



Designation: C 94/C 94M – 03

Standard Specification for Ready-Mixed Concrete¹

This standard is issued under the fixed designation C 94/C 94M; 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 Department of Defense.

1. Scope

1.1 This specification covers ready-mixed concrete manufactured and delivered to a 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. In any case where the requirements of the purchaser differ from these in this specification, the purchaser's specification shall govern. This specification does not cover the placement, consolidation, curing, or protection of the concrete after delivery to the purchaser.

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 non-conformance with the standard.

1.3 As used throughout this specification the manufacturer shall be the contractor, subcontractor, supplier, or producer who furnishes the ready-mixed concrete. The purchaser shall be the owner or representative thereof.

1.4 The text of this standard 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 the standard.

2. Referenced Documents

2.1 ASTM Standards:

- C 31/C 31M Practice for Making and Curing Concrete Test Specimens in the Field²
- C 33 Specification for Concrete Aggregates²
- C 39/C 39M Test Method for Compressive Strength of Cylindrical Concrete Specimens²
- C 109/C 109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)³

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.

Current edition approved Apr. 10, 2003. Published June 2003. Originally approved in 1933. Last previous edition approved in 2001 as C 94/C 94M-00^{ε2}.

² Annual Book of ASTM Standards, Vol 04.02.

³ Annual Book of ASTM Standards, Vol 04.01.

- C 138 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete²
- C 143/C 143M Test Method for Slump of Hydraulic Cement Concrete²
- C 150 Specification for Portland Cement³
- C 172 Practice for Sampling Freshly Mixed Concrete²
- C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method²
- C 191 Test Method for Time of Setting of Hydraulic Cement by Vicat Needle³
- C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method²
- C 260 Specification for Air-Entraining Admixtures for Concrete²
- C 330 Specification for Lightweight Aggregates for Structural Concrete²
- C 494 Specification for Chemical Admixtures for Concrete²
- C 567 Test Method for Unit Weight of Structural Lightweight Concrete²
- C 595 Specification for Blended Hydraulic Cements³
- C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete²
- C 989 Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars²
- C 1017 Specification for Chemical Admixtures for Use in Producing Flowing Concrete²
- C 1064 Test Method for Temperature of Freshly Mixed Portland-Cement Concrete²
- C 1077 Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation²
- C 1157 Performance Specification for Hydraulic Cement³
- D 512 Test Methods for Chloride Ion in Water⁴
- D 516 Test Method for Sulfate Ion in Water⁴
- 2.2 ACI Documents:⁵
 - CP-1 Technician Workbook for ACI Certification of Concrete Field Testing Technician—Grade I

⁴ Annual Book of ASTM Standards, Vol 11.01.

⁵ Available from American Concrete Institute, 38800 Country Club Drive, Farmington Hills, MI 48331.

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TABLE 1 Recommended Total Air Content for Air-Entrained Concrete^{A,B}

Exposure Condition ^C	Total Air Content, %					
	Nominal Maximum Sizes of Aggregate, in. [mm]					
	¾ [19.0]	½ [12.5]	¾ [19.0]	1 [25.0]	1½ [37.5]	2 [50.0]
Mild	4.5	4.0	3.5	3.0	2.5	2.0
Moderate	6.0	5.5	5.0	4.5	4.0	3.5
Severe	7.5	7.0	6.0	6.0	5.5	5.0

^A For air-entrained concrete, when specified.

^B 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.

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

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

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 Manual⁶

AASHTO T26 Method of Test for Quality of Water to be Used in Concrete⁷

3. Basis of Purchase

3.1 The basis of purchase shall be the cubic yard or cubic metre of freshly mixed and unhardened concrete as discharged from the mixer.

3.2 The volume of freshly mixed and unhardened concrete in a given batch shall be determined from the total mass of the batch divided by the mass per unit volume of the concrete. The total mass of the batch shall be calculated either as the sum of the masses of all materials, including water, entering the batch or as the net mass of the concrete in the batch as delivered. The mass per unit volume shall be determined in accordance with Test Method C 138 from the average of at least three measurements, each on a different sample using a ½-ft³ [14-L³] container. Each sample shall be taken from the midpoint of each of three different truck loads by the procedure outlined in Practice C 172.

NOTE 1—It should be understood that the volume of hardened concrete may be, or 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 producer.

4. Ordering Information

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

4.1.1 Designated size, or sizes, of coarse aggregate,

4.1.2 Slump, or slumps, desired at the point of delivery (see Section 6 for acceptable tolerances),

4.1.3 When air-entrained concrete is specified, the air content of the samples taken at the point of discharge from the

transportation unit (see Section 7 and Table 1 for the total air content and tolerances) (Note 2),

4.1.4 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, and

4.1.5 When structural lightweight concrete is specified, the mass per unit volume as wet mass, air-dry mass, or oven-dry mass (Note 3).

NOTE 2—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 3—The mass per unit volume of fresh concrete, which is the only unit mass determinable at the time of delivery, is always higher than the air-dry or oven-dry mass. Definitions of, and methods for determining or calculating air-dry and oven-dry masses, are covered by Test Method C 567.

4.2 Option A:

4.2.1 When the purchaser requires the manufacturer to assume full responsibility for the selection of the proportions for the concrete mixture (Note 4), the purchaser shall also specify the following:

4.2.1.1 Requirements for compressive strength as determined on samples taken from the transportation unit at the point of discharge evaluated in accordance with Section 17. The purchaser shall specify the requirements in terms of the compressive strength of standard specimens cured under standard laboratory conditions for moist curing (see Section 17). Unless otherwise specified the age at test shall be 28 days.

NOTE 4—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 Standard Practice ACI 211.1 and Standard Practice ACI 211.2 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.

4.2.2 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 masses of cement and saturated surface-dry-masses 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. He shall also furnish evidence satisfactory to the purchaser.

⁶ Available from Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

⁷ Available from the American Association of State Highway and Transportation Officials, 444 N. Capitol St., NW, Suite 225, Washington, DC 20001.

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the materials to be used and proportions selected will produce concrete of the quality specified.

4.3 Option B:

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

4.3.1.1 Cement content in bags or pounds per cubic yard [kilograms per cubic metre] of concrete,

4.3.1.2 Maximum allowable water content in gallons per cubic yard [litres per cubic metre] of concrete, including surface moisture on the aggregates, but excluding water of absorption (Note 4), and

4.3.1.3 If admixtures are required, the type, name, and dosage to be used. The cement content shall not be reduced when admixtures are used under this option without the written approval of the purchaser.

4.3.2 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 masses of cement and saturated-surface-dry masses 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.

4.4 Option C:

4.4.1 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 (Note 5), the purchaser shall also specify the following:

4.4.1.1 Required compressive strength as determined on samples taken from the transportation unit at the point of discharge evaluated in accordance with Section 17. The purchaser shall specify the requirements for strength in terms of tests of standard specimens cured under standard laboratory conditions for moist curing (see Section 17). Unless otherwise specified the age at test shall be 28 days.

4.4.1.2 Minimum cement content in bags or pounds per cubic yard [kilograms per cubic metre] of concrete.

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

NOTE 5—Option C can be distinctive and useful only if the designated minimum cement content is at about the same level that would ordinarily be required for the strength, aggregate size, and slump specified. At the same time, it must be an amount that will be sufficient to ensure durability under expected service conditions, as well as satisfactory surface texture and density, in the event specified strength is attained with it. For additional information refer to Standard Practice ACI 211.1 and Standard Practice 211.2 referred to in Note 4.

4.4.2 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 masses of cement and saturated surface-dry masses 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. He shall also furnish evidence satisfactory to the purchaser that the materials to be used and proportions selected will produce concrete of the quality specified. Whatever strengths are attained the quantity of cement used shall not be less than the minimum specified.

4.5 The proportions arrived at by Options A, B, C for each class of concrete and approved for use in a project shall be assigned a designation to facilitate identification of each concrete mixture delivered to the project. This is the designation required in 13.1.7 and supplies information on concrete proportions when they are not given separately on each delivery ticket as outlined in 13.2. A certified copy of all proportions as established in Options A, B, or C shall be on file at the batch plant.

4.6 The purchaser shall ensure that the manufacturer is provided copies of all reports of tests performed on concrete samples taken to determine compliance with specification requirements. Reports shall be provided on a timely basis.

5. Materials

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

5.1.1 **Cement**—Cement shall conform to Specification C 150, Specification C 595, or Specification C 1157 (see Note 6). The purchaser shall specify the type or types required, but if no type is specified, the requirements of Type I as prescribed in Specification C 150 shall apply.

NOTE 6—These different cements will produce concretes of different properties and should not be used interchangeably.

5.1.2 **Aggregates**—Aggregates shall conform to Specification C 33 or Specification C 330 if lightweight concrete is specified by the purchaser.

5.1.3 Water:

5.1.3.1 The mixing water shall be clear and apparently clean. If it contains quantities of substances which discolor it or make it smell or taste unusual or objectionable or cause suspicion, it shall not be used unless service records of concrete made with it or other information indicates that it is not injurious to the quality of the concrete. Water of questionable quality shall be subject to the acceptance criteria of Table 2.

5.1.3.2 Wash water from mixer washout operations is permitted to be used for mixing concrete provided tests of wash water comply with the physical test limits of Table 2. Wash water shall be tested at a weekly interval for approximately 4 weeks, and thereafter at a monthly interval provided no single

TABLE 2 Acceptance Criteria for Questionable Water Supplies

	Limits	Test Method
Compressive strength, min % control at 7 days	90	C 109/C 109M ^A
Time of set, deviation from control, h: min	from 1:00 early to 1:30 later	C 191 ^A

^A Comparisons shall be based on fixed proportions and the same volume of test water compared to control mix using city water or distilled water.