



Designation: E252 – 24

Standard Test Method for Thickness of Foil and Thin Sheet by Mass Measurement¹

This standard is issued under the fixed designation E252; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers the determination of the thickness of metallic foil and sheet 0.015 in. (0.38 mm) and less in thickness by measuring the mass of a specimen of known area and density.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and are not considered standard.

1.2.1 The density within this standard is provided in units of lb/in.³ (kg/m³) to be consistent with those listed in the “Aluminum Standards and Data” published by the Aluminum Association.

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.*

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 The following documents of the issue in effect on the date of material purchase, unless otherwise noted, form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*²

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

¹ This test method is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.05 on Testing.

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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.

2.3 *The Aluminum Association:*³

AS&D Aluminum Standards & Data

TEAL-1 International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys (Teal Sheets)

3. Significance and Use

3.1 This test method is intended for determination of an average thickness of a specimen of thin sheet or foil based on mass, density, and area. It is intended to be used where pointwise contact thickness measurements by conventional means (micrometer, optimizer) do not have sufficient accuracy.

4. Apparatus

4.1 *Precision Blanking Press*—to cut foil or sheet circles that are 8.000 in.² ± 0.008 in.² (51.61 cm² ± 0.05 cm²) in area or 3.1915 in. ± 0.0015 in. (81.06 mm ± 0.04 mm) in diameter. Other size specimens may be used with the recognition that the accuracy stated in 7.1 is no longer applicable. See Annex A1 for the selection of other specimen sizes and the resulting change in accuracy of the test method.

4.2 *Balance*—capable of measuring to the nearest 0.1 mg for the 8.000 in.² (51.61 cm²) circle.

5. Procedure

5.1 Blank specimen with an 8.000 in.² ± 0.008 in.² (51.61 cm² ± 0.05 cm²) circle representative of the foil or sheet, or other suitable size (see 4.1).

5.2 Use a suitable solvent to remove any coating that would contribute more than a 0.5 % error to the mass measurement.

5.3 Swab with acetone or other suitable solvent to ensure a surface free of soil, and determine the mass of the clean, dry specimen to the nearest 0.1 mg.

6. Calculation

6.1 Determine the thickness from the relationship:

$$T = \frac{M}{A \cdot D}$$

³ Available from The Aluminum Association, Inc., 1400 Crystal Drive, Suite 430, Arlington, VA 22202, <http://www.aluminum.org>.

*A Summary of Changes section appears at the end of this standard

where:

T = thickness of the foil, or sheet, in. (or cm),
 M = mass of the specimen (without coating), lb (or g),
 A = area of the specimen, in.² (or cm²), and
 D = density of the foil, or sheet, lb/in.³ (or g/cm³).

NOTE 1—Common conversion factors are 10² cm = 1 m; 10³ g = 1 kg; 10⁴ cm² = 1 m²; 1 g/cm³ = 10³ kg/m³.

6.2 Densities of Aluminum Alloys:

6.2.1 Calculate the density of aluminum foil or sheet from chemical composition limits of the alloy by the method described in **Annex A2**.

NOTE 2—The densities of foil or sheet alloys determined in this manner are accurate to within $\pm 0.3\%$.

6.2.2 Calculated densities for some of the common aluminum foil or sheet alloys in **Table 1** may be used.

7. Precision and Bias

7.1 Following the procedure outlined in this test method, repeated mass measurements of the same specimen on different balances should result in agreement within 1 mg. It is outside of the scope of this test method to describe maintenance and calibration procedures for balances, but disagreement larger than 1 mg warrants attention to maintenance or recalibration of the balance.

8. Keywords

8.1 density; dimensions; foil; gauge; mass; measure; thickness; thin sheet

TABLE 1 Densities of Aluminum Foil or Sheet Alloys Applicable to Determination of Thickness by Mass Measurement Method

Alloy	Density		mils/g for 8.000 in. ² Area ^C
	lb/in. ³ ^B	(kg/m ³) ^A	
1100	0.098	2.71×10^3	2.815
1145	0.0975	2.700×10^3	2.826
1188	0.0975	2.700×10^3	2.826
1199	0.0975	2.700×10^3	2.826
1235	0.0975	2.705×10^3	2.820
3003	0.099	2.73×10^3	2.794
5052	0.097	2.68×10^3	2.846
5056	0.095	2.64×10^3	2.890
8079	0.098	2.72×10^3	2.805
8111	0.098	2.71×10^3	2.815

^A These calculated densities are nominal values from the "International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys" (known as the "Teal Sheets"), the minimum mass percent of aluminum to compute nominal density, described in **Annex A2**, are determined from the "Teal Sheets." In the case that there is a discrepancy in values listed in **Table 1** with those listed in the "International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys," the composition limits registered with the Aluminum Association and published in the "Teal Sheets" shall be considered the controlling composition. The "Teal Sheets" are available at <http://www.aluminum.org/tealsheets>.

^B The US customary (lb/in.³) unit values are derived from SI values (kg/m³) and subsequently rounded and shall not be back-converted to SI values.

^C The column headed "mils/g for 8.000 in.² Area" is added for convenience in determining thickness of the 8.000 in.² (51.61 cm²) specimens. The mass of the specimen in grams multiplied by this factor is equal to the thickness of the foil or sheet in mils. One mil is equal to 0.001 in. (0.0254 mm).

ANNEXES

(Mandatory Information)

A1. SPECIMEN SIZE AND SHAPE AND THEIR EFFECT ON ACCURACY

A1.1 General

A1.1.1 Specimens of sizes and shapes other than the 8.000 in.² (51.61 cm²) circle may be used provided consideration is given to controllable factors affecting the accuracy of the method. Specifically, the area of the specimen shall be known and controlled to an accuracy of $\pm 0.1\%$, and the minimum mass of the specimen shall be 70 mg. Specimens ranging in size from 8 in.² to 36 in.² (52 cm² to 230 cm²) are

convenient to handle and can be prepared to meet the aforementioned requirements.

A1.2 Source of Error

A1.2.1 Inherent errors in determining thickness by the mass measurement method result from the limits on the accuracy of the density value assigned to the alloy, the accuracy with which a specimen can be cut and its area determined, and the