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

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American Water Works Association

MANUAL OF WATER SUPPLY PRACTICES—M51, First Edition

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

Project manager and copy editor: Melissa Christensen
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Preface

This manual is a guide for selecting, sizing, locating, and installing air valves in water applications. It is a discussion of recommended practice, not an American Water Works Association (AWWA) standard. It provides guidance on generally available methods and capacity information. Questions about specific situations or applicability of specific valves should be directed to the manufacturer or supplier.

Information contained in this manual is useful for operators, technicians, and engineers for gaining a basic understanding of the use and application of air valves. There are many special water pipeline applications that are beyond the scope of the methodology given in this manual and may require special tools such as computer programs for analysis of hydraulic transients. The valve capacity information is generic information. Actual capacity charts of the intended manufacturer's valve should be consulted before making the final selection of valve size and options. The manual provides information only on the air valve types listed in AWWA Standard C512, latest edition, including the following:

- Air-release valve
- Air/vacuum valve
- Combination air valve

Wastewater air valves, vacuum breakers, slow-closing air valves, and throttling devices are only introduced in this manual. Other sources of information should be consulted for the use and application of these devices.

This manual refers to AWWA standards, which are available for purchase from the AWWA Bookstore by calling (800) 926-7337 or online at <www.awwa.org/bookstore>.

Manufacturers graciously provided valve illustrations and other documentation. AWWA does not endorse any manufacturer's products, and the names of the manufacturers have been removed from the material provided.

Metrication Note: Valve sizes are listed in their current US designation, i.e., nominal pipe sizes in inches. To obtain an approximate metric equivalent, use a conversion factor of 25.4 mm per inch.

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M.E. Wollam, Chair, Montgomery Watson, Pasadena, Calif.

J.V. Ballun, Val-Matic Valve & Manufacturing Corp., Elmhurst, Ill.
J.H. Bambei Jr., Denver Water, Denver, Colo.
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W.A. Hunt, Consulting Engineer, Bozeman, Mont.
P.O. Landon, Val-Matic Valve & Manufacturing Corp., Elmhurst, Ill.
J.E. Lescovich, G.A. Industries Inc., Cranberry Township, Pa.
B.J. Lewis, Multiplex Manufacturing, Berwick, Pa.
W.L. Meinholz, Alvord, Burdick & Howson, Chicago, Ill.
W.J. Nicholl, G.A. Industries Inc., Cranberry Township, Pa.
J.L. Patton, Black & Veatch LLP, Kansas City, Mo.
J. Radtke, Aqua-Dynamic Systems, Wilkes-Barre, Pa.
M.I. Schwartz, Loudon County Sanitation Authority, Leesburg, Va.
R.J. Wahanik, Hystras, Wyomissing, Pa.
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Chapter 1

Introduction

Air valves are hydromechanical devices designed to automatically release or admit air during the filling, draining, or operation of a water pipeline or system. The safe operation and efficiency of a pipeline are dependent on the continual removal of air from the pipeline. This chapter includes an explanation of the effects of air and the sources of air in a pipeline.

OCCURRENCE AND EFFECT OF AIR IN PIPELINES

Water contains at least two percent dissolved air by volume in standard conditions (14.7 psia and 60°F)(Dean, 1992) but can contain more, depending on the water pressure and temperature within the pipeline. Henry's law states that "the amount of gas dissolved in a solution is directly proportional to the pressure of the gas above the solution" (Zumdahl, 1997). Therefore, when water is pressurized, its capacity to hold air is greatly magnified. The bubbling in soft drinks occurs after they are opened because the pressure over the fluid is reduced, and the excess carbon dioxide gas rapidly escapes. In a water system, a similar condition may occur at the consumer's tap when excess air comes out of solution. Once out of solution, air will not readily return to solution and will collect in pockets at high points along the pipeline.

Air comes out of solution in a pipeline because of low-pressure zones created by partially open valves, cascading flow in a partially filled pipe, variations in flow velocity caused by changing pipe diameters and slopes, and changes in pipeline elevation.

An air pocket may reduce the flow of water in a pipeline by reducing the cross-sectional flow area of the pipeline and may, if the volume of the air pocket is sufficient, completely air bind the pipeline and stop the flow of water (Karassik, 2001).

Generally, the velocity of the flow of water past an enlarging air pocket is sufficient to prevent complete air binding of the pipeline by carrying part of the air pocket downstream to collect at another high point. Although the flow velocity of water flow may prevent the pipeline from complete air binding, air pockets will increase head loss in the pipeline (Edmunds, 1979). Additional head loss in a pipeline decreases the flow of water and increases power consumption required to pump the

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