



Designation: C 563 – 03

## Standard Test Method for Optimum SO<sub>3</sub> in Hydraulic Cement Using 24-h Compressive Strength<sup>1</sup>

This standard is issued under the fixed designation C 563; 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 describes the determination of optimum SO<sub>3</sub> for maximum 24-h compressive strength by measuring the change in strength produced in hydraulic cement mortar as a result of substituting calcium sulfate for a portion of the cement. Usually, but not always, the SO<sub>3</sub> content that produces the highest 24-h strength at 23°C also produces approximately the lowest expansion in water and the lowest contraction in air at that temperature.

1.2 This test method refers to the sulfur trioxide (SO<sub>3</sub>) content of the cement only. Slag cements and occasionally other hydraulic cements can contain sulfide or other forms of sulfur. The determination of SO<sub>3</sub> content by rapid methods may include these other forms, and may therefore produce a significant error. If a significant error occurs, analyze the cement for SO<sub>3</sub> content using the reference test method of Test Methods C 114 for sulfur trioxide.

1.3 Values stated as SI units are to be regarded as 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:

- C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)<sup>2</sup>
- C 114 Test Methods for Chemical Analysis of Hydraulic Cement<sup>2</sup>
- C 150 Specification for Portland Cement<sup>2</sup>
- C 204 Test Method for Fineness of Hydraulic Cement by Air Permeability Apparatus<sup>2</sup>
- C 305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency<sup>2</sup>
- C 471M Test Methods for Chemical Analysis of Gypsum

and Gypsum Products [Metric]<sup>2</sup>

- C 511 Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes<sup>2</sup>
- C 595 Specification for Blended Hydraulic Cements<sup>2</sup>
- C 778 Specification for Standard Sand<sup>2</sup>
- C 1157 Performance Specification for Hydraulic Cement<sup>2</sup>

### 3. Significance and Use

3.1 The purpose of this test method is to estimate the SO<sub>3</sub> content for a hydraulic cement that gives maximum 24-h compressive strength in mortar made and cured at 23°C. The value obtained is used to establish the level of sulfate in the manufacture of cements specified in Specifications C 150, C 595 and C 1157. In Specifications C 150 and C 595 it is used to justify exceeding the prescriptive limits for SO<sub>3</sub>.

3.2 The optimum SO<sub>3</sub> content for 24-h compressive strength is not necessarily the optimum SO<sub>3</sub> content for later ages or for volume change. Confirming tests can be made if the relationships between SO<sub>3</sub> and these properties are not known for the cement being tested.

3.3 This test method indicates optimum SO<sub>3</sub> content for cement in mortar made and cured at a standard temperature of 23.0 ± 2.0°C (73.5 ± 3.5°F). The optimum SO<sub>3</sub> increases with increasing temperature and may increase when water-reducing admixtures are used.

3.4 It should not be assumed that the optimum SO<sub>3</sub> estimated in this test method is the same SO<sub>3</sub> content for optimum performance of a concrete prepared from the cement.

3.5 The test method is applicable to cements specified in Specifications C 150, C 595, and C 1157.

### 4. Apparatus

4.1 Use the apparatus as specified in Test Method C 109/C 109M.

### 5. Materials

5.1 *Calcium Sulfate*—Use calcium sulfate for addition to the cement that is either a high-grade natural gypsum having an SO<sub>3</sub> content of at least 46 %, <sup>3</sup> or the calcium sulfate from the

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee C01 on Cement and is the direct responsibility of Subcommittee C01.28 on Sulfate Content.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.01.

<sup>3</sup> Terra Alba, available from the U.S. Gypsum Co., Southard, OK plant, meets these requirements for fineness and SO<sub>3</sub> content.