SLOVENSKI STANDARD
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Jeklena žica za vzmeti - 3. del: Nerjavna jeklena žica za vzmeti

Steel wire for mechanical springs - Part 3: Stainless spring steel wire

Stahldraht für Federn - Teil 3: Nichtrostender Federstahldraht

Fils en acier pour ressorts mécaniques - Partie 3: Fils en acier inoxydable

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ICS:

77.140.25	Vzmetna jekla	Spring steels
77.140.65	Jeklene žice, jeklene vrvi in verige	Steel wire, wire ropes and link chains

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EUROPEAN STANDARD

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English Version

Steel wire for mechanical springs - Part 3: Stainless spring steel wire

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Foreword

This document (EN 10270-3:2011) has been prepared by Technical Committee ECISS/TC 106 “Wire rod and wires”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2012, and conflicting national standards shall be withdrawn at the latest by April 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 10270-3:2001.

This European Standard for steel wire for mechanical springs is composed of the following parts:

— *Part 1: Patented cold drawn unalloyed spring steel wire*;

— *Part 2: Oil hardened and tempered spring steel wire*;

— *Part 3: Stainless spring steel wire*.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

1.1 This European Standard applies to the grades of stainless steels listed in Table 1, which are usually used in the cold drawn condition in the form of wire of circular cross-section up to 10,00 mm in diameter, for the production of springs and spring parts that are exposed to corrosive effects and sometimes to slightly increased temperatures (see A.1).

1.2 In addition to the steels listed in Table 1 certain of the steel grades covered by EN 10088-3 e.g. 1.4571, 1.4539, 1.4028 are also used for springs, although to much lesser extent. In these cases the mechanical properties (tensile strength, etc.) should be agreed between purchaser and supplier. Similarly, diameters between 10,00 mm and 15,00 mm may be ordered according to this standard; in this case the parties should agree upon the required mechanical characteristics.

1.3 In addition to this European Standard the general technical delivery requirements of EN 10021 are applicable.

2 Normative references

The following referenced documents are indispensable for the application 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 10021, *General technical delivery conditions for steel products*

EN 10027-1:2005, *Designation systems for steels — Part 1: Steel names*

EN 10027-2:1992, *Designation systems for steels — Part 2: Numerical system*

EN 10088-3, *Stainless steels — Part 3: Technical delivery conditions for semi-finished products, bars, rods and sections for general purposes*

EN 10204:2004, *Metallic products — Types of inspection documents*

EN 10218-1, *Steel wire and wire products — General — Part 1: Test methods*

EN 10218-2, *Steel wire and wire products — General — Part 2: Wire dimensions and tolerances*

CEN/TR 10261, *Iron and steel — Review of available methods of chemical analysis*

EN ISO 377, *Steel and steel products — Location and preparation of samples and test pieces for mechanical testing (ISO 377:1997)*

EN ISO 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature (ISO 6892-1:2009)*

EN ISO 14284, *Steel and iron — Sampling and preparation of samples for the determination of chemical composition (ISO 14284:1996)*

3 Information to be supplied by the purchaser

The purchaser shall clearly state in his enquiry or order the product and following information:

a) the desired quantity;

b) the term spring steel wire or straightened and cut lengths;

c) the number of this European Standard: EN 10270-3;

d) the steel grade (see Table 1) and for grade 1.4301, 1.4310 and 1.4462 also the tensile strength level (see Table 2);

e) the nominal wire diameter (see Table 4) and for cut length the length and the length tolerance class (see Table 6);

f) the surface finish (see 4.3, i.e. coating);

g) the form of delivery (see 4.2);

h) the type of inspection document to be supplied (see 5.1);

i) any particular agreement made.

EXAMPLE 2 t stainless steel spring wire according to this standard, grade 1.4310, normal tensile strength level and nominal diameter 2,50 mm, nickel coated in coils with inspection document 3.1 according to EN 10204:2004:

2 t spring steel wire EN 10270-3 – 1.4310-NS – 2,50 - Ni-coated in coils, EN 10204:2004 – 3.1

4 Requirements

4.1 Manufacturing process

Unless otherwise agreed in the order, the manufacturing process used in the making of the stainless steel wire is left to the discretion of the manufacturer. The starting condition (+AT: solution annealed) of the wire (rod) is specified in EN 10088-3.

4.2 Form of delivery

The wire shall be supplied in coils, on spools, on spoolless cores or carriers. Several coils may be assembled on a carrier. Unless otherwise specified the form of delivery shall be at the manufacturer's discretion. They shall however inform the purchaser about the form of delivery.

The delivery requirements are specified in 4.7.

Wire in straight lengths is normally supplied in bundles.

4.3 Surface finish

The wire may be coated or not. The specific coating and finish for stainless steel spring wire shall be agreed upon at the time of enquiry and order - e.g. uncoated, polished finish, nickel coated.

4.4 Chemical composition

4.4.1 The requirements for the chemical composition given in Table 1 apply to the heat analysis.

4.4.2 The permissible deviation of the product analysis from the values specified in Table 1 shall be in accordance with the provision in EN 10088-3. For a single heat the deviation of an element in the product analysis may be only below the minimum or only above the maximum value of the range specified for the heat analysis, but not both at the same time.

Table 1 — Chemical composition — Heat analysis[a] (% by mass)

Steel grade		C	Si	Mn	P	S	Cr	Mo	Ni	Other elements
			max.	max.	max.	max.				
Name[b]	Number[b]									
X10CrNi18-8	1.4310	0,05 to 0,15	2,00	2,00	0,045	0,015	16,0 to 19,0	≤ 0,80	6,0 to 9,5	N ≤ 0,11
X5CrNiMo17-12-2	1.4401[c]	≤ 0,07	1,00	2,00	0,045	0,015	16,5 to 18,5	2,00 to 2,50	10,0 to 13,0	N ≤ 0,11
X7CrNiAl17-7	1.4568[d]	≤ 0,09	0,70	1,00	0,040	0,015	16,0 to 18,0	-	6,5 to 7,8	Al: 0,70 to 1,50
X5CrNi18-10	1.4301	≤ 0,07	1,00	2,00	0,045	0,015	17,5 to 19,5	-	8,0 to 10,5	N ≤ 0,11
X1NiCrMoCu25-20-5	1.4539	≤ 0,020	0,70	2,00	0,030	0,010	19,0 to 21,0	4,0 to 5,0	24,0 to 26,0	N ≤ 0,15 Cu: 1,20 to 2,00
X2CrNiMoN22-5-3	1.4462[e]	≤ 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	N: 0,10 to 0,22

[a] Alternative compositions may be used by agreement.

[b] "Name" and "Number" are derived in accordance with EN 10027-1 and -2 respectively.

[c] Steel 1.4436 may be used to provide increased corrosion resistance compared with 1.4401, with the specification of this part of EN 10270 applicable for steel 1.4401.

[d] For better cold formability the upper limit of nickel content may be increased up to 8,30 %.

[e] Duplex grades.

4.5 Mechanical properties

4.5.1 For the tensile strength in the as drawn condition the data of Table 2 shall apply.

Table 2 — Tensile strength in the drawn condition

Nominal diameter mm [g]	Tensile strength (MPa) [a b c d e f] for the following steel grades																
	1.4310				1.4401		1.4568		1.4301			1.4539		1.4462			
	Normal tensile strength (NS) -		High tensile strength (HS) -						Normal tensile strength (NS)	High tensile strength (HS)				Normal tensile strength (NS) -		High tensile strength (HS) -	
	min.	max.	min.	max.	min.	max.	min.	max.	min.	min.	max.	min.	max.	min.	max.	min.	max.
$d \leq 0{,}20$	2 200	2 530	2 350	2 710	1 725	1 990	1 975	2 280	2 000	2150	2 300	1 600	1 840	2 150	2 480	2 370	2 730
$0{,}20 < d \leq 0{,}30$	2 150	2 480	2 300	2 650	1 700	1 960	1 950	2 250	1 975	2050	2 280	1 550	1 790	2 100	2 420	2 370	2 730
$0{,}30 < d \leq 0{,}40$	2 100	2 420	2 250	2 590	1 675	1 930	1 925	2 220	1 925	2050	2 220	1 550	1 790	2 000	2 300	2 370	2 730
$0{,}40 < d \leq 0{,}50$	2 050	2 360	2 200	2 530	1 650	1 900	1 900	2 190	1 900	1950	2 190	1 500	1 750	2 000	2 300	2 370	2 730
$0{,}50 < d \leq 0{,}65$	2 000	2 300	2 150	2 480	1 625	1 870	1 850	2 130	1 850	1950	2 130	1 450	1 670	1 900	2 190	2 370	2 730
$0{,}65 < d \leq 0{,}80$	1 950	2 250	2 100	2 420	1 600	1 840	1 825	2 100	1 800	1850	2 070	1 450	1 670	1 900	2 190	2 230	2 570
$0{,}80 < d \leq 1{,}00$	1 900	2 190	2 050	2 360	1 575	1 820	1 800	2 070	1 775	1850	2 050	1 400	1 610	1 800	2 070	2 140	2 470
$1{,}00 < d \leq 1{,}25$	1 850	2 130	2 000	2 300	1 550	1 790	1 750	2 020	1 725	1750	1 990	1 350	1 560	1 800	2 070	2 090	2 410
$1{,}25 < d \leq 1{,}50$	1 800	2 070	1 950	2 250	1 500	1 730	1 700	1 960	1 675	1750	1 930	1 350	1 560	1 700	1 960	2 090	2 410
$1{,}50 < d \leq 1{,}75$	1 750	2 020	1 900	2 190	1 450	1 670	1 650	1 900	1 625	1650	1 870	1 300	1 500	1 700	1 960	2 000	2 300
$1{,}75 < d \leq 2{,}00$	1 700	1 960	1 850	2 130	1 400	1 610	1 600	1 840	1 575	1650	1 820	1 300	1 500	1 700	1 960	2 000	2 300
$2{,}00 < d \leq 2{,}50$	1 650	1 900	1 750	2 020	1 350	1 560	1 550	1 790	1 525	1550	1 760	1 300	1 500	1 550	1 790	1 900	2 190
$2{,}50 < d \leq 3{,}00$	1 600	1 840	1 700	1 960	1 300	1 500	1 500	1 730	1 475	1550	1 700	1 300	1 500	1 550	1 790	1 860	2 140
$3{,}00 < d \leq 3{,}50$	1 550	1 790	1 650	1 900	1 250	1 440	1 450	1 670	1 425	1450	1 640	1 300	1 500	1 550	1 790	–	–
$3{,}50 < d \leq 4{,}25$	1 500	1 730	1 600	1 840	1 225	1 410	1 400	1 610	1 400	1450	1 610	1 250	1 440	1 450	1 670	–	–
$4{,}25 < d \leq 5{,}00$	1 450	1 670	1 550	1 790	1 200	1 380	1 350	1 560	1 350	1350	1 560	1 250	1 440	1 450	1 670	–	–
$5{,}00 < d \leq 6{,}00$	1 400	1 610	1 500	1 730	1 150	1 330	1 300	1 500	1 300	1350	1 500	1 250	1 440	1 350	1 560	–	–
$6{,}00 < d \leq 7{,}00$	1 350	1 560	1 450	1 670	1 125	1 300	1 250	1 440	1 250	1300	1 440	1 200	1 380	1 350	1 560	–	–
$7{,}00 < d \leq 8{,}50$	1 300	1 500	1 400	1 610	1 075	1 240	1 250	1 440	1 200	1300	1 380	1 150	1 330	–	–	–	–
$8{,}50 < d \leq 10{,}00$	1 250	1 440	1 350	1 560	1 050	1 210	1 250	1 440	1 175	1250	1 360	–	–	–	–	–	–

[a] Tensile strength calculated on actual diameter.

[b] The range of tensile strength values within a production batch of the same heat shall be a maximum of 9 % of the minimum values in this table.

[c] After straightening, it is recognized that the tensile strength may reduce by up to 10 % but the minimum values of this Table have to be fulfilled.

[d] When better formability is required, lower tensile strength values may be agreed upon.

[e] The wire is supplied in the cold drawn condition. The tensile strength in the finished spring may be substantially influenced by a heat treatment; particularly precipitation hardening of grade 1.4568 results in substantially higher tensile strength (see A.5.2 and Table A.3).

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

[g] Larger diameters may be specified in which case the parties shall agree the tensile strength at the time of enquiry and order.

NOTE 1 Grade 1.4310 and 1.4462 can be delivered in normal tensile strength (NS) or high tensile strength (HS).

NOTE 2 For steel 1.4568 the characteristics of the springs are not only determined by the characteristics of the drawn wire but also by the heat-treatment of the spring (see A.2). Therefore the steel should be of such quality so that by the heat treatment after drawing the mechanical properties are met.

4.5.2 In addition to the requirements of Table 2 the maximum tensile strength range within one unit package (individual coil, spool or reel,..) shall satisfy Table 3.

For straightened and cut lengths the values of Table 3 apply for the individual bundles.

Table 3 — Tensile strength range within an individual unit package (coil/spool/bundle)

Wire diameter *d* (mm)	Max. range (MPa)
$d \leq 1{,}50$	100
$1{,}50 < d \leq 10{,}00$	70

4.6 Technological properties

4.6.1 Coiling test

For evaluation of uniformity of coiling and surface condition the coiling test may be applied to wire with a diameter of 0,50 mm to 1,50 mm. The spring coiled in accordance with 5.4.3 shall show a defect free surface condition without splits or fracture; the coil shall have uniform pitch of the turns and a fair dimensional regularity of its diameter.

NOTE Although the usefulness of the coiling test is not generally recognized, it has been retained since it offers the possibility of revealing internal stresses. If doubtful test results are obtained the wire concerned should not be rejected immediately but efforts should be made by the parties concerned to elucidate the cause.

4.6.2 Wrapping test

The wrapping test may be applied to wire with a diameter of 0,30 mm to 3,00 mm. The wire shall not show any sign of cracks or surface imperfections when closely wrapped eight turns around a mandrel of a diameter equal to the wire size (see also 5.4.4).

4.6.3 Simple bend test

Where requested, the bend test may be applied for wire with a diameter over 3,00 mm. The wire shall withstand the test without any sign of failure.

NOTE In some applications the material is severely deformed by bending. Such is the case for extension springs with tight hooks, springs with bends on legs, spring wire forms, etc. In such cases the bend test provides for a wire test very close to actual use.

4.7 Supply conditions of wire on coils/reels and spools

4.7.1 General

The wire of each coil shall consist of one single length of wire originating from only one heat. It shall be wound so that there are no kinks.

Where wire is delivered on spools, spoolless cores or carriers up to 10 % of those may consist of a maximum of two wire lengths. The joints shall be properly made, suitably marked and labelled.

4.7.2 Coil size

The internal diameter of unit packages (coil/reels or spools) shall reach at least the values given in Table 4, unless otherwise agreed.

Table 4 — Wire diameter and associated minimum coil internal diameter

Wire diameter (d) (mm)	Minimum internal diameter (mm)
$0,18 \leq d \leq 0,28$	100
$0,28 < d \leq 0,50$	150
$0,50 < d \leq 0,70$	180
$0,70 < d \leq 1,60$	250
$1,60 < d \leq 4,50$	400
$4,50 < d$	500

4.7.3 Circular wire cast

The wire shall be uniformly cast and take a circular cast. Unless otherwise specified the wap diameter of the wire supplied in coils/reels may expand when the binding wires are removed, but should usually not retract to less than the unit internal diameter, other than by agreement between supplier and purchaser. The expansion shall be approximately even within a single unit package and within all the units in a production batch.

4.7.4 Helix cast of wire

The wire shall be dead cast, free from helix cast. The requirement shall be considered fulfilled in the case of wire below 5,00 mm if the following condition is satisfied.

An individual wap taken from a unit package and freely hung on a hook may show an axial displacement ' f_a' at the ends of the wap (see Figure 1); the displacement f_a shall not exceed a value given by the following equation:

$$f_a \leq \frac{0,2W}{\sqrt[4]{d}}$$

where

f_a the axial displacement in mm;

W the diameter of the free wap in mm;

d the diameter of the wire in mm.