Designation: D 6683 – 01

Standard Test Method for Measuring Bulk Density Values of Powders and Other Bulk Solids[1]

This standard is issued under the fixed designation D 6683; 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 an apparatus and procedure for determining a range of bulk densities of powders and other bulk solids as a function of compaction pressure.

1.2 This test method should be performed in the laboratory under controlled conditions of temperature and humidity.

1.3 This test method is similar to those of B 212-89(1995) Test Method for Apparent Density of Free-Flowing Metal Powders, D 29-86(1994) Test Methods for Sampling and Testing Lac Resins, D 2854-89(1993) Test Method for Apparent Density of Activated Carbon.

1.4 The values stated are in SI Units and are to be regarded as the standard.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 4753 Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Testing Soil, Rock, and Related Construction Materials[2]

3. Terminology

3.1 Definitions of terms used in this test method shall be in accordance with Terminology D 653.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *area of the lid (A_l)*—this is the area of the cover in m^2.

3.2.2 *incremental height (h_m)*—the height due to the addition of weights in m.

3.2.3 *initial bulk density (ρ)*—the initial density (Kg/m^3) when the cup is filled, prior to compressing the material with the weights.

3.2.4 *initial height (H_i)*—the initial height prior to compressing the specimen in m.

3.2.5 *maximum consolidation pressure (P_m)*—the maximum desired pressure at which a bulk density value is to be determined in kPa.

3.2.6 *maximum force (W_m)*—the weight that produces the maximum consolidation pressure (P_m) appropriate for the application: ($W_m = P_m \times A_l$). Units are in kN.

4. Summary of Test Method

4.1 Bulk density values are determined by measuring the volume change of a given mass of bulk solid under increasing compaction pressure conditions.

5. Significance and Use

5.1 The data from this test can be used to estimate the bulk density of materials in bins, hoppers and for material handling applications such as silos.

5.2 The test results can be greatly affected by the sample selected for testing. For meaningful results it is necessary to select a representative sample of the particulate solid with respect to moisture content, particle size distribution and temperature. For the tests an appropriate size sample should be available, and a fresh material should be used for each individual test specimen.

5.3 Initial bulk density may or may not be used as the minimum bulk density. This will depend on the material being tested.

5.4 Bulk density values may be dependent upon the magnitude of the load increments. Traditionally, the load is doubled for each increment resulting in a load-increment ratio of 1. Smaller than standard load increment ratios may be desirable for materials that are highly sensitive to the load increment ratio.

5.5 Bulk density values may be dependent upon the duration of each load increment. Traditionally, the load duration is the same for each increment and equal to 15 s. For some materials,

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.24 on Characterization and Handling of Powders and Bulk Solids.

Current edition approved June 10, 2001. Published October 2001.

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

the rate of consolidation is such that complete consolidation (dissipation of excess pore pressure) will require significantly more than 15 s.

6. Apparatus

A schematic of the arrangement of the test apparatus of the system is shown in Fig. 1.

6.1 *Balance*, having a capacity to determine mass by using weight per class GP1 scale as per method ASTM document D 4753.

6.2 *Stand*, to support the density cup, and to mount the dial indicator. The stand must be level and securely mounted on a vibration free base to support the test apparatus.

6.3 *Density Cup*, with cover to contain the test specimen. Density cup cover has a ball mounted in the center. The density cup is to be a cylindrical cup with the minimum cell diameter of 64 mm and a minimum height of 21 mm or five times the diameter of the largest particle whichever results largest cell height. The ratio of diameter to height must be at least 3:1.

6.4 *Weights*, to be used with the weight hanger for consolidation purposes.

6.5 *Weight Hanger*, to support weights, and guide load onto the density cup cover.

6.6 *Dial or Digital Displacement Indicator*, to measure height. Dial indicator should be able to read in 0.02 mm increments.

6.7 *Plug*, or gage block is used to zero the dial indicator and should equal in length to the inside height of the density cup.

6.8 *Weight Support*, to support weights as they are added to compress the material.

7. Preparation of Apparatus

7.1 Calibrate the balance and set it on a sturdy table or bench for accurate measurement.

7.2 Make sure that the density cup and cover are clean and free of foreign material prior to starting each new test.

7.3 Calibrate the weights and keep them clean of foreign material.

7.4 Select a minimum of five weights to be used according to the following procedure. Additional weights may be used if more data points are desired or required.

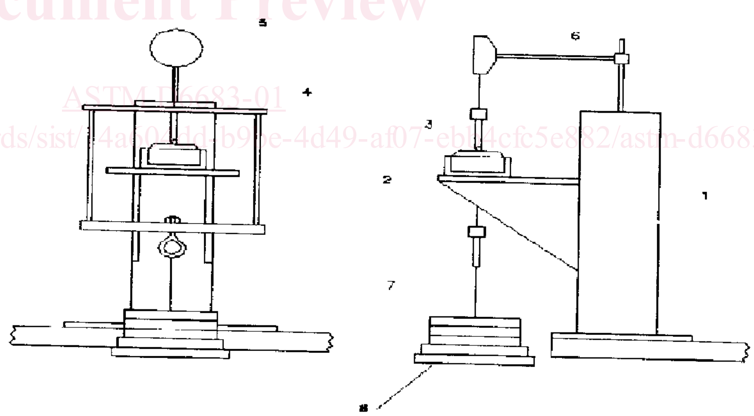
7.4.1 Calculate the maximum force W_m. (This will be one of the weights.)

7.4.2 Divide the maximum force W_m in half then in half again and continue until at least five weights have been identified.

8. Procedure

8.1 Determine the mass of the density cup and record this value to the nearest 0.1 g on a test data sheet as the tare weight.

8.2 Determine the weight of the cover and the weight hanger (this weight along with the spring force from the dial indicator, become the initial weight). Be sure this weight is less than the smallest weight to be used. These are to be recorded to the nearest 0.1 g on a test data sheet, and the total of these will be used as the first compression weight.



1. Stand
2. Density cup
3. Cover
4. Weight hanger
5. Dial indicator
6. Dial indicator holder
7. Weights
8. Mass support

FIG. 1 Test Apparatus