
**Fibre ropes — Determination of certain
physical and mechanical properties**

*Cordages en fibres — Détermination de certaines caractéristiques
physiques et mécaniques*

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 2307 was prepared by Technical Committee ISO/TC 38, *Textiles*.

This fourth edition cancels and replaces the third edition (ISO 2307:2005), which has been technically revised.

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Fibre ropes — Determination of certain physical and mechanical properties

1 Scope

This International Standard specifies, for ropes of different kinds, a method of determining each of the following characteristics:

- linear density;
- lay length;
- braid pitch;
- elongation;
- breaking force.

The linear density, lay length and braided pitch are measured with the rope under a specified tension called the reference tension, as specified in Annex A.

The elongation corresponds to the measured increase in length of the rope when the tension to which it is subjected is increased from an initial value (reference tension) to a value equal to 50 % of the minimum specified breaking strength of the rope.

The breaking force is the maximum force registered (or reached) during a breaking test on the test piece, carried out on a tensile testing machine with constant rate of traverse of the moving element. The breaking force values given in the tables of rope specifications are only valid when this type of testing machine is used.

When it is not possible to test the whole section of rope, the method described in Annex B can be used, subject to agreement between the parties involved.

This International Standard also provides a method for measuring water repellency, lubrication and finish content, and heat setting treatment, when requested by the customer.

2 Normative references

The following referenced documents are indispensable for the application 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 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 1968, *Fibre ropes and cordage — Vocabulary*

ISO 9554:2010, *Fibre ropes — General specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1968 and the following apply.

3.1

unspliced breaking force

breaking force which is obtained by application of the method described in 9.7.2

3.2

spliced breaking force

breaking force which is obtained by application of the method described in 9.7.3

4 Principle

4.1 Calculation of the linear density

The linear density is obtained by measurement of the mass and the length, under a reference tension, of a conditioned test piece.

4.2 Measurement of the lay length and braid pitch

This measurement is taken at the time of application of the reference tension.

4.3 Measurement of the elongation of the rope

This measurement is taken by comparing the lengths of a section of the test piece that has been subjected successively to

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- a) the reference tension, and
 - b) a tension equal to 50 % of the minimum specified breaking force for the rope.

4.4 Measurement of the breaking force

This measurement is carried out by increasing the tension in 4.3 b) to the breaking point.

5 Apparatus

5.1 Tensile testing machine, accommodating the assumed breaking force of the rope, which allows a constant rate of traverse of the moving element, in accordance with 9.5, and measurement of the breaking force to an accuracy of ± 1 %.

Different types of tensile testing machines may be used:

- pulley-type grip (“*cors de chasse*” testing machine);
- testing machine with bollards for eye splices;
- wedge-grip testing machine.

In the case of a “*cors de chasse*” tensile testing machine, the diameter of the pulleys or catches holding down the test pieces shall be equal to at least 10 times that of the rope being tested.

In the case of a testing machine with bollards, the diameter of the bollards passing through the eye-spliced test pieces shall be at least twice the diameter of the rope being tested.

5.2 Balance, allowing measurement of mass to an accuracy of ± 1 %.

6 Sampling

6.1 Sample size

When specified by the purchaser, a lot sample for acceptance testing shall be taken at random in accordance with 6.4.

6.2 Sample unit

If required, test samples shall be taken from each shipping unit, in the lot in the number and the length required to perform the specified tests. The test samples shall be included in the delivered mass or length.

As an alternative, the manufacturer's production and inspection records may be used, if agreed upon between the purchaser and the manufacturer.

6.3 Composition of the batch to be sampled

Samples shall be taken from a homogeneous batch, i.e. consisting of ropes of the same size and same dimensions and which have been subject to the same series of manufacturing operations and the same control procedure.

6.4 Selection of samples

Take the number N_S of samples at random from the batch in accordance with Equation (1):

$$N_S = 0,4 \sqrt{N} \quad \text{ISO 2307:2010} \quad (1)$$

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where N is the batch size, expressed as the number of 220 m coils.

When the calculated value of N_S is not a whole number, the number obtained shall be rounded to the nearest whole number.

EXAMPLE 27,5 and 30,35 are rounded to 28 and 30, respectively.

Where $N_S < 1$, take one sample length.

7 Test pieces for tensile testing and force-elongation

7.1 Length

The test piece shall be of adequate length to give an effective length, L_U (see 9.3), between terminations which is at least equal to that given in Table 1, when mounted on the tensile testing machine (see Figures 1, 2 and 3).

Table 1 — Effective lengths

Type of rope	Type of mounting device	Minimum effective length, L_U mm
Man-made fibre ropes, reference number ≤ 10	all types	400
Man-made fibre ropes, reference number > 10 and ≤ 20	“cors de chasse”	400
	bollard type	1 000
	wedge grip	—
Man-made fibre ropes, reference number > 20	bollard type	2 000 ^a
Natural fibre ropes	all types	2 000

^a If the lay length is greater than 360 mm, L_U shall be increased to 5 lay lengths, if possible.

7.2 Number of test pieces

Take one test piece from each sample.

7.3 Taking the test pieces

Take the test piece either from one end of the samples, or from the body of the samples if they are intended to be cut. Take all necessary steps to prevent unlaying. If necessary, remove slightly unlayed ends.

8 Conditioning

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Ropes shall be tested in the ambient atmosphere, except in cases of dispute, when the test piece shall be placed in the atmosphere specified in ISO 139 for at least 48 h, immediately prior to testing.

9 Procedure

9.1 General

For the measurement of force-elongation and breaking force, perform the procedures specified in 9.2 to 9.7 sequentially.

For the linear density, perform the procedures specified in 9.8.

9.2 Initial measurements

Lay the test piece out straight on a flat surface by pressing with a slight force of the hand (not exceeding 20 % of the reference tension) (see Annex A).

Make two “w” marks on the test piece, spaced symmetrically with regard to its mid-point, and at a distance apart of l_0 that is greater than 400 mm.

In exceptional circumstances, when $L_U < 400$ mm, l_0 and l_2 (see 9.4) are measured on a separate test piece, with a minimum length of 400 mm, following the same procedure; the value l_2 is obtained by applying the appropriate tension by means of weights and a pulley.

9.3 Mounting the test piece on the testing machine

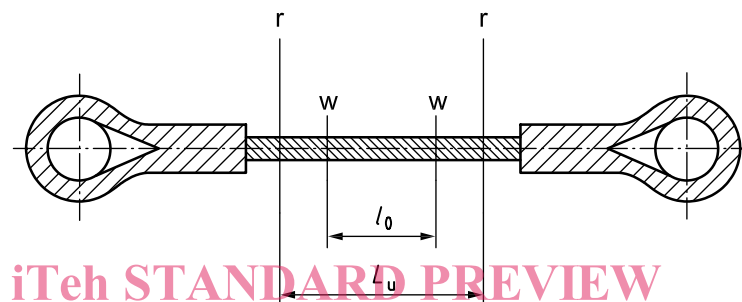
Fix the ends of the test piece onto the machine, in order to obtain the effective length of the test piece specified in 7.1.

In the case of a test on splices, the eyes shall have a minimum internal length of 6 times the rope diameter when closed; their production is left to the manufacturer's discretion.

In the case of man-made fibre ropes, it is recommended that the ends of the splices be tapered to finish.

Outside the segment l_0 , make two "r" marks on the test piece, delimiting the section in which a rupture is considered as normal, as shown in Figures 1 to 3.

The distance from each mark "r" to the end of the splice (or to the tangent point in the case of a "cors de chasse") shall be a minimum of twice the diameter and a maximum of three times the diameter of the rope.



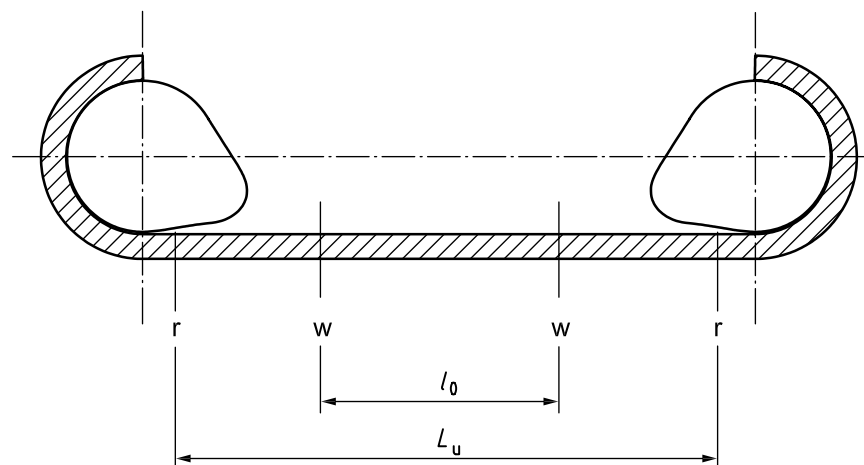
Key

r limiting marks for the standard test

L_u effective length measured with no tension [ISO 2307:2010](https://standards.iteh.ai/catalog/standards/sist/2174e774-647e-4547-ba5d-0e4fc9ec1d49/iso-2307-2010)

w limiting marks for [l₀](https://standards.iteh.ai/catalog/standards/sist/2174e774-647e-4547-ba5d-0e4fc9ec1d49/iso-2307-2010)

Figure 1 — Effective length, L_u , for testing machines with bollards for eye splices applied to ropes of reference number 20 and above



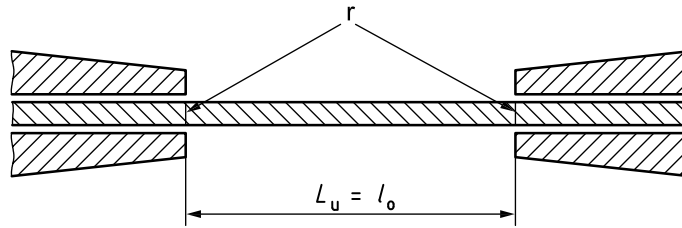
Key

r limiting marks for the standard test

L_u effective length measured with no tension

w limiting marks for l_0

Figure 2 — Effective length, L_u , for pulley-type grips ("cors de chasse") testing machine applied to ropes of reference number < 20



Key

- r limiting marks for the standard test
- L_u effective length measured with no tension

Figure 3 — Effective length, L_u , for wedge-grip testing machine applied to ropes of reference number < 20

9.4 Measurement of lay and gauge length

Apply the reference tension specified for the type of rope being tested (refer to Annex A) to the test piece and measure the following:

- a) the length of the maximum number of lays possible within L_u , expressed in millimetres;

NOTE The length of lay for laid ropes, and plait pitch for 8- and 12-strand ropes, are shown in Figures 4, 5 and 6, respectively.

- b) the distance between the two “w” marks. Let this distance be l_2 , the gauge length, expressed in millimetres, under the reference tension.

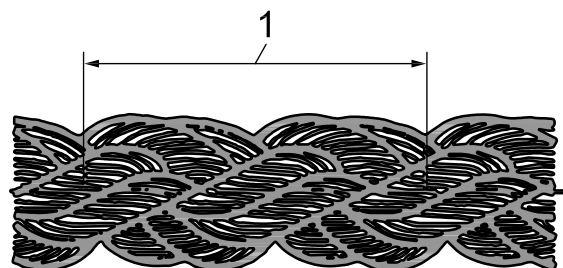


Key

- 1 one lay of a 3-strand rope

NOTE This also applies to 4- and 6-strand ropes, and this figure showing one lay of a 3-strand rope is provided as an example.

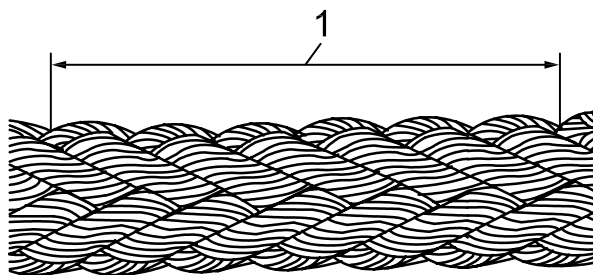
Figure 4 — Length of lay for 3-, 4- and 6-strand ropes



Key

- 1 one-plait pitch

Figure 5 — Plait pitch for 8-strand braided rope

**Key**

1 one-plait pitch

Figure 6 — Plait pitch for 12-strand braided rope**9.5 Bedding-in of the test piece**

Before testing to the breaking point, subject the sample three times to a cyclic load between the reference tension and 50 % of the minimum breaking force of the rope. The test speed is (250 ± 50) mm/min, unless otherwise specified in a specific rope standard.

9.6 Measurement of the elongation of the rope

Increase the tension again by moving the moving element of the testing machine. The test shall be carried out at a speed of (250 ± 50) mm/min, unless otherwise specified in a specific rope standard.

When the tensile force reaches 50 % of the minimum breaking force, measure the distance between the “w” marks (the stoppage necessary for measurement shall be as brief as possible). Designate this distance as l_3 , the gauge length, expressed in millimetres, for a tensile force equal to 50 % of the specified minimum breaking force.

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By previous agreement between the purchaser and supplier, a force-elongation curve, recorded during the tensile tests up to 50 % of the minimum breaking force of the rope, may be supplied.

It may be requested that the elongation be determined on a particular test piece. In this case, the procedure given in Annex C shall be followed to obtain the force-elongation coordinates.

9.7 Measurement of the breaking force

9.7.1 Continue to increase the tension, at the same speed, until a strand breaks.

Record the breaking force and the place on the test piece where the break occurs.

9.7.2 If an unspliced breaking force is specified, the specimen shall be deemed to meet the requirement if the break occurs:

- within the “r” marks and at a force equal to or higher than the specified value, or
- outside the “r” marks and at a force equal to or higher than 90 % of the specified value.

In the latter case, it should not be assumed that the true breaking force of the specimen would be represented by multiplying the result by 10/9.

9.7.3 If a spliced minimum breaking force is specified, the specimen shall be deemed to meet the requirement if it breaks at a force equal to or higher than the value for ropes with eye-spliced terminations, as indicated in the relevant standard.