

# Standard Practice for Ultrasonic Examination of Metal Pipe and Tubing<sup>1</sup>

This standard is issued under the fixed designation E 213; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

## 1. Scope

1.1 This practice<sup>2</sup> covers a procedure for detecting discontinuities in metal pipe and tubing using pulse-reflection ultrasonic contact or immersion angle beam techniques. Artificial discontinuities consisting of longitudinal reference notches are employed as the primary means of standardizing the ultrasonic system. If transverse as well as longitudinal examination is desired, a procedure for employing transverse notches is provided.

1.2 This practice is intended for use with tubular products having outside diameters approximately ½ in. (12.7 mm) and larger, provided that the examination parameters comply with and satisfy the requirements of Section 12. These procedures have been used successfully for smaller sizes, however, and may be specified upon contractual agreement between the using parties.

NOTE 1—**Caution:** Exercise caution when examining pipe or tubes near or below the ½-in. specified limit. Certain combinations of search unit size, frequency, *thin* wall thicknesses, and small diameters could cause generation of unwanted sound waves that may produce erroneous test results.

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

1.4 The values stated in inch-pound units are to be regarded as standard. The SI equivalents are in parentheses and may be approximate.

1.5 *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 Testing<sup>3</sup>

E 1316 Terminology for Nondestructive Examinations<sup>3</sup>

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee E-7 on Nondestructive Testing and is the direct responsibility of Subcommittee E07.06 on Ultrasonic Method.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Practice SE-213 in the Code.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.03.

### 2.2 ASNT Documents:

Recommended Practice SNT-TC-1A for Nondestructive Testing Personnel Qualification and Certification<sup>4</sup>  
ANSI/ASNT CP-189 Standard for Qualification and Certification of Nondestructive Testing Personnel<sup>4</sup>

### 2.3 Military Standards:

MIL-STD-410 Nondestructive Testing Personnel Qualification and Certification<sup>5</sup>

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, see Terminology E 1316.

## 4. Summary of Practice

4.1 A pulsed ultrasonic angle beam by either the surface contact or immersion method shall be used. Fig. 1 illustrates the characteristic angle beam sound entry into the pipe wall for both contact and immersion testing using a single search unit.

NOTE 2—Immersion test method may include tanks, wheel search units, or systems that use liquid streams.

4.2 Variations of the single-search unit method using multiple-search units with the same or various angles and special gating are sometimes desirable and may be necessary for efficient examination of thicker wall material.

## 5. Significance and Use

5.1 The purpose of this practice is to outline a procedure for detecting and locating significant discontinuities such as pits, voids, inclusions, cracks, splits, and the like, by the ultrasonic pulse-reflection method.

## 6. Basis of Application

6.1 The following are items that must be decided upon by the using party or parties.

6.1.1 Size and type of tubing to be examined,

6.1.2 Extent of examination, that is, scanning in one or both circumferential directions, scanning in one or both axial directions, weld zone only if welded, pitch of feed helix during scanning, etc.,

6.1.3 The point(s) in the manufacturing process at which the material will be examined,

<sup>4</sup> Available from American Society for Nondestructive Testing, Inc., 1711 Arlingate Lane, Columbus, OH 43228.

<sup>5</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

**FIG. 1 Circumferential Propagation of Sound in Tube Wall**

- 6.1.4 Surface condition,
- 6.1.5 Maximum time interval between equipment standardization checks, if different from that described in 13.2,
- 6.1.6 Type, dimensions, location, method of manufacture, and number of artificial discontinuities to be placed on the reference standard,
- 6.1.7 Method(s) for measuring dimensions of artificial discontinuities and tolerance limits if different than specified in Section 11,
- 6.1.8 Criteria for reportable and rejectable indications (that is, acceptance criteria),
- 6.1.9 Reexamination of repaired/reworked items is not addressed in this standard and if required shall be specified in the contractual agreement.
- 6.1.10 Requirements for permanent records of the response from each tube, if applicable,
- 6.1.11 Contents of testing report,
- 6.1.12 Operator qualifications and certification, if required, and
- 6.1.13 Qualification of Nondestructive Agencies. If specified in the contractual agreement, NDT agencies shall be qualified and evaluated as described in E 543. The applicable edition of E 543 shall be specified in the contractual agreement.
- 6.1.14 Level of personnel qualification. (See 7.1)

## 7. Personnel Qualification

7.1 If specified in the contractual agreement, personnel performing examinations to this standard shall be qualified in accordance with a nationally recognized NDT personnel qualification practice or standard such as ANSI/ASNT-CP-189, SNT-TC-1A, MIL STD-410, or a similar document and certi-

fied by the employer or certifying agency, as applicable. The practice or standard used and its applicable revision shall be identified in the contractual agreement between the using parties.

## 8. Surface Condition

8.1 All surfaces shall be clean and free of scale, dirt, grease, paint, or other foreign material that could interfere with interpretation of test results. The methods used for cleaning and preparing the surfaces for ultrasonic examination shall not be detrimental to the base metal or the surface finish. Excessive surface roughness or scratches can produce signals that interfere with the test.

## 9. Apparatus

9.1 The instruments and accessory equipment shall be of the pulse-reflection type and shall be capable of distinguishing the reference notches described in Section 11 to the extent required in the standardization procedure described in Section 12. Fig. 1 illustrates the refraction of sound in the pipe or tube wall, and the circumferential direction of ultrasonic energy propagation used to detect longitudinal notches.

## 10. Couplant

10.1 A liquid couplant such as water, oil, or glycerin, capable of conducting ultrasonic vibrations between the transducer and the pipe or tube being tested shall be used. Rust inhibitors, softeners, and wetting agents may be added to the couplant. The couplant liquid with all additives should not be detrimental to the surface condition of the pipe or tube, and shall wet the surface of the material to provide adequate coupling efficiency.