ANSI/AWWA B100-16
(Revision of ANSI/AWWA B100-09)

American Water Works Association

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AWWA Standard

Granular Filter Material

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AWWA Standard

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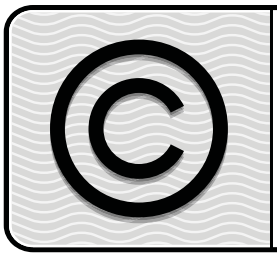

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Contents

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 B100.*

I. Introduction.

I.A. *Background.* The purpose of ANSI/AWWA B100 is to provide purchasers with a standard for the purchase and installation of granular filter material (filter material).

A wealth of information on innovations in filter design is available from various sources, including *Journal AWWA*, *Water Treatment Plant Design*,† and references found in appendix A. These sources include design parameters for filters using single and multiple media. As a result, ANSI/AWWA B100 makes reference to filter design only as the design relates to the filter materials used. ANSI/AWWA B604, Standard for Granular Activated Carbon (GAC), should be consulted when using GAC as a filter medium, because GAC is not specifically covered in ANSI/AWWA B100.

I.B. *History.* The AWWA Standard for Filtering Material was approved as tentative by the AWWA Board of Directors on Nov. 15, 1948, and as a standard on Jan. 16, 1950. Revisions were approved on June 2, 1953, Jan. 31, 1972, June 20, 1980, Jan. 29, 1989, Dec. 1, 1996, and June 17, 2001. The original standard was approved and promulgated in the course of activities of the Water Purification Division and under jurisdiction of the Committee on Water Works Practice. The last edition was approved on Jan. 25, 2009. This edition was approved on Jan. 16, 2016.

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

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† AWWA, ASCE, and CSSE. *Water Treatment Plant Design*, 5th Ed. Denver, Colo. (2012).
‡ Persons outside the United States should contact the appropriate authority having jurisdiction.

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 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.

ANSI/AWWA B100 does not address additives requirements. Thus, 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.

II. Special Issues.

II.A. *Source of Supply.* Filter material, such as silica sand, high-density sand, granular activated carbon, or anthracite, as well as support gravel, should be obtained from sources that can certify the site-specific manufacturing facilities are

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

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

expressly qualified to produce and supply these materials for water treatment plants, in compliance with the ANSI/AWWA B100 standard.

II.B. *Filter Media.* Filter media are the component of a filter that removes particulate matter from the water during the filtration process. This standard describes anthracite, silica sand, high-density sand, and filter-media support gravel material.

High-specific gravity (high-density) filter media consisting of garnet, ilmenite, hematite, magnetite, or associated minerals of those ores are used by some utilities in an attempt to remove more suspended solids at higher filtration rates. These small, high-density media remain as a layer under the silica sand as a result of particle size and specific gravity differences in the same way that silica sand remains separated from overlaid anthracite in a dual-media filter. Some intermixing usually occurs at the interface between the layers.

The term *garnet* refers to several different minerals (mostly almandite and andradite) that are silicates of iron, aluminum, and calcium mixtures. However, garnet could also be grossularite, spessartite, and uvarovite, the latter being a chromium mineral. Ilmenite is an iron titanium mineral that invariably is associated with hematite and magnetite, both iron oxides.

Properties of granular activated carbon when used as a filter medium are described in ANSI/AWWA B604, Standard for Granular Activated Carbon. Testing requirements for granular activated carbon vary from those for anthracite, silica and garnet. Refer to ANSI/AWWA B604, Standard for Granular Activated Carbon.

Properties of media used in precoat filters (such as diatomaceous earth) can be found in ANSI/AWWA B101, Precoat Filter Media. Synthetic media and membrane filters are not included in this standard.

Sand or anthracite filter media used in a wide range of bed depths and particle sizes have produced satisfactory results. Selection of the bed depth, particle size, and particle density of each media layer to be used in any particular filter is the responsibility of the designer and should be done with careful consideration of raw water conditions, plant pretreatment facilities, and filter backwash system design.

If questions arise regarding the authenticity of the anthracite filter medium relative to the standard, the procedures and calculations for anthracite verification can be found in ASTM D388—Standard Classification of Coal by Rank. The results of the verification shall be reported as anthracite or nonanthracite.

If questions arise regarding the silicon dioxide content of silica sand, the content can be determined using ASTM C114-15 Standard Test Method for Chemical Analysis of Hydraulic Cement. The result can be reported as percent silicon dioxide.

II.C. *Particle Size Distribution.* There are two methods of classifying particle size distribution. The designer and end user are cautioned not to use both methods simultaneously. These methods are described in appendix C of this standard.

II.D. *Filter-Media Support.* If the openings in the underdrain system are larger than the filter media, a system of supporting material is required to prevent the filter media from entering and blocking the underdrain system and to help distribute backwash water evenly. This can be achieved by layers of gravel installed over the underdrain system or by use of proprietary media support systems provided by underdrain system manufacturers. When using gravel, the size and depth of the gravel layers must be selected to achieve the objectives of minimizing media loss through the underdrains, aid in evenly distributing backwash water, and minimizing displacement of the gravel by the rising backwash water and/or air scour supply. Guidance for selecting appropriate support gravel size and layer depths, along with examples, is included in appendix D. The use of air scour must also be considered in the proper selection of underdrain and media support systems. The user of this standard is urged to carefully consider several factors in determining the appropriate underdrain and filter-media support system for a particular application, including water quality, filter operating and backwash rates, whether air scour is provided, and type of treatment practiced at the facility (softening, biological filtration, etc.). Information and guidance to assist the user in proper selection of filter underdrains and media support systems are available in several of the references included in appendix A. In addition, advice and guidance can be solicited from underdrain system manufacturers and qualified consulting engineers.

II.E. *Acid Solubility.* An acid-solubility test is included in this standard to provide a means of measuring acid-soluble minerals or other impurities that may be present in the filter material. The limits for acid solubility given in this standard are based on tests of filter material with proven performances in a wide range of water treatment applications. Acid-solubility limits are necessary to ensure against substantial quantities of detrimental minerals or other substances in the filter material and also to ensure against substantial solution of filter material in acidic waters or during an acid cleaning. In many cases, the principal acid-soluble impurity in filter silica sand and gravel is calcium carbonate (limestone).

II.F. *Anthracite Quality Test.* ANSI/AWWA B100 defines *anthracite*, as used herein, as anthracite coal in accordance with ASTM D388. The intent of this reference and definition is to provide the capability to verify the specified filter media is anthracite coal and not bituminous coal.

II.G. *Bulk Shipment.* The issue of protecting filter material from contamination during shipment is addressed in this standard.

Bulk shipment is not recommended; however, when trucks or railcars are specified for hauling a bulk shipment of filter material, it is recommended that an impermeable plastic liner be used because the trucks or railcars may be contaminated from hauling previous bulk material.

Vibration during transit will result in segregation of the filter material, with the coarser material migrating toward the top. If one compartment of the bulk shipment is divided between two or more filters or filter halves, the media are likely to have different size gradations and consequently perform differently. Therefore, if bulk shipment is allowed, the container should be required to be compartmentalized so that each compartment fills no more than one filter cell. If it is specified, representative filter media samples for analysis can be obtained at the point of production or loading and a duplicate sample can be provided to the user if additional testing is required. If the purchaser requires sampling at the time of delivery, this requirement should be stated in the contract documents.

II.H. *Media Records.* Users are encouraged to maintain records of the physical characteristics and chemical composition of filter material installed in filters. For limits on undesirable impurities, refer to NSF/ANSI 61 and Sec. I.C in the foreword.

II.I. *Removal of Filter Material and Reuse.* Occasionally, there are circumstances, such as a filter media upset, an underdrain problem, or a header-lateral distribution system problem, that will cause the necessity for removal of filter material from the filter cell and replacement or reuse of the material. Unless the filter material is new or found by visual inspection to be in near-original condition, reuse is discouraged because the material will be worn to some degree, may be coated, may be damaged or contaminated during handling, and may create potential filtering problems if not properly combined with new material to obtain a desired gradation. In addition, removed material should not be installed in another filter plant without proper investigation of process and filter gradation requirements.

Removal may be performed hydraulically, pneumatically or by hand excavation. Care must be taken not to damage filter cell components, such as the underdrain or header lateral system. If any component is damaged, it should be replaced immediately. If the filter material is to be replaced, it should be disposed of in accordance with applicable regulations. If the filter material is to be reused, extreme care must be taken not to damage or contaminate it. The filter material should be stored in clean containers or on clean reinforced impervious tarpaulins that have not been used for any other

purpose. The containers or tarpaulins shall then be covered with a durable opaque material to protect the filter material from the weather and airborne contaminants. If any filter material becomes contaminated, it shall be replaced or cleaned to the user's satisfaction.

Disturbed filter-media support gravel should be replaced in its proper gradation prior to reuse and should be sieved to its original gradations. Filter media components (high-density sand, silica sand, or anthracite) will be intermixed and should be separated through sieving or other methods. A small quantity of the filter media may still remain intermixed but should restratify during backwashing. Any additional high-density sand and silica sand required should have the same size and specific gravity characteristics as the originally specified sands. Anthracite to be reused should have representative samples taken and tested to determine its uniformity coefficient and effective size so that any additional anthracite required can be properly sized to provide a combined anthracite bed meeting original user requirements.

Placement of the filter material in the filter cell, backwashing, and disinfection should be in accordance with procedures stated in this standard. This standard does not apply to reuse of GAC. See ANSI/AWWA B605, Granular Activated Carbon, for GAC reuse requirements.

II.J. *Possible Adverse Effects on Submerged Concrete Walls in Filter Box.* Aggressive waters have been identified as being responsible for attacking submerged surfaces of concrete structures. Filter backwashing, including surface wash, may be responsible for accelerating this action by removing loose or softened materials at the surface of the concrete in filter boxes. The purchaser may want to evaluate the need to provide a protective coating on submerged surfaces of concrete based on the quality of the water being filtered.

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 covered by the purchaser:

1. Standard used—that is, ANSI/AWWA B100, Granular Filter Material, of latest revision.
2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.
3. Whether project includes providing filter material only or providing and placement of materials and preparation for service.

4. Whether an affidavit of compliance is required or whether the purchaser will select a representative to inspect supply for compliance with this standard (Sec. 6.3).

5. Sizes, types, and characteristics of filter material required and quantities of each (foreword II.B and II.C, Sec. 4.1.1, and Sec. 4.1.2). For filter media sampling after initial placement, the supplier, manufacturer, or constructor should supervise the transportation, handling, on-site storage, placement, and field preparation of the filter media for sampling. This includes backwashing of filter media prior to sampling. Sampling before delivery and/or after delivery prior to placement is recommended to verify compliance with the purchase documents. Sampling after placement is not a substitute for sampling after delivery prior to placement because of the effects of installation and the difficulties in collecting representative samples. Sampling for monitoring purposes after placement may help in documenting the installed conditions, the effectiveness of post-installation skimming and backwash, and any media fines retained following the installation. Testing results can form a benchmark for subsequent condition monitoring and filter condition records. Guidance is provided in appendix E.

6. Method of placing the material (Sec. 4.4.2).

7. Method of disinfecting (Sec. 4.5.3) and who will perform the disinfection procedure.

8. Sampling before delivery (Sec. 5.1) and after delivery prior to placement (Sec. 5.2).

9. Whether an affidavit of compliance is required (Sec. 6.3) or whether the purchaser will select a representative to inspect supply for compliance with this standard.

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

1. Sec. 4.1.1.4, added language highlighting that test procedures for granular activated carbon when used as a filtering material vary from those indicated in this standard for anthracite and can be found in AWWA B604.

2. Sec. 4.1.1.5, added language stating that when defining fine media effective size, a plus and minus tolerance range shall be allowed to account for sampling, testing, and test repeatability variances.

3. Sec. 5.1, added language stating that samples taken during the manufacturing process before delivery in accordance with this standard are more representative than samples taken after delivery prior to placement or after placement because of the

effects of transportation, handling and installation, and difficulties in collecting representative samples in the field.

4. Sec. 5.3.4.3, modified language in accordance with latest revisions to ASTM E11 describing test sieves and procedures.

5. Appendix B, Table B.1, modified column 4, "Permissible Variation of Average Opening From Standard Sieve Designations," in accordance with revised ASTM E11

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.

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SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes gravel, high-density gravel, silica sand, high-density media, anthracite filter materials, and the placement of the materials in filters for water supply service application. ANSI/AWWA B604, Standard for Granular Activated Carbon, addresses use of GAC as a filter medium and as an adsorbent.

Sec. 1.2 Purpose

The purpose of this standard is to provide purchasers with a standard for purchasing and installing granular filter material (filter material) and is not a guide for filter design.

Sec. 1.3 Application

This standard can be referenced for purchasing and receiving filter material and can be used as a guide for testing the physical and chemical properties of filter material samples. The stipulations of this standard apply when this document has been referenced, and then only to filter materials used in the treatment of drinking water supplies.