PROCEDURE COVER SHEET

PENNSYLVANIA POWER & LIGHT CO. SUSQUEHANNA STEAM ELECTRIC STATION	TP-ISI-307 Revision 0 Page 1 of 27
MANUAL ULTRASONIC EXAMINATION OF AUSTENITIC PIPING WELDS	

Effective Date 11-1-84 Expiration Date 11-1-86

Revised Expiration Date _____

PROCEDURE TYPE: PORC ____, NON-PORC ____, Alternate Review ____

PORC MTG. NO. _____ (If applicable)

Prepared by Ed Connell Date 10/17/84

Reviewed by Mariann Strenk Date 10/18/84

Recommended: R. A. Breslin Date 10/25/84
Section Head/Manager

F Keiser Date 10-26-84
Superintendent of Plant

8412270410 841219
PDR ADOCK 05000387
Q PDR

PROCEDURE DEVIATION

SITE:	PSI	ISI	PROCEDURE/REVISION NO.
Susquehanna, Unit 2	☐	☒	600-31/12

DEVIATION NO.	DEVIATION PAGE NO.:	DATE REQUESTED:	EXAMINATION PERIOD:
2	1 OF: 2	18 October 1984	1984

SECTION(S) AFFECTED:	PROCEDURE PAGE(S):
2,3,5,7 and 8	2,6, 18 and 23 OF: 24

EXAMINATION AREA(S) AFFECTED:

Manual ultrasonic examination of austenitic pressure piping welds

THIS DEVIATION SUPERCEDES DEVIATION 1

DEVIATION: It is requested that the paragraph(s) shown below in the above procedure/revision be deviated from as follows (use exact wording proposed, additional sheets may be used if necessary):

Change the first paragraph of Section 2 to read as follows:

Pressure piping welds and the adjacent base material in the nominal thickness range of greater than 0.4 to 5.0 inches and with a nominal diameter of 4.0 inches or greater shall be examined.

Change (1) and the first paragraph of (2) under 3. APPLICABLE DOCUMENTS to read as follows:

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1980 Edition with Addenda through Winter 1981, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1980 Edition with Addenda through Winter 1981, "Nondestructive Examination," with the exception of the following:

JUSTIFICATION: Reason change is necessary and what it is intended to accomplish (use additional sheets if necessary):

Changes made at the request of Pennsylvanis Power & Light Company (PP&L)

APPROVED
Nuclear Support
Date: 10/25/84
Title: Supr - Nuclear Maint. Support
Signature: R.A. Breslin

SA: FLD
DATE: 10/25/84
DEPARTMENT DIRECTOR: [signature]
DATE: 19 Oct 84
QA MANAGER: [signature]
DATE: 19 Oct 1984
TECHNICAL REVIEW: [signature]
DATE: 19 Oct. 1984
REQUESTED BY: DWT [signature]

Change 5.6 to read as follows:

Couplant

(1) USP-grade glycerine or deionized water (with or without wetting agent) shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure.

(2) USP-grade glycerine shall be certified for sulfur content and total halogens in accordance with ASTM SD-129 and ASTM SD-808 of Article 24, Section V. Only ultrasonic couplants meeting PP&L requirements shall be used.

The following metals shall not be known added constituents of the material: silver, zinc, cadium, mercury, gallium, indium, lead, tin, arsenic, antimony, and bismuth. Deionized water, when used, shall be supplied by the customer.

(3) Other compounds, which in the opinion of the Level II or III examiner provide adequate ultrasonic coupling, may be used upon concurrence of the Project Manager responsible for the examination.

(4) Couplant materials used for examination shall be the same as used for the calibration.

Change the first paragraph of 7.1.1 to read as follows:

Circumferential and longitudinal full-penetration butt welds with a nominal thickness of greater than 0.4 to 5.0 inches and a nominal diameter of 4.0 inches or greater shall be examined from the outside surface of the pipe.

Change the first paragraph of 7.1.2 to read as follows:

Full-penetration butt welds of branch connections in pressure piping greater than 0.4 to 5.0 inches nominal thickness and a nominal diameter of 4.0 inches or greater shall be examined from the outside surface of the pipe.

Add the following as the fifth paragraph under Section 8:

The investigation of ultrasonic reflectors not readily attributable to geometry should be accomplished, but not limited to, taking profiles and additional thickness measurements at the location of the indication, plotting the indication on a scale drawing, reviewing previous baseline data including that of other NDE methods used or re-examination using different angles.

SOUTHWEST RESEARCH INSTITUTE
NUCLEAR PROJECTS
OPERATING PROCEDURE

SwRI-NDT-600-31
Revision 12
June 1984

Title

MANUAL ULTRASONIC EXAMINATION OF AUSTENITIC PRESSURE PIPING WELDS

EFFECTIVITY AND APPROVAL

Revision 12 of this procedure became effective on 11 June 1984. Other revisions of the base document may be effective concurrently.

SA

Approvals

Written By	Date	Technical Review	Date
D W Farwell	1 June 1984	E A Rancher	8 June 1984
Manager of Q.A.	**Date**	**Cognizant Director**	**Date**
R Engelhardt	6/8/84	Wayne I. Black	6/11/84

The following information may be used for convenience. Completion of this portion is not mandatory.

Deviation No.								
Date Effective								
Procedure Section(s) Affected								

Notes:

APPROVED Date: 10/12/84
Nuclear Support
Title: Supv - Nuclear Maint Support
Signature: R. A. Breslin

MANUAL ULTRASONIC EXAMINATION OF AUSTENITIC PRESSURE PIPING WELDS

SwRI-NDT-600-31

1. PURPOSE

This procedure provides the technical information and detailed steps required to ensure a complete, accurate manual ultrasonic examination of similar or dissimilar metal welds and adjacent base material in clad or unclad austenitic pressure piping in accordance with the applicable ASME Boiler and Pressure Vessel Codes.

2. SCOPE AND APPLICATION

Pressure piping welds and the adjacent base material in the nominal thickness range of greater than 0.4 to 5.0 inches shall be examined.

Manual, contact, pulse-echo, shear-wave angle-beam, and longitudinal-wave straight-beam ultrasonic techniques shall be utilized for the examination of welds and adjacent base material in extruded austenitic pressure piping.

Similar and dissimilar metal circumferential and longitudinal pipe welds and branch connection butt welds to be examined shall be as specified in the applicable SwRI Examination Plan.

3. APPLICABLE DOCUMENTS

(1) ASME Boiler and Pressure Vessel Code, Section XI, 1980 Edition, with Addenda through Winter 1980, "Rules for Inservice Inspection of Nuclear Power Plant Components"

(2) ASME Boiler and Pressure Vessel Code, Section V, 1980 Edition, with Addenda through Winter 1980, "Nondestructive Examination," with the exception of the following:

Figure T-546.1 of Article 5, Section V, requires the basic calibration block for the average weld thickness (t) up to and including 1 inch to be 3/4 inch or t. Paragraph 5.3 of this procedure requires the basic calibration block to be either t, no more than 25% less than t, or closer in thickness to t than the 3/4-inch alternate thickness allowed by Article 5 for t up to and including 1 inch. This will assure a more accurate calibration than the Article 5 basic calibration block design allowed by Code.

(3) SwRI Nuclear Quality Assurance Program Manual (NQAPM)

3.1 Calibration and Examination Records

SwRI-NDTR Form No.	Revision Date
17-18	7-31-75
17-19	12-1-83
17-25	7-10-80
17-37	2-18-80
17-89	8-19-80
17-90	8-19-80

4. RESPONSIBILITY

(1) The Director of the Department of Engineering Services, Quality Assurance Systems and Engineering Division, shall be responsible for the preparation, review, approval, and control of this procedure.

(2) The Project Manager shall be responsible for the implementation of this procedure in accordance with the NQAPM specified in the applicable SwRI Project Plan.

(3) The examiner shall be responsible for implementing the requirements of this procedure.

(4) The Manager of the Support and Administration Section, Quality Assurance Systems and Engineering Division, shall be responsible for storage of records generated in accordance with this procedure.

5. PERSONNEL AND EQUIPMENT

5.1 Personnel Certification

Personnel performing ultrasonic examinations shall be certified in accordance with SwRI NQAP 11-1, "Special Process Control."

5.2 Reference Block

Reference blocks used for screen distance calibration and verification shall be of the same material as the production material; i.e., stainless steel or carbon steel, and shall be one of the following: (1) SwRI Half-Round, (2) AWS Type DC, or (3) IIW.

5.3 Basic Calibration Block for Circumferential, Longitudinal, and Branch Pipe Connection Welds

Side-drilled basic calibration hole reflectors, in accordance with Section V of the ASME Boiler and Pressure Vessel Code, shall be placed in a block manufactured from the same product form, and material specification and heat treatment as one of the materials being joined. The calibration material shall be determined by the production piping material to which the search unit is applied.

The basic calibration block thickness shall be determined by the average weld thickness of the piping to which the search unit is applied and Article 5, Section V. When a basic calibration block of the same thickness as t is not available and where t is 1 inch or less, the basic calibration block thickness shall be no more than 25% thinner than t or shall be closer to t than the 3/4-inch thick alternate calibration block allowed by Article 5.

Where the component material is clad, the block shall be clad by the same welding procedure as the production part. Where the automatic method is impractical, deposition of clad shall be by the manual method.

The surface finish of the basic calibration block shall be representative of the surface finish of the piping.

Flat basic calibration blocks or blocks of essentially the same curvature as the part to be examined may be used when contact surface curvatures are greater than 20 inches in diameter.

A curved basic calibration block shall be used to establish distance amplitude correction (DAC) curves for examinations on contact surfaces in the range of curvature from 0.9 to 1.5 times the basic calibration block diameter, when contact surface curvature is 20 inches in diameter or less.

The curvature of the main run pipe shall be used to establish the requirements for the basic calibration block curvature for the examination of branch connection welds.

Approved drawings of basic calibration blocks to be used in accordance with this procedure are contained in the applicable SwRI Examination Plan.

5.4 Search Units

Search units shall be selected from the following tables:

(1) Straight-Beam

Average Weld Thickness	Nominal Search Unit Size
2.0" or less	1/4" Round
1.0" to 3.0"	3/8" Round
2.0" to 4.0"	1/2" Round
3.0" to 5.0"	3/4" to 1" Round

(a) The nominal straight-beam longitudinal-wave search unit frequency for austenitic piping shall be 1.5 MHz or 2.25 MHz, and 2.25 MHz for carbon steel.

(2) Angle-Beam

Average Weld Thickness	Nominal Search Unit Size
1.0" or less	1/4" x 1/4", 1/4" Round
0.4" to 2.0"	3/8" x 3/8", 3/8" Round
0.75" to 4.0"	1/2" x 1/2", 1/2" Round
2.0" to 5.0"	1/2" to 1", 3/4" Round

NOTE

The nominal angle-beam shear-wave search unit size for austenitic materials should be 3/8" round or 3/8" x 3/8" when thickness and curvature permit its usage.

(a) The exit point of the sound beam and the actual refracted beam angle of shear-wave search units shall be determined on an IIW block. The exit point shall be marked on the search unit wedge.

(b) The nominal angle-beam shear-wave search unit frequency for examination of austenitic piping shall be 1.5 MHz.

(c) The nominal angle-beam shear-wave search unit frequency for the carbon steel side of dissimilar piping welds shall be 2.25 MHz.

(d) Search unit wedges shall be fabricated to produce 45° ±2° refracted shear-wave when examining circumferential piping welds. A 60° ±2° refracted shear-wave shall be used only to augment the examination.

(e) For examination of longitudinal piping welds or branch connection welds, search unit wedges shall be fabricated to produce 45° ±2° refracted shear waves.

5.5 Ultrasonic Instrument

The examiner shall use a Sonic FTS Mark I ultrasonic instrument which shall be aligned and shall display a valid alignment calibration tag as required by NQAP 10-1.

5.6 Couplant

(1) USP-grade glycerine or deionized water (with or without wetting agent) shall be used when performing ultrasonic calibrations and examinations in accordance with this procedure.

(2) USP-grade glycerine shall be certified for sulfur content and total halogens in accordance with SD-129 and SD-808 of Article 24, Section V. The residual amount of total sulfur or halogens shall not exceed 1% by weight. Deionized water, when used, shall be supplied by the customer.

(3) Couplant materials used for examinations shall be the same as used for the calibration.

5.7 Thermometer

The thermometer to be used for measuring the calibration block and component temperatures shall be calibrated and certified and shall display a valid calibration tag as required by NQAP 10-1.

6. CALIBRATION METHOD

6.1 Instrument Linearity

Ultrasonic instrument linearity shall be verified onsite as a minimum within one day before and one day after examining all welds to be examined with an instrument during an outage or every three months, whichever is less, in accordance with Paragraphs 6.1.1 and 6.1.2. Additionally, if a calibration verification does not meet the requirements of 6.6.3 of this procedure, an instrument linearity check must be performed prior to continuing

examinations. Data required shall be recorded on the SwRI Instrument Linearity Verification Record and the sheet number shall be referenced on each applicable SwRI Sonic Instrument Calibration Record.

NOTE

The setting of the damping control shall be recorded in REMARKS on the SwRI Instrument Linearity Verification Record. The damping control shall be in the same position during linearity verification, calibrations and examinations or a new linearity verification shall be performed.

6.1.1 Amplitude Linearity

(1) Position a shear-wave search unit on a calibration block to obtain indications from the 1/2T and 3/4T holes.

(2) Adjust the search unit position to give a 2:1 ratio between the two indications, with the larger indication (1/2T hole) set at 80% of full screen height (FSH) and the smaller indication (3/4T hole) at 40% of FSH.

(3) Without moving the search unit, set the larger indication to 100% of FSH; record the amplitude of the smaller indication, estimated to the nearest 1% of FSH.

(4) Successively set the larger indication from 100% to 20% of FSH in 10% increments (or 2 dB steps if a fine control is not available); observe and record the smaller indication estimated to the nearest 1% of FSH at each setting. The reading must be 50% of the larger amplitude within 5% of FSH.

6.1.2 Amplitude Control Linearity

(1) Position a shear-wave search unit on a calibration block to obtain maximum amplitude from the 1/2T hole.

(2) Without moving the search unit, set the indication to the required percent of FSH and increase or decrease the dB as specified below. The estimated signal shall be recorded to the nearest 1% of FSH and shall fall within the limits of the following table:

Indication Set at % of FSH	dB Control Change*	Indication Limits, % of FSH
80%	-6dB	32 to 48%
80%	-12dB	16 to 24%
40%	+6dB	64 to 96%
20%	+12dB	64 to 96%

*Minus denotes decrease in amplitude; plus denotes increase.

6.2 Calibration

The ultrasonic calibration shall be completed prior to the examination.

The REJECT control shall be maintained in the 0 position.

The FREQ MHz control shall be turned to 1 when a 1.5 MHz search unit is used and to 2 with a 2.25 MHz search unit.

The instrument gain controls shall not be changed once the primary reference response has been established.

The centerline of the search unit shall be at least 1-1/2 inches from the nearest side of the block. Rotating the beam into the corner formed by the hole and the side of the block may produce a higher amplitude at a longer beam path. This beam path shall not be used for calibration.

The type and length of the search unit cable shall be recorded on the SwRI Sonic Instrument Calibration Record, and all other information blocks on the form shall be filled in.

The nominal piping production material thickness shall be used to determine the correct calibration block and search units for examinations with geometric restrictions such as piping or components which may be thicker than the nominal pipe size, examinations limited to one side of the weld or wide weld crowns. The Level II or III examiner shall ensure that complete coverage of the examination area is obtained. Additional calibration vee-path positions and larger screen sizes which may be required to assure this coverage shall be used for the examination from either side of the weld.

6.2.1 Temperature

The temperature of the calibration block shall be within 25°F of the component temperature and shall be recorded on the SwRI Sonic Instrument Calibration Record for the initial calibration and each verification.

The surface temperature of the component to be examined shall be taken prior to performing an examination and shall be recorded on the applicable SwRI Examination Record.

6.3 Calibration for Circumferential Butt Welds

6.3.1 Straight-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/4t beyond the thickest production material to which the search unit is applied.

Observing back reflections from the applicable reference block, set up the required linear sound path distance along the screen baseline.

6.3.2 Angle-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/8 vee-path past the anticipated examination range.

Observing radius echoes from the applicable reference block, set up the required linear sound path distance along the screen baseline.

If a 60° shear-wave angle-beam is required to augment the examination, and the same instrument is used for both 45° and 60° examinations, the screen distance calibration shall be conducted as follows:

(1) The screen distance size shall be determined by the angle-beam search unit requiring the longer examination range.

(2) Position the 45° search unit on the appropriate reference block and record all required reference block entries on the appropriate SwRI Sonic Instrument Calibration Record.

(3) Without changing the calibrated screen distance, repeat step (2) with the 60° search unit.

(4) No attempt shall be made to compensate for the delay difference between 45° and 60° screen distance calibrations. This difference shall be considered when resolving indications.

6.3.3 Straight-Beam Distance Amplitude Correction

A DAC curve shall be established by utilizing responses from the basic calibration holes.

6.3.3.1 Production Material 1 Inch or Less in Thickness

(1) Position the straight-beam search unit to obtain maximum response from the 1/2T hole, and set this response to 80% ±5% of FSH.

(2) Draw a straight horizontal line on the instrument screen at this amplitude to extend a distance equal to the nominal thickness of the production material.

(3) Signal amplitudes for indications recorded shall be referenced as a percentage of this line.

6.3.3.2 Production Material Greater Than 1 Inch in Thickness

(1) Position the straight-beam search unit to obtain maximum response from the calibration hole selected from the following, which produces the highest amplitude:

Hole
1/4T
1/2T (if present)
3/4T

(2) Set this response to 80% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(3) Obtain maximum response from the remaining calibration holes; mark and join all amplitude points with a smooth curved line that shall extend 1/4T beyond the last qualified calibration point.

6.3.4 Angle-Beam Distance Amplitude Correction

If a curved block is used, DAC curves for the examination of circumferential welds shall be constructed by utilizing the responses from the holes oriented perpendicular to the axis of the basic calibration block.

6.3.4.1 Material 1 Inch or Less in Thickness

(1) Position the 45° search unit to obtain maximum response from the calibration hole and vee-path position, selected from the following, that produces the highest amplitude:

Hole	Vee-Path Positions
1/2T	2/8, 6/8, 10/8

(2) Set this response to 80% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(4) If a 60° shear-wave angle-beam is required to augment the examination, repeat steps (1) through (3) using a 60° search unit.

EXCEPTIONS

If the configuration of the weld is such that the 45° search unit sound-beam is not directed into the A-B-E-F intersect (as depicted in Figure 1), a 14/8 vee-path calibration shall be accomplished with the 45° search unit.

6.3.4.2 Material Greater Than 1 Inch to 3 Inches in Thickness

(1) Position the 45° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, that produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Set this response to 80% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(4) If a 60° shear-wave angle-beam is required to augment the examination, repeat steps (1) through (3) using a 60° search unit.

EXCEPTION

If the configuration of the weld is such that a 45° search unit beam is not directed into the A-B-E-F intersect (as shown in Figure 1), a 13/8 vee-path calibration shall be accomplished with the 45° search unit.

6.3.4.3 Material Greater Than 3 Inches to 5 Inches in Thickness

(1) Position the 45° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, that produces the highest amplitude:

Hole	45° Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Set this response to 80% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

(4) If a 60° shear-wave angle-beam is required to augment the examination, repeat steps (1) through (3) with a 60° search unit utilizing the following vee-path positions:

Hole	60° Vee-Path Positions
1/4T	1/8
1/2T (if present)	2/8, 6/8
3/4T	3/8, 5/8

6.3.4.4 Clad Piping

(1) Position the 45° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, that produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	1/8
1/2T (if present)	2/8
3/4T	3/8

(2) Set this response to 80% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall extend 1/8 vee-path beyond the last qualified calibration point.

(4) If a 60° shear-wave angle-beam is required to augment the examination, repeat steps (1) through (3) with a 60° search unit.

6.4 Calibration for Branch Connection and Longitudinal Seam Welds

6.4.1 Straight-Beam Distance Calibration

The straight-beam distance calibration shall be the same as that described in Paragraph 6.3.1.

6.4.2 Angle-Beam Distance Calibration

The screen distance chosen shall be the shortest applicable size to include at least 1/8 vee-path past the anticipated examination range.

Observing the radius echoes from the applicable reference block, obtain the required linear sound path distance along the screen baseline.

6.4.3 Straight-Beam Distance Amplitude Correction

The straight-beam distance amplitude correction shall be the same as that described in Paragraph 6.3.3.

6.4.4 Angle-Beam Distance Amplitude Correction

If a curved block is utilized, DAC curves shall be constructed by utilizing the responses from the basic calibration holes oriented axially with the basic calibration block.

6.4.4.1 Material 1 Inch or Less in Thickness

(1) Position the 45° search unit to obtain maximum response from the calibration hole and vee-path position, selected from the following, that produces the highest amplitude:

Hole	Vee-Path Positions
1/2T	2/8, 6/8, 10/8

(2) Set this response to 80% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

6.4.4.2 Material Greater Than 1 Inch to 5 Inches in Thickness

(1) Position the 45° search unit to obtain maximum response from the calibration hole and the vee-path position, selected from the following, that produces the highest amplitude:

Hole	Vee-Path Positions
1/4T	7/8
1/2T (if present)	2/8
3/4T	3/8, 5/8

(2) Set this response to 80% ±5% of FSH and mark the amplitude on the screen. The gain controls shall not be adjusted once this primary reference response has been established.

(3) Obtain maximum response from the remaining vee-path positions; mark and join all amplitude points with a smooth curved line that shall not extend more than 1/8 vee-path beyond the last qualified calibration point.

6.4.4.3 Clad Piping

This calibration shall be the same as that described in Paragraph 6.3.4.4, steps (1) through (3), using the 45° search unit only.

6.5 Secondary DAC Calibrations

If all points on the DAC curve do not appear at 20% of FSH or greater, a secondary DAC curve shall be constructed as follows:

(1) All secondary DAC curves shall contain at least 2 points.

(2) The DAC point at 20% of FSH or greater, adjacent to a DAC point that falls below 20% of FSH, shall be brought to the primary reference level and marked on the instrument screen. The adjacent point(s), previously at less than 20% of FSH, shall be marked on the screen and all points connected with a smooth curved line. The gain setting for this secondary DAC curve shall be recorded on the appropriate SwRI Sonic Instrument Calibration Record.

EXCEPTIONS

When the first DAC point is the only point above 20% of FSH, the next highest point shall be brought to the primary reference level and marked on the instrument screen. The other points previously at less than 20% of FSH shall be marked on the screen and all points connected with a smooth curved line.

It shall not be necessary to construct a secondary DAC when the calibration consists of a 2/8, 6/8, and 10/8 vee-path.

6.6 Calibration Verification

6.6.1 Sweep Range and DAC Curve Verification

Sweep range calibration shall be verified on the appropriate reference block; and DAC curve calibration, if applicable, shall be verified on the appropriate basic calibration block:

(1) Prior to a series of examinations

(2) With any substitution of the same type or length of search unit cable

(3) With any substitution utilizing the same type of power source: e.g., a change of batteries

(4) At least every 4 hours during the examination

(5) At the completion of a series of examinations

(6) Whenever the validity of the calibration is in doubt

6.6.2 Verification of Calibration Reflectors at Scanning Speed

The examiner shall verify the presence of the calibration reflector at scanning speed when required.

NOTE

It is not necessary to assure that this check confirms the signal amplitude at 100% of reference level, but merely to demonstrate that the signal from the calibration reflectors are readily observable at scanning speed.

The following statement shall be documented on the SwRI Sonic Instrument Calibration Record and initialed:

"Calibration reflectors have been verified at scanning speed."

6.6.3 Calibration Changes

(1) Perform the following if any point on the DAC curve has decreased more than 20% of FSH or 2 dB in amplitude, or any point on the sweep line has moved more than 10% of the sweep division reading or 5% of full sweep whichever is greater:

(a) Void all examinations referring to the calibration in question and performed after the last valid calibration verification.

(b) Conduct a new calibration.

(c) Reexamine the areas for which examinations have been voided.

(2) Perform the following if any point on the DAC curve has increased in amplitude more than 20% of FSH or 2 dB:

(a) Correct the calibration.

(b) Reexamine all indications recorded since the last valid calibration verification.

(c) Enter proper values on a new SwRI Examination Record.

6.6.4 Recalibration

Substitution of any of the following shall be cause for recalibration:

(1) Search unit transducer or wedge

(2) Search unit cable type or length

(3) Ultrasonic instrument

(4) Examination personnel

(5) Couplant

(6) Change in type of power source; e.g., a change from alternating to direct current

7. EXAMINATION

7.1 Examination Areas

7.1.1 Circumferential and Longitudinal Butt Welds in Piping

Circumferential and longitudinal full-penetration butt welds with a nominal thickness of greater than 0.4 to 5.0 inches shall be examined from the outside surface of the pipe.

Scanning of the weld and base material shall be adequate to ensure complete coverage for 1/3t from the inside surface of the pipe as shown in Figure 1. The base material shall be examined for a distance of 1/4 inch as measured from the outside surface fusion line on each side of the weld.

Class 1 longitudinal welds shall be examined along the entire length of the weld during the preservice examination and for at least one pipe-diameter length or 12 inches, whichever is less, from the fusion line of the intersecting circumferential weld during inservice examinations.

Class 2 longitudinal welds shall be examined for at least 2-1/2t length from the fusion line of the intersecting circumferential weld during preservice and inservice examinations.

7.1.2 Butt Welds of Branch Connections

Full penetration butt welds of branch connections in pressure piping greater than 0.4 to 5.0 inches nominal thickness shall be examined from the outside surface of the pipe.

Scanning of the weld and base material shall be adequate to ensure complete coverage for 1/3t from the inside surface of the pipe. The base material shall be examined for a distance of 1/4 inch measured from the outside surface fusion line on the main run pipe side of the weld.

7.2 Surface Condition

The contact surfaces shall be free from weld spatter, roughness, or other conditions which interfere with free movement of the search unit or impair the transmission of ultrasound.

7.3 Indication Length Zero Reference (Lo) Location

Areas to be examined in accordance with this procedure shall have an Lo marked in accordance with the applicable revision of SwRI Nuclear Projects Operating Procedure IX-FE-103.

7.4 Scanning

When practicable, scanning shall be performed at a minimum gain setting of 2 times the reference level sensitivity.

Instrument gain setting for scanning shall be determined on the basic calibration block as follows for each primary reference level utilized:

(1) With the instrument at the primary reference level, manipulate the search unit on the basic calibration block to obtain a signal of 40% of FSH from a calibration reflector (side-drilled hole).

(2) Add 6 dB gain by utilizing the 6 dB switch (if present), the fine gain control, or a combination of the fine and coarse gain controls and choose any method that yields a signal response within ±2 dB of 80% FSH.

(3) This amplitude and method shall be recorded on the SwRI Sonic Instrument Calibration Record and shall be used during the valid calibration period for all scanning at 2 times the reference level sensitivity.

Scanning overlap shall be a minimum of 25% of the search unit piezoelectric element dimension perpendicular to the direction of the scan.

The search unit movement rate shall not exceed 3 inches per second.

7.5 Thickness Measurements and Lamination Scan

7.5.1 Thickness Measurements

Thickness measurements shall be taken at a minimum of three points adjacent to Lo for longitudinal and circumferential welds (on the centerline of the weld and at one point in the base material on each side of the weld). Thickness measurements shall be taken at a minimum of two points adjacent to Lo for branch connection welds (one on the base material of the main run pipe, and one on the base material of the branch connection). If these measurements cannot be taken adjacent to Lo, the location of the measurements shall be recorded on the appropriate SwRI Examination Record.

Screen distance calibration for this examination shall be conducted in accordance with Paragraph 6.3.1. These measurements shall be recorded on the appropriate SwRI Examination Record.

7.5.2 Base Material Lamination Scan

Before the angle-beam examination, a lamination scan using longitudinal-wave shall be performed. This scan shall cover as much as practical of the area through which the angle-beam is later to be passed. The lamination scan shall be conducted as follows:

(1) Screen distance calibration for this examination shall be conducted in accordance with Paragraph 6.3.1.

(2) Scanning sensitivity shall be as required to maintain the first back reflection at an amplitude of between 50% and 90% of FSH.

(3) To record an intermediate indication, a back reflection signal shall be obtained from an indication-free area and the instrument gain control adjusted until this signal is at 75% ±5% of FSH; record the intermediate indication when its amplitude is equal to the remaining back reflection. If total loss of back reflection accompanies the intermediate echo, the area of total loss of back reflection shall be recorded on the appropriate SwRI Examination Record.

EXCEPTION

A base material lamination scan need not be conducted on components which have received a lamination scan during a previous examination and laminar reflectors were not recorded.

7.6 Examination of Circumferential and Longitudinal Butt Welds in Piping

7.6.1 Angle-Beam Examination for Indications Parallel with the Weld

Angle-beam examinations for circumferential welds shall be accomplished using the required refracted shear-wave from both sides of the weld. For this examination, the sound-beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4.

Angle-beam examinations for longitudinal welds shall be accomplished using the required refracted shear-wave from both sides of the weld.

For this examination, the sound-beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for this examination shall be in accordance with Paragraphs 6.4.2 and 6.4.4.

7.6.2 Alternate Examination

A shear-wave angle-beam examination shall be conducted as required to assure complete coverage from both sides of the circumferential or longitudinal weld. Any areas of the weld not receiving complete coverage from both sides shall be examined from one side of the weld with the required shear-wave(s) and a straight-beam longitudinal-wave applied to the surface of the weld crown in the affected areas. Calibration for the longitudinal-wave search unit shall be in accordance with Paragraphs 6.3.1 and 6.3.3.

7.6.3 Angle-Beam Examination for Indications Perpendicular to the Weld

A shear-wave angle-beam examination shall be conducted on each weld by placing the search unit on the weld with the sound beam directed into and parallel with the weld to detect indications perpendicular to the weld. The entire length and width of the weld shall be scanned with the search unit beam directed in this manner, once in a clockwise and once in a counterclockwise direction.

For austenitic materials, the search unit shall then be placed on the base metal with the search unit sound beam directed tangentially into the weld at a 45° ±10° angle. The entire length of the weld and adjacent base material shall be scanned with the search unit beam directed in this manner on each accessible side of the weld. The search unit shall then be turned 90° and the scans repeated. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4 for circumferential welds, and Paragraphs 6.4.2 and 6.4.4 for longitudinal welds and branch pipe connection welds. Geometric root ripple echoes occurring at the same metal path distance as flaws adjacent to the weld root are to be expected. A flaw must be distinguished from root ripple by the greater echo amplitude of a flaw compared to the amplitude of the root ripple at the same location. A flaw indication adjacent to the weld root tends to mask out several facets of the root ripple and travels along the baseline through the root ripple package.

7.6.4 Angle-Beam Examination for Indications in Austenitic Base Material Perpendicular to the Weld

A shear-wave angle-beam examination shall be conducted on 1t of base material adjacent to each weld by placing the search unit on the base material with the sound beam directed parallel to the weld to detect indications perpendicular to the weld. The base material within 1t of the weld shall be

scanned with the search unit directed in this manner, once in a clockwise direction and once in a counterclockwise direction. Calibration for these examinations shall be in accordance with Paragraphs 6.3.2 and 6.3.4 for circumferential welds, and Paragraphs 6.4.2 and 6.4.4 for longitudinal welds and branch pipe connection welds.

7.7 Examination of Butt Welds of Branch Connections

7.7.1 Straight-Beam Examination of Welds

A straight-beam examination shall be performed on the surface of the weld crown when possible. Calibration for the straight-beam examination shall be in accordance with Paragraphs 6.3.1 and 6.3.3.

7.7.2 Angle-Beam Examination for Indications Parallel with the Weld

A shear-wave angle-beam examination shall be accomplished from the main run pipe side of the weld. For this examination, the sound beam shall be directed perpendicularly into the weld to detect indications parallel with the weld. Calibration for these examinations shall be in accordance with Paragraphs 6.4.2 and 6.4.4.

7.7.3 Angle-Beam Examination for Indications Perpendicular to the Weld

The angle-beam examination for indications perpendicular to the weld shall be the same as the examination described in Paragraphs 7.6.3 and 7.6.4.

7.8 Postexamination Cleaning

Arrangements shall be made with the customer for postexamination removal of couplant materials.

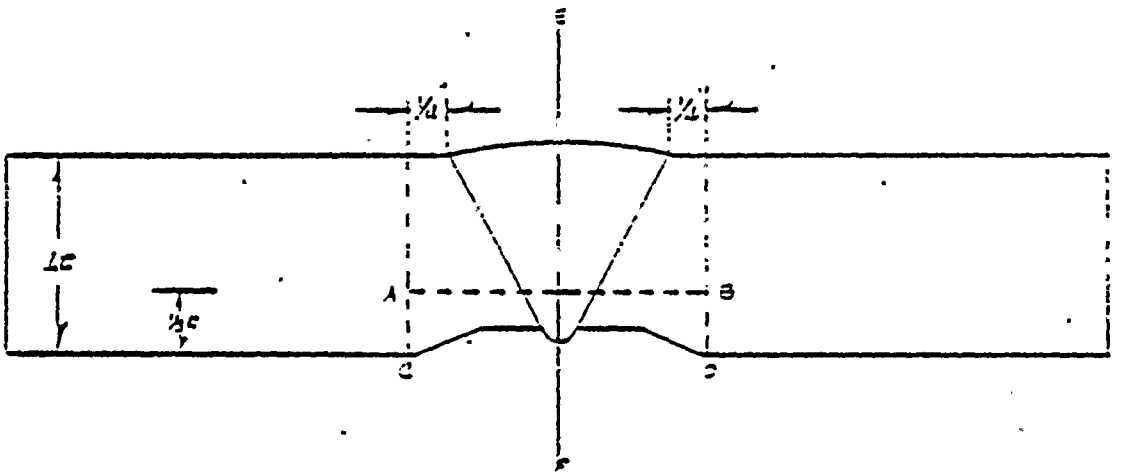
8. RECORDING CRITERIA

Indications shall be recorded in accordance with the techniques outlined in the applicable revision of SwRI Nuclear Projects Operating Procedure IX-FE-117.

Ultrasonic reflectors producing a response greater than 50% of the reference level shall be recorded on the appropriate SwRI Ultrasonic examination record and investigated.

The end points of the indication as determined by 100% DAC shall be recorded.

FIGURE 1



EXAM VOLUME A-B-C-D

EXAMINATION AREA FOR CIRCUMFERENTIAL
AND LONGITUDINAL WELDS