Designation: C202 – 19

Standard Test Method for Thermal Conductivity of Refractory Brick[1]

This standard is issued under the fixed designation C202; 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 supplements Test Method C201, and shall be used in conjunction with that test method to determine the thermal conductivity of refractory brick with the exception of insulating firebrick (use Test Method C182) and carbon refractories (use Test Method C767). This test method is designed for refractories having a conductivity factor of not more than 200 Btu·in./h·ft^2·°F (28.8 W/m·K).

1.2 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 *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]

C155 Classification of Insulating Firebrick

C182 Test Method for Thermal Conductivity of Insulating Firebrick

C201 Test Method for Thermal Conductivity of Refractories

C767 Test Method for Thermal Conductivity of Carbon Refractories

E220 Test Method for Calibration of Thermocouples By Comparison Techniques

3. Significance and Use

3.1 The thermal conductivity of refractory brick is a property required for selecting their thermal transmission characteristics. Users select refractory brick to provide specified conditions of heat loss and cold face temperature, without exceeding the temperature limitation of the brick. This test method establishes placement of thermocouples and positioning of test specimens in the calorimeter.

3.2 This procedure must be used with Test Method C201 and requires a large thermal gradient and steady-state conditions. The results are based upon a mean temperature.

3.3 The data from this test method are suitable for specification acceptance, estimating heat loss and surface temperature, and design of multi-layer refractory construction.

3.4 The use of these data requires consideration of the actual application environment and conditions.

4. Apparatus

4.1 The apparatus shall consist of that described in Test Method C201 with the addition of thermocouples, back-up insulation, and refractory fiber paper as described in Sections 6 and 7 of this test method.

5. Test Specimens

5.1 The test specimens shall be selected and prepared in accordance with Test Method C201.

6. Installation of Thermocouples in Test Specimen

6.1 *Thermocouples*—Calibrated[3] thermocouples shall be embedded in the test specimen at two points for measuring temperature. Platinum-10 % rhodium⁄platinum thermocouples shall be used. Wire of AWG Gage 28 (0.320 mm) shall be used in making the thermocouples.

6.2 *Installation of Thermocouples*—The hot junction of the thermocouples shall be placed in the center of each 9 by 4½-in. (228 by 114-mm) face and just below the surface of the test specimen. Grooves to receive the wire shall be cut in each 9 by 4½-in. (228 by 114-mm) face of the brick to a depth of 1⁄32 in.

[1] This test method is under the jurisdiction of ASTM Committee C08 on Refractories and is the direct responsibility of Subcommittee C08.02 on Thermal 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] Test Method E220 specifies calibration procedures for thermocouples.

(0.8 mm) by means of an abrasive wheel 0.02 in. (0.5 mm) in thickness. The layout for the grooves allows all of the cold junction ends of the wires to extend from one end of the brick. A groove shall be cut in the center of each 9 by 4½-in. (228 by 114-mm) face along the 4½-in. (114-mm) dimension and ending 1 in. (25.4 mm) from each edge. The path of each groove is extended at an angle of 90° to one end of the brick by cutting grooves parallel to and 1.0 in. (25.4 mm) from the edge of the specimen. Before cementing[4] the thermocouple wires in place, measurements shall be taken to obtain, within ±0.01 in. (0.3 mm), the eventual distance between the center lines of the thermocouple junctions. This shall be done by measuring the 2½-in. (64-mm) dimension of the brick at the location for the hot junctions and deducting the distance between the center line of each junction in its embedded position and the surface of the brick.

7. Set-Up of Back-Up Insulation, Specimen, and Silicon Carbide Slab

7.1 The calorimeter and inner and outer guards shall be covered with a 0.50-in. (12.7-mm) thick layer of Group 20 insulating firebrick (see Classification C155) for the purpose of obtaining a higher mean temperature in the test specimen than would result by placing the specimen directly over the calorimeter area. The back-up insulation shall be cut and ground so as to provide surfaces that are plane and do not vary from parallel by more than ±0.01 in (0.3 mm). The sides of the pieces that are to be placed in contact shall be ground plane and at right angles to the horizontal faces. The joints between the pieces shall be tight without the use of any mortar.

7.2 Two strips of refractory fiber paper 13½ by ½ by 0.02 in. (343 by 13 by 0.5 mm) shall be placed along the 13½-in. (343-mm) dimension of the inner guard at the outside edges. Twelve strips of refractory fiber paper 2 by ½ by 0.02 in. (51 by 13 by 0.5 mm) shall be placed on the outer guard at intervals in the pattern shown in Fig. 1. These strips serve as spacers to prevent contact between the test material and the calorimeter assembly. The back-up insulation shall then be placed on the calorimeter assembly so as to provide a level and plane surface. Additional strips of refractory fiber paper of the same dimensions shall be placed in the same pattern upon the back-up insulation. These strips serve as spacers to prevent contact between the fireclay brick and the back-up insulation. The test specimen shall be placed centrally over the center of the calorimeter section on its 9 by 4½-in. (228 by 114-mm) face, the guard brick placed at the sides of the test specimen so as to completely cover the calorimeter and inner guard area, and the soap brick placed along the edges of the three brick so as to completely cover the calorimeter assembly. The small space between the furnace walls and the test brick assembly shall be filled with granulated insulating firebrick.

7.3 The silicon carbide slab shall be placed over the 13½ by 9-in. (343 by 228-mm) area of the three 9-in. (228-mm) brick specimens, and it shall be spaced 1 in. (25.4 mm) above the

[4] Alundum Cement RA 562 supplied by the Norton Co., One New Bond St., Worcester, MA 01606, is satisfactory for this purpose.

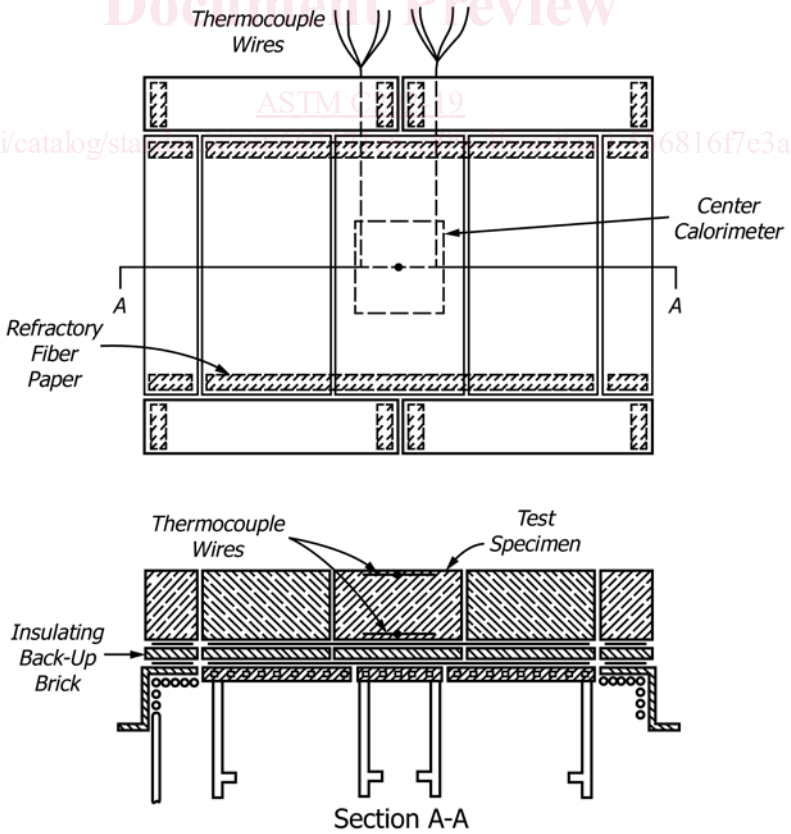

FIG. 1 Arrangement of Refractory Fiber Paper Strips in Calorimeter Assemblage