting relief valve, in addition to level control for which, using an auxiliary stilling tank, a part of the pipeline system is entirely dedicated.

The PLC and control station allows for the operation of step by step and solenoid operated valves to determine the sensitivity of such kind of application and pressure management solutions. Thanks to this important and powerful tool valves can be customized, simulated and set according to the project requirements assuring the perfect performance and accuracy.

The testing process

All our valves undergo severe tests according to EN standards to ensure they are mechanically resistant, watertight, and high performing. After testing every valve is identified by means of a metallic tag or sticker, and duly registered and certified.



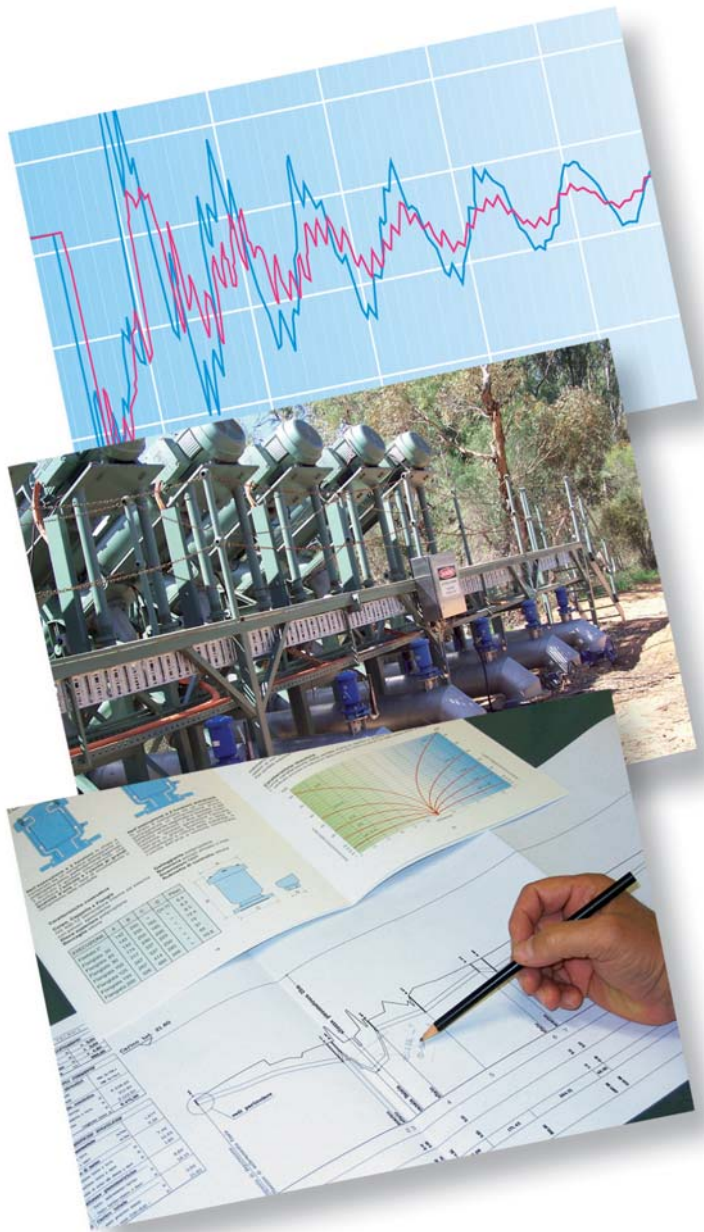
CSA HYCONSULT

Water hammer analysis CSA Hyconsult

CSA Hyconsult was founded to provide designers and consultants, involved in the design of water distribution and sewage systems, with accurate and unique technical support.

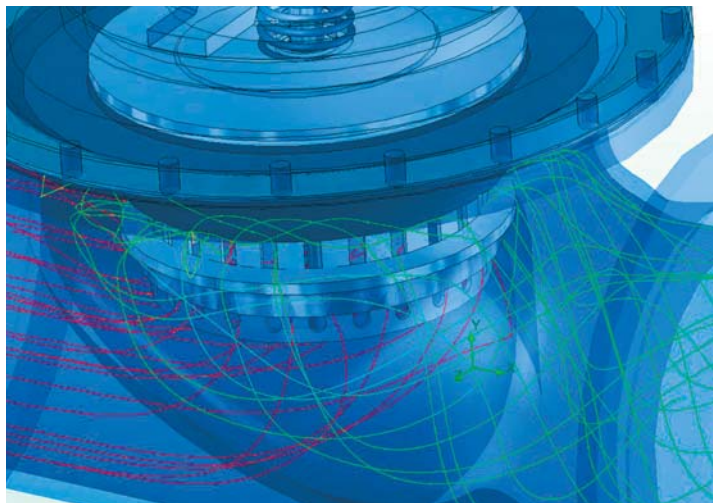
CSA Hyconsult has specialized in hydraulic modelling and transients analysis, entirely through the use of modern computational tools and advanced algorithms. Simulations are essential to predict system responses to events under a wide range of conditions without disrupting the actual system.

Using simulations, problems can be anticipated in possible or existing situations, and solutions can be evaluated in order to invest time, money and material in the most productive manner.



Research and innovation

CSA has always regarded knowledge as being indispensable for the kind of research that consistently feeds innovation at all levels. The R&D department at CSA constantly strives to improve product performance and continually searches for new solutions to meet our customer's needs. Twenty years of experience in valve design and sizing, supported by advanced computational tools, cooperation with external entities at the highest level, and test facilities for the verification of theoretical results which are available for our customers, guarantee our professionalism and reliability.





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