

ICS 77.040.99

CCS H24



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

GB/T 30834-2022

**Rating and classifying of inclusions in steel - Scanning electron
microscope method**

钢中非金属夹杂物的评定和统计 扫描电镜法

Issued on: October 12, 2022

Implemented on: February 1, 2023

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

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Foreword

This document was issued on 12 October 2022 by the State Administration for Market Regulation; Standardization Administration of the PRC and takes effect on 1 February 2023.

It is a GB/T standard: recommended rather than compulsory, but it is the text a Chinese reviewer applies when assessing a submission.

1 Scope

GB/T 30834-2022 covers the rating and classification of non-metallic inclusions in steel with a scanning electron microscope - the microscope and the accessories it needs, including image acquisition software and the spectrometer, the calibration and verification of that equipment, the sampling, the specimen preparation, the test steps, the classification, rating and statistics of what is found, the inspection report, and the precision and bias of the

result. Three methods sit alongside each other. Method 1 keeps the inclusion classes of GB/T 10561 and uses the characteristic spectrum to confirm and separate them; Method 2 shares its sampling; Method 3 is sampled by agreement between supplier and purchaser. Informative annexes give typical acquisition conditions, worked examples of results from Method 1 and Method 3, results on rare-earth-treated steel, and X-ray counting with chemical classification statistics. Under an optical microscope, two inclusions of the same shape and shade are the same inclusion. Under the electron microscope one may be an oxide and the other a sulphide, and only that difference points back to the process step - deoxidation practice, refractory wear, casting - that produced it. Since inclusions are where fatigue cracks begin, the chemistry is what turns a rating into something a steelmaker can act on. Written for steelworks metallurgists, materials laboratories and purchasers writing cleanliness requirements into a steel specification.

This document specifies the equipment for evaluating and classifying non-metallic inclusions in steel by scanning electron microscope (SEM), calibration and verification of equipment, sampling, specimen preparation, test procedures, inclusion classification, rating and statistics, test reports, precision and bias.

This document recommends three inspection methods. Method 1 mainly classifies inclusions according to their morphology. Method 2 mainly classifies inclusions according to their chemical composition. Method 1 and Method 2 are suitable for microscopic evaluation of non-metallic inclusions larger than 2µm in rolled or forged steel with a compression ratio greater than or equal to 3. Method 3 is used to determine the specific details of a certain type of inclusion such as volume fraction, number fraction and other stereological parameters. It is suitable for the statistical classification of inclusions of all sizes (including below 2µm) in various slabs or steel products.

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 10561, Steel - Determination of content of nonmetallic inclusions -

Micrographic method using standards diagrams

GB/T 13298, Inspection methods of microstructure for metals

GB/T 17359, Microbeam analysis - Quantitative analysis using energy dispersive spectrometry

GB/T 18876.1, Standard practice for determining the metallographic constituent and inclusion content of steels and other metals by automatic image analysis - Part 1: Determining the inclusion or second-phase constituent content of steels and other metals by automatic

GB/T 18876.2, Standard practice for determining the metallographic constituent and inclusion content of steels and other metals by automatic image analysis - Part 2: Determining the inclusion ratings of steels by automatic image analysis and stereology

GB/T 27788, Microbeam analysis - Scanning electron microscopy - Guidelines for calibrating image magnification

GB/T 30067, Standard terminology relating to metallography

3 Terms and definitions

For the purposes of this document, the terms and definitions defined in GB/T 30067 as well as the followings apply.

3.1 acquisition analysis rules

The conditions for terminating X-ray acquisition (count, time or both), the list of elements to be analyzed, the number of fields or particles to be analyzed, the shape of particles to be analyzed, and so on.

NOTE: Typical acquisition conditions for SEM (see Annex A).

3.2 post-acquisition analysis rules

The elemental composition that identifies the chemical classification of the inclusions.

NOTE: For Method 1 and Method 2, in addition to setting the elemental composition of the chemical classification of inclusions, it is also necessary to set the type of inclusion (class A, class

B or class C) to which each chemical classification belongs.

3.3 chemical classification

Set the category to which inclusions belong based on elemental composition.

NOTE: It can be broadly classified, such as sulfide, alumina, and silicates. It can also be finely

classified, such as calcium sulfide, calcium silicate, and anorthite.

3.4 aspect ratio; AR

The ratio of the longitudinal and transverse directions of the extension of the inclusions.

3.5 stringer

A single inclusion that is highly extended in the direction of deformation. Two or more type A or type C inclusions, three or more type B inclusions, and these two or more inclusions must be arranged in a row, parallel to the direction of the thermal processing axis. The center line of offset stringer inclusions is less than or equal to 15um. The distance between any two adjacent inclusions is less than or equal to 40um.

3.6 Feret's diameter

chemical classification should be indicated in the inspection report.

4.4 Method 1 and Method 2 provide a quantitative evaluation method for each type of inclusion and each width series of inclusion levels (level 0~5) in half-level increments.

4.5 Method 3 specifies procedures for analyzing and counting inclusions by size and chemical classification. Method 3 is used to determine and record some basic stereological parameters of inclusions, such as the area fraction of sulfides and oxides, the number of sulfides or oxides per square millimeter. Method 3 is not used for rating.

5 Equipment

5.1 The scanning electron microscope should be equipped with the following accessories:

- Image acquisition software: It can acquire images.
- Sample stage: Computer control, X-Y direction motor drive. Automatic sample stage is recommended. Manual operation is also possible. Pay attention to the continuity of the field of view when operating manually.
- Energy spectrometer: Its resolution should meet the requirements of GB/T 17359.