Designation: E345 – 16

Standard Test Methods of Tension Testing of Metallic Foil[1]

This standard is issued under the fixed designation E345; 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 These test methods cover the tension testing of metallic foil at room temperature. Exception to these methods may be necessary in individual specifications or test methods for a particular material.

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

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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B193 Test Method for Resistivity of Electrical Conductor Materials

E4 Practices for Force Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

E8/E8M Test Methods for Tension Testing of Metallic Materials

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

E252 Test Method for Thickness of Foil, Thin Sheet, and Film by Mass Measurement

E796 Test Method for Ductility Testing of Metallic Foil (Withdrawn 2009)[3]

E2309 Practices for Verification of Displacement Measuring Systems and Devices Used in Material Testing Machines

3. Terminology

3.1 The definitions of terms relating to tension testing appearing in Terminology E6 apply to the terms used in these methods of tension testing.

4. Significance and Use

4.1 Tension tests provide information on the strength and ductility of materials under uniaxial tensile stresses. This information may be useful in comparisons of materials, alloy development, quality control, and design.

4.2 The results of tension tests from selected portions of a part or material may not totally represent the strength and ductility of the entire end product of its in-service behavior in different environments.

4.3 These test methods are considered satisfactory for acceptance testing of commercial shipments, since the methods have been used extensively for these purposes.

4.4 Tension tests provide a means to determine the ductility of materials through the measurement of elongation or reduction of area. However, as specimen thickness is reduced, tension tests may become less useful for determining ductility. For these purposes Test Method E796 is an alternative procedure for measuring ductility.

4.5 Different industries differentiate between foil and sheet at different thicknesses.

NOTE 1—In 2013, to harmonize with international standards, the Aluminum Association revised its definition of foil to include thicknesses less than or equal to 0.2 mm (0.0079 in.).

4.6 This standard differs from Test Methods E8/E8M in that it permits determining the specimen thickness by weighing (7.3) and determining the elongation from crosshead displacement for some specimens (7.8).

4.7 It is impossible for this standard to define the thickness range for every possible alloy where this standard should be used instead of Test Methods E8/E8M or other tensile test standards. Superior results for a specific alloy and thickness could be obtained by measuring the specimen thickness by weighing (7.3) to avoid damaging the material and to obtain sufficient accuracy. In addition, it may be acceptable for a given alloy and thickness to determine the elongation from

[1] These test methods are under the jurisdiction of ASTM Committee E28 on Mechanical Testing and are the direct responsibility of Subcommittee E28.04 on Uniaxial Testing.

Current edition approved July 15, 2016. Published August 2016. Originally approved in 1968. Last previous edition approved in 2013 as E345 – 93 (2013)ε1. DOI: 10.1520/E0345-16.

[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.

crosshead displacement in cases where conventional extensometers that contact the specimen or scribed fiducial marks could damage the specimen or affect the test results.

5. Apparatus

5.1 *Testing Machines*—Machines used for tension testing shall conform to the requirements of Practices E4. The forces used in determining tensile strength, yield strength, and yield point shall be within the verified loading range of the testing machine as defined in Practices E4.

5.2 *Gripping Devices:*

5.2.1 *General*—Various types of gripping devices may be used to transmit the measured force applied by the testing machine to the test specimen. To ensure axial tensile stress within the gauge length, the axis of the test specimen shall coincide with the center line of the heads of the testing machine. Any departure from this center line could introduce bending stresses that are not included in the usual stress computation (force divided by cross-sectional area).

5.2.2 *Wedge Grips*—Testing machines usually are equipped with wedge grips. These wedge grips generally furnish a satisfactory means of gripping long specimens of ductile materials in the thicker foil gauges. If, for any reason, one grip of a pair advances farther than the other as the grips tighten, an undesirable bending stress could be introduced. When liners are used behind the wedges, they shall be of the same thickness and their faces shall be flat and parallel. For proper gripping, it is desirable that the entire length of the serrated face of each wedge be in contact with the specimen. A buffer material such as 320-grit silicon carbide paper may be inserted between the specimen and serrated faces to minimize tearing of specimens.

5.2.3 *Smooth Face Grips*—For foils less than 0.076 mm (0.003 in.) thickness, it may be desirable that the grips have smooth faces and that the gripping pressure be about 0.7 MPa (100 psi) for each 0.025 mm (0.001 in.) of specimen thickness.

6. Test Specimen

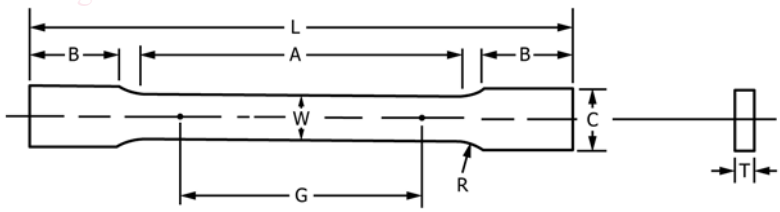
6.1 *General*—Test specimens shall be prescribed in the product specification for the material being tested. If a Type A specimen is used, all specimen dimensions, test procedures, and calculations shall comply with those shown in Test Methods E8/E8M.

6.2 *Type A Specimen*—Type A specimens shall be in accordance with the 12.5-mm (0.500 in.) sheet-type specimen shown in Fig. 1. To avoid lateral buckling in tests of some materials, the minimum radius of the fillet should be 19 mm (0.75 in.), or the width of the grip ends should be only slightly larger than the width of the reduced section, or both.

6.3 *Type B Specimens*—Type B specimens shall be in accordance with the 12.5-mm (0.500 in.) wide parallel sided specimen shown in Fig. 1.

7. Procedures

7.1 *Type A Specimen Preparation*—The specimens may be machined in packs by use of a milling-type cutter. Examine the machined specimens under about 20× magnification to determine that the edges are smooth and that there are no surface scratches or creases. Reject specimens that show discernible scratches, creases, or edge discontinuities. Sharpened or renew the milling-type cutter when necessary. When machining some thicknesses and tempers of material the samples may be interleaved with hard aluminum sheet, a plastic, or other suitable material. For some materials the edges of the specimens may be polished, either mechanically or by electropolishing.



	Dimensions			
	Specimen			
	Type A		Type B	
	mm	in.	mm	in.
G—Gauge length	50.0 ± 0.1	2.000 ± 0.005	125	5
W—Width	12.50 ± 0.25	0.500 ± 0.010	12.5	0.500
T—Thickness		thickness of foil		thickness of foil
R—Radius of fillet, min	19	0.75	...	...
L—Overall Length, min	200	8	230	9
A—Length of reduced section, min	60	2.25	...	...
B—Length of grip section, min	50	2	...	...
C—Width of grip section, approx.	20	0.75	12.5	0.500

NOTE 1—For Type A specimens, the ends of the reduced section shall not differ in width by more than 0.05 mm (0.002 in.). Also, there may be a gradual decrease in width from the ends to the center, but the width at either end shall not be more than 0.10 mm (0.005 in.) larger than the width at the center.

NOTE 2—The dimension *T* is the thickness of the test specimen as provided for in the applicable material specifications.

NOTE 3—For Type B specimens, measure the gauge length, *G*, to an accuracy of 0.25 mm (0.01in).

FIG. 1 Foil Tension Test Specimen