



Designation: E706 – 23

Standard Master Matrix for Light-Water Reactor Pressure Vessel Surveillance Standards¹

This standard is issued under the fixed designation E706; 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 master matrix standard describes a series of standard practices, guides, and methods for the prediction of neutron-induced changes in light-water reactor (LWR) pressure vessel (PV) and support structure steels throughout a pressure vessel's service life (Fig. 1). Referenced documents are listed in Section 2. The summary information that is provided in Sections 3 and 4 is essential for establishing proper understanding and communications between the writers and users of this set of matrix standards. It was extracted from the referenced standards (Section 2) and references for use by individual writers and users. More detailed writers' and users' information, justification, and specific requirements for the individual practices, guides, and methods are provided in Sections 3 – 5. General requirements of content and consistency are discussed in Section 6.

1.2 This master matrix is intended as a reference and guide to the preparation, revision, and use of standards in the series.

1.3 To account for neutron radiation damage in setting pressure-temperature limits and making fracture analyses ((1-12)² and Guide E509), neutron-induced changes in reactor pressure vessel steel fracture toughness must be predicted, then checked by extrapolation of surveillance program data during a vessel's service life. Uncertainties in the predicting methodology can be significant. Techniques, variables, and uncertainties associated with the physical measurements of PV and support structure steel property changes are not considered in this master matrix, but elsewhere ((2, 6, 7, 11-26) and Guide E509).

1.4 The techniques, variables, and uncertainties related to (1) neutron and gamma dosimetry, (2) physics (neutronics and gamma effects), and (3) metallurgical damage correlation procedures and data are addressed in separate standards be-

longing to this master matrix (1, 17). The main variables of concern to (1), (2), and (3) are as follows:

1.4.1 Steel chemical composition and microstructure,

1.4.2 Steel irradiation temperature,

1.4.3 Power plant configurations and dimensions, from the core periphery to surveillance positions and into the vessel and cavity walls,

1.4.4 Core power distribution,

1.4.5 Reactor operating history,

1.4.6 Reactor physics computations,

1.4.7 Selection of neutron exposure units,

1.4.8 Dosimetry measurements,

1.4.9 Neutron special effects, and

1.4.10 Neutron dose rate effects.

1.5 A number of methods and standards exist for ensuring the adequacy of fracture control of reactor pressure vessel belt lines under normal and accident loads ((1, 7, 8, 11, 12, 14, 16, 17, 23-27), Referenced Documents: ASTM Standards (2.1), Nuclear Regulatory Documents (2.3) and ASME Standards (2.4)). As older LWR pressure vessels become more highly irradiated, the predictive capability for changes in toughness must improve. Since during a vessel's service life an increasing amount of information will be available from test reactor and power reactor surveillance programs, procedures to evaluate and use this information must be used (1, 2, 4-9, 11, 12, 23-26, 28). This master matrix defines the current (1) scope, (2) areas of application, and (3) general grouping for the series of ASTM standards, as shown in Fig. 1.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

¹ This master matrix 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 The boldface numbers in parentheses refer to a list of references at the end of this standard.

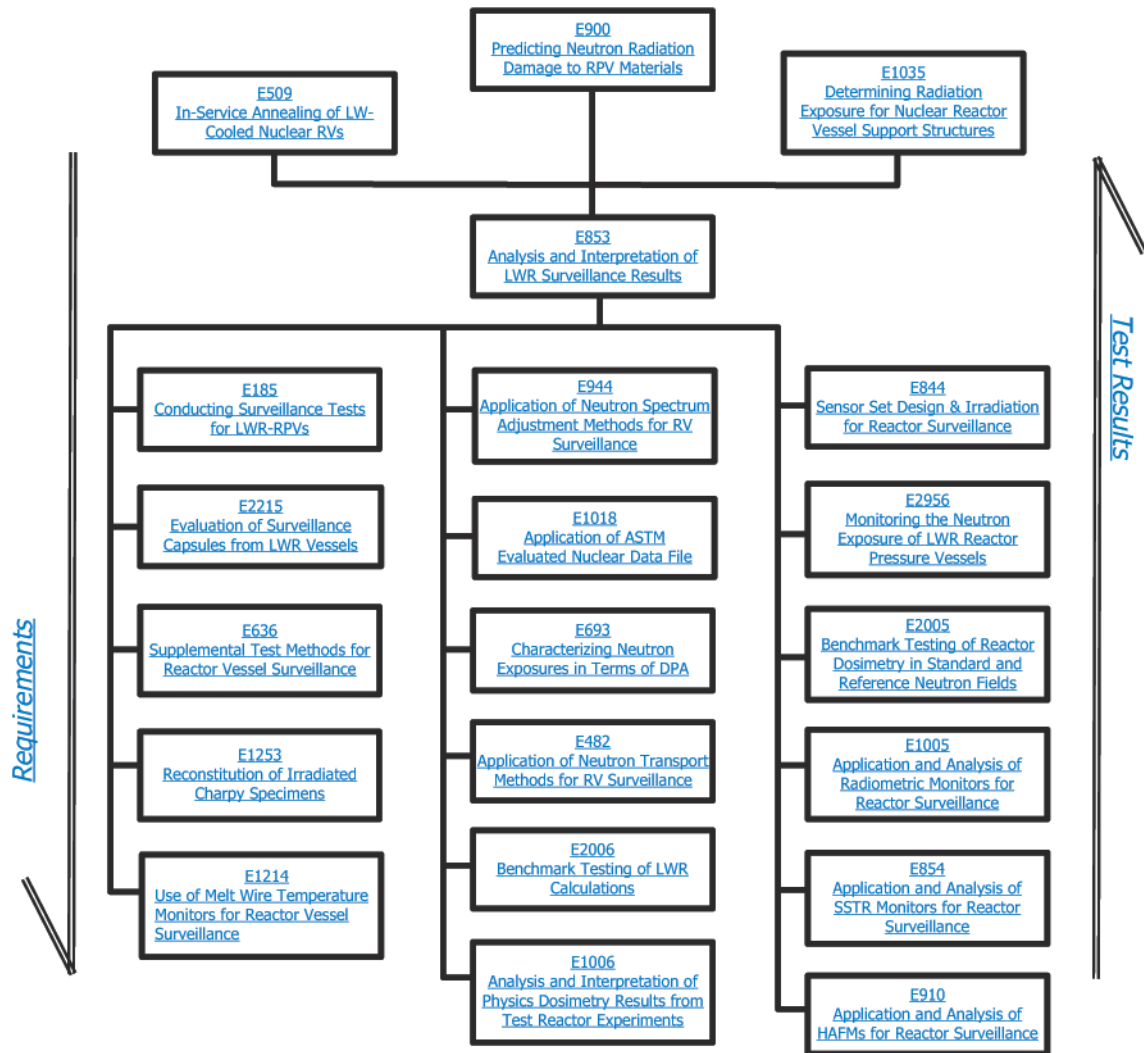


FIG. 1 Organization and Use of ASTM Standards in the E706 Master Matrix

2. Referenced Documents

2.1 ASTM Standards:³

- C859 Terminology Relating to Nuclear Materials
- E23 Test Methods for Notched Bar Impact Testing of Metallic Materials
- E170 Terminology Relating to Radiation Measurements and Dosimetry
- E185 Practice for Design of Surveillance Programs for Light-Water Moderated Nuclear Power Reactor Vessels
- E482 Guide for Application of Neutron Transport Methods for Reactor Vessel Surveillance
- E509 Guide for In-Service Annealing of Light-Water Moderated Nuclear Reactor Vessels
- E636 Guide for Conducting Supplemental Surveillance Tests for Nuclear Power Reactor Vessels

- E646 Test Method for Tensile Strain-Hardening Exponents (n -Values) of Metallic Sheet Materials
- E693 Practice for Characterizing Neutron Exposures in Iron and Low Alloy Steels in Terms of Displacements Per Atom (DPA)
- E844 Guide for Sensor Set Design and Irradiation for Reactor Surveillance
- E853 Practice for Analysis and Interpretation of Light-Water Reactor Surveillance Neutron Exposure Results
- E854 Test Method for Application and Analysis of Solid State Track Recorder (SSTR) Monitors for Reactor Surveillance
- E900 Guide for Predicting Radiation-Induced Transition Temperature Shift in Reactor Vessel Materials
- E910 Test Method for Application and Analysis of Helium Accumulation Fluence Monitors for Reactor Vessel Surveillance
- E944 Guide for Application of Neutron Spectrum Adjustment Methods in Reactor Surveillance

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.