



Standard Test Method for Measurement of Heat of Hydration of Hydraulic Cementitious Materials Using Isothermal Conduction Calorimetry¹

This standard is issued under the fixed designation C1702; 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 specifies the apparatus and procedure for determining total heat of hydration of hydraulic cementitious materials at test ages up to 7 days by isothermal conduction calorimetry.

1.2 This test method also outputs data on rate of heat of hydration versus time that is useful for other analytical purposes, as covered in Practice C1679.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

C186 Test Method for Heat of Hydration of Hydraulic Cement

C1679 Practice for Measuring Hydration Kinetics of Hydraulic Cementitious Mixtures Using Isothermal Calorimetry

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

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *baseline, n*—the time-series signal from the calorimeter when measuring output from a sample of approximately

the same mass and thermal properties as a cement sample, but which is not generating or consuming heat.

3.1.2 *heat, n*—the time integral of thermal power measured in joules (J).

3.1.3 *isothermal conduction calorimeter, n*—a calorimeter that measures heat flow from a sample maintained at a constant temperature by intimate thermal contact with a constant temperature heat sink.

3.1.4 *reference cell, n*—a heat-flow measuring cell that is dedicated to measuring power from a sample that is generating no heat.

3.1.4.1 *Discussion*—The purpose of the reference cell is to correct for baseline drift and other systematic errors that can occur in heat-flow measuring equipment.

3.1.5 *sensitivity, n*—the minimum change in thermal power reliably detectable by an isothermal calorimeter.

3.1.5.1 *Discussion*—For this application, sensitivity is taken as ten times the random noise (standard deviation) in the baseline signal.

3.1.6 *thermal mass, n*—the amount of thermal energy that can be stored by a material (J/K).

3.1.6.1 *Discussion*—The thermal mass of a given material is calculated by multiplying the mass by the specific heat capacity of the material. For the purpose of calculating the thermal mass used in this standard, the following specific heat capacities can be used: The specific heat capacity of a typical unhydrated portland cement and water is 0.75 and 4.18 J/(g·K), respectively. Thus a mixture of *A* g of cement and *B* g of water has a thermal mass of $(0.75 \times A + 4.18 \times B)$ J/K. The specific heat capacity of typical quartz and limestone is 0.75 and 0.84 J/(g·K), respectively. The specific heat capacity of most amorphous supplementary cementitious material, such as fly ash or slag, is approximately 0.8 J/(g·K).

3.1.7 *thermal power, n*—the heat production rate measured in joules per second (J/s).

3.1.7.1 *Discussion*—This is the property measured by the calorimeter. The thermal power unit of measure is J/s, which is equivalent to the watt. The watt is also a common unit of measure used to represent thermal power.

¹ This test method is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.26 on Heat of Hydration.

Current edition approved Dec. 1, 2015. Published January 2016. Originally approved in 2009. Last previous edition approved in 2015 as C1702 – 15a. DOI: 10.1520/C1702-15B.

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.