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Standard Test Methods for Municipal Ferrous Scrap[1]

This standard is issued under the fixed designation E701; 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 These test methods cover various tests for assessing the usefulness of a ferrous fraction recovered from municipal wastes.

1.2 These test methods comprise both chemical and physical tests, as follows:

	Section
Sampling	5
Bulk Density	6
Total Combustibles	7
Chemical Analysis (for Industries Other Than the Detinning Industry)	8
Magnetic Fraction (for the Detinning Industry)	9
Chemical Analysis for Tin (for the Detinning Industry)	10
Metallic Yield for All Industries Other Than the Copper Industry and the Detinning Industry	11

1.3 The values stated in inch-pound 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:*[2]

C29/C29M Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

C702 Practice for Reducing Samples of Aggregate to Testing Size

D2234/D2234M Practice for Collection of a Gross Sample of Coal

E30 Test Methods for Chemical Analysis of Steel, Cast Iron, Open-Hearth Iron, and Wrought Iron

E122 Practice for Calculating Sample Size to Estimate, With Specified Precision, the Average for a Characteristic of a Lot or Process

E350 Test Methods for Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

E351 Test Methods for Chemical Analysis of Cast Iron—All Types

E415 Test Method for Atomic Emission Vacuum Spectrometric Analysis of Carbon and Low-Alloy Steel

E702 Specification for Municipal Ferrous Scrap

3. Significance and Use

3.1 The establishment of these test methods for municipal ferrous scrap as a raw material for certain industries (see Specification E702) will aid commerce in such scrap by providing the chemical and physical tests for the characterization of the scrap needed as a basis for communication between the purchaser and supplier.

4. Hazards

4.1 Due to the origins of municipal ferrous scrap in waste destined for disposal, common sense dictates that some precautions should be observed when conducting tests on the samples. Recommended hygienic practices include using gloves when handling municipal ferrous scrap and washing hands before eating or smoking.

5. Sampling

5.1 *Gross Sample of Loose Ferrous Scrap*:

5.1.1 Take a minimum of one gross sample having a volume of 7 ft^3 (0.2 m^3) (approximately equal to a 55-gal drum). Guidance for determining the number of gross samples needed to characterize a given lot of material and methods for accumulating a gross sample can be found in Practice E122 and Test Method D2234/D2234M, respectively. In all cases, the actual sampling procedures to be used and the number of gross samples required to obtain a representative sample of the lot shall be established in accordance with an agreement between the purchaser and supplier.

5.1.2 Air-dry the gross sample at ambient temperature for a period of 24 h by spreading the sample on a clean, dry surface to one-layer thickness. Protect the sample from contamination by falling dust and debris. Reduce the gross sample to four

[1] These test methods are under the jurisdiction of ASTM Committee D34 on Waste Management and are 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.

samples by the method of coning and quartering, as described in Method B of Practice C702.

5.2 *Gross Sample of Baled Ferrous Scrap*—Take a minimum of two bales. Guidance for determining the number of bales needed to characterize a given lot of material and methods for selecting the bales can be found in Practice E122. In all cases, the actual sampling procedures to be used and the number of gross samples required to obtain a representative sample of the lot shall be established in accordance with an agreement between the purchaser and supplier.

6. Bulk Density

6.1 *Loose Ferrous Scrap*:

6.1.1 *Apparatus*:

6.1.1.1 *Container*, constructed of suitable materials, for example, plywood, having the following approximate internal dimensions: base of 1 by 1 ft (300 by 300 mm) and a height of at least 2 ft (600 mm). Measure the internal dimensions of the box to the nearest 0.1 in. (3 mm). Suitable handles may be attached to the exterior of the container to aid in subsequent handling. Alternatively, containers of other geometries, agreeable to the purchaser and supplier, may be employed provided the area of the base is at least 1 ft^2 (0.09 m^2).

NOTE 1—The operator should be aware that this test method is not intended for those occasional pieces whose size is of the order of the dimensions of the box. As a guide, the maximum length of a single piece should not exceed three fourths of the maximum dimension of the base.

6.1.1.2 *Balance or Scale*, accurate within 0.1 % of the test load within the range of use. The range of use shall be considered to extend from the weight of the container empty to the weight of the container plus its contents at 100 lb/ft^3 (1600 kg/m^3).

6.1.1.3 *Measuring Rod*, calibrated in 0.1-in. (3-mm) intervals having a blunt end with an area of 4 $in.^2$ (26 cm^2).

6.1.2 *Procedure*:

6.1.2.1 Use each of the four samples from 5.1.2 to determine the bulk density.

6.1.2.2 Before each determination, weigh the empty container to the nearest 0.1 lb (0.05 kg).

6.1.2.3 Place oversize pieces, likely to protrude above the surface of the material in the container, at the bottom of the container prior to filling with the remainder of the sample.

6.1.2.4 Fill the container in three approximately equal layers. After each layer, place the container on a firm base, for example, a concrete floor, raising the opposite sides alternately about 2 in. (50 mm) and allowing the container to drop in such a manner as to hit with a sharp, resounding impact. Do this settling step ten times, five times on each side, in the manner described. Level the surface of the material manually to minimize surface irregularities.

6.1.2.5 Using the measuring rod described in 6.1.1.3, measure the distance from the top of the container to the surface of the material to the nearest 0.1 in. (3 mm) in each of the four corners of the container. Subtract the average of the four measurements from the inside height of the container to determine the height of the material.

6.1.2.6 Weigh the filled container to the nearest 0.1 lb (0.05 kg).

6.1.3 *Calculation*— Calculate the bulk density as follows:

$$\text{Bulk density, lb/ft}^3\ (\text{kg/m}^3) = \frac{a-b}{c \times d \times e} \times f \quad (1)$$

where:

a = weight of container plus material, lb (or kg),
b = weight of container, lb (or kg),
c = inside length of container base, in. (or m),
d = inside depth of container base, in. (or m),
e = height of material in container, in. (or m),
f = 1 for container dimensions measured in metres, or 1728 for container dimensions measured in inches.

6.1.4 *Report*—Report each bulk density determination and the average of the four determinations.

6.2 *Baled Ferrous Scrap*:

6.2.1 *Procedure*:

6.2.1.1 Determine the weight of each bale from 5.2 to the nearest 0.1 lb (0.05 kg) using a scale described in 6.1.1.2.

6.2.1.2 Measure individually the length, width, and height of the bale to the nearest 0.1 in. (3 mm).

6.2.2 *Calculations*— Calculate the bulk density as follows:

$$\text{Bulk density, lb/ft}^3\ (\text{kg/m}^3) = \frac{g}{h \times i \times j} \times k \quad (2)$$

where:

g = weight of bale, lb (or kg),
h = length of bale, in. (or m),
i = width of bale, in. (or m),
j = height of bale, in. (or m),
k = 1 for bale dimensions measured in metres, or 1728 for bale dimensions measured in inches.

6.2.3 *Report*—Report each bulk density determination and the average of all of the determinations.

7. Total Combustibles

7.1 *Procedure*:

7.1.1 Use two of the four bulk density volumes from 6.1.2.1 for the total combustibles determination. Reduce the size of each sample, if necessary, to approximately 20 lb (9.1 kg) by the method of coning and quartering, as described in Method B of Practice C702. Determine the weight of each of the two samples to the nearest 0.1 lb (0.05 kg) before heating.

7.1.2 Heat each of the two samples in excess air at 750°F (400°C) for 60 min. An external source of air at low flow rates and pressures can be introduced at several locations within the sample to provide for combustion and excess air. The sample may be stirred every 15 min to expose fresh surface. Determine the weight of each of the two samples after heating to the nearest 0.1 lb (0.05 kg).

NOTE 2—For example, the amount of air needed can be estimated as in the following example:

Assume a 20-lb (9-kg) sample containing 10 % combustibles that are 40 % carbon. For complete combustion, the amount of carbon to be removed is:

$$20 \times 0.1 \times 0.4 = 0.8 \text{ lb} \quad (3)$$

For the combustion reaction $C + O_2 = CO_2$, 0.8 lb of carbon requires 0.8 × (32 lb/lb·mol)/(12 lb/lb·mol) = 2.13 lb of oxygen or 2.13 × (359 ft^3/lb·mol)/(32 lb/lb·mol) of O_2 = 23.9 ft^3 of oxygen at standard temperature and pressure (STP). Assuming the oxygen contribution from the sample is zero, and since air is 21 % oxygen by volume, 23.9/0.21 = 114 ft^3 of air at