Designation: D 1155 – 03

Standard Test Method for Roundness of Glass Spheres[1]

This standard is issued under the fixed designation D 1155; 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[2] covers the determination of the percent of true spheres in glass spheres used for retroreflective marking purposes and industrial uses.

1.2 This test method includes two procedures as follows:

1.2.1 *Procedure A*, in which the selected specimen is split into two size ranges or groups prior to separation into true spheres and irregular particles, and

1.2.2 *Procedure B*, in which the selected specimen is split into five size ranges or groups prior to separation.

1.2.3 In determining compliance with specification requirements, either Procedure A or Procedure B may be used. Where tests indicate failure to meet the specified percent of true spheres and irregular particles, the referee test shall be made in accordance with Procedure B.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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. Referenced Documents

2.1 *ASTM Standards:*

E 11 Specification for Wire Cloth and Sieves for Testing Purposes[3]

3. Summary of Test Method

3.1 The glass particles are mechanically separated into true spheres and irregular particles by controlled vibration on a glass plate fixed at a predetermined slope.

4. Significance and Use

4.1 The roundness of glass spheres is one measureable aspect relating to their performance as a retroreflective media. The function of this test method is to measure the percent of true spheres as related to compliance with applicable specifications.

NOTE 1—This method has been used in other industrial areas outside the intended scope of this test method.

5. Apparatus (Fig. 1)

5.1 *Electrical Feeder-Vibrator*, upon which is mounted a smooth glass panel, 152.4 mm (6 in.) wide and 381 mm (15 in.) long.

5.2 *Hinged Base*, supporting the vibrator and panel in such a manner that the angle of slope of the glass panel with the horizontal may be varied and fixed in any predetermined position.

5.3 *Vibrator*—Means of varying the amplitude or strength of the vibrations transmitted to the glass panel, at a fixed frequency of 60 impulses per second.

5.4 *Feeding Device or Pan*, affixed to the glass panel in such a manner that the selected sample of glass may be evenly dropped at a uniform rate upon the glass panel, from various heights above the panel and at various points on the slope.

5.5 *Collecting Pans or Containers*, at either end of the sloping panel, in which to collect the spheres and irregular particles.

6. Selection of Specimen

6.1 Select a 50-g specimen of the glass spheres to be tested for roundness in one of the following ways:

6.1.1 By mechanically splitting a bag or other container of glass spheres, selected at random from the shipment to be tested, or

6.1.2 By grain or seed-rod selection from the container.

7. Procedure A

7.1 Sieve the selected specimen through a 300-μm (No. 50) sieve (Note 2). Run the spheres retained on the sieve as one group, and run the spheres passing the sieve as a second group.

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[1] This test method is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.44 on Traffic Coatings.

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[2] For information on the development of this test method, reference may be made to the paper by Keeley, A. E., "Roundness Testing of Glass Spheres," *ASTM Bulletin*, No. 174, May, 1951, p. 72.

[3] *Annual Book of ASTM Standards*, Vol 14.02.

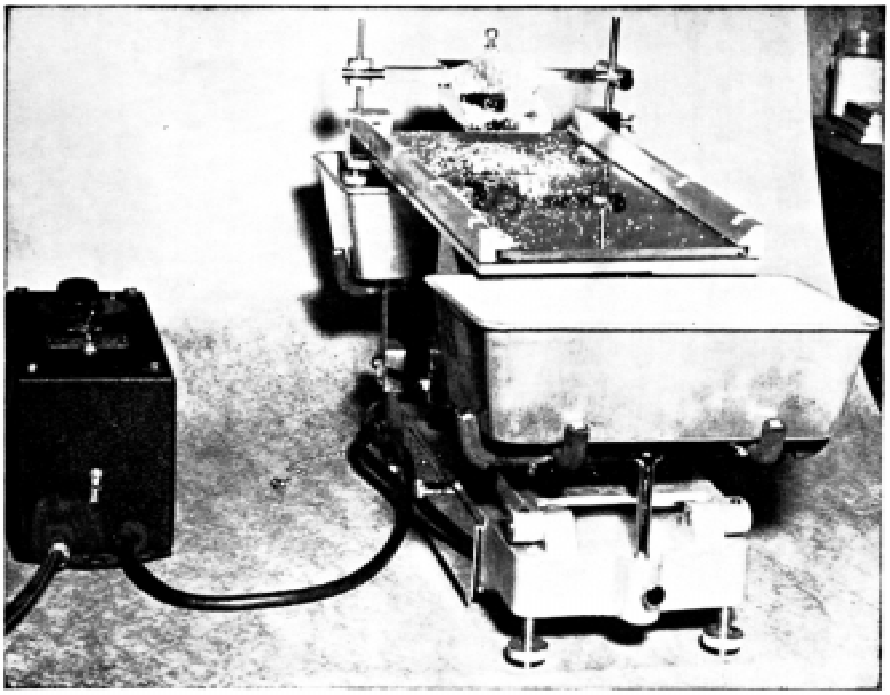

FIG. 1 Apparatus for Roundness Test of Glass Spheres

NOTE 2—Detailed requirements for ASTM sieves are given in Specification E 11.

7.2 Level the glass panel; then raise one end from the horizontal by the distance in inches indicated on the calibration curve in Fig. 2 for the average diameter of spheres in the group. Affix the feed hopper to the side of the panel at the upper one-third point of the slope, so that the spheres may be dropped in a uniform monolayer onto the glass panel from a height of approximately 13 mm (½ in.).

7.3 Place the size group to be tested in the feed pan, and start the vibrator. Set the vibrator amplitude control at such a position that irregular particles on the upper half of the panel will move slowly up the slope, while the true spheres roll down. Feed slowly, at such a rate that no "bunching up" or flooding of spheres on the panel occurs.

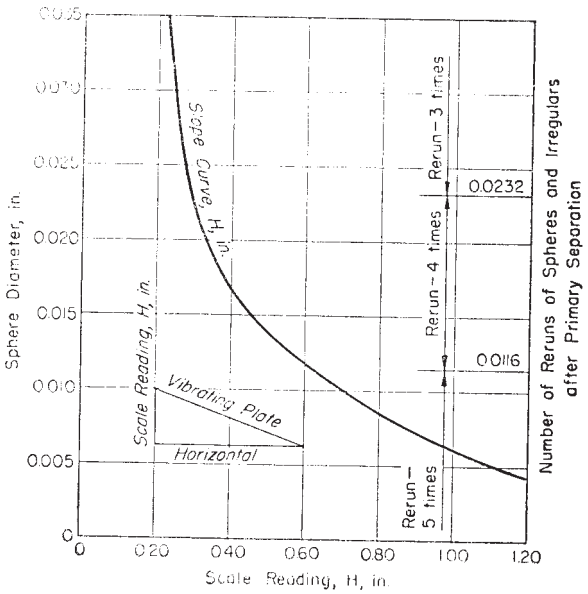

FIG. 2 Calibration Curve for Roundness Tester

7.4 When the glass panel is well covered with spheres, stop feeding until separation of true spheres has occurred. Stop the vibrator and, after all true spheres have rolled down the slope into the sphere pan, brush or scrape all particles remaining on the panel into the upper pan containing the irregular particles. For purpose of test, all particles not rolling freely down the slope are considered as irregular.

7.5 Repeat the procedure described in 7.3 and 7.4 until the selected size group has been completely separated, removing the true spheres and irregular particles from the collecting pans into appropriate containers.

7.6 Fill the feed pan with the true spheres collected in the primary separation, and repeat the procedure described in 7.3 and 7.4. Next, fill the feed pan with the irregular particles collected in the primary separation, and again repeat the procedure described in 7.3 and 7.4. Examine the separated spheres and irregular particles under a 20-diameter magnifying glass and repeat the reruns until satisfactory separation is obtained.

7.7 Determine the total weights of the true spheres and of the irregular particles obtained by the above separations, and record.

7.8 Using the second size group obtained in accordance with 7.1, repeat the procedure described in 7.2-7.7.

7.9 From the total weight of true spheres obtained from both size groups, calculate the percent of true spheres in the total specimen, using as 100 % the total weight of true spheres plus irregular particles collected in the test—thereby eliminating

from the calculation any loss of spheres that may have occurred during handling and testing.

8. Procedure B

8.1 Divide the specimen into five size ranges or groups, as follows:

Passing Sieve	Retained on Sieve
600-µm (No. 30)	425-µm
425-µm (No. 40)	300-µm
300-µm (No. 50)	212-µm
212-µm (No. 70)	...

8.2 Level the glass panel; then raise one end from the horizontal by the distance in inches indicated on the calibration curve in Fig. 2 for the minimum diameter of spheres in the group. Affix the feed hopper over the center line of the panel, at the upper one-third point of the slope, with the feed end up-slope and approximately 10 mm (⅜ in.) from the glass panel.

8.3 Place the size group to be tested in the feed pan, and start the vibrator. Set the vibrator amplitude control at such a position that irregular particles on the upper half of the panel will move slowly up the slope, while the true spheres roll down. Feed slowly, at such a rate that no "bunching up" or flooding of spheres on the panel occurs.

8.4 When the glass panel is well covered with spheres, stop feeding until separation of true spheres has occurred. Stop the vibrator and, after all true spheres have rolled down the slope into the sphere pan, brush or scrape all particles remaining on the panel into the upper pan containing the irregular particles. For purposes of this test, all particles not rolling freely down the slope are considered as irregular.

8.5 Repeat the procedure described in 8.3 and 8.4 until the selected size group has been completely separated, removing the true spheres and irregular particles from the collecting pans into appropriate containers.

8.6 Fill the feed pan with the true spheres collected in the primary separation, and repeat the procedure described in 8.3 and 8.4. Next, fill the feed pan with the irregular particles collected in the primary separation and again repeat the procedure described in 8.3 and 8.4. Examine the separated spheres and irregular particles under a 20-diameter magnifying glass and repeat the reruns until satisfactory separation is obtained.

8.7 The procedure described in 8.3, 8.4, and 8.5 comprises the primary separation and that in 8.6 is one complete rerun. Make a primary separation for each of the five size groups listed in 8.1 and then make the appropriate number of reruns for each size group, as follows:

Spheres Retained on Sieve	Reruns
425-µm (No. 40)	4
300-µm (No. 50)	4
212-µm (No. 70)	5
Spheres Passing Sieve	
212-µm (No. 70)	5

8.8 From the total weight of true spheres obtained from separations from all five size groups, calculate the percent of true spheres in the total specimen, using as 100 % the total weight of true spheres plus irregular particles collected in the complete test—thereby eliminating from the calculation any loss of spheres that may have occurred during handling and testing.

9. Report

9.1 Report the following information:

9.1.1 The weight percent of true spheres in the total specimen and

9.1.2 Whether Procedure A or Procedure B was used.

10. Precision and Bias

10.1 A round-robin study is currently underway in order to generate a precision statement.

11. Keywords

11.1 roundness; glass spheres