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Method for magnetic flux leakage testing of round steel

圆钢漏磁检测方法

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1 Scope

This Standard specifies terms and definitions, testing principle, testing method, comparative sample, testing equipment, testing conditions and steps, result determination and testing report for magnetic flux leakage testing of round steel.

This Standard is applicable to magnetic flux leakage testing on surface and near surface of round steel of which diameter is 10mm ~ 350mm (including steel wire). Other specifications shall refer to this Standard for implementation.

2 Normative references

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

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

GB/T 12604.5, *Non-destructive testing - Terminology - Terms used in magnetic particle testing*

YB/T 145, *Die Casting and Size Measurement Method of Artificial Defects on the Reference Sample Pipes*

YB/T 4289, *Measurement Method of Comprehensive Properties for Automatic Magnetic Flux Leakage Flaw Detection System for Steel Tubes*

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 12604.5 apply.

4 Testing principle

After ferromagnetic round steel is magnetized, the existence of discontinuity on

5.2 Magnetization mode

According to magnetization mode of round steel, testing method is divided into DC magnetization and AC magnetization.

a) DC magnetization

DC current excites electromagnet to generate a magnetic field. Use this magnetic field to magnetize tested round steel. DC magnetization efficiency is low. Magnetization intensity can be adjusted by controlling current size.

b) AC magnetization

AC current excites electromagnet to generate a magnetic field. Use this magnetic field to magnetize tested round steel. It is easy for AC magnetic field to generate skin effect and eddy current in tested round steel; and as current frequency increases, depth of magnetization decreases. Therefore, only defect on surface or near surface of tested round steel can be tested. AC magnetization efficiency is high. Magnetization intensity can be adjusted by controlling current size.

6 Comparative sample

6.1 Use

Comparative sample is used to test sensitivity of magnetic flux leakage testing equipment, to measure overall performance of testing equipment as well as to calibrate equipment during testing process. Size of artificial defect on comparative sample shall not be interpreted as the minimum size of defect that magnetic flux leakage testing equipment may detect.

6.2 Material

Nominal specification of comparative sample shall be same with that of tested round steel. Surface conditions and electromagnetic properties are same or similar. On comparative sample, there shall be no discontinuity that affects normal indication of artificial defect.

6.3 Length and straightness

Length and straightness of comparative sample shall meet requirements of testing method and testing equipment.

6.4 Artificial defect

6.4.1 Shape

Feed drive mechanism ensures that round steel concentrically passes through rotary scanning device, making polar boots of magnetization device and magnetic flux leakage sensor remain a constant clearance with round steel.

7.3 Magnetization device

Magnetization device applies magnetic field to round steel testing area that acts on magnetic flux leakage sensor, so as to make it near saturation. Magnetization device can be permanent magnet, direct current electromagnet or alternating current electromagnet. When permanent magnet is used, in order to achieve a suitable level of magnetization, there shall be means to adjust magnetic pole gap. Excitation current of direct current electromagnet or alternating current electromagnet shall be continuously adjustable; and there shall be current intensity display device.

7.4 Magnetic flux leakage sensor

Sensor is used to test defective magnetic field in round steel. Magnetic flux leakage sensor consists of one or more detection elements. It is used to test magnetic flux change. Detection element of magnetic flux leakage sensor can be induction coil, Hall element, magnetic sensitive diode, magnetic control switch or magnetic resistance. To ensure testing sensitivity and signal-to-noise ratio, the maximum axial width of each detection element in sensor is 30 mm. In magnetic flux leakage sensor, there shall be a sufficient number of detection elements (i.e. sensor length) to ensure that when scanning round steel surface at a required speed, it shall achieve 100% scanning.

Depth and orientation of surface defect affect amplitude of receiving signal. During testing, as spacing between magnetic flux leakage sensor and round steel increases, sensitivity shall be significantly reduced. Therefore, sensor shall be remained clean and stably contact with round steel surface. If there is gap, it shall ensure that sensor remains a constant distance from round steel surface.

7.5 Magnetic flux leakage testing instrument

Magnetic flux leakage testing instrument is used to amplify and process signals from sensor and implement an alarm. Each channel shall be able to respectively control respective sensitivity and threshold, so as to independently set threshold to determine as waste. Magnetic flux leakage testing instrument shall have marking function to record testing signal and control detected defect. Magnetic flux leakage testing instrument shall especially pay attention to prevent noise interference.

7.6 Mechanical transmission

Mechanical transmission makes tested round steel concentrically pass through

time, there shall be a repeated coverage that is no less than 10%.

8.2.2.3 Adjustment of testing sensitivity: in order to fully display artificial defect on comparative sample, adjust variable parameters such as magnetization current, gain and filtering.

8.2.3 Tested sensitivity

Before testing, based on the above adjustments, use selected testing speed to continuously run comparative sample. Ensure it passes at least 3 times. All artificial defects on comparative sample each time shall be able to alarm reliably. Use as tested sensitivity.

8.2.4 Testing

Perform testing after the above debugging is completed.

8.2.5 Equipment calibration

When equipment is continuously used, it shall at least calibrate once every 4h according to steps in 8.2.3. If requirements are met, it shall continue testing; otherwise conduct re-debugging according to 8.2.2~8.2.3. Re-test round steel that has been calibrated by the previous equipment.

8.2.6 End blind area testing

End blind area of round steel may use other testing methods to ensure its quality (excluding coil round steel wire).

9 Result determination

9.1 Quality level

Artificial defect size (groove depth, groove width, groove length) can, according to round steel product standard, select sizes in Table 1. Or agreed by the supplier and the purchaser in contract, quality level is carried out according to Table 1. Selection of quality level shall consider factors such as surface roughness, straightness and machining status of tested round steel.

9.2 Accepted product

For round steel that has been tested as above, if there is no super alarm threshold defect signal, it shall be determined that it has passed magnetic flux leakage testing.

9.3 Suspicious product

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