International Standard

ISO 1099

Metallic materials — Fatigue testing — Axial force-controlled method

Matériaux métalliques — Essais de fatigue — Méthode par force axiale contrôlée

Fourth edition
2026-10

Reference number
ISO 1099:2026(en)

© ISO 2026



COPYRIGHT PROTECTED DOCUMENT

© ISO 2026

All rights reserved.

This ISO publication is protected by copyright and is owned by ISO and/or its licensors.

The content of this ISO publication is provided under licence, not sold. Use is subject to the applicable licence terms issued by ISO, an ISO member body, or an authorized third-party distributor.

Except as required for implementation or expressly permitted by a separate licence, no part of this ISO publication may be reproduced, distributed, modified, used, or made available in any form or by any means – electronic or mechanical, including photocopying, scanning, recording, or posting on internal or external digital platforms.

Any use beyond the scope of the granted rights is prohibited and may result in legal action.

ISO copyright office
CP 401 • CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword ... **iv**
Introduction ... **v**
1 Scope ... **1**
2 Normative references ... **1**
3 Terms and definitions ... **1**
4 Test plan ... **3**
5 Specimen shape and dimensions ... **4**
5.1 Form of specimens ... 4
5.2 Dimension of specimens ... 4
5.2.1 Bars and flat sheets > 5 mm thick ... 4
5.2.2 Flat sheets ≤ 5 mm ... 5
6 Preparation of specimens ... **6**
6.1 General ... 6
6.2 Machining procedure ... 6
6.3 Sampling and marking ... 7
6.3.1 General ... 7
6.3.2 Surface condition of the specimen ... 7
6.3.3 Dimensional checks ... 7
6.3.4 Storage and handling ... 8
7 Apparatus ... **8**
7.1 Force transducer ... 8
7.2 Test machine ... 8
7.3 Alignment check ... 9
8 Procedure ... **9**
8.1 Gripping of specimen ... 9
8.2 Mounting of specimen ... 9
8.3 Selecting testing frequencies ... 9
8.4 Application of force ... 10
8.5 Recording of temperature and humidity ... 10
9 Heating device and temperature measurement ... **10**
10 Instrumentation for test monitoring ... **10**
10.1 Recording systems ... 10
10.2 Cycle counter ... 10
10.3 Criterion of failure ... 10
10.4 Test termination ... 10
11 Checking and verification ... **11**
12 Test report ... **11**
Annex A (informative) **Presentation of results** ... **18**
Bibliography ... **23**

© ISO 2026 – All rights reserved

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.

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 document 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).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 testing*.

This fourth edition cancels and replaces the third edition (ISO 1099:2017), which has been technically revised.

The main changes are as follows:

— format has been changed to be similar to ISO 22407:2021, ISO 1143:2021 and ISO 1352:2021.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

© ISO 2026 – All rights reserved

Introduction

This document is intended to provide requirements and guidance for conducting axial, constant-amplitude, force-controlled, cyclic fatigue tests on specimens of a metal for the sake of generating fatigue-life data (i.e. stress vs. cycles to failure) for material characterization.

Nominally identical specimens are mounted in an axial force-type fatigue-testing machine and subjected to the required cyclic force conditions that introduce any one of the types of cyclic stress as illustrated in Figure 1. The test waveform should be of constant amplitude and sinusoidal unless otherwise specified.

The force being applied to the specimen is along the longitudinal axis passing through the centroid of each cross-section. The test is continued until the specimen fails or until a predetermined number of stress cycles have been exceeded (see Clauses 4 and 10). Tests are typically conducted at ambient temperature (ideally between 10 °C to 35 °C).

NOTE The results of a fatigue test can be affected by atmospheric conditions and where controlled conditions are required, ISO 554:1976, 2.1 applies.

Caution should be taken regarding the selected test temperature of such isothermal testing so that there are no possible phase changes in the material's microstructure. At elevated temperature creep phenomena can occur. It is recommended to maintain the test temperature, T, at ≤ 0,3 of the melting temperature, T_m, of the material being tested, i.e. the homologous temperature defined as: $T_h = T(\mathrm{K})/T_m(\mathrm{K})$.

© ISO 2026 – All rights reserved

Metallic materials — Fatigue testing — Axial force-controlled method

WARNING — This document calls for the use of substances and/or procedures that can be injurious to health if adequate safety measures are not taken. This document does not address any health hazards, safety or environmental matters associated with its use. It is the responsibility of the user of this document to establish appropriate health, safety and environmentally acceptable practices.

1 Scope

This document specifies the conditions for conducting axial, constant-amplitude, force-controlled, fatigue tests at ambient, elevated, and low temperature on metallic specimens, without deliberately introduced stress concentrations. The object of testing while employing this document is to provide fatigue information, such as the relation between applied stress and number of cycles to failure for a given material condition, such as microstructure, at various stress ratios.

While the form, preparation and testing of specimens of circular and rectangular cross-section are described, component testing and other specialized forms of testing are not included in this document.

NOTE 1 Fatigue tests on notched specimens are not covered by this document since the shape and size of notched test pieces have not been standardized. However, fatigue-test procedures described in this document can be applied to fatigue tests of such notched specimens.

NOTE 2 Throughout this document, the engineering stress is employed. Engineering stress is equal to the axially applied force divided by the cross-sectional area of the test specimen, S = Force/Area, [MPa], at the test temperature.

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 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

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
test specimen diameter
d
diametric distance or width of the specimen or test piece where the stress is at a maximum

© ISO 2026 – All rights reserved

3.2
grip diameter
D
diameter of the specimen at grip end

3.3
thickness of test section
t
thickness of reduced section of rectangular test specimen

3.4
width of test section
w
width of reduced section of rectangular test specimen

3.5
parallel length
L_c
length in the gauge test section of a specimen or test piece that has equal *test specimen diameter* (3.1) or *width of test section* (3.4) and is parallel

3.6
specimen length
L_z
overall length of test specimen

3.7
fillet radius
r
radius between the parallel length and the grip end of test specimen

Note 1 to entry: The curve need not be a true arc of a circle over the whole of the distance between the end of the parallel length and the start of the grip end.

3.8
maximum stress
S_{max}
greatest algebraic value of stress in a *stress cycle* (3.14)

Note 1 to entry: See Figure 2.

3.9
mean stress
S_m
one-half the algebraic sum of the *maximum stress* (3.8) and the *minimum stress* (3.10) in a *stress cycle* (3.14)

Note 1 to entry: See Figure 2.

3.10
minimum stress
S_{min}
least algebraic value of stress in a *stress cycle* (3.14)

Note 1 to entry: See Figure 2.

3.11
stress amplitude
S_a
one-half the algebraic difference between the *maximum stress* (3.8) and the *minimum stress* (3.10)

Note 1 to entry: See Figure 2.

© ISO 2026 – All rights reserved

3.12
stress range
ΔS_a
algebraic difference between the *maximum stress* (3.8) and the *minimum stress* (3.10)

$$\Delta S_a = S_{max} - S_{min}$$

Note 1 to entry: See Figure 2.

3.13
stress ratio
R
ratio of minimum to *maximum stress* (3.8) during any single cycle of fatigue operation

$$R = S_{min}/S_{max}$$

Note 1 to entry: See Figure 2.

3.14
stress cycle
variation of stress with time, repeated periodically and identically

Note 1 to entry: See Figure 2.

3.15
number of cycles
N
number of smallest segments of the force-time, stress-time, etc.; function that is repeated periodically

3.16
fatigue life
N_f
number of applied cycles to achieve a defined failure criterion

3.17
fatigue strength at *N* cycles
S_N
value of the stress amplitude at a stated stress ratio under which the specimen would have a life of N cycles

4 Test plan

Before commencing testing, the following shall be agreed by the parties concerned, unless specified otherwise in the relevant product standard:

a) the form of specimen to be used (see 5.1);

b) the R-ratio(s) to be used;

c) the objective of the tests, i.e. which of the following is to be determined:

   1) the fatigue life at a specified stress amplitude;

   2) the fatigue strength at specified fatigue cycles (N cycles), S_N; i.e. fatigue limit to a fixed number of cycles (e.g. 2 million to 10 million);

   3) a full Wöhler or S-N curve.

d) the number of specimens to be tested and the testing sequence;

e) the number of cycles at which a test on an unfailed specimen shall be terminated;

© ISO 2026 – All rights reserved