



Designation: ~~D6023-02~~ Designation: D 6023 – 07

Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)¹

This standard is issued under the fixed designation D 6023; 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 determination of the ~~mass per cubic foot (cubic meter) density (Note 1)~~ of freshly mixed Controlled Low-Strength Material (CLSM) and gives formulas for calculating the yield, cement content, and the air content of the CLSM. This test method is based on Test Method C 138 for Concrete.

~~NOTE 1—Unit Weight is the traditional terminology used to describe the property determined by this test method. The proper term is density. It has also been termed unit mass or bulk density. To be compatible with terminology used in the concrete industry, unit weight is referenced in this test method.~~
~~1—Unit Weight was the previous terminology used to describe the property determined by this test method, which is mass per unit volume.~~

1.2 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 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.

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

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.~~ 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

~~C29/C29M Test Method for Unit Weight and Voids in Aggregate~~ 29/C 29M Test Method for Bulk Density (Unit Weight) and Voids in Aggregate

C 125 Terminology Relating to Concrete and Concrete Aggregates

~~C 128 Test Method for Specific Gravity and Absorption of Fine Aggregates~~² Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate

~~C138 Test Method for Unit Weight, Yield and Air Content (Gravimetric) of Concrete~~² 138/C 138M Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete

C 150 Specification for Portland Cement

C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 3740 Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as

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~~ With Admixtures.

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² Annual Book of ASTM Standards, Vol 04.02.

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*, Vol 04.08, 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.

used in Engineering Design and Construction

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

D 5971 Practice for Sampling Freshly Mixed Controlled Low-Strength Material

D 6024 Test Method for the Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application

D 6026 Practice for Using Significant Digits in Geotechnical Data

D 6103 Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

3. Terminology

3.1 *Definitions*—For definitions of terms in this standard, refer to Terminology C 125 and D 653.

3.1.1 *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).

3.1.1.1 *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.

3.1.2 *mass, n*—the quantity of matter in a body. (See *weight*.)

3.1.2.1 *Discussion*—Units of mass are the kilogram (kg), the pound (lb) or units derived from these. Masses are compared by weighing the bodies, which amounts to comparing the forces of gravitation acting on them.

3.1.3 *weight, n*—the force exerted on a body by gravity. (see *mass*.)

3.1.3.1 *Discussion*—Weight is equal to the mass of the body multiplied by the acceleration due to gravity. Weight may be expressed in absolute units (newtons, Newton, poundals) or in gravitational units (kgf, lbf). Since weight is equal to mass times the acceleration due to gravity, the weight of a body will vary with the location where the weight is determined, while the mass of the body remains constant. On the surface of the earth, the force of gravity imparts to a body that is free to fall an acceleration of approximately 9.81 m/s² (32.2 ft/s²).

3.1.4 *yield*—the volume of CLSM produced from a mixture of known quantities of the component materials.

4. Summary of Test Method

4.1 The density of the CLSM is determined by filling a measure with CLSM, determining the mass, and calculating the volume of the measure. The density is then calculated by dividing the mass by the volume. The yield, cement content, and the air content of the CLSM is calculated based on the masses and volumes of the batch components.

5. Significance and Use

5.1 This test method provides the user with a procedure to calculate the density of freshly mixed CLSM for determination of compliance with specifications, for determining mass/volume relationships or conversions such as those found in purchase agreements, and also for quality control purposes.

5.2 This test method is intended to assist the user for quality control purposes and when specified to determine compliance for air content, yield, and cement content of freshly mixed CLSM.

5.3 This test method is not meant to predict the air content of hardened CLSM, which may be either higher or lower than that determined by this test method.

5.4 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 6024, and D 6103

NOTE 2—The ~~quality~~ quality of the results 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 D 3740 are generally considered capable of competent and objective testing/sampling/inspection/ and the like. Users of this standard are cautioned that compliance with Practice D 3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D 3740 provides a means of evaluation some of those factors.

6. Apparatus

6.1 *Balance*—A balance or scale accurate to within 0.3 % of the test load at any point within the range of use. The range of use shall be considered to extend from the mass of the measure empty to the mass of the measure plus the CLSM.

6.2 *Filling Apparatus*—Scoop, bucket or pail of sufficient capacity to facilitate filling the measure in a rapid, efficient manner.

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

6.4 *Measure*—A cylindrical container made of steel or other suitable metal (Note 3). It shall be watertight and sufficiently rigid to retain its form and calibrated volume under rough usage. Measures that are machined to accurate dimensions on the inside and provided with handles are preferred. All measures, except for measuring bowls of air meters shall conform to the requirements of Test Method C 29/C 29M. The minimum capacity of the measure shall conform to the requirements of Table 1. When measuring bowls of air meters are used, they shall conform to the requirements of Test Method C 231. The top rim of the air meter bowls shall be smooth and plane within 0.01 in. (0.25 mm) 0.3 mm (0.01 in.) (Note 4).

NOTE 3—The metal should not be readily subject to attack by cement paste. However, reactive materials such as aluminum alloys may be used in