ICS 77.040.10
CCS H 22

NATIONAL STANDARD OF THE

PEOPLE'S REPUBLIC OF CHINA

GB/T 42903-2023

Metallic materials - Testing methods for creep crack and creep-fatigue crack growth rates

金属材料 蠕变裂纹及蠕变-疲劳裂纹扩展速率测定方法

Issued on: August 6, 2023 **Implemented on: December 1, 2023**

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

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Foreword

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1.Structure and Drafting Rules of Standardization Documents" Drafting. Please note that some content in this document may be subject to patents. The publisher of this document assumes no responsibility for identifying patents. This document is proposed by the China Iron and Steel Industry Association. This document is under the jurisdiction of the National Steel Standardization Technical Committee (SAC/TC183). This document was drafted by: East China University of Science and Technology, China Machinery Testing Equipment Co., Ltd., Gangyan Nake Testing Technology Co., Ltd., Tianjin University of Tianjin, China University of Petroleum (East China), Metallurgical Industry Information Standards Research Institute, Shenzhen Wantai Testing Equipment Co., Ltd., Xiamen Special Equipment Inspection and Testing Institute, Lishi (Shanghai) Scientific Instrument Co., Ltd., China United Heavy-Duty Gas Turbine Technology Co., Ltd., China Aviation Development Commercial Aviation Engine Co., Ltd., China General Nuclear Power Research Institute Co., Ltd., China Nuclear Power Research and Design Institute, Baoshan Iron and Steel Co., Ltd. The main drafters of this document. Zhang Xiancheng, Tan Jianping, Tu Shandong, Xuan Fuzhen, Gao Yifei, Dong Li, Ma Wei, Chen Gang, Jiang Wenchun, Huang Xing, Zou Zhijian, Wang Bin, Li Wei, Wang Ji, Lu Rongsheng, Wang Runzi, Hou Huining, Wang Zhengdong, Ma Shuangwei, Xu Huoli, Duan Fangmiao, Zhang Chengcheng, Chen Yalong, Zhu He, Du Juan, Zhao Yuchen, Zeng Fei, Liu Liqiang, Fang Jian, Tian Genqi, Li Yilei, Zhang Yucai, Hu Hongwei, Gao Yunxiao, Liu Lanzhou, Lin Qiang, Shi Kexian, Fu Xibin.

Equipment in the fields of electric power, refining, metallurgy, and aviation has shown a trend of increasing service temperature and extending service time, causing creep And creep-fatigue failure and prevention and control issues have become more prominent. Due to the limitations of the manufacturing process, many components already have cracks before use. cracks or other defects; at the same time, cracks are likely to initiate at the stress concentration locations of the component during service. It is these cracks and their creeping The expansion under deformation and creep-fatigue conditions causes failure of high-temperature components and even causes catastrophic accidents. To accurately evaluate structures with cracks To ensure the safety and reliability of parts, it is necessary to test the creep crack and creep-fatigue crack growth properties of materials. Determine the creep crack initiation time and creep cracking time of metallic materials and welded joints under constant temperature and static or quasi-static loads. Expansion rate, sample types are compact tensile specimen, C-type tensile specimen, single-sided notched tensile specimen, single-sided notched bending specimen, double-sided notched specimen Tensile specimen or center notch tensile specimen. The relationship between crack growth rate and fracture parameter K or C*(C*(t) or Ct) is obtained through data processing. Tie. For creep brittle materials, K or Ct is used to characterize the crack growth rate; for creep ductile materials, the fracture parameter C*(C*(t) is used or Ct) characterizes the crack growth rate. Under constant temperature and uniaxial cyclic loading, the creep-fatigue crack growth rate of metallic materials is measured. The test specimen is a compact tensile test. Sample. The relationship between the crack growth rate and the fracture parameter DeltaK or (Ct)avg is obtained through data processing. For creep brittle materials, the stress The strength factor range DeltaK represents the creep-fatigue crack growth rate da/dN; for creep ductile materials, the average value of the fracture parameters is used (Ct)avg represents the average crack growth rate (da/dt)avg during cyclic load maintenance. Creep cracks and creep-fatigue crack propagation of metallic materials Rate determination method

1 Scope

China's national test methods for creep crack growth and creep-fatigue crack growth rates. The measurements underlie the assessment of high temperature plant that contains known defects, which is most plant that has been in service for decades. A component operating in the creep range with a crack in it does not fail immediately: the crack grows at a rate determined by the material, the temperature and the crack-tip loading, and the whole question for an operator is how long remains before it reaches a critical size. Measuring that rate requires a specimen held at temperature under load for thousands of hours with the crack length monitored continuously, and the creep-fatigue variant adds cycling on top. The parameter that correlates the growth is not the stress intensity factor of ordinary fracture mechanics but a time-dependent equivalent, which is one reason the method needs standardising - the analysis is as much a part of it as the experiment.

This document specifies the symbols and descriptions, test principles, and tests related to creep crack and creep-fatigue crack growth rate tests on metallic materials. Sample design, test procedures, test results processing and test reports. This document is applicable to the determination of creep cracks in metallic homogeneous materials and metallic welded joints under static or quasi-static loading at constant temperature. Crack initiation time and creep crack growth rate; Determination of creep-fatigue cracks in metallic homogeneous materials under uniaxial cyclic loading at constant temperature Expansion rate.

2 Normative reference documents

The contents of the following documents constitute essential provisions of this document through normative references in the text. Among them, the dated quotations For undated referenced documents, only the version corresponding to that date applies to this document; for undated referenced documents, the latest version (including all amendments) applies to this document.

GB/T 8170 Numerical rounding rules and representation and determination of limit values

GB/T 12160 Calibration of extensometer systems for uniaxial testing of metallic materials

GB/T 16825.1 Inspection and calibration of static uniaxial testing machines for metallic materials Part

1.Tensile and/or compression testing machines Inspection and calibration of force measuring systems

GB/T 16825.2 Inspection of static uniaxial testing machines Part

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 Creep crack growth rate creepcrackgrowthrate The change in crack length per unit time under constant temperature and load.

3.2 da/dN Crack length variation within a single cycle under constant temperature and cyclic loading with holding load.