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## Stainless steel bars for the reinforcement of concrete

*Barres en aciers inoxydables pour l'armature du béton*

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# Contents

Page

Foreword.....	iv
<b>1 Scope.....</b>	<b>1</b>
<b>2 Normative references.....</b>	<b>1</b>
<b>3 Terms and definitions.....</b>	<b>1</b>
<b>4 Symbols.....</b>	<b>2</b>
<b>5 Dimensions, mass per unit length and permissible deviations.....</b>	<b>2</b>
<b>6 Requirements for ribs.....</b>	<b>5</b>
<b>7 Chemical composition.....</b>	<b>5</b>
<b>8 Mechanical properties.....</b>	<b>7</b>
8.1 Tensile properties.....	7
8.2 Bending properties.....	9
8.3 Rebending properties after ageing.....	9
8.4 Impact properties on austenitic-ferritic steels.....	9
8.5 Magnetic permeability.....	10
8.6 Corrosion resistance properties.....	10
<b>9 Testing.....</b>	<b>10</b>
9.1 Tensile test.....	10
9.2 Bend test.....	10
9.3 Rebend test.....	10
9.4 Chemical composition.....	11
9.5 Impact property test.....	11
9.6 Magnetic permeability.....	11
9.7 Corrosion resistance test.....	11
<b>10 Designation.....</b>	<b>11</b>
<b>11 Marking.....</b>	<b>11</b>
11.1 Marking on bars.....	11
11.2 Identification of bundles.....	12
<b>12 Testing and inspection.....</b>	<b>12</b>
12.1 General.....	12
12.2 Evaluation of conformity during production.....	12
12.3 Acceptance testing of a specific delivery.....	13
12.3.1 General.....	13
12.3.2 Evaluation of characteristic values.....	13
12.3.3 Evaluation of specified minimum/maximum values.....	15
12.3.4 Test report.....	15
<b>Annex A (informative) Options for agreement between the manufacturer and purchaser.....</b>	<b>16</b>
<b>Annex B (normative) Corrosion resistant test.....</b>	<b>17</b>
<b>Annex C (informative) Guidance on magnetic permeability.....</b>	<b>21</b>
<b>Bibliography.....</b>	<b>22</b>

## 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 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](http://www.iso.org/directives)).

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

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).

# Stainless steel bars for the reinforcement of concrete

## 1 Scope

This document specifies technical requirements for hot rolled stainless steel plain bars and ribbed bars used as reinforcement in concrete.

It is applicable to steel delivered in the form of bars, coils and de-coiled products. It does not apply to ribbed bars produced from finished products

The production process is at the discretion of the manufacturer.

## 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 148-1, *Metallic materials — Charpy pendulum impact test — Part 1: Test method*

ISO 6935-1, *Steel for the reinforcement of concrete — Part 1: Plain bars*

ISO 6935-2, *Steel for the reinforcement of concrete — Part 2: Ribbed bars*

ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition*

ISO 15510, *Stainless steels — Chemical composition*

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

EN 196-1, *Methods of testing cement — Part 1: Determination of strength*

EN 197-1, *Cement — Part 1: Composition, specifications and conformity criteria for common cements*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6935-1, ISO 6935-2, ISO 15510 and the following 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

#### stainless steel bars

stainless steel bars with at least 10,5 % (mass fraction) of chromium and max. 1,2 % (mass fraction) of carbon

## 4 Symbols

Symbol	Unit	Description
$A$	%	Percentage elongation after fracture
$A_{gt}$	%	Percentage total extension at maximum force
$S_0$	mm <sup>2</sup>	Nominal cross-sectional area
$d$	mm	Nominal diameter of the bar
$R_m$	MPa <sup>a</sup>	Tensile strength
$R_{p0,2}$	MPa <sup>a</sup>	0,2 % proof strength, plastic extension
$R_{7,0}$	MPa <sup>a</sup>	7,0 % proof strength, plastic extension

<sup>a</sup> 1 MPa = 1 N/mm<sup>2</sup>.

## 5 Dimensions, mass per unit length and permissible deviations

Dimensions are given in [Table 1](#), mass per unit length and permissible deviations are given in [Table 2](#), [Table 3](#) and [Table 4](#). By agreement between the manufacturer and the purchaser, the following options shall be applied.

- Ribbed bars and plain bars for which the nominal diameters are other than those shown in [Table 2](#) may be used. The permissible deviation of nominal diameters larger than 50 mm shall be  $\pm 4\%$ .
- The permissible deviation on mass per length of plain bars may be replaced by tolerances on diameters.

A list of options for agreement between the manufacturer and the purchaser is provided in [Annex B](#).

**Table 1 — Dimensions**

Nominal bar diameter $d$ mm		Nominal cross-sectional area <sup>a</sup> $S_0$ mm <sup>2</sup>
Ribbed bars	Plain bars	
6	6	28,3
8	8	50,3
10	10	78,5
12	12	113
14	14	154
16	16	201
20	20	314
	22	380
25		491
28		616
32		804
40		1 257
50		1 964

<sup>a</sup>  $S_0 = 0,785 4 \times d^2$ .

Table 2 — Mass per unit length and permissible deviations: Austenite

Nominal bar diameter <sup>a</sup> <i>d</i> mm		Mass per unit length <sup>b</sup> kg/m								Permissible deviation <sup>c</sup> %	
R	P	4301- 304-00-I	4311- 304-53-I	4401- 316-00-I	4429- 316-53-I	4404- 316-03-I	4529- 089-26-I	4315- 304-51-I	4495- 316-51-J	R	P
6	6	0,224		0,226		0,229		0,224	0,226	±8	±8
8	8	0,397		0,402		0,407		0,397	0,402	±8	±8
10	10	0,620		0,628		0,636		0,620	0,628	±6	±5
12	12	0,893		0,904		0,915		0,893	0,904	±6	±5
14	14	1,22		1,23		1,25		1,22	1,23	±5	±5
16	16	1,59		1,61		1,63		1,59	1,61	±5	±5
20	20	2,48		2,51		2,54		2,48	2,51	±5	±5
	22	3,00		3,04		3,08		3,00	3,04		±5
	25	3,88		3,93		3,98		3,88	3,93	±4	
	28	4,87		4,93		4,99		4,87	4,93	±4	
	32	6,35		6,43		6,51		6,35	6,43	±4	
	40	9,93		10,06		10,18		9,93	10,06	±4	
	50	15,52		15,7		15,91		15,52	15,71	±4	

<sup>a</sup> "R" means ribbed bars and "P" means plain bars.

<sup>b</sup> Mass per unit length = Density × 10<sup>-3</sup> × S<sub>0</sub>.

<sup>c</sup> Permissible deviation refers to a single bar.

**Table 3 — Mass per unit length and permissible deviations: Austenite-Ferrite**

Nominal bar diameter <sup>a</sup> <i>d</i> mm		Mass per unit length <sup>b</sup> kg/m							Permissible deviation <sup>c</sup> %	
R	P	4482-320-01-X	4462-318-03-I	4362-323-04-I	4460-312-00-I	4410-327-50-E	4501-327-60-I	4062-322-02-U	R	P
6	6	0,221							±8	±8
8	8	0,392							±8	±8
10	10	0,612							±6	±5
12	12	0,881							±6	±5
14	14	1,20							±5	±5
16	16	1,57							±5	±5
20	20	2,45							±5	±5
	22	2,96								±5
25		3,83							±4	
28		4,80							±4	
32		6,27							±4	
40		9,80							±4	
50		15,32							±4	

<sup>a</sup> “R” means ribbed bars and “P” means plain bars.

<sup>b</sup> Mass per unit length = Density × 10<sup>-3</sup> × S<sub>0</sub>.

<sup>c</sup> Permissible deviation refers to a single bar.

  
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**Table 4 — Mass per unit length and permissible deviations: Ferrite and martensite**

Nominal bar diameter <sup>a</sup> <i>d</i> mm		Mass per unit length <sup>b</sup> kg/m			Permissible deviation <sup>c</sup> %	
		Ferrite		Martensite		
R	P	4030-410-90-X	4003-410-77-I	4024-410-09-E	R	P
6	6	0,218			±8	±8
8	8	0,387			±8	±8
10	10	0,604			±6	±5
12	12	0,870			±6	±5
14	14	1,19			±5	±5
16	16	1,55			±5	±5
20	20	2,42			±5	±5
	22	2,93				±5
25		3,78			±4	
28		4,74			±4	
32		6,19			±4	
40		9,68			±4	
50		15,12			±4	

<sup>a</sup> “R” means ribbed bars and “P” means plain bars.  
<sup>b</sup> Mass per unit length = Density × 10<sup>-3</sup> × S<sub>0</sub>.  
<sup>c</sup> Permissible deviation refers to a single bar.

The delivery length is subject to agreement between the manufacturer and purchaser.

NOTE Common delivery lengths of straight bars are 6 m, 9 m, 12 m, 15 m and 18 m.

Unless otherwise agreed, the permissible deviation on delivery lengths from the rolling mill shall be +100,0 mm.

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## 6 Requirements for ribs

Ribbed bars shall have transverse ribs. Longitudinal ribs may be present or not.

There shall be at least two rows of transverse ribs equally distributed around the perimeter of the bar. The transverse ribs within each row shall be distributed uniformly over the entire length of the bar, except in the area of marking.

Ribs shall conform to the requirements given in ISO 6935-2.

## 7 Chemical composition

The chemical composition of the steel, as determined by cast analysis, shall conform to [Table 5](#), [Table 6](#) and [Table 7](#).

The elements not listed in [Table 5](#), [Table 6](#) and [Table 7](#) shall not be intentionally added without agreement between manufacturer and purchaser. Precautionary measures shall be taken to avoid unintentional chemical elements which would impair mechanical properties.

In cases where product analysis is required, it shall be agreed at the time of enquiry and order.

The permissible deviation of the product analysis relative to the cast analysis as specified in [Table 5](#), [Table 6](#) and [Table 7](#) are given in [Table 8](#).

**Table 5 — Chemical composition based on cast analysis — Maximum values of mass fractions, in percentage: Austenite**

ISO number <sup>a</sup>	C	Si	Mn	P	S	Cr	Mo	Ni <sup>c</sup>	N	Others <sup>d</sup>
4301-304-00-I	0,07	1,00	2,00	0,045	0,030 <sup>b</sup>	17,5 to 19,5	-	8,0 to 10,5	0,10	-
4311-304-534	0,030	1,00	2,00	0,045	0,030	17,5 to 19,5	-	8,0 to 11,0	0,12 to 0,22	-
4401-316-00-I	0,08	1,00	2,00	0,045	0,030	16,0 to 18,0	2,00 to 3,0	10,0 to 13,0	0,10	-
4429-316-53-I	0,030	1,00	2,00	0,045	0,030	16,5 to 18,5	2,50 to 3,0	10,5 to 13,0	0,12 to 0,22	-
4404-316-03-I	0,030	1,00	2,00	0,045	0,030	16,5 to 18,5	2,00 to 3,0	10,0 to 13,0	0,10	-
4529-089-26-I	0,020	0,75	2,00	0,035	0,015	19,0 to 21,0	6,0 to 7,0	24,0 to 26,0	0,15 to 0,25	Cu: 0,50 to 1,50
4315-304-51-I	0,08	1,00	2,50	0,045	0,030	18,0 to 20,0	-	7,0 to 10,5	0,10 to 0,30	-
4495-316-51-J	0,08	1,00	2,00	0,045	0,030	16,0 to 18,0	2,00 to 3,0	10,0 to 14,0	0,10 to 0,22	-
4406-316-53-I	0,030	1,00	2,00	0,045	0,030	16,5 to 18,5	2,00 to 3,0	10,0 to 12,5	0,12 to 0,22	-
4571-316-35-I	0,08	1,00	2,00	0,045	0,030	16,5 to 18,5	2,00 to 2,50	10,5 to 13,5	-	Ti : 5xC to 0,70

<sup>a</sup> The ISO numbers and chemical compositions are referenced in ISO 15510.

<sup>b</sup> Particular ranges of sulphur mass fraction can provide improvement of particular properties. For machinability, a controlled sulphur mass fraction between 0,015 % to 0,030 % is recommended.

<sup>c</sup> For special purposes (e.g. hot workability), the maximum nickel mass fraction can be increased by the following amounts to minimize ferrite content:  
 — by 0,50 % for 4301-304-00-I;  
 — by 1,00 % for 4401-316-00-I and 4429-316-53-I;  
 — by 1,50 % for 4404-316-03-I.

<sup>d</sup> Nb can be added up to 0,15 %.

**Table 6 — Chemical composition based on cast analysis — Maximum values of mass fractions, in percentage: Austenite-Ferrite**

ISO number <sup>a</sup>	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
4482-320-01-X	0,030	1,00	4,0 to 6,0	0,035	0,030	19,5 to 21,5	0,10 to 0,60	1,50 to 3,50	0,05 to 0,20	Cu: 1,00
4462-318-03-I <sup>b</sup>	0,030	1,00	2,00	0,035	0,015	21,0 to 23,0	2,50 to 3,5	4,5 to 6,5	0,10 to 0,22	-
4362-323-04-I	0,030	1,00	2,00	0,035	0,015	22,0 to 24,5	0,10 to 0,60	3,5 to 5,5	0,05 to 0,20	Cu: 0,10 to 0,60
4460-312-00-I	0,050	1,00	2,00	0,035	0,030 <sup>a</sup>	25,0 to 28,0	1,30 to 2,00	4,5 to 6,5	0,05 to 0,20	-
4410-327-50-E	0,030	1,00	2,00	0,035	0,015	24,0 to 26,0	3,0 to 4,5	6,0 to 8,0	0,24 to 0,35	-
4501-327-60-I	0,030	1,00	1,00	0,030	0,010	24,0 to 26,0	3,0 to 4,0	6,0 to 8,0	0,20 to 0,30	Cu: 0,50 to 1,00 W: 0,50 to 1,00
4062-322-02-U	0,030	1,00	2,00	0,040	0,010	21,5 to 24,0	0,45	1,00 to 2,80	0,18 to 0,26	-
4162-321-01-E	0,040	1,00	4,0 to 6,0	0,040	0,015	21,0 to 22,0	0,10 to 0,80	1,35 to 1,70	0,20 to 0,25	Cu: 0,10 to 0,80

<sup>a</sup> The ISO numbers and chemical compositions are referenced in ISO 15510.

<sup>b</sup> For special applications, the lower limits of N, Cr, and Mo can be limited to 0,14 %, 22,0 %, and 3,0 %.

**Table 7 — Chemical composition based on cast analysis — Maximum values of mass fractions, in percentage: Ferrite and martensite**

ISO number <sup>a</sup>	C	Si	Mn	P	S	Cr	Mo	Ni	N	Others
4030-410-90-X	0,030	1,00	1,00	0,040	0,030	11,00 to 13,50	-	-	-	-
4003-410-77-I	0,030	1,00	2,00	0,040	0,015	10,5 to 12,5	-	0,30 to 1,10	0,030	-
4024-410-09-E	0,12 to 0,17	1,00	1,00	0,040	0,015	12,0 to 14,0	-	-	-	-

<sup>a</sup> The ISO numbers and chemical compositions are referenced in ISO 15510.