FINAL
DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
10544**

ISO/TC **17**/SC **16**

Secretariat: **SN**

Voting begins on:
2023-09-05

Voting terminates on:
2023-10-31

Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric

Fils en acier à béton transformés à froid pour armatures passives et la fabrication des treillis soudés

Reference number
ISO/FDIS 10544:2023(E)

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Published in Switzerland

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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 document 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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This document was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 16, *Steels for the reinforcement and prestressing of concrete*.

This second edition cancels and replaces the first edition (ISO 10544:1992), which has been technically revised.

The main changes are as follows:

— normative references have been revised;

— terms and definitions have been revised;

— diameters have been extended to 18 mm;

— geometry of ribbed and indented wires have been revised;

— steel grade and chemical composition have been revised;

— example of identification of manufacturer on ribbed wire and indented wire have been added.

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.

Cold-reduced steel wire for the reinforcement of concrete and the manufacture of welded fabric

1 Scope

This document specifies technical requirements for cold-reduced steel wire designed for the reinforcement of concrete or for use in welded fabric.

Two steel grades, CRB500 and CRB540H are defined as examples. Other grades can be used.

This document is applicable to wire made from rod by working through dies or rollers. The production process is at the discretion of the manufacturer.

For wire supplied in coil form, this document is applicable to the straightened product.

Wires produced from finished products, such as plates and railway rails, are outside the scope of this document.

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 404, *Steel and steel products — General technical delivery requirements*

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

ISO 15630-1, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 1: Reinforcing bars, rods and wire*

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
cast analysis
chemical analysis of a sample of the molten steel during casting

3.2
characteristic value
value having a prescribed probability of not being attained in a hypothetical unlimited test series

Note 1 to entry: Equivalent to fractile, which is defined in ISO 3534-1:2006.

[SOURCE: ISO 16020:2005, 2.4.10]

3.3
core
part of cross-section of the wire that contains neither ribs nor indentations

3.4
indentation inclination
β_{ind}
angle between the indentation and the longitudinal axis of the wire

Note 1 to entry: See Figure 3 and Figure 4.

3.5
indentation spacing
c_{ind}
distance between the centres of two consecutive indentations measured parallel to the axis of the wire

Note 1 to entry: See Figures 3 and 4.

3.6
indented wire
wire whose surface has indentations at regular intervals along the length

3.7
inspection
activities such as measuring, examining, testing, gauging one or more characteristics of a product or service and comparing these with specified requirements to determine conformity

3.8
nominal cross-sectional area
cross-sectional area equivalent to the area of a circular plain wire of the nominal diameter

3.9
plain wire
smooth surfaced wire without bond enhancing properties

3.10
product analysis
chemical analysis of a sample from a wire

3.11
rib height
a
distance from the highest point of the rib to the surface of the core, measured normal to the axis of the wire

Note 1 to entry: See Figures 1 and 2.

3.12
rib inclination
β_{rib}
angle between the rib and the longitudinal axis of the wire

Note 1 to entry: See Figures 1 and 2.

3.13
rib spacing
c_{rib}
distance between the centres of two consecutive transverse ribs measured parallel to the axis of the wire

Note 1 to entry: See Figures 1 and 2.

3.14
ribbed wire
wire whose surface has ribs at regular intervals along the length

3.15
test unit
number of pieces or the tonnage of products be accepted or rejected together, on the basis of the tests carried out on sample products in accordance with the requirements of the product standard or order

3.16
specific projected indentation area
f_p
area of the projections of all indentations on a plane perpendicular to the longitudinal axis of the wire, divided by the wire length and the nominal circumference

Note 1 to entry: See 5.2.

3.17
specific projected rib area
f_r
area of the projections of all ribs on a plane perpendicular to the longitudinal axis of the wire, divided by the wire length and the nominal circumference

Note 1 to entry: See 5.1.

3.18
transversal indentationless perimeter
$\sum e_i$
sum of the distances along the surface of the core between the transverse indentations of adjacent rows measured as the projection on a plan perpendicular to the wire axis

Note 1 to entry: See Figures 3 and 4.

3.19
transversal ribless perimeter
$\sum f_i$
sum of the distances along the surface of the core between the transverse ribs of adjacent rows measured as the projection on a plane perpendicular to the wire axis

Note 1 to entry: See Figures 1 and 2.

3.20
passive reinforcement
reinforcement that does not apply a compressive stress to the concrete

4 Dimensions, masses and tolerances

The nominal diameter of the wire shall be in the range from 4 mm to 18 mm. Recommended nominal diameters, *d*, are given in Table 1.

For nominal diameters not listed in Table 1, the mass divided by length shall be 7 850 kg/m^3 x nominal cross-sectional area.

Table 1 — Recommended diameters and required masses

Nominal wire diameter d mm	Nominal cross-sectional area mm^2	Mass divided by length	
		Requirement kg/m	Permissible deviation [a] %
4	12,6	0,099	±4
5	19,6	0,154	
6	28,3	0,222	
7	38,5	0,302	
8	50,3	0,395	
9	63,6	0,499	
10	78,5	0,617	
12	113,1	0,888	
14	153,9	1,208	
16	201,1	1,578	
18	254,5	1,998	

[a] Refers to a single wire.

5 Geometry of ribbed and indented wires

5.1 Ribbed wire

Ribbed wire shall have two or more rows of transverse ribs equally distributed around the perimeter with a substantially uniform spacing shall be between 0,6d to 1,0d, where d is the nominal diameter. Figure 1 shows an example with two rows, Figure 2 shows an example with three rows.

The minimum value for the specific projected rib area, f_r, shall be

0,036 for 4 mm ≤ d < 5 mm;

0,039 for 5 mm ≤ d ≤ 6 mm;

0,045 for 6 mm < d ≤ 8 mm;

0,052 for 8 mm < d ≤ 10 mm;

0,056 for 10 mm < d ≤ 18 mm.

f_r is calculated using Formula (1):

$$f_r = \frac{k \times F_R \times \sin \beta_{rib}}{\pi \times d \times c_{rib}} \quad (1)$$

where

k is the number of rib rows;

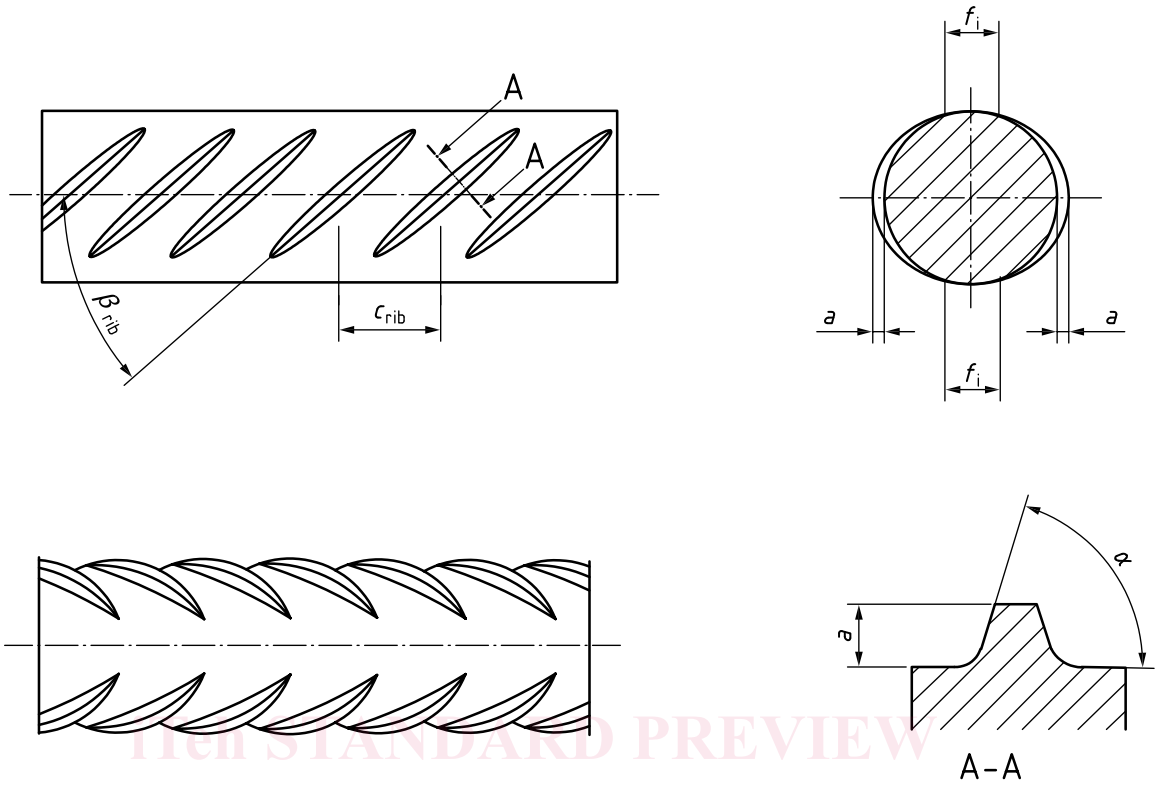
F_R is the area of the projection of one rib on a plane parallel to that rib;

β_{rib} is the rib inclination relative to the axis of the wire;

d is the nominal diameter of the wire;

c_{rib} is the rib spacing.

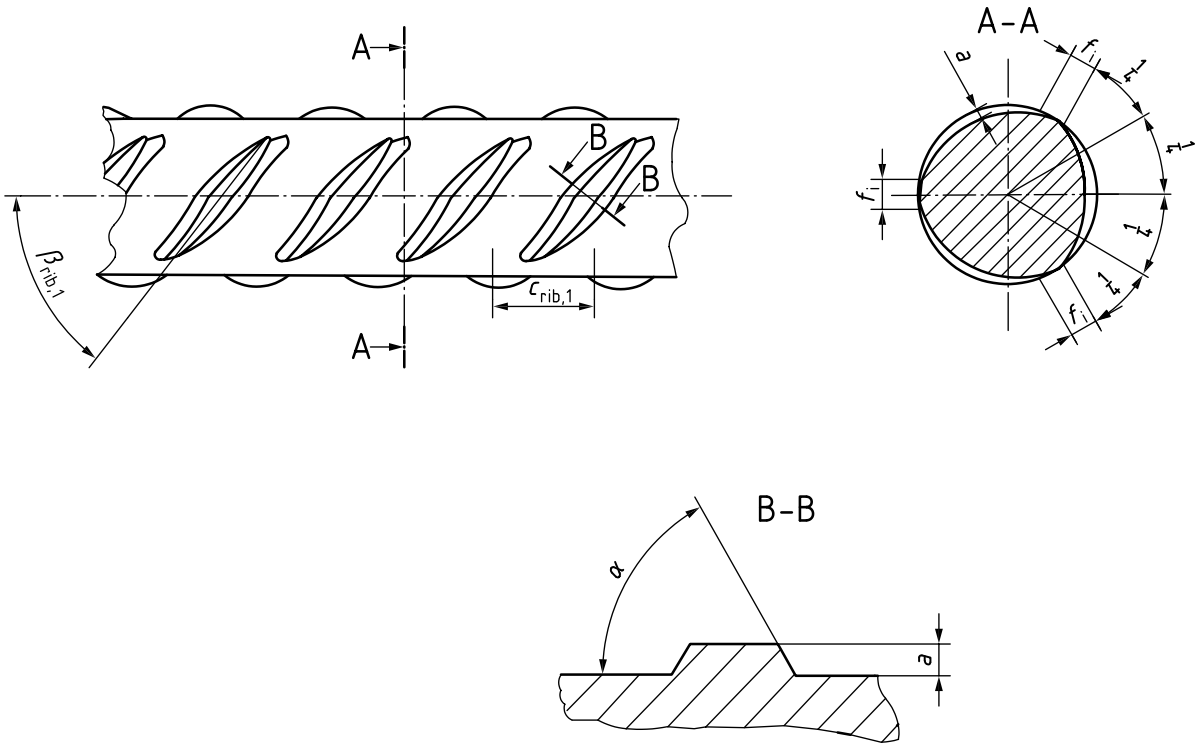
In the area of marking, deviations from the requirements of this subclause may occur (see 10.1).



Key

β_{rib} rib inclination
c_{rib} rib spacing
f_i 1/2 of the transversal ribless perimeter
a rib height
α rib flank inclination

Figure 1 — Example of ribbed wire with two rows



Key

$\beta_{rib,1}$ rib inclination

$c_{rib,1}$ rib spacing

f_i 1/3 of the transversal ribless perimeter

a rib height

α rib flank inclination

Figure 2 — Example of ribbed wire with three rows

5.2 Indented wire

5.2.1 Indented wire shall have two or more rows of indentations. The indentations shall be distributed uniformly over the circumference and length of the wire.

5.2.2 The specific projected indentation area f_P shall be calculated in accordance with the full formula or one of the simplified formulas given in ISO 15630-1.

5.2.3 The f_P value shall be agreed at the time of ordering in accordance with of 5.2.3.1 or 5.2.3.2.

5.2.3.1 For prestressing of concrete indented steel wire, the indentation parameters in Table 2 and profiles are shown in Figure 3, the minimum value for the specific projected indentation area, f_P, shall be:

0,007 for 4 mm ≤ d < 5 mm;

0,008 for 5 mm ≤ d ≤ 6 mm;

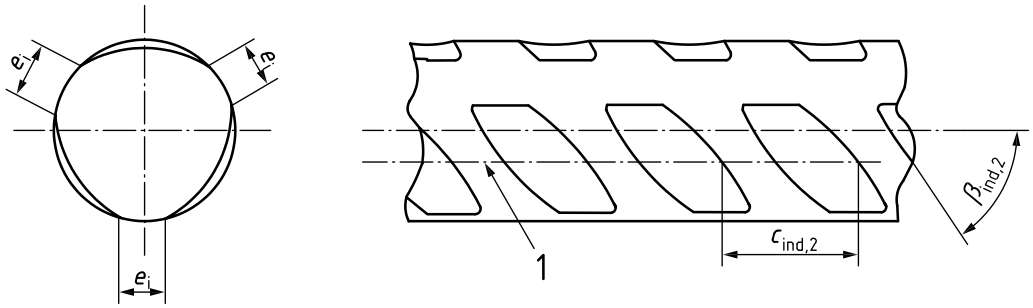
0,010 for 6 mm < d ≤ 8 mm;

0,013 for 8 mm < d ≤ 10 mm;

0,014 for 10 mm < d ≤ 18 mm.

Table 2 — Nominal indentation dimension for the steel wire

Nominal	Nominal indentation dimension						
Diameter	Depth			Length	Spacing	Angle	Gape
d mm	$a_{1/4}$ mm	a_m mm	$a_{3/4}$ mm	b, min. mm	C_{ind}, min. mm	β_{ind} °	Σe mm
≤5,0	0,10 ± 0,05	0,12 ± 0,05	0,10 ± 0,05	3,5	5,5	≥40 ≤55	≤0,3πd
>5,0	0,12 ± 0,05	0,15 ± 0,05	0,12 ± 0,05	5,0	8,0		



Key

$c_{ind,2}$ indentation spacing

e_i 1/3 of the transversal indentationless perimeter

$\beta_{ind,2}$ indentation inclination

1 center-line of indentations

Figure 3 — Example of indented wire with three rows

5.2.3.2 For passive reinforcement of concrete indented steel wire, the indentation parameters in Table 3 and profiles are shown in Figure 4 the minimum value for the specific projected indentation are-a, f_p, shall be

0,035 for 4 mm ≤ d ≤ 6 mm;

0,040 for 6 mm < d ≤ 12 mm;

0,056 for 12 mm < d ≤ 18 mm.

Table 3 — Ranges for the indentation parameters

Nominal	Nominal indentation dimension					
Diameter	Depth	Spacing	Ratio	∑e	Angle	Angle
d mm	a_m mm	C mm	b/c	mm	α °	β_{ind} °
≥4,0 ≤18,0	≥0,03 d ≤0,15d	≥0,4 d ≤1,2 d	≥0,50	≤0,75 d	≥45,0	≥40,0 ≤75,0