SLOVENSKI STANDARD
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Prednapeta jekla - 3. del: Palice

Prestressing steels - Part 3: Bars

Spannstähle - Teil 3: Stäbe

Armatures de précontrainte en acier - Partie 3 : Barres

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77.140.15	Jekla za armiranje betona	Steels for reinforcement of concrete
77.140.60	Jeklene palice in drogovi	Steel bars and rods

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Prestressing steels - Part 3: Bars

Armatures de précontrainte en acier - Partie 3 : Barres

Spannstähle - Teil 3: Stäbe

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 459/SC 4.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (prEN 10138-3:2023) has been prepared by Technical Committee CEN/TC 459/SC4 “Concrete reinforcing and prestressing steels”, the secretariat of which is held by DIN.

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 Scope

This document specifies the requirements and definitions for the essential characteristics of prestressing bars, which are used for the prestressing of concrete and which are delivered as finished products in the form of:

— hot rolled and processed bars;

— plain and threaded bars.

NOTE 1 The specification of manufacturing processes related to the finished product is required to ensure that the essential characteristics can be tested properly and that test results are valid. It is not possible to anticipate that any other manufacturing process leads to products which can be tested properly with the specified test methods. Thus, a conclusion to the safe application in building construction would not any longer be possible for those products.

This document does not apply to:

— galvanized steel;

— epoxy coated steel;

— reinforcing steel (see EN 10080);

— further processing.

NOTE 2 Example for further processing: Plain bars are also applied in systems for the prestressing of concrete with threaded ends. The threaded ends depend in length and type on the intended use of the system and are manufactured downstream in the supply chain.

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

EN 10079:2007, *Definition of steel products*

EN ISO 15630-3:2019, *Steel for the reinforcement and prestressing of concrete — Test methods — Part 3: Prestressing steels (EN ISO 15630-3:2019, Corrected version 2019-10)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 10020:2000 and EN 10079:2007 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
prestressing steel
steel product with a circular or practically circular cross-section which is suitable for the prestressing of concrete

3.2
hot rolled bar
product manufactured in straight lengths in a hot rolling mill

NOTE 1 to entry: It may be plain or present threads.

3.3
processed bar
hot rolled bar treated after production by accelerated cooling (including quenching), cold stretching or additional tempering, either singly or in combination

NOTE 1 to entry: It may be plain or present threads.

3.4
threaded prestressing bar
bar with up to two rows of transverse ribs arranged helically or circumferential, which are uniformly distributed over the entire length and which are screwable

3.5
plain prestressing bar
bar with a smooth surface

3.6
heat
quantity of steel corresponding to the same casting operation identified by a single number so designated by the steel manufacturer

3.7
rib height
distance from the highest point of the thread to the surface of the core, to be measured normal to the axis of the bar

3.8
rib spacing
distance between the centres of two consecutive threads measured parallel to the axis of the bar

3.9
rib inclination
angle between the axis of the transverse thread or indentation and the longitudinal axis of the bar

3.10
specified value
value which is defined in a standard and has not been measured or calculated with measured values. A specified value can be a characteristic, a minimum, a maximum or any testing value

NOTE 1 to entry: The specified value may be declared by the manufacturer in his declaration of performance.

3.11
testing value
value which defines testing conditions such as e.g. testing temperature, specified maximum stress in the fatigue test or bending diameter in the bend test

3.12
characteristic value
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.

3.13
minimum value
value below which no test result shall fall

3.14
maximum value
value which no test result shall exceed

3.15
median value
value separating the higher half from the lower half of a data sample

3.16
product type
set of representative performance levels or classes of a construction product, in relation to its essential characteristics, produced using a given combination of raw materials or other elements in a specific production process (see CPR – Regulation No 305/2011, Article 2. 9)

NOTE 1 to entry: A set of different diameters of the same mechanical properties and same surface geometry of bars tested on the same cross-section type.

3.17
test unit
number of pieces or the tonnage of products to accept or reject together, on the basis of the verification tests carried out on sample products in accordance with the requirements of the product standard or order

3.18
sample product
item (e.g. bar, sheet, coil) selected for inspection or testing

3.19
sample
sufficient quantity of material taken from the sample product for the purpose of producing one or more test pieces

3.20
test piece
part of a sample, with specified dimensions, machined or unmachined, brought to a required condition for submission to a given verification test

NOTE 1 to entry: Example for the application of the terms test piece, sample, sample product, test unit and product type:

The product type consist of prestressing bars in the diameter range of 18 mm to 47 mm, manufactured as hot rolled bars with a set of mainly same declared performance level for the essential characteristics. (e.g. for mainly: Same declared performance level each for tensile strength, tensile yield strength etc. independent on diameter but with different performance levels for fatigue strength, relaxation).

The test unit for the product type testing of e.g. the essential characteristic tensile yield strength is specified as lower, intermediate and upper diameter of the diameter range of the product type each manufactured out of 3 different heats. This test unit is composed of in total 9 sample products (each a combination of heat and diameter). For each sample product a specified number of test pieces is to be taken. This specified number of test pieces per sample product is called sample.

4 Symbols

The symbols used in this document and the corresponding designations are given in Table 1.

Table 1 — Symbols and corresponding designations

Symbol	Unit	Designation
A_{gt}	%	Characteristic value of percentage total elongation at maximum force
A_{gtr}	%	Elongation under maximum force after test for durability testing according to Annex A
a	mm	Rib height for threaded bar
b_K	mm	Rib top width of a threaded bar
b_F	mm	Rib bottom width of a threaded bar
C_v	kN, %,-	Specified characteristic value for essential characteristics
c	mm	Rib space for a threaded bar
d	mm	Nominal diameter
d_h	mm	Horizontal core diameter of a threaded bar
d_{ma}	mm	Major diameter of a threaded bar
d_{mi}	mm	Minor diameter of a threaded bar
d_v	mm	Vertical core diameter of a threaded bar
E	GPa	Characteristic value of modulus of elasticity
F_0	kN	Initial force in relaxation and durability test, based on actual force
$\overline{F_m}$	kN	Mean value of maximum force in durability testing according to EN ISO 15630-3
F_{mr}	kN	Maximum force after test for durability testing according to Annex A
$F_{p0,1r}$	kN	Force at the conventional yield point at 0,1 % after test for durability testing according to Annex A

Symbol	Unit	Designation
F_r	kN	Force range in the axial force fatigue test
F_{up}	kN	Upper force in the axial force fatigue test
h_b	mm/m	Deviation from straightness
k	—	Coefficient as a function of the number of test results
L	mm	Length of the test piece for durability testing according to Annex A
L_0	mm	Length of the test piece immersed in distilled water for durability testing according to Annex A
m	g/m	Nominal mass per meter
N	-	Number of load cycles in fatigue test
n	—	Number of test pieces
P	-	Surface geometry – plain bar
P_{th}	mm	Pitch of a threaded bar
p	-, %	Reliable failure rate
q	I/min	Flow rate of water circulation for durability testing according to Annex A
R	°	Radius of the transition from rib to core for a threaded bar
R_m	kN	Characteristic value of tensile strength
$R_{p0,1}$	kN	Characteristic value of 0,1 % yield strength
$R_m/R_{p0,1}$	-	Characteristic value of stress ratio
s	kN, %,-	Estimated standard deviation of the test results for essential characteristics
S_n	mm^2	Nominal cross-sectional area
T	°C	Test temperature for durability testing according to Annex A
t_a	h	Minimum time without fracture in durability test
$t_{f,m}$	h	Median time to fracture in durability test
t_{fr}	h	Time to fracture for durability testing according to Annex A
$\bar{x}$	kN, %-	Estimated average value of test results for essential characteristics
Z_r	%	Stress coefficient after test for durability testing according to Annex A
α	°	Rib flank angle of a threaded bar
(1-α)	—	Statistically reliable failure rate
β	°	Rib inclination of a threaded bar
ΔF_{rt}	%	Percentage loss of initial force F_0 in relaxation test
Δl	mm	Deviation from the nominal length

Symbol	Unit	Designation
Δm	%	Deviation from the nominal mass per meter

5 Essential characteristics

5.1 Tensile strength, tensile yield strength, stress ratio (ult. tensile strength/tens. yield strength), modulus of elasticity and elongation at maximum load

a) In the context of this document the characteristic value C_v is the lower or upper limit (fractile p) of the confidence interval at which there is a 95 % probability (1 - α = 0,95) that 95 % (p = 0,95) or 90 % (p = 0,90) of the individual measured values are at or above this lower limit, and/or are at or below this upper limit respectively (see Table 5 and Table 6). This definition refers to the long-term quality level of production (see 6.3.2.5.4).

b) The essential characteristics tensile strength (R_m), tensile yield strength ($R_{p0,1}$), stress ratio ($R_m/R_{p0,1}$), modulus of elasticity (E) and elongation at maximum load (A_{gt}) of prestressing bars are determined in tensile tests in accordance with EN ISO 15630-3 with the specified number of test pieces according to Clause 6.

c) The determined characteristic values C_v for tensile strength, tensile yield strength, stress ratio, modulus of elasticity and elongation at maximum load (R_m, $R_{p0,1}$, $R_m/R_{p0,1}$, E and A_{gt}) shall be at least the corresponding specified characteristic values C_v with:

— R_m: p = 0,05 at 1- α = 0,95 (95 %) and p = 0,95 at 1- α = 0,95 (95 %);

— $R_{p0,1}$: p = 0,05 at 1- α = 0,95 (95 %);

— $R_m/R_{p0,1}$: p=0,10 at 1- α = 0,95 (95 %);

— A_{gt}: p=0,10 at 1- α = 0,95 (95 %);

— *E:* p=0,10 at 1- α = 0,95 (95 %) and p = 0,90 at 1- α = 0,95 (95 %).

The declared performance is the corresponding specified characteristic value C_v.

d) The values E, $R_{p0,1}$ and R_m shall be calculated using the nominal cross-sectional area S_n of the product.

5.2 Relaxation

a) Relaxation of a prestressing bar is specified as the percentage loss of initial force F_0 determined in an isothermal relaxation test in accordance with EN ISO 15630-3 with the number of test pieces according to Clause 6.

b) The declared performance for relaxation is the percentage loss ΔF_{rt} of initial force F_0. Different relaxations may be declared for one product or the product type. This applies as well for different diameter ranges within one product type.

5.3 Fatigue strength

a) Fatigue strength is specified as a number of force cycles N at a force range F_r and a maximum force F_{up} and shall be determined by an axial force controlled fatigue test in accordance with EN ISO 15630-3 with the number of test pieces according to Clause 6. For the force range F_r and the maximum force F_{up} nominal values apply.

b) The declared performance is the number of force cycles N fulfilled for the specified number of individual tests at a force range F_r and a maximum force F_{up}. Different fatigue strengths may be declared for one product or the product type. This applies as well for different diameter ranges within one product type.

It is recommended that the declared number of force cycles N fulfilled for the specified number of individual tests at a force range F_r and a maximum force F_{up} corresponds to the design specification for N^* and $\Delta\sigma_{Rsk}$ of EN 1992-1-1.

5.4 Durability

a) Durability is specified as the resistance of prestressing bar against hydrogen induced stress corrosion cracking in thiocyanate solutions A and/or B and/or distilled water (solution C) determined in accordance with EN ISO 15630-3 and/or Annex A with the number of test pieces according to Clause 6.

b) The declared performance is the minimum time in hours t_a without fracture and/or, where applicable, the median time in hours $t_{f,m}$ until fracture in the used test solution (A or B according to EN ISO 15630-3 or distilled water C according to Annex A) at an initial force F_0 declared as percentage of $\overline{F_m}$ (mean value according to EN ISO 15630-3) for the specified number of individual tests. Different durability's may be declared for one product or the product type. This applies as well for different diameter ranges within one product type.

According to EN ISO 15630-3, F_0 = 80 % of $\overline{F_m}$ is recommended.

5.5 Surface geometry

5.5.1 Plain bar surface

For plain bars no parameters and measurements apply and the declaration of performance is *P* for plain bar.

5.5.2 Thread bar surface for threads over the entire circumference

Surface geometry is declared as a full set of the following thread parameters (see Figure 1):

Major diameter d_{ma}

Minor diameter d_{mi}

Pitch P_{th}

Rib flank angle α