

ग्राहक सेवा में.....
“अग्रगामी से अग्रणी, उत्कृष्ट से सर्वोत्कृष्ट”



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BHOPAL DIVISION

PROCEDURE FOR ULTRASONIC TESTING OF SEJ AND TONGUE RAIL OF POINTS AND CROSSINGS DURING SERVICE & INSPECTION OF USFD MACHINE

इंजीनियरिंग विभाग
पश्चिम मध्य रेलवे। भोपाल मण्डल द्वारा जारी।

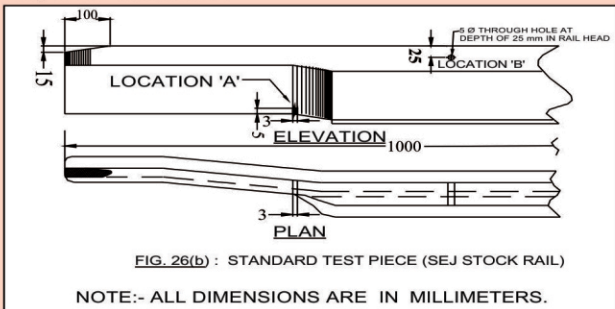
PROCEDURE FOR ULTRASONIC TESTING OF SWITCH EXPANSION JOINT

Procedure for ultrasonic Testing of stock rail of SEJ

Probes :- (i) 45°/2MHz, 20x20mm, Single crystal
(ii) 70°/2MHz, 20x20mm, Single crystal

Couplant :- Water/ soft grease/ thick oil.

Standard test piece:- A 1m long piece of nose of SEJ stock rail is having one simulated flaw of 3mm x 5mm in the bottom of flange and 5mm dia. through hole in the rail head 25mm. below the top of the rail surface.



Range calibration :- 500mm longitudinal wave (275mm shear wave) for 45° angle probe and 300mm longitudinal wave (165mm shear wave) for 70° angle probe.

Sensitivity setting:- 45°/2MHz single crystal angle probe

After setting depth range for 500mm longitudinal wave (275mm shear wave) place the 45°/2MHz single crystal angle probe directing the beam towards the simulated flaw in bottom at a distance of 160mm (for 52 Kg.) /175mm (For 60 Kg.) approximately from the junction of flange.

Move the probe towards the saw cut in zigzag manner so as to get maximum reflection from saw cut.

The height of this reflected signal shall be adjusted to 40% of full screen height with the use of gain control knob.

This gain setting shall be utilized during examination of SEJ using 45° angle probe while maintaining the movement towards the nose of SEJ.

Any flaw peak of amplitude higher than 20% of full screen height shall be classified as IMR. The SEJ should be adequately protected till it is replaced.

70°/ 2MHz single crystal angle probe

After setting depth range for 300mm longitudinal wave (165mm shear wave), place the 70°/2MHz single crystal angle probe on the rail head at a distance of approximately 70mm from 5mm dia hole so as to direct the beam towards the hole.

The maximum reflection from 5mm dia. hole shall be adjusted to 60% of full screen height with use of gain control.

This gain setting shall be utilized during testing of SEJ while testing with 70° angle probe with probe movement towards SEJ.

Any flaw peak of amplitude higher than 20% of full screen height shall be classified as IMR. The SEJ should be adequately protected till it is replaced.

Testing frequency - Same as that for normal rail testing of track in the need based concept

Procedure for ultrasonic Testing of tongue rail of SEJ

Probe:- 70°/ 2 MHz, 20 mm Single Crystal probe.

Couplant:- Soft grease or thick oil shall be used as couplant.

General Condition:

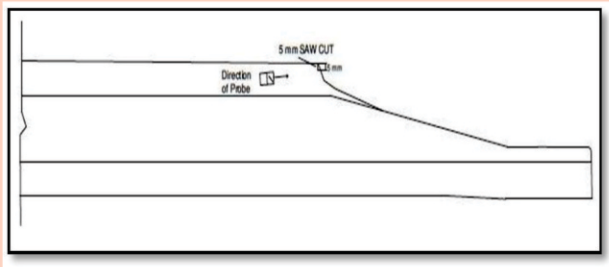
Prior to conducting testing, the bracket over the sharp curvature in the flange portion of tongue rail of SEJ shall be removed.

Cleaning of flange with kerosene shall be done to remove dirt oil or grease over it.

Flange shall be smooth and free from pitting otherwise paper grinding shall be carried out for smothering the surface.

Standard test piece:

The sensitivity of the ultrasonic equipment shall be set with the help of Standard Tongue rail of SEJ test piece containing a 5 mm cut at sharp curved location of flange



Range Calibration:- The equipment shall be set for a depth range of 165 mm Shear Wave.

Sensitivity Setting:-

Place the 70°/ 2 MHz probe at a distance of approx. 110 mm far from saw cut on the upper zone of flange of tongue rail with beam directing towards the saw cut.

Move the probe in slight zig zag manner towards cut direction

The reflection from 5 mm cut shall be maximized and shall be set to 60% full screen height by suitable adjustment of gain control.

This gain setting shall be utilized during testing of SEJ tongue rail while testing with 70° angle probe with probe movement towards sharp curve portion.

Test Procedure:-

The 70° probe shall be placed on the upper zone of flange at a distance of approx. 110 mm far from sharp curve portion with beam directing towards curve portion.

Move the probe in slight zigzag manner up to curve portion.

This scanning shall be carried out 2-3 times.

Any flaw signal obtained by 70° probe of 20% vertical height of Screen or more shall be treated as defective tongue rail of SEJ.

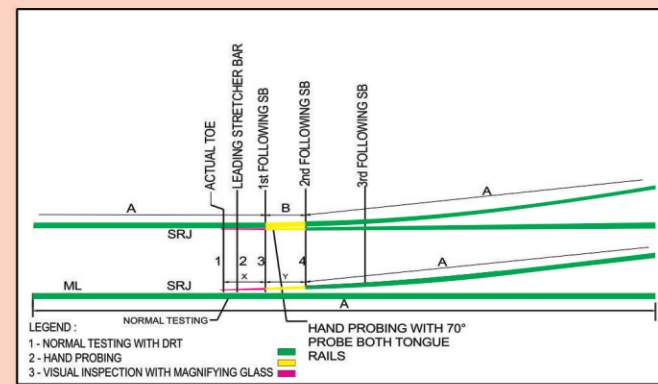
Testing frequency:- frequency testing of USFD testing of tongue rail of SEJ shall be **once in a year**

PROCEDURE FOR USFD TESTING OF TONGUE RAIL OF POINTS AND CROSSING IN SERVICE

For the purpose of USFD testing of tongue rail of points and crossing, the tongue rail can be demarcated in three zones as under

- a- Zone-1: Where full width of Rail head is available. This zone shall be covered in normal rail testing.
- b- Zone-2: Region where scanning by 70° hand probe is easily feasible i.e. up to width of rail head of tongue rail where 70° probe of 20mm crystal size can suitably placed over it.
- c- Zone-3: Rest portion of tongue rail.

Rough sketch showing Zones in switch portion



Approximate measurement of different zones in curved switch

Switch	Zone 3	Zone 2	Zone 1
1 in 8½ Curved Switch	0.00m to 1.85m	1.85m to 2.85m	2.85m onwards
1 in 12 Curved Switch	0.00m to 4.10m	4.10m to 5.35m	5.35m onwards

Range Calibration :- The equipment shall be set for a depth range of 165 mm Shear Wave.

Sensitivity setting: Same as used for through periodic rail testing.

Test Procedure:-

a- Zone-1: In this part, full width of tongue rail of points and crossing is available and shall be covered in normal rail testing. In some switches, guide rollers of DRTs hinder the movement of trolley up to full width of rail head part, lower dia. guide roller shall be used.

b- Zone-2: This part of tongue rail shall be tested manually using 70° /2MHz, Single Crystal angle probe having crystal Size 20mm dia. or 20X20mm square crystal.

c- Zone-3 : This part of tongue rail shall be examined visually

Defect classification :-

The defect classification shall be made according to IMR classification of rail defects.

a-Zone-1: The defect classification shall be made according to IMR classification of rail defects in Item 1(A), 2(A), 3(A) and 4(A) of Annexure-II-A of USFD Manual 2012. (same as in rail testing)

b- Zone-2: In zone-2 provisions given in Item 2(A) and 3(A) of Annexure-II-A of USFD Manual 2012 is applicable. (only IMR classification in rail testing)

Action to be taken after detection of defects: SSE/JE (P.way)/USFD shall impose speed restriction of 30kmph or stricter stricter immediately and to be continued till flawed tongue rail is replaced which should be done within three days.

INSPECTION OF USFD MACHINE

Ref: USFD manual 2012 and IS 12666:1988 (Reaffirmed 2003)

Types of inspection of USFD machine and frequency

- a) Visual inspection of equipments and accessories, daily check
- b) Calibration of equipment, weekly check.
- c) Sensitivity setting of the equipment, once in three days.
- d) Checking of the equipment characteristics, monthly check.

a) Visual inspection of Equipments and accessories - Daily check

Check the battery condition. Only fully charged battery is to be used.

Check proper functioning of all controls of electronic unit.

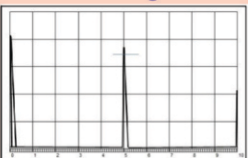
Check proper functioning of trolley and probes.

Check water outlet, probe cable contact and ensure smooth movement of trolley wheels.

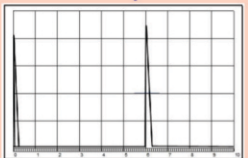
Maintain proper gap between probing face and probe shoe (0.2 mm).

Check probe alignment by keeping the rail tester on the rail

b) Calibration of Digital USFD machine - weekly check



Calibration 200mm
longitudinal wave



Calibration 165mm
shear wave

Calibration for 200 mm longitudinal wave using 0° DC probe

Connect the 0° (4 MHz) Double Crystal probe to requisite channel.

Feed the required range 200 mm. Put 0° Double Crystal probe on IIW (V1) block after applying couplant at 100 mm width side

Set Delay / Probe Zero as per operational manual.

Set first reflected peak at 5.0 using delay key. Place Gate over it and read the beam path it should be 100 mm.

Second reflected peak will appear at 10.0.

If last peak is not at 10.0, velocity may be adjusted to set the last peak at 10.0 (if velocity control is available).

To verify the calibration put probe on top of rail head, the back peak position will be at 7.8 for 52 Kg. rail & at 8.6 for 60 Kg. rail

Calibration for 165 mm Shear wave using 70° SC angle Probe

Connect the 70° SC angle probe to requisite channel.

Feed the required range 165 mm Shear wave.

Set Delay and Probe Zero as per operational manual.

Put 70° SC probe on IIW block after applying couplant and direct the beam towards 100 mm curvature.

Move the probe slightly to and fro to get maximum signal height. Adjust the peak at 6.0 using delay/Probe Zero.

Place the gate over this peak, and read the beam path it shall be 100 mm.

To verify the calibration, direct the probe towards 25 mm curvature and maximize the peak.

Put the gate on this peak, the beam path shall be 25 mm

c) Sensitivity setting of the equipment and probes - (Once in three days)

Place the testing trolley on the standard rail piece having artificial flaws.

Check the alignment of probes, ensure 70° Central probe & 0°

probe travel centrally on the rail head & web. 70° GF & 70°

NGF probes shall be aligned towards GF & NGF respectively at appropriate positions.

Set the acoustic barrier of the normal probe at right angle to the longitudinal direction of rail.

Open the water nozzle and regulate water flow on the probes at an optimum speed.

Sensitivity setting of 70° Gauge Face (F&B) and Non-gauge Face Corner (F&B) probes

The trolley is moved on the standard test piece having 5mm Flat Bottom Hole (FBH).

Signals from end surface and 5mm FBH will appear on the screen.

Move the trolley forward and backward very slowly to get the maximum signal amplitude from the 5mm FBH and adjust the gain to get 60% of full height. Same procedure shall be adopted for other probes.

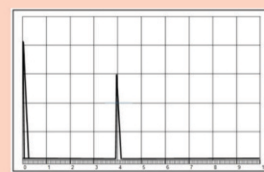
Sensitivity setting of angle probe 70° (Central forward & Central backward)

Get the reflection from 12 mm dia. hole, the amplitude of the flaw shall be set to 3 div. i.e. 60% of full screen height.

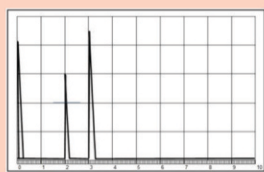
While testing on single line section and 'D' marked rails on double / multiple line section, additional gain of 10db is to be employed.

Sensitivity setting of normal probe

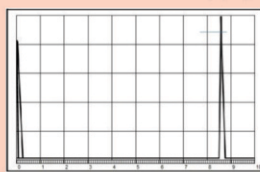
Place the trolley on track and the back wall echo will be adjusted by gain control of USFD tester to 100% of full screen height and the same shall be taken as reference echo.



Sensitivity setting of
70° central probe



Sensitivity setting of
70° GF & NGF probe



Sensitivity setting of Normal probe

d) Checking of equipment characteristics- Monthly check

The characteristics of the equipment shall be checked at least once in a month according to IS 12666 - 88.

The following characteristics shall be checked

- i. Linearity of time base of flaw detector
- ii. Linearity of Amplification of flaw detector
- iii. Penetrative power
- iv. Resolving power
- v. Probe Index
- vi. Beam angle
- vii. Dead Zone

i. Linearity of time base of flaw detector

By using IIW block time base is adjusted for multiple echo pattern display.

Range is set or calibrated for 100mm or 250mm or 500mm for at least two of bottom echoes, first and last. Then intermediate echoes should line up with appropriate positions.

Intervals between leading edges of successive bottom echoes are measured and their deviation (a_{max}) with respect to graticule recorded.

If b is the full scale of time base linearity is given as

$$(a_{max} / 0.8b) 100\%.$$

The variation shall be within $\pm 1.25\%$ at ranges 100mm, 250mm and 500mm.

ii. Linearity of Amplification of flaw detector

By using IIW block range is set for 100mm or 250mm or 500mm multiple echoes are observed respectively.

Gain is set to obtain all the echoes.

The Gain shall be reset to obtain n^{th} echo at half the previous previous scale height. The linearity shall be assessed by checking if the following echo ($n+1$) is also reduced by 50%.

$$\text{Deviation} = \{(h_1 - 2h_2) / h_1\} \times 100\%$$

h_1 = The height of ($n+1$) echo previously and

h_2 = The height of ($n+1$) echo after reset.

The linearity shall be within $\pm 3\%$ at ranges 100mm, 250mm and 500mm

iii. Penetrative power

By using IIW block range is set for 500 mm longitudinal wave.

The probe shall be placed on 23mm Perspex of IIW block keeping the energy level of equipment to minimum.

Apply gain and observe the echoes.

The equipment shall give at least 5 full echoes and 6th appearing with SC probe (2/2.5MHz) in 23mm perspex of IIW block.

iv. Resolving power

Depends on probe and USFD machine both.

Resolving power is assessed if echo signals from two steps of 85mm and 91mm of IIW block is clearly separated.

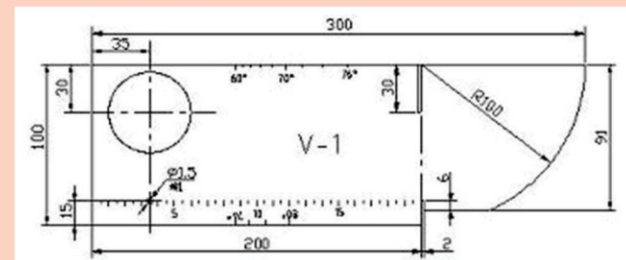
Range is set for 100 mm longitudinal wave.

The probe shall be placed to get echo signals of both steps 85mm and 91mm.

Probe position is adjusted so that the echoes from the two successive steps are of the same height.

Increase the gain to make the echoes height 100%.

At this position the onset (the combined part of close echoes) should be below 50%



v. Probe Index

This depends only upon the probe.

Beam angle of an angle probe can be determined with the help of IIW block.

Calibrate the USFD machine for 165mm SW.

Place the probe facing towards 100mm curvature

Get the maximum echo height.

Record the variation between probe index and mark of IIW block.

The Probe index should be ascertainable to within ± 1 mm.

vi. Beam angle

This depends only upon the probe.

Probe index of an angle probe can be determined with the help of IIW block.

Calibrate the USFD machine for 165mm SW.

Place the probe facing towards 23mm Perspex of IIW block from desired angle-marking side and get the maximum echo height.

Record the variation between probe index and Angle mark on IIW block.

The Beam angle should be within $\pm 1^\circ$

vii. Dead Zone

Place the Probe on Step Gauge and the echo of the corresponding depth is observed on the screen.

The Dead Zone shall be less than 7mm for (S/C probe) and less than 3mm for (D/C probe)