



Designation: E 531 – 76 (Reapproved 1996)^{ε1}

Standard Practice for Surveillance Testing of High-Temperature Nuclear Component Materials¹

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^{ε1} NOTE—Keywords were added editorially in August 1996.

1. Scope

1.1 This practice covers procedures for specimen testing to establish changes occurring in the mechanical properties due to irradiation and thermal effects of nuclear component metallic materials where these materials are used for high temperature applications above 370°C (700°F).

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 8 Test Methods for Tension Testing of Metallic Materials³
- E 21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials³
- E 23 Test Methods for Notched Bar Impact Testing of Metallic Materials³
- E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴
- E 45 Test Methods for Determining the Inclusion Content of Steel³
- E 112 Test Methods for Determining the Average Grain Size³
- E 139 Practice for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials³
- E 184 Practice for Effects of High-Energy Neutron Radiation on the Mechanical Properties of Metallic Materials, E706 (IB)⁵
- E 185 Practice for Conducting Surveillance Tests for Light Water-Cooled Nuclear Power Reactor Vessels, E706 (IF)⁵
- E 206 Definitions of Terms Relating to Fatigue Testing and the Statistical Analysis of Fatigue Data⁶
- E 261 Practice for Determining Neutron Fluence Rate, Flu-

ence, and Spectra by Radioactivation Techniques⁵

E 399 Test Method for Plane-Strain Fracture Toughness of Metallic Materials³

E 453 Practice for Examination of Fuel Element Cladding Including the Determination of the Mechanical Properties⁵

E 482 Guide for Application of Neutron Transport Methods for Reactor Vessel Surveillance, E706 (IID)⁵

E 844 Guide for Sensor Set Design and Irradiation for Reactor Surveillance, E706 (IIC)⁵

3. Significance and Use

3.1 The requirements contained herein can be used as a basis for establishing conditions for safe operation of critical components. The requirements provide for general plant assessment and verification that materials meet design criteria. The test specimens and procedures presented in this practice are for guidance when establishing a surveillance program.

3.2 This practice for high-temperature materials surveillance programs is used when nuclear reactor component materials are monitored by specimen testing. Periodic testing is performed through the service life of the components to assess changes in selected material properties that are caused by neutron irradiation and thermal effects. The properties are those used as design criteria for the respective nuclear components. The extent of material property change caused by neutron irradiation depends on the composition and structure of the initial material, its conditioning in component fabrication, as well as the nature of the irradiation exposure. The need for surveillance arises from a concern of specific material behavior under all irradiation conditions including spectrum and rate effects on material properties.

4. Description of Term

4.1 *test specimen*—a coupon or a piece of metal cut from a larger metal piece which is then formed to final size for testing to determine physical or mechanical properties.

5. Test Specimens

5.1 *Pre-Exposure Material Characterization*—It is important that test specimen materials be characterized prior to exposure and that the following should be considered as a minimum:

¹ This recommended practice is under the jurisdiction of ASTM Committee E-10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.02 on Behavior and Use of Metallic Materials in Nuclear Systems.

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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 14.02.

⁵ *Annual Book of ASTM Standards*, Vol 12.02.

⁶ Discontinued—see 1986 *Annual Book of ASTM Standards*, Vol 03.01.