Designation: D167/D167M – 20

Standard Test Method for Apparent and True Specific Gravity and Porosity of Lump Coke[1]

This standard is issued under the fixed designation D167/D167M; 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 test method covers the determination of apparent specific gravity (Sections 5 to 9) and true specific gravity (Sections 10 to 14) of lump coke larger than 25 mm [1 in.] size and calculating porosity (Section 15) from the specific gravity data.

1.2 *Units*—The values stated in either SI units or non-SI 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.

1.3 *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.*

1.4 *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]

D121 Terminology of Coal and Coke

D346 Practice for Collection and Preparation of Coke Samples for Laboratory Analysis

3. Terminology

3.1 For definitions of terms used in this test method, refer to Terminology D121.

4. Significance and Use

4.1 Apparent and true specific gravity, as determined by this test method, are influenced by the type of coals carbonized and the operating and preparational conditions of that carbonization, that is, charge bulk density, heating rate, and pulverization level. In turn, these properties directly influence the performance in processes using coke.

APPARENT SPECIFIC GRAVITY

5. Apparatus

5.1 The apparatus for the determination of the apparent specific gravity of coke shall consist of the following:

5.1.1 *An Elliptical or Rectangular Cross-Sectioned Container,* approximately 560 mm [22 in.] in length, 280 mm [11 in.] in width, and a minimum of 330 mm [13 in.] in height, provided with a spout consisting of a short 13 mm [½ in.] nipple extending horizontally from the container about 270 mm [10.5 in.] above the bottom.

5.1.2 *Wire Cage or Basket,* of about 13 mm [½ in.] square-mesh screen wire cloth provided with a cover and two long handles, suitable for holding the entire sample of coke and so made as to fit inside the container below the spout.

5.1.3 *Bucket or Other Vessel,* 11 L [3 gal], suitable for receiving the displaced water.

5.1.4 *Pan,* about 380 mm [15 in.] square and 76 mm [3 in.] in height or the equivalent for containing the coke during the determination of its mass.

5.1.5 *Balance,* sensitive to 0.05 kg [0.1 lb].

6. Sampling at Source

6.1 When the porosity test is desired on run-of-oven coke, the sample shall be collected from the coke wharf.

6.1.1 *By-Product Coke*—About 23 kg [50 lb] of representative pieces of coke shall be selected from the coke wharf for each test. This is best accomplished by dividing the coke on the wharf into approximately equal areas and selecting an equal number of pieces from each area. Each piece of coke selected shall be approximately equal in length to one half of the width of the coke ovens, and shall show a "cauliflower" end produced at the walls of the ovens, and an "inner" end produced at the center of the ovens.

[1] This test method is under the jurisdiction of ASTM Committee D05 on Coal and Coke and is the direct responsibility of Subcommittee D05.15 on Metallurgical Properties of Coal and Coke.

Current edition approved Aug. 1, 2020. Published September 2020. Originally approved in 1923. Last previous edition approved in 2012 as D167 – 12a. DOI: 10.1520/D0167_D0167M-20.

[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.

7. Sampling at Delivery

7.1 If the porosity test is desired on coke for furnace or cupola use, the sample shall be representative of the material in question and collected at the place of delivery.

7.1.1 *By-Product*—The sample is best collected as the coke is delivered from the railroad cars into the bins. This can be accomplished by securing a representative sample of 5 kg to 7 kg [10 lb to 15 lb] capacity in the coke stream at regular intervals during the period of unloading. The sample collected shall be large enough to give about 23 kg [50 lb] of coke pieces, none of which would in any position pass through a 25 mm [1 in.] square-mesh sieve so that the pieces will remain in the 13 mm [½ in.] cage when it is removed from the water.

7.1.2 Since it is very difficult to collect a representative sample from coke exposed in bins and cars, care shall be taken to take pieces representing the entire exposed area, if sampling must be done in this manner. It is best accomplished by dividing the exposed surface to be sampled into approximately equal areas, and selecting an equal number of pieces from each area. A 23 kg [50 lb] sample of representative pieces shall be collected, none of which shall in any position pass through a 25 mm [1 in.] square-mesh sieve.

8. Procedure

8.1 Select about 11 kg [25 lb] of coke from the sample so that it is representative of the material under consideration with regard to size, shape, and general appearance. Dry the coke to constant mass at a temperature of 105 °C to 200 °C. Cool to room temperature, remove adhering dust by shaking or brushing, and determine the mass to the nearest 0.05 kg [0.1 lb].

8.2 Place a cork in the spout of the container, which has been placed on a level and rigid base or floor. After the empty cage has been placed into the container, pour water at room temperature into the container until the water level is above the spout. After the water has come to rest, remove the cork from the spout and permit the excess water to drain out for 1 min after the overflow stream starts to discharge drop by drop. Then replace the cork and remove the cage from the water, care being taken to shake all adhering water back into the container. Then place the weighed dried coke sample into the cage and after fastening the cover, lower the cage containing the coke into the water. If there is not sufficient capacity in the container above the spout to retain the displaced water, some of the water may be drawn off into a weighed bucket, or other suitable vessel, by removing the cork from the spout while the coke is being lowered.

8.3 Permit the cage to remain in the water for 15 min, with occasional shaking to detach any air bubbles adhering to the surface of the coke, care being taken not to disturb the position of the container. At the end of the 15 min period, during which the coke shall have been completely submerged at all times, remove the cork after the water has come to rest and permit the displaced water to drain into a weighed bucket or other suitable vessel for 1 min after the overflow stream starts to discharge drop by drop. Replace the cork, remove the cage containing the coke from the water, and permit it to drain for 1 min. Remove the wet coke from the cage and determine the mass to the nearest 0.05 kg [0.1 lb].

8.4 Determine the mass of the displaced water, which has been caught in the bucket, to the nearest 0.05 kg [0.1 lb].

9. Calculation

9.1 Calculate the apparent specific gravity, SG_{app}, as follows:

$$SG_{app} = W/[W_1 + (W_2 - W)] \quad (1)$$

where:

W = mass of dry coke,
W_1 = mass of water displaced by wet coke, and
W_2 = mass of wet coke.

TRUE SPECIFIC GRAVITY

10. Apparatus

10.1 *Hogarth's Specific Gravity Bottle,* with side tubulure, having a capacity of about 100 mL.

10.2 *Balance,* sensitive to 0.01 g.

11. Sample Preparation

11.1 Select about 5 kg [10 lb] of coke from the sample (see Section 6) so that it is representative of the material under consideration with regard to size, shape, and general appearance. If necessary, dry the sample before crushing and pulverizing. Crush the coke to pass through a 6.3 mm [¼ in.] screen and split the sample size to about 2 kg [5 lb]. Crush this fraction to pass through a 850 µm [No. 20] U.S Standard sieve and further split the sample to approximately 200 g. Grind the 200 g fraction to pass through a 250 µm [No. 60] U.S Standard sieve and split the sample size to approximately 50 g. Pulverize this entire fraction to minus 75 µm [No. 200] and dry for 1 h at 105 °C. Equipment used for reducing the sample particle size and quantity is described in Practice D346. In all cases, care must be taken to select equipment that will not abrade and add unwanted impurities to the sample during the size-reduction steps.

12. Calibration

12.1 Calibrate the Hogarth specific gravity bottle to determine the mass of the bottle and the distilled water required to fill it (variable P). This can be done by *(1)* constructing a table graph of actual mass measurements of the bottle filled with distilled water at various temperatures or *(2)* using the data in the tables of corrections for determining the true capacities of glass vessels from the mass of water in air (Lange[3] or *CRC Handbook*[4]).

13. Procedure

13.1 Carefully introduce a 10 g portion, weighed to the nearest 0.01 g, of 75 µm [200 mesh] coke, which has been previously dried for 1 h at 105 °C, into the specific gravity bottle with a sufficient quantity of distilled water to fill the

[3] Dean, J. A., *Lange's Handbook of Chemistry*, McGraw-Hill.
[4] *CRC Handbook*, CRC Press.