
**Steel wire ropes for the petroleum and
natural gas industries — Minimum
requirements and terms of acceptance**

*Câbles en acier pour les industries du pétrole et du gaz naturel —
Exigences minimales et conditions de réception*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 10425:2003

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10425:2003](https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003)

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>

© ISO 2003

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
Introduction	v
1 Scope.....	1
2 Normative references	1
3 Terms and definitions.....	2
4 Requirements	2
4.1 Material.....	2
4.2 Rope manufacture.....	3
4.3 Diameter	5
4.4 Lay length	6
4.5 Breaking force	6
4.6 Length	8
5 Verification of requirements and test methods	9
5.1 Stranded ropes and spiral ropes.....	9
5.2 Tests on well-measuring wire.....	11
5.3 Tests on well-servicing strands.....	11
5.4 Facilities for witnessing tests.....	11
6 Information for use	11
6.1 Certificate.....	11
6.2 Packaging and marking.....	12
Annex A (normative) Dimensional and mechanical properties of round wires (before rope fabrication).....	13
Annex B (normative) Methods of wire testing for Levels 2, 3, 4 and 5	23
Annex C (normative) Requirements for bright or drawn galvanized well measuring wire.....	25
Annex D (normative) Physical dimensions and mechanical properties of well-servicing strand	26
Annex E (normative) Determination of breaking force (Method 1).....	27
Annex F (normative) Calculation of minimum breaking force for ropes in accordance with Annex G — Rope grades 1770, 1960 and 2160	29
Annex G (normative) Tables of breaking forces for the more common classes, sizes and grades of stranded ropes up to and including 60 mm diameter.....	31
Annex H (normative) Sampling and acceptance criteria for type testing of ropes produced in series	48
Annex I (informative) Tests on wires from the rope (if specified by the purchaser)	50
Annex J (informative) Large diameter ropes	53
Annex K (informative) Information with enquiry or order	55
Bibliography	56

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 10425 was prepared by Technical Committee ISO/TC 105, *Steel wire ropes*.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO 10425:2003](https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003)

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>

Introduction

This International Standard is based upon API¹⁾ Specification 9A, 24th edition, June 1995.

This International Standard was developed in response to worldwide demand for minimum specifications for ropes for use on equipment and machinery associated with the petroleum and natural gas industries.

In recognition of equipment already in use and originally designed to accommodate rope sizes (nominal rope diameters) based on “English” units, some of the more common “converted SI unit” sizes have also been included.

In addition, and in recognition of equipment already in use and designed to operate with ropes having specific rope grades (e.g. IPS), based on “US” wire levels, these grades have also been included in order to give prominence to the required minimum values of breaking force associated with these grades and help to ensure that existing design safety levels are maintained.

Having due regard to size and breaking force for a particular rope class or construction, in some cases it is possible to safely substitute a US customary size and grade with one based solely on SI units and grade, and vice-versa. To assist in this process, this International Standard gives a size range for each nominal rope diameter and equivalent minimum breaking forces (converted from US customary units) for comparison, although it is recommended that the equipment designer or rope manufacturer (or other competent person) is consulted prior to ordering a substitute rope.

It should also be noted that a particular design of rope may be capable of offering a higher breaking force value than the one specified either in the relevant table in this International Standard or by the manufacturer in his catalogue. In such cases, a higher minimum breaking force value (or actual breaking force value if the rope has already been manufactured and tested) may be provided by the manufacturer before an order is placed.

Designers of new equipment are encouraged to select ropes having the preferred SI units and grades.

To complement this International Standard, ISO 17893, covering definitions, designation and classification, has been prepared.

1) American Petroleum Institute, 1220 L Street NW, Washington D.C. 20005, USA.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 10425:2003

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ae6c-c0846a7c6ab2/iso-10425-2003>

Steel wire ropes for the petroleum and natural gas industries — Minimum requirements and terms of acceptance

1 Scope

This International Standard specifies the minimum requirements and terms of acceptance for the manufacture and testing of steel wire ropes not exceeding rope grade 2160 for the petroleum and natural gas industries.

Typical applications include tubing lines, rod hanger lines, sand lines, cable-tool drilling and clean out lines, cable tool casing lines, rotary drilling lines, winch lines, horse head pumping unit lines, torpedo lines, mast-raising lines, guideline tensioner lines, riser tensioner lines, mooring and anchor lines. Ropes for lifting slings and cranes, and wire for well-measuring and strand for well-servicing, are also included.

The minimum breaking forces for the more common sizes, grades and constructions of stranded rope are given in tables. However, this International Standard does not restrict itself to the classes covered by those tables. Other types, such as ropes with compacted strands and compacted (swaged) ropes, may also conform with its requirements. The minimum breaking force values for these ropes are provided by the manufacturer.

For information only, other tables present the minimum breaking forces for large diameter stranded and spiral ropes (i.e. spiral strand and locked coil), while approximate nominal length masses for the more common stranded rope constructions and large diameter stranded and spiral ropes are also given.

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>

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 2232:1990, *Round drawn wire for general purpose non-alloy steel wire ropes and for large diameter steel wire ropes — Specifications*

ISO 4345, *Steel wire ropes — Fibre main cores — Specification*

ISO 4346, *Steel wire ropes for general purposes — Lubricants — Basic requirements*

ISO 6892, *Metallic materials — Tensile testing at ambient temperature*

ISO 7500-1, *Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system*

ISO 7800, *Metallic materials — Wire — Simple torsion test*

ISO 7801, *Metallic materials — Wire — Reverse bend test*

ISO 17893²⁾, *Steel wire ropes — Definitions, designations and classifications*

2) To be published.

3 Terms and definitions

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

4 Requirements

4.1 Material

4.1.1 Wire

The wires for stranded ropes and well-servicing strand of carbon steel shall, before rope fabrication, conform to the diameter, tensile, torsion and, when applicable, zinc-coating requirements specified in Annex A.

The methods of test for wires of tensile strength grades 1 370 N/mm², 1 570 N/mm², 1 770 N/mm², 1 960 N/mm² and 2 160 N/mm² shall be in accordance with those given in ISO 2232.

The methods of test for wires of tensile strength grades Levels 2, 3, 4 and 5 shall be in accordance with Annex B.

For those ropes where a rope grade is applicable, the tensile strength grade of the wires shall be subject to the limits given in Table 1.

NOTE The minimum breaking force values of those ropes of grades 1770, 1960 and 2160 as covered by the tables are calculated on the basis of rope grade and not individual wire tensile strength grades or levels.

Table 1 — Range of wire tensile strength grades

Rope grade	Wire tensile strength grades N/mm ²
1770	1 570 or Level 2 to 1 960 or Level 4
1960	1 770 or Level 3 to 2 160 or Level 5
2160	1 960 or Level 4 to 2 160 or Level 5
IPS	Level 2 or 1 570 to Level 4 or 1 960
EIP	Level 3 or 1 770 to Level 5 or 2 160
EEIP	Level 4 or 1 960 to Level 5 or 2 160

For those ropes (e.g. larger diameter ropes) where a rope grade is not applicable, the tensile strength grades of the wires shall be one, or a combination, of those given in Annex A.

All wires of the same nominal diameter in the same wire layer shall be of the same tensile strength grade.

Well-measuring wire and wires used in the manufacture of well-servicing strand shall normally be of carbon steel but other materials (e.g. stainless steel) may be used.

The purchaser should specify any particular material requirements.

4.1.2 Core

Cores of stranded ropes shall normally be of steel or fibre, although other types, such as composites (e.g. steel plus fibres or plastics) or cores made of solid polymer, may also be supplied.

The purchaser should specify the type of core.

Fibre cores shall conform to ISO 4345.

The fibre cores for single-layer stranded ropes larger than 8 mm diameter shall be doubly closed (i.e. from yarn into strand and from strand into rope). Natural fibre cores shall be treated with an impregnating compound to inhibit rotting and decay.

Steel cores shall be either an independent wire rope (IWRC) or wire strand (WSC).

Steel cores of single-layer stranded ropes larger than 12 mm diameter shall be an independent wire rope (IWRC), unless specified otherwise.

4.1.3 Lubricant

Lubricants shall conform to ISO 4346.

4.2 Rope manufacture

4.2.1 General

In stranded ropes, all the wire layers in a strand shall have the same direction of lay. The lay lengths of corresponding wire layers in strands of the same size, construction and strand layer shall be uniform.

The core of a stranded rope, except for compacted (swaged) ropes, shall be designed (steel) or selected (fibre) so that in a new rope under no load there is clearance between outer strands.

The rope ends shall be secured such that they are prevented from unlaying

4.2.2 Wire joints

Diameters shall be continuous, but for wires other than well-measuring wires, if joints are necessary in wires over 0,4 mm they shall have their ends joined by brazing or welding.

For stranded ropes, the minimum distance between joints within one strand shall be $18 \times$ rope diameter (d).

For spiral ropes, the minimum distance between joints in any wire layer shall be $36 \times$ diameter of the wire layer.

Wires up to and including 0,4 mm may be joined by twisting or by ends being simply inserted into the strands' formation.

4.2.3 Preformation and postformation

Stranded ropes shall be preformed or postformed or both, unless specified otherwise by the purchaser.

NOTE Some parallel-closed ropes and rotation-resistant ropes may be non-preformed.

4.2.4 Construction

The rope construction shall be either one of those covered in Annex G or as stated by the manufacturer.

The constructions of compacted strand ropes, compacted (swaged) ropes, large diameter (i.e. over 60 mm) stranded ropes and spiral ropes (i.e. spiral strand and full-locked coil) shall be stated by the manufacturer.

Where only the rope class is specified by the purchaser, the construction supplied shall be stated by the manufacturer.

For well-servicing strand, the construction shall be either $1 \times 16M$ or $1 \times 19M$ or as stated by the manufacturer.

4.2.5 Rope grade

The rope grades for the more common classes and sizes of stranded ropes shall be as given in Annex G.

Intermediate grades may be supplied by agreement between the purchaser and the manufacturer or supplier.

NOTE Not all ropes (e.g. large diameter stranded ropes and spiral ropes) will necessarily have a nominated rope grade.

4.2.6 Wire finish

The finish of the wires shall be uncoated (bright), zinc-coated class B or zinc-coated class A.

For ropes of bright wire finish, substitution of bright wires by zinc-coated wires shall be limited to inner wires, centre wires, filler wires and core wires.

For ropes of zinc-coated wire finish, all of the wires shall be zinc-coated, including those of any steel core.

Where zinc-coated is specified, this may also include zinc alloy Zn95/Al5.

4.2.7 Direction and type of rope lay

The direction and type of rope lay for stranded ropes shall be one of the following:

- a) right ordinary lay (sZ)³;
- b) left ordinary lay (zS)⁴;
- c) right lang lay (zZ)⁵;
- d) left lang lay (sS)⁶;
- e) right alternate lay (aZ)⁷;
- f) left alternate lay (aS)⁸.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10425:2003](https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003)

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>

Well-servicing strand shall be left lay (S).

Spiral ropes (i.e. spiral strand and full locked coil) shall be either right (Z) or left lay (S).

The direction and type of rope lay should be specified by the purchaser.

4.2.8 Designation and classification

For the purposes of this International Standard, the designation and classification systems according to ISO 17893 shall apply.

-
- 3) Formerly referred to as right-hand ordinary (designated RHO) and right regular lay (designated RRL).
 - 4) Formerly referred to as left-hand ordinary (designated LHO) and left regular lay (designated LRL).
 - 5) Formerly referred to as right-hand langs (designated RHL) or right lang lay (designated RLL).
 - 6) Formerly referred to as left-hand langs (designated LHL) or left lang lay (designated LLL).
 - 7) Formerly designated RAL.
 - 8) Formerly designated LAL.

4.3 Diameter

4.3.1 General

The nominal diameter shall be that by which the wire, strand or rope is designated.

4.3.2 Tolerance

When measured in accordance with 5.1.3, the measured (actual) diameter of stranded ropes shall be within the tolerances given in Table 2.

Table 2 — Tolerances on rope diameter (stranded rope)

Nominal rope diameter d mm	Tolerance as percentage of nominal diameter	
	Ropes with strands that are exclusively of wire or incorporate solid polymer centres	Ropes with strands that incorporate fibre centres
$2 \leq d < 4$	+8 0	+9 0
$4 \leq d < 6$	+7 0	+9 0
$6 \leq d < 8$	+6 0	+8 0
≥ 8	+5 0	+7 0

When measured in accordance with 5.1.3, the measured (actual) diameter of spiral ropes shall be within $+5_0$ % of the nominal diameter. <http://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>

When measured in accordance with 5.1.3, the measured (actual) diameter of well-servicing strand shall be within the tolerances given in Annex D.

4.3.3 Difference between diameter measurements

For stranded and spiral ropes, the difference between any two of the four measurements taken in accordance with 5.1.3 and expressed as a percentage of the nominal diameter shall not exceed the values given in Table 3.

Table 3 — Permissible differences between any two diameter measurements

Nominal rope diameter d mm	Ropes with strands that are exclusively of wire or incorporate solid polymer centres and spiral ropes	Ropes with strands that incorporate fibre centres
	%	%
$2 \leq d < 4$	7	—
$4 \leq d < 6$	6	8
$6 \leq d < 8$	5	7
≥ 8	4	6

4.4 Lay length

For single-layer ropes of 6×7 class, the length of lay of the finished rope shall not exceed $8 \times$ rope diameter (d).

For other single-layer ropes with round strands (except those with three or four strands), parallel-lay closed ropes and rotation-resistant ropes with round strands or shaped strands, the length of lay of the finished rope shall not exceed $7,25 \times$ rope diameter (d).

For single-layer ropes with shaped strands, e.g. triangular strand, the length of lay of the finished rope shall not exceed $10 \times$ rope diameter (d).

For well-servicing strand, the length of lay of the finished strand shall not exceed $10 \times$ strand diameter (d).

4.5 Breaking force

4.5.1 Well-measuring wire

The minimum breaking force for a given diameter of well-measuring wire shall be as given in Clause C.1.

When tested in accordance with the method specified in Clause C.2, the measured breaking force shall be greater than or equal to the minimum breaking force.

4.5.2 Well-servicing strand

The minimum breaking force for a given diameter and construction shall be either

a) as given in Annex D, or

b) as stated by the manufacturer. standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003

When tested in accordance with Method 1 (see 5.1.4.1), the measured breaking force shall be greater than or equal to the minimum breaking force.

4.5.3 Stranded ropes and spiral ropes

4.5.3.1 General

The minimum breaking force, F_{\min} , for a given rope diameter and construction shall be either

a) as given in Annex G for stranded ropes, or

b) as stated by the manufacturer.

NOTE 1 Values of minimum breaking force for large diameter stranded and spiral ropes are given for information in Annex J.

For those ropes covered in Annex G, the minimum breaking force of intermediate rope diameters shall be calculated with the respective minimum breaking force factors in accordance with Annex F.

When tested in accordance with Method 1 of 5.1.4.1, the measured breaking force, F_m , shall be greater than or equal to the minimum breaking force, F_{\min} .

Breaking force testing requirements shall be in accordance with Table 4.

NOTE 2 The requirements for breaking force take into account: (i) the rope size; (ii) whether or not ropes are produced in series, i.e. repeatedly produced; (iii) whether or not the minimum breaking force factor is consistent throughout a range of diameters; (iv) whether or not the manufacturer is operating a quality system in accordance with ISO 9001, certified by an accredited third party certification body.

4.5.3.2 Ropes produced in series — Manufacturer operating a quality system in accordance with ISO 9001, certified by an accredited third party certification body

The manufacturer shall be able to provide the results from type testing in accordance with the sampling and acceptance criteria given in Annex H.

Type testing shall be repeated on any rope that has its design changed in any way which results in a modified (e.g. increased) breaking force. If the same design, apart from wire tensile strength grades, is used for ropes of a lower grade or lower breaking force, or both, than the one which has successfully passed the type testing requirements, it shall not be necessary to repeat the tests on those ropes provided the breaking force is calculated with the same spinning loss.

Subsequent production lengths of ropes produced in series shall be deemed to conform to the breaking force requirements when the manufacturer has satisfactorily completed

- a) the appropriate type tests (see Annex H), and
- b) a periodic breaking force test in accordance with Method 1 or one of the alternative methods, known as Methods 2 and 3 (see 5.1.4.2 and 5.1.4.3),

on a sample from every twentieth production length.

ITEH STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10425:2003](https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003)

<https://standards.iteh.ai/catalog/standards/sist/be74c571-cef4-4162-ac6c-c0846a7c6ab2/iso-10425-2003>

Table 4 — Breaking force testing requirements

Rope diameter <i>d</i> mm	Min. breaking force factor	Manufacturer operating a quality system in accordance with ISO 9001, certified by an accredited third party certification body	Manufacturer NOT operating a quality system in accordance with ISO 9001, certified by an accredited third party certification body
$d \leq 60$	Same factor throughout a sub-group of rope diameters	Breaking force test in accordance with 5.1.4.1 (Method 1) on a sample from each production length; or, if produced in series, Type testing in accordance with H.1.1 plus periodic test in accordance with 5.1.4.1 (Method 1), 5.1.4.2 (Method 2) or 5.1.4.3 (Method 3) on a sample from every twentieth production length relating to the sub-group of diameters.	Breaking force test in accordance with 5.1.4.1 (Method 1) on a sample from each production length.
	Different factor throughout a sub-group of rope diameters	Breaking force test in accordance with 5.1.4.1 (Method 1) on a sample from each production length; or, if produced in series, Type testing in accordance with Annex H.1.2 plus periodic test in accordance with 5.1.4.1 (Method 1), 5.1.4.2 (Method 2) or 5.1.4.3 (Method 3) on a sample from every twentieth production length of a given rope diameter and construction.	Breaking force test in accordance with 5.1.4.1 (Method 1) on a sample from each production length.
$d > 60$		Breaking force test in accordance with 5.1.4.1 (Method 1), 5.1.4.2 (Method 2) or 5.1.4.3 (Method 3) on a sample from each production length, or either of the following: a) if produced in series, type testing in accordance with Clause H.2 plus periodic test in accordance with 5.1.4.1 (Method 1), 5.1.4.2 (Method 2) or 5.1.4.3 (Method 3) on a sample from every twentieth production length; or b) if produced for supply as a set of ropes of the same design for a specific installation, the alternative breaking force testing and sampling as also given in Clause H.2.	Breaking force test in accordance with 5.1.4.1 (Method 1), 5.1.4.2 (Method 2) or 5.1.4.3 (Method 3) on a sample from each production length.
<p>NOTE The result from Method 1 is known as measured breaking force. The result from Method 2 is known as calculated measured (post-spin) breaking force. The result from Method 3 is known as calculated measured (pre-spin) breaking force.</p>			

4.6 Length

For those ropes not forming part of an assembly, the actual length of rope supplied shall be the specified nominal length subject to the following tolerances.

- a) Up to and including 400 m: ${}^{+5}_0$ % of the specified length.
- b) Over 400 m, up to and including 1 000 m: ${}^{+20}_0$ m.
- c) Over 1 000 m: ${}^{+2}_0$ % of the specified length.

The rope shall be measured under no load.

Ropes required with smaller length tolerance should be the subject of agreement between the purchaser and the manufacturer.

5 Verification of requirements and test methods

5.1 Stranded ropes and spiral ropes

5.1.1 Materials

Compliance with the wire, core and lubricant requirements shall be through a visual verification of the inspection documents supplied with the wire, core and lubricant.

5.1.2 Rope manufacture

Compliance with the requirements for wire joints and preformation shall be through visual verification.

5.1.3 Test on rope for diameter

Diameter measurements shall be taken on a straight portion of rope, either under no tension or a tension not exceeding 5 % of the minimum breaking force, at two positions spaced at least 1 m apart. At each position, two measurements, at right angles, of the circumscribed circle diameter shall be taken. The measuring equipment shall extend over at least two adjacent strands (see Figure 1). The average of these four measurements shall be the measured diameter.

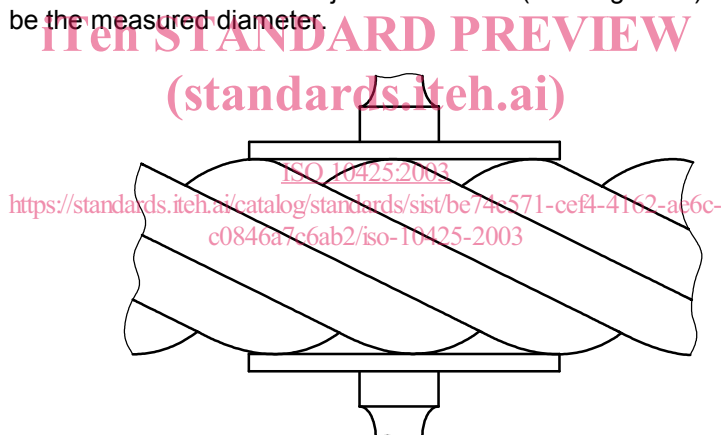


Figure 1 — Method of measuring rope diameter

5.1.4 Test on rope for breaking force

5.1.4.1 Method 1 — Measured breaking force

The method shall be in accordance with Annex E.

The rope shall be deemed to have satisfied the breaking force requirement when the measured breaking force reaches or exceeds the minimum value.

When the minimum breaking force is not reached, three additional tests may be carried out, one of which shall achieve or exceed the minimum breaking force value.