

# Flowmeters in Water Supply

Third Edition

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American Water Works  
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Third Edition



**American Water Works  
Association**

Manual of Water Supply Practices — M33, Third Edition

## Flowmeters in Water Supply

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## Foreword

This manual provides information about the most common large 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, communications, information and signal output, 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 Bibliography lists 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, modeling, 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, the fluid must be homogeneous, with evenly dispersed solids or gases, acting as a single-phase fluid with no relative motion among 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 as follows:

- Density ( $\rho$ )—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.
- Electrical conductivity—ability of the fluid to conduct electricity.
  - This condition is typically met in the water industry.
- Flow area—area of unobstructed flow.
  - Accuracy of cross-sectional area measurement plays a major role in flow measurement accuracy. For example, a  $\frac{1}{8}$ -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.
- Pressure—force per unit area.
  - Flow is driven by the difference in pressure.
  - Some flowmeters use the pressure differential across an obstruction to measure flow.
  - Pressure is a measure of the static component of the fluid's energy.