



Standard Specification for Impregnated Activated Carbon Used to Remove Gaseous Radio-Iodines from Gas Streams¹

This standard is issued under the fixed designation D4069; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This standard covers the specifications for physical properties and performance requirements of virgin impregnated activated carbon to be used for the removal of gaseous radioiodine species from gas streams.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 ASTM Standards:²

- D2652 Terminology Relating to Activated Carbon
- D2854 Test Method for Apparent Density of Activated Carbon
- D2862 Test Method for Particle Size Distribution of Granular Activated Carbon
- D2866 Test Method for Total Ash Content of Activated Carbon
- D2867 Test Methods for Moisture in Activated Carbon
- D3466 Test Method for Ignition Temperature of Granular Activated Carbon
- D3802 Test Method for Ball-Pan Hardness of Activated Carbon
- D3803 Test Method for Nuclear-Grade Activated Carbon
- D3838 Test Method for pH of Activated Carbon
- E300 Practice for Sampling Industrial Chemicals

2.2 ANSI/ASME Standard:

- NQA-1 Quality Assurance Program Requirements for Nuclear Facilities³

¹ This specification is under the jurisdiction of ASTM Committee D28 on Activated Carbon and is the direct responsibility of Subcommittee D28.04 on Gas Phase Evaluation Tests.

Current edition approved July 1, 2014. Published September 2014. Originally approved in 1981. Last previous edition approved in 2008 as D4069–95 (2008). DOI: 10.1520/D4069-95R14.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

3. Terminology

3.1 *Definitions*— Definitions relating to this specification are given in Terminology D2652.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *lot*—a quantity of impregnated activated carbon of the same grade or type, consisting of one or more batches, that has been produced under the same manufacturer's production order using the same manufacturing procedure and equipment.

3.2.2 *batch*—a quantity of impregnated activated carbon of the same grade or type that has been produced using the same manufacturing procedures and equipment, and that has been homogenized so as to exhibit the same physical properties and performance characteristics throughout its mass.

NOTE 1—The maximum allowable batch size shall be 10 m.

3.2.3 *qualification test*—a one-time test performed on each of three grab samples taken randomly from a single homogenized batch of a vendor's grade or type of impregnated activated carbon to determine its suitability for the purpose stated herein. The size of each grab sample should be at least 500 cm.

3.2.4 *batch test*—a test performed on a representative sample of each batch of the same grade or type of impregnated activated carbon to determine whether that batch meets the specification prescribed herein.

3.2.5 *grade or type*—the manufacturer's designation for an impregnated activated carbon having a given set of performance capabilities and physical properties.

4. Materials and Manufacture

4.1 The activated carbon furnished under this specification shall be virgin material. Reactivated carbon shall not be used.

4.2 Impregnated activated carbon furnished under this specification shall be subject to the document control provisions of Section 7 of ANSI NQA-1.

4.3 Materials used in the manufacture of impregnated-activated carbon furnished under this specification shall be traceable as provided in Section 9 of ANSI NQA-1.

5. Significance and Use

5.1 Activated carbons used in containment systems for nuclear reactors must be capable of functioning under both

normal operating conditions and those conditions which may exist following a design basis accident (DBA). Adsorbent beds that are part of recirculatory systems *inside* containment may be exposed to the peak pressure, temperature, and steam content of a post-DBA condition.

5.2 Carbon beds *outside* containment will be protected by fast-acting shutoff valves from the sudden rise in pressure, temperature, and humidity of the containment atmosphere which would exist following a DBA. However, some rise in temperature and humidity will be experienced even by beds outside containment if they are reconnected to containment after the initial pressure rise (due to escape of steam into the containment volume) has been reduced by containment coolers. The amount of radioactivity that can reach either type of adsorption system is conceivably quite high; hence, there is a possibility of a bed temperature rise due to decay heating. The gaseous radioactive contaminants of most interest are organic iodides. In this test, CH₃I is used to typify the performance of the carbon on organic iodine compounds in general. The test described here provide a reasonable picture of the effectiveness of an activated carbon for organic iodides under normal and post-DBA conditions. The equipment and methods described can be used, with discretion, for similar tests at different gas flow conditions and, to some extent, on different gaseous radioactive contaminants and other adsorbents.

6. Homogeneity Requirement

6.1 A batch shall be considered homogeneous if the apparent density of each of three grab samples differs by no more than ±3.0 % from the average value of all three determinations. Failure of this test requires rehomogenization.

7. Performance Requirements

7.1 Each batch of impregnated activated carbon shall conform to the following performance requirement: use the Methyl iodide efficiency test (See Test Method D3803), at 30°C, 95 % relative humidity, and a minimum percent specification of 97.0 %.

8. Physical Properties Requirements

8.1 Each batch of impregnated activated carbon shall conform to the requirements for physical properties prescribed in Table 1.

9. Sampling

9.1 A representative sample shall be obtained from each batch using the methods prescribed in Practice E300 in quantity sufficient to perform all of the tests prescribed herein in triplicate. A 2-L sample is usually sufficient.

10. Number of Tests and Retests

10.1 Each batch test specified in Section 8 and Table 1 shall be performed at least once on each batch of carbon unless the test method prescribes a greater number of tests.

10.2 If a single test from 10.1 fails to meet the specification value, the test may be repeated two additional times. The average of the three determinations shall meet the specifica-

TABLE 1 Physical Properties

Test	Test Method	Specification
Apparent density	D2854	0.38 g/mL, min
Particle size distribution, ASTM E-11 Sieves:	D2862	
Retained on No. 6		0.1 %, max
Retained on No. 8		5.0 %, max
Through No. 8, Retained on No. 12		60.0 %, max
Through No. 12, Retained on No. 16		40.0 %, min
Through No. 16		5.0 %, max
Through No. 18		1.0 %, max
Ash content ^A	D2866	State value
Moisture content	D2867	State value
Ignition temperature	D3466	330°C, min
Ball-pan hardness	D3802	92.0 %, min
pH	D3838	State value

^A This test to be performed on the base carbon prior to impregnation.

tion. In addition, the coefficient of variation, *v*, for the three determinations shall not exceed ±5.0 %:

where:

$$v = 100 s / \bar{X} \%,$$

$$s = \sqrt{\sum_1^3 \frac{(X - \bar{X})^2}{2}} \text{ \% efficiency units,}$$

X = percent efficiency units, individual sample, and

\bar{X} = percent efficiency units, average of three samples.

11. Test Methods

11.1 The test program shall conform to the test control requirements of Section 12 of ANSI NQA-1.

11.2 The test methods used to determine the physical properties and performance capability of the sample shall be those prescribed in Section 8 and Table 1.

12. Quality Assurance and Inspection

12.1 The producer or supplier of impregnated activated carbon furnished under this specification shall comply with the applicable Quality Assurance Requirements of ANSI NQA-1 as identified by the user's specification.

12.2 Inspection of the impregnated activated carbon shall be agreed upon between the user and the supplier as part of the purchase contract.

13. Rejection and Rehearing

13.1 Impregnated activated carbon that fails to conform to the requirements of this specification shall be rejected. Rejection shall be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

14. Certification

14.1 The producer or supplier shall certify to the user as follows:

14.1.1 The impregnated-activated carbon comprising the lot was produced using the same manufacturing procedure and equipment as that used to produce the impregnated activated carbon submitted for the original qualification tests. The producer or supplier shall furnish a copy of the qualification test results to the user.

14.1.2 The impregnated activated carbon furnished to the user was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements of Sections 1 through 16 hereof. The producer or supplier shall furnish a copy of the batch test results to the user.

15. Packaging

15.1 The impregnated activated carbon shall be packaged in a durable container in such a way as to minimize degradation of the particles during handling, shipping, and storage. The container shall be provided with a vapor barrier in order to minimize the adsorption of water and organic vapors after packaging.

16. Package Marking

16.1 Each package shall be clearly and indelibly marked to show the producer's or supplier's name, trade name, and impregnated activated carbon type or grade number; lot, batch, and drum number; gross and net weights of the package; and the number of this specification.

17. Verification

17.1 The user shall sample each batch of impregnated activated carbon comprising the lot furnished hereunder using the procedures prescribed herein, and perform or have performed those tests necessary to verify the certification of the producer or supplier. As a minimum, the verification test program shall include the determination of the methyl iodide decontamination efficiency at 30°C and 95 % relative humidity (Section 7), and ignition temperature (Test 5, **Table 1**). The verifying laboratory shall test the impregnated carbon in accordance with this specification and shall report the actual test results to the user in writing.

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