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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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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).

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For an explanation of 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 www.iso.org/iso/foreword.html.

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

This fifth edition cancels and replaces the fourth edition (ISO 2307:2010), which has been technically revised. The main changes compared to the previous edition are as follows:

— inclusion of diameter in the scope, and describe methods to measure it;

— changes in test length;

— changes in test speed;

— inclusion of another method for determination of realization factor in Annex B;

— addition of a sample of a test report (Annex D).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Fibre ropes — Determination of certain physical and mechanical properties

1 Scope

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

— linear density;

— diameter;

— lay length;

— braid pitch;

— elongation;

— breaking force.

This document also provides a method for measuring water repellence, lubrication and finish content, when requested by the customer.

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 139, *Textiles — Standard atmospheres for conditioning and testing*

ISO 1968, *Fibre ropes and cordage — Vocabulary*

ISO 9554, *Fibre ropes — General specifications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1968 in ISO 9554 and the following apply.

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

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

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

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
force at which the rope breaks, 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 the reference tension specified in Annex A, of a conditioned test piece.

4.2 Measurement of the diameter, lay length and braid pitch

These measurements are 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 (this length is called l_0, see Figures 1, 2 and 3), and

b) a tension equal to 50 % of the minimum specified breaking force for the rope. Alternatively, additional elongation measurements may be made in increments of, for example, 10 % tension, from 10 % to 50 % of the minimum specified breaking force of the rope. See 9.6 for procedures and safety recommendations.

4.4 Measurement of the breaking force

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

Alternatively, the methods described in Annex B can be used, subject to agreement between the parties involved. In such case, a mention shall be made in the test report that the breaking strength was calculated from yarn test results

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 %.

The stroke and bed length should be long enough to extend the specimen to rupture in one continuous pull.

NOTE In case a specimen is pulled to break to rupture in more than one pull, the result can be affected.

Different types of tensile testing machines may be used:

— bollard-type grip testing machine;

— testing machine with pins for eye splices;

— wedge-grip testing machine.

In the case of a bollard-type tensile testing machine, the diameter of the bollard or capstan 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 pins, the diameter of the pins passing through the eye-spliced test pieces shall be of an adequate size so that the rope does not break in the eye, in principle 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 Composition of the batch to be sampled

Samples shall be taken from a homogeneous manufacturing 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.

If additional information is required, test samples shall be taken from each shipping unit (manufacturing batch), with the necessary characteristics to perform the specified tests. The 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.

6.2 Sample size

Batch samples for acceptance testing shall be taken at random in accordance with 6.3 or as per a sampling plan defined and accepted by both the purchaser and the manufacturer.

6.3 Selection of samples

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

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

where N is the batch size, expressed as the number of continuous lengths or coils.

NOTE A typical coil size is 220 m.

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 measurements

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 5 pitches or lays or 400 mm, whichever is greater.

7.2 Number of test pieces

Take one test piece from each sample.

7.3 Taking the test pieces

7.3.1 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.

An alignment line should be marked along the rope specimen surface, parallel to its axis, using a suitable marking device. When the rope specimen is mounted on the test bed, it shall be arranged such that the marked line is straight.

7.3.2 When testing the rope on pins, eye splices shall be made in accordance with the rope manufacturer's instructions. In case of a deviation of the manufacturer's instructions, the result can be different. The splice method used shall then be documented with the report. The splice shall be suitable for general rope service and should not be a special design intended to enhance performance during testing.

Eye splices shall be of sufficient size that the rope does not break in the eye. In principle, the eyes shall have a minimum internal length of 6 times the rope diameter when closed.

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

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 Clause 10.

9.2 Initial measurements

Lay the test piece out straight on a flat surface by pulling 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.

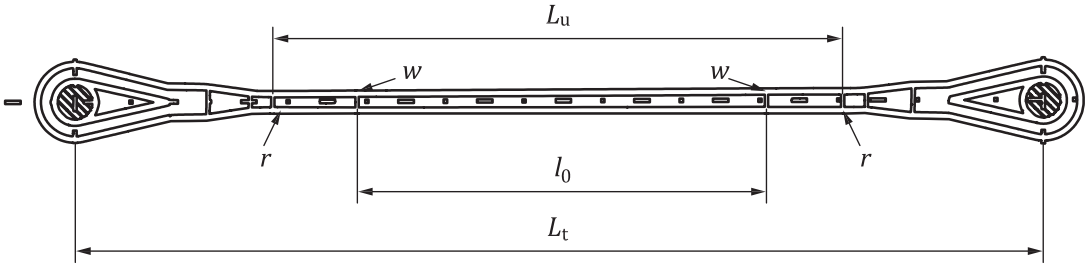
9.3 Mounting the test piece on the testing machine

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.

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 bollard) shall be a minimum of twice the diameter and a maximum of three times the diameter of the rope.

For testing a sample with a braider splice (see ISO 9554:2019, 4.4.3), the marked braider splice shall be located in the middle of the test specimen, with a minimum of 400 mm of undisturbed rope between the ends of the braider splice and the "*r*" marks on either side of it.



Key

r limiting marks for the standard test

l_0 length measured with no tension

L_u effective length measured with no tension

L_t length from the middle of the pin to the middle of the pin measured at reference tension

w limiting marks for l_0

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

Key

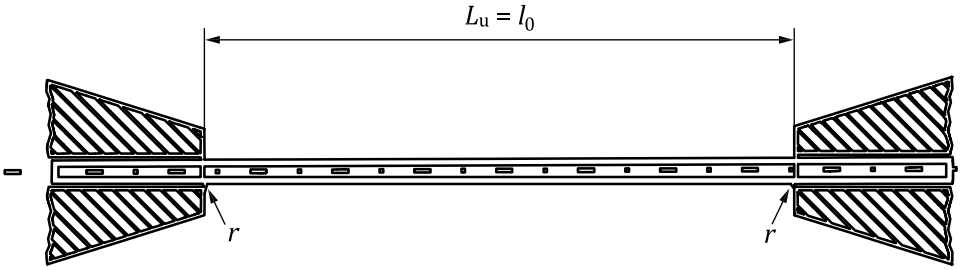
r limiting marks for the standard test

l_o length measured with no tension

L_u effective length measured with no tension

w limiting marks for l_0

Figure 2 — Effective length, L_u, for bollard-type grips testing machine applied to ropes of reference number < 20 mm



Key

r limiting marks for the standard test

l_o length measured with no tension

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 mm

9.4 Measurement of diameter, lay length or braid pitch 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) Diameter or circumference. The circumference can either be measured with a suitable tape or a low-stretch yarn.

— With a measuring tape, wrap it around the rope, apply a moderate tension, and read the circumference while it is still in contact with the rope.

— With a low-stretch yarn, wrap it once around the rope. Apply moderate tension and mark the yarn at the point of overlap. Then remove the marked portion of the yarn from the rope. Measure the circumference as the length of the marked portion.

Do this measurement on at least three positions more than 2 lay lengths or braid pitches apart.

Alternatively, a suitable caliper may also be used. A caliper is considered suitable for measuring rope diameter if it has sufficient wide or long measuring jaws to make contact with at least two strand crowns along each side of the rope. Apply a moderate compression. Secure the caliper feet in this position. Remove the calipers from the rope and read the value.

This measurement should also be done at least three positions more than 2 lay lengths or plait pitches apart. At each position two measurements should be taken, which are 90° apart.

The resulting diameter or circumference is the average of the three measurements.

b) The length of the maximum number of lays possible (or braid pitch) within L_u, expressed in millimetres.

Do this measurement on at least three positions more than 2 lay lengths or plait pitches apart.

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.

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

