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Document Title: Specification for Phased Array Ultrasonic Testing procedure for Butt Welded Joints in Bridge Girders			

**RESEARCH DESIGNS AND STANDARD ORGANISATION**

**MANAK NAGAR, LUCKNOW-226011**

Document No. : **BS-S-7.5.3.1-6 Ver 1.0**

Document Title: **SPECIFICATION FOR PHASED ARRAY ULTRASONIC TESTING  
PROCEDURE FOR BUTT WELDED JOINTS IN BRIDGE GIRDERS**

**AMENDMENT HISTORY:**

SN	Amendment Date	Version	Reasons for Amendments
1.	11.09.2019	1.0	New Specification for PAUT procedure for Butt Welded Joints in Bridge Girders

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**SPECIFICATION FOR PHASED ARRAY ULTRASONIC TESTING PROCEDURE  
FOR BUTT WELDED JOINTS IN BRIDGE GIRDERS**

**1. Scope**

This document describes the procedure for Phased Array Ultrasonic Testing (PAUT called hereinafter) of Full Penetration Butt Weld joints of thickness 8mm to 30mm.

**2. Reference Standards**

This procedure refers to the following standards:

- (a) BS EN 473:2000 – Qualification and Certification of NDT Personnel.
- (b) BS EN 5817:2003 – Fusion welded joints in steel, nickel, titanium and their alloys –Quality levels for imperfections.
- (c) IS 2062:2011- Hot Rolled Medium and High tensile Structural Steel- Specification
- (d) BS 1714:1998 - Non-destructive Testing of Welds using Ultrasonic Testing
- (e) BS 1713:1998 – Non-destructive Testing of Welds – Characterization indications in welds
- (f) BS EN 12668:2010 – Nondestructive Testing- Characterization and verification of Ultrasonic Examination- Probes
- (g) BS EN 13558-2012 – Nondestructive testing of welds using Ultrasonic Testing Use of Automated Phased Array Technology
- (h) BS EN 12668- 2012- Non-destructive testing – Characterization and verification of Ultrasonic Examination- Equipments
- (i) BS EN 1712- 1997- Non-destructive testing of welds- Ultrasonic testing of welded joints- Acceptance Level
- (j) BS EN 583:2001- Non-destructive testing of welds- Ultrasonic Examination- Sensitivity and Range setting
- (k) ASTM E 2491:2008 – Standard Guide for evaluating performance characteristics of Phased Array Ultrasonic Testing Instruments and System.
- (l) ISO 18563 & EN 16392 – Nondestructive Testing- Characterization and verification of Ultrasonic Examination – Probes

**3. Personnel Qualification**

The personnel performing testing in accordance with this written procedure shall be qualified Level-2. He will set up and verify the PAUT equipment, perform the tests, interpret and evaluate the results, organize and report the same. Level-3 personnel will establish and validate NDT procedure. RDSO’s approval of the procedure will be obtained

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prior to its implementation. Testing Personnel shall be able to demonstrate their ability to use equipment in compliance with this procedure.

#### 4. Safety

All personnel employed in the PAUT of Bridge Girder welds are responsible for ensuring that they as well as their fellow employees perform their job in a safe and professional manner and adhere strictly to the safety protocol established by Indian Railways.

#### 5. Equipment setting, Scanner and Encoder

5.0 The Ultrasonic Phased Array Equipment employed shall be having the features and facilities as mentioned in the specification sheet enclosed at Appendix-A. It shall be equipped with a calibrated gain or attenuation control stepped in increments of 1dB or less. The PAUT system shall be capable of generating and displaying linear scan & sectorial scan images, which can be stored and recalled for subsequent review. Suitable software shall be used for post analysis of the acquired test data. The storage and analysis facility shall also be used for Data Analysis Personnel for data compilation and analysis.

Any control which affects the instrument linearity and reject function shall be in "OFF" mode while carrying out equipment calibration, system calibration and examination by PAUT. The equipment and system calibration shall be conducted every three months and under no circumstances the PAUT equipment will be used beyond this period without carrying out fresh calibration.

5.1 The probe motion shall be achieved manually and the mechanical holding device of the probes shall be equipped with a suitable encoder which will be synchronized with the sampling of A-Scans.

5.2 The calibration check shall be performed at least once a month by moving the encoder along the welded joint length for a minimum distance of 500 mm and the displayed distance shall be within  $\pm 1\%$  of the actual distance moved.

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## 6. Performance Evaluation of Phased Array Ultrasonic Testing System

Appendix- B provides the details of the performance evaluation methodology for the PAUT system to be followed in respect of the characteristics mentioned therein. Some of the significant aspects are described here:

### Determination of Phased Array Element Activity

This assessment is carried out to determine that all the elements of the phased array equipment are active and of uniform acoustic energy. The phased array probe to be employed for testing shall be connected to the PAUT equipment and refracting wedge and delay line shall be removed. The probe shall be acoustically coupled to the 25 mm thickness of the IIW Block with a uniform layer of couplant.

The scan shall be configured such that it should consist of one element which is stepped along one element at a time covering the entire 64 elements in the array. Pulsar parameters shall be set to optimize the signal for the nominal frequency of the probe array and establish a pulse-echo signal from the back wall of the block to 80% of the display height for each element in the probe. The A-Scan display shall be observed for each element in the array and record the receiver gain required to achieve the 80% signal amplitude for each element. The results shall be recorded. The details of the elements that do not provide a back wall indicating their inactive state shall be recorded. The receiver gain to provide 80% signal amplitude shall be within a range of  $\pm 2$ dB of any previous assessment and within  $\pm 2$ dB of each other.

If more than 25% of the elements are found to be inactive in a probe, such probes shall not be utilized for further testing.

To check the adequacy of the coupling, the assessment of the elements producing signals outside the  $\pm 2$ dB range the coupling shall be rechecked and test run conducted again. If the elements still show variation beyond the stated limit, the probe shall be removed from usage and corrected prior to further use.

## 7. System Linearity Verification

Instrument Linearity shall be checked in accordance with ASTM E 2491-2008 or IS 12668 prior to the employing the PAUT equipment as well as every six months thereafter.

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### 7.1 Time Base Linearity

Select the compressive probe and configure the phased array equipment to display a range suitable to attain at least 10 multiple back wall reflections from the 25 mm thickness of the IIW Block. Use the display software to assess the interval between adjacent back wall signals and record the same. The error on the multiples shall not exceed 60.5 nm.

### 7.2 Screen Height Linearity Verification

The angle beam search unit shall be positioned on a calibration block as shown in Figure 1 so that the indications from the  $\frac{1}{2}$  T and  $\frac{3}{4}$  T holes give amplitudes in the ratio of 2:1 between the two indications. The sensitivity shall be adjusted so that larger indication is set at 80% of full screen height as shown in Figure-1. The search unit shall not be moved while setting the sensitivity. Progressively the larger amplitude indication on the screen shall be varied from 100% down to 20% in increments of 10% and the corresponding reading on the smaller indication shall be read and recorded. All the readings shall be at 50% of the larger amplitude with a tolerance of 5% (estimated to the nearest 1%).

### 7.3 Amplitude Linearity Verification

The angle beam search unit shall be positioned on a basic calibration block as shown in Figure 1 so that the signal from the  $\frac{1}{2}$  T side drilled hole is maximum on the screen. The sensitivity shall be adjusted as shown in the Table below.

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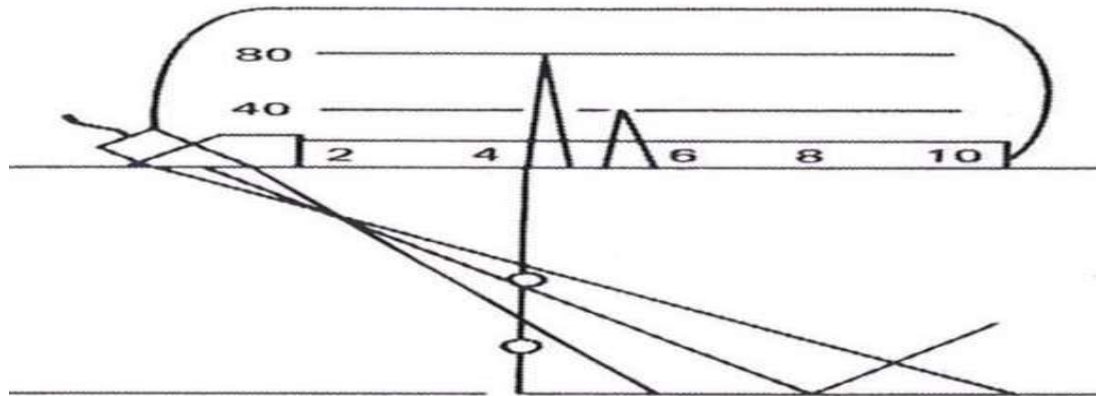


Figure 1

Table -A

SN	Indication set at % of Full Screen	dB control change	Indication Limits(% of Full screen
1.	80%	-6dB	32-48%
2.	60%	-12dB	16-24%
3.	40%	+ 6 dB	64-96%
4.	20%	+12dB	64-96%

The indication shall fall within the specified limits. Any other convenient reflector from any calibration block may also be used with angle or straight beam search units, but the indication shall be set at % of Full Screen dB control change indication limits% of full screen as indicated in the Table 1 above.

## 8 Couplant

The couplant used shall generally be machine oil of appropriate viscosity which is capable of providing a constant transmission of Ultrasonic Waves between the Probes and the material of examination. It shall provide an optimum wetting, adequate resistance to corrosion and shall be easily removable.

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## 9 Surface Temperature

The temperature of the material under test shall not be more than 50°C. The temperature of the material under test and the calibration block temperature shall be similar and the difference shall not exceed 10°C.

## 10 Surface Preparation

The scanning surface shall be even, free from loose rust, foreign particles, dust, dirt, grease etc. Freedom from weld spatter, notches and grooves shall be ensured before conducting the test. Surface to be scanned shall be even and the flatness ensured below 0.5 mm.

## 11 Search Unit

The nominal frequency shall be from 2 MHz to 10 MHz. The pulse duration of the probe shall not exceed 2 cycles as measured to the 20 dB level below the peak response.

Table -B

SN	No. of elements	Frequency	Pitch mm
1	64	2 MHz	0.6
2	64	5 MHz	0.6

## 12. Calibration & Reference Block

The material of the calibration Block shall be of the same grade, thickness, heat treatment and metallurgical characteristics. Surface finish of the scanning surface of the block shall be similar to the surface finish of the material under test. The reference level shall be 2.5 mm side drilled hole. (See Figure 2) This block shall be used for sensitivity setting of the PAUT system employed.

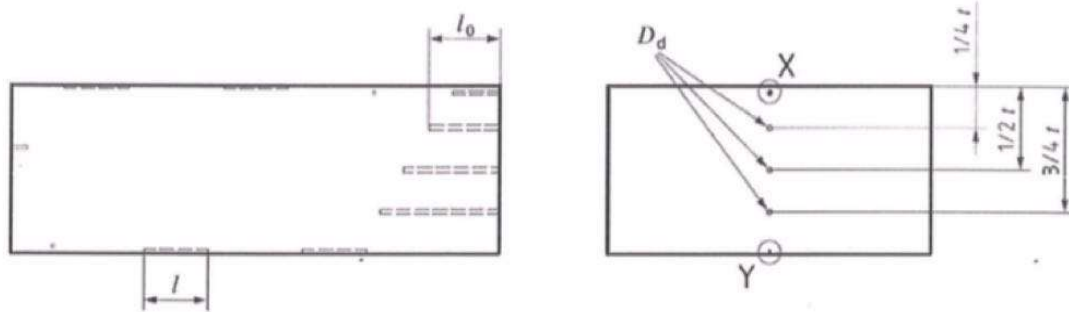


Figure 2

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### 13. Wedge Delay Calibration

Wedge delay calibration shall be carried out for both linear scan as well as sectorial scan. The wedge delay calibration shall be carried out in true depth mode for a known reflector depth. Peak up this signal from the calibration reflector and scan from the phased array probe to ensure that all the different angles or focal laws lie within the threshold. This will ensure that wedge delays are calibrated for all focal laws.

### 14. Sensitivity (Angle Corrected Gain)

The PAUT equipment shall be calibrated for wedge delay and sensitivity. The sensitivity calibration shall provide the required gain adjustments for each refracted angle. Select a calibration reflector, which is approximately ½ the thickness of the component to be examined, or within the zone of the material to be examined. Peak up this signal from the calibration reflector and scan the phased array probe backwards through all the different angles of focal laws. The PAUT system shall calculate the required gain needed at each focal law to adjust the amount of gain required to obtain the sensitivity.

### 15. Preparation for DAC (Distance Amplitude Correction/TCG (Time calibrated gain))

All individual beams used in the examination shall be calibrated to provide measurement of Distance Amplitude correction over the sound path employed in the examination. This shall also include applicable compensation for wedge sound path variations and wedge attenuation effects. The objective of this calibration is to automatically produce an equal signal amplitude from a reference reflector irrespective of their sound path travelled.

Distance Amplitude Correction graph shall be plotted on a 3-point gain level using a 3 mm dia. SDH in the single reference block (BS EN: 1712 - 1997) of the same material as that of Bridge Girder with 3 holes at different depths. For plotting the DAC curve, the gain shall be set to a reference level of 80% of the Full Screen Height. The DAC must cover entire area of scan used for examination. The dB displayed after plotting the DAC shall be used as Standard Sensitivity level for the PAUT.

The results of the DAC calibration shall be stored in the system for all future references and verified prior to commencement of the test every shift and the results recorded.

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## 16. Acceptance range for the sensitivity & range

SENSITIVITY	
Deviations $\leq$ 4 dB	No action needed. Correction may be made by software
Deviations $>$ 4dB	Entire system to be rechecked. If no defective components are identified, settings may be corrected and tests carried out since last verification repeated.
RANGE	
Deviations $\leq$ 0.5 mm or 2% of the depth range, whichever is greater	No action needed
Deviations $>$ 0.5mm or 2% of depth range whichever is greater	Settings to be corrected and all tests done since the last valid verification repeated.

## 17. System calibration Changes

The calibration of the system shall be carried out afresh in the event of the DAC values show 20% reduction or 2 dB of its amplitude or any point on the horizontal sweep line moving beyond 10% of the sweep division reading. Under such circumstances, all the examinations done since the last valid calibration shall be treated as VOID and retests carried out for the same after correcting the system with fresh calibration.

## 18. Examination Coverage

The PAUT examination shall cover the entire volume of the weld and the HAZ which is generally approx. 10 mm on either side of the weld seam. However, actual coverage may be enhanced if HAZ is found to be more during welding process qualification but in no case it shall be less than 10 mm on either side. The control of positioning and scanning device shall be carried out with the help of suitable mark on the weldment. A fixed stand-off distance (skip distance) shall be marked parallel to the weld axis from which the transducer beam shall be perpendicularly oriented. A suitable guide or a gadget shall be used for this purpose to ensure the fixed distance of the transducer. The range of angles for scanning shall be chosen based on the scan plan. The overlap between adjacent active

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apertures shall be minimum 50% of the effective height of the aperture. For ease of examination, if the weld is divided into multiple segments, minimum overlap between adjacent scans shall be 25 mm.

## 19. Scan Plan

Before commencement of the PAUT, the scan plan shall be prepared indicating coverage of the entire welded zone including the HAZ. The effectiveness of the scan plan shall be demonstrated on a calibration block including the overlap. In case of laminar reflectors in the base metal evaluated during the scan, suitable modification in the scan plan shall be made to ensure maximum possible coverage. This aspect shall be recorded in the test results for future reference and scrutiny.

## 20. Scanning

Before commencement of the test, reference sensitivity shall be set and entire evaluation done without any change. The scanning speed shall be such that the images are clearly generated and distinguished without any loss of data. The supervising team shall standardize the speed of scanning and the same will be followed by the test personnel. It shall be ensured that no part of the weldment remains unscanned by maintaining adequate overlap. While scanning, the pulse repetition frequency shall be such that reflector signal from the farthest distance is received prior to the next pulse is transmitted.

## 21. Evaluation & Recording Level

All indications equal to or exceeding - 10 dB of reference level shall be evaluated. Recording levels shall be in accordance with the acceptance criteria.

## 22. Acceptance Criteria

Detailed acceptance criteria will have to be decided in consultation with Chief Bridge Engineer/Chief Engineer Construction. However, the following criteria may be considered reasonable.

- (a) **Longitudinal Discontinuities** – Any indication with a length exceeding the thickness of the plate in the thickness range of 8- 15 mm shall be subjected to detailed testing. Final evaluation of the indication shall be made based on the echo amplitude and the

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length measured at an angle providing the maximum response. Acceptance level of this range shall be - 6dB (50% DAC). For thickness range 15.1 mm -30 mm, the acceptance level shall be – 2 dB (80% DAC).

- (b) **Linearly aligned and grouped indications-** Linearly aligned indications shall be less than 5 mm in the cross section direction and less than 5 mm in the thickness direction. They shall be considered continuous if they are separated by length twice the longest indication. All the adjacent indications are shall also be considered continuous. Discrete indications shall be grouped for deciding their acceptance or otherwise. All indications of less than 5 mm in the thickness direction shall be at least 10mm apart along the cross section direction. Indication with lesser separation shall not be considered acceptable.
- (c) **Cumulative Length of acceptable indications-** In addition to the individually acceptable indications mentioned above, maximum cumulative length of all the indications is also significant from safety considerations. For any length of weld equal to six times the thickness the maximum cumulative length shall not exceed 20% of the length.
- (d) **Acceptance criteria for Lamellar Tearing (Laminations)** – Ideally, this aspect needs to be checked at the time of raw plate inspection and any plate having Lamination beyond the acceptance limit shall not be processed for fabrication. However, this aspect needs to be checked once again during PAUT of new construction and more so for the girders in use. General guidelines for acceptance of the lamination defect shall be as under.

Total length of discontinuity for length up to 600 mm	Maximum height of a single discontinuity measured in thickness direction	Maximum length of the discontinuity (when the clear distance between two discontinuities or between a discontinuity and the nearest surface is < 6mm )	Maximum length of the discontinuity (when the clear distance between two discontinuities or between a discontinuity and the nearest surface is ≥ 6mm )
10 times the thickness of the thinner plate	3 mm	5 mm	10 mm

### 23. Re-test

Retest of the welded joint shall be performed under the following circumstances.

- (a) Any change in the calibration setup.
- (b) Missing lines in the display exceed 5% of the scan lines to be collected and adjacent lines are missed.

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(c) Scan length is less than the actual weld seam length.

#### 24. Post cleaning

Immediately after the PAUT examination, evaluation and the documentation, the tested area shall be cleaned while ensuring that the parts are not adversely affected.

#### 25. Reporting

**(a) On site Reporting** - A report containing brief summary of the weldment inspected, results obtained, defect indications observed shall be provided on site.

**(b) Final Report** - The final report shall consist of printed images of each scan with adequate information to facilitate traceability of the weld. These reports shall be compiled and submitted to the Indian Railways Designated Authority on a periodicity decided mutually. The information contained in the final report is provided at Appendix-C. All original data shall be supplied on soft copy at the end of inspection. All repairable indications shall be supplied in PDF format for reference.

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**APPENDIX –A**

**Technical Specifications of Phased Array Equipment**

**(The equipment shall be such that it can be operated in Pulse-Echo mode, as well as in (multi-element) Phased Array Mode).**

SN	DESCRIPTION	VALUE FOR PA	VALUE FOR UT
1.	Number of focal laws	256 or more	Nil
2.	Pulsar	PA Channel	UT Channel
	Voltage (Nominal)	40 V, 80 V and 115 V	95 V, 175 V and 340 V
	Pulse width	Adjustable from 30 ns to 500 ns, resolution of 2.5 ns	Adjustable from 30 ns to 1,000 ns; resolution of 2.5 ns
	Pulse shape	Negative square pulse	Negative square pulse
	Output impedance (Nominal)	35 Ω in pulse-echo mode 30 Ω in pitch-catch mode	< 30 Ω
	Output impedance (Nominal)	25 Ω	< 30 Ω
3.	Receiver		
	Gain	0 dB to 80 dB	0 dB to 120 dB
	Input impedance (Nominal)	50 Ω in pulse-echo mode 90 Ω in pitch-catch mode	60 Ω in pulse-echo mode 50 Ω in pitch-catch
	System bandwidth	0.6 MHz to 18 MHz (3 dB)	0.25 MHz to 28 MHz (3 dB)
	Beam-forming	Scan type - Sectorial and linear Group quantity - Up to 8	–
	Digitizing frequency	100 MHz or more	–
	Maximum pulsing rate	Up to 10 kHz (C-scan)	–
4.	Data Processing	PA Channel	UT Channel
	Number of data points	Up to 8192	–
	Real-time averaging	2, 4, 8, 16	2, 4, 8, 16, 32, 64
	Rectifier	RF, full wave, half wave +, half wave –	RF, full wave, half wave +, half wave –
	Filtering	Low-pass, Band-pass and High-pass filters	Low-pass, Band-pass and High-pass filters .
	Video filtering	Smoothing (adjusted to probe frequency range)	–

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SN	DESCRIPTION	VALUE FOR PA	VALUE FOR UT
5.	Data Visualization	A-scan refresh rate-Real time: 60 Hz	-
	Data Synchronization	On internal clock- 1 Hz to 10 kHz	-
		On 2 axes : from 1 to 65, 636 steps	-
6.	Programmable Time Corrected Gain(TCG)	Number of points	32: One TCG curve per focal law
7.	Alarm	Number of alarm-Minimum- 2	-
8.	Calibration Standard	ISO 18563 (EN16392) & EN12668	-

## APPENDIX-B

### PERFORMANCE EVALUATION OF PHASED ARRAY ULTRASONIC TESTING SYSTEM

**Scope-** This evaluation procedure shall embrace performance characteristics of complete examination system of the PAUT including search unit, instrument, inter-connections, scanner and other auxiliary devices in accordance with ASTM E 2491:2008. This evaluation is in addition to the calibration or standardization of the system as well as the sensitivity setting which has to be carried out regularly before commencing test.. The objective of this evaluation is to detect long term changes in the equipment or system characteristics which may indicate potential loss of performance and would call for suitable corrective intervention.

**Periodicity** – The PAUT system shall be examined at least once every month and the details of the assessment results recorded and maintained for scrutiny and comparison with the past assessment.

**Parameters to be assessed** – The following parameters shall be assessed for the PAUT system

- (a) Beam profile
- (b) Beam steering capability
- (c) Element activity

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- (d) Focusing capability
- (e) Receiver gain linearity

### Beam profile Determination

Assessment of the beam in the active plane should be made by use of an electronic scan sequence for probes with sufficient numbers of elements to electronically advance the beam past the targets of interest. Side drilled holes of 2 mm dia. and of length 25 mm arranged at various depths in a defect free sample of test material, for which focal laws have been programmed, are used for the assessment. Using the linear scan feature of the PAUT system the beam is passed over the simulated defects. Data collection of the entire waveform is made. The display shall be a typical B-Scan indicating Time Vs Displacement.

Beam profiling in the passive mode can also be made. The passive plane is perpendicular to the active plane and refers to the plane in which no steering of the beam is possible by phasing effects. In this mode, a corner reflector from a side drilled hole at appropriate depth is used.

### Beam steering capability

This part describes the procedure to determine practical limits for the steering capabilities of a Phased Array probe. For this purpose, assessment of beam steering capability is based on the signal to noise ratios at varying angular displacements. Configure the probe focal laws for the conditions of the test. Prepare a series of Side Drilled Holes in the material to be used for the application at the distance. The side drilled hole pattern shall be at 5° intervals at 25 mm and 50 mm distance from the a centre of probe position. The diameters of the holes shall be 1.5 mm and 2 mm respectively. While assessing, the centre of the beam ray from the probe should enter the test block at the indicated centerline and the midpoint of the element array shall coincide with the centerline. The probe assessment is done in one direction and then rotated 180° and the opposite sweep assessed.

Assessment of the steering capability shall be made by the dB difference between the maximum and the minimum signal amplitudes between two adjacent side drilled holes. For a particular angle of sweep, the higher of the pair of the SDHs having 6 dB separation shall be considered the maximum steering limit of the probe.

### Phased Array Element Activity

This assessment is used to determine that all the elements of the Phased array probe are active and of uniform acoustic energy. Connect the phased array probe to be evaluated to the PAUT system

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and remove any delay line or refracting wedge from the probe. Acoustically couple the probe to the 25 mm thickness of an IIW block with uniform layer of couplant. Configure an electronic scan consisting of one element that is stepped along one element at a time for the total number of elements in the array. Set the pulser parameters to optimize the response for the nominal frequency of the probe array and establish a pulse-echo response from the block backwall to 80% display height for each element in the probe. Observe the A-scan display for each element in the array and record the receiver gain required to achieve the 80% signal amplitude for each element.

Comparison to previous assessments is made using the same instrument settings. The receiver gain to provide an 80% response should be within  $\pm 2$ dB of the previous assessments and within  $\pm 2$ dB of each other. The total number of inactive elements and number of adjacent inactive elements in a probe shall be recorded. If more than 25% of the elements in a probe are inactive, sensitivity and steering capability shall be unsatisfactory. Such probes shall be removed from usage and corrected before further use. Prior to removing the probe from service the cable used for the test should be exchanged with another cable to verify that the inactive elements indication are not account of improper cable.

### **Focusing Capability**

Unlike single element probes, PAUT systems can be configured to focus over a range of sound paths and in both transmitter and receiver modes. Configure the Phased array system for the focusing focal laws to be assessed and acoustically couple the phased array probe to a suitable block with inclined SDHs. Using either an electronic scan or encoded mechanical scan the full waveforms are collected and displayed in a depth corrected B-scan projection image.

Effectiveness of the focusing algorithm is assessed by sizing the diameter of the projected image on a dB drop from maximum amplitude and comparing that dimension to the actual machined diameter of the side drilled hole. 2 mm dia. SDHs and the 6dB drop is used to gauge the diameter from the B-scan. The working range shall be defined as the depth or the sound path distance that the B-scan can maintain the 6 dB dimension to less than twice the actual diameter. For each hole diameter at least 4 samples shall be used.

### **Receiver Gain Linearity**

In view of the multiple pulsers and receivers used in the PAUT system, it is essential to assess the linearity specifically suited for this system. The Phased array equipment is configured to display the A-scan display. Adjust the time-base of the A-scan to a suitable range to display the pulse echo signal selected for the linearity verification. Pulser parameters shall be selected for the frequency

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and bandpass filter to optimize the response from the pulse-echo (single element) probe used for linearity verification. The receiver gain is set to display the signals for display height and amplitude control linearity assessments.

Connect the probe to the PAUT equipment and couple to block that will produce two signals. Adjust the probe such that the amplitude of the two signals are at 80% and 40% of the display screen height. Increase the gain using the receiver gain adjustment to obtain 100% of the full screen height of the larger response. The height of the lower response is recorded at this gain setting as a percentage of the full screen height. The height of the higher response is reduced in steps of 10% to 10% of the full screen height and the second response height is recorded for each step. Return the larger signal to 80% to ensure that the smaller signal has not drifted from its original 40% level due to coupling variation. Repeat the test if variation of the second signal is greater than 41% or less than 39% FSH.

The responses from the two reflectors should bear a ratio of 2:1 relationship to within  $\pm 3\%$  of FSH throughout the range 10% to 100% of FSH. The results shall be recorded in instrument linearity form.

## APPENDIX-C

### FINAL REPORT FORMAT CONTENTS

The following information shall be incorporated in the Final report.

1. Name of the Railway (Zone, Division, Section)
2. Location (Km post and the section)
3. Date of Inspection
4. PAUT equipment identification no.
5. Probe type, its serial number, frequency, number of elements, size of elements.
6. Search Unit cable used, length of the cable and type.
7. Wedges, shoes, automatic scanning equipment employed if any, recording device details
8. Beam Angle(s) employed
9. Scan Plan
10. Computerised program identification
11. Scanner and guiding mechanism
12. Calibration Block Identification

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13. Demonstrations Block Identifications
14. Gain Level employed and the Reject Level
15. Calibration Data
16. Data correlating demonstration Block
17. Couplant used
18. Probe Centre spacing
19. Weld Joint Identification
20. Material of the steel Bridge Girder
21. Welding procedure and Heat Treatment
22. Surface from which examination conducted
23. Record of rejectable indication
24. Nominal Thickness
25. Stage of Manufacture/ the age of the girder
26. WPSS details and identification
27. Operator's name
28. Identification of the operator
29. Certificate details of the operator

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