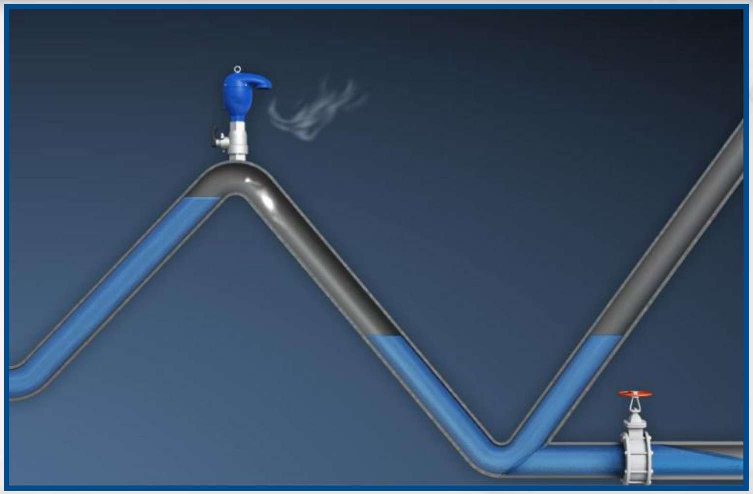
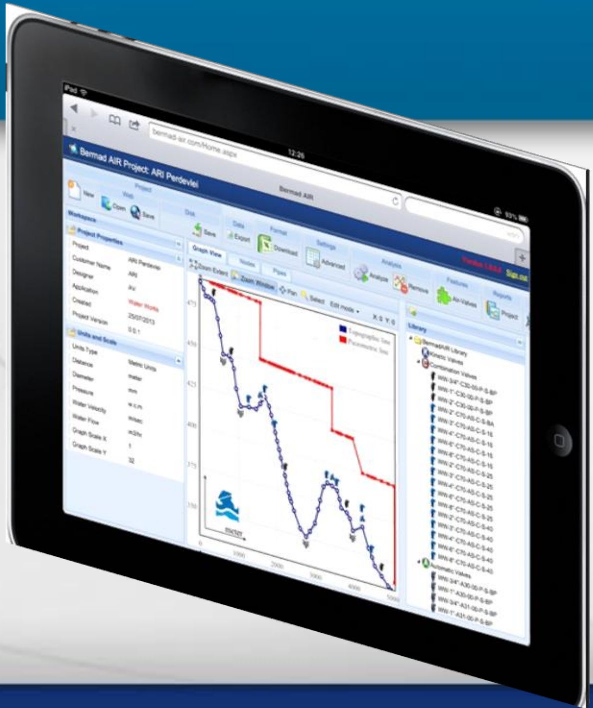
Bermad Air Valves





How does air enter pipeline systems?

1/ Henry's Law – re dissolved air in water
….. At 25°C water contains 2% air

Amount of dissolved air increases with pressure, and decreases with temperature.

Whenever the temperature of the water increases, air will be released as a gas …. Example : Cold water in reservoir being put into pipelines above ground.

Whenever the pressure drops in a mainline, air will be released as a gas …. Examples : Mainlines running up-hill, in pumps (high volute pressure to lower mainline pressure), when pipelines expand (into filter stations as example)

How does air enter pipelines

2/ Air physically ‘sucked’ into the system through leaks or vortexing, typically on suction side of pump stations.

Air physically ‘sucked’ into the system through leaks where constrictions create venturi effect. Low velocity changes to high velocity. As velocity head increases, the pressure head decreases, potentially causing suction

3/ Water Vapour & air is created in pipelines when pipe pressure drops below the vapour pressure of water (“making tea on Everest”). This can occur in situations of Column Separation, resulting typically from pump failure.

Problems with air in pipe systems

So.... What is wrong with air in pipelines?

1/ Corrosion of pipes and metal components

Galvanic corrosion is particularly rapid, effecting not only metal pipes, but also any bare metal in valves, meters, pump stations etc.

Problems with air in pipe systems

2/ Reduced pipeline capacity (Video)

Problems with air in pipe systems

3/ Air pockets can cause air-lock in equipment with small ports and tubing – like control valves

Inaccuracy in flow meters, measuring air instead of water

Reduced efficiency of pumps and filters

Problems with air in pipe systems

4/ Vacuum conditions •

Material	Collapse Pressure (m)
PVC	-1
Fiberglass	-2
Concrete	-3
Iron	-4
Steel	-5

Vacuum conditions can result in catastrophic collapse of pipework.

It may also allow suction of dirt and debris into any orifice , causing blockage and contamination risk (eg 3 way pilots, or leaky fittings)

Problems with air in pipe systems

4/ Vacuum conditions

Problems with air in pipe systems

5/ Column Separation and Surge Damage

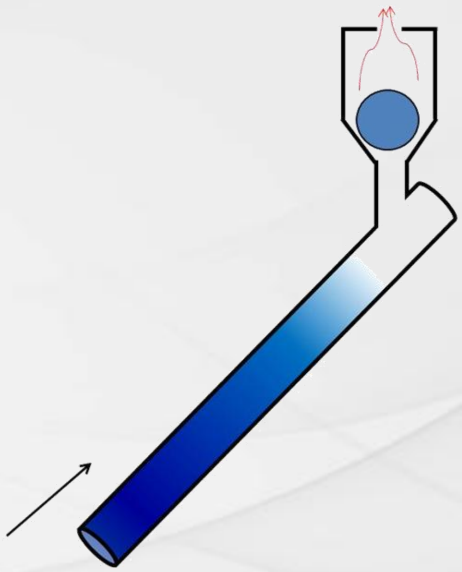
Visualize the momentum of water moving in a pipe, and the forces it generates.

Water is not compressible – it won’t absorb impact and shocks

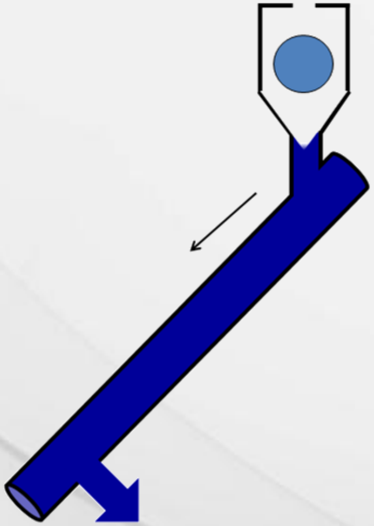
So…. What are Air Valves Types

- **Kinetic Air Valve – high air flow (expected/unexpected scenarios)**
- Automatic Air Valve
- Combination Air Valve

Initial Filling

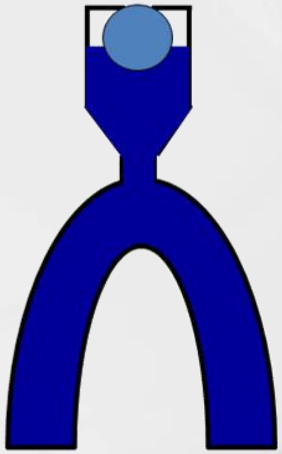


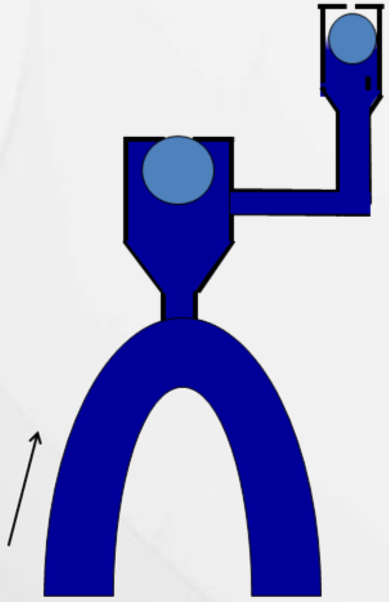
Drainage / Burst



Air Valves Types

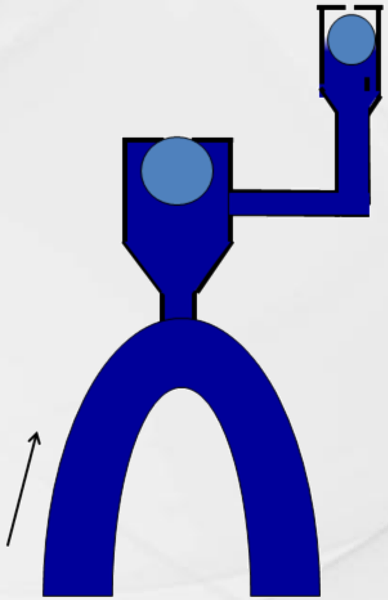
- Kinetic Air Valve
- **Automatic Air Valve – Steady State (pressurized system)**
- Combination Air Valve





Air Valves Types

- Kinetic Air Valve
- Automatic Air Valve
- **Combination Air Valve**

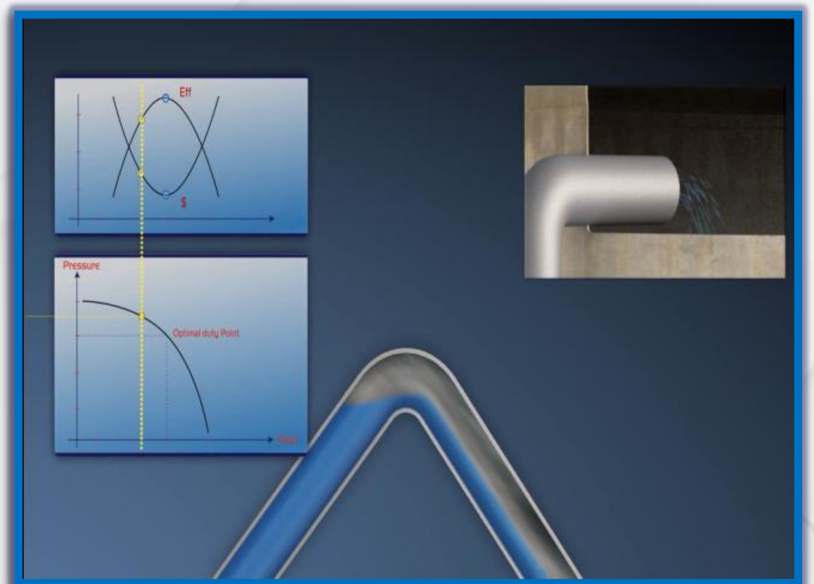


Video

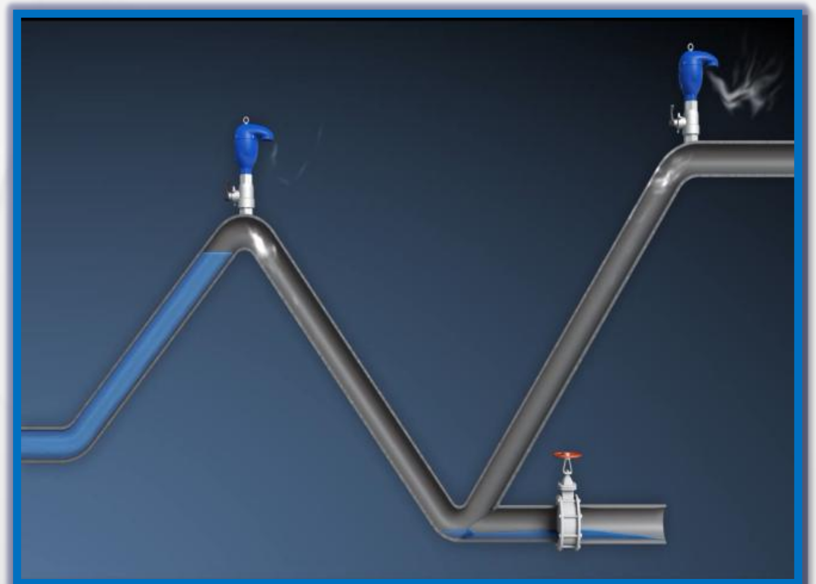
What do Air valves do?

Videos : Filling and Operation, Vacuum Condition, Column Separation

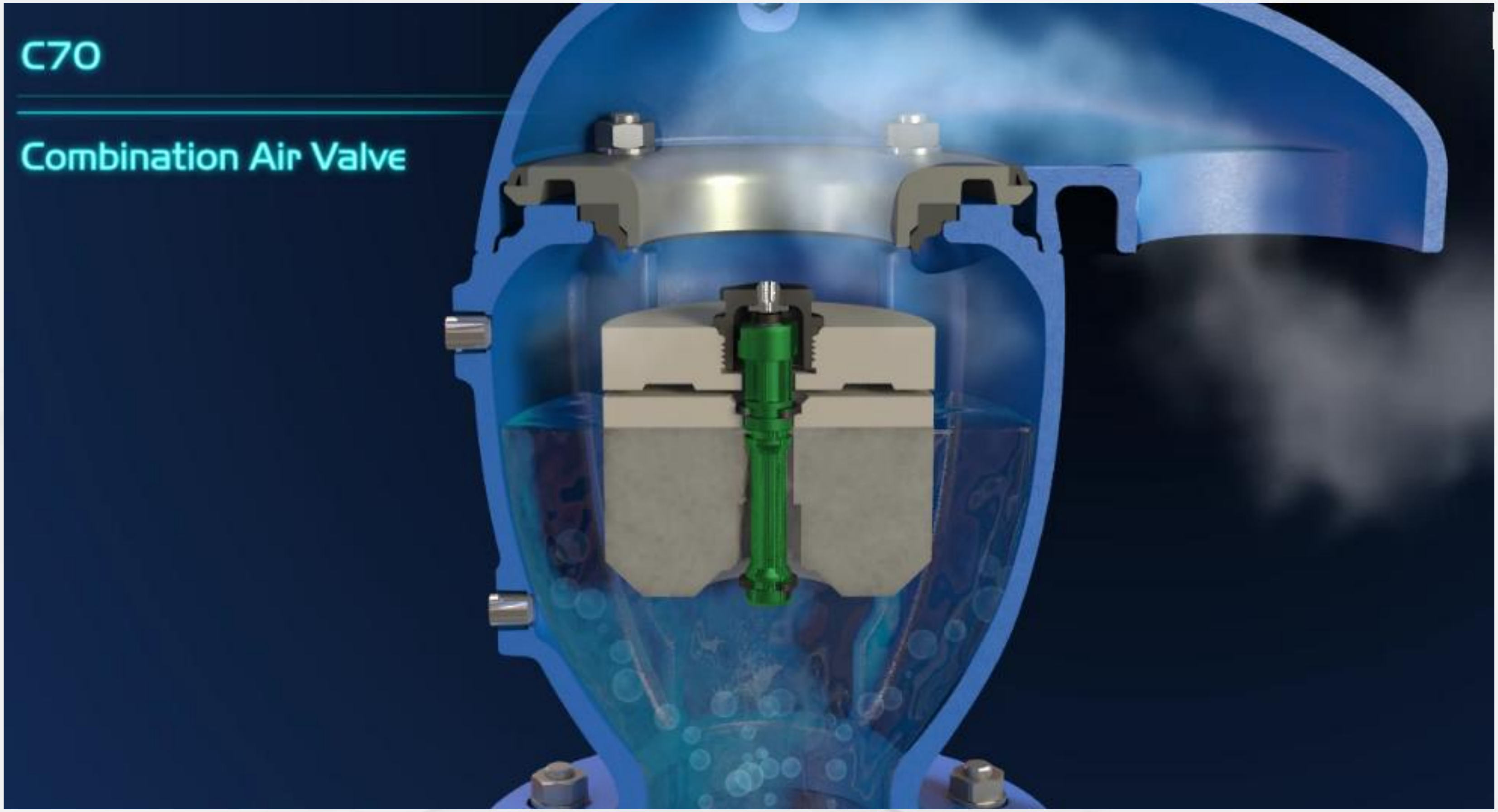
Initial Filling of the Pipeline System



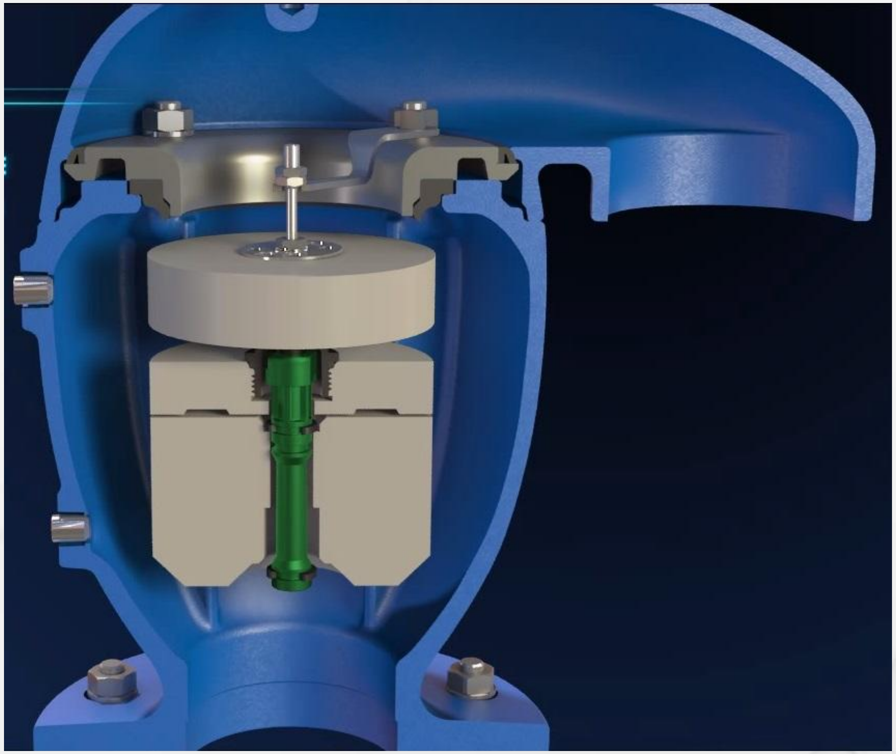
Vacuum Conditions

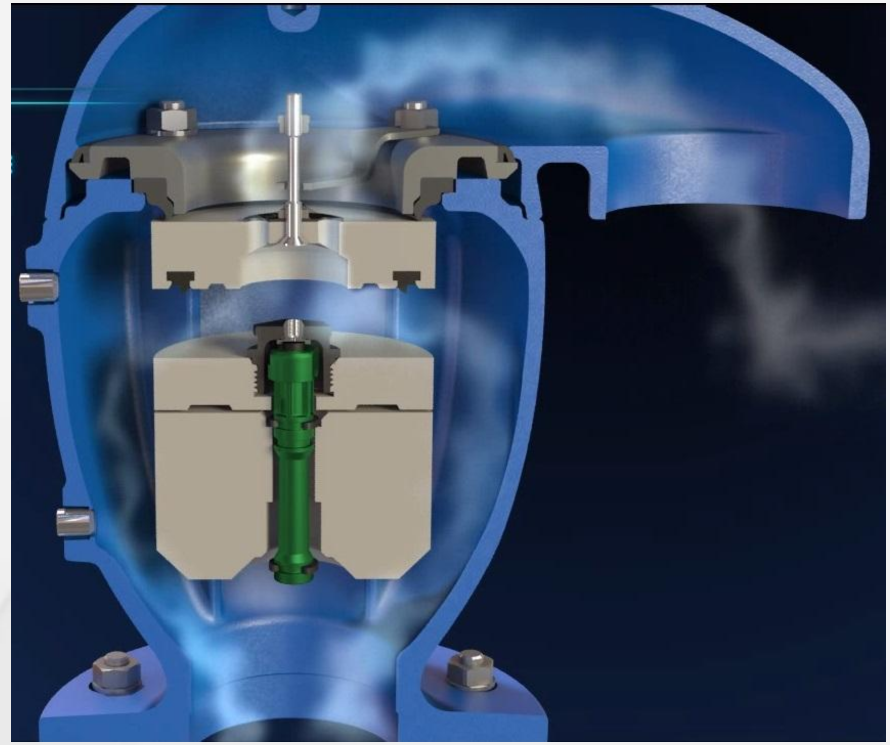


How Does the C70 Work



Surge Protection operation





As the air pressure rises the Surge Protection disc moves upward and partially closes the passageway, creating a resistance which slows pipe filling

Bermad Air Valve – Designed and developed in-house

What do we have…..PN16 rated

Automatic,PN16, ¾”, 1” (0.1bar-16bar),male BSP
¾”-A30
1”-A30

Automatic, PN16, ¾”, 1” (Low pressure 0.02-16 bar)
¾”-A31
1”-A31

Combination, PN16, ¾”,1”,2” (0.1bar-16 bar),male BSP
¾”-C30
1”-C30
2”-C30

What do we have….PN16 (Ductile Iron)

Down Outlet

Side Outlet
Fem threaded

Mushroom Outlet
Shorter overall height

2”-C70
3”- C70
4”- C70
6”- C70

3”, 4” (BSP) – C75 seal from 0.1 bar
6”, 8”, 10”, 12” (Flange) – C75
In PN 16, PN 25, PN 40 options
Cast Iron or Stainless steel options

Designed in compliance with :

- Functional standard ***EN-1074/4 and AS4956 (Australia)***
- Water service standards – ***NSF ,WRAS, ACS, DGW***

What do we have….PN 10 & PN16 rated for Sewerage

Combination, PN10, 2”, 3” (0.1bar-10 bar)
2”-C50
3”-C50

Combination, PN16, 2”,3”, Ductile Iron
2”-C60
3”-C60

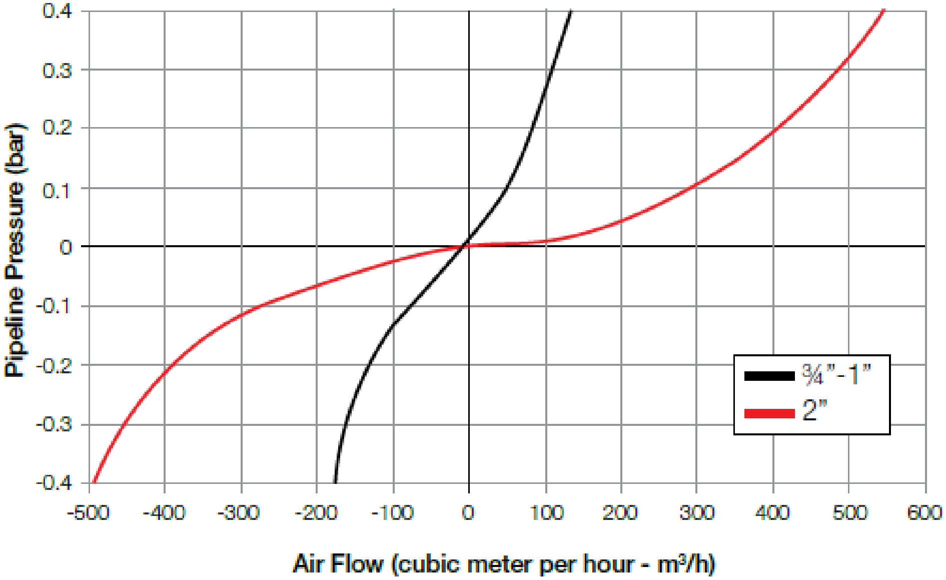
What makes a good air valve ?

1/ Effective low pressure sealing – just 0.1 bar •
2/ High air flow rates (re valve sizing) •
3/ Minimal spray •
4/ Robust materials, corrosion resistant, and solid floats : •
Plastic Air valves – Glass Filled Reinforced Nylon bodies, with •
Polypropylene floats
5/ Comply with international standards

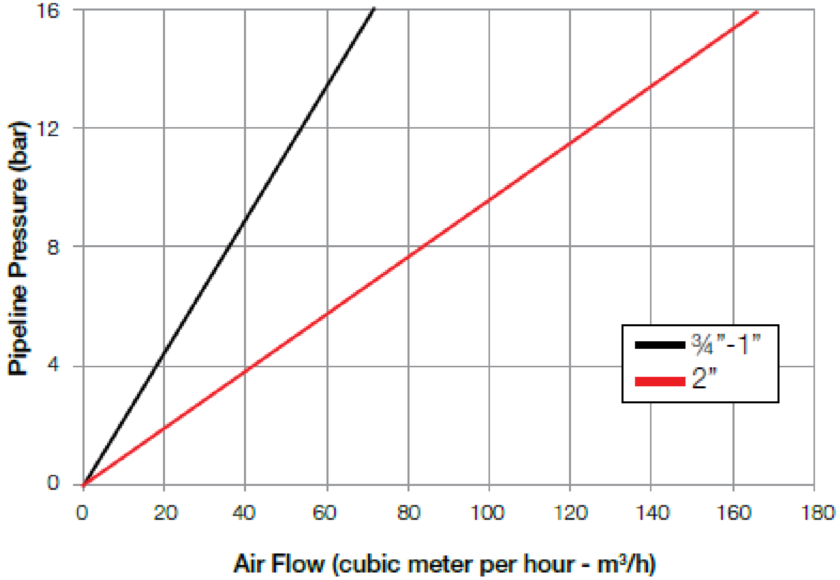
6/ Options:
Anti-Slam 'exhale' feature
Bug screen

C30 (PN16 Air Valve, Plastic)

Air Relief and Intake (Pipeline Filling, Draining and Vacuum Conditions)

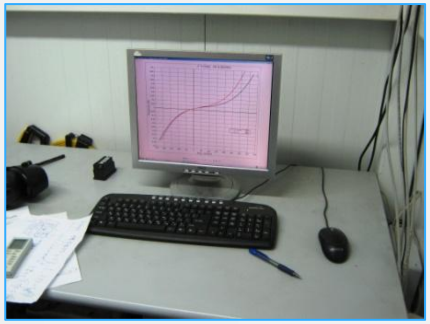


Air Release (Pressurized Operation)



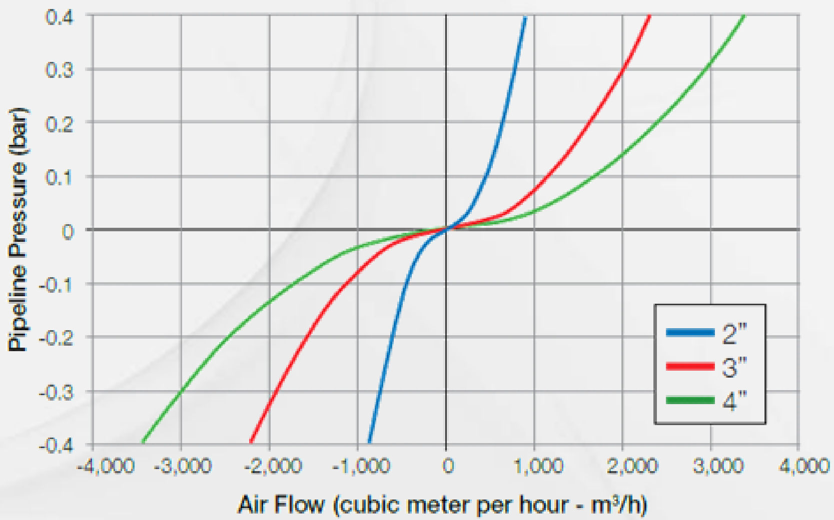
Air Valve Test Bench

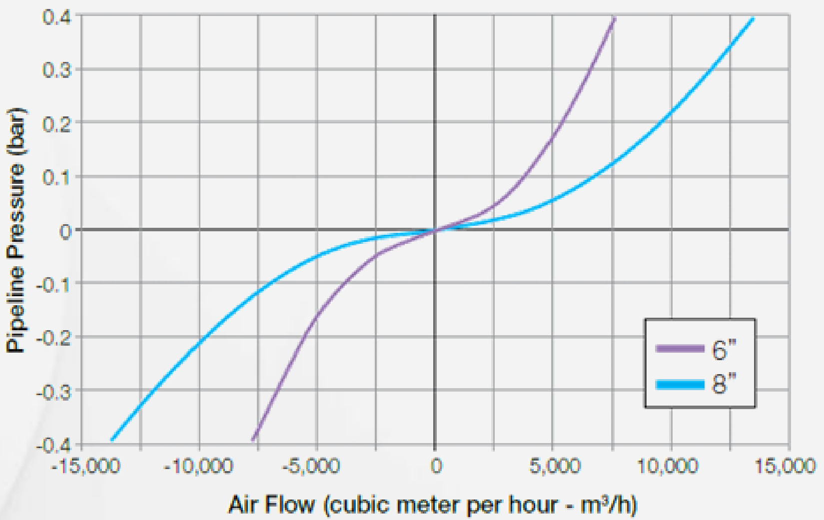
- Set up according to EN-1074/4
- Online data gathering at every point (Pressure / Flow / Temp) during pipeline filling and vacuum conditions
- Presentation of actual air flow charts



C50 (PN 16, Ductile Iron)

Air Relief and Intake (Pipeline Filling, Draining and Vacuum Conditions)

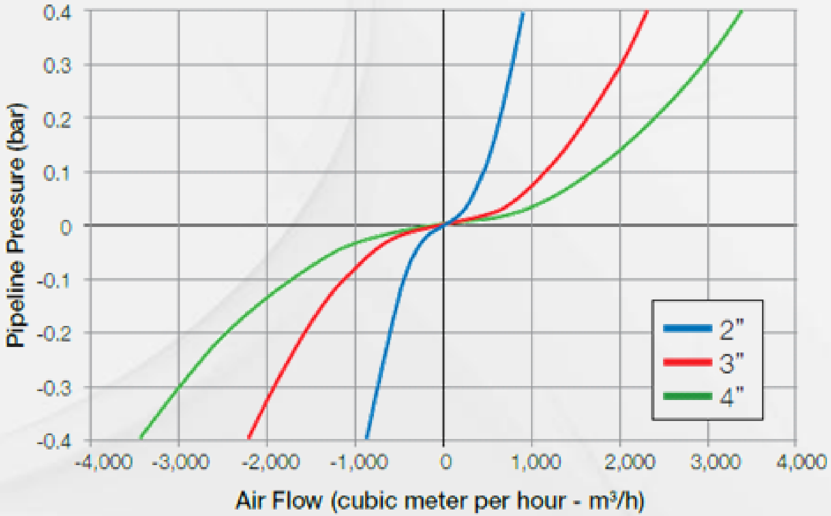


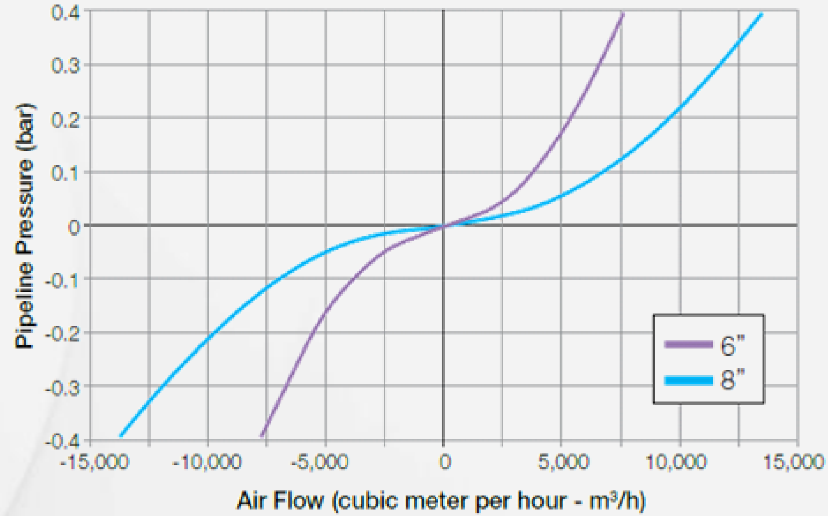


Bermad air valves are tested against the best in the industry, and outperform in almost all characteristics consistently.

Air Flow Performance Charts

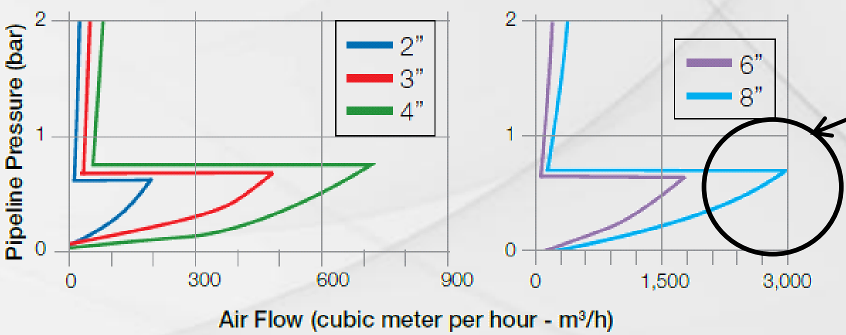
Air Relief and Intake (Pipeline Filling, Draining and Vacuum Conditions)





With Surge Protection (SP)

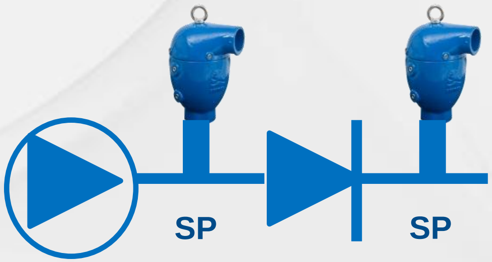
Air Relief with Surge Protection



"Switching Point"

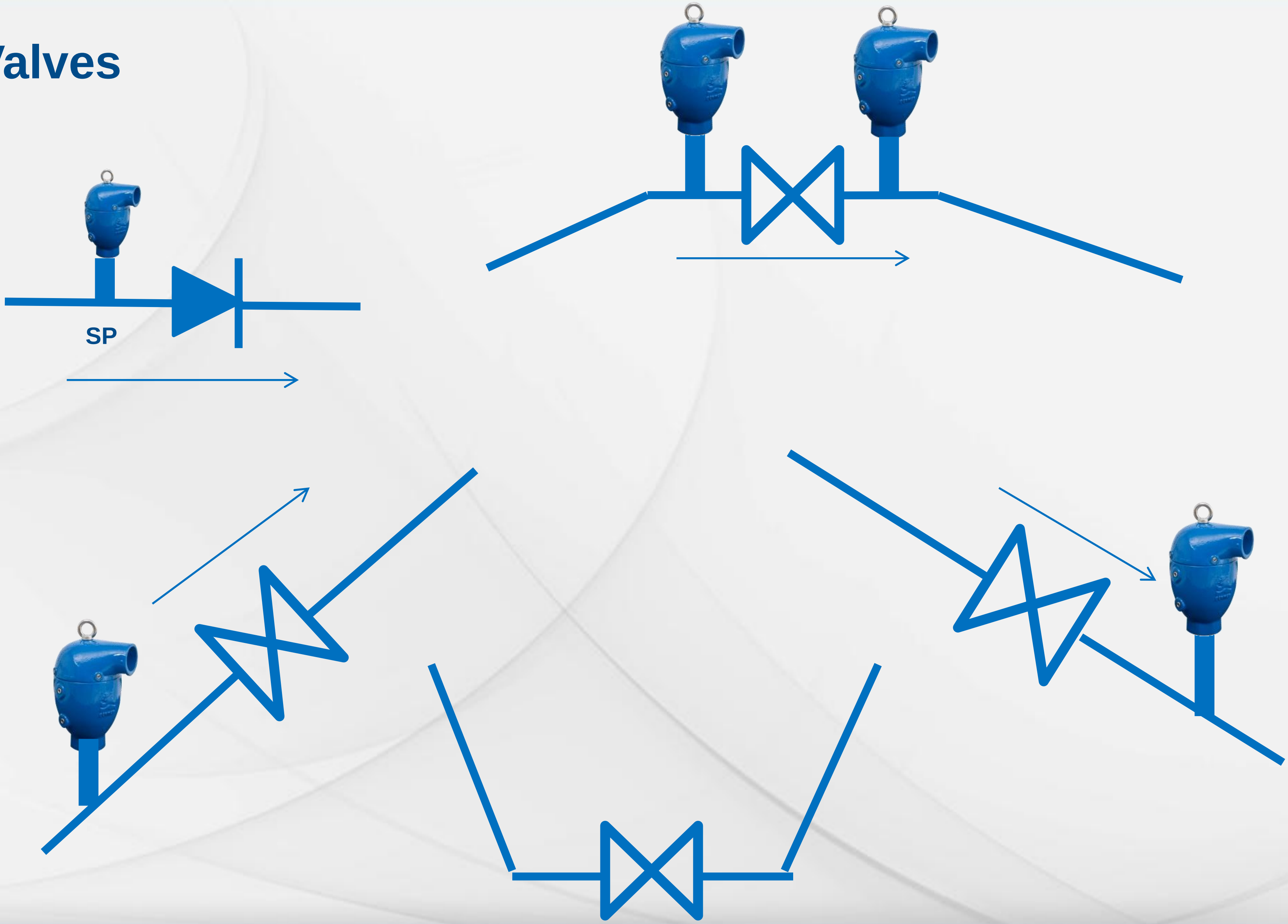
Air Valve Placement

Pumping Station



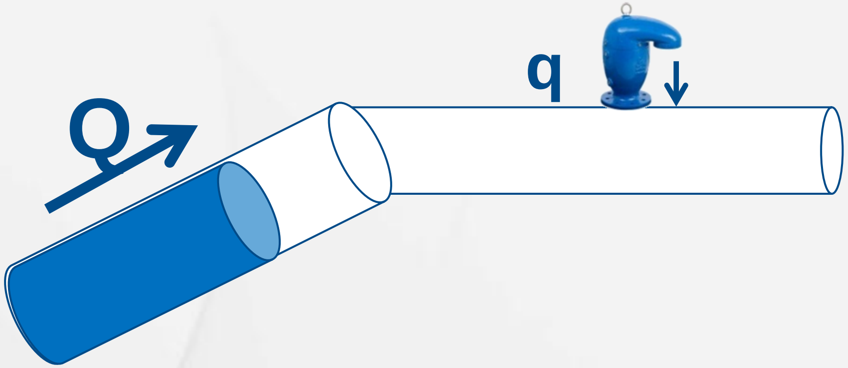
Air valve placement

Valves



Sizing Air Valves – Line filling

$$Q = q$$



Example :
300mm main filling at 0.4 m/sec

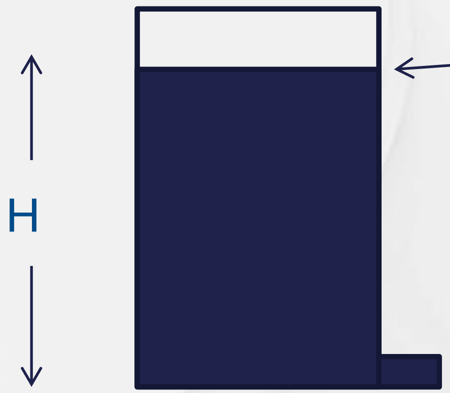
Pipe area = Π x 0.150^2
= $0.0707 m^2$

Exhale rate = 0.0707 x 0.4
= 0.0283 m^3/sec
= 101.8 m^3/hr

$$q = v * \pi * (D\hat{\ }2/4)$$

q = Air flow to be released (m^3/sec).
V = Water velocity 0.3-0.5 (m/sec).
D = Pipe diameter (m)

What is ‘inhale’ needed for a draining pipe?



Potential energy of water molecule =m.g.H

Kinetic energy of exiting water =1/2 .m. V^2

Conservation of energy : $m.g.H = ½ m. V^2$

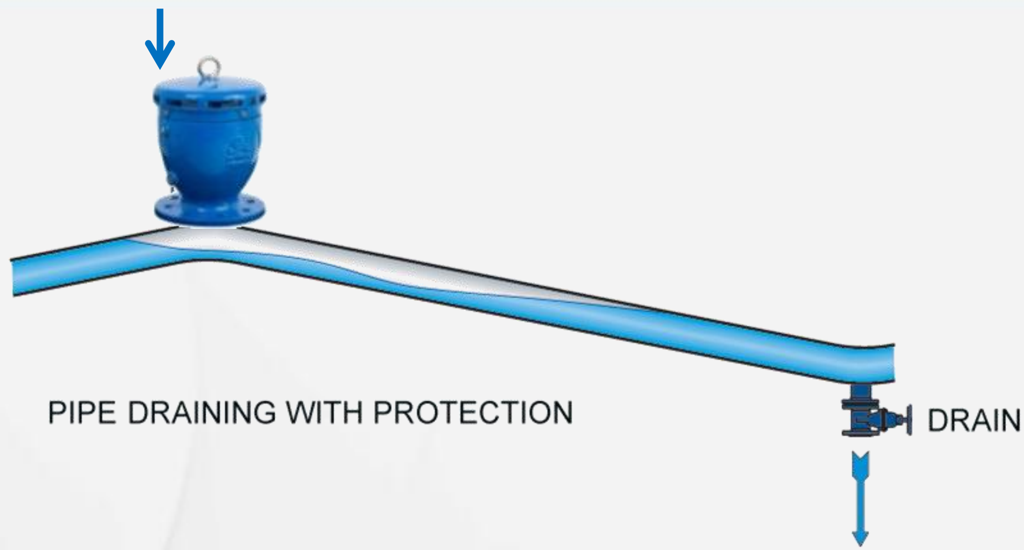
$g.H = ½ V^2$

or…. $V = \sqrt{2.g.H}$

However, there is a resistance factor depending on the outlet shape, denoted K

$V= \sqrt{2.g.H/K}$

What is 'inhale' needed for a draining pipe?



V = √2.g.H/K

For a gate valve, K = 3.3 typically

So, V = √(2.g.H) x √1/(3.3)
V = 0.55 x √(2.g.H)

& Q = V x A

Giving equation……………………..

$$\boxed{Q = 0.55 * A * \sqrt{(2 * g * Dh)}}$$

Q (m³/sec) - Discharge

A (m^2) – Cross Section are of the Drainage Valve

Dh (m) – Different in height between the Drain and the High Point

Example: 6m drop-off to a 100mm drain
Area = (Π x 0.1²) / 4 = 0.00785 m²

Q = 0.55 x 0.00785 x √(2x 9.81 x 6)
= 0.0468 m³/sec
= 168 m³/hr

Sizing Air Valves for a pipe Burst

From Hazen Williams, where:

Q - m^3/hr

D – pipe id in mm

ΔH – Pressure change (m)

L – pipe length (m)

C – roughness coefficient of pipe (ie C=130 for clean steel pipe)

$$Q = 1000 \times C \times (D/1000)^{2.63} \times (\Delta H/L)^{0.54}$$

Or…… Use software : Bermad AIR - STA

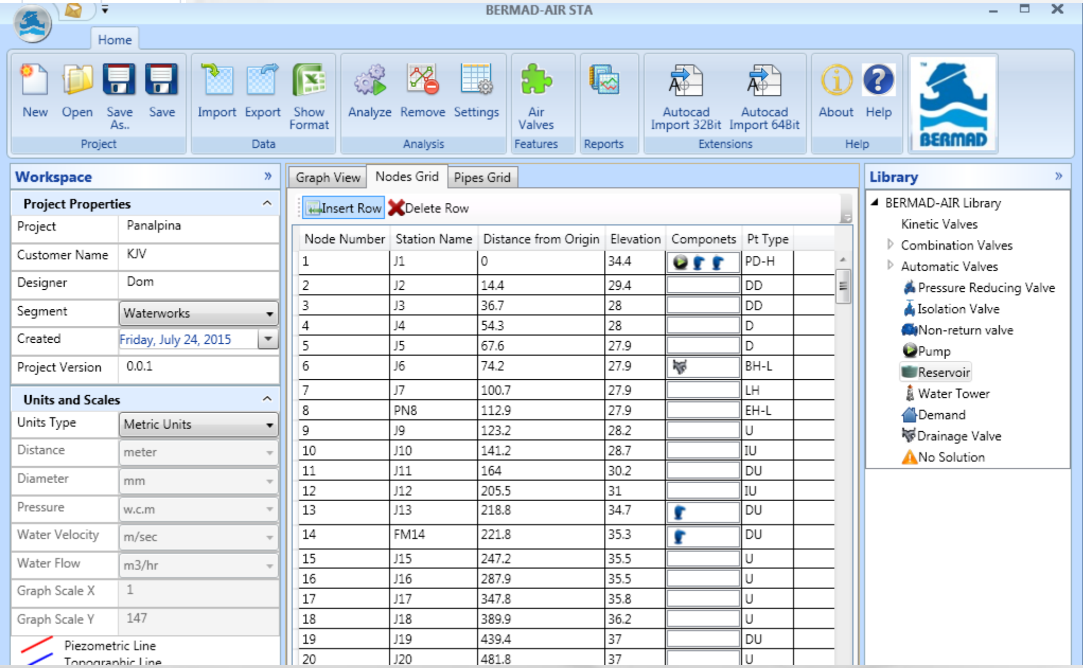
Node Number	Accumulated distance from beginning of line	Invert Level (I.L.) of pipe at given distance	Main Line Diameter
	[m]	[m]	(mm)
J1	0.0	34.4	600
J2	14.4	29.4	600
J3	36.7	28.0	600
J4	54.3	28.0	600
J5	67.6	27.9	600
J6	74.2	27.9	600
J7	100.7	27.9	600
PN8	112.9	27.9	600
J9	123.2	28.2	600
J10	141.2	28.7	600
J11	164.0	30.2	600
J12	205.5	31.0	600
J13	218.8	34.7	600
FM14	221.8	35.3	600
J15	247.2	35.5	600
J16	287.9	35.5	600
J17	347.8	35.8	600

Water transfer from low lake (at 34.4m elev) to storage reservoir 16.25 Km away, at elevation 80m. Use 600m concrete pipe, max flow velocity 1.2 m/s. At 1200 m³/hr, friction loss 34 m. Elev head

Bermad AIR STA
1/ Import data 'AirPlay' A3,B3,C3,D3
2/ Locate pump. Enter head 84m
Locate reservoir. Enter 'From top' and Q of 1200 m³/
4/ Analyze
5/ Reports

1/ Compile data in Excel : Nodes, distance from source, elevation, pipe size

2/ Import Excel data into Bermad AIR STA

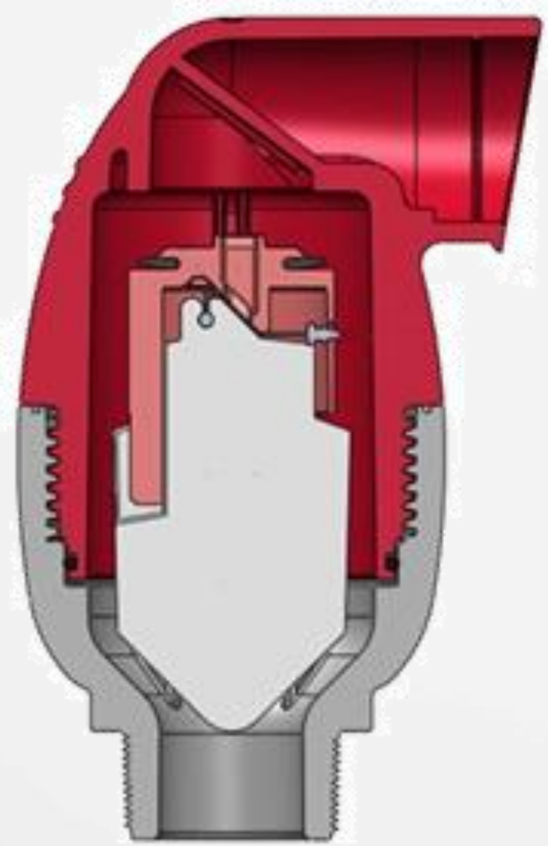


A30 – Automatic Air valve : 16bar / 230 PSI

- ***Allows efficient release*** of air pockets, while ***reducing undesirable leakage.***
- ***Pipelines*** – Protection against air accumulation in horizontal or low slope lines and road/river crossings.
- In ***proximity to control valves and water meters*** – Prevention of biased readings and inaccurate pressure regulation due to air flow through devices.
- ***Industrial and residential networks*** - Protection against air accumulation in

C30 - Features & Benefits (continued)

- ***Designed in compliance with :***
    - Functional standard ***EN-1074/4***
    - Water service standards – ***NSF , WRAS, ACS, DGW***
- Compact, simple and reliable structure with fully corrosion-resistant parts; ***lower maintenance and increased life span.***
- Factory approval and ***Quality Control*** - Performance and specification tested and measured with ***specialized test bench***, including vacuum pressure conditions.



C70 Combination AV - Typical applications

- ***Pumping stations and deep well pumps –*** Air relief, and vacuum prevention.

- ***Pipelines –*** Protection against air accumulation and vacuum formation at elevations, slope change points and at road/river crossings.

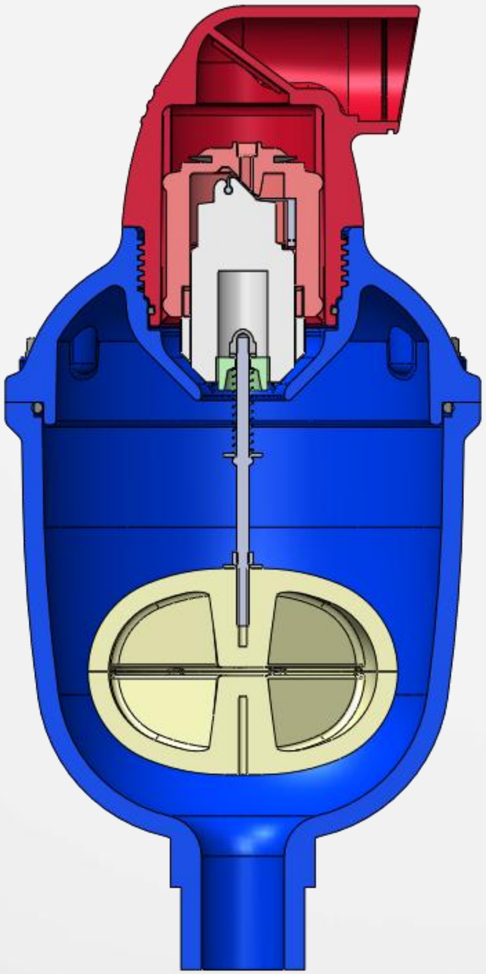
- ***Water networks –*** Protection against vacuum formation, surge and water hammers at points   likely to experience ***water column separation.***

C70 - Features & Benefits (continued)

- ***2 service ports*** - connection of pressure gauge, check point or test drain for air valve function.
- ***Designed in compliance with :***
  - Functional standard ***EN-1074/4 and AS4956 (Australia)***
  - Water service standards – ***NSF ,WRAS, ACS, DGW***
- Compact, simple, robust and reliable structure with fully corrosion-resistant parts **–** ***Lower maintenance and increased life span*****.**

C50 - Features & Benefits

- Straight flow body with large diameter automatic orifice - ***Higher than usual flow rates***.
- Aerodynamic full-body kinetic shield – ***Prevents premature closing*** without disturbing air intake or discharge.
- Elongated body design - ***Prevents solids from making contact*** with valve's operating parts.
- ***Easy maintenance*** - Valve is opened from the top.



Design in compliance with air valves standards

- **Functional**
  - ***AS4956 (Australia) – approved (C70)***
  - European Standard EN1074/4 – ***approved (C70)***
  - WRAS (UK) - ***approved (C70),*** pending (A30, C30)
- **Water Service**
  - ***NSF 60/61 – approved (A30, C30, C70)***
  - ***AS4020 (Australia) – approved (C70)***
  - ***KTW270 (Germany) - approved***
  - ACS (France) – ***approved (A30, C30, C70)***
  - WRAS (UK) – ***approved (C70),*** pending(A30, C30)

ANSI/AWWA C512-07
(Revision of ANSI/AWWA C512-04)

American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service

Australian Standard®

AS 4956—2008

Air valves for water supply

Certified Product
Australian Standard

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 1074-4

July 2000

ICS 91.140.60

English version

Valves for water supply - Fitness for purpose requirements and appropriate verification tests - Part 4: Air valves

Bermad Air Valves - Major Advantages

- ***Higher flow rates.***
- ***Low pressure sealing.***
- ***Minimal spray effects*** during automatic air release.
- ***Built in Surge Protection*** (anti slam).
- Versatile design for ***easy installation***
- Design in compliance to ***international standards.***

Bermad's hydraulic control and air valves creating comprehensive solutions for the control of pressurized pipelines and networks.

Typical installations

3”+4” C70

3”-C70

6”-C70

4 ”-C70 (Brazil, 105km pipeline, 350 units)

BERMAD Solution