Designation: D4832 – 16ε1

Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders[1]

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 (ε) indicates an editorial change since the last revision or reapproval.

ε1 NOTE—Editorially updated units of measurement statement in April 2018.

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 covers CLSM materials that have a higher strength than the soil but less than 8400 kPa (1200 psi). Typical strengths for most applications fall between 350 to 700 kPa (50 to 100 psi).

1.3 The CLSM 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 any admixtures.

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

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

1.6 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026.

1.6.1 The procedures used to specify how data are collected/recorded and calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that should generally be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this standard to consider significant digits used in analysis methods for engineering design.

1.7 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.7.1 The converted inch-pound units use the gravitational system of units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The converted slug unit is not given, unless dynamic (F=ma) calculations are involved.

1.8 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* See Section 7.

1.9 *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:*[2]

C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field

C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens

C125 Terminology Relating to Concrete and Concrete Aggregates

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

C1231/C1231M Practice for Use of Unbonded Caps in

[1] 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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[2] 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.

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

Determination of Compressive Strength of Hardened Cylindrical Concrete Specimens
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
D6026 Practice for Using Significant Digits in Geotechnical Data
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 C125 and D653.

3.1.2 *Controlled Low Strength Material (CLSM), n*—a mixture of soil, aggregates (sand, gravel, or both), cementitious materials, water, and sometimes admixtures, that hardens into a material with a higher strength than the soil but less than about 8400 kPa (1200 psi).

3.1.2.1 *Discussion*—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 are tested to determine the compressive strength of the CLSM. The cylinders are prepared by pouring a representative CLSM sample into molds, then depending on the strength development, either curing the cylinders then removing them from the molds or removing the molds prior to curing the cylinders, and preparing the cylinders for compression testing. The cylinders are then tested to obtain compressive strengths. Duplicate cylinders are required for each test age specified.

5. Significance and Use

5.1 This test method provides standardized requirements for the preparation, curing, transporting and testing of test cylinders of CLSM under field conditions by replicating a "field cure" of the material.

5.1.1 If the cylinders are field cured, as stipulated herein, the resulting compressive strength test data may be used for the following purposes:

5.1.1.1 Acceptance testing for specified strength,

5.1.1.2 Checking the adequacy of mixture proportions for strength,

5.1.1.3 Quality control,

5.1.1.4 Determination of whether the CLSM is capable of being put in service,

5.1.1.5 Adequacy of curing.

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 quality 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 Practice D5971 and Test Methods D6023, D6024, and D6103.

5.4 There are many other combinations of soil, cement, fly ash (cementitious or not), admixtures, water quality or other materials that could be tested using this method. The mixtures will 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 150 × 300 mm (6 × 12 in.) or 100 × 200 mm (4 × 8 in.) cylinder molds with tight-fitting lids (see 9.2.2.1 regarding cautionary statement for "air-tight" 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 150 × 300 mm (6 × 12 in.) molds are preferred for use in concrete compression apparatus (Section 6.5) because of the low strength of the material and the larger surface area of the ends of the cylinders.

6.1.1 Mold removal can be accomplished with the use of low air pressure. The pressure shall be low enough so the sample is undamaged.

6.2 *Sampling and Mixing Receptacle*—The receptacle shall be a suitable non-absorbent material (heavy-gauge metal or heavy duty plastic container, wheelbarrow, etc.) of sufficient capacity to allow easy sampling and remixing with a shovel or scoop and to allow preparation of at least two cylinders and for other tests such as described in Test Methods D5971, D6023, 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 location of the storage container shall be away from direct sunlight and protected from