

ULTRASONIC STRAIGHT BEAM EXAMINATION OF MATERIAL - ASTM A578/A578M (SA-578)

1.0 SCOPE

This procedure establishes the minimum requirements for the contact, ultrasonic shear wave examination of steel plate per ASTM A578/A578M. This procedure also meets the requirements of the ASME Boiler and Pressure Vessel Code, Section V, Article 5 and SA-578/SA-578M. This procedure may also be applied to forged components other than plate.

2.0 REFERENCES

- A. LANL Engineering Standards Manual STD-342-100, Chapter 13, Volume 6, WIGN 6-02, Attachment 1, Written Practice for Qualification and Certification of LANL Nondestructive Examination Personnel, latest revision.
- B. ASTM A578/A578M, Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications.
- C. ASME Boiler and Pressure Vessel Code, Section V, Article 5, Ultrasonic Examination Methods for Materials.
- D. ASME Boiler and Pressure Vessel Code, Section V, Mandatory Appendix I, Screen Height Linearity.
- E. ASME Boiler and Pressure Vessel Code, Section V, Mandatory Appendix I, Amplitude Control Linearity.
- F. ASME Boiler and Pressure Vessel Code, Section V, Article 5, SA-578/SA-578M, Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications.

3.0 REQUIREMENTS

- A. Personal protective equipment. Personnel performing examinations using this procedure often encounter work environments where personal protective equipment (PPE) is required. Typically, the minimum requirements are safety toe shoes and eye protection – this is a general statement, the examiner must verify what the facility specific PPE requirements are.
- B. Personnel. Personnel performing examinations per this procedure shall be certified as Level I, Level II, or Level III per reference 2.A. Level I personnel can perform this procedure and evaluate results as given in this procedure. Trainees may perform work under the direct supervision of a Level II or Level III, but under no circumstances may the trainee perform work independently.
- C. Instrument. Instrumentation used with this procedure shall be evaluated for screen height linearity and amplitude control linearity per references 2.C and 2.D, above. The Olympus Epoch 650 and Olympus X3 in conventional UT mode may be used with this procedure. Other instrumentation is permitted provided the required linearity evaluations have been completed and successful calibration can be performed.
- D. Search Unit. The search unit shall be 1 or 1-1/8 inch in diameter, or 1 inch square. A nominal 2.25Mhz is recommended, but other frequencies may be used.
- E. Couplant. Couplant shall not be detrimental to the surface to be examined, and shall be a gel (for instance, Ultragel) or water. Couplants used on nickel-based alloys shall not contain more than 250ppm of sulfur. Couplants used on austenitic stainless steel or titanium shall not contain more than 250ppm of halides (chlorides plus fluorides).

F. Calibration Standard

1. No specific calibration standard is used for this examination. Calibration is performed using the back surface reflection from the material being examined.

4.0 PROCEDURE

A. Calibration.

1. The instrument is calibrated using the first back wall reflection from the material being examined.
2. A back surface amplitude of at least 50% of full screen height (FSH) shall be obtained. A maximum amplitude of 90% FSH is allowed.

B. Examination – Surfaces and surface condition

1. The examination surface shall be sufficiently clean and free of scale to allow the examiner to maintain the first back surface reflection at 50% FSH.
2. General scanning is performed with the back surface reflection maintained between 50% and 90% FSH.
3. Minor gain adjustments are permitted during scanning to account for variations in surface roughness.

C. Examination – Grid Sample

1. The examination may be performed from either major surface of the plate. Scan one major surface of the plate on grid lines perpendicular and parallel to the rolling surface. The grid lines shall be on 9-inch centers. A smaller grid may be used at the discretion of the Specifier.
2. Measure grid lines from the center or one corner of the plate. Include an additional scan path within two inches of the edge of the plate.
3. When a discontinuity indication is detected, adjust the instrument to produce a first back surface reflection amplitude adjacent to the indication of 75% +/-5% FSH.
4. At each recorded discontinuity location, conduct a 100% examination of the volume under a 9-inch square which has the recorded discontinuity at its center. Conduct the examination in directions perpendicular and parallel to the major rolling direction.
5. Use of a smaller grid is permitted and shall be recorded in the report.

D. Examination – 100% Volumetric

1. The examination may be performed on either major surface of the plate. 100% volumetric examination is a special case and shall be implemented as required by the Specifier.

5.0 INDICATION EVALUATION AND RECORDING

A. Record all discontinuities or conditions causing complete loss of back reflection.

B. Record all indications greater than 50% of back reflection when accompanied by a 50% loss of back reflection.

1. Indications occurring mid-way between the initial pulse and the back reflection can cause a second reflection at the location of the first back reflection. When this condition is observed, it shall be investigated additionally using multiple back reflections.

2. When a grid scan is employed, and a recordable indication is detected, the full surface area of the squares adjacent to the location of the indication shall be scanned.
3. Sizing of the indication shall be performed by moving the transducer from the location of the indication peak amplitude to a point where the back reflection and the reflection from the indication are the same amplitude. Mark the plate to show the extent of the indication and record the location and dimensions on the report.

6.0 ACCEPTANCE STANDARD

- A. Any area where one or more discontinuities produce a total loss of back reflection accompanied by continuous indications on the same plane and cannot be encompassed within a 1-inch circle shall be rejected.
- B. Specifier requirements may require rejection of smaller indications, or employment of the larger indications permitted by ASME SA-578. Those specific criteria shall be noted in the examination report.

7.0 REPORTING

- A. The examination report shall contain the following minimum information:
 1. Component identification
 2. Component material
 3. Calibration standard identification
 4. Examination parameters, including:
 - a. Instrument and serial number
 - b. Search unit and cable, frequency, and dimensions
 - c. Beam angle
 - d. Couplant
 - e. Model and serial number of instrument
 - f. Reference gain
 - g. Damping and reject settings, if used
 - h. Surface(s) from which examination was performed
 - i. Map of indications detected, or areas cleared
 5. Any restricted access or inaccessible areas
 6. Identity and level of certification of examiner(s)