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

GB/T 46169-2025

**Metallic materials - Steel - Method of test for the determination
of brittle crack arrest toughness, Kca**

金属材料 钢 脆性裂纹止裂韧度Kca测定的试验方法

(English Translation)

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Table of Contents

Preface
Introduction
1 Scope
2 Normative References
3 Terms and Definitions
4 Symbols and Explanations
5 Principle
6 Test equipment
7 Sample
8 Test Methods
9 Experimental Procedure
10 Determination of crack arrest toughness
11 Test Report
Appendix A (Informative) Compound Crack Arrest Test
Appendix B (Informative) Equipment and methods for controlling and monitoring sample temperature
Appendix C (Normative) Calculation of Stress Intensity Factor for Non-linear Cracks
Appendix D (Informative) Dynamic Measurement Methods
Appendix E (Normative) Methods for obtaining K _{ca} at a specific temperature
References

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 modified to adopt ISO.20064.2019 "Metallic materials - Test method for determination of brittle crack arrest toughness K_{ca} of steel".

Compared with ISO.20064.2019, this document has undergone the following structural adjustments.

---Chapter 5.3 corresponds to D.1 of Annex D in ISO.20064.2019;

---Chapter 6 corresponds to Chapter 5 of ISO.20064.2019, where 6.4 corresponds to D.4 of

Annex D of ISO.20064.2019;

- Chapter 7 corresponds to Chapter 6 in ISO.20064.2019;
- Chapter 8 corresponds to Chapter 7 in ISO.20064.2019;
- Chapter 9 corresponds to Chapter 8 in ISO.20064.2019;
- Chapter 10 corresponds to Chapter 9 in ISO.20064.2019;
- Chapter 11 corresponds to Chapter 10 in ISO.20064.2019;
- Appendix A corresponds to Appendix E in ISO.20064.2019;
- Appendix D corresponds to Appendix F in ISO.20064.2019.

The technical differences between this document and ISO.20064.2019, and the reasons therefor, are as follows.

---The scope of application has been changed, extending the applicable tensile strength of steel plates from no more than 950 MPa to no more than 1150 MPa, in accordance with my country's national standards.

This is consistent with the requirements in the current standards;

---ISO 7500-1 (see 6.2.2) has been replaced with the normatively referenced GB/T 16825.1 to adapt to my country's technical conditions and increase compliance.

Operability;

---Added explanations of test principles, including the ESSO test principle and the double tensile test principle (see Chapter 5), to adapt to my country's technical requirements.

Improve technical conditions and increase operability;

---Added description of the secondary tensioning device, including installation method, loading system and loading method (see 6.4), to adapt to my country's technical conditions.

Add components and increase operability;

---Added instructions on the double tensile test crack initiation method (see 8.2.2) to adapt to my country's technical conditions and increase operability;

---The section on controlling the temperature field after loading the specimen in part 8.1.4 of ISO.20064.2019 has been deleted to adapt to Chinese technology.

Conditions, increase operability;

---Formula (4) and related requirements in section 8.1.4 of ISO.20064.2019 have been deleted to adapt to my country's technical conditions and increase operability.

Actual nature;

---Added instructions for the secondary stretching procedure (see 9.3) to adapt to my country's technical conditions and increase operability.

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

This document provides a test method for determining the crack arrest toughness of steel. Reference [6] introduces test methods for crack propagation and arrest.

The method, of which GB/T 19744[3] provides a test method for evaluating the lower limit of crack arrest toughness K_{IA} under plane strain conditions.

In addition, a wide plate crack arrest test method was developed in the 1950s[7], which has been used to evaluate the crack arrest energy of cryogenic vessels[7] and pressure vessels[8][9][10].

Force. In recent years, these methods have been widely used to evaluate the crack arrest toughness of marine steel[11].

The crack arrest test for wide plates aims to evaluate the crack arrest toughness K_{ca} of steel plates at actual service thicknesses, rather than the lower limit of the crack arrest toughness K_{Ia} . Existing...

The results of the studies [8][10] show that the lower limit of K_{ca} is consistent with that of K_{Ia} . Furthermore, wide-plate crack arrest tests can be used to evaluate [the results] in a higher temperature range.

K_{ca} , but K_{Ia} cannot be evaluated. References [12] and [13] introduce the theoretical background of crack arrest toughness testing under temperature gradient conditions.

This document provides a test method for determining the brittle crack arrest toughness of steel using a temperature gradient wide plate tensile test. The test method covers the specimen width...

After setting a temperature gradient in the direction and applying uniform tensile stress to the specimen, the specimen is then subjected to impact at the edge notch or through a slow-speed tensile plate.

The brittle cracks initiate at the edge of the specimen, propagate along the width direction, and then arrest.

Appendix A describes the specimens and methods for the compound crack arrest test.

Appendix B provides typical apparatus and recommended methods for establishing a temperature gradient on a sample.

The method in Annex C can be used to determine the stress intensity factor of nonlinear cracks.

Appendix D describes methods for determining the dynamic characteristics of crack propagation and measuring the dynamic strain of specimens.

Appendix E provides a method for obtaining the K_{Ic} value at a specific temperature, such as the structural design temperature.

Brittle crack arrest toughness of steel in metallic materials (K_{Ic}) Test methods for determination

1 Scope

This document specifies the test principle, test equipment, test specimens, test methods, and test procedures for determining the brittle crack arrest toughness K_{Ic} of metallic materials.

Preface, calculation and test report of crack arrest toughness.

This document applies to materials with a tensile strength not exceeding 1150 MPa, a crack arrest temperature range of -196°C to 100°C, and exhibiting ductile-brittle transition characteristics.

Ferritic rolled flat steel plates with a thickness not exceeding 200mm are suitable, but not for steel plates formed by flattening pipes, as flattening can cause cracking.

The toughness changes.

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 16825.1 Inspection and calibration of static uniaxial testing machines for metallic materials - Part 1: Tensile and/or compressive testing machines Inspection and calibration of force measurement systems (GB/T 16825.1-2022, ISO 7500-1:2018, IDT)