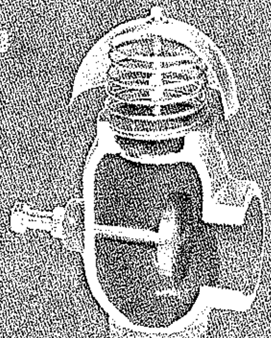
VAL-MATIC®

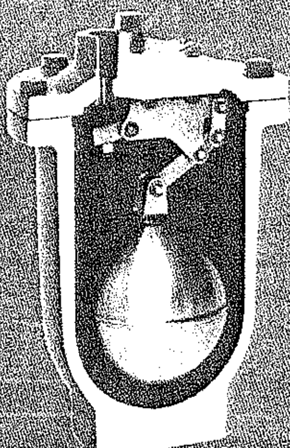
airValve

Bulletin 1500

AIR VALVES

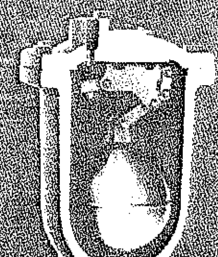


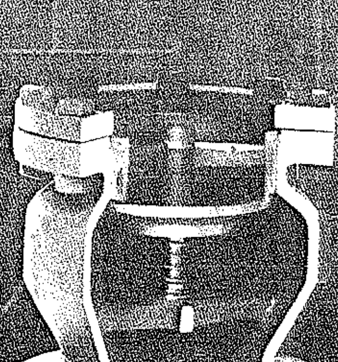
PROVIDING SYSTEM EFFICIENCY AND PROTECTION

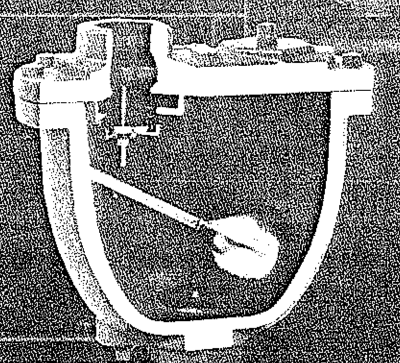


CLASSIFIED UL WATER QUALITY

NSF/ANSI 61 Certified







AIR & Its Impact on a Water and Wastewater System

One of the most misunderstood aspects of the Water & Wastewater industry is the presence of air in a pipeline and its impact on operations. Many operational problems, especially at the time of initial start-up, including broken pumps, valves and pipe, as well as faulty instrumentation readings, are blamed on inadequate thrust blocking, improper pipeline bedding, etc. In reality, many of these problems are not caused by improper installation of the line, but by failure to de-aerate the line. Properly de-aerating your pipeline will safeguard it from air-related problems, however if no steps are taken to accomplish this, you should be ready for trouble.

SOURCES OF AIR

Air in a pressurized, operating pipeline comes from three primary sources. First, prior to start-up, the line is not empty - it is full of air. To entirely fill a pipeline with fluid, it is necessary to eliminate this air. As the line fills, much of this air will be pushed downstream to be released through hydrants, faucets, etc. but a large amount will become trapped at system high points (Figure 1). This phenomenon will occur because air is lighter than water

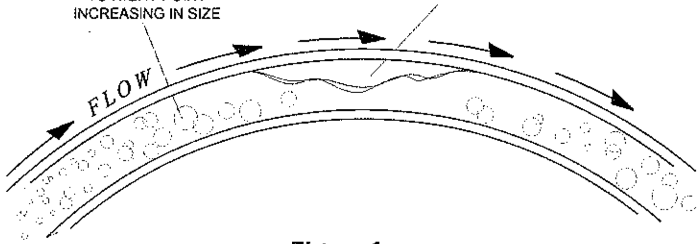


Figure 1
Air in pipeline collects at high points

and therefore, will collect at the high points. This air will continuously be added to by the second and third sources as the system continues operation.

Source number two is the water itself. Water contains approximately 2% air by volume. During system operation, the entrained air will continuously separate out of the water and once again accumulate at system high points. To illustrate the potential massive amount of air this 2% represents, consider the following: A 1000 ft. length of pipe could contain a pocket of air 20 ft. long if all the air accumulated in one location. Or a one mile length of pipe could contain a 100 ft. pocket of air. This would be true regardless of the diameter of the pipe.

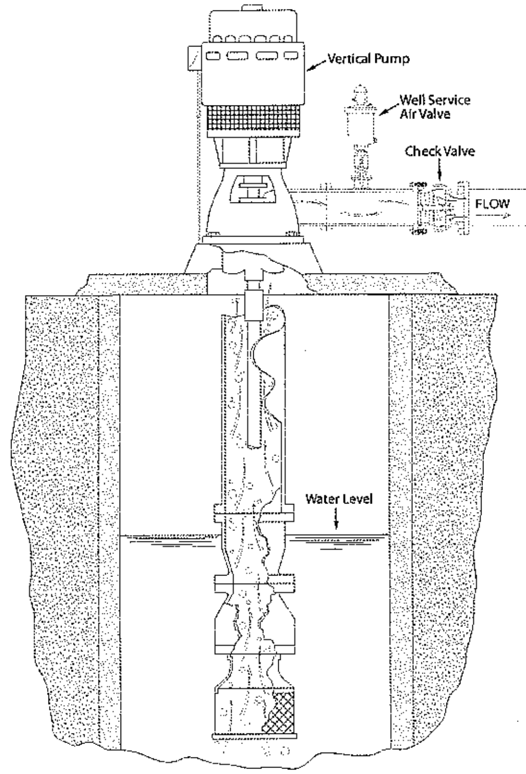


Figure 2
Air entering through mechanical equipment

The third source of air is that which enters through mechanical equipment (Figure 2). This includes air being forced into the system by pumps as well as air being drawn in through packing, valves, etc. under vacuum conditions. As one can see, a pressurized pipeline is never without air and typically the volume is substantial.

IMPACT OF AIR ON SYSTEM

Now that we have identified the air sources, let us consider their impact on the system. Two problems are apparent. The pocket(s) of air accumulating at a high point(s) can result in a line restriction (Figure 3). Like any restriction, the

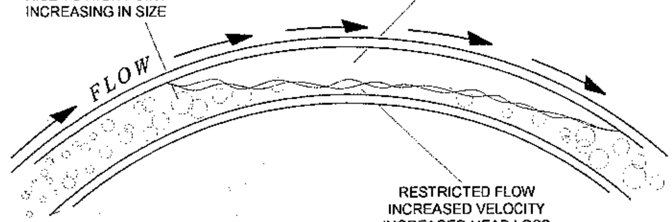


Figure 3
Air pockets can lead to line restriction

"Air in a pressurized pipeline is a serious concern. Obviously, its removal will result in a more efficient, cost effective operation and potentially avoid more serious problems."

pocket(s) of air increases headloss, extends pumping cycles and increases energy consumption. The presence of air can also promote corrosion of pipe and fittings. As air continues to accumulate at system high points, the fluid velocity increases as the fluid is forced through a smaller and smaller opening.

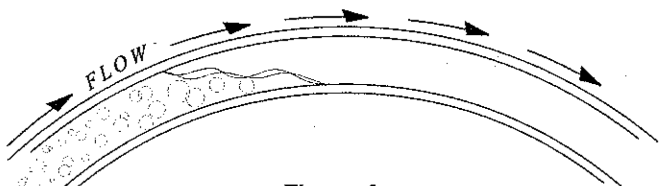


Figure 4
Air pockets can lead to total flow stoppage

As the pocket(s) grows, one of two phenomena will occur. The first possibility is a total flow stoppage (Figure 4). If system dynamics are such that the air cannot be continuously removed by the increased fluid velocity and pushed downstream, then this could happen. As the pocket(s) continues to accumulate air, a pressure drop higher than pump capacity can develop and stop all flow.

The second, and more likely occurrence, is that the increased velocity will cause all, or part of, the pocket to suddenly dislodge and be pushed downstream (Figure 5). The sudden and rapid change in fluid velocity when the pocket dislodges and is then stopped by another high point, can and often will, lead to a high pressure surge (water hammer). Serious damage to valves, fittings, gaskets, or even breakage of the line can occur. This is the most serious of the possible consequences of air being allowed to accumulate in system high points.

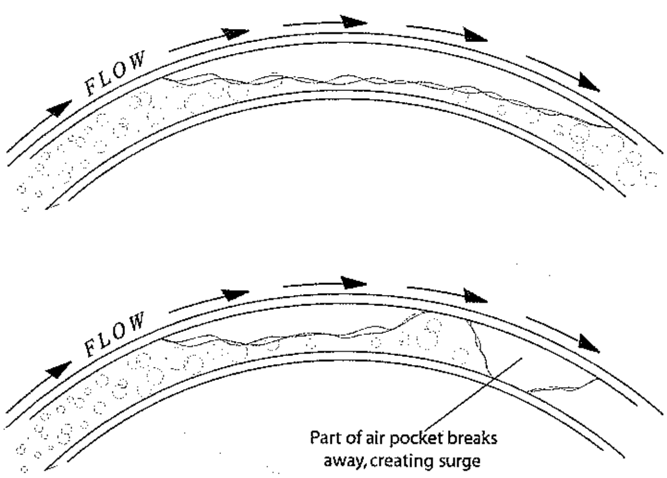


Figure 5
Air pockets can lead to surges in the line

HISTORICAL SOLUTIONS

As we can see, air in a pressurized pipeline is a serious concern. Obviously, its removal will result in a more efficient, cost effective operation and potentially avoid more serious problems. In the early 1900's, engineers and water works personnel started developing an understanding of the problems associated with air and the search for a solution began. Some depended on standpipes, believing that a large portion of the air would be expelled through them.

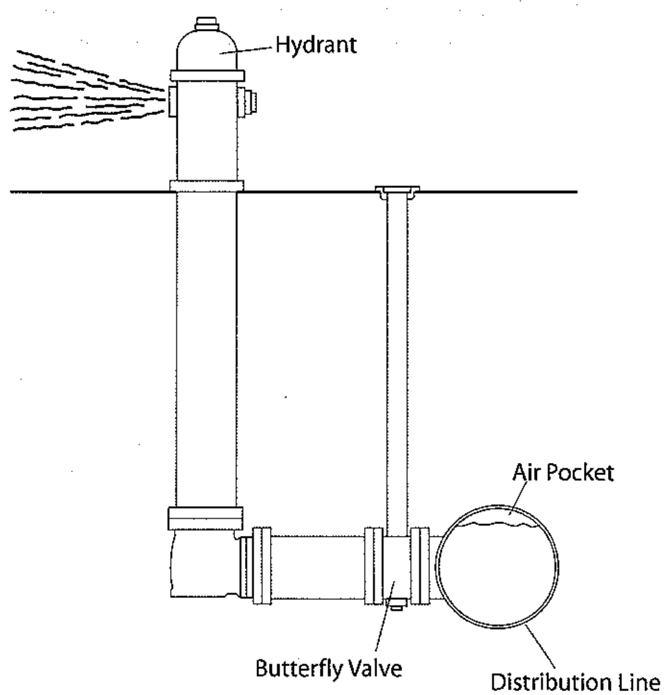


Figure 6
Opening a hydrant may not eliminate air pockets

Many began placing gate or ball valves at system high points to manually bleed off accumulated air. Unfortunately, it has proved impossible to predict when it is time to bleed the air. This proved impractical, especially on larger systems. Open fire hydrants (Figure 6) are frequently used under the assumption that all air in the pipeline will be released. Unfortunately, hydrants are generally connected to the side of the pipe, leaving air trapped at the top and at system high points. It should be noted that there are still municipalities using these methods.

"An added benefit of an Air/Vacuum Valve is its ability to provide pipeline vacuum protection. If a negative pressure develops, the valve will open, admitting air into the line, reducing the potential for surges related to column separation and possible pipeline collapse."

THE AIR VALVE SOLUTION

Today, most municipalities utilize Automatic Air Valves. They are available in many different designs and configurations for a wide range of applications. Their function is to automatically release and admit air without operator assistance. Today, countless Air Valves are performing this task around the globe on a daily basis.

Air Valves are available in three basic configurations (Figure 7): Air Release Valves, Air/Vacuum Valves and Combination Air Valves. Correct sizing and location of all three types are critical. Every high point greater than one pipe diameter where the pipeline converts from a positive grade to a negative grade requires an air valve. Even minimal high points with small air pockets can cause serious surge problems and reduce line efficiency. In addition, it is recommended that air valves be installed every half mile or 2500 feet on straight horizontal runs (AWWA M51). Air Valve Sizing Software is available, see page 27.

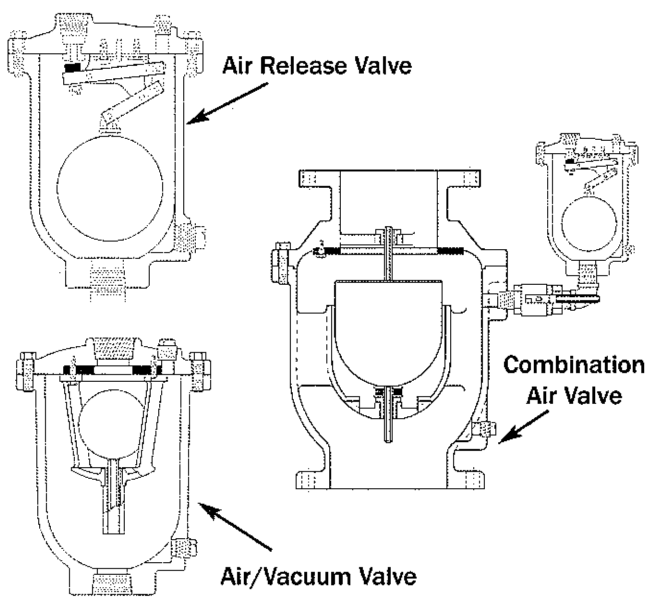


Figure 7
Basic Air Valve configurations

AIR RELEASE VALVES

An Air Release Valve (Figure 8), sometimes referred to as a "small orifice" valve, will continuously release accumulated air during system operation. As air from the pipeline enters the valve, it displaces the water, allowing the float to drop. The air is then released into the atmosphere through a small orifice. As the air is vented it is replaced

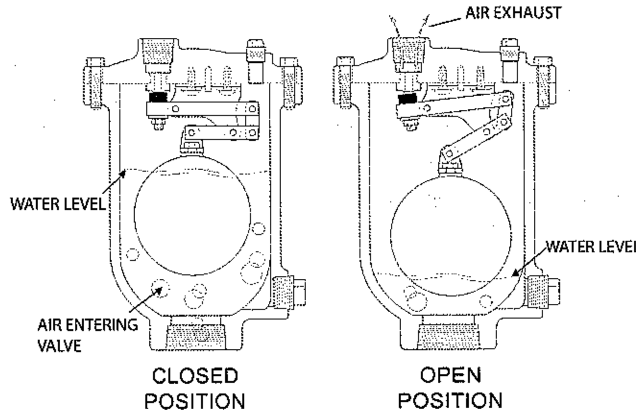


Figure 8
Air Release Valve in Operation

by water, raising the float and closing the valve orifice. As air accumulates, the valve will continue to cycle in this manner to remove collected air.

AIR/VACUUM VALVES

Air/Vacuum Valves (Figure 9), sometimes referred to as "large orifice" valves, are used to exhaust large quantities of air upon system start-up, as well as allowing air to re-enter the line upon system shut down or system failure. As water enters the valve, the float will rise, closing the discharge port. The valve will remain closed until system pressure drops to near zero psi. **It will not open to release any accumulation of air while the system is under pressure.**

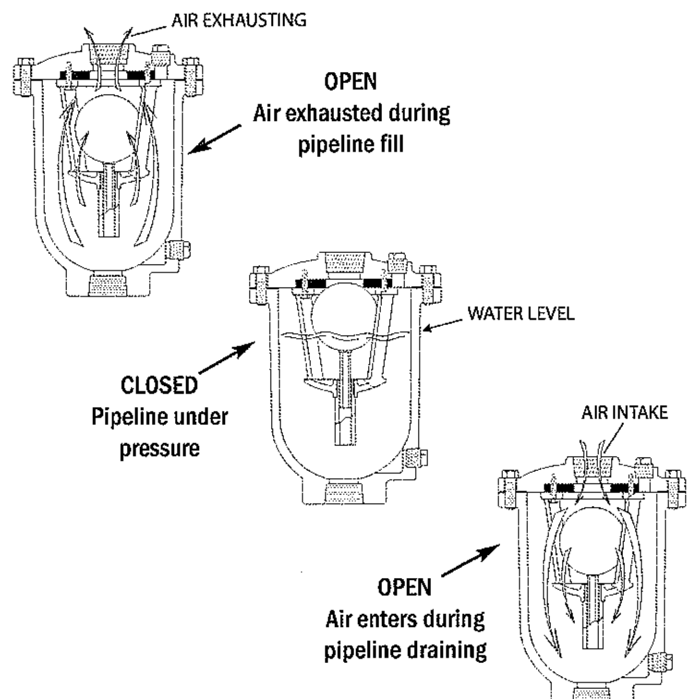


Figure 9
Air/Vacuum Valve Operation

An added benefit of an Air/Vacuum Valve is its ability to provide pipeline vacuum protection. If a negative pressure develops, the valve will open, admitting air into the line, reducing the potential for surges related to column separation and possible pipeline collapse. While Air/Vacuum Valves will exhaust large quantities of air upon start-up, it should be remembered that they will not continuously release air during system operation. For this function, an Air Release Valve is also required.

COMBINATION AIR VALVES

Combination Air Valves (Figure 10) are the most commonly used valves. They perform the functions of an Air/Vacuum Valve (exhaust large quantities of air on start-up, admit air on shut-down) and Air Release Valves (release air continuously during operation). Combination Air Valves are available in single body and dual body (an Air/Vacuum Valve and Air Release Valve piped together) configurations. The single body configuration is more compact and economical. The dual body configuration provides two independent valves so that if maintenance is being performed on the Air Release Valve, the Air/Vacuum Valve is still protecting the pipeline. The dual body valve also provides a much wider range of sizing options.

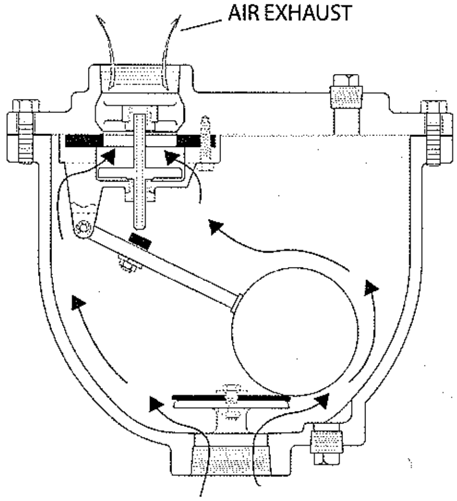


Figure 10
Single Body Combination Air Valve

SURGE-SUPPRESSION AIR VALVES

Pipelines with high points, where pressure transients or column separation can occur should have air valves equipped with slow closing devices (regulated-exhaust device) to restrict the outflow of air (AWWA C512-07). During these conditions, typically caused by unexpected pump shut down, line break, power outage etc., the air valve must allow air to flow rapidly into the pipeline. The large volume of air entering the pipeline will prevent the formation of a severe vacuum pocket and the damaging pressures that can occur when these pockets collapse. When the water columns rejoin and the pressure recovers, the air valve should exhaust the air in a regulated manner to suppress surges. While the pipeline is pressurized and in operation, the Air Valve must continue to automatically release entrained air to maintain the pipeline flow efficiency.

Surge-Suppression Air Valves are Combination Air Valves equipped with Regulated-Exhaust Devices (slow closing devices) as shown in Figure 11. The Regulated-Exhaust Device consists of a flanged or threaded body with a normally-open restrictor disc. The Surge-Suppression Air Valve provides full airflow into the pipeline during vacuum conditions to prevent a vapor pocket (vacuum) from forming. When the pressure recovers and the water column rejoins, air is expelled through the valve, which lifts the restrictor disc. This action regulates the discharge airflow creating an air pocket that cushions the surge effect of the returning water column. When the column reaches the restrictor disc, the water flows through the reduced ports and gently closes the air valve. Transient studies (Kroon 1984, Lingireddy 2004) have shown a dramatic reduction in pressure surges when the exhausting air is controlled under these conditions.

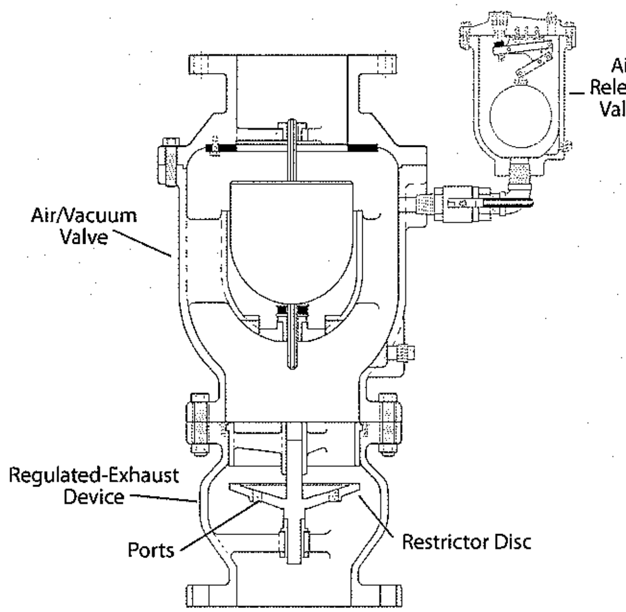


Figure 11
Surge-Suppression Air Valve

WELL SERVICE AIR VALVES

Well Service Air Valves (Figure 12) are a member of the Air/Vacuum Valve family and are used with vertical pumps. Vertical pumps (Figure 2) lift water from a reservoir or deep well at high velocities because they start against little head

Features & Benefits

From the float material to the shape of the body, Val-Matic Air Valves are designed for optimum performance. All valves meet AWWA C512 requirements.

EXPERIENCE

Val-Matic offers over 40 years of experience in providing a full line of air valves up to 20 inch and vacuum breakers up to 42 inch in size. The Val-Matic Air Release, Air/Vacuum and Combination Air Valves are manufactured in accordance to the rigorous industry requirements given in American Waterworks Association (AWWA) Standard C512. The standard was developed and based on decades of successful application of air valves in our industry. Val-Matic's AWWA Air Valves feature 316 stainless steel trim, full size ports, ANSI threaded or flanged connections and stringent testing. Val-Matic manufactures air valves in a wide range of materials and pressure ratings with many accessories including Regulated-Exhaust Devices, Dual Port Throttling Devices, Isolation Valves, Screened Hoods and Backwash Accessories. Val-Matic also provides Windows-Based software to locate, select and size air valves for pipelines and force mains.

NSF/ANSI 61 CERTIFICATION

Val-Matic Air Valves for water service are independently NSF/ANSI 61 certified and marked for use in drinking water applications.

TYPE 316 STAINLESS STEEL TRIM

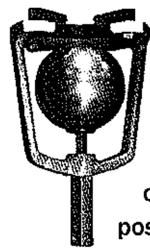
Type 316 stainless steel is the standard for all internal components in Val-Matic Air Valves. Type 316 stainless steel provides the greatest protection from aggressive waters and hydrogen sulfide exposure in wastewater application.

UNCONDITIONALLY GUARANTEED FLOATS

Floats are unconditionally guaranteed for the life of the valve from corrosion, collapse or leakage. No other valve manufacturer has the confidence in their float construction to provide this guarantee.

GUIDED FLOATS

Providing a quality float is not enough to assure a good seal every time. When entering the seat, a damaged or off-center float will prevent a valve from sealing tight. The high air and water velocities in air valves can cause unguided floats to violently strike the sides of the valve body. Val-Matic floats are guided; four inch and larger valves feature double guides (top and bottom). Guiding assures that the float approaches the center of the seat every time to provide a positive drop tight seal.



SELF CLEANING FLOAT GUIDES

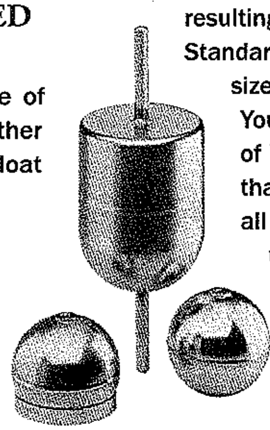
The Val-Matic floats are guided by hexagonal float stems. The float stems pass through round stainless steel bushings preventing the build up of debris or scale and provide self cleaning of the bushings.

RESILIENT SEATS

All Val-Matic valves incorporate a resilient seat or orifice button which mates with a 316 stainless steel float or seat for positive drip tight seating. Val-Matic elastomers are specially formulated for water and wastewater service and have been NSF/ANSI 61 certified. Air Release Valves have a synthetic sealing button mounted to the float linkage mechanism. On Air/Vacuum and Combination Air Valves, the stainless steel float closes against the resilient seat mechanically retained in a body register. The seats contain raised sealing beads and/or a unique flex edge that provide positive shutoff from the lowest system pressure to the valve's rated working pressure.

FULL SIZE FLOW AREA

Val-Matic Air/Vacuum and Combination Air Valves are equipped with full and equal size inlets and outlets in accordance with AWWA C512. Some air valve manufacturers use common covers for different size air valves resulting in undersized outlets and reduced flow. Standard industry calculations assume a full port size so the air valve should provide the same. You can be assured that the inlets and outlets of Val-Matic's Air Valves are equal to or larger than the area of the nominal valve size. Finally, all Combination Air Valves with float guides in the outlet have expanded flow areas around the guide spokes to provide full flow area through the valve.



Look to Val-Matic for Solutions

The wide range of air related concerns in pipeline and treatment plant design require a multitude of solutions. With the broadest line of air valves available coupled with Engineering expertise and Manufacturing experience, Val-Matic is the number one source for solutions to air related issues. The following are a few of the basic valve applications and the solutions Val-Matic can provide.

EFFICIENCY AND VACUUM PROTECTION

The primary purpose of air valves is to provide pipeline efficiency by continuous removal of air at pipeline highpoints and vacuum protection by admitting large quantities of air upon pump shut down or system failure.

SURGE CONTROL

Air valves play an important role in pipelines to control or reduce surges. Surges result from sudden changes in velocity of the pipeline fluid. These velocity changes occur regularly due to pipeline filling, pump operation, line breaks and power failure. The effects of surges can be devastating. Surges are typically 50 psi for every 1 ft/sec of rapid change in flow velocity. This is added to the pipeline static pressure. Through computer modeling and transient analysis, it has been shown that air valves can play a critical role in suppressing pipeline surges during column separation conditions.

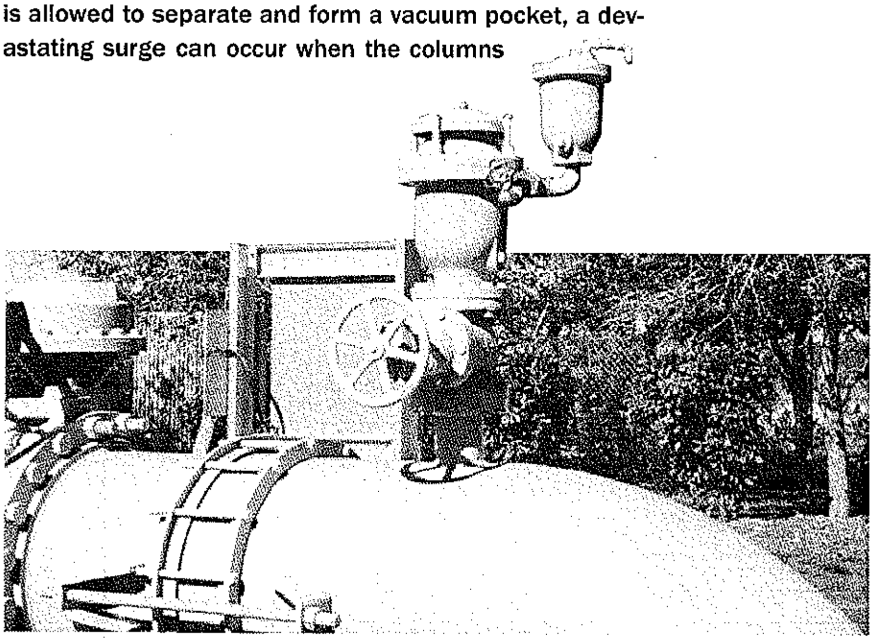
PIPELINE SURGES

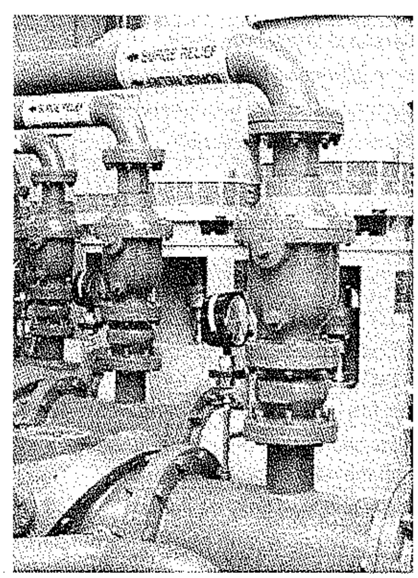
Power or system failures can often result in water column separation at high points in the line. If the water column is allowed to separate and form a vacuum pocket, a devastating surge can occur when the columns rejoin. To prevent a vacuum from forming, a Surge-Suppression Air Valve or Vacuum Breaker is used to admit large quantities of air into the pipeline.

A Surge-Suppression Air Valve consists of a Combination Air Valve equipped with a Regulated-Exhaust Device that allows full airflow into the pipeline, but restricts the airflow out of the pipeline. Similarly, a Vacuum Breaker allows rapid entry of air into the pipeline, but prevents flow out of the pipeline. When equipped with an Air Release Valve, the Vacuum Breaker will provide controlled release of air through the small Air Release Valve orifice. Both methods dampen or suppress surges in the pipeline by temporarily trapping a pocket of air and cushioning the impact of the returning columns of water by regulating the exhaust of the air pocket.

VERTICAL PUMP COLUMN SURGES

High velocity rapidly develops in a pump column when a vertical turbine or deep well pump starts against an air-filled column and closed check valve. A power-actuated check valve must absorb the full force of the impending impact. A mechanical check valve will open, relieving a portion of the force but still sees extreme surges. The best way to prevent surges in the pump column and connecting piping is to regulate the exhaust of the air in the pump column during pump start-up (AWWA M-51, p. 24). A Well Service Air Valve equipped with either a Dual Port Throttling Device or a Regulated-Exhaust Device vent air from the pump column at a controlled rate so that all or most of the air escapes just before the check valve opens. (See Val-Matic technical paper AEG-302.)





Applications, Functions, Purpose & Features

AWWA
MEMBER

Val-Matic Air Valves fully comply with ANSI/AWWA C512 and are NSF/ANSI 61 Certified for Water Quality.

	Air Release Valve	Air/Vacuum Valve	Combination Air Valve	Surge-Suppression Air Valve	Vacuum Breaker Valve	Well Service Air Valve	Wastewater Air Release Valve	Wastewater Air/Vacuum Valve	Wastewater Combination Valve	Vacuum Priming Valve
PIPELINE APPLICATIONS										
Water distribution and transmission	x	x	x	x	x					
Municipal wastewater collection							x	x	x	
Force Main				x	x		x	x	x	
PUMP APPLICATIONS										
Centrifugal pump volute	x						x		x	x
Lift station							x	x	x	x
Pump station high points	x		x	x						
Turbine well pump discharge						x				
Booster pump station	x		x	x						
Fire pumps (FM Approved, UL Listed)	x					x				
WATER/WASTEWATER TREATMENT PLANT APPLICATIONS										
High Points	x		x	x			x		x	
Filter backwash piping	x		x	x			x			
Pressure filters	x		x	x						
Venturi meters	x									
TANK APPLICATIONS										
Storage tank valves			x	x						
Hydropneumatic tanks	x									
FUNCTION										
Venting of accumulated air during system operation	x		x	x			x		x	x
Admitting large volumes of air during shut down and draining operations (Power failure)		x	x	x	x	x		x	x	
Vacuum protection (pipe joints, gaskets, packing, etc.)		x	x	x	x	x		x	x	
Regulated-Exhaust of large volumes of air during start-up and filling operations				x		x				
PURPOSE										
Maintain pipeline efficiency	x		x	x			x		x	
Provide protection from pipeline collapse due to vacuum		x	x	x	x			x	x	
Air related surge protection		x	x	x	x	x	x	x	x	
Air related head loss protection (efficiency)	x		x	x			x		x	
Column separation vacuum protection				x	x	x		x	x	
Air bound pump protection	x									x
Extend air valve life				x						
Maintain pump prime										x
Reduce Air/Vacuum valve size requirement				x						
FEATURES										
Conforms to AWWA standard	x	x	x	x		x				x
Certified to NSF/ANSI 61	x	x	x	x	x	x				
Adjustable seating	x		x	x			x		x	x
Full flow area equal to nominal valve size		x	x	x	x	x		x	x	
Inlets and Outlets equal to or greater than the nominal valve size		x	x	x	x	x		x	x	
Single and dual body designs			x	x					x	
Bell bottom body (anti-clog)							x	x	x	
Regulated-Exhaust Device (Slow-Closing Device)				x		x				

Air/Vacuum Valves

Operational Highlights:

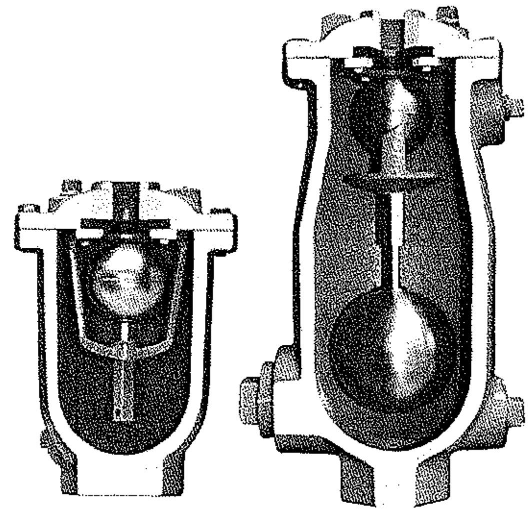
- Exhausts large quantities of air at system start-up
- Provides pipeline vacuum protection
- Responds to loss of pressure during power failures, line breaks and intentional drainage

Product Features:

- Unconditionally guaranteed stainless steel floats
- Stainless steel 316 internal trim
- Exclusive high/low pressure resilient seating
- Full pipe size inlets and outlets provide maximum protection
- Non-clog design eliminates backwashing

Optional Accessories:

- Outlet hood with screen (prevents debris from entering valves)
- Flanged outlets on sizes 8 inch & smaller
- Ball, plug, and butterfly isolation valves (allows valve maintenance)
- Inflow Preventer on outlet (stops flood water and resulting contamination from entering pipeline)
- Backwash kit (for severe wastewater applications)

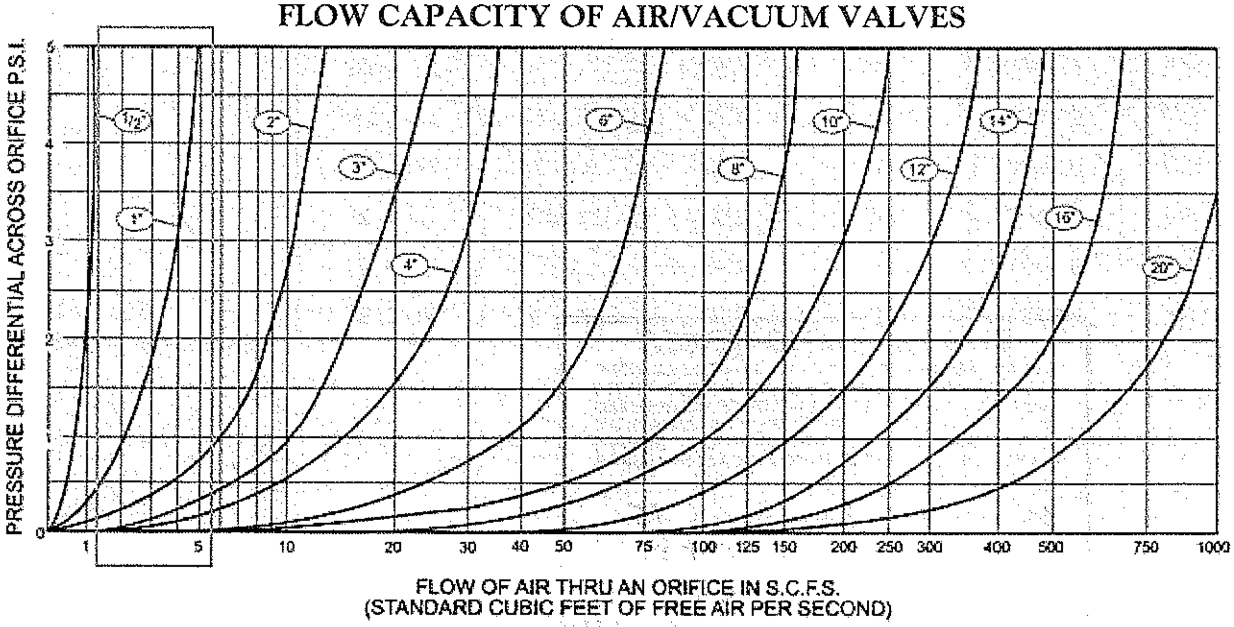


Clean Water* Wastewater

*WATER QUALITY

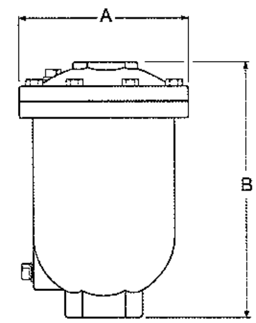
MATERIALS OF CONSTRUCTION		
COMPONENT	STANDARD	OPTIONAL
Body and Cover	Cast Iron ASTM A126 Class B Class 125 and 250	Ductile Iron ASTM A536 Grade 65-45-12 Stainless Steel ASTM A351 Grade CF8M
Trim	Type 316 Stainless Steel	-
Coating	Universal Alkyd Primer (external)	Non-Stick Fusion Bonded Epoxy (internal & external)

FLOW CAPACITY OF AIR/VACUUM VALVES

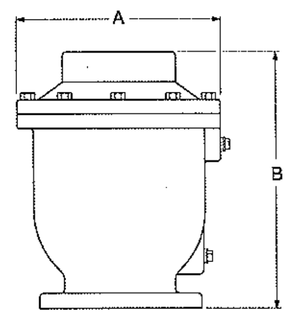


Air/Vacuum Valves Installation Dimensions

WATER AIR/VACUUM VALVES					
Inlet Size	Outlet Size	Model Number	CWP PSI	Dimensions	
				A	B
1/2" NPT	1/2" NPT	100S	300	6 1/8"	7"
1" NPT	1" NPT	101S	300	7"	9 1/2"
2" NPT	2" NPT	102S	300	9 1/2"	12"
3" NPT	3" NPT	103S	300	9 1/2"	12"
4" Flg	4" NPT	104S 154S	125lb - 150 250lb - 300	12"	20 3/4"
6" Flg	6" NPT	106S 156S	125lb - 150 250lb - 300	14"	18 5/8"
8" Flg	8" NPT	108S 158S	125lb - 150 250lb - 300	17 1/4"	21 5/8"
10" Flg	10" Flg	110F 160F	125lb - 150 250lb - 300	20"	26"
12" Flg	12" Flg	112F 162F	125lb - 150 250lb - 300	24"	31"
14" Flg	14" Flg	114F 164F	125lb - 150 250lb - 300	27"	34"
16" Flg	16" Flg	116F 166F	125lb - 150 250lb - 300	30 1/2"	34"
20" Flg	20" Flg	120F 170F	125lb - 150 250lb - 300	38 1/4"	36 1/4"

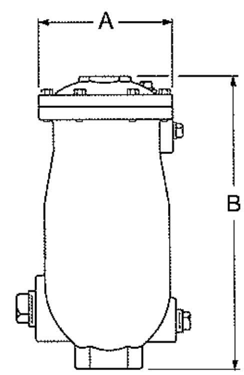


100S - 103S
Air/Vacuum Valves



104S - 170F
Air/Vacuum Valves

WASTEWATER AIR/VACUUM VALVES					
Inlet Size	Outlet Size	Model Number	CWP PSI	Dimensions	
				A	B
2" NPT	1" NPT	301A	150	7"	15 1/16"
2" NPT	2" NPT	302A	150	9 1/2"	17 7/16"
3" NPT	3" NPT	303A	150	9 1/2"	17 7/16"
4" Flg	4" NPT	304	150	11 1/2"	36 1/2"
6" Flg	6" NPT	306	150	14"	36 1/2"
8" Flg	8" NPT	308	150	17 1/4"	40 1/8"



301A - 308
Wastewater Air/Vacuum Valves

SHOP DRAWING REVIEW

THIS DRAWING HAS BEEN REVIEWED FOR GENERAL CONFORMANCE WITH THE DESIGN CONCEPT ONLY. SUCH REVIEW SHALL NOT RELIEVE THE CONTRACTOR OF HIS RESPONSIBILITY FOR ERRORS OR OMISSIONS OR OF MEETING THE REQUIREMENTS OF THE CONTRACT DOCUMENTS. NO RESPONSIBILITY IS ASSUMED FOR CORRECTNESS OF DIMENSIONS

✓	NO COMMENT	Submission No. 15
	NOTE COMMENTS	Project No. 078107
	AMEND & RESUBMIT	By CJ
	REJECTED	Date May 21/10

DILLON CONSULTING LIMITED