



Designation: C1608 – 17

Standard Test Method for Chemical Shrinkage of Hydraulic Cement Paste¹

This standard is issued under the fixed designation C1608; 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 measures the internal (absolute) volume change of hydraulic cement paste that results from the hydration of the cementitious materials. This volume change is known as *chemical shrinkage*.

1.1.1 Procedure A, volumetric method.

1.1.2 Procedure B, the density method.

1.2 The values stated in SI units are to be regarded as the 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 and health practices and determine the applicability of regulatory limitations prior to use. (Warning—Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.²)*

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:³

C114 Test Methods for Chemical Analysis of Hydraulic Cement

C186 Test Method for Heat of Hydration of Hydraulic Cement

C188 Test Method for Density of Hydraulic Cement

C219 Terminology Relating to Hydraulic Cement

C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency

¹ This test method is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.31 on Volume Change.

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² See the section on Safety, Manual of Cement Testing, *Annual Book of ASTM Standards*, Vol. 04.01.

³ 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.

C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials

3. Terminology

3.1 Definitions:

3.1.1 *chemical shrinkage, n*—the absolute (internal) volume change accompanying the hydration of cement, due to the fact that the cement hydration products occupy less physical volume than the reactants.

3.1.2 All other terms are as defined in Terminology C219.

4. Significance and Use

4.1 Numerous properties of cementitious materials are controlled by their initial hydration rate. Examples include early-age strength development, heat release, and crack resistance. One direct and convenient measure of this initial hydration rate is provided by the measurement of the chemical shrinkage of the cement paste during its hydration. As cement hydrates, the hydration products occupy less volume than the initial reacting materials (cement and water). Due to this volume change, a hydrating cement paste will sorb water from its immediate surroundings, when available. At early times, this sorption is in direct proportion to the amount of hydration that has occurred.⁴ This method is based on the one developed by Geiker.⁵ The results are relevant to understanding the hydration behavior of cements. This method does not measure the bulk volume changes (autogenous shrinkage) associated with chemical shrinkage nor the cracking potential of concretes produced with the evaluated cement.

5. Apparatus

5.1 *Devices for Determining Mass*, conforming to the requirements of Test Methods C114 and evaluated for precision and accuracy at a total load of 100 g.

⁴ L.J. Parrott, M. Geiker, W.A. Gutteridge, and D. Killoh, "Monitoring Portland Cement Hydration: Comparison of Methods," *Cement and Concrete Research*, Vol. 20, 919-926, 1990.

⁵ M. Geiker, "Studies of Portland Cement Hydration: Measurements of Chemical Shrinkage and a Systematic Evaluation of Hydration Curves by Means of the Dispersion Model," Ph.D. Thesis, Technical University of Denmark, Copenhagen, Denmark, 1983.

*A Summary of Changes section appears at the end of this standard