ICS 77.040.10
CCS H 22

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 24522-2020

Metallic materials--Method of test for the determination of resistance to stable crack extension using specimens of low constraint

Issued on: June 2, 2020 **Implemented on: December 1, 2020**

Issued by: State Administration for Market Regulation, China National Standardization Administration

Table of Contents

Foreword

This standard was drafted in accordance with the rules given in GB/T 1.1-2009.

This standard replaces GB/T 24522-2009 "Test method for the determination of stable crack propagation resistance of low-constrained metal materials", and

Compared with GB/T 24522-2009, except for editorial changes, the main technical changes are as follows.

--- Modified normative references and replaced our standards with international standards (see Chapter 2, Chapter 2 of the.2009 edition);

--- Increased the maximum notch width requirement of the specimen (see 5.2.2.3, 5.2.2.3 in.2009 edition);

--- Modify the limit conditions of the maximum prefabricated fatigue load in the compact tensile specimen (see 5.2.2.4.3, 5.2.2.4.3 of the.2009 edition);

--- Modify the limit conditions of the maximum prefabricated fatigue load in the central crack tensile specimen (see 5.2.2.4.4, 5.2.2.4.4 of the.2009 edition);

--- Corrected the error in equation (3), changed a to a0 (see 5.2.2.4.4, 5.2.2.4.4 of the.2009 edition);

--- Modify the compact tensile specimen a0/W ratio range from 0.45~0.65 to 0.40~0.70 (see 5.6.1.3a),.2009 edition

5.6.1.3a)];

--- Modified the length requirements for prefabricated fatigue cracks [see 5.6.1.3d),.2009 version 5.6.1.3d)];

--- Increased the minimum crack propagation deltaamin, and increased formula (12) (see 6.4.2, 6.4.3,.2009 version 6.4);

--- Modified the data checklist [see 7.3.5d), 7.3.5e),.2009 version 7.3.5d), 7.3.5e)].

This standard uses the translation method to be equivalent to the ISO 22889.2013 "Test for the determination of steady-state crack propagation resistance of low-restrained metallic materials

Test Method".

The Chinese documents that have a consistent correspondence with the international documents normatively cited in this standard are as follows.

---GB/T 12160-2019 Calibration of extensometer system for uniaxial test of metal materials (ISO 9513.2012, IDT)

---GB/T 16825.1-2008 Inspection of static uniaxial testing machine Part 1.Tension and/or compression testing machine force measuring system

Inspection and calibration (ISO 7500-1.2004, IDT)

---GB/T 20832-2007 Marking of metal material sample axis relative to product texture (ISO 3785.2006, IDT)

---GB/T 21143-2014 Unified test method for quasi-static fracture toughness of metal materials (ISO 12135.2002, MOD)

This standard has made the following editorial changes.

--- The order of the sub-pictures in Figure 4 has been rearranged.

This standard was proposed by China Iron and Steel Association.

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

This standard was drafted by. Wuhan Iron and Steel Co., Ltd., Dongguan Institute of Advanced Materials Science and Technology, East China University of Science and Technology, Force Test (Shanghai) Division

Instrument Co., Ltd., Shenzhen Wanchao Test Equipment Co., Ltd., Metallurgical Industry Information Standards Institute, CNNC Wuhan Nuclear Power Operation Technology Co., Ltd.

Co., Ltd., Inner Mongolia Baotou Steel Union Co., Ltd., China University of Petroleum (Beijing).

Introduction

ISO 12135.2002 uses compact tensile specimens and bending specimens to determine the specific fracture toughness of the starting point of steady-state or unstable crack growth,

And the resistance to steady-state crack propagation. Because these specimen types have nearly square residual ligaments, the crack tip is maintained in a highly constrained state.

If the size requirements are met, the KIC, delta0.2BL, and J0.2BL thus determined are not sensitive to size and are considered to be the lower limit of fracture toughness. Although not

In particular, the crack propagation resistance curve (R-curve) is also insensitive to size.

In the course of engineering practice, some situations are not covered by ISO 12135.2002, for example.

---The thickness of the sample is much lower than the thickness of the sample using ISO 12135.2002 to determine the dimensional insensitive fracture performance;

---The thickness of the available materials cannot guarantee that the processed samples meet the criterion of dimensional insensitivity;

---The stress state of the structural member is stretching rather than bending.

In these cases, the restrained state of the structural parts is lower than that specified in ISO 12135.2002, so based on ISO 12135.2002

The test results will lead to too low prediction of the crack propagation resistance and bearing capacity of the structural parts.

Determination of steady-state cracks in low-constrained metal samples

Test method for extended resistance

1 Scope

This standard specifies the low-constrained, easy-to-plastic-deform homogeneous metal materials with cracks when subjected to quasi-static loading, steady-state crack propagation resistance,

Method for measuring crack opening displacement delta5 and critical crack tip opening angle Psic. Tension on compact tensile specimens with notches and central cracks

The specimens were pre-fractured through fatigue and tested under conditions of slowly increasing displacement.

The test methods described in this standard cover those specimens that do not meet the dimensional insensitivity of fracture performance, such as the relatively thin compact tensile

Tensile specimen and central crack tensile specimen.

This standard provides a method for determining the crack propagation resistance curve (R-curve). Determine the breaking of compact tensile specimens with ISO 12135.2002

The characteristic values of crack toughness are similar. In Appendix D, a method for measuring the characteristic values of fracture toughness using a central crack tensile specimen is given.

For the measurement of crack propagation resistance, the multi-sample method and the single-sample method can be used. The multi-sample method requires loading multiple nominally identical samples

To different displacements. The crack growth resistance curve is obtained by identifying the ductile crack growth area and the subsequent measurement of the fracture crack growth

line. The single-sample method based on the unloading compliance method and the potentiometric method can also measure crack propagation as long as it meets the specified accuracy requirements.

The recommended single sample method is described by ISO 12135.2002.Either way, the goal is to obtain enough data points to fully describe

Material crack propagation resistance behavior.

Measuring delta5 is relatively simple and easy. The result of delta5 is represented by the resistance curve, showing the uniqueness of the crack propagation within the limited range. keep away

In this limited range, the delta5 resistance curve of the compact tensile specimen shows a strong dependence on the width of the specimen, while the delta5 resistance of the central crack tensile specimen

The force curve shows a weak dependence on the width of the specimen.

The CTOA test is more difficult to determine than delta5.The critical CTOA is represented by a stable value reached after a certain degree of crack propagation. CTOA

The concept can be applied to the occasions where the crack propagation is very large, and the applicability exceeds the existing application range of delta5.

Both determinations of crack propagation resistance are suitable for structural evaluation. The concept of delta5 is complete, based on a simple crack driving force formula

The existing evaluation steps can be applied to structural integrity issues.

The concept of CTOA is generally more accurate. Numerical methods are needed in structural applications, such as finite element analysis.

Studies have shown that the compact tensile specimen and the central crack tensile specimen are loaded until the maximum load, stable CTOA and only resistance

The curves are closely related. The establishment of an analytical or numerical relationship between the delta5 resistance curve and the critical CTOA remains to be further studied.

2 Normative references

The following documents are essential for the application of this document. For dated