SLOVENSKI STANDARD
oSIST prEN 10370:2023

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Jeklo za armiranje betona - Nerjavno jeklo

Steel for the reinforcement of concrete - Stainless steel

Stahl für die Bewehrung von Beton - Nichtrostender Stahl

Aciers pour béton armé - Aciers inoxydables

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Stahl für die Bewehrung von Beton - Nichtrostender Stahl

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 10370:2023) has been prepared by Technical Committee CEN/TC 459 “ECISS - European Committee for Iron and Steel Standardization”[1], the secretariat of which is held by AFNOR.

This document is currently submitted to the CEN Enquiry.

This document has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

[1] Through its sub-committee SC 4 “Concrete reinforcing and prestressing steels” (secretariat: DIN)

1 Scope

This document specifies product characteristic test/assessment method and the way of expressing test results for stainless steel as defined in EN 10088-1:2014 and designated as in EN 10088-1:2014 for the use of the reinforcement of concrete.

It applies to stainless steel products with ribbed or indented surfaces, which are in the form of:

— bars and coils (rod, wire);

— sheets of factory-made machine-welded fabric;

— lattice girders and hybrid lattice girders composed by stainless steel and by weldable reinforcing steel according to prEN 10080:2023.

Steels according to this document have a ribbed, indented or smooth surface.

NOTE The protrusions between indentations of indented reinforcing steel have the same function as transverse ribs of ribbed reinforcing steel. There is no definition, which specifies the difference between ribbed and indented surface geometry. Therefore, in this document, the same bond parameters are used for ribbed and indented steel.

This document does not apply to:

— pre-stressed stainless steels;

— indented strip;

— stainless steel tube filled with carbon steel swarf, which is then hot or cold reduced;

— stainless steel smooth bar with weld material deposited on it;

— galvanized reinforcing steel;

— epoxy-coated reinforcing steel.

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.

EN 1766:2017, *Products and systems for the protection and repair of concrete structures — Test methods — Reference concretes for testing*

EN 10020:2000, *Definition and classification of grades of steel*

EN 10079:2007, *Definition of steel products*

EN 10088-1:2014, *Stainless steels — Part 1: List of stainless steels*

EN 12390-3:2019, *Testing hardened concrete — Part 3: Compressive strength of test specimens*

EN ISO 377:2017, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377:2017)*

EN ISO 6892-2:2018, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature (ISO 6892-2:2018)*

EN ISO 7500-1:2018, *Metallic materials — Calibration and verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Calibration and verification of the force-measuring system (ISO 7500-1:2018)*

EN ISO 15630-1:2019, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 1: Reinforcing bars, rods and wire (ISO 15630-1:2019)*

EN ISO 15630-2:2019, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 2: Welded fabric and lattice girders (ISO 15630-2:2019)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020:2000, EN 10079:2007 and the following apply.

3.1
7% strength
strength at 7% total elongation, $R_{7.0}$

3.2
angle of inclination of diagonals, ϑ
angle between the axis of a diagonal and the longitudinal axis of a lattice girder in the plane of the diagonal in the middle of the height of a lattice girder

3.3
angle of transverse rib or indentation inclination, β
angle between the axis of the transverse rib and the longitudinal axis of the bar, rod or wire

3.4
batch
quantity of rebars, processed from an identical heat or cast, size or alloy, processed in the same production lot, in the same process conditions or any quantity of welded fabric or lattice girders of one type produced by one manufacturer and presented for examination at any one time

3.5
characteristic value C_v
value of a material or product property having a prescribed probability of not being attained in a hypothetical unlimited test series

Note 1 to entry: This value generally corresponds to a specific fractile of the assumed statistical distribution of the particular property of the material or product.

3.6
coil
single length of reinforcing steel wound in concentric rings, including coils welded together to produce a single coiled length

3.7
design height of a lattice girder, H_1
distance between the lowest point of the lower chord and the highest point of the upper chord

3.8
design width of a lattice girder, B_1
distance between the outlying points of the lower chords

3.9
hybrid lattice girder
lattice girder where the metallic structure is composed of both stainless steel used for the reinforcement of concrete and weldable reinforcing steel.

Note 1 to entry: For hybrid lattice girders, the same definitions apply as for lattice girders.

3.10
indented reinforcing steel
reinforcing steel with defined indentations uniformly distributed over the entire length

3.11
indentation depth, t
distance between the surface of the wire and the deepest point of the indentation

3.12
indentation width, b
width of the indention to be measured parallel to the axis of the bar, rod or wire

3.13
lattice girder
two or three-dimensional metallic structure comprising an upper chord, one or more lower chords and continuous or discontinuous diagonals which are welded or mechanically assembled to the chords

3.14
lattice girder length, L_{lg}
overall length of a lattice girder

3.15
lattice girder overhang, u_1,u_2
length of the diagonals beyond either the upper chord (u1) or the lower chord (u2)

3.16
length of a welded fabric sheet, L_{wf}
dimension of the longest side of a sheet of welded fabric, irrespective of the manufacturing direction

3.17
longitudinal rib
uniform continuous protrusion parallel to the axis of the bar, rod or wire

3.18
longitudinal wire
reinforcing steel in the manufacturing direction of the welded fabric

3.19
lower chord
set of longitudinal reinforcing steels placed in the lower part of a lattice girder

Note 1 to entry: They form harmonic curves in the case of continuous diagonals or are independent elements in the case of discontinuous diagonals.

3.20
minimum value
value below which no test result shall fall

3.21
maximum value
value which no test result shall exceed

3.22
nominal cross-sectional area, A_n
cross-sectional area equivalent to the area of a circular plain bar of the same nominal diameter, d_{nom} $\left(\text{i.e.} \frac{nd_{nom}^2}{4} \right)$

3.23
overall height of a lattice girder, H_2
distance between the lowest point and the highest point of a lattice girder

3.24
overall width of a lattice girder, B_2
distance between the outlying points of a lattice girder

3.25
overhang of welded fabric, u_1, u_2, u_3, u_4
length of longitudinal or transverse wires projecting beyond the centre of the outer crossing wire in a sheet of welded fabric

3.26
pitch of diagonals, P_s
distance between equivalent consecutive junction points of the diagonals with the chords

3.27
pitch of welded fabric
centre-to-centre distance of wires in a sheet of welded fabric

3.28
production lot
an uninterrupted period of production

3.29
purpose made lattice girder
lattice girder manufactured according to user's specific requirements

3.30
purpose made welded fabric
welded fabric manufactured according to user's specific requirements

3.31
reinforcing steel
steel product with a circular or practically circular cross-section which is suitable for the reinforcement of concrete

3.32
relative indentation area f_P
area of the projection of all indentations on a plane perpendicular to the longitudinal axis of the bar, rod or wire, divided by the indentation spacing and the nominal circumference

3.33
relative rib area, f_R
area of the projection of all ribs on a plane perpendicular to the longitudinal axis of the bar, rod or wire, divided by the rib spacing and the nominal circumference

3.34
ribbed reinforcing steel
reinforcing steel with at least two rows of transverse ribs, which are uniformly distributed over the entire length

3.35
rib height *h*
distance from the highest point of the rib (transverse or longitudinal) to the surface of the core, to be measured normal to the axis of the bar, rod or wire

3.36
rib or indentation spacing, *c*
distance between the centres of two consecutive transverse ribs measured parallel to the axis of the bar, rod or wire

3.37
semi-finished product
ribbed or indented product which requires further processing in order to achieve the standard and special properties specified in this document for reinforcing steels

3.38
special property
property contained in this document which is not determined as part of the factory production control requirements for every test unit

3.39
standard lattice girder
lattice girder manufactured according to specified delivery conditions and available from stock

3.40
standard property
property which is contained in this document as part of the factory production control requirements for every test unit

3.41
standard welded fabric
welded fabric manufactured according to specified delivery conditions and available from stock

3.42
transverse rib
any rib on the surface of the bar, rod or wire other than a longitudinal rib

3.43
transverse rib flank inclination, α
angle of the rib flank measured perpendicular to the longitudinal axis of the rib

3.44
transverse wire
reinforcing steel perpendicular to the manufacturing direction of the welded fabric

3.45
welded fabric
arrangement of longitudinal and transverse bars, rods or wires of the same or different nominal diameter and length that are arranged substantially at right angles to each other and factory electrical resistance welded together by automatic machines at all points of intersection

3.46
width of a welded fabric sheet, *B*
dimension of the shortest side of the sheet of welded fabric, irrespective of the manufacturing direction

3.47
bar
product of plain round or ribbed cross-section

Note 1 to entry: Symbols, unit and abbreviated terms used in this European Standard are listed in Table 1.

Note 2 to entry: For comparison of symbols used in this European Standard with those used in EN 1992-1-1 and EN 1992-1-2 see Annex F.

Table 1 — Symbols, unit and abbreviated terms

Symbol	Description	Unit
$\bar{x}$	Average value of test results	a
α	Transverse rib flank inclination	°
ϑ	Inclination of the diagonals in lattice girder or in hybrid lattice girder	°
a1, a2, a3, a4	Increment (specified in the product specification)	a
A_{Ch}	Cross-sectional area of chord	mm²
A_{Di}	Cross-sectional area of diagonal	mm²
A_{gt}	Percentage total elongation at maximum force	%
A_n	Nominal cross-sectional area	mm²
b	Width of indentation	mm
B	Length of transverse wire in welded fabric	mm
B_1	Design width of lattice girder or hybrid lattice girder	mm
B_2	Overall width of lattice girder or hybrid lattice girder	mm
c	Transverse rib or indentation spacing	mm
C_v	Specified characteristic value	
d_{nom}	Nominal diameter of the reinforcing steel	mm
d_C	Diameter of transverse wires in welded fabric	mm

Symbol	Description	Unit
d_L	Diameter of longitudinal wires in welded fabric	mm
e	Gap between rib or indentation rows	mm
E	Young's modulus	MPa[b]
F_d	Shear force of a clamped joint in lattice girder or hybrid lattice girder	kN
f_P	Relative indentation area	-
f_R	Relative rib area	-
F_w	Shear force of a single weld in lattice girder or hybrid lattice girder	kN
h	Rib height	mm
H_1	Design height of lattice girder or hybrid lattice girder	mm
H_2	Overall height of lattice girder or hybrid lattice girder	mm
k	Coefficient as a function of the number of test results	-
L_{lg}	Length of lattice girder or hybrid lattice girder	mm
L_{wf}	Length of longitudinal wire in welded fabric	mm
N_C	Number of transverse wires in welded fabric	-
N_L	Number of longitudinal wires in welded fabric	-
P_C	Pitch of transverse wires in welded fabric	mm
P_L	Pitch of longitudinal wires in welded fabric	mm
Ps	Pitch of diagonals of lattice girder or hybrid lattice girder	mm
$R_{7.0}$	strength at 7 % total elongation	MPa[b]
R_m	Tensile strength	MPa[b]
$R_m/R_{p0.2}$	Ratio tensile strength/0,2 % proof strength	-
$R_{p0,2}$	0,2 % proof strength (tensile yield strength)	MPa[b]
$R_{p0.2act}$	Actual value of 0,2 % proof strength	MPa[b]
$R_{p0.2act}/R_{p0.2nom}$	Ratio actual value of 0,2 % proof strength/specified value of 0,2 % proof strength	-
$R_{p0.2Ch}$	0,2 % proof strength of the chord in lattice girder or in hybrid lattice grider	MPa[b]
$R_{p0.2Di}$	0,2 % proof strength of the diagonal in lattice girder or in hybrid lattice girder	MPa[b]
$R_{p0.2nom}$	Specified value of 0,2 % proof strength	MPa[b]
s	Estimate of the standard deviation	[a]
$ß$	Angle of transverse rib or indentation inclination	°
t	Depth of indentation	mm
$u1, u2$	Overhang of the longitudinal wires in welded fabric or length of the diagonals beyond the upper or lower chord of a lattice girder or hybrid lattice girder	mm
$u3, u4$	Overhang of the transverse wires in welded fabric	mm

[a] The unit depends on the property.

[b] 1 MPa = 1 N/mm^2.

4 Essential characteristics

4.1 General information

Table 2, for information only, summarizes the tensile product characteristics of the voluntary standards, national regulations and Eurocodes in force in the European countries.

Table 2 — Tensile properties (informative)

Properties	Ductility Classes		
	A	B	C
Characteristic value of 0,2 % Proof Strength $R_{p0,2}$ [MPa]	400 to 750 [a, b]		
Characteristic values of Ratio tensile strength 0,2 % Proof Strength $R_m/R_{p0,2}$	≥ 1,05	≥ 1,08	≥ 1,15 <1,35 [c]
Characteristic values of Elongation at maximum load A_{gt} (%)	≥ 2,5	≥ 5,0	≥ 7,5

[a] In EN 1992-1-1 the minimum prof strength range is 400 ÷ 700 [MPa]

[b] In EN 1992-1-1 the maximum actual proof stress $R_{p0.2}$, shall not exceed (1,3 x $R_{p0.2}$), where $R_{p0.2}$ is the characteristic value.

[c] In the case of austenitic and duplex stainless steels, because of their specific stress-strain constitutive relationship, the ratio is calculated by using the value of $R_{7.0}$ instead of R_m.

In this standard, the specified values for the tensile properties (R_m, $R_{p0.2}$, R_m/ $R_{p0.2}$, A_{gt},) shall be the corresponding specified characteristic value with p = 95 % for R_m and $R_{p0.2}$, and p = 90 % for A_{gt}, R_m/ $R_{p0.2}$. The values $R_{p0.2}$ and R_m shall be calculated using the nominal cross-sectional area of the product.

For stainless steel the 0,2 % proof strength ($R_{p0.2}$) shall be assumed as the tensile yield strength

4.2 Elongation at maximum load

The elongation at maximum load (A_{gt}%) is determined according to 5.2. The determined characteristic value for elongation at maximum load shall be the lower limit (fractile p) of the confidence interval at which there is a 90 % probability (1 - α = 0, 90) that 90 % (p = 0,90) of the individual measured values are at or above this lower limit with at least A_{gt} (%) ≥ 2,5 %. This definition refers to the long-term quality level of production. The declared performance is the corresponding specified characteristic value.

4.3 Weldability

The weldability of stainless steel for the reinforcement of concrete is a function of the chemical composition and determined according to 5.3. The list of the stainless steel designations is given in EN 10088-1:2014 (see examples in Table 3). For each designated chemical composition according to EN 10088-1:2014 each individual element shall comply with the specified maximum values. The declared performance is the steel class designated according to EN 10088-1:2014.

The chemical compositions of the stainless steel used for the reinforcement of concrete are listed in the relevant Tables of EN 10088-1:2014.