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Method of the ultrasonic testing for rails

钢轨超声波探伤方法

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Method of the ultrasonic testing for rails

1 Scope

This Standard specifies the terms and definitions, flaw detection principles, flaw detection methods, personnel requirements, flaw detection requirements, test pieces and sample rails, probes, equipment and apparatuses, signal-to-noise ratio, stability, operation, result determination and marking of ultrasonic testing for rails.

This Standard is applicable to ultrasonic flaw detection of 37 cm/m ~ 75 kg/m railway symmetrical section rails and asymmetric section rails. Ultrasonic flaw detection of other rails can also be carried out with reference.

2 Normative references

The following documents are indispensable for the application of this document. For dated references, only the dated version applies to this document. For undated references, the latest edition (including all amendments) applies to this document.

GB 2585, Hot-rolled steel rails for railway

GB/T 9445, Non-destructive testing - Qualification and certification of NDT personnel

GB/T 11259, Practice for fabrication and control of steel reference blocks used in ultrasonic testing

GB/T 12604.1, Non-destructive testing. Terminology. Terms used in ultrasonic testing

GB/T 23905, Non-destructive testing. Blocks for ultrasonic testing

JB/T 10061, Commonly used specification for A-mode ultrasonic flaw detector using pulse echo technique

JB/T 10062, Testing methods for performance of probes used in ultrasonic flaw detection

3 Terms and definitions

Terms and definitions determined by GB/T 12604.1 and the following ones are applicable to this document.

3.1 Center of rail base

Any point on the longitudinal axis of the rail base surface of the rail.

3.2 Stability

The actual sensitivity change range during the rail flaw detection.

3.3 Stability indices

The limitation of stability during rail flaw detection.

3.4 Benchmark echo height

The reference height for determining the relative height of various echoes, generally in a percentage of the full scale. The range of the benchmark echo height: 50% to 80% of the full scale.

3.5 Modified value of sensitivity

The difference in sensitivity between the special comparative test piece and the static sample piece, the dynamic sample rail due to the material and surface condition.

3.6 Special comparative test piece

The test piece that is made, according to the method specified in GB/T 11259, by reference to the artificial defects that is required by the technical conditions of the rail.

3.7 Static sample piece

The test piece that is made, according to the specified artificial defects, of a rail of which the length is not less than 100 mm, the shape is same as the rail of flaw detection, the portion is same as the detection position, and there is no alarm-level defect.

3.8 Dynamic sample rail

The sample that is made, according to the specified equivalent artificial defect, of the same section rail with a length of not less than 6 m, no defect above the alarm level.

3.9 Reference sensitivity

The sensitivity value of the specified alarm gate that the artificial defect amplitude reaches on the dynamic sample rail.

4 Flaw detection principles

The mutual conversion between electrical energy and acoustic energy AND the physical properties of ultrasonic waves in elastic media are the basic principles of ultrasonic testing for rails. The directionally emitted ultrasonic beam is reflected and attenuated when it encounters a defect in the rail, and it is subjected to signal processing by the flaw detector to give a quantitative defect indication.

5 Flaw detection methods

5.1 Use the pulse reflection method to perform automatic inspection under the condition that the probe and the rail move relative to each other.

5.2 During the inspection, coupling medium with good sound permeability and no damage to the surface of the rail, such as water, shall be used.

6 Personnel requirements

6.1 The flaw detection operator shall hold the ultrasonic testing technical qualification certificate that is recognized, in accordance with the requirements of GB/T 9445, by the relevant departments.

6.2 The flaw detection report issuing personnel shall hold the ultrasonic testing technical qualification certificate of ultrasonic level-II or above that is recognized, in accordance with the requirements of GB/T 9445, by the relevant departments.

7 Flaw detection requirements

7.1 Rail flaw detection requirements shall comply with the provisions of GB 2585.

7.2 The undetectable length on the ends of the rail shall be less than the machining allowance and meet the requirements for full-length flaw detection of the product rail.

7.3 Dynamic sample rails shall be provided for ultrasonic testing of rails. The artificial defects and positions of the rail head, rail waist and rail base shall be as shown in 7.3.1 and 7.3.2 respectively. Other artificial defects can also be

9 Probe

9.1 Probe performance and test methods shall be in accordance with the provisions of JB/T 10062 and Appendix A.

9.2 The parameters of the probe and its arrangement shall meet the sensitivity and flaw detection area that are specified in 7.3.

10 Instruments and apparatuses

10.1 It uses the general analog ultrasonic flaw detector or digital ultrasonic flaw detector, of which, the technical requirements shall comply with the provisions of JB/T 10061.

10.2 It uses the multi-gate system; the initial position, width and alarm sensitivity of the alarm gate are adjustable. After 8 hours of continuous operation, the alarm gate drift is no more than the sound path of 1 mm carbon steel.

10.3 The frequency of the flaw detector shall meet the requirements for flaw detection.

10.4 The flaw detector repeat frequency F is calculated according to Formula (1):

$$F \geq \frac{v}{0.5B} \dots\dots\dots (1)$$

Where:

F -- repeat frequency, in per second (1/s);

v -- detection speed, in millimeters per second (mm/s);

B -- wafer width, in millimeters (mm).

11 Signal-to-noise ratio

The signal-to-noise ratio is not less than 12 dB.

12 Stability

Under the same flaw detection condition, the change in echo height shall not exceed 3 dB.

13 Operation

13.1 Echo height adjustment: the echo height shall be within the benchmark echo height range.

13.2 Reference sensitivity adjustment: adjust the artificial defect echo on the dynamic sample rail to the alarm state.

13.3 Stability adjustment: use dynamic rail to go back and forth for several times, so that the stability meets the requirements.

13.4 Flaw detection sensitivity adjustment: the flaw detection sensitivity shall be at least 4 dB higher than the reference sensitivity that is specified in 13.2.

13.5 Alarm gate adjustment: use the dynamic sample rail to adjust the gate range to meet the flaw detection area and continuous monitoring requirements. The noise within the gate range shall be lower than the threshold value of 12 dB.

13.6 Flaw detection: after the above ultrasonic test adjustments are completed, perform the flaw detection according to the flaw detection sensitivity.

14 Result determination and marking

14.1 Result determination: when the defect reflection wave exceeds the alarm gate of flaw detection sensitivity in 13.4, the sensitivity shall be improved by 2 dB for further ultrasonic detection. Use the improved sensitivity to perform the ultrasonic detection, and when the defect signal of the rail still exceeds the threshold value, the section of the rail shall be scrapped or the defective part shall be cut off.

14.2 Marking: rails that fail to pass the flaw detection must be marked.

14.3 Record

14.3.1 Rails that fail to pass the flaw detection must have a flaw detection record.

14.3.2 The modification of flaw detection sensitivity must be recorded.

14.4 Flaw detection report

14.4.1 Rails that pass the flaw detection must be issued with a report.

14.4.2 Main contents of the flaw detection report: date, steel number, flaw detection conditions, equipment, personnel, etc.

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