INTERNATIONAL STANDARD

ISO 12108

Second edition
2012-08-15

Metallic materials — Fatigue testing — Fatigue crack growth method

Matériaux métalliques — Essais de fatigue — Méthode d'essai de propagation de fissure en fatigue

Reference number
ISO 12108:2012(E)

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12108 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 5, *Fatigue testing*.

This second edition cancels and replaces the first edition (ISO 12108:2002), which has been technically revised.

Introduction

This International Standard is intended to provide specifications for generation of fatigue crack growth rate data. Test results are expressed in terms of the fatigue crack growth rate as a function of crack-tip stress-intensity factor range, ΔK, as defined by the theory of linear elastic fracture mechanics [1]-[6]. Expressed in these terms the results characterize a material's resistance to subcritical crack extension under cyclic force test conditions. This resistance is independent of specimen planar geometry and thickness, within the limitations specified in Clause 6. All values are given in SI units [7].

This International Standard describes a method of subjecting a precracked notched specimen to a cyclic force. The crack length, a, is measured as a function of the number of elapsed force cycles, N. From the collected crack length and corresponding force cycles relationship the fatigue crack growth rate, da /dN, is determined and is expressed as a function of stress-intensity factor range, ΔK.

Materials that can be tested by this method are limited by size, thickness and strength only to the extent that the material must remain predominantly in an elastic condition during testing and that buckling is precluded.

Specimen size may vary over a wide range. Proportional planar dimensions for six standard configurations are presented. The choice of a particular specimen configuration may be dictated by the actual component geometry, compression test conditions or suitability for a particular test environment.

Specimen size is a variable that is subjective to the test material's 0,2 % proof strength and the maximum stress-intensity factor applied during test. Specimen thickness may vary independent of the planar size, within defined limits, so long as large-scale yielding is precluded and out-of-plane distortion or buckling is not encountered. Any alternate specimen configuration other than those included in this International Standard may be used, provided there exists an established stress-intensity factor calibration expression, i.e. stress-intensity factor geometry function, $g\ (a/W)$. [9]-[11]

Residual stresses[12],[13], crack closure[14],[15], specimen thickness, cyclic waveform, frequency and environment, including temperature, may markedly affect the fatigue crack growth data but are in no way reflected in the computation of ΔK, and so should be recognized in the interpretation of the test results and be included as part of the test report. All other demarcations from this method should be noted as exceptions to this practice in the final report.

For crack growth rates above 10^{-5} mm/cycle, the typical scatter in test results generated in a single laboratory for a given ΔK can be in the order of a factor of two[16]. For crack growth rates below 10^{-5} mm/cycle, the scatter in the da/dN calculation may increase to a factor of 5 or more. To ensure the correct description of the material's da/dN versus ΔK behaviour, a replicate test conducted with the same test parameters is highly recommended.

Service conditions may exist where varying ΔK under conditions of constant K_{max} or K_{mean} control [17] may be more representative than data generated under conditions of constant force ratio; however, these alternate test procedures are beyond the scope of this International Standard.

Metallic materials — Fatigue testing — Fatigue crack growth method

1 Scope

This International Standard describes tests for determining the fatigue crack growth rate from the fatigue crack growth threshold stress-intensity factor range, ΔK_{th}, to the onset of rapid, unstable fracture.

This International Standard is primarily intended for use in evaluating isotropic metallic materials under predominantly linear-elastic stress conditions and with force applied only perpendicular to the crack plane (mode I stress condition), and with a constant stress ratio, R.

2 Normative references

The following normative 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.

ISO 4965-1, *Metallic materials — Dynamic force calibration for uniaxial fatigue testing — Part 1: Testing systems*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
crack length
a
linear measure of a principal planar dimension of a crack from a reference plane to the crack tip

NOTE This is also called crack size.

3.2
cycle
N
smallest segment of a force-time or stress-time function which is repeated periodically

NOTE The terms "fatigue cycle", "force cycle" and "stress cycle" are used interchangeably. The letter N is used to represent the number of elapsed force cycles.

3.3
fatigue crack growth rate
$\mathrm{d}a/\mathrm{d}N$
extension in crack length

3.4
maximum force
F_{max}
force having the highest algebraic value in the cycle; a tensile force being positive and a compressive force being negative

3.5
minimum force
F_{min}
force having the lowest algebraic value in the cycle; a tensile force being positive and a compressive force being negative