

Flowmeters in Water Supply

AWWA MANUAL M33

Second Edition



**American Water Works
Association**

Science and Technology

AWWA unites the drinking water community by developing and distributing authoritative scientific and technological knowledge. Through its members, AWWA develops industry standards for products and processes that advance public health and safety. AWWA also provides quality improvement programs for water and wastewater utilities.

MANUAL OF WATER SUPPLY PRACTICES—M33, Second Edition

Flowmeters in Water Supply

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Foreword

This manual was prepared as an introduction to the most common large flowmeters currently used in water supply systems. This manual provides information about the most common flowmeters used in water treatment and in custody-transfer applications. Information on other meters can be obtained from AWWA Manual M6 *Water Meters—Selection, Installation, Testing, and Maintenance*. The flowmeters discussed in this manual include the Venturi, modified Venturi, orifice plate, electromagnetic (mag), turbine and propeller, transit-time ultrasonic, vortex, averaging Pitot, and averaging insertable electromagnetic (mag). The discussion of these meters covers basic theory, installation, maintenance, and advantages and disadvantages. General concepts applicable to flowmeters are also discussed, including flow characteristics, installation and performance issues, communication, information and signal outputs, and flowmeter selection.

The manual can be used as a bridge to other literature on flowmeters, to prepare the reader for further investigations into instrumentation design and applications. The cited references will provide excellent information sources. For additional information, the reader should acquire the relevant manuals from the meter manufacturers. These manuals contain comprehensive information on meter specifications, theory, sizing, handling, installation, power and wiring, operation, maintenance, troubleshooting, and parts.

While this manual attempts to include recommended practice in the use of flowmeters, it is not intended as an AWWA standard.

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Chapter 1

Characteristics of Flow

Flow is an important measurement made at treatment and distribution facilities, and flowmeters are used to measure this flow. Flowmeters measure product output of a plant, water distribution into a community, pacing of chemical feeds, and customer charges, to name just a few applications. Day-to-day operational decisions and long-term planning are based on measurements from flowmeters. To achieve proper flow measurement, it is required that the fluid is homogenous with the solids or gases evenly dispersed, acting as a single-phase fluid with no relative motion between its components. The fluids of main concern in water treatment generally meet these conditions.

FLUID PARAMETERS

The parameters and properties of fluids important to flowmetering are

- Pressure—force per unit area.
 - Flow is driven by the difference in pressure.
 - Some flowmeters utilize the pressure differential across an obstruction to measure flow.
 - A measure of the static component of the fluid's energy.
- Density (ρ)—mass per unit volume.
 - Density is important when mass transfer measurements are needed.
 - It affects the nature of the flow and fluid behavior and is used to calculate many other fluid parameters.
- Viscosity (μ)—fluid's resistance to flow.
 - It affects the nature of the flow and fluid behavior and is used to calculate many other fluid parameters.
 - Causes shear forces to be dominant at lower velocities.
 - Causes a point of zero velocity at the pipe's surface.
- Velocity (V)—fluid's speed of flow.
 - V is the average velocity over the flow area.
- Flow area—area of unobstructed flow.
 - Accuracy of cross-sectional area measurement plays a major role in flow measurement accuracy. For example, a $1/8$ -in. deviation in the diameter of a 12-in. pipe will cause a 2 percent change in area. This is important because of the probable change of flow area caused by corrosion and erosion with time.