Designation: ~~C201 – 93 (Reapproved 2013)~~ C201 – 93 (Reapproved 2019)

Standard Test Method for Thermal Conductivity of Refractories[1]

This standard is issued under the fixed designation C201; 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 the comparative thermal conductivity of refractories under standardized conditions of testing. This test method is designed for refractories having a conductivity factor of not more than 200 Btu·in./h·ft^2·°F (2818 W/m·K), for a thickness of 1 in. (25 mm).

1.2 Detailed ASTM test methods to be used in conjunction with this procedure in testing specific types of refractory materials are as follows: Test Method C182, Test Method C202, Test Method C417, and Test Method C767.

1.3 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.

1.4 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

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]

C134 Test Methods for Size, Dimensional Measurements, and Bulk Density of Refractory Brick and Insulating Firebrick
C155 Classification of Insulating Firebrick
C182 Test Method for Thermal Conductivity of Insulating Firebrick
C202 Test Method for Thermal Conductivity of Refractory Brick
C417 Test Method for Thermal Conductivity of Unfired Monolithic 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 refractories is a property required for selecting their thermal transmission characteristics. Users select refractories to provide specified conditions of heat loss and cold face temperature, without exceeding the temperature limitation of the refractory. This test method establishes the testing for thermal conductivity of refractories using the calorimeter.

3.2 This procedure requires a large thermal gradient and ~~steady state~~ steady-state conditions. The results are based upon a mean temperature.

3.3 The data from this test method are suitable for specification ~~acceptance,~~acceptance and design of multi-layer refractory construction.

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

[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.

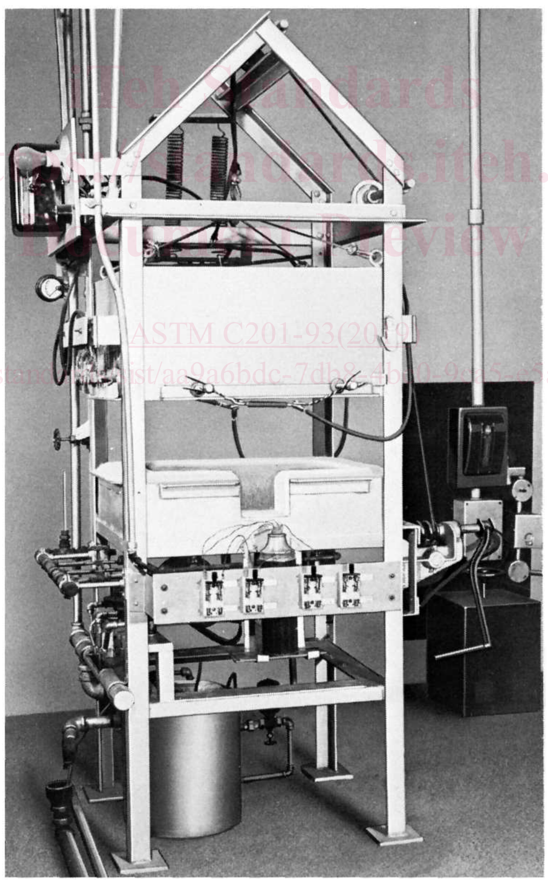
4. Apparatus

4.1 The apparatus shall conform in close detail with that shown in the approved drawings.[3] The equipment is shown in ~~Fig. 1~~Figs. 1 and 2 ~~and Fig. 2~~, and the essential parts are as follows:

4.1.1 *Heating Chamber*—A heating chamber, shown in Fig. 3, shall be capable of being heated electrically over a temperature range from 400 to ~~2800°F~~2800 °F (205 to ~~1540°C)~~1540 °C) in a neutral or oxidizing atmosphere. The temperature of the heating unit shall be controlled by a mechanism capable of maintaining the temperature in the chamber constant to within ~~±5°F (±3°C).~~ ±5 °F (±3 °C). A silicon carbide slab 13½ by 9 by 1 in. (342 by 228 by ~~25 mm),~~ 25 mm), with the 13½ by 9-in. (342 by ~~228 mm)~~ 228-mm) faces plane and parallel, shall be placed above the sample for the purpose of providing uniform heat distribution. A layer of insulation equivalent at least to 1 in. (25 mm) of Group 20 insulating firebrick (see Classification C155) shall be placed below the calorimeter and guard plates.

4.1.2 *Calorimeter Assembly*—A copper calorimeter assembly, of the design shown in Fig. 4, shall be used for measuring the quantity of heat flowing through the test specimen. The water circulation is such that adjacent passages contain incoming and outgoing streams of water. The calorimeter shall be 3 by 3 in. (76 by 76 mm) square and shall have one inlet and one outlet water connection. The inner guard surrounding the calorimeter shall be 13½ by 9 in. (342 by ~~228 mm)~~ 228 mm) and shall have two inlet and two outlet water connections. The outer guard shall extend 2 in. (51 mm) laterally from the inner guard and shall extend vertically to the member comprising the bottom of the heating chamber (see Fig. 3). The separation between the calorimeter and the inner guard shall be 1⁄32 in. (0.8 mm).

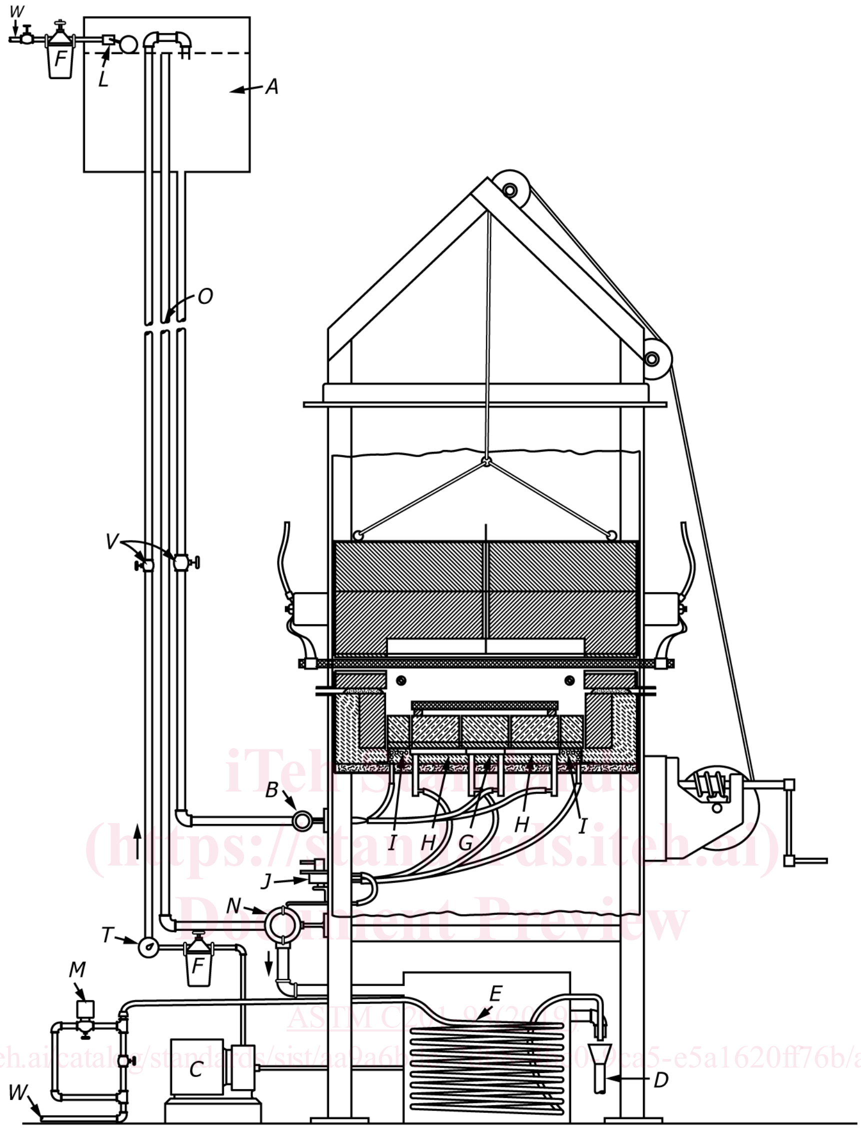
4.1.3 ~~*Water-Circulating*~~ *Water Circulating System*—A ~~water-circulating~~ water circulating system shall be provided for supplying the calorimeter assembly with water at constant pressure and at a temperature that is not changing at a rate greater than ~~1°F (0.5°C)/h.~~ 1 °F (0.5 °C)/h. The inlet water pressure shall be at least the equivalent of 10 ft of hydrostatic pressure (29.9 kPa). The



NOTE 1—The upper half of the heating chamber has been raised to permit introduction of the test samples.

FIG. 1 Photograph of Thermal Conductivity Apparatus

[3] The complete set of approved drawings necessary for the construction of the apparatus and suggested operating instructions, each of which requires too much space to be included with this test method, ~~were~~was originally drafted by the Insulating Products Division of Babcock and Wilcox Co. ASTM has been advised that these drawings are no longer available. Subcommittee ~~C08.05 currently~~ C08.02 is currently taking this issue under advisement.



~~*A*—Constant-head water supply.~~
~~*B*—Inlet manifold and thermometer.~~
~~*C*—Circulating pump.~~
~~*D*—To drain.~~
~~*E*—Cooling coil.~~
~~*F*—Water filter.~~
~~*G*—Center calorimeter.~~
~~*H*—Inner guard calorimeter.~~
~~*I*—Outer guard calorimeter.~~
~~*J*—Microregulating valves.~~
~~*L*—Water-level valve.~~
~~*M*—Magnetic control valve.~~
~~*N*—Outlet manifold.~~
~~*O*—Overflow pipe.~~
~~*T*—Thermostat (controls *M*).~~
~~*V*—Valves.~~
~~*W*—Water inlet.~~

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T—Thermostat (controls *M*)
V—Valves
W—Water inlet

FIG. 2 Diagram Showing Essential Parts of Thermal Conductivity Apparatus

inlet water temperature shall at all times be within ~~+5°F (+3°C) or −2°F (−1°C)~~+5 °F (+3 °C) or −2 °F (−1 °C) of the room temperature. Fig. 5 shows the arrangement that shall be used for meeting these conditions. The regulating valves for controlling the rate of water flow through the calorimeter assembly shall be capable of maintaining a constant rate of flow within ±1 % during the test period.