ULTRASONIC ANGLE BEAM EXAMINATION OF MATERIAL - ASTM A577/A577M (SA-577)

1.0 SCOPE

This procedure establishes the minimum requirements for the contact, ultrasonic shear wave examination of steel plate per ASTM A577/A577M. This procedure also meets the requirements of the ASME Boiler and Pressure Vessel Code, Section V, Article 5 and SA-577/SA-577M. 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 A577/A577M, Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates.

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-577/SA-577M, Standard Specification for Ultrasonic Angle-Beam Examination of Steel Plates.

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 have a nominal 45 degree angle (in steel). Active element dimensions shall be a minimum of ½ inch and a maximum of 1 inch. The minimum frequency shall be 2.25MHz – higher frequencies are recommended, but a 3:1 signal to noise ratio must be maintained.

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. The calibration standard shall be of the same P-number or same material as that under test.

a. The calibration standard shall be of the same product form and heat treatment.

b. Standard thickness

1) For material less than 2 inches in thickness, the standard shall be within 10% of the thickness of the material under test.

2) For material 2 inches or greater in thickness, the standard shall be within 1 inch of the thickness of the material under test.

c. The calibration reflector shall be a notch with depth not greater than 3% of the wall thickness of the material under test, and at least 1 inch long.

a. For material 2 inches or less in thickness, the notch shall be installed on the examination surface of the standard.

1) For material greater than 2 inches in thickness, notches shall be placed on both surfaces.

4.0 PROCEDURE

A. Calibration. The calibration process is based upon the thickness of the material to be examined.

1. For material 2 inches or less in thickness, place the search unit on the notched side of the standard, and obtain the full vee response from the notch. Adjust the signal amplitude to at least 50% and not more than 80% of full screen height (FSH). Record this amplitude on the report. This is the reference level.

2. For material greater than 2 inches up to 6 inches in thickness, obtain half-vee signal from the notch on the opposite side of the standard. Record this point per the Electronic Distance Amplitude Correction (eDAC) or Time Corrected Gain (TCG) function of the instrument. Repeat for the full vee and 1-1/2 vee notch signals. Create the eDAC or TCG from these points with a reference level of nominally 80% FSH.

3. For material greater than 6 inches in thickness, perform the steps in 4.A.2, above for the ½ vee and full vee responses.

B. Examination – Surfaces and surface condition

1. The examination surface shall be as specified by the Specifier.

2. The surface finish of the calibration standard shall be representative of the material being examined. The component may have a smoother finish than the calibration standard, but shall not be rougher than the standard as assessed visually.

C. Examination – Grid Sample

1. 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. Scan by placing the search unit near one edge and move the search unit along the grid line in a direction perpendicular to the edge to a location two plate thicknesses beyond the plate center. Repeat this scanning procedure on all grid lines from each of the four edges.
2. Measure grid lines from the center to one corner of the plate.
3. Position the search unit to obtain the maximum amplitude from each observed discontinuity.
4. Indications exceeding the reference level shall be recorded. Location, length, and amplitude shall be recorded. Unless directed otherwise, indications less than the reference level shall not be recorded.
5. 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.
6. Use of a smaller grid is permitted, and shall be recorded in the report.

D. Examination – 100% Volumetric

1. 100% volumetric examination is a special case, and shall be implemented as required by the Specifier.
2. 100% volumetric examination requires scans in four directions, perpendicular to the four edges of the plate or area of interest. On shapes, such as spherical surfaces, use of a grid is suggested to ensure that full coverage of all volumes in four directions is achieved.
3. For 100% coverage examinations there shall be an overlap equal to no less than 10% of the search unit width.

5.0 ACCEPTANCE STANDARD

A. All indications of relevant discontinuities greater than the reference level shall be rejected, unless determined to be laminar by investigation using the straight beam longitudinal technique.

B. Specifier requirements may require rejection of indications below the reference level established by this procedure. The specific parameters utilized must be noted in, or attached to, the test report.

6.0 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)