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ANSI/AWWA B605-18
(Revision of ANSI/AWWA B605-13)

AWWA Standard

Reactivation of Granular Activated Carbon

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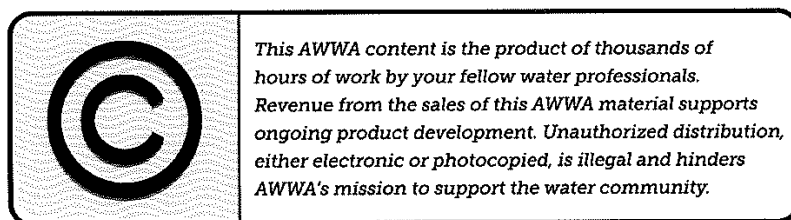
AWWA Standard

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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.

SEC.	PAGE	SEC.	PAGE
Foreword		4	Requirements
I	Introduction..... vii	4.1	Physical/Chemical Requirements..... 4
I.A	Background..... vii	4.2	Performance Criteria for Reactivated GAC 5
I.B	History..... vii	4.3	Characterizing Spent GAC 6
I.C	Acceptance vii	4.4	Handling and Transporting GAC.... 7
II	Special Issues. viii	4.5	Reactivation Facility 8
II.A	General viii	4.6	Placing Reactivated GAC Filter Medium 9
II.B	Source of Supply and Services..... ix	4.7	Preparing the Filter for Service 9
II.C	GAC Size Distribution ix	4.8	Impurities..... 9
II.D	Adsorptive Capacity x		
II.E	Caution in Handling and Storage.... xi	5	Verification
III	Use of This Standard xi	5.1	Sampling..... 9
III.A	Purchaser Options and Alternatives xi	5.2	Testing Methods..... 11
III.B	Modification to Standard xii	5.3	Basis for Shipment, Acceptance, and Rejection of Reactivated GAC... 11
IV	Major Revisions..... xii		
V	Comments xiii	6	Delivery
		6.1	Marking 12
		6.2	Packaging and Shipping 13
		6.3	Affidavit of Compliance 14
Standard		Appendix	
1	General	A	Bibliography..... 15
1.1	Scope..... 1		
1.2	Purpose 1		
1.3	Application..... 1		
2	References 2		
3	Definitions 2	Table	
		1	Sampling of Bagged Media..... 10

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Foreword

This Foreword is for information only and is not a part of ANSI/AWWA B605.*

I. Introduction.

I.A. *Background.* A number of municipal water utilities employ granular activated carbon (GAC) to remove organic impurities from potable water sources.

These impurities include compounds imparting taste and odors, algal toxins, synthetic organic compounds, endocrine disruptors, pharmaceutically active compounds, and disinfection byproduct precursors. As GAC service time increases, GAC's capacity to adsorb impurities decreases. When the GAC filter no longer produces water of the desired quality, a potable water utility faces the decision either to replace the GAC with virgin (new) carbon or to reactivate the used GAC and use it again. This standard offers guidelines for reactivation and is intended to provide criteria for use by the potable water utilities that use granular activated carbon and to the suppliers who provide a thermal reactivation service.

I.B. *History.* The AWWA Standards Council authorized the development of this standard in 1993. The standard was developed by the AWWA Reactivation of Granular Activated Carbon Subcommittee, and the first edition was approved by the AWWA Board of Directors Jan. 14, 1999. Subsequent editions were approved on Feb. 15, 2007, and Jan. 20, 2013. This edition was approved on Jan. 20, 2018.

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

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

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

1. Specific policies of the state or local agency.
2. 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.
3. 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 jurisdiction. 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 B605 does not address additives requirements. Users of this standard should also 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. *General.* A description of virgin GAC and its production is provided in ANSI/AWWA B604, Granular Activated Carbon.

GAC is used to remove a broad spectrum of impurities from water. At some point in the service life of a GAC, the GAC adsorption capacity decreases to the point that the GAC no longer produces the desired effluent water quality. At this time, the GAC is characterized as *spent*, and it must be replaced. The spent GAC can be disposed of and replaced with virgin GAC, or the spent GAC can be reactivated and reinstalled for additional use.

^{*} 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.

During reactivation, GAC is typically exposed to the following conditions: drying, desorption/devolatilization, pyrolysis, and oxidation. The reactivation process requires high-temperature conditions. Reactivation is a form of regeneration. Regeneration can also include low-temperature processes that may not be as effective as reactivation.

Varying conditions within a water treatment plant, such as process upsets, length of GAC service, or widely fluctuating influent water quality, will affect how efficiently a specific spent GAC may be reactivated. Because of this, characterizing a representative sample of the spent GAC and determining its reactivation characteristics (possibly by laboratory reactivation testing) are the most reliable means for projecting how the GAC will behave in a commercial reactivation system.

For generic classification purposes, lightly loaded GACs are those that have been subjected to low loadings of organics (e.g., contaminants, total organic carbon [TOC]) and inorganics (e.g., calcium, oxidized iron, manganese). At the other extreme are highly loaded GACs that have experienced high loadings of organics and inorganics. The relationship between loading and reactivation will vary by GAC type and water quality, but in general, lightly loaded GACs will recover a higher percentage of adsorptive capacity than heavily loaded GACs. Metals can accumulate even in lightly loaded GAC and remain present at detectable concentrations after reactivation.

Some loss of GAC will occur during reactivation. Causes for this loss include transportation and handling and reactivation losses. Therefore, makeup GAC is added to the reactivated GAC to bring the total GAC volume back to the original level. The makeup GAC should be virgin GAC or other reactivated GAC from the same potable water facility, exclusively. Use of virgin GAC as makeup avoids the potential liability of introducing leachable inorganic material from reactivated GAC from sources other than the purchaser's own water. However, commingling of municipal-grade reactivated carbon may be done with the purchaser's approval and regulatory approval, as required.

II.B. *Source of Supply and Services.* GAC and carbon reactivation services should be obtained from sources regularly used to produce and supply these materials and services for water utilities.

II.C. *GAC Size Distribution.* The reactivated GAC should possess a particle size distribution, effective size, and uniformity coefficient comparable to the virgin product to ensure proper physical filtration performance and adsorption behavior. The makeup GAC can be either virgin or reactivated GAC. Because the makeup GAC can contribute significantly to the overall GAC volume, the acceptability of placing the entire makeup GAC shipment in a filter should be determined by considering the impact and effect of the makeup GAC on the particle size distribution, effective size,

and uniformity coefficient. More information on the definition and significance of GAC size distribution is provided in ANSI/AWWA B604.

II.D. *Adsorptive Capacity.* To accurately assess the effectiveness of reactivated GAC, test work should be completed using water from the particular plant in question. If the GAC sees significant variations in the water quality, every effort should be made to test each type of water quality, ensuring (or understanding) the effectiveness of the GAC in treating the varying water qualities. Evaluating the removal of a specific challenge compound, such as geosmin or 2-methylisoborneol, may be included in the test work. It is strongly recommended that users of reactivated GAC follow this approach, as it will reflect the actual conditions under which the GAC will be used.

Various surrogate tests have been developed that give an indication of a GAC's performance under specific conditions. The tests use a specific adsorbate at a high concentration to reduce the amount of time required to run the test. These tests are of limited versatility and are not necessarily indicative of a GAC's performance for a given application. Examples of these tests are the iodine number, tannin value, and acetoxime adsorption tests. Iodine number is indicative of the total surface area of a carbon. As stated in ASTM* D4607, iodine number is the relative indicator of porosity in activated carbon. It does not necessarily provide a measure of the carbon's ability to adsorb another species. Also, it must be realized that any relationship between surface area and iodine number cannot be generalized. This relationship varies with changes in carbon raw material, processing conditions, and pore volume distribution. Acetoxime number is used as an index of GAC's ability to remove some low-molecular-weight organic compounds, such as volatile organic chemicals from groundwater. The acetoxime test's applicability for evaluating GAC for use in surface water applications has not been demonstrated. The same can be said for acetoxime number as for iodine number; the number cannot be generalized and should be reviewed and/or tested for each individual application. This value may not be applicable for every drinking water system. Tannin value is used as an index of a carbon's ability to remove high-molecular-weight impurities, such as natural organic matter. The test method for iodine number can be found in ASTM D4607. Information on tannin value and acetoxime adsorption tests may be found in Appendix B to ANSI/AWWA B604 for those purchasers who want to include these requirements in their documents. Please note that the use of these surrogates may not appropriately model adsorption of actual water contaminants,

* ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

and, therefore, it is highly encouraged that GAC users follow the Water Research Foundation's* *Standardized Protocol for the Evaluation of GAC* (Summers et al. 1992).

II.E. *Caution in Handling and Storage.* Wet GAC will readily adsorb oxygen from the air, creating an acute oxygen depletion hazard in confined areas. Appropriate safety measures for oxygen-deficient atmospheres should be strictly adhered to when entering enclosed or partially enclosed areas containing GAC. In storing dry, reactivated GAC, users should take precautions to avoid direct contact with strong oxidizing agents such as chlorine, hypochlorite, potassium permanganate, ozone, chlorite, and peroxide. Contact with these agents can produce significant exothermic reactions or the rapid production of gaseous decomposition products. GAC can ignite or explode if it is overpressurized.

Mixing of GAC with hydrocarbons (oils, gasoline, diesel fuel, grease, paint thinners, etc.) may cause spontaneous combustion. Therefore, GAC must be kept separate from hydrocarbon storage or spills.

GAC dusts are classified as "nuisance particulates," and the applicable threshold limit values should be followed.

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 information should be provided by the purchaser:

1. Standard used—that is, ANSI/AWWA B605, *Reactivation of Granular Activated Carbon*, of latest revision.
2. Whether compliance with NSF/ANSI 61, *Drinking Water System Components—Health Effects*, is required.
3. Any chain-of-custody requirements and documentation needed to track spent GAC from point of origin, through transportation, reactivation, storage, and return to the purchaser (water utility).
4. Quantity of spent GAC to be reactivated. Reactivated GAC, including makeup GAC, intended for immediate placement in an adsorption bed is typically purchased by the volume that remains following in-place backwashing and draining, per ANSI/AWWA B604.
5. Details of other federal, state or provincial, and local requirements (Sec. 4.1.1).
6. Required moisture content (Sec. 4.1.2).

* Water Research Foundation, 6666 West Quincy Avenue, Denver, CO 80235.

7. Required particle size distribution (Sec. 4.1.4).
8. Required effective size (Sec. 4.1.5).
9. Required uniformity coefficient (Sec. 4.1.6).
10. Additional adsorptive capacity tests (Sec. 4.2.2).
11. Information on the spent GAC and water treatment facility physical characteristics provided by the purchaser (Sec. 4.3.2).
12. Handling and transport requirements (Sec. 4.4).
13. If an environmental audit of facility is required (Sec. 4.5.2).
14. Reference sample, authorizing for shipment, and basis of acceptance (Sec. 5.3.1, 5.3.2, and 5.3.5).
15. Provisions for failing to reactivate GAC to required conditions (Sec. 5.3.6).
16. If shipment is to be in bulk, the type of railcar or truck/trailer (Sec. 6.2.4); the type of bulk bag (Sec. 6.2); and whether the bulk shipments are to be accompanied by weight certificates by certified weighers (Sec. 6.2.5).
17. Whether an affidavit of compliance is required (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. Major revisions made to the standard in this edition include the following:

1. Options to include various quality control requirements in the purchase documents including:
 2. Amount of metals that can leach from the reactivated GAC at initial startup.
 3. Documentation from GAC reactivator that verifies the origin of the spent GAC used, provides spent GAC characterization attributes (Sec. 4.3.3), and ensures trucking/handling/storage requirements have been met.
 4. Documentation from GAC transporters that certifies all requirements have been met.
 5. Requirements for the reactivation facility relative to documentation of GAC origin, custom segregation, and chain of custody.
 6. Required MCL or other chemical parameters.
 7. Provide purchaser with a quality assurance/quality control plan that describes the methodology used.
 8. Testing of defined physical and chemical parameters and performance characteristics.
 9. Basis for Rejection section (Sec. 5.3.6) replaces Notice of Nonconformance.

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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AWWA Standard

Reactivation of Granular Activated Carbon

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes the procurement of granular activated carbon (GAC) reactivation services and the use of reactivated GAC for potable water, wastewater, and reclaimed water treatment. This standard does not cover the design of activated carbon handling facilities, reactivation facilities, or adsorption processes. Background information on GAC reactivation can be found in references listed in the Bibliography to this standard (Appendix A).

Sec. 1.2 Purpose

The purpose of this standard is to provide guidelines for use in preparing purchase documents for the procurement of GAC reactivation services where GAC is used as an adsorptive medium for treatment in potable water, wastewater, and reclaimed water systems.

Sec. 1.3 Application

This standard can be referenced in purchase documents for the reactivation of GAC. The stipulations of this standard apply when this document has been referenced and then only to the reactivation of GAC.

SECTION 2: REFERENCES

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

ANSI^{*}/AWWA B100—Granular Filter Material.

ANSI/AWWA B604—Granular Activated Carbon.

ANSI/ASQ[†] Z1.4—Sampling Procedures and Tables for Inspection by Attributes.

40 CFR Part 261—*US Code of Federal Regulations* (CFR). Identification and Listing of Hazardous Waste.

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Activated carbon*: A family of carbonaceous substances manufactured by processes that develop internal porosity, thereby creating adsorptive properties.
2. *Adsorption*: A process in which dissolved substances are concentrated on a surface by chemical forces, physical forces, or both.
3. *Bag*: A plastic, paper, or woven container that may contain approximately 2.0–5.0 ft³ of GAC.
4. *Bulk containers*: These are specially constructed trucks that may contain 20,000–40,000 lb of GAC.
5. *Commingled GAC*: A mixture of spent media from different spent media sources so long as the GAC was used for potable water treatment. Reactivated/ regenerated media from a single source that are mixed with virgin media are not considered to be commingled.
6. *Custom segregated reactivation (custom reactivation)*: A process that segregates a purchaser's spent GAC such that it is stored and reactivated with no intermingling with a spent GAC from another source. Thus, the purchaser receives back the original GAC in a reactivated condition.
7. *Day*: A day is defined as a 24-hour period.

^{*} American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

[†] American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203.

8. *Effective size:* That size sieve opening that will just pass 10 percent of a representative sample of a filter material. For example, if the size distribution of the particles is such that 10 percent of a sample is finer than 0.45 mm, the filter material has an effective size of 0.45 mm.

9. *Extruded activated carbon:* A form of granular activated carbon in which the particles are uniform cylinders or cylindrical pellets. Effective size and uniformity coefficient are not applicable for extruded carbons. The diameter is normally listed.

10. *Makeup GAC:* Virgin GAC or additional reactivated GAC from the same potable water facility that is used to account for spent GAC losses that occur during transport, handling, and reactivation of a spent GAC. Commingled reactivated GAC may be used if approved by state or local regulations and with approval by the purchaser.

11. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.

12. *Potable/food-grade reactivation facility:* Reactivation facility or reactivation system where all process equipment in contact with spent GAC is used exclusively to handle carbons used to treat products designated for human consumption, which do not include pharmaceutical-related applications. If the facility is part of a larger GAC facility that handles nonpotable/non-food-grade GAC, the potable/food-grade reactivation facility shall have separate entry and shall not allow transport between the facility and the nonpotable/non-food-grade portion. Any GAC classified as hazardous under the Resource Conservation and Recovery Act (RCRA) or by state or provincial regulations is excluded from reactivation in a potable/food-grade reactivation facility.

13. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

14. *Reactivated GAC:* A spent GAC that has undergone the reactivation process. When referring to the final delivered product, this may also include makeup GAC.

15. *Reactivation:* A thermal process that exposes spent GAC to a temperature and gas environment similar to that used in the GAC's original manufacture to restore its adsorption capacity.

16. *Reclaimed water:* Wastewater that becomes suitable for beneficial use as a result of treatment.

17. *Semibulk container:* A large plastic or woven bulk container that may contain 800–2,000 lb of GAC.

18. *Spent GAC:* GAC that has been in service for some period and is no longer able to produce a desired effluent quality.

19. *Supplier:* The party that supplies material or services. A supplier may or may not be the manufacturer.

20. *Support media:* A bed of material of specifically graded particle size used as a subfill to support the GAC medium. See ANSI/AWWA B100.

21. *Uniformity coefficient:* Uniformity coefficient is a measure of how well a granular material is graded. It is determined by a ratio of the sieve size opening that will just pass 60 percent by mass of a representative sample of the filter material divided by the sieve size that will just pass 10 percent by mass of the same sample.

22. *Wastewater:* A combination of the liquid and water-carried waste from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and stormwater that may be present.

Other definitions related to GAC and adsorption can be found in Section 3 of ANSI/AWWA B604.

SECTION 4: REQUIREMENTS

Sec. 4.1 Physical/Chemical Requirements

4.1.1 *Materials.* Materials shall comply with the requirements of the Safe Drinking Water Act and other federal regulations for potable water, wastewater, and reclaimed water systems as applicable.

4.1.2 *Moisture.* The moisture content of reactivated GAC shall not exceed 8 percent by weight of the listed container contents as packed, or at the time it is shipped by the supplier if shipped in bulk, unless otherwise agreed to by the supplier and purchaser. The moisture content shall be determined in accordance with ANSI/AWWA B604.

NOTE: As the moisture content of reactivated GAC may increase during bulk shipment because of ambient conditions that may be beyond the control of the supplier, a moisture content exceeding 8 percent is permitted in the reference sample collected after the shipment is received.

4.1.3 *Apparent density.* The apparent density of the reactivated GAC shall not be less than 0.20 g/cm³ as determined in accordance with ANSI/AWWA B604. Apparent density should be indexed to the virgin GAC value.

4.1.4 *Particle size distribution.* Particle size distribution shall be determined in accordance with ANSI/AWWA B604. The particle size range of the reactivated GAC shall be as required by the purchaser. No more than 15 percent of the reactivated GAC shall be retained on the maximum-size sieve, and no more than 5 percent of the reactivated GAC shall pass the minimum-size sieve. If the reactivated GAC is designated for a postfilter contactor, where particle size distribution is not as stringent, the reactivated GAC will be minimally screened over the nominal screens designated by the purchaser (e.g., 12 × 40-mesh screened over 12- and 40-mesh screens). Particle size distribution should be indexed to the virgin GAC value and in line with the purchase documents.

4.1.4.1 *Makeup GAC.* The makeup GAC can be either virgin or reactivated GAC or commingled reactivated GAC as allowed by local regulations and with approval by the purchaser.

4.1.5 *Effective size.* The effective size of the reactivated GAC shall be within the limits required by the purchaser. This parameter does not apply to extruded activated carbons. The effective size should be indexed to the virgin GAC effective size.

4.1.6 *Uniformity coefficient.* When required in the purchase documents, reactivated GAC shall have a uniformity coefficient not greater than 2.1. This parameter does not apply to extruded activated carbons. More uniform GACs may be required where desirable for filtration performance.

4.1.7 *Abrasion resistance.* The retention of average particle size of the reactivated GAC shall not be less than 70 percent as determined by either the stirring abrasion test or the Ro-Tap abrasion test, according to ANSI/AWWA B604.

4.1.8 *Acceptable metals.* When required in the purchase documents, the amount of metals that can leach from the reactivated GAC at initial startup shall be declared.

Sec. 4.2 Performance Criteria for Reactivated GAC

4.2.1 *Adsorptive capacity—iodine number.* The iodine number of the reactivated GAC shall not be less than 500 mg/g carbon as determined according to ANSI/AWWA B604; a higher iodine number may be required. The iodine number should be indexed to the virgin GAC iodine number.

4.2.2 *Additional testing.* If the purchaser wants to use additional testing facilities to measure adsorptive capacity of the reactivated GAC, the purchaser shall notify the supplier of the tests required (Sec. 5.3.5 and 5.3.6).

Sec. 4.3 Characterizing Spent GAC

4.3.1 *Documentation/chain of custody.* When required in the purchase documents, the purchaser shall require documentation from GAC reactivator that verifies the origin of the spent GAC used, provides spent GAC characterization attributes (Sec. 4.3.3), and ensures trucking/handling/storage requirements have been met.

4.3.2 *Spent sample collection.* To determine to what degree a spent GAC can be successfully reactivated, it is necessary to characterize a sample of the spent material. This involves removing a representative sample from the existing GAC installation. A reactivation service provider will have its own methodology for collecting samples representative of the spent carbon. The sample collection method used shall ensure the spent sample truly represents the condition of the GAC in the filter.

4.3.3 *Characterizing spent GAC and water treatment facility.* Maintenance of technical data and other records on the GAC, treated water quality, and water treatment conditions are useful in a reactivation program. The purchaser shall supply the following information on the spent GAC and water treatment facility:

1. GAC identification and return information
 - a. Manufacturer of the virgin GAC product.
 - b. GAC product name and type.
 - c. GAC US mesh size.
 - d. Reactivation history of the spent GAC.
 - e. Number of filters/quantity of GAC to be reactivated/support media used.
 - f. Change-out cycle and return-time requirements.
2. Water treatment facility information
 - a. Describe water treatment processes used ahead of the GAC.
 - b. Provide a characterization of the influent water, including a list of principal components and their concentrations in the stream.
 - c. Document any spills or unusual water quality conditions since last reactivation.
 - d. Describe how the GAC was used (e.g., filter adsorber or postfilter contactor).
 - e. Describe whether the spent GAC is free flowing.

- f. Describe any foreign matter the spent GAC contains, such as silt, sand, or gravel.
 - g. Describe length of time the GAC has been online and the volume of water treated.
 - h. Site utilities (i.e., water, air, electricity).
 - i. Document distance from filters to a staging area.
 - j. Document any factors that would hinder/restrict direct access to the filters.
3. Regulatory profile information
- a. State whether the spent GAC is an RCRA hazardous waste as defined by 40 CFR Part 261.
 - b. State whether the spent GAC is classified as a hazardous waste in the facility's state or province.
 - c. State whether the spent GAC has been exposed to polychlorinated biphenyls, dioxins, or 1,2-dibromo-3-chloropropane.

The supplier shall determine how effectively the spent GAC can be reactivated, as measured by the iodine number or other characteristics agreed to by both the purchaser and supplier, using their own procedures. The supplier will report these results to the purchaser to determine whether to continue contract negotiations.

Further contract negotiations should then be predicated on whether this reactivated quality is satisfactory to the purchaser. If the reactivator determines that the material cannot be reactivated to a suitable quality, the water utility should consider how to dispose of the spent GAC. (Options may include selling it to a reactivator for use in a different application, e.g., industrial waste treatment, or it may be landfilled or incinerated.)

Sec. 4.4 Handling and Transporting GAC

4.4.1 Removing spent material. The drained level of the filter shall be marked before GAC is removed. Proper Occupational Safety and Health Administration procedures shall be followed when entering a confined space. **WARNING:** Wet GAC will remove oxygen from the surrounding environment within a confined space, resulting in a lack of oxygen.

4.4.1.1 Eduction. If the filter vessel is an open-type gravity filter, eduction is the preferred removal method. The main barriers to educting GAC from the filter are the water pressure available as a motive force and the distance the GAC must be moved. Care shall be taken to minimize the amount of filter support material (sand or gravel) removed with the spent GAC. This procedure could also be included in the contract as a service provided by the supplier.

4.4.1.2 *Vessel pressurization.* Where the adsorption vessel is a pressure vessel with the proper drain connections included at the base of the vessel, the preferred method of spent GAC transfer shall be to apply air pressure to the vessel filled with water to move the GAC slurry to the truck or other source of transportation. Trucks receiving the spent material shall be equipped with a screened drain and screened overflow, so excess water can be removed without loss of GAC.

4.4.1.3 *Mechanical or manual removal.* The least preferred method for removing spent GAC is to use mechanical or manual labor. However, mechanical or manual labor can be used to remove the spent GAC if site characteristics preclude the use of simpler methods. Care shall be taken to minimize crushing and abrasion of the spent material as it is removed.

4.4.2 *Transporting materials.*

4.4.2.1 *Means of transportation.* Trucks used should be the closed hopper-type truck or dump truck with a dewatering screen. Trucks and containers used to transport spent GAC from a potable water treatment facility must be suitably cleaned to hold materials contacting food or other items intended for human consumption. A cleaned trailer or container that is not licensed as an RCRA hazardous trailer or container shall be used to pick up spent GAC and deliver reactivated GAC. Appropriate trailers or containers can be exclusively dedicated to such a purpose or cleaned by a procedure agreed to by both the purchaser and supplier. Trucks or containers contacting spent GAC must be properly washed before being used to transport reactivated product.

4.4.2.2 *Transporting reactivated product.* Guidelines for packaging and shipping reactivated GAC shall be followed according to ANSI/AWWA B604.

4.4.2.3 *Required documentation.* When required in the purchase documents, documentation shall be provided from GAC transporters that certifies all requirements have been met.

Sec. 4.5 Reactivation Facility

4.5.1 *Classifying facility.* The reactivation equipment used to handle the spent and reactivated material shall be classified as potable and food grade. This classification shall dictate that only those spent GACs used to treat products intended for human consumption (excepting pharmaceuticals and products classified as hazardous under RCRA or by state or provincial regulations) may come into contact with this equipment.

4.5.2 *Environmental audit of facility.* The purchaser shall state if an environmental audit of the reactivation facility is needed before the spent GAC is returned.

4.5.3 *Facility documentation.* When required in the purchase documents, the purchaser shall state any requirements for the reactivation facility relative to documentation of GAC origin, custom segregation, and chain of custody.

Sec. 4.6 Placing Reactivated GAC Filter Medium

Reactivated GAC should be placed according to the procedures outlined for virgin GAC in ANSI/AWWA B604.

Sec. 4.7 Preparing the Filter for Service

The filter should be prepared for service according to the procedures for virgin GAC outlined in ANSI/AWWA B604.

Sec. 4.8 Impurities

4.8.1 *General impurities.* The reactivated GAC supplied according to this standard shall impart to the water treated no substances in quantities that could harm or injure those consuming water that has been properly treated with reactivated GAC or that exceeds a maximum contaminant level or other chemical parameter required in the purchase documents.

SECTION 5: VERIFICATION

Sec. 5.1 Sampling

5.1.1 *Sampling location.* If the purchaser accepts the material on the basis of those requirements outlined in ANSI/AWWA B604, samples shall be taken at the point of destination. The supplier and the purchaser shall both agree on how the sample will be collected before the sample is shipped.

5.1.2 *Mechanical sampling.* If the reactivated GAC is handled by conveyor, elevator, or shipped in bulk, a mechanical sampling arrangement may be used.

5.1.3 *Package sampling.* When material is shipped to the jobsite in bags, representative samples shall be collected using a core sampler. The representative samples from each bag shall be combined to produce the required composite sample. The minimum-sized composite sample shall be 10 lb (4.5 kg), and the number of bags to be sampled is indicated in Table 1.

Table 1 Sampling of bagged media*

Lot Size (number of bags shipped)	Minimum Sample Size (number of bags sampled)
2–8	2
9–15	3
16–25	5
26–50	8
51–90	13
91–150	20
151–280	32
281–500	50
501–1,200	80
1,201–3,200	125
3,201–10,000	200
10,001–35,000	315
35,001–150,000	500

*Refer to ANSI/ASQ Z1.4, Sampling Procedures and Tables for Inspection by Attributes.

5.1.4 Sampling tube. Reactivated GAC may be sampled using a sampling tube of at least $\frac{3}{4}$ -in. diameter. Samples may be from railcar/truckload shipments in bulk or from packages. When taking samples from packages, the sampling tube shall be extended the full length of the package to obtain a representative sample.

NOTE: It is virtually impossible to avoid particle fracture when using a sampling tube. Extreme care should be taken to minimize the effect of particle fractures on particle size distribution. Sampling bulk shipping containers after shipment from the supplier is subject to error caused by stratification and compaction during shipping. Extreme care should be exercised in sampling bulk shipping containers after shipment.

5.1.5 Handling samples. The gross composite sample of approximately 10 lb shall be sealed in airtight, vapor-proof, moisture-proof containers. Each sample container shall be labeled to identify it, and the label shall be signed by the sampler. The gross composite sample shall be divided using one of the following methods:

1. Mix thoroughly and divide the sample to provide three 1-lb (0.45-kg) samples.
2. Pour through a sample riffler. Repeat as necessary using the split portions to provide three 1-lb (0.45-kg) samples.

5.1.6 *Quality control.* Methodology should include consideration for composites and field duplicates. Supplier should provide purchaser with a quality assurance/quality control plan that describes the methodology used.

Sec. 5.2 Testing Methods

5.2.1 *Spent GAC sample.* As explained in the Foreword, the quality of the reactivated GAC is strongly influenced by the condition of the spent GAC. Therefore, a representative sample of the spent GAC should be collected and provided to the reactivation services supplier for characterization.

5.2.2 *Reactivated GAC sample.* Testing and test methods for characterizing reactivated GAC shall be those designated in ANSI/AWWA B604. When required in the purchase documents, testing of defined physical and chemical parameters and performance characteristics shall be done.

Sec. 5.3 Basis for Shipment, Acceptance, and Rejection of Reactivated GAC

5.3.1 *Reference sample.* When required in the purchase documents, the supplier shall submit a representative sample of the reactivated GAC to the purchaser for acceptance before shipment. This sample must be submitted in clean vapor-proof containers, plainly marked with the address of the supplier and identified as to the lot number of the contents. A duplicate sample shall be tested by the supplier. A certified test report shall be submitted to the purchaser with the purchaser's sample, showing compliance with the requirements of the purchase documents along with a statement certifying that the material for shipment is equal in quality to the sample submitted.

5.3.2 *Authorizing for shipment.* The purchaser may authorize shipment on the basis of the supplier's certification of quality or may test the reference sample submitted to confirm compliance before authorizing shipment.

5.3.3 *Sampling and testing after delivering shipment.* The purchaser may elect to collect a representative sample of the material after delivery. The procedure used shall be in accordance with Sec. 5.1. One of the three 1-lb (0.45-kg) sample portions taken may be tested to determine compliance with the purchase documents.

5.3.4 *Documentation of reactivation facility.* The supplier shall provide appropriate documentation on the reactivation services being purchased including a description of the reactivation facility and the means used to ensure provision of custom segregated storage and reactivation.

5.3.5 *Acceptance.* The purchaser may elect to accept the reactivated GAC on the basis of (1) the supplier's certified test report and accompanying affidavit of compliance indicating compliance with this standard and with the purchase documents, with no exceptions; or (2) the supplier's certified test report completed by a qualified third-party testing laboratory approved by the purchaser and accompanying affidavit of compliance; (3) the purchaser's own testing of the reference sample submitted by the supplier and the required affidavit of compliance; or (4) the purchaser's own testing of the representative sample, collected according to Sec. 5.1 after receipt of shipment, showing compliance with this standard and the purchase documents.

5.3.6 *Basis for rejection.* Material not complying with the requirements of this standard and the purchaser's documents may be rejected. Repairs, replacements, and retesting shall be accomplished in accordance with the purchaser's documents.

5.3.7 *Removing material or adjusting price.* If the material does not meet the requirements of this standard and the purchase documents, the supplier shall remove it from the purchaser's premises and replace it with a like amount of satisfactory virgin GAC or make an adjustment that is acceptable to the purchaser.

SECTION 6: DELIVERY*

Sec. 6.1 Marking

Each shipment of the material shall carry with it some means of identification.

6.1.1 *Packaged material.* Each container of reactivated GAC shall have marked legibly on it the net weight of the contents, name of the supplier, lot number, and purchaser's name and shall bear any other markings required by applicable regulations and laws. Reactivated GAC containing commingled GAC shall be clearly identified as commingled.

6.1.2 *Bulk material.* When shipped in bulk, the information required in Sec. 6.1.1 for packaged material shall accompany the Bill of Lading.

6.1.3 *Conformance with standard (optional).* Containers may bear the statement: "This material meets the requirements of ANSI/AWWA B605, Standard for Reactivated Granular Activated Carbon," provided the requirements of this

* Governmental packaging and marking references reflect US requirements. Users of this standard outside the United States should verify applicable local and national regulatory requirements. Because of frequent changes in these regulations, all parties should remain informed of possible revisions. Provisions of the purchaser's documents should not preclude compliance with applicable regulations.

standard are met and the material is not of a different quality in separate agreement between the supplier and purchaser.

Sec. 6.2 Packaging and Shipping

6.2.1 *Containers.* Reactivated GAC shall be shipped in packages acceptable to the US Department of Transportation. Individual paper bags shall contain 35 lb (16 kg) to 150 lb (68 kg) each, and semibulk containers shall contain 800 lb (363 kg) to 2,000 lb (908 kg) or other quantity as agreed on by the purchaser and supplier.

6.2.2 *Package shipments.* Paper bag packages used to ship reactivated GAC in less than railcar/truckload lots shall be protected by a wear-resistant outer package to avoid tearing the bags. Complete protection from weather shall be provided for the individual packages or by means of conveyance.

6.2.3 *Tolerances.* The net dry weight of the packages shall not deviate from the recorded weight by more than plus or minus 5 percent. Objections to the weight of the material received shall be based on a certified unit weight of not less than 10 percent of the packages shipped, selected at random from the entire shipment.

6.2.4 *Bulk shipments.* Bulk shipments of reactivated GAC shall be in clean railcars or trucks with tight closures to prevent materials from being lost or contaminated in transit. The interior of the railcars or trucks shall be clean and free of dirt, corrosion, scale, and other sources of contamination. Shipments in open-top hopper-bottom railcars are only acceptable with adequate provision for covering the material and keeping it contained and protected in shipment. Before shipment, the supplier and the purchaser shall agree on the type of railcar or hopper truck to be used. The important factors to consider in deciding on a type of vehicle are the type of handling equipment and the unloading facilities at the destination. Caution should be used when unloading bulk containers because particle stratification may occur during shipment. If the entire bulk shipment is used to fill a single contactor or filter, no special precautions are required. Where the bulk shipment will be divided between or among contactors or filters, different bays should be used to fill the various units, or reactivated GAC additions should be rotated among the various contactors or filters.

6.2.5 *Weight certification (bulk).* Bulk shipments shall be accompanied by weight certificates of certified weighers, if required by the purchaser; or the weights may be checked by certified weighers for the purchaser on delivery.

Sec. 6.3 Affidavit of Compliance

The purchaser may require (1) an affidavit from the manufacturer that the reactivation services provided and the material provided comply with applicable requirements of this standard, and (2) a tracking manifest that documents that a handling procedure is in place that ensures the purchaser's spent GAC has been separated from other GACs from the time of removal, through the reactivation process, and during storage until it is received by the purchaser.

APPENDIX A

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This Appendix is for information only and is not a part of ANSI/AWWA B605.

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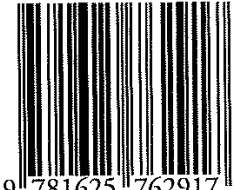
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