



Standard Test Method for Application and Analysis of Radiometric Monitors for Reactor Vessel Surveillance, E 706(IIIA)¹

This standard is issued under the fixed designation E 1005; 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 method describes general procedures for measuring the specific activities of radioactive nuclides produced in radiometric monitors (RMs) by nuclear reactions induced during surveillance exposures for reactor vessels and support structures. More detailed procedures for individual RMs are provided in separate standards identified in 2.1 and in Refs **11, 24-27**. The measurement results can be used to define corresponding neutron induced reaction rates which can in turn be used to characterize the irradiation environment of the reactor vessel and support structure. The principal measurement technique is high resolution gamma-ray spectrometry, although X-ray photon spectrometry and Beta particle counting are used to a lesser degree for specific RMs **(1-29)**.²

1.1.1 The measurement procedures include corrections for detector background radiation, random and true coincidence summing losses, differences in geometry between calibration source standards and the RMs, self absorption of radiation by the RM, other absorption effects, and radioactive decay corrections **(1-10, 12-22)**.

1.1.2 Specific activities are calculated by taking into account the time duration of the count, the elapsed time between start of count and the end of the irradiation, the half life, the mass of the target nuclide in the RM, and the branching intensities of the radiation of interest. Using the appropriate half life and known conditions of the irradiation, the specific activities may be converted into corresponding reaction rates **(24-30)**.

1.1.3 Procedures for calculation of reaction rates from the radioactivity measurements and the irradiation power time history are included. A reaction rate can be converted to neutron fluence rate (flux density) and fluence using the appropriate integral cross section and effective irradiation time values, and, with other reaction rates can be used to define the neutron spectrum through the use of suitable computer programs **(24-30)**.

1.1.4 The use of benchmark neutron fields for calibration of RMs can reduce significantly or eliminate systematic errors

since many parameters, and their respective uncertainties, required for calculation of absolute reaction rates are common to both the benchmark and test measurements and therefore are self cancelling. The benchmark equivalent fluence rates, for the environment tested, can be calculated from a direct ratio of the measured saturated activities in the two environments and the certified benchmark fluence rate **(24-30)**.

1.2 This method is intended to be used in conjunction with ASTM Guide E 844, also referred to as E 706 (IIC)³. The following existing or proposed ASTM practices, guides, and methods are also directly involved in the physics-dosimetry evaluation of reactor vessel and support structure surveillance measurements:

E 706 (O) Master Matrix for Light-Water Reactor Pressure Vessel Surveillance Standards³

E 706 (IA), E 853 Analysis and Interpretation of Light-Water Reactor Surveillance Results³

E 706 (IC), E 560 Practice for Extrapolating Reactor Vessel Surveillance Dosimetry Results³

E 706 (ID), E 693 Practice for Characterizing Neutron Exposures in Ferritic Steels in Terms of Displacements Per Atom (DPA)³

E 706 (IE) Damage Correlation for Reactor Vessel Surveillance³

E 706 (IF), E 185 Practice for Conducting Surveillance Tests for Light-Water Nuclear Power Reactor Vessels³

E 706 (IG) Surveillance Tests for Nuclear Reactor Support Structures³

E 706 (IH), E 636 Practice for Conducting Supplemental Surveillance Tests for Nuclear Power Reactor Vessels³

E 706 (IIA), E 944 Guide for Application of Neutron Spectrum Adjustment Methods in Reactor Surveillance³

E 706 (IIB), E 1018 Guide for Application of ASTM Evaluated Cross Section and Data File³

E 706 (IID), E 482 Guide for Application of Neutron Transport Methods for Reactor Vessel Surveillance³

E 706 (IIE) Benchmark Testing of Reactor Vessel Dosimetry³

E 706 (IIIB), E 854 Test Method for Application and Analysis of Solid State Track Recorder (SSTR) Monitors for Reactor Vessel Surveillance³

¹ This method is under the jurisdiction of ASTM Committee E-10 on Nuclear Technology and Applications and is the direct responsibility of Subcommittee E10.05 on Nuclear Radiation Metrology.

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² The boldface numbers in parentheses refer to the list of references appended to this method.

³ The reference in parentheses refers to Section 5 as well as Figs. 1 and 2 of Matrix E 706.