

Revised

**ISO**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

**ISO RECOMMENDATION  
R 89**

**TENSILE TESTING OF STEEL WIRE**

1st EDITION  
February 1959

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## BRIEF HISTORY

The ISO Recommendation R 89, *Tensile Testing of Steel Wire*, was drawn up by Technical Committee ISO/TC 17, *Steel*, the Secretariat of which is held by the British Standards Institution (B.S.I.).

The drawing up of an ISO Recommendation concerning this test was decided on at the third meeting of ISO/TC 17, held in London, in December 1953. The Technical Committee instructed its Working Group No. 1, *Methods of Mechanical Testing for Steel*, to prepare a draft proposal which was circulated to the members of the Technical Committee in August 1954.

The draft proposal was considered with the comments received from the Member Bodies at the fourth meeting of the full Committee, held in Stockholm, in June 1955, and was adopted, with a number of small amendments, as a Draft ISO Recommendation.

On 31 January 1957, the Draft ISO Recommendation (No. 160) was submitted to all the ISO Member Bodies and, subject to a few modifications, was approved by the following Member Bodies:

*Australia	*Greece	Pakistan
Belgium	Hungary	Portugal
*Canada	*Ireland	Spain
Czechoslovakia	Italy	Sweden
Denmark	Japan	Union
Finland	Mexico	of South Africa
Germany	*New Zealand	

One Member Body opposed the approval of the Draft: France.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in February 1959, to accept it as an ISO RECOMMENDATION.

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\* These Member Bodies stated that they had no objection to the Draft being approved.

## TENSILE TESTING OF STEEL WIRE

### 1. SCOPE

This ISO Recommendation applies to products of constant cross-section and mainly characterized by this section, in particular its form and dimensions. The dimensions of the cross-section are always very small compared with the usual lengths produced and the ratio of the dimension defining the width to that defining the thickness is generally less than 4.

### 2. PRINCIPLE OF TEST

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

### 3. DEFINITIONS

**3.1 Gauge length.** At any moment during the test, the prescribed part of the test piece on which elongation is measured. In particular, a distinction should be made between the following:

- (a) *the original gauge length ( $L_o$ ).* Gauge length before the test piece is strained; and
- (b) *the 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.

**3.2 Percentage permanent elongation.** Variation of the gauge length of a test piece subjected to a prescribed stress (see clause 3.8) and after removal of same, expressed as a percentage of the original gauge length. The symbol of this elongation is supplemented by an index indicating the prescribed stress.

**3.3 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  $L_o$ .

**3.4 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.

**3.5** *Maximum load ( $F_m$ )*. The highest load which the test piece withstands during the test.

**3.6** *Final load ( $F_u$ )*. Load imposed on the test piece at the moment of fracture.

**3.7** *Load at yield point ( $F_e$ )*. Load at which the elongation of the test piece first increases without increase of load or with decrease of load.

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

**3.9** *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.

**3.10** *Yield stress ( $R_e$ )*. Stress at yield point. If, in testing, a drop in the load is observed, the stress corresponding to the highest load is known as the "upper yield point" and the stress corresponding to the lowest load subsequently observed is known as the "lower yield point".

**3.10.1** In assessing the values of the upper and lower yield points, the characteristics of the testing machine should be taken into consideration; for example, the inertia of the dynamometer of the testing machine may result in the load dropping below the true lower yield point.

**3.11** *Stress at permanent set limit*. Stress at which, after removal of load, a prescribed permanent elongation, expressed as a percentage of the original gauge length, occurs; the prescribed value may frequently be 0.2 per cent (see Fig. 3 (a), page 6).

**3.11.1** The symbol used for this stress is supplemented by an index giving the prescribed percentage of the original gauge length, e.g. 0.5.

**3.12** *Stress at proof limit*. Stress at which a non-proportional elongation, equal to a specified percentage of the original gauge length, occurs. When a stress at proof limit is specified, the non-proportional elongation should be stated, e.g. proof limit 0.1 per cent or 0.2 per cent (see Fig. 3 (b), page 6).

**3.12.1** The symbol used for this stress is supplemented by an index giving the prescribed percentage of the original gauge length, e.g. 0.1.

## 4. SYMBOLS AND DESIGNATION

Number	Symbol	Designation
1	$d^*$	Diameter of a round wire, or, with other sections, diameter of the minimum circumscribing circle
2	$a$	Thickness of a flat wire
3	$b$	Width of a flat wire
4	$L_o^{**}$	Original gauge length
5	$L_t$	Total length
6	—	Gripped ends
7	$S_o$	Original cross-sectional area of the gauge length
8	$L_u$	Final gauge length
9	$S_u$	Minimum cross-sectional area after fracture
10	—	Permanent elongation after yield limit
11	$F_e$	Load at yield point
12	$R_e$	Yield stress
13	$F_m$	Maximum load
14	$R_m^{**}$	Tensile strength
15	$F_u$	Final load, i.e. load at moment of fracture
16	$L_u - L_o$	Permanent elongation after fracture
17	$A$	Percentage elongation after fracture $\frac{L_u - L_o}{L_o} \times 100$
18	$Z$	Percentage reduction of area $\frac{S_o - S_u}{S_o} \times 100$
19	—	Stress at permanent set limit
20	—	Permanent set limit
21	—	Stress at proof limit
22	—	Proof limit

\* The minimum circumscribing circle is the smallest circle which completely circumscribes the whole periphery of the cross-section, but it need not pass through more than two points.

\*\* In correspondence and where no misunderstanding is possible, the symbols  $L_o$  et  $R_m$  may be replaced by  $L$  and  $R$  respectively.

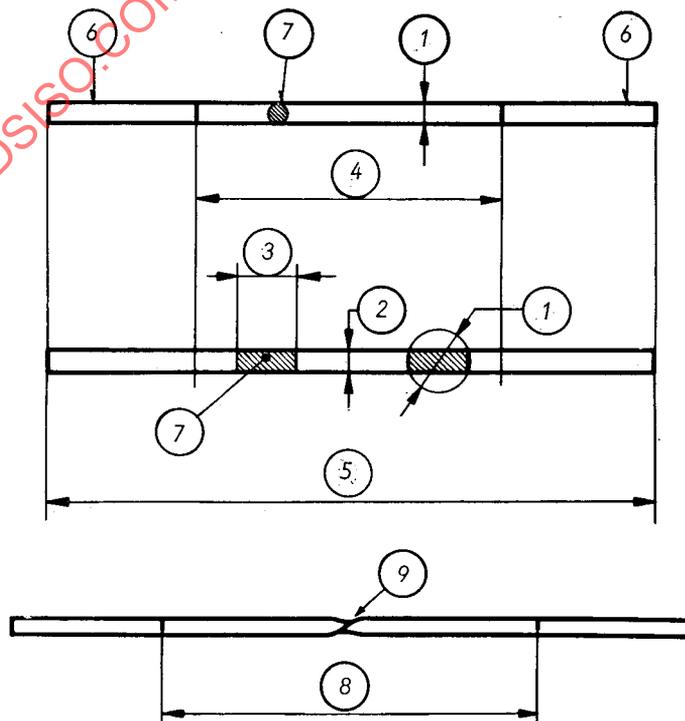
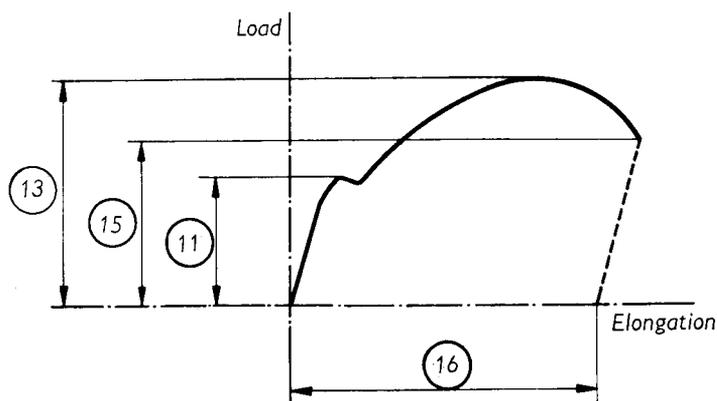


FIG. 1



F G. 2

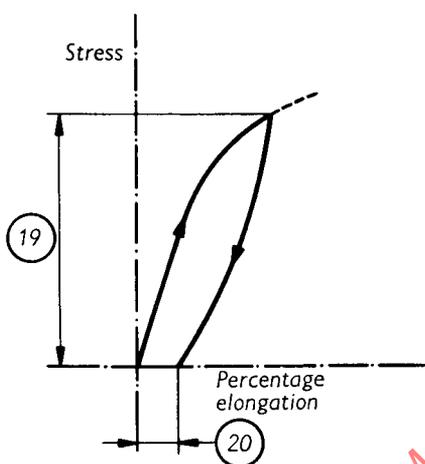


FIG. 3(a)

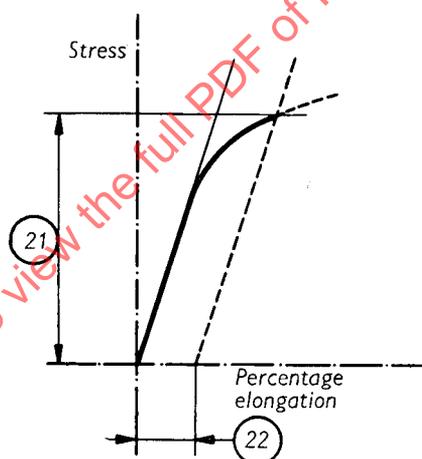


FIG. 3(b)

## 5. TEST PIECES

**5.1** The test piece consists of a straight piece of wire of such a length that the distance between the grips of the machine is not less than 150 mm.

**5.2** If a test piece having a gauge length  $L_0 = 11.3 \sqrt{S_0}$  is used, such test pieces are known as proportional test pieces.

**5.2.1** When test pieces other than proportional test pieces are used, the gauge length should, in principle, be equal to 100 mm (4 in); however, for steels having small elongations, e.g. less than 5 per cent, the specification for the product may fix a gauge length of 200 mm (8 in).

**5.2.2** The gauge length used should be stated in the test report.