Designation: ~~C830 – 00 (Reapproved 2011)~~ C830 – 00 (Reapproved 2016)

Standard Test Methods for Apparent Porosity, Liquid Absorption, Apparent Specific Gravity, and Bulk Density of Refractory Shapes by Vacuum Pressure[1]

This standard is issued under the fixed designation C830; 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 These test methods cover the determination of the following properties of refractory shapes:

1.1.1 Apparent porosity,

1.1.2 Liquid absorption,

1.1.3 Apparent specific gravity, and

1.1.4 Bulk density.

1.2 These test methods are applicable to all refractory shapes except those that chemically react with both water and mineral spirits. When testing a material capable of hydration or other chemical reaction with water but which does not chemically react with mineral spirits, mineral spirits is substituted for water and appropriate corrections for the density differences are applied when making calculations.

1.3 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3.1 *Exception*—The apparatus used in this standard is only available in SI units.

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

NOTE 1—Test Methods C20 cover procedures for testing properties of refractories that are not attacked by water.

2. Referenced Documents

2.1 *ASTM Standards*:[2]

C20 Test Methods for Apparent Porosity, Water Absorption, Apparent Specific Gravity, and Bulk Density of Burned Refractory Brick and Shapes by Boiling Water

C134 Test Methods for Size, Dimensional Measurements, and Bulk Density of Refractory Brick and Insulating Firebrick

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Significance and Use

3.1 Apparent porosity, water absorption, apparent specific gravity, and bulk density are primary properties of refractory shapes. These properties are widely used in the evaluation and comparison of product quality and as part of the criteria for selection and use of refractory products in a variety of industrial applications. These test methods are used for determining any or all of these properties and are particularly useful for testing hydratable products.

3.2 These test methods are primary standard methods that are suitable for use in quality control, research and development, establishing criteria for and evaluating compliance with specifications, and providing data for design purposes.

3.3 Fundamental assumptions inherent in these test methods are:

3.3.1 The test specimens conform to the requirements for size, configuration, and original faces,

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[1] These test methods are under the jurisdiction of ASTM Committee C08 on Refractories and are the direct responsibility of Subcommittee C08.03 on Physical Properties.

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[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.

3.3.2 The open pores of the test specimens are fully impregnated with liquid during the vacuum-pressure treatment, and

3.3.3 The blotting of the saturated test specimens is performed as specified in a consistent and uniform manner to avoid withdrawing liquid from the pores.

3.3.4 Deviation from any of these assumptions adversely affects the test results.

3.4 In laboratory studies involving castable specimen, a bias was noted between formed 2 × 2 × 2 in. (50 × 50 × 50 mm) and specimens quartered from larger 9 × 4.5 × 2.5 in. (228 × 114 × 64 mm) cast specimens. Additionally, an error in the apparent porosity determination was found on castables whenever the specimens were heated to 1500°F (816°C) and then exposed to water as a saturation media. The error was attributed to reactivity of cement with water and subsequent re-hydration of cement phases. The higher the cement level of the castable, the greater the error noted. It was concluded that an error in porosity values could occur for refractory materials having a potential to form hydrated species with water. Testing under the same conditions in kerosene produced results that were believed to be more accurate, but the data suggested that the kerosene might not have saturated the open pores of cast specimen as readily as water.[3]

3.5 Certain precautions must be exercised in interpreting and using results from these test methods. All four property values are interrelated by at least two of the three base data values generated during testing. Thus, an error in any base data value will cause an error in at least three of the property values for a given test specimen. Certain of the properties, that is, apparent specific gravity and bulk density, are functions of other factors such as product composition, compositional variability within the same product, impervious porosity, and total porosity. Generalizations on or comparisons of property values should be judiciously made between like products tested by these test methods or with full recognition of potentially inherent differences between the products being compared or the test method used.

3.6 When a liquid other than water is used, such as types of kerosene or mineral spirits, specific gravity must be known by either determination or monitoring on a controlled basis. Specific gravity will change due to different grades of liquids, evaporation, or contamination with dirt or foreign material. The test should not be run if the liquid becomes dirty, foamy, or changes color, because foreign particles can block pores and prevent impregnation of the sample.

4. Test Specimens

4.1 When testing 9-in. (228-mm) straight brick, use a quarter-brick specimen obtained by halving the brick along a plane parallel to the 9 by 2½ or 3-in. (228 by 64 or 76-mm) face and along a plane parallel to the 4½ by 2½ or 3-in. (114 by 64 or 76-mm) face. Four of the surfaces of the resultant quarter-brick specimen include part of the original molded faces.

4.2 When testing other refractory shapes, cut drill, or break from each shape a specimen having a volume of approximately 25 to 30 in.^{3} (410 to 490 cm^3). The specimen shall include interior and exterior portions of the shape.

4.3 Remove all loosely adhering particles from each specimen.

5. Procedures

5.1 *Determination of Dry Weight, D:*

5.1.1 Dry the test specimens to constant weight by heating to 220 to 230°F (105 to 110°C) and determine the dry weight, *D*, in grams to the nearest 0.1 g.

5.1.2 The drying procedure may be omitted only when the test specimens are known to be dry, as may be the case with samples taken directly from kilns.

5.1.3 The drying of the specimens to constant weight and the determination of their dry weight may be done either before or after the saturation operation (5.2). Usually, the dry weight is determined before saturation; if, however, the specimens are friable or evidence indicates that particles have broken loose during the saturating operation, dry and weigh the specimens after the suspended weight, *S*, and the saturated weight, *W*, have been determined as described in 5.3 and 5.4. Use this second dry weight in all appropriate calculations.

5.2 *Saturation*—Place the test specimens in a suitable vacuum-pressure vessel (Note 2) which shall be closed, secured, and pumped down to an absolute pressure of not more than 1.9 in. Hg (6.4 kPa). Hold this pressure for 30 min. Allow the water or mineral spirits (see 1.2) to enter the vessel while maintaining the vacuum for 5 min. Then close the vacuum line and pressurize the vessel by means of compressed air or a pressure pump. Maintain this pressure at 30 psi (207 kPa) or more for 60 min. Then release the pressure; the saturated specimens are now ready for weighing.

NOTE 2—The vacuum-pressure vessel should be capable of withstanding an absolute pressure of 1.0 in. Hg (3.4 kPa) or a pressure of 65 to 70 psi (448 to 483 kPa) without deforming or rupturing. It should be provided with gages or manometers for indicating vacuum or pressure and a relief valve, as well as vacuum, pressure, and liquid lines. The liquid may be introduced at the bottom, in which case a dual-acting valve will suffice for both filling and draining the vessel.

5.3 *Determination of Suspended Weight, S:*

5.3.1 Determine the weight, *S*, of each test specimen in grams to the nearest 0.1 g after saturation and while suspended in liquid.

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:C08-1014.