Purpose, Function, and Design Principles for Air Release Valves

May 15, 2019

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Jones | Carter

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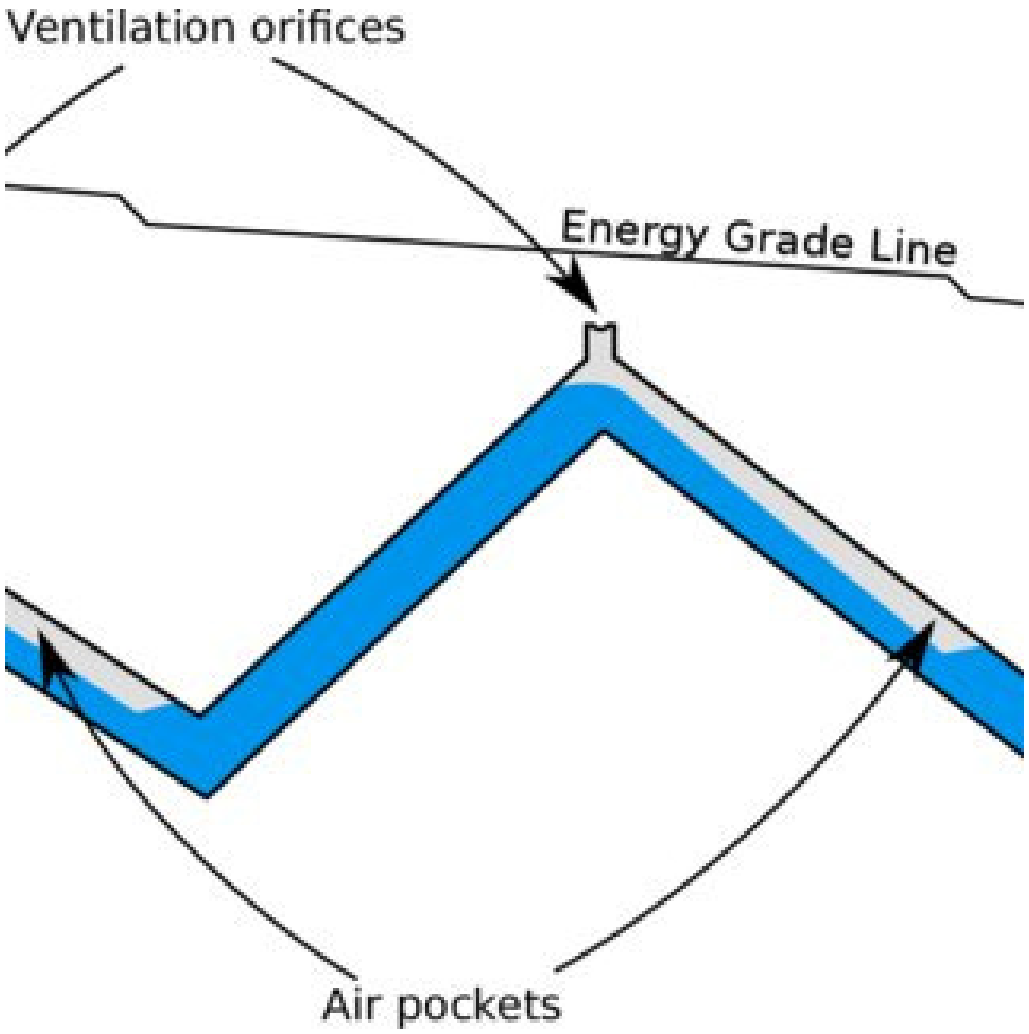
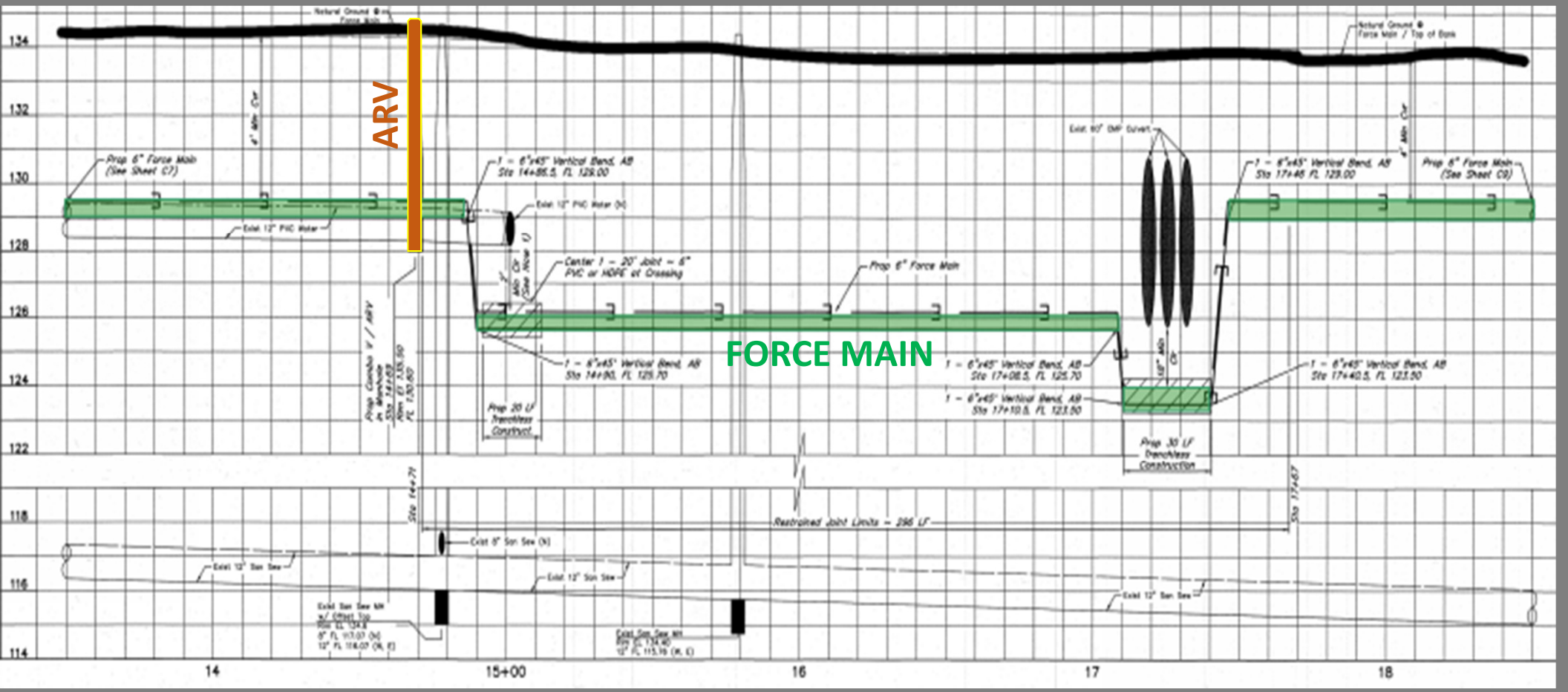
Design Topics

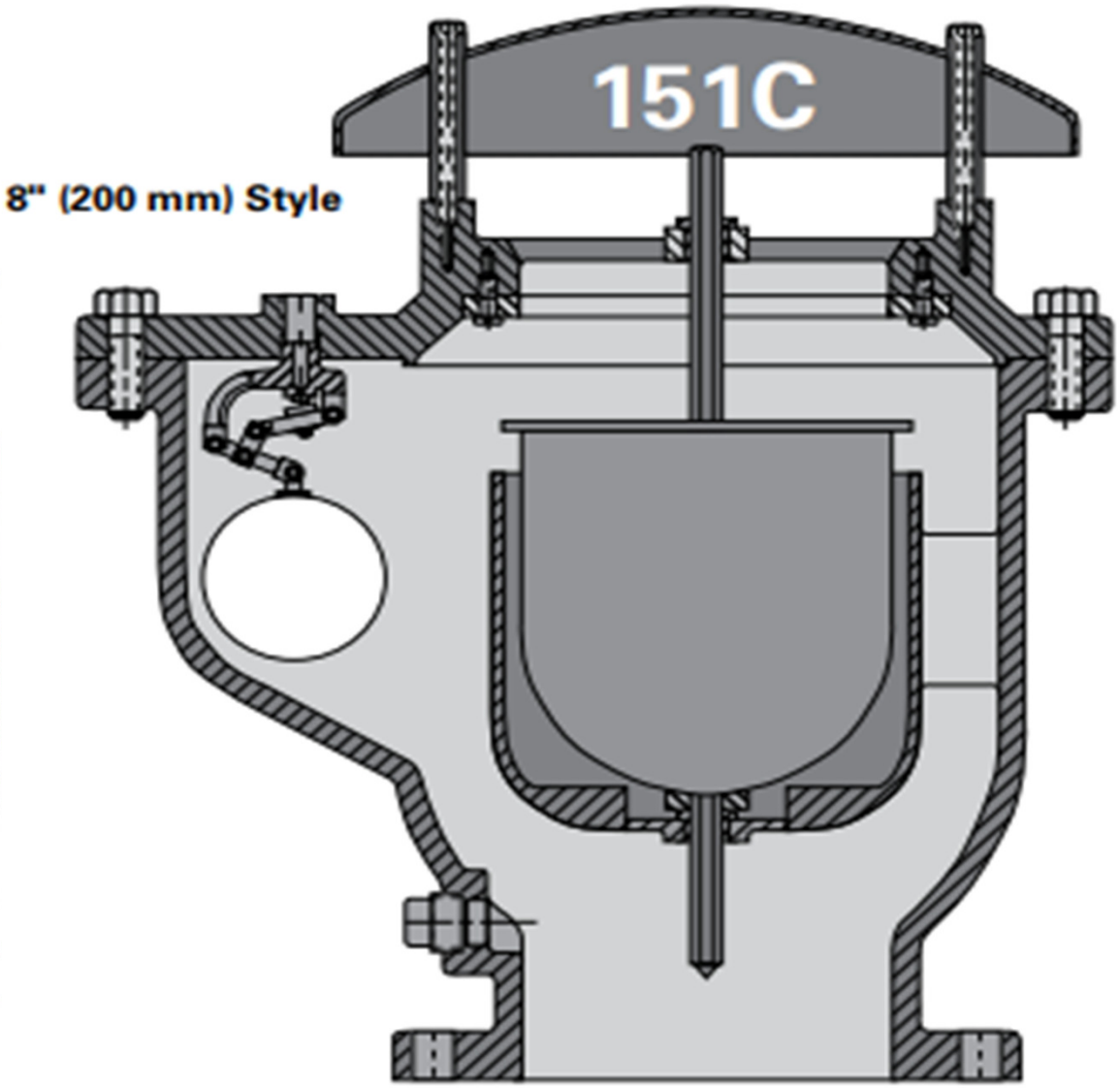
- Purpose of ARVs
- Internal Components of the Valves
- ARV Types & Applications
- Sizing, Selection, & Location
- Design Guidelines & Resources
- Special Considerations & Specifications
- Constructability & Future Maintenance

Air Release Valves




ARV
FORCE MAIN
Natural Ground @ Force Main
Natural Ground @ Force Main / Top of Bank
Prop 6" Force Main (See Sheet C7)
Prop 6" Force Main (See Sheet C9)
Exist 12" PVC Water
Exist 12" PVC Water (N)
Exist 60" CMP Culvert
Center 1 - 20' Joint - 6" PVC or HDPE at Crossing
Prop 6" Force Main
1 - 6"x45° Vertical Bend, AB
Sta 14+85.5, FL 129.00
1 - 6"x45° Vertical Bend, AB
Sta 14+90, FL 129.70
1 - 6"x45° Vertical Bend, AB
Sta 17+08.5, FL 125.70
1 - 6"x45° Vertical Bend, AB
Sta 17+10.5, FL 123.50
1 - 6"x45° Vertical Bend, AB
Sta 17+40.5, FL 123.50
1 - 6"x45° Vertical Bend, AB
Sta 17+46 FL 129.00
Prop 20 LF Trenchless Construct
Prop 30 LF Trenchless Construction
Prop Combo 'A' / ARV in Manhole
Sta 14+63
Rim El 133.50'
FL 130.80'
Sta 14+71
Sta 17+63
Restrained Joint Limits = 296 LF
Exist 8" San Sew (N)
Exist 12" San Sew
Exist San Sew MH w/ Offset Top
Rim EL 134.8
8" FL 117.07 (N)
12" FL 116.07 (W, E)
Exist San Sew MH
Rim EL 134.40
12" FL 115.98 (W, E)
6' Min Cvr
4' Min Cvr
134
132
130
128
126
124
122
118
116
114
14
15+00
16
17
18

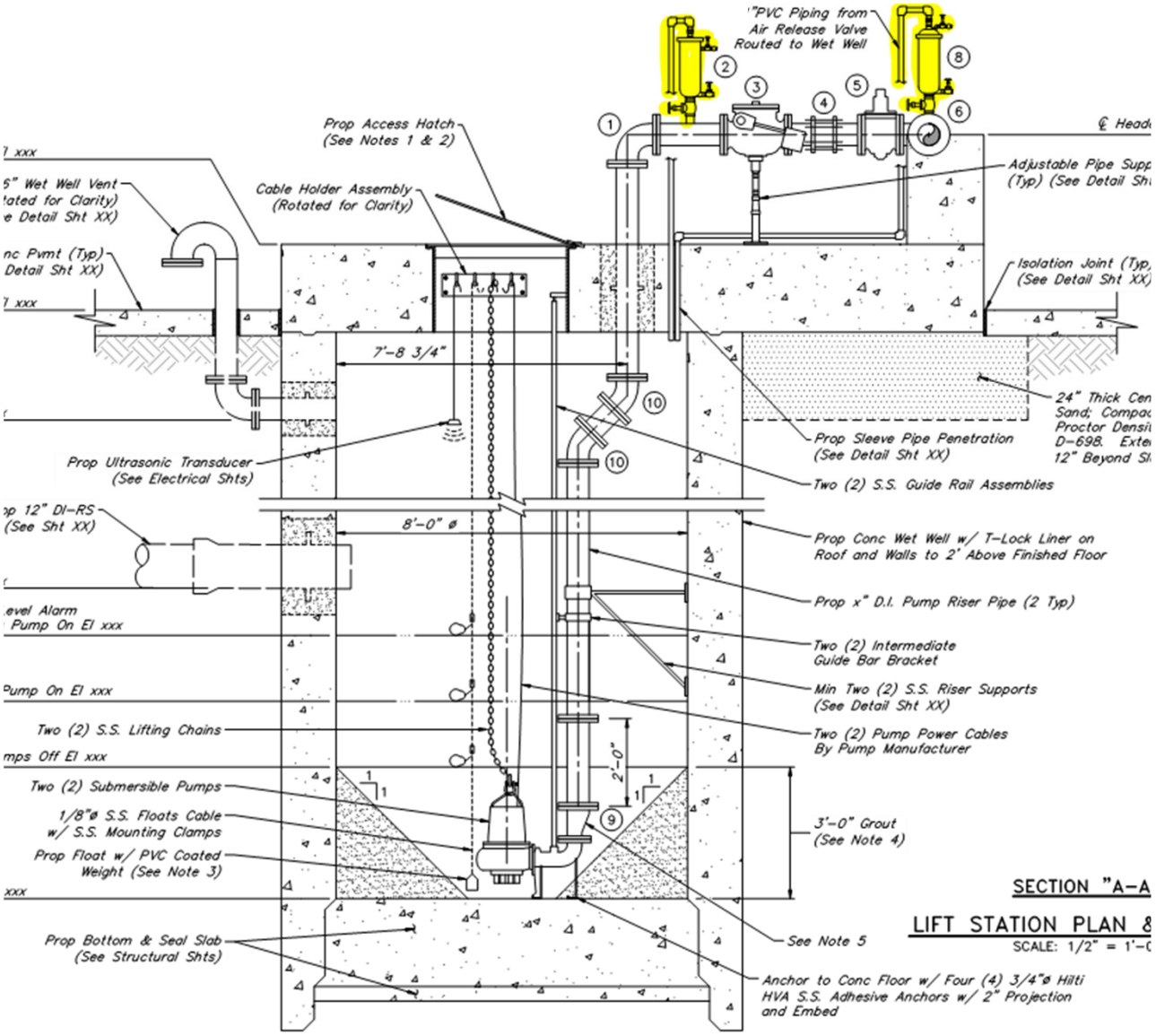
How do they work?



Water vs Wastewater Applications

Clean Water*

Wastewater



Types of ARV's and how they differ?

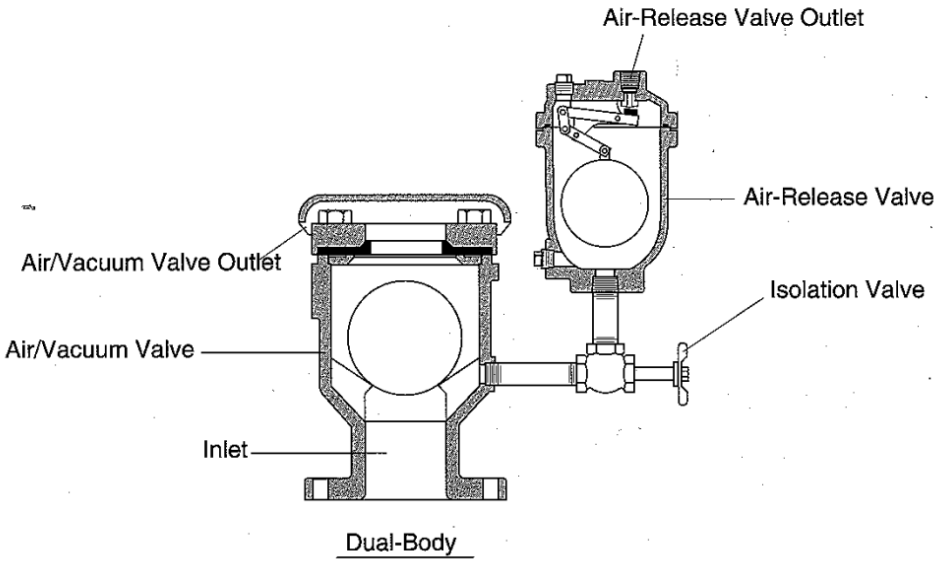
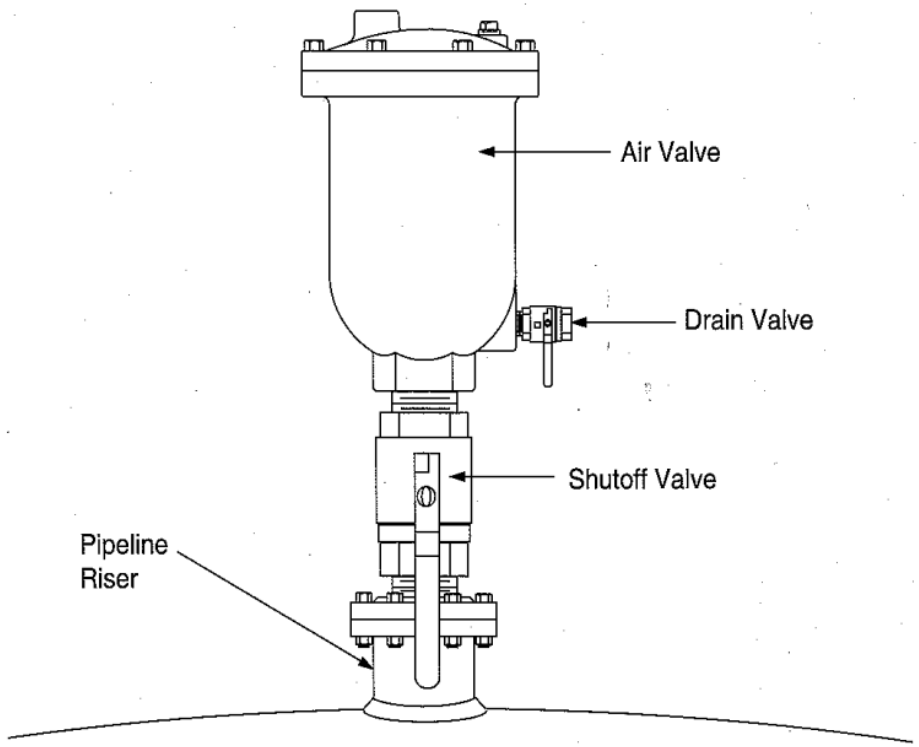


Figure 2-3 Single-body and dual-body comination air valves



Pipeline installation of an air-release valve

Ref. AWWA M51

Definitions

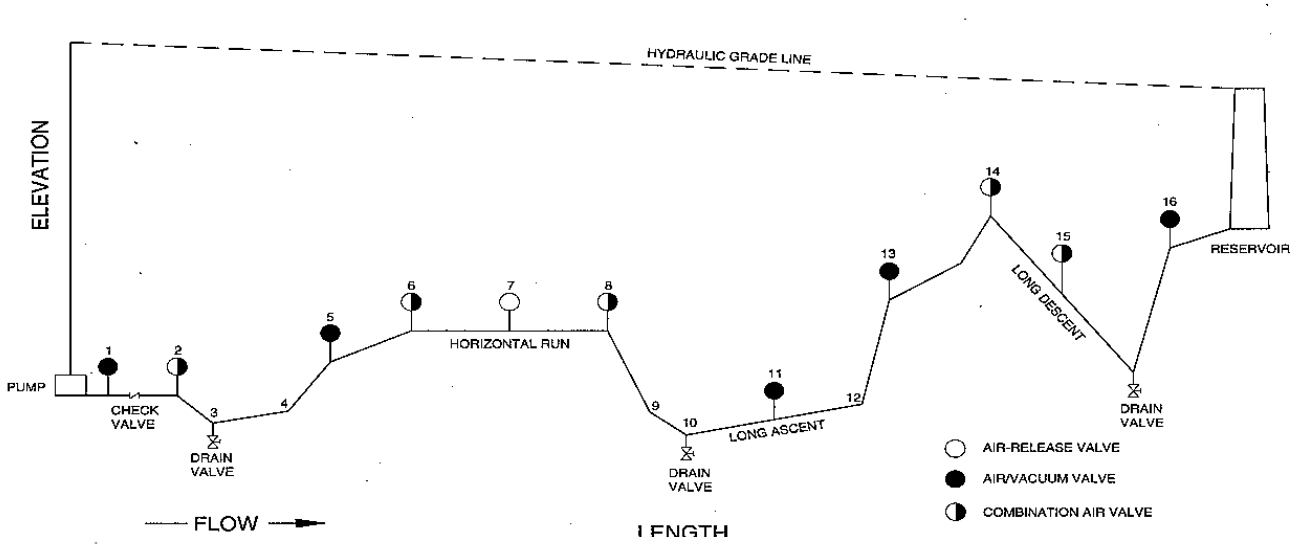
- Sewage Air Release Valves - specially designed for sanitary sewer systems. The float allows the build up of gas to escape the pipeline while preventing media spillage or spurting. The valves are designed to vent large volumes of air when sewage line is filled and small amounts of air during normal operation. Only opens to entrapped air and closes once liquid levels rise.

- Sewage Air/Vacuum - valves utilize 2 floats, each connected to common stem guided through a bushing. Vents large volumes of air when sewage line is filled and vents during negative pressure to prevent vacuum. Once valve is closed and system pressurized valve will not open to release air or wastewater gas.

- Sewage Combination Air Valves - only way to both vent and admit air. Can vent large volumes of air when the sewage line is filled and allow air to re-enter when draining to prevent vacuum or column separation from occurring. The valve also vents small pockets of air during normal operation.

    - Single body configurations are more economical, compact, less likely to freeze, tamper resistant
    - Dual body configurations more complex for large systems, allow partial operation during maintenance

ARV Breakdown & Description by Location



No.	Description	Recommended Types	No.	Description	Recommended Types
1	Pump Discharge	Air/Vac	9	Decr. Downslope	No Valve Required
2	Incr. Downslope	Combination	10	Low Point	No Valve Required
3	Low Point	No Valve Required	11	Long Ascent	Air/Vac or Combination
4	Incr. Upslope	No Valve Required	12	Incr. Upslope	No Valve Required
5	Decr. Upslope	Air/Vac or Combination	13	Decr. Upslope	Air/Vac or Combination
6	Beg. Horiz.	Combination	14	High Point	Combination
7	Horizontal	Air-Rel or Combination	15	Long Descent	Air-Rel or Combination
8	End Horiz.	Combination	16	Decr. Upslope	Air/Vac or Combination

Figure 3-1 Sample pipeline profile illustrating typical valve locations

Ref. AWWA M51

Design Guidelines? Regulatory Requirements?

Air-Release, Air/Vacuum,
and Combination
Air Valves

AWWA MANUAL M51
First Edition

American Water Works Association
Dedicated to the World's Most Important Resource®

ANSI/AWWA C512-15
(Revision of ANSI/AWWA C512-07)

AWWA Standard

FOUNDED 1881

American Water Wo

Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service

Effective date Nov. 1, 2015.
First edition approved by AWWA Board of Directors Jan. 26, 1992.
This edition approved: June 7, 2015.
Approved by American National Standards Institute: July 6, 2015.

STANDARD Since 1881

ANSI

Texas Commission on Environmental Quality
Chapter 217 - Design Criteria for Domestic Wastewater Systems

(f) Odor Control.

(1) A force main must terminate below a manhole invert with the top of the pipe matching the water level in the manhole at design flow.

(2) A force main must be designed to abate any anticipated odor.

(g) Air Release Valves in Force Mains.

(1) Any high point along the vertical force main alignment must include an air release valve or a combination of air release and air vacuum valves.

(2) An air release valve must have an isolation valve between the air release valve and the force main.

(3) An air release valve must be inside of a vault that is at least 48 inches in diameter and has a vented access opening at least 30 inches in diameter.

(h) Valves. A force main must have valves spaced at no more than 2,000 foot intervals to facilitate initial testing and subsequent maintenance and repairs.

Adopted August 6, 2008 Effective August 28, 2008

Sizing Help?

Orifice sizing method for pipeline filling

(Assumes air valve is at sea level and 60°F [15.5°C]).

Step 1. Calculate the venting flow rate in scfm using:

$$Q = q\ (.134\ \text{ft}^3/\text{gal})\ \frac{(\Delta P + 14.7\ \text{psi})}{(14.7\ \text{psi})}$$

Where:

Q	=	flow rate, scfm
q	=	fill rate, gpm
ΔP	=	differential pressure, 2 psi

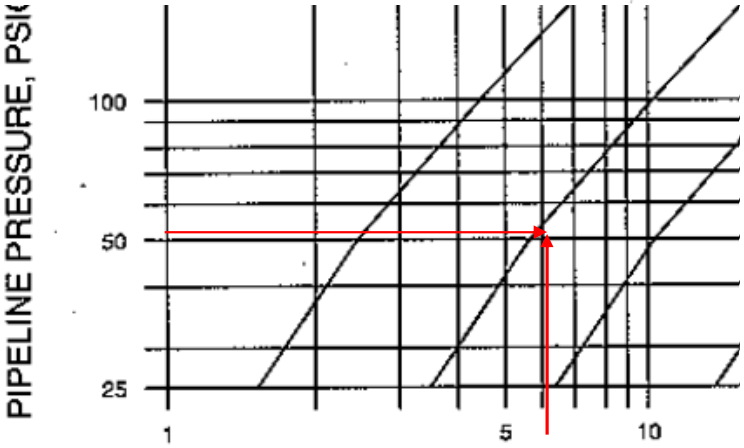


Table 4-2 Air discharge table of large orifices (C_d = 0.7, T = 60°F, sea level)

Differential Pressure (*psi*)	Orifice Diameter, *In.* 1	2	3	4	6	8	10	12	14	16	18	20
1.0	79	317	712	1,270	2,850	5,070	7,910	11,400	15,500	20,200	25,600	31,700
1.5	97	387	870	1,550	3,480	6,190	9,670	14,000	18,900	24,700	31,300	38,600
2.0	111	445	1,000	1,780	4,010	7,120	11,100	16,000	21,800	28,500	36,100	44,500
2.5	124	497	1,120	1,990	4,470	7,950	12,400	17,900	24,300	31,800	40,200	49,600
3.0	136	543	1,220	2,170	4,890	8,690	13,600	19,500	26,600	34,700	44,000	54,300
3.5	146	585	1,320	2,340	5,270	9,370	14,600	21,100	28,700	37,500	47,400	58,500
4.0	156	625	1,410	2,500	5,620	10,000	15,600	22,500	30,600	40,000	50,600	62,500
4.5	165	662	1,490	2,650	5,960	10,600	16,500	23,800	32,400	42,300	53,600	66,200
5.0	174	697	1,570	2,790	6,270	11,100	17,400	25,100	34,100	44,600	56,400	69,700

NOTE: Metric conversions—in. × 25.4 = mm, cfm × 0.4719 = L/sec, psi × 6.89476 = kPa.

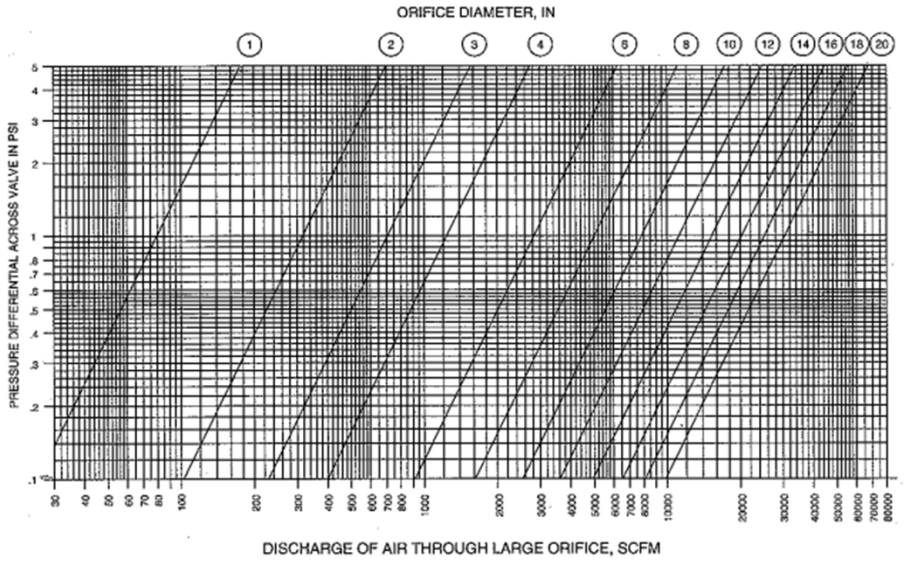


Figure 4-2 Air discharge graph of large orifices (C_d = 0.7).

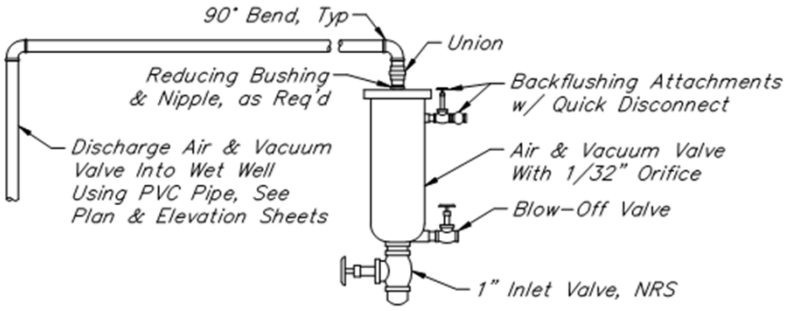
Ref. AWWA M51

Design Considerations & Specifications

1. Standard used—that is, AWWA/ANSI C512, *Air-Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service*, of latest revision.
2. Valve size.
3. Design pressure and minimum and maximum operating pressure of each valve (Sec. II.F and II.G).
4. Quantity required.
5. Type of installation (underground, in-plant, in-vault, or outdoor).
6. Warranty statement, if other than manufacturer's standard warranty.
7. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.
8. Valve type—air-release valve, air/vacuum valve, or combination air valve (Section 3).
9. Catalog data, if required (Sec. 4.1.1).
10. Certified drawings, if required (Sec. 4.1.2).
11. Operating manual, if required (Sec. 4.1.3).
12. Details of other federal, state or provincial, and local requirements (Sec. 4.2.1).
13. Records of physical and chemical tests, if required (Sec. 4.2.2).
14. Cover bolt materials of construction (Sec. 4.2.2.4 and Sec. 4.3.2.6).
15. Body inlet configuration, threaded or flanged (Sec. 4.3.2.1.1).
16. Size of inlet port connection if different from the nominal valve size (Sec. 4.3.2.1.2).

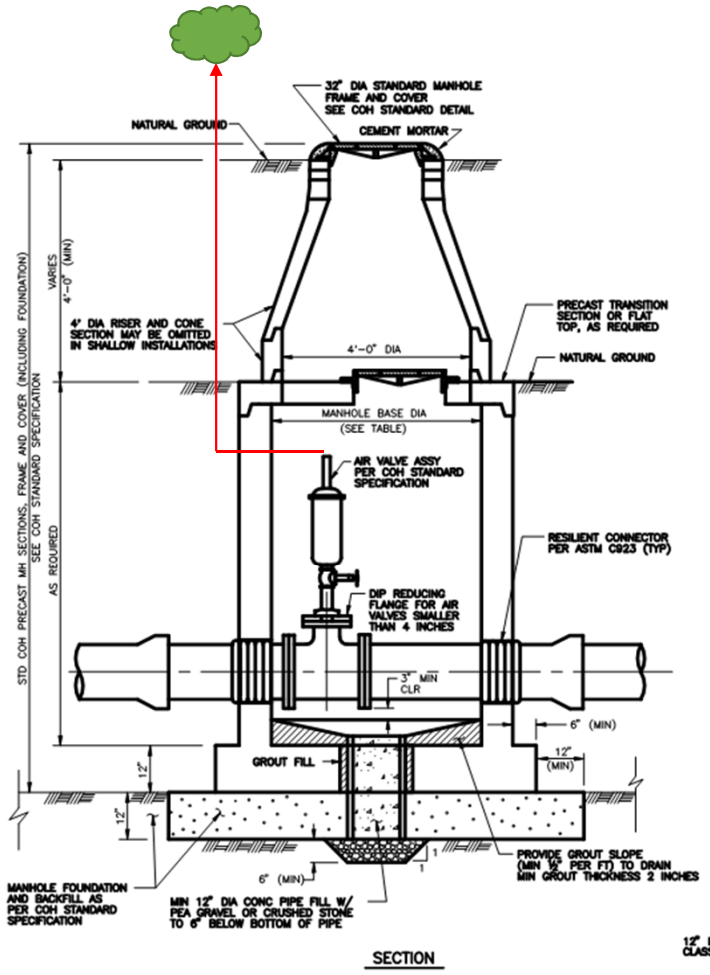
Ref. AWWA C512-15

Design -> Construction



TYPICAL AIR & VACUUM VALVE ASSY

NOT TO SCALE



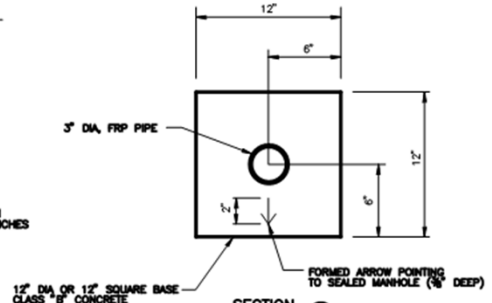
SECTION

TABLE

MANHOLE BASE DIAMETER (FT)	MAX FORCE MAIN DIAMETER
5	8
6	16
8	36

NOTES:

1. AIR RELEASE VALVE MAY BE 2" APCO 401 SAVV OR PRE-APPROVED EQUAL OR AIR AND VACUUM RELEASE VALVE AS NOTED ON PLAN AND PROFILE SHEET.
2. SEE COH STANDARD SPECIFICATION FOR AIR VALVE ASSEMBLY REQUIREMENTS.
3. PROVIDE LINED DUCTILE IRON PIPE, THICK CLASS 53, FOR FORCE MAIN WITHIN 12" OF OUTSIDE FACE OF MANHOLE. JOINTS WITHIN MANHOLE MAY BE FLANGED (AS SHOWN) OR GROOVED (PER ASTM 606) WITHIN MANHOLE, WITH 316 STAINLESS STEEL BOLTS.
4. MANHOLE TOP MAY BE CONCENTRIC CONE, ECCENTRIC CONE, OR FLAT TOP WITH ECCENTRIC OPENING. PROVIDE 32" FRAME & COVER. ORIENT ECCENTRIC OPENING OPPOSITE SIDE FROM AIR VALVE.
5. PROVIDE VENTED MANHOLE FOR AIR AND VACUUM VALVE INSTALLATIONS AND AT LOCATIONS INDICATED ON THE DRAWINGS.



SECTION (A)

CONCRETE FOUNDATION

SANITARY SEWER
AIR RELEASE OR AIR/VACUUM RELEASE VALVE MANHOLE

N.T.S.

Construction Photos