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Steel wire ropes — Test method — Determination of measured breaking force

Câbles en acier — Méthode d'essai — Détermination de la force de rupture mesurée

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Contents

Page

Foreword ..... **iv**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Principle **2**
5 Sample preparation **2**
5.1 General 2
5.2 Molten metal or resin socketing method 3
5.3 Ferrule pressing method 3
5.4 Direct gripping method 4
5.5 Sample preparation by method of wrapping 4
6 Test equipment **4**
7 Procedure **4**
8 Test report **5**
Bibliography **6**

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 105, *Steel wire ropes*.

This second edition cancels and replaces the first edition (ISO 3108:1974), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the following clauses have been added:

  — Terms and definitions (see Clause 3);

  — Principle (see Clause 4);

  — Sample preparation (see Clause 5);

  — Testing machine requirements (see Clause 6);

  — Safety requirements (see 7.6);

  — Testing result justification (see 7.8);

— the test speed of the load applied at approximately 10 Mpa per second after 80 % of F_{min} achieved has been changed to the speed at the rate of not more than 0,5 % of F_{min} per second (see 7.6).

Steel wire ropes — Test method — Determination of measured breaking force

1 Scope

This document specifies a method of tensile test to destruction for determining the actual breaking force of steel wire ropes as given in ISO 2408.

It is also applicable for other ropes, unless the International Standard concerned specifically excludes its use, or gives another method.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 7500-1, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system*

ISO 17558, *Steel wire ropes — Socketing procedures — Molten metal and resin socketing*

ISO 17893, *Steel wire ropes — Vocabulary, designation and classification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17558, ISO 17893 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
force at first wire breaking
force value measured when breaking of the first wire occurs during the tensile testing process

3.2
minimum breaking force
F_{min}
specified value, expressed in kilonewtons, below which the *measured breaking force* (F_m) (3.3) shall meet or exceed in a prescribed breaking force test and which is normally obtained by

$$F_{min} = \frac{d^2 \times R_r \times K}{1\,000}$$

where

d is the nominal diameter;

R_r is the rope grade;

K is the breaking force factor.

3.3
measured breaking force
F_m
measured breaking force value of steel wire rope, expressed in kilonewtons

3.4
method of molten metal socketing
procedure whereby a socket or cone is attached to a wire rope by means of molten metal

3.5
method of resin socketing
procedure whereby a socket or cone is attached to a wire rope by means of resin

3.6
method of ferrules pressing
sampling method of tensile test in which the two ends of the rope piece are equipped with suitable ferrules and pressed firmly with a press machine

3.7
method of direct gripping
method of tensile test in which the rope pieces are directly gripped by wedges in the test machine

3.8
method of wrapping
method of tensile test in which the rope pieces are directly wrapped in the grooves of sheave

4 Principle

Apply a tensile force on the wire rope piece until fracture occurs to determine the actual breaking force, or until the force reaches or exceeds the required minimum breaking force or a specified value.

5 Sample preparation

5.1 General

5.1.1 The wire rope shall be cut by abrasive wheel, percussive or shearing methods, paying particular attention not to disturb the position of the wires below the permanent serving. Cutting methods that fuse the wire rope end shall not be used.

5.1.2 Unused wire rope pieces should be cut from wire ropes free from damage. They should be straight and without any flexure.

5.1.3 Used wire rope pieces should be cut from agreed upon sections.

5.1.4 Temporary servings shall be used to hold the strands and wires in position during the cutting operation.

5.1.5 The permanent serving shall be soft wire or strand for rope. Materials used for permanent serving shall preserve the rope lay. If the test piece is to be terminated with molten metal, the serving material should be capable of withstanding the temperature involved in the socketing procedure. Copper and brass wires should not be used for servings.

5.1.6 The minimum free test length, excluding terminations, shall be in accordance with Table 1.

5.1.7 The total length of the test piece is made up of the test length plus an allowance for gripping.

Table 1 — Test length

Dimensions in millimetres

Nominal diameter of steel wire rope d	Minimum test length L	
	Stranded rope	Spiral rope
$d \leq 6$	≥300	≥500
$6 < d \leq 20$	≥600	≥1 000
$20 < d \leq 60$	≥30d	≥50d
$d > 60$	≥3 000	

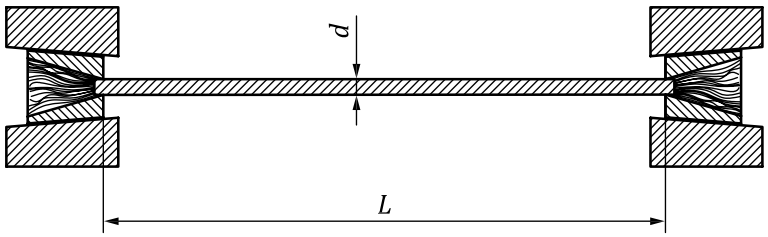
NOTE For large diameter rope, a minimum of six rope lay lengths may be required to achieve the minimum breaking force.

5.2 Molten metal or resin socketing method

5.2.1 The molten metal or resin socketing sample preparation method shall comply with ISO 17558. Figure 1 shows the conditions of the test piece terminated by this method.

5.2.2 The method of molten metal applies to wire ropes with a diameter of no less than 6mm or a wire diameter of no less than 0,5 mm.

5.2.3 The method of resin socketing applies to all kinds of wire ropes.



Key

d nominal diameter

L minimum test length

Figure 1 — Test piece terminated by molten metal or resin socketing method.

5.3 Ferrule pressing method

5.3.1 Suitable metal fittings should be chosen. The inner diameter, wall thickness and length of the fittings should ensure that the breaking location of the rope after testing is effective. The inner and outer wall at both sides of the fittings should be chamfered.

5.3.2 This method applies to wire ropes with all kinds of core. For wire ropes with a fibre core, the fibre core at the pressing section should be removed and replaced by a tapered steel bar with the same diameter before pressing.

5.3.3 Sleeve the test piece with metal fittings at both ends and press the fittings firmly in the pressing machine.

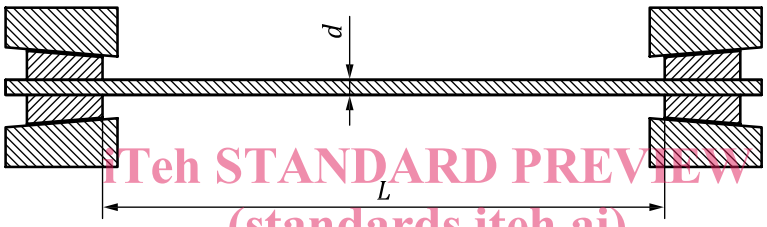
5.3.4 The surface of the rope piece should not be damaged during pressing.

5.4 Direct gripping method

5.4.1 Wedge grips or liners suited to the diameter of the rope shall be selected.

5.4.2 The ends of the test piece may extend beyond the wedge grips/liners, see Figure 2.

5.4.3 This method applies to tensile test on spiral strand wire ropes or wire ropes with other constructions.



Key

d nominal diameter

L minimum test length

Figure 2 — Test piece held by wedge grips

5.5 Sample preparation by method of wrapping

5.5.1 Sheave suited to the diameter of wire ropes shall be selected.

5.5.2 This method applies to wire ropes with all kinds of cores. But the ratio of wrapping sheave diameter to nominal diameter of the wire ropes should be no less than 16.

6 Test equipment

The testing machine shall comply with ISO 7500-1.

7 Procedure

7.1 In general, the test shall be carried out at an ambient temperature within the limits of 10 °C to 35 °C. In a strictly controlled test, the test temperature shall be maintained at 23 °C ± 5 °C.

7.2 Place the test piece on the test machine, ensure the centre axis of the test piece is in alignment with the centreline of the grips on the test machine.

7.3 For tensile pieces treated with the molten metal or resin socketing method, when a vertical machine is used, one end of the test piece should be held in the upper jaw, then set the force-measuring system to zero before attaching the lower fitting.

7.4 For the direct gripping method, a proper fixture should be chosen. Aluminium foil with carborundum can be used, if necessary, between the test piece and the fixture to avoid damage of the test piece by the fixture.

7.5 During the test, effective measures should be taken to avoid the rotation of the rope pieces which will affect the test accuracy.

7.6 The test force should be applied steadily during the test. It may be applied quickly until it exceeds 80 % of the minimum breaking force, F_{min}. After 80 % of F_{min} has been achieved, the force shall be applied at a rate of not more than 0,5 % F_{min} per second.

It is important to observe safety procedures in the tensile testing of wire rope for the operator of the machine, as well as for observers and the surroundings, as uncontained wires during testing can impact and penetrate objects at a great distance. Adequate safety shields placed directly around samples, as well as around the operator and observers, should be used as a minimum.

7.7 Properties such as elongation at a specified force, elongation at fracture, force at first wire breaking, etc. can also be monitored according to the requirements.

7.8 The test may be discounted in cases where the rope fracture occurs within a distance of six rope diameters from the base of the grip or the termination and the minimum breaking force has not been achieved.

NOTE Improper end termination selection, improper attachment of end termination or improper alignment in the tensile machine will cause a reduction in the wire ropes' measured breaking force.

8 Test report

The test report shall contain at least the following information, unless otherwise agreed by the parties concerned:

a) a reference to this document, i.e. ISO 3108;

b) the identification of the rope piece by direct traceability to the supplied rope;

c) the nominal diameter of the rope;

d) the condition of the piece, e.g. unused, used, etc.;

e) the sampling method, e.g. method of molten metal or resin socketing, methods of ferrule pressing, method of direct gripping, method of wrapping, etc.;

f) the test condition, e.g. effective length, loading speed, test temperature, etc.;

g) the test results, i.e. measured breaking force and required minimum breaking force.