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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)[1]

This standard is issued under the fixed designation D 6103; 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.

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 (¾ in.) or less, or to the portion of CLSM that passes a 19.0 mm (¾ in.) sieve.

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

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 *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:*

C 143 Test Method for Slump of Hydraulic Cement Concrete[2]

C 172 Practice for Sampling Freshly Mixed Concrete[2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[3]

D 3740 Practice for Minimum Requirements of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction[3]

D 4832 Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders[3]

D 5971 Practice for Sampling Freshly Mixed Controlled Strength Material[4]

D6023 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Controlled Low Strength Material[4]

D 6024 Test Method for Ball Drop on Controlled Low Strength Material to Determine Suitability for Load Application[4]

3. Terminology

3.1 *Definitions*—Except as follows in 3.2, all definitions are in accordance with Terminology D 653

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *controlled low strength material (CLSM), n*—a mixture of soil or aggregates, cementitious material, fly ash, water and sometimes chemical admixtures, that hardens into a material with a higher strength than the soil, but less than 84 00 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.

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 small than 19.0 mm (¾ in.). If the coarse aggregate is larger than 19.0 mm (¾in.), the test method is applicable when it is made on the fraction of CLSM passing a 19.0 mm (¾ in.) sieve, with the larger aggregate being removed in accordance with the section on Additional Procedures for Large Maximum size Aggregate Concrete in Practice C 172.

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 mm (¾ in.) or larger, a measurement of the slump is more appropriate.

5.3 For nonflowable CLSM, or for mixtures that do not come out of the flow cylinder easily, measure the slump as outlined in Test Method C 143.

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

[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] *Annual Book of ASTM Standards*, Vol 04.02.

[3] *Annual Book of ASTM Standards*, Vol 04.08.

[4] *Annual Book of ASTM Standards*, Vol 04.09.

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

that can be used during construction control are Test Methods D 4832, D 6023, and D 6024.

NOTE 2—Not withstanding the statements on precision and bias contained in this test method, the precision of this test method 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 D 3740 generally are considered capable of competent and objective testing. Users of this test method are cautioned that compliance with Practice D 3740 does not in itself assure reliable testing. Reliable testing depends on several factors. Practice D 3740 provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Flow Cylinder*—The flow cylinder shall be a 150 mm (6 in.) length of 76 mm (3 in.) inside diameter, straight tubing of steel, plastic or other non-absorbent material, non-reactive with CLSM containing Portland cement. Individual diameters and lengths shall be within ± 3 mm (⅛ in.) of the prescribed dimensions. 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, 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–ft) square, or larger, made of a nonporous material that is also noncorroding, 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 s intervals.

6.5.2 *Straight edge*—A stiff metal straightedge of any convenient length but not less than 254 mm (10 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 noncorroding.

6.5.3 Measuring device, capable of measuring spread diameter. Must be able to measure a minimum of 6 mm (¼ in.).

7. Test Sample

7.1 Obtain the sample of freshly mixed CLSM in accordance with D 5971.

8. Procedure

8.1 Place the nonporous surface on a flat, level area that is free of vibration or other disturbances.

8.2 Dampen the flow cylinder with water and place it on end, on a smooth nonporous level surface. Hold firmly in place during filling.

8.3 Thoroughly remix the CLSM, the minimum amount necessary to ensure uniformity, in the sampling and mixing receptacle.

NOTE 3—The test for flow consistency, unit weight, and air content (D 6023) must be started within 5 min after obtaining the final portion of the composite sample, Complete these tests as expeditiously as possible.

8.4 With the filling apparatus, scoop through the center portion of the receptacle and pour the CLSM into the flow cylinder. Fill the flow cylinder until it is just level full or slightly overfilled.

8.5 Strike off the surface with a suitable straight edge, until the surface is flush with the top of the flow cylinder, while holding the flow cylinder in place. Remove any spillage away from the cylinder after strike off.

8.6 Within 5 s of filling and striking off, raise the flow cylinder quickly and carefully in a vertical direction. Raise the flow cylinder at least 15 cm (6 in.) by a steady upward lift with no lateral or torsional motion in a time period between 2 and 4 s. Complete the entire test from the start of filling through removal of the flow cylinder without interruption within an elapsed time of 1½ min.

8.7 Immediately measure the largest resulting spread diameter of the CLSM. Take two measurements of the spread diameter perpendicular to each other. The measurements are to be made along diameters which are perpendicular to one another.

NOTE 4—As the CLSM spreads, segregation may occur, with the water spreading beyond the spread of the cohesive mixture. The spread of the cohesive mixture should be measured.

NOTE 5—For ease in measuring perpendicular diameters, the surface that the flow cylinder will be placed on can be marked with perpendicular lines and the cylinder centered where the lines cross.

NOTE 6—The average diameter of the CLSM patty typically is established by the specifying organization and may vary depending on how the CLSM is being used. For flowable CLSM used to readily fill spaces (without requiring vibration), the average diameter of the patty typically is 20 to 30 cm (8 to 12 in.).

9. Report

9.1 *Include the following information in the report*:

9.1.1 Sample identification.

9.1.2 Identification of individual performing the test method.

9.1.3 Date the test is performed.

9.1.4 Record the two measurements to the nearest 1 cm(½ in.). Compute the average of the two measurements rounded off to the nearest 5 mm (¼in.), and report as the average flow consistency of the CLSM.

10. Precision and Bias

10.1 *Precision*—Data are being evaluated to determine the precision of this test method. Additionally, Subcommittee D 18.15 is seeking pertinent data from users of the test method.[5]

10.2 *Bias*—No statement on bias can be prepared because there are no standard reference materials.

11. Keywords

11.1 backfill; CLSM; construction control; flowable fill; flow consistency; flow cylinder; mix design; quality control; soil stabilization

[5] Anyone having data pertinent to the precision of this test method or wishing to participate in a round robin test, contact the D18.15 Subcommittee Chairman at ASTM Headquarters.

APPENDIX

(Nonmandatory Information)

X1. Rationale

X1.1 This test method was developed to provide an accepted, consensus method of measuring the flow characteristics of CLSM. Although CLSM may be mixed and delivered like concrete, the mixture typically is much more fluid than concrete so that it readily will fill voids and spaces. This test method provides a procedure to quantify the flow characteristics.

SUMMARY OF CHANGES

This test method previously was provisional standard (PS) 28 and has been revised and approved as a full consensus standard.

(1) This standard previously had the designation PS 28–95, a provisional standard.
(2) The differences between this version of the standard and the previous one are as follows:
(3) Addition of Sections 1.3, 5.4, 6.4, 6.5, 8.1, 8.2, 8.3, 8.4, Note 2, Note 4, Note 5, Note 6, Appendix X1.1 and this section.
(4) Revised wording in Sections 3.2.1, 3.2.2, 4.1, 6.1, 8.2, 8.4, 8.5, 8.6, 9.1, 10.1, 11 and Note 4
(5) SI units made the standard