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Metallic materials — Torque-controlled fatigue testing

Matériaux métalliques — Essais de fatigue par couple de torsion commandé

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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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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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

This third edition cancels and replaces the second edition (ISO 1352:2011), which has been technically revised.

The main changes are as follows:

— addition of the test apparatus and procedure for the elevated temperature testing;

— addition of measurement uncertainty estimation.

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Metallic materials — Torque-controlled fatigue testing

1 Scope

This document specifies the conditions for performing torsional, constant-amplitude, nominally elastic stress fatigue tests on metallic specimens without deliberately introducing stress concentrations. The tests are typically carried out at ambient temperature or an elevated temperature in air by applying a pure couple to the specimen about its longitudinal axis.

While the form, preparation and testing of specimens of circular cross-section and tubular cross-section are described in this document, component and other specialized types of testing are not included. Similarly, low-cycle torsional fatigue tests carried out under constant-amplitude angular displacement control, which lead to failure in a few thousand cycles, are also excluded.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 554:1976, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 23788, *Metallic materials — Verification of the alignment of fatigue testing machines*

3 Terms and definitions

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

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

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

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

3.1
maximum stress
τ_{max}
highest algebraic value of shear stress at the outer diameter in the stress cycle

Note 1 to entry: See Figure 1.

3.2
minimum stress
τ_{min}
lowest algebraic value of shear stress in the stress cycle

Note 1 to entry: See Figure 1.

3.3
mean stress
τ_{m}
static component of the shear stress

Note 1 to entry: It is one half of the algebraic sum of the maximum shear stress and the minimum shear stress:

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$$\tau_m = \frac{\tau_{max} + \tau_{min}}{2}$$

3.4
stress amplitude
τ_a
variable component of shear stress

Note 1 to entry: It is one half of the algebraic difference between the maximum shear stress and the minimum shear stress:

$$\tau_a = \frac{\tau_{max} - \tau_{min}}{2}$$

3.5
number of cycles
N
number of cycles applied at any stage during the test

3.6
stress ratio
R
algebraic ratio of the minimum shear stress to the maximum shear stress in one cycle

Note 1 to entry: It is expressed as:

$$R = \frac{\tau_{min}}{\tau_{max}}.$$

3.7
stress range
$\Delta\tau$
range between the maximum and minimum shear stresses

Note 1 to entry: It is expressed as:

$$\Delta\tau = \tau_{max} - \tau_{min}.$$

3.8
fatigue life at failure
N_f
number of stress cycles to failure in a specified condition

3.9
fatigue strength at *N* cycles
τ_N
value of the shear *stress amplitude* (3.4) at a stated *stress ratio* (3.6) under which the specimen would have a life of *N* cycles

3.10
torque
M
twisting couple producing shear stress or twisting deformation about the axis of the specimen

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