Designation: C 31/C 31M – 00

Standard Practice for Making and Curing Concrete Test Specimens in the Field[1]

This standard is issued under the fixed designation C 31/C 31M; 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 practice covers procedures for making and curing cylinder and beam specimens from representative samples of fresh concrete for a construction project.

1.2 The concrete used to make the molded specimens shall be sampled after all on-site adjustments have been made to the mixture proportions, including the addition of mix water and admixtures. This practice is not satisfactory for making specimens from concrete not having measurable slump or requiring other sizes or shapes of specimens.

1.3 The values stated in either inch-pound units or SI units shall be regarded separately as standard. The SI units are shown in brackets. The values stated may not be exact equivalents; therefore each system must be used independently of the other. Combining values from the two units may result in nonconformance.

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.*

1.5 The text of this standard references notes which provide explanatory material. These notes shall not be considered as requirements of the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

C 138 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete[2]

C 143/C 143M Test Method for Slump of Hydraulic Cement Concrete[2]

C 172 Practice for Sampling Freshly Mixed Concrete[2]

C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method[2]

C 192/C 192M Practice for Making and Curing Concrete Test Specimens in the Laboratory[2]

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method[2]

C 330 Specification for Lightweight Aggregate for Concrete Masonry Units[2]

C 403/C 403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance[2]

C 470/C 470M Specification for Molds for Forming Concrete Test Cylinders Vertically[2]

C 511 Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes[3]

C 617 Practice for Capping Cylindrical Concrete Specimens[2]

C 1064 Test Method for Temperature of Freshly Mixed Portland-Cement Concrete[2]

2.2 *American Concrete Institute Publication:*[4]

CP-1 Concrete Field Testing Technician, Grade I

309R Guide for Consolidation of Concrete

3. Significance and Use

3.1 This practice provides standardized requirements for making, curing, protecting, and transporting concrete test specimens under field conditions.

3.2 If the specimens are made and standard cured, as stipulated herein, the resulting strength test data when the specimens are tested are able to be used for the following purposes:

3.2.1 Acceptance testing for specified strength,

3.2.2 Checking adequacy of mixture proportions for strength, and

3.2.3 Quality control.

3.3 If the specimens are made and field cured, as stipulated herein, the resulting strength test data when the specimens are tested are able to be used for the following purposes:

3.3.1 Determination of whether a structure is capable of being put in service,

3.3.2 Comparison with test results of standard cured specimens or with test results from various in-place test methods,

3.3.3 Adequacy of curing and protection of concrete in the structure, or

[1] This practice is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregatesand is the direct responsibility of Subcommittee C09.61 on Testing Concrete for Strength.

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[2] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.01.

[4] Available from American Concrete Institute, P.O. Box 9094, Farmington Hills, MI 48333-9094.

3.3.4 Form or shoring removal time requirements.

4. Apparatus

4.1 *Molds, General*— Molds for specimens or fastenings thereto in contact with the concrete shall be made of steel, cast iron, or other nonabsorbent material, nonreactive with concrete containing portland or other hydraulic cements. Molds shall hold their dimensions and shape under all conditions of use. Molds shall be watertight during use as judged by their ability to hold water poured into them. Provisions for tests of water leakage are given in the Test Methods for Elongation, Absorption, and Water Leakage section of Specification C 470/C 470M. A suitable sealant, such as heavy grease, modeling clay, or microcrystalline wax shall be used where necessary to prevent leakage through the joints. Positive means shall be provided to hold base plates firmly to the molds. Reusable molds shall be lightly coated with mineral oil or a suitable nonreactive form release material before use.

4.2 *Cylinder Molds*— Molds for casting concrete test specimens shall conform to the requirements of Specification C 470/C 470M.

4.3 *Beam Molds*—Beam molds shall be of the shape and dimensions required to produce the specimens stipulated in 5.2. The inside surfaces of the molds shall be smooth. The sides, bottom, and ends shall be at right angles to each other and shall be straight and true and free of warpage. Maximum variation from the nominal cross section shall not exceed ⅛ in. [3 mm] for molds with depth or breadth of 6 in. [150 mm] or more. Molds shall produce specimens at least as long but not more than 1/16 in. [2 mm] shorter than the required length in 5.2.

4.4 *Tamping Rod*— A round, straight steel rod with the dimensions conforming to those in Table 1, having the tamping end or both ends rounded to a hemispherical tip of the same diameter as the rod.

4.5 *Vibrators*—Internal vibrators shall be used. The vibrator frequency shall be at least 7000 vibrations per minute [150 Hz] while the vibrator is operating in the concrete. The diameter of a round vibrator shall be no more than one-fourth the diameter of the cylinder mold or one-fourth the width of the beam mold. Other shaped vibrators shall have a perimeter equivalent to the circumference of an appropriate round vibrator. The combined length of the vibrator shaft and vibrating element shall exceed the depth of the section being vibrated by at least 3 in. [75 mm]. The vibrator frequency shall be checked periodically.

NOTE 1—For information on size and frequency of various vibrators and a method to periodically check vibrator frequency see ACI 309.

4.6 *Mallet*—A mallet with a rubber or rawhide head weighing 1.25 ± 0.50 lb [0.6 ± 0.2 kg] shall be used.

4.7 *Small Tools*— Shovels, hand-held floats, scoops, and a vibrating-reed tachometer shall be provided.

TABLE 1 Tamping Rod Requirements

Diameter of Cylinder or Width of Beam in. [mm]	Rod Dimensions[A]	
	Diameter in. [mm]	Length of Rod in. [mm]
<6 [150]	3/8 [10]	12 [300]
6 [150]	5/8 [16]	20 [500]
9 [225]	5/8 [16]	26 [650]

[A] Rod tolerances length ±4 in. [100 mm] and diameter ±1/16 in. [2 mm].

4.8 *Slump Apparatus*— The apparatus for measurement of slump shall conform to the requirements of Test Method C 143/C 143M.

4.9 *Sampling Receptacle*—The receptacle shall be a suitable heavy gage metal pan, wheelbarrow, or flat, clean nonabsorbent board of sufficient capacity to allow easy remixing of the entire sample with a shovel or trowel.

4.10 *Air Content Apparatus*—The apparatus for measuring air content shall conform to the requirements of Test Methods C 173 or C 231.

4.11 *Temperature Measuring Devices*—The temperature measuring devices shall conform to the applicable requirements of Test Method C 1064.

5. Testing Requirements

5.1 *Cylindrical Specimens*—Compressive or splitting tensile strength specimens shall be cylinders cast and allow to set in an upright position, with a length equal to twice the diameter. The standard specimen shall be the 6 by 12-in. [150 by 300-mm] cylinder when the nominal maximum size of the coarse aggregate does not exceed 2 in. [50 mm] (Note 2, Note 3). When the nominal maximum size of the coarse aggregate does exceed 2 in. [50 mm], either the concrete sample shall be treated by wet sieving as described in Practice C 172 or the diameter of the cylinder shall be at least three times the nominal maximum size of coarse aggregate in the concrete. For acceptance testing for specified strength, cylinders smaller than 6 by 12 in. [150 by 300 mm] shall not be used, unless another size is specified (Note 4).

NOTE 2—The nominal maximum size is the smallest sieve opening through which the entire amount of aggregate is permitted to pass.

NOTE 3—When molds in SI units are required and not available, equivalent inch-pound unit size mold should be permitted.

NOTE 4—For uses other than acceptance testing for specified strength, a 4 by 8 in. [100 by 200 mm] or 5 by 10 in. [125 by 250 mm] cylinder may be suitable. However, the diameter of any cylinder shall be at least three times the nominal maximum size of the coarse aggregate in the concrete (Note 2). When cylinders smaller than the standard size are used, within-test variability has been shown to be higher but not to a statistically significant degree. The compressive strength results are affected by a number of factors including cylinder size.

5.2 *Beam Specimens*— Flexural strength specimens shall be beams of concrete cast and hardened in the horizontal position. The length shall be at least 2 in. [50 mm] greater than three times the depth as tested. The ratio of width to depth as molded shall not exceed 1.5. The standard beam shall be 6 by 6 in. [150 by 150 mm] in cross section, and shall be used for concrete with nominal maximum size coarse aggregate up to 2 in. [50 mm] (Note 2). When the nominal maximum size of the coarse aggregate exceeds 2 in. [50 mm], the smaller cross sectional dimension of the beam shall be at least three times the nominal maximum size of the coarse aggregate. Unless required by project specifications, beams made in the field shall not have a width or depth of less than 6 in. [150 mm].

5.3 *Field Technicians*—The field technicians making and curing specimens for acceptance testing shall be certified ACI Field Testing Technicians, Grade I or equivalent. Equivalent personnel certification programs shall include both written and performance examinations, as outlined in ACI CP-1.