
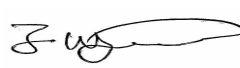





TECHNOLOGY MANAGEMENT TRACK TECHNOLOGY SPECIFICATION

PROCEDURE FOR THE ULTRASONIC TESTING OF FLASH BUTT WELDED JOINTS FOR QUALITY CONTROL PURPOSES.

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1.0 INTRODUCTION

- 1.1 This procedure covers the ultrasonic testing technique of flash butt welded rail joints by using pulse-echo, A-scan examination method, utilised to detect weld discontinuities using 70° and 45° refracted angle probes.

2.0 PURPOSE

- 2.1 The purpose of this document is to provide Ultrasonic testing personnel with guiding principle of how to test a flash butt welded rail joint by using the pulse echo system.

3.0 DEFINITIONS

- 3.1 **Probe:** A piezo-electric transducer responsible for generating sound, transmitting it to the specimen and receiving it.
- 3.2 **Specimen:** The test piece being tested
- 3.3 **Discontinuity:** An interruption or change in the physical structure or characteristics of a material.
- 3.4 **Flaw:** A material discontinuity whose size, shape, orientation, or location may make it detrimental to the useful service of the test object.
- 3.5 **Back wall echo:** A signal reflecting sound energy at the end of the screen, it signifies the bottom of the tested specimen.
- 3.6 **Couplant:** A substance (usually liquid) used between the transducer and the test surface to permit or improve transmission of ultrasonic energy into the test object.

4.0 PERSONNEL QUALIFICATION

- 4.1 It is highly essential that evaluation be performed by personnel who is qualified and certified in accordance with ASNT Documents SNT-TC-1A to a minimum level I for technician; supervised by a level II U.T, from an internationally recognised Non-destructive testing institution.
- 4.2 A certified level I may only evaluate for acceptance or rejection provided with written acceptance criteria or supervised by certified level II.

5.0 REQUIREMENTS OF THE ULTRASONIC TESTING PROCEDURE

5.1 Equipment and accessories

- 5.1.1 Pulse-echo type ultrasonic flaw detector.
- 5.1.2 One single crystal 70° (steel), shear wave, 2 MHz probe.
- 5.1.3 One single crystal 45° (steel), shear wave, 2 MHz probe
- 5.1.3 Battery and a battery charger.
- 5.1.4 Standard rail piece of 400mm length having standard simulated defects at standard locations.
- 5.1.5 Reference block 50mm x 30mm x 72mm of Class IV steel and International Institute of Welding calibration block; V1 or V2 block.
- 5.1.6 Steel measuring tape or ruler.

5.2 Pre-requisites

5.2.1 Battery Power:

Before undertaking testing, check the power of the battery to ensure that it is fully charged.

5.2.2 Functioning of the Machine:

Check the correct functioning of the ultrasonic flaw detector and all angular probes on the International Institute of Welding calibration block; V1 or V2 block.

5.2.3 Coupling condition/surface preparation:

The protruding upset metal around the welded joint shall be removed by any suitable mechanical means in such a way that the remaining protruded metal does not produce sharp corners and the finished surface of the protruded metal if any left should merge smoothly into the surfaces of the adjacent base metal. The scanning surfaces must be free from weld spatter, scale, and dirt, rust, and extreme roughness on each side of the weld for a distance equal to 200mm.

5.2.4 Couplant:

The couplant should wet the surface for the probes and the scanning surfaces it should also eliminate any air space between the two. Depending upon availability and feasibility of the testing, water, oil, or grease can be used as couplant. Couplant must be wiped off after testing.

5.2.5 Calibration

Calibrate the depth range of ultrasonic flaw detector with the help of a Reference block 50mm x 30mm x 72mm of Class IV steel, I.I.W V1 and V2 block.

6.0 CALIBRATION STEPS

- 6.1 Time base calibration shall be for the shortest range which accommodates the beam path length and the scanning limits of the probe and material to be scanned. This ensures that discontinuity reflections when maximised are visible on the time base at no more than $\pm 75\%$ of the calibrated sound path to allow for probe manipulation and echo envelope observation.
- 6.2 The scanning limits and the beam path length for each probe must be determined and plotted on the material tested for the correct testing standard (see Figure below).

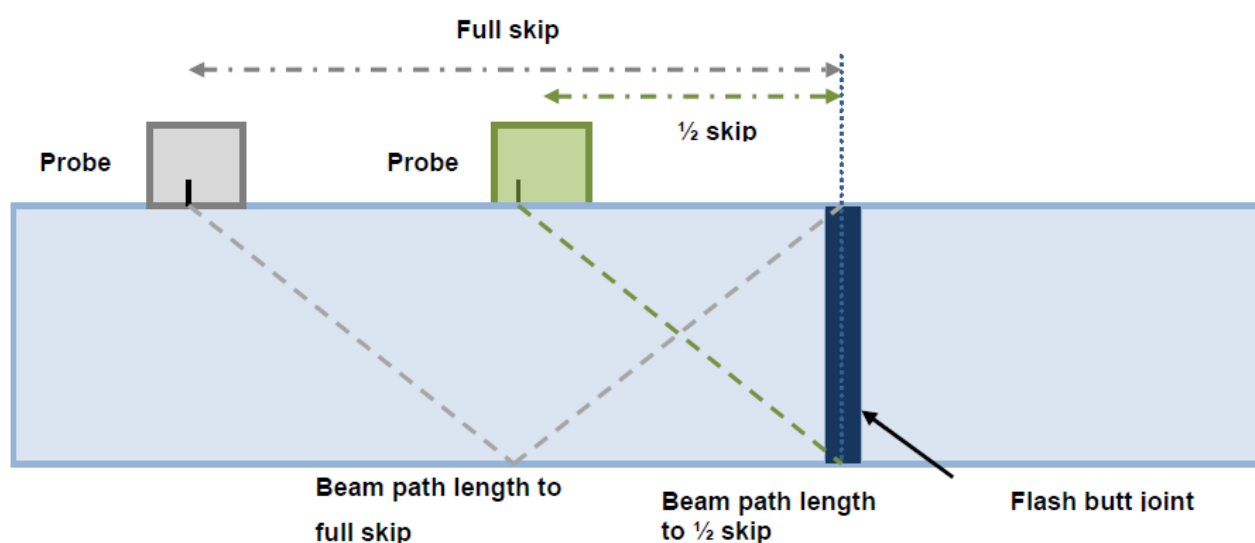


Figure 1: Schematic presentation of scanning limits and probe placement for testing

7.0 PROCEDURE

7.1 SCANNING PROCEDURE

- 7.1.1 Scanning using the 70° and 45° probes must be performed from the normal rail side not from the weld.
- 7.1.2 The 70° and 45° probes are to be used for scanning. The 70° probe is used to cover the crown and the flange of the rail while the 45° probe will cover the web and the crown.
- 7.1.3 Calibration of time base is to be done using the I.I.W V1 block for a suitable range. For a parent metal thickness up to 172 mm, a time base range of 300 mm, 200 mm and 100 mm are to be set for the web, crown, and flange respectively.
- 7.1.4 The probe index is to be marked on the probe using the I.I.W V1 block.
- 7.1.5 Calculate the ½ skip and ½ skip beam path length of selected probes.
- 7.1.6 Mark the scan lines at the ½ skip distance from the weld centre line on the side of the normal rail.
- 7.1.7 Test sensitivity may be set up by obtaining the calibrated echo from the calibration block, then raising the echo to 100% screen height and adding a minimum of 6dB gain for scanning.

7.2 TESTING PROCEDURE

- 7.2.1 When testing the flange, the 70° probe shall be placed on the flange at a suitable distance (full skip) corresponding to the toe of the flange such that ultrasonic waves are directed towards the weld. The probe shall thereafter be moved slowly in a zig-zag manner towards the weld. This should be carried out from both sides of the weld.
- 7.2.2 When testing the crown and the web using 70° and 45° single crystal probe, the probe shall be placed on the rail crown head at suitable distance (full skip) that ultrasonic waves are directed towards the weld. The probe shall thereafter be moved slowly in a zig-zag manner towards the weld. This should be carried out from both sides of the weld.

8.0 ACCEPTANCE CRITERIA.

- 8.1 Any defect detected in the weld using an Ultrasonic testing method is deemed an immediate reject.

9.0 RECORDING AND REPORTING.

- 9.1 The report must be written in plain English. Technical terms should be used in their correct sense and initials, or abbreviations should only be used after they have been used once in association with the full terms, for example, 3 mm diameter (3mm dia) flat bottom hole (f.b.h). Results that are shown in tabular form or as scale drawings are easier to follow than long written descriptions.
- 9.2 The report must be user friendly. The information given in the report must be such that by using the report it would be possible to reconstruct the exact condition of the test in case a repetition of the results is required. The report must also allow for locating the exact area of defective test parts in case repairs are to be undertaken.
- 9.3 The detail of the type of specimen, its thickness, geometry, shape, surface condition and the portion being ultrasonically tested should be recorded in the report. A unique identification number should be allocated to each test piece, and this should appear on the test specimen and in the report.
- 9.4 The form of the report must achieve the above-mentioned objectives and it must clearly and concisely contain the following:

9.4.1 IDENTIFICATION

- Date of the inspection.
- Time of inspection.
- Place of inspection.
- Customer for whom the work was done.
- Inspector who carried out the work.
- The examined component's serial number and a description of the component,

- including material type.
- Code, specification, or standards used.

9.4.2 EQUIPMENT

- Type of flaw detector.
- Probes, with size, frequency, and angle.
- Calibration and reference blocks used.
- Couplant.

9.4.3 CALIBRATION

- Sensitivity for all probes used.
- Time base/range for all probes used.

9.4.4 TECHNIQUE

- Scan modes (limits and coverage with each probe).
- Sizing method used.
- Recording and reporting level used.
- Limitations on inspection quality imposed by shape or situation of object, time or other factors.

9.4.5 RESULTS

- Indications found.
- Scale drawing showing location and size of defects.
- Relation between defects found and acceptance standards.

10.0 REFERENCES

- 10.1 Flash butt welding of new and second hand flat bottom rails, specification S170, (2012).
- 10.2 Track Welding manual, BBB8341, Version 5, (2011).
- 10.3 Government of India, Ministry of railways, manual for ultrasonic testing of rails and welds (2006).
- 10.4 Ultrasonic testing of material at Level 2 No:10 (1999)
- 10.5 ASNT Document SNT-TC-1A Qualification and Certification of NDE Personnel