



Designation: D 6024 – 9602

## Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application<sup>1</sup>

This standard is issued under the fixed designation D 6024; 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 specification explains the determination of the ability of Controlled Low Strength Material (CLSM) to withstand loading by repeatedly dropping a metal weight onto the in-place material.

1.2 ~~The~~All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D 6026.

1.2.1 The method used to specify how data are collected, calculated, or recorded in this test method 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.

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

1.3.4 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<sup>5</sup> *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>1</sup> This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.15 on Stabilization with Admixtures.

Current edition approved ~~Oct. 10, 1996~~ 2002. Published ~~June 1997~~ September 2002. Originally published as PS 31 – 95. Last previous edition D 6024 – 96.

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

C 125 Terminology Relating to Concrete and Concrete Aggregates<sup>2</sup>

~~C 360 Test Method for Ball Penetration in Freshly Mixed Hydraulic Cement Concrete<sup>2</sup>~~

D 653 Terminology Relating to Soil, Rock, and Contained Fluids<sup>3</sup>

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as used in the Engineering Design and Construction<sup>3</sup>

D 4832 Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders<sup>3</sup>

D 6023 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)<sup>4</sup>

~~PDS 60286 Practice for Using Significant Digits in Geotechnical Data<sup>4</sup>~~

D 6103 Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)<sup>3</sup>

### 3. Terminology

3.1 ~~Definitions—Except as follows in 3.2, all~~ For definitions of terms in accordance with this test method, refer to Terminology C 125 and 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 8400 kPa (1200 psi).

3.2.1.1 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 A standard cylindrical weight is dropped five times from a specific height onto the surface of in-place CLSM. The diameter of the resulting indentation is measured and compared to established criteria. The indentation is inspected for any free water brought to the surface from the impact.

### 5. Significance and Use

5.1 This test method is used primarily as a field test to determine the readiness of the CLSM to accept loads prior to adding a temporary or permanent wearing surface.

5.2 This test method is not meant to predict the load bearing strength of a CLSM mixture.

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 are Test Methods D 4832, D 6023, and ~~Provisional Test Method PS-28—D 6103.~~

~~NOTE 1—Notwithstanding 1—The quality of the statements on precision and bias contained in result produced by this test method: the precision of this test method standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies which that meet the criteria of Practice D 3740 are generally considered capable of competent and objective testing/sampling/inspection/and the like. Users of this test method standard are cautioned that compliance with Practice D 3740 does not in itself ensure assure reliable testing- results. Reliable testing depends results depend on several many factors; Practice D 3470 provides a means of evaluating some of those factors.~~

### 6. Apparatus

6.1 Ball-drop Apparatus—a cylinder with a hemispherically shaped bottom and handle with a mass of 14 + 0.05 kg (30 + 0.1 lb), and a stirrup or frame to guide the handle (Fig. 1).

6.1.1 Weight—The cylindrical weight (ball) shall be approximately 15 cm (6 in.) in diameter and 12 cm (4<sup>7</sup>/<sub>8</sub> in.) in height, with the top surface at right angles to the axis and the bottom in the form of a hemisphere of 75 mm (3 in.) radius. The cylindrical weight may be machined from metal stock or cast or spun provided the dimensions and weight with the handle meet requirements, and the finish is smooth.

6.1.2 Handle—The handle shall be a metal rod, 13 mm (1/2 in.) in diameter. The handle may be T-shaped or a closed rectangle at the top to permit grasping by the hand.

6.1.3 Stirrup—The stirrup shall be at least 38 mm (1 1/2 in.) in width. The stirrup frame is attached securely to blocks elevating it 9 cm (3 1/2 in.).

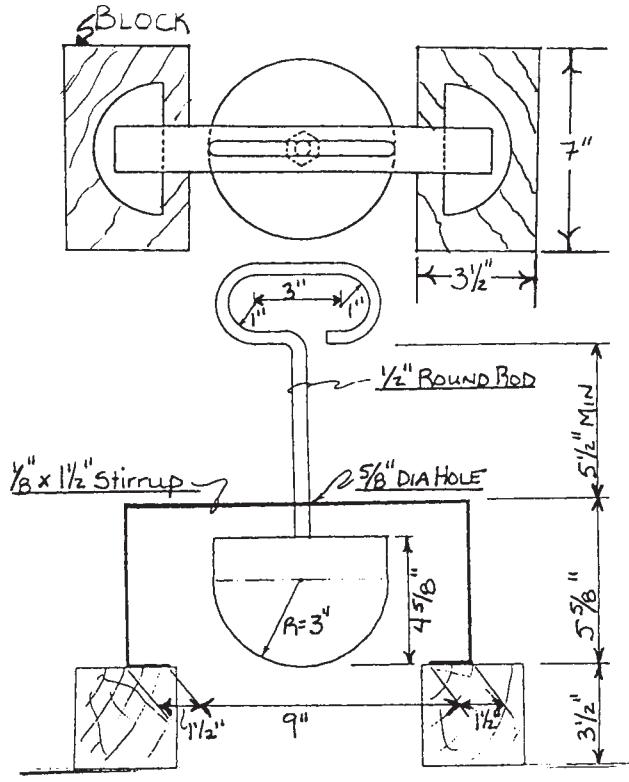
6.1.4 Blocks—pieces of wood, or ultra high molecular weight plastic (UHMW) that are 9 cm (3 1/2 in.) high are used to elevate the stirrups to the proper height. The stirrups must be centered on the blocks to avoid tipping, and attached securely to the stirrups so shifting does not occur. The blocks shall be parallel to each other and perpendicular to the main stirrup frame. The blocks must not interfere with the ball-drop apparatus. Each block shall have the minimum dimension of 9-cm (3 1/2 in.) wide by 18-cm (7-in.) long with a minimum bearing area of 155 cm<sup>2</sup> (24 in<sup>2</sup>).

6.2 Measuring Device—capable of measuring the diameter of the indentation. It must be capable of measuring a minimum of 3 mm (1/8 in.).

<sup>2</sup> Annual Book of ASTM Standards, Vol 04.02.

<sup>3</sup> Annual Book of ASTM Standards, Vol 04.08.

<sup>4</sup> Annual Book of ASTM Standards, Vol 04.09.



Metric Equivalents			
in.	mm	in.	mm
1/8	3.2	4 5/8	117
1/2	13	5 1/2	140
5/8	16	5 5/8	143
1	25	9	228
1 1/2	38	12	305
3	76		

FIG. 1 Ball-drop Apparatus

**7. Procedure**

7.1 The surface of the CLSM will need to be as level as possible either by self-leveling or by slight brooming action with hand tools. Set the elevated base of the apparatus on the leveled CLSM surface, with the handle in a vertical position and free to slide through the frame. Put slight pressure on the frame with your free hand to stabilize the device. Lift the handle as far as possible allowing the top surface of the ball to contact the underside of the stirrup frame. Release the weight allowing it to free fall to the surface of the CLSM. Repeat this for a total of five times at each location tested. Before testing a new location of the in-place CLSM remove any material that has adhered to the ball from previous testing.

7.2 Measure the diameter of the indentation left by the ball with a measuring device (Note 2). If the diameter of indentation is 76 mm (≤3 in.) then the CLSM is suitable for the load application. If the diameter of indentation is 76 mm (>3 in.) then the CLSM is unsuitable or not ready for load application.

NOTE 2—It has been shown under limited use that an indentation of ≤75 mm (3 in.) is suitable for normal load application.

7.3 Inspect the indentation for visible surface water or sheen brought to the surface by the dropping action of the ball. The surface should look similar to that before the test with the exception of an indentation. The presence of surface water indicates that the CLSM is unsuitable or not ready for load application.

**8. Report**

- 8.1 Report the following:
  - 8.1.1 Project Identification,
  - 8.1.2 Location of test,
  - 8.1.3 Identification of individual performing the test method, and
  - 8.1.4 Date test is performed.
- 8.2 Report the following information:

- 8.2.1 Visible surface water or sheen brought to the surface by the dropping action,
- 8.2.2 Irregularities on the surface of the in place CLSM such as indentations left by the blocks or severe cracking, and
- 8.2.3 Diameter of indentation to nearest 3 mm ( $\frac{1}{8}$  in.).

## 9. Precision and Bias

~~9.1 Precision—Data are being evaluated—Test data on precision is not presented due to determine the precision nature of this test method. In addition, it is either not feasible or too costly at this time to have ten or more agencies participate in an in situ testing program at a given site.~~

9.1.1 The Subcommittee D18.15 is seeking pertinent any data from users of the test method that might be used to make a limited statement on precision.

~~9.2 Bias—There is no accepted reference value for this test method, therefore, bias cannot be determined.~~

## 10. Keywords

10.1 backfill; ball drop apparatus; bearing; CLSM; construction control; early load; flowable fill; mix design; quality control; soil stabilization; surface water; wearing surface

## SUMMARY OF CHANGES

~~In accordance with Committee D18 policy, this section identifies the location of changes to this test method since the last edition.~~

- ~~(1) This test method previously had edition (1996) that may impact the designation PS 31—95, a provisional standard.~~
- ~~(2) The differences between this version use of the test method this standard.~~
- ~~(1) Sections 1.2 and the previous one are as follows:~~
- ~~(3) Sections 1.3, 5.3 and 6.2 1.2.1 were added.~~
- ~~(4) Note 1 added in accordance with D18 policy and Note 2 were added.~~
- ~~(5) SI units were made the standard.~~
- ~~(6) Sections 3.2.1, 4.1, 6.1.3, 6.1.4, 7.1, 7.2, 8, 9.1, subsequent sections renumbered.~~
- ~~(2) C 360 was removed and 10 were rewritten.~~
- ~~(7) Fig. 1 blocks were Practice D 6026 was added to the list of Referenced Documents.~~
- ~~(3) The designation “PS 28” was updated to Test Method D 6103 in Sections 2 and 5.3~~
- ~~(4) Section 3 was revised to comply with D18 policy.~~
- ~~(5) Note 1 was revised to comply with the current wording according to D18 policy.~~
- ~~(6) Section 9, was revised to comply with suggested wording found in the D18 Standards Preparation Manual.~~

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