Designation: D6347/D6347M – 05 (Reapproved 2018)

Standard Test Method for Determination of Bulk Density of Coal Using Nuclear Backscatter Depth Density Methods[1]

This standard is issued under the fixed designation D6347/D6347M; 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.

INTRODUCTION

Data obtained from the density of coal stockpiles is combined with volume determinations per Test Method D6172 to complete the physical inventory of total tons. The book inventory is compared to the physical inventory for determining the accumulation of measurement difference that have occurred since the last physical inventory.

Since the physical inventory is the reference value used to compare and adjust the book inventory, it is important that the standard methods for conducting the density and volume measurements introduce the least possible error. Close adherence to the details of the procedures described in this standard is a prerequisite to the objective of this test method.

This standard test method for determination of bulk density of stockpiled coal is used for all ranks of coal. Proper density determination involves an understanding of the physical characteristics of the coal types and the stockpiling facilities.

1. Scope

1.1 This test method covers procedures for determining the bulk density of coal using instrumentation that measures the relative backscatter of nuclear gamma radiation throughout the depth of the stockpile under test.

1.2 This procedure is applicable to all ranks of coal.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use. The equipment uses radioactive materials, which may be hazardous to the health of users, unless proper precautions are taken.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1586 Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

D6172 Test Method for Determining the Volume of Bulk Materials Using Contours or Cross Sections Created by Direct Operator Compilation Using Photogrammetric Procedures

[1] This test method is under the jurisdiction of ASTM Committee D05 on Coal and Coke and is the direct responsibility of Subcommittee D05.07 on Physical Characteristics of Coal.

Current edition approved Nov. 1, 2018. Published December 2018. Originally approved in 1998. Last previous edition approved in 2010 as D6347/D6347M – 05(2010). DOI: 10.1520/D6347_D6347M-05R18.

[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.

2.2 *NIST Standard:*[3]
National Institute for Standards and Technology Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices

2.3 *ASME Standard:*[4]
ASME Pipe Codes

2.4 *Code of Federal Regulations:*[5]
Title 10, Parts 19 and 20
Title 49

3. Terminology

3.1 *Definitions of Terms:*

3.1.1 *access hole*—used loosely in this standard to denote the opening made into the stockpile for insertion of the probe access tube.

3.1.2 *counting period*—the period of time, set using the scaler time switch, during which the readout device accumulates pulses.

3.1.3 *penetration*—inserting the probe access tube in a selected position for collecting test count readings.

3.1.4 *reference standard count*—a series of 30 consecutive standard counts, taken on the occasions specified in 9.1.5.

3.1.5 *stability check standard count*—a series of five consecutive standard counts, taken on the occasions specified in 9.1.6.

3.1.6 *standard count*—a test count taken with the probe positioned inside the shield and standard assembly.

3.1.7 *test counts*—the recording of pulses accumulated by the readout device during a counting period. The test count is initiated by pushing a start button located on the scaler, which resets the accumulator and starts a new counting period.

3.1.8 *vertical interval*—the vertical interval moved by the test probe when repositioned from one vertical position to the next test vertical position in the same access hole. For this test method, a vertical interval is equal to 30 in. [76 cm].

3.1.9 *vertical position*—the position of the probe where a test count reading is taken, measured from a reference elevation.

4. Summary of Test Method

4.1 The area of the stockpile accessible for stockpile penetration is first identified. An access (sampling) plan for the accessible area is determined, and the depth of the stockpile is accessed at locations within the area according to plan. The probe is used to obtain test count readings at vertical intervals within each access hole. Test count readings of compacted coal in field calibration vessels are taken using coal from the stockpile so as to convert stockpile test count readings to bulk density using a calibration curve. The mean bulk density of the stockpile is estimated using the test count reading and calibration data.

4.2 The procedures appear in the following order:

Procedures	Section
Preparation of Sampling Plan	8
Standardization of Nuclear Depth Density Gauge	9
Field standardization	9.1
Stockpile Penetration and Access Procedures	10
Standardize the nuclear depth probe	10.1
Penetrate the stockpile	10.2
Measure and record depth	10.3
Place access stabilization and sample collection device	10.4
Taking replicate test counts	10.5
Procedure A—split-barrel sampler/large auger procedure	10.6
Procedure B—small auger procedure	10.7
Procedure C—hydraulic access procedure	10.8
Field Calibration of Nuclear Depth Density Gauge	11
Influence of elemental composition on nuclear depth density probe	11.1
Perform calibration procedures on-site	11.2
Minimum eight calibration vessels	11.3
Weight and record empty calibration vessel weight	11.4
Compact coal in calibration vessel	11.5
Weigh and record compacted coal in calibration vessel	11.6
Penetrate compacted coal in calibration vessel	11.7
Minimum number of replicate test counts	11.8
Conduct a uniform compaction check	11.9
Data for establishing calibration curve (Annex A3)	11.10
Develop calibration curve (Annex A3)	11.11
Separate calibration curve for each access method	11.12
Interpretation of Results	12
Report	13

5. Significance and Use

5.1 The measured mean bulk density of a coal stockpile is used with a measurement of the stockpile volume per Test Method D6172. Procedures to determine the quantity of stockpiled coal. This measure of quantity is often used as a reference value for adjusting inventory records.

6. Apparatus

6.1 Field-test location preparation equipment consisting of:

6.1.1 *Drilling Rig*—mobile equipment capable of boring, driving, or hydraulically forcing, on its own power, access holes through the entire depth of the stockpile.

6.1.2 *Access Tube*—hollow tubing with an inside diameter allowing clearance between 0.035 in. [0.90 mm] and 0.060 in. [1.50 mm] for the nuclear depth probe to be positioned at specified vertical intervals. The tubing shall be sufficiently durable to withstand the applied forces of insertion into the access hole. The inside diameter of the access tube shall provide a smooth path with an annular space and wall thickness sufficient that there is no deformation of shape under normal use. ASME Schedule 80 thickness PVC pipe is the most commonly used access tube material. Other materials may be used, but their use may require a different tube wall thickness or a different counting period, or both, to obtain an equivalent test count.

6.1.3 *Small Auger*—a boring apparatus with connecting sections used to provide an access hole the entire depth of the stockpile. The outside diameter of the auger is sized to produce an access hole with a diameter equal to the outside diameter of the access tube. To obtain reliable test count readings, it is

[3] Available from National Institute of Standards and Technology (NIST), 100 Bureau Dr., Stop 1070, Gaithersburg, MD 20899-1070, http://www.nist.gov.

[4] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, http://www.asme.org.

[5] Available from the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402.