



Designation: A578/A578M – 17

# Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications<sup>1</sup>

This standard is issued under the fixed designation A578/A578M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification<sup>2</sup> covers the procedure and acceptance standards for straight-beam, pulse-echo, ultrasonic examination of rolled carbon and alloy steel plates,  $\frac{3}{8}$  in. [10 mm] in thickness and over, for special applications. The method will detect internal discontinuities parallel to the rolled surfaces. Three levels of acceptance standards are provided. Supplementary requirements are provided for alternative procedures.

1.2 Individuals performing examinations in accordance with this specification shall be qualified and certified in accordance with the requirements of the latest edition of ASNT SNT-TC-1A or an equivalent accepted standard. An equivalent standard is one which covers the qualification and certification of ultrasonic nondestructive examination candidates and which is acceptable to the purchaser.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *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.*

1.5 *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.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.11 on Steel Plates for Boilers and Pressure Vessels.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-578/SA-578M in Section II of that Code.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

A263 Specification for Stainless Chromium Steel-Clad Plate  
A264 Specification for Stainless Chromium-Nickel Steel-Clad Plate

A265 Specification for Nickel and Nickel-Base Alloy-Clad Steel Plate

E317 Practice for Evaluating Performance Characteristics of Ultrasonic Pulse-Echo Testing Instruments and Systems without the Use of Electronic Measurement Instruments

E1316 Terminology for Nondestructive Examinations

E2491 Guide for Evaluating Performance Characteristics of Phased-Array Ultrasonic Testing Instruments and Systems

### 2.2 ANSI Standard:<sup>4</sup>

B 46.1 Surface Texture

### 2.3 ASNT Standard:<sup>5</sup>

SNT-TC-1A

## 3. Terminology

3.1 *Definitions*—For definitions of terms relating to nondestructive examinations used in this specification, refer to Terminology E1316.

## 4. Ordering Information

4.1 The inquiry and order shall indicate the following:

4.1.1 Acceptance level requirements (Sections 8, 9, and 10). Acceptance Level B shall apply unless otherwise agreed to by purchaser and manufacturer.

4.1.2 Any additions to the provisions of this specification as prescribed in 6.2, 14.1, and Section 11.

4.1.3 Supplementary requirements, if any.

<sup>3</sup> 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.

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

<sup>5</sup> Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlingate Ln., Columbus, OH 43228-0518, http://www.asnt.org.

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

## 5. Apparatus

5.1 The ultrasonic instrument shall be a pulse echo type instrument capable of addressing either a mono-element probe or a phased-array probe and shall be equipped with a standardized dB gain or attenuation control stepped in increments of 1 dB minimum. The system shall be capable of generating and displaying A-scans.

5.2 Vertical and horizontal linearity and amplitude control linearity shall be checked in accordance with Practice E317, Guide E2491, or another procedure approved by the users of this specification. An acceptable linearity performance may be agreed upon by the manufacturer and purchaser.

5.3 The transducer shall be 1 or 1½ in. [25 or 30 mm] in diameter or 1 in. [25 mm] square. When phased-array systems are used, focal laws using an equivalent active aperture shall be used.

5.4 Other search units may be used for evaluating and pinpointing indications.

## 6. Procedure

6.1 Perform the inspection in an area free of operations that interfere with proper performance of the test.

6.2 Unless otherwise specified, make the ultrasonic examination on either major surface of the plate.

6.3 The plate surface shall be sufficiently clean and smooth to maintain a first reflection from the opposite side of the plate at least 50 % of full scale during scanning. This may involve suitable means of scale removal at the manufacturer's option. Condition local rough surfaces by grinding. Restore any specified identification which is removed when grinding to achieve proper surface smoothness.

6.4 Perform the test by one of the following methods: direct contact, immersion, or liquid column coupling. Use a suitable couplant such as water, soluble oil, or glycerin. As a result of the test by this method, the surface of plates may be expected to have a residue of oil or rust or both.

6.5 A nominal test frequency of 2¼ MHz is recommended. When testing plates less than ¾ in. [20 mm] thick a frequency of 5 MHz may be necessary. Thickness, grain size or microstructure of the material and nature of the equipment or method may require a higher or lower test frequency. Use the transducers at their rated frequency. A clean, easily interpreted A-scan display should be produced during the examination.

### 6.6 Scanning:

6.6.1 Scanning shall be along continuous perpendicular grid lines on nominal 9-in. [225-mm] centers, or at the option of the manufacturer, shall be along continuous parallel paths, transverse to the major plate axis, on nominal 4-in. [100-mm] centers, or shall be along continuous parallel paths parallel to the major plate axis, on 3-in. [75-mm] or smaller centers. Measure the lines from the center or one corner of the plate with an additional path within 2 in. [50 mm] of all edges of the plate on the examination surface.

6.6.2 Conduct the general scanning with an instrument adjustment that will produce a first reflection from the opposite

side of a sound area of the plate from 50 to 90 % of full scale. Minor sensitivity adjustments may be made to accommodate for surface roughness.

6.6.3 When a discontinuity condition is observed during general scanning adjust the instrument to produce a first reflection from the opposite side of a sound area of the plate of  $75 \pm 5$  % of full scale. Maintain this instrument setting during evaluation of the discontinuity condition.

## 7. Recording

7.1 Record all discontinuities causing complete loss of back reflection.

7.2 For plates ¾ in. [20 mm] thick and over, record all indications with amplitudes equal to or greater than 50 % of the initial back reflection and accompanied by a 50 % loss of back reflection.

NOTE 1—Indications occurring midway between the initial pulse and the first back reflection may cause a second reflection at the location of the first back reflection. When this condition is observed it shall be investigated additionally by use of multiple back reflections.

7.3 Where grid scanning is performed and recordable conditions as in 7.1 and 7.2 are detected along a given grid line, the entire surface area of the squares adjacent to this indication shall be scanned. Where parallel path scanning is performed and recordable conditions as in 7.1 and 7.2 are detected, the entire surface area of a 9 by 9-in. [225 by 225-mm] square centered on this indication shall be scanned. The true boundaries where these conditions exist shall be established in either method by the following technique: Move the transducer away from the center of the discontinuity until the height of the back reflection and discontinuity indications are equal. Mark the plate at a point equivalent to the center of the transducer. Repeat the operation to establish the boundary.

## 8. Acceptance Standard—Level A

8.1 Any area where one or more discontinuities produce a continuous total loss of back reflection accompanied by continuous indications on the same plane (within 5 % of plate thickness) that cannot be encompassed within a circle whose diameter is 3 in. [75 mm] or ½ of the plate thickness, whichever is greater, is unacceptable.

## 9. Acceptance Standards—Level B

9.1 Any area where one or more discontinuities produce a continuous total loss of back reflection accompanied by continuous indications on the same plane (within 5 % of plate thickness) that cannot be encompassed within a circle whose diameter is 3 in. [75 mm] or ½ of the plate thickness, whichever is greater, is unacceptable.

9.2 In addition, two or more discontinuities smaller than described in 9.1 shall be unacceptable unless separated by a minimum distance equal to the greatest diameter of the larger discontinuity or unless they may be collectively encompassed by the circle described in 9.1.

## 10. Acceptance Standard—Level C

10.1 Any area where one or more discontinuities produce a continuous total loss of back reflection accompanied by continuous indications on the same plane (within 5 % of plate