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# Standard Guide for Comparing Performance of Concrete-Making Materials Using Mortar Mixtures<sup>1</sup>

This standard is issued under the fixed designation C1810/C1810M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This guide provides information on how to compare the relative performance and potential incompatibility of combinations of concrete-making materials. Performance tests on fresh and early-age properties of mortar mixtures can be useful indicators of concrete performance using similar materials. The performance tests described in this guide include mortar-slump, mortar spread, mortar-workability retention, time of setting, air entrainment, and hydration kinetics.

1.2 *Units*—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 this guide. Some values only have SI units because the inch-pound equivalents are not used in guide.

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

**Warning**—Fresh hydraulic cementitious mixtures are caustic and may cause burns to skin and tissue upon prolonged exposure.<sup>2</sup>

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.*

<sup>1</sup> This guide is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.48 on Performance of Cementitious Materials and Admixture Combinations.

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<sup>2</sup> Section on Safety Precautions, Manual of Aggregate and Concrete Testing, *Annual Book of ASTM Standards*, Vol. 04.02.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

- C70 Test Method for Surface Moisture in Fine Aggregate
- C125 Terminology Relating to Concrete and Concrete Aggregates
- C128 Test Method for Relative Density (Specific Gravity) and Absorption of Fine Aggregate
- C185 Test Method for Air Content of Hydraulic Cement Mortar
- C305 Practice for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
- C403/C403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
- C494/C494M Specification for Chemical Admixtures for Concrete
- C566 Test Method for Total Evaporable Moisture Content of Aggregate by Drying
- C778 Specification for Standard Sand
- C1679 Practice for Measuring Hydration Kinetics of Hydraulic Cementitious Mixtures Using Isothermal Calorimetry
- E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E2251 Specification for Liquid-in-Glass ASTM Thermometers with Low-Hazard Precision Liquids
- IEEE/ASTM SI 10 American National Standard for Metric Practice

### 2.2 ISO Standard:<sup>4</sup>

- ISO 679 Cement—Test Methods—Determination of Strength

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>4</sup> Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

### 3. Terminology

3.1 *Definitions*—For definitions of terms used in this guide, refer to Terminology **C125**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *mortar-slump*—vertical distance between the original and displaced position of the center of the top surface of mortar when tested with the mortar-slump mold.

3.2.2 *mortar-spread*—distance of lateral flow of mortar from the mortar-slump test.

3.2.3 *mortar-slump retention time*—the duration of time over which the mortar mixture maintains at least 50 % of its initial mortar-slump.

3.2.4 *up-front addition of admixture*—concurrent addition of admixture with the mixing water to the dry materials of the mortar mixture.

3.2.5 *delayed addition of admixture*—addition of admixture at least one minute after the initial mixing of cementitious materials and water.

3.2.6 *workability index*—relative indicator of workability calculated as the sum of the mortar-slump and mortar spread minus 100 for measurements in SI units, and minus 4 for measurements in inch-pound units.

### 4. Significance and Use

4.1 The results of mortar mixture tests can be suitable for comparing the relative performance of combinations of concrete-making materials such as fine aggregate, chemical admixtures, supplementary cementitious materials (SCMs), water, and hydraulic cement. Furthermore, this guide can be useful to identify unexpected performances due to combination of various materials. The relative trends in performance observed with the mortar method may suggest relative performance in concrete mixtures batched with the same materials and relative mixture proportions.

4.2 While there are a number of ways to proportion and mix mortar mixtures, two procedures described in this guide have been used extensively for evaluating the performance of admixtures. Method A enables evaluation of materials using mixture proportions that correspond to specific job conditions; whereas Method B can be used as a general mixture using fixed amounts of a standard sand, cement, and supplementary cementitious materials.

### 5. Apparatus

5.1 The following equipment is used for the mortar preparation and testing:

5.1.1 *Mixer with Paddle and Bowl*—A table-mounted mixer meeting the requirements of Practice **C305**.

NOTE 1—Similar mixers with larger capacity are acceptable if the same mixer is used for preparing all mixtures that will be compared.

5.1.2 *Timer*, able to measure a total time of at least 60 min with an accuracy of 1 s.

5.1.3 *Scraper*, consisting of a rubber blade attached to a handle about 150 mm [6 in.] in length, with a blade of about 75 mm long [3 in.], 50 mm [2 in.] wide, and tapered to a thin edge about 2 mm [0.08 in.] thick.

NOTE 2—A kitchen tool known as a plate and bowl scraper may conform to these requirements.

5.1.4 *Balance*, of sufficient capacity to measure the mass of materials to the nearest 0.5 g.

5.1.5 *Spoon and Tamper*—Conforming to Test Method **C185**.

5.1.6 *Pointed Mortar Trowel*—Having a steel blade 100 to 150 mm [4 to 6 in.] long with straight edges. The edges when placed on a plane surface shall not depart from straightness by more than 1 mm [0.04 in.].

5.1.7 *Plastic Syringes (without needles)*, 1 to 250 mL capacity, with markings readable to  $\pm 5$  % of capacity.

5.1.8 *Mortar-slump Mold*—With a top opening of 50 mm [2 in.], bottom opening of 100 mm [4 in.], a height of 150 mm [6 in.], and wall thickness of at least 2 mm [0.08 in.].<sup>5</sup> The tolerance for height and diameter is  $\pm 2$  mm [ $\frac{1}{16}$  in.].

5.1.9 *Plastic Ring*, 12.5 mm [ $\frac{1}{2}$  in.] thick by 250 mm [10 in.] diameter with a 70 mm [2.75 in.] diameter hole in the center.

NOTE 3—The ring fits over the mortar-slump mold to hold the mold on to the base plate and to catch mortar overflowing as it is added to the mold.

5.1.10 *Funnel*—The mold described in Test Method **C128** or other suitable funnel for filling mortar-slump mold.

5.1.11 *Base Plate*—Square, non-absorbent, at least 300 mm [12 in.]. The plate shall be sufficiently flat so that there is no leakage of mortar at the base of the slump mold during the filling process.

5.1.12 *Steel Tamping Rod*, 9.5 mm [ $\frac{3}{8}$  in.] diameter by 300 mm [12 in.] long with rounded ends.

5.1.13 *Ruler*, at least 300 mm [12 in.] long.

5.1.14 *Calipers*, 300 mm [12 in.] readable to 1 mm [0.05 in.].

5.1.15 *Nominal 400 mL Brass Cup*, or similar size container with a known volume.

5.1.16 *16 mm [ $\frac{5}{8}$  in.] diameter Tapping Stick*, made of hard wood, 150 mm [6 in.] in length.

5.1.17 *Sieve*, 4.75 mm (No. 4) as described in Specification **E11**.

5.1.18 *Thermometer*—The thermometer shall be capable of measuring the temperature of the fresh mortar to  $\pm 0.5$  °C [ $\pm 1$  °F]. ASTM liquid-in-glass thermometers having a temperature range from  $-20$  to  $50$  °C [ $0$  to  $120$  °F], and conforming to the requirements of Thermometer 97F (or 97C) as prescribed in Specification **E2251** are satisfactory. Other thermometers of the required accuracy, including the metal immersion type, are acceptable.

### 6. Mortar Mixture Proportions

6.1 Two methods are described for proportioning mortar mixtures. Method A is adapted from specific job mixture proportions, and Method B is based on fixed proportions,

<sup>5</sup> The sole source of supply of the apparatus known to the committee at this time is Certified Material Testing Products, Palm Bay, FL., under the name, Mini Steel Slump Cone. 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,<sup>1</sup> which you may attend.