Designation: E889 – 82 (Reapproved 2023)

Standard Test Method for Composition or Purity of a Solid Waste Materials Stream[1]

This standard is issued under the fixed designation E889; 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 covers the determination of the composition of a materials stream in a solid waste resource recovery processing facility. The composition is determined with respect to one or more defined components. The results are used for determining the purity resulting from the operation of one or more separators, and in conjunction with Test Method E1108 used to measure the efficiency of a materials separation device.

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

1.3 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For hazard statements, see Section 7.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C566 Test Method for Total Evaporable Moisture Content of Aggregate by Drying

C702/C702M Practice for Reducing Samples of Aggregate to Testing Size

D75/D75M Practice for Sampling Aggregates

D644 Test Method for Moisture Content of Paper and Paperboard by Oven Drying (Withdrawn 2010)[3]

E1107 Test Method for Measuring the Throughput of Resource-Recovery Unit Operations

E1108 Test Method for Determination of the Recovery of a Product in a Materials Separation Device

3. Terminology Definitions

3.1 *binary separator*—a device that separates a single input feed stream into two output or product streams.

3.2 *gross sample*—a sample representing one lot and composed of a number of increments on which neither reduction nor division has been performed.

3.3 *laboratory sample or analysis sample*—a portion of one gross sample representative of a lot and taken at random from the gross sample.

3.4 *polynary separator*—a device that separates a single input feed stream into three or more output product streams.

3.5 *purity*—the purity of a stream is defined in terms of one or more identifiable components, x, y, z, etc. The purity for any component such as x is the mass of x in a stream divided by the total mass of that stream. In some cases, the mass of x must be defined in practical terms that relate to the origin of the feed. For example, the purity of a ferrous product magnetically recovered from refuse can be expressed as the purity of ferrous by proximate analysis. Alternatively, it can be expressed as the purity by manual sorting, with all nonferrous materials that cannot readily be removed by hand as the contaminants. In any case, purity must be defined for each application.

4. Summary of Test Method

4.1 A gross sample of a preselected process stream is taken and subdivided into four laboratory samples. Two of the laboratory samples are analyzed for composition of the component(s) or item(s) of interest by hand-picking and weighing. The third sample is used if the results of the first two do not agree within specified limits. The composition is computed as the weight ratio of the component(s) of interest to the weight of the sample.

[1] This test method is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.03 on Treatment, 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

4.2 The composition is expressed as the purity of the stream with respect to the component(s) indicated.

5. Significance and Use

5.1 This method is used to document the ability of solid waste resource recovery separators to concentrate or classify a particular component (or components) present in solid waste.

5.2 The purity determined in this way is used to calculate the recovery achieved by a separator as another measure of its performance, according to Test Method E1108.

6. Apparatus

6.1 *Scales*—Several size scales must be available to weigh gross samples and laboratory samples that will range in size from less than 1 kg (2.2 lb) to more than 100 kg (220 lb). All scales should have a precision and accuracy of ±0.1 %.

6.2 *Sorting Apparatus*—This may be any convenient work surface, such as a table and bins as described by Kaiser et al.[4]

6.3 *Polyethylene Bags,* used to store laboratory and sometimes gross samples as the means of preserving their moisture content. These bags should be 0.10 to 0.15 mm (0.004 to 0.006 in.) thick and supplied with metal ties.

6.4 *Laboratory Drying Oven,* and general associated equipment are required.

7. Hazards

7.1 This procedure calls for the hand-picking of solid waste and its processed fractions. Because the origin of all of 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.

7.2 Particular caution shall be exercised when collecting samples near moving equipment.

8. Sampling

8.1 Samples are taken from processor streams, or separator output or input streams, according to the procedures outlined in Test Method E1107.

8.2 The purity is determined with respect to a particular component in the stream, such as steel cans or glass. Hence, sampling and containment of samples must be done in a manner to preserve the integrity of the components being analyzed and the mass of the entire sample. As an example, if a stream is to be analyzed for the purity with respect to pieces of glass larger than 10 mm (0.4 in.) in size, the sample must be handled and stored in a manner in which pieces of glass larger than 10 mm are not broken.

[4] Kaiser, E. R., "Sampling and Analysis of Solid-Incinerator Refuse and Residue," *Proceedings of 1970 National Incineration Conference*, Am. Soc. Mechanical Engrs., pp. 25–31.

9. Test Specimen and Samples

9.1 The size of sample is determined by the particle size of the material in accordance with Practice D75/D75M. The size of sample specified constitutes the gross sample.

9.1.1 For particle sizes greater than 90 mm (3½ in.), not included in Table 1, Size of Samples, of Practice D75/D75M, the size of sample shall be 250 kg (550 lb).

9.1.2 Gross samples shall be weighed, without subdivision.

9.1.3 A gross sample may be sized in accordance with the section on Test Specimen and Samples of Test Method E1107 in circumstances where Practice D75/D75M cannot be practiced.

9.2 Gross samples shall be subdivided in accordance with Practice C702/C702M to form four laboratory samples. Each is weighed and labeled. This is recorded as "as-received weight."

9.3 Samples from wet processing steps, for example, wet screening, spiral classification, jigging, etc., are to be weighed after draining the water, in accordance with 11.3. The weight of such samples is recorded as the "drained weight."

10. Conditioning

10.1 Weigh the samples immediately after being taken with due precaution so that they neither gain nor lose weight from natural drying or from being left uncovered in wet or dusty areas. This is known as "as-received weight."

10.2 Condition wet samples by draining in accordance with 11.8. This is known as "drained weight."

10.3 The weight of dry samples, either of gross or laboratory samples, must exclude the contained moisture. Dry samples in accordance with 11.10. This is known as "dry weight."

11. Procedure

11.1 Take a gross sample in accordance with the section on Procedures in Test Method E1107.

11.1.1 Contain the gross sample in a moisture barrier container in accordance with 11.8.1 if the moisture content is to be preserved.

11.1.2 Record the weight of the gross sample.

11.2 Subdivide the gross sample into four near equal parts in accordance with Practice C702/C702M to form four laboratory samples.

11.2.1 Place the laboratory samples in moisture barrier containers, in accordance with 11.10 if the moisture content is to be preserved.

11.2.2 Record the weight of each laboratory sample.

11.3 Choose two of the laboratory samples at random for analysis; retain the other two, if needed, in accordance with 11.5.1.

11.4 Perform the analysis by spreading a laboratory sample on a clean, flat surface, and hand-picking the component(s) of interest.

11.4.1 Place the component(s) of interest in a clean, tared container. If the moisture content is to be preserved, this must be a moisture barrier container in accordance with 11.8.1.

11.4.2 Carefully remove adhering tramp substances from the component(s) of interest. Do not remove tramp substances that are physically attached so as not to be readily removed by hand and classify the entire piece as either components of interest (accept) or not of interest (reject). Record this decision on the data sheet.

11.4.3 Record the weights of component(s) picked from each laboratory sample as "as-received weight."

11.5 Compute the purity of the stream in regard to the component(s) of interest in accordance with Section 12.

11.5.1 The computed values of the purity of the two laboratory samples must agree within 10 % to be accepted. If they do not so agree, repeat the analysis procedure for a third laboratory sample chosen at random from the remaining two. Discard the fourth sample. If the value of the purity of the third sample does not agree within 10 % of the value of either of the first two, discard all samples and repeat the entire determination using a larger gross sample.

11.6 Hand-picking and weighing must be done without spillage and loss of material. Remove adhering tramp materials on the component(s) of interest that can be removed before the component(s) are placed in the tared container.

11.7 Record within 0.1 % all weights and in accordance with the precautions of Section 10 and 11.8.

11.8 Handle samples and weigh them in a manner to preserve the moisture content, except for samples taken from a wet process or separator, as described in 11.9.

11.8.1 Store laboratory samples in polyethylene bags, 0.10 to 0.15 mm (0.004 to 0.006 in.) in wall thickness. Secure the bags with two metal ties at the neck, and label.

11.8.2 In transferring the contents of material from a polyethylene bag, if the weight is to be preserved (that is, the contents are to be transferred quantitatively), take note of any condensed moisture or fine particulate solid materials adhering to the inside of the bag. Shake out any adherent solid material into the sample before or after the step outlined in 11.8.3.

11.8.3 If the bag contains condensed moisture, the weight of this moisture must be included in the weight of the sample transferred from this bag. After the bag is emptied, weigh it and place it in a forced-air drying oven at 55 °C (130 °F) and dry it to constant weight. Shake out the remaining solid materials (see 11.8.1). Add the weight loss of the bag to the weight of the sample as "contained moisture." Add the weight loss, after shaking out solid materials, to the weight of the sample as part of the solids. Determine moisture content in accordance with 11.10.

11.8.4 If the contents of a laboratory sample do not have to be transferred quantitatively, 11.8.2 and 11.8.3 are not applicable.

11.9 As mentioned in 9.3, samples from wet separators are to be weighed after draining the water. Record the weight as "drained weight."

11.9.1 Draining is accomplished by having the laboratory sample remain in a sieve until water is no longer observed dripping from the sieve but not longer than 1 h.

11.9.2 If drained weight is used, report purity on a "wet basis."

11.9.3 Alternatively, samples after draining may be dried to constant weight to determine the moisture content in accordance with 11.10. Subsequently, hand-pick the dried sample for the component(s) of interest. In this case, report the purity on a "dry basis."

11.10 The moisture content of paper or paper-like streams or components is to be determined by Test Method D644. Determine the moisture content of inorganic or aggregate-like streams or components by Test Method C566.

11.10.1 The temperature of drying in these methods may have to be lowered to avoid damaging any of the components in the sample. Melting pieces of plastic beyond recognition is an example of such damage.

12. Calculation

12.1 Calculate the purity as a mass fraction with respect to component x as follows:

$$\text{Purity of } x = P_x = \frac{\text{mass of x in the stream}}{\text{total mass of the stream}} \quad (1)$$

12.2 Calculate the mass of the stream, M_s, as follows:

$$M_s = C - T \quad (2)$$

where:

C = weight of the container filled with the laboratory sample, and

T = weight of that container alone.

12.3 Calculate the mass of the component of interest, M_x, as follows:

$$M_x = C' - T' \quad (3)$$

where:

C' = weight of the container filled with the hand-picked component x, and

T' = the weight of that container alone.

13. Report

13.1 Report purity, P_x, of component x for each of the laboratory samples analyzed. Report the average of the two measurements as the P_x for the separator stream analyzed.

13.2 The location of the separator stream as well as the component(s) of interest are identified.

13.3 The report must distinguish if the purity is based on as-received weight, drained weight, or dry weight. In any case, note the amount of moisture in the component(s) of interest and in the process stream.

13.4 The recommended report form is shown in Fig. 1. Complete all items.

14. Precision and Bias

14.1 There are not yet sufficient data available to compute the expected precision and bias of this test method.