Designation: E 798 – 96 (Reapproved 2003)

Standard Practice for Conducting Irradiations at Accelerator-Based Neutron Sources[1]

This standard is issued under the fixed designation E 798; 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 procedures for irradiations at accelerator-based neutron sources. The discussion focuses on two types of sources, namely nearly monoenergetic 14-MeV neutrons from the deuterium-tritium T(d,n) interaction, and broad spectrum neutrons from stopping deuterium beams in thick beryllium or lithium targets. However, most of the recommendations also apply to other types of accelerator-based sources, including spallation neutron sources **(1)**.[2] Interest in spallation sources has increased recently due to their proposed use for transmutation of fission reactor waste **(2)**.

1.2 Many of the experiments conducted using such neutron sources are intended to simulate irradiation in another neutron spectrum, for example, that from a DT fusion reaction. 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. In general, the intent of these simulations is to establish the fundamental relationships between irradiation or material parameters and the material response. The extrapolation of data from such experiments requires that the differences in neutron spectra be considered.

1.3 The procedures to be considered include methods for characterizing the accelerator beam and target, the irradiated sample, and the neutron flux and spectrum, as well as procedures for recording and reporting irradiation data.

1.4 Other experimental problems, such as temperature control, are not included.

1.5 *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:*

C 859 Terminology Relating to Nuclear Materials[3]

E 170 Terminology Relating to Radiation Measurements and Dosimetry[4]

E 181 Test Methods for Detector Calibration and Analysis of Radionuclides[4]

E 261 Practice for Determining Neutron Fluence Rate, Fluence, and Spectra by Radioactivation Techniques[4]

E 263 Test Method for Measuring Fast-Neutron Reaction Rates by Radioactivation of Iron[4]

E 264 Test Method for Measuring Fast-Neutron Reaction Rates by Radioactivation of Nickel[4]

E 265 Test Method for Measuring Reaction Rates and Fast-Neutron Fluences by Radioactivation of Sulfur-32[4]

E 266 Test Method for Measuring Fast-Neutron Reaction Rates by Radioactivation of Aluminum[4]

E 393 Test Method for Measuring Reaction Rates by Analysis of Barium-140 from Fission Dosimeters[4]

E 854 Test Method for Application and Analysis of Solid State Track Recorder (SSTR) Monitors for Reactor Surveillance, E 706 (IIIB)[4]

E 910 Specification for Application and Analysis of Helium Accumulation Fluence Monitors for Reactor Vessel Surveillance, E 706 (IIIC)[4]

3. Terminology

3.1 Descriptions of relevant terms are found in Terminology C 859 and Terminology E 170.

4. Summary of Existing and Proposed Facilities

4.1 *T(d,n) Sources*:

4.1.1 Neutrons are produced by the highly exoergic reaction $d + t \rightarrow n + \alpha$. The total nuclear energy released is 17.589 MeV, resulting in about a 14.8-MeV neutron and a 2.8-MeV alpha particle at low deuterium beam energies **(3)**. The deuteron energy (generally 150 to 400 keV) is chosen to

[1] This practice is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.08 on Procedures for Neutron Radiation Damage Simulation.

Current edition approved Jan. 10, 1996. Published March 1996. Originally published as E 798 – 81. Last previous edition E 798 – 89.

[2] The boldface numbers in parentheses refer to a list of references at the end of this practice.

[3] *Annual Book of ASTM Standards*, Vol 12.01.

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

Copyright © ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States.