



Designation: E959 – 83 (Reapproved 2005)

Standard Test Method for Characterizing the Performance of Refuse Size-Reduction Equipment¹

This standard is issued under the fixed designation E959; 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 measuring the performance of solid waste size reduction equipment.

1.2 This test method can be used to measure the flow (that is, throughput) of solid waste through the size-reduction equipment, energy usage of the size-reduction device, and particle size of the shredded product.

1.3 This test method includes instructions for measuring energy usage, solid waste throughput, net processing time, and particle size distribution.

1.4 This test method applies only to size reduction equipment that produces a shredded product with a size corresponding to 90 % cumulative passing in the range of 0.5 to 15 cm (0.2–6 in.) on an air-dry weight basis. For material with nominal sizes outside of this range, the precision and bias statements for particle size designation (Section 14) may not apply.

1.5 This test method can be applied to size reduction equipment located anywhere within a processing line.

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

1.7 *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. See Section 7 for specific hazard information.*

2. Referenced Documents

2.1 *ASTM Standards:*²

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.

Current edition approved Feb. 1, 2005. Published March 2005. Originally approved in 1983. Last previous edition approved in 1999 as E959-83(1999). DOI: 10.1520/E0959-83R05.

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.

E828 Test Method for Designating the Size of RDF-3 From its Sieve Analysis³

E929 Test Method for Measuring Electrical Energy Requirements of Processing Equipment

3. Terminology Definitions:

3.1 *characteristic product size*—the screen size corresponding to 63.2 % cumulative passing by weight.

3.2 *discrete throughput method*—the method whereby average throughput is calculated as the average of a number of discrete throughput measurements conducted during a test period.

3.3 *idling time*—time periods during which a size reduction device is freewheeling, that is, not processing refuse.

3.4 *net processing time*—the time during which refuse is processed through the size reduction device.

3.5 *nominal product size*—the screen size corresponding to 90 % cumulative passing by weight.

3.6 *size reduction device or equipment*—a device which size reduces (Synonyms: shredder, grinder, pulverizer, and mill).

3.7 *stationary belt method*—a method of gross sample collection in which the conveyor belt is stopped and the sample of material is removed manually.

3.8 *time-averaged throughput method*—the method whereby the average throughput is calculated by dividing the total mass size reduced by the net processing time.

3.9 *test interval*—a test interval is equal to one-quarter of the test period.

3.10 *test period*—the test period is two to four continuous h of net-processing time.

4. Summary of Test Method

4.1 The duration of the test period is established and refuse is prepared for processing.

4.2 An energy measuring system is installed.

4.3 Solid waste is processed through the size reduction equipment, energy usage and throughput is measured, and samples for analysis of product particle size distribution are collected.

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

4.4 Average throughput, power requirements, specific energy, and particle size of the shredded product are calculated.

4.5 Two methods (Time-Averaged Throughput Method and Discrete Throughput Method [Section 10]) for measuring the performance of size reduction equipment are described. The selection of a particular method is governed by the layout of the processing equipment, the location of the size-reduction equipment relative to the other processing equipment, and the preference of the parties conducting the test.

5. Significance and Use

5.1 Throughput, power and energy requirements, and product size are key parameters that describe the operation and performance of solid waste size-reduction equipment.

5.2 This test method can be used to determine if the size-reduction equipment is operating within specifications and meeting performance criteria.

5.3 Having determined the parameters given in 5.1, the equipment that has been subjected to the test may be compared to other equipment similarly tested in order to establish relative levels of performance among equipment.

5.4 The basic test period is a continuous two to four h duration. The use of several test periods may be warranted to assess adequately the performance of size reduction equipment.

6. Apparatus

- 6.1 *Hand Broom.*
- 6.2 *Dust Pan.*
- 6.3 *Wide-mouthed Shovel.*
- 6.4 *Clock or Stopwatch, accurate to 0.1 s.*
- 6.5 *Plastic Bags, large containers, or both.*
- 6.6 *Push-broom.*
- 6.7 *Ties and Labels.*
- 6.8 *Electrical Metering System.*
- 6.9 *Sieving Equipment, manual or mechanical.*

7. Hazards

7.1 The test procedure described in 11.4 requires the removal of shredded material from a stopped conveyor belt by test personnel. Precautions should be taken to ensure that the belt cannot be started while occupied. These precautions consist of lockout of the electrical power to the conveyor, ready access to a safety “stop” cord located on the conveyor, or both.

7.2 This test method requires installation of electrical metering equipment. Consequently, the precautions described in Test Method E929 should be observed.

7.3 Gross samples should be collected sufficiently far from the size reduction equipment such that test personnel are protected from potential explosions and flying objects from the equipment.

8. Equipment Calibration

8.1 All electrical metering equipment used for energy measurement shall be calibrated in accordance with Test Method E929.

8.2 All weight-measuring equipment shall be calibrated according to the manufacturer’s instructions.

9. Preparation for Test

9.1 *Refuse Preparation and Establishment of Test Intervals*—The duration of the test period is to be a minimum of 2 h and a maximum of 4 of net-processing time. During the test period, collect four gross samples of shredded product from which subsamples for particle size distribution analysis will be taken subsequently. The test period is divided into four equal test intervals (that is, test intervals 1, 2, 3, and 4). Calculate the approximate duration of the test intervals using the following relation:

$$t_i^* \approx \frac{t_p^*}{4} \quad (1)$$

where:

t_p^* = estimate of the duration of the test interval (h), and
 t_p^* = estimated duration of the test period (h), subject to the condition $2 \text{ h} \leq t_p^* \leq 4 \text{ h}$.

Weigh refuse, uniformly mixed as much as possible, and form into four discrete piles, each of which has an approximate (nominal) weight as calculated by the following relation:

$$M_i^* \approx \frac{\dot{m}^* t_i^*}{4} \quad (2)$$

where:

M_i^* = approximate weight of the refuse pile in Mg,
 \dot{m}^* = nominal throughput value (Mg/h) established for the test, and
 t_i^* = estimated duration of the test interval (h) derived from Eq 1.

The measured weight of each pile (M_i) is to be within $\pm 5\%$ of the nominal weight (M_i^*). Record the weight of each pile on the sample data form shown in Fig. 1.

9.2 *Time Measurements and Logbook*—Keep a time log during the conduct of the test program, the primary purpose of which is to allow the calculation of net-processing time. A sample format for the log is shown in Fig. 2.

9.2.1 The key time recordings for each time interval are as follows:

9.2.1.1 Starting time of the time interval,

9.2.1.2 Starting time of idling periods in which the size reduction device is electrically energized but in which no size reduction of refuse is occurring,

9.2.1.3 Starting time of any periods in which the size reduction device is electrically shut down (de-energized), and

9.2.1.4 Finishing time of the test interval.

9.2.2 In order to obtain representative test data, it is recommended that the net-processing time be a minimum of 75 % of the duration of the test period. For example, if a four-h test period is chosen, the net processing time should be equal to or greater than three h.

9.3 *Setup and Use of the Energy Measuring Equipment*—Measure energy usage of the size reduction device during the test period using Test Method E929. Use a rotating disk-type wattmeter or equivalent as the measuring instrument. Install and test the energy measuring equipment prior to initiating the test period.

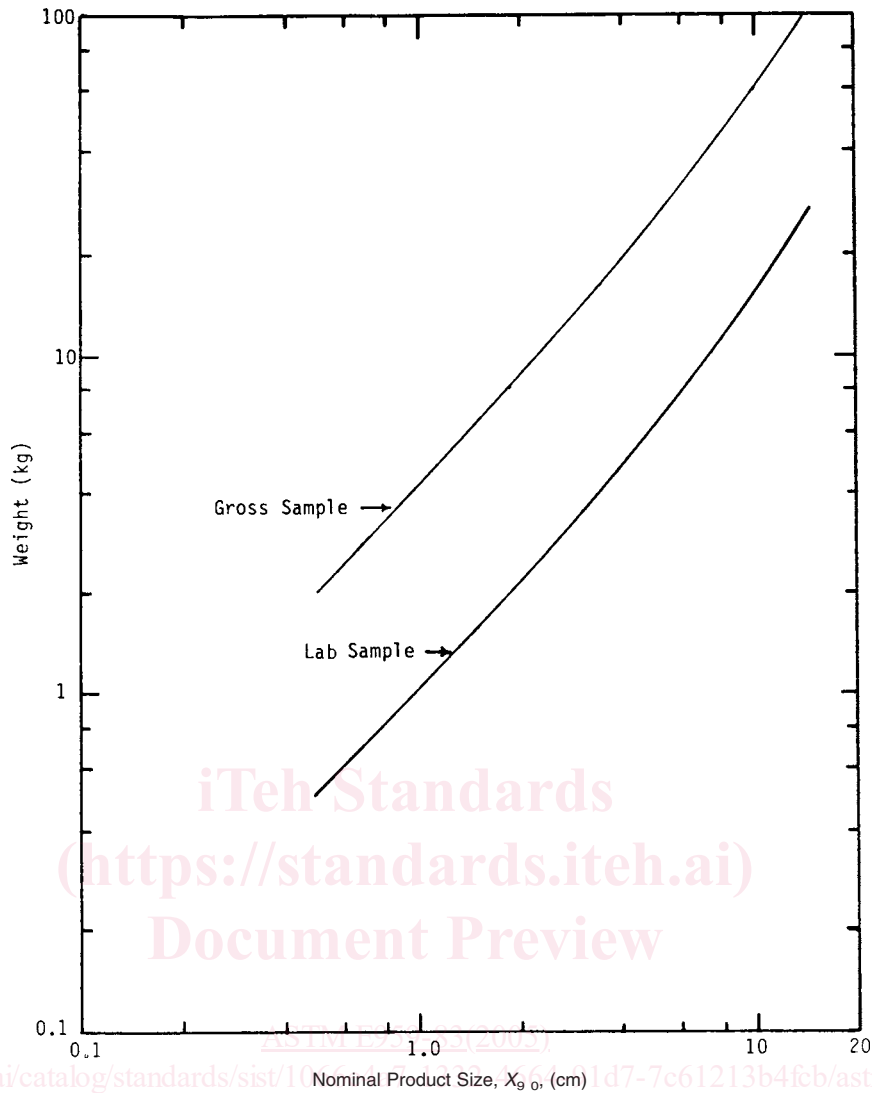


FIG. 3 Weight Requirements for Gross and Lab Samples as a Function of Nominal Product Size

recording the weights of gross and laboratory samples (Fig. 4) and the data sheets used to record particle size distribution data (Fig. 5).

10.6 Weigh the gross sample and store in a waterproof container or bag until the representative laboratory samples are chosen. Record weight data on the data sheet shown in Fig. 4.

10.7 At the conclusion of the time interval, note the time and record the reading on the time log.

10.8 Collect the second, third, and fourth gross samples for product particle size analysis approximately midway into the second, third, and fourth test intervals, respectively, of the test period, following the procedures in 10.4 through 10.7. Note and record on the time logs the starting times of the subsequent test intervals.

10.9 Following the fourth time interval and immediately upon size reducing the remainder of the fourth pile of refuse, note the time and record the final wattmeter reading on Table X4 of Test Method E929. After the final wattmeter reading has

been noted, measure the final freewheeling power draw and record the data in Fig. 2, Energy Measurement Data Sheet of Test Method E929.

11. Discrete Throughput Method Procedure

11.1 The Discrete Throughput Method is used in those instances where splitting of the raw refuse stream occurs prior to its entering the size-reduction device, for example, in those systems where a pre-trommel screen is located upstream of the size-reduction device.

11.2 Follow the procedures in 10.2 through 10.4. The preferred method of collection of the gross sample is by diversion of the entire cross section of the shredded refuse stream into a collection container or through collection of the entire cross section of the stream in free fall at a conveying transition point. Use a stopwatch to measure the time during which the throughput sample is being collected.