Designation: E 266 – 02

Standard Test Method for Measuring Fast-Neutron Reaction Rates by Radioactivation of Aluminum[1]

This standard is issued under the fixed designation E 266; 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 test method covers procedures measuring reaction rates by the activation reaction ^{7}Al(n,α)^{24}Na.

1.2 This activation reaction is useful for measuring neutrons with energies above approximately 6.5 MeV and for irradiation times up to about 2 days (for longer irradiations, see Practice E 261).

1.3 With suitable techniques, fission-neutron fluence rates above $10^{6}\cdot cm^{-2}\cdot s^{-1}$ can be determined.

1.4 Detailed procedures for other fast neutron detectors are referenced in Practice E 261.

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:*

E 170 Terminology Relating to Radiation Measurements and Dosimetry[2]

E 181 Test Methods for Detector Calibration and Analysis of Radionuclides[2]

E 261 Practice for Determining Neutron Fluence Rate, Fluence, and Spectra by Radioactivation Techniques[2]

E 844 Guide for Sensor Set Design and Irradiation for Reactor Surveillance, E 706(IIC)[2]

E 944 Guide for Application of Neutron Spectrum Adjustment Methods in Reactor Surveillance, (IIA)[2]

E 1005 Test Method for Application and Analysis of Radiometric Monitors for Reactor Vessel Surveillance, E706(IIIA)[2]

E 1018 Guide for Application of ASTM Evaluated Cross Section Data File, Matrix E 706(IIB)[2]

3. Terminology

3.1 *Definitions:*

3.1.1 Refer to Terminology E 170.

4. Summary of Test Method

4.1 High-purity aluminum is irradiated in a neutron field, thereby producing radioactive ^{24}Na from the ^{27}Al(n,α)^{24}Na activation reaction.

4.2 The gamma rays emitted by the radioactive decay of ^{24}Na are counted (see Test Methods E 181) and the reaction rate, as defined by Practice E 261, is calculated from the decay rate and irradiation conditions.

4.3 The neutron fluence rate above about 6.5 MeV can then be calculated from the spectral-weighted neutron activation cross section as defined by Practice E 261.

5. Significance and Use

5.1 Refer to Guide E 844 for the selection, irradiation, and quality control of neutron dosimeters.

5.2 Refer to Practice E 261 for a general discussion of the determination of fast-neutron fluence rate with threshold detectors.

5.3 Pure aluminum in the form of foil or wire is readily available and easily handled.

5.4 ^{24}Na has a half-life of 14.9512 h and emits gamma rays with energies of 1.368.633 and 2.754028 MeV.[3]

5.5 Fig. 1 shows a plot of cross section versus neutron energy for the fast-neutron reaction ^{27}Al(n,α)^{24}Na.[4] This figure is for illustrative purposes only to indicate the range of

[1] This test method is under the jurisdiction of ASTM Committee E10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.05 on Nuclear Radiation Metrology.

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

[3] Evaluated Nuclear Structure Data File (ENSDF), a computer file of evaluated nuclear structure and radioactive decay data, which is maintained by the National Nuclear Data Center (NNDC), Brookhaven National Laboratory (BNL), on behalf of the International Network for Nuclear Structure Data Evaluation, which functions under the auspices of the Nuclear Data Section of the International Atomic Energy Agency (IAEA). The URL is http://www.nndc.bnl.gov/nndc/ensdf. The data quoted here comes from the database as of January 1, 2002.

[4] "International Reactor Dosimetry File (IRDF–90)," assembled by N.P. Kocherov, et al., International Atomic Energy Agency, Nuclear Data Section, IAEA-NDS-141, Rev. 0, August 1990.