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Fibre ropes — Determination of certain physical and mechanical properties

Cordages en fibres — Détermination de certaines caractéristiques physiques et mécaniques

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Foreword

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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.

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ISO 2307 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 248, *Textiles and textile products*, in collaboration with Technical Committee ISO/TC 38, *Textiles*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 2307:1990), which has been technically revised.

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;

— braided 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 may 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 — Terms and definitions*

ISO 9554:—[1)], *Fibre ropes — General specification*

1) To be published. (Revision of ISO 9554:1991)

3 Terms and definitions

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

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 (see Clause 9 and Annex C).

4.2 Measurement of the lay length and braided pitch length

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

a) the reference tension;

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

$$N_S = 0{,}4\sqrt{N} \quad (1)$$

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

7.1 Length

The test piece shall be of adequate length to give an effective length, L_u (see 9.2), between terminations which is at least equal to that given in Table 1, when mounted on the tensile testing machine (see Figure 1).

Table 1 — Effective lengths

Type of rope	Type of mounting device	Minimum effective length, L_u mm
Man-made fibre ropes, reference number $\leqslant$ 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 $\geqslant$ 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 unlaid ends.

8 Conditioning

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

Perform the procedures specified in 9.2 to 9.7 sequentially.

9.2 Initial measurements

Lay the test piece out straight with a slight hand force (not to exceed 20 % of the reference tension) on a flat surface. Measure the initial length L_0, in metres, to the nearest millimetre.

Mark two "w's" 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.

NOTE When $L_u < 400$ mm, L_0 and l_2 are measured on a separate test piece, with a length of 400 mm minimum, following the same procedure; the value l_2 is obtained by applying the appropriate tension by means of weights and a pulley.

Determine the mass, m, expressed in grams, of the test piece to the nearest 0,5 %.

An alternative method for ropes sizes greater than reference number 70 is given in Annex C.

9.3 Mounting the test piece on the testing machine

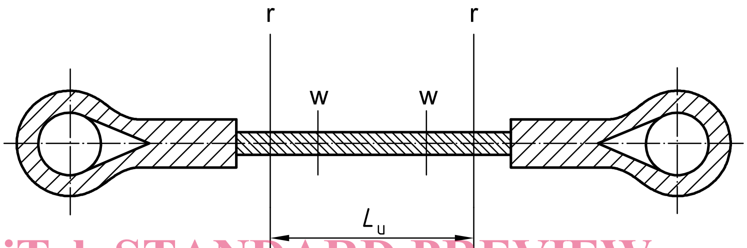
Fix the ends of the test piece onto the machine in order to obtain the effective length of test piece specified in 7.1.

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, mark two “r's” 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 splice (or to the tangent point in the case of a “cors de chasse”) shall be a minimum of two times the diameter and a maximum of three times the diameter of the rope.

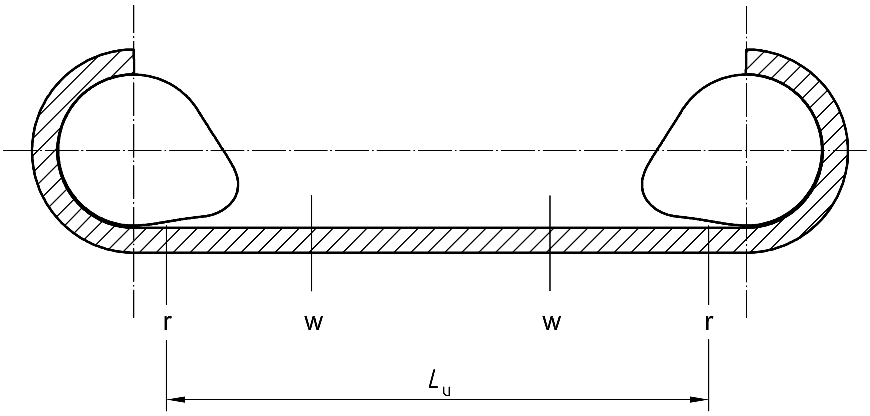


Key

r limiting marks for the standard test

L_u effective length measured with no tension

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

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

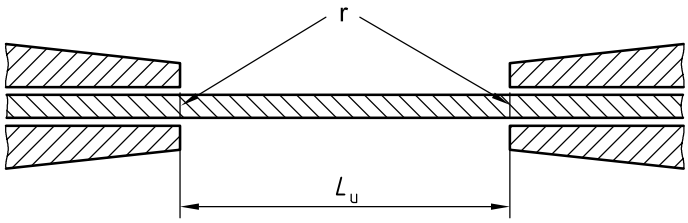


Figure 3 — Effective length, L_u, for wedge-grip testing machine applied to ropes of reference number < 20

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-strand rope are shown in Figures 4, 5 and 6, respectively.

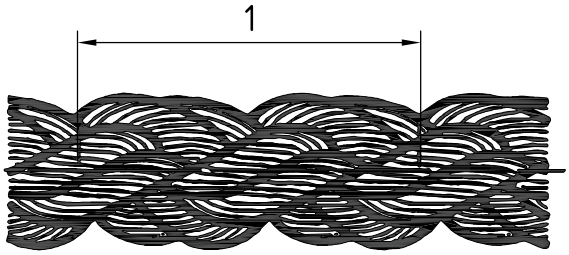
b) the distance between the two "w" marks. Let this distance be l_2, the gauge length, expressed in millimetres, under the reference tension.

Key

1 one lay of a 3-strand rope

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

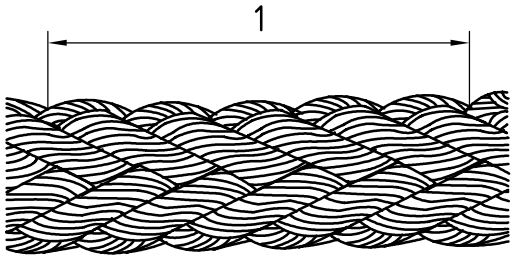
Figure 4 — Length of lay for 3-, 4- and 6-strand ropes



Key

1 one plait pitch

Figure 5 — Length of plait pitch for 8-strand braided rope



Key

1 one plait pitch

Figure 6 — Length of plait pitch for 12-strand braided rope

9.5 Bedding-in of the test piece

Before testing to the breaking point, subject the sample to a cyclic load of three times 50 % of the minimum breaking force of the rope. The test speed of (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.

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 D shall be followed to obtain the force-elongation co-ordinates.

9.7 Measurement of the breaking force

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.

The specimen shall be deemed to meet the requirements if the break occurs outside "r" marks and at a force not less than 90 % of the minimum breaking force of the cordage. It should not be assumed that the true breaking force of the specimen would be represented by multiplying the result by 10/9.

10 Expression and interpretation of results

10.1 General

For the linear density, lay length or braided pitch and elongation (see 10.2 to 10.4), the numerical result of a test is the arithmetic mean of the individual values obtained on each test piece in the batch. As far as the tensile strength is concerned (see 10.5), the result is expressed by giving the breaking force for each of the test pieces in the batch, without calculating the mean value.

The individual values are obtained as given in 10.2 to 10.5.