

Tensile testing of metallic materials —

Part 5: Method of test at elevated temperatures

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Contents

	Page
Cooperating organizations	Inside front cover
National foreword	ii
Foreword	2
Text of EN 10002-5	5
National annex NA (informative)	Inside back cover
National annex NB (informative)	Inside back cover

National foreword

This British Standard has been prepared under the direction of the Iron and Steel and the Non-ferrous Metals Standards Policy Committees. It is identical with EN 10002-5 “*Metallic materials — Tensile testing — Part 5: Method of testing at elevated temperature*” drawn up by ECISS (European Committee for Iron and Steel Standardization).

It supersedes BS 3688-1:1963 which is withdrawn.

Cross-references. Details of European Standards quoted in this British Standard for which there is a corresponding British Standard are given in National appendix NB.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 26, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

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English version

Metallic materials — Tensile testing — Part 5: Method of testing at elevated temperature

Matériaux métalliques — Essai de traction —
Partie 5: Méthode d'essai à température élevée

Metallische Werkstoffe — Zugversuch —
Teil 5: Prüfverfahren bei erhöhter Temperatur

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CEN

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Comité Européen de Normalisation
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Foreword

This European Standard was prepared by the Technical Committee ECISS/TC1A “Mechanical and physical tests”, the Secretariat of which has been allocated to the Association Française de Normalisation (AFNOR).

It represents the fifth part of the general standard: Metallic materials — Tensile testing.

This European Standard replaces the EURONORM: EU 2270 Determination or verification of the yield point of steel at elevated temperatures.

This European Standard EN 10002-5 was approved by CEN on 1991-08-05.

According to the Common CEN/CENELEC Rules, being part of the Internal Regulations of CEN, the following countries are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Contents

	Page
Foreword	2
Introduction	5
1 Scope	5
2 Normative references	5
3 Principle	5
4 Definitions	5
4.1 Gauge length (L)	5
4.2 Parallel length (L_c)	5
4.3 Elongation	5
4.4 Percentage elongation	5
4.5 Extensometer gauge length	6
4.6 Extension	6
4.7 Percentage reduction of area (Z)	6
4.8 Maximum force (F_m)	6
4.9 Stress	6
5 Symbols and designations	7
6 Test pieces	7
6.1 Shape and dimensions	7
6.2 Types	7
6.3 Preparation of test pieces	7
7 Determination of original cross-sectional area (S_0)	7
8 Marking the original gauge length (L_0)	9
9 Testing apparatus	9
9.1 Testing machine	9
9.2 Extensometer	9
9.3 Heating device	9
10 Conditions of testing	10
10.1 Heating of the test piece	10
10.2 Loading of the test piece	10
10.3 Rate of the loading	10
10.4 Method of gripping	10
11 Determination of percentage elongation after fracture (A)	10
12 Determination of proof strength (non-proportional extension (R_p))	11
13 Determination of proof strength (total extension) (R_t)	11
14 Method of verification of permanent set strength (R_r)	12
15 Test report	12

	Page		Page
Annex A (Normative annex) Types of test piece to be used for thin products: sheets, strips and flats between 0.1 mm and 3 mm	20	Table 1 — Symbols and designations	8
Annex B (Normative annex) Types of test piece to be used in the case of wire, bars and sections with a diameter or thickness of less than 4 mm	21	Table 2 — Product types	9
Annex C (Normative annex) Types of test piece to be used in the case of sheets and flats of thickness equal to or greater than 3 mm, and wire, bars and sections of diameter or thickness equal to or greater than 4 mm	21	Table A1 — Dimensions of test pieces	20
Annex D (Normative annex) Types of test piece to be used in the case of tubes	23	Table A2 — Tolerances on the width of the test piece	20
Annex E (Normative annex) Measurement of percentage elongation after fracture, based on sub-division of the original gauge length	24	Table C1 — Circular cross-section test pieces	22
Annex F (Informative annex) List of national standards corresponding to reference Euronorm 18	25	Table C2 — Tolerances relating to the transverse dimensions of test pieces	22
Annex G (Informative annex) Bibliography	25	Table F1 — National standards corresponding to Euronorm 18	26
Figure 1 — Definitions of elongation	12		
Figure 2 — Definitions of upper and lower yield strength for different types of curve	13		
Figure 3 — Proof strength, non-proportional extension (R_p)	14		
Figure 4 — Proof strength, total extension (R_t)	14		
Figure 5 — Permanent set strength (R_r)	15		
Figure 6 — Proof strength, non-proportional extension (R_p)	15		
Figure 7 — Lower yield strength (R_{eL})	16		
Figure 8 — Maximum force (F_m)	16		
Figure 9 — Machined test pieces of rectangular cross section (see Annex A)	17		
Figure 10 — Test pieces comprising a non-machined portion of the product (see Annex B)	17		
Figure 11 — Proportional test pieces (see Annex C)	18		
Figure 12 — Test pieces comprising a length of tube (see Annex D)	18		
Figure 13 — Test piece cut from a tube (see Annex D)	19		
Figure E1 — Example of elongation measurement after fracture	25		

Introduction

The Standard EN 10002 will comprise the following parts:

- *Part 1: Metallic materials; Tensile test; Method of test (at ambient temperature);*
- *Part 2: Metallic materials; tensile test; Verification of the force measuring system of the tensile testing machine;*
- *Part 3: Metallic materials; Tensile test; Calibration of proving devices used for the verification of uniaxial testing machines;*
- *Part 4: Metallic materials; Tensile test; Verification of extensometers used in uniaxial testing;*
- *Part 5: Metallic materials; Tensile test; Method of test at elevated temperatures.*

1 Scope

This European Standard specifies the method for tensile testing of metallic materials and defines the mechanical properties which can be determined thereby at elevated temperature.

For certain particular metallic materials and applications, the tensile test may be the subject of specific standards or particular requirements. It should be noted that tests carried out at the same temperature in accordance with the tensile testing method at ambient temperature (EN 10002/1) and this standard should give different results by reason of different testing conditions, for example the loading rate (see Annex G).

A harmonising of the two tests operating conditions should be envisaged on the occasion of the next revision of the corresponding standards.

2 Normative references

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test at ambient temperature.*

EN 10002-2, *Tensile testing — Verification on the load cell of tensile testing machine.*

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.*

EN 10002-4¹⁾, *Metallic materials — Verification of extensometers used in uniaxial testing.*

EU 18-1979²⁾, *Selection and preparation of samples and test pieces for steel and iron and steel products.*

3 Principle

The test involves straining a test piece by tensile force, generally to fracture, for the purpose of determining one or more of the mechanical properties defined in clause 4.

The test is carried out at the specified temperature.

4 Definitions

For the purposes of this European Standard, the following definitions apply.

4.1 gauge length (L)

Length of the cylindrical or prismatic portion of the test piece on which elongation is measured at any moment during the test. In particular, a distinction is made between:

4.1.1

original gauge length (L_0)

gauge length before heating of the test piece and before application of force

4.1.2

final gauge length (L_u)

gauge length after rupture of the test piece (see 11.1). This length shall be measured at ambient temperature

4.2

parallel length (L_c)

length of the reduced section parallel portion of the test piece

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

4.3

elongation

increase in the original gauge length (L_0) at the end of the test

4.4 percentage elongation

Elongation expressed as a percentage of the original gauge length (L_0).

4.4.1

percentage permanent elongation

increase in the original gauge length of a test piece after removal of a specified stress (see 4.9), expressed as a percentage of the original gauge length (L_0)

¹⁾ In preparation.

²⁾ Until this Euronorm is transformed into European Standards, it can either be used or reference made to the corresponding national standards, a list of which is given in Annex F of this European Standard.

4.4.2

percentage elongation after fracture (A)

permanent elongation of the gauge length after fracture ($L_u - L_0$) expressed as a percentage of the original length (L_0)

NOTE In the case of proportional test pieces, only if the original gauge length is other than $5,65\sqrt{S_0}$,³⁾ where S_0 is the original cross-sectional area of the parallel length, the symbol A shall be supplemented by an index indicating the coefficient of proportionality used, for example:

$A_{11,3}$ = percentage elongation on a gauge length (L_0)

of $11,3\sqrt{S_0}$

In the case of non-proportional test pieces, the symbol A shall be supplemented by an index indicating the original gauge length used, expressed in millimetres, for example:

A_{80} mm = percentage elongation on a gauge length (L_0)

of 80 mm.

4.4.3

percentage total elongation at fracture (A_t)

total elongation (elastic elongation plus plastic elongation) of the gauge length at the moment of fracture expressed as a percentage of the original gauge length (L_0)

4.5

extensometer gauge length (L_e)

length of the parallel portion of the test piece used for the measurement of extension by means of an extensometer (this length may differ from L_0 and shall be of any value greater than b , d or D (see Table 1) but less than the parallel length (L_c))

4.6 extension

Increase in the extensometer gauge length (L_e) at a given moment of the test.

4.6.1

percentage permanent extension

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

4.6.2

percentage yield point extension (A_e)

extension between the start of yielding giving localized deformation and the commencement of homogeneous deformation giving smooth work hardening. It is expressed as a percentage of the extensometer gauge length (L_e)

4.7

percentage reduction of area (Z)

maximum change in cross-sectional area which has occurred during the test ($S_0 - S_u$) expressed as a percentage of the original cross-sectional area (S_0)

4.8

maximum force (F_m)

the greatest force which the test piece withstands during the test once the yield point has been passed

4.9 stress

Force at any moment during the test divided by the original cross-sectional area (S_0) of the test piece.

4.9.1

tensile strength (R_m)

stress corresponding to the maximum force (F_m)

4.9.2 yield strength

When the metallic material exhibits a yield phenomenon, a point is reached during the test at which plastic deformation occurs without any increase in the force. A distinction is made between:

4.9.2.1

upper yield strength (R_{eH})

value of stress at the moment when the first decrease in force is observed (see Figure 2)

4.9.2.2

lower yield strength (R_{eL})

lowest value of stress during plastic yielding, ignoring any transient effects (see Figure 2)

4.9.3

proof strength, non-proportional extension (R_p)

stress at which a non-proportional extension is equal to a specified percentage of the extensometer gauge length (L_e) (see Figure 3). The symbol used is followed by a suffix giving the prescribed percentage of the extensometer gauge length, for example $R_{p0,2}$

4.9.4

proof strength, total extension (R_t)

stress at which total extension (elastic extension plus plastic extension) is equal to the specified percentage of the extensometer gauge length (L_e) (see Figure 4). The symbol used is followed by a suffix giving the prescribed percentage of the original gauge length for example: $R_{t0,5}$

4.9.5

permanent set strength (R_r)

stress at which, after removal of force, a specified permanent elongation or extension expressed respectively as a percentage of the original gauge length (L_0) or extensometer gauge length (L_e) has not been exceeded (see Figure 5). The symbol used is followed by a suffix giving the specified percentage of the original gauge length or of the extensometer gauge length (L_e), for example: $R_{r0,2}$

³⁾ $5,65\sqrt{S_0} = 5\sqrt{\frac{4S_0}{\pi}}$