

Cold rolled narrow steel strip for heat treatment — Technical delivery conditions —

Part 4: Spring steels and other applications

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British Standard

ICS 77.140.25

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee ISE/31, Wrought steels, which has the responsibility to:

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Amendments issued since publication

Amd. No.	Date	Comments

This British Standard, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 May 2000

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ISBN 0 580 35853 4

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EUROPEAN STANDARD

EN 10132-4

NORME EUROPÉENNE

EUROPÄISCHE NORM

February 2000

ICS 77.140.10; 77.140.25; 77.140.50

English version

Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 4: Spring steels and other applications

Feuillards laminés à froid pour traitement thermique -
Conditions techniques de livraison - Partie 4: Aciers à
ressorts et autres applications

Kaltband aus Stahl für eine Wärmebehandlung -
Technische Lieferbedingungen - Teil 4: Federstähle und
andere Anwendungen

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Ref. No. EN 10132-4:2000 E

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Foreword

This European Standard has been prepared by Technical Committee ECISS/TC 23, Steels for heat treatment, alloy steels and free-cutting steels - Qualities and dimensions, the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by August 2000, and conflicting national standards shall be withdrawn at the latest by August 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

The European Standard EN 10132, Cold rolled narrow steel strip for heat-treatment - Technical delivery conditions, is subdivided as follows:

- Part 1: General;
- Part 2: Case hardening steels;
- Part 3: Steels for quenching and tempering;
- Part 4: Spring steels and other special applications.

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1 Scope

1.1 This part of EN 10132 applies to:

- non-alloy and alloy cold rolled narrow steel strip thicknesses up to 6 mm;
- non-alloy and alloy cold rolled narrow steel strip in the quenched and tempered condition in thicknesses between 0,30 mm and 3,00 mm

for springs and for other special applications.

1.2 This EN 10132-4 is complemented by EN 10132-1.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 10020, *Definition and classification of grades of steel.*

EN 10132-1, *Cold rolled narrow steel strip for heat treatment - Technical delivery conditions - Part 1: General.*

EN ISO 6508-1, *Metallic materials - Rockwell hardness test - Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T) (ISO 6508-1:1999).*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in EN 10132-1 apply.

4 Classification and designation

4.1 Classification

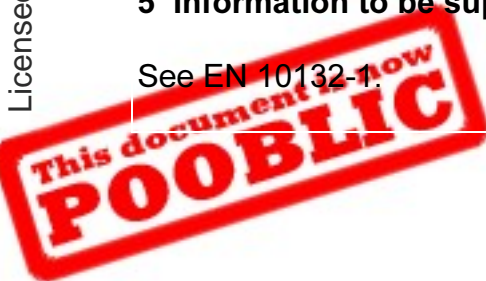
All steels covered by this European Standard are classified according to EN 10020. Steel grades C55S, C60S, C67S, C75S, C85S, C90S, C100S and C125S are non-alloy special steels, steel grades 48Si7, 56Si7, 51CrV4, 80CrV2, 75Ni8, 125Cr2 and 102Cr6 are alloy special steels.

4.2 Designation

See EN 10132-1.

5 Information to be supplied by the purchaser

See EN 10132-1.



6 Manufacturing process

See EN 10132-1.

7 Requirements

7.1 General

See EN 10132-1.

7.2 Method of delivery

See EN 10132-1.

7.3 Delivery condition

Cold rolled narrow steel strip covered by EN 10132-4 shall be supplied in one of the following delivery conditions:

- annealed or annealed and skin passed (+A or +LC);
- cold rolled (+CR);
- quenched and tempered (+QT).

NOTE The delivery condition - annealed to achieve spheroidized carbides (+AC) - may be agreed. In such cases, limits on spheroidization and mechanical properties may also be agreed at the time of enquiry and order.

7.4 Chemical composition

7.4.1 Cast analysis

The chemical composition shall be in accordance with the values specified in Table 1 for the cast analysis.

7.4.2 Product analysis

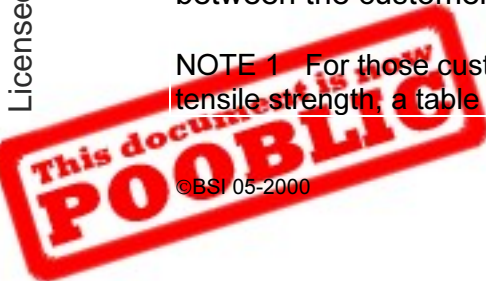
In cases where a product analysis is requested, the admissible deviations from the values specified for the cast analysis are indicated in Table 2.

7.5 Mechanical properties

7.5.1 Tensile properties and hardness

The mechanical properties of the strip shall be in accordance with the values given in Table 3. For thicknesses outside this range, mechanical properties shall be agreed between the customer and the supplier.

NOTE 1 For those customers who specify Rockwell hardness rather than Vickers hardness or tensile strength, a table is given in A.1, showing Rockwell hardness values for information.



NOTE 2 The steels may be quenched in oil or isothermally heat treated. For information, the minimum hardness values given in Table A.2 show the minimum values after quenching, without tempering.

NOTE 3 For spring applications, the preferred hardness range (HV) for steels according to Table 3 in the quenched and tempered condition are given in Table A.3 for information.

7.5.2 Bend test

Requirements for the bend test for steels in the annealed condition (+A) may be agreed at the time of enquiry and order.

7.6 Structure

7.6.1 Grain size

See EN 10132-1.

7.6.2 Non-metallic inclusions

See EN 10132-1.

7.6.3 Decarburization

For silicon alloyed steels, decarburization shall not exceed 3 % of the material thickness per side, for non-silicon alloyed steels, decarburization shall not exceed 2 % of the material thickness per side when measured at a distance of 5 mm from the strip edge (see also EN 10132-1).

7.7 Surface finish

The surface finish of cold rolled narrow steel strip shall be bright as produced by rolling and annealing in a controlled atmosphere.

The surface finishes of quenched and tempered cold rolled strip are as follows:

- grey/blue oxide finish: unpolished;
- bright tempered: unpolished;
- polished: obtained by fine grinding, abrasive brushing or other processes;
- polished and coloured: blue or yellow colour obtained by oxidization by heat treatment.

7.8 Dimensions and tolerances on dimensions and shape

See EN 10132-1.

8 Inspection

See EN 10132-1.



9 Sampling

See EN 10132-1.

10 Test methods

See EN 10132-1.

11 Labelling, packaging and protection

See EN 10132-1.

12 Retests

See EN 10132-1.



Table 1 - Chemical composition of steels for springs and other special applications^a (cast analysis)

Steel designation		% by mass								
name	number	C	Si	Mn	P max.	S max.	Cr	Mo max.	V	Ni
C55S	1.1204	0,52 to 0,60	0,15 to 0,35	0,60 to 0,90	0,025	0,025	max. 0,40	0,10	-	max. 0,40
C60S	1.1211	0,57 to 0,65	0,15 to 0,35	0,60 to 0,90	0,025	0,025	max. 0,40	0,10	-	max. 0,40
C67S	1.1231	0,65 to 0,73	0,15 to 0,35	0,60 to 0,90	0,025	0,025	max. 0,40	0,10	-	max. 0,40
C75S	1.1248	0,70 to 0,80	0,15 to 0,35	0,60 to 0,90	0,025	0,025	max. 0,40	0,10	-	max. 0,40
C85S	1.1269	0,80 to 0,90	0,15 to 0,35	0,40 to 0,70	0,025	0,025	max. 0,40	0,10	-	max. 0,40
C90S	1.1217	0,85 to 0,95	0,15 to 0,35	0,40 to 0,70	0,025	0,025	max. 0,40	0,10	-	max. 0,40
C100S	1.1274	0,95 to 1,05	0,15 to 0,35	0,30 to 0,60	0,025	0,025	max. 0,40	0,10	-	max. 0,40
C125S	1.1224	1,20 to 1,30	0,15 to 0,35	0,30 to 0,60	0,025	0,025	max. 0,40	0,10	-	max. 0,40
48Si7	1.5021	0,45 to 0,52	1,60 to 2,00	0,50 to 0,80	0,025	0,025	max. 0,40	0,10	-	max. 0,40
56Si7	1.5026	0,52 to 0,60	1,60 to 2,00	0,60 to 0,90	0,025	0,025	max. 0,40	0,10	-	max. 0,40
51CrV4	1.8159	0,47 to 0,55	max. 0,40	0,70 to 1,10	0,025	0,025	0,90 to 1,20	0,10	0,10 to 0,25	max. 0,40
80CrV2	1.2235	0,75 to 0,85	0,15 to 0,35	0,30 to 0,50	0,025	0,025	0,40 to 0,60	0,10	0,15 to 0,25	max. 0,40
75Ni8	1.5634	0,72 to 0,78	0,15 to 0,35	0,30 to 0,50	0,025	0,025	< 0,15	0,10	-	1,80 to 2,10
125Cr2	1.2002	1,20 to 1,30	0,15 to 0,35	0,25 to 0,40	0,025	0,025	0,40 to 0,60	0,10	-	max. 0,40
102Cr6	1.2067	0,95 to 1,10	0,15 to 0,35	0,20 to 0,40	0,025	0,025	1,35 to 1,60	0,10	-	max. 0,40

^a Elements not quoted in this table shall not be intentionally added to the steel without the agreement of the purchaser, other than for the purpose of finishing the heat. All reasonable precautions shall be taken to prevent the addition, from scrap or other material used in manufacture, of such elements which affect the hardenability, mechanical properties and application.



Table 2 - Permissible deviations between the product analysis and the limiting values given in Table 1 for the cast analysis

Element	Permissible maximum content in the cast analysis	Permissible deviation ^a
	% by mass	% by mass
C	≤ 0,50	±0,02
	> 0,50 ≤ 1,00	±0,03
	> 1,00 ≤ 1,30	±0,04
Si	≤ 1,00	+0,03
	> 1,00 ≤ 2,00	±0,10
Mn	≤ 1,00	±0,04
	> 1,00 ≤ 1,10	±0,05
P	≤ 0,025	+0,005
S	≤ 0,025	+0,005
Cr	≤ 0,40	+0,03
	> 0,40 ≤ 1,60	±0,04
Mo	≤ 0,10	+0,02
V	≤ 0,25	±0,03
Ni	≤ 0,40	+0,03
	> 0,40 ≤ 2,10	±0,05
^a ± means that in one cast the deviation may occur over the upper value or under the lower value of the specified range in Table 1, but not both at the same time.		



Table 3 - Mechanical properties and hardness requirements^{a, b}

Steel designation		delivery condition							
		annealed (+A) or annealed and skin passed (+LC)				cold rolled ^c (+CR)		quenched and tempered (+QT) ^d	
name	number	R _{p0.2} ^e N/mm ² max.	R _m ^e N/mm ² max.	A ₈₀ ^e % min.	HV ^e max.	R _m ^e N/mm ² max.	HV ^e max.	R _m ^e N/mm ²	HV ^e
C55S	1.1204	480	600	17	185	1 070	300	1 100 to 1 700	340 to 520
C60S	1.1211	495	620	17	195	1 100	305	1 150 to 1 750	345 to 530
C67S	1.1231	510	640	16	200	1 140	315	1 200 to 1 900	370 to 580
C75S	1.1248	510	640	15	200	1 170	320	1 200 to 1 900	370 to 580
C85S	1.1269	535	670	15	210	1 190	325	1 200 to 2 000	370 to 600
C90S	1.1217	545	680	14	215	1 200	325	1 200 to 2 100	370 to 600
C100S	1.1274	550	690	13	220	1 200	325	1 200 to 2 100	370 to 630
C125S	1.1224	600	740	11	230	1 200	325	1 200 to 2 100	370 to 630
48Si7	1.5021	580	720	13	225	-	-	1 200 to 1 700	370 to 520
56Si7	1.5026	600	740	12	230	-	-	1 200 to 1 700	370 to 520
51CrV4	1.8159	550	700	13	220	-	-	1 200 to 1 800	370 to 550
80CrV2	1.2235	580	720	12	225	-	-	1 200 to 1 800	370 to 550
75Ni8	1.5634	540	680	13	210	-	-	1 200 to 1 800	370 to 550
125Cr2	1.2002	590	750	11	235	-	-	1 300 to 2 100	405 to 630
102Cr6	1.2067	590	750	11	235	-	-	1 300 to 2 100	405 to 630

^a The customer may specify hardness or tensile values but not both. If neither is specified then tensile values shall apply.

^b Values apply to thicknesses 0,30 mm ≤ t < 3,00 mm. For thicker strip, the values for the mechanical properties shall be agreed at the time of enquiry and order.

^c For material supplied in the cold rolled condition, a range of 150 N/mm² or 50 HV shall apply, e.g. 850 N/mm² to 1 000 N/mm² or e.g. 240 HV to 290 HV.

^d For material supplied in the quenched and tempered condition, a range of 150 N/mm² or 50 HV shall apply, e.g. 1 350 N/mm² to 1 500 N/mm² or e.g. 450 HV to 500 HV.

^e R_{p0.2} 0,2 %-Proof strength; R_m Tensile strength; A₈₀ Elongation on a gauge length of 80 mm; HV Vickers hardness.

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Annex A
(informative)

Technical information on steels for springs and other applications

Table A.1 - Reference values for Rockwell hardness for steels for springs^a

Steel designation		delivery condition	
name	number	annealed (+A) or annealed and skin passed (+LC) HRB ^c max.	quenched and tempered (+QT) HRC ^c
C55S	1.1204	90	34 to 50,5
C60S	1.1211	91	35 to 51,5
C67S	1.1231	92	38,5 to 54
C75S	1.1248	93	38,5 to 54
C85S	1.1269	94	38,5 to 55
C90S	1.1217	94	38,5 to 55
C100S	1.1274	95	38,5 to 57
C125S	1.1224	97	38,5 to 57
48Si7	1.5021	95	38,5 to 50,5
56Si7	1.5026	96	38,5 to 50,5
51CrV4	1.8159	94	38,5 to 52,5
80CrV2	1.2235	95	38,5 to 52,5
75Ni8	1.5634	93	38,5 to 52,5
125Cr2	1.2002	97	42 to 57
102Cr6	1.2067	97	42 to 57
<p>^a For thicknesses less than those allowed in EN ISO 6508-1, the scale of Rockwell hardness shall be agreed at the time of enquiry and order.</p> <p>^b For material supplied in the quenched and tempered condition, a range of 5 HRC shall apply for hardnesses ≤ 40 HRC and a range of 4 HRC shall apply for hardnesses > 40 HRC.</p> <p>^c HRB Rockwell hardness (scale B); HRC Rockwell hardness (scale C).</p>			

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Table A.2 - Reference values for the heat treatment and the minimum hardness values in the quenched condition

Steel designation		Austenitizing temperature °C	Quenching medium	Minimum hardness ^a in the quenched condition without tempering	
name	number			HRC ^b	HV ^b
C55S	1.1204	830 to 860	oil	55	600
C60S	1.1211	825 to 855	oil	57	640
C67S	1.1231	815 to 845	oil	59	670
C75S	1.1248	810 to 840	oil	60	700
C85S	1.1269	800 to 830	oil	61	720
C90S	1.1217	790 to 820	oil	61	720
C100S	1.1274	790 to 820	oil	61	720
C125S	1.1224	780 to 810	oil	62	750
48Si7	1.5021	840 to 870	water	52	540
56Si7	1.5026	840 to 870	oil	55	600
51CrV4	1.8159	840 to 870	oil	57	640
80CrV2	1.2235	840 to 870	oil	60	700
75Ni8	1.5634	820 to 850	oil	60	700
125Cr2	1.2002	820 to 850	oil	62	750
102Cr6	1.2067	830 to 860	oil	61	720
<p>^a The thickness range up to which these minimum values apply is 0,30 mm to 3,00 mm.</p> <p>^b HRC Rockwell hardness (scale C), HV Vickers hardness.</p>					

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Table A.3 - Guidance values for hardness (HV) for material in different thickness ranges in the quenched and tempered condition

Steel designation		Hardness HV in the quenched and tempered condition					
		Specified thickness (mm)					
name	number	0,30 ≤ 0,50	0,50 ≤ 0,75	0,75 ≤ 1,00	1,00 ≤ 1,50	1,50 ≤ 2,00	2,00 ≤ 3,00
C55S	1.1204	485 to 535	465 to 515	455 to 505	445 to 495	425 to 475	415 to 465
C60S	1.1211	485 to 535	465 to 515	455 to 505	445 to 495	425 to 475	415 to 465
C67S	1.1231	485 to 535	465 to 515	455 to 505	445 to 495	425 to 475	415 to 465
C75S	1.1248	520 to 570	500 to 550	480 to 530	465 to 515	440 to 490	435 to 485
C85S	1.1269	520 to 570	500 to 550	480 to 530	465 to 515	440 to 490	435 to 485
C90S	1.1217	555 to 605	525 to 575	505 to 555	485 to 535	465 to 515	455 to 505
C100S	1.1274	555 to 605	525 to 575	505 to 555	485 to 535	465 to 515	455 to 505
C125S	1.1224	555 to 605	525 to 575	505 to 555	485 to 535	465 to 515	455 to 505
48Si7	1.5021	485 to 535	465 to 515	455 to 505	445 to 495	425 to 475	415 to 465
56Si7	1.5026	485 to 535	465 to 515	455 to 505	445 to 495	425 to 475	415 to 465
51CrV4	1.8159	520 to 570	500 to 550	480 to 530	465 to 515	440 to 490	435 to 485
80CrV2	1.2235	555 to 605	525 to 575	505 to 555	485 to 535	465 to 515	455 to 505
75Ni8	1.5634	520 to 570	500 to 550	480 to 530	465 to 515	440 to 490	435 to 485
125Cr2	1.2002	555 to 605	525 to 575	505 to 555	485 to 535	465 to 515	455 to 505
102Cr6	1.2067	555 to 605	525 to 575	505 to 555	485 to 535	465 to 515	455 to 505



Annex B
(informative)

List of corresponding former national designations

Table B.1 - List of corresponding former designations

Steel designation according to EN 10132-4:2000		Comparable former steel designation in					
name	number	Germany		France	United Kingdom	Finland	Sweden
		name	number				
C55S	1.1204	Ck55	1.1203	C50RR	CS50		
C60S	1.1211	Ck60	1.1221	C60RR	CS60		
C67S	1.1231	Ck67	1.1231	C68RR	CS70		
C75S	1.1248	Ck75	1.1248	C75RR	CS80		
C85S	1.1269	Ck85	1.1269	-	CS80		
C90S	1.1217	-	-	C90RR	CS95		
C100S	1.1274	Ck101	1.1274	C100RR	CS95		
C125S	1.1224	-	-	C125RR	-		
48Si7	1.5021	-	-	46SiCr7	-		
56Si7	1.5026	55Si7	1.5026	55Si7RR	-		
51CrV4	1.8159	50CrV4	1.8159	51CrV4	-		
80CrV2	1.2235	-	-	-	-		
75Ni8	1.5634	-	-	75Ni8RR	-		
125Cr2	1.2002	-	-	-	-		
102Cr6	1.2067	-	-	100Cr6RR	-		



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