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

GB/T 21143-2025

Replacing GB/T 21143-2014

**Metallic materials - Unified method of test for determination of
quasistatic fracture toughness**

金属材料 准静态断裂韧度的统一试验方法

(English Translation)

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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 supersedes GB/T 21143-2014 "Unified Test Method for Quasi-Static Fracture Toughness of Metallic Materials" and is consistent with GB/T 21143-2014, aside from structural adjustments and editorial changes, the main technical changes are as follows.

---The welding materials have been modified to conform to GB/T 28896 (see Chapter 1);

---Added symbols CMOD, CTOD, F_d , F_L , F_m , F_Q , F_u , $KJ0.2BL$, M , η and their explanations (see Chapter 4, 2014 edition) Chapter 4);

---The calculation formulas for δ_0 and J_0 have been changed (see 6.3.4 and 6.4.4, 2014 versions of 6.3.4 and 6.4.4);

---The required range of δ_{amax} and the calculation formulas for its upper boundaries J_{max} and δ_{amax} have been modified (see 7.4.2.2, 7.5.1.1 and 7.5.2.1, 2014 edition).
(7.4.2.2, 7.5.1.1 and 7.5.2.1)

---A conversion formula for converting $J0.2BL$ to $KJ0.2BL$ has been added (see 7.6.1.6).

This document is modified to adopt ISO 12135:2021 "Unified test method for quasi-static fracture toughness of metallic materials".

This document has undergone significant structural adjustments compared to ISO 12135:2021. A table comparing the structural numbering changes between the two documents is provided.

See Appendix A.

This document differs significantly from ISO 12135:2021 in several technical aspects. The vertical single [unclear text - possibly referring to a specific element or label] is present in the margin of the relevant clauses.

The lines (I) are marked. A summary of these technical differences and their reasons can be found in Appendix B.

The following editorial changes have been made to this document.

---Note. The hardness of the device is greater than the hardness of the sample (see Figures 10-12);

---Corrected the editing error in formula (35) (see 7.3.1);

- Added content on passivation line calibration (see C.1, C.5);
- Added a compliance formula for calculating crack length using the compliance method for straight-through notched compact tensile specimens (see D.5.3);
- Added calculation formulas for the radius of rotation R and formulas applicable to different loading positions and specimen types (see D.5.5.1).
D.5.5.2);
- The formula for rotation correction has been modified (see D.5.5);
- The formula for calculating the initial crack length has been modified (see D.6.2);
- An informative appendix, "Guide to Load Separation Method," has been added (see Appendix E);
- An informative appendix, "Determination of CTOD Values by Profile Method," has been added (see Appendix F);
- The formulas for calculating the compliance of compact tensile specimens with straight-through notches and stepped notches have been modified (see Appendix H);
- Added a formula for calculating U_p using the crack opening displacement of a three-point bending specimen (see K.5).

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).

1 Scope

This document describes the experimental methods for assessing the fracture toughness and resistance curves of homogeneous metallic materials under quasi-static loading, considering K , δ , and J .

Method. The specimen includes a notch, and a fatigue method is used to pre-induce cracks. Tests are conducted under conditions of slowly increasing displacement. Fracture toughness is determined by independent...

The state of the specimen during or after ductile crack propagation, ductile crack propagation instability, or unstable crack propagation is determined. When crack propagation...

Currently, under stable propagation conditions of ductile tearing, a resistance curve relating fracture toughness to crack propagation can be determined. This is applicable to certain

ferritic materials.

During testing, unstable crack propagation due to cleavage may occur, or the initiation and propagation of ductile cracks may be interrupted by cleavage propagation.

Constraint conditions are not within the scope of this document. GB/T 28896 supplements this with specific test requirements and data processing procedures for welding materials.

Note: Statistical differences in test results are related to the fracture type. For example, fracture toughness values obtained from cleavage fracture in ferritic steel will fluctuate. For applications requiring high reliability...

Regarding the situation of fracture toughness, a method for quantitatively characterizing the fluctuation of fracture toughness values in the ductile-brittle transition region is given in reference [4]. This document does not address this issue.

The number of experiments and the application and understanding of the results under these circumstances will be further explained.

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 8170 Rules for rounding off numerical values and the representation and determination of limiting values
 GB/T 12160 Calibration of extensometer systems for uniaxial testing of metallic materials (GB/T 12160-2019, ISO 9513:2012) IDT)
 GB/T 16825.1 Inspection and calibration of static uniaxial testing machines for metallic materials - Part 1: Tensile and/or compressive tests
 Inspection and calibration of mechanical force measurement systems (GB/T 16825.1-2022, ISO 7500-1:2018, IDT)
 GB/T 20832 Marking of the axis of a specimen relative to the texture of a product (GB/T 20832-2007, ISO 3785:2006) IDT)
 GB/T 28896 Test method for determination of quasi-static fracture toughness of welded joints of metallic materials (GB/T 28896-2023)
 ISO 15653:2018, MOD)
 JJG762 Extensometer Verification Procedure

3 Terms and Definitions

The following terms and definitions apply to this document.

The magnitude of the elastic stress field of a uniform linear elastic body.

Note: The stress intensity factor is a function of the applied force, specimen size, geometry, and