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(First Edition)

American Water Works Association

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AWWA Standard

Microfiltration and Ultrafiltration Membrane Systems

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AWWA Standard

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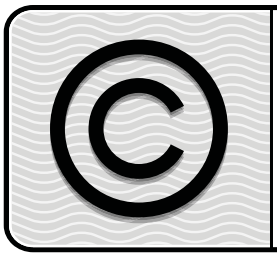

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA B112-15.*

I. Introduction.

I.A. *Background.* The purpose of ANSI/AWWA B112-15 is to provide purchasers with a standard for the purchase and installation of microfiltration (MF) and ultrafiltration (UF) membrane treatment systems.

A wealth of information about MF and UF membrane systems and their design is available from various sources, including *Journal - American Water Works Association*, AWWA Manual M53,† *Water Treatment Plant Design*,‡ *Water Quality and Treatment*,§ and other references listed in appendix A.

I.B. *History.* MF and UF membranes have been used to treat water for municipal use since the 1980s. Membrane technology has been and continues to be developed, improved, and widely applied in a myriad of water treatment applications, including producing potable water from groundwater under the direct influence of surface water and surface water sources as well as pretreatment for membrane desalting systems. Today, potable water production with membrane technology is widely accepted and practiced worldwide.

The potential for membranes in the production of potable water was already well proven when the US Environmental Protection Agency (USEPA) promulgated the Surface Water Treatment Rule (SWTR), which allowed the states to accept and permit alternatives to conventional granular media filtration. Pilot studies conducted during the development of the SWTR led to the acceptance of the first MF and UF membrane installations for microbial removal credit in the mid-1990s. Today, numerous utilities throughout the United States and around the world have installed MF and UF systems for potable water and reclaimed water applications, and the number is growing. Utilities in the United States and Canada routinely consider MF and UF systems acceptable treatment methods.

Membranes are made from a variety of polymeric and inorganic materials, although polymeric varieties currently predominate. New membrane materials, structures, and

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† AWWA, *Microfiltration and Ultrafiltration Membranes for Drinking Water*, Manual of Water Supply Practices M53, 2nd Ed. (2005).
‡ AWWA and ASCE, *Water Treatment Plant Design*, 5th Ed., McGraw-Hill (2005).
§ AWWA, *Water Quality and Treatment*, 6th Ed., McGraw-Hill (1999).

surface treatments are being developed. For comparisons between membrane performance parameters to be meaningful, test conditions must be carefully considered, since they can have a marked effect on results. Membrane separation performance can be described by a variety of measures, including nominal molecular weight cutoff, nominal and absolute pore size, permeability, and bubble point, all within the context of specific test conditions. Measurement of membrane performance including separation and output is not standardized by regulatory agencies. However, some standards groups have published standardized measurement methods and the industry has developed common and accepted approaches. This is one of the purposes of the testing requirements outlined in the USEPA *Membrane Filtration Guidance Manual* (USEPA 2005) associated with the Long Term 2 Enhanced Surface Water Treatment Rule (USEPA 2006).

Regulatory concerns may or may not be the primary drivers for the use of membranes by a municipality, but in all cases the regulations must be assessed for applicability. At present, US federal drinking water standards covering membrane treatment deal mainly with how much removal credit can be received from membrane treatment's use as a microbial barrier. Such other issues as acceptable water contact materials and meeting the primary and secondary contaminant levels in the finished water may also apply.

This membrane standard is intended to aid utilities in the selection and procurement of MF and UF filtration systems and in the regulatory permitting process. This standard should be considered as a list of minimum requirements for planning, procurement, selection, construction, and commissioning of MF- and UF-based treatment systems. However, its proper application requires this standard to be coupled with a thorough professional review of site-specific water treatment conditions.

On June 14, 2009, the AWWA Board of Directors approved the first edition of AWWA/ANSI B110-09, Membrane Systems Standard. The intent of the standard was to provide a standard for all membrane systems used in treating water. Subsequent to that, the Membrane Standards Committee elected to create standards that are more specific to each general membrane type—microfiltration and ultrafiltration, nanofiltration and reverse osmosis, and electrodialysis and electrodialysis reversal. In addition to the new standards for these membrane systems, a new standard (B130) was also to be developed for membranes used in wastewater treatment, such as membrane bioreactors.

The AWWA Standards Council authorized a new AWWA standard for MF and UF systems in September 2010 and assigned the task of development to the AWWA Standards Committee on Membrane Standards.

A guide to the AWWA membrane systems standards is presented in Table 1.

Table 1 Guide to AWWA membrane standards and typical membrane characteristics

Membrane Type	Applicable AWWA Standard	Nominal Pore Size *(µm)*	≥3-µm Particle or Surrogate Organism Removal	Virus (MS2 Phage) Removal	Typical Molecular Weight Cutoff *(daltons)*	Salt (NaCl) Rejection *(%)**
Microfiltration (MF)	B112	0.1 to 0.5	≥99.9% (≥3 log)	<90% (<1 log)	≥200,000	None
Ultrafiltration (UF)	B112	0.005 to 0.1	≥99.9% (≥3 log)	≥90% (≥1 log)	10,000 to 200,000	None
Nanofiltration (NF)*,†	B114	0.001 (approximate conceptual value)	Same as UF, but typically not designed for verifiable removal	Same as UF, but typically not designed for verifiable removal	~ 200 to > 500	0% to 95%
Reverse osmosis (RO)†	B114	0.001 (approximate conceptual value)	Same as UF, but typically not designed for verifiable removal	Same as UF, but typically not designed for verifiable removal	<200 to 500	>95%
Electrodialysis/ion-exchange membranes (IEMs)	B116	Not applicable	Not applicable: demineralized product does not pass through a membrane barrier	Not applicable: demineralized product does not pass through a membrane barrier	Not applicable	>45%
Membrane bioreactors (MBRs)	B130	§	§	§	§	§

* NF is similar to RO with the key difference being that NF has lower sodium chloride rejection than RO and NF exhibits greater selectivity in the types of ions that are removed such that NF allows a comparatively higher percentage of monovalent ions to pass to the permeate than multivalent ions.

† For NF and RO, rejection is generally based on test conditions for a single element, but there is some variation among membrane manufacturers and membrane models. In general, test conditions tend to vary as follows: (1) feed solutions: 500 to 700 mg/L sodium chloride, magnesium chloride, calcium chloride, or mixed solute solutions for NF; 1,500 to 2,000 mg/L sodium chloride for brackish water RO membranes; 32,000 to 38,000 mg/L sodium chloride for seawater RO membranes; (2) 25°C (77°F) temperature or corrected to that temperature; (3) 6 to 8 pH; (4) 8 to 20 percent recovery per element.

‡ Standard B114 is still under development.

§ For a description of typical MBR characteristics, please refer to AWWA Standard B130-13.

This first edition of new standard ANSI/AWWA B112-15, Microfiltration and Ultrafiltration Membrane Systems for Water Treatment, was approved by the AWWA Board of Directors on Jan. 24, 2015. The standard was approved and promulgated in the course of the activities of the AWWA Standards Committee on Membrane Standards.

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 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 or local agency.
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 60 and 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.

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

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

‡ American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

§ Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

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.

II. Special Issues. There is no consensus of opinion in academic, scientific, applied engineering, and regulatory practitioners for the precise definitions of reverse osmosis (RO), nanofiltration (NF), ultrafiltration (UF), and microfiltration (MF). The definitions and typical membrane characteristics of the membrane types shown in this standard are considered applicable to this standard and its use.

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.* The following items should be provided by the purchaser:

1. Standard used—that is ANSI/AWWA B112-15, Microfiltration and Ultrafiltration Membrane Systems, latest revision.
2. Details of other federal, state, local, and provincial requirements (Sec. 4.1.1).
3. Required equipment (Sec. 4.2.1).
4. Excluded systems and facilities (Sec. 4.2.2).
5. Required net production rate (Sec. 4.3.1.b).
6. Required documents for permitting (Sec. 4.3.1.u and 4.3.3.e).
7. Record drawings format (Sec. 4.3.4).
8. Whether compliance with NSF/ANSI 60 or NSF/ANSI 61 or other standards, rules, or regulations in addition to the requirements of the Safe Drinking Water Act is required (Sec. 4.6.4, 4.6.4.1, 4.6.4.2).
9. Element shipment requirements (Sec. 4.6.6.2).
10. Spare part requirements (Sec.4.6.7.1).
11. Interface coordination requirements on project drawings (Sec. 4.6.8.1).
12. Electrical coordination requirements on project drawings (Sec. 4.6.8.4).
13. Instrumentation and control requirements on project drawings (Sec. 4.6.8.5).
14. Pneumatic requirements on project drawings (Sec. 4.6.8.6).
15. Flushing requirements (Sec. 5.1.2).
16. Installation requirements (Sec. 5.1.3).
17. Preservation flushing and disposal requirements (Sec. 5.1.4).

18. Requirements for approval of field testing (Sec.5.4.1).
19. Demonstration testing requirements (Sec. 5.4.4).
20. Performance testing requirements (Sec. 5.4.5).
21. Basis for rejection (Sec. 5.5).
22. Affidavit of compliance (Sec. 6.3)

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

IV. Major Revisions. This is the first edition of this standard.

V. Comments. If you have any comments or questions about this standard, please contact 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.

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AWWA Standard

Microfiltration and Ultrafiltration Membrane Systems

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard sets minimum requirements for microfiltration (MF) and ultrafiltration (UF) membrane systems for water and reclaimed water filtration systems. This standard does not cover the membranes used in biological wastewater treatment, such as membrane bioreactors.

Sec. 1.2 Purpose

The purpose of this standard is to provide a minimum set of requirements for MF and UF systems used for water and reclaimed water filtration systems. This standard is intended to assist with the design, procurement, installation, and commissioning of MF and UF systems.

Sec. 1.3 Application

This standard can be referenced for design, procurement, installation, and commissioning of MF and UF systems used for water and reclaimed water filtration systems.