



Designation: D6024/D6024M – 16

Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application¹

This standard is issued under the fixed designation D6024/D6024M; 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 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 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice [D6026](#).

1.2.1 The procedures used to specify how data are collected/recorded and calculated in the standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should 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 these test methods to consider significant digits used in analysis methods for engineering data.

1.3 *Units*—The values stated in either SI units or inch-pound units presented in brackets are to be regarded separately as standard. The values stated in each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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

1.5 *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. (Warning—Fresh*

hydraulic cementitious mixtures are caustic and may cause chemical burns to skin and tissue upon prolonged exposure.²)

2. Referenced Documents

2.1 *ASTM Standards*:³

[C125](#) Terminology Relating to Concrete and Concrete Aggregates

[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

[D6023](#) Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)

[D6026](#) Practice for Using Significant Digits in Geotechnical Data

[D6103](#) Test Method for Flow Consistency of Controlled Low Strength Material (CLSM) (Withdrawn 2013)⁴

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of common technical terms in this test method, refer to Terminology standards [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 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.

² Section on Safety Precautions, *Manual of Aggregate and Concrete Testing*, Annual Book of ASTM Standards, Vol. 04.02.

³ 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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

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

4. Summary of Test Method

4.1 A half spherical 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 [D4832](#), [D6023](#), and [D6103](#).

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 *Ball-drop Apparatus*—A Ball Penetration Apparatus (Kelly Ball) that consists of a half sphere with a handle, together weighing 14-15 kg [30-33 lb]. The half spherical weight may be machined from metal stock or cast or spun with a smooth finish and shall have a radius of 73 mm [2.875 in.] to 79 mm [3.125 in.]. A stirrup or frame approximately 270 mm [10.5 in.] wide and approximately 140 mm [5.5 in.] high shall guide the handle such that the Kelly Ball falls freely and perpendicular to the surface being tested (see [Fig. 1](#)).

6.1.1 *Blocks*—pieces of wood, or ultra high molecular weight plastic (UHMW) that are approximately 90 mm [3.5 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 dimensions of approximately 90 mm [3.5 in.] wide by 180 mm [7 in.] long with a minimum bearing area of 0.015 m² [24 in²] and shall support the stirrup such that the Kelly Ball falls freely for a distance of 108 mm [4.25 in.] to 114 mm [4.5 in.].

6.2 *Measuring Device*—a ruler, metal roll-up measuring tape, or similar rigid or semi-rigid length measuring instrument marked in increments of 3 mm [0.125 in.] or smaller capable of measuring the diameter of the indentation.

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

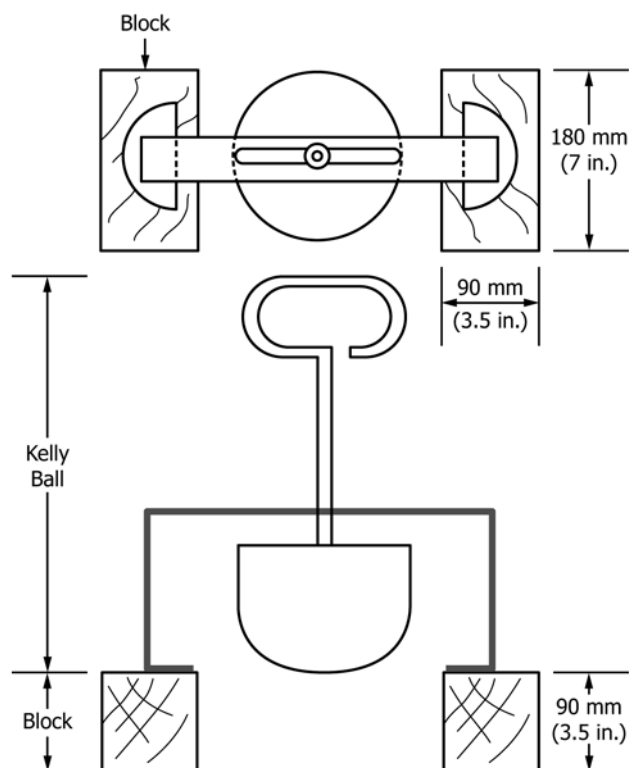


FIG. 1 Ball-drop Apparatus

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 consecutive 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 to the nearest 2.5 mm [0.125 in.] with a measuring device.

NOTE 2—See [Appendix X1](#) for nonmandatory information about acceptance criteria.

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 may indicate the CLSM is unsuitable or not ready for load application.

8. Report: Test Data Sheet(s)/Form(s)

8.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s), as given below, is covered in [1.2](#).

8.2 Record as a minimum the following general information (data):

8.2.1 Project Identification,

8.2.2 Location of test,

8.2.3 Identification of individual performing the test method,



8.2.4 Date test is performed, and

8.2.5 Identification of CLSM mixture.

8.3 Record as a minimum the following test data:

8.3.1 Visible surface water or sheen brought to the surface by the dropping action,

8.3.2 Irregularities on the surface of the in place CLSM, such as indentations left by the blocks or severe cracking, and

8.3.3 Diameter of indentation to the nearest 2.5 mm [0.125 in.].

9. Precision and Bias

9.1 *Precision*—Test data on precision is not presented due to the nature of this test method. 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 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

APPENDIX

X1. EXAMPLE APPLICATIONS OF THE TEST METHOD

X1.1 Application of this test method is typically based on establishing a maximum allowed diameter of the indentation caused by the ball drop apparatus prior to application of additional load. The subcommittee is not aware of any published data or studies supporting specific acceptance criteria. Subcommittee members familiar with the application of the method have reported 75 mm [3 in.] as a common criterion in utility applications (for example, trench backfill) and 100 mm

[4 in.] being acceptable in other applications such as pavement subgrade. Field conditions and application should be considered carefully when establishing acceptance criteria.

X1.2 Hot weather can cause a hard crust to form on the surface of CLSM that should be removed before performing the test method. It may be necessary to remove a depth of 25 to 75 mm [1 to 3 in.] in such cases.

SUMMARY OF CHANGES

Committee D18 has identified the location of selected changes to this standard since the last issue (2015) that may impact the use of this standard. (December 1, 2016)

(1) Revised Section 3.

Committee D18 has identified the location of selected changes to this standard since the last issue (2007) that may impact the use of this standard. (July 1, 2015)

(1) Standard caveats were updated.

(2) Section 3.2.1 revised the definition of CLSM to be consistent with the definition in other standards.

(3) Section 6 Ball-drop apparatus description was changed from cylindrical to half spherical and additional dimensional requirements were included.

(4) Figure 1 was revised to include SI units and inch-pound units. The Metric Equivalents table was removed.

(5) Note 2, which suggested acceptance criteria, was revised to refer the user to information in the appendix.

(6) Appendixes were added to provide the user with nonmandatory information related to the application and use of the standard.



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