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

GB/T 14999.1-2025

Replacing GB/T 14999.1-2012

Test method for superalloys - Part 1: Macro-structures

高温合金检验方法 第1部分：低倍组织

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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.

1. Low-magnification tissue;

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). This document was drafted by: Fushun Special Steel Co., Ltd., Beijing Steel Research Institute Gaona Technology Co., Ltd., and Metallurgical Industry Information Standards Research Institute, Panzhihua Iron and Steel Group Jiangyou Great Wall Special Steel Co., Ltd., and Western Superconducting Materials Technology Co., Ltd. The main drafters of this document are: Gu Qiang, Yu Teng, Chen Huixia, Luan Yan, Wang Lin, Wang Hongxiao, Li Ke, Chen Qingxin, Yang Yujun, Yan Chengming, and Du Yujun. Zhu Hua. The document replaced by this document has been released in the following versions.

---GB/T 14999.1, first published in.1994, was incorporated into GB/T 14999.5-1994 "High Temperature" during its first revision in.2012. Chapter 1, "Longitudinal Low-Magnification Microstructure Rating Chart of High-Temperature Alloy Bars," in the book "Standard Rating Charts of Low-Magnification and High-Magnification Microstructures of Alloys," contains the content of this book. (GB/T 14999.5 was first published in.1994);

---GB/T 14999.2, first published in.1994, first revised in.2012;

1 Scope

GB/T 14999.1-2025 is the Chinese national standard on test method for superalloys - part 1: macro-structures, in the field of metallurgy. The /T suffix marks it as a recommended standard: it is not compulsory by itself, but it becomes binding as soon as a contract, a tender or a customer specification calls it up - which in practice is how most foreign buyers meet it. It was issued on 29 August 2025 by the State Administration for Market Regulation; Standardization Administration of China, and has been in force since 1 March 2026.

Classification: ICS 77.140.99, CCS H40. This page is published from the official record of the standard held by the Chinese standards administration: the identification, the dates, the classification and the issuing body are taken from there. The clause text, the tables and the numeric limits are in the document itself, which is delivered complete in English translation.

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.

3.1 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.

3.2 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.

3.3 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.

3.4 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.

3.5 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, "S"-shaped fine cracks on transverse low-magnification specimens of forged and rolled parts; observed at higher magnification, they are... Cracks without inclusions.

3.6 crack Striped metal separation is formed when metal breaks on or inside the surface of an alloy ingot, billet, or material due to various reasons.

Note. The following are some common types of cracks.

a) Due to improper control of the smelting and casting processes, the alloy ingot contains numerous inclusions and exhibits severe segregation. During hot working, these inclusions often become more prominent in these areas. Cracks may form. For example, a large number of chain-like inclusions and carbide segregation may accumulate at the crack site, usually accompanied by fine grain zones.

b) Cracks caused by low hot working temperatures, especially in processes such as punching, reaming, molding, rolling, and forging. For example, transgranular or intergranular cracks.