

ICS 77.040.99

CCS H 24



**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

GB/T 1979-2025

Replacing GB/T 1979-2001, GB/T 7736-2008

**Evaluation of macrostructural defects in structural steels - Acid
etching method and ultrasonic testing method**

结构钢低倍组织缺陷评级图

Issued on: August 29, 2025

Implemented on: March 1, 2026

**Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC**

Table of Contents

1 Scope
2 Normative References
3 Terms and Definitions
3.1 Applicable to Mold Casting Materials
3.2 Applicable to Continuous Casting Materials
3.3 Applicable to Mold Casting Materials and Continuous Casting Materials
4 Evaluation Methods
4.1 General Rules
4.2 Acid Etching Method
4.2.2 Standard rating diagrams
4.3 Ultrasonic Testing Method...
5 Inspection Report...
5.1 Acid Etching Method...
Appendix B

1 Scope

GB/T 1979 is the Chinese standard for judging the macrostructural defects of structural steel: the porosity, segregation, cracks and inclusions that a billet carries out of the caster or the ingot mould and that no amount of downstream processing removes. It covers two routes. The acid etching method cuts a cross-section, etches it and rates what appears against a series of standard rating diagrams, separated into a mould-casting series, a continuous-casting series and typical defects. The ultrasonic method examines the material without cutting it, and applies where the section is uniform. The 2025 edition replaces both GB/T 1979-2001 and GB/T 7736-2008, bringing the two into one document. It applies to carbon structural steel, alloy structural steel and spring steel in forged and rolled billet form, and other steels may use it as a reference. In practice this is the text a steel supply contract points to when it sets an acceptance level for internal quality.

This document describes the evaluation of macrostructural defects in structural steels using acid etching and ultrasonic testing methods. It includes the principle, defect classification, characteristics, causes, and evaluation principles, the classification of rating diagrams and applicable scopes of the acid etching method, as well as the principle, instruments and equipment, reference blocks, testing conditions and procedures, and result evaluation of the ultrasonic testing method. This document applies to the evaluation of macrostructural

defects in carbon structural steel, alloy structural steel, and spring steel (forged and rolled billets). The evaluation of macrostructural defects in other steels may take this document as a reference.

2 Normative References

The contents of the following documents constitute indispensable clauses of this document through the 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 226 Test Method for Macrostructure and Defect of Steel by Etching

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

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

GB/T 27664.2 Non-destructive Testing - Characterization and Verification of Ultrasonic Test Equipment - Part

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 Applicable to Mold Casting Materials

3.1.1 general looseness During the solidification process of steel ingots, micro-voids and some precipitated low- melting-point components, gases, and non-metallic inclusions, which are generated during the solidification of molten steel, exist between the main and secondary axes of the dendritic crystals.

3.1.2 ingot segregation During the crystallization process of steel ingots, due to the influence of crystallization laws, caused by the compositional segregation and impurity aggregation at the boundary between the columnar crystal zone and the central equiaxed crystal zone.

3.1.3 risers segregation Caused by the carbon-containing insulating filler near the riser, which has a re-carburization effect on the metal.

3.2 Applicable to Continuous Casting Materials

3.2.1 frame segregation During the solidification of molten steel, due to factors such as the enrichment of solute elements at the solidification front, the non-uniformity of solidification rate, and the flow of molten steel, caused by structural segregation and impurity aggregation at the boundary between the columnar crystal zone and the central equiaxed

crystal zone.

3.2.2 white band During the solidification process of continuous casting billets, due to improper electromagnetic stirring, the temperature gradient at the solidification front of the molten steel reduces, and the molten steel enriched with solute at the solidification front flows out and forms a white frame band, which is a negative segregation band.

3.3 Applicable to Mold Casting Materials and Continuous Casting Materials

3.3.1 center porosity Caused by volume shrinkage during the solidification of molten steel, and by gas precipitation and impurity accumulation in the center of the ingots due to final solidification.

3.3.2 freckle type segregation Spot-like compositional segregation generated by the relatively slow cooling of molten steel during crystallization. NOTE 1. when spots are dispersed across the entire cross-section, it is called general freckle type segregation; when spots are present at the edges of the test pieces, it is called edge freckle type segregation. NOTE 2. when a large amount of gas and inclusions are present, freckle type segregation is

3.3.11 non-metallic inclusions Caused by improper smelting operations, incomplete melting of alloy materials, or foreign metals falling into the casting system.

4.1 General Rules

4.1.1 This document specifies two evaluation methods for macrostructural defects. acid etching method and ultrasonic testing method. The ultrasonic testing method is applicable to materials with a single cross-section and can determine the location and some types of defects, which is a supplement to the acid etching method. When there is disagreement regarding the use of the ultrasonic testing method to detect macrostructural defects, the results of the acid etching method shall be reported.

4.1.2 The permissibility and acceptance level of macrostructural defects in steels shall be specified in the product standard or technical agreement.

4.2 Acid Etching Method

4.2.1 Specimen cutting and display method The method for cutting and displaying the cross-section of a specimen shall be performed in accordance with the provisions of GB/T 226. The corrosion time of the specimen varies with the chemical composition, dimensions, and pre-heating treatment state of the steel. The corrosion of the specimen shall be deemed sufficient to clearly display the macrostructure. Over-corrosion will lead to misjudgment of the results. Other specimen display methods may also be used upon agreement between the supply-side and the demand-side.

4.2.2 Standard rating diagrams

4.2.2.1 Based on different smelting processes, defect nature, and dimension of steel (forged and rolled billets), the rating diagrams are classified into the mold casting series, continuous casting series, and typical defect series. The specific applicable scopes are shown in Table 1.

4.2.2.2 The macrostructural defects of round or square steels with a nominal diameter or side length less than 40 mm, except for general looseness, center porosity, and ingot segregation, which are evaluated in accordance with Rating Diagram 1, can be evaluated by referring to the corresponding rating diagrams in Table 1 at a reduced scale.

4.2.2.3 The macrostructural defects of round or square steels with a nominal diameter or side length greater than 250 mm can be evaluated by referring to the corresponding rating diagrams in Table 1 at a magnified scale.

Appendix B

(normative) Ultrasonic Testing Method B.1 Instruments and Equipment B.1.1 Ultrasonic testing instrument The performance indicators of the ultrasonic testing instrument shall meet the requirements of JJG 746. B.1.2 Probe The probe shall have a frequency of 2 MHz ~ 10 MHz, be capable of penetrating the steels under test and meeting the requirements of detection resolution. The probe chip diameter (side length) should preferably not exceed 28 mm. A probe with a relatively low frequency can be used when inspecting continuous casting billets. Probe parameters shall be tested in accordance with the method in GB/T 27664.2 and meet the requirements. B.1.3 Coupling agent A coupling agent with good coupling effect and harmless to the human body and steel surface should be selected. B.2 Personnel Personnel engaged in testing shall participate in training in accordance with GB/T 9445 or corresponding documents and obtain an ultrasonic testing qualification certificate. Those who issue test reports shall obtain a Level 2 or higher ultrasonic testing qualification certificate. B.3 Reference Blocks B.3.1 The acoustic performance of the reference blocks shall be the same as or similar to that of the steels under test. There shall be no echoes on the reference blocks that may affect the use. B.3.2 When using a dual-crystal probe, at least two artificial defects of the same size should be machined on the reference blocks; when using a straight probe for testing, at least one artificial defect located in the far-field region should be machined on the reference blocks to determine the static detection sensitivity. B.3.3 The location of the artificial defects on the reference blocks shall be able to cover the scanning range of the acoustic wave on the steel cross-section. B.3.4 For steels with a testing size greater than three times the near-field region of the probe, the static detection sensitivity can be determined using the workpiece bottom wave calculation method, and the diameter of the flat-bottom hole can be selected as ϕ