SLOVENSKI STANDARD
SIST EN 10002-1:1996

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Kovinski materiali - Natezni preskus - 1. del: Metoda preskušanja pri navadni temperaturi

Metallic materials - Tensile testing - Part 1: Method of test (at ambient temperature)

Metallische Werkstoffe - Zugversuch - Teil 1: Prüfverfahren(bei Raumtemperatur)

Matériaux métalliques - Essais de traction - Chapitre 1: Méthode d'essai (a la température ambiante).

Ta slovenski standard je istoveten z: EN 10002-1:1990/AC1:1990

ICS:

77.040.10 Mehansko preskušanje kovin Mechanical testing of metals

SIST EN 10002-1:1996 **en**

EUROPEAN STANDARD

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EUROPAISCHE NORM

EN 10 002
Part 1

March 1990

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Key words: Metal products, mechanical tests, tensile tests, determination, mechanical properties, elongation.

English version

Metallic materials - Tensile testing - Part 1: Method of test

Matériaux métalliques - Essais de traction - Chapitre 1: méthode d'essai

Metallische Werkstoffe - Zugversuch - Teil 1: Prüfverfahren

This European Standard was accepted by CEN on 1989-11-27.
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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN Central Secretariat or to any CEN member.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

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BRIEF HISTORY

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

It represents the first part of the general standard : Metallic materials - Tensile testing.

This European Standard replaces the EURONORMS:

EU 2-80 : Tensile testing for steel

EU 11-80 : Tensile test for steel sheet and strip less than 3mm thick

This European Standard was adopted by CEN on 1989-11-27

According to the Common CEN/CENELEC Rules, being part of the Internal Regulations of CEN, the following countries are bound to implement this European Standards : Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

FOREWORD

The Standard EN 10 002 will comprise the following parts:

Part 1 : Metallic materials; Tensile test; Method of test (at ambient temperature

Part 2 : 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.

CONTENTS

1. Object and field of application

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

For certain particular metallic materials and applications, the tensile test may be the subject of specific standards or particular requirements.

2. References

EN 10 002-2 1) Metallic materials ; Tensile testing ; Part 2 : Verification of tensile testing machines

ISO 2566-1-1984 Steel - Conversion of elongation values - Part 1 : Carbon and low alloy steels

ISO 2566-2-1984 Steel - Conversion of elongation values - Part 2 : Austenitic steels.

ISO/DIS 9513 2) Metallic materials - Verification of extensometers used in uniaxial testing

EU 18-1979 3) 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 ambient temperature between 10 °C and 35 °C, unless otherwise specified. Tests carried out under controlled conditions shall be made at a temperature of 23 ± 5°C.

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1) In preparation

2) Pending the preparation of Part 4 of this European Standard

3) Until this EURONORM is transformed into a European Standard 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. 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_o): Gauge length before application of force.

4.1.2 Final gauge length (L_u): Gauge length after rupture of the test piece (see 11.1).

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_o) at the end of the test.

4.4 Percentage elongation: Elongation expressed as a percentage of the original gauge length (L_o).

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_o)

4.4.2 Percentage elongation after fracture: (A) Permanent elongation of the gauge length after fracture ($L_u - L_o$), expressed as a percentage of the original length (L_o).

Note. In the case of proportional test pieces, only if the original gauge length is other than $5{,}65\sqrt{S_o}$ 4), where S_o 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_o) of $11{,}3\sqrt{S_o}$

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_o) 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_o)

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

4.4.4 **Percentage elongation at maximum force:** Increase in the gauge length of the test piece at maximum force, expressed as a percentage of the original gauge length (L_o). A distinction is made between the percentage total elongation at maximum force (A_{gt}) and the percentage non-proportional elongation at maximum force (A_g) (see figure 1).

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_o 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 ($S_o - Su$) expressed as a percentage of the original cross-sectional area (S_o).

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_o) 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: $R_{t\ 0,5}$.

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_o) 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: Rr0,2.

5. Symbols and designations

Symbols and corresponding designations are given in table 1.

Table 1 - Symbols and designations

Reference Number 1)	Symbol	Unit	Designation
Test piece			
1	a	mm	Thickness of a flat test piece or wall thickness of a tube
2	b	mm	Width of the parallel length of a flat test piece or average width of the longitudinal strip taken from a tube or width of flat wire
3	d	mm	Diameter of the parallel length of a circular test piece, or diameter of round wire or internal diameter of a tube
4	D	mm	External diameter of a tube
5	Lo	mm	Original gauge length
6	Lc	mm	Parallel length
-	Le	mm	Extensometer gauge length
7	Lt	mm	Total length of test piece
8	Lu	mm	Final gauge length after fracture
9	So	mm2	Original cross-sectional area of the parallel length
10	Su	mm2	Minimum cross-sectional area after fracture
11	Z	%	Percentage reductionof area: $\left(\frac{S_o - S_u}{S_o}\right) 100$
12	-	-	Gripped ends

Table 1

Reference Number	Symbol	Unit	Designation
Elongation			
13	-	mm	Elongation after fracture: $L_u - L_o$
14	$A^{2)}$	%	Percentage elongation after fracture: $\left(\frac{L_u - L_o}{L_o}\right) 100$
15	Ae	%	Percentage yield point extension
16		%	Percentage non-proportional elongation at maximum force F_m
17		%	Percentage total elongation at maximum force F_m
18	At	%	Percentage total elongation at fracture
19	-	%	Specified percentage non-proportional extension
20	-	%	Percentage total extension
21	-	%	Specified percentage permanent set extension or elongation
Force			
22	Fm	N	Maximum force

Table 1 concluded

Reference Number	Symbol	Unit	Designation
Yield strength - Proof strength - Tensile strength			
23	R_{eH}	N/mm^2 3)	Upper yield strength
24	R_{eL}	N/mm^2	Lower yield strength
25	R_m	N/mm^2	Tensile strength
26	R_p	N/mm^2	Proof strength, non-proportional extension
27	R_t	N/mm^2	Permanent set strength
28	R_t	N/mm^2	Proof strength, total extension
-	E	N/mm^2	Modulus of elasticity

1) See figures 1 to 13

2) See 4.4.2

3) 1 N/mm2 = 1 MPa