



Designation: ~~A577/A577M – 90 (Reapproved 2012)~~ A577/A577M – 17

Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates¹

This standard is issued under the fixed designation A577/A577M; 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-~~Scope~~*

1.1 This specification² covers an ultrasonic angle-beam procedure and acceptance standards for the detection of internal discontinuities not laminar in nature and of surface imperfections in a steel plate. This specification is intended for use only as a supplement to specifications which provide straight-beam ultrasonic examination.

NOTE 1—An internal discontinuity that is laminar in nature is one whose principal plane is parallel to the principal plane of the plate.

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 inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.4 *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:³

[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 ASNT Standards:⁴

[SNT-TC-1A Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing](#)

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 any additions to the provisions of this specification as prescribed in ~~H-11.2.1~~.

5. Examination Conditions

5.1 The examination shall be conducted in an area free of operations that interfere with proper performance of the examination.

¹ 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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² For ASME Boiler and Pressure Vessel Code applications, see related Specification SA-577/SA-577M in Section II of that Code. Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

³ 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.

⁴ Available from American Society for Nondestructive Testing (ASNT), P.O. Box 28518, 1711 Arlington Ln., Columbus, OH 43228-0518, <http://www.asnt.org>.

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

5.2 The surface of the plate shall be conditioned as necessary to provide a clear, easily interpreted ~~trace pattern~~ A-scan on the ~~screen~~ screen of the ultrasonic instrument. Any specified identification which is removed to achieve proper surface smoothness shall be restored.

6. Apparatus

6.1 Ultrasonic Instruments:

6.1.1 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.

6.2 ~~The amplitude~~ Vertical and horizontal linearity and amplitude control linearity shall be checked by ~~positioning the transducer in accordance with Practice E317 over the, Guide E2491~~ depth resolution notch in the HW or similar block so that the signal from the notch is approximately 30 % of the screen height, and the signal from one of the back surfaces is approximately 60 % of the screen height (two times the height of the signal from the notch). A curve is then plotted showing the deviations from the above established 2:1 ratio that occurs as the amplitude of the signal from the notch is raised in increments of one scale division until the back reflection signal reaches full scale, and then is lowered in increments of one scale division until the notch signal reaches one scale division. At each increment the ratio of the two signals is determined. The ratios are plotted on the graph at the position corresponding to the larger signal. Between the limits of 20 % and 80 % of the screen height the ratio shall be within 10 % of 2:1. Instrument settings used during inspection shall not cause variation outside the 10 % limits established above. or another procedure approved by the users of this specification. An acceptable linearity performance may be agreed upon by the manufacturer and purchaser.

6.3 The search unit shall be a 45-deg (in steel) angle-beam type with active transducer length and width dimensions of a minimum of ½ in. [12.5 mm] and a maximum of 1 in. [25 mm]. When phased-array systems are used, focal laws using an equivalent active aperture shall be used. Search units of other sizes and angles may be used for additional exploration and evaluation.

7. Examination Frequency

7.1 A nominal test frequency of 5 MHz is recommended. Thickness, grain size, or microstructure of the material and nature of the equipment or method may permit a higher or require a lower examination frequency. The ultrasonic frequency selected for the examination shall be the highest frequency that permits permit detection of the required calibration notch, such that the amplitude of the indication yields a signal-to-noise ratio of at least 3:1.

8. Calibration Reflector

8.1 A calibration notch, the geometry of which has been agreed upon by the purchaser and the manufacturer, with a depth of 3 % of the plate thickness, shall be used to calibrate the ultrasonic examination. The notch shall be at least 1 in. [25 mm] long.

8.2 ~~Insert~~ Machine the notch or notches on the surface of the plate so that they are perpendicular to the long axis at a distance of 2 in. [50 mm] or more from the short edge of the plate. Locate the notch not less than 2 in. [50 mm] from the long edges of the plate.

8.3 When the notch cannot be ~~inserted~~ machined in the plate to be tested, it may be placed in a calibration plate of ultrasonically similar material. The calibration plate will be considered ultrasonically similar if the height of the first back reflection ~~through it of a straight-beam through its thickness~~ is within 25 % of that through the plate to be tested at the same instrument calibration. The calibration plate thickness shall be within 1 in. [25 mm] of the thickness of plates to be tested, for plates of 2 in. [50 mm] thickness and greater and within 10 % of plates whose thickness is less than 2 in. [50 mm].

8.4 For plate thicknesses greater than 2 in. [50 mm], ~~insert~~ machine a second calibration notch as described in 7.28.2 or 8.3, as applicable, on the opposite side of the plate.

9. Calibration Procedure

9.1 Plate 2 in. [50 mm] and Under in Thickness:

9.1.1 Place the search unit on the notched surface of the plate with the sound beam directed at the broad side of the notch and ~~position to obtain maximum amplitude~~ maximize the response from the first vee-path indication ~~which is clearly resolved from the initial pulse~~ indication. Adjust the instrument gain so that this reflection amplitude is at least 50 but not more than ~~75 %~~ 80 % of full screen height. Record the location and amplitude of this indication on the screen.

9.1.2 Move the search unit away from the notch until the second vee-path indication is obtained. ~~Position the search unit for maximum amplitude~~ Maximize the response and record the indication amplitude. Draw a line between the peaks from the two successive notch indications on the screen. This line is the distance amplitude ~~curve~~ correction (DAC) curve for this material and shall be a 100 % reference line for reporting indication amplitudes. Alternatively the second vee-path indication may be set to equalize its amplitude to the first vee-path signal using time-corrected gain.