Eq. #	Design Criteria	Sizing Equation	Comments
1	Gravity Water Flow From Pipe Break or Draining Event	$Q = 0.0472\ C\ (S\ D^5)^{0.5}$	Assumes the pipe is sloped. Draining criteria usually governs over filling criteria. Use for sizing inflow for an air/vacuum valve.
2	Pipe Collapse Pressure of Thin Wall Pipe	$P = 12{,}500{,}000\ (T/D)^3$	Uses a safety factor of 4. Consider pipe reinforcement If vacuum exceeds P or 5 psid.
3	Transient Vacuum Formation	None	Computer simulation recommended. Use for sizing air inflow of a air/vacuum valve or vacuum breaker.
4	Air Flow Rate Through an Orifice	$Q^* = 678\ Y\ D^2\ C_d\ (P_d\ P_1\ /\ T_1)^{0.5}$	Typical pipe fill velocities are 1-2 fps. Valve capacity should exceed the greater of the water fill rate (cf/m) or air exhaust rate (scfm). Use for sizing air flow out of an air/vacuum valve or air release valve. When sizing air release valve P_d is limited to $0.47(P_1)$, $P_1 = P$, and $Y = 0.71$. Assumes a specific gravity of 1 for air.
5	Typical Dissolved Air Quantity	$Q^* = Q\ (0.134)(0.02)$	Use for sizing air release valves. Assumes typical 2% of operational flow is the amount of dissolved air in the water. Water density of 0.134 f^3/gal. Increase the air quantity if air entrainment from other sources is believed significant. This criteria may oversize the orifice, if multiple air relief valves will be installed in series.

Q = water flow rate (cfm)
Q* = air flow rate valve capacity (scfm)
C = Chezy coeff = iron=110, concrete=120, steel=130, PVC=190
C_d = discharge coeff. = 0.6 for square edge orifice, 0.65 for small orifice air release
S = pipe slope (ft/ft)
D = pipe ID (in)
P = collapse pressure (psid)
P_0 = Pipe normal operating pressure (psia)
P_1 = Inlet pressure = 14.7 psia (flow in), 16.7 psia (flow out at 2 psid), 19.7 psia (flow out at 5 psid)
P_d = pressure differential = lower of 5 psid or P (flow in); 2 or 5 psid (for flow out. 5 psid is typical for valves with anti-slam provision)
Y = Expansion factor =0.79 (flow in), 0.93 (flow out) or 0.85 (flow out when P_d=5)
T = pipe thickness (in)
T_1 = inlet temperature (520 R)