



Standard Test Method for Bulk Solids Characterization by Carr Indices¹

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1. Scope

1.1 This test method covers the apparatus and procedures for measuring properties of bulk solids, henceforth referred to as Carr Indices.²

1.2 This test method is suitable for free flowing and moderately cohesive powders and granular materials up to 2.0 mm in size. Materials must be able to pour through a 7.0 ± 1.0 -mm diameter funnel outlet when in an aerated state.

1.3 This method consists of eight measurements and two calculations to provide ten tests for Carr Indices. Each individual test or a combination of several tests can be used to characterize the properties of bulk solids. These ten tests are as follows:

- 1.3.1 *Test A*—Measurement of Carr Angle of Repose
- 1.3.2 *Test B*—Measurement of Carr Angle of Fall
- 1.3.3 *Test C*—Calculation of Carr Angle of Difference
- 1.3.4 *Test D*—Measurement of Carr Loose Bulk Density
- 1.3.5 *Test E*—Measurement of Carr Packed Bulk Density
- 1.3.6 *Test F*—Calculation of Carr Compressibility
- 1.3.7 *Test G*—Measurement of Carr Cohesion
- 1.3.8 *Test H*—Measurement of Carr Uniformity
- 1.3.9 *Test I*—Measurement of Carr Angle of Spatula
- 1.3.10 *Test J*—Measurement of Carr Dispersibility

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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 *Carr angle of difference, n*—the difference between the Carr angle of repose and Carr angle of fall.

2.1.2 *Carr angle of fall, n*—an angle of repose measured from a powder heap to which a defined vibration has been given.

2.1.3 *Carr angle of repose, n*—a measurement from the powder heap built up by dropping the material through a vibrating sieve and funnel above a horizontal plate.

2.1.4 *Carr angle of spatula, n*—a measurement by which a spatula is inserted into a powder heap parallel to the bottom and then lifting it up and out of the material.

2.1.5 *Carr cohesion, n*—a descriptive measure of interparticle forces based on the behavior of the material during sieving.

2.1.6 *Carr compressibility, n*—a calculation made by using Carr loose bulk density and Carr packed bulk density as determined in 5.8.

2.1.7 *Carr dispersibility, n*—a measurement by which a powder sample is dropped through a hollow cylinder above a watch glass and then the amount of powder collected by the watch glass is measured.

2.1.8 *Carr dynamic bulk density, n*—a calculated bulk density of a material. It is used to compute vibration time for the Carr cohesion measurement.

2.1.9 *Carr loose bulk density, n*—a measurement obtained by sieving the sample through a vibrating chute to fill a measuring cup.

2.1.10 *Carr packed bulk density, n*—a measurement obtained by dropping a measuring cup, which is filled with the sample, a specific number of times from the same height. Sometimes known as a *tapped density*.

2.1.11 *Carr uniformity, n*—a measurement calculated from the particle size distribution of the powder as measured by sieving.

3. Significance and Use

3.1 This test method provides measurements that can be used to describe the bulk properties of a powder or granular material.

3.2 The measurements can be combined with practical experience to provide relative rankings of various forms of bulk handling behavior of powders and granular materials for a specific application.

4. Apparatus

4.1 The main instrument includes a *timer/counter* (A), a *vibrating mechanism* (B), an *amplitude gage* (C), a *rheostat* (D), and a *tapping device* (E) (see Fig. 1).³

4.1.1 *Timer/Counter*—The timer is used to control the duration of vibration and the number of taps. A minimum 180-s timer for 60 Hz power supply is required. Alternatively, a

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.24 on Characterization and Handling of Powders and Bulk Solids.

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² Carr, R.L., "Evaluating Flow Properties of Solids," *Chemical Engineering*, January 18, 1965, pp. 163–168.

³ Available from Hosokawa Micron International Inc., New York, NY.