



Designation: D6103/D6103M – 17^{ε1}

Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)¹

This standard is issued under the fixed designation D6103/D6103M; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

^{ε1} NOTE—Editorially corrected units of measurement statement in June 2021.

1. Scope*

1.1 This test method covers the procedure for determination of the flow consistency of fresh Controlled Low Strength Material (CLSM). This test method applies to flowable CLSM with a maximum particle size of 19.0 mm [$\frac{3}{4}$ in.] or less, or to the portion of CLSM that passes a 19.0 mm [$\frac{3}{4}$ in.] sieve.

1.2 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.

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026 unless superseded by this test method.

1.3.1 The method used to specify how data are collected, calculated, or recorded in this standard is not directly related to the accuracy to which the data can be applied in design or other uses, or both. How one applies the results obtained using this standard is beyond its scope.

1.4 *Units*—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 nonconformance with the standard.

1.4.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight) while the unit for mass is slugs. The rationalized slug unit is not given, unless dynamic ($F=ma$) calculations are involved.

1.4.2 It is common practice in the engineering/construction profession to concurrently use pounds to represent both a unit of mass (lbm) and of force (lbf). This implicitly combines two

separate systems of units: that is, the absolute system and the gravitational system. It is scientifically undesirable to combine two separate sets of inch-pound units within a single standard. As stated, this standard includes the gravitational system of inch-pound units and does not use/present the slug unit for mass. However, the use of balances or scales recording pounds of mass (lbm) or recording in lbm/ft³ shall not be regarded as nonconformance with this standard.

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 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.7 *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.*

1.8 *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

C125 Terminology Relating to Concrete and Concrete Aggregates

C143/C143M Test Method for Slump of Hydraulic-Cement Concrete

C172/C172M Practice for Sampling Freshly Mixed Concrete

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

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

D4832 Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

D5971/D5971M 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/D6024M 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

mm [$\frac{3}{4}$ in.] or larger, a measurement of the slump by Test Method **C143/C143M** is more appropriate.

5.3 For non-flowable CLSM, or for mixtures that do not come out of the flow cylinder easily, measure the slump as outlined in Test Method **C143/C143M**.

5.4 This test method 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 are Test Methods **D4832**, **D6023**, and **D6024/D6024M**.

NOTE 2—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/etc. 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.

3. Terminology

3.1 *Definitions*—For definitions of common technical terms used in this standard, refer to Terminology standards **C125** and **D653**.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *controlled low strength material (CLSM), n*—a mixture of soil or 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 8400 kPa [1200 psi].

3.2.1.1 *Discussion*—Used as a replacement for compacted backfill, CLSM can be placed as a slurry, or a mortar, or a compacted material and typically has strengths of 350 to 700 kPa [50 to 100 psi] for most applications.

3.2.2 *flow consistency, n*—a measurement of the spread of a predetermined volume of CLSM achieved by removal of the flow cylinder within a specified time.

4. Summary of Test Method

4.1 An open-ended cylinder is placed on a flat, level surface and filled with fresh CLSM. The cylinder is raised quickly so the CLSM will flow into a patty. The average diameter of the patty is determined and compared to established criteria.

5. Significance and Use

5.1 This test method is intended to provide the user with a procedure to determine the fluidity of CLSM mixtures for use as backfill or structural fill.

5.2 This test method is considered applicable to fresh CLSM containing only sand as the aggregate or having coarse aggregate smaller than 19.0 mm [$\frac{3}{4}$ in.]. If the coarse aggregate is larger than 19.0 mm [$\frac{3}{4}$ in.], the test method is applicable when it is made on the fraction of CLSM passing a 19.0 mm [$\frac{3}{4}$ in.] sieve, with the larger aggregate being removed in accordance with the section on Additional Procedures for Large Maximum size Aggregate Concrete in Practice **C172/C172M**.

NOTE 1—Removing the coarse aggregate will alter the characteristics of the mix and therefore will give information only about the remaining material. It is suggested that for mixes containing coarse aggregate 19.0

6. Apparatus

6.1 *Flow Cylinder*—The flow cylinder shall be a 150 ± 3.0 mm [6 ± 0.125 in.] length of 76 ± 3.0 mm [3 ± 0.125 in.] inside diameter, straight tubing of steel, plastic or other non-absorbent material, non-reactive with CLSM containing portland cement, fly ash or other supplementary cementitious materials or additives. The flow cylinder shall be constructed such that the planes of the ends are parallel to one another and perpendicular to the longitudinal axis of the cylinder. The flow cylinder shall have a smooth interior, open at both ends and a rigid shape that is able to hold its dimensions and under conditions of severe use.

6.2 *Sampling and Mixing Receptacle*—The receptacle shall be a suitable container, wheelbarrow, etc., of sufficient capacity to allow easy sampling and remixing of the CLSM.

6.3 *Filling Apparatus*—Scoop, shovel, bucket, or pail of sufficient capacity to facilitate filling of the flow cylinder in a rapid, efficient manner.

6.4 *Nonporous Surface*—A 0.6-m [2.0-ft] square, or larger, made of a nonporous material that is also non-corroding, such as acrylic, cast aluminum, or stainless steel. The surface must be smooth, free of defects, and rigid.

6.5 *Miscellaneous Equipment:*

6.5.1 *Timing Device*—Watch, clock, or stopwatch capable of timing 1 second intervals.

6.5.2 *Straight Edge*—A stiff metal straightedge of any convenient length but not less than 254 mm [10.0 in.]. The total length of the straightedge shall be machined straight to a tolerance of +0.1 mm [+0.005 in.]. The metal shall be made of suitable material that is non-corroding.

6.5.3 *Measuring Device*, ruler, metal roll-up measuring tape, or similar rigid or semi-rigid measuring instrument marked in increments of 6 mm [$\frac{1}{4}$ in.] or smaller. The instrument length shall be at least 380 mm [15 in.].

7. Test Sample

7.1 Obtain the sample of freshly mixed CLSM in accordance with **D5971/D5971M**.