



Standard Test Method for Shear Testing of Bulk Solids Using the Jenike Shear Cell¹

This standard is issued under the fixed designation D 6128; 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 method ²covers the apparatus and procedures for measuring the cohesive strength of bulk solids during both continuous flow and after storage at rest. In addition, measurements of internal friction, bulk density, and wall friction on various wall surfaces are included.

1.2 This standard is not applicable to testing bulk solids that do not reach the steady state requirement within the travel limit of the shear cell. It is impossible to classify ahead of time which bulk solids cannot be tested, but one example may be those consisting of highly elastic particles.

1.3 The values stated in SI units are to be regarded as standard.

1.4 The most common use of this information is in the design of storage bins and hoppers to prevent flow stoppages due to arching and ratholing, including the slope and smoothness of hopper walls to provide mass flow. Parameters for structural design of such equipment also may be derived from this data.

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 Fluids³

3. Terminology

3.1 *Definitions*—Definitions of terms used in this test method are in accordance with Terminology D 653.

3.1.1 *adhesion test, n*—a static wall friction test with time consolidation.

3.1.2 *angle of internal friction, ϕ , n*—the angle between the axis of normal stress (abscissa) and the tangent to the yield locus.

3.1.3 *angle of wall friction, ϕ' , n*—the arctan of the ratio of the wall shear stress to the wall normal stress.

3.1.4 *bin, n*—a container or vessel for holding a bulk solid, frequently consisting of a vertical cylinder with a converging hopper. Sometimes referred to as silo, bunker, or elevator.

3.1.5 *bulk density, ρ_b , n*—the mass of a quantity of a bulk solid divided by its total volume

3.1.6 *bulk solid, n*—an assembly of solid particles handled in sufficient quantities that its characteristics can be described by the properties of the mass of particles rather than the characteristics of each individual particle. May also be referred to as granular material, particulate solid, or powder. Examples are sugar, flour, ore, and coal.

3.1.7 *bunker, n*—synonym for bin, but sometimes understood as being a bin without any or only a small vertical part at the top of the hopper.

3.1.8 *cohesive strength, n*—synonym for unconfined yield strength.

3.1.9 *consolidation, n*—the process of increasing the strength of a bulk solid.

3.1.10 *critical state, n*—a state of stress in which the bulk density of a bulk solid and the shear stress in the shear zone remain constant.

3.1.11 *effective angle of friction, δ , n*—the inclination of the effective yield locus (EYL).

3.1.12 *effective yield locus (EYL), n*—straight line passing through the origin of the σ , τ -plane and tangential to the steady state Mohr circle, corresponding to steady state flow conditions of a bulk solid of given bulk density.

3.1.13 *elevator, n*—synonym for bin, commonly used in the grain industry.

3.1.14 *failure (of a bulk solid), n*—plastic deformation of an overconsolidated bulk solid subject to shear, causing dilation and a decrease in strength.

3.1.15 *flow, steady state, n*—continuous plastic deformation of a bulk solid at critical state.

3.1.16 *flow function, FF , n*—the plot of unconfined yield strength versus major consolidation stress for one specific bulk solid.

3.1.17 *granular material, n*—synonym for bulk solid.

3.1.18 *hopper, n*—the converging portion of a bin.

¹ This testing 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 November 10, 2000. Published March 2001. Originally published as D 6128 – 97. Last previous edition D 6128 – 97.

² This test method is based on the “Standard Shear Testing Technique for Particulate Solids Using the Jenike Shear Cell,” a report of the EFCE Working Party on the Mechanics of Particulate Solids. Copyright is held by the Institution of Chemical Engineers and the European Federation of Chemical Engineering.

³ *Annual Book of ASTM Standards*, Vol 04.08.