Designation: E 1109 – 86 (Reapproved 2004)

Standard Test Method for Determining the Bulk Density of Solid Waste Fractions[1]

This standard is issued under the fixed designation E 1109; 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 determines the bulk density of various fractions from the resource recovery processing of municipal solid waste. It is intended as a means of characterizing such fractions and for providing data useful to designers of solid waste processing plants.

1.2 *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.* Specific precautionary information is given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

C 702 Practice for Reducing Field Samples of Aggregate to Testing Size

D 75 Practice for Sampling Aggregates

E 689 Reference Radiographs for Ductile Iron Castings

E 1107 Test Method for Measuring the Throughput of Resource-Recovery Unit Operations

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bulk density*—the mass per unit volume of particulate matter. Bulk density is not an absolute material property as is the density of individual particles of a material. The bulk density depends on the size of the container and how the material is loaded into the container. For example, the bulk density of material placed loosely in a container will be less than that of material tamped into a container. Also, some materials placed loosely in a container will settle with time due to its own weight; thus, its bulk density will increase.

4. Summary of Test Method

4.1 A sample of a solid waste stream is tamped in a cubical container of known volume and then weighed. Bulk density is calculated from the weight of the contents and volume of the container.

5. Significance and Use

5.1 This test method describes a physical property of solid waste in processing facilities; a property that characterizes the solid waste streams and hence the operation of resource recovery separators and processors.

5.2 The bulk density is an important property for the design of materials handling equipment, separators, and processors.

6. Apparatus

6.1 *Balance*—A balance or scale accurate within 0.1% of the test load at any point within the range of use. The range of use shall be considered to extend from the weight of the measure empty to the weight of the measure plus its contents.

6.2 *Cubical Measure*, with internal dimensions approximately 60 by 60 by 60 cm (24 by 24 by 24 in.) provided with handles. The interior surfaces of the measure shall be nonabsorbent to moisture.

NOTE 1—A satisfactory weigh box has been constructed of ¾ in. (1.9 cm) exterior grade plywood with the finished surface on the inside. Reinforcing strips, approximately 5 cm (2 in.) wide and 1.3 cm (½ in.) thick were fastened to the outside walls; two of them in a way to provide handles.

6.3 Larger cubical weigh boxes shall be used as necessary to accommodate large particles of material. No particle larger than two-thirds the length, height, or width of the weigh box shall be put into the weigh box in determining the bulk density.

7. Precautions

7.1 This procedure calls for the handling of solid waste and its processed fractions. Because the origin of all the materials is generally unknown, workers must use proper safety precautions when handling samples. Workers shall wear gloves and safety glasses. When appropriate, dust masks shall be worn. Workers must be cautioned to wash their hands thoroughly before eating or smoking.

[1] This test method is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.06 on Recovery and Reuse.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

8. Sampling

8.1 Sample shall be obtained from the processor streams or separator output streams in accordance with 11.1, Test Method E 1107, and shall constitute the gross sample.

8.2 The amount of material in each sample shall conform to the requirements of Table 1, Practice D 75, except that samples of material with greater than 90 mm (3½ in.) maximum nominal size shall weigh not less than 250 kg (550 lb).

9. Sample Preparation

9.1 Prepare and test the samples as soon as practicable with due precaution that they neither gain nor lose weight from natural drying or being left uncovered in wet or dusty areas, as described in Section 11, Test Method E 1107.

9.2 Weigh the gross samples before being subdivided. Drain wet samples in accordance with 11.g of Method E 689 before weighing and report the test results as "per drained weight."

9.3 Subdivide gross samples in accordance with Practice C 702 to form four test specimens. If the cone and quartering Method of Practice C 702 is used, take special care to include the fine particulate material that may sift to the bottom of the pile. Keep the test specimens in moisture barrier containers until tested or discarded.

10. Procedure

10.1 Measure the internal dimensions of the weight box to ±1 mm (0.05 in). Then calculate and record the volume to ±0.1%.

10.2 Determine the weight of the weigh box to ±0.1%.

10.3 Select a test specimen at random from the four and fill the weigh box to overflowing, taking special care to avoid segregation, compaction or spillage; especially loss of the fine particulate material. Then tamp the box three times by lifting it 6 cm (2½ in.) above the ground and dropping squarely. After tamping, draw a rigid straightedge across the top of the box to level the contents. Some agitation of the straightedge may be necessary to force particulate either in or out of the box. If the contents remain below the top of the box, empty the box and start the test again using another specimen.

10.4 Weigh the filled box ±0.1 % and calculate the bulk density to three significant figures.

10.5 Repeat the procedures of 10.3 and 10.4 with another test specimen selected at random from the remaining three.

10.6 Calculate the average of the two bulk densities. If the densities are more than 10 % different, select at random another specimen from the remaining two specimens and make a third bulk density determination. If the third density is more than 5 % above or below the average of the first two, discard all four test specimens, obtain another gross sample and repeat the test procedure using a larger weigh box. If the third determination is within 5 % of the average of the first two, report the average of the three determinations.

11. Calculation

11.1 Calculate the bulk density as follows:

$$\text{Bulk Density} = (W - W_T)/V$$

where:

W = the weight of the box full,
W_T = the weight of the box empty, and
V = the volume of the box as determined in 10.1.

11.2 If the box is weighed in kilograms, the volume of the box shall be expressed in cubic metres. If the box is weighed in pounds, the volume of the box shall be expressed in cubic feet and the bulk density in pounds per cubic feet.

12. Report

12.1 The bulk density is reported as the average of the two or three determinations.

12.2 The report shall indicate whether the density is based on as-received weight, drained weight, or other.

12.3 The report form is shown in Fig. 1. All items shall be completed.

13. Precision and Bias

13.1 There are not yet sufficient data available to determine the precision of this test method. There are no known standard materials for determining the bias of this test method.

Computation and Reporting of Bulk Density

Date _____ Location _____
Time _____ Operation _____
Pressure Stream _____

Weight Box Weight = W_T = _____

	Sample 1	Sample 2	Sample 3*
Box + Sample = W=			
Bulk Density = $(W - W_T)/v$ =			

Average
Average +5 %
Average −5 %

Indicate if: Dry weight _____
Drained weight _____
As-received weight _____

FIG. 1 Sample Bulk Density Computation and Report Sheet