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NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 28896-2023

Metallic materials - Method of test for the determination of quasistatic fracture toughness of welds

金属材料 焊接接头准静态断裂韧度测定的试验方法

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Foreword

This document is in accordance with the provisions of GB/T 1:1-2020 "Guidelines for Standardization Work Part 1: Structure and Drafting Rules for Standardization Documents" drafting: This document replaces GB/T 28896-2012 "Test method for the determination of quasi-static fracture toughness of welded joints of metallic materials", and GB/T Compared with 28896-2012, except for structural adjustment and editorial changes, the main technical changes are as follows:

--- Added the formula for estimating the tensile strength at low temperature based on the tensile strength at room temperature (see 12:1);

--- Added a series of calculation formulas for calculating the opening displacement delta of the crack tip of the deep notch (see 12:2);

---Changed the calculation formula of the output estimation V of the shallow notch three-point bending sample double extensometer, and the calculation formula of calculating the single-point J integral formula, the calculation formula for calculating the eigenvalue of the opening displacement of the single point crack tip (delta) and the calculation of the eigenvalue of the opening displacement of the single point crack tip (delta) calculation formula (see Appendix E, Appendix E of the:2012 edition): This document is modified to adopt ISO 15653:2018 "Test method for the determination of quasi-static fracture

toughness of welded joints of metallic materials": The technical differences between this document and ISO 15653:2018 and their reasons are as follows:

--- Replaced ISO 12135 with the normative reference document GB/T 21143 to meet the technical requirements of our country (see Chapter 3, Chapter 4, Chapter 5, 6:2, 8:1, 8:4, 9:1, 9:2, Chapter 10, 12:2:1, 12:2:2, 12:3:1, 12:3:2, 12:3:3, 12:3:4, Chapter 13, D:1, D:2, D:5, E:2, E:3):

---Changed the calculation formula applicable to the opening displacement delta of the crack tip for deep notches (0:45< a0/W< 0:7) to ensure the calculation results accuracy: [See formula (10) and formula (11), formula (10) of ISO 15653:2018]:

--- In order to be consistent with the standard technical content, change the informative Appendix E to a normative appendix: The following editorial changes have been made to this document:

---Corrected the error noted in Figure 9;

---Changed the number of formula (11) ~ formula (15), and changed formula (11) ~ formula (15) to formula (12) ~ formula (16);

--- Changed the symbol of formula (E:3) in Appendix E, and changed the symbol A0 to AP;

---In the informative appendix B, "Accumulation of specific microstructure areas within 75% of the thickness of the center of the through-thickness notch specimen Example of length sum value";

--- Added references [3]: Please note that some contents of this document may refer to patents: The issuing agency of this document assumes no responsibility for identifying patents: This document is proposed by China Iron and Steel Industry Association: This document is under the jurisdiction of the National Steel Standardization Technical Committee (SAC/TC183): This document is drafted by: Tianjin University, National Petroleum and Natural Gas Pipeline Group Co:, Ltd:, Shiyan City Industrial Product Quality Inspection and Testing Institute, Jiangsu Chengxin Inspection and Certification Co:, Ltd:, Tianjin Jinqiao Welding Material Group Co:, Ltd:, Shougang Group Co:, Ltd:, Dongguan Material Base Yin Institute of Advanced Science and Technology, Shenzhen Wance Test Equipment Co:, Ltd:, Beijing Institute of Space Mechatronics, and Institute of Metallurgical Industry Information Standards: The main drafters of this document: Wang Dongpo, Feng Qingshan, Liu Chuanlong, Zhu Guosen, Zhang Qiang, Xiao Huiying, Li Rongfeng, Dong Li, Huang Xing, Zang Bo, Gong Baoming, Dai Lianshuang, Wei Qijun, Gan Meilu, Deng Caiyan, Zhao Haiwei, Wang Ting, Wang Fuxiang, Hou Huining, Wang Shuqiang, Guo Baichen, Ma Qiang: This document was first published in:2012, and this is the first revision: Quasi-static fracture toughness of welded joints of metallic materials Determination of test methods

1 Scope

GB/T 28896-2023 extends fracture toughness testing to welded joints, which is where structures actually fail. Fracture toughness is the property that decides whether a crack in a component grows stably or runs, and it is normally measured on homogeneous material. A weld is the opposite of homogeneous: within a few millimetres it passes from parent metal through a heat-affected zone of transformed microstructure to cast weld metal, it carries residual stresses of yield magnitude, and its toughness can vary by an order of magnitude across that distance. The lowest value usually sits in a narrow region that a specimen must be deliberately positioned to sample, and a test that misses it returns a reassuring number for a joint that is not tough at all. This document describes the test methods for determining the stress intensity factor (K), the crack tip opening displacement (CTOD, delta) and the J-integral for welded joints in metallic materials. It supplements GB/T 21143, which covers the same measurements on homogeneous material. Under ICS 77.040.10 and CCS H22, it is written for welding engineers, for the fabricators of pressure and offshore structures operating under fitness-for-service assessment, and for materials testing laboratories.

This document describes the stress intensity factor (K), crack tip opening displacement [CTOD(delta)] and J-integral for testing welded joints of metallic materials: test method: This document is a supplement to GB/T 21143, GB/T 21143 covers the test methods for the fracture toughness test of metal base materials In all aspects, this document is used in conjunction with GB/T 21143: This document is suitable for determining the characteristic value of fracture toughness and not suitable for determining the effective R-curve (crack growth resistance curve), but this document The processing method of the sample in the workpiece is also applicable to the R-curve determination of the weld metal: The tests specified are for welded, machined defects: Metal material specimens with prefabricated fatigue cracks, the notch is located in the target area of the weld metal or heat-affected zone, if applicable, fatigue cracks shall be The validity of the crack location is evaluated:

2 Normative references

The contents of the following documents constitute the essential provisions of this document through normative references in the text: Among them, dated references Only the version corresponding to the date applies to this document; for undated references, the latest version (including all amendments) applies used in this document:

GB/T 21143 Unified test method for quasi-static fracture toughness of metallic materials (GB/T 21143-2014, ISO 12135: 2002, MOD)

3 Terms and Definitions

The following terms and definitions defined in GB/T 21143 apply to this document: 3:1 stretch zone width stretchzonewidth ZW The length of crack extension produced during

crack passivation:

Note: Crack passivation generally occurs before unstable crack growth, pop-in or slow and stable crack growth, and its location is at the same location as the prefabricated fatigue crack: above a plane: 3:2 target area targetarea location of the preformed fatigue crack tip in the weld metal (3:7) or heat-affected zone (3:9) 3:

3 Breakthrough pop-in A sudden discontinuity point appears on the force-displacement record curve, which is generally characterized by a sudden increase in displacement and a rapid decrease in force, and then the force And the displacement can continue to increase above the value at which the discontinuity started: