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## Fibre ropes — General specifications

*Cordages en fibres — Spécifications générales*

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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.

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](http://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](http://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 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](http://www.iso.org/iso/foreword.html).

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

This fourth edition cancels and replaces the third edition (ISO 9554:2010), which has been technically revised. The main changes compared to the previous edition are as follows:

- methodology for rope design and strength realization factor has been introduced;
- strand interchanges have been introduced;
- [Table A.1](#) has been updated;
- [Annex C](#) has been updated.

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](http://www.iso.org/members.html).

# Fibre ropes — General specifications

**IMPORTANT** — It is the responsibility of the user to select a rope that is fit for purpose, i.e. of the right size and with the physical properties that meet the requirements of the application and to determine the limitations prior to its use.

## 1 Scope

This document specifies the general characteristics of fibre ropes and their constituent materials. It is intended to be used in conjunction with the standards for the individual types of fibre rope, which cover the physical properties and specific requirements for that particular product type.

This document also gives some information on the use of fibre ropes and also on their inspection and retirement criteria.

This document does not intend to address all of the safety matters associated with its use.

## 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 1968, *Fibre ropes and cordage — Vocabulary*

ISO 2307, *Fibre ropes — Determination of certain physical and mechanical properties*

## 3 Terms and definitions

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

#### **strand interchange**

overlapping continuation, in a braided rope, of a single interrupted strand (or multiple strand) with another identical strand which follows an identical path in the braid

### 3.2

#### **minimum breaking strength**

#### **MBS**

force a fibre rope shall at least achieve when tested following a recognized procedure/test method

Note 1 to entry: The MBS is set by each manufacturer, as per their own internal statistical methods based on breaking tests. In [Annex D](#), two statistical methods are given that can be used to determine the MBS.

## 4 Manufacture

### 4.1 Constituent materials

The following materials are considered in this document:

a) natural fibres:

- sisal;
- manila;
- hemp;
- cotton.

b) man-made fibres:

- polyamide, PA;
- polyester, PES;
- polypropylene, PP;
- polyethylene, PE;
- mixed polyolefin, PP/PE;
- polyester/polyolefin dual fibres;
- high modulus polyethylene, HMPE;
- Para-Aramid, AR;
- Polyarylate, LCP;

— Polybenzobisoxazole, PBO. <https://standards.iso/ba1d68a9-e507-4558-a3ed-53fa79614fb7/iso-9554-2019>

Typical characteristics for these materials are given in [Annex A](#). Specific applications should involve technical discussions with rope manufacturers.

### 4.2 Construction and structure

#### 4.2.1 Laid ropes

Unless otherwise specified, 3-, 4- and 6-strand laid ropes shall be Z-twist (right-hand lay), their strands S-twist and their roping yarns Z-twist.

#### 4.2.2 Braided ropes

The 8-strand braided ropes shall consist of four S-twist strands and four Z-twist strands arranged so that S-twist strands alternate (individually or in pairs) with Z-twist strands (individually or in pairs).

The 12-strand braided ropes shall consist of six S-twist strands and six Z-twist strands arranged so that S-twist strands alternate (individually or in pairs) with Z-twist strands (individually or in pairs).

#### 4.2.3 Double-braided ropes

A double-braided rope shall consist of a number of strands that are braided to form a core, around which additional strands are braided to form a sheath. The core lies coaxially within the sheath. The number of strands varies, based upon the size of the rope.

#### 4.2.4 Covered ropes

A covered rope consists of a core protected by a non-load bearing cover. A parallel rope construction is a covered rope where the core consists of a number of sub-ropes.

#### 4.2.5 Strands

Each strand shall consist of an equal number of rope yarns sufficient to provide the characteristics specified in the International Standard for the relevant product. For ropes of reference number 36 or higher, the number of yarns in each strand may differ by one yarn or  $\pm 2,5$  % from the intended number of yarns in the strand.

The ropes and their strands should be continuous, without splice for standard delivered lengths or shorter lengths. However, some lengths or methods of manufacture impose limitations. To overcome these limitations, strand interchanges can be used, these shall be in accordance with [4.4.3](#).

Yarns may be joined as necessary.

The strands can be assembled yarns.

#### 4.2.6 Lay length or braid pitch

The manufacturer shall establish the lay length or the braid pitch of the rope according to its intended use, or based upon the purchaser's acceptance.

NOTE For a given reference number of rope, the smaller the lay length or braid pitch, the harder the rope will be. This hardness can affect the estimated breaking strength of the rope.

### 4.3 Treatment

#### 4.3.1 Polyamide and polyester ropes

**4.3.1.1** Polyamide and polyester laid ropes that are required to be heat set to ensure lay and dimensional stability are designated as type 1 ropes in the relevant product standard.

**4.3.1.2** In other cases, polyamide and polyester laid ropes that are not required to have a heat setting on the rope are designated as type 2 ropes in the relevant product standard.

If type 1 or 2 are not specified in a particular product standard, it shall be understood that heat setting is not considered for that particular product.

**4.3.1.3** The fibre producer or the rope manufacturer may apply a finish to the fibre to control friction, fibre tension and reduce fibre damage during manufacturing. The total amount of additives or extractable materials shall not exceed 2,5 % in mass.

**4.3.1.4** Upon request of the purchaser, the manufacturer may use a coating or impregnation of the product for special applications.

#### 4.3.2 Polypropylene and polyethylene ropes

Polypropylene and polyethylene ropes shall be protected against deterioration due to sunlight (UV).

The inhibiting system used should ensure the expected performance in usage under the foreseen geographical areas for applications, provided that the manufacturer is kept informed by the user.

### 4.3.3 High modulus polyethylene ropes

4.3.3.1 High modulus polyethylene ropes are typically coated.

4.3.3.2 High modulus polyethylene ropes may be subject to a heat setting process. Heat set ropes of HMPE are designated as type 1 ropes in the relevant product standard.

4.3.3.3 High modulus polyethylene ropes which have not been heat set are designated as type 2 ropes in the relevant product standard.

Heat setting usually enhances the breaking strength of a high modulus polyethylene rope. However, the overall life time of the rope may be decreased.

### 4.3.4 Manila and sisal

#### 4.3.4.1 General

All ropes of manila and of sisal shall be made exclusively of new fibres.

#### 4.3.4.2 Manila

A cordage oil lubricant of suitable quality shall be applied. The lubricant shall not impart an offensive odour to the finished rope. The percentage of extractable matter based on the dry weight of the rope shall not be less than 11,5 % nor more than 16,5 %.

When specified, the rope shall have a mildew-resistant treatment.

Anti-bacterial additives for manila may be added to extend the performance of the natural fibre when requested by the purchaser.

#### 4.3.4.3 Sisal

A cordage oil lubricant of suitable quality shall be applied. The lubricant shall not impart an offensive odour to the finished rope. The percentage of extractable matter based on the dry weight of the rope shall not be more than 11,5 % for an un-oiled product and not more than 16,5 % for an oiled product.

When specified, the rope shall be free from any oils and sold as un-oiled rope.

Anti-bacterial additives for sisal may be added to extend the performance of the natural fibre when requested by the purchaser.

## 4.4 Workmanship

4.4.1 The finished rope shall contain no cuts, kinks or soft spots caused by change in lay or pitch length, hockles, chafed or damaged sections, or broken, loose or projecting ends in the rope or the strands.

4.4.2 The unspliced ends of all ropes shall be cut off squarely and shall be securely whipped, taped or heat-sealed.

4.4.3 Strand interchanges, when present in 12-strand ropes or sub ropes, shall be staggered along the length of the rope and at sufficient distance apart. The interrupted and replacement strands are arranged



in parallel over some distance and are buried or tucked into the braid so as to secure them into the braid. To maintain strength, the strands shall overlap one another for a sufficient distance.

A test sample including a strand interchange in one strand shall achieve 100 % of the specified minimum breaking strength (MBS) when tested in accordance with ISO 2307.

NOTE For strand interchanges in double braid ropes, see the relevant product standard.

The process of strand interchange shall be completely documented. Documentation shall contain at least the following information and shall be available to an inspector upon request:

- length of one strand interchange;
- minimum distance between two strand interchanges;
- total length of the strand interchange;
- positions of the strand interchanges from beginning to end in the rope.

If required, every splice of a strand/part shall be permanently marked (for example by paint) on the rope in order to enable early detection of a strand interchange slipping apart, and to distinguish a strand interchange from damage. Strand interchanges are allowed only in 12-strand braided ropes.

## 5 Rope design

Ropes of different sizes are considered to be of the same design when the following rope parameters remain constant across the size range:

- a) rope yarn;
- b) dimensionless lay of strand is fixed (= lay of strand divided by diameter of the strand);
- c) dimensionless lay length or braid pitch is fixed (= lay of rope divided by diameter of the rope);
- d) type of equipment used;
- e) coating type, pick-up and penetration (when applicable);
- f) quality control and splicing.

The design should be reported in a design specification sheet containing general information on the company, independent inspector, rope design and prototype tests done to validate the design. This specification should be made available to interested parties on request. See [D.3.1](#).

The details of rope design and prototype tests should be given in a second sheet (see [D.3.2](#)). Details of the fibre used for the design are specified in [D.3.3](#). These last two sheets should be made available for inspection by independent inspectors on request of interested parties.

## 6 Requirements

The main requirements shall be those specified in the relevant International Standard for the product and shall include the following:

- a) reference number;
- b) linear density;
- c) minimum breaking force.

The test methods for b) and c) are specified in ISO 2307.

Other requirements, for example the lay length, the braid pitch, the diameter of the circumscribed circle, and the elongation of the rope under specific tensile conditions, may be specified, subject to agreement between the manufacturer and the purchaser.

## 7 Marking and labelling

### 7.1 Marking

#### 7.1.1 General

The identification of the material, quality and origin of a fibre rope conforming to this document shall be marked using a tape placed within the article (see 7.1.3) so as to remain recognizable despite soiling, soaking or discoloration during use.

The tape shall be at least 3 mm wide, and shall be printed with the number of the relevant International Standard, and a reference identifying the manufacturer. The maximum distance between two consecutive markings shall be 0,5 m.

#### 7.1.2 Ropes of reference number less than 14

These do not need to be marked, unless specified in a product standard.

#### 7.1.3 Ropes of reference number equal to or greater than 14

A marker tape as defined in 7.1.1 shall be incorporated into the centre of one strand for 3-, 4-, and 8-strand ropes. 12-strand ropes can either have a marker in the centre of one strand or in the centre of the rope. Double-braided ropes shall have a marker tape in or outside the core.

For covered ropes, the marking tape shall be incorporated between the cover and the core or within the core.

### 7.2 Labelling

Each coil shall have a label, which is firmly fixed in place, giving the following information:

- constituent material;
- identification of manufacturer and country of origin;
- reference number;
- delivered length;
- reference to the relevant product standard.

## 8 Packaging, invoicing and delivered length

### 8.1 Packaging and invoicing

8.1.1 The packaging unit may be a reel, a coil, a hank, a box, a bag or as specified by the purchaser.

8.1.2 The finished rope shall be supplied in a package, so that it can be dispensed freely without entanglement of any kind.

8.1.3 Either the unit mass or the length may be used to invoice the rope. When the gross mass is used for invoicing, the mass of the packaging shall not exceed 1,5 % of the gross mass of the rope.

## 8.2 Delivered length

### 8.2.1 Standard delivered length

The length of the coil shall be determined by dividing the mass of the coil by the mass per metre of the rope, determined in accordance with ISO 2307.

The limit deviation on delivered length shall be

- -5 % for ropes with a reference number less than or equal to 14, or
- -3 % for ropes with a reference number greater than 14.

However, the gross mass corresponding to the delivered length shall not be less than the product of the minimum linear density and the theoretical delivered length.

Standard delivered lengths are the following:

- 100 m;
- 183 m;
- 200 m;
- 220 m;
- 366 m.

Other lengths may be supplied for special orders.

### 8.2.2 Shorter delivered length due to sampling

To carry out testing at the request of the purchaser, test pieces may be taken from the ordered length of rope. The length of rope delivered shall then be less than the ordered length because of these test pieces (which are considered to be part of the delivery).

In the event that a specific length and testing are required, the purchaser may be invoiced the additional length or mass of the rope required to perform such testing.

## 9 Testing

**9.1** The minimum breaking strength shall be taken from a relevant ISO standard, or as agreed to between parties, the manufacturer may use his own internal statistical methods.

The testing of the finished rope shall be conducted as specified in the applicable International Standard and in the purchase order or contract.

**9.2** The required length and number of test samples shall be removed from the selected test reels as outlined in [8.2.2](#), if required.

**9.3** Test reports shall be prepared in accordance with the contract or the purchase order.

## 10 Visual quality control

### 10.1 Responsibility for inspection

Unless otherwise specified in the contract or in the purchase order, the rope manufacturer is responsible for the performance of all quality-control requirements specified in this document and in the applicable

fibre rope standard. The purchaser shall have the option to have a representative present during the control by the manufacturer. The purchaser, at his/her expense, reserves the right to perform or have a third party perform any of the controls set forth in the specification where controls are deemed necessary to ensure that ropes conform to specifications. A representative of the rope manufacturer shall have the option to be present during these controls.

## 10.2 Finished-rope visual control

Each sample shall be subject to visual examination. The samples shall be selected at random. If any defects are noted in the original test units, an equal number of additional test units shall be selected at random and, if any specified defects are noted, the entire lot shall be rejected. See [Annex B](#).

## 11 Manufacturer declaration

When requested by the purchaser, the manufacturer of the rope shall issue declarations of conformity with the relevant International Standard when invoicing. These declarations shall always be available for any of the phases of the distribution and/or usage of the rope.

If manufacturing declaration is required, it shall be requested at the time of placing the order.

## 12 Instructions for use

The manufacturer shall provide the purchaser with a set of instructions for the use and maintenance of fibre ropes.

NOTE Recommendations on information for the use and maintenance of fibre ropes to be provided by the manufacturer are given in [Annex C](#).

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