

ULTRASONIC EXAMINATION FOR  
THE DETECTION OF INTERGRANULAR  
STRESS CORROSION CRACKING

J.A. FITZPATRICK  
NUCLEAR POWER PLANT

PROCEDURE NO. JAF-UT-5

1328/12-75

## INSERVICE INSPECTION

PROCEDURE NO JAF-UT-5

TITLE ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING			LEGEND R - INDICATES REVISION	DATE 10/23/81
PREPARED BY <i>D.H. Haggard</i>	REVIEWED BY <i>N. Paul</i>	APPROVED BY <i>W. Sawicki</i>		REPLACES ISSUE OF N/A
REV 0	PREPARED <i>D.H.</i>	APPROVED <i>WS</i>		

1.0 SCOPE

- 1.1 This procedure defines the requirements for manual ultrasonic examination of stainless steel piping for intergranular stress corrosion cracking.
- 1.2 This procedure covers both straight beam and 45° angle beam shear wave techniques applied to the outside of the austenitic stainless steel piping.

2.0 APPLICABLE DOCUMENTS, CODES AND STANDARDS

- 2.1 The following documents form a part of this procedure to the extent specified herein.

2.1.1 Ebasco Documents

- 2.1.1.1 Ebasco Services Incorporated Procedure for Qualification and Certification of Nondestructive Examination Personnel.

2.1.2 Codes and Standards

- 2.1.2.1 American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.
  - a. Section III, Nuclear Vessels, 1974 Edition including Code case Nos. 1698, June "75" and 1705, March "76".
  - b. Section XI, Inservice Inspection of Nuclear Reactor Coolant Systems, 1974 Edition, Summer "75" Addenda.
  - c. Section V, 1974 Edition, Summer "75" Addenda.
- 2.1.2.2 American Society for Nondestructive Test (ASNT)
  - a. SNT-TC-1A, Nondestructive Testing Personnel Qualification, 1975 Edition.

3.0 DESCRIPTION

- 3.1 The examination volume and area where IGSCC is typically detected is the area between the weld root and the outboard edge of the weld heat affected zone.

The typical weld configurations and areas of IGSCC covered by this procedure are shown in Figures 1 and 2.

1328A/12-75

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING	LEGEND R - INDICATES REVISION	DATE 10/23/81
	REPLACES ISSUE OF N/A	
	REV 0	PREPARED <i>[Signature]</i>
	APPROVED <i>[Signature]</i>	

4.0 REQUIREMENTS4.1 Personnel

- 4.1.1 All personnel performing the nondestructive examinations in accordance with this procedure shall be qualified and certified to at least Level I in accordance with SNT-TC-1A and Ebasco Services Incorporated Procedure for Qualification and Certification of Nondestructive Examination Personnel.

NOTE: At least one member of each examination crew shall have a minimum qualification of Level II.

4.2 Equipment

- 4.2.1 Pulse-echo ultrasonic equipment (Krautkramer USM2, USL-38, Sonic MKI, or equivalent) shall be used. The ultrasonic instrument shall be equipped with a fine gain and/or attenuation control graduated in units no larger than 2 db.
- 4.2.2 Straight beam examination shall be performed using a longitudinal wave search unit having a nominal frequency of 2.25 MHz or 5 MHz.
- 4.2.3 Angle beam examinations shall be performed using a  $45^{\circ}$  ( $\pm 3^{\circ}$ ) angle beam shear wave search unit having a nominal frequency range of 1.5 MHz to 5 MHz. For search unit size see Table 3.  
NOTE: When performing initial calibration, beam angle shall be checked on the IIW block and noted on the calibration data sheet.
- 4.2.4 At the discretion of the Level III, transducers of different size, shape, and frequency may be used as permitted by Section V, Article 5 Para. T-535 and T-536. These changes shall be documented on the data sheets.
- 4.2.5 Equipment certification shall be transmitted to the customer.

4.3 Calibration Blocks

- 4.3.1 Piping calibration blocks shall be those provided by the customer (PASNY).
- 4.3.2 Standard calibration blocks such as IIW blocks, miniature angle beam, DSC blocks, etc. may be used to establish distance (metal path) during calibration.  
NOTE: The piping calibration blocks shall be within  $25^{\circ}$  of the component temperature.

1328A/12-75

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE	ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING	LEGEND R - INDICATES REVISION	DATE 10/23/81
		REPLACES ISSUE OF N/A	
REV	PREPARED	APPROVED	
0	<i>[Signature]</i>	<i>WS</i>	

4.4 Surface Preparation and Couplant

- 4.4.1 The contact surface shall be clean and free of dirt, dust, weld splatter, loose scale or other material which would interfere with free movement of the transducer or impair transmission of ultrasonic energy into the material. The weld surface shall also merge smoothly into the surfaces of the adjacent base materials.
- 4.4.2 Glycerine or approved couplant shall be used in sufficient quantity to maintain continuous sonic contact. The couplant used shall be noted on the calibration data sheet.

4.5 Scanning Requirements

- 4.5.1 The scanning speed shall not exceed 3 inches persecond.
- 4.5.2 The scan path of the search unit shall overlap adjacent scans by a minimum of 25% of the search unit width.
- 4.5.3 Scanning shall be performed at a gain setting of at least 2 times (6db) the reference level except for straight beam examination set up on a back reflection.
- 4.5.4 Examination areas shall include the entire circumference of the selected circumferential welds and at least a one foot length of each longitudinal weld intersecting the circumferential weld.

4.6 Weld Identification

- 4.6.1 Prior to examination, the welds shall be identified in accordance with the weld identification plan identified in the Inservice Inspection Program.

5.0 CALIBRATION5.1 Instrument Calibration

- 5.1.1 At the beginning of each day, the ultrasonic instrument shall be checked for amplitude linearity and amplitude control linearity as follows:

1328A/12-75

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING	LEGEND R - INDICATES REVISION	DATE 10/23/81
	REPLACES ISSUE OF N/A	
	REV 0	PREPARED <i>[Signature]</i>

A. Amplitude Linearity

- (1) Position a search unit (transducer) on the reference standard so that indications from both the 1/2T and 3/4T holes are visible. (Other reflectors which provide the 2 to 1 ratio required in (2) may be substituted).
- (2) Manipulate search unit to establish a 2 to 1 ratio of amplitudes between the two indications with the larger at 80% FSH.
- (3) Without moving search unit, adjust sensitivity to run the higher response from approximately 100% to 20% FSH in 2 db steps (10% if fine control available).
- (4) Read and record the relative amplitudes of the two indications to the nearest 1%.
- (5) If the smaller indication does not fall within 5% FSH or 50% of the larger indication, the instrument shall not be used for examinations until corrected.

B. Amplitude Control Linearity

- (1) Position a search unit (transducer) on the reference standard to obtain an 80% FSH indication from the 1/2T hole. (any reflector providing 80% FSH may be substituted).
- (2) Using amplitude control, decrease signal amplitude by 6 db and by 12 db to obtain nominal 40% FSH and 20% FSH signals. Read and record actual signal amplitudes to closest 1%.
- (3) Obtain a 40% FSH indication from the 1/2T hole and increase amplitude with the amplitude control by 6 db to obtain a nominal 80% signal. Read and record as in (2).
- (4) Obtain a 20% FSH indication from the 1/2T hole and increase amplitude with the amplitude control by 12 db to obtain a nominal 80% FSH signal. Read and record as in (2).
- (5) If the indications obtained in (2), (3) and (4) are not within  $\pm 20\%$  of nominal, the instrument shall not be used for examination until corrected.

1328A/12-75

## INSERVICE INSPECTION

PROCEDURE NO JAF-UT-5

TITLE

ULTRASONIC EXAMINATION FOR THE DETECTION OF  
INTERGRANULAR STRESS CORROSION CRACKING

LEGEND

R - INDICATES  
REVISION

DATE

10/23/81

REPLACES ISSUE OF

N/A

REV

PREPARED

APPROVED

0

5.2 System Calibration

- 5.2.1 Basic system calibration shall be performed using the appropriate reference standard, search units and instrumentation immediately prior to examination, or series of similar examination.
- 5.2.2 Examination system calibration verifications shall be performed at least at the beginning and at the completion of each 4 hour period of examination and/or when any change is made in examination personnel or system combination. In addition, system calibration shall be checked and DAC curve verified after any interruption in power when using AC or after any change in power supply. (e.g. from AC to battery or vice versa).
- 5.2.3 Calibration verification shall be checked at the primary reference sensitivity level.
- 5.2.4 Signal response obtained during calibration verification shall be within plus or minus 20% of that established during basic system calibration.
- 5.2.5 If any point on the DAC curve has changed by more than 20% of its amplitude, the examiner shall:
- (1) Mark all weld data sheets since previous calibration void.
  - (2) Recalibrate examination system.
  - (3) Reexamine voided areas.
- 5.2.6 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 the sweep calibration and note it on the Calibration Data Sheet.
  - (2) Void any data sheets made since the previous calibration which have recorded indications and reexamine those areas.
- 5.3 If configuration or adjacent parts of the component are such that scanning from both sides of the weld is not practicable, it shall be recorded on the examination data sheet.

1328A/12-75

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE

ULTRASONIC EXAMINATION FOR THE DETECTION OF  
INTERGRANULAR STRESS CORROSION CRACKING

LEGEND

R - INDICATES  
REVISION

DATE

10/23/81

REPLACES ISSUE OF

N/A

REV

PREPARED

APPROVED

0

*JS**WS*

- 5.4 The reject control shall be set at the minimum position unless approved by the cognizant Level III provided the instrument linearity is within the requirements of Section 5.1 of this procedure. Approval by the Level III shall be documented by signing the Calibration Data Sheet.

6.0 EXAMINATION6.1 Straight Beam Base Metal Examination for Laminar Reflectors

- 6.1.1 Using a reference standard such as one referenced in 4.3.2 set up sweep to accurately display the thickness range of the weld be inspected.
- 6.1.2 Place the search unit in a defect free area of the base material adjacent to the weld. Adjust instrument sensitivity to produce a minimum 50% to a maximum 75% of full screen reference back reflection and record actual thickness of base material.
- 6.1.3 The area of the base material through which the sound will travel in angle beam examination, as shown in figure 2, shall be completely scanned with a straight beam search unit to detect reflectors which might affect interpretation of angle beam results. (This is not intended as an acceptance-rejection examination).
- 6.1.4 Using applicable columns on Indication Data Sheet record all areas which produce a continuous indication equal to or greater than the remaining back reflection and which can not be contained within 1 square inch.

6.2 Straight Beam Examination of Weld and Heat Affected Zone

NOTE: To be performed only if angle beam examination per 6.3 can not be accomplished.

- 6.2.1 (A) Material thickness (T) 1 inch and less

- (1) Position straight beam transducer on appropriate calibration standard to obtain maximum signal amplitude from the 1/2T hole.
- (2) Adjust the gain to produce a 50 percent full screen height response. Mark the sweep position and amplitude on the CRT screen.



1320A/12-75

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING	LEGEND R - INDICATES REVISION	DATE 10/23/81
	REPLACES ISSUE OF N/A	
	REV 0	PREPARED <i>[Signature]</i>

- (3) Draw a horizontal line across the display screen at the 50% FSH level. This is the primary reference sensitivity. Record this information on the Calibration Data Sheet.

6.2.1 (B) Material thickness (T) greater than 1 inch

- (1) Using the appropriate calibration standard, position the transducer for maximum response from the 1/4T hole.
- (2) Adjust the gain to produce a 50 percent FSH response. Mark the sweep position and amplitude on the CRT screen.
- (3) Without changing the gain control, maximize the response from the 3/4T hole and join the two points with a straight line on the screen to cover the test range. This is the primary reference sensitivity. Record this information on the Calibration Data Sheet.

6.2.2 Examination coverage shall include the weld and 1T on each side of the weld.

6.3 Angle Beam Examination

6.3.1 One-half vee path examination techniques using the search units referenced in Table 2, shall be the preferred method and performed as follows:

- (1) Select the appropriate search unit for the piping wall thickness and diameter from Table 2.
- (2) Using a standard calibration block, such as one referenced in 4.3.2, set up the sweep display so that each major horizontal screen division on the CRT represents 1/4" of sound path.
- (3) Using the appropriate piping standard, obtain maximized responses from the side drilled holes at 1/4T, 1/2T, 3/4T and 1 1/4T (if possible). Mark the positions on horizontal sweep of the CRT using a grease pencil or similar marker to establish a range reference.



1328A/12-75

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING	LEGEND R - INDICATES REVISION	DATE 10/23/81
	REPLACES ISSUE OF N/A	
	REV 0	PREPARED <i>[Signature]</i>

- (4) Without altering the range established above, maximize the signal response from the ID notch, and using the sensitivity controls, set the signal to 80% of full screen height (FSH). Mark its amplitude and position on the CRT as above. This notch response is the primary reference sensitivity.
  - (5) Draw a horizontal line across the CRT from the 1/2T hole position to the notch position. This line shall delineate the area of interest and the primary reference sensitivity. Record all sensitivity control settings on the appropriate Calibration Data Sheet.
  - (6) Upon completion of calibration, ensure that all instrument settings and search unit data are recorded on the Calibration Data Sheet.
  - (7) Each weld shall be scanned as shown in figs. 1 & 2 using 45° angle beam, techniques applied in two directions parallel to the weld axis and in two directions perpendicular to the weld axis, where geometry permits.
- 6.3.2 If component geometry and/or accessibility prohibits the technique referenced in 6.3.1, the following method shall be employed:
- (1) A nominal 3.5MHz, 1/4 diameter transducer, affixed to an appropriate wedge to yield a nominal 45 degree refracted shear wave shall be used.
  - (2) Maximize the signal responses from the first ID notch, the OD notch, and the second ID notch (if possible) to generate a one and on-half vee range.
  - (3) Using the sensitivity control, set the highest response of 80% of FSH and mark its position and amplitude on the CRT screen. Without changing the sensitivity, maximize the settings from the remaining notches and mark the amplitudes and positions on the CRT.
  - (4) Plot a DAC curve by connecting the locations marked on the CRT with a continuous line from the from surface to the second ID notch (when possible).
  - (5) This is the reference sensitivity level. Record all instrument settings on the Calibration Data Sheet.

1328A/12-75

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE	LEGEND	DATE
ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING	R - INDICATES REVISION	10/23/81
		REPLACES ISSUE OF
		N/A
REV	PREPARED	APPROVED
0	<i>[Signature]</i>	<i>W'S</i>

- (6) Each weld shall be scanned such that the area of interest, as shown in figure 1, is covered (access permitting) as referenced in 6.3.1 (7).

- NOTES: 1. If indication, other than geometry, are found in the area of interest it may be necessary to take additional thickness readings in that area to accurately plot the location. Straight beam may also be used to locate counterbore.
2. The search unit shall be swivelled ( $45^{\circ}$  each way) as it is moved along a rectilinear scan pattern to ensure a minimum of 25% overlap of the transducer width. This is required to detect cracks which may be oriented at odd angles.

#### 7.0 RECORDING AND EVALUATION OF TEST RESULTS

- 7.1 All indications which produce a response greater than 10% of the reference level shall be investigated to the extent that the operator can determine the shape, identity and location of all such reflectors.
- 7.2 All non-geometric indications within the area of interest regardless of length or signal amplitude shall be unacceptable and recorded on the Indication Data Sheet (sample attached).
- 7.3 Further evaluation of reportable indications to determine disposition and/or the need to make repairs shall be the responsibility of the Utility Owner who will evaluate in accordance with Section XI.

#### 8.0 REPORTS

- 8.1 A detailed ultrasonic examination report shall be prepared using the Indication Data Sheet and any additional sketches or photographs as may be applicable. If no reportable indications are detected it shall be so noted on report form. All final Data Sheets shall be in ink.
- 8.2 Prompt (24 hours) notification of recordable indications will be made to the representative designated by the Utility Owner.

1328A/12-75

**INSERVICE INSPECTION**

PROCEDURE NO. JAF-UT-5

TITLE

ULTRASONIC EXAMINATION FOR THE DETECTION OF  
INTERGRANULAR STRESS CORROSION CRACKING

LEGEND

R - INDICATES  
REVISION

DATE

10/23/81

REPLACES ISSUE OF

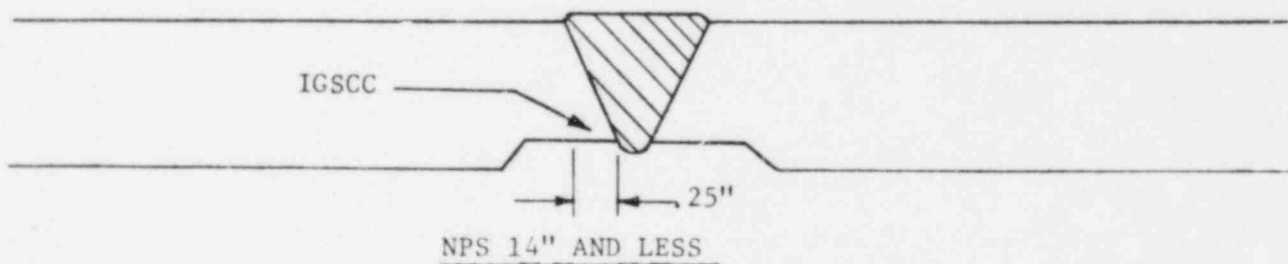
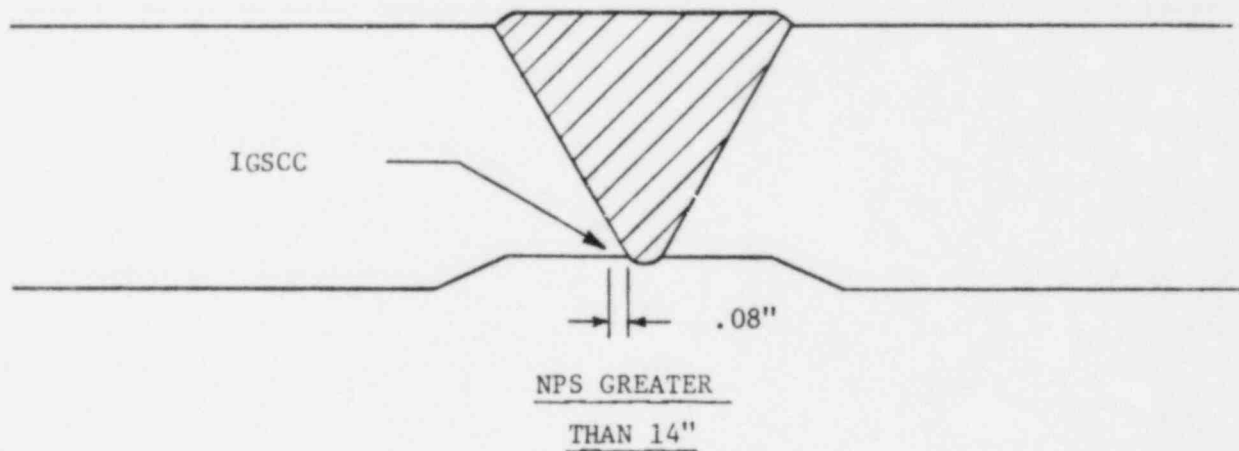
N/A

REV

0

PREPARED

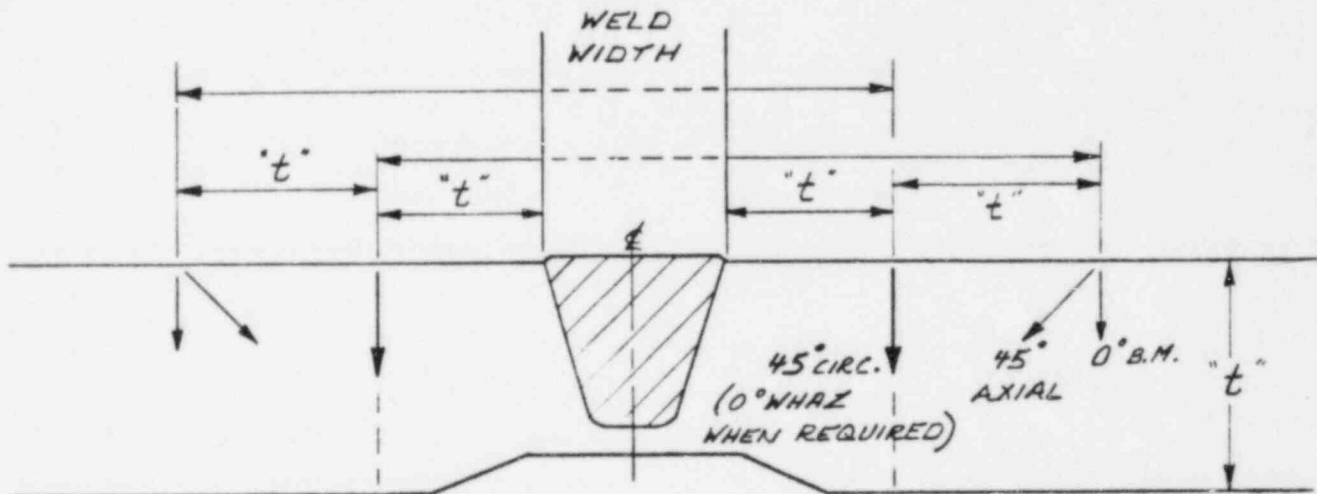
APPROVED



Predominate locations of inter granular stress corrosion cracking in stainless steel piping as a function of pipe size.

FIGURE 1

TITLE <b>ULTRASONIC EXAMINATION FOR THE DETECTION OF INTERGRANULAR STRESS CORROSION CRACKING</b>		LEGEND R - INDICATES REVISION	DATE 10/23/81
		REPLACES ISSUE OF N/A	
REV 0	PREPARED <i>[Signature]</i>	APPROVED <i>WS</i>	



NPS	Pipe Schedule	"t"	NPS	Pipe Schedule	"t"
3"	10	.120"	8"	20	.250"
3"	80	.300"	10"	10	.165"
3"	160	.438"	10"	20	.250"
4"	10	.120"	12"	20	.250"
4"	80	.337"	12"	140	1.125"
6"	10	.134"	18"	10	.250"
6"	80	.432"	24"	10	.250"
6"	120	.562"	28"	—	1.350"
6"	160	.718"	28"	—	1.411

FIGURE 2

## INSERVICE INSPECTION

PROCEDURE NO. JAF-UT-5

TITLE

ULTRASONIC EXAMINATION FOR THE DETECTION OF  
INTERGRANULAR STRESS CORROSION CRACKING

LEGEND

R - INDICATES  
REVISION

DATE

10/23/81

REPLACES ISSUE OF

N/A

REV

PREPARED

APPROVED

0

JAF

WS

TABLE 2 SEARCH UNIT SELECTION

NOMINAL PIPE SIZE	WALL THICKNESS	ELEMENT SIZE	STYLE NUMBER
4" - 12"	.25" - .875"	1/4" X 1/4" each	11
10" - 18"	.6" - 1.0"	3/8" X 3/8" each	10
10" - 18"	.8" - 1.8"	3/8" X 3/8" each	16
16" and Larger	.8" - 1.5"	3/8" X 3/8" each	16

NOTE: The above search units are recommended for angle beam examination per 6.3.1. Others of similar design may be substituted.

4064/5-80

EBASCO SERVICES INCORPORATED  
QUALITY ASSURANCE ENGINEERING  
INSERVICE INSPECTION  
UT INSTRUMENT CALIBRATION

INSTRUMENT MANUFACTURER \_\_\_\_\_

PROJECT \_\_\_\_\_

MODEL \_\_\_\_\_ SERIAL NO. \_\_\_\_\_

DATE \_\_\_\_\_

### AMPLITUDE LINEARITY

<u>dB CONTROL CHANGE</u>	<u>ACTUAL dB</u>	<u>SCREEN HEIGHT LARGER INDICATION</u>	<u>SCREEN HEIGHT* SMALLER INDICATION</u>
Initial (0dB)	_____	_____	_____
+2dB	_____	_____	_____
0dB	_____	_____	_____
-2dB	_____	_____	_____
-4dB	_____	_____	_____
-6dB	_____	_____	_____
-8dB	_____	_____	_____
-10dB	_____	_____	_____
-12dB	_____	_____	_____

\* Must be 50% of the Larger Amplitude, within  $\pm 5\%$  of Full Screen Height

### AMPLITUDE CONTROL LINEARITY

<u>INDICATION SET AT % FSH</u>	<u>dB CONTROL CHANGE</u>	<u>INDICATION LIMITS % FSH</u>	<u>ACTUAL % FSH</u>
80	- 6dB	32 to 48	_____
80	-12dB	16 to 24	_____
40	+ 6dB	64 to 96	_____
20	+12dB	64 to 96	_____

	ACCEPTABLE	
	YES	NO
Amplitude Linearity	_____	_____
Amplitude Control Linearity	_____	_____

EXAMINER(S)

1. \_\_\_\_\_ TC-1A LEVEL \_\_\_\_\_

2. \_\_\_\_\_ TC-1A LEVEL \_\_\_\_\_

EBASCO SERVICES INCORPORATED  
QUALITY ASSURANCE ENGINEERING  
INSERVICE INSPECTION  
CALIBRATION DATA

Page 14 of 15

PROJECT \_\_\_\_\_

DATA SHEET NO. \_\_\_\_\_ DATE \_\_\_\_\_

PROCEDURE ISI-UT- \_\_\_\_\_ REV \_\_\_\_\_

COMPONENT OR SYSTEM \_\_\_\_\_ PIPE OD (IF APPLICABLE) \_\_\_\_\_

ITEM IDENTIFICATION NO(S). LISTED ON REVERSE SIDE - COMPONENT TEMP \_\_\_\_\_

CALIBRATION BLOCK NO. \_\_\_\_\_ THICKNESS \_\_\_\_\_ TEMP \_\_\_\_\_

**SCAN COVERAGE**

☐ OF WHAZ

☐ OF BASE MATERIAL

☐ AXIAL

☐ CIRCUMFERENTIAL

**EQUIPMENT DATA**

**SEARCH UNIT**

Manufacturer \_\_\_\_\_

Style \_\_\_\_\_

Serial No. \_\_\_\_\_

Size \_\_\_\_\_ Frequency \_\_\_\_\_

Angle \_\_\_\_\_ Mode \_\_\_\_\_

Couplant \_\_\_\_\_ Batch No. \_\_\_\_\_

**INSTRUMENT**

Manufacturer \_\_\_\_\_ Model \_\_\_\_\_

Serial No. \_\_\_\_\_ Cable Length \_\_\_\_\_

Frequency \_\_\_\_\_ Reject \_\_\_\_\_

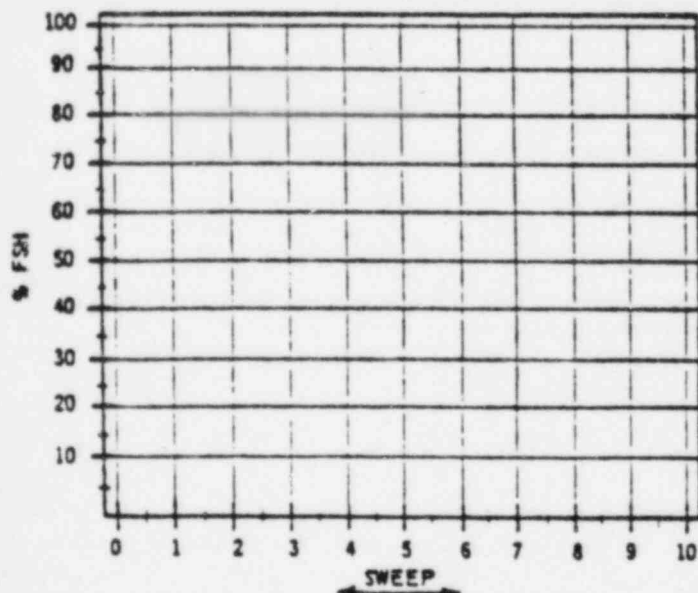
Rep Rate \_\_\_\_\_ Damping \_\_\_\_\_

dB Gain - Coarse \_\_\_\_\_ Fine \_\_\_\_\_

Primary Reference Response

Amplitude % Full Screen Height \_\_\_\_\_

DAC PLOT - TIME \_\_\_\_\_ AM, PM



NOTE: When performing examinations where no DAC is required, indicate reference reflector location and amplitude above.

**CALIBRATION CHECKS**

TIME	AMPL $\pm$ 20% (2dB) OF INITIAL AMPL		SWEEP $\pm$ 5% OF INITIAL LOCATION	
	YES	NO	YES	NO

NOTE: If response above is "NO" refer to Calibration Check section of procedure.

**EXAMINER(S)**

1. \_\_\_\_\_ TC-1A LEVEL \_\_\_\_\_

2. \_\_\_\_\_ TC-1A LEVEL \_\_\_\_\_

REVIEWED BY \_\_\_\_\_ DATE \_\_\_\_\_

ADDITIONAL REMARKS



**EDASCO SERVICES INCORPORATED  
QUALITY ASSURANCE ENGINEERING  
INSERVICE INSPECTION  
INDICATION DATA**

SHEET \_\_\_\_\_ OF \_\_\_\_\_

ITEM IDENTIFICATION \_\_\_\_\_

CALIBRATION DATA SHEET NO. \_\_\_\_\_

## DATA TABULATION

[illegible]

Page 15 of 15

### EXAMINE R(S)

TC-1A LEVEL

**TC-1A LEVEL**

REVIEWED BY \_\_\_\_\_ DATE \_\_\_\_\_

CONTINUATION ATTACHED - ☐ Yes ☐ No

## RESULTS

ATTACHMENT NO. 4

---