



Designation: F 2516 – 05

Standard Test Method for Tension Testing of Nickel-Titanium Superelastic Materials¹

This standard is issued under the fixed designation F 2516; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope

1.1 This test method covers the tension testing of superelastic nickel-titanium (nitinol) materials, specifically the methods of determination of upper plateau strength, lower plateau strength, residual elongation, tensile strength, and elongation.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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

E 6 Terminology Relating to Methods of Mechanical Testing

E 8 Test Methods for Tension Testing of Metallic Materials

E 83 Practice for Verification and Classification of Extensometer System

E 111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus

E 1875 Test Method for Dynamic Young's Modulus, Shear Modulus, and Poisson's Ratio by Sonic Resonance

F 2005 Terminology for Nickel-Titanium Shape Memory Alloys

3. Terminology

3.1 *Definitions*—The definitions of terms relating to tension testing appearing in Terminology **E 6** and the terms relating to nickel-titanium shape memory alloys appearing in Terminology **F 2005** shall be considered as applying to the terms used in this test method. Additional terms being defined are as follows (see Fig. 1):

¹ This test method is under the jurisdiction of ASTM Committee F04 on Medical and Surgical Materials and Devices and is the direct responsibility of Subcommittee F04.15 on Material Test Methods.

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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.

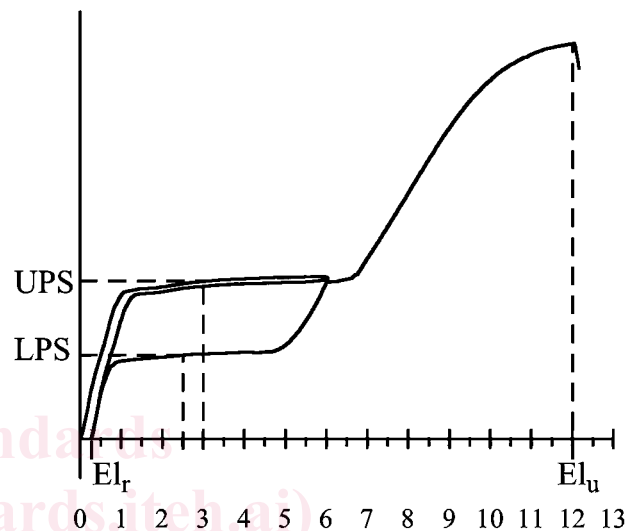


FIG. 1 Terms Illustrated on Typical Stress-Strain Diagram of Superelastic Nitinol

3.1.1 *lower plateau strength (LPS)*—the stress at 2.5 % strain during unloading of the sample, after loading to 6 % strain.

3.1.2 *residual elongation, El_r [%]*,—the strain after loading to 6 % strain and unloading to 7 MPa.

3.1.3 *uniform elongation, El_u [%]*—the elongation determined at the maximum force sustained by the test piece just prior to necking, or fracture, or both.

3.1.4 *upper plateau strength (UPS)*—the stress at 3 % strain during loading of the sample.

4. Summary of Test Method

4.1 Using conventional tensile testing apparatus, the material is pulled to 6 % strain, then unloaded to less than 7 MPa, then pulled to failure.

5. Significance and Use

5.1 Tension tests provide information of the strength and ductility of materials under uniaxial tensile stresses.

5.2 Tension tests, as described in this test method, also provide information on the superelasticity, as defined in Terminology **F 2005**, of the material at the test temperature.