
**Round non-alloy steel wires for
general purpose wire ropes, large
diameter wire ropes and mine
hoisting wire ropes — Specifications**

*Fils ronds en acier non allié pour câbles à usage général, câbles de
grand diamètre et câbles d'extraction minière — Spécifications*

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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).

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).

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.

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

This third edition cancels and replaces the second edition (ISO 2232:1990), which has been technically revised.

The main changes are as follows:

- addition of tensile grades 2 260 N/mm² and 2 360 N/mm²;
- inclusion of wire for mine hoisting ropes previously covered by ISO 6984.

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.

Introduction

This document was developed in response to a worldwide demand for a specification giving minimum requirements for round non-alloy steel wires for general purpose, large diameter and mine hoisting wire ropes.

As in previous editions, this edition of ISO 2232 specifies metric sizes and grades of wire for the more common diameter and grades of wire.

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Round non-alloy steel wires for general purpose wire ropes, large diameter wire ropes and mine hoisting wire ropes — Specifications

1 Scope

This document specifies round non-alloy steel wires used in the manufacture of general purpose and large diameter ropes to according to ISO 2408:2017 and mine hoisting wire ropes according to ISO 3154:1988.

It specifies:

- the dimensional tolerances;
- the mechanical characteristics;
- the required conditions for any coatings;
- the conditions of sampling, control and terms of acceptance.

It applies to round, bright, zinc (Zn) or zinc/aluminium (Zn/Al) alloy coated wires of quality A or quality B and of nominal diameters from 0,2 mm to 7,0 mm.

It does not apply to steel wire taken from manufactured ropes.

It does not apply to wire for steel wire ropes for special applications, such as:

- ropes for aircraft controls;
- ropes for aerial ropeways;
- ropes for lifts;
- ropes for prestressed concrete;
- ropes for conveyor belts.

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 1460, *Metallic coatings — Hot dip galvanized coatings on ferrous materials — Gravimetric determination of the mass per unit area*

ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

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

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

ISO 7802, *Metallic materials — Wire — Wrapping test*

ISO 16120-1, *Non-alloy steel wire rod for conversion to wire — Part 1: General requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 lot

definite quantity of wire of the same nominal diameter, grade and finish, presented for control and manufactured under conditions which are presumed uniform

3.2 unit

coil of single length of wire of which the mass or length is variable or fixed, or variable or fixed quantity of a single length of wire which is wound on a bobbin with flanges, or variable or fixed quantity of a single length of wire which is wound on a cardboard centre; known as a cheese wound coil

Note 1 to entry: Unit can also be called as unit of product.

3.3 basic sampling unit

m_1
mass, expressed in kilograms, having by convention a value equal to $100d$, d being the diameter of the wire expressed in millimetres

3.4 size of lot

N
number given by the formula below

$$N = \frac{m}{10^{-3} \times m_1}$$

where

m is the mass of the *lot* (3.1) in tonnes and m_1 is the *basic sampling unit* (3.3) in kilograms, since, by convention $m_1 = 100d$;

d is the nominal diameter of the wire, it follows that

$$N = \frac{m}{10^{-3} \times 100d} = \frac{10m}{d}$$

3.5 test piece

length of wire sufficient for one test of one characteristic

3.6 test length

length of wire sufficient to provide all the *test pieces* (3.5) needed for one test of all characteristics

3.7 sample

all *test lengths* (3.6) intended to provide information on the *lot* (3.1)

3.8**size of sample***n*number of *test lengths* (3.6)**3.9****defect**

non-conformance of the result of a test with the requirement for a characteristic

3.10**defective length***test length* (3.6) showing one or more *defects* (3.9)**4 Wire characteristics****4.1 General conditions of manufacture**

Wires shall be manufactured from steel according to the requirements of ISO 16120-1.

The finished wires shall not show superficial defects (e.g. defective length) detrimental to their use.

When specified, the wires shall be supplied with a zinc coating or Zn/Al alloy coating, as required, applied by the hot dip or the electrolytic process.

4.2 Diameter**4.2.1 Nominal diameter *d***

The nominal diameter of the wire in millimetres is that by which the wire is designated. It shall be the basis on which the values of all characteristics are determined for acceptance of the wire.

4.2.2 Actual diameter

The actual diameter of the wire is the arithmetic mean of the two measurements carried out in accordance with 7.1. It shall be within the limits of tolerance specified in Table 1.

4.3 Ovality of the wire

The arithmetic difference between the two measurements of the diameter shall not be more than half the tolerance specified in Table 1.

Table 1 — Tolerances on diameter

Dimensions in millimetres

Nominal wire diameter d [mm]	Tolerance on diameter	Nominal wire diameter d [mm]	Tolerance on diameter
	Bright wires and Zn or Zn/Al alloy coated wires quality B		Zn or Zn/Al alloy coated wires quality A
$0,2 \leq d < 0,3$	$\pm 0,008$	$0,3 \leq d < 0,5$	$\pm 0,025$
$0,3 \leq d < 0,5$	$\pm 0,01$	$0,5 \leq d < 1,0$	$\pm 0,03$
$0,5 \leq d < 0,8$	$\pm 0,015$	$1,0 \leq d < 1,7$	$\pm 0,04$
$0,8 \leq d < 1,0$	$\pm 0,015$	$1,7 \leq d < 2,1$	$\pm 0,05$
$1,0 \leq d < 1,8$	$\pm 0,02$	$2,1 \leq d < 2,8$	$\pm 0,06$
$1,8 \leq d < 2,8$	$\pm 0,025$	$2,8 \leq d < 4,0$	$\pm 0,07$
$2,8 \leq d < 5,4$	$\pm 0,03$	$4,0 \leq d < 5,4$	$\pm 0,08$
$5,4 \leq d \leq 7,0$	$\pm 0,04$	$5,4 \leq d < 6,75$	$\pm 0,09$
		$6,75 \leq d \leq 7,0$	$\pm 0,10$

4.4 Type

This specification provides details on two types of wire:

- standard duty - wire is specified for general purpose and large diameter ropes;
- high duty- wire is specified for demanding applications such as mine hoisting ropes.

5 Tensile grades

5.1 General

- 1 570 MPa for wires of all classes, quality A and B
- 1 770 MPa for wires of all classes, quality A and B
- 1 960 MPa for wires of all classes, quality A and B
- 2 160 MPa for bright wires and zinc or Zn/Al alloy coated wires, quality B
- 2 260 MPa for bright wires and zinc or Zn/Al alloy coated wires, quality B
- 2 360 MPa for bright wires and zinc or Zn/Al alloy coated wires, quality B

These nominal values are the lower limits of strength. The upper limits are equal to the lower limits plus the tolerances specified in [Table 2](#).

The tensile test shall be performed in accordance with [7.2](#).

NOTE Other tensile grades can be used by agreement between the manufacturer and the supplier.

Table 2 — Upper limit tolerances for all tensile grades

Nominal wire diameter, d [mm]	Tolerance on tensile grade [MPa]
$0,2 \leq d < 0,5$	390
$0,5 \leq d < 1,0$	350
$1,0 \leq d < 1,5$	320
$1,5 \leq d < 2,0$	290
$2,0 \leq d < 3,5$	260
$3,5 \leq d \leq 7,0$	250

5.2 Reverse bend strength

The wire shall withstand, without breaking, the minimum number of reverse bends specified in [Table 3](#) or [4](#) for the appropriate type, diameter, tensile grade and finish. The radius of curvature of the supports for the various wire diameters is also specified.

The reverse bend strength test shall be in accordance with [7.3](#).

If the tensile grade of a wire lies between two tensile grades given in [Tables 3](#) and [4](#), then the number of reverse bends for the next upper tensile grade shall be chosen.

Table 3 — Minimum number of reverse bends for standard duty wire for general purpose and large diameter ropes

Nominal wire diameter d [mm]	Radius of curvature of supports [mm]	Bright and Zn or Zn/Al alloy coated wire quality B						Zn or Zn/Al alloy coated wire quality A		
		Tensile strength grade [MPa]						Tensile strength grade [MPa]		
		1 570	1 770	1 960	2 160	2 260	2 360	1 570	1 770	1 960
$0,2 \leq d < 0,25$ $0,25 \leq d < 0,3$ $0,3 \leq d < 0,4$ $0,4 \leq d < 0,5$										
$0,5 \leq d < 0,55$ $0,55 \leq d < 0,6$ $0,6 \leq d < 0,65$ $0,65 \leq d < 0,7$	1,75	15 14 12 11	14 13 11 10	13 12 10 9	12 11 9 8	11 10 8 7	10 9 7 6			
$0,7 \leq d < 0,75$ $0,75 \leq d < 0,8$ $0,8 \leq d < 0,85$ $0,85 \leq d < 0,9$ $0,9 \leq d < 0,95$ $0,95 \leq d < 1,0$	2,5	17 16 14 13 12 11	16 15 13 12 11 10	15 14 12 11 10 9	14 13 11 10 9 8	13 12 10 9 8 7	12 11 9 8 7 6	13 12 11 10 9 8	12 11 10 9 8 7	11 10 9 8 7 6
$1,0 \leq d < 1,1$ $1,1 \leq d < 1,2$ $1,2 \leq d < 1,3$ $1,3 \leq d < 1,4$ $1,4 \leq d < 1,5$	3,75	18 17 16 14 12	17 16 15 13 11	16 15 14 12 10	14 13 12 10 9	13 12 11 9 8	12 11 10 8 7	15 14 12 10 8	14 13 11 8 7	12 11 9 7 6
$1,5 \leq d < 1,6$	5	15	14	13	12	11	10	11	10	9