Designation: D 6940 – 03

# Standard Practice for Measuring Sifting Segregation Tendencies of Bulk Solids[1]

This standard is issued under the fixed designation D 6940; 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 practice covers an apparatus and procedure for simulating the segregation tendencies of bulk solids by means of the sifting mechanism.

1.2 Temperature- and humidity-sensitive bulk solids may need to be tested at different temperatures and moisture contents, as would happen in an industrial environment.

1.3 The maximum particle size should be limited to 3 mm, to reduce the likelihood of binding the slide gate.

1.4 This standard is not applicable to all bulk solids and segregation mechanisms: while sifting is a common segregation mechanism experienced by many bulk solids, other segregation mechanisms not evaluated by this standard might induce segregation in practice.

1.5 The extent to which segregation will occur in an industrial situation is not only a function of the bulk solid and its tendency to segregate, but also the handling equipment (for example, bin design), process (for example, transfer rates), and environment.

1.6 *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]

## 3. Terminology

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

3.1.1 *funnel flow pattern*, *n*—a flow sequence in a bin or hopper characterized by having some bulk solids moving through stagnant bulk solids. In general, there is no flow along the hopper walls.

3.1.2 *segregation*, *n*—a process through which blended or uniform powders or bulk solids become non-uniform, with regions of varying composition, for example, particle size.

3.1.3 *sifting segregation*, *n*—a mechanism in which finer particles preferentially percolate into a zone within the bulk solid.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *collection cup*, *n*—a collection cup holds a sample of bulk solid once it is discharged from the apparatus.

3.2.2 *inner hopper*, *n*—the inner hopper is transparent. It has a steep inner conical section designed to sit within the outer hopper.

3.2.3 *outer hopper*, *n*—the outer hopper consists of a shallow transparent hopper designed to provide funnel flow for most bulk solids. It has an attached slide gate/guide cylinder and support legs.

3.2.4 *representative sample*, *n*—a quantity of the bulk solid to be tested that is representative of that solid in an industrial application being studied. Parameters of interest that may affect whether or not a sample is representative include: moisture, particle size distribution, raw material variation, method of production, aging, chemical composition.

## 4. Summary of Practice

4.1 A representative sample of a bulk solid is placed in the upper hopper of the apparatus.

4.2 The bulk solid is discharged to form a pile within the lower hopper, allowing segregation to take place.

4.3 The segregated material is discharged in a funnel flow pattern intended to recover zones of segregated material in a known sequence. Samples are collected from the discharge stream.

4.4 The samples are then available to be tested for differences relevant to the application, for example, particle size or chemical assay.

## 5. Significance and Use

5.1 Sifting segregation can cause horizontal segregation (for example, center-to-periphery) within bins used to hold and transport bulk solids. This can affect final product quality in industrial applications.

[1] This practice 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.

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

5.2 By measuring a bulk solid's segregation tendency, one can compare results to other bulk solids with known history, or determine if the given bulk solid may have a tendency to segregate in a given process.

5.3 Sifting, which is a process by which smaller particles move through a matrix of larger ones, is a common method of segregation. Four conditions must exist for sifting to occur:

5.3.1 *A Difference in Particle Size between the Individual Components*—This ratio can be as low as 1.3 to 1. In general, the larger the ratio of particle sizes, the greater the tendency for particles to segregate by sifting.

5.3.2 *A Sufficiently Large Mean Particle Size*—Sifting segregation can occur with a mean particle size in the 50 µm range and can become a dominant segregation mechanism if the mean particle size is above 100 µm.

5.3.3 *Sufficiently Free Flowing Material*—This allows the smaller particles to sift through the matrix of larger particles. With cohesive materials, the fine particles are bound to one another and do not enter the voids among the coarse particles.

5.3.4 *Interparticle Motion*—This can be caused during formation of a pile, by vibration, or by a velocity gradient across the flowing material.

5.4 All four of these conditions must exist for sifting segregation to occur. If any one of these conditions does not exist, the material will not segregate by this mechanism.

## 6. Apparatus

6.1 The apparatus is shown in Fig. 1, and all critical dimensions are specified in Fig. 2. The apparatus consists of the following:

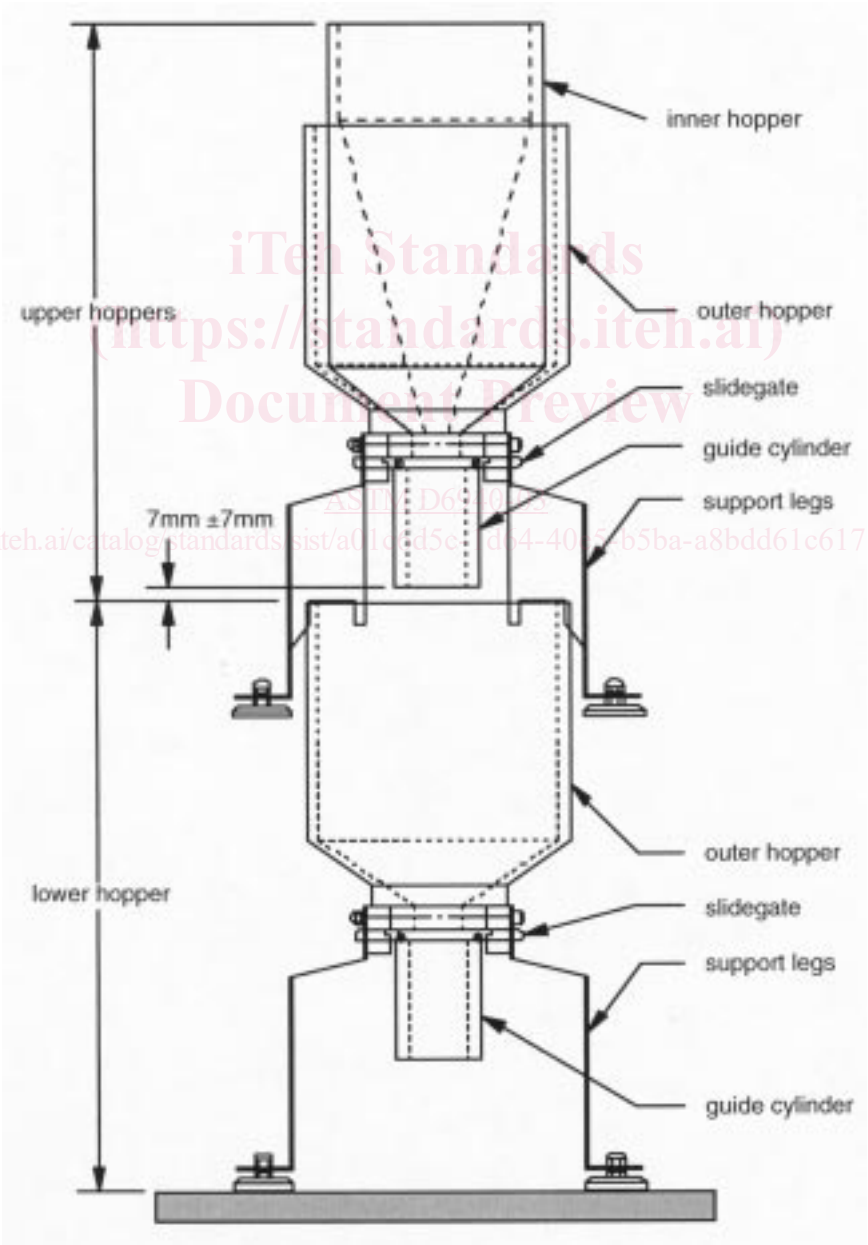




**FIG. 1 Apparatus**