FINAL DRAFT

INTERNATIONAL STANDARD

ISO/FDIS 6892-1

ISO/TC **164**/SC **1**

Secretariat: **AFNOR**

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Metallic materials — Tensile testing —

Part 1:
Method of test at room temperature

Matériaux métalliques — Essais de traction —

Partie 1: Méthode d'essai à température ambiante

Please see the administrative notes on page iii

Reference number
ISO/FDIS 6892-1:2008(E)

ISO/CEN PARALLEL PROCESSING

The CEN Secretary-General has advised the ISO Secretary-General that this final draft International Standard covers a subject of interest to European standardization. Consultation on the ISO/DIS had the same effect for CEN members as a CEN enquiry on a draft European Standard. In accordance with the ISO-lead mode of collaboration as defined in the Vienna Agreement, this final draft, established on the basis of comments received, is hereby submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

Positive votes shall not be accompanied by comments.

Negative votes shall be accompanied by the relevant technical reasons.

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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 6892-1 was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 1, *Uniaxial testing*.

This first edition of ISO 6892-1, together with ISO 6892-2, ISO 6892-3, and ISO 6892-4, cancels and replaces ISO 6892:1998.

ISO 6892 consists of the following parts, under the general title *Metallic materials — Tensile testing*:

— *Part 1: Method of test at room temperature*

The following parts are under preparation:

— *Part 2: Method of test at elevated temperature*

— *Part 3: Method of test at low temperature*

The following part is planned:

— *Part 4: Method of test in liquid helium*

Introduction

During discussions concerning the speed of testing in the preparation of ISO 6892:1998, it was decided to recommend the use of strain rate control in future revisions.

In ISO 6892 (all parts), there are two methods of testing speeds available. The first, method A, is based on strain rates (including crosshead separation rate) and the second, method B, is based on stress rates. Method A is intended to minimize the variation of the test rates during the moment when strain rate sensitive parameters are determined and to minimize the measurement uncertainty of the test results.

Metallic materials — Tensile testing —

Part 1:
Method of test at room temperature

1 Scope

This part of ISO 6892 specifies the method for tensile testing of metallic materials and defines the mechanical properties which can be determined at room temperature.

NOTE Annex A indicates complementary recommendations for computer controlled testing machines.

2 Normative references

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

ISO 2566-1, *Steel — Conversion of elongation values — Part 1: Carbon and low alloy steels*

ISO 2566-2, *Steel — Conversion of elongation values — Part 2: Austenitic steels*

ISO 7500-1:2004, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 9513:—[1)], *Metallic materials — Calibration of extensometers used in uniaxial testing*

3 Terms and definitions

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

3.1
gauge length
L
length of the parallel portion of the test piece on which elongation is measured at any point during the test

[ISO/TR 25679:2005[3]]

1) To be published. (Revision of ISO 9513:1999)

3.1.1
original gauge length
L_o
length between **gauge length** (3.1) marks on the piece measured at room temperature before the test

NOTE Adapted from ISO/TR 25679:2005[3].

3.1.2
final gauge length after rupture
final gauge length after fracture
L_u
length between **gauge length** (3.1) marks on the test piece measured after rupture, at room temperature, the two pieces having been carefully fitted back together so that their axes lie in a straight line

NOTE Adapted from ISO/TR 25679:2005[3].

3.2
parallel length
L_c
length of the parallel reduced section of the test piece

[ISO/TR 25679:2005[3]]

NOTE The concept of parallel length is replaced by the concept of distance between grips for unmachined test pieces.

3.3
elongation
increase in the **original gauge length** (3.1.1) at any moment during the test

NOTE Adapted from ISO/TR 25679:2005[3].

3.4
percentage elongation
elongation expressed as a percentage of the **original gauge length**, L_o (3.1.1)

[ISO/TR 25679:2005[3]]

3.4.1
percentage permanent elongation
increase in the **original gauge length** (3.1.1) of a test piece after removal of a specified stress, expressed as a percentage of the original gauge length, L_o

[ISO/TR 25679:2005[3]]

3.4.2
percentage elongation after fracture
A
permanent elongation of the gauge length after fracture, ($L_u - L_o$), expressed as a percentage of the **original gauge length**, L_o

[ISO/TR 25679:2005[3]]

NOTE For proportional test pieces, if the original gauge length is not equivalent to $5{,}65\sqrt{S_o}$ [2)] where S_o is the original cross-sectional area of the parallel length, the symbol A should be supplemented by a subscript indicating the coefficient of proportionality used, e.g. $A_{11,3}$ indicates a percentage elongation of the gauge length, L_o, of

$$A_{11,3} = 11{,}3\sqrt{S_o}$$

For non-proportional test pieces (see Annex B), the symbol A should be supplemented by a subscript indicating the original gauge length used, expressed in millimetres, e.g. $A_{80\ \mathrm{mm}}$ indicates a percentage elongation of a gauge length, L_o, of 80 mm.

3.5
extensometer gauge length
L_e
initial extensometer gauge length used for measurement of extension by means of an extensometer

NOTE 1 Adapted from ISO/TR 25679:2005[3].

NOTE 2 For measurement of yield and proof strength parameters, L_e should span as much of the parallel length of the test piece as possible. Ideally, as a minimum, L_e should be greater than $0{,}50L_o$ but less than approximately $0{,}9L_c$. This should ensure that the extensometer detects all yielding events that occur in the test piece. Further, for measurement of parameters “at” or “above” maximum force, L_e should be approximately equal to L_o.

3.6
extension
increase in the **extensometer gauge length**, L_e (3.5), at any moment during the test

[ISO/TR 25679:2005[3]]

3.6.1
percentage extension
“strain”
extension expressed as a percentage of the **extensometer gauge length**, L_e (3.5)

3.6.2
percentage permanent extension
increase in the extensometer gauge length, after removal of a specified stress from the test piece, expressed as a percentage of the **extensometer gauge length**, L_e (3.5)

[ISO/TR 25679:2005[3]]

3.6.3
percentage yield point extension
A_e
in discontinuous yielding materials, the extension between the start of yielding and the start of uniform work hardening, expressed as a percentage of the **extensometer gauge length**, L_e (3.5)

NOTE Adapted from ISO/TR 25679:2005[3].

See Figure 7.

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2) $5{,}65\sqrt{S_o} = 5\sqrt{(4S_o/\pi)}$.

3.6.4
percentage total extension at maximum force
A_{gt}
total extension (elastic plus plastic) at maximum force, expressed as a percentage of the **extensometer gauge length**, L_e (3.5)

See Figure 1.

3.6.5
percentage plastic extension at maximum force
A_g
plastic extension at maximum force, expressed as a percentage of the **extensometer gauge length**, L_e (3.5)

See Figure 1.

3.6.6
percentage total extension at fracture
A_t
total extension (elastic extension plus plastic extension) at the moment of fracture, expressed as a percentage of the **extensometer gauge length**, L_e (3.5)

See Figure 1.

3.7 Testing rate

3.7.1
strain rate
$\dot{e}_{L_e}$
increase of strain, measured with an extensometer, in **extensometer gauge length**, L_e (3.1), per time

NOTE See 3.5.

3.7.2
estimated strain rate over the parallel length
$\dot{e}_{L_c}$
value of the increase of strain over the **parallel length**, L_c (3.2), of the test piece per time based on the **crosshead separation rate** (3.7.3) and the parallel length of the test piece

3.7.3
crosshead separation rate
v_c
displacement of the crossheads per time

3.7.4
stress rate
$\dot{R}$
increase of stress per time

NOTE Stress rate should only be used in the elastic part of the test (method B).

3.8
percentage reduction of area
Z
maximum change in cross-sectional area which has occurred during the test, $(S_o - S_u)$, expressed as a percentage of the original cross-sectional area, S_o:

$$Z = \frac{S_o - S_u}{S_o} \times 100$$

3.9 Maximum force

NOTE For materials which display discontinuous yielding, but where no work hardening can be established, F_m is not defined in this part of ISO 6892 [see footnote to Figure 8 c)].

3.9.1
maximum force
F_m
⟨materials displaying no discontinuous yielding⟩ highest force that the test piece withstands during the test

3.9.2
maximum force
F_m
⟨materials displaying discontinuous yielding⟩ highest force that the test piece withstands during the test after the beginning of work hardening

NOTE See Figure 8 a) and b).

3.10
stress
at any moment during the test, force divided by the original cross-sectional area, S_o, of the test piece

NOTE 1 Adapted from ISO/TR 25679:2005[3].

NOTE 2 All references to stress in this part of ISO 6892 are to engineering stress.

NOTE 3 In what follows, the designations "force" and "stress" or "extension", "percentage extension" and "strain", respectively, are used on various occasions (as figure axis labels or in explanations for the determination of different properties). However, for a general description or definition of a well-defined point on a curve, the designations "force" and "stress" or "extension", "percentage extension" and "strain", respectively, are interchangeable.

3.10.1
tensile strength
R_m
stress corresponding to the **maximum force**, F_m (3.9)

[ISO/TR 25679:2005[3]]

3.10.2
yield strength
when the metallic material exhibits a yield phenomenon, stress corresponding to the point reached during the test at which plastic deformation occurs without any increase in the force

NOTE Adapted from ISO/TR 25679:2005[3].