Designation: E 453 – 79 (Reapproved 2001)

Standard Practice for Examination of Fuel Element Cladding Including the Determination of the Mechanical Properties[1]

This standard is issued under the fixed designation E 453; 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.

1. Scope

1.1 This practice covers the procedures for postirradiation examination of cladding, determination of breached nuclear fuel elements, selection of material and tests for radiation studies, determination of radiation conditions, conduction of tests for mechanical properties of cladding, and the reporting of data.

1.2 The purpose of this practice is to provide detailed guidelines for the postirradiation examination of fuel element cladding and to achieve better correlation and interpretation of the data in the field of radiation effects.

1.3 This practice may be applied to metallic cladding from all types of fuel elements. The tests described in this practice for determining mechanical properties of the fuel element cladding practice should be included in the preirradiation characterization of the cladding and for planning irradiation effects tests for evaluation of materials for cladding and other components in nuclear reactors.

NOTE 1—The values stated in SI units as described in Standard E 380 are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

B 353 Specification for Wrought Zirconium and Zirconium Alloy Seamless and Welded Tubes for Nuclear Service (Except Nuclear Fuel Cladding)[2]

E 3 Methods of Preparation of Metallographic Specimens[3]

E 8 Test Methods for Tension Testing of Metallic Materials[3]

E 12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases[4]

E 21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials[3]

E 45 Test Methods for Determining the Inclusion Content of Steel[3]

E 92 Test Method for Vickers Hardness of Metallic Materials[3]

E 94 Guide for Radiographic Testing[5]

E 112 Test Methods for Determining the Average Grain Size[3]

E 139 Practice for Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials[3]

E 146 Methods of Chemical Analysis of Zirconium and Zirconium Alloys (Silicon, Hydrogen, and Copper)[6]

E 165 Test Method for Liquid Penetrant Examination[5]

E 261 Practice for Determining Neutron Fluence Rate, Fluence, and Spectra by Radioactivation Techniques[7]

E 263 Test Method for Measuring Fast-Neutron Reaction Rates by Radioactivation of Iron[7]

E 380 Practice for Use of the International System of Units (SI) (the Modernized Metric System)[8]

E 466 Practice for Conducting Force Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials[3]

E 606 Practice for Strain-Controlled Fatigue Testing[3]

F 77 Test Method for Apparent Density of Ceramics for Electron Device and Semiconductor Application[9]

3. Significance

3.1 The physical and mechanical properties of cladding materials can be altered by exposure to a high-energy neutron flux. The magnitude and relationship of these changes are functions of the material and its metallurgical condition; the amount, rate, and energy spectrum of the radiation; the exposure temperature; the test temperature; the purity, velocity, volume, and purification system of the coolant; and effects of contained fuel.

4. Determination of Radiation Conditions

4.1 Report all available data on the nuclear environment including reactor operating history, reactor geometry, and operating temperature. Provide neutron dosimetry for each experiment (refer to Practice E 261 for applicable practices). Suggestions as a minimum guide in measuring the radiation

[1] This practice is under the jurisdiction of ASTM CommitteeE10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.02 on Behavior and Use of Nuclear Structural Materials.

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[2] *Annual Book of ASTM Standards*, Vol 02.04.

[3] *Annual Book of ASTM Standards*, Vol 03.01.

[4] *Annual Book of ASTM Standards*, Vol 15.05.

[5] *Annual Book of ASTM Standards*, Vol 03.03.

[6] Discontinued—see *1989 Annual Book of ASTM Standards*, Vol 03.05.

[7] *Annual Book of ASTM Standards*, Vol 12.02.

[8] *Annual Book of ASTM Standards*, Vol 14.02.

[9] *Annual Book of ASTM Standards*, Vol 15.02.

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