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Government of India-Ministry of Railways
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CT/USFD/Phased Array SRT

Date: 12.09.2024

Principal Chief Engineers
Chief Administrative Officers (Cons),
PSUs & All concerned
(As per mailing list enclosed)

Sub: Procedure Order & Technical eligibility Criteria for Phased Array Ultrasonic Single Rail Tester (PAUT SRT)

Ref: Railway Board letter no. 2018/Track-1/11/1/AT Welding Vol-II dated 11.09.2024

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1. Railway Board, vide letter referred above, has approved the Procedure Order & Technical Eligibility Criteria of Phased Array Ultrasonic Single Rail Tester (PAUT SRT) for rail testing.

2. This Procedure Order, defect classification, and Technical Eligibility Criteria for rail testing by PAUT SRT are enclosed herewith as Annexure-I, II & III respectively.

3. Zonal Railways/PSUs are advised for adoption of Phased Array Ultrasonic Single Rail Tester (PAUT SRT) for rails testing on CC+8+2t routes on 52 Kg rails & the nominated 25T axle load routes.

DA: As above

KAMAL KUMAR TALREJA
Digitally signed by KAMAL KUMAR TALREJA

Executive Director/Track-I

Mailing list

I. **Principal Chief Engineer:**

1. Central Railway, Mumbai CST – 400001
2. Eastern Railway, Fairlie Place, Kolkata – 700001
3. Northern Railway, Baroda House, New Delhi – 110001
4. N.E. Railway, Gorakhpur – 273012
5. Southern Railway, Park Town, Chennai – 600003
6. S.C. Railway, Rail Nilayam, Secunderabad – 500371
7. Western Railway, Churchgate, Mumbai – 400020
8. South Eastern Railway, Garden Reach, Kolkata – 700043
9. N.F. Railway, Maligaon, Guwahati – 781011
10. East Central Railway, Hajipur – 844101
11. East Coast Railway, Bhubaneshwar – 364001
12. North Central Railway, HQ Office, Subedarganj, Block – Bhagirathi, Prayagraj – 211015
13. North Western Railway, Jaipur – 755001
14. South East Central Railway, Bilaspur – 495004
15. South Western Railway, Hubli – 580023
16. West Central Railway, Jabalpur – 482001

II. **Chief Administrative Officer (Cons):**

1. Central Railway, New Administrative Office Building, 6th Floor, D.N. Road, Mumbai CST – 400001
2. CAO (I), Eastern Railway, 4th Floor, New Koilaghat Building, Strand Road, Kolkata – 700001
3. CAO (II), Eastern Railway, 4th Floor, New Koilaghat Building, Strand Road, Kolkata – 70000
4. Northern Railway, Kashmere Gate, Delhi – 110001
5. USBRL Project, Opp. R.R.B. Jammu Tawi – 180013
6. North Eastern Railway, Gorakhpur – 273012
7. Southern Railway, Egmore, Chennai – 600003
8. West Central Railway, Jabalpur – 482001
9. South Western Railway, 18, Millar Road, Bangalore – 560046
10. South Central Railway, Rail Nilayam, Secunderabad – 500371
11. South Eastern Railway, Garden Reach, Kolkata – 700043
12. East Coast Railway, Chandrashekharpur, Bhubaneswar – 751023
13. Western Railway, Churchgate – 400020
14. CAO (North), East Central Railway, Mahendrughat, Patna - 800004
15. CAO (South), East Central Railway, Mahendrughat, Patna - 800004
16. North Western Railway, Near Railway Station, Jaipur – 302001
17. South East Central Railway, Bilaspur – 495004 (Chhattisgarh)
18. North Central Railway, HQ Office, Subedarganj, Block – Bhagirathi, Prayagraj – 211015
19. CAO (I), N.F. Railway, Guwahati – 781001
20. CAO (II), N.F. Railway, Guwahati – 781001
21. CAO (III), N.F. Railway, Guwahati – 781001

III. **Public Sector Units (PSUs) & Rail Manufacturing Plants:**

1. Chairman and Managing Director, Rail Vikas Nigam Ltd., Plot No. 25, First Floor, August Kranti Bhawan, Bhikaji Cama Place, R.K. Puram, New Delhi-110066
2. Managing Director, DFCCIL, 5th Floor, Pragati Maidan, Metro Station Building Complex, New Delhi- 110001
3. MD, RITES Ltd., RITES BHAWAN. No. 1, Sector-29, Gurgaon-122001 (Haryana)
4. MD, IRCON International Ltd., C-4, District Centre, Saket, New Delhi-110017
5. CMD/ Konkan Railway Corporation Ltd., Belapur Bhawan, Plot No. 6, Sector 11, CBD, Belapur, New Mumbai-400614
6. Chief General Manager (Quality), Bhilai Steel Plant, Bhilai-490001
7. Managing Director, M/s Jindal Steel & Power Limited, Raigarh-496001

IV. **PEDs/EDs of Railway Board and RDSO:**

1. Principal Executive Director/CE (P), Railway Board, Rail Bhawan, New Delhi – 110001
2. Executive Director, Track (P&P), Railway Board, Rail Bhawan, New Delhi – 110001
3. Executive Director, Track (M & MC), Railway Board, Rail Bhawan, New Delhi – 110001
4. Executive Director/Track-II, RDSO, Lucknow
5. Executive Director/M&C, RDSO, Lucknow.
6. Executive Director, IRCAMTECH, Maharajpur Gwalior-474 020

V. **GM/Con, CCRS, DG & Kolkata Metro:**

1. General Manager (Cons.), N.F. Railway, Maligaon, Guwahati-781 011.
2. Chief Commissioner of Railway Safety, 3rd floor, Traffic Account Office, State Entry Road, New Delhi 110055.
3. Director General, Railway Staff College, Vadodara-390 004.
4. Director General, IRICEN, Pune- 411 001.
5. Metro Railways, Metro Bhawan, 33/1 Chowringhee Road, Kolkata-700071

Annexure-I

Procedure order for ultrasonic testing of Rails/Welds using Phased Array Ultrasonic Single Rail Tester (PAUT SRT)

1 Background:

1.1 The present pedestrian system of ultrasonic testing of rails by Single Rail Tester (SRT)/Double Rail Tester (DRT) is capable of detecting multiple defects in the rail section. This system has been in practice on the Indian Railway for quite some time. As per the experience gained, continuous improvements & upgrades have been done in pedestrian ultrasonic testing of rails by SRT/DRT.

1.2 Currently SRT/DRT detects the defects in rail head [including transverse fatigue (Kidney) defects inclined around 20 degrees], web & foot region. However, this technology is not capable of detecting vertically oriented transverse fatigue defects & other unfavorably oriented defects in rails.

1.3 To upgrade the technology for detecting such undetected transverse fatigue defects in rail head, RDSO has conducted field trial for one of the Phased Array Ultrasonic Single Rail Tester (PAUT SRT) in sections of NE Railway.

PAUT SRT Aspects:

1.4 PAUT is an advanced ultrasonic technique that permits the shaping and steering of ultrasonic beam angles and enhanced beam coverage. The Phased Array beam sweeps like a searchlight through the object, and is able to detect unfavorably oriented defects. Moreover, due to presence of higher number of probes, it is more sensitive in detecting the defects compared to conventional UT.

1.5 As per the results obtained in field trials of PAUT SRT, following aspects have been observed:

1.5.1 PAUT SRT is capable of detecting transverse vertical fatigue defects and half-moon defects in rails. This was seen during testing over the simulated artificial defects at RDSO.

1.5.2 PAUT SRT displays detailed analysis of defect signals in 'A', 'B' and 'S' Scan which allows the operator to determine a defect shape index. PAUT SRT is capable of displaying all these scans, which provide visual information about the location and coordinates of the defect and approx. defect size.

1.5.3 All probes shall run in the center region of rail head. Probes are fixed in such a way that the entire head shall be scanned, including gauge and non-gauge faces. This feature addresses the problem of frequent misalignment of the probes in gauge and field side of the rail with conventional USFD testing machines.

1.5.4 The software of the PAUT SRT provides the following information in real time:

a. PAUT SRT display "A" scan: In A-scan presentation, the horizontal axis represents the depth of defect as per ultrasonic beam travel path. The vertical axis represents the amplitude of corresponding signals, measured as a percentage of full height of the display screen.

b. PAUT SRT display "B" scan: The B-scan presentation is a profile (cross-sectional) view of the test object. In the B-scan, the time-of-flight (travel time) of the sound energy is displayed along the vertical axis and the linear position of the transducer is displayed along the horizontal axis. From the B-scan, the depth of the reflector and its approximate linear dimensions in the scan direction can be determined.

c. PAUT SRT display "S" type scan: It refers to sectorial scan, which is produced when a phased Array is used to electronically sweep an ultrasonic beam through a range of angles. It shows a two-dimensional view of all amplitude and time or depth data from all focal laws of a Phased Array probe, corrected for delay and refracted angle.

1.5.5 GPS enabled electronic units can provide the GPS coordinates of the defects.

1.5.6 Data directly can be transferred to the Server/ cloud storage in real time.

1.5.7 PAUT SRT is lightweight equipment portable enough to transport and off-tracking of the machine while movement of trains on the track similar to the conventional SRTs.

1.5.8 PAUT SRT is able to test the head, web and foot (central region) of the rail. The dead zone area is reduced compared to conventional methods.

2 **Scope of Procedure Order:** This procedure order covers the following aspects for outsourcing agencies involved in ultrasonic testing of Rails/Welds by Phased Array Ultrasonic Single Rail Tester (PAUT SRT)-

2.1 Verification of PAUT SRT

2.2 Verification of competency of Operators for PAUT SRT

2.3 Approval of Quality Assurance Plan (QAP)

2.4 Verification of competency of Quality Control In-charge

3 Generic Specification:

3.1 PAUT SRT should display detailed analysis of defect signals in 'A', 'B' & 'S' scan which allows the operator to determine a defect shape index. PAUT SRT should be capable of displaying all these scans which provide visual information about the location and coordinates of the defects, approx. defect size.

3.2 Different types of presentation of defect signal in PAUT SRT is given as under:

3.2.1 **A-Scan presentation:** In A-scan presentation, the horizontal axis represents depth of defect & the vertical axis represents the signal's amplitude, measured as a percentage of full height of the display screen.

3.2.2 **B-Scan presentation:** The B-scan presentation is a profile (cross-sectional) view of the test object. In the B-scan, travel time (of sound energy) is displayed along vertical axis and linear position of probe is displayed along horizontal axis. From the B-scan, the depth of the reflector and its approximate linear dimensions in the scan direction can be determined.

3.2.3 **S-Scan presentation:** It refers to sectoral scan. It shows a two-dimensional view of all amplitude and time or depth data from all focal laws of a Phased Array probe, corrected for delay and refracted angle.

3.3 The PAUT SRT should have multichannel continuous recording of flaw detection information for the rails in real time.

3.4 Frequency of PAUT SRT probes should be between 2 to 5 Hz.

4 General Guidelines for verification of PAUT SRT:

4.1 The firm shall approach RDSO for verification of their PAUT SRT, competency of USFD operators and quality control In-charge and Quality Assurance Plan (QAP). After verification of PAUT SRT, competency of USFD operators/Quality In charge and QAP by RDSO, firms can participate in tenders. During verification of PAUT SRT, the firm shall provide following details to Metallurgical & Chemical (M&C) Directorate of RDSO:

4.1.1 Make… Model… Serial number… year of manufacturing… and codal life (OEM certified)…

4.1.2 Details of Probes:

- **i.** Frequency : It should be between 2 to 5 MHz.
- **ii.** No. of elements : As per OEM.
- **iii.** Angle of steering : As per OEM.
- **iv.** Number of probes : As per OEM.

4.1.3 Couplant : It should be Water.

4.1.4 Mode of operation of system : Pedestrian movement.

4.1.5 Facility to display: must include A- Scan, B- Scan & S-Scan.

4.1.6 Details of control unit: Electronic Unit / PC tablet etc.

4.1.7 Calibration procedure: As per standard block (approved by OEM) or otherwise.

4.1.8 Sensitivity setting procedure: To be done by any standard block (approved by OEM) or otherwise.

4.1.9 Details of records: In the form of defect location (H/W/F), depth of defect (from top of the Rail or any other reference point, surface distance in mm from probe to defect, horizontal movement of defect signal in % (in case of A-Scan), amplitude in % (in case of A-Scan), approx. size of defect (in case of B-Scan).

4.1.10 Defect classification system: IMR/IMRW/OBS/OBSW/NR.

5 Verification procedure of PAUT SRT:

5.1 The performance of PAUT SRT shall be verified by M&C Directorate of RDSO. Sensitivity setting block offered by the agency shall also be verified by M&C Directorate

5.2 The agency shall deposit verification charges as per the prescribed norms of RDSO in advance as advised by M&C Directorate of RDSO.

5.3 The agency shall depute one certified USFD Operator cum Analyzer trained and certified by OEM as per clause 08 of this document for the entire verification process of their PAUT SRT at RDSO.

5.4 The capability of PAUT SRT will be shown to representative of M&C/RDSO by the firm at M&C Directorate, on the artificial and natural defects available at M&C Directorate of RDSO.

5.5 The PAUT SRT under test, shall exhibit equal or better coverage of rail sections in detection of flaw as compared to the 09 channel/rail B-Scan SRT/DRT of IR.

5.6 After verification, the approval certificate with a unique number indicating machine make & number, validity etc. will be issued by M&C Directorate of RDSO.

5.7 This approval certificate will be valid for half of the codal life of the equipment. As such, recertification will be done only once in the service life of the machine. Codal life of the PAUT SRT has to be declared by OEM.

6 Testing of Rails by PAUT SRT:

6.1 After calibration and sensitivity setting, scanning of complete rail head (center, gauge and non-gauge face region), web and central part of foot region of rail shall be done by PAUT SRT carefully. During scanning, proper coupling and alignment of probes must be ensured.

6.2 Recording of all the test data/parameters required along with A-Scan, B-Scan & S- Scan for analysis.

7 Defect classification by PAUT SRT:

7.1 In the Oscillogram pattern of defect classification by PAUT SRT, horizontal scale represents the depth of defect and vertical scale represents the Amplitude of signal.

7.2 Classification of Rail/Weld defects by PAUT SRT is attached as Annexure-II. Defect classification for PAUT SRT has been adopted as per pattern of USFD Manual/Revised-2022, for scanned area of normal and angular probes i.e. central, gauge, non-gauge, bolthole crack location.

7.3 Action to be taken after detection of defects and frequency of testing to be adopted is the same as specified in USFD Manual Revised-2022.

7.4 Sensitivity and Calibration procedure mentioned in USFD Manual Revised-2022 is not applicable for PAUT SRT. Sensitivity and Calibration of PAUT SRT to be carried out as per Procedure specified by OEM.

7.5 Para 6.3.1 of USFD Manual Revised-2022 *"Defect at any location which is detected by two or more probes and are considered to be classified as OBS/OBSW based on peak pattern of individual probe, should be classified as IMR/IMRW and action shall be taken accordingly as per Para 6.4"* *shall not be followed in non-critical locations during PAUT SRT ultrasonic testing*. This is due to its higher sensitivity, more number of probes & larger beam coverage area.

7.6 *For critical locations such as in tunnel & on tunnel approaches (100m either side), on major bridges & bridge approaches (100m either side) & in the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld, the criteria as mentioned in Para 6.3.1 of USFD Manual Revised-2022 shall be followed in PAUT SRT ultrasonic testing also.*

7.7 Para 6.3.2 of USFD Manual Revised-2022 *"In case two or more OBS/OBSW defects are located within a distance of 4.0 metre from each other, such OBS/OBSW defects shall be classified as IMR/IMRW and action shall be taken accordingly as per Para 6.4"* shall be followed in PAUT SRT ultrasonic testing also.

7.8 Increase in gain of 10 dB for probe which scans the center portion of head for single line and 'D' marked rails on double/multiple line *shall not be employed for classification of defect in PAUT SRT.*

8 Verification of competency of Operators for PAUT SRT:

8.1 The operator should fulfill the following requirements for ultrasonic testing of rail by PAUT SRT:

8.1.1 The operator should have a valid competency certificate for Rail testing by conventional Ultrasonic system, issued by the M&C Directorate of RDSO as described in IRS-T-53.

8.1.2 The operator should have competency certificate issued by OEM after completing requisite training for operation and data analysis of PAUT SRT.

9 Quality Assurance Program (QAP):

The firm will have to submit a Quality Assurance Plan (QAP) for Ultrasonic Testing of Rail by PAUT SRT for outsourcing and furnish the following information in the QAP, while submitting QAP to RDSO. The QAP shall necessarily have following contents:

9.1 Name of agency/ firm, registered address along with contact number & mailing address.

9.2 Registration certificate, details of GST registration, PAN number and ISO certificate.

9.3 Total number of PAUT SRT.

9.4 Total number of competent operators for testing of rail by PAUT SRT.

9.5 Quality Control In-charge.

9.6 Details of calibration and sensitivity setting block.

9.7 QAP shall be approved on the basis of verification of PAUT SRT for ultrasonic testing of Rail, competency of USFD operators & Quality Control In-charge and other information given by the firm in Quality Assurance Plan. The validity of QAP shall be 3 years. After this period QAP shall be renewed based on the machines available with firms, qualified operators, performance of operators and other relevant factors.

9.8 **Self-assessed capacity:** The self-assessed capacity shall be as under-

Maximum length of Track as 06 Km per day per machine with two operators

10 Verification of competency of Quality control In-charge:

10.1 In order to have a proper implementation of QAP the firm shall have a proper quality control organization headed by a Quality Control In-charge, having RDSO certification as described in IRS-T-53 for Quality Control In-charge. He shall be responsible for maintaining the operator training record and to undertake continuous monitoring of performance of all the operators, carry out the test checks of work done of all operators working under him and ensure that all operators have been imparted proper training for the duties assigned to them.

10.2 In addition to above, the Quality control In-charge should have competency certificate issued by OEM after completing requisite training for operation and data analysis of PAUT SRT.

11 Documentation:

11.1 The firm shall determine and record all information as specified below pertaining to Recording of Data with respect to the detection of flaw:

11.2 Daily test report gives a summary of the day's testing

- Date and time of testing (should come in auto mode and non-editable)
- Model and Sl. No. of equipment (should come in auto mode and non-editable)
- Name of operator :
- Railway & Division :
- Block section :
- Rail Rolling mark:
- Rail Number or Weld Number :
- Line- Single line/UP/DN/SL/NL3L/4L
- Chainage of start and finish of USFD testing
- Section of Rail tested
- Horizontal movement (in case A-Scan in %) :
- Amplitude (in case A-Scan in %) :
- Classification of defect:
- Previous classification:
- Approx. size of defect (in case of B-Scan in mm) :
- Location of defect (H/W/F) :
- Depth of defect from Rail Table or any other reference point (in mm) :
- Surface distance from probe to defect (in mm):
- Other relevant details (as per request of Zonal Railways) :

Note: Agency shall submit a declaration from OEM that the date, time, model & sl.no. are non-editable in machine & report.

12 Test Check:

12.1 During the first round of Ultrasonic testing by PAUT SRT 100 TKM track for the first work/contract of Zonal Railways to be fully test checked by Zonal Railways using their 09 channel B-Scan SRT/DRT.

The data collected from PAUT SRT and 09 channel B-Scan SRT/DRT testing is to be shared with RDSO by the Zonal Railway, as it will be utilized for further analysis.

12.2 Subsequently, the test check as specified by Railway shall be carried out.

12.3 The defects detected by PAUT SRT be broke open by Railways for further analysis and to determine correctness of reporting. The percentage of such defects shall be as considered necessary by the Railway.

12.4 In case of Under-Reporting of IMR/IMRW category defects in test check, repeat test of the corresponding complete stretch shall be carried out by the firm by the 09 channel B-Scan SRT/DRT. No additional payment would be made to the firm for such a repeat test.

13 Items to be ensured by Zonal Railways:

13.1 Firms can participate in tenders only after verification/certification of their PAUT SRT for ultrasonic testing of Rail/Weld, competency of USFD operators, Quality Control In-charge and Quality Assurance Plan (QAP) by RDSO.

13.2 Addition/ deletion/ change of machine (PAUT SRT), Quality Control In-charge, USFD operator for PAUT SRT, QAP etc. shall be dealt as per IRS T-53.

13.3 The certification of the machine/ system is done by RDSO initially. Regular check on test pieces having artificial defects mentioned in Manual for Ultrasonic testing of Rails and Welds, Revised-2022 shall be ensured by Zonal Railways. Any deterioration in performance shall be advised to RDSO.

13.4 As the role of RDSO is limited to verification/certification of machines and verification of competency of USFD operator & QAP, the concerned authority finalizing the tenders shall be responsible for checking and ensuring that the firm meets the minimum technical and financial eligibility criteria. The eligibility criteria are not part of QAP, as QAP is meant basically to regiment the Quality control system. As such, availability of RDSO approved QAP with the firm shall in no way be construed that RDSO has checked and verified eligibility criteria. It is reiterated that assessing the capability of the firm, checking eligibility criteria and other relevant factors will be the sole responsibility of tendering authority. Technical eligibility criteria has been defined in Annexure-III attached herewith. This procedure order contains general technical guidelines, final tender document shall be framed by concerned Zonal Railway considering the extant policies.

13.5 Zonal Railways shall test check the capability of the operator and Ultrasonic test system from time to time.

These test checks can be carried out as per this procedure order. Before commencement of work by PAUT SRT in all concerned Zonal Railways where Phased Array testing of Rails has been allowed, firm shall arrange a demonstration in Zonal Railways regarding operation and data analysis of PAUT SRT for officials of Zonal Railways.

13.6 The operator shall possess original / photocopy attested by Railway officer, of the valid competency certificate issued by RDSO as per provisions of IRS-T-53 and certificate issued by OEM for Rail/Weld testing by PAUT SRT while performing testing in the field and produce the same to railway officials when demanded. Zonal Railways shall put in place a mechanism to maintain day to day records of operators employed by the contractor along with equipment used (Sr. No. of machines etc.).

13.7 The approval of QAP by RDSO does not certify the agency's eligibility for meeting required norms. Technical eligibility criteria has been defined in Annexure-III attached herewith. The Zonal Railway shall ensure the compliance about firm's capability, eligibility criteria and other requirements as per extant instructions

13.8 On the basis of advice/ complaints raised by the railway, RDSO shall critically review/ check the QAP of the agency along with performance verification of PAUT SRT.

13.9 M&C Directorate of RDSO shall act as third party to investigate whether the defect was detectable at the time of USFD testing or not. The decision of RDSO shall be final and binding on both the parties and this decision is not arbitrable.

13.10 Based on the feedback received from Zonal Railways, this procedure order will be modified in consultation with the M&C Directorate of RDSO.

14 **Safety**: All personnel employed in ultrasonic testing by PAUT SRT are responsible for ensuring that they as well as their fellow employees are performing their jobs in a safe and professional manner and adhere strictly to the safety protocol established by Indian Railways.

This Procedure order will be applicable w.e.f. August, 2024.

Digitally signed by SANTOSH
Date: 2024.09.12 12:15:25 +05'30'

(Santosh)
Director/ Track-V

SUNITA Digitally signed by SUNITA
Date: 2024.09.12 14:36:04 +05'30'

(Sunita)
Director/ M&C-II

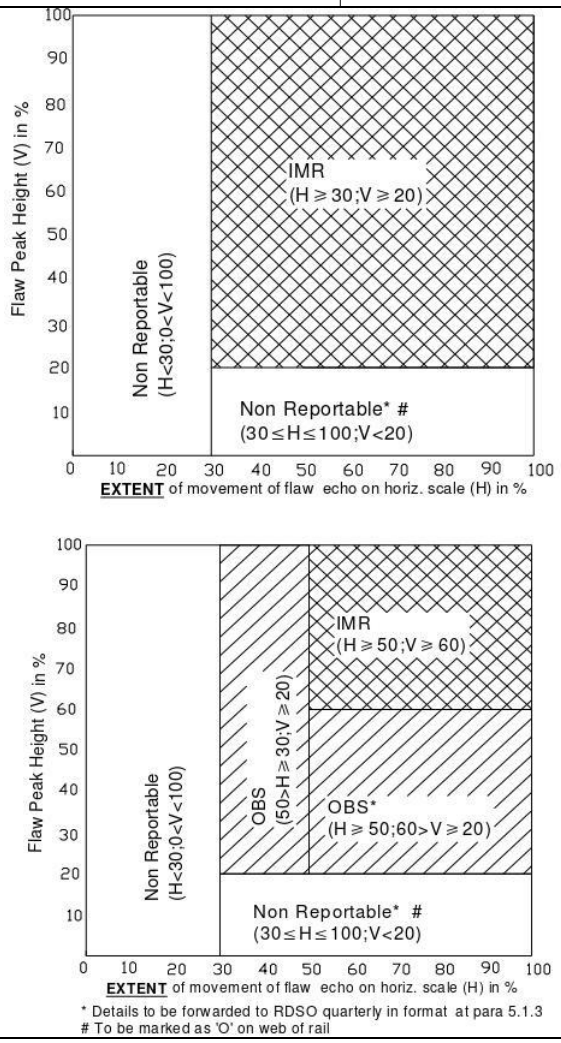
Annexure-II

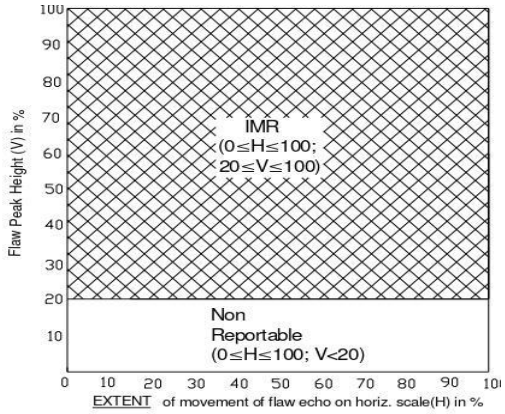
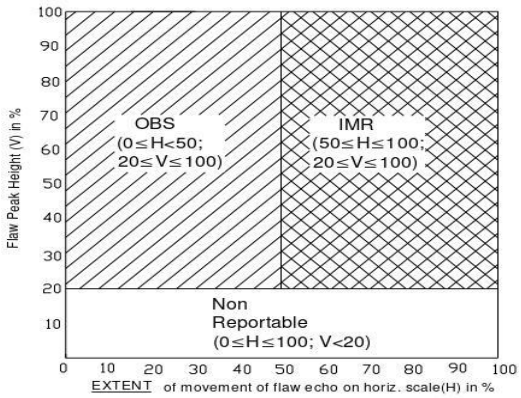
Classification of Rail/Weld Defects by Phased Array Pedestrian USFD Machines

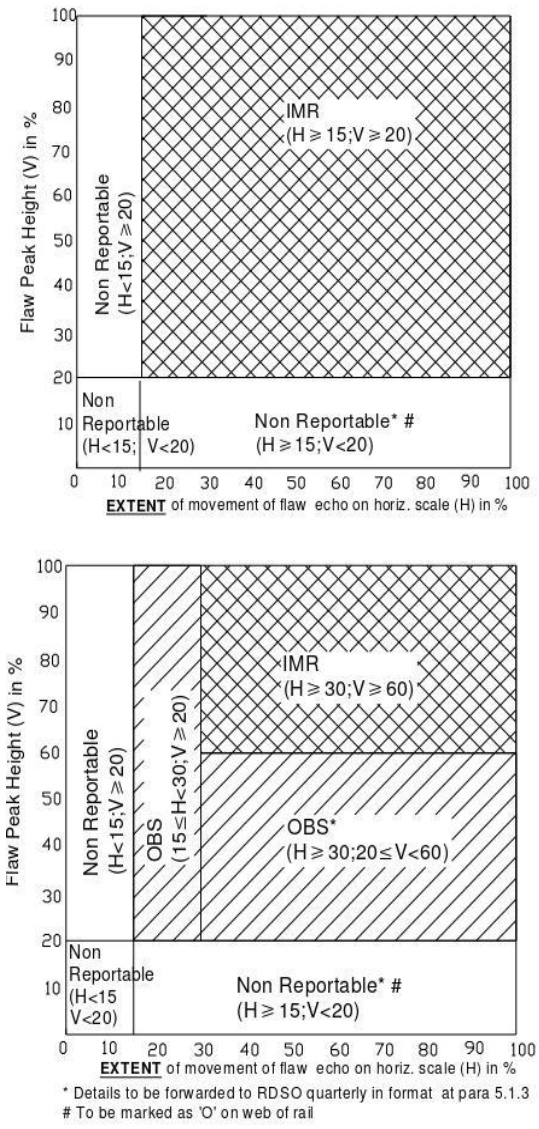
For Rail Defects

S. No	Probe used	Nature of defect	Oscillogram pattern	Classification
1.	0^0 (Normal Probe)	**A) Within fish plated area -** (i) Any horizontal defect in head web or foot of length equal to distance between rail end and first bolt hole and connected with the rail head. (ii) Any horizontal defect connecting both bolt holes (iii) Any defect originating from bolt holes and progressing at an angle towards head-web junction or web-foot junction.	No back echo before or after appearance of bolt hole echo with Flaw echo with or without multiples **OR** Drop in back echo before or after appearance of bolt hole echo with flaw echo with or without multiple No back echo between bolt hole echo. Flaw echo with or without multiples. No back echo before or after appearance of bolt hole echo with or without flaw echo	IMR IMR IMR
		B) Outside fish plated area - a) Any horizontal defect progressing at an angle in vertical plane in the rail at the following locations in the track: (i) In tunnel & on tunnel approaches (100m either side) (ii) On major bridges & bridge approaches (100m either side) (iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld)	No back echo with flaw echo (shifting/without shifting) for any horizontal length OR No back echo and no flaw echo	IMR
		b) Any horizontal defect progressing at an angle in vertical plane in the rail at track locations other than (a) above.	No back echo with flaw echo (shifting/without shifting) for horizontal length $\geq$ 20mm No back echo with or without shifting flaw echo for horizontal length< 20 mm	IMR OBS

		C) Vertical longitudinal split (piping)	In case of partial/complete loss of back echo, side probing shall be carried out with 0^{o} probe, if any flaw echo with/ without multiples is observed (in any length)	IMR

S. No	Probe used	Nature of defect	Oscillogram pattern	Classification
2.	Depart 55^0-70^0 & Approach 55^0-70^0 Or Central Phased Array probe covering head region <u>(For non 'D' marked rails on double/multiple line sections)</u>	A) Any transverse defect in the rail head at the following locations in the track i) In tunnel & on tunnel approaches (100m either side) ii) On major bridges & bridge approaches (100m either side) iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld) B) Any transverse defect in the rail head at track locations other than A) above		

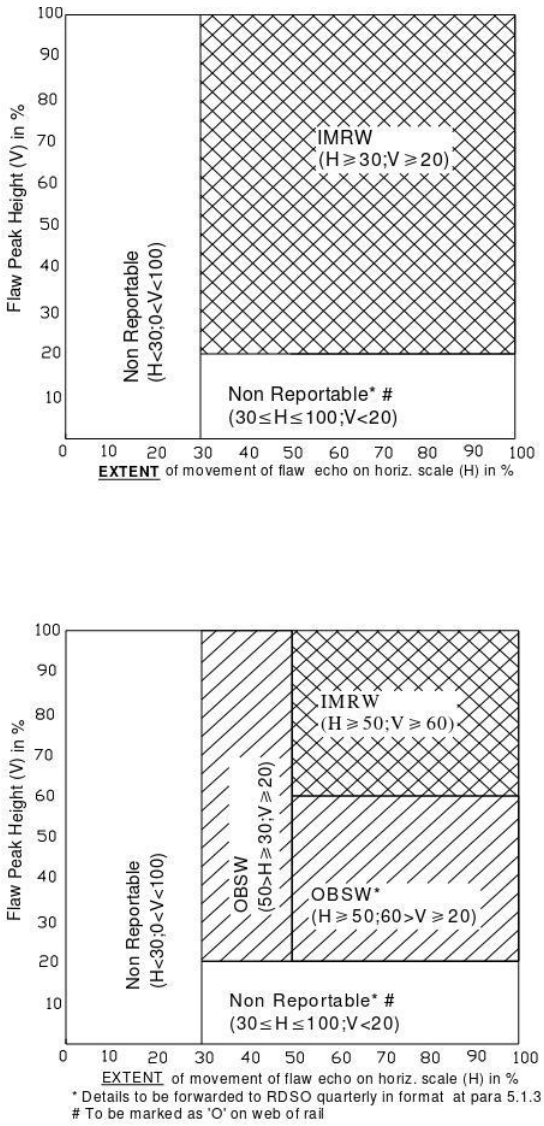
S. No	Probe used	Nature of defect	Oscillogram pattern	Classification
3.	Depart 55^0-70^0 & Approach 55^0-70^0 Or Central Phased Array probe covering head region <u>(For all single line sections and 'D' marked rails on double /multiple line sections)</u>	A) Any transverse defect in the rail head at the following locations in the track i) In tunnel & on tunnel approaches (100m either side) ii) On major bridges & bridge approaches (100m either side) iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld) B) Any transverse defect in the rail head at track locations other than A) above	 	

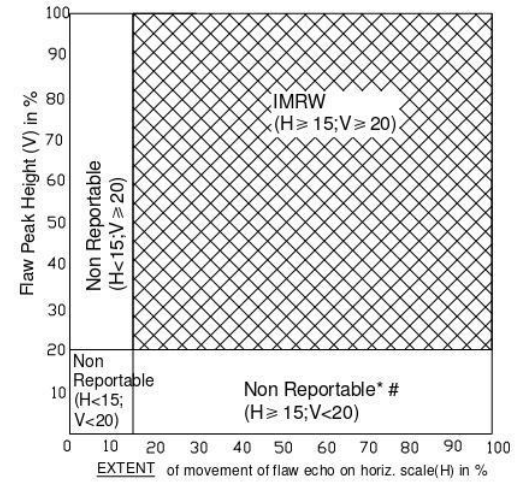
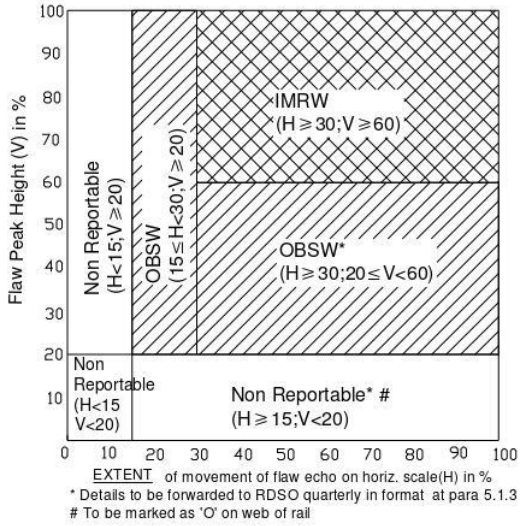
S. No	Probe used	Nature of defect	Oscillogram pattern	Classification
4.	Gauge f. 50^0-60^0 & Field f. 50^0-60^0 Or Gauge and field face Phased Array probe covering head region in gauge and field side	A) Any transverse defect in the rail head on gauge face side/ Non-gauge Face at the following locations in the track i) In tunnel & on tunnel approaches (100m either side) ii) On major bridges & bridge approaches (100m either side) iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld) B) Any transverse defect in the rail head on gauge face/ Non-gauge Face side at track locations other than A) above		

S No	Probe Used	Nature of Defect	Oscillogram Pattern	Classification
5.	45^0 probes mounted in test rig (sensitivity set to 100% with respect to reflection signal received from opposite face of rail head)	A) Any transverse defect in the rail head, with scabs/wheel burn on top surface, at the following locations in the track i) In tunnel & on tunnel approaches (100m either side) ii) On major bridges & bridge approaches (100m either side) iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld)	Loss of signal height equal to or more than 20% of full scale height.	IMR
		B) Any transverse defect in the rail head with scabs/wheel burn on top surface at track locations other than A) above.	Loss of signal height equal to or more than 80% of full scale height.	IMR
			Loss of signal height equal to or more than 20% but less than 80% of full scale height	OBS
6	Depart 40^0-50^0 & Approach 40^0-50^0 Or Phased Array probe for detecting bole hole crack & web region defects	Any defect originating from bolt holes and progressing at an angle towards head-web junction or web-foot junction.	During testing any moving signal observed in web region other than standard peak from bolt hole, bond wire hole etc.	IMR

For Weld defects (AT+FBW)

S.No.	Probe used	Nature of defect	Oscillogram pattern	Classification
1.	0^0 (Normal Probe)	A) Any horizontal defect progressing at an angle in vertical plane in the rail at the following locations in the track: i). In tunnel & on tunnel approaches (100m either side) ii). On major bridges & bridge approaches (100m either side) iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld)	No back echo with flaw echo (shifting or without shifting)	IMRW
		B) Any horizontal defect progressing transversely in the rail at track locations other than A) above	No back echo with flaw echo (shifting or without shifting)	OBSW

S.No.	Probe used	Nature of defect	Oscillogram pattern	Classification
2.	Depart 55^0-70^0 & Approach 55^0-70^0 Or Central Phased Array probe covering head region	A) Any transverse defect in the rail head at the following locations in the track i) In tunnel & on tunnel approaches (100m either side) ii) On major bridges & bridge approaches (100m either side) iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld) B) Any transverse defect in the rail at track locations other than A) above		

S.No.	Probe used	Nature of defect	Oscillogram pattern	Classification
3.	Gauge f. 50^0-60^0 & Field f. 50^0-60^0 Or Gauge and field face Phased Array probe covering head region in gauge and field side	A) Any transverse defect in the rail head on gauge face/ Non-gauge Face side at the following locations in the track i) In tunnel & on tunnel approaches (100m either side) ii) On major bridges & bridge approaches (100m either side) iii) In the vicinity of holes near the weld (50 mm for old AT weld and 75mm for new AT weld from the centre of weld on either side of weld) B) Any transverse defect in the rail head on gauge face/ Non-gauge Face side at track locations other than A) above	 	

Annexure-III

Technical Eligibility Criteria for testing of rail by PAUT SRT through outsourcing

1. Firm shall have RDSO verified PAUT SRT.
2. Firm shall have RDSO certified USFD operators for Rail testing by conventional Ultrasonic testing method as described in IRS-T-53. In addition to above, the operator should have competency certificate issued by OEM after completing requisite training for operation and data analysis of PAUT SRT.
3. Firm shall have RDSO verified Quality Assurance Plan (QAP) for Ultrasonic testing of rail by PAUT SRT.
4. The PAUT SRT proposed to be used by firms on IR network should be in service on at least 02 other/foreign Railways network for USFD testing of Rails and should have carried out USFD testing of at least 1000 Tkm with satisfactory performance.

   Firm shall submit a certificate of satisfactory performance regarding USFD testing of 1000 Tkm in each Railway network.
5. Original Equipment Manufacturer (OEM) firms shall be eligible to participate in the tender. However, in case the OEM firm is not located in India, any Authorized Indian service provider or representative can participate in the tender.

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