Manual of Water Supply Practices

M51

Air Valves: Air-Release, Air/Vacuum & Combination

Second Edition

American Water Works Association

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Air-Valves:

Air-Release, Air/Vacuum and Combination

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Preface

This manual is a guide for selecting, sizing, locating, and installing air valves in water and wastewater applications. Water includes raw water, potable water, and reclaimed wastewater that has been treated. Wastewater is a combination of used liquid and liquid-carried waste from residences, commercial buildings, industrial plants, and institutions, together with any groundwater infiltration, surface water, and stormwater that may enter the collection system.

The manual 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 to operators, technicians, and engineers for gaining a basic understanding of the use and application of air valves. There are many special liquid piping systems 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 ANSI/AWWA Standard C512, latest edition, including the following:

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

Vacuum breakers, slow-closing devices, and throttling devices are also discussed in this manual. Other sources of information should be consulted for the use and application of these devices.

This second edition includes new or revised information pertaining to wastewater applications, penstocks, slow-closing devices, throttling devices, and vault products for freeze and flood protection. Also, new and alternate air valve sizing methodologies were added for partial rupture gravity flow and air-release valves.

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.

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Chapter 1

Introduction

Air valves are hydromechanical devices designed to automatically release air and wastewater gases or admit air during the filling, draining, or operation of liquid piping systems for water and wastewater services. The safe and efficient operation of a liquid piping system is dependent on the continual removal of air and wastewater gases from the liquid piping system. This chapter includes an explanation of the effects of air and wastewater gases and their sources in liquid piping systems.

OCCURRENCE AND EFFECT OF AIR AND WASTEWATER GASES IN LIQUID PIPING SYSTEMS

Water contains approximately 2 percent dissolved air or gas by volume at standard conditions (14.7 psia [101 kPa absolute] and 60°F [16°C]) (Dean 1992) but can contain more, depending on the liquid pressure and temperature within the liquid piping system.

Wastewater systems can also contain more undissolved air and wastewater gases due to the decomposition of materials in the wastewater. Dissolved air and wastewater gases can come out of solution in pumps and in different locations along the liquid piping system where turbulence, hydraulic jumps, and other pressure variation phenomena occur. Once out of solution, air and wastewater gases will not readily dissolve and will collect in pockets at high points along the liquid piping system.

Air and wastewater gases come out of solution in a liquid piping system due to low-pressure zones created by partially open valves, cascading flow in a partially filled pipe, variations in flow velocity caused by changing pipe diameters or slopes, and changes in pipe elevation. Entrained air that reaches water service connections may be detrimental to the customer's water systems.

An air and wastewater gas pocket may reduce the flow of liquid in a liquid piping system by reducing the cross-sectional flow area of the pipe, and if the volume of the air and wastewater gas pocket is sufficient, complete binding of the liquid piping system is possible, stopping the flow of liquid (Karassik et al. 2007).