INTERNATIONAL

Designation: C31/C31M – 17

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

This standard is issued under the fixed designation C31/C31M; 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 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 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 the standard.

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.* (**Warning—**Fresh hydraulic cementitious mixtures are caustic and may cause chemical burns to exposed skin and tissue upon prolonged exposure.[2]*)*

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

1.6 *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]

C125 Terminology Relating to Concrete and Concrete 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
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
C330/C330M Specification for Lightweight Aggregates for Structural Concrete
C403/C403M Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
C470/C470M Specification for Molds for Forming Concrete Test Cylinders Vertically
C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
C617/C617M Practice for Capping Cylindrical Concrete Specimens
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
C1758/C1758M Practice for Fabricating Test Specimens with Self-Consolidating Concrete

2.2 *American Concrete Institute Publication:*[4]

309R Guide for Consolidation of Concrete

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

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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.

[4] Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, http://www.aci-int.org.

***A Summary of Changes section appears at the end of this standard**

3. Terminology

3.1 For definitions of terms used in this practice, refer to Terminology C125.

4. Significance and Use

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

4.2 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:

4.2.1 Acceptance testing for specified strength,

4.2.2 Checking adequacy of mixture proportions for strength, and

4.2.3 Quality control.

4.3 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:

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

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

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

4.3.4 Form or shoring removal time requirements.

5. Apparatus

5.1 *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 C470/C470M. 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.

5.2 *Cylinder Molds*—Molds for casting concrete test specimens shall conform to the requirements of Specification C470/C470M.

5.3 *Beam Molds*—Beam molds shall be of the shape and dimensions required to produce the specimens stipulated in 6.2. 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 3 mm [1⁄8 in.] for molds with depth or breadth of 150 mm [6 in.] or more. Molds shall produce specimens at least as long but not more than 2 mm [1⁄16 in.] shorter than the required length in 6.2.

5.4 *Tamping Rod*—A round, smooth, straight, steel rod with a diameter conforming to the requirements in Table 1. The length of the tamping rod shall be at least 100 mm [4 in.] greater than the depth of the mold in which rodding is being performed, but not greater than 600 mm [24 in.] in overall length (see Note 1). The rod shall have the tamping end or both ends rounded to a hemispherical tip of the same diameter as the rod.

TABLE 1 Tamping Rod Diameter Requirements

Diameter of Cylinder or Width of Beam mm [in.]	Diameter or Rod mm [in.]
<150 [6]	10 ± 2 [3⁄8 ± 1⁄16]
≥150 [6]	16 ± 2 [5⁄8 ± 1⁄16]

NOTE 1—A rod length of 400 mm [16 in.] to 600 mm [24 in.] meets the requirements of the following: Practice C31/C31M, Test Method C138/C138M, Test Method C143/C143M, Test Method C173/C173M, and Test Method C231/C231M.

5.5 *Vibrators*—Internal vibrators shall be used. The vibrator frequency shall be at least 150 Hz [9000 vibrations per minute] 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 75 mm [3 in.]. The vibrator frequency shall be checked periodically with a vibrating-reed tachometer or other suitable device.

NOTE 2—For information on size and frequency of various vibrators and a method to periodically check vibrator frequency see ACI 309R.

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

5.7 *Placement Tools*—of a size large enough so each amount of concrete obtained from the sampling receptacle is representative and small enough so concrete is not spilled during placement in 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.

5.8 *Finishing Tools*—a handheld float or a trowel.

5.9 *Slump Apparatus*—The apparatus for measurement of slump shall conform to the requirements of Test Method C143/C143M.

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

5.11 *Air Content Apparatus*—The apparatus for measuring air content shall conform to the requirements of Test Methods C173/C173M or C231/C231M.

5.12 *Temperature Measuring Devices*—The temperature measuring devices shall conform to the applicable requirements of Test Method C1064/C1064M.

6. Testing Requirements

6.1 *Cylindrical Specimens*—Compressive or splitting tensile strength specimens shall be cylinders cast and allowed to set in an upright position. The number and size of cylinders cast shall be as directed by the specifier of the tests. In addition, the length shall be twice the diameter and the cylinder diameter shall be at least 3 times the nominal maximum size of the coarse aggregate. When the nominal maximum size of the coarse aggregate exceeds 50 mm [2 in.], the concrete sample shall be treated by wet sieving through a 50-mm [2-in.] sieve as described in Practice C172/C172M. For acceptance testing for specified compressive strength, cylinders shall be 150 by 300 mm [6 by 12 in.] or 100 by 200 mm [4 by 8 in.] (Note 3).

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

6.2 *Beam Specimens*—Flexural strength specimens shall be beams of concrete cast and hardened in the horizontal position. The length shall be at least 50 mm [2 in.] greater than three times the depth as tested. The ratio of width to depth as molded shall not exceed 1.5.

6.2.1 The minimum cross-sectional dimension of the beam shall be as stated in Table 2. Unless otherwise specified by the specifier of tests, the standard beam shall be 150 by 150 mm [6 by 6 in.] in cross section.

6.2.2 When the nominal maximum size of the coarse aggregate exceeds 50 mm [2 in.], the concrete sample shall be treated by wet sieving through a 50-mm [2-in.] sieve as described in Practice C172/C172M.

6.2.3 The specifier of tests shall specify the specimen size and the number of specimens to be tested to obtain an average test result (Note 4 and Note 5). The same specimen size shall be used when comparing results and for mixture qualification and acceptance testing.

NOTE 4—The modulus of rupture can be determined using different specimen sizes. However, measured modulus of rupture generally increases as specimen size decreases.[5,6] The strength ratio for beams of different sizes depends primarily on the maximum size of aggregate.[7] Experimental data obtained in two different studies have shown that for maximum aggregate size between 19.0 and 25.0 mm [¾ and 1 in.], the ratio between the modulus of rupture determined with a 150 by 150 mm [6 by 6 in.] and a 100 by 100 mm [4 by 4 in.] may vary from 0.90 to 1.07[5] and for maximum aggregate size between 9.5 and 37.5 mm [⅜ and 1½ in.], the ratio between the modulus of rupture determined with a 150 by 150 mm [6 by 6 in.] and a 115 by 115 mm [4.5 by 4.5 in.] may vary from 0.86 to 1.00.[6]

NOTE 5—It has been shown that the variability of individual test results increases as the specimen size decreases.[5,6]

6.3 *Field Technicians*—The field technicians making and curing specimens for acceptance testing shall meet the personnel qualification requirements of Practice C1077.

7. Sampling Concrete

7.1 The samples used to fabricate test specimens under this standard shall be obtained in accordance with Practice C172/C172M unless an alternative procedure has been approved.

7.2 Record the identification of the sample with respect to the location of the concrete represented and the time of casting.

8. Slump, Air Content, and Temperature

8.1 *Slump*—Measure and record the slump of each batch of concrete from which specimens are made immediately after remixing in the receptacle, as required in Test Method C143/C143M.

8.2 *Air Content*—Determine and record the air content in accordance with either Test Method C173/C173M or Test Method C231/C231M. The concrete used in performing the air content test shall not be used in fabricating test specimens.

8.3 *Temperature*—Determine and record the temperature in accordance with Test Method C1064/C1064M.

NOTE 6—Some specifications may require the measurement of the unit weight of concrete. The volume of concrete produced per batch may be desired on some projects. Also, additional information on the air content measurements may be desired. Test Method C138/C138M is used to measure the unit weight, yield, and gravimetric air content of freshly mixed concrete.

9. Molding Specimens

9.1 *Place of Molding*—Mold specimens promptly on a level, rigid surface, free of vibration and other disturbances, at a place as near as practicable to the location where they are to be stored.

9.2 *Casting Cylinders*—Select the proper tamping rod from 5.4 and Table 1 or the proper vibrator from 5.5. Determine the method of consolidation from Table 3, unless another method is specified. If the method of consolidation is rodding, determine molding requirements from Table 4. If the method of consolidation is vibration, determine molding requirements from Table 5. Select a scoop of the size described in 5.7. While placing the concrete in the mold, move the scoop around the perimeter of the mold opening to ensure an even distribution of the concrete with minimal segregation. Each layer of concrete shall be consolidated as required. In placing the final layer, add an amount of concrete that will fill the mold after consolidation.

[5] Tanesi, J; Ardani, A. Leavitt, J. "Reducing the Specimen Size of Concrete Flexural Strength Test (AASHTO T97) for Safety and Ease of Handling," *Transportation Research Record: Journal of the Transportation Research Board,* No. 2342, Transportation Research Board of National Academies, Washington, D.C., 2013.

[6] Carrasquillo, P.M. and Carrasquillo, R. L "Improved Concrete Quality Control Procedures Using Third Point Loading", *Research Report 119-1F*, Project 3-9-87-1119, Center for Transportation Research, The University of Texas at Austin, November 1987.

[7] Bazant, Z. and Novak, D. "Proposal for Standard Test of Modulus of Rupture of Concrete with its Size Dependence," *ACI Materials Journal*, January-February 2001.

TABLE 2 Minimum Cross-Sectional Dimension of Beams

Nominal Maximum Aggregate Size (NMAS)	Minimum Cross-Sectional Dimension
≤ 25 mm [1 in.]	100 by 100 mm [4 by 4 in.]
25 mm [1 in.] < NMAS ≤ 50 mm [2 in.]	150 by 150 mm [6 by 6 in.]

TABLE 3 Method of Consolidation Requirements

Slump, mm [in.]	Method of Consolidation
≥25 [1]	rodding or vibration
< 25 [1]	vibration

TABLE 4 Molding Requirements by Rodding

Specimen Type and Size	Number of Layers of Approximately Equal Depth	Number of Roddings per Layer
Cylinders:		
Diameter, mm [in.]		
100 [4]	2	25
150 [6]	3	25
225 [9]	4	50
Beams:		
Width, mm [in.]		
100 [4] to 200 [8]	2	see 9.3
>200 [8]	3 or more equal depths, each not to exceed 150 mm [6 in.].	see 9.3

TABLE 5 Molding Requirements by Vibration

Specimen Type and Size	Number of Layers	Number of Vibrator Insertions per Layer	Approximate Depth of Layer, mm [in.]
Cylinders:			
Diameter, mm [in.]			
100 [4]	2	1	one-half depth of specimen
150 [6]	2	2	one-half depth of specimen
2256 [9]	2	4	one-half depth of specimen
Beams:			
Width, mm [in.]			
100 [4] to 200 [8]	1	see 9.4.2	depth of specimen
over 200 [8]	2 or more	see 9.4.2	200 [8] as near as practicable

9.2.1 *Self-Consolidating Concrete*—If casting cylinders of self-consolidating concrete, use the mold filling procedures in Practice C1758/C1758M instead of the procedure in 9.2. After filling the mold, finish the cylinders in accordance with 9.5, without further consolidation.

9.3 *Casting Beams*—Select the proper tamping rod from 5.4 and Table 1 or proper vibrator from 5.5. Determine the method of consolidation from Table 3, unless another method is specified. If the method of consolidation is rodding, determine the molding requirements from Table 4. If the method of consolidation is vibration, determine the molding requirements from Table 5. Determine the number of roddings per layer, one for each 14 cm^2 [2 $in.^2$] of the top surface area of the beam. Select a placement tool as described in 5.7. Using the scoop or shovel, place the concrete in the mold to the height required for each layer. Place the concrete so that it is uniformly distributed within each layer with minimal segregation. Each layer shall be consolidated as required. In placing the final layer, add an amount of concrete that will fill the mold after consolidation.

9.3.1 *Self-Consolidating Concrete*—If casting beams of self-consolidating concrete, use the mold filling procedures in Practice C1758/C1758M instead of the procedure in 9.3. After filling the mold, finish the beams in accordance with 9.5, without further consolidation.

9.4 *Consolidation*—The methods of consolidation for this practice are rodding or internal vibration.

9.4.1 *Rodding*—Place the concrete in the mold in the required number of layers of approximately equal volume. Rod each layer uniformly over the cross section with the rounded end of the rod using the required number of strokes. Rod the bottom layer throughout its depth. In rodding this layer, use care not to damage the bottom of the mold. For each upper layer, allow the rod to penetrate through the layer being rodded and into the layer below approximately 25 mm [1 in.]. After each layer is rodded, tap the outsides of the mold lightly 10 to 15 times with the mallet to close any holes left by rodding and to release any large air bubbles that may have been trapped. Use an open hand to tap cylinder molds that are susceptible to denting or other permanent distortion if tapped with a mallet. After tapping, spade each layer of the concrete along the sides and ends of beam molds with a trowel or other suitable tool. Underfilled molds shall be adjusted with representative concrete during consolidation of the top layer. Overfilled molds shall have excess concrete removed.

9.4.2 *Vibration*—Maintain a uniform duration of vibration for the particular kind of concrete, vibrator, and specimen mold involved. The duration of vibration required will depend upon the workability of the concrete and the effectiveness of the vibrator. Usually sufficient vibration has been applied as soon as the surface of the concrete has become relatively smooth and large air bubbles cease to break through the top surface. Continue vibration only long enough to achieve proper consolidation of the concrete (see Note 7). Fill the molds and vibrate in the required number of approximately equal layers. Place all the concrete for each layer in the mold before starting vibration of that layer. In compacting the specimen, insert the vibrator slowly and do not allow it to rest on the bottom or sides of the mold. Slowly withdraw the vibrator so that no large air pockets are left in the specimen. When placing the final layer, avoid overfilling by more than 6 mm [¼ in.].

NOTE 7—Generally, no more than 5 s of vibration should be required for each insertion to adequately consolidate concrete with a slump greater than 75 mm [3 in.]. Longer times may be required for lower slump concrete, but the vibration time should rarely have to exceed 10 s per insertion.

9.4.2.1 *Cylinders*—The number of insertions of the vibrator per layer is given in Table 5. When more than one insertion per layer is required distribute the insertion uniformly within each layer. Allow the vibrator to penetrate through the layer being vibrated, and into the layer below, about 25 mm [1 in.]. After each layer is vibrated, tap the outsides of the mold at least 10 times with the mallet, to close holes that remain and to release entrapped air voids. Use an open hand to tap molds that are susceptible to denting or other permanent distortion if tapped with a mallet.

9.4.2.2 *Beams*—Insert the vibrator at intervals not exceeding 150 mm [6 in.] along the center line of the long dimension of the specimen. For specimens wider than 150 mm [6 in.], use alternating insertions along two lines. Allow the shaft of the vibrator to penetrate into the bottom layer about 25 mm [1 in.]. After each layer is vibrated, tap the outsides of the mold sharply at least 10 times with the mallet to close holes left by vibrating and to release entrapped air voids.

9.5 *Finishing*—Perform all finishing with the minimum manipulation necessary to produce a flat even surface that is level with the rim or edge of the mold and that has no depressions or projections larger than 3.3 mm [1⁄8 in.].

9.5.1 *Cylinders*—After consolidation, finish the top surfaces by striking them off with the tamping rod where the consistency of the concrete permits or with a handheld float or trowel. If desired, cap the top surface of freshly made cylinders with a thin layer of stiff portland cement paste which is permitted to harden and cure with the specimen. See section on Capping Materials of Practice C617/C617M.

9.5.2 *Beams*—After consolidation of the concrete, use a handheld float or trowel to strike off the top surface to the required tolerance to produce a flat, even surface.

9.6 *Identification*—Mark the specimens to positively identify them and the concrete they represent. Use a method that will not alter the top surface of the concrete. Do not mark the removable caps. Upon removal of the molds, mark the test specimens to retain their identities.

10. Curing

10.1 *Standard Curing*—Standard curing is the curing method used when the specimens are made and cured for the purposes stated in 4.2.

10.1.1 *Storage*—If specimens cannot be molded at the place where they will receive initial curing, immediately after finishing move the specimens to an initial curing place for storage. The supporting surface on which specimens are stored shall be level to within 20 mm/m [1⁄4 in.⁄ft]. If cylinders in the single use molds are moved, lift and support the cylinders from the bottom of the molds with a large trowel or similar device. If the top surface is marred during movement to place of initial storage, immediately refinish.

10.1.2 *Initial Curing*—Immediately after molding and finishing, the specimens shall be stored for a period up to 48 h in a temperature range from 16 to 27°C [60 to 80°F] and in an environment preventing moisture loss from the specimens. For concrete mixtures with a specified strength of 40 MPa [6000 psi] or greater, the initial curing temperature shall be between 20 and 26°C [68 and 78°F]. Various procedures are capable of being used during the initial curing period to maintain the specified moisture and temperature conditions. An appropriate procedure or combination of procedures shall be used (Note 8). Shield all specimens from the direct sunlight and, if used, radiant heating devices. The storage temperature shall be controlled by use of heating and cooling devices, as necessary. Record the temperature using a maximum-minimum thermometer. If cardboard molds are used, protect the outside surface of the molds from contact with wet burlap or other sources of water.

NOTE 8—A satisfactory moisture environment can be created during the initial curing of the specimens by one or more of the following procedures: (1) immediately immerse molded specimens with plastic lids in water saturated with calcium hydroxide, (2) store in properly constructed wooden boxes or structures, (3) place in damp sand pits, (4) cover with removable plastic lids, (5) place inside plastic bags, or (6) cover with plastic sheets or nonabsorbent plates if provisions are made to avoid drying and damp burlap is used inside the enclosure, but the burlap is prevented from contacting the concrete surfaces. A satisfactory temperature environment can be controlled during the initial curing of the specimens by one or more of the following procedures: (1) use of ventilation, (2) use of ice, (3) use of thermostatically controlled heating or cooling devices, or (4) use of heating methods such as stoves or light bulbs. Other suitable methods may be used provided the requirements limiting specimen storage temperature and moisture loss are met. For concrete mixtures with a specified strength of 40 MPa [6000 psi] or greater, heat generated during the early ages may raise the temperature above the required storage temperature. Immersion in water saturated with calcium hydroxide may be the easiest method to maintain the required storage temperature. When specimens are to be immersed in water saturated with calcium hydroxide, specimens in cardboard molds or other molds that expand when immersed in water should not be used. Early-age strength test results may be lower when stored at 16°C [60°F] and higher when stored at 27°C [80°F]. On the other hand, at later ages, test results may be lower for higher initial storage temperatures.

10.1.3 *Final Curing:*

10.1.3.1 *Cylinders*—Upon completion of initial curing and within 30 min after removing the molds, cure specimens with free water maintained on their surfaces at all times at a temperature of 23.0 ± 2.0°C [73.5 ± 3.5°F] using water storage tanks or moist rooms complying with the requirements of Specification C511, except when capping with sulfur mortar capping compound and immediately prior to testing. When capping with sulfur mortar capping compound, the ends of the cylinder shall be dry enough to preclude the formation of steam or foam pockets under or in cap larger than 6 mm [1⁄4 in.] as described in Practice C617/C617M. For a period not to exceed 3 h immediately prior to test, standard curing temperature is not required provided free moisture is maintained on the cylinders and ambient temperature is between 20 and 30°C [68 and 86°F].

10.1.3.2 *Beams*—Beams are to be cured the same as cylinders (see 10.1.3.1) except that they shall be stored in water saturated with calcium hydroxide at 23.0 ± 2.0°C [73.5 ± 3.5°F] at least 20 h prior to testing. Drying of the surfaces of the beam shall be prevented between removal from water storage and completion of testing.

NOTE 9—Relatively small amounts of surface drying of flexural specimens can induce tensile stresses in the extreme fibers that will markedly reduce the indicated flexural strength.

10.2 *Field Curing*—Field curing is the curing method used for the specimens made and cured as stated in 4.3.

10.2.1 *Cylinders*—Store cylinders in or on the structure as near to the point of deposit of the concrete represented as possible. Protect all surfaces of the cylinders from the elements in as near as possible the same way as the formed work. Provide the cylinders with the same temperature and moisture environment as the structural work. Test the specimens in the moisture condition resulting from the specified curing treatment. To meet these conditions, specimens made for the purpose of determining when a structure is capable of being put in service shall be removed from the molds at the time of removal of form work.

10.2.2 *Beams*—As nearly as practicable, cure beams in the same manner as the concrete in the structure. At the end of 48 ± 4 h after molding, take the molded specimens to the storage location and remove from the molds. Store specimens representing pavements of slabs on grade by placing them on the ground as molded, with their top surfaces up. Bank the sides and ends of the specimens with earth or sand that shall be kept damp, leaving the top surfaces exposed to the specified curing treatment. Store specimens representing structure concrete as near the point in the structure they represent as possible, and afford them the same temperature protection and moisture environment as the structure. At the end of the curing period leave the specimens in place exposed to the weather in the same manner as the structure. Remove all beam specimens from field storage and store in water saturated with calcium hydroxide at 23.0 ± 2.0°C [73.5 ± 3.5°F] for 24 ± 4 h immediately before time of testing to ensure uniform moisture condition from specimen to specimen. Observe the precautions given in 10.1.3.2 to guard against drying between time of removal from curing to testing.

10.3 *Structural Lightweight Concrete Curing*—Cure structural lightweight concrete cylinders in accordance with Specification C330/C330M.

11. Transportation of Specimens to Laboratory

11.1 Prior to transporting, cure and protect specimens as required in Section 10. Specimens shall not be transported until at least 8 h after final set. (See Note 10). During transporting, protect the specimens with suitable cushioning material to prevent damage from jarring. During cold weather, protect the specimens from freezing with suitable insulation material. Prevent moisture loss during transportation by wrapping the specimens in plastic, wet burlap, by surrounding them with wet sand, or tight fitting plastic caps on plastic molds. Transportation time shall not exceed 4 h.

NOTE 10—Setting time may be measured by Test Method C403/C403M.

12. Report

12.1 Report the following information to the laboratory that will test the specimens:

12.1.1 Identification number,

12.1.2 Location of concrete represented by the samples,

12.1.3 Date, time and name of individual molding specimens,

12.1.4 Slump, air content, and concrete temperature, test results and results of any other tests on the fresh concrete and any deviations from referenced standard test methods, and

12.1.5 Curing method. For standard curing method, report the initial curing method with maximum and minimum temperatures and final curing method. For field curing method, report the location where stored, manner of protection from the elements, temperature and moisture environment, and time of removal from molds.

13. Keywords

13.1 beams; casting samples; concrete; curing; cylinders; testing

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this practice since the last issue, C31/C31M–15a$^{\varepsilon 1}$, that may impact the use of this practice. (Approved June 15, 2017.)

(1) Added Practice C1758/C1758M to Referenced Documents.

(2) Added 9.2.1 and 9.3.1.