

ICS 77.140.99
CCS H 40



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

GB/T 14999-1994

Replacing GB/T 14999.1-2012, GB/T 14999.2-2012, GB/T 14999.3-2012

**Test method for superalloys - Part 1: Macro-structures
(English Translation)**

Issued on: August 29, 2025

Implemented on: March 1, 2026

Issued by: State Administration for Market Regulation

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Foreword

This document complies with the provisions of GB/T 1.1-2020 "Standardization Work Guidelines Part 1: Structure and Drafting Rules of Standardization Documents".

Drafting.

This document is Part 1 of GB/T 14999, "Test Methods for High-Temperature Alloys". GB/T 14999 has the following parts published.

---Part 1: Low-magnification tissue;

---Part 2: High-resolution structures.

This document replaces GB/T 14999.1-2012 "Test Methods for High Temperature Alloys - Part 1: Longitudinal Low Magnification Microstructure and Defects - Acid Immersion Inspection".

Test methods for high-temperature alloys, GB/T 14999.2-2012 "Test methods for high-temperature alloys - Part 2: Acid etching inspection of transverse low-magnification microstructure and defects" and GB/T 14999.3-2012 "High-Temperature Alloys - Test Methods - Part 3: Examination of Longitudinal Fracture Surfaces of Bars". This document is based on GB/T 14999.1-this document primarily follows the 2012 standard, integrating the content of GB/T 14999.2-2012 and GB/T 14999.3-2012. This document is consistent with GB/T 14999.1-2012.

In comparison, aside from structural adjustments and editorial changes, the main technical changes are as follows.

a) Six terms have been changed. foreign inclusions, looseness, bubbles, cracks, delamination, and dark spots. The terms foreign metal inclusions, looseness, bubbles, and overheating have also been changed.

The English equivalents for the seven terms stratification, carbide accumulation, point segregation, etc. (see Chapter 3, 2012 edition);

- b) The requirements for surface roughness of low-magnification test pieces have been added (see 4.1.5);
- c) Three recommended etchants, etching conditions, and methods have been added (see 4.2.1);
- d) Added requirements related to the assessment of transverse low-magnification microstructure and defects (see Appendix B);
- e) Added requirements related to longitudinal fracture assessment (see Appendix C).

Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents.

This document was proposed by the China Iron and Steel Association.

This document is under the jurisdiction of the National Steel Standardization Technical Committee (SAC/TC183).

Introduction

GB/T 14999, "Test Methods for High-Temperature Alloys," is a standard for the metallographic examination of high-temperature alloys, aiming to guide the testing of wrought and cast high-temperature alloys.

Inspection of low-magnification and high-magnification microstructures and defects in high-temperature alloys and powder metallurgy high-temperature alloys. GB/T 14999 is proposed to consist of three parts.

constitute.

---Part 1: Low-magnification tissue;

---Part 2: High-Magnification Structure;

---Part 3: Determination of casting grain size, primary dendrite spacing and microporosity.

This document provides low-magnification images of the microstructure and fracture surface of the following deformed high-temperature alloy materials.

---Macroscopic average grain size, coarse grain bands, fine grain bands, and primary carbide banding microstructure standard rating of melt-tested materials, forgings (rolled billets) or parts.

picture;

---Typical images of longitudinal microstructure and defects from ingots, melt-tested materials, forged (rolled) billets or parts, magnified at low magnification;

---Typical images of common defects and inhomogeneities in the transverse

low-magnification structure of ingots, melt-tested materials, forgings (rolled billets) or parts;
---Images showing the longitudinal fracture porosity and delamination rating of hot-rolled bars.

This document presents a recommended testing method, applicable only to two-dimensional planar (section) longitudinal and transverse low-magnification microstructures and three-dimensional longitudinal fracture surfaces.

Inspection cannot determine whether the low magnification or fracture structure and defects of the tested high-temperature alloy are acceptable or suitable for use.

Areas where low-magnification tissue examination is questionable can be examined with high-magnification tissue, analyzed, and then comprehensively evaluated.

High Temperature Alloy Inspection Methods Part 1: Low Magnification Structure

1 Scope

This document describes common defects and inhomogeneities in the longitudinal and transverse low-magnification microstructure of wrought superalloys, as well as porosity and fracture surface defects in the longitudinal fracture surface.

The types and characteristics of the layers, sample cutting and preparation, testing and evaluation, result presentation methods, test reports, etc.

This document applies to the inspection of longitudinal and transverse low-magnification microstructure and defects in wrought high-temperature alloy ingots, melt-tested materials, forged (rolled) billets, or finished products.

His products follow the same guidelines.

This document also applies to the inspection of fracture porosity and delamination in deformed hot-rolled high-temperature alloy bars with a nominal diameter of not less than 16 mm.

The fracture surface inspection of other types of bars shall be performed in accordance with the same procedure.

2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are not included.

For references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies.

This document.

GB/T 6394 Method for Determination of Average Grain Size of Metals GB/T 30067
Metallographic Terminology

3 Terms and Definitions

The terms and definitions defined in GB/T 30067 and the following terms and definitions apply to this document.

foreign slag inclusion Defects are caused by the mixing of alloy slag and foreign materials such as refractory materials during the smelting and casting process.

Defects caused by incomplete melting of alloy materials or mixing with foreign metals during the smelting and casting process.

Note: The color of the acid-etched specimen differs from the matrix tissue, and it has no fixed shape. Some specimens have a clear boundary with the matrix tissue, while others have an unclear boundary.

residual shrinkage

The defect is caused by insufficient cutting of the alloy ingot, resulting in some shrinkage cavities remaining on the billet.

Note: Irregular voids or cracks appear in the center of the transverse alloy low-magnification acid-etched specimens; constricted tubular structures appear on the longitudinal specimens; on the longitudinal fracture surface, corresponding to the residual...

Delamination occurs at the shrinkage cavity site. Severe porosity, inclusions (slag inclusions), and component segregation are often present on or near it.

loose porosity

The defect is due to insufficient feeding of the final solidified alloy liquid in the center of the alloy ingot, resulting in a non-dense microstructure.

Note: Dark black dots and fine pores appear in the center of the transverse specimen after low-magnification acid leaching of the alloy; the longitudinal fracture surface is layered and fibrous. At the filling end of the alloy ingot...

The loose texture may be accompanied by the accumulation of gas and inclusions.

Bubble bubbles

Pores are formed when gas cannot escape during the solidification process of an alloy.

Note: In the transverse low-magnification specimens of the alloy ingot, bubbles appear as round pores, while in the longitudinal low-magnification specimens, they appear as spindle-shaped pores, and sometimes as silkworm-shaped grooves of varying lengths.

Appearing at the bottom of electroslag ingots; appearing as clusters of irregular, short,