



Designation: E 706 – 87 (Reapproved 1994)

Standard Master Matrix for Light-Water Reactor Pressure Vessel Surveillance Standards, E 706(0)¹

This standard is issued under the fixed designation E 706; 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 (Figs. 1 and 2). Some of these are existing ASTM standards, some are ASTM standards that have been modified, and some are newly proposed ASTM standards. General requirements of content and consistency are discussed in Section 7. More detailed writers' and users' information, justification, and specific requirements for the nine practices, six guides, and five methods are provided in Sections 3-5. Referenced documents, references, and a matrix standard steering committee task group are discussed in Sections 2 and 6. The summary-type 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 documents, Section 2 and Table 1 and references **(1-104)**² for use by individual writers and users.

1.2 This master matrix is intended as a reference and guide to the preparation, revision, and use of standards in the series and for planning and scheduling purposes, particularly as may concern future activities of E10.05 and E10.02. This index is to help ensure the accomplishment of an objective irrespective of the time required, the number of ASTM committees concerned, or the complexity of the issues involved.

1.3 This master matrix standard provides a guide to ASTM standards related to the energy-critical areas that are to be developed under the category of Fission Reactor Development, Section 10, of Guide E 584 and as discussed in Practice E 583.³ With reference to Fig. 1 of Guide E 584, this (E 706) master matrix standard is identified with the horizontal and vertical

subdivisions, respectively:

1.3.1 *Energy Source-Research, Development, and Application Areas:*

1.3.1.1 *Fission Reactor Development Converter:*

(a) LWR Pressurized Water (PWR).

(b) LWR Boiling Water (BWR).

1.3.2 *Standards-Needed Area:*

1.3.2.1 Definition of Function Characteristics.

1.3.2.2 Provision to Achieve Function.

1.3.2.3 Quality Assurance and Reliability.

1.4 To account for neutron radiation damage in setting pressure-temperature limits and making fracture analyses (see Refs **2-7, 9-14, 21-57, 63, 69-71, 77, 78, 83-104**, and Recommended Guide E 509), 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 (**1, 3, 4, 10-13, 17, 21, 22-27, 32-39, 42, 43, 45, 49-57, 71, 77, 78, 83, 91-104**, and Recommended Guide E 509). 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 this master matrix **(2, 3 4)**. 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 edge 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 spectral effects, and

1.4.10 Neutron dose rate effects.

1.5 A number of potential methods and standards exist for assuring the adequacy of fracture control of reactor pressure vessel belt lines under normal and accident loads **(1-4, 7, 13, 14, 21-28, 29-34, 52-57, 71, 77, 78, 91, 93, Recommended**

¹ This master matrix 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 at the end of this standard.

³ With reference to the E583 matrix approach, Subcommittee E10.05 on Nuclear Radiation Metrology assumes the lead responsibility for developing and maintaining this LWR Pressure Vessel Surveillance Master Matrix with the liaison assistance of Subcommittee E10.02 on Behavior and Use of Nuclear Metallic Materials in Nuclear Systems.