



Designation: D4832 – 02

# Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders<sup>1</sup>

This standard is issued under the fixed designation D4832; 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 test method covers procedures for the preparation, curing, transporting and testing of cylindrical test specimens of controlled low strength material (CLSM) for the determination of compressive strength.

1.2 This test method also may be used to prepare and test specimens of other mixtures of soil and cementitious materials, such as self-cementing fly ashes.

1.3 CLSM is also known as flowable fill, controlled density fill, soil-cement slurry, soil-cement grout, unshrinkable fill, K-Krete, and other similar names.

1.4 The values stated in SI units are to be regarded as the standard. The inch-pound equivalents are shown for information only.

1.5 *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.* See Section 7.

## 2. Referenced Documents

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

- [C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field](#)
- [C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens](#)
- [C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory](#)
- [C470/C470M Specification for Molds for Forming Concrete Test Cylinders Vertically](#)
- [C617 Practice for Capping Cylindrical Concrete Specimens](#)

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.15 on Stabilization With Admixtures.

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<sup>2</sup> 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.

- [C1231/C1231M Practice for Use of Unbonded Caps in Determination of Compressive Strength of Hardened Concrete Cylinders](#)
- [D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)
- [D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction](#)
- [D5971 Practice for Sampling Freshly Mixed Controlled Low-Strength Material](#)
- [D6023 Test Method for Density \(Unit Weight\), Yield, Cement Content, and Air Content \(Gravimetric\) of Controlled Low-Strength Material \(CLSM\)](#)
- [D6024 Test Method for Ball Drop on Controlled Low Strength Material \(CLSM\) to Determine Suitability for Load Application](#)
- [D6103 Test Method for Flow Consistency of Controlled Low Strength Material \(CLSM\)](#)

## 3. Terminology

### 3.1 Definitions

3.1.1 For common definitions of terms in this standard, refer to Terminology D653.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *Controlled Low Strength Material (CLSM), n*— A mixture of soil, cementitious materials, water, and sometimes admixtures, that hardens into a material with a higher strength than the soil but less than 8400 kPa (1200 psi). Used as a replacement for compacted backfill, CLSM can be placed as a slurry, a mortar, or a compacted material and typically has strengths of 350 to 700 kPa (50 to 100 psi) for most applications.

## 4. Summary of Test Method

4.1 Cylinders of CLSM are tested to determine the compressive strength of the material. The cylinders are prepared by pouring a representative sample into molds, curing the cylinders, removing the cylinders from the molds, and capping the cylinders for compression testing. The cylinders are then tested to obtain compressive strengths. Duplicate cylinders are required.

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

## 5. Significance and Use

5.1 This test method is used to prepare and test cylindrical specimens of CLSM to determine the compressive strength of the hardened material.

5.2 CLSM is typically used as a backfill material around structures, particularly in confined or limited spaces. Compressive strength testing is performed to assist in the design of the mix and to serve as a control technique during construction. Mix design is typically based on 28-day strengths and construction control tests performed 7 days after placement. The compressive strength(s) and other test age(s) will vary according to the requirements for the end product. Additional information on the use and history of CLSM is contained in **Appendix X1**.

5.3 This test is one of a series of quality control tests that can be performed on CLSM during construction to monitor compliance with specification requirements. The other tests that can be used during construction control of CLSM are Test Methods **D5971**, **D6023**, **D6024**, and **D6103**.

5.4 There are many other combinations of soil, cement, flyash (cementitious or not), admixtures or other materials that could be tested using this method. The mixtures would vary depending on the intended use, availability of materials, and placement requirements.

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice **D3740** are generally considered capable of competent and objective testing/sampling/inspection and the like. Users of this standard are cautioned that compliance with Practice **D3740** does not in itself assure reliable results. Reliable results depend on many factors; Practice **D3740** provides a means of evaluating some of those factors.

## 6. Apparatus

6.1 *Single-Use Cylindrical Molds*—Plastic single-use 15 cm (6-in.) diameter by 30 cm (12-in.) high molds with tight fitting lids, conforming to Specification **C470/C470M**. Other sizes and types of molds may be used as long as the length to diameter ratio is 2 to 1. The 15-cm by 30-cm (6 in. by 12 in.) molds are preferred because of the low strength of the material and the larger surface area of the ends of the cylinders.

6.2 *Sampling and Mixing Receptacle*—The receptacle shall be a suitable heavy-gage container, wheelbarrow, etc. of sufficient capacity to allow easy sampling and mixing and to allow preparation of at least two cylinders and for other tests such as described in Test Methods **D5971**, **D6023**, **PS D6024**, and **D6103**.

6.3 *Storage Container*—A tightly constructed, insulated, firmly braced wooden box with a cover or other suitable container for storage of the CLSM cylinders at the construction site. The container shall be equipped, as necessary, to maintain the temperature immediately adjacent to the cylinders in the range of 16 to 27°C (60 to 80°F). The container shall be marked for identification and shall be a bright color to avoid disturbance.

6.4 *Transportation Container*—A sturdy wooden box or other suitable container constructed to minimize shock, vibration, or damage to the CLSM cylinders when transported to the laboratory.

6.5 *Testing Machine*—The testing machine shall meet the requirements as described in Test Method **C39/C39M**.

NOTE 2—Since the compressive strength of CLSM cylinders will typically be 100 kPa (about 15 to 1200 lbf/in.<sup>2</sup>), the testing machine must have a loading range such that valid values of compressive strength can be obtained.

6.6 *Curing Environment*—A curing environment (water bath, damp sand, fog room) that meets the requirements of Method **C192/C192M**. The cylinders may be cured in the same curing environment used for concrete cylinders at the laboratory performing the testing.

6.7 *Small Tools*—Tools and items that may be required such as shovels, pails, trowels, and scoops.

## 7. Hazards

7.1 *Technical Precaution*—The procedure for the preparation of CLSM test cylinders has many similarities to preparing concrete test cylinders (Practice **C31/C31M** and Practice **C192/C192M**). However, the cylinders are much more fragile than concrete cylinders, and special care should be taken in their preparation, storage, and handling.

7.2 *Safety Hazards:*

7.2.1 Strictly observe the safety precautions stated in Practice **C617**.

7.2.2 If the cylinders are capped with molten sulfur mortar, wear proper personnel protective equipment, including gloves with cuffs at least 15 cm (6-in.) long.

## 8. Sampling and Test Specimens

8.1 Take samples of the CLSM for each test specimen in accordance with **D5971**. Record the identity of the CLSM represented and the time of casting.

8.2 The sample from the batch should be a minimum of 0.03 m<sup>3</sup> (1 ft<sup>3</sup>) for each two cylinders to be prepared. Prepare a minimum of two compressive strength cylinders for each test age to represent each sampled batch. Additional material may be required if other testing is to be performed, such as in Test Methods **D5971**, **D6023**, **D6024**, and **D6103**.

NOTE 3—In the initial stage of CLSM usage, preparation of three cylinders is recommended to obtain reliable compressive strength data for each test age. Subsequently, two cylinders may be used to maintain testing records and to ascertain an overall quality of the mix. However, since the cylinders are fragile and may be damaged during transportation, mold removal, and capping, preparation of an extra cylinder may be necessary to provide the minimum number of test specimens (see **Note 8** and **Note 9**). In addition, it may be useful to determine the density of the test cylinders to help evaluate the uniformity of the compressive strength values.

## 9. Specimen Molding and Curing

9.1 *Place of Molding*—Mold specimens promptly on a level, rigid, horizontal surface free from vibration and other disturbances. The specimens should be prepared at a place as near as practicable to the location where they are to be stored during the first four days.

9.2 *Placing the CLSM:*

9.2.1 Thoroughly mix the CLSM in the sampling and mixing receptacle.