Designation: E345 – 93(Reapproved 2013)ε1

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.

ε[1] NOTE—Editorial changes were made throughout in May 2014.

1. Scope

1.1 These test methods cover the tension testing of metallic foil at room temperature in thicknesses less than 0.006 in. (0.150 mm).

NOTE 1—Exception to these methods may be necessary in individual specifications or test methods for a particular material.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI 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E796 Test Method for Ductility Testing of Metallic Foil (Withdrawn 2009)[3]

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.

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

[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.

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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.

machine to the test specimen. To ensure axial tensile stress within the gauge length, the axis of the test specimen must coincide with the center line of the heads of the testing machine. Any departure from this center line may 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 may be introduced. When liners are used behind the wedges, they must be of the same thickness and their faces must 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 0.003 in. (0.076 mm) thickness, it may be desirable that the grips have smooth faces and that the gripping pressure be about 100 psi (0.7 MPa) for each 0.001 in. (0.025 mm) 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 ½-in. (12.5-mm) sheet-type specimen shown in Fig. 1. To avoid lateral buckling in tests of some materials, the minimum radius of the fillet should be ¾ in. (19 mm), or the width of the grip ends should be only slightly larger than the width of the reduced section, or both; and the reduced section should be at least 20 % longer than the gauge length.

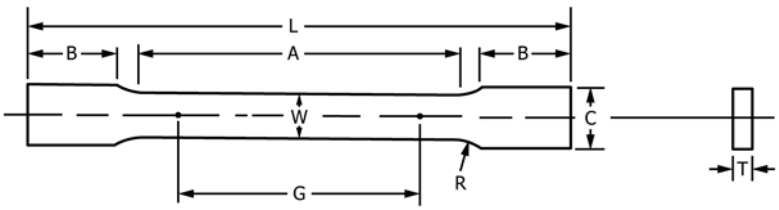
6.3 *Type B Specimens*—Type B specimens shall be in accordance with the ½-in. (12.5-mm) wide parallel sided specimen shown in Fig. 1.

7. Procedures

7.1 *Type A Specimen Preparation*—The specimens can be machined in packs by use of a milling-type cutter. The machined specimens shall be examined under about 20× magnification to determine that the edges are smooth and that there are no surface scratches or creases. Specimens showing discernible scratches, creases, or edge discontinuities shall be rejected. The milling-type cutter shall be sharpened or renewed when necessary. When machining some thicknesses and tempers of material it may be necessary to interleave the samples with hard aluminum sheet, a plastic, or other suitable material. For some materials it may be desirable to polish the edges of the specimens, either mechanically or by electropolishing.

7.2 *Type B Specimen Preparation*—The specimens, particularly of soft and of thin hard metals, may be prepared by shearing, for example, by use of a double-bladed cutter[4] (Fig. 2) or by slitting. The cutting edges should be lubricated, if necessary with a material such as stearic acid in alcohol or another suitable material. The finished specimens shall be examined under about 20× magnification to determine that the

[4] The sole source of supply of the Thwing-Albert JDC-50 precision cutter known to the committee at this time is Thwing-Albert Instrument Co., 14 W. Collings Ave. West Berlin, NJ 08091. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.



	Dimensions			
	Specimen			
	Type A		Type B	
	in.	mm	in.	mm
G—Gauge length	2.000 ± 0.005	50.0 ± 0.1	5	125
W—Width	0.500 ± 0.010	12.50 ± 0.25	0.500	12.5
T—Thickness	thickness of foil		thickness of foil	
R—Radius of fillet, min	¾	19	...	...
L—Overall Length, min	8	200	9	230
A—Length of reduced section, min	2¼	60	...	...
B—Length of grip section, min	2	50	...	...
C—Width of grip section, approx.	¾	20	0.500	12.5

NOTE 1—For Type A specimens, the ends of the reduced section shall not differ in width by more than 0.002 in. (0.05 mm). 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 0.005 in. (0.10 mm) 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.

FIG. 1 Foil Tension Test Specimen