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DESCRIPTION:

Ltr re our 3-11-75 ltr...trans the following:

ENCLOSURES:

Interim responses concerning recirculation bypass piping....(40 cys encl rec'd)

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ACKNOWLEDGED

PLANT NAME: Monticello

FOR ACTION/INFORMATION 7-7-75 ehf

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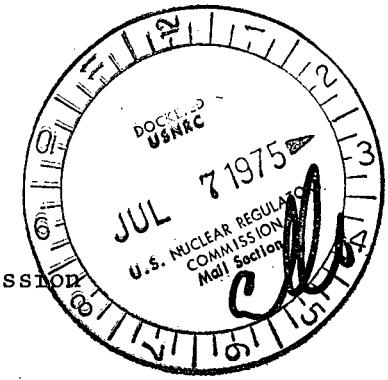


June 24, 1975

Mr. D. L. Ziemann, Chief
Operating Reactors Branch # 2
Division of Reactor Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Ziemann:

MONTICELLO NUCLEAR GENERATING PLANT
DOCKET NO. 50-263 LICENSE NO. DPR-22

Interim Response to March 11, 1975 Letter

Your March 11, 1975 letter requested information in four areas associated with the Monticello recirculation bypass piping:

A. Plant operating chemistry data
B. Test procedures, standards and codes
C. Report of metallurgical examination of removed material
D. Information on initial piping fabrication

Information requested on item A was included in our March 24, 1975 letter. Items B and D are discussed in this letter and its attachments. Item C will not be available in report form for approximately another month. It should be noted that when Mr. John Weeks of the NRC task force on this matter visited the Argonne Laboratory where the metallurgical examination was done, he had the opportunity to review photo-micrographs, view specimens, and discuss the results with personnel who conducted the examination.

Attached are three Nuclear Services Corporation procedures for ultrasonic examination of pipe welds that were used during Monticello's 1975 inservice inspection and the inspection to comply with USNRC IE Bulletins 75-01 and 75-01A. General Electric Corporation performed the preservice inspection and Nuclear Services Corporation of Campbell, California has performed the inservice inspections to date.

Our policy has been to maintain the test procedures and techniques current with the ASME Section XI Code requirements for each of the annual inservice inspections. Therefore, in determining compliance of these procedures with the rules of the ASME Code, Section III, Section V, and Section XI, it required a reconstruction of the evolution of them with relation to Code changes used for the investigation and evaluation requirements of ultrasonic indications. The following is a summary of these Code changes and the interrelationship of the respective Sections of the ASME Code as they applied to the evolution of our procedures:

1. Section XI (1971) required ultrasonic inservice and preservice examination as per ASME Section III Appendix IX-3000. This Appendix required the investigation and evaluation of all indications greater than 20%, but did not require reporting of such indications if evaluated as being acceptable.

2. The 1971 Summer Addenda to Section XI reduced the requirements for investigation and evaluation of indications to those greater than 100% of DAC.

3. The Summer 1973 Addenda to Section XI provided procedures for the ultrasonic examination of wrought ferritic components over 1" in wall thickness (vessels), but did not change the standards for piping examinations contained in Section III and its Summer 1971 Addenda.

4. The 1974 edition of Section XI of the Code referred all ultrasonic examinations of non-vessel material to Article 5 of Section V. This article again required that all indications greater than 20% of the reference DAC be investigated and evaluated in terms of the acceptance criteria of the referencing section of the Code, in this case, Section XI. However, there is no requirement for reporting an indication if evaluated as being acceptable. Until now, and until acceptance standards for piping are adopted for Section XI, any indications must be evaluated in terms of the edition of Section III under which the plant was constructed. In the case of the Monticello Plant, there was no edition of Section III covering piping.

Guidance on the intent of the Section XI Committee in the interpretation of the word "evaluation" is provided by an ASME letter of April 12, 1973 on this subject The subject letter from Mr. W. J. Woollacott to Mr. R. Von Osenski, of Westinghouse, states it is the length of a discontinuity indication exceeding the reference level that is to be evaluated in terms of acceptance-rejection criteria.

With this interpretation in mind, all U. T. procedures were approved by NSP and the authorized inspector (Hartford Steam Boiler Inspection and Insurance Co.) as meeting the requirements of reference Section XI Editions.

However, the recording and evaluation levels used actually are limited only by the capability of the equipment. The test system that has been used for the inservice inspections consists of an ultrasonic digital analog tester and a two channel Brush strip chart recorder. The two channel recorder automatically records at 8 to 10% of scale of the amplitude of the reflected signal and the sound metal path. The strip chart recording not only provides a permanent record for future references, but also provides an opportunity for evaluation subsequent to that performed by the Level II Inspector who is performing the weld inspection and the initial evaluation from the ultrasonic CRT scope. All inspection reports, which are prepared and signed by the Level II Inspector, consists of the data and evaluation sheet and the strip charts. These reports are further evaluated by a Review Board which consists of NSP's Level III Inspector, the inspection contractor's Level III Inspector and the Authorized Inspector. This review is documented on each report.

Although section 8.0 of the attached ultrasonic test procedure, NUT-NC-1A, requires the inspector to further evaluate indications greater than 100% of the reference level (DAC), in actuality, all indications greater than 8 to 10% of scale (above noise level) are recorded and evaluated. The DAC curve is used only as a reference and not as a accept-reject curve. The minimum acceptance standards as described in paragraph 10.0 of the subject procedure comply with ASME, Section III (1974) Code. The indication's signal, response and travel are as important as the signal amplitude when evaluating indications.

The manufacturer of the original recirculation bypass piping was contacted concerning your request for information on the fabrication of that piping. He informed us that in the years following the fabrication they have moved their factory and can no longer locate this information.

Yours very truly,

L. O. Mayer, PE
Manager, Nuclear Support Services

LOM/MHV/deb

cc: J. G. Keppler
G. Charnoff
MPCA Attn: J. W. Ferman

Attachments:

NUT-NC-1A, Revision 4, Nuclear Ultrasonic Testing Procedure, Ultrasonic Inspection of Welds, in the 1/4" to 2-1/2" Thickness Range

NUT-NC-1E, Revision 4, Nuclear Ultrasonic Weld Examination Calibration Procedure

NUT-NC-3, Revision 4, Procedure for Automatic Recording Of Ultrasonic Test Data

SPECIAL PROCESS STANDARD

SPS	REV.
NUT-NC-1A	4

	PREPARED BY – DATE	EFFECTIVE DATE
Nuclear Ultrasonic Testing Procedure Ultrasonic Inspection of Welds, in the 1/4" to 2-1/2" Thickness Range.	T. G. Lambert 1/1/75	January 1, 1975
	APPROVED BY – DATE T. G. Lambert 1/1/75	PAGE 1 OF 17

1.0 SCOPE

1.1 This document covers the general procedure and requirements for ultrasonic examination of welds in Nuclear Reactor Piping Systems, and meets the requirements of the ASME Code, Section III, Appendix 9, Paragraph 3400 and, Section XI of the ASME Code.

2.0 SPECIFICATIONS

2.1 The indicated revision of the following specifications shall form a part of this document.

2.1.1 ASME Code Section III Nuclear Vessels (Summer 1974 Addenda).

2.1.2 ASME Code Section XI Rules for Inservice Inspection of Nuclear Reactor Coolant Systems (Summer 1974 Addenda).

2.1.3 ASME Code Section V Nondestructive Examination (Summer 1974 Addenda).

2.2 Other Specifications

2.2.1	ASTM E114	Recommended Practices for UT.
2.2.2	ASTM A-388	UT of Heavy Steel Forgings.
2.2.3	ASNT-TC-1A	Qualification and Certification of Nondestructive Testing Personnel, Supp. C.
2.2.4	NUT-PQ-1	Nuclear Services Corporation Personnel Qualification Procedure.
2.2.5	NUT-NC-3	Procedure for Automatic Recording of Ultrasonic Test Data.
2.2.6	NUT-NC-1E	Ultrasonic Testing Calibration Procedure.

3.0 PERSONNEL QUALIFICATIONS

3.1 All personnel engaged in ultrasonic inspection shall be qualified in accordance with ASME Code requirements as either Level I (operator), Level II (inspector), or Level III (examiner) as defined in SNT-TC-1A, Supplement C and NUT-PQ-1, Rev. 0. Only a Level II Inspector or Level III Examiner shall make judgment as to the acceptance or rejection of indications. The Nuclear Services Corporation Level III Examiner will submit to the Purchaser, upon request, a copy of personnel qualifica-

3.1 (continued)

tions and qualified ultrasonic procedures. Personnel shall, at the request of the Purchaser, demonstrate their knowledge and understanding of pertinent specifications and procedures, and their ability to satisfactorily operate all required equipment prior to performing an ultrasonic inspection. The job shall be provided with adequate equipment to perform and fulfill the contractual requirements. It shall be the responsibility of Nuclear Services Corporation to set up the equipment, perform the examination, interpret the results, and make reports. Final reports shall be submitted to the Purchaser for disposition.

3.1.1 Certification of Personnel to NUT-PQ-1 requirements shall be directed by the Nuclear Services Corporation Authorized Level III Examiner.

3.1.2 Level III Examiners appointed by Nuclear Services Corporation shall conform to SNT-TC-1A, Supplement C and the Nuclear Services Corporation Personnel Qualification Procedure, NUT-PQ-1.

3.2 Personnel Certification

3.2.1 Certification of personnel shall conform to SNT-TC-1A, Supplement C and Nuclear Services Corporation Personnel Qualification Procedure, NUT-PQ-1.

3.2.2 In order to attain certification in any level, the candidate must demonstrate to the Nuclear Services Corporation Level III Examiner's satisfaction a thorough knowledge of the procedures and requirements contained in this document.

3.3 Visual Acuity Requirements

Visual requirements for near distance acuity and color shall conform to SNT-TC-1A, Supplement C and Nuclear Services Corporation Personnel Qualification Procedure, NUT-PQ-1.

3.4 Records

3.4.1 Records of personnel certification, including copies of test results, eye examination results, and certification documents, shall be maintained by the Nuclear Services Corporation Level III Examiner at the home office and at the job site and shall conform to SNT-TC-1A, Supplement C and Nuclear Services Corporation Personnel Qualification Procedure, NUT-PQ-1.

4.0 INSPECTION METHODS

The method used to fulfill the inspection requirements shall be the Pulse Echo Method.

4.1 Pulse Echo Method

This method consists of transmitting a sound beam into a specimen and interpreting the returned echos. Pulse Echo Testing shall be conducted using either straight beam or angle beam techniques.

5.0 SCANNING TECHNIQUE

Scanning shall be performed manually by moving the search unit in a directed path at a maximum scanning rate of 6 inches per second. A minimum of 15 per cent overlap shall be used.

5.1 Contact Scanning

This method requires the search unit to be placed in direct contact with the specimen surface. A coupling fluid is required to make effective contact between the search unit and the specimen surface.

5.1.1 Coupling Fluids

For the sound beam to be transmitted into the specimen, the surface of both the transducer and the specimen must be wet by a transmission medium. A water base halogen free couplant shall be used for contact testing and the type recorded on the inspection report.

6.0 SURFACE REQUIREMENT

The surfaces of material for inspection shall be clean, uniformly smooth, and free of surface defects such as laps, weld splatter, or irregularities that would interfere with free movement of the search unit or impair the transmission of ultrasonic vibrations. The surface of a weld should merge smoothly into the surfaces of the adjacent base material.

7.0 ULTRASONIC EXAMINATION OF BUTT WELDS IN THE 1/4" to 2-1/2" THICKNESS RANGE

7.1 Welds shall be examined by the angle beam method where practical. In the examination of weldments where geometry does not allow angle beam examination from both sides of the weld from a single surface or a combination of surfaces, either a combination of angle beam and straight beam or straight beam in two (2) directions at 90 degrees to each other shall be used.

7.2 Calibration Reference Reflectors

Side drilled holes shall be used as basic calibration reflectors to establish the primary reference response of the equipment and to construct a distance-amplitude correction curve. These holes shall be located either in the production material or in a basic calibration block of an equivalent P-number grouping conforming to Figure 1.

7.2.1 Basic Calibration Block (Figure 1 and 6)

If a basic calibration block is used, it shall have a thickness related to the production material thickness, according to the table of Figure 1. Where two or more thicknesses are involved, the calibration thickness shall be determined by the thickness of the production material to which the search unit is applied. For examination of circumferential welds on material with contact surface curvature greater than 20 inches in diameter, flat, basic calibration block or blocks of essentially the same curvature as the part to be examined shall be used. The basic calibration block contact surface shall be curved for material contact surface curvatures less than 20 inches in diameter. A curved basic calibration block shall be used to calibrate the examination on contact surfaces in the range of curvature from 9/10 to 1-1/2 times the basic calibration block diameter. For example, the 8 inch diameter curved block may be used to calibrate the examination on material contact surfaces in the range of curvatures from 7.2 to 12 inches in diameter.

7.2.2 Basic Calibration Holes

Basic Calibration Holes shall conform to Figure 1.

7.2.3 Portable Calibration Check Block

An IIW-2 block or similar portable block containing side drilled holes may be used as a calibration stability reference, where the use of the basic block is not feasible.

7.2.4 Calibration Procedure

Calibration and Calibration Recording Procedures are contained in Nuclear Services Corporation Procedure NUT-NC-1E.

7.3 Angle Beam Method

7.3.1 Before angle beam examination is attempted, the volume of the base material through which the sound will travel in angle beam examination shall be completely scanned with a straight beam search unit to detect reflectors which might affect the interpretation of angle beam results. Consideration must be given to these reflectors during interpretation of weld examination results, but their detection shall not be a basis for rejection of the base material.

7.3.2 Calibration of Equipment for Angle Beam Testing

a) Transducer Frequency and Size

The nominal transducer frequency shall be 2.25 MHz unless large grain structure or geometry necessitate the use of other frequencies. The maximum size of the transducer shall be 1" by 1".

b) Beam Angle

The beam angle in the production material shall be in the range of 40 degrees to 75 degrees.

c) Distance-Amplitude Correction

Compensation for the distance traversed by the ultrasonic beam as it passes through the material shall be provided by the use of correction curves as described below:

d) Determination of the Distance Amplitude Correction Curve for Angle Beam Testing

1. Nodal Method

Distance-amplitude correction curves (see Figure 2) shall be constructed by utilizing the responses from the basic calibration holes described in 7.1.2.2. The first point on the curve is obtained by placing the search unit as near the basic calibration hole as possible and adjusting the tester gain for maximum response at 75 per cent of full scale. This is the primary reference response. Without changing the gain, the search unit shall be placed similarly at other nodal positions, and the sweep adjusted to display 2-1/2 nodes to extend the calibrated examination into the half node region.

7.3.2 (continued)

2. Multiple Hole Method

Multiple calibration holes may be drilled, covering the contemplated examination distance range and the corresponding responses marked on the screen. These points shall be joined by a smooth line, the length of which shall be sufficient to cover the examination range.

e) Inspection parameters, a, b, and c shall be recorded on suitable forms.

f) Calibration shall be performed on a daily basis before each day's examinations and checked before and after each examination, and at least every 4 hours during examination.

1. If a check indicates a change in system response recalibration is required.

g) Calibration and Calibration recording procedures are contained in Nuclear Services Corporation procedure NUT-NC-1E.

7.3.3 Reference Sensitivity Level

The reference level for monitoring discontinuities is the primary reference response corrected for distance by the Distance Amplitude Correction curve.

7.3.4 Scanning Sensitivity Level

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

7.3.5 Coverage

Where possible, welds shall be examined from both sides of the weld (usually from one surface only).

7.3.5.1 Detection of Defects Parallel to the Weld

The search unit shall be placed on the contact surface with the beam aimed at the weld at about 90 degrees and manipulated laterally and longitudinally so that the ultrasonic beam passes through all of

7.3.5.1 (continued)

the weld metal in two different approaches of the beam, i.e., from both sides of the weld. Techniques employing two search units may be used to detect lack of penetration in double welded butt joints (see Figure 3).

7.3.5.2 Detection of Defects Transverse to the Weld

Two search units shall be placed on the contact surfaces adjacent to the weld, one on each side, making an angle of 45 degrees or less with the axis of the weld with the beam directed along the weld in such a manner that the entire depth and width of the weld is scanned (see Figure 4). Alternatively when the weld surface is suitable, one transducer may be placed on the centerline of the weld and manipulated so that the centerline of the beam covers the entire weld volume.

7.4 Straight Beam Method

7.4.1 Calibration of Equipment for Straight Beam Testing

a) Transducer Frequency and Size

The nominal frequency shall be 2.25 MHz unless grain structure or geometry necessitate the use of other frequencies. The maximum size of the transducer shall be one square inch.

b) Distance-Amplitude Correction

A distance-amplitude correction curve need not be constructed when the thickness of material is one inch or less. For greater thicknesses, using the proper basic calibration block (see Figure 1), position the search unit for maximum response from the basic calibration hole at 1/4T (see Figure 5). Adjust the signal amplitude to 50 per cent of full screen. This is the primary reference response. Without changing the gain control, position the search unit for maximum response from the basic calibration hole to 3/4T and marks its amplitude on the screen. Join the two points with a straight line and extend its length to cover the test range (see Figure 5).

7.4.1 (continued)

c) Inspection parameters a and b shall be recorded on suitable forms.

d) Calibration shall be performed daily before each days' examinations and checked before and after each examination.

e) If a check indicates a change in system response, recalibration is required.

f) Calibration and Calibration Recording procedures are contained in Nuclear Services Corporation procedure NUT-NC-1E.

7.4.2 Reference Sensitivity Level

The reference level for monitoring discontinuities is the primary reference response corrected for distance by the distance amplitude curve.

7.4.3 Scanning Sensitivity Level

When possible, scanning shall be performed at a minimum gain setting of two (2) times the primary reference level.

7.4.4 Verification of Penetration

Penetration shall be verified by obtaining a reflection on similar material while using approximately the same length of sound travel.

7.4.5 Coverage

The weld shall be examined by moving the search unit progressively along and across a sufficient contact area so as to scan the entire weld volume.

7.5 Transfer Mechanism

7.5.1 Transfer correction shall be one (0 db) when the basic calibration block is judged to be similar in surface condition to the material under test.

7.5.1.1 Such variables as coatings, scale, roughness, and curvature shall be considered in evaluating the above similarity.

7.5.2 Where there is dissimilarity between the calibration block and the material under test and the transfer mechanism is applied it shall be detailed on the technique sheet.

8.0 INDICATIONS

All indications which produce a response greater than 100 per cent of the reference level shall be investigated to the extent that the examiner can determine the shape, identity, and locate all such reflectors and evaluate them in terms of the acceptance standards. Oscillograph chart records of indication amplitude and range may be used as an aid in comparison of the indication response with that of the primary reference reflector.

9.0 EVALUATION OF INDICATIONS

The angle of the flaw to the surface, dispersion characteristics of the metal which change the echo strength with depth, and the effect of surface curvature and narrow inspection faces shall be considered in estimating flaw size. Under certain conditions, non-standard reference blocks and/or special techniques will be used to determine the exact character of the actual defect.

10.0 ACCEPTANCE STANDARDS

10.1 The following shall constitute the minimum requirements for welds:

Linear type discontinuities are unacceptable if the amplitude exceeds the reference level and discontinuities have lengths which exceed the following:

1/4 in.for t up to 3/4 in.inclusive.
1/3 in.for t over 3/4 in. to 2-1/4 in. inclusive, and
3/4 in.for t over 2-1/4 in.

Where t is the thickness of the thinner portion of the weld being examined. Where discontinuities are interpreted to be cracks, lack of fusion, and incomplete penetration, they are unacceptable regardless of discontinuity length or signal amplitude.

11.0 REPORTS

11.1 Report of Ultrasonic Examination

The specific technique for each examination shall be recorded on form NSC-TS-003-6/74 and shall include the following minimum information (see attached form) which will be developed from information obtained when inspecting the first unit.

11.0 (continued)

a) Weld type and configuration, part or piece number to be tested, including thickness and diameter dimesions.

b) Automatic defect alarm and recording equipment or both, if used.

c) Special search unit, wedges, shoes, or saddles, if used.

d) Scanning mechanisms, if used.

e) Stage of manufacture when test was made.

f) The surface or surfaces from which the test was performed.

g) Surface finish.

h) Couplant.

i) Method(s) used.

j) Description of the calibration method(s) and method of correlating indications with defects.

k) Scanning method(s).

l) Types and sizes of transducers.

m) Test frequency.

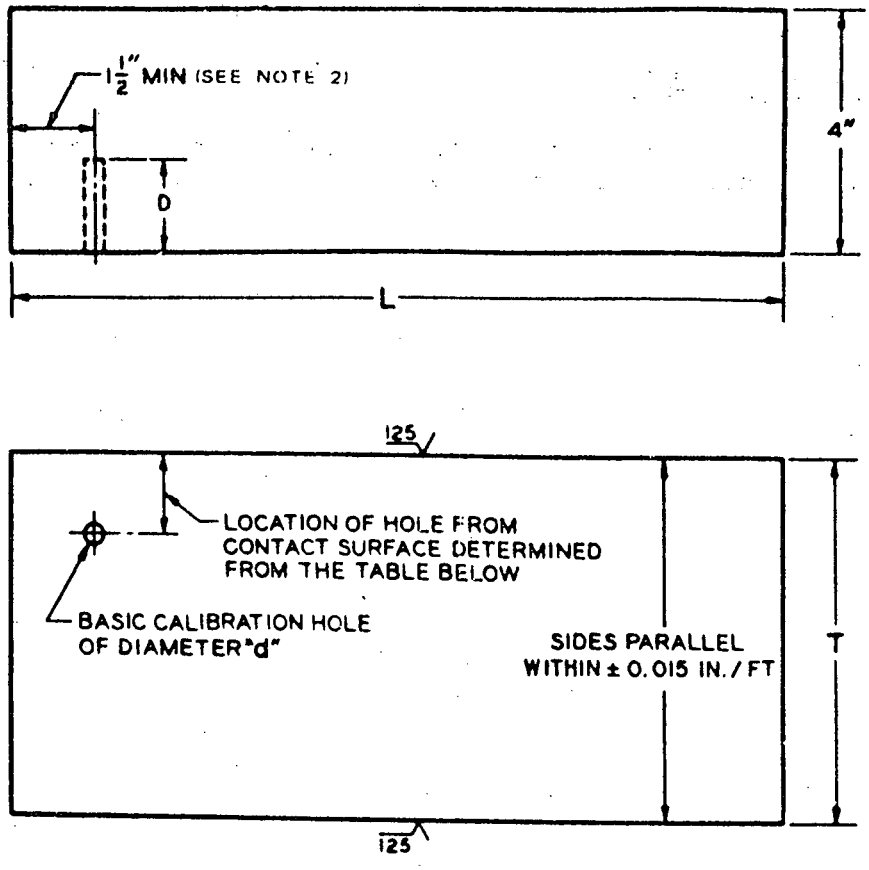
n) Calibration checks before and after each examination.

11.2 Nuclear Services Corporation Certification Form NSC-TS-003-6/74 shall be filled out completely by qualified personnel and the report shall be signed by Nuclear Services Corporation certified inspector. When requested, all rejectable indications will be shown on a drawing or chart of the item and an inspection technique sheet shall be provided. Two copies of the certification form(s) shall be retained by Nuclear Services Corporation and three copies shall be given to the client.

11.3 Applicable oscillograph strip chart records of the examination generated according to Nuclear Services Corporation Procedure NUT-NC-3 shall be attached to the report.

12.0 QUALITY ASSURANCE

12.1 It shall be the responsibility of the Nuclear Services Corporation Level III Examiner to enforce the requirements of this procedure.



L = Length of block determined by the angle of search unit and the vee-path used
T = Thickness of basic calibration block (see table below)
D = Depth of side-drilled hole (see table below)
d = Diameter of side-drilled hole (see table below)
t = Nominal production material thickness

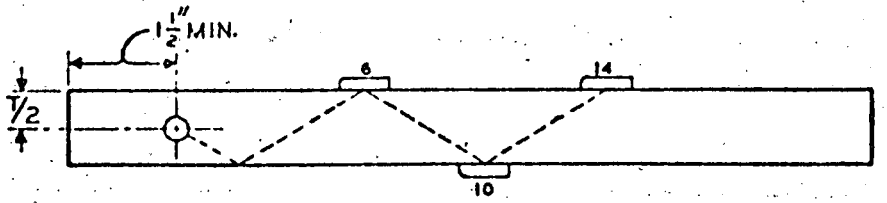
Nominal Production Material Thickness (*t*) in.	Basic Calibration Block Thickness (*T*), in.	Hole Location	Hole Diameter (*d*), in.	Minimum Hole Depth (*D*), in.
Up to 1 incl.	¾ or *t*	½ *T*	3/32	1½
Over 1 thru 2	1½ or *t*	¼ *T*	⅛	1½
Over 2 thru 4	3 or *t*	¼ *T*	3/16	1½
Over 4 thru 6	5 or *t*	¼ *T*	¼	1½
Over 6 thru 8	7 or *t*	¼ *T*	5/16	1½
Over 8 thru 10	9 or *t*	¼ *T*	⅜	1½
Over 10	*t*	¼ *T*	See Note 1	1½

Note 1 For each increase in thickness of 2 in., or a fraction thereof, the hole diameter shall increase 1/16 in.

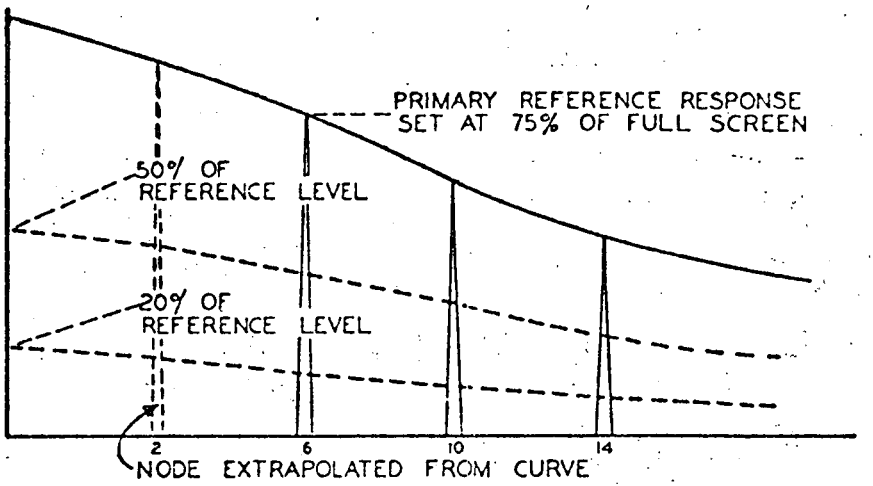
Note 2—For block sizes over 3 in. in thickness (*T*), the distance from the hole to the end of the block shall be ½*T* min. to prevent coincident reflections from the hole and the corner in the ⅝ th vee-path position. Blocks fabricated with a 1½-in. minimum dimension need not be modified if the corner and hole indications can be easily resolved.

Figure 1

MF



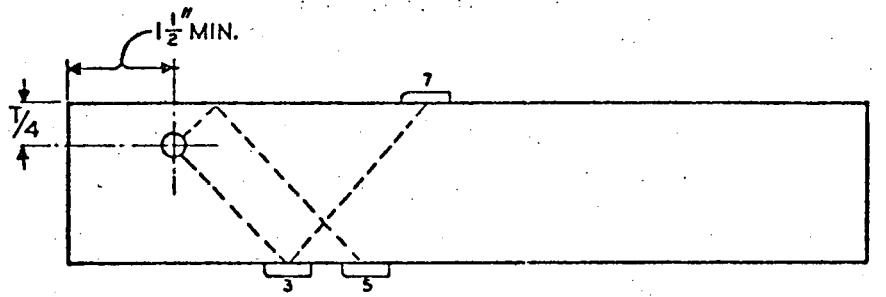
FOR THICKNESS 1 INCH OR LESS



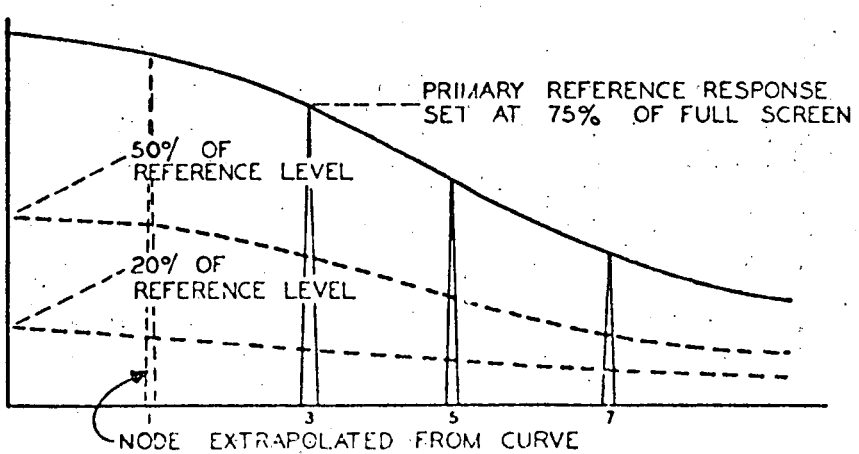
TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE

(ANGLE BEAM METHOD)

DISTANCE IN EIGHTHS OF A NODE. FOR EXAMPLE 14 IS $\frac{14}{8}$ NODE



FOR THICKNESS OVER 1 INCH

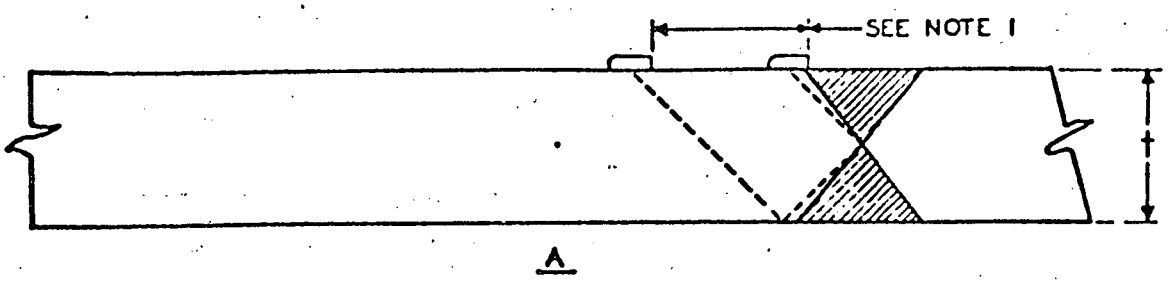


TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE

(ANGLE BEAM METHOD)

DISTANCE IN EIGHTHS OF A NODE. FOR EXAMPLE 14 IS $\frac{14}{8}$ NODE

Figure 2



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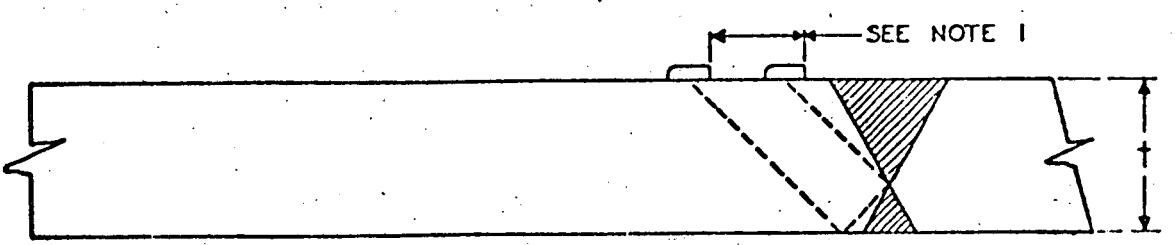


B

NOTE 1

THE POSITION OF THE SEARCH UNITS WILL VARY BECAUSE THE SEARCH UNITS MUST BE LOCATED IN RELATIONSHIP TO THE SOUND BEAM TRAVEL.

FIG. 3

TYPICAL DOUBLE SEARCH UNIT TECHNIQUE

FOR DETECTING LACK OF PENETRATION IN DOUBLE WELDED JOINTS

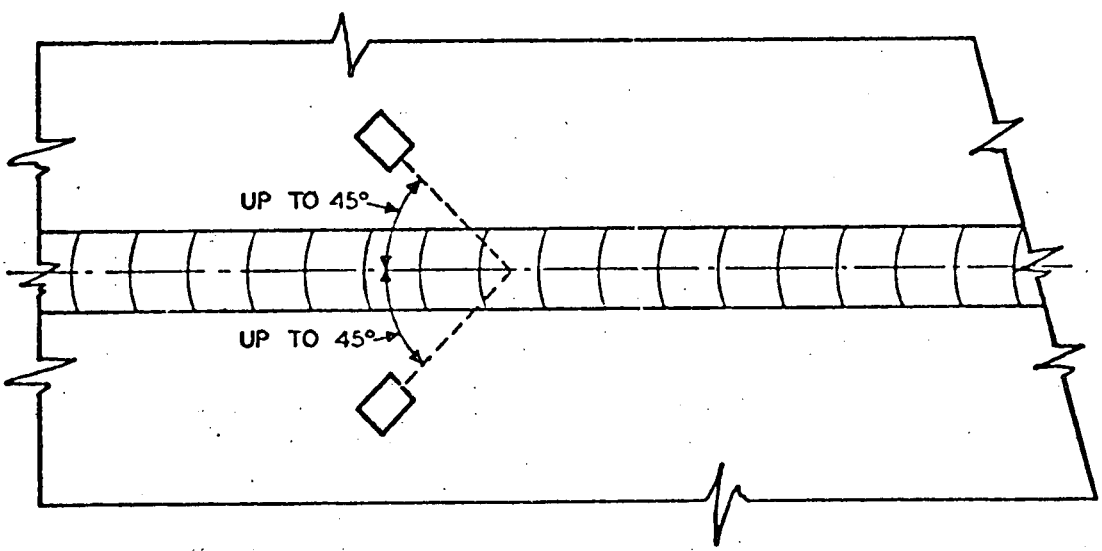
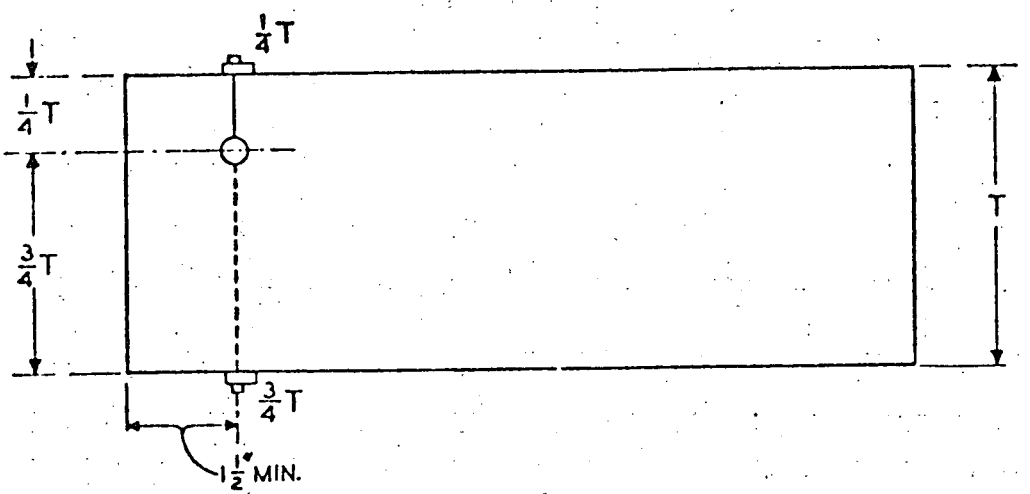


FIG. 4

TYPICAL TWO SEARCH UNIT TECHNIQUE

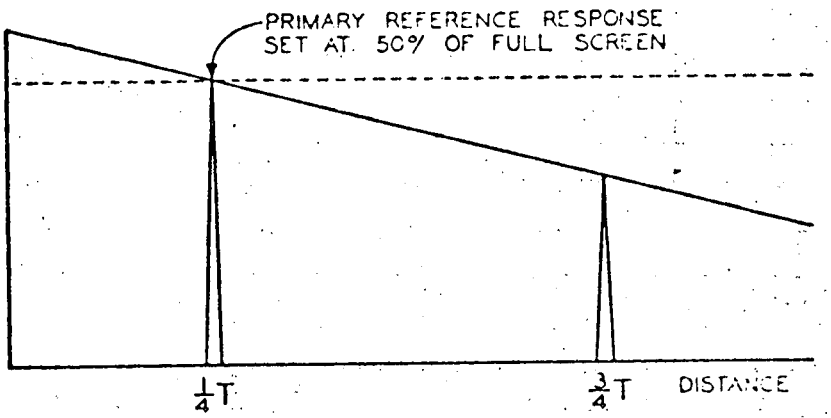
FOR DETECTING TRANSVERSE DISCONTINUITIES

FIG. 3 & 4



A

Figure 5



B

TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE

(STRAIGHT BEAM METHOD)

Figure 6

NUCLEAR SERVICES CORPORATION

477 DIVISION STREET
CAMPBELL, CALIFORNIA 95008

CONSTRUCTION
OPERATION

(408) 374-1880

REPORT OF ULTRASONIC EXAMINATION

CUSTOMER			DATE	START TIME	FINISH TIME
JOB OR PROJECT LOCATION	JOB NO.		RPT. NO.		
COMPONENT DESCRIPTION			PLAN OR DWG. NO.		
IDENTIFICATION NUMBER	MATERIAL	SURFACE COND.	THICKNESS	TEMP.	RADIATION FIELD
INSPECTION CODE REFERENCE	NOE PROCEDURE REV.	EVALUATION LEVEL	REPORTING LEVEL		
U.T. EQUIPMENT S/N	ANGLE BEAM S/N ANGLE	L-WAVE S/N	TEST BLOCK DESC. S/N	SCANNING METHOD & SPEED	
CALIBRATION NO.	COUPLANT	EXAMINATION TYPE P.E. THROUGH T.	TRANSMISSION MODE LONG. SHEAR	OVERLAP	
SCAN ATTEN (DB): ANGLE STR.	GAIN	EGC	DAMPING – PULSE L. ANGLE STR.	REP. RATE	VIDEO RESPONSE
SWEEP (IN): ANGLE STR.	ANGLE BEAM TEST REF. REFLECTOR AMP. %	μS	STRAIGHT BEAM TEST REF. REFLECTOR AMP	μS	
DELAY (IN): ANGLE STR.	CALIBRATION CHECK PERFORMED ANGLE BEAM L WAVE		CHECK REF. BLOCK	MATERIAL MARKER	PHOTO
GATED CIRCUIT: OFF MAN AUTO CHART	RECORDER S/N		LEVELS: ALARM DAMP REJECT		

NAD = NO APPARENT DISCONTINUITIES S = SPOT INDICATION L = LINEAR INDICATION G = GEOMETRY

SCANS	ACC	REJ	IND	DESCRIPTION OF INDICATIONS AT EVALUATION SENSITIVITY LOCATION & LENGTH	RANGE	MAX AMP	MAX DAC
VISUAL PER NVT-NC-1							
BASE METAL PRE EXAM							

CONFIGURATION SKETCH AND SCANNING DIRECTIONS

TEST TECHNICIAN _____

ASST. TEST TECHNICIAN _____

Level III ~~Q.A. TECHNICIAN~~ _____

CUSTOMER (Level III) _____

AUTHORIZED INSPECTOR _____
SIGNATURE

ENCLOSURE ADDED
YES [ ] NO [ ]

PAGE _____ OF _____

INCLUDE ENCLOSURE PAGES

Record of Revisions

No.	Date	Revision	By
4	1/10/75	Revised	
3	3/1/74	Revised	
2	1/11/74	Revised	
1	7/30/73	Revised	
0	3/1/73	Issued for Comments	

Field Change for NUT-NC-1A Rev 4

January 30TH 1975

Examine the base metal near all stainless steel piping girth welds for a distance of at least one pipe radius, on all UT scans.

T.J. Lambert
NSC Corp Inspector
at the Montrello Site

P.J. Kemper

SPECIAL PROCESS STANDARD

SPS	REV.
NUT-NC-1E	4

Nuclear Ultrasonic Weld Examination Calibration Procedure	PREPARED BY - DATE	EFFECTIVE DATE
	T. G. Lambert-1/5/75	January 10, 1975
	APPROVED BY - DATE: T G Lambert 1/10/75	PAGE: 1 OF 22

1.0 SCOPE

This document defines procedures for preparing ultrasonic testing equipment calibration records to meet or exceed the requirements of Appendix IX, Section III, Summer 1974 Addenda, Section V, Summer 1974 Addenda, and Section XI, Summer 1974 Addenda of the ASME Boiler & Pressure Vessel Code.

2.0 SPECIFICATIONS

2.1 The indicated revision of the following specification shall form a part of this document.

2.1.1 ASME Boiler and Pressure Vessel Code Section XI (Summer 1974)

2.1.2 SNT-TC-1A, Qualification and Certification of Nondestructive Testing Personnel Supplement C

2.1.3 ASTM E-317-68, Evaluating Performance Characteristics of Pulse Echo Ultrasonic Testing Systems

2.1.4 ASME Boiler and Pressure Vessel Code, Section III (Summer 1974)

2.1.5 NUT-NC-1A, Nuclear Ultrasonic Testing Procedures Ultrasonic Inspection of Welds

2.1.6 NUT-NC-1C, Ultrasonic Examination of Inner Radius of Pressure Vessels at Monticello

2.1.7 NUT-NC-7, Nuclear Ultrasonic Examination of Reactor Pressure Vessel Butt and Nozzle Welds

2.1.8 NUT-NC-3, Procedure for Automatic Recording of Ultrasonic Test Data

2.1.9 ASME Boiler and Pressure Vessel Code Section V (Summer 1974)

2.1.10 ASTM E-164, Standard Recommended Practice for Ultrasonic Contact Examination of Weldments

3.0 PERSONNEL QUALIFICATIONS

3.1 All personnel performing ultrasonic inspections shall be qualified in accordance with Code accepted standards and procedures as either Level I (Operator), Level II (Inspector), or Level III (Examiner),

3.1 (continued)

as defined in SNT-TC-1A, Supplement C and NUT-PQ-1, Rev. 0. Only a Level II Inspector or Level III Examiner shall make judgment as to the acceptance or rejection of indications. The Nuclear Services Corporation Level III Examiner will submit to the purchaser, upon request, a copy of personnel qualification and ultrasonic procedures. Personnel shall, at the request of the Purchaser, demonstrate their knowledge and understanding of pertinent specifications and procedures and their ability to satisfactorily operate all required equipment prior to performing an ultrasonic inspection.

4.0 TEST EQUIPMENT

4.1 Ultrasonic test instruments calibrated per ASTM E317-68 shall be used.

4.2 Electronic calibration records shall be maintained for all instruments and certification for all transducers. Instrument calibration shall be performed at three month intervals.

4.3 Battery powered instruments shall include internal stabilization resulting in gain changes of less than 1 db and horizontal linearity changes of less than 6 percent of scale length during battery operating life.

4.4 Ultrasonic testing instruments shall have a calibrated gain control adjustable in, at most, 2 decibel steps over a range of at least 60 db. The accuracy of the gain control setting shall be verified as a part of system calibration as per item 4.1.

4.5 Ultrasonic transducer, either angle or straight beam, shall produce a sound beam within $\pm$ 3 degrees of the stated nominal value, i.e., 0°, 45°, etc., as measured using an IIW-2 weld test block.

4.6 The nominal transducer parameters shall be clearly and permanently marked on the transducer. These must include size, frequency, materials, angle, and index point. Transducers shall be serialized.

5.0 CALIBRATION STANDARDS

5.1 Basic Calibration Blocks typified by those shown in Figures 1, 4, 5, and 6 shall be used to determine the primary reference response of the equipment. These blocks conform to the requirements of Section III and XI of the ASME Boiler and Pressure Vessel Code, and the applicable Nuclear Services Weld Inspection procedure.

5.2 Curved basic calibration blocks for testing piping may contain an additional notch reference reflector.

5.3 An International Institute of Welding Block (IIW-2) may be used for calibration check in situations where the primary standard cannot be conveniently applied.

5.4 An International Institute of Welding Block (IIW-2) may be used for determining transducer delay and display sweep settings.

5.5 Basic Calibration Blocks shall be certified as to material and shall be traceable.

6.0 COUPLANT

6.1 A Water base couplant certified free from halogen shall be used and its type shall be recorded on the Calibration Record Sheet.

7.0 CALIBRATION OF THE SYSTEM FOR TESTING OF WELDS - EXCLUDING THE REACTOR PRESSURE VESSEL WELDS

7.1 Basic calibration blocks similar to those shown in Figures 1, 3, and 5 shall be used.

a) The calibration reference reflectors shall be side drilled holes. These reference reflectors shall be used to establish the primary reference response and to construct a distance amplitude correction curve (DAC).

b) The Basic Calibration Block shall have thickness as indicated in the table of Figure 1 to match production material thickness. Calibration for tests of circumferential welds on material less than 20" in diameter shall be made using curved Basic Calibration Blocks. A curved block may be used to calibrate tests on material having diameters ranging from 90% to 150% of the basic block diameter.

c) The appropriate calibration reference reflector shall be machined in the block as shown in Figures 3 and 5.

d) The completed block shall be permanently marked to enable traceability to material documentation.

7.2 Calibration Interval For the Examination Of Welds Other Than the Reactor Pressure Vessel

7.2.1 Calibration shall be performed on a daily basis before each day's examination and shall be checked before the performance of each examination.

7.2.2 Calibration checks may be made using a conveniently portable test block such as the IIW in lieu of the basic calibration block.

7.2.3 Should a check indicate a change in amplitude response greater than 20% (2 db) the tester shall be immediately recalibrated.

7.2.4 Performance of the calibration check shall be indicated on the inspection report or chart record generated for each examination.

7.3 Generation Of the Distance Amplitude Curve For Angle Beam Testing Of Nuclear Piping and Components - Excluding the Reactor Pressure Vessel

7.3.1 The distance amplitude correction curve shall be constructed by plotting responses from the Basic Calibration Reflector. The first plotted point is the response from the reflector at the nearest point. This response shall be obtained by positioning the transducer for maximum return. The gain control is then set so that this response is 75 percent of full screen. Without further changing the gain, the search unit shall be placed similarly at other nodal positions and the indication response shall be marked on the tester screen, and its metal path (in microseconds) and amplitude marked on the DAC curve plot of Figure 2. This point is the PRIMARY REFERENCE RESPONSE. The tester sweep shall be adjusted to display 2-1/2 modes whenever possible.

7.3.2 Connect the plotted points on the tester screen and on the DAC curve plot with a smooth line to form the DISTANCE AMPLITUDE CORRECTION curve.

7.4 Generation Of the Distance Amplitude Curve For Straight Beam Testing Of Piping and Component Welds - Excluding the Reactor Pressure Vessel

7.4.1 A Distance Amplitude Correction Curve is not required for material one inch or less in thickness.

7.4.2 For material over one inch thick a Distance Amplitude Correction Curve may be constructed using the proper calibration block (determined by Figure 1). With the search unit positioned for maximum response from the basic calibration hole at 1/4 T (see Figure 4), set the signal amplitude to 50% of screen height. This is the PRIMARY STRAIGHT BEAM REFERENCE RESPONSE. Without changing the instruments settings, similarly position the search units over the reference reflector at 3/4 T. Mark the amplitude and position of both points on the screen and on the DAC Curve plot on the Calibration Record Sheet.

7.4.3 Join the points generated in 7.4.2 with a straight line. This is the STRAIGHT BEAM DISTANCE AMPLITUDE CORRECTION curve. It shall be plotted on the tester screen and on the DAC curve plot on the Calibration Record Sheet.

8.0 CALIBRATION OF THE SYSTEM TO PERFORM ULTRASONIC TESTING OF REACTOR PRESSURE VESSEL WELDS

8.1 Basic Calibration Block (Figure 6)

8.1.1 Basic Calibration Blocks shall be utilized in accordance with the Table and drawing of Figure 6.

8.1.2 Basic Calibration Blocks shall be fabricated from reactor pressure vessel material, such as a nozzle dropout.

8.1.3 The Basic Calibration Block shall be clad in a manner similar to the reactor pressure vessel. The cladding shall be 1/4 ± 1/8" thick.

8.1.4 The Basic Calibration Block shall receive heat treatment as required by the material specification type and grade.

8.1.5 Surface finish of the Basic Calibration Block shall be representative of the pressure vessel.

8.1.6 The block shall not utilize areas containing ultrasonically detectable defects producing indications larger than the back reflection.

8.1.7 Curved Blocks are required for surface curvatures less than 20" in diameter.

8.2 Basic Calibration Reflector

8.2.1 A side drilled hole, parallel to the surface and perpendicular to the edge of the material is the Basic Calibration Reflector.

8.2.2 A square notch reflector will be utilized in the calibration procedure.

8.2.3 Other reflectors may be incorporated but may not interfere with the primary reference.

8.3 Test for Instrument Amplitude Linearity (Figure 7A)

8.3.1 Place the angle beam transducer on the basic calibration block so that echoes from both the 1/2 T and 3/4 T can be observed.

8.3.1 (continued)

Adjust the transducer position and gain controls to obtain a 2/1 amplitude ratio between them with the larger at .80% of full screen height. Adjust the gain controls or the attenuator to vary the larger indication from 20% to 100% of full screen height in 10% increments, or 2 db stops. Read the indication at each setting. The smaller echo must be 50% of the larger, within 5% of full screen height. Amplitude readings shall be read from a signal height meter or estimated to 1%.

8.3.2 Amplitude control linearity is verified by placing the search unit on the basic calibration block so that the echo from the 1/2 T hole is peaked on the screen. The db attenuator controls shall be varied as shown below and the echo amplitude must increase and decrease accordingly. If the tester is not equipped with a meter to measure signal amplitude the signal height must be estimated to the nearest 1% of full screen.

Indication	Change db Control	Resultant Indication
80%	- 6 db	32 to 48%
80%	-12	16 to 24%
40%	+ 6	64 to 96%
20%	+12	64 to 96%

8.4 Examination System Calibration General Conditions

8.4.1 Calibration shall include the complete system. Any change in the components of the system shall be cause for recalibration.

8.4.2 The original calibration must be performed on a basic vessel calibration block. Calibration checks may be performed on a calibration block simulator.

8.4.3 The temperature of the basic calibration block shall be within 25°F of the component temperature.

8.4.4 Complete calibration shall be performed prior to the use of the system in each inservice inspection.

8.4.5 Calibration verification shall be performed at the beginning of each day's testing, at the start and finish of each examination, with any change in examination personnel, and at no greater than four hour intervals.

8.4.6 Calibration verification shall be performed by verifying the Distance Amplitude Curve. If any point on the curve has changed in amplitude by more than 20% (2 db) all data sheets since the last successful verification shall be marked void, a new calibration performed and recorded, and the voided examinations repeated.

8.4.7 If any indication on the DAC curve has moved more than 5% of the sweep division reading, correct the sweep range calibration and note the correction in the examination record. If recordable indications are noted on the data sheets, those data sheets shall be voided, a new calibration performed and recorded, and the voided examinations repeated.

8.4.8 The calibration parameters (Figure 7B) are: sweep range, test sensitivity, distance amplitude correction, position calibration with respect to the front of the search unit and the examination surface, calibration correction for planner reflectors at or near the material surface, beam angle and beam spread.

8.5 Angle Beam Calibration

8.5.1 Angle Beam Sweep Calibration for metal path (Figure 7C).

8.5.1.1 Using the 2" and 4" reflectors on a 4340 IIW 2 block, adjust the sweep zero and range controls to show 2" and 4" appropriately on the tester screen. Record range meter readings.

8.5.1.2 Position the transducer for maximum first indication from the 1/4 T side drilled holes. Record range meter reading. Measure actual metal path from the transducer index to the hole and compare with screen indication and meter reading. Values must agree within 5%.

8.5.1.3 Repeat step b using the 3/4 T hole. Trim range and delay controls if necessary to perform calibration.

8.5.1.4 Repeat step b using the 4/4 T notch. Trim range and delay controls if necessary to perform calibration.

8.5.2 Angle Beam Testing Distance Amplitude Correction (Figure 7D and 7E).

8.5.2.1 Position the search unit for maximum response from the hole which gives the greatest amplitude.

8.5.2.2 With at least 20 db gain remaining available at the tester adjust the gain control to place the indicator of step A at 80% of screen height. Make the peak of the indication on the tester screen plot trim point on the calibration record sheet plot.

8.5.2.3 Repeat step 8.5.2.2 for the remaining two holes in the basic calibration block. Connect the peak response points both on the tester screen and the DAC.

8.5.2.4 Position the transducer for maximum amplitude indication from the square notch on the opposite surface of the basic calibration block. Mark the peak of the indication on the tester screen and on the DAC plot. Consider the response of this reflector in evaluating surface reflectors.

8.5.2.5 Electronic Distance Amplitude Correction shall equalize the response of the basic calibration block to 50% of screen height over the range of the test.

8.5.3 Angle Beam Position Calibration (Figure 7G)

8.5.3.1 Position the Transducer for maximum response from the 1/4 T hole in the basic calibration block. Measure and record on the Calibration Record Sheet the distance from the front of the transducer to the scribe line above the hole. Also record the depth of the notch.

8.5.3.2 Repeat step 8.5.3.1 for the remaining holes and the notch.

8.5.4 Angle Beam Vertical Plane Beam Spread (Figure 7H)

8.5.4.1 Position the transducer for maximum response from the 1/4 T hole, with the tester set at twice the primary reference (DAC) sensitivity of step 11.4.6. Move the transducer forward and backward from the point of maximum response until the response falls to the 50% level as indicated by the DAC curve drawn on the screen. Record the maximum point on the distance movement to the 50% points in each direction as measured from the front of the transducer to the scribe line above the hole.

8.5.4.2 Repeat step 8.5.4.1 for the remaining holes.

8.5.4.3 Prepare a full scale drawing of the beam profile by correcting common response points from each hole.

8.6 Straight Beam Test Calibration

8.6.1 Straight Beam Sweep Range Calibration

8.6.1.1 Adjust the range and delay controls of the instrument to place the left edge of the maximized responses from the 1/4 T and 3/4 T side drilled holes at 20% and 60% of the horizontal scale, respectively.

8.6.2 Distance Amplitude Correction

8.6.2.1 Position the transducer for the maximum response from the side drilled hole which gives the highest amplitude.

8.6.2.2 With at least 20 db of gain remaining adjust the gain controls to provide an 80% of scale indication from the hole. Mark the peak of the indication on the tester screen and on the DAC plot in the Calibration Record.

8.6.2.3 Obtain maximum indications, and similarly plot the responses of the remaining side drilled holes.

8.6.2.4 Where electronic distance amplitude correction is used, the response of all holes must be adjusted to 50% of screen height.

8.7 Transfer Methods

8.7.1 Transfer methods are not permitted.

9.0 CALIBRATION RECORD SHEET

9.1 Record required calibration information on Ultrasonic Calibration Test Record Sheets NSC-TS-026-6-24 and NSC-TS-027-6-74.

9.1.1 Site

9.1.2 Date and Time

9.1.3 Examiners and Level

9.1.4 Instrument, S/N and modules (if any)

9.1.5 Calibration Procedure and Test Block No.

9.1.6 Examination Procedure

9.1.7 Transducer Index and Beam Angle

9.2 When the tester is provided with a range meter calibrated in micro-seconds, calculate and record.

9.2.1 Two way sonic Velocity factor, developed from IIW-2 Test Block Data.

9.2.2 Transducer delay in microseconds.

9.3 Record the reference sensitivity.

9.3.1 Record the response of the stability reference (IIW-2) at the reference sensitivity.

9.4 Plot the DAC curve on a separate page.

9.5 Record angle beam width and position data.

9.6 Record pertinent instrument settings.

9.7 Record scanning and evaluation sensitivities.

9.8 The completed calibration record shall accompany the examination team during the day's inspection as a necessary reference. It shall then be filed with other examination documentation.

10.0 STRIP CHART CALIBRATION RECORDS

10.1 The NORTEC 130 D tester used by Nuclear Services Corporation shall be used to generate a strip chart record of the amplitude and range of an ultrasonic examination. Test information shall be related directly to the basic calibration block response through Nuclear Services Corporation Procedure NUT-NC-3.

10.1.1 Strip chart recordings shall be made of the calibration response of this reference reflector used in generating the DAC curve plot, and these recordings shall become an attachment record sheet.

10.1.2 A strip chart recording shall be made of the stability reference reflector for comparison with later recordings made at

10.1.2 (continued)

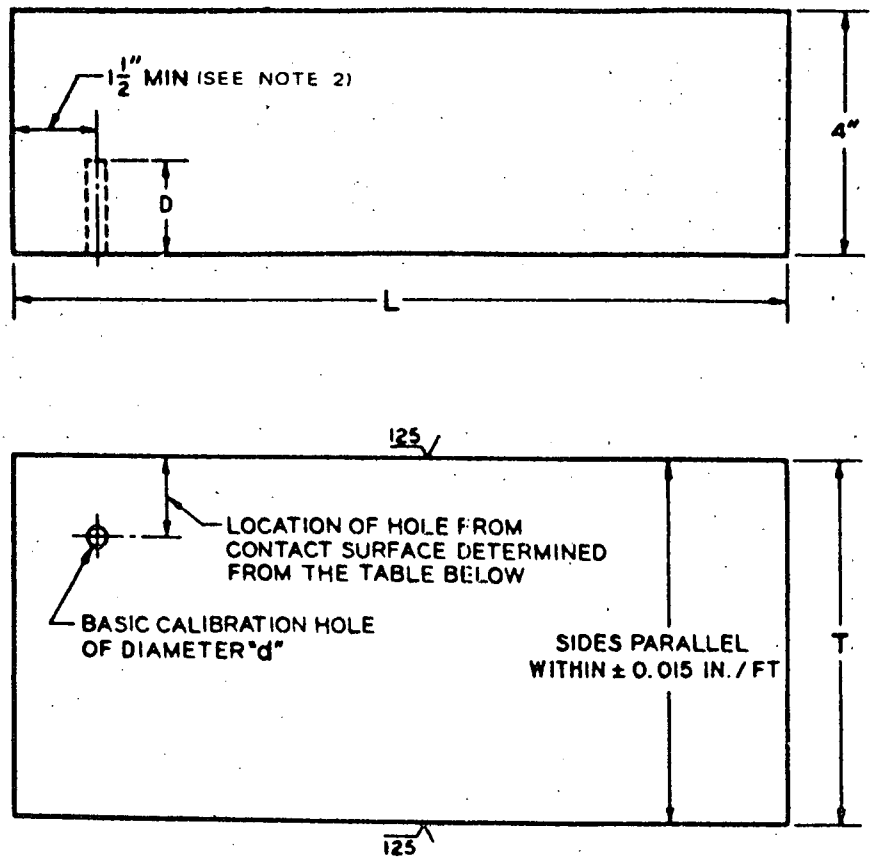
the time examinations are performed, to prove that no change in calibration took place in the interval.

10.1.3 Recordings of the basic reference reflectors response and/or the stability reference reflectors response shall be used in the evaluation of examination records.

11.0 QUALITY ASSURANCE

11.1 Calibration records shall be maintained in a field file in such condition as to be readily available for audit.

11.2 It is the responsibility of the Nuclear Services Corporation Level III Examiner to enforce the requirements of this procedure.



L = Length of block determined by the angle of search unit and the vee-path used
T = Thickness of basic calibration block (see table below)
D = Depth of side-drilled hole (see table below)
d = Diameter of side-drilled hole (see table below)
t = Nominal production material thickness

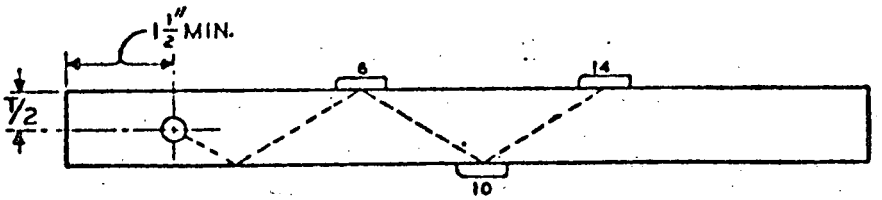
Nominal Production Material Thickness (*t*) in.	Basic Calibration Block Thickness (*T*), in.	Hole Location	Hole Diameter (*d*), in.	Minimum Hole Depth (*D*), in.
Up to 1 incl.	3/4 or *t*	1/2 *T*	3/32	1 1/2
Over 1 thru 2	1 1/2 or *t*	1/4 *T*	1/8	1 1/2
Over 2 thru 4	3 or *t*	1/4 *T*	3/16	1 1/2
Over 4 thru 6	5 or *t*	1/4 *T*	1/4	1 1/2
Over 6 thru 8	7 or *t*	1/4 *T*	5/16	1 1/2
Over 8 thru 10	9 or *t*	1/4 *T*	3/8	1 1/2
Over 10	*t*	1/4 *T*	See Note 1	1 1/2

Note 1 - For each increase in thickness of 2 in., or a fraction thereof, the hole diameter shall increase 1/16 in.

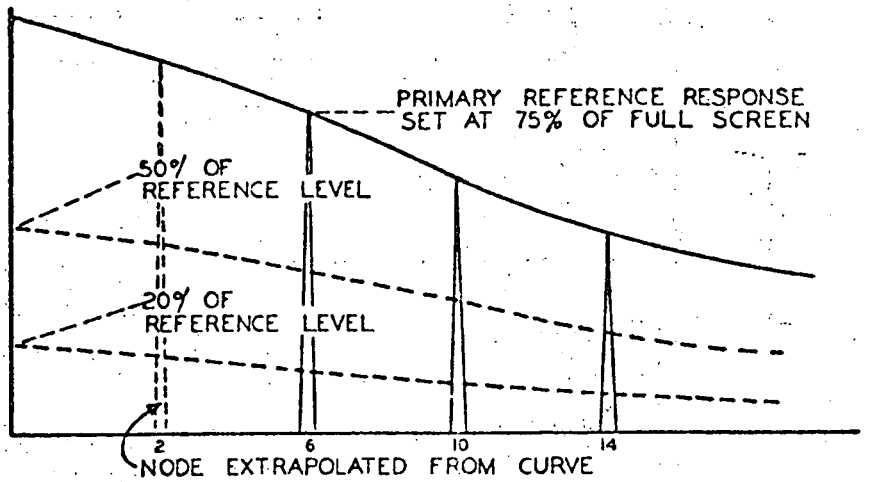
Note 2 -For block sizes over 3 in. in thickness (*T*), the distance from the hole to the end of the block shall be ½*T* min. to prevent coincident reflections from the hole and the corner in the 5/8 th vee-path position. Blocks fabricated with a 1½-in. minimum dimension need not be modified if the corner and hole indications can be easily resolved.

Figure 1

MF



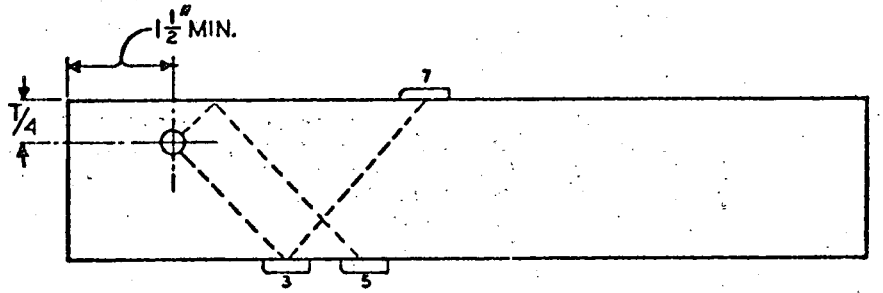
FOR THICKNESS 1 INCH OR LESS



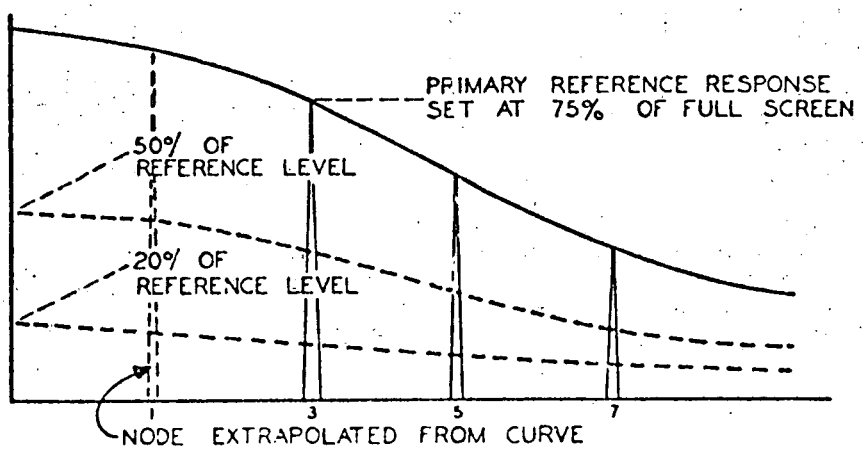
TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE

(ANGLE BEAM METHOD)

DISTANCE IN EIGHTHS OF A NODE. FOR EXAMPLE 14 IS $\frac{14}{8}$ NODE



FOR THICKNESS OVER 1 INCH

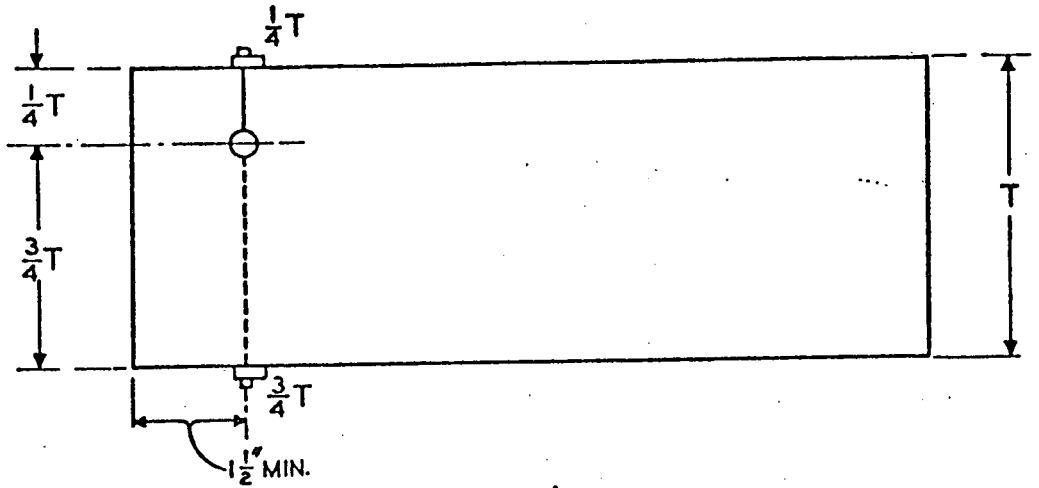


TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE

(ANGLE BEAM METHOD)

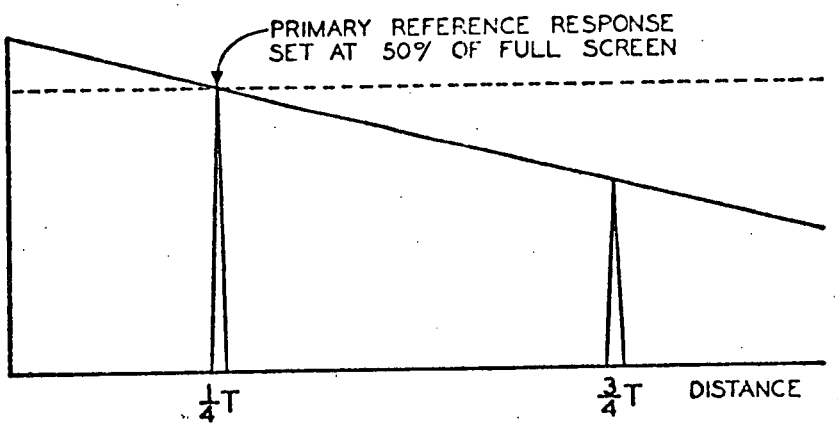
DISTANCE IN EIGHTHS OF A NODE. FOR EXAMPLE 14 IS $\frac{14}{8}$ NODE

Figure 2



A

Figure 3



B

TYPICAL DISTANCE AMPLITUDE CORRECTION CURVE
(STRAIGHT BEAM METHOD)

Figure 4

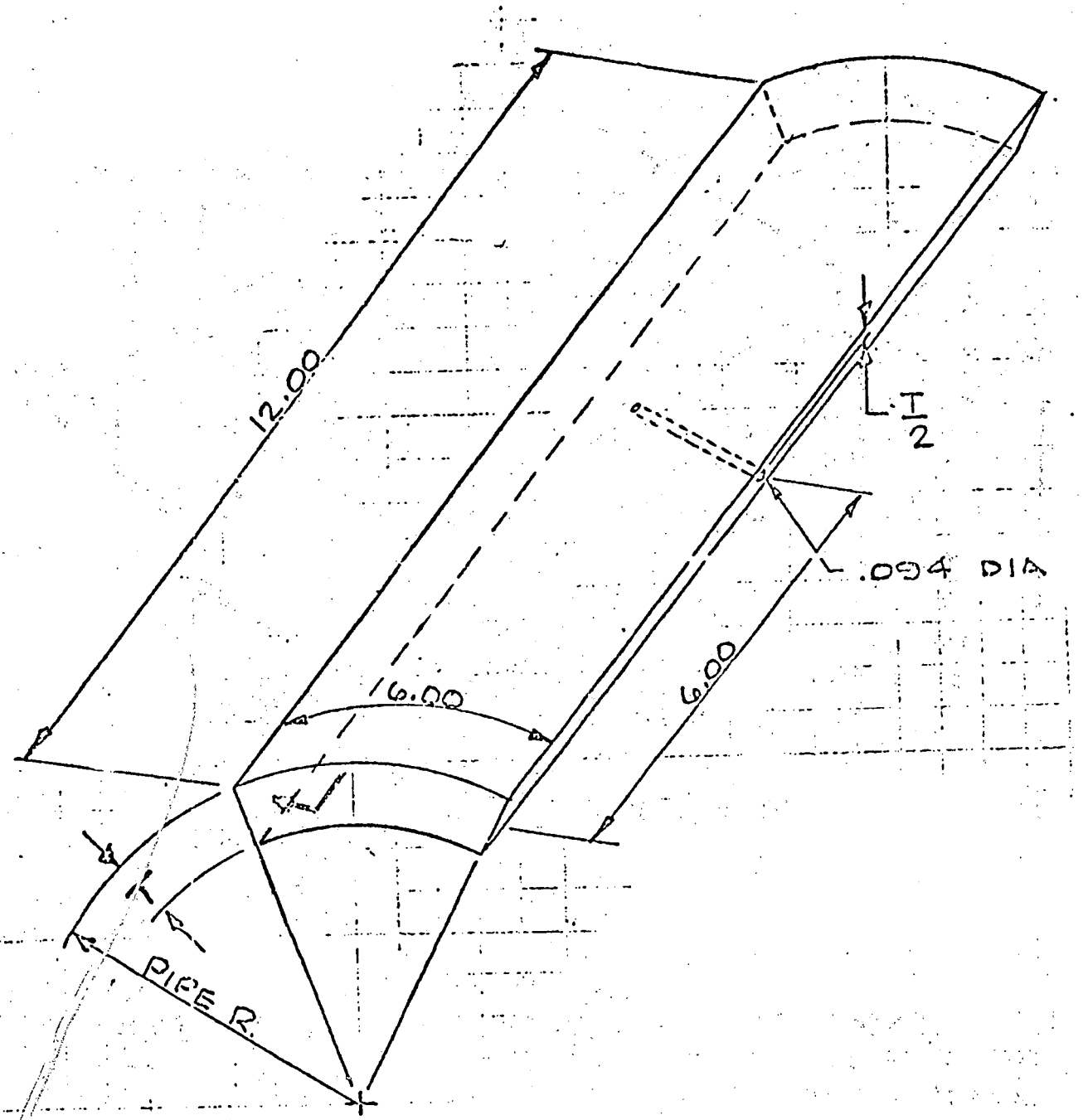
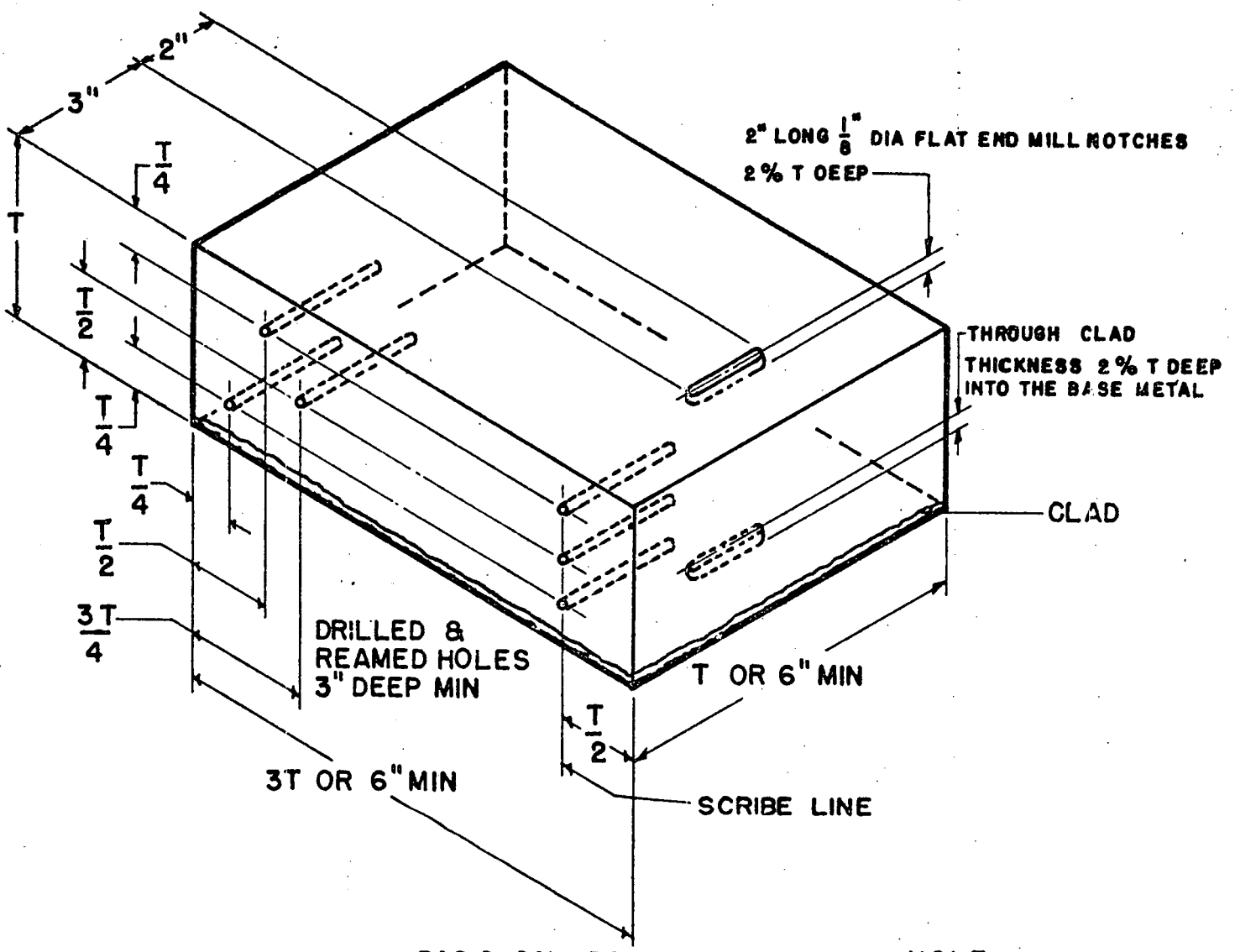


Figure 5

Typical Curved Basic Calibration Block



WELD THICKNESS (T)	BASIC CALIBRATION BLOCK THICKNESS (T)	HOLE DIAMETER
OVER 1" THRU 2"	1-1/2" OR T	1/8"
OVER 2" THRU 4"	3" OR T	3/16"
OVER 4" THRU 6"	5" OR T	1/4"
OVER 6" THRU 8"	7" OR T	5/16"
OVER 8" THRU 10"	9" OR T	3/8"
OVER 10"	*	*

* FOR EACH INCREASE IN THICKNESS OF 2" OR FRACTION THEREOF THE HOLE DIAMETER SHALL INCREASE 1/16".

FIG. 6

BASIC CALIBRATION BLOCK
AS PER ASME XI APPENDIX I
FOR PRESSURE VESSEL WELDS ONLY

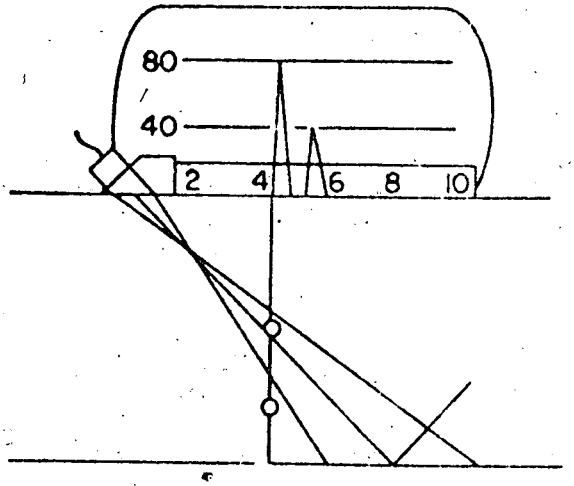


Figure 7A Test for Linearity

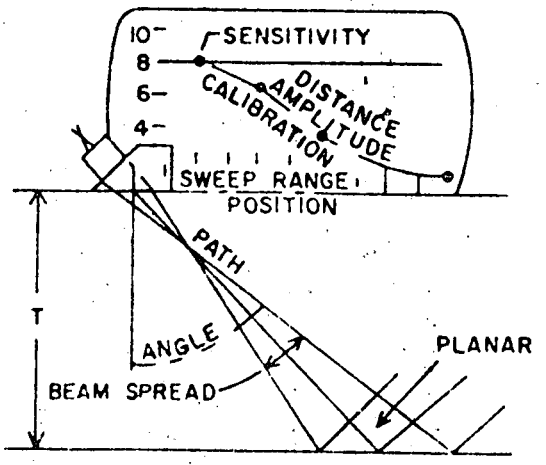


Figure 7B Calibration Parameters

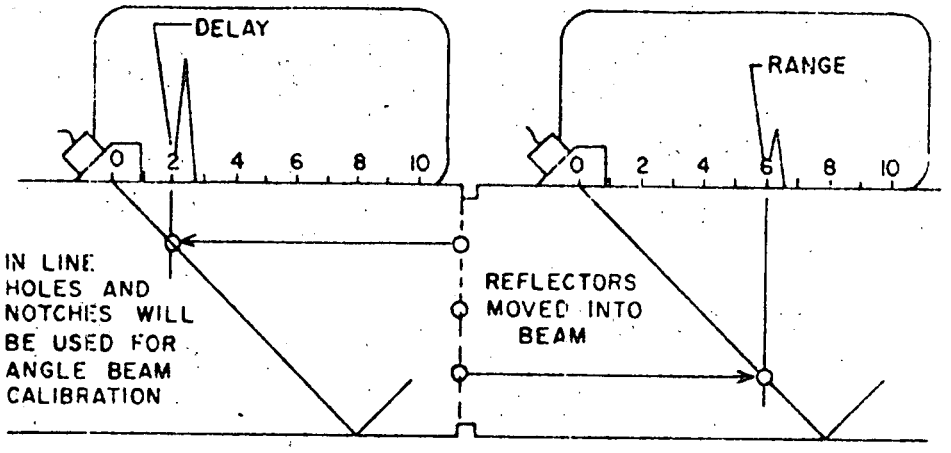


Figure 7C Sweep Range Calibration

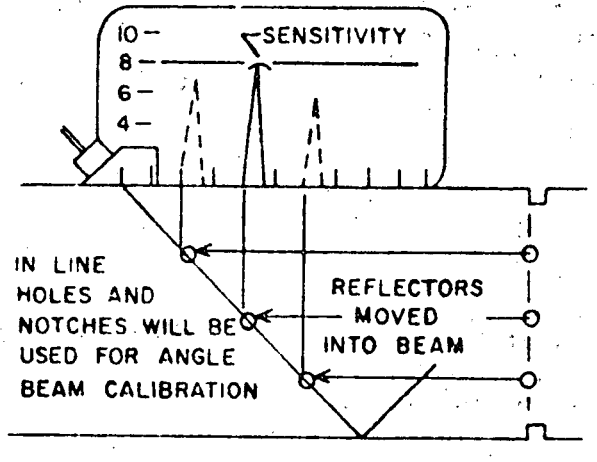


Figure 7D Sensitivity Adjustment

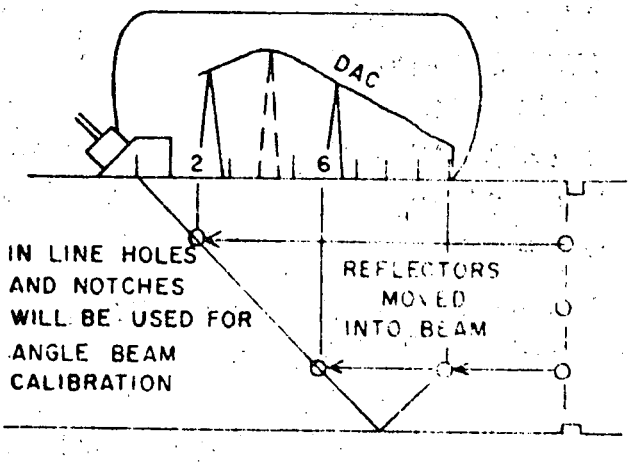


Figure 7E DAC Generation

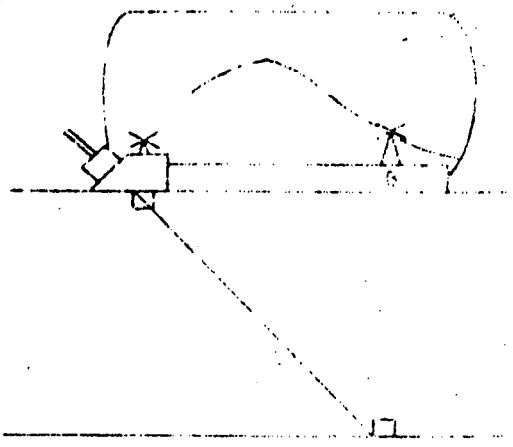


Figure 7F Planar Surface Reflector

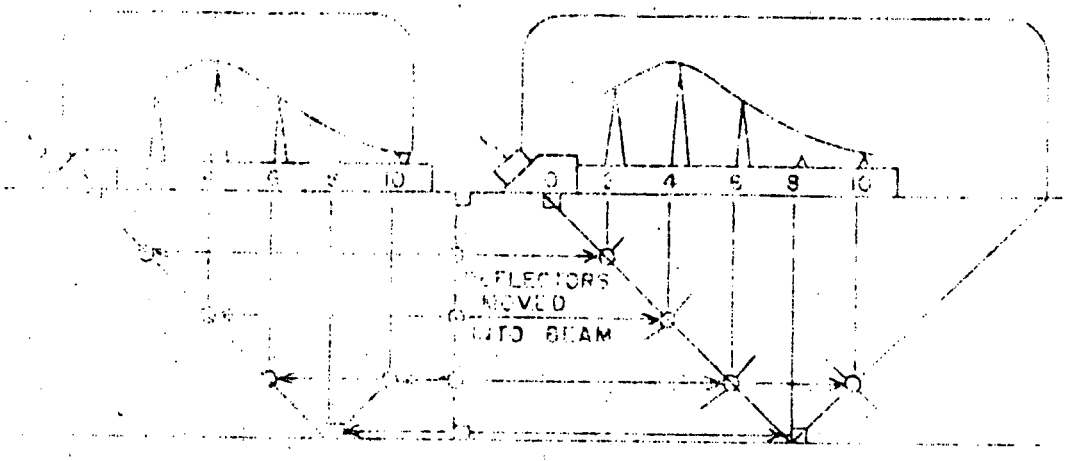


Figure 7G Position Calibration

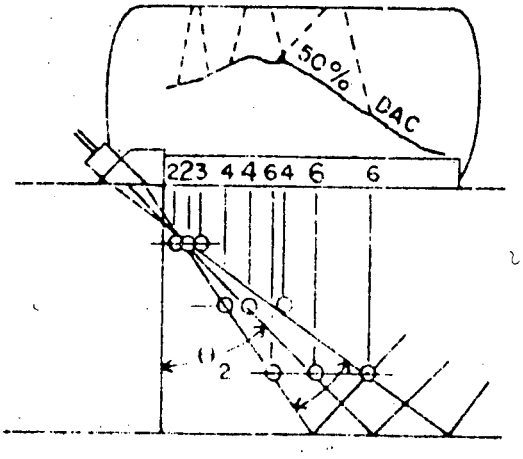


Figure 7H Beam Spread Measurement

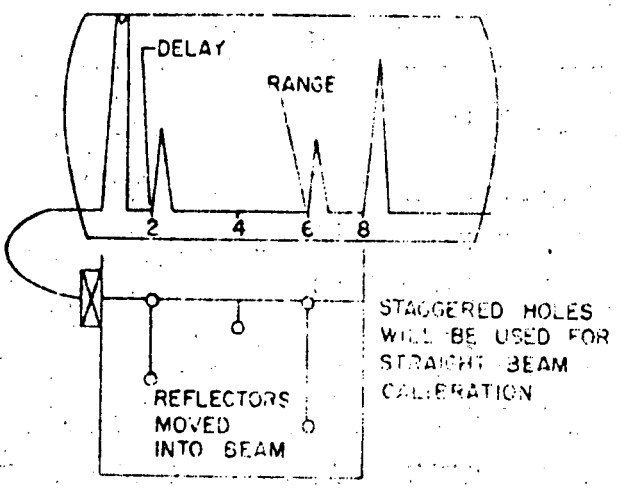


Figure 8A Sweep Range Calibration

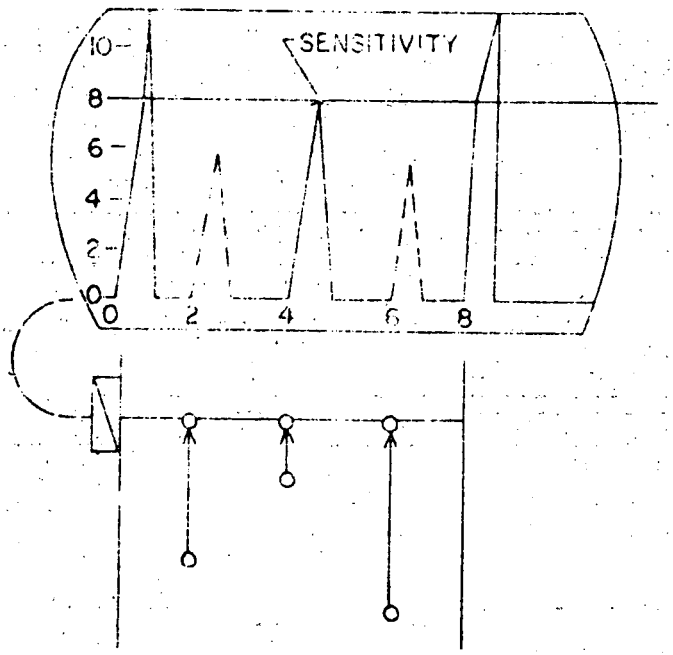


Figure 8B Sensitivity Calibration

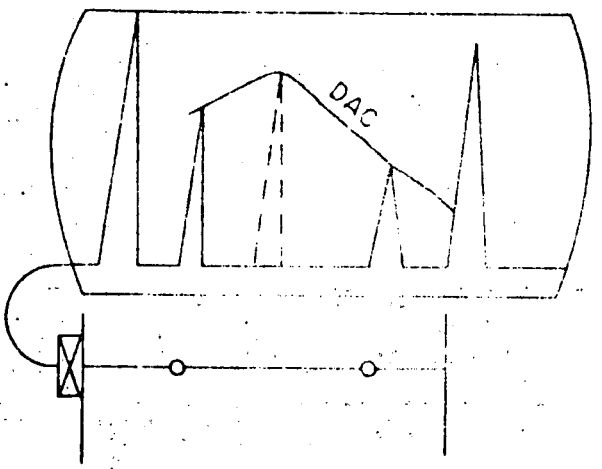


Figure 8C Distance Amplitude Correction

ULTRASONIC CALIBRATION TEST RECORD

Site:_____ Cal. No.:_____ Examiners:_____ Level:_____

Date:_____ Time:_____ Calib. Procedure:_____ Test Block S/N_____

Examination Procedure:_____ Instruments & Modules:_____

TRANSDUCER DATA

Mfg.:_____ Freq.:_____ Mat.:_____ Size:_____ S/N_____

Mfg.:_____ Freq.:_____ Mat.:_____ Size:_____ S/N_____

CALIBRATION DATA

1.0 IIW-2 Angle Beam Transducer Beam Angle:_____ Transducer Index Checked:_____

2.0 Sweep Range & Delay Setting from IIW-2 Block

2.1 Angle Beam Setting Using 2" and 4" Radius Reflectors a. 2"=_____ µs b. 4"=_____ µs
2.2 Straight Beam-Set using 1" block thickness _____ µs
2.3 Velocity = $\frac{2}{2.1.b - 2.1.a}$ in./microsecond (µs)
2.4 Transducer Delay = (2.1.a) - 2"/(2.3) = _____ microsecond (µs)

3.0 Instrument Reference Sensitivity Data from Basic Calibration Block
3.1 Ampl.Lin.Chk. 20%__ 30%__ 40%__ 50%__ 60%__ 70%__ 80%__ 100%__.
3.2 Ampl.Control Lin. -6db___ -12db___ +6db___ +12db___.
3.3 Primary Reference Reflector: Angle Beam__% ___µs Straight Beam__% ___µs.
3.4 IIW-2 Block 1/8"SDH Response: Angle Beam % µs Straight Beam % µs.

4.0 Angle Beam Data from Basic Cal. Block Side Drilled Holes	1/4 T	1/2 T	3/4 T	Planar
4.1 Signal Amplitude (max.):				
4.2 Distance "a"* and range at max. signal:				
4.3 Distance "a"* and range at leading ray (50% max.)				
4.4 Distance "a"* and range at trailing ray (50% max.)				

5.0 Instrument Settings at Reference Sensitivity	Angle Beam	Straight Beam
5.1 Gain		
5.2 Attenuation		
5.3 Sweep		
5.4 Delay		
5.5 Markers		
5.6 Pulse Length		
5.7 Damping		
5.8 Reject		
5.9 PRF		
5.10 VIDEO		

6.0 Gain and/or Attenuation at Scanning Sensitivity		
7.0 Gain and/or Attenuation at Evaluation Sensitivity		

*"a" Longitudinal distance from the line scribed above the hole to the transducer case front.

ULTRASONIC CALIBRATION TEST RECORD

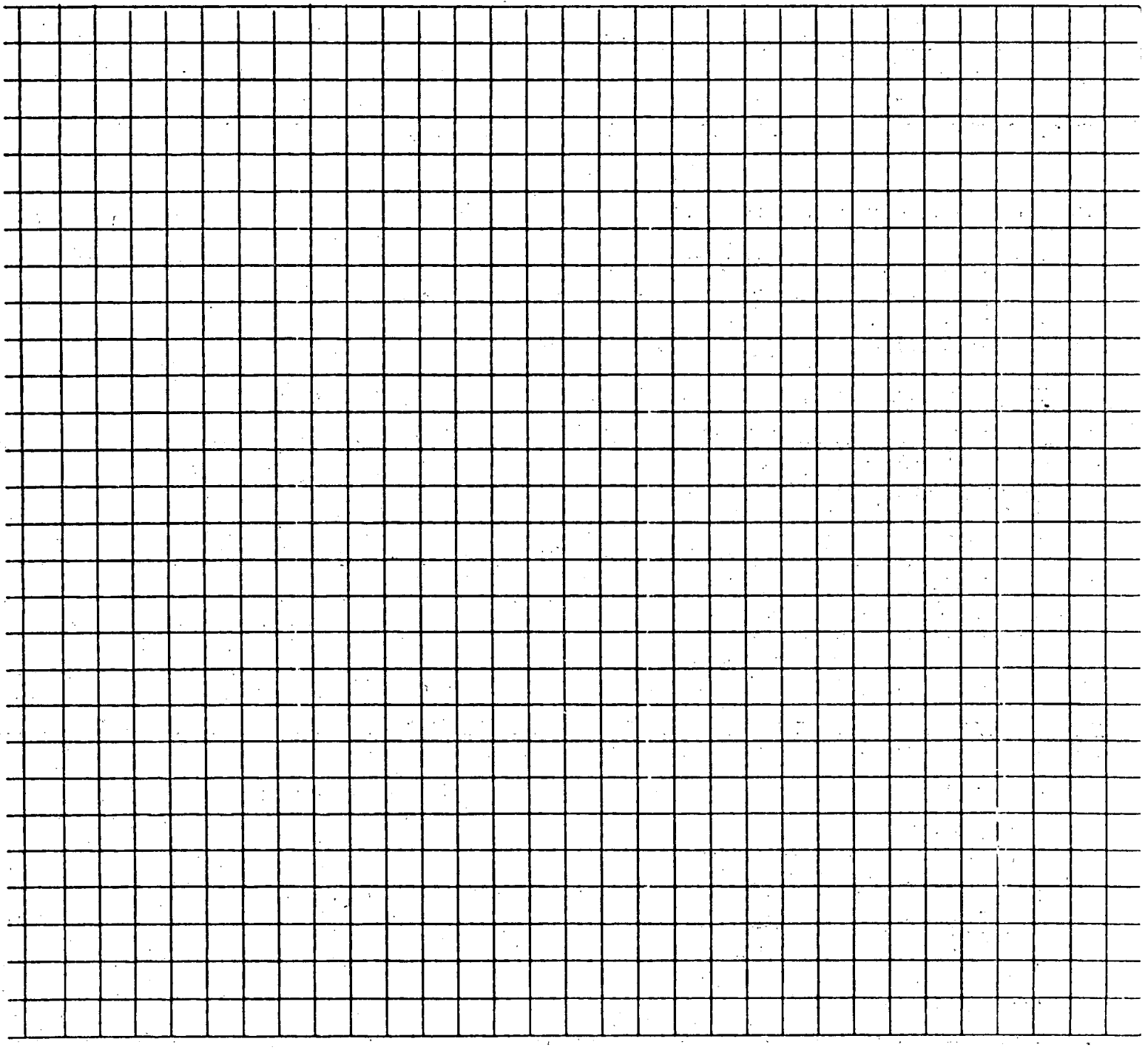
NUT-NC-1E, Rev. 4

Site: _____ Cal. No. _____ Examiners: _____

Date: _____ Time: _____ Level: _____

Transducers S/N _____ Instrument S/N _____

Test Block S/N _____



Record of Revisions

NUT-NC-1E

No.	Date	Revision	By
4	1/10/75	Revision to 1974 Code	
3	3/1/74	Revision	
2	1/11/74	Revision	
1	7/1/73	Revised	
0	7/27/71	Issued for Comments	

SPECIAL PROCESS STANDARD

SPS	REV.	EFFECTIVE DATE
NUT-NC-3	4	January 10, 1975

Procedure for Automatic Recording of Ultrasonic Test Data

PREPARED BY - DATE: T. G. Lambert 1/9/75

APPROVED BY - DATE: T. G. Lambert 1/9/75

PAGE 1 OF 8

1.0 SCOPE

1.1 This document covers the requirements and procedures to be used when automatically recording ultrasonic test data on analog charts.

2.0 SPECIFICATIONS

2.1 This specification is to be used in conjunction with the following Nuclear Services Corporation Special Process Standards.

2.1.1 NUT-NC-1A, Nuclear Ultrasonic Testing Procedure Ultrasonic Inspection of Welds.

2.1.2 NUT-NC-1B, Nuclear Ultrasonic Testing Procedure for Longitudinal Wave Inspection.

2.1.3 NUT-NC-1C, Ultrasonic Examination of the Inner Radius of Pressure Vessel Nozzle Welds.

2.1.4 NUT-NC-1E, Nuclear Ultrasonic Weld Examination Calibration Procedure.

2.1.5 NUT-NC-7, Nuclear Ultrasonic Examination of Reactor Pressure Vessel Butt and Nozzle Welds.

2.1.6 SNT-TC-1A, Qualification and Certification of Nondestructive Testing Personnel, Supplement C.

2.1.7 NUT-PQ-1, Nuclear Services Corporation Personnel Qualification Procedure.

2.1.8 ASME B. & P.V. Code, Section XI, Inservice Inspection of Nuclear Reactor Power Plant Components (Summer 1974).

2.1.9 ASME B. & P.V. Code Section V, Nondestructive Examination (Summer 1974).

3.0 PERSONNEL QUALIFICATIONS

3.1. All personnel performing ultrasonic inspections shall be qualified in accordance with Code accepted standards and procedures as either Level I (Operator), Level II (Inspector), or Level III (Examiner),

3.1 (continued)

as defined in SNT-TC-1A, Supplement C and NUT-PQ-1, Rev. 0. Only a Level II Inspector or Level III Examiner shall make judgment as to the acceptance or rejection of indications. The Nuclear Services Corporation Level III Examiner will submit to the Purchaser, upon request, a copy of personnel qualification and ultrasonic procedure. Personnel shall, at the request of the Purchaser, demonstrate their knowledge and understanding of pertinent specifications and procedures, and their ability to satisfactorily operate all required equipment prior to performing an ultrasonic inspection.

3.1.1 Certification of personnel to NUT-PQ-1 requirements shall be directed by the authorized Level III Examiner.

3.2 Certification of Personnel

3.2.1 Certification of personnel shall conform to SNT-TC-1A, Supplement C and Nuclear Services Corporation Personnel Qualification Procedure NUT-PQ-1.

3.2.2 In order to obtain certification of any level, the candidate must demonstrate to the Level III Examiner's satisfaction a thorough knowledge of the procedures and requirements contained in this document.

3.3 Visual Acuity Requirements

Visual requirements for near distance acuity and color shall conform to SNT-TC-1A, Supplement C and Nuclear Services Corporation Personnel Qualification Procedure, NUT-PQ-1.

3.4 Records

3.4.1 Records of personnel certifications shall be maintained by the Nuclear Services Corporation Level III Examiner at the Campbell office and at the job site. These records shall conform to SNT-TC-1A, Supplement C and Nuclear Services Personnel Qualification Procedure, NUT-PQ-1.

3.4.2 Records of instrumentation calibration shall be maintained by the Nuclear Services Corporation Level III Examiner at the Campbell office and at the job site.

4.0 INSPECTION METHODS

4.1 The inspection methods which may be used with this recording procedure are ultrasonic pulse echo, and through transmission. The ultrasonic energy may be transmitted in either the longitudinal or shear wave mode.

5.0 RECORDING METHODS

5.1 The ultrasonic test data concerning indication range and amplitude are (shown in Figure 1) recorded on dual trace analog recording charts. Additional information or test parameters will be written on the chart using the stamped form shown in Figure 2. Any further information such as transducer position or direction run shall be hand written on the chart by the technician serving as data recorder.

6.0 EQUIPMENT

6.1 The ultrasonic examination shall be performed using a NORTEC 130D or equivalent ultrasonic tester meeting the requirements of ASTM E-164 and certified to be calibrated according to ASTM E-317. The tester produces an analog output proportional to metal path and a second proportional to amplitude. The instrument also provides digital readout.

6.2 The analog signals generated by the tester shall be recorded using a strip chart pen recorder certified to be electronically calibrated within the past 90 days. A typical recorder for this purpose is the Brush 220.

6.3 An intercom system connecting the examiners at the recorder and the tester shall be used where necessary for clear communication. Battery powered, line connected phone systems are considered adequate for this purpose.

7.0 CALIBRATION

7.1 For vessel examinations the ultrasonic tester shall be calibrated to meet the requirements of the ASME Boiler and Pressure Vessel Code Sections V and XI, Summer 1974 Addenda, and the resulting responses shall be recorded on a calibration record chart.

7.1.1 Amplitude and range readings taken from the digital display of the tester shall be recorded on the calibration chart.

8.0 RECORDING OF EXAMINATION DATA

8.1 Before the performance of an examination the following data shall be recorded on the recording chart using the form stamp of Figure 2 as a guide.

1) Inspector Names
2) Weld No. & Configuration
3) Type
4) Pipe Size & Schedule
5) Scan No. & Type
6) Report No.
7) Transducer Size
8) Test Frequency
9) Transducer Angle
10) Chart Speed
11) Sensitivity of Recorder
12) Scanning Sensitivity

8.2 Before and after the performance of an examination, the stability reference shall be scanned and the resulting trace becomes a permanent part of the examination record.

8.3 The weld shall be scanned in a systematic manner, generally beginning at a dead center position which shall be noted as 1200. As the scanning proceeds the 0300, 0600, and 0900 positions shall be noted on the chart record.

8.3.1 The orientation data essential to indication location shall be noted on the Inspection Report.

8.4 Detailed evaluation of an indication should be noted on the recorder chart and amplitude, metal path, and signal with measurements taken from the digital meter recorded in appropriate locations on the chart.

9.0 RECORDING CONVENTIONS

9.1 The left hand chart section of the dual trace chart shall be connected to record signal amplitude with positive amplitudes causing left pen deflection. A full scale deflection on this chart shall correspond to a full scale (100%) signal amplitude on the ultrasonic tester.

9.2 The right section of the dual trace chart shall be used to record metal path (range) with increasing range causing left pen deflections. A full scale deflection on this chart shall correspond to a full range (100% of sweep) display on the ultrasonic tester screen.

10.0 REPORTS

10.1 The chart record shall be attached to an ultrasonic report form and technique sheet to constitute the permanent inspection record (NSC-TS-003-6/74), which shall be signed by the examiner and his assistant. When requested, all rejectable indications will be shown on a drawing of the joint.

11.0 QUALITY ASSURANCE

11.1 Inspection records shall be maintained in a field file in such condition as to be readily available for audit.

11.2 It shall be the responsibility of the Nuclear Services Corporation Level III Examiner to enforce the requirements of this procedure.

SPECIAL PROCESS STANDARD

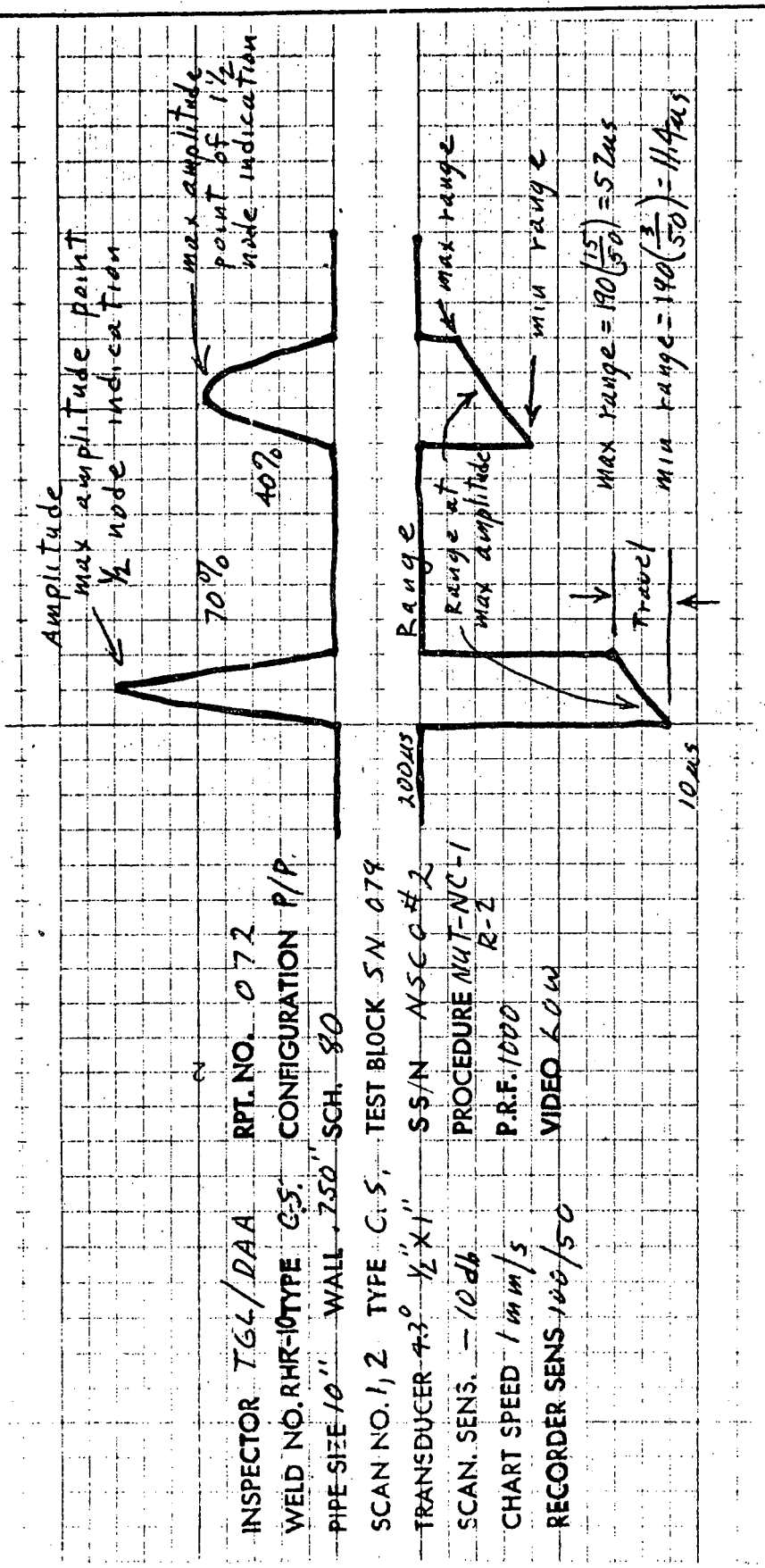


Figure 1

INSPECTOR		RPT. NO.
WELD NO.	TYPE	CONFIGURATION
PIPE SIZE	WALL	SCH.
SCAN NO.	TYPE	TEST BLOCK
TRANSDUCER		S S/N
SCAN. SENS.		PROCEDURE
CHART SPEED		P.R.F.
RECORDER SENS		VIDEO

Figure 2

RECORD OF REVISIONS

NUT-NC-3

NO.	DATE	REVISION	BY
4	1/10/75	Revised to meet 1974 Code	
3	8/20/74	Revised	
2	3/1/74	Revised	
1	7/1/73	Revised	
0	7/27/71	Issued for Comments	