INTERNATIONAL STANDARD

ISO 18338

Second edition
2021-12

Metallic materials — Torsion test at room temperature

Matériaux métalliques — Essai de torsion à température ambiante

Reference number
ISO 18338:2021(E)

© ISO 2021



COPYRIGHT PROTECTED DOCUMENT

© ISO 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2021 – All rights reserved

Contents

Page

Foreword ... **iv**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Symbols and designations ... **3**

5 Principle of test ... **4**

6 Test piece ... **4**
6.1 Shape and dimensions of test pieces ... 4
6.1.1 Cylinder test pieces ... 4
6.1.2 Tube test pieces ... 5
6.1.3 Preparation of test pieces ... 6

7 Determination of original cross-sectional dimensions ... **6**
7.1 Cylinder test pieces ... 6
7.2 Tube test pieces ... 6

8 Accuracy of the testing apparatus ... **6**
8.1 Testing machine ... 6
8.2 Troptometer ... 7

9 Conditions of testing ... **7**

10 Determination of the properties ... **8**
10.1 Calculations of shear stress and shear strain ... 8
10.2 Determination of the slope of linear portion of shear stress-shear strain curve ... 8
10.3 Torsional proof strength, plastic torsion ... 9
10.4 Upper torsional yield strength and the lower torsional yield strength ... 10
10.5 Determination of torsional strength ... 11
10.6 Determination of maximum plastic shear strain ... 12

11 Test report ... **12**

Annex A (informative) **Determination of the reference proof strength, plastic torsion and reference torsional strength** ... **13**

Bibliography ... **17**

© ISO 2021 – 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 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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.

The committee responsible for this document is ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 2, *Ductility testing*.

This second edition cancels and replaces the first edition (ISO 18338:2015), of which it constitutes a minor revision. The changes are as follows:

— the duplicated part of Formula (A.4) has been deleted;

— minor editorial changes.

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 2021 – All rights reserved

Metallic materials — Torsion test at room temperature

1 Scope

This document specifies the method for torsion test at room temperature of metallic materials. The tests are conducted at room temperature to determine torsional properties.

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 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing*

ISO 9513, *Metallic materials — Calibration of extensometer systems used in uniaxial testing*

ASTM E2624, *Standard Practice for Torque Calibration of Testing Machines and Devices*

DIN 51309, *Materials testing machines — Calibration of static torque measuring devices*

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
troptometer gauge length
L_e
length of the parallel reduced section of the test piece for measurement of angle of twist by means of a troptometer

3.2
torque
T
moment of couple that generates or tends to generate rotation or torsion

3.3
maximum torque
T_m
for materials displaying discontinuous yielding, highest torque that the test piece withstands during the test after the yielding period, or for materials displaying no discontinuous yielding, highest torque that the test piece withstands during the test

© ISO 2021 – All rights reserved

3.4
angle of twist
ϕ
angle of relative rotation measured between two planes normal to the test-piece's longitudinal axial over the gauge length

Note 1 to entry: See Figure 1.

3.5
shear angle
ψ
angle due to shearing displacement at surface of test piece along the gauge length

Note 1 to entry: See Figure 1.

3.6
shear stress
τ
any moment during the test, torque, T , divided by the original polar section modulus, W_{p}

3.7
shearing displacement
ΔL
arc length swept out by the cylinder or major tube radius moving through the angle of twist, also being equivalent to the gauge length sweeping through the shear angle

Note 1 to entry: See Figure 1.

3.8
shear strain
γ
based on the gauge length, the increase of the shearing displacement, ΔL, at any moment during the test, expressed as a percentage of the gauge length L_{e}, or is equal to the tangent of the shear angle, ψ

3.9
slope
m_{G}
slope of the linear, elastic portion of the shear stress-shear strain curve

3.10
torsional proof strength, plastic torsion
τ_{p}
shear stress at which the plastic component of shear strain, due to torsion at the test piece outer surface, is equal to a specified percentage

Note 1 to entry: A suffix is added to the subscript to indicate the prescribed percentage, e.g. $\tau_{\mathrm{p0,35}}$.

3.11
torsional yield strength
when the metallic material exhibits a yield phenomenon, shear stress corresponding to the point reached during the torsion test at which plastic deformation occurs without any increase in the torque

3.11.1
upper torsional yield strength
$\tau_{\mathrm{e,H}}$
maximum value of shear stress prior to the first decrease in torque when the discontinuous yielding occurs

© ISO 2021 – All rights reserved

3.11.2
lower torsional yield strength
$\tau_{e,L}$
lowest value of shear stress during discontinuous yielding, ignoring any initial transient effects

3.12
torsional strength
τ_m
shear stress corresponding to the maximum torque, T_m

3.13
maximum plastic shear strain
γ_{max}
maximum plastic shear strain component at the outer surface when total separation of the test piece occurs

3.14
reference torsional proof strength, plastic torsion
$\tau_{r,p}$
shear stress at the outer surface of a test piece, calculated according to Nadai's expression, when cross-section of the test piece is in partly plastic torsion and attained the proof plastic shear strain

Note 1 to entry: A suffix is added to the subscript to indicate the prescribed percentage, e.g. $\tau_{r,p0,35}$.

3.15
reference torsional strength
$\tau_{r,m}$
maximum shear stress is calculated according to the Nadai's expression for fractured test piece

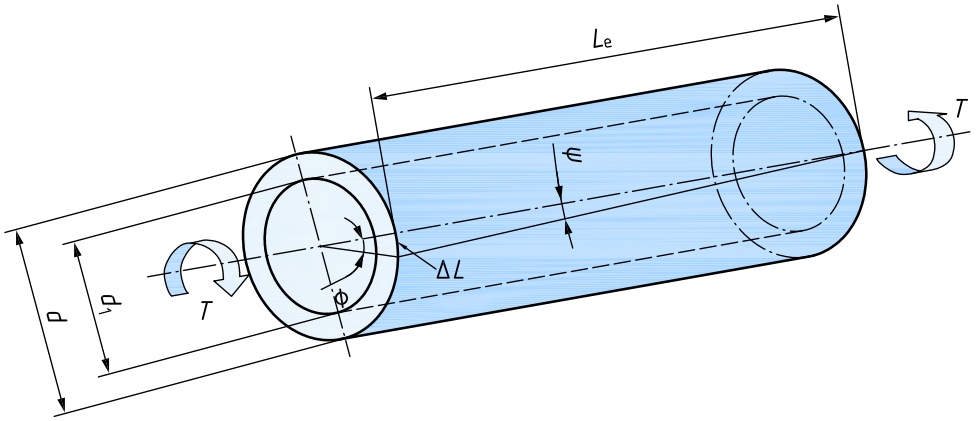


Figure 1 — Basic symbols for torsion test

4 Symbols and designations

Symbols and corresponding designations are given in Table 1 and Figure 1 or elsewhere in this document where they appear.

© ISO 2021 – All rights reserved