



Designation: E2904 – 22

Standard Practice for Characterization and Verification of Linear Phased Array Ultrasonic Probes¹

This standard is issued under the fixed designation E2904; 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 covers measurement procedures for evaluating certain characteristics of phased-array ultrasonic probes that are used with phased-array ultrasonic examination instrumentation.

1.2 This practice describes means for obtaining performance data that may be used to define the acoustic and electric responses of phased-array ultrasonic probes including contact (with or without a wedge) and immersion linear phased-array probes used for ultrasonic nondestructive testing with central frequencies ranging from 0.5 MHz to 10 MHz. Frequencies outside of this range may use the same methods but the testing equipment may vary.

1.3 When ultrasonic values dependent on material are specified in this practice, they are based on carbon steel with an ultrasonic wave propagation speed of 5920 m/s (± 50 m/s) for longitudinal wave modes and 3255 m/s (± 30 m/s) for transverse or shear wave modes.

1.4 This practice describes some of the characterization and verification procedures that can be carried out at the end stage of the manufacturing process of linear phased array probes. This practice does not describe the methods or acceptance criteria used to verify the performance of the combined phased array ultrasonic instrument and probe system.

1.5 While this practice is intended to provide standardized procedures for evaluating linear phased-array ultrasonic probes, it may, with suitable modifications, be used for evaluation of configurations other than linear; for example, 1.5D or 2D matrix array probes.

1.6 *Units*—The values stated in SI units are to be regarded as the standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

¹ This practice 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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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.*

2. Referenced Documents

2.1 *ASTM Standards*:²

E1065 Practice for Evaluating Characteristics of Ultrasonic Search Units

E1316 Terminology for Nondestructive Examinations

3. Terminology

3.1 *Definitions*:

3.1.1 For definitions of terms used in this practice, see Terminology E1316.

3.1.2 *Technical Specification of the Phased Array Probes*:

3.1.2.1 *certification, n*—defined as measured performance of an individual probe. This is the document that reports the measured performance of a specific probe (specific to a serial number).

3.1.2.2 *datasheet, n*—defined as specification. This is the document that defines the general geometry and expected performance of a specific model or part number.

3.1.2.3 *probe shape and size, n*—probe form and dimensions.

3.1.2.4 *probe type, n*—contact or immersion.

3.1.3 *Terminology for Array Probes*:

3.1.3.1 *active aperture, n*—pitch times the number of elements.

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.

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

3.1.3.2 *element length, n*—in a rectangular element, the acoustic element’s long dimension. See *passive aperture* (also called element elevation) and Fig. 3.

3.1.3.3 *element pitch (or pitch), n*—the distance between the centers of two adjacent array elements.

3.1.3.4 *element width, n*—in a rectangular element, the acoustic element’s short dimension.

3.1.3.5 *passive aperture, n*—the dimension of an array element’s length.

3.1.3.6 *saw cut, n*—also called “kerf,” space or gap. The space between adjacent elements.

4. Summary of Practice

4.1 The physical, acoustic and electrical characteristics which can be described from the data obtained by procedures outlined in this guide are described as follows.

4.2 *Physical Aspects*—Identification and physical dimension aspects of the probe should be noted. Details to be noted are described in 7.1.

4.3 *Center Frequency, Bandwidth And Time Response*—Section 7.2 describes procedures for determining center frequency, bandwidth, and time response of the individual elements of the linear array probe.

4.4 *Sensitivity Range Of Elements*—Section 7.3 describes a procedure to determine variation of sensitivity from one element to the next based on a fixed input voltage.

4.5 *Probe Sensitivity*—The overall sensitivity performance of all the elements in the array is assessed in the procedure described in 7.4.

4.6 *Element Crosstalk*—A procedure for assessment of damping between elements to eliminate crosstalk is provided in 7.5.

Element #1 Waveform

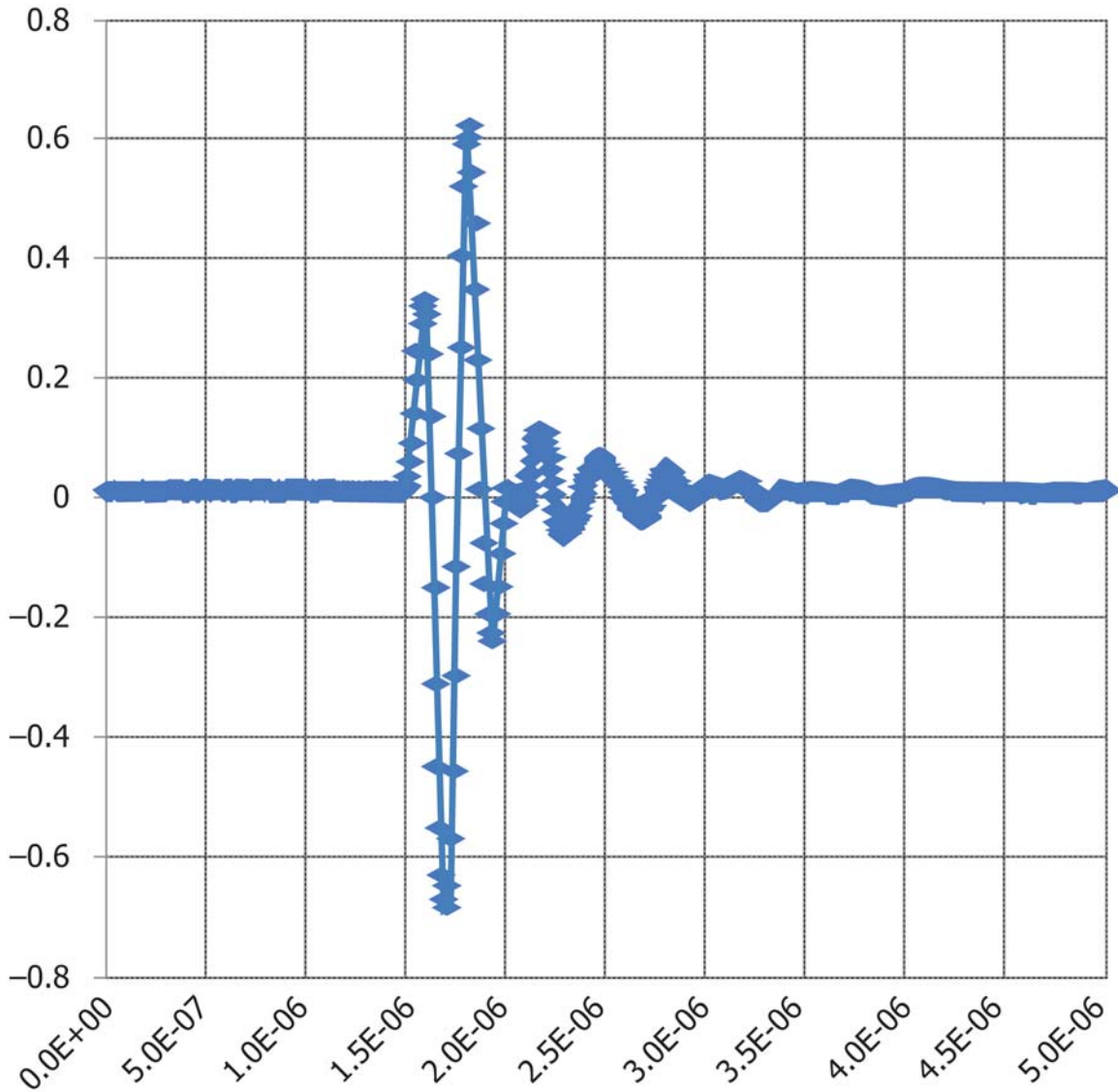


FIG. 1 Schematic Showing Digitization Rate