



Standard Practice for Measurement of Mechanical Properties During Charged- Particle Irradiation¹

This standard is issued under the fixed designation E 821; 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.

PART I—EXPERIMENTAL PROCEDURE

1. Scope

1.1 This practice covers the performance of mechanical tests on materials being irradiated with charged particles. These tests are designed to simulate or provide understanding of, or both, the mechanical behavior of materials during exposure to neutron irradiation. Practices are described that govern the test material, the particle beam, the experimental technique, and the damage calculations. Reference should be made to other ASTM standards, especially Practice E 521. Procedures are described that are applicable to creep and creep rupture tests made in tension and torsion test modes.²

1.2 The word simulation is used here in a broad sense to imply an approximation of the relevant neutron irradiation environment. The degree of conformity can range from poor to nearly exact. The intent is to produce a correspondence between one or more aspects of the neutron and charged particle irradiations such that fundamental relationships are established between irradiation or material parameters and the material response.

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:

E 170 Terminology Relating to Radiation Measurements and Dosimetry³

E 521 Practice for Neutron Radiation Damage Simulation by Charged-Particle Irradiation³

3. Terminology

3.1 Definitions:

3.1.1 Descriptions of relevant terms are found in Terminology E 170.

4. Specimen Characterization

4.1 Source Material Characterization:

4.1.1 The source of the material shall be identified. The chemical composition of the source material, as supplied by the vendor or of independent determination, or both, shall be stated. The analysis shall state the quantity of trace impurities. The material, heat, lot, or batch, etc., number shall be stated for commercial material. The analytical technique and compositional uncertainties should be stated.

4.1.2 The material form and history supplied by the vendor shall be stated. The history shall include the deformation process (rolling, swaging, etc.), rate, temperature, and total extent of deformation (given as strain components or geometrical shape changes). The use of intermediate anneals during processing shall be described, including temperature, time, environment, and cooling rate.

4.2 Specimen Preparation and Evaluation:

4.2.1 The properties of the test specimen shall represent the properties of bulk material. Since thin specimens usually will be experimentally desirable, a specimen thickness that yields bulk properties or information relatable to bulk properties should be selected. This can be approached through either of two techniques: (1) where the test specimen properties exactly equal bulk material properties; (2) where the test specimen properties are directly relatable to bulk properties in terms of deformation mechanisms, but a size effect (surface, texture, etc.) is present. For the latter case, the experimental justification shall be reported.

4.2.2 The specimen shape and nominal dimensions shall be stated and illustrated by a drawing. Deviations from ASTM standards shall be stated. The dimensional measurement techniques and the experimental uncertainty of each shall be stated. The method of specimen preparation, such as milling, grinding, etc., shall be stated. The degree of straightness, flatness, surface condition, edges, fillets, etc., shall be described. The method of

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² These practices can be expanded to include mechanical tests other than those specified as such experiments are proposed to Subcommittee E10.08.

³ *Annual Book of ASTM Standards*, Vol 12.02.