BRITISH STANDARD

BS 7448-3:2005

Incorporating

Fracture mechanics toughness tests —

Part 3: Method for determination of fracture toughness of metallic materials at rates of increase in stress intensity factor greater than 3.0 MPa·m$^{0.5}$s^{-1}

ICS 77.040.10

BSI British Standards

British Standard

This British Standard was entrusted by Technical Committee ISE/NFE/4, Mechanical testing of materials, to Subcommittee ISE/NFE/4/4, Toughness testing, upon which the following bodies were represented:

British Non-Ferrous Metals Federation

GAMBICA Limited

HSE — Health and Safety Executive

Lloyd's Register

National Physical Laboratory

Network Rail

QinetiQ

Society of British Aerospace Companies Ltd.

UK Steel Association

United Kingdom Accreditation Service

Welding Institute

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Foreword

This part of BS 7448 has been prepared by Technical Committee ISE/NFE/4. It is required because the instrumentation and procedures in BS 7448-1 may not be adequate for high rate tests.

This British Standard supersedes BS 6729:1987 which is withdrawn.

This part of BS 7448 is one of a series dealing with fracture mechanics toughness tests, the other parts being:

— *Part 1: Fracture mechanics toughness tests — Method for determination of K_{Ic} critical CTOD and critical J values of metallic materials.*

— *Part 2: Fracture mechanics toughness tests — Method for determination of K_{Ic}, critical CTOD and critical J values of welds in metallic materials.*

— *Part 4: Fracture mechanics toughness tests — Method for determination of fracture resistance curves and initiation values for stable crack extension in metallic materials.*

It is assumed in the drafting of this standard that the execution of its provisions is entrusted to appropriately qualified and competent people.

This British Standard describes methods of test only, and should not be used or quoted as a specification. References to this standard should indicate that the methods of test used are in accordance with BS 7448-3:2005.

CAUTION It is important to note that tests of the type described involve the use of large forces, and may involve the rapid movement of machine parts and fractured test specimens. Therefore it is important to consider the safety of machine operators.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Summary of pages

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1 Scope

This part of BS 7448 describes a method for determining the opening mode plane strain fracture toughness K_{Ic}, the critical crack tip opening displacement (CTOD) fracture toughness and the critical J fracture toughness of metallic materials. The method uses fatigue precracked specimens tested in displacement control at rates of increase in stress intensity factor greater than 3.0 $MPa \cdot m^{0.5} s^{-1}$ but less than 3 000 $MPa \cdot m^{0.5} s^{-1}$[1)] during the initial elastic deformation. Stress intensity factors greater than 3 000 $MPa \cdot m^{0.5} s^{-1}$ are covered in Annex A. These rates are greater than those permitted in BS 7448-1.

The definition of fracture toughness values relevant to particular structural integrity assessments is outside the scope of this British Standard.

NOTE This standard does not cover integrity assessments. Such assessments are covered in BS 7910.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 7448-4:1997, *Fracture mechanics toughness tests — Part 4: Method for determination of fracture resistance curves and initiation values for stable crack extension in metallic materials.*

BS 7935-1, *Constant amplitude dynamic force calibration — Part 1: Calibration and verification of non-resonant uniaxial dynamic testing systems — Method.*

BS 7935-2, *Constant amplitude dynamic force calibration — Part 2: Calibration of the calibration device instrumentation to be used for the dynamic calibration of non-resonant uniaxial dynamic testing systems — Method.*

BS EN ISO 7500-1:1999, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system.*

BS EN ISO 12737, *Metallic materials — Determination of plane-strain fracture toughness.*

3 Terms and definitions

For the purposes of this part of BS 7448 the following terms and definitions apply.

3.1
stress intensity factor
K
magnitude of the stress field near the crack tip (a stress-field singularity) (see **3.2**) in a homogeneous, ideally linear-elastic body

NOTE This is a function of applied force, crack length and specimen geometry, and is expressed in units of $MPa \cdot m^{0.5}$.

3.2
opening mode
opening displacement of the crack surfaces in a direction normal to the original (undeformed) crack plane near the crack tip

3.3
plane strain fracture toughness
$\boldsymbol{K_{Ic}}$
measure of a material's resistance to crack extension when the stress state near the crack tip is predominantly plane strain, plastic deformation is limited, and opening mode monotonic loading is applied

3.4
maximum fatigue stress intensity factor
$\boldsymbol{K_f}$
maximum value of opening mode stress intensity factor which is applied during the final stages of fatigue crack extension

[1)] 1 $N.mm^{-1.5}$ = 0.0316 $MPa \cdot m^{0.5}$ = 0.0316 $MN \cdot m^{1.5}$.