Designation: ~~C452/C452M – 10~~ C452 – 15

Standard Test Method for Potential Expansion of Portland-Cement Mortars Exposed to Sulfate[1]

This standard is issued under the fixed designation ~~C452/C452M;~~C452; 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, which is applicable only to portland cements, covers the determination of the expansion of mortar bars made from a mixture of portland cement and gypsum in such proportions that the mixture has a sulfur trioxide (SO_3) content of 7.0 mass %.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard. Values in SI units [or inch-pound units] shall be obtained by measurement in SI units [or inch pound units] or by appropriate conversion, using the Rules for Conversion and Rounding given in IEEE/ASTM SI 10, of measurements made in other units ~~[or~~(or SI ~~units]~~.units). Values are stated in only SI units when inch-pound units are not used in practice.

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]

2. Referenced Documents

2.1 *ASTM Standards:*[3]

C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)
C150 Specification for Portland Cement
C219 Terminology Relating to Hydraulic Cement
C230/C230M Specification for Flow Table for Use in Tests of Hydraulic Cement
C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
C471M Test Methods for Chemical Analysis of Gypsum and Gypsum Products (Metric)
C490 Practice for Use of Apparatus for the Determination of Length Change of Hardened Cement Paste, Mortar, and Concrete
C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
C778 Specification for Sand
C1005 Specification for Reference Masses and Devices for Determining Mass and Volume for Use in the Physical Testing of Hydraulic Cements
D1193 Specification for Reagent Water
IEEE/ASTM SI 10 Practice for Use of the International System of Units (SI): The Modern Metric System

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology C219.

[1] This test method is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.29 on Sulfate Resistance.
Current edition approved ~~June 1, 2010~~Aug. 1, 2015. Published ~~July 2010~~August 2015. Originally approved in 1960. Last previous edition approved in ~~2006~~2010 as ~~C452~~C452/C452M – 10.~~06.~~ DOI: ~~10.1520/C0452_C0452M-10.~~10.1520/C0452_C0452M-15.

[2] 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.

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

4. Interferences

4.1 This test method is not suitable for establishing the sulfate resistance of blended hydraulic cements nor for combinations of portland cement and pozzolans or slag cement (Note 1).

NOTE 1—The main increase in sulfate resistance provided by blended hydraulic cements, pozzolans and slag cement occurs when concrete is exposed after the pozzolans or slag cement have had time to react.

5. Significance and Use

5.1 This test method is used primarily by those interested in research on methods for determining the potential sulfate resistance of portland cement. This test method is also used to establish that a sulfate-resisting portland cement meets the performance requirements of Specification C150.

6. Apparatus

6.1 *Weights and Weighing Devices,* conforming to the requirements of Specification C1005.

6.2 *Flow Table,* conforming to the requirements of Specification C230/C230M.

6.3 *Mixer, Bowl, and Paddle,* conforming to the requirements of Practice C305.

6.4 *Trowel and Tamper,* conforming to the requirements of Test Method C109/C109M.

6.5 *Glass Graduates, Molds, and Length Comparator,* conforming to the requirements of Practice C490.

7. Temperature and Humidity

7.1 *Molding Room, Dry Materials, and Mixing Water*—Maintain the temperature of the molding room, dry materials, and mixing water at 23.0 ± ~~4.0 °C~~ 4.0°C [73.5 ± ~~7 °F]~~ 7°F] and the relative humidity of the molding room at not less than 50 %.

7.2 *Moist Cabinet or Room,* conforming to the requirements of Specification C511.

8. Materials

8.1 Use graded sand that conforms to Specification C778 Table 1 Standard Sand Requirements for making the test mortar.

8.2 For the gypsum addition to portland cement, use high grade natural gypsum[4] with 100 % passing the ~~150-µm~~ 150 µm (No. 100) sieve, at least 94 % passing the ~~75-µm~~ 75 µm (No. 200) sieve, and at least 90 % passing the ~~45-µm~~ 45 µm (No. 325) sieve. Calculate the percentage of cement and gypsum required to provide a mixture containing 7.0 mass % SO_3 as follows:

$$\text{Cement}, \% = [(g - 7.0)/(g - c)] \times 100 \quad (1)$$

$$\text{Gypsum}, \% = [(7.0 - c)/(g - c)] \times 100 \quad (2)$$

where:

c = SO_3 content of the portland cement, %,
g = SO_3 content of the gypsum, %, and
7.0 = SO_3 content of the cement-gypsum mixture, %.

8.3 If the SO_3 content of the gypsum is unknown, analyze the gypsum for SO_3 content using Test Methods C471M. Determine the SO_3 content to the nearest 0.1 %.

8.4 *Purity of Water*—Unless otherwise indicated, references to water mean reagent water conforming to Type IV of Specification D1193.

9. Number and Dimensions of Test Specimens

9.1 Make six 25 by 25 by ~~285-mm~~ 285 mm [or 1 by 1 by 11¼-in.] test specimens, three from each of two batches, for each cement.

9.2 In routine tests, 25 by 25 by ~~160-mm~~ 160 mm [or 1 by 1 by 6¼-in.] specimens may be used, but in case of dispute, results obtained with 25 by 25 by ~~285-mm~~ 285 mm [or 1 by 1 by 11¼-in.] specimens govern.

10. Preparing Specimen Molds

10.1 Prepare the molds in accordance with Practice C490.

11. Proportioning, Consistency, and Mixing of Mortar

11.1 Use 400 g (cement plus gypsum) and 1100 g of sand for each batch. Use 194 mL of mixing water for all non-air-entraining portland cements, and 184 mL of mixing water for all air-entraining portland cements.

[4] The sole source of supply of the apparatus known to the committee at this time is Terra Alba No. 1, available from the U.S. Gypsum Co., Southard, OK plant. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.