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BSI Standards Publication

Metallic materials — Principles and designs for multiaxial fatigue testing

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee ISE/101/6, Fatigue testing of metals and metal matrix composites.

The UK committee would like to clarify the relationship between the images and keys in the figures of Annex A. The images correspond with their position in the key, with the left column containing images 1, 2, and 3 in ascending order, and the right column containing images 4, 5 and 6 in ascending order. This applies to both Figures A.1 and A.2.

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31 May 2018	Missing elements of Figures A.1 and A.2 reinstated

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TECHNICAL REPORT

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2018-04-27

Metallic materials — Principles and designs for multiaxial fatigue testing

Matériaux métalliques — Principes et conventions associés aux essais de fatigue multiaxiale

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 4, *Fatigue, fracture and toughness testing*.

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Introduction

Structural components in industry are frequently subject to some form of multiaxial stressing. Fatigue cracks generally initiate from surface defects or discontinuities and are thus primarily influenced by the surface biaxial stress system. This can vary from equibiaxial, where surface principal stresses are equal in magnitude and sign (present under conditions of pressurization, rotation and thermal loading) to pure shear where surface stresses are equal in magnitude, opposite in sign (as in shafts and shear panels).

The majority of fatigue test data gathered worldwide have been and will continue to be under uniaxial conditions for reasons of simplicity and cost. A secondary goal of multiaxial testing is therefore to develop behavioural models which relate failure under specified multiaxial conditions to established uniaxial cases.

This document utilizes data gathered from the past 80 years spanning most multiaxial fatigue research. It can be of interest to new researchers in the field and form a basis for full International Standards as the need arises.

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Metallic materials — Principles and designs for multiaxial fatigue testing

1 Scope

This document discusses the general principles of multiaxial fatigue testing and the design recommendations for specific classes of multiaxial testing machines and test specimens.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
biaxial strain ratio
ϕ
ratio of the surface principal strains, smaller/larger

3.2
biaxial stress ratio
ψ
ratio of the surface principal stresses, smaller/larger

3.3
principal strains
$\varepsilon_1 > \varepsilon_2 > \varepsilon_3$
principal direct strains at a point in a multiaxial strain field

3.4
principal stresses
$\sigma_1 > \sigma_2 > \sigma_3$
principal direct stresses at a point in a multiaxial strain field

3.5
Poisson's ratio
ν
negative ratio of transverse to longitudinal strain under uniaxial tensile stressing

3.6
specimen diameter
d
diameter of a cylindrical tubular specimen

Note 1 to entry: The symbols d_0, d_i and d_m are used to express outside, inside and mean diameters, respectively.

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