



Designation: E 690 – 98

Standard Practice for In Situ Electromagnetic (Eddy-Current) Examination of Nonmagnetic Heat Exchanger Tubes¹

This standard is issued under the fixed designation E 690; 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 describes procedures to be followed during eddy-current examination (using an internal, probe-type, coil assembly) of nonmagnetic tubing that has been installed in a heat exchanger. The procedure recognizes both the unique problems of implementing an eddy-current examination of installed tubing, and the indigenous forms of tube-wall deterioration which may occur during this type of service. The document primarily addresses scheduled maintenance inspection of heat exchangers, but can also be used by manufacturers of heat exchangers, either to examine the condition of the tubes after installation, or to establish baseline data for evaluating subsequent performance of the product after exposure to various environmental conditions. The ultimate purpose is the detection and evaluation of particular types of tube integrity degradation which could result in in-service tube failures.

1.2 This practice does not establish acceptance criteria; they must be specified by the using parties.

1.3 *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 543 Practice for Evaluating Agencies that Perform Non-destructive Testing²

E 1316 Terminology for Nondestructive Examinations²

2.2 Other Documents:

SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing³

ANSI/ASNT-CP-189 ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel³

MIL-STD-410E Nondestructive Testing Personnel Qualifi-

cation and Certification⁴

NAS-410 NAS Certification and Qualification of Nondestructive Personnel (Quality Assurance Committee)⁵

3. Terminology

3.1 Standard terminology relating to electromagnetic examination may be found in Terminology E 1316, Section C, Electromagnetic Testing.

4. Summary of Practice

4.1 The examination is performed by passing an eddy-current probe through each tube. These probes are energized with alternating currents at one or more frequencies. The electrical impedance of the probe is modified by the proximity of the tube, the tube dimensions, electrical conductivity, magnetic permeability, and metallurgical or mechanical discontinuities in the tube. During passage through the tube, changes in electromagnetic response caused by these variables in the tube produce electrical signals which are processed so as to produce an appropriate combination of visual displays, alarms, or temporary or permanent records, or combination thereof, for subsequent analysis.

NOTE 1—The agency performing the testing or examination shall meet the requirements of Practice E 543.

5. Significance and Use

5.1 Eddy-current testing is a nondestructive method of locating discontinuities in tubing made of materials that conduct electricity. Signals can be produced by discontinuities located either on the inner or outer surfaces of the tube, or by discontinuities totally contained within the tube wall. When using an internal probe, the density of eddy currents in the tube wall decreases very rapidly as the distance from the internal surface increases; thus the amplitude of the response to outer surface discontinuities decreases correspondingly.

5.2 Some indications obtained by this method may not be relevant to product quality. For example, an irrelevant signal may be caused by metallurgical or mechanical variations that

¹ This practice is under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.07 on Electromagnetic Methods.

Current edition approved Dec. 10, 1998. Published February 1999. Originally published as E 690 – 79. Last previous edition E 690 – 91.

² *Annual Book of ASTM Standards*, Vol 03.03.

³ Available from American Society for Nondestructive Testing, 1711 Arlingate Plaza, P.O. Box 28518, Columbus, OH 43228-0518.

⁴ Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave. Philadelphia, PA 19111-5904, Attn: NPODS.

⁵ Available from Aerospace Industries Association of America, Inc., 1250 Eye Street, N.W., Washington, DC 20005.