



Standard Practice for Strain-Controlled Fatigue Testing¹

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1. Scope

1.1 This practice covers the determination of fatigue properties of nominally homogeneous materials by the use of uniaxially loaded test specimens. It is intended as a guide for fatigue testing performed in support of such activities as materials research and development, mechanical design, process and quality control, product performance, and failure analysis. While this practice is intended primarily for strain-controlled fatigue testing, some sections may provide useful information for load-controlled or stress-controlled testing.

1.2 The use of this practice is limited to specimens and does not cover testing of full-scale components, structures, or consumer products.

1.3 This practice is applicable to temperatures and strain rates for which the magnitudes of time-dependent inelastic strains are on the same order or less than the magnitudes of time-independent inelastic strains. No restrictions are placed on environmental factors such as temperature, pressure, humidity, medium, and others, provided they are controlled throughout the test, do not cause loss of or change in dimension with time, and are detailed in the data report.

NOTE 1—The term *inelastic* is used herein to refer to all nonelastic strains. The term *plastic* is used herein to refer only to the time-independent (that is, noncreep) component of inelastic strain. To truly determine a time-independent strain the load would have to be applied instantaneously, which is not possible. A useful engineering estimate of time-independent strain can be obtained when the strain rate exceeds some value. For example, a strain rate of $1 \times 10^{-3} \text{ sec}^{-1}$ is often used for this purpose. This value should increase with increasing test temperature.

1.4 This practice is restricted to the testing of axially loaded uniform gage section test specimens as shown in Fig. 1(a). Testing is limited to strain-controlled cycling. The practice may be applied to hourglass specimens, see Fig. 1(b), but the user is cautioned about uncertainties in data analysis and interpretation. Testing is done primarily under constant amplitude cycling and may contain interspersed hold times at repeated intervals. The practice may be adapted to guide testing for more general cases where strain or temperature may vary

according to application specific histories. Data analysis may not follow this practice in such cases.

2. Referenced Documents

2.1 ASTM Standards:

- A 370 Test Methods and Definitions for Mechanical Testing of Steel Products²
- E 3 Methods of Preparation of Metallographic Specimens³
- E 4 Practices for Force Verification of Testing Machines³
- E 8 Test Methods for Tension Testing of Metallic Materials³
- E 9 Test Methods of Compression Testing of Metallic Materials at Room Temperature³
- E 83 Practice for Verification and Classification of Extensometers³
- E 111 Test Method for Young's Modulus, Tangent Modulus, and Chord Modulus³
- E 112 Test Methods for Determining Average Grain Size³
- E 132 Test Method for Poisson's Ratio at Room Temperature³
- E 157 Practice for Assigning Crystallographic Phase Designations in Metallic Systems³
- E 209 Practice for Compression Tests of Metallic Materials at Elevated Temperatures with Conventional or Rapid Heating Rates and Strain Rates³
- E 337 Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures)⁴
- E 384 Test Method for Microhardness of Materials³
- E 399 Test Method for Plane-Strain Fracture Toughness of Metallic Materials³
- E 466 Practice for Conducting Force Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials³
- E 467 Practice for Verification of Constant Amplitude Dynamic Loads on Displacements in an Axial Load Fatigue Testing System³
- E 468 Practice for Presentation of Constant Amplitude Fatigue Test Results for Metallic Materials³
- E 739 Practice for Statistical Analysis of Linear or Linearized Stress-Life ($S-N$) and Strain-Life ($\epsilon-N$) Fatigue Data³
- E 1012 Practice for Verification of Specimen Alignment

¹ This practice is under the jurisdiction of ASTM Committee E-8 on Fatigue and Fracture and is the direct responsibility of Subcommittee E08.05 on Cyclic Deformation and Fatigue Crack Formation.

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² Annual Book of ASTM Standards, Vol 01.03.

³ Annual Book of ASTM Standards, Vol 03.01.

⁴ Annual Book of ASTM Standards, Vol 11.03.