INTERNATIONAL STANDARD 89

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Steel — Tensile testing of wire

Acier — Essai de traction des fils

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 89 was drawn up by Technical Committee ISO/TC 17, *Steel*, and circulated to the Member Bodies in March 1972.

It has been approved by the Member Bodies of the following countries :

Australia	France	South Africa, Rep. of
Austria	Germany	Spain
Belgium	Hungary	Sweden
Canada	India	Switzerland
Chile	Ireland	Thailand
Czechoslovakia	Italy	Turkey
Denmark	Netherlands	United Kingdom
Egypt, Arab Rep. of	New Zealand	U.S.A.
Finland	Romania	U.S.S.R.

The Member Body of the following country expressed disapproval of the document on technical grounds :

Norway

This International Standard cancels and replaces ISO Recommendation R 89-1959.

Steel — Tensile testing of wire

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies requirements for the tensile testing of steel products which have usually been cold-worked and are of constant cross-section, either round, square, rectangular, or special. The dimensions of the cross-section are always very small compared with the usual lengths produced, and for wire of rectangular or special cross-section the ratio of width to thickness is generally less than 4. The diameter, or other characteristic dimension, is usually not greater than 10 mm.

For the tensile testing of other steel products, ISO 82, ISO 86 and ISO 375 are applicable.

2 REFERENCES

ISO 82, *Steel — Tensile testing.*

ISO 86, *Steel — Tensile testing of sheet and strip less than 3 mm and not less than 0,5 mm thick.*

ISO 375, *Steel — Tensile testing of tubes.*

ISO/R 147, *Load calibration of testing machines for tensile testing of steel.*

ISO/R 205, *Determination of proof stress and proving test for steel at elevated temperatures.*

ISO/R 783, *Mechanical testing of steel at elevated temperatures — Determination of lower yield stress and proof stress and proving test.*

ISO 2573, *Determination of K-values of a tensile testing system.*[1)]

3 PRINCIPLE

The test consists in straining a test piece by tensile stress, generally to fracture, with a view to determining one or more of the mechanical properties enumerated hereafter.

The test is carried out at ambient temperature unless otherwise specified. For tests at elevated temperatures, ISO/R 205 and ISO/R 783 are applicable.

1) At present at the stage of draft.

4 DEFINITIONS

4.1 gauge length : The prescribed part 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 to be made between the following :

4.1.1 original gauge length (L_o) : Gauge length before the test piece is strained;

4.1.2 final gauge length (L_u) : Gauge length after the test piece has been fractured and the fractured parts have been carefully fitted together so that they lie in a straight line.

4.2 extensometer gauge length (L_e) : The length of the parallel portion of the test piece used for the measurement of extension by means of an extensometer. (The length may differ from L_o).

4.3 percentage permanent elongation : Increase in the gauge length of a test piece subjected to a prescribed stress (see 4.11) and after removal of the stress, expressed as a percentage of the original gauge length. If a symbol for this elongation is used, it is to be supplemented by an index indicating the prescribed stress.

4.4 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.

NOTE – The symbol A is to be supplemented by a suffix denoting the gauge length. The suffix units are to be identified, for example A_{10d}, $A_{200\text{ mm}}$.

4.5 percentage reduction of area (Z) : Ratio of the maximum change in cross-sectional area which has occurred during the test, $S_o - S_u$, to the original cross-sectional area, S_o, expressed as a percentage. (S_u = minimum cross-sectional area after fracture.)

4.6 maximum load (F_m) : The highest load which the test piece withstands during the test.

4.7 stress (actually "nominal stress") : At any moment during the test, load divided by the original cross-sectional area of the test piece.

4.8 tensile strength (R_m) : Maximum load divided by the original cross-sectional area of the test piece, i.e. stress corresponding to the maximum load.

4.9 proof stress (non-proportional elongation) (R_p) : The stress at which a non-proportional elongation, equal to a specified percentage of the original gauge length, occurs. (See figure 2.)

When a proof stress (R_p) is specified, the non-proportional elongation is to be stated (for example 0,2 %) and the symbol used for the stress is to be supplemented by an index giving this prescribed percentage of the original gauge length, for example $R_{p0,2}$.

4.10 proof stress (total elongation) or **proof stress under load** (R_t) : The stress at which a non-proportional elongation plus elastic elongation, equal to a specified percentage of the original gauge length, occurs. (See figure 3.)

When a proof stress (R_t) is specified, or agreed between the interested parties, the total elongation is to be stated and the symbol used for the stress is to be supplemented by an appropriate index, for example $R_{t0,5}$.

NOTE – The value obtained by this total elongation method will only be equivalent to R_p if suitable allowance is made for the measurement of elastic extension.

4.11 permanent set stress (R_r); **(stress at permanent set limit)** : The stress at which, after removal of load, a prescribed permanent elongation, expressed as a percentage of the original gauge length, occurs. The symbol used for this stress is to be supplemented by an index giving the prescribed percentage of the original gauge length, for example $R_{r0,2}$ (See figure 4.)

5 SYMBOLS AND DESIGNATIONS

Symbols and designations are given in the table below.

Number	Preferred symbol	Designation
1	d	Diameter or characteristic dimension of round wire (Figure 1)
2	a	Thickness of flat wire (Figure 1)
3	b	Width of flat wire (Figure 1)
4	L_o 1)	Original gauge length (Figure 1)
5	L_c	Parallel length
—	L_e	Extensometer gauge length
6	L_t	Total length (Figure 1)
7	—	Gripped ends (Figure 1)
8	L_u	Final gauge length after fracture (Figure 1)
9	$L_u - L_o$	Permanent elongation after fracture (Figure 5)
10	A	Percentage elongation after fracture $\left(\frac{L_u - L_o}{L_o}\right) 100$
	(e.g. $A_{200\ mm}$)	(Percentage elongation on a gauge length of 200 mm)
11	S_o	Original cross-sectional area of the gauge length (Figure 1)
12	S_u	Minimum cross-sectional area after fracture (Figure 1)
13	R_p	Proof stress (non-proportional elongation) or yield strength (offset) 2) (Figure 2)
	(e.g. $R_{p0,2}$)	(0,2 % proof stress)
14	R_t	Proof stress (total elongation) or yield strength (total elongation) 2) (Figure 3)
	(e.g. $R_{t0,5}$)	(0,5 % total elongation)
15	R_r	Permanent set stress (Figure 4)
	(e.g. $R_{r0,2}$)	(0,2 % permanent set stress)
16	F_m	Maximum load
17	Z	Percentage reduction of area $\left(\frac{S_o - S_u}{S_o}\right) 100$
18	R_m 1)	Tensile strength $\frac{F_m}{S_o}$ (Figure 5)

1) In correspondence and where no misunderstanding is possible, the symbols L_o and R_m may be replaced by L and R respectively.

2) The latter term is used in the U.S.A. and in Canada.

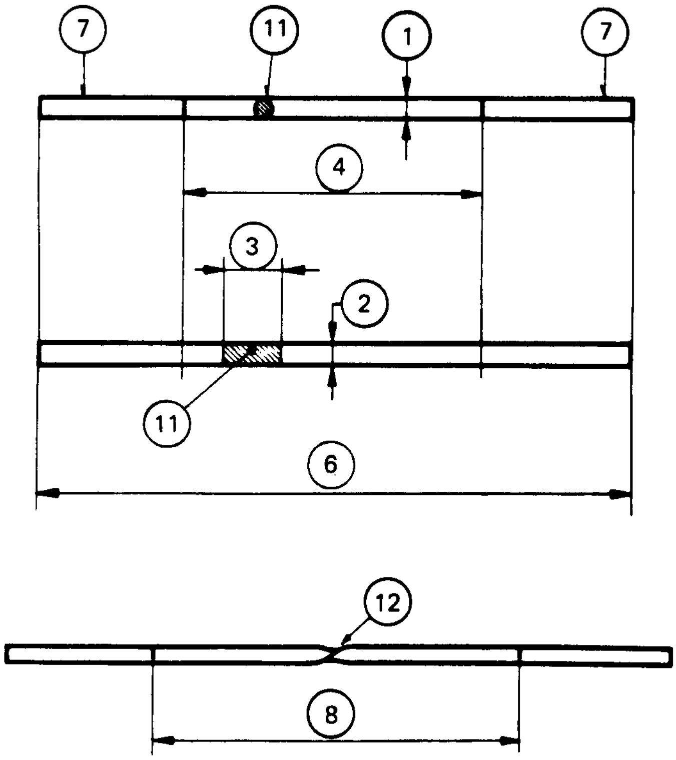

FIGURE 1

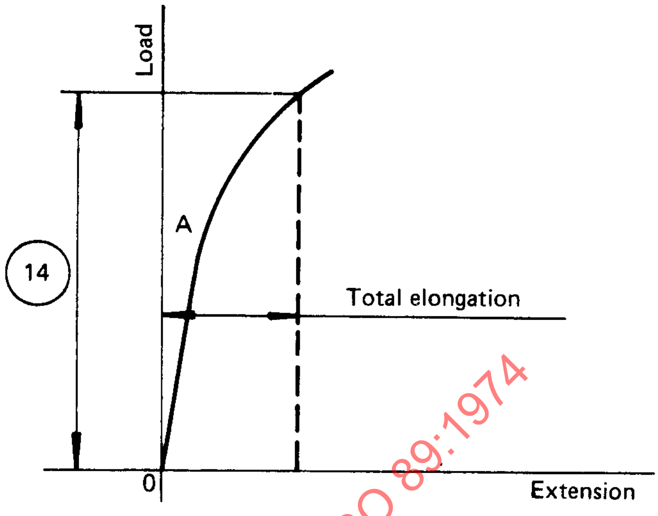

FIGURE 3

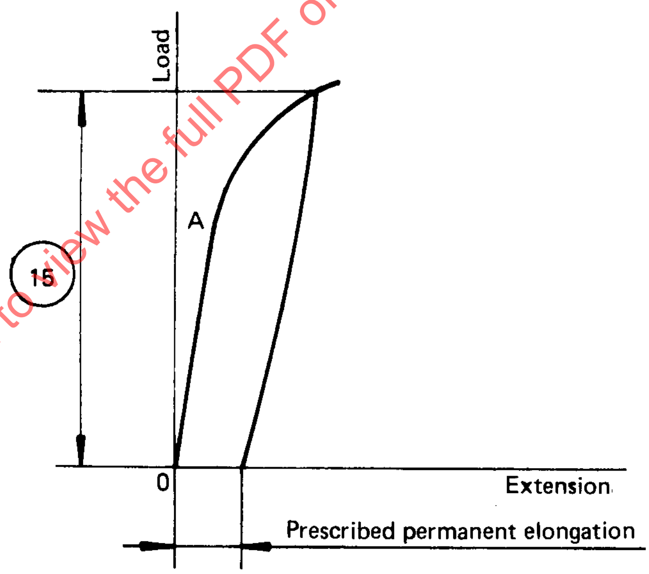

FIGURE 4

Load/extension diagrams :

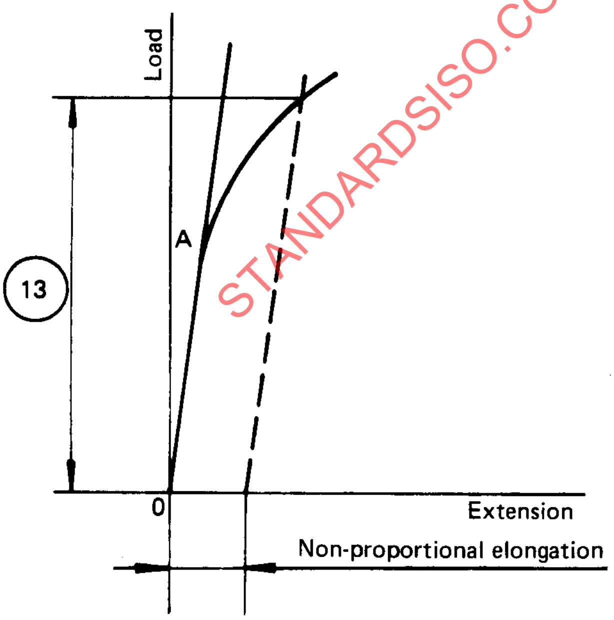

FIGURE 2

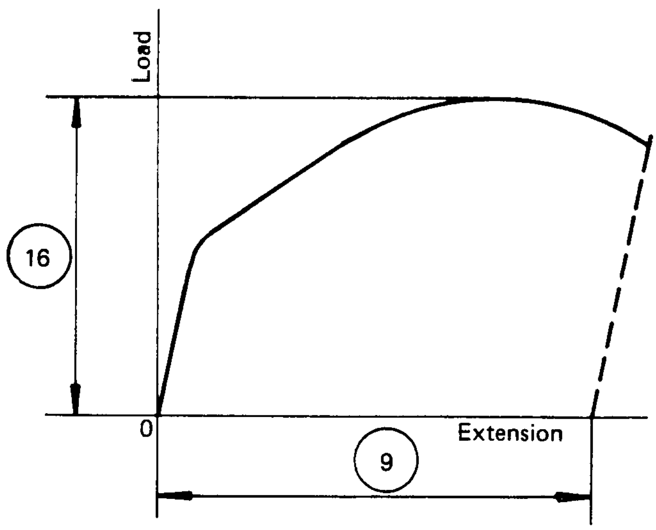

FIGURE 5

A = Elastic limit