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Standard Guide for Electromagnetic Acoustic Transducers (EMATs)¹

This standard is issued under the fixed designation E1774; 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 guide is intended primarily for tutorial purposes. It provides an overview of the general principles governing the operation and use of electromagnetic acoustic transducers (EMATs) for ultrasonic examination.

1.2 This guide describes a non-contact technique for coupling ultrasonic energy into an electrically conductive or ferromagnetic material, or both, through the use of electromagnetic fields. This guide describes the theory of operation and basic design considerations as well as the advantages and limitations of the technique.

1.3 This guide is intended to serve as a general reference to assist in determining the usefulness of EMATs for a given application as well as provide fundamental information regarding their design and operation. This guide provides guidance for the generation of longitudinal, shear, Rayleigh, and Lamb wave modes using EMATs.

1.4 This guide does not contain detailed procedures for the use of EMATs in any specific applications; nor does it promote the use of EMATs without thorough testing prior to their use for examination purposes. Some applications in which EMATs have been applied successfully are outlined in Section 9.

1.5 *Units*—The values stated in inch-pound units are to be regarded as the standard. The SI values given in parentheses are for information only.

1.6 *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.*

1.7 *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 guide is under the jurisdiction of ASTM Committee E07 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.06 on Ultrasonic Method.

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2. Referenced Documents

2.1 ASTM Standards:²

E127 Practice for Fabrication and Control of Aluminum Alloy Ultrasonic Standard Reference Blocks

E428 Practice for Fabrication and Control of Metal, Other than Aluminum, Reference Blocks Used in Ultrasonic Testing

E1065 Practice for Evaluating Characteristics of Ultrasonic Search Units

E1316 Terminology for Nondestructive Examinations

E543 Specification for Agencies Performing Nondestructive Testing

2.2 ASNT Documents:³

SNT-TC-1A Recommended Practice for Personnel Qualifications and Certification in Nondestructive Testing

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

2.3 Aerospace Industries Association Standard:⁴

NAS-410 Certification and Qualification of Nondestructive Test Personnel

2.4 ISO Standard:⁵

ISO 9712 Non-Destructive Testing: Qualification and Certification of NDT Personnel

3. Terminology

3.1 *Definitions*—Related terminology is defined in Terminology E1316.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bulk wave*—an ultrasonic wave, either longitudinal or shear mode, used in nondestructive testing to interrogate the volume of a material.

3.2.2 *electromagnetic acoustic transducer (EMAT)*—an electromagnetic device for converting electrical energy into acoustical energy in the presence of a magnetic field.

² 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.

³ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

⁴ Available from Aerospace Industries Association of America, Inc. (AIA), 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209-3928, <http://www.aia-aerospace.org>.

⁵ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

*A Summary of Changes section appears at the end of this standard