



# Standard Test Method for Tension Testing of Structural Alloys in Liquid Helium<sup>1</sup>

This standard is issued under the fixed designation E1450; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method describes procedures for the tension testing of structural alloys in liquid helium. The format is similar to that of other ASTM tension test standards, but the contents include modifications for cryogenic testing which requires special apparatus, smaller specimens, and concern for serrated yielding, adiabatic heating, and strain-rate effects.

1.2 To conduct a tension test by this standard, the specimen in a cryostat is fully submerged in normal liquid helium (He I) and tested using crosshead displacement control at a nominal strain rate of  $10^{-3} \text{ s}^{-1}$  or less. Tests using force control or high strain rates are not considered.

1.3 This standard specifies methods for the measurement of yield strength, tensile strength, elongation, and reduction of area. The determination of the elastic modulus is treated in Test Method E111.

NOTE 1—The boiling point of normal liquid helium (He I) at sea level is 4.2 K ( $-269^\circ\text{C}$  or  $-452.1^\circ\text{F}$  or  $7.6^\circ\text{R}$ ). It decreases with geographic elevation and is 4.0 K ( $-269.2^\circ\text{C}$  or  $-452.5^\circ\text{F}$  or  $7.2^\circ\text{R}$ ) at the National Institute of Standards and Technology in Colorado, 1677 m (5500 ft) above sea level. In this standard the temperature is designated 4 K.

1.4 Values stated in SI units are treated as primary. Values stated in U.S. customary units are treated as secondary.

1.5 *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.* See Section 5.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E28 on Mechanical Testing and is the direct responsibility of Subcommittee E28.04 on Uniaxial Testing.

Current edition approved June 1, 2009. Published August 2009. Originally approved in 1992. Last previous edition approved in 2003 as E1450–03. DOI: 10.1520/E1450-09.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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  
E83 Practice for Verification and Classification of Extensometer Systems  
E111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus  
E1012 Practice for Verification of Testing Frame and Specimen Alignment Under Tensile and Compressive Axial Force Application

## 3. Terminology

### 3.1 Definitions:

3.1.1 The definitions of terms relating to tension testing that appear in Terminology E6 shall apply here. The definitions in this section also apply.

3.1.2 *adiabatic heating*—the internal heating of a specimen resulting from tension testing under conditions such that the heat generated by plastic work cannot be quickly dissipated to the surrounding cryogen.

3.1.3 *adjusted length of the reduced section*—the length of the reduced section plus an amount calculated to compensate for strain in the fillet region.

3.1.4 *axial strain*—the average of the longitudinal strains measured at opposite or equally spaced surface locations on the sides of the longitudinal axis of symmetry of the specimen. The longitudinal strains are measured using two or more strain-sensing devices located at the mid-length of the reduced section.

3.1.5 *bending strain*—the difference between the strain at the surface of the specimen and the axial strain (the bending strain varies around the circumference and along the reduced section of the specimen).

3.1.6 *Dewar*—a vacuum-insulated container for cryogenic fluids.

3.1.7 *discontinuous yielding stress*,  $\sigma_i$ —the peak stress at the initiation of the first measurable serration on the curve of stress-versus-strain.

3.1.7.1 *Discussion*—The parameter  $\sigma_i$  is a function of test variables and is not a material constant.