



Designation: C685/C685M – 17

Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing¹

This standard is issued under the fixed designation C685/C685M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers concrete made from materials continuously batched by volume, mixed in a continuous mixer, and delivered to the purchaser in a freshly mixed and unhardened state as hereinafter specified. Requirements for quality of concrete shall be either as hereinafter specified or as specified by the purchaser. When the requirements of the purchaser differ from this specification, the purchaser's specification shall govern. This specification does not cover the placement, consolidation, finishing, curing, or protection of the concrete after delivery to the purchaser. Tests and criteria for batching accuracy and mixing efficiency are specified herein.

1.2 The values stated in either SI units, shown in brackets, 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 nonconformance with the standard.

1.3 This specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this specification.

1.4 *This standard does not purport to address all 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 use.²)*

1.5 *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

- C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field
- C33/C33M Specification for Concrete Aggregates
- C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C94/C94M Specification for Ready-Mixed Concrete
- C125 Terminology Relating to Concrete and Concrete Aggregates
- C127 Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
- C136/C136M Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C138/C138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
- C143/C143M Test Method for Slump of Hydraulic-Cement Concrete
- C150/C150M Specification for Portland Cement
- C172/C172M Practice for Sampling Freshly Mixed Concrete
- C173/C173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
- C231/C231M Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C260/C260M Specification for Air-Entraining Admixtures for Concrete
- C330/C330M Specification for Lightweight Aggregates for Structural Concrete
- C494/C494M Specification for Chemical Admixtures for Concrete
- C567/C567M Test Method for Determining Density of

¹ This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.40 on Ready-Mixed Concrete.

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

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

- Structural Lightweight Concrete
- C595/C595M** Specification for Blended Hydraulic Cements
- C618** Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C637** Specification for Aggregates for Radiation-Shielding Concrete
- C989/C989M** Specification for Slag Cement for Use in Concrete and Mortars
- C1017/C1017M** Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- C1064/C1064M** Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete
- C1077** Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
- C1157/C1157M** Performance Specification for Hydraulic Cement
- C1240** Specification for Silica Fume Used in Cementitious Mixtures
- C1602/C1602M** Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

2.2 *ACI Documents:*⁴

- CP-1** Technician Workbook for ACI Certification of Concrete Field Testing Technician-Grade I
- 211.1** Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- 211.2** Standard Practice for Selecting Proportions for Structural Lightweight Concrete
- 301** Standard Specifications for Structural Concrete
- 304.6R** Guide for Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment
- 305R** Hot Weather Concreting
- 306R** Cold Weather Concreting
- 318** Building Code Requirements for Structural Concrete and Commentary

2.3 *Other Documents:*

- Bureau of Reclamation Concrete Manual**⁵
- VMMB 100-01** Volumetric Mixer Standards of the Volumetric Mixer Manufacturers Bureau⁶

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *manufacturer, n—of concrete*, the producer of the concrete.

3.2.2 *purchaser, n—of concrete*, the buyer of the concrete.

4. Basis of Purchase

4.1 The basis of purchase shall be the cubic yard or cubic metre of fresh concrete as it is continuously discharged from the batching and mixing apparatus.

4.2 The volume of fresh concrete in a given batch shall be determined by, or calculated from, a calibrated indicating device driven directly by the batching apparatus.

NOTE 1—It should be understood that the volume of hardened concrete may be, or may appear to be, less than expected due to waste and spillage, over-excavation, spreading forms, some loss of entrained air, or settlement of wet mixtures, none of which are the responsibility of the manufacturer.

5. Materials

5.1 In the absence of designated applicable specifications covering requirements for quality of materials, the following specifications shall govern:

5.2 *Cementitious Materials:*

5.2.1 *Hydraulic Cement*—Hydraulic Cement shall conform to Specification **C150/C150M**, Specification **C595/C595M**, or Specification **C1157/C1157M** (Note 2).

5.2.2 *Supplementary Cementitious Materials*—Coal Fly Ash or natural pozzolans shall conform to Specification **C618**. Slag Cement shall conform to Specification **C989/C989M**. Silica Fume shall conform to Specification **C1240**.

NOTE 2—These different cementitious materials will produce concretes of different properties and should not be used interchangeably.

5.3 *Aggregates*—Normal weight aggregates shall conform to Specification **C33/C33M**. Lightweight aggregates shall conform to Specification **C330/C330M** and heavyweight aggregates shall conform to Specification **C637**.

5.4 *Water*—Water shall conform to Specification **C1602/C1602M**.

5.5 *Air-Entraining Admixtures*—Air-entraining admixtures shall conform to Specification **C260/C260M** (Note 3).

TABLE 1 Recommended Total Air Content for Air-Entrained Concrete^A

| Exposure Condition ^{B,C} | Total Air Content, % | | | | | | |
|-----------------------------------|--|----------|----------|----------|-----------|----------|----------|
| | Nominal Max Sizes of Aggregate, in. [mm] | | | | | | |
| | ¾ [9.5] | ½ [12.5] | ¾ [19.0] | 1 [25.0] | 1½ [37.5] | 2 [50.0] | 3 [75.0] |
| Mild | 4.5 | 4.0 | 3.5 | 3.0 | 2.5 | 2.0 | 1.5 |
| Moderate | 6.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 3.5 |
| Severe | 7.5 | 7.0 | 6.0 | 6.0 | 5.5 | 5.0 | 4.5 |

^A For air-entrained concrete, when specified.

^B For description of exposure conditions, refer to ACI Standard Practice 211.1, Section 6.3.3 with attention to accompanying footnotes.

^C Unless exposure conditions dictate otherwise, it is permissible to reduce air contents recommended above by up to 1 % for concretes with specified compressive strength, f'_c , of 5000 psi [35 MPa] or above.

5.6 *Chemical Admixtures*—Chemical admixtures shall conform to either Specification C494/C494M or C1017/C1017M, as applicable (Note 3).

NOTE 3—In any given instance, the required dosage of air-entraining, accelerating, and retarding admixtures may vary. Therefore, a range of dosages should be allowed which will permit obtaining the desired effect.

6. Ordering Information

6.1 In the absence of designated applicable general specifications, the purchaser shall specify the following:

6.1.1 Designated size or sizes of coarse aggregate,

6.1.2 Slump or slumps desired at the point of delivery (see 10.3),

6.1.3 When air-entrained concrete is specified, the air content of samples taken at the point of discharge from the transportation unit (see 10.4 and Table 1 for the total air content and tolerances) (Note 4),

6.1.4 When structural lightweight concrete is specified, the density as fresh density, equilibrium density, or oven-dry density (Note 5), and

6.1.5 Which of Options A, B, or C shall be used as a basis for determining the proportions of the concrete to produce the required quality (see 6.2, 6.3, or 6.4).

NOTE 4—In selecting the specified air content, the purchaser should consider the exposure conditions to which the concrete will be subjected. Air contents less than shown in Table 1 may not give the required resistance to freezing and thawing, which is the primary purpose of air-entrained concrete. Air contents higher than the levels shown may reduce strength without contributing any further improvement of durability.

NOTE 5—The density of fresh concrete, which is the only density determinable at the time of delivery, is always higher than the equilibrium density, or oven-dry density. Definitions of, and methods for determining or calculating equilibrium density and oven-dry density, are covered in Test Method C567/C567M.

6.2 Option A:

6.2.1 When the purchaser requires the manufacturer to assume full responsibility for the selection of the proportions for the concrete mixture, the purchaser shall also specify the following:

6.2.1.1 Requirements for compressive strength as determined on samples taken from the mixer at the point of discharge and evaluated in accordance with Section 11. The purchaser shall specify the requirements in terms of the compressive strength of standard specimens cured under standard curing conditions for moist curing. Unless otherwise specified, the age at test shall be 28 days, and

6.2.2 At the request of the purchaser, the manufacturer shall, prior to the actual delivery of the concrete, furnish a statement to the purchaser, giving the dry mass of cement and saturated surface-dry mass of fine and coarse aggregate and quantities, type, and name of admixtures (if any) and of water per cubic yard or cubic metre of concrete that will be used in the manufacture of each class of concrete ordered by the purchaser. The manufacturer shall also furnish evidence satisfactory to the purchaser that the materials to be used and proportions selected will produce concrete of the quality specified.

6.3 Option B:

6.3.1 When the purchaser assumes responsibility for the proportioning of the concrete mixture, the purchaser shall also specify the following:

6.3.1.1 Cement content in pounds per cubic yard or kilograms per cubic metre of concrete, or equivalent units,

6.3.1.2 Maximum allowable water content in gallons per cubic yard or litres or kilograms per cubic metre of concrete or equivalent units, including surface moisture on the aggregates, but excluding water of absorption (Note 6), and

6.3.1.3 If admixtures are required, the type, name, and dosage range to be used. Admixtures shall not be used as a substitute for a portion of specified amounts of cement without the written approval of the purchaser.

NOTE 6—The purchaser, in selecting requirements for which he assumes responsibility should give consideration to requirements for workability, placeability, durability, surface texture, and density, in addition to those for structural design. The purchaser is referred to ACI Standard Practice 211.1 for normal weight concrete, and ACI Standard Practice 211.2 for lightweight concrete, for the selection of proportions that will result in concrete suitable for various types of structures and conditions of exposure. The water-cement ratio of most structural lightweight concretes cannot be determined with sufficient accuracy for use as a specification basis.

6.3.2 At the request of the purchaser, the manufacturer shall, prior to the actual delivery of the concrete, furnish a statement to the purchaser giving the sources, densities, and sieve analyses of the aggregates and the dry mass of cement and saturated surface-dry mass of fine and coarse aggregate and quantities, type, and name of admixture (if any) and of water per cubic yard or cubic metre of concrete that will be used in the manufacture of each class of concrete ordered by the purchaser.

6.4 Option C:

6.4.1 When the purchaser requires the manufacturer to assume responsibility for the selection of the proportions for the concrete mixture with the minimum allowable cement content specified, the purchaser shall also specify the following in addition to the requirements of 6.1.1 through 6.1.5:

6.4.1.1 Required compressive strength as determined on samples taken from the mixer at the point of discharge and evaluated in accordance with Section 11. The purchaser shall specify the requirements for strength in terms of tests of standard specimens cured under standard curing conditions for moist curing. Unless otherwise specified, the age at test shall be 28 days.

6.4.1.2 Minimum cement content in pounds per cubic yard or kilograms per cubic metre of concrete (Note 7), and

6.4.1.3 If admixtures are required, the type, name, and dosage range to be used. The cement content shall not be reduced when admixtures are used.

6.4.2 At the request of the purchaser, the manufacturer shall, prior to the actual delivery of the concrete, furnish a statement to the purchaser, giving the dry mass of cement and saturated surface-dry mass of fine and coarse aggregate and quantities, type, and name of admixture (if any) and of water per cubic yard or cubic metre of concrete that will be used in the manufacture of each class of concrete ordered by the purchaser. The manufacturer shall also furnish evidence satisfactory to the purchaser that the materials to be used and proportions selected