



# Standard Practice for Preparing and Testing Specimens from Shotcrete Test Panels<sup>1</sup>

This standard is issued under the fixed designation C1140/C1140M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This practice covers procedures for preparing test panels of dry-mix or wet-mix shotcrete and for testing specimens sawed or cored from the panels.

1.2 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.

1.3 The text of this standard references notes and footnotes that provide explanatory materials (excluding those in tables and figures) that shall not be considered as requirements of 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.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- C78 Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
- 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

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.46 on Shotcrete.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- C171 Specification for Sheet Materials for Curing Concrete
- C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C457 Test Method for Microscopical Determination of Parameters of the Air-Void System in Hardened Concrete
- C511 Specification for Mixing Rooms, Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
- C513 Test Method for Obtaining and Testing Specimens of Hardened Lightweight Insulating Concrete for Compressive Strength
- C642 Test Method for Density, Absorption, and Voids in Hardened Concrete
- C995 Test Method for Time of Flow of Fiber-Reinforced Concrete Through Inverted Slump Cone (Withdrawn 2009)<sup>3</sup>
- C1018 Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam With Third-Point Loading) (Withdrawn 2006)<sup>3</sup>
- C1399 Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete

## 3. Terminology

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

## 4. Significance and Use

4.1 Specimens obtained in accordance with the procedure section of this practice may be used for preconstruction studies of shotcrete mixtures, to qualify nozzlemen and equipment, or for quality control, or compressive or flexural strength testing, during the progress of a project.

## 5. Test Panels

### 5.1 *Forms for Panels:*

5.1.1 The form for receiving the shotcrete shall be either wood or steel construction and sufficiently rigid to prevent dislodging of the shotcrete through vibration or deformation. The form shall have a minimum width and length of 610 mm

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

[24 in.] and a minimum depth of 89 mm [3½ in.] with either square or sloped sides. Larger panels may be desirable for qualifying nozzlemen, equipment, or mixture design.

5.1.1.1 *Wood Forms*—Wood forms shall have a back made from plywood at least 19 mm [¾ in.] thick. Side pieces shall be made of lumber with a minimum thickness of 38 mm [1½ in.].

5.1.1.2 *Steel Forms*—Steel forms shall be made using material having a minimum thickness of 5 mm [⅜ in.].

## 6. Materials

6.1 *Dry-Mix Process*—The test mixture shall be of the same materials and proportions being used or proposed for use in the structure.

6.2 *Wet-Mix Process*—The test mixture shall be of the specified slump and have the specified air content and unit weight, or, when fibers are used, the specified time of flow, air content, and unit weight as the mixture being used or proposed for use in the structure. Determine the air content by Test Method **C231**, the unit weight by Test Method **C138/C138M**, slump by Test Method **C143/C143M** and time of flow by Test Method **C995** prior to shooting the panels.

## 7. Procedure

7.1 *Number of Panels*—A separate panel shall be shot for each mixture representing each admixture type or dosage, fiber type or fiber volume and each shooting position anticipated in the structure (that is, slab, slopes, vertical, and overhead).

7.2 The admixture, if one is used, shall be added in the same manner and dosage as proposed for use or used in the structure.

7.3 Reinforcing bars shall be included in test specimens used for bar encapsulation studies and qualification of personnel, equipment, and application techniques. Reinforcing bars should be excluded from samples prepared for compressive, flexural, and tensile tests. If fibers are added to the shotcrete, they should be included in the respective test samples.

### 7.4 Shotcreting:

7.4.1 *Equipment*—Shotcrete shall be applied using the equipment, water pressure, and air pressure to be used on the structure.

7.4.2 *Personnel*—The operating personnel (nozzlemen and gun operator) shall be those to be used on the structure.

7.4.3 *Application of Shotcrete*—Apply the shotcrete to the panel forms in the manner as proposed for use or as is being done in the structure. Dampen wood forms just prior to shotcreting.

## 8. Curing

8.1 To prevent evaporation of water from the panels, the panels shall be covered and tightly wrapped (as soon after fabrication as is safe to prevent damage) with a sheet of material meeting requirements of Specification **C171** or stored in a moist room meeting the requirements of Specification **C511**. Field cured specimens shall be moved to the laboratory just prior to testing.

8.2 Latex admixed shotcrete panels shall be moist-cured for 24 h and then air-dried for the balance of the curing cycle.

## 9. Obtaining and Testing Specimens

9.1 Specimens shall be obtained from panels by drilling cores or sawing beams in accordance with Test Method **C42/C42M**, or by sawing cubes in accordance with Test Method **C513**. Samples to be cored or sawed shall be removed from the central portion of the specimen. Samples shall not be taken from the shotcrete in the space equal to the depth plus 25.4 mm [1 in.] from the outside edges. For 89 mm [3½ in.] deep, 610 × 610 mm [24 × 24 in.] forms, this corresponds to 114 mm [4½ in.] from the inside of the bottom corner formed by the base of the form, resulting in a sample area of 381 × 381 mm [15 × 15 in.]. Cores and beams shall be free from corrugations and striations caused by uneven sawing or coring. It is recommended that all flat surfaces be sawed to ensure parallel and smooth surfaces. Cores shall be drilled and tested for compressive strength perpendicular to the surface of the panel. Cubes and beams may be tested either perpendicular or parallel to the surface of the panel. The direction of testing can influence the results and shall be specified. Proper handling of freshly applied specimens requires they be protected from damage due to extremes of temperature and vibrating movements, shaking, or shock during the hydration process. Beams shall be tested in accordance with Test Method **C78** except that beams of fiber-reinforced concrete shall be tested in accordance with Test Method **C1018** or Test Method **C1399**.

9.1.1 *Age*—Specimens shall be obtained from panels and tested at designated ages. Unless moisture conditioning is specified, the specimens shall be obtained from panels no more than 2 h before being tested.

9.1.2 *Conditioning*—When moisture conditioning is specified, it shall be in accordance with the provisions of Test Method **C42/C42M** unless otherwise specified by the purchaser.

9.2 The density, absorption, and voids shall be determined in accordance with the provisions of Test Method **C642**. Data obtained in flexural tests shall be treated in accordance with Test Methods **C78**, **C1018** or **C1399**.

NOTE 1—If the purchaser requests it, the air content of the hardened shotcrete may be determined by Test Method **C457**.

## 10. Calculation

10.1 The length to diameter correction factor found in Test Method **C42/C42M** shall be applied to compressive strengths. For sawed cubes, compressive strengths shall be multiplied by a correction factor of 0.85 to obtain equivalent strength of drilled cores.

## 11. Report

11.1 The report shall include the following data pertinent to the variables or combinations of variables studied in the tests:

11.1.1 Type and proportions of cement and admixture, fine and coarse aggregate including maximum size and grading, free water content, in the case of wet-mix shotcrete, and temperature.

11.1.2 Type and proportion of any fibers used.



- 11.1.3 Position of panel as shot.
- 11.1.4 Type of shotcrete, that is, wet or dry.
- 11.1.5 Name of nozzleman and gun operator.
- 11.1.6 Specimen size and moisture conditioning.
- 11.1.7 Direction of testing relative to panel surface.
- 11.1.8 Unit weight, air content, absorption and voids, slump, and time of flow, if applicable.
- 11.1.9 Strength and other mechanical properties evaluated and test methods used, and correction factors applied.

## 12. Precision and Bias

12.1 The precision and bias of tests conducted on specimens prepared according to this practice will be that of the referenced test methods.

## 13. Keywords

- 13.1 beams; cores; cubes; shotcrete; test panels

## SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this practice since the last issue, C1140–03a, that may impact the use of this practice. (Approved December 1, 2011)

(1) Revised the standard as a dual units practice.

(2) Replaced old Section 3 with a Terminology Section including reference to **C125**.

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