NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 6402-2024

Replacing GB/T 6402-2008

Methods for the ultrasonic testing of steel forgings

钢锻件超声检测方法

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1 Scope

GB/T 6402-2024 specifies the ultrasonic testing of steel forgings. A forging is the component you cannot inspect after it is installed and cannot afford to have fail: a turbine rotor, a crankshaft, a pressure vessel shell, a wind turbine main shaft. Ultrasonic testing is how the inside of it is examined, and the whole value of the examination depends on the procedure being fixed, because the same forging examined at a different frequency, with a different probe, a different couplant or a different sensitivity setting will show a different indication pattern. The standard sets the requirements on the personnel, the equipment and the reference blocks, the surface preparation and the couplant, the scanning coverage and directions for each forging geometry, the setting of the sensitivity and the

distance-amplitude correction, the detection and the sizing of indications by the equivalent flat-bottom hole and by the amplitude drop methods, the recording levels, the acceptance classes and the criteria for each, and the report. The 2024 edition replaces GB/T 6402-2008. For a forge, a purchaser or an inspection body in China, this is the acceptance text.

This document specifies the general requirements, testing equipment, comparison test block, testing implementation, classification, assessment, recording levels, acceptance standards and testing report of ultrasonic testing of steel forgings. This document is applicable to ultrasonic pulse reflection testing of ferritic, martensitic and ferritic-martensite steel forgings, austenitic and austenitic-ferritic stainless-steel forgings. It also applies to the ultrasonic testing of forged high-temperature alloys and alloy steel tortillas. Steel forgings with other structures may take this as a reference.

2 Normative References

The content of the following documents constitutes indispensable clauses of this document through normative references in the text. In terms of references with a specified date, only versions with a specified date are applicable to this document. In terms of references without a specified date, the latest version (including all the modifications) is applicable to this document.

GB/T 9445 Non-destructive Testing - Qualification and Certification of NDT Personnel

GB/T 12604.1 Non-destructive Testing - Terminology - Ultrasonic Testing

GB/T 20737 Non-destructive Testing - General Terms and Definitions

GB/T 23905 Non-destructive Testing - Blocks for Ultrasonic Testing

GB/T 27664.1 Non-destructive Testing - Characterization and Verification of Ultrasonic Test Equipment - Part

3 Terms and Definitions

The terms and definitions defined in GB/T 12604.1 and GB/T 20737 are applicable to this document.

4 Terms of Agreement

When ordering, the supply-side and the demand-side shall reach a consensus on one or more of the following items related to ultrasonic testing (if the demand-side does not specify, then, the testing method shall be chosen by the supply-side).

---timing of testing (see 5.3);

---whether it is necessary to submit written testing procedures approved by the demand-

side (see 5.4);

---whether near-surface testing is required (see 6.2.5);

---other testing requirements for Category 4 complexly shaped forgings or complex parts of forgings (see 8.2.3);

---sensitivity setting method (see 8.3);

---whether it is required to use angle probe for testing (see 8.3.3);

---the range to be tested, and whether to perform grid scanning or 100% scanning (see 8.6.1);

5 General Requirements

5.1 Personnel Qualifications Personnel engaged in ultrasonic testing in accordance with this document shall comply with the requirements of GB/T 9445 or other corresponding documents and obtain an ultrasonic testing qualification certificate.

5.2 Coupling Agent During sensitivity setting and review, scanning and discontinuity assessment, the same type of coupling agent shall be used. After the testing is completed, if the coupling agent on the surface of the workpiece under test has an adverse effect on the subsequent production, inspection or the integrity of the finished product, then, it shall be removed.

5.3 Timing of Testing Unless otherwise specified in the product standard, ultrasonic testing shall be performed after final heat treatment. Forgings that cannot be tested after the final heat treatment shall be tested at a certain suitable stage before that. For cylindrical and rectangular forgings that require drilling, ultrasonic testing should be performed before drilling.

5.4 Testing Procedures

5.4.1 Ultrasonic testing shall be performed in accordance with testing procedures. When it is specified by a product standard, the testing procedures shall be submitted to the demand-side for approval before testing.

5.4.2 The testing procedures shall be one of the following.

5.4.3 The testing procedures shall at least include the following content.

6 Testing Equipment

6.1 Ultrasonic Testing Instrument The ultrasonic testing instrument shall comply with the requirements of GB/T 27664.1.

6.2 Probes

6.2.1 Conventional straight probe and angle probe shall comply with the requirements of GB/T 27664.2.If further information is required, other probes may be used for supplementary testing, but the supplementary probes cannot be used for the initial discontinuity testing.

6.2.2 The nominal frequency of the probes is between 1 MHz ~ 10 MHz.

6.2.3 The nominal diameter of the transducer shall be between 10 mm ~ 40 mm.

6.2.4 The refraction angle of the angle probe shall be between 35 ~ 70. The effective area of the nominal transducer shall be between 20 mm2 ~ 625 mm2.

6.2.5 The near-surface testing may use double crystal probe.

6.2.6 The shape grinding method of the probe contact surface shall comply with GB/T 39242.

6.3 Combined Equipment Performance Inspection The performance of combined equipment (ultrasonic testing instrument and probe) shall be regularly inspected.

7 Comparison Test Block

7.1 The production and inspection of comparison test block shall comply with the requirements of GB/T 23905.

7.2 When adopting the Distance Amplitude Curve (DAC) technique for sensitivity setting and the amplitude of the reflector is referenced to determine the size of the discontinuity, comparison test block shall be provided. The surface condition of the comparison test block shall be the same or similar to that of the workpiece under test. Unless otherwise specified, the comparison test block shall be able to cover at least 3 artificial reflectors throughout the entire testing depth range.

7.3 The comparison test block can be made of one of the following materials.

7.4 The size of the artificial reflector of the comparison test block shall comply with the requirements of the corresponding quality grade.

8.1 Surface Condition

8.1.1 The scanned surface shall be free of defects, such as. scale, dirt, paint and pits that may affect coupling. If the above situation occurs, appropriate methods shall be used to remove or machine them, so as to satisfy the testing requirements.

8.1.2 When forgings are delivered in forged surface condition, if they can satisfy the specified quality grade inspection requirements, they can be directly tested. NOTE. when it is difficult to conduct comprehensive testing of the forging surface, the method of shot