
Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

AASHTO Designation: R 39M/R 39-23^{1,2}

Technically Revised: 2023

Editorially Revised: 2023

Technical Subcommittee: 3b, Fresh Concrete

ASTM Designation: C192/C192M-19



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1. SCOPE

- 1.1. This standard practice covers procedures for making and curing test specimens of concrete in the laboratory under accurate control of materials and test conditions.
- 1.2. The values stated in either inch-pound units or SI 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 standard practice does not purport to address the safety concerns associated with its use. It is the responsibility of the user of this standard practice 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 exposed skin and tissue upon prolonged exposure.
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 194M/M 194, Chemical Admixtures for Concrete
 - M 201, Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
 - M 205M/M 205, Molds for Forming Concrete Test Cylinders Vertically
 - R 60M/R 60, Sampling Freshly Mixed Concrete
 - R 100M/R 100, Making and Curing Concrete Test Specimens in the Field
 - T 27, Sieve Analysis of Fine and Coarse Aggregates
 - T 84, Specific Gravity and Absorption of Fine Aggregate
 - T 85, Specific Gravity and Absorption of Coarse Aggregate
 - T 119M/T 119, Slump of Hydraulic Cement Concrete
 - T 121M/T 121, Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
 - T 152, Air Content of Freshly Mixed Concrete by the Pressure Method
 - T 196M/T 196, Air Content of Freshly Mixed Concrete by the Volumetric Method
 - T 197M/T 197, Time of Setting of Concrete Mixtures by Penetration Resistance

- T 231, Capping Cylindrical Concrete Specimens
- T 255, Total Evaporable Moisture Content of Aggregate by Drying
- T 309, Temperature of Freshly Mixed Portland Cement Concrete
- T 345, Passing Ability of Self-Consolidating Concrete (SCC) by J-Ring
- T 347, Slump Flow of Self-Consolidating Concrete (SCC)
- T 351, Visual Stability Index (VSI) of Self-Consolidating Concrete (SCC)
- T 395, Characterization of the Air-Void System of Freshly Mixed Concrete by the Sequential Pressure Method

2.2. *ASTM Standards:*

- C125, Standard Terminology Relating to Concrete and Concrete Aggregates
- C330/C330M, Standard Specification for Lightweight Aggregates for Structural Concrete
- C470/C470M, Standard Specification for Molds for Forming Concrete Test Cylinders Vertically
- C512/C512M, Standard Test Method for Creep of Concrete in Compression
- C1758/C1758M, Standard Practice for Fabricating Test Specimens with Self-Consolidating Concrete

2.3. *American Concrete Institute (ACI) Publications:*

- 211.3 Practice for Selecting Proportions for No Slump Concrete³
- 309R Guide for Concrete Consolidation¹

3. SIGNIFICANCE AND USE

3.1. This standard practice provides standardized requirements under laboratory conditions for preparation of materials, mixing concrete, determining the plastic properties thereof, and casting and curing concrete test specimens for determining the properties of hardened concrete.

3.2. If specimen preparation is controlled as stipulated herein, the specimens may be used to develop information for the following purposes:

3.2.1. Mixture proportioning for project concrete;

3.2.2. Evaluation of different mixtures and materials;

3.2.3. Correlation with nondestructive tests; and

3.2.4. Providing specimens for research purposes.

Note 1—The concrete test results for concrete specimens cast and cured using this standard practice are widely used. They may be the basis for acceptance testing for project concrete, research evaluation, and other studies. Careful and knowledgeable handling of materials, mixing concrete, casting test specimens, and curing test specimens is necessary. Many laboratories performing this important work are independently inspected or accredited, and qualify technicians by participating in certification programs. AASHTO, ASTM, WAQTC, NETTCP, and ACI are examples of entities that can provide guidance on laboratory inspections and accreditation programs as well as technician qualifications and certifications.

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 conform to the dimensions and tolerances specified in the method for which the specimens are required. Molds shall hold their dimensions and shape under conditions of severe use. Watertightness of molds during use shall be judged by their ability to hold water poured into them. Test procedures for watertightness are given in the section on Test Methods for Elongation, Absorption, and Watertightness in M 205M/M 205. 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 release material before use.
- 4.2. *Cylinder Molds:*
- 4.2.1. Molds for casting specimens vertically shall conform to the requirements of Section 4.1 and M 205M/M 205.
- 4.2.2. Horizontal molds for creep test cylinders, ASTM C512/C512M, shall conform to the requirements of Section 4.1 and to the requirements for symmetry and dimensional tolerance in the general requirements section of M 205M/M 205. The requirement in M 205M/M 205 for a vertical filling orientation of the mold is not applicable to horizontal molds. The use of horizontal molds is intended only for creep specimens that contain axially embedded strain meter. Molds for creep cylinders to be filled while supported in a horizontal position shall have a filling slot parallel to the axis of the mold that extends the full length to receive the concrete. The width of the slot shall be one-half the diameter of the specimen. If necessary, the edges of the slot shall be reinforced to maintain dimensional stability. Unless specimens are to be capped or ground to produce plane ends, the molds shall be provided with two machined metal end plates at least 25 mm (1 in.) thick, and the working surfaces shall comply with the requirements for planeness and surface roughness of Section 4.1 of T 231. Provision shall be made for fixing both end plates firmly to the mold. The inside surface of each end plate shall be provided with at least three lugs or studs approximately 25 mm (1 in.) long, firmly fastened to the plate for embedment in the concrete. One base plate shall be drilled from the inside at an angle to permit the lead wire from the strain meter to exit the specimen through the edge of the plate. Provision shall be made for accurately positioning the strain meter. All necessary holes shall be as small as possible to minimize disturbance to subsequent strain measurements and shall be sealed to prevent leakage.
- 4.3. *Beam and Prism Molds*—Beam and prism molds shall be rectangular in shape (unless otherwise specified) and of the dimensions required to produce the desired specimen size. The inside surfaces of the molds shall be smooth and free from indentations. 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 3 mm ($1/8$ in.) for molds with depth or breadth of 150 mm (6 in.) or more, or 1.6 mm ($1/16$ in.) for molds of smaller depth or breadth. Except for flexure specimens, molds shall not vary from the nominal length by more than 1.6 mm ($1/16$ in.). Flexure molds shall not be shorter than 1.6 mm ($1/16$ in.) of the required length but may exceed it by more than that amount.
- 4.4. *Tamping Rod*—A round, smooth, straight steel rod. The length of the tamping rod shall be at least 100 mm (4 in.) greater than the depth of the mold in which the rodding is being performed, but not greater than 600 mm (24 in.) in overall length. The rod shall have the tamping end or both ends rounded to a hemispherical tip of the same diameter as the rod.
- Note 2**—A rod length of 400 mm (16 in.) to 600 mm (24 in.) meets the requirements of the following: R 100M/R 100, T 119M/T 119, T 121M/T 121, T 152, and T 196M/T 196.

- 4.5. *Mallets*—A mallet with a rubber or rawhide head weighing 0.57 ± 0.23 kg (1.25 ± 0.50 lb) shall be used.
- 4.6. *Vibrators*:
- 4.6.1. *Internal Vibrators*—The vibrator frequency shall be at least 9000 vibrations per minute (vpm) (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 or prism mold. Other shaped vibrators shall have a perimeter equivalent to the circumference of an appropriate round vibrator. The combined length of the vibratory shaft and vibrating element shall exceed the depth of the section being vibrated by at least 75 mm (3 in.). The vibrator frequency shall be checked periodically.
- Note 3**—For more information on size and frequency of various vibrators and method to periodically check vibrator frequency, see ACI 309R.
- 4.6.2. *External Vibrators*—The two types of external vibrators permitted are either table or plank. The external vibrator frequency shall be 3600 vpm (60 Hz) or higher.
- Note 4**—Vibratory impulses are frequently imparted to a table or plank vibrator through electromagnetic means, or by use of an eccentric weight on the shaft of an electric motor or on a separate shaft driven by a motor.
- 4.6.2.1. Provisions shall be made for clamping the mold securely to the apparatus.
- 4.7. *Placement Tools*—Of a size large enough so that each amount of concrete obtained from the sampling receptacle is representative and small enough so that concrete is not spilled during the placement of the mold. For placing concrete in a cylinder mold, the acceptable tool is a scoop. For placing concrete in a beam mold, either a shovel or scoop is permitted.
- 4.8. *Small Tools*—Tools and items such as pails, trowels, handheld float, blunted trowels, straightedge, feeler gauge, rulers, rubber gloves, and metal mixing bowls shall be provided.
- 4.9. *Slump Apparatus*—The apparatus for measurement of slump shall conform to the requirements of T 119M/T 119.
- 4.10. *Passing Ability*—The apparatus for measurement of the passing ability shall conform to the requirements of T 345.
- 4.11. *Slump Flow*—The apparatus for measurement of the slump flow shall conform to the requirements of T 347.
- 4.12. *Visual Stability Index (VSI)*—The apparatus for measurement of the VSI shall conform to the requirements of T 351.
- 4.13. *Sampling and Mixing Pan*—The pan shall be flat-bottomed and of heavy-gauge metal, watertight, of convenient depth, and of sufficient capacity to allow easy mixing by shovel or trowel of the entire batch, or, if mixing is by machine, to receive the entire batch on discharge of the mixer and allow remixing in the pan by trowel or shovel.
- 4.14. *Wet-Sieving Equipment*—If wet sieving is required, the equipment shall conform to the requirements of R 60M/R 60.
- 4.15. *Air Content Apparatus*—The apparatus for measuring air content shall conform to the requirements of T 196M/T 196, T 152, or T 395.