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Welding Engineering Standard

Standard test method for crack-tip opening displacement (CTOD) fracture toughness measurement

Introduction

This standard specifies the fracture mechanics test method for evaluating the fracture toughness of metallic material using the crack-tip opening displacement (CTOD). The first edition published in 1995 used a CTOD calculation formula based on a geometric plastic hinge model as in **BS 7448 Part 1**. Considering the plastic deformation property of material in the CTOD calculation, the standard was revised to improve the accuracy of evaluation.

1. Scope

This test method uses a fatigue precracked specimen to determine the fracture toughness of metallic material at the initiation of unstable fracture. Two types of unstable fracture exist depending on material and test temperature. In one type, the unstable crack starts directly from the fatigue precrack tip. In the other type, it starts from the tip of ductile crack which has developed stably from the fatigue precrack tip. The start of ductile crack is out of the scope of this standard.

The formula for calculating the critical CTOD used in this test method is applicable to the material with the yield ratio, R_Y, in the range of 0.6 to 0.98 and the specimen thickness, B, in the range of 10 to 200 mm.

The CTOD value at the initiation of unstable fracture determined by this test method (δ_c or δ_u among the critical CTOD) can be used in the safety assessment of structural element as in **WES 2805** or in the evaluation for material selection.

The critical CTOD value determined by this test method is an index for characterizing the fracture behavior of metallic material. It should be noted, however, that this test method cannot be applied to the macroscopically inhomogeneous material such as weld just as it is. **WES 1109** describes a method to deal with such a case.

In the materials with high ductility and toughness, unstable fracture does not occur in most cases and only the CTOD at the maximum load can be determined. This type of critical CTOD (δ_m) cannot be a toughness index for unstable fracture.

2. Normative References

The standards listed below contain the provisions which, through reference in this standard, constitute the provisions of this standard. If the indication of year is given to the referred standard, only the edition of the indicated year applies, but the revision or amendment made thereafter does not. If the indication of year is not given to the referred standard, only the latest edition or amendment applies.

JIS B 7728 Calibration of force-proving instruments used for the verification of uniaxial testing machines