INTERNATIONAL STANDARD

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Third edition
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Steel wire ropes for general purposes — Minimum requirements

Câbles en acier pour usages courants — Exigences minimales

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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 2408 was prepared by Technical Committee ISO/TC 105, *Steel wire ropes*.

This third edition cancels and replaces the second edition (ISO 2408:1985), which has been technically revised.

Introduction

This International Standard was developed in response to a worldwide demand for a specification giving minimum requirements for ropes for general purposes.

As in previous editions, this edition of ISO 2408 specifies metric sizes and grades of rope for the more common classes of rope. In addition, and for comparison, information is given in this edition on imperial rope sizes and grades in order to assist in the rope selection process and help to ensure that existing levels of safety are maintained on equipment originally designed to use such ropes. In these cases, it is recommended that the equipment designer or rope manufacturer (or other competent person) be consulted prior to ordering a substitute rope.

This International Standard does not restrict itself to those classes covered by the tables: other types, such as ropes with compacted strands and compacted (swaged) ropes, may also conform to it.

Complementing this International Standard is ISO 17893, which covers definitions, designation and classification.

Steel wire ropes for general purposes — Minimum requirements

1 Scope

This International Standard specifies minimum requirements for the manufacture and testing of stranded steel wire ropes for general purposes, including lifting equipment such as cranes and hoists. Ropes for slings are also dealt with, and tables giving minimum breaking forces for the more common sizes, grades and constructions of stranded rope presented. It is applicable to single-layer, rotation-resistant and parallel-closed ropes made from wires of uncoated (bright), zinc-coated and zinc-alloy coated finish in rope diameters of up to 60 mm, supplied as bulk manufacture. It is not applicable to ropes for

— mining purposes,

— aircraft control,

— the petroleum and natural gas industries,

— aerial ropeways and funiculars,

— lifts, or

— fishing purposes.

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 3108, *Steel wire ropes for general purposes — Determination of actual breaking load*

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

ISO 10425:2003, *Steel wire ropes for the petroleum and natural gas industries — Minimum requirements and terms of acceptance*

ISO 17893[1)], *Steel wire ropes — Vocabulary, designations and classifications*

1) 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

Before ropemaking, wires shall conform to the diameter, torsion and, where applicable, coating requirements specified in Annex A.

NOTE 1 Annex A is based on ISO 2232 but with extended wire sizes and wire tensile strength grades.

NOTE 2 For a given wire size and tensile strength grade, the torsional properties of the wires in A.2 of ISO 10425:2003 meet or exceed the values given in Annex A of this International Standard.

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

Table 1 — Tensile strength grades of wires (excluding centre and filler wires) for given rope grades

Rope grade	Range of wire tensile strength grades N/mm^2
1570	1 370 to 1 770
1770	1 570 to 1 960
1960	1 770 to 2 160
2160	1 960 to 2 160

NOTE 3 The minimum breaking force values of those ropes of grades 1570, 1770, 1960 and 2160 as covered by Tables C.1 to C.14 are calculated on the basis of rope grade and not individual wire tensile strength grades.

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

The methods of test shall be in accordance with ISO 2232.

4.1.2 Core

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

The purchaser should specify any particular core type requirements.

Fibre cores for single-layer stranded ropes shall conform to ISO 4345 and for rope diameters 8 mm and above 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 a 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

All the wires in a strand shall have the same direction of lay.

The core, except for compacted (swaged) ropes, shall be designed (steel) or selected (fibre) so that in a new rope under tension on the closing machine there is clearance between the outer strands.

The completed rope shall be evenly laid and free from loose wires, distorted strands and other irregularities.

When uncoiled and under no load the rope shall not be wavy.

Rope ends that have no end fittings shall, when necessary, be so secured as to maintain the integrity of the rope and prevent its unravelling.

4.2.2 Wire joints

Wires over 0,4 mm in diameter shall, where necessary, have their ends joined by brazing or welding.

Wires up to and including 0,4 mm diameter shall, where necessary, be joined by brazing, welding, twisting or by ends being simply inserted in the strand's formation.

If twisting as a joint is performed during rope manufacture, any protruding twisted wire ends shall be removed from the finished rope.

4.2.3 Lubrication

The amount of lubrication and type of lubricant shall be appropriate to the rope duty.

The purchaser should specify the rope duty or any particular lubrication requirements.

4.2.4 Preformation and postformation

Ropes shall be preformed and/or postformed unless specified otherwise by the purchaser.

NOTE Some parallel-closed and rotation-resistant ropes could be non-preformed or be only partially preformed.

4.2.5 Construction

The rope construction shall be either one of those covered by the following classes or a construction, including compacted strand ropes and compacted (swaged) ropes, as stated by the manufacturer:

6×7, 6×24FC, 6×37M, 6×19, 6×36, 8×19, 8×36, 6×25TS, 18×7, 34(M) $\times$ 7 and 35(W) $\times$ 7.

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

The purchaser should specify the rope construction or class.

4.2.6 Grade

The rope grades for the more common classes of ropes shall be as given in Tables C.1 to C.14.

Intermediate rope grades, including those as given in ISO 10425, may be supplied by agreement between the purchaser and the manufacturer providing all of the other requirements are met.

NOTE Not all ropes will necessarily have a rope grade.

4.2.7 Wire finish

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

4.2.8 Direction and type of lay

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

a) right ordinary lay (sZ)[2];

b) left ordinary lay (zS)[3];

c) right lang lay (zZ)[4];

d) left lang lay (sS)[5];

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

4.3 Designation and classification

Rope designation and classification shall conform to the system requirements of ISO 17893.

4.4 Dimensions

4.4.1 Diameter

4.4.1.1 General

The nominal diameter shall be the dimension by which the rope is designated.

4.4.1.2 Tolerance

When measured in accordance with 5.3, the measured diameter shall be within the tolerances given in Table 2.

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2) Formerly referred to as right hand ordinary (designated RHO) and right regular lay (designated RRL).

3) Formerly referred to as left hand ordinary (designated LHO) and left regular lay (designated LRL).

4) Formerly referred to as right hand langs (designated RHL) or right lang lay (designated RLL).

5) Formerly referred to as left hand langs (designated LHL) or left lang lay (designated LLL).

Table 2 — Tolerances on rope diameter

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[a]
$2 \leqslant d < 4$	$^{+8}_{0}$	—
$4 \leqslant d < 6$	$^{+7}_{0}$	$^{+9}_{0}$
$6 \leqslant d < 8$	$^{+6}_{0}$	$^{+8}_{0}$
$\geqslant 8$	$^{+5}_{0}$	$^{+7}_{0}$
[a] For example, 6 × 24FC.		

4.4.1.3 Difference between diameter measurements

The difference between any two of the four measurements taken in accordance with 5.3 and expressed as a percentage of the nominal rope diameter shall not exceed the values given in Table 3.

Table 3 — Permissible differences between any two diameter measurements

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[a]
$2 \leqslant d < 4$	7	—
$4 \leqslant d < 6$	6	8
$6 \leqslant d < 8$	5	7
$\geqslant 8$	4	6
[a] For example, 6 × 24FC.		

4.4.2 Lay length

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

4.4.3 Rope length

The length of rope supplied, under no load, shall be equivalent to the specified length subject to the following tolerances:

— $\leqslant$ 400 m: $^{+5}_{0}$ %;

— $>$ 400 m and $\leqslant$ 1 000 m: $^{+20}_{0}$ m; and

— $>$ 1 000 m: $^{+2}_{0}$ %.

4.5 Breaking force

4.5.1 General

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

a) as given in Tables C.1 to C.14, or

b) as stated by the manufacturer.

For those ropes covered by Tables C.1 to C.14, the minimum breaking force of intermediate rope diameters shall be calculated using the formula given in Annex D with the respective minimum breaking force factors as given in Table D.1.

When tested in accordance with 5.4.1, 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 The requirements for breaking force testing take into account: a) the rope size; b) whether or not ropes are produced in series, i.e. repeatedly produced; c) whether or not the minimum breaking force factor is consistent throughout a range of diameters; and d) whether or not the manufacturer is operating a quality system in accordance with ISO 9001:2000 certified by an accredited third party certification body.

4.5.2 Ropes produced in series — Manufacturer operating a quality system in accordance with ISO 9001:2000 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 in Annex B.

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 B), and

b) a periodic breaking force test in accordance with Method 1 (see 5.4.1) or one of the alternative methods, known as Methods 2 and 3 (see 5.4.2 and 5.4.3),

on a sample from every twentieth production length.

Table 4 — Breaking force testing requirements

Min. breaking force factor	Manufacturer operating a quality system in accordance with ISO 9001:2000, certified by an accredited third party certification body	Manufacturer NOT operating a quality system in accordance with ISO 9001:2000, certified by an accredited third party certification body
Same factor throughout a subgroup of rope diameters	Breaking force test in accordance with 5.4.1 (Method 1) on a sample from each production length; or, if produced in series, Type testing in accordance with the sampling regime and acceptance criteria of B.1 plus periodic breaking force test in accordance with 5.4.1 (Method 1), 5.4.2 (Method 2) or 5.4.3 (Method 3) on a sample from every twentieth production length relating to the subgroup of diameters.	Breaking force test in accordance with 5.4.1 (Method 1) on a sample from each production length.
Different factor throughout a subgroup of rope diameters	Breaking force test in accordance with 5.4.1 (Method 1) on a sample from each production length; or, if produced in series, Type testing in accordance with the sampling regime and acceptance criteria of Annex B.2 plus periodic test in accordance with 5.4.1 (Method 1), 5.4.2 (Method 2) or 5.4.3 (Method 3) on a sample from every twentieth production length of a given rope diameter and construction.	Breaking force test in accordance with 5.4.1 (Method 1) on a sample from each production length.
NOTE Breaking force type testing demonstrates that a steel wire rope produced in series and certified by the manufacturer as conforming to this International Standard possesses the minimum breaking force stated by the manufacturer. The purpose of these tests is to prove the design, material and method of manufacture.		

5 Verification of requirements and test methods

5.1 Materials

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

5.2 Rope manufacture

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

5.3 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 90° apart, of the circumscribed circle diameter shall be taken. The measuring equipment shall extend over at least two adjacent strands.

The average of these four measurements shall be the measured diameter.

5.4 Test on rope for breaking force

5.4.1 Method 1 — Measured breaking force, F_m

The method of test and acceptance criteria shall be in accordance with ISO 3108 except for the following:

a) the selected test piece shall have its ends secured to ensure that the rope does not unravel;

b) the minimum free test length excluding any rope terminations shall be 600 mm or 30 × nominal rope diameter, whichever is the greater;