Designation: C 135 – 96 (Reapproved 2003)

Standard Test Method for True Specific Gravity of Refractory Materials by Water Immersion[1]

This standard is issued under the fixed designation C 135; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This test method covers the determination of true specific gravity of refractory materials under prescribed conditions. It is not applicable to materials attacked by water.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 604 Test Method for True Specific Gravity of Refractory Materials by Gas-Comparison Pycnometer[2]

D 153 Test Methods for Specific Gravity of Pigments[3]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[4]

3. Significance and Use

3.1 The true specific gravity of a material is the ratio of its true density, determined at a specific temperature, to the true density of water, determined at a specific temperature. Thus, the true specific gravity of a material is a primary property which is related to chemical and mineralogical composition.

3.2 For refractory raw materials and products the true specific gravity is a useful value for: classification, detecting differences in chemical composition between supposedly like samples, indicating mineralogical phases or phase changes, calculating total porosity when the bulk density is known, and for any other test method which requires this value for the calculation of results.

3.3 This test method is a primary standard method which is suitable for use in specifications, quality control, and research and development. It can also serve as a referee test method in purchasing contracts or agreements.

3.4 Fundamental assumptions inherent in this test method are the following:

3.4.1 The sample is representative of the material in general,

3.4.2 The total sample has been reduced to the particle size specified,

3.4.3 No impurity has been introduced during processing of the sample,

3.4.4 The sample itself is not magnetic and all magnetic material introduced during processing of the sample has been removed,

3.4.5 The material is not hydratable or reactive with water, and

3.4.6 The test method has been conducted in a meticulous manner.

3.4.7 Deviation from any of these assumptions negates the usefulness of the results.

3.5 In interpreting the results of this test method it must be recognized that the specified sample particle size does not guarantee that all closed pores have been eliminated. The amount of residual closed pores may vary between materials or even between samples of the same or like materials, and the specified sample particle size is not the same as that specified for Test Method C 604. The values generated by this test method may, therefore, be close approximations rather than accurate representations of true specific gravities. Thus, comparisons of results should only be judiciously made between like materials tested by this test method or with full recognition of potentially inherent differences between the materials being compared or the test method used.

4. Apparatus

4.1 *Analytical Balance*, accurate to 0.1 mg.

4.2 *Pycnometer Bottle*, 50-mL, with ground-joint fitted thermometer and capillary side tube with cap.

4.3 *Vacuum Source*, capable of 0.5 to 1.0 in. (13 to 25 mm) Hg, for use with alternative method (Note 1).

NOTE 1—A suitable alternative evacuation method is described in Test Methods D 153.

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[1] This test method is under the jurisdiction of the ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.03 on Physical Tests and Properties.

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[2] *Annual Book of ASTM Standards*, Vol 15.01.

[3] *Annual Book of ASTM Standards*, Vol 06.03.

[4] *Annual Book of ASTM Standards*, Vol 14.02.

5. Preparation of Sample

5.1 Extract two walnut-sized pieces from different positions in a solid specimen in such a way as to exclude any part of the original exterior surface (skin surface). When an average value of specific gravity is desired, prepare a composite sample by taking pieces in this manner from at least five different specimens.

5.2 Crush the pieces between hardened steel surfaces to a maximum size of ⅛ in. (3 mm). Thoroughly mix the crushed material and reduce by quartering or riffling to a test sample of 50 g.

5.3 If the material submitted for test is already crushed or ground, a representative portion of at least 500 g shall be thoroughly mixed and reduced by quartering or riffling.

5.4 Grind the entire 50-g sample to pass an ASTM No. 100 (150-µm) sieve (equivalent to a 100-mesh Tyler Standard Series) (Note 2). The grinding may be done by hand or by a mechanical sample grinder of such material and construction as to prevent the introduction of any impurity. Remove any magnetic material introduced during crushing or grinding by a magnet. Special care should be taken in all stages of preparation of the test sample not to exclude any portions that are difficult to crush or grind.

NOTE 2—Detailed requirements for this sieve are given in Specification E 11.

5.5 Transfer the 50-g sample to a glass-stoppered weighing bottle and dry to constant weight at 105 to 110°C (220 to 230°F).

6. Procedure

6.1 Make duplicate tests on material from the 50-g sample. Make all weighings to the nearest 0.1 mg.

6.2 Dry the pycnometer at 105 to 110°C (220 to 230°F), cool in a desiccator, and weigh on an analytical balance. Record the weight as p. Fill the pycnometer with distilled water at room temperature, t, which should be between 60 and 75°F (16 and 24°C) and should not vary more than 0.5°F (0.3°C) during the test, and again weigh, recording the weight as W_1. In filling the pycnometer, there should be an overflow of water through the capillary when the thermometer (stopper) is inserted. Wipe the excess water from the tip in such a manner as not to withdraw any water from the capillary. Place the cap on the capillary tube, thoroughly dry any water adhering to the outside of the pycnometer, and weigh as directed above.

6.3 Empty the pycnometer and again dry it at 105 to 110°C (220 to 230°F). Place approximately 1.5 mL of the sample in the dry pycnometer, weigh, and record the weight as W. Fill the pycnometer to one fourth to one half of its capacity with distilled water, and boil the water either under reduced pressure (Note 2) or at atmospheric pressure for 10 to 15 min. Boiling should not be so vigorous as to cause loss of sample due to popping. Where boiling is done at atmospheric pressure, it is advisable to insert a thin strip of paper with the stopper before the boiling operation. After boiling, fill the pycnometer with distilled water, cool to room temperature, t, in a water bath, insert the thermometer stopper, wipe off excess water from the tip of the capillary tube, replace the cap, and thoroughly dry the pycnometer with a lintless towel. Weigh the pycnometer and contents and report the weight as W_2.

7. Calculation

7.1 Calculate the true specific gravity as follows:

$$\text{Sp gr, } t/t = (W - p)/[W_1 - p) - (W_2 - W)] \quad (1)$$

where:

t = material and water temperature, °C
p = weight of the stoppered pycnometer, g,
W = weight of the stoppered pycnometer and sample, g,
W_1 = weight of the stoppered pycnometer filled with water, g, and
W_2 = weight of the stoppered pycnometer, sample, and water, g.

8. Report

8.1 Both determinations shall be reported to the nearest 0.01. The results shall check to within 0.03, or additional determinations shall be made in duplicate.

9. Precision and Bias

9.1 The precision and bias of this test method for measuring the true specific gravity of refractory materials by water immersion is being determined. It is not feasible to specify the precision and bias of this test method at this time because the ruggedness and round-robin testing is incomplete.

10. Keywords

10.1 nonhydratable; pycnometer; refractory material; true specific gravity; water immersion