USFD OF RAILS AND WELDS

1. Characteristics of Machine And Accessories

Objective: To check the proper functioning of the equipment and accessories.

2. Apparatus Required:

Fig. 1: IIW Block

Fig. 2: Zero Degree 2 /2.5 MHz Single Crystal Probe

Fig. 3: Soft grease or Thick oil of high viscosity

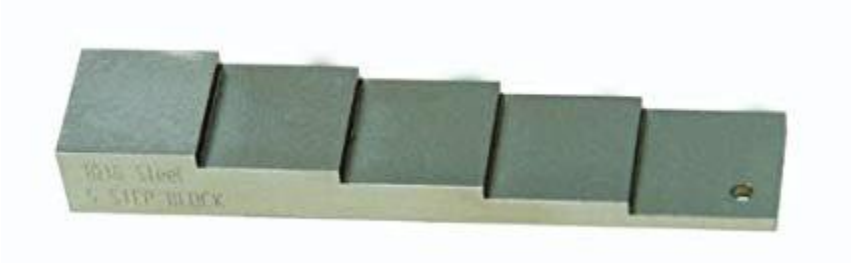


Fig. 6: Step gauge

Fig. 4: USFD Machine

Fig. 5: Angle probe for checking of probe index and probe angle

3. Reference: IS 12666 – 1988: Methods for Performance Assessment of Ultrasonic Flaw Detection Equipment (Reaffirmed- 2003)

4. Frequency of Test: Once in a month.

The following are the characteristics of machine and Accessories:

1. Linearity of Time Base.
2. Linearity of Amplification.
3. Resolution Power.
4. Penetration Power .

Machine

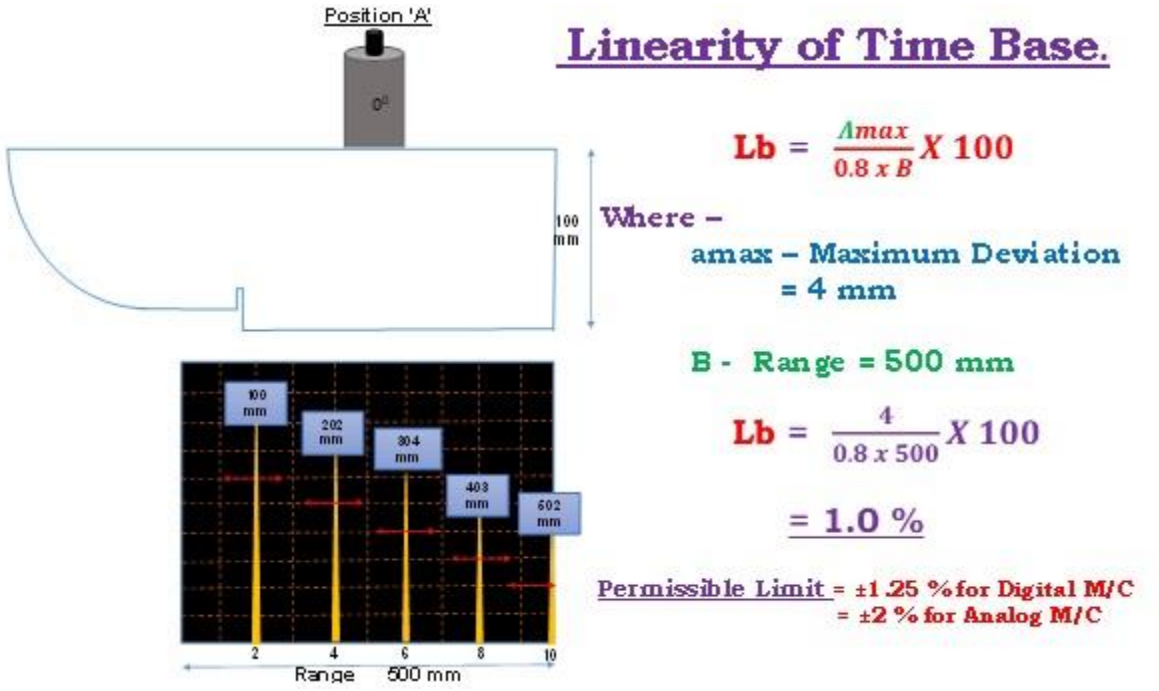
5. Probe Index .
6. Probe Angle .

Probe

5. Characteristics Checking Of Machine and Accessories:

1. For checking Linearity of Time base:

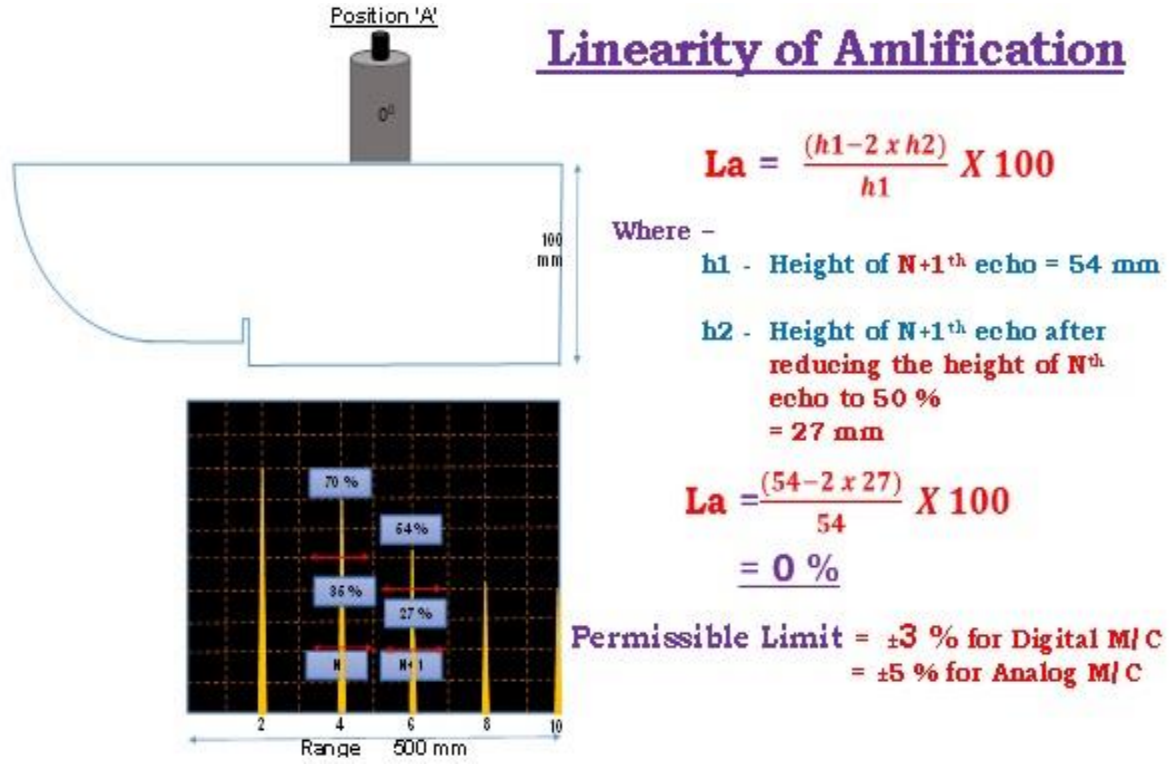
1. Connect the 0^0, 2 Mhz or 2.5 Mhz, Single Crystal Probe.
2. Set any Range between 100 mm to 500 mm. Here range taken is 500mm.
3. Set Probe Angle 0^0. Set Velocity of Longitudinal Wave – 5920 m/sec. Set Mode of Single Crystal probe – (T + R).
4. Apply Couplant and Place The Probe on IIW Block at Position 'A'. Nos. of peaks will appear from 100 mm. Set the First peak on 100 mm by adjusting the Probe Zero Key.
5. Put the GATE on each Peak and notice the Deviation of each peak. Note the Maximum Deviation of Peak and selected Range.
6. Calculate the Linearity of Time base (Lb) = (a_{max} X 100) / (0.8 X B). Where, "a_{max}" is the Maximum Deviation of the echo and "B" is the Range.
7. Permissible limit is ±1.25 % for Digital Machine & ±2 % for Analogue Machine.



2. For checking Linearity of Amplification

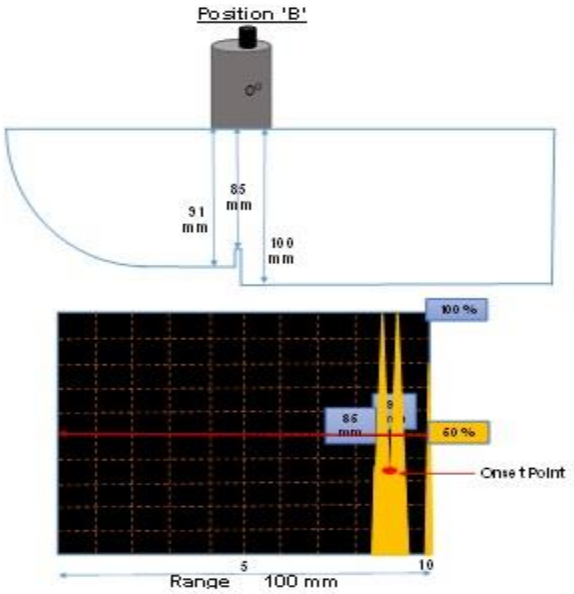
1. Connect the 0^0, 2 Mhz or 2.5 Mhz, Single Crystal Probe.
2. Set Range 100 mm to 500 mm.
3. Set Probe Angle 0^0. Set Velocity of Longitudinal Wave – 5920 m/sec. Set Mode of Single Crystal probe – (T + R).

4. Apply Couplant and Place The Probe on IIW Block at Position 'A'. Nos. of peaks will appear from 100 mm, 200 mm, 300 mm, 400 mm, 500 mm.
5. Notice the Height of N^{th} echo and $(N+1)^{th}$ echo that is h1 at a particular gain.
6. Reduce the Height by 50 % of N^{th} echo by minimizing gain. Notice the Height of $N+1)^{th}$ Echo at that Gain that is h2.
7. Calculate the Linearity of amplification (La) = (h1 -2*h2) X 100/ h1
8. Permissible limit is ±3 % for Digital Machine & ±5 % for Analogue Machine.



3. For checking Resolution Power:

1. Connect the 0^0, 2 Mhz or 2.5 Mhz, Single Crystal Probe.
2. Set Range 100 mm to 500 mm.
3. Set Probe Angle 0^0. Set Velocity of Longitudinal Wave – 5920 m/sec. Set Mode of Single Crystal probe – (T + R).
4. Apply Couplant and Place The Probe on IIW Block at Position 'B'. Peaks will appear From 85 mm, 91 mm & 100 mm.
5. Make the equal Height of 85 mm & 91 mm echo by adjusting the Probe. Now Make the 100 % Height of both the echoes by increasing the Gain.
6. Notice the Onset Point of Both the echoes (85 mm and 91 mm) is above or below the 5 Division.
7. If the onset point is below the 5 Divisions, the resolution power of Machine is O.K.

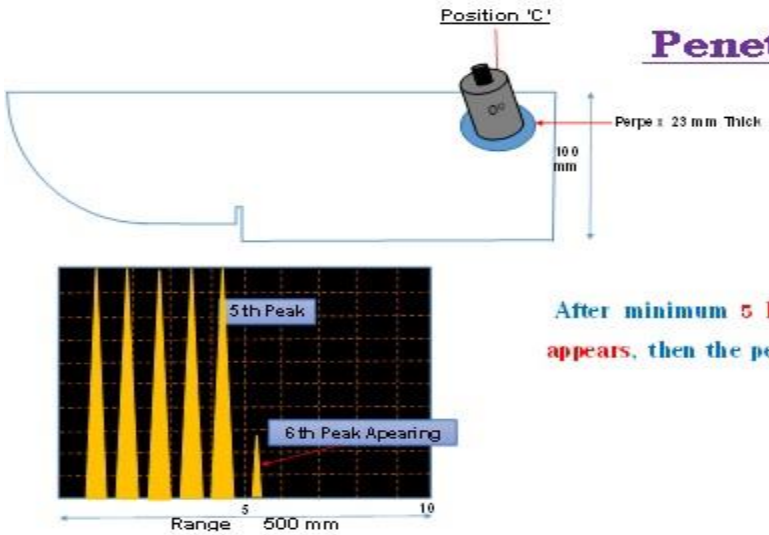


Resolution Power

After Increasing the Height of 85 mm & 91 mm echoes up to 100 %, The Onset point of both the echoes should be below 5 Division.

4. For checking Penetration Power

1. Connect the 00, 2 Mhz or 2.5 Mhz, Single Crystal Probe.
2. Set Range 500 mm. Rejection should be minimum.
3. Set Probe Angle 00. Set Velocity of Longitudinal Wave – 5920 m/sec. Set Mode of Single Crystal probe – (T + R).
4. Apply Couplant and Place The Probe on IIW Block at Position 'C'on Perpex of 23 mm Thick. The Peak will appear From base of Perpex.
5. Increase the gain until mimimum 5 full peaks appears on screen. Now Notice the Sixth peak is appearing or not.
6. If Five full and the Sixth peak is appearing the Penetration power of Machine is O.K.

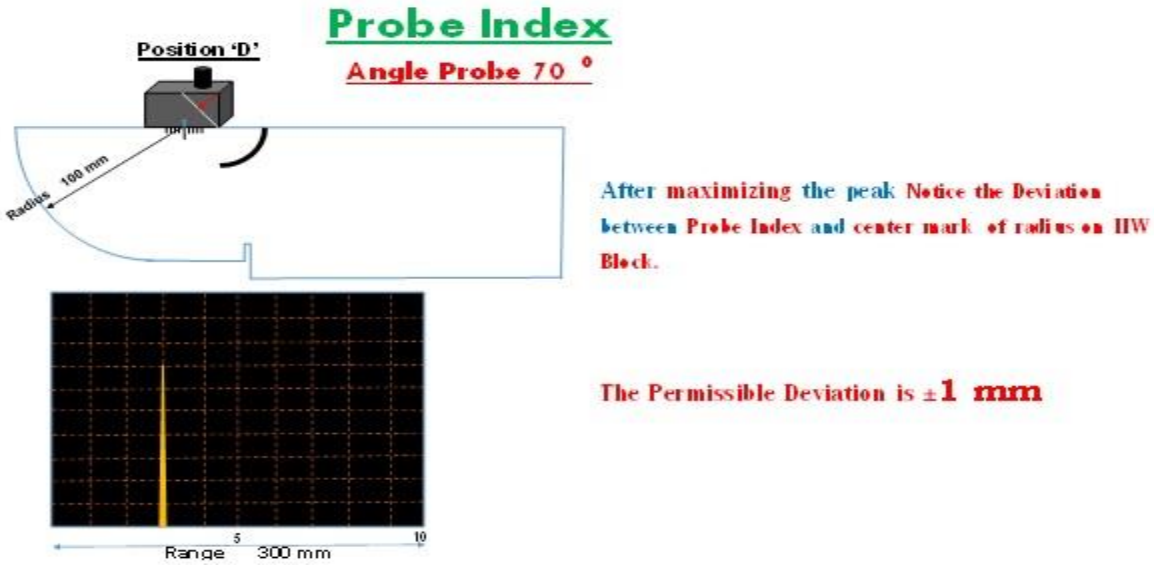


Penetration Power

After minimum 5 Full Peaks Appearing if the 6th Peak appears, then the penetration power of Machine is OK.

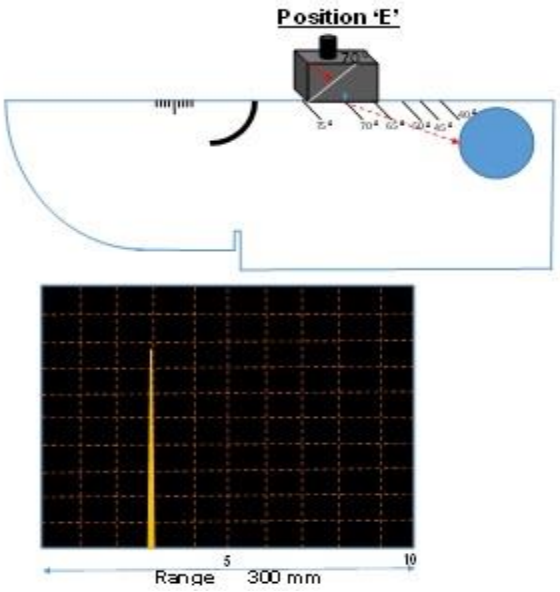
5. For checking Probe Index

1. Connect the 70^0, 2 Mhz, Single Crystal Probe.
2. Set Range 165 mm.
3. Set Probe Angle 70^0. Set Velocity of Longitudinal Wave – 3230 m/sec. Set Mode of Single Crystal probe – (T + R).
4. Apply Couplant and Place The Probe on IIW Block at Position 'D'.
5. The Peak will appear From 100 mm radius. Maximize the Peak by moving the probe forward and backwards. Now Notice the Deviation between probe index and center mark of radius on IIW Block.
6. The Permissible limit of Deviation is ±1 mm.



6. For checking Probe Angle

1. Connect the 70^0, 2 Mhz, Single Crystal Probe.
2. Set Range 165 mm.
3. Set Probe Angle 70^0. Set Velocity of Longitudinal Wave – 3230 m/sec. Set Mode of Single Crystal probe – (T + R).
4. Apply Couplant and Place The Probe on IIW Block at Position 'E'.
5. The Peak will appear From 50 mm Diameter Perpex. Maximize the Peak by moving the probe forward and backwards. Now Notice the Deviation between probe index and 70^0Angle mark of IIW Block.
6. The Permissible limit of Deviation is $\pm 1^0$.



Probe Angle

Angle Probe 70 °

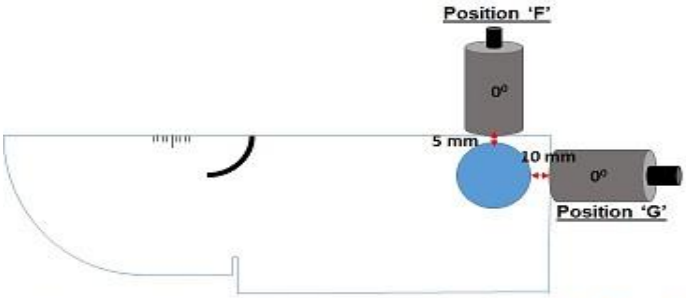
After maximizing the peak Notice the Deviation between Probe Index and 70° Angle mark on IIW Block.

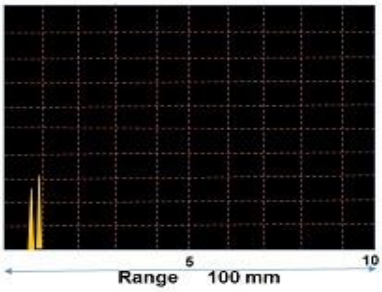
The Permissible Deviation is ±1 °

7. For checking Dead Zone

1. Connect the 0^0, 2 Mhz, Single Crystal Probe.
2. Set Range 100 mm.
3. Set Probe Angle 0^0. Set Velocity of Longitudinal Wave – 5920 m/sec. Set Mode of Single Crystal probe – (T + R).
4. Apply Couplant and Place The Probe on IIW Block at Position 'F'.
5. Notice The Peak is appearing or not from 5 mm side. It may not appear. Apply Couplant and Place The Probe on IIW Block at Position 'G'. Notice The Peak is appearing or not from 10 mm side. It Should appear.
6. It means that Dead zone is within 5mm to 10 mm. Now Place the Probe on Step Gauge to check the exact Dead zone.
7. Notice the exact Dead zone at which Step the peak appear.

DEAD ZONE



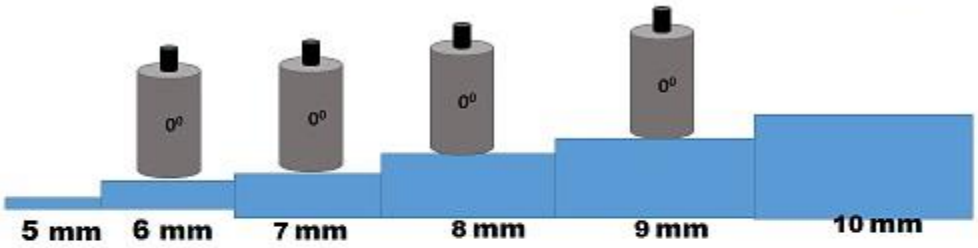


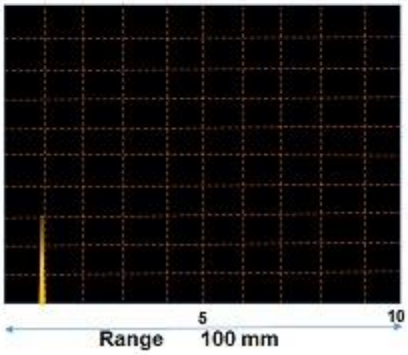
1) Notice The Peak Appearing or not from 5 mm side

2) Notice the Peak Appearing or not from 10 mm side

STEP GAUGE

3) Then Check the Exact Dead Zone at Step Gauge



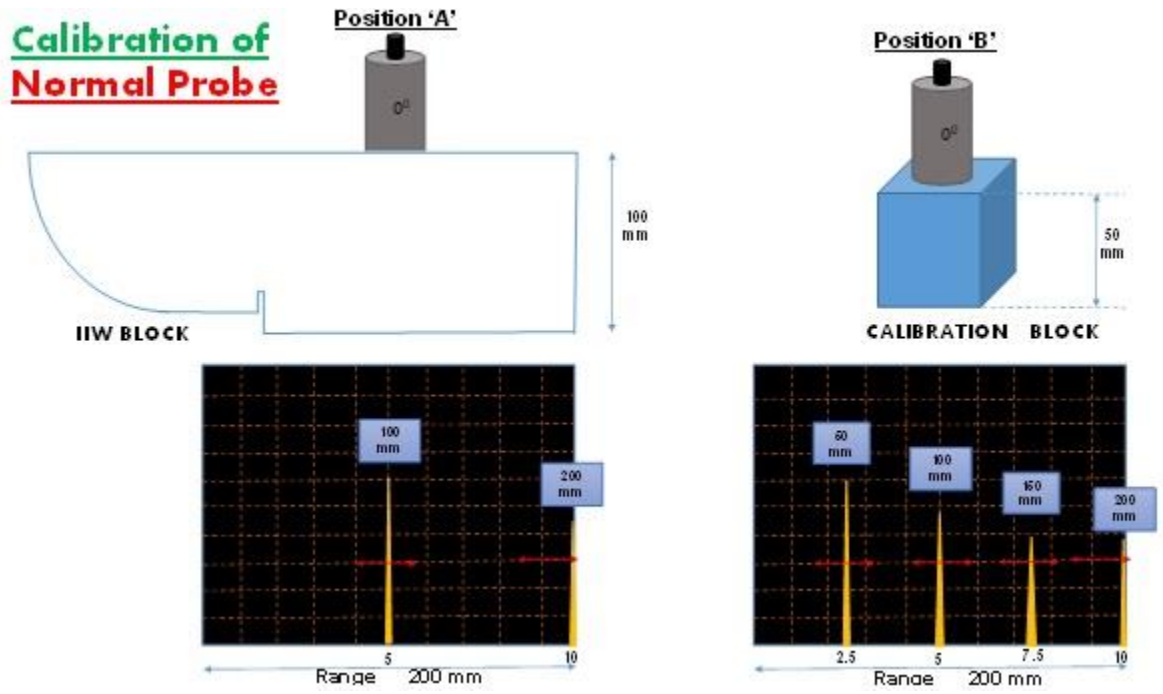


Dead Zone for
Single Crystal Probe – 3 to 4 mm.
Double Crystal Probe – 7 mm

6. Callibration Of Machine And Probe:

1. For Calibration of Normal Probe:

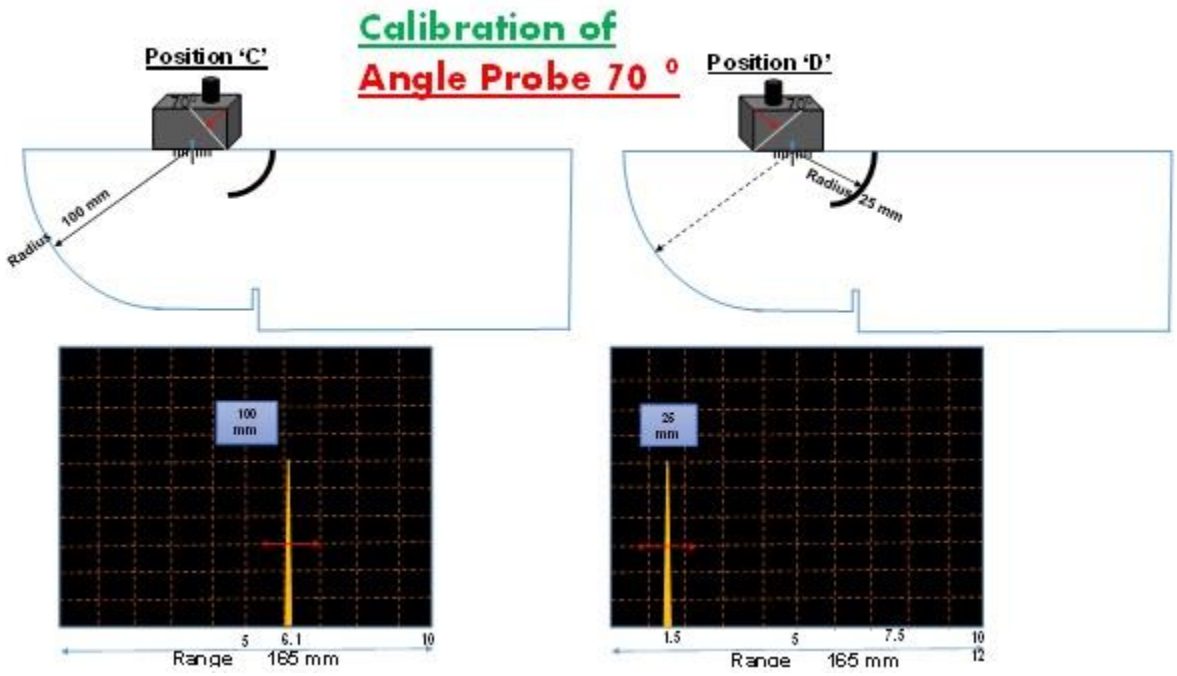
1. Connect the 0^0, 2 Mhz, Double Crystal Probe.
2. Set Range 200 mm.
3. Set Delay 0.0. Set Probe Zero 0.0. Set Probe Angle 0^0.
4. Set Velocity of Longitudinal Wave – 5920 m/sec. Set Mode of Double Crystal probe – (T - R).
5. Apply Couplant and Place The Probe on IIW Block at Position 'A'. Appears 2 peaks at 100 mm and 200 mm i.e. on 5 div. and 10 div.
6. Put the GATE on 1st Peak and notice the Depth (D) in Machine. If D is not 100 mm. Adjust the peak by Probe Zero Key and make it at 100 mm.
7. To Verify, Put the Probe on Calibration Block and Notice the Depth (D).



2. For Callibration of 70^0 Probe

1. Connect the 70^0, 2 Mhz, Single Crystal Probe.
2. Set Range 165 mm.
3. Set Delay 0.0. Set Probe Zero 0.0. Set Probe Angle 70^0.
4. Set Velocity of Transverse Wave – 3230 m/sec. Set Mode of Single Crystal probe – (T + R).

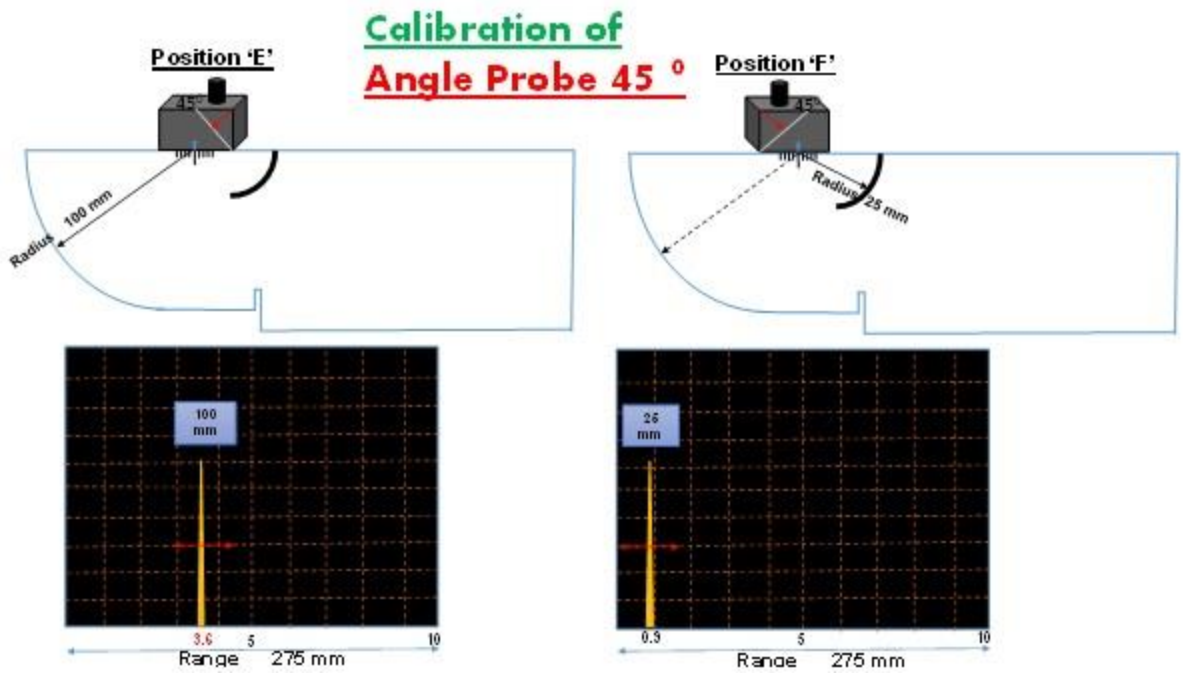
5. Apply Couplant and Place The Probe on IIW Block at Position ‘C’. Maximize the peaks From 100 mm Radius which is appears on 6.1 div.
6. Put the GATE on Peak and notice the Beam Path (B) in Machine. If (B) is not 100 mm. Adjust the peak by Probe Zero Key and make it 100 mm. To Verify, Put the Probe on IIW Block at Position ‘D’.
7. Notice the peaks From 25 mm Radius which is appears between 1 and 2 div. It should be 25 mm.



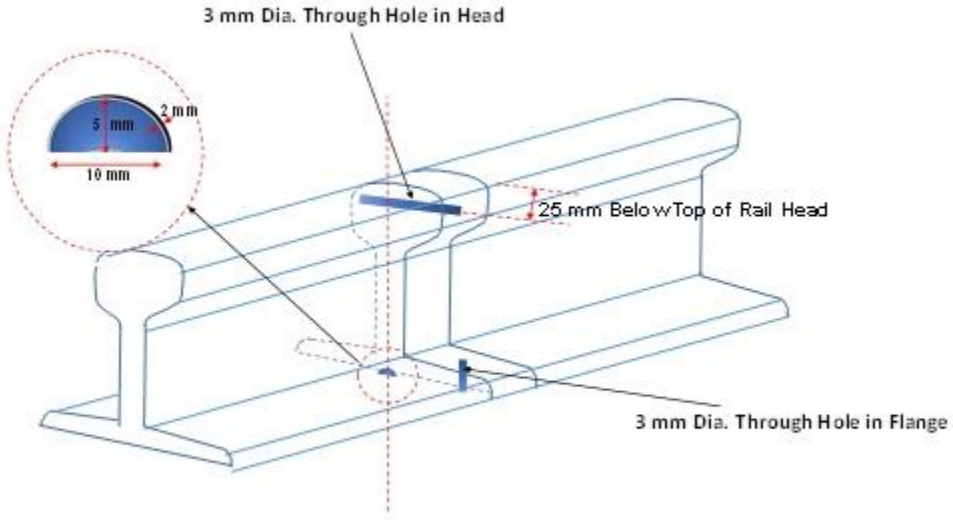
3. For Callibration of 45^0 Probe

1. Connect the 45^0, 2 Mhz, Single Crystal Probe.
2. Set Range 275 mm.
3. Set Delay 0.0. Set Probe Zero 0.0. Set Probe Angle 45^0.
4. Set Velocity of Transverse Wave – 3230 m/sec. Set Mode of Single Crystal probe – (T + R).
5. Apply Couplant and Place The Probe on IIW Block at Position ‘E’. MMaximize the peaks From 100 mm Radius which is appears on 3.6 div.
6. Put the GATE on Peak and notice the Beam Path (B) in Machine. If (B) is not 100 mm. Adjust the peak by Probe Zero Key and make it 100 mm. To Verify, Put the Probe on IIW Block at Position ‘F’.

7. Notice the peaks From 25 mm Radius which is appears between 0 and 1 div. It should be 25 mm.



7. Sensitivity Setting

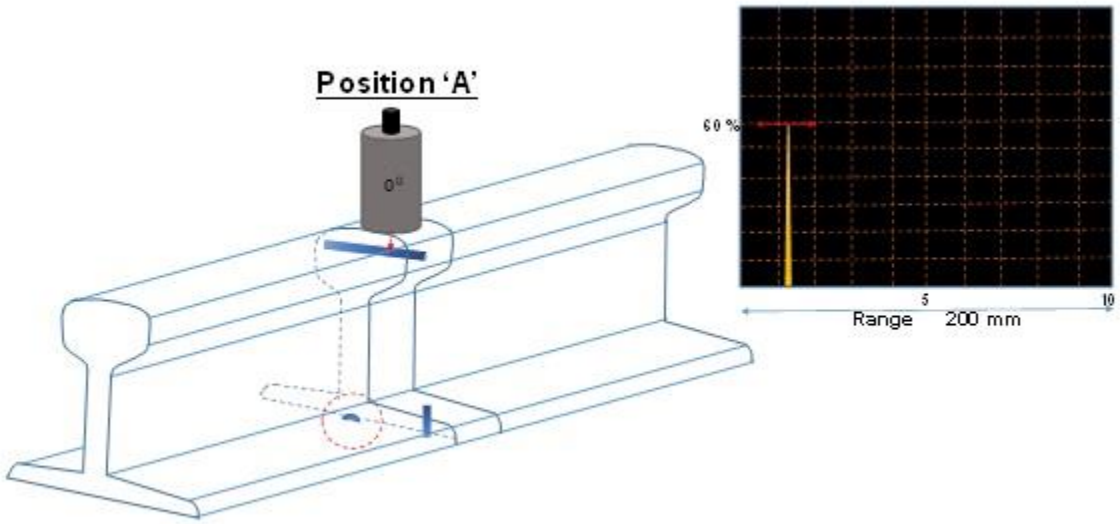


Standard Test Piece of Weld with Artificial Flaw

Fig. 7: Standard Test Piece of AT Weld

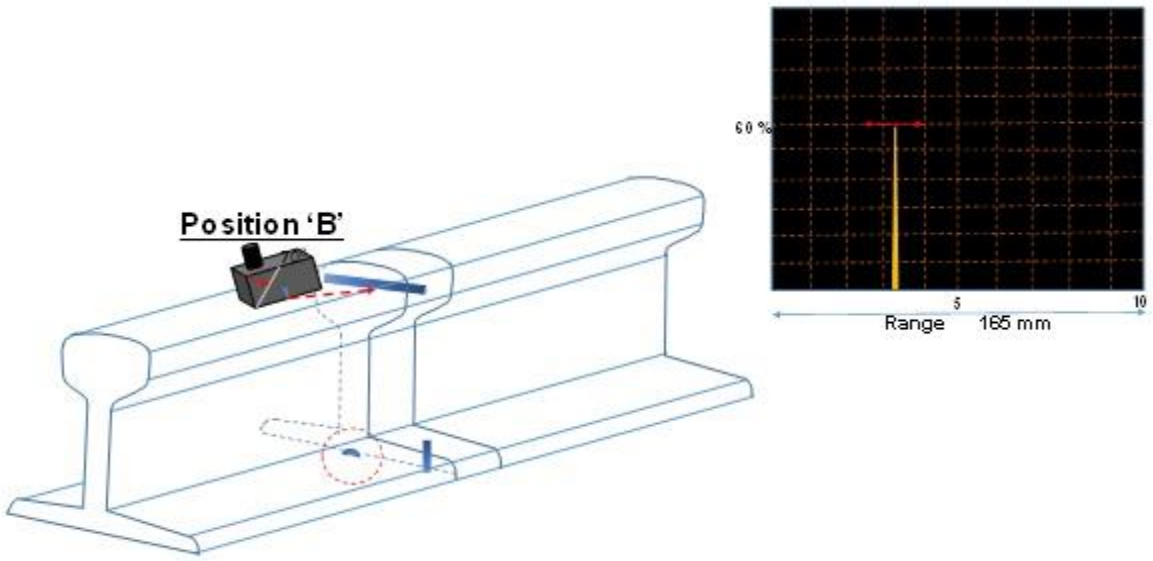
1. For Sensitivity Setting of Normal Probe

1. Connect the 0^0, 2 Mhz, Double Crystal Probe.
2. Set Range 200 mm.
3. Set Delay 0.0. Set Probe Zero 0.0. Set Probe Angle 0^0.
4. Set Velocity of Longitudinal Wave – 5920 m/sec. Set Mode of Double Crystal probe – (T - R).
5. Apply Couplant and Place The Probe on Standard Test Piece on Position 'A'.
6. Peak will appear from 3 mm Dia. Hole in Rail Head.
7. Make the Height of the Peak 60 % by adjusting the Gain.



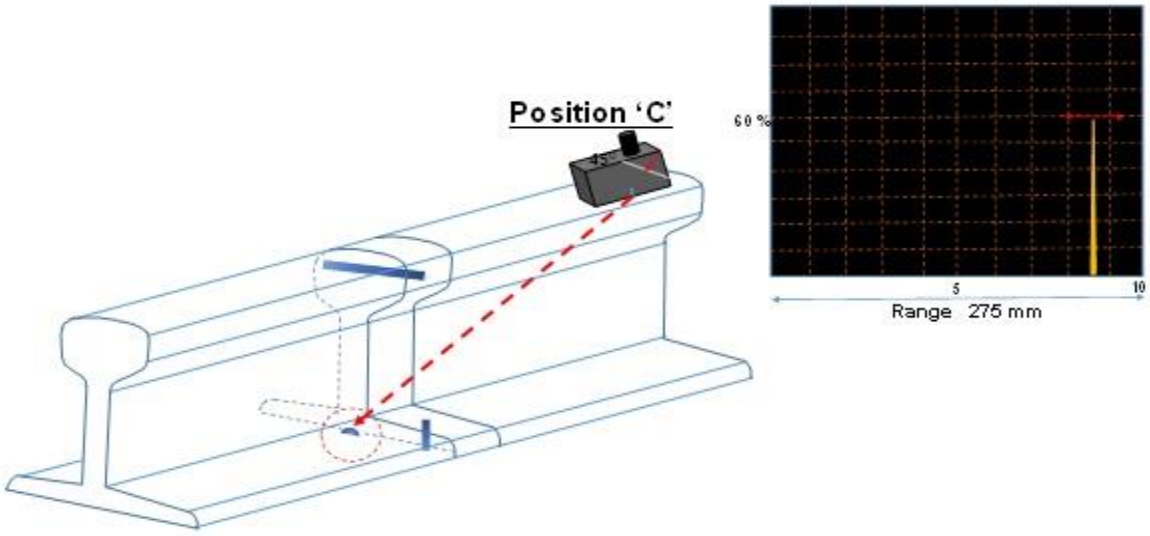
2. For Sensitivity Setting of 70^0 Probe

1. Connect the 70^0, 2 Mhz, Single Crystal Probe.
2. Set Range 165 mm.
3. Set Delay 0.0. Set Probe Zero 0.0. Set Probe Angle 70^0.
4. Set Velocity of Transverse Wave – 3230 m/sec. Set Mode of Single Crystal probe – (T + R).
5. Apply Couplant and Place The Probe on Standard Test Piece on Position 'B'.
6. Maximize the peak by moving the probe receiving from 3 mm Dia. Hole in Rail Head.
7. Make the Height of the Peak 60 % by adjusting the Gain.



3. For Sensitivity Setting of 45^0 Probe:

1. Connect the 45^0, 2 Mhz, Single Crystal Probe.
2. Set Range 275 mm.
3. Set Delay 0.0. Set Probe Zero 0.0. Set Probe Angle 45^0.
4. Set Velocity of Transverse Wave – 3230 m/sec. Set Mode of Single Crystal probe – (T + R).
5. Apply Couplant and Place The Probe on Standard Test Piece on Position 'C'.
6. Maximize the peak by moving the probe receiving from 5 mm X 10 mm Artificial Half moon Cut.
7. Make the Height of the Peak 60 % by adjusting the Gain.



8. Sensitivity Setting For Rail Testing:

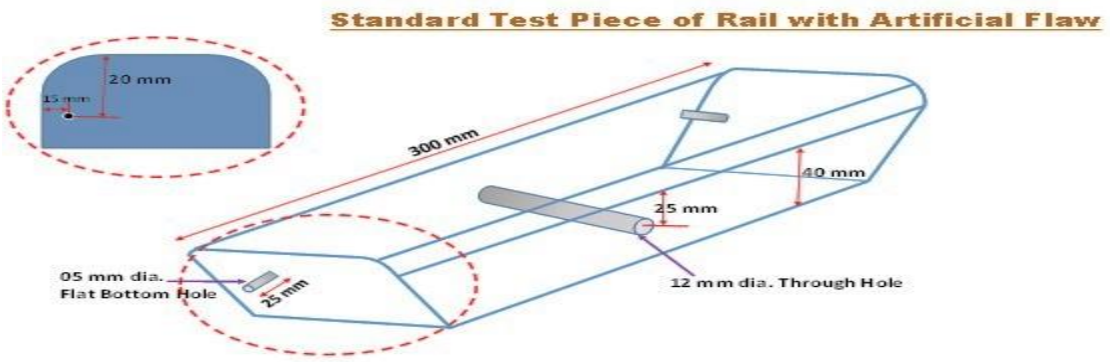


Fig. 8: Standard Rail Test Piece

1. For Sensitivity Setting of Normal Probe:

1. Switch on the Machine and run the Calibration mode.
2. Move the Machine on Rail and notice the Back echo from bottom of rail.
3. Make the Height of Back Echo to 100 % by increasing the Gain.
4. Save This Gain for Testing in Section.

2. For Sensitivity Setting of 70^0Probe Center:

1. Move the Machine on Standard test piece of rail directing towards the 12 mm dia. through hole.
2. A Moving peak will appear on screen.
3. Maximize this Moving peak and set the height to 60 % by adjusting the Gain.
4. Repeat this Procedure for Backward Probe.

3. For Sensitivity Setting of 70^0Probe Gauge Face and Non Gauge Face

1. Move the Machine on Standard test piece of rail directing towards the 05 mm dia. Flat Bottom hole.
2. Two Moving peaks will appear on screen 1st of Flat bottom hole and 2nd of inclined face.
3. Maximize this Moving peak of Flat Bottom hole and set the height to 60 % by adjusting the Gain.
4. Repeat this Procedure for Backward Probe.
5. Now Repeat the Same Procedure for Non Gauge Face Forward & Backward Probe.