MANUAL ULTRASONIC EXAMINATION PROCEDURES FOR VESSEL NOZZLE SAFEENDS AND CLOSURE HEAD NOZZLE-FLANGE WELDS

LONG ISLAND LIGHTING COMPANY

SHOREHAM NUCLEAR POWER STATION

UNIT 1

Prep'd by _____

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					NES	LILCO
1	7/27/79	Changed; 2.1(4) & (5), 5.2.3, 5.3.1, 6.1(2) & (3), 7.3.2, 5.2.7, 7.3.3, and Figures 2, 5, 6, and 7. Deleted; 2.3 Added; 5.1.3 CRA-972	General revision to incorporate latest NES requirements. Incorporated Field Change 1	F. T. Carr	FTC	8/7/79
2	1/16/81	Para 1.1 Added Item 6 Para 1.2.1 Revised Para 1.2.3 Added Para 1.4 & 1.5 Changed to Figures 1 through 7 Para 2.1.3, 2.1.4, 2.1.5, Updated Para 5.2 Revised Para 6.1 Revised Para 6.2 Added Item 10 Para 7.1 Revised Para 7.2 Added & renumbered accordingly Section 8, 9, 10 Revised Added Fig. 7 Delete Fig. 9, 10, 11, 12, 13, 14, & Table 1 Added new Figs. and numbered accordingly CRA 1670	Update procedure	S. L. Foote SLF	M.S.	

REV. NO.	DATE	DESCRIPTION	REASON	PRE'D BY	APPROVED BY	
					NES	LILCO
3	2/3/81	Para. 4.1.2 added ...Level I Trainee Para. 4.2.2 changed submitted to available Para. 5.2.1 deleted last sentence Para. 5.3.4 added ...when required Para. 6.1(5) revised Para. 6.1(8) added ...when required Para. 6.2(10) added feedwater Para. 8.2 - typo Para. 8.4.2 revised title Para. 8.4.3 revised title Para. 8.4.4 deleted and revised Para. 10.1.1(1) deleted (as a percent of T) Para. 10.1.2(4) deleted ...hole representing T Para. 10.1.3 revised Para. 10.1.5 deleted (as a percent of T) Revised to upstream and downstream	Customer Comment	S. L. Foote	[illegible]	

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				S. L. Foote	NES	LILCO
3	2/3/81	Para. 11.1 changed shall to may Para. 11.2 changed examiner to NES	Customer Comment			
4	8/28/81	Para. 5.3.4 deleted Where required... Deleted para. 7.5.5 Renumbered remainder of section Revised para. 8.4 Revised para. 10.1.6 Revised Figure 7 Revised Figure 12 Refer to CRA 2086	Incorporate all previous field changes			10-7-81
5	12-11-81	Procedure completely revised. Due to the extent of Technique and Format change, previous Revision numbers will not be illustrated on the boarder of the revised paragraphs.	To upgrade the examination Technique			12/31/81
6	2/16/82	Delete pg. 17 and renumber CRA 2352	Extra page inserted			3-30-82

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REVISION LOG

NUCLEAR ENERGY SERVICES, INC.

DOCUMENT NO. 80A0475

REV. NO.	DATE	PAGE NO.	DESCRIPTION	APPROVAL
7	6/1/83	7	Para. 1.4.1, 1.4.2 and 1.5 change figures	
			1 through 9 to read 1 though 10	
			Para. 2.10 add Applicable...examinations	
		9	Para. 5.2.3 Note reworded.	
			Para. 5.2.8 reworded	
		21-28	Figures 2,3,5,6,8,9 revised.	
		29	Added new Figures 10.	
		37-38	Added new Figures 18,19.	
			Field changes 1 through 5 were incorporated	
			Refer to CRA No. 3400	

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MANUAL ULTRASONIC EXAMINATION PROCEDURES FOR VESSEL NOZZLE SAFE ENDS AND CLOSURE HEAD NOZZLE-FLANGE WELDS

1. SCOPE

1.1 AREA OF EXAMINATION

This document covers the manual ultrasonic examination procedures for:

1. Main Steam (N3) nozzle to transition piece welds.
2. Jet Pump Instrumentation (JP1) (N8) nozzle to safe end piece welds.
3. Control Rod Drive (CRD) (N9) return nozzle to cap weld.
4. Core Differential Pressure (ΔP) (N10) nozzle to safe end piece weld.
5. Closure Head Vent (N7) and Instrumentation (N6) nozzle to flange welds.
6. Feedwater (N4) nozzle to safe end welds.
7. Core Spray (N5) nozzle to safe end welds.
8. Recirculation Outlet (N1) nozzle to safe end piece weld.
9. Recirculation Inlet (N2) nozzle to safe end piece weld.

1.2 TYPE OF EXAMINATION

1.2.1 Volumetric examination shall be performed using ultrasonic pulse echo nominal 35° or 45° angle beam shear wave, 45° refracted longitudinal wave, and 0° straight beam techniques applied to the outside surfaces of the piping, safe ends transition pieces and flanges.

1.2.2 The examination shall be performed manually using contact search units (transducers).

1.2.3 Other beam angles may be used as alternative examination techniques when they facilitate examination or evaluation.

1.3 TIME OF EXAMINATION

These procedures shall govern the preservice examination and reexamination of repaired areas of the pipe welds as required by the ASME Boiler and Pressure Vessel Code, Section XI.

1.4 WELD CONFIGURATION

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1.4.1 The nozzle and safe end/transition piece/flange weld configurations covered by this procedure are shown in Figures 1 through 10.

1.4.2 Nominal weld thicknesses range from 0.28" to 1.844" and are specified in Figures 1 through 10.

1.5 MATERIALS

The nozzles, safe ends and fittings are constructed of austenitic stainless steel, carbon steel, or inconel, as designated in Figures 1 through 10.

2. REFERENCES

The following documents form a part of this examination procedure:

1. ASME Boiler and Pressure Vessel Code, Section XI, 1971 Edition and Summer of 1972 Addenda
2. ASME Boiler and Pressure Vessel Code, Section III, 1971 Edition and Summer of 1972 Addenda
3. ASNT Recommended Practice, SNT-TC-1A, 1975 Edition
4. NES Document 80A0482, Preservice Inspection Program Plan, Unit 1 (latest revision)
5. NES Document 80A0448, Quality Assurance Program Plan for Inservice Inspection Program (latest revision)
6. NES Document 80A9068, Procedure for Training and Certification of Nondestructive Examination Personnel (latest revision)
7. NES Document 80A9053, Procedure for Ultrasonic Instrument Linearity Verification (latest revision) as modified in paragraph 7.4.2 of this procedure
8. NES Document 80A9005, Inservice Inspection Data Review Procedure (latest revision)
9. NES Document 80A9060, Inservice Inspection Field Change Procedure (latest revision)
10. Applicable technique sheets attached to the procedure for unique examinations

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3. PROCEDURES CERTIFICATION

The examination procedures described in this document comply with Section XI of the ASME Boiler and Pressure Vessel Code, 1971 Edition, including 1972 Summer Addenda, except where examination coverage is limited by part geometry or access.

4. PERSONNEL CERTIFICATION

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4.1 PERSONNEL CERTIFICATION REQUIREMENTS

1. Each person performing ultrasonic examination governed by this procedure shall be certified in accordance with the documents referenced in paragraphs 2.1, 2.3 and 2.6 above.

2. An examination crew shall consist of one or two members as needed. At least one member of each crew shall have a minimum qualification of Level II in accordance with the above referenced documents. The remaining member(s) shall have a minimum qualification of Level I or Level I Trainee.

4.2 PERSONNEL RECORDS

1. Records of personnel qualification shall be maintained by the Examination Contractor.

2. A copy of the examiner's certification summary and a current eye test report as required by SNT-TC-1A shall be filed with each permanent examination record, with a copy available for the Plant Owner, or his Agent, prior to performing examinations per this procedure.

5. EXAMINATION REQUIREMENTS

5.1 EXAMINATION FREQUENCY

1. The nominal examination frequency shall be 2.25 MHz for all straight beam and angle beam examinations.

2. Other pulse frequencies shall be used if such variables as material attenuation, grain structure, etc., necessitate their use to achieve penetration or resolution. This information shall be recorded on the data sheets.

3. 5.0 MHz transducer may be required to achieve resolution of the side drilled holes in the calibration blocks.

5.2 EXAMINATION ANGLES AND COVERAGE

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1. The intent of this procedure is to provide maximum coverage to ensure weld integrity. Each weld shall be scanned with a minimum of 25% overlap of the transducer element dimensional width (diameter) for each scan pass. The area to be examined shall be divided into two (2) zones; carbon and stainless steel. The instrument shall be properly calibrated for examination of each separate zone.

2. The rate of search unit movement shall not exceed 6" per second.

3. Each weld and the required volume of metal (WRV) for 1T on each side of the weld shall be ultrasonically examined using 35° or 45° shear wave or 45° refracted longitudinal wave angle beam techniques applied in two directions towards the weld and in two directions parallel with the weld, except where restricted by part geometry or access.

   Note: Circumferential scanning performed on safe ends with thickness/diameter (T/D) ratios greater than .15 shall utilize a 35° angle beam technique and 1/2 vee calibration. 7

4. Straight beam techniques shall be applied, where part geometry permits, to all base material through which the angle beams will pass during angle beam examinations. Indications detected are to be recorded in accordance with paragraph 10.1.1 of this procedure. In addition, straight beam techniques shall be applied to the WRV where part geometry permits. Indications shall be recorded in accordance with paragraph 10.1.2 of this procedure.

5. Other beam angles and or longitudinal waves may be used as determined necessary, i.e., for evaluation of reflectors, to compensate for geometric constraints, etc. All information shall be recorded on the data sheets.

6. Where the examination surface, geometry, or other conditions (weld, contour, access, etc.) do not permit a meaninful ultrasonic examination to be performed, the examiner shall record the area of non-examination and the particular interfering condition in the space provided on the Weld Scan Data Sheet. In addition, he may make a sketch of the weld and adjacent pipe and fitting conditions on a separate sheet of paper and attach to the Calibration Data Sheet. Photos may be taken when possible and incorporated as part of the report.

7. All examination weld/areas shall be entered in the space provided on the Calibration Data Sheet. If there are no recordable indications, it shall be so recorded.

8. Coverage for the welds specified in this procedure is shown in Figures 1 through 10. 7

5.3 LIQUID COUPLANT

1. The ultrasonic couplant shall be suitable for use on nuclear plant materials and be certified not to exceed 50 ppm halogen and 200 ppm sulfur.

2. The couplant shall be supplied in clean containers of sufficient quantity to perform the examination. /5

3. The couplant shall be applied manually with a brush or other suitable device.

4. The examiner shall be responsible for removing couplant from the examination surface at the conclusion of the examination, when required.

5.4 SURFACE PREPARATION

All examination surfaces shall be clean and free of dirt, weld spatter, etc., or any other condition which would interfere with the examination or impair proper transmission of the sound beam.

5.5 WELD IDENTIFICATION

Each weld shall be located and identified per appropriate weld maps in the Program Plan Book.

5.6 DATUM POINT

1. The examiner shall verify that there has been marked a reference datum point on each weld from which all examination data and reported indications shall be referenced.

2. Datum points shall be marked by the use of low stress stamps or vibratooling and shall not be deeper than 1/32".

3. The datum point for all safe end/transition piece welds in horizontal lines shall be located on the top of the pipe at weld centerline.

4. Closure Head nozzle to flange weld datum points shall be on the weld centerline at Closure Head 0°.

5. Each weld datum point, along with respective weld reference points and divisions, shall be shown on each examination report.

6. EQUIPMENT REQUIREMENTS

6.1 EXAMINATION CONTRACTOR'S EQUIPMENT

The following test equipment, or its equivalent, shall be provided by the Examination Contractor (as a minimum) for examination of welds specified in this procedure.

1. Pulse echo ultrasonic instruments.

2. Search Units, 1/4" thru 1-1/8" dia., 2.25 MHz, 0°

3. Search Units, 1/4" thru 1-1/8" dia., 5.0 MHz 0°

4. Search Units, 2.25 MHz (all sizes) for angle beam wedges

5. Wedges: Assorted sizes to accomodate search units

6. Any additional angle wedges to aid in examination or evaluation

7. Couplant

8. 45° Dual refracted longitudinal wave for use on material $\geq$ .750" in thickness, when required

9. Miniature angle beam verification block

10. Thermometer

6.2 PLANT OWNER'S EQUIPMENT

The Plant Owner, or his Agent, shall provide the following service facilities and equipment as required:

1. Scaffolding

2. Water, air, and electricity

3. Temporary lighting

4. Crane or lifting devices

5. Calibration Block No. STEAM

6. Calibration Block No. JPI

7. Calibration Block No. CRD

8. Calibration Block No. ΔP

9. Calibration Block No. VENT

10. Calibration Block No. Later (feedwater)

11. Calibration Blocks Nos. CS-1-1B, CS-1-1A, CS-2-A and CS-2-B

12. Calibration Block No. RC IN

13. Calibration Block No. RC OUT

14. Test Surface Preparation (cleaning and finishing)

15. Drawings of each Examination Area

16. Post-examination cleanup of Test Area

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7. CALIBRATION REQUIREMENTS

7.1 CALIBRATION DATA SHEETS

Calibration Data Sheets shall be numbered 475-1, 475-2, 475-3, etc., and shall be signed by the examiner(s) upon completion noting applicable SNT-TC-1A levels.

7.2 CALIBRATION BLOCKS

1. The miniature angle beam calibration block designated in 6.1(9) shall be used to establish horizontal linear instrument range.

2. The calibration blocks designated in 6.2 (5) through (13) shall be used for establishing reference sensitivity levels for examination of the specified welds.

3. Spot thickness checks of the components shall be made prior to preservice examinations to ensure that the proper calibration block is used.

4. The identity of the calibration block used for performing calibration shall be recorded on each Calibration Data Sheet.

5. System calibration shall be performed using the material side which corresponds to the material which will be examined; i.e., carbon and carbon; stainless and stainless; of the calibration block.

6. The temperature of the calibration block shall be within 25°F of the component temperature. Calibration block and component temperatures shall be recorded on the Calibration Data Sheet.

7.3 REFERENCE SENSITIVITY LEVEL

1. The reference sensitivity level shall be the distance-amplitude curve initially obtained directly from the calibration block and shall be the sensitivity level used for evaluating and recording all indications.

2. During actual weld scanning, the reference sensitivity level shall be increased a minimum of 2X (6dB), but not more than 10dB. The actual scan sensitivity shall be recorded on the data sheets.

7.4 TIMES OF CALIBRATION

1. Basic instrument calibration shall be performed using the appropriate calibration block, search units and instrumentation immediately prior to the examination of the welds specified in this procedure.

2. Instrument vertical linearity checks shall be performed at the beginning of each day of examination in accordance with the technique in the procedure referenced in paragraph 2(7) using an angle beam search unit applied to a code calibration block.

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3. Examination system calibration checks shall be performed at least at the beginning and at the completion of each four (4) hour period of examination and/or at the change of Level II examination personnel, equipment, search units, coupler shoes, etc., and at the completion of the examination of each similar series of welds in accordance with Sections 8.3 and 8.6 of this procedure.

7.5 CALIBRATION RESPONSE

7.5.1 Calibration response shall be checked at the primary reference sensitivity level.

7.5.2 Signal response obtained during calibration check shall be within plus or minus 20% of that established during basic instrument calibration.

7.5.3 If any point on the Distance Amplitude Correction (DAC) curve is below the 20% limit, the examiner shall:

1. Mark all Weld Data Sheets since previous calibration "void".

2. Recalibrate examination system.

3. Reexamine voided areas.

7.5.4 If any point on the DAC curve is above the 20% limit, the examiner shall:

1. Recalibrate examination system.

2. Reevaluate all indications recorded since the previous calibration at the corrected sensitivity level.

7.5.5 If any point on the DAC curve has moved horizontally more than 5% of the sweep line from its original settings, the examiner shall:

1. Correct sweep calibration indication data taken since the previous calibration or calibration check and reexamine the applicable area using the corrected sweep.

2. Void any recorded indication data taken since the previous calibration or calibration check and reexamine the applicable area using the corrected sweep.

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8. EXAMINATION SYSTEM CALIBRATION

8.1 STRAIGHT BEAM CALIBRATION FOR BASE MATERIAL

Straight beam calibration for all base material through which the angle beams will pass shall be performed at a sensitivity level which gives an initial back reflection signal amplitude from the component safe ends of at least 80% FSH.

8.2 STRAIGHT BEAM CALIBRATION FOR WRV

Straight beam sweep calibration and Distance-Amplitude Correction shall be performed as follows for each type of material which will be examined; i.e., carbon and carbon; stainless and stainless on the Safe end calibration block.

1. Adjust the instrument sweep controls so that the examination area is displayed on the CRT screen. Mark the horizontal screen positions selected for the hole or holes directly on the CRT screen and on the chart on the Calibration Data Sheet.

2. Position search unit to obtain maximum response from the side drilled (1/4T if T > 1" or 1/2T if T $\leq$ 1") calibration hole. Adjust sensitivity control to provide a signal amplitude of 80% of FSH and mark location and amplitude on CRT screen.

3. This is the reference sensitivity level. Record all sensitivity control settings on the appropriate Calibration Data Sheet.

4. This completes calibration for thicknesses $\leq$ 1". No DAC is necessary.

5. For weld thicknesses > 1" DAC curve shall be established as follows:

   A. Without changing the sensitivity obtained in (2) above, position the search unit for maximum response from the 3/4T hole and mark amplitude on the CRT screen.

   B. Plot a DAC curve by connecting the two signal response positions with a continuous line extending over the full examination range.

6. Upon completion of calibration, ensure that all data and instrument settings are recorded on the Calibration Data Sheet. The examiner(s) shall sign the completed data sheet, noting applicable SNT-TC-1A levels.

7. Repeat steps (1) thru (6) for each different weld thickness just prior to examination.

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8.3 STRAIGHT BEAM CALIBRATION CHECK

Straight beam calibration check as required by paragraph 7.4.3 shall be performed as follows:

1. Position the search unit on the material side, i.e., carbon or stainless and adjust the sensitivity control settings to match those recorded in paragraph 8.2(6).

2. Reposition search unit at each respective test hole and observe maximum signal response amplitudes, and horizontal screen positions.

3. Position the search unit on the other material side of the safe end calibration block and repeat step (2).

4. See Section 7.5 for signal response requirements during calibration check.

8.4 ANGLE BEAM CALIBRATION NOZZLE SIDE EXAMINATIONS

(Where ID conditions have no stainless steel cladding the technique outlined in Section 8.5 shall be utilized.)

1. Adjust the instrument sweep and delay controls so that the entire calibration presentation for 1/2 vee path is displayed on the CRT (see Figure 10 for the appropriate metal path calibration).

2. From the OD surface of the calibration block, position the search unit to obtain maximum response from the hole which gives the highest amplitude signal. Adjust the sensitivity control to provide a signal amplitude of 80% full screen height (FSH) and mark location and amplitude peak on CRT.

3. Without changing sensitivity, position the search unit respectively on the remaining hole and mark signal location and amplitude on the CRT.

4. Plot a DAC curve connecting the locations marked on the CRT with a continuous line extended to cover the full examination range (OD to ID).

5. Repeat steps 1 through 4 for each different weld thickness just prior to examination.

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6. Record all data and instrument settings on the Calibration Data Sheet and sign upon completion, noting applicable SNT-TC-1A certification level(s).

8.5 ANGLE BEAM CALIBRATION SAFE END SIDE EXAMINATIONS

(Where ID conditions have stainless steel cladding, the technique outlined in Section 8.4 shall be utilized.)

1. Adjust the instrument sweep and delay controls so that the entire calibration presentation for one full vee path is displayed on the CRT (see Figure 10 for the appropriate metal calibration).

2. From the OD surface of the calibration block, position the search unit to obtain maximum response from the hole which gives the highest amplitude signal. Adjust the sensitivity control to provide a signal amplitude of 80% FSH and mark location and amplitude peak on CRT.

3. Without changing sensitivity, position the search unit respectively on the remaining holes and mark signal location and amplitude on the CRT.

4. Plot a DAC curve connecting the locations marked on the CRT with a continuous line extended to cover the full examination range. (OD to ID to OD)

5. Repeat steps 1 through 4 for each different weld thickness just prior to examination.

6. Record all data and instrument settings on the Calibration Data Sheet and sign upon completion, noting applicable SNT-TC-1A certification level(s).

8.6 ANGLE BEAM CALIBRATION CHECK

Angle beam calibration check as required by paragraph 7.4.3 shall be performed as follows:

1. Adjust the sensitivity control settings to match those recorded for the calibrated reference sensitivity.

2. Reposition search unit at each respective test hole and observe signal response amplitudes and horizontal screen positions.

3. See Section 7.5 for signal response requirements during calibration check.

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9. EXAMINATION PROCEDURES

9.1 STRAIGHT BEAM EXAMINATION FOR BASE MATERIAL

Straight beam examinations to detect laminar reflectors which might affect the interpretation of angle beam results shall be performed at a sensitivity level giving a back reflection from the component of at least 80% FSH as noted in Section 8.1.

9.2 STRAIGHT AND ANGLE BEAM EXAMINATION OF WRV

9.2.1 All straight and angle beam examination of weld and required volume shall be performed at a scanning sensitivity level, a minimum of 2X (6dB) but no more than 10dB greater than the calibrated reference sensitivity level. All scanning sensitivity levels shall be recorded on the Examination Data Sheets.

9.2.2 For straight beam examinations, a rectilinear scan pattern shall be used.

9.2.3 For angle beam examinations, the search unit shall be swivelled to ensure maximum coverage as it is moved along a rectilinear scan pattern.

9.2.4 For the location and numbers of the welds, refer to the Program Plan. Examinations shall not be considered complete until all recordable indications have been evaluated.

10. EVALUATION CRITERIA

10.1 RECORDING OF INDICATIONS

10.1.1 For straight beam examinations of base metal for laminations, all areas presenting indications equal to or greater than the remaining back reflection shall be recorded on the appropriate data sheet prior to angle beam examination of the weld and required volume.

1. Each recorded area shall be identified as to distance from surface, length and position relative to the weld datum point.

2. Pertinent recorded data shall be taken on each parallel scan pass at increments not to exceed that permitted by the 25% overlap of transducer element (width).

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10.1.2 For straight beam examinations of weld and required volume, and angle beam examinations, all nongeometric indications showing a signal amplitude response equal to or greater than 50% of the reference response shall be recorded on the appropriate data sheet at the time of weld examination.

1. Each recorded nongeometric indication shall be identified as to depth, distance from surface, length, signal amplitude, and location relative to the weld datum point.

2. Recorded data shall be taken on each parallel scan pass at increments not to exceed that permitted by the 25% overlap of transducer element diameter (width).

3. The end points of recorded indications shall be determined by 50% DAC amplitude points.

4. Planar indications at or near the far surface shall be compared directly with the amplitude obtained from the notch if available.

10.1.3 Geometric indications shall be recorded at one location and noted as geometric caused by thickness change, ID geometry, etc.

10.1.4 Nongeometric Indications for straight beam examinations of weld and required volume and angle beam examinations, all indications showing a signal amplitude response equal to or greater than 50% of the reference response shall be recorded on the appropriate data sheet at the time of examinations.

10.1.5 Each recorded indication shall be identified as to depth, length, signal amplitude, and location relative to the weld datum point.

10.1.6 Indications from all welds shall be recorded in inches upstream or downstream in relation to the flow from the weld center line, and in inches CW or CCW from the datum point.

10.2 EVALUATION OF INDICATIONS

10.2.1 Evaluation of all indications shall be made at the reference sensitivity level and in accordance with the requirements of the referenced ASME Boiler and Pressure Vessel Code, Section XI, IS-300. All evaluations shall be performed by a Level II or Level III examiner.

10.2.2 Results of this evaluation shall be reported to the Plant Owner, or his Agent, in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section XI, IS-600. Disposition of evaluation results shall be made in accordance with the Owner's Plant Procedures.

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11. EXAMINATION RECORDS

11.1 CERTIFICATION OF RECORDS

The Examiner shall complete and sign all data sheets immediately upon completion of each weld examination. The data sheets may be reviewed by the authorized Code Inspector.

11.2 FILING OF RECORDS

NES shall be responsible for submitting to the Plant Owner, or his Agent, a completely documented set of examination records including certification of personnel qualifications with a current eye test report in accordance with SNT-TC-1A.

11.3 PROCEDURE CORRECTIONS AND ADDITIONS

11.3.1 All procedure corrections and/or additions required during the preservice examinations shall be made in accordance with requirements of NES QA Program Plan 80A0448.

11.3.2 The Examiner shall contact LILCO representatives on site to initiate all changes. All changes shall be documented in the record of revisions section of this procedure.

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LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume

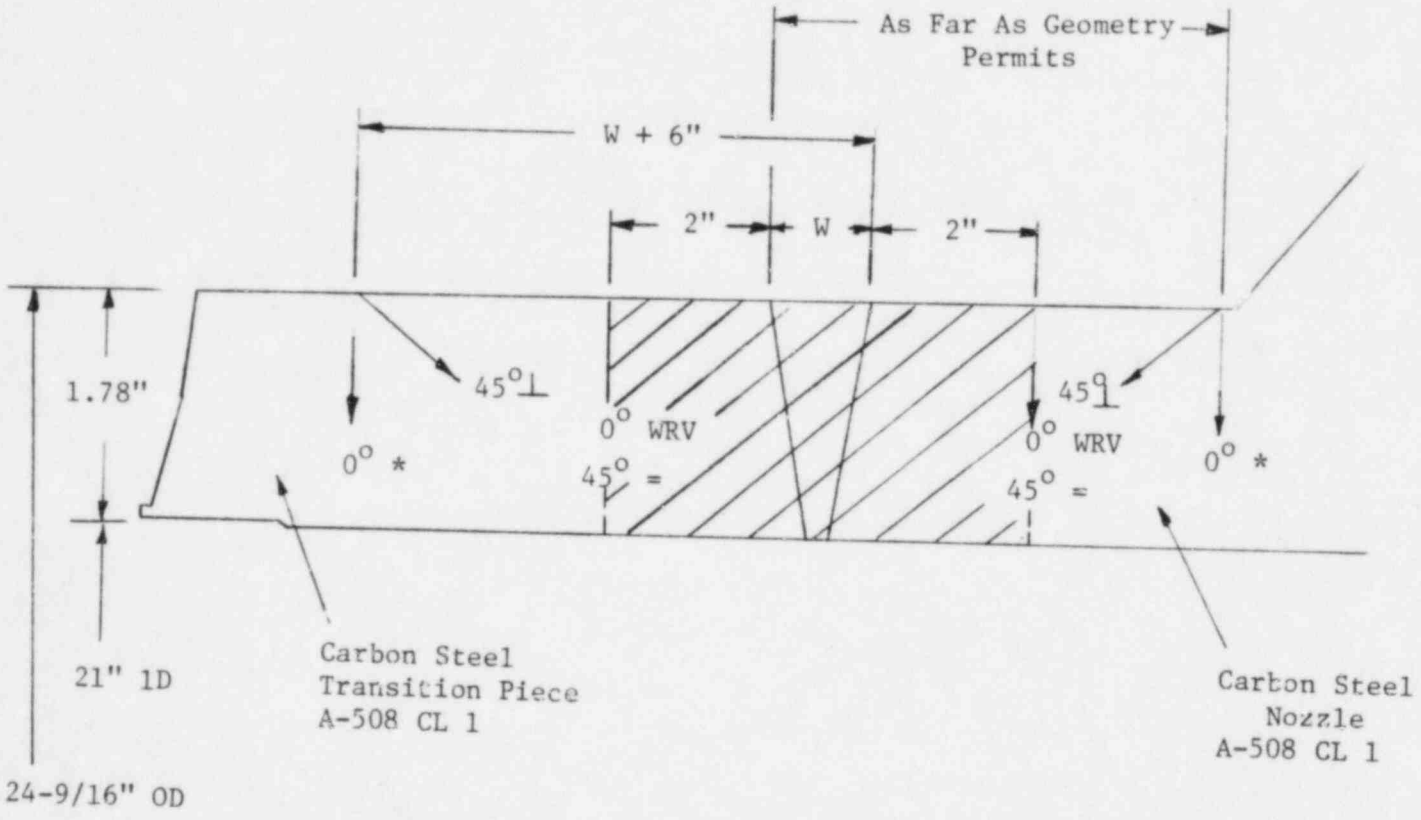

Figure 1 - Ultrasonic Examination Procedures for Main Steam (N3) Nozzle to Transition Piece Welds. Cal. Block "Steam"

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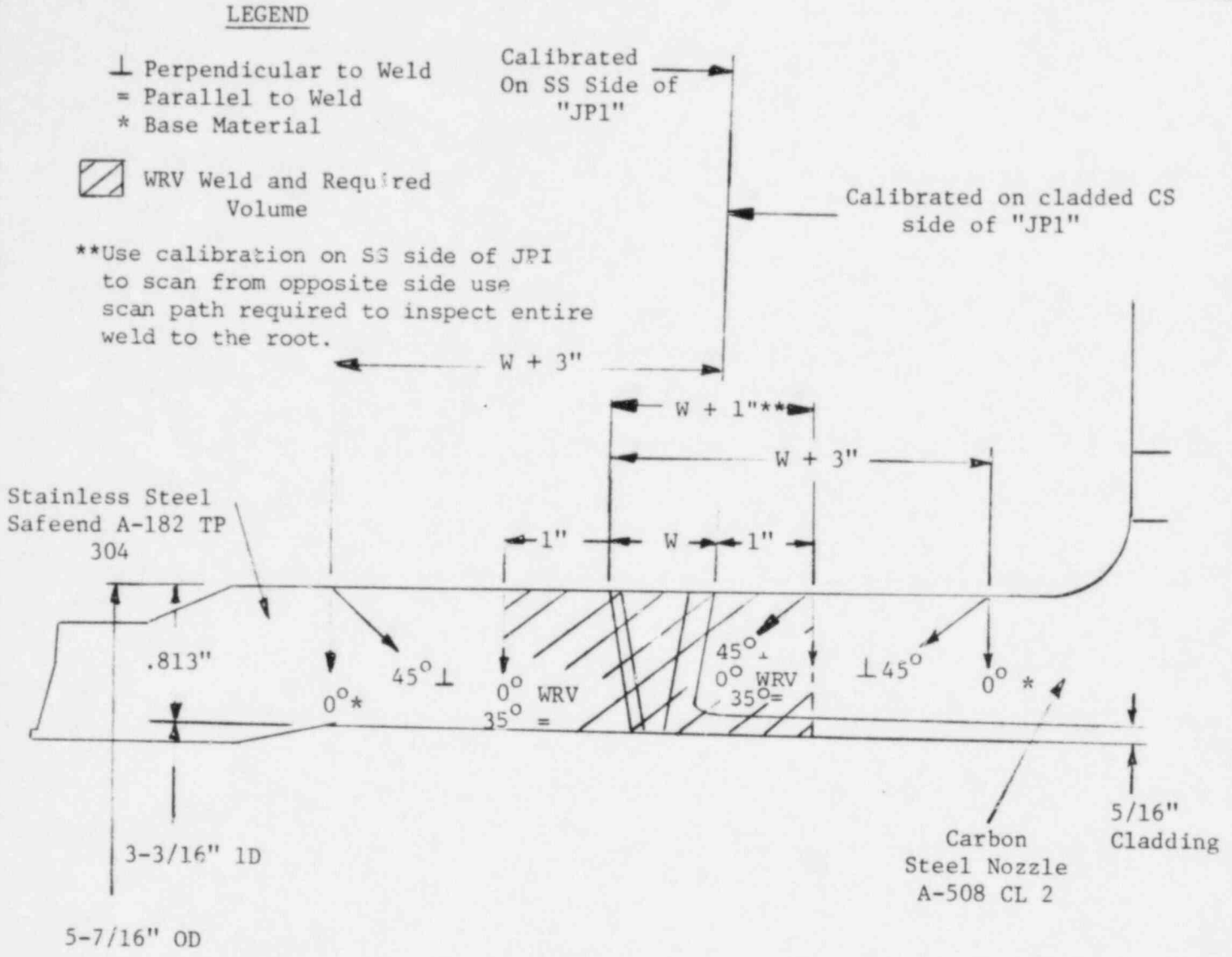

Figure 2 - Ultrasonic Examination Procedures for Jet Pump Instrumentation (N8) Nozzle to Safeend Welds, Cal. Block "JP1"

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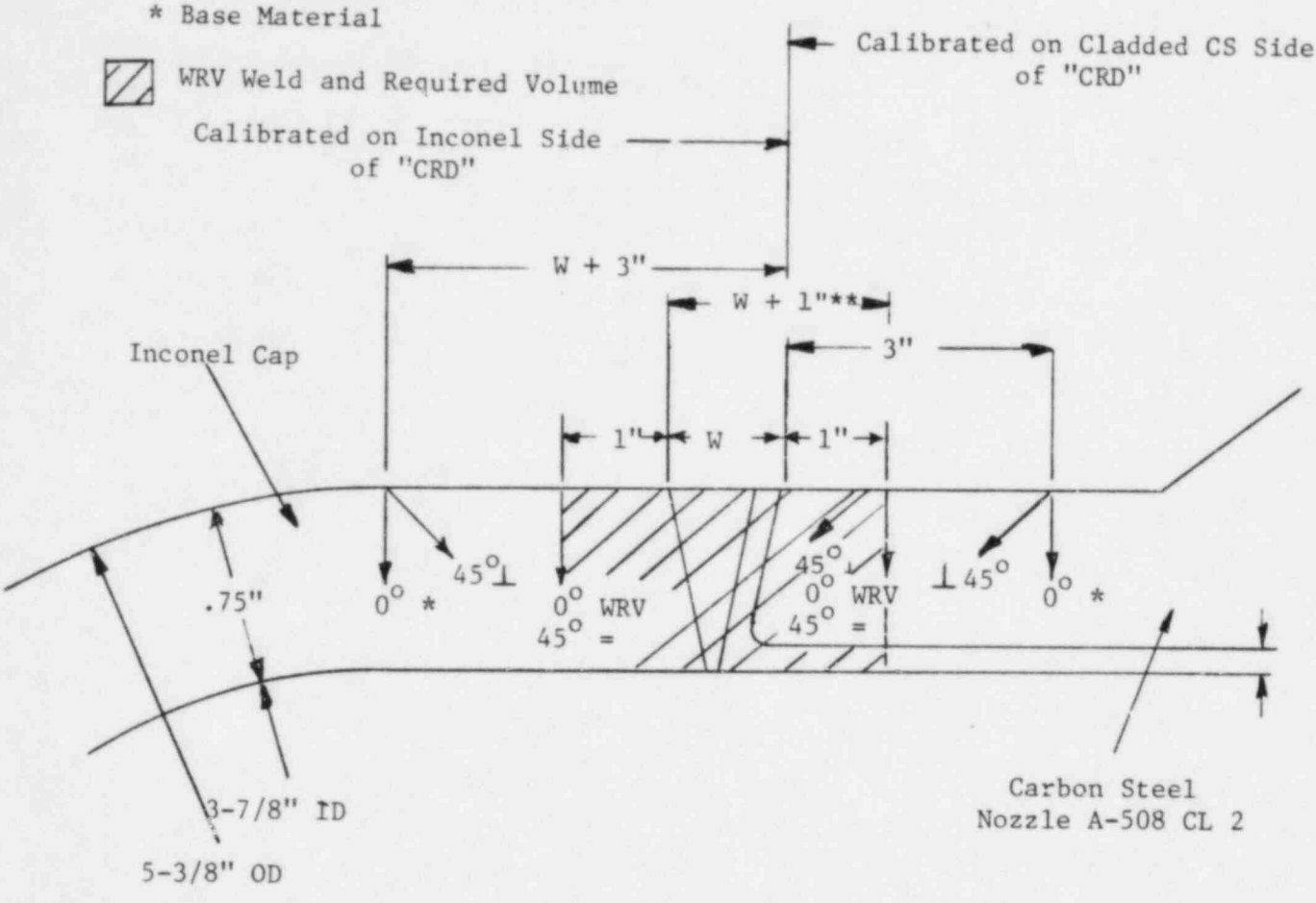
LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume



**Use calibration on inconel side of CRD to scan from opposite side. Use scan path required to inspect entire weld to the root.

Figure 3 - Ultrasonic Examination Procedures for Control Rod Drive (N9) Nozzle to Cap Weld. Cal. Block "CRD"

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LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume

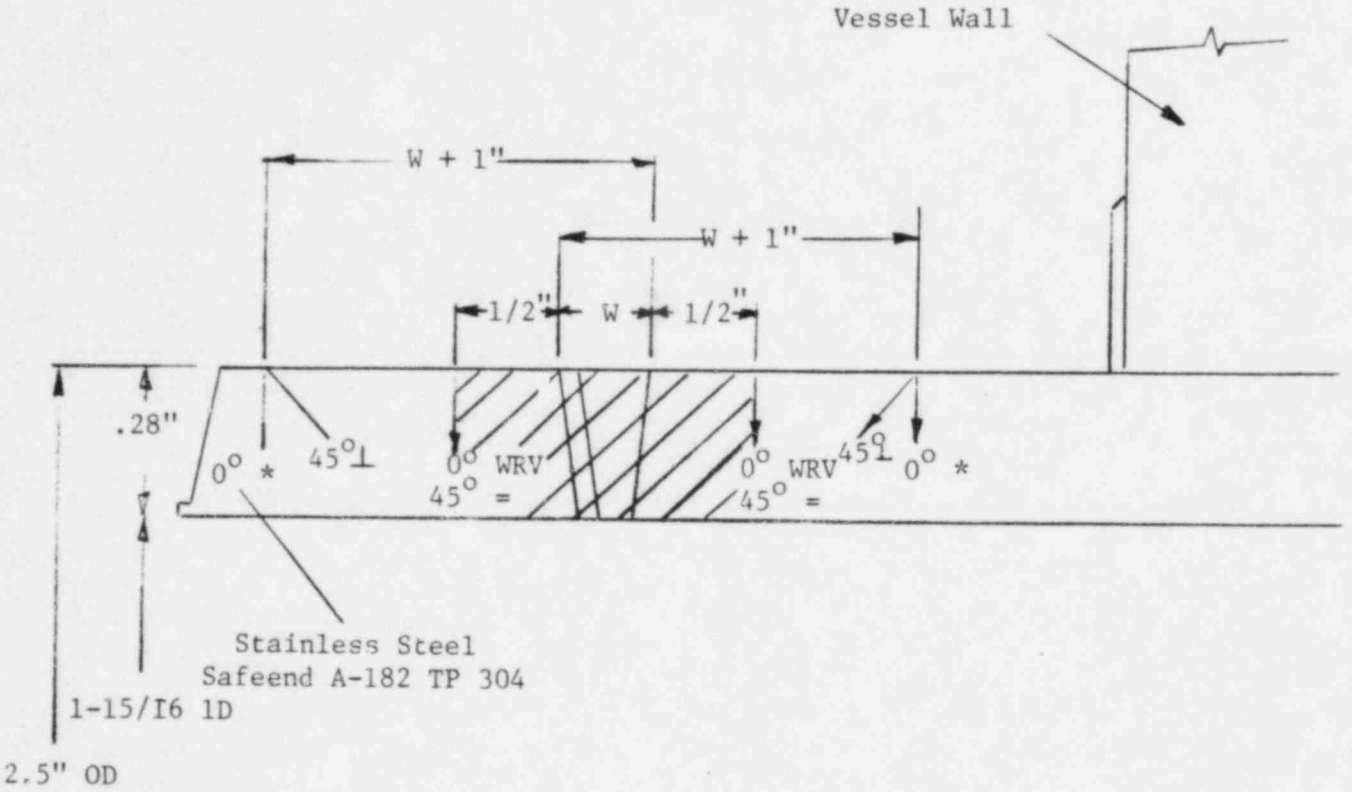

Figure 4 - Ultrasonic Examination Procedures for Pressure Differential (N10) Nozzle to Safeend Weld.
Cal. Block " P"

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LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume

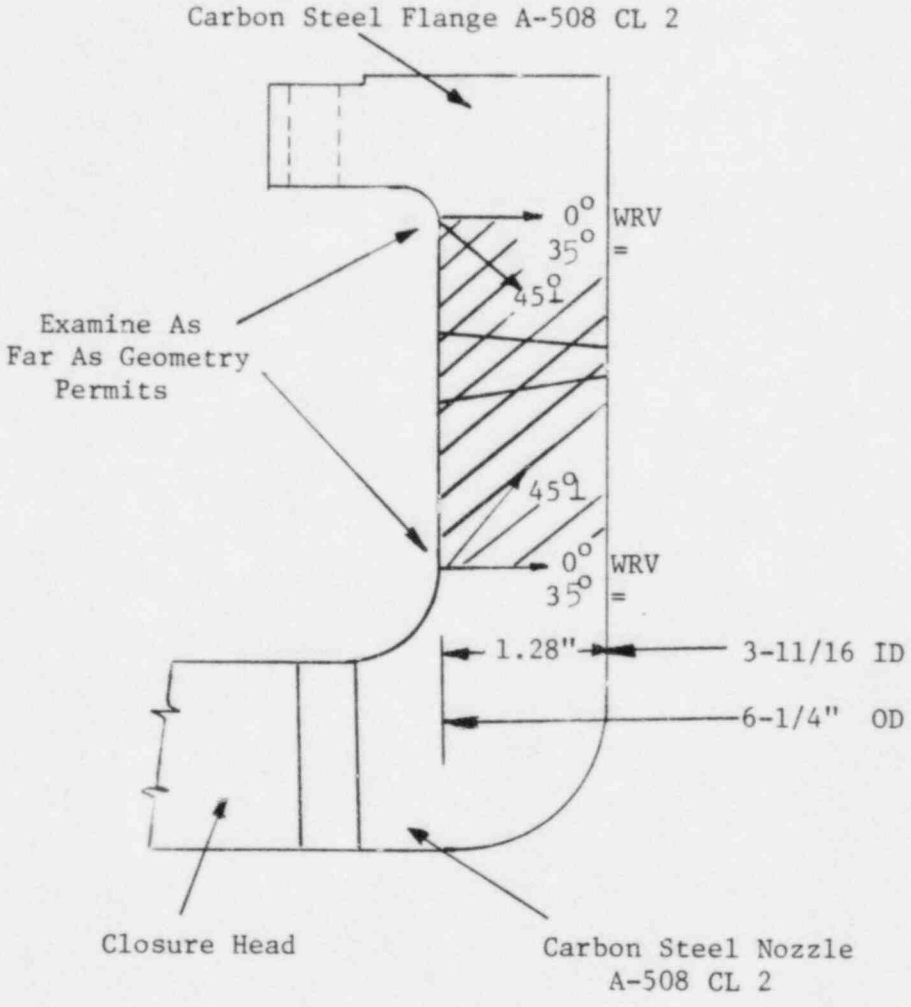

Figure 5 - Ultrasonic Examination Procedures for Closure Head Vent (N7) Nozzle to Flange Weld. Cal. Block "VENT"

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LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* Base Material

WRV Weld and Required Volume

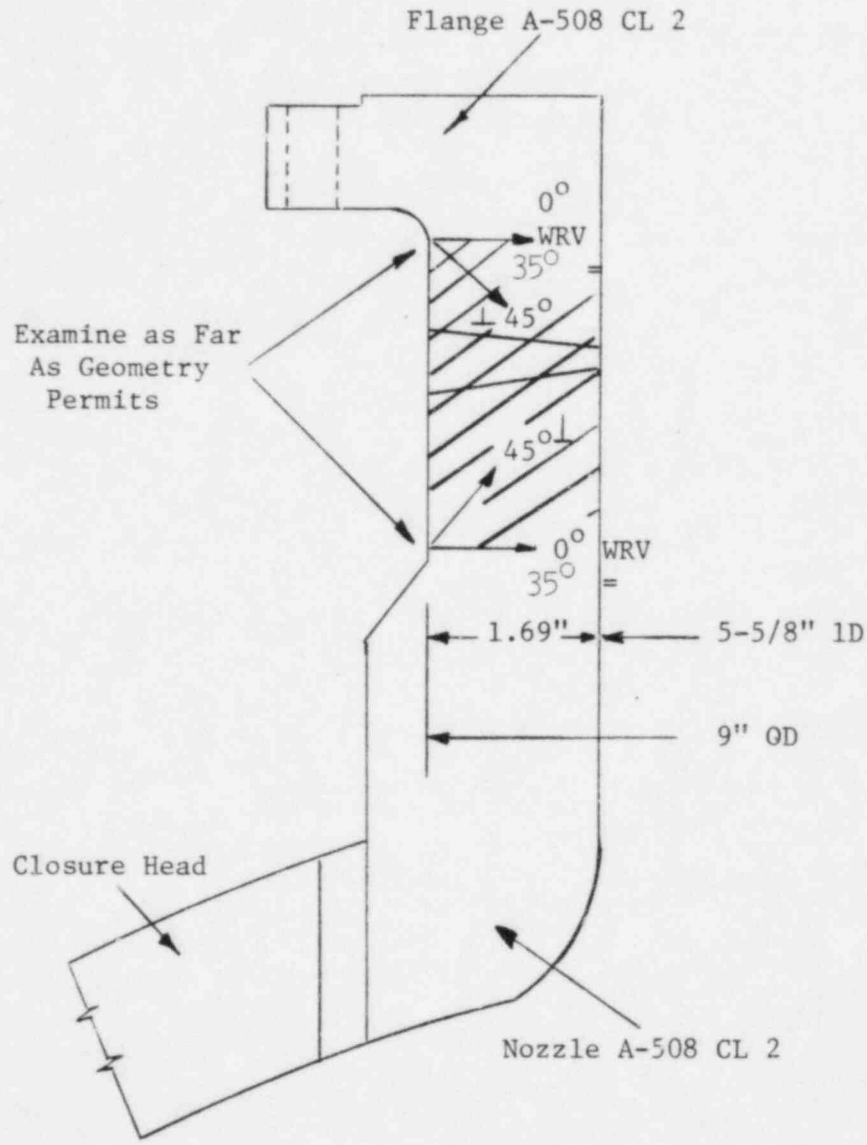


Figure 6 - Ultrasonic Examination Procedures for Closure Head Instrumentation (N6) Nozzle to Flange Welds. Cal. Block "VENT"

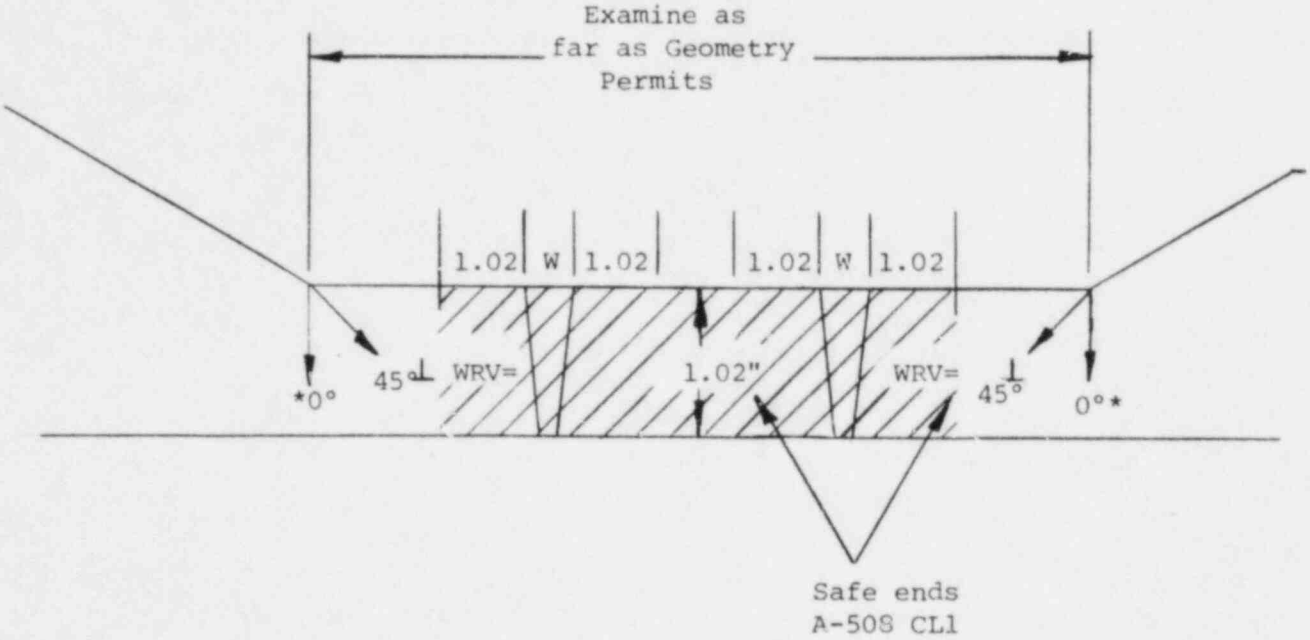
SCAN LEGEND

⊥ Perpendicular to Weld

= Parallel to Weld

* Base Material

▨ WRV Weld and Required Volume

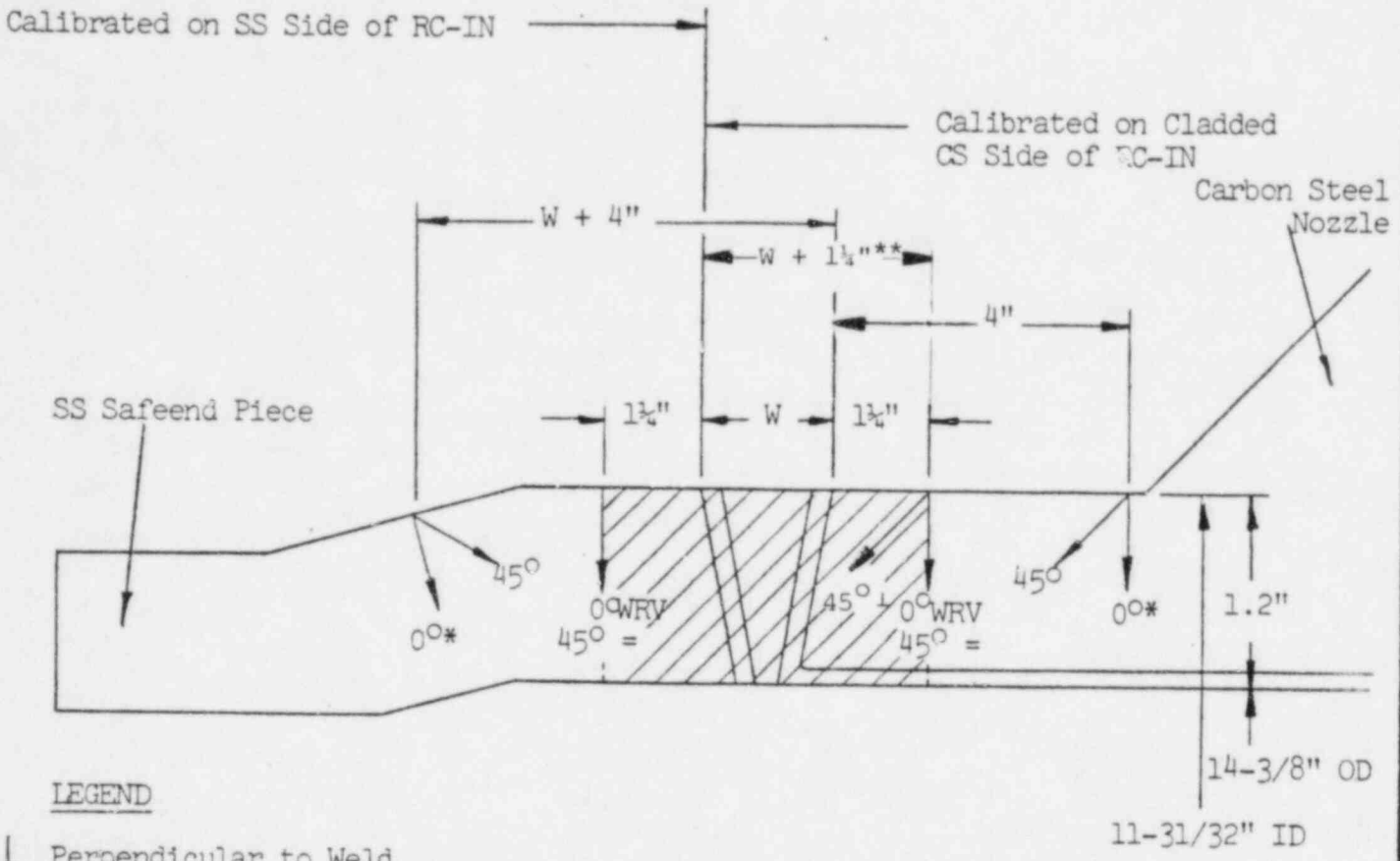


Note: Due to Configuration of Safe end extend scan path as far as geometry permits

FIGURE 7. ULTRASONIC EXAMINATION PROCEDURE FOR FEEDWATER (N4) NOZZLE TO SAFE END WELDS. CAL BLOCK 131C8523 (FEEDWATER)

2 3 4

5 7



LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* 0° Base Material

WRV Weld and Required Volume

** Use calibration on SS side of RC-IN to scan from opposite side. Use scan path required to inspect entire weld to the root.

Figure 8 Ultrasonic Examination Procedure for Recirculation Inlet Nozzle Safeend Weld (Cal. Block RC-IN).

LEGEND

⊥ Perpendicular to Weld
= Parallel to Weld
* 0° Base Material
WRV Weld and Required Volume

** Use calibration on SS side of RC-OUT to scan from opposite side. Use scan path required to inspect entire weld to the root.

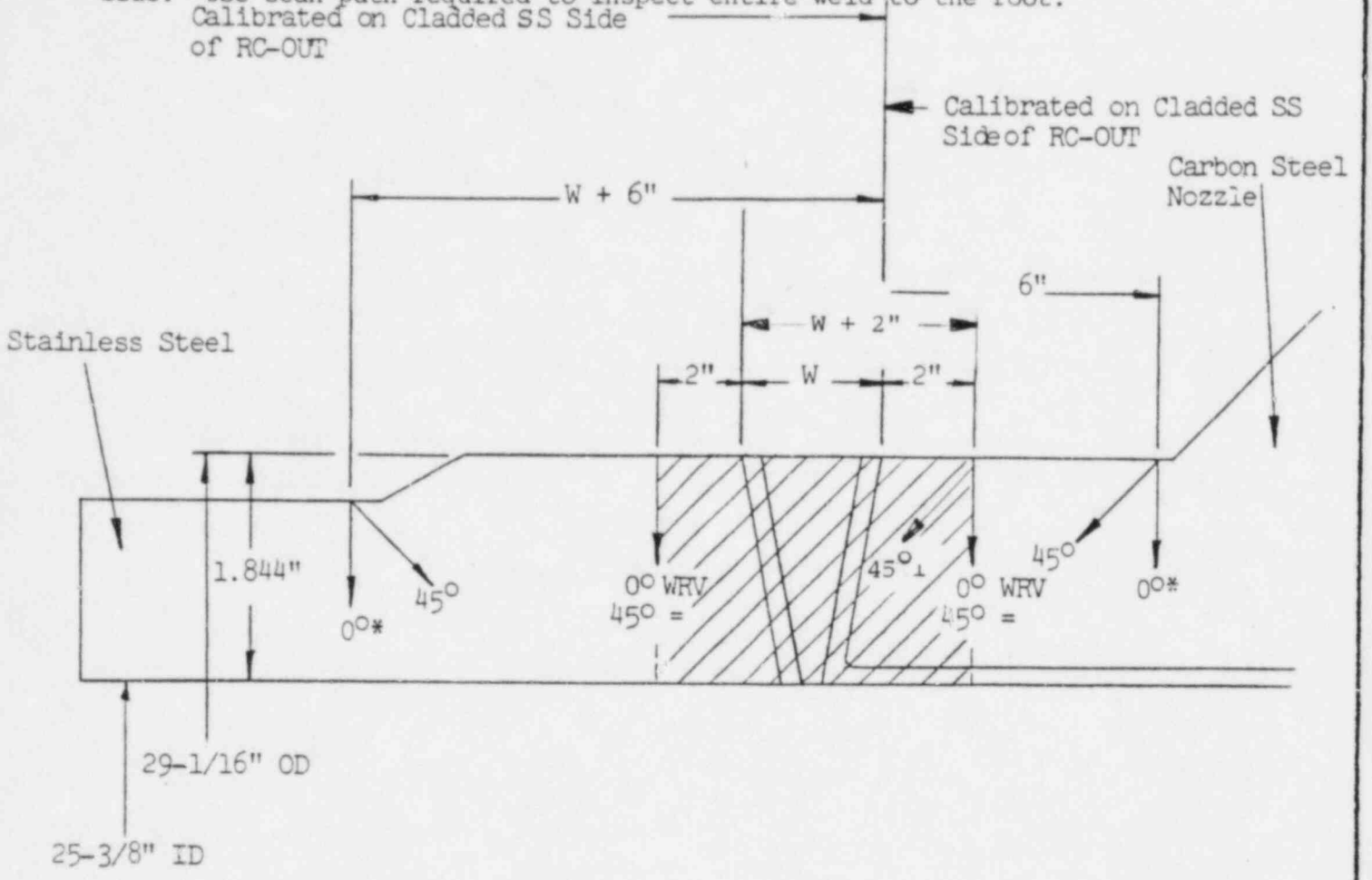
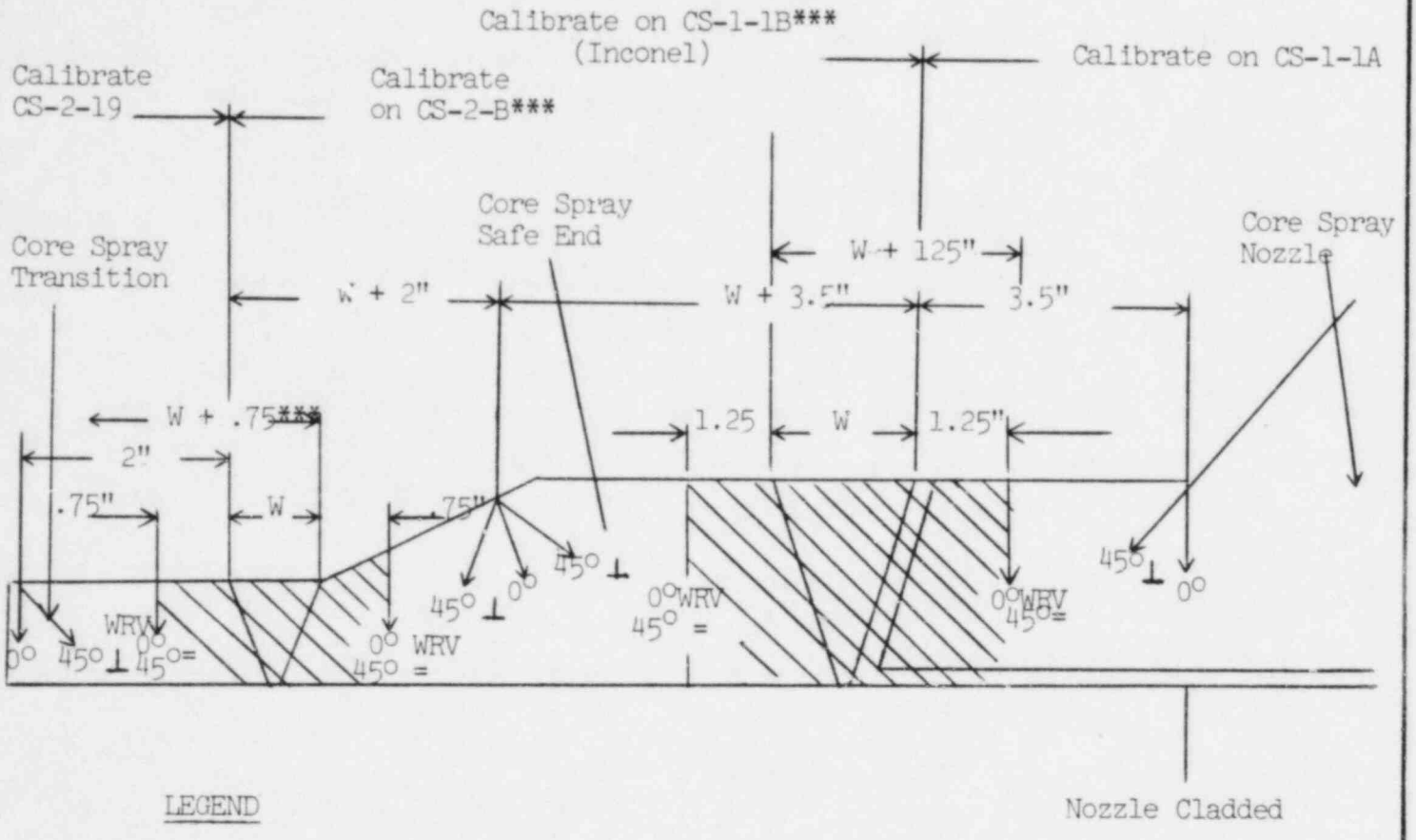


Figure 9 Ultrasonic Examination Procedures for Recirculation Outlet Nozzle Safeend Welds (Cal. Block RC-OUT)

7



LEGEND

⊥ = Perpendicular to Weld
= = Parallel to Weld
* = 0° Base Metal
** = Use CS-1-1B Calibration to scan weld from opposite Side. Use Scan Path required to inspect entire weld to the root
*** = Use CS-2-B Calibration to Scan Weld from opposite Side. Use Scan Path required to inspect entire weld to the root.
WRV = Weld Required Volume

FIGURE 10. ULTRASONIC EXAMINATION PROCEDURE FOR CORE SPRAY SAFE END WELDS (CAL. BLOCK CS-1-1A, CS-1-1B, CS-2-A, CS-2-B)

METAL PATH CALIBRATION TABLE

1&1/2 VEE SCAN PATH EXAMINATION

Metal Path Calibration Recommended	Material Thickness Range 45°	60°	70°
2.5"	≤ 0.5"	≤ 0.4"	N/A
5.0"	> 0.5" - ≤ 1.0"	> 0.4" - ≤ 0.8"	≤ 0.5"
10.0"	> 1.0" - ≤ 2.0"	> 0.8" - ≤ 1.6"	> 0.5" - ≤ 1.0"
20.0"	> 2.0" - ≤ 4.5"	1.6" - ≤ 3.3"	> 1.0" - ≤ 2.2"

FULL VEE SCAN PATH EXAMINATION

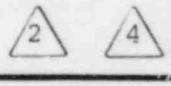
Metal Path Calibration Recommended	Material Thickness Range 45°	60°	70°
2.5"	≤ 0.8"	≤ 0.6"	≤ 0.4"
5.0"	> 0.8" - ≤ 1.7"	> 0.6" - ≤ 1.2"	> 0.4" - ≤ 0.8"
10.0"	> 1.7" - ≤ 3.5"	> 1.2" - ≤ 2.5"	> 0.8" - ≤ 1.6"
20.0"	> 3.5" - ≤ 7.0"	> 2.5" - ≤ 5.0"	> 1.6" - ≤ 3.3"

1/2 VEE SCAN PATH EXAMINATION

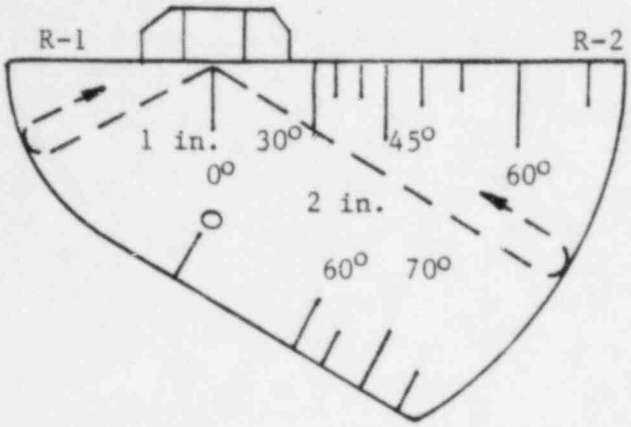
Metal Path Calibration Recommended	Material Thickness Range 45°	60°	70°
2.5"	≤ 1.7"	≤ 1.2"	≤ 0.8"
5.0"	> 1.7" - ≤ 3.5"	> 1.2" - ≤ 2.5"	> 0.8" - ≤ 1.6"
10.0"	> 3.5" - ≤ 7.0"	> 2.5" - ≤ 5.0"	> 1.6" - ≤ 3.3"
20.0"	> 7.0" - ≤ 14.0"	> 5.0" - ≤ 10.0"	> 3.3" - ≤ 6.6"

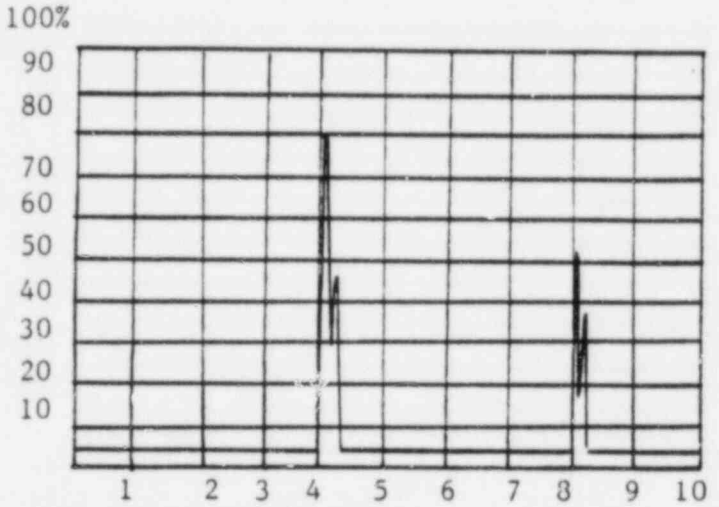
INSTRUCTIONS: The Vee Path and the examination angle are given in the specific procedure. Using the appropriate Vee Path Examination Cha.t (1/2 Vee, Full Vee, and 1-1/2 Vee Paths) and the appropriate examination angle column, find the thickness range that encompasses the thickness of the material being examined.

FIGURE 11



ANGLE BEAM VERIFICATION BLOCK





METAL PATH CALIBRATION FOR A 2.5" CRT PRESENTATION

1 - Obtain a maximized indication from the short radius (R-1) reflection surface of the "Miniature Angle Beam Verification Block" (1" metal path).

2 - Using the material calibration control and the delay control, align this signal at CRT position 4.

3 - Revolve the search unit around and obtain a maximized indication from the long radius (R-2) reflection surface (2" metal path).

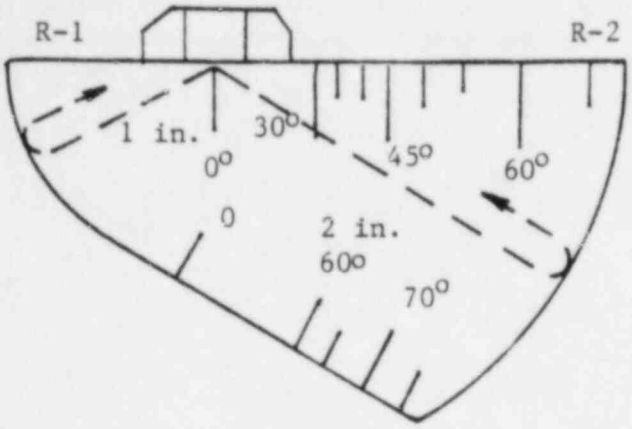
4 - Using the material calibration control align this signal at CRT position 8.

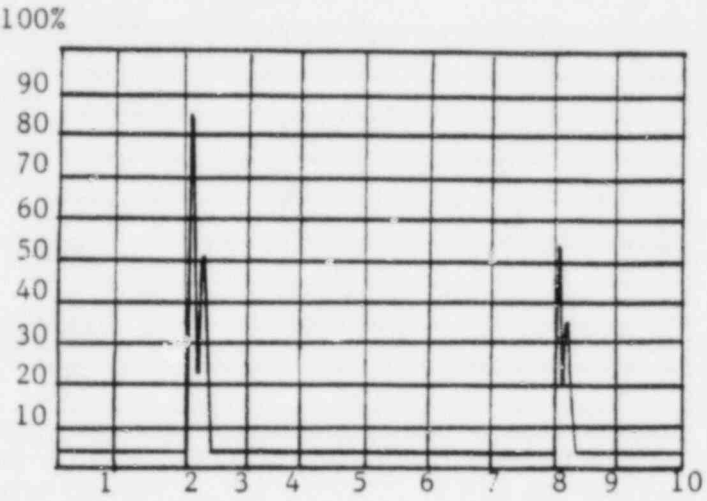
5 - Repeat steps 1 through 4 until no further adjustments need to be accomplished.

6 - The CRT is now calibrated in inches of metal path, (each major division equaling 1/4 inch). Make no further adjustments to the sweep range or delay controls.

Figure 12

ANGLE BEAM VERIFICATION BLOCK





METAL PATH CALIBRATION 5" CRT PRESENTATION

1 - Obtain a maximized indication from the short radius (R-1) reflection surface of the "Miniature Angle Beam Verification Block" (1" metal path).

2 - Using the material calibration control and the delay control, align this signal at CRT position 2.

3 - Increase the instrument gain until a secondary echo occurs.

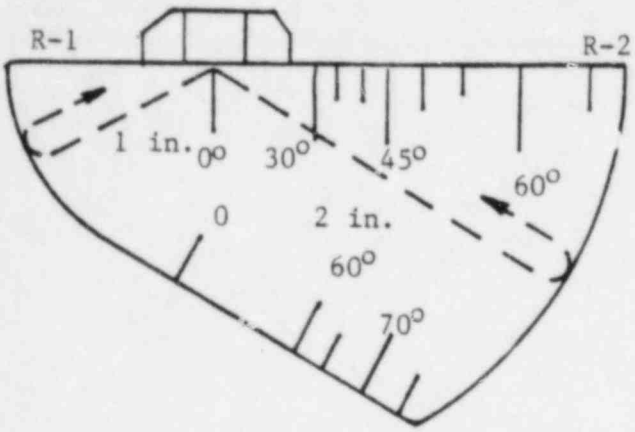
4 - Align the secondary signal at CRT position 8.

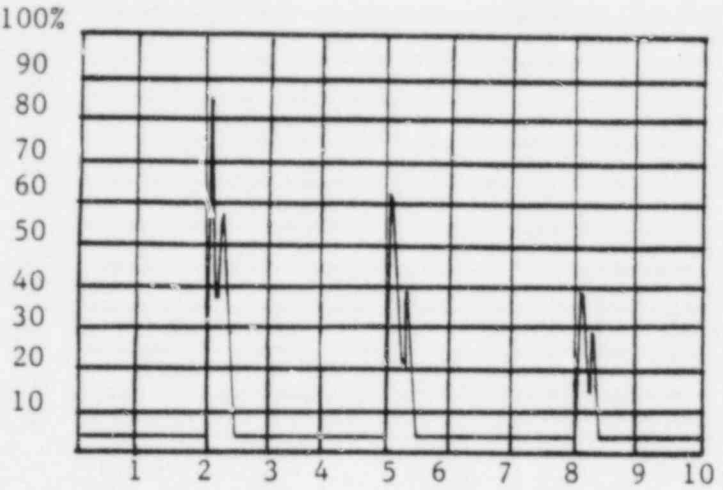
5 - For reference check the primary signal from the long radius (2"). This signal should peak at CRT position 4.

6 - The CRT is now calibrated in inches of metal path, (each major division equaling 1/2 inch). Make no further adjustments to the sweep range or delay controls.

Figure 13

ANGLE BEAM VERIFICATION BLOCK





METAL PATH CALIBRATION 10" PRESENTATION

1 - Obtain a maximized indication from the long radius (R-2) reflection surface of the "Miniature Angle Beam Verification Block" (2" metal path).

2 - Using the material calibration control and the delay control, align this signal at CRT position 2.

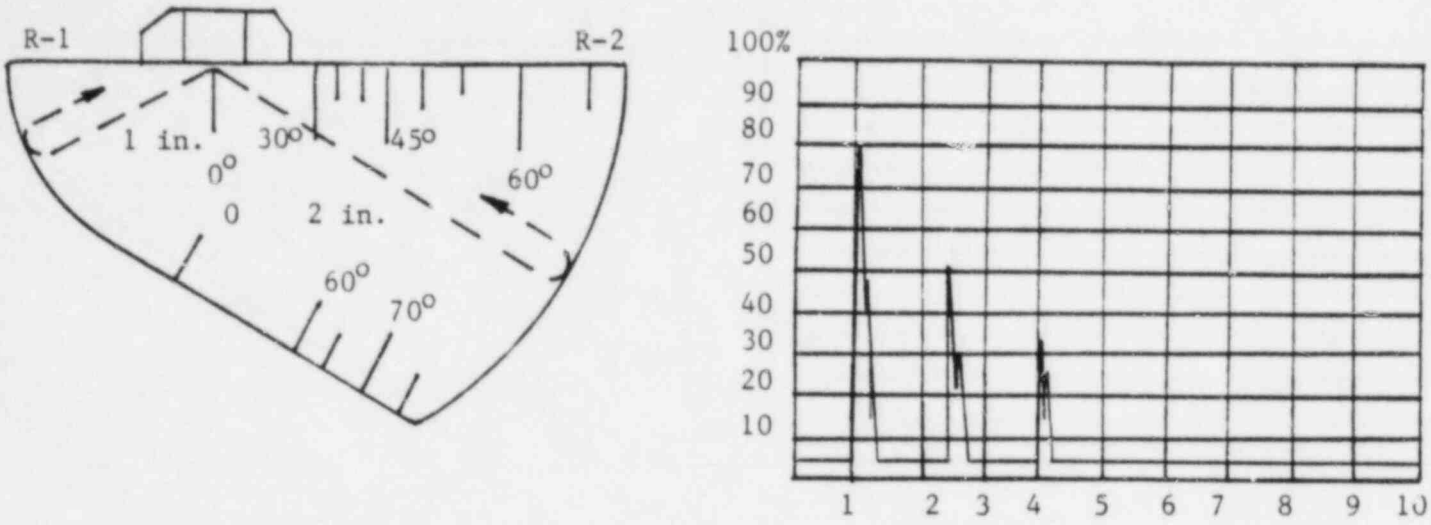
3 - Increase the instrument gain until secondary echos occur.

4 - Align the secondary echos shall be aligned at CRT positions 5 and 8.

5 - The CRT is now calibrated in inches of metal path (each major division equaling 1 inch). Make no further adjustments to the sweep range or delay controls.

Figure 14

ANGLE BEAM VERIFICATION BLOCK



METAL PATH CALIBRATION FOR A 20" CRT PRESENTATION

1 - Obtain a maximized indication from the long radius (R-2) reflection surface of the "Miniature Angle Beam Verification Block" (2" metal path).

2 - Using the material calbiration control and the delay control, align this signal at CRT position 1.

3 - Increase the instrument gain until secondary echos occur.

4 - Secondary echos shall be aligned at CRT position 2.5 and 4.

5 - The CRT is now calibrated in inches of metal path (each major division equaling 2 inches). Make no further adjustments to the sweep range or delay controls.

Figure 15

Plant/Unit _____
Comp/System _____
ISO _____ Loop _____

FIGURE 16 (2)
CALIBRATION DATA SHEET

Data Sheet No. _____
Procedure No. _____
Subject: _____
Rev/Change No. _____
Calibration
Block No. _____
Fabrication No. _____
Surface _____
Block Temp _____ °F
Comp. Temp _____ °F
Thickness _____
CRT Calibrated in _____
_____
Each Maj. Screen Div= _____

INSTRUMENT SETTINGS
Mfg/Model No.:
Serial No. :
Sweep Length :
Sweep Delay :
Pulse Length/Damping:
Freq.: Rep. Rate:
Filter: Video: Jack:
DEC/Gate Switch: Range:
Mode Select: Reject:
Gain (coarse): (fine):
Scan Sensitivity:

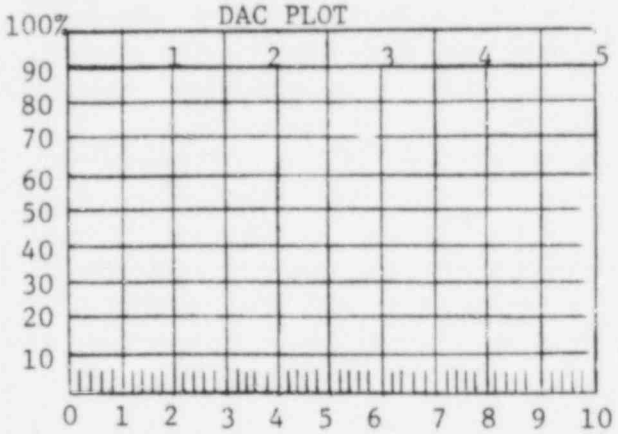
SEARCH UNIT
Scan Angle: Mode:
Fixturing (if any):
Style or Type No. :
Size & Shape:
Frequency :
Serial No/Brand:
Measured Angle :
Cable Type & Length:
Couplant Brand:
Couplant Batch:

SCAN AREA	
0° WRV	
0° Mat'l	
= To Weld	
⊥ To Weld	
Calibration	
Axial	
Circ	

INSTR. LINEARITY CAL.

	Amplitude				
	High	Low		High	Low
1			5		
2			6		
3			7		
4			8		

DAC PLOT



AMPL. CONTROL LINEARITY		
Initial	dB	Result
80	-6	
80	-12	
40	+6	
20	+12	

EXAMINATION WELD/AREA	Recordable Indications			COMMENTS/REASON FOR INCOMPLETED SCAN (S)
	Yes	No	Geom	

SAMPLE ONLY

SIMILAR VERSIONS WHICH REQUIRE THE SAME INFORMATION ARE ACCEPTABLE.

CALIBRATION CHECKS	TIME
Initial Cal.	
Intermediate	
Intermediate	
Intermediate	
Final Cal.	

EXAMINERS 1 _____ Date _____ Level _____
2 _____ Date _____ Level _____

REVIEWERS 1 _____ Date _____
2 _____ Date _____
3 _____ Date _____

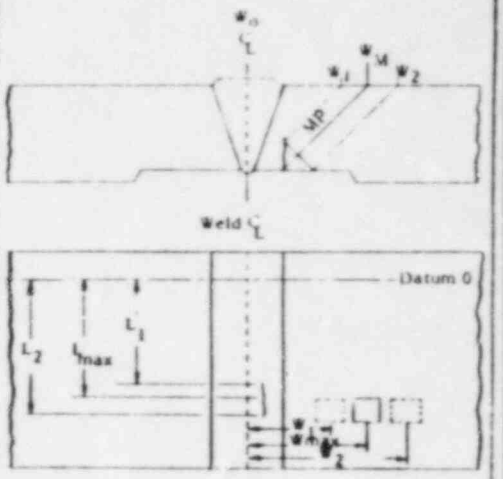
ADDITIONAL SHEETS? CHECK BOX			
Continuation		Beam Plot	
Supplements		None	

NUCLEAR ENERGY SERVICES, INC.

Project No.	Site	L_o Location	Date: (Day/Mo/Yr)
Item Identification		W_o Location	Page _____ of _____
Examiner: TC-1A Level		Angle Used: 0° / 45°⊥ / 45°=	Attached Cal. Data Sheet _____
Examiner: TC-1A Level		Scanning dB	Thickness _____
			Diameter (nom.)

MP Metal Path
RBR Remaining Back Reflection
L Distance from Datum 0

W max Distance from $\mathcal{C}_L$ to S.U. at maximum response.
W_1 Distance from weld $\mathcal{C}_L$ at 50% of DAC (fwd)
W_2 Distance from weld $\mathcal{C}_L$ at 50% of DAC (backward)



Ind. No.	% of DAC	W MAX W	W MAX MP	FWD 50% DAC W_1	FWD 50% DAC MP	BACKWARD 50% DAC W_2	BACKWARD 50% DAC MP	L_1 50% DAC	L max	L_2 50% DAC	RBR amp	S.U. Loc.	REMARKS

DRAW FULL SCALE PLOT HERE:

REVIEWER _____ DATE _____
REVIEWER _____ DATE _____
REVIEWER _____ DATE _____

FIGURE 17

TECHNIQUE SHEET
FOR
RECIRCULATION OUTLET ANGLE BEAM EXAMINATION

(from the stainless steel side including the weld)

1) The examination shall be conducted with a longitudinal unit exhibiting a 1.0 MHz nominal frequency.

2) The surface of the lucite wedge shall be contoured to the outside radius of the component being examined. (This is to enhance the percentage of sound induced into the material and increase the signal to noise ratio.)

3) Due to the curved lucite wedge design all angles will be measured directly from the components designated calibration standard.

4) The calibration shall be conducted utilizing the technique referenced in Section 8.4 of Document 80A0475.

5) Scanning sensitivity will be 6db above reference.

6) All indications noted within the material shall utilize the typical recording levels noted in Document 80A0475.

7) Due to the lower sensitivity of the notch response in relation to the DAC curve when examining with refracted longitudinal techniques, all indications found at the ID will be recorded at 50% of the notch response. This will enchance a more conservative examination.

Figure 18 △7

TECHNIQUE SHEET
FOR
FEEDWATER SAFE-ENDS

1) Axial Scans ⊥

A 60° angle beam shear wave technique, either full vee or half vee calibration shall be used for examination areas masked by excessive excavations.

2) Circumferential Scans =

A 55° angle beam shear wave technique, either full vee or half vee calibration, shall be used for examination areas masked by excessive excavations.

Figure 19

7