ANSI/AWWA C700-15
(Revision of ANSI/AWWA C700-09)

American Water Works Association

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AWWA Standard

Cold-Water Meters—Displacement Type, Metal Alloy Main Case

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American Water Works Association STANDARD Since 1881

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AWWA Standard

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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

Foreword

This foreword is for information only and is not a part of ANSI/AWWA C700.*

I. Introduction.

I.A. *Background.* For the past century, no tool available to water utilities has played a greater part in the conservation of water than the water meter. It has reduced waste and distributed the cost of operating a water system in the most equitable manner possible.

Although patents were issued earlier, it is thought that the first meter produced in the United States was made in 1857. It was a positive-displacement type with reciprocating pistons. This design consisted of two cylinders and pistons with inlet and outlet ports arranged so that while water in one cylinder was discharging, the other was filling. Water flowing through the meter was subject to pulsation and high friction loss. Other types of displacement meters manufactured before the turn of the 20th century were the rotary piston, oscillating piston, and nutating disc. Only the oscillating and nutating types remain in production today, as they have proved satisfactory for metering domestic water services.

I.B. *History.* Standardization of water meters was a matter of concern for many years before the first standard was adopted. An AWWA committee appointed in 1913 proposed the adoption of standards on overall meter lengths and connections in 1915 and 1916.

The standards were not adopted officially but were recorded in the proceedings for 1915† and for 1916.‡

The New England Water Works Association (NEWWA), in separate action, appointed a committee in 1916 that produced drafts of standards in 1917. Action on adoption or publication was delayed on the recommendation of manufacturers.

In 1916, the meter manufacturers, which for several years had worked informally on the matter of meter standards, formally organized a meter standards committee on which most of the meter manufacturers were represented. The records indicate that those who were not represented were kept informed of the committee's activities and given the opportunity to comment on drafts of proposed standards.

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* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† AWWA Proceedings 35th Year, *Journal of the American Water Works Association*, 3:283 (1915).
‡ AWWA Proceedings 36th Year, *Journal of the American Water Works Association*, 2:690 (1916).

On Mar. 9–10, 1920, the AWWA and NEWWA committees met for the first time as a joint committee to review drafts of a proposed standard that had been prepared by the manufacturers' committee. Subcommittees appointed at that meeting prepared a final draft that was approved by the joint committee and submitted to both associations for approval. AWWA adopted the standard on June 9, 1921, and NEWWA adopted it on Sept. 14, 1921. The standard, the first for any type of meter, was titled "Standard Specifications for Cold-Water Meters, Disc Type."

The first revision of the standard was approved as tentative by AWWA on Oct. 31, 1941. The effective date of the standard was delayed until Jan. 1, 1943. On Mar. 15, 1943, it was approved by NEWWA. The document was advanced from tentative to standard by AWWA on May 10, 1946.

Emergency alternative provisions were imposed by the War Production Board from Dec. 1, 1942, to Jan. 8, 1945. Emergency provisions were imposed again on Jan. 1, 1952.

The next edition of the standard was approved by AWWA as tentative on Jan. 23, 1961, and was later advanced to standard without revision on Feb. 11, 1964, and subsequently revised on Jan. 24, 1971, May 8, 1977, Jan. 28, 1990, June 17, 1995, June 16, 2002, and Jan. 25, 2009. This edition was approved on Jan. 24, 2015.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the Water Research Foundation (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.* Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state, provincial, or local agency.

* Persons outside the United States should contact the appropriate authority having jurisdiction.

3. Two standards developed under the direction of NSF*: NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects.

4. Other references, including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,† and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdictions. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

In an alternative approach to inadvertent drinking water additives, some jurisdictions (including California, Louisiana, Maryland, and Vermont, at the time of this writing) are calling for reduced lead limits for materials in contact with potable water. Various third-party certifiers have been assessing products against these lead content criteria, and a new ANSI-approved national standard, NSF/ANSI 372, Drinking Water System Components—Lead Content, was published in 2010.

On Jan. 4, 2011, legislation was signed revising the definition for "lead free" within the Safe Drinking Water Act (SDWA) as it pertains to "pipe, pipe fittings, plumbing fittings, and fixtures." The changes went into effect on Jan. 4, 2014. In brief, the new provisions to the SDWA require that these products meet a weighted average lead content of not more than 0.25 percent.

ANSI/AWWA C700 does not address additives requirements. Users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.

2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.

3. Determine current information on product certification.

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* NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

† Both publications available from National Academy of Sciences, 500 Fifth Street, N.W., Washington, DC 20001.

II. Special Issues.

II.A. *Fire Flow.* The meters described in this standard are not designed to be used in water service piping intended to extinguish fire. Requirements for meters used for residential fire sprinkler applications that meet the requirements of NFPA* 13D in single- and two-family dwellings and manufactured homes, sizes ¾ in. (20 mm) through 2 in. (50 mm), are found in ANSI/AWWA C714.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

III.A. *Purchaser Options and Alternatives.* This standard provides for several options and alternatives that purchasers must designate if they wish to exercise the options or if they have a preference among the alternatives. Also, several items must be specified by purchasers to describe completely the type, size, and quantity of meters required. All such items, options, and alternatives are summarized in the following itemized list. Purchasers should review each one and then make the appropriate provisions in their specifications to describe specific requirements.

1. Standard used—that is, ANSI/AWWA C700, Cold-Water Meters—Displacement Type, Metal Alloy Main Case, of latest revision.
2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects; NSF/ANSI 372, Drinking Water System Components—Lead Content; or an alternative lead content criterion is required.
3. If meters are to be provided with nutating discs or oscillating pistons (Sec. 1.1), and if there is a preference.
4. Details of other federal, state or provincial, and local requirements (Sec. 4.1).
5. If meters are to be provided with cast-iron, stainless-steel, copper alloy, or suitable engineering-plastic top or bottom covers (Sec. 4.1.9), and if there is a preference.
6. If corrosion protection is required for cast-iron frost-protection covers (Sec. 4.1.9.1 and 4.2.5), and if there is a preference.
7. Size of meter (Sec. 4.2.1 and Tables 1 and 2) and quantity required.
8. Modifications of test specifications (Sec. 4.2.8) if operating water temperature will exceed 80°F (27°C).
9. If meters in sizes ½ in. (13 mm) through 1 in. (25 mm) are to be of split-case or frost-protection-type design (Sec. 4.3.1.1).

* National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169.

10. If ½-in. (13-mm), ½-in. × ¾-in. (13-mm × 20-mm), ⅝-in. (15-mm), ⅝-in. × ¾-in. (15-mm × 20-mm), ¾-in. (20-mm), and 1-in. (25-mm) meters are to be provided with coupling nuts and tailpieces (Sec. 4.3.2.1), and whether tailpieces are to be of a copper alloy or a suitable engineering plastic (Sec. 4.1.11).

11. If 1½-in. (40-mm) and 2-in. (50-mm) meters are to be provided with flanged ends or threaded (spud) ends (Sec. 4.3.2.2).

12. If flanged meters are to be provided with companion flanges, gaskets, bolts, and nuts (Sec. 4.3.2.2), and whether companion flanges are to be of a copper alloy, cast iron, or suitable engineering plastic (Sec. 4.1.12).

13. Details of register (Sec. 4.3.3) to be provided, where there is a preference, with regard to the following:

a. If the registers shall be read in US gallons, cubic feet, or cubic meters.

b. If the registers shall be permanently sealed against the disassembly of the gear train or have replaceable change gears.

14. If a direct-reading remote register or an encoder-type remote register is required (Sec. 4.3.3.4), specify in detail.

15. If warranty requirements will be specified (Sec. 5.1.1).

16. If the size of individual meters will be permanently marked on the register dial face (Sec. 6.1).

17. If an affidavit of compliance (Sec. 6.3) and certificate of testing for accuracy (Sec. B.3.3) are required.

18. Special materials required, if any, to resist corrosion if water is highly aggressive (Sec. B.5.3).

III.B. *Modification to Standard.* Any modifications to the provisions, definitions, or terminology in this standard must be provided by the purchaser.

IV. Major Revisions. Major revisions made to the standard in this edition include the following:

1. The scope of the standard has been changed from meters with bronze main cases to those with metal alloy main cases. The title of the standard has been changed accordingly to "Cold-Water Meters—Displacement Type, Metal Alloy Main Case."

2. Foreword Sec. I.C provides information on lead content criteria and the new NSF/ANSI Standard 372, Drinking Water System Components—Lead Content, as well as recent federal legislation revising the definition of "lead free" in the Safe Drinking Water Act.

3. Foreword Section II provides new information that meters used for residential fire sprinkler applications meeting the requirements of NFPA 13D, sizes ¾ in. (20 mm) through 2 in. (50 mm), are found in ANSI/AWWA C714.

4. Foreword Sec. III.A contains a new purchaser option for compliance with NSF/AWWA 372 or other lead content criterion.

5. In Section 3, the definition of "manufacturer" has been changed to include the party that supplies the product marked with its brand name.

6. In Section 4, the materials have been updated in response to legislation revising the definition of "lead free" in the Safe Drinking Water Act. Stainless steel has been added as a material for pressure casings (Sec. 4.1.2) and measuring chambers (Sec. 4.1.4).

7. Sec. 4.3.3 on registers has been updated to include requirements for electronic display registers.

8. Editorial clarifications have been provided throughout the standard.

V. Comments. If you have any comments or questions about this standard, please call AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603; write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098; or email at standards@awwa.org.

American Water Works Association
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AWWA Standard

Cold-Water Meters—Displacement Type, Metal Alloy Main Case

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes the various types and classes of cold-water displacement meters with metal alloy main cases, in sizes ½ in. (13 mm) through 2 in. (50 mm), and the materials and workmanship employed in their fabrication. The displacement meters described, known as *nutating-disc* or *oscillating-piston meters*, are positive in action because the pistons and discs displace or carry over a fixed quantity of water for each nutation or oscillation when operated under positive pressure.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for cold-water meters—displacement type, metal alloy main case, including materials and design.

Sec. 1.3 Application

This standard can be referenced in specifications for purchasing and receiving cold-water meters—displacement type, metal alloy main case. This standard can be used as a guide for manufacturing this type of meter. The stipulations of this standard apply when this document has been referenced and only to cold-water meters—displacement type, metal alloy main case.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, these documents form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.

ANSI*/AWWA C706—Direct-Reading, Remote-Registration Systems for Cold-Water Meters.

ANSI/AWWA C707—Encoder-Type Remote-Registration Systems for Cold-Water Meters.

ASME† B1.20.1—Pipe Threads, General Purpose (Inch).

ASTM‡ A48—Standard Specification for Gray Iron Castings.

ASTM A126—Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

ASTM A159—Standard Specification for Automotive Gray Iron Castings.

ASTM A167—Standard Specification for Stainless and Heat-Resisting Chromium–Nickel Steel Plate, Sheet, and Strip.

ASTM A276—Standard Specification for Stainless Steel Bars and Shapes.

ASTM A351—Standard Specification for Castings, Austenitic, for Pressure Containing Parts.

ASTM A493—Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.

ASTM A582—Standard Specification for Free-Machining Stainless Steel Bars.

ASTM B16—Standard Specification for Free-Cutting Brass Rod, Bar, and Shapes for Use in Screw Machines.

ASTM B36—Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar.

ASTM B98—Standard Specification for Copper–Silicon Alloy Rod, Bar, and Shapes.

ASTM B103—Standard Specification for Phosphor Bronze Plate, Sheet, Strip, and Rolled Bar.

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† ASME International, 3 Park Avenue, New York, NY 10016.
‡ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

ASTM B127—Standard Specification for Nickel–Copper Alloy (UNS N04400) Plate, Sheet, and Strip.

ASTM B139—Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.

ASTM B164—Standard Specification for Nickel–Copper Alloy Rod, Bar, and Wire.

ASTM B176—Standard Specification for Copper–Alloy Die Castings.

ASTM B271—Standard Specification for Copper–Base Alloy Centrifugal Castings.

ASTM B584—Standard Specification for Copper Alloy Sand Castings for General Applications.

ASTM D1248—Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

ASTM D2874—Standard Specification for Polyphenylene Oxide Molding and Extrusion Materials. (Discontinued in 1983.)

ASTM D3935—Standard Specification for Polycarbonate (PC) Unfilled and Reinforced Material.

ASTM D4066—Standard Specification for Nylon Injection and Extrusion Materials (PA).

ASTM D4067—Standard Specification for Reinforced and Filled Polyphenylene Sulfide (PPS) Injection Molding and Extrusion Materials.

ASTM D4101—Standard Specification for Propylene Injection and Extrusion Materials.

ASTM D4181—Standard Specification for Acetal (POM) Molding and Extrusion Materials.

ASTM D4203—Standard Specification for Styrene-Acrylonitrile (SAN) Injection and Extrusion Materials.

ASTM D4507—Standard Specification for Thermoplastic Polyester (TPES) Materials.

ASTM D4549—Standard Specification for Polystyrene and Rubber-Modified Polystyrene Molding and Extrusion Materials.

ASTM D4673—Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastics and Alloys Molding and Extrusion Materials.

ASTM E527—Standard Practice for Numbering Metals and Alloys (UNS) (SAE J 1086).*

ASTM F467—Standard Specification for Nonferrous Nuts for General Use.

ASTM F468—Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.

AWWA Manual M6—*Water Meters—Selection, Installation, Testing, and Maintenance*.

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products, or supplies the product marked with its brand name.
2. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.
3. *Supplier:* The party that supplies material or services. A supplier may or may not be the manufacturer.

SECTION 4: REQUIREMENTS

Sec. 4.1 Materials.

Materials shall comply with the requirements of the Safe Drinking Water Act and other federal requirements.

4.1.1 *General.* Materials used in the manufacture of water meters shall conform to the requirements stipulated in the following section. Where plastic materials are allowed, the manufacturer may provide any plastic materials that meet the performance requirements specified; typical examples are provided.

4.1.1.1 Materials.† Materials shall be selected for their strength and resistance to corrosion and shall not impart to the water objectionable taste or odor nor toxic substances in normalized concentrations exceeding the maximum contaminant levels (MCLs) as defined by the US Environmental Protection Agency (USEPA).

* Also refer to Copper Development Association, Greenwich Office Park 2, P.O. Box 1840, Greenwich, CT 06836.
† The US Safe Drinking Water Act (SDWA) limits the lead content in materials used for wetted pipe fittings.

4.1.2 *Pressure casings.* Water meter main cases shall be made of a copper alloy containing not less than 75 percent copper, such as UNS* C89510, C89520, C89833, or C89836, or a similar copper alloy as listed in ASTM B584, or a cast austenitic stainless steel as listed in ASTM A351.

Materials used in the construction of meter main cases shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 105°F (40°C) and shall not permanently warp or deform when exposed to temperatures up to 150°F (66°C) for 1 hr.

4.1.3 *Register-box rings and lids.* Register-box rings and lids shall be made of a copper alloy containing not less than 57 percent copper, such as UNS C85700 or UNS C86200, or a similar copper alloy as listed in ASTM B584 or UNS C85800 as listed in ASTM B176; or a suitable engineering plastic, such as polycarbonate (PC) in accordance with ASTM D3935, acetal in accordance with ASTM D4181, nylon (PA) in accordance with ASTM D4066, or propylene in accordance with ASTM D4101.

Materials used in the construction of register-box rings and lids shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 105°F (40°C) and shall not permanently warp or deform when exposed to temperatures up to 150°F (66°C) for 1 hr.

4.1.4 *Measuring chambers.* Measuring chambers shall be made of a copper alloy containing not less than 85 percent copper, such as UNS C89510, C89520, C89833, or C89836, or a similar copper alloy as listed in ASTM B584; or a cast austenitic stainless steel as listed in ASTM A351; or a suitable engineering plastic, such as polyethylene in accordance with ASTM D1248, polyphenylene oxide (PPO) in accordance with ASTM D2874, polystyrene (PS) in accordance with ASTM D4549, styrene-acrylonitrile (SAN) in accordance with ASTM D4203, or polyphenylene sulfide (PPS) in accordance with ASTM D4067.

Measuring chambers shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 80°F (27°C) and shall not warp or deform when exposed to operating temperatures of 100°F (38°C).

4.1.5 *Pistons and discs.* Pistons and discs shall be such that the specific gravity approximately equals that of water and shall be made of a suitable engineering plastic, such as PS in accordance with ASTM D4549, PPS in accordance with

* Unified Numbering System as described in ASTM E527.

ASTM D4067, styrene-acrylonitrile (SAN) in accordance with ASTM D4203, PPO in accordance with ASTM D2874, or PC in accordance with ASTM D3935.

Pistons and discs shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 80°F (27°C) and shall not warp or deform when exposed to operating temperatures of 100°F (38°C).

4.1.6 *Measuring-chamber diaphragms.* Measuring-chamber diaphragms shall be made of monel, such as UNS N04400 as listed in ASTM B127; phosphor bronze as listed in ASTM B103; or austenitic stainless steel as listed in ASTM A167; or a suitable engineering plastic, such as PA in accordance with ASTM D4066, PPS in accordance with ASTM D4067, PPO in accordance with ASTM D2874, or SAN in accordance with ASTM D4203.

Measuring-chamber diaphragms shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 80°F (27°C) and shall not warp or deform when exposed to operating temperatures of 100°F (38°C).

4.1.7 *Piston/disc spindles, thrust rollers, and thrust-roller bearing plates.* Piston/disc spindles, thrust rollers, and thrust-roller bearing plates shall be made of monel UNS N04400 in accordance with ASTM B164; phosphor bronze in accordance with ASTM B139; austenitic stainless steel as listed in ASTM A276; or a suitable engineering plastic, such as PC in accordance with ASTM D3935, PPS in accordance with ASTM D4067, or thermoplastic polyester (TPES) in accordance with ASTM D4507.

Piston/disc spindles, thrust rollers, and thrust-roller bearing plates shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 80°F (27°C) and shall not warp or deform when exposed to operating temperatures of 100°F (38°C).

4.1.8 *Register gear trains.* Frames, gears, and pinions of gear trains shall not be exposed to water and shall be made of metals such as copper alloys in accordance with ASTM B16, brass alloys in accordance with ASTM B36, silicon–bronze alloys in accordance with ASTM B98, or any copper-based alloys in accordance with ASTM F467 and ASTM F468; stainless steel, such as those listed in ASTM A276, ASTM A493, and ASTM A582; or suitable engineering plastics, such as acrylonitrile-butadiene-styrene (ABS) in accordance with ASTM D4673, PC in accordance with ASTM D3935, TPES in accordance with ASTM D4507, PS in accordance with ASTM D4549, or acetal in accordance with ASTM D4181.

Register gear trains shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 80°F (27°C) and shall not warp or deform when exposed to operating temperatures of 100°F (38°C).

4.1.9 *Covers, top or bottom.* If engineering plastic materials are used in the manufacture of top or bottom covers, only virgin or first-generation-grade rigid engineering plastic materials compounded with ultraviolet stabilizers shall be used. Engineering plastic covers, top or bottom, shall have sufficient dimensional stability to retain operating clearances at working temperatures up to 105°F (40°C) and shall not permanently warp or deform when exposed to temperatures up to 150°F (66°C) for 1 hr. Breakable and nonbreakable top or bottom covers shall be as follows:

4.1.9.1 Breakable. Breakable covers (frost-protection devices) shall be made of cast iron, such as those listed in ASTM A48, ASTM A126, or ASTM A159; austenitic stainless steel, such as those listed in ASTM A167 or ASTM A351; a copper alloy containing not less than 75 percent copper, such as UNS C89510, C89520, C89833, or C89836 as listed in ASTM B584; or a suitable engineering plastic, such as PC in accordance with ASTM D3935, PPS in accordance with ASTM D4067, PA in accordance with ASTM D4066, or TPES in accordance with ASTM D4507. The design and composition of such components will be such that they will satisfy the break or yield requirements stated in Sec. 4.2.9. Meters equipped with frost-protection devices can cause flooding to occur due to frost-protection devices yielding or fracturing, as indicated in AWWA Manual M6.

4.1.9.2 Nonbreakable. Nonbreakable covers shall be made of austenitic stainless steel, such as those listed in ASTM A167 or ASTM A351; a copper alloy containing not less than 75 percent copper, such as UNS C89510, C89520, C89833, or C89836 as listed in ASTM B584; or a suitable engineering plastic, such as PC in accordance with ASTM D3935, PPS in accordance with ASTM D4067, PA in accordance with ASTM D4066, or TPES in accordance with ASTM D4507. The design and composition of these components shall be such that they will satisfy the break or yield requirements stated in Sec. 4.2.9.

4.1.10 *External-case closure fasteners.* External fasteners shall be made of a copper alloy containing not less than 57 percent copper, such as the wrought alloys covered by ASTM B16 (for example, UNS C36000); a brass alloy, such as UNS C27200 as listed in ASTM B36; a silicon–bronze alloy as listed in ASTM B98; any of the copper-based alloys specified for general fastener use in ASTM F467 or ASTM F468; or stainless steel of the austenitic, ferritic, or martensitic types as listed in ASTM A276, ASTM A493, and ASTM A582.

Fasteners for nonpressure containment assemblies may be made of a suitable engineering plastic, such as PC in accordance with ASTM D3935, PA in accordance with ASTM D4066, acetal in accordance with ASTM D4181; or any of the aforementioned copper-based or stainless-steel materials.

4.1.11 *Coupling tailpieces and nuts.* Coupling tailpieces and nuts shall be made from a copper alloy containing not less than 75 percent copper, such as UNS C84400 or C93200 for nuts, and such as UNS C89510, C89520, C89833, or C89836 for tailpieces, or a similar copper alloy as listed in ASTM B584; or, when specified by the purchaser, of a suitable virgin-grade engineering plastic, such as PC in accordance with ASTM D3935, PA in accordance with ASTM D4066, or PPS in accordance with ASTM D4067.

4.1.12 *Companion flanges.* Companion flanges shall be made of cast iron, such as those listed in ASTM A48, ASTM A126, or ASTM A159; or, when so specified by the purchaser, of a copper alloy containing not less than 75 percent copper, such as UNS C89510, C89520, C89833, or C89836, or a similar copper alloy as listed in ASTM B584; or, when so specified by the purchaser, of a suitable virgin-grade engineering plastic.

Sec. 4.2 General Design

4.2.1 *Size.* The operating and physical characteristics listed in Tables 1 and 2 shall determine the nominal size of meters.

4.2.2 *Capacity.** The nominal capacity ratings and the related pressure-loss limits shall be the same as those listed in Table 1 for the safe maximum operating capacities.

4.2.3 *Length.* The length of the meters shall be the face-to-face dimensions of the spuds or flanges listed in Table 2.

4.2.4 *Pressure requirement.* Meters supplied under this standard shall operate without leakage or damage to any part at a continuous working pressure of 150 psi (1,050 kPa).

4.2.5 *Frost-protection devices.* Frost-protection devices, when provided, shall be of such design that they will yield or break under normal freezing conditions in order to minimize damage to any other part of the meter. The internal portion of the top or bottom covers, designed to provide frost protection, may be protected from corrosion by an inner lining or coating.

* See Sec. B.3.

Table 1 Characteristics of displacement-type meters

Meter Size		Safe Maximum Operating Capacity*		Maximum Pressure Loss at Safe Maximum Operating Capacity		Recommended Maximum Rate for Continuous Operations†		Minimum Test Flow‡		Normal Test Flow Limits‡		Maximum Number of Disc Nutations or Piston Oscillations per		
in.	*(mm)*	*gpm*	*(m^3/h)*	*psi*	*(kPa)*	*gpm*	*(m^3/h)*	*gpm*	*(m^3/h)*	*gpm*	*(m^3/h)*	10 *gal*	*ft^3*	(0.01 m^3)
½	(13)	15	(3.4)	15	(103)	7.5	(1.7)	¼	(0.06)	1–15	(0.2–3.4)	875	657	(231)
½ × ¾	(13 × 20)	15	(3.4)	15	(103)	7.5	(1.7)	¼	(0.06)	1–15	(0.2–3.4)	875	657	(231)
⅝	(15)	20	(4.5)	15	(103)	10.0	(2.3)	¼	(0.06)	1–20	(0.2–4.5)	580	435	(154)
⅝ × ¾	(15 × 20)	20	(4.5)	15	(103)	10.0	(2.3)	¼	(0.06)	1–20	(0.2–4.5)	580	435	(154)
¾	(20)	30	(6.8)	15	(103)	15.0	(3.4)	½	(0.11)	2–30	(0.5–6.8)	333	250	(88)
1	(25)	50	(11.4)	15	(103)	25.0	(5.7)	¾	(0.17)	3–50	(0.7–11.4)	153	115	(40)
1½	(40)	100	(22.7)	15	(103)	50.0	(11.3)	1½	(0.34)	5–100	(1.1–22.7)	67	50	(18)
2	(50)	160	(36.3)	15	(103)	80.0	(18.2)	2	(0.45)	8–160	(1.8–36.3)	40	30	(11)

* Operation at this flow rate should not exceed 10 percent of usage, or 2 hr in a 24-hr period.

† See Sec. B.5.1.

‡ See Sec. 4.2.8.

Table 2 Dimensional design limits for meters and external connections

Meter Size		Meter Length*				Meter-Casing Spuds		Coupling Tailpieces			
		Threaded Spud Ends		Flanged Ends		Nominal Thread Size		Length		Nominal Thread Size	
in.	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*
½	(13)	7½	(190)			¾	(19)	2⅜	(60)	½	(13)
½ × ¾	(13 × 20)	7½	(190)			1	(25)	2½	(64)	¾	(19)
⅝	(15)	7½	(190)			¾	(19)	2⅜	(60)	½	(13)
⅝ × ¾	(15 × 20)	7½	(190)			1	(25)	2½	(64)	¾	(19)
¾	(20)	9	(229)			1	(25)	2½	(64)	¾	(19)
1	(25)	10¾	(273)			1¼	(32)	2⅝	(67)	1	(25)
1½	(40)	12⅝	(321)	13	(330)	1½	(38)†				
2	(50)	15¼	(387)	17	(432)	2	(51)†				

* 0.03937 in. = 1 mm.
† Internal threaded spuds.

WARNING: Meters equipped with frost-protection devices can cause flooding to occur because of frost-protection devices yielding or fracturing, as indicated in AWWA Manual M6.

4.2.6 *External-case closure fasteners.* External-case closures, such as rings, clamps, screws, bolts, cap bolts, nuts, and washers, shall be designed for easy removal following lengthy service.

4.2.7 *Accessibility.* Meters larger than 1 in. (25 mm) shall be designed for easy removal of interior parts without disturbing the connections to the pipeline.

4.2.8 *Registration accuracy.* Meters shall meet the following requirements for accuracy with water at a temperature less than 80°F (27°C):

4.2.8.1 Normal flow limits. At any rate of flow within the normal test-flow limits as listed in Table 1, the meter shall register not less than 98.5 percent and not more than 101.5 percent of the water that actually passes through it.

4.2.8.2 Minimum flow rate. At the minimum test-flow rate to the lowest normal test-flow rate as listed in Table 1, the meter shall register not less than 95 percent and not more than 101 percent of the water that actually passes through it.

4.2.9 *Plastic covers, top or bottom design.* The design of plastic covers, top or bottom (Sec. 4.1.9), shall meet the following requirements:

4.2.9.1 Fatigue limit. Covers, top or bottom, shall be designed to be watertight and capable of withstanding, without exceeding the fatigue limit of the material or being structurally damaged, a hydrostatic pressure of two times the rated maximum working pressure (300 psi [2,100 kPa] minimum) for a period of 15 min.

4.2.9.2 Burst pressure. Covers, top or bottom, not designed to break shall be designed to have a burst pressure of at least four times the rated maximum working-line pressure (600 psi [4,200 kPa] minimum). Breakable covers, top or bottom, shall be designed to have a burst pressure of at least three times the rated maximum working-line pressure (450 psi [3,100 kPa]). Components shall be watertight at 150 psi (1,050 kPa) after being subjected to a minimum of 100,000 pressure cycles of 100–300 psi (700–2,100 kPa) in 1.5 sec and a hold time of 1 min and followed by an immediate release of pressure to the 100-psi (700-kPa) lower limit.

Sec. 4.3 Detailed Design

4.3.1 *Main casing.* Meters shall have an outer case with separate, removable measuring chambers. Cases shall not be repaired in any manner. The inlet and outlet shall have a common axis. Connection flanges shall be parallel.

4.3.1.1 Small-size meter casings. Casings of meters in sizes ½ in. (13 mm) through 1 in. (25 mm) shall be of either frost-protection or split-case design, as designated by the purchaser.

4.3.2 *Connections.*

4.3.2.1 ½-in. (13-mm), ½-in. × ¾-in. (13-mm × 20-mm), ⅝-in. (15-mm), ⅝-in. × ¾-in. (15-mm × 20-mm), ¾-in. (20-mm), and 1-in. (25-mm) meters. Main-case connections for meters ½-in. (13-mm) through 1-in. (25-mm) sizes shall be meter-casing spuds having external straight threads (NPSM) conforming to ASME B1.20.1. When a ½-in. (13-mm) or ⅝-in. (15-mm) meter is provided with connections for a ¾-in. (20-mm) pipe, the spud dimensions shall be as shown for the ½-in. × ¾-in. (13-mm × 20-mm) or ⅝-in. × ¾-in. (15-mm × 20-mm) sizes.

Coupling nuts, if required by the purchaser, shall have internal straight pipe threads (NPSM) conforming to ASME B1.20.1.

Coupling tailpieces, if required by the purchaser, shall have external taper pipe threads (NPT) conforming to ASME B1.20.1 and internal diameters that are approximately equal to the nominal thread size of the tailpiece. Lengths and thread sizes shall be as listed in Table 2.

Table 3 Flange dimensions

Meter Size		Minimum Thickness at Bolt Hole		Diameter of Bolt Circle		Number of Bolt Holes	Diameter of Bolt Holes*		Thickness at Hub	
in.	*(mm)*	*in.*	*(mm)*	*in.*	*(mm)*		*in.*	*(mm)*	*in.*	*(mm)*
1½	(40)	9/16	(14.3)	4	(102)	2	1 1/16	(17.5)	13/16	(20.6)
2	(50)	5/8	(15.9)	4½	(114)	2	3/4	(19.0)	7/8	(22.2)

*Minimum

4.3.2.2 1½-in. (40-mm) and 2-in. (50-mm) meters. Main-case connections for 1½-in. (40-mm) and 2-in. (50-mm) meters shall be either spuds on both ends or flanges on both ends.

Spuds shall have internal taper pipe threads (NPT) conforming to ASME B1.20.1.

Flanges shall be faced and drilled and shall be of the oval type. The drilling shall be on the horizontal axis; the number of boltholes and the diameters of the boltholes and bolt circle shall be as listed for companion flanges in Table 3.

Oval companion flanges, gaskets, bolts, and nuts shall be provided if required by the purchaser. Companion flanges shall be faced, drilled, and tapped in conformance with ASME B1.20.1. Dimensions shall be as listed in Table 3.

4.3.3 *Registers.* Registers shall be straight-reading, permanently sealed by the manufacturer, or have replaceable change gears, and shall read in US gallons, cubic feet, or cubic meters as specified by the purchaser. No portion of the reduction gearing or totalizing mechanism shall be in contact with the measured water.

As specified by the purchaser, the register shall be a mechanical display–type register or an electronic display–type register.

4.3.3.1 Mechanical display–type registers. If a mechanical display–type register is provided, the register shall meet the following requirements.

4.3.3.1.1 Configuration. Register gear trains shall be located in the register compartment. Piston oscillations or disc nutations shall be transmitted by magnetic couplings.

4.3.3.1.2 Number-wheel numerals. The totalizing numbers on the registers shall not be less than 5/32 in. (4.0 mm) in height and shall be readable at a 45° angle from the vertical. Billable units shall be clearly indicated on the register.

4.3.3.1.3 Test hands. Registers shall be furnished with center-sweep test hands with an index circle located near the periphery of the register and graduated in

Table 4 Maximum indication on initial dial and minimum register capacity

Meter Size		Maximum Allowable Indication of Initial Dial			Minimum Allowable Capacity of Register (Millions)		
in.	*(mm)*	*ft*^{3}	*gal*	*m*^{3}	*ft*^{3}	*gal*	*m*^{3}
½	(13)	1	10	0.1	0.1	1	0.01
⅝	(15)	1	10	0.1	0.1	1	0.01
¾	(20)	1	10	0.1	1.0	10	0.10
1	(25)	10	100	1.0	1.0	10	0.10
1½	(40)	10	100	1.0	10.0	100	1.00
2	(50)	10	100	1.0	10.0	100	1.00

100 equal parts, with each tenth graduation being numbered. The hand or pointer shall taper to a point and shall be set accurately and held securely in place.

4.3.3.1.4 The quantities indicated by a single revolution of the test hand shall be as listed in Table 4 for initial dial indication. The minimum capacity shall be as listed in Table 4.

4.3.3.2 Electronic display registers. If an electronic display register is provided, the register shall meet the following requirements:

4.3.3.2.1 The electronic display register digits shall not be less than 5⁄32 in. (4 mm) in height and shall be readable at a 45° angle from the vertical position.

4.3.3.2.2 For the purposes of meter testing, the electronic display register shall be capable of directly displaying 1⁄1,000 of the value listed in the initial dial in Table 4.

4.3.3.2.3 The totalized consumption shall be displayed with leading zeros so that all digits capable of displaying are readable.

4.3.3.2.4 The delimiter in the totalized display shall be in the form of a period (.) or comma (,).

4.3.3.2.5 The electronic display register shall clearly distinguish digits used for customary billing units.

4.3.3.2.6 The electronic display register shall be straight reading and shall read in US gallons, cubic feet, or cubic meters, as required by the purchaser.

4.3.3.2.7 The electronic display register shall be permanently sealed so that moisture does not impede the register's operation and readability.

4.3.3.2.8 If a battery is used as the primary power source, the electronic display register shall indicate low battery voltage and shall be designed to provide at least 180 days of useful life from the initial low-battery-voltage indication to the end of the battery's life.

4.3.3.2.9 If rate of flow is part of the register's functionality, the electronic display register shall meet the following additional requirements:

1. The display shall be capable of toggling between totalized flow and flow rate if the same digits are used.

2. The display shall have indication to clearly designate when the display is in rate mode.

3. The display shall be capable of providing flow-rate information—volume (US gallons, cubic feet, or cubic meters) per unit time (per second, per minute, or per hour)—in the purchaser's preferred units of measurement, as required by the purchaser.

4.3.3.2.10 Other alarm indicators, such as "reverse flow," "backflow," "flow direction," or "leak," may be displayed as required by the purchaser.

4.3.3.3 Register boxes. The lid shall be recessed and shall overlap the register box in order to protect the lens. The lens shall be held securely in place.

4.3.3.4 Registers—remote type. If required by the purchaser, the register type shall be a direct-reading remote register (ANSI/AWWA C706) or encoder-type remote register (ANSI/AWWA C707).

4.3.4 *Measuring chambers.* The measuring chambers shall be self-contained units, smoothly finished, firmly seated, and easily removed from the main cases and shall not be produced as part of the main cases. Measuring chambers shall be secured in the main cases so that the accuracy of the meter will not be affected by any distortion of the main case that might occur when operating with a pressure less than 150 psi (1,050 kPa).

4.3.5 *Pistons and discs.* Pistons and discs shall be smoothly finished. Disc plates, whether flat or conical, shall be either reinforced or equipped with thrust rollers if required. Discs may be one piece or composed of a plate with two half-balls. The piston and disc spindles shall be fastened securely. The disc nutations or piston oscillations shall not exceed the quantities listed in Table 1.

4.3.6 *Strainers.* Meters shall either be provided with strainer screens installed in the meter or be self-straining by means of an annular space between the measuring chamber and the external case. Strainer screens shall be rigid, fit snugly, be easy to remove, and have an effective straining area at least double that of the main-case inlet.

4.3.7 *Tamper-resistant features.* Register-box screws, locking pins, case bolts, and inlet and outlet coupling nuts, if provided, shall be equipped with tamper-resistant features. If drilled for seal wires, seal-wire holes shall not be less than 3⁄32 in. (2.4 mm) in diameter.

SECTION 5: VERIFICATION

Sec. 5.1 Rejection

Meters not complying with requirements of this standard and purchaser documents shall be rejected. The manufacturer shall replace or satisfactorily correct meters rejected for failure to comply with this standard.

5.1.1 *Workmanship and materials.* Purchasers should review warranties offered by meter manufacturers and consider applicable warranty protection provided by individual state statute.

SECTION 6: DELIVERY

Sec. 6.1 Marking

The size, model, and direction of flow through the meter shall be marked permanently on the outer cases of all meters. The size (or sizes) of the meter shall be marked permanently on the register dial face. The manufacturer's meter serial number shall be imprinted permanently on the outer case.

6.1.1 *Register-box marking.* The name of the manufacturer shall be marked permanently on the lid of the register box. The serial number of the meter shall be imprinted on the lid.

Sec. 6.2 Packaging and Shipping

This standard has no applicable information for this section.

Sec. 6.3 Affidavit of Compliance

The purchaser may require an affidavit from the manufacturer that the meters provided comply with applicable requirements of this standard.

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APPENDIX A

Bibliography

This appendix is for information only and is not a part of ANSI/AWWA C700.

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APPENDIX B

Supplemental Information

This appendix is for information only and is not a part of ANSI/AWWA C700.

SECTION B.1: UNITS OF MEASURE

The majority of water meters presently in service in the United States register in either US gallons or cubic feet. With the availability of the metric system, the user may now determine the most suitable unit of measure from the three available units—US gallons, cubic feet, or cubic meters.

SECTION B.2: REGISTER DIAL TYPES

The recommended water-meter register is the straight-reading odometer type, with billable units shown with black numbers on white dials. Although the round-reading type is still in existence, it is no longer manufactured. The round-reading type is more often misread, and the problem is further complicated if more than one make of meter is used in a single water system. Also, it is more difficult to print postcards for customers to record meter readings when two or more makes of meters with round-reading registers are used.

SECTION B.3: TESTS

Sec. B.3.1 Capacity and Pressure-Loss Tests

Capacity tests are tests of the design of a meter. Once a meter of each size of a given design has been tested for pressure loss at safe maximum operating capacity, it should not be necessary to test others of the same design. The pressure loss should be determined using two identical piezometer rings of the same diameter as the nominal size of the meter being tested. The piezometer rings must be free from any burrs where the holes are drilled through the wall of the ring. No fewer than four holes should be provided, drilled in pairs on diameters at right angles to each other. The inlet ring should be set close to the meter at a distance of eight diameters or more below the nearest upstream stop valve or fitting. The outlet ring should be placed at a distance of eight to 10 diameters from the outlet of the meter. The diameter of the inlet and outlet pipes should be the same as the nominal size of the meter to be tested. The rings are to be connected to a suitable differential pressure cell or manometer with a measurement capability of 0.1 psi (0.7 kPa). If a manometer is used, provisions should be made for the complete removal of air from the apparatus, and the installation should be such that air will rise to the air outlets.

Provisions must be made for traps to prevent accidental expulsion of mercury into the test line when using mercury manometers. If measurements of U-tube manometers are to be made at relatively high flow rates, it is necessary to read both sides of the mercury column simultaneously to compensate for irregularities in the diameter of the manometer tube and to avoid errors caused by fluctuations. (Other appropriate types of manometers may be used.)

The pressure loss of inlet and outlet piping from meter to piezometer rings should be deducted in determining meter pressure loss.

Sec. B.3.2 Pressure Tests

A pressure test should be made on each size of a particular design of meter provided. The test pressure should be 300 psi (2,100 kPa) static for 1 min, which may be produced by use of a hand pump or any other available device. The meter should be tested for accuracy before and after it has been pressure-tested to determine whether there has been any distortion that could affect the registration. If satisfactory results are obtained, it is unnecessary to make more than one pressure test on each size of a given design of meter.

Sec. B.3.3 Accuracy Tests

Meters should be tested for accuracy of registration at flow rates and test-flow quantities in accordance with Sec. 4.2.8 of ANSI/AWWA C700 and AWWA Manual M6. If the purchaser does not have suitable means for testing, the manufacturer should be requested to provide a certificate showing that each meter has been tested for accuracy of registration and that it complies with the accuracy and capacity requirements of ANSI/AWWA C700.

SECTION B.4: TESTING EQUIPMENT

The measuring device that is used to determine the amount of water discharged when testing should be designed to provide measuring accuracy to within 0.25 percent of the actual quantity. Tanks and scales should be tested and calibrated at least once a year and records kept of such tests and calibrations.

SECTION B.5: REGISTRATION ACCURACY

In a displacement meter, the motion of the measuring element (piston or disc) is transmitted by a system of gearing to the register, which records the flow in convenient units of measure. The gearing translates the motion of the element into the unit of measure indicated by the register. The registration is directly dependent on the number of nutations or oscillations of the element. The registration is a true measure of flow only when the meter has been properly calibrated. After proper calibration, the meter should continue to register correctly only so long as the element continues to make the required number of cycles for each unit of quantity that passes through the meter. If any condition develops whereby the element is compelled to make other than the required number of cycles per unit of quantity that passes through the meter, the registration will not be accurate. Under ordinary working conditions, several factors may cause inaccurate registration after comparatively short intervals. The more important of these factors are excessive wear, extreme temperatures, corrosion, materials in suspension, and the presence of entrained air in the lines.

Sec. B.5.1 Excessive Wear

Excessive wear of moving parts of the meter may be caused by improper setting or by overspeeding because the meter is too small for the water demand. The results of excessive wear of the measuring chamber are slippage and underregistration. Excessive wear in the register reduction gearing may cause the gears to slip or bind. In either case, if the meter does not stop entirely, underregistration will result. To avoid excessive wear, meters should not be operated at excessive speeds. The safe maximum operating capacities listed in Table 1 of ANSI/AWWA C700 are the maximum rates of flow at which water should be passed through the meter for only short periods of time and at infrequent intervals. Maximum flow could be destructive if continuous. For continuous 24-hr service, displacement meters should not be operated at flows greater than approximately one-half the safe maximum operating capacities as listed in column 4 of Table 1 of ANSI/AWWA C700.

Sec. B.5.2 Temperature Extremes

Cold-water meters are not affected by temperatures of up to approximately 80°F (27°C). For temperatures higher than 80°F (27°C), meters with slightly larger than usual clearances should be used and the accuracy limits, as stated in Sec. 4.2.8 of ANSI/AWWA C700, may have to be modified. High temperatures can cause the expansion of pistons and discs and create unusual friction or bind the parts in the chambers. The results are slippage and underregistration or complete stoppage of the meter. Lower temperatures have no noticeable effect on the working parts of the meter unless the water freezes, which will cause damage to the meter. To avoid the problems caused by temperature extremes, meters should be located where they will be protected from extreme heat, direct sunlight, and freezing. If the authority having jurisdiction so requires, at locations where hot water from heating systems is not allowed to expand back through the meter, a backflow-prevention device, consistent with the degree of hazard, and a pressure- and temperature-relief valve should be installed sufficiently downstream of the meter.

Sec. B.5.3 Corrosion

The metals used in the construction of a meter are affected by the corrosive action of water, although the action is very slow with most potable waters. However, it should be recognized that when meters are used in highly aggressive waters, it may be necessary to use materials that are more resistant to corrosive attack. A high degree of experience and knowledge is required to solve corrosion problems, and the manufacturer should be consulted for assistance.

Sec. B.5.4 Materials in Suspension

Foreign material carried in suspension has a tendency to fill the spaces between the measuring element and the measuring chamber, thus affecting registration. Meters provided with strainers will retain the larger particles in suspension, but the strainer will soon become clogged if the water is not kept reasonably free from suspended matter. Sand is especially destructive, and care should be exercised to keep sand from reaching meters.

Sec. B.5.5 Entrained Air

Water meters will record the presence of entrained air in the lines inaccurately; this inaccuracy can result in substantial overregistration under certain circumstances. In addition, entrained air can cause meter damage and premature wear; precautions should be taken to either eliminate or minimize this condition.

SECTION B.6: PERIODIC TESTS

Meters properly selected as to size and type should give satisfactory service over a long period of time without attention only if operated under ideal conditions. Under ordinary conditions, meters must be given some care if they are to function properly. In most cases, it is impossible to ascertain without actual testing whether a meter in service is registering with the required degree of accuracy. Consequently, to ensure reliable meter measurements, it is essential that all meters be subjected to periodic tests. The intervals between tests and the methods for conducting them must be governed largely by local conditions. Many state regulatory commissions specify intervals between tests on both a time and a quantity basis. The most frequently used intervals between tests are stated in Table B.1.

Sec. B.6.1 Time Intervals

The time interval between tests should be based on local conditions and the amount of consumption. Sec. B.5 should be reviewed in its entirety before establishing test intervals for individual utilities.

SECTION B.7: METER STORAGE

Meters should be stored in a location that is not subject to unduly high or low temperatures. When the meters are to be stored outdoors for an extended period of

Table B.1 Most frequently used intervals between meter tests

Meter Size		
in.	*(mm)*	Years Between Tests
½	(13)	10
⅝	(15)	10
¾	(20)	8
1	(25)	6
1½	(40)	4
2	(50)	4

time, they should be capped and covered to protect them from exposure to direct sunlight.

SECTION B.8: INSTALLATION

Any and all instruction manuals supplied by the manufacturer should be reviewed in detail before installation of meters. Service line valves before and after the water meter are recommended to facilitate customer shutoffs and meter servicing or replacement. It is recommended that new service lines be flushed prior to installing a water meter. A spool piece of a length matching the meter to be installed should be used in place of the installed meter when flushing. An old meter with the measuring element removed could be used in place of the spool piece.

Sec. B.8.1 Electrical Grounded Pipe Systems

"AWWA opposes the systematic interchange of stray electric current between electrical distribution systems and water distribution systems, as well as the use of the water pipe system as an essential part of any electrical system. AWWA does not object, however, to the connection of all interior piping of a building to the electrical service neutral and to a separate grounding electrode, provided that such interior pipe systems and grounding connections are electrically isolated from the water utility pipe system."* At the time this edition of ANSI/AWWA C700 was published, the AWWA policy statement on the grounding of electrical circuits to water pipes had last been revised on Jan. 19, 2014. However, it must be recognized that many pipe systems continue to be used as a grounding electrode system.

Sec. 250.53(D) of the National Electrical Code® (NEC) requires that "continuity of the grounding path or bonding connection to interior piping shall not rely on water meters."† Most utilities require a permanent conductive meter setting or a grounding strapping around meters to prevent accidents to workers changing meters. Meters, both metal and plastic, should be installed in a permanent metallic meter setter or provided with permanently ground-strapped strapping. This is especially important in the case of plastic main cases or plastic meter couplings, which are nonconductors of electricity.

* Statement of Policy on Public Water Supply Matters: Grounding of Electrical Circuits on Water Pipe. AWWA, Denver, Colo. (2014).

† Available from the National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169.

Sec. B.8.2 Misaligned Pipes

Meters should be set in a horizontal position and protected from freezing, damage, and tampering. The line opening in which the meter is to be set should match the lay length, allowing slight additional space for coupling gaskets. The inlet and outlet sides of the meter should be axially aligned to the service pipes. The meter should not be used to straighten misaligned pipes because of the potential for damage to the meter. This is especially true when meters with plastic threads are installed in outdoor pits. Installing meters with plastic threads in outdoor-pit settings where the service lines are subject to continual misalignment caused by ground shifting should be avoided, unless a meter set or other specialty connectors are used.

Sec. B.8.3 Meter Installation Methods

To prevent cross-threading at installation, the meter should be set between the coupling nuts with the direction of flow through the meter corresponding to the direction of flow in the system. The coupling nuts should be engaged to the threaded meter ends. It shall be ensured that the nuts are properly aligned to avoid cross-threading damage to the threaded meter ends. An effective method for properly starting meter coupling nuts is to position the nuts squarely against the meter spud end. The nut is turned counterclockwise (in reverse) while holding the nut against the meter spud ends. When the first threads on both the coupling nut and the meter spud end coincide, a slight clicking or snap will be heard as the nut moves into the starting position. The nut is then turned clockwise to complete the connection. On plastic thread systems, the use of pipe wrenches on the meter body itself shall be avoided. After the coupling nut has engaged the first thread of the meter, the coupling nut is turned clockwise by hand until it is tight, and then a partial turn with an open-end wrench. Do not overtighten. Pipe dope and sealants are not required or recommended. Soft rubber gaskets, rather than fiber or leather washers, are recommended for plastic thread systems.

Sec. B.8.4 Placing Meter in Service

After the line has been thoroughly flushed, the shutoff valve should be opened slowly to pressurize the service line to the meter setting. The inlet side valve should be slowly opened, which will fill the meter with water. The meter and connections should be checked for leaks. The meter outlet side valve should be opened slowly to pressurize the consumer side of the system. A consumer faucet should be opened slowly to allow entrapped air to escape. The faucet is then turned off.

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