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# Standard Test Methods for Tension Testing of Metallic Materials[1]

This standard is issued under the fixed designation E8/E8M; 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 materials in any form at room temperature, specifically, the methods of determination of yield strength, yield point elongation, tensile strength, elongation, and reduction of area.

1.2 The gauge lengths for most round specimens are required to be 4D for E8 and 5D for E8M. The gauge length is the most significant difference between E8 and E8M test specimens. Test specimens made from powder metallurgy (P/M) materials are exempt from this requirement by industry-wide agreement to keep the pressing of the material to a specific projected area and density.

1.3 Exceptions to the provisions of these test methods may need to be made in individual specifications or test methods for a particular material. For examples, see Test Methods and Definitions A370 and Test Methods B557, and B557M.

1.4 Room temperature shall be considered to be 10 °C to 38 °C [50 °F to 100°F] unless otherwise specified.

1.5 The values stated in SI units are to be regarded as separate from inch/pound units. The values stated in each system are not exact equivalents; therefore each system must be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.6 *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.*

1.7 *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 *ASTM Standards:*[2]

A356/A356M Specification for Steel Castings, Carbon, Low Alloy, and Stainless Steel, Heavy-Walled for Steam Turbines

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products

B557M Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)

E4 Practices for Force Calibration and Verification of Testing Machines

E6 Terminology Relating to Methods of Mechanical Testing

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

E83 Practice for Verification and Classification of Extensometer Systems

E345 Test Methods of Tension Testing of Metallic Foil

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E1012 Practice for Verification of Testing Frame and Specimen Alignment Under Tensile and Compressive Axial Force Application

D1566 Terminology Relating to Rubber

E1856 Guide for Evaluating Computerized Data Acquisition Systems Used to Acquire Data from Universal Testing Machines

E2658 Practices for Verification of Speed for Material Testing Machines

[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.

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

2.2 *ISO/ASTM Standard:*[3]
ISO/ASTM 52909:2024(en) Additive manufacturing of metals — Finished part properties — Orientation and location dependence of mechanical properties for metal parts

## 3. Terminology

3.1 *Definitions of Terms Common to Mechanical Testing—*
3.1.1 The definitions of mechanical testing terms that appear in the Terminology E6 apply to this test method.
3.1.1.1 These terms include bending strain, constraint, elongation, extensometer, force, gauge length, necking, reduced section, stress-strain diagram, testing machine, and modulus of elasticity.
3.1.2 In addition, the following common terms from Terminology E6 are defined:
3.1.3 *discontinuous yielding, n—in a uniaxial test*, a hesitation or fluctuation of force observed at the onset of plastic deformation, due to localized yielding.
3.1.3.1 *Discussion*—The stress-strain curve need not appear to be discontinuous.

3.1.4 *elongation after fracture, n*—the elongation measured by fitting the two halves of the broken specimen together.

3.1.5 *elongation at fracture, n*—the elongation measured just prior to the sudden decrease in force associated with fracture.

3.1.6 *lower yield strength, LYS [$FL^{-2}$]—in a uniaxial test*, the minimum stress recorded during discontinuous yielding, ignoring transient effects.

3.1.7 *reduced parallel section, A, n*—the central portion of the specimen that has a nominally uniform cross section, with an optional small taper toward the center, that is smaller than that of the ends that are gripped, not including the fillets.
3.1.7.1 *Discussion*—This term is often called the parallel length in other standards.
3.1.7.2 *Discussion*—Previous versions of E8/E8M defined this term as "reduced section."

3.1.8 *reduction of area, n*—the difference between the original cross-sectional area of a tension test specimen and the area of its smallest cross section.
3.1.8.1 *Discussion*—The reduction of area is usually expressed as a percentage of the original cross-sectional area of the specimen.
3.1.8.2 *Discussion*—The smallest cross section may be measured at or after fracture as specified for the material under test.
3.1.8.3 *Discussion*—The term reduction of area when applied to metals generally means measurement after fracture; when applied to plastics and elastomers, measurement at fracture. Such interpretation is usually applicable to values for reduction of area reported in the literature when no further qualification is given. **(E28.04)**

3.1.9 *tensile strength, $S_u$* [$FL^{-2}$], *n*—the maximum tensile stress that a material is capable of sustaining.
3.1.9.1 *Discussion*—Tensile strength is calculated from the maximum force during a tension test carried to rupture and the original cross-sectional area of the specimen.

3.1.10 *uniform elongation, $El_u$, [%]*—the elongation determined at the maximum force sustained by the test specimen just prior to necking or fracture, or both.
3.1.10.1 *Discussion*—Uniform elongation includes both elastic and plastic elongation.

3.1.11 *upper yield strength, UYS [$FL^{-2}$]—in a uniaxial test*, the first stress maximum (stress at first zero slope) associated with discontinuous yielding at or near the onset of plastic deformation.

3.1.12 *yield point elongation, YPE, n—in a uniaxial test*, the strain (expressed in percent) separating the stress-strain curve's first point of zero slope from the point of transition from discontinuous yielding to uniform strain hardening.
3.1.12.1 *Discussion*— If the transition occurs over a range of strain, the YPE end point is the intersection between *(a)* a horizontal line drawn tangent to the curve at the last zero slope and *(b)* a line drawn tangent to the strain hardening portion of the stress-strain curve at the point of inflection. If there is no point at or near the onset of yielding at which the slope reaches zero, the material has 0 % YPE.

3.1.13 *yield strength, YS* or $S_y$ [$FL^{-2}$], *n*—the engineering stress at which, by convention, it is considered that plastic elongation of the material has commenced.
3.1.13.1 *Discussion*—This stress may be specified in terms of (*a*) a specified deviation from a linear stress-strain relationship, (*b*) a specified total extension attained, or (*c*) maximum or minimum engineering stresses measured during discontinuous yielding.

3.2 *Definitions of Terms Specific to This Standard:*
3.2.1 *referee test, n*—test made to settle a disagreement as to the conformance to specified requirements, or conducted by a third party to arbitrate between conflicting results. **D1566, D11.08**

## 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 under certain circumstances.

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

4.3 These test methods are considered satisfactory for acceptance testing of commercial shipments. The test methods have been used extensively in the trade for this purpose.

## 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 and yield strength shall be

[3] Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, https://www.iso.org.