

Cold Rolled Steel Strips for Springs

Technical Conditions of Delivery

DIN
17 222

Kaltgewalzte Stahlbänder für Federn; Technische Lieferbedingungen

This Standard is related to **EURONORM 132** (see Explanations) issued by the ECSC (European Coal and Steel Community).

The sections marked with a dot (●) contain information on agreements to be made or which may be made at the time of ordering.

1 Scope

1.1 This Standard applies to cold rolled strip made of the steels according to Table 1 in thicknesses ≤ 5 mm and widths ≤ 600 mm ordered in the as-delivered conditions as shown in Table 3 and used predominantly for springs, but also for a very wide range of other highly stressed parts.

1.2 This Standard does not apply to

- hot rolled steels for springs suitable for quenching and tempering (see DIN 17 221),
- patented drawn spring wire made of unalloyed steels (see DIN 17 223 Part 1),
- quenched and tempered spring wire and quenched and tempered valve spring wire made of unalloyed steels (see DIN 17 223 Part 2),
- spring wire and spring strip made of stainless steels (see DIN 17 224 [preliminary Standard]) and
- high temperature steels for springs (see DIN 17 225 [preliminary Standard]).

1.3 In combination with this Standard, DIN 17 010 — General technical conditions of delivery for steel and steel products — (at present still in draft form) also applies.

2 Other relevant Standards and documents

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|-------------------|---|
| DIN 1544 | Flat steel products; cold rolled steel strip; dimensions, permissible deviations on dimensions and form |
| DIN 1605 Part 1 | Testing of materials; mechanical testing of metals, general and acceptance |
| DIN 17 007 Part 2 | Material numbers; skeleton plan |
| DIN 17 010* | (at present in draft form) General technical conditions of delivery for steel and steel products |
| DIN 17 014 Part 1 | Heat treatment of ferrous materials; technical terms and technical expressions |
| DIN 50 049 | Certificates on material testings |
| DIN 50 111 | Testing of metallic materials; technological bend test (bendover test) |

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| DIN 50 114 | Testing of metallic materials; tensile test on sheet and strip under 3 mm thick without using an extensometer |
| DIN 50 133 Part 1 | Testing of metallic materials; Vickers hardness testing; test load range: 49 to 980 N (5 to 100 kp) |
| DIN 50 133 Part 2 | Testing of metallic materials; Vickers hardness testing; test load range: 1.96 to 49 N (0.2 to 5 kp) (minimum load range) |
| DIN 50 145 | Testing of metallic materials; tensile test |
| DIN 50 192 | Determination of the decarburization depth |
| DIN Normenheft No. 3 | Code numbers and material numbers for ferrous metals in DIN Standards and Stahl-Eisen Werkstoffblätter (Steel-Iron Data Sheets) (Beuth Verlag GmbH, Berlin und Köln; Verlag Stahleisen mbH, Düsseldorf) |
| EURONORM 79 | Terminology and classification of steel products according to shape and dimensions |
| Stahl-Eisen-Prüfblatt | (Steel-Iron Test Sheet) 1570 — 71 Microscopic testing of high quality steels for non-metallic inclusions, using photographs (Verlag Stahleisen mbH, Düsseldorf) |
| Stahl-Eisen-Prüfblatt | 1570 — 71 Beiblatt (supplement) 1 Microscopic testing of high grade steels for narrow elongated non-metallic inclusions (Verlag Stahleisen mbH, Düsseldorf) |
| Handbuch für das Eisenhüttenlaboratorium | (Handbook for steelworks laboratories) Vol. 2: Investigation of metallic materials, Düsseldorf 1966 (Verlag Stahleisen mbH, Düsseldorf) |
| Handbuch für das Eisenhüttenlaboratorium | Vol. 5 (supplementary volume): A 4.1 — Setting up the recommended arbitration procedures
B — Sampling procedure,
C — Analysis procedure,
in each case the most recent edition (Verlag Stahleisen mbH, Düsseldorf) |

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3 Terms

3.1 Cold rolled steel strips for springs

Cold rolled steel strip for springs is distinguished by high dimensional accuracy and good surface quality and, in the cold rolled + hardened + tempered condition (H + A) offers the possibility of achieving high values of hardness, tensile strength and elastic limit.

3.2 Forms of product

The definitions of terms in EURONORM 79 apply to the product forms.

3.3 Types of heat treatment

The definitions of terms and technical expressions in DIN 17 014 Part 1 apply to the types of heat treatment mentioned in this Standard.

4 Dimensions and permissible deviations on dimension and form

4.1 DIN 1544 applies to dimensions and permissible deviations on dimension and form.

● Requirements going beyond those of DIN 1544 can be agreed at the time of ordering.

4.2 ● Cold rolled steel strips for springs are supplied with cut edges (GK) unless otherwise agreed at the time of ordering; they can also be supplied with subsequently worked edges (SK) or natural edges (NK).

5 Calculation of weight

A density of 7.85 kg/dm^3 is assumed for the weight calculation for steels covered by this Standard.

6 Classification of grades

6.1 Steel grades

6.1.1 The steel grades listed in Table 1 are classified into quality steels and high quality steels.

6.1.2 High quality steels are distinguished from quality steels not only in having a lower phosphorus and sulphur content but also by the uniformity of their properties in respect of the result of heat treatment and by a greater degree of freedom from non-metallic inclusions and a better surface quality.

6.1.3 ● Selection of the steel grade is the responsibility of the customer. It is advisable for him to consult the manufacturer.

6.2 ● Treatment condition on delivery

According to what is agreed at the time of ordering, steels are supplied in one of the treatment conditions listed in Table 3.

7 Designations

7.1 Designation of steel grades and as-delivered conditions

The code numbers are in accordance with Section 2.1.2.1 and Section 2.1.2.2 of the Explanations to DIN-Normen-

heft No. 3 and the material numbers are in accordance with DIN 17 007 Part 2. The code letters for the treatment condition on delivery, as shown in Table 3, should be appended to the code number or material number.

Example:

Steel 67 SiCr 5, material number 1.7103, in the cold rolled + soft annealed condition (G):

67 SiCr 5 G or 1.7103 G

7.2 Standard designation

The standard designation for cold rolled steel strip according to this Standard is formed in accordance with the dimensional Standard 1544, as shown in the following example:

Designation of a steel strip for springs made of steel with the code number 67 SiCr 5 (or material number 1.7103), cold rolled + soft annealed (G) meeting requirement class 5 according to DIN 17 222, 1.5 mm thick with normal deviations on nominal thickness:

Strip DIN 1544 – 67 SiCr 5 G – 5

DIN 17 222 – 1.5

or Strip DIN 1544 – 1.7103 G – 5

DIN 17 222 – 1.5

7.3 Order designation

The order should specify the quantities, shape of product, dimensional Standard, code number or material number of the required grade of steel, as-delivered condition, requirement class, the number of this Standard and the dimensions.

Example:

20 t cold rolled + soft annealed strip (G), 1.5 mm thick with normal deviations on nominal thickness, 200 mm wide with natural rolled edges (NK), in bars of manufacturing lengths of 4000 mm with normal deviations on straightness of the longitudinal edges, according to DIN 1544, made of a steel with the code number 67 SiCr 5 or material number 1.7103, requirement class 5 according to DIN 17 222:

20 t strip DIN 1544 – 67 SiCr 5 G – 5

DIN 17 222 – 1.5 x 200 NK x 4000

or 20 t strip DIN 1544 – 1.7103 G – 5

DIN 17 222 – 1.5 x 200 NK x 4000

8 Requirements

8.1 ● Manufacturing process

Unless otherwise agreed at the time of ordering, the method of smelting the steel and the forming process for the product are at the discretion of the manufacturer. The customer must however if he so wishes be informed of the smelting method used for marking the steel.

8.2 Requirement classes

8.2.1 Steels to this Standard are supplied to one of the requirement classes (combination of quality requirements) listed in Table 4.

8.2.2 ● The treatment condition on delivery (see Table 3) and the requirement class (see Table 4) should be agreed at the time of ordering.

8.3 ● Separation of melts

In the case of strips supplied in the cold rolled + hardened + tempered condition (H + A), separate delivery by melts can be agreed at the time of ordering. In all other cases (G and G + K) strips must be supplied separately by melts.

8.4 Chemical composition

8.4.1 The chemical composition determined from the ladle analysis must meet the specifications in Table 1 (see Section 8.4.3).

8.4.2 ● For all deliveries meeting requirement class 1 and for all deliveries in the cold rolled + soft annealed condition (G) agreement may be made at the time of ordering that the sample analysis shall conform to the limits given in Table 1 for the ladle analysis subject to the permissible deviations listed in Table 2.

8.4.3 For strips supplied in the cold rolled + soft annealed + cold rolled (G + K) or cold rolled + hardened + tempered (H + A) condition and ordered as meeting requirement class 5, the mechanical properties in the as-delivered condition constitute the criterion for acceptance. If these values are complied with, the ladle analysis may differ slightly from the limits given in Table 1.

8.5 Mechanical properties

8.5.1 The following information applies to the cold rolled + soft annealed condition (G) ¹⁾ (see also Section 8.5.4 and Section 8.5.5).

8.5.1.1 When ordering strip to meet requirement classes 5 and 5a, the tensile strength values and the values for elongation at break in Table 5 apply.

8.5.1.2 When ordering strip to meet requirement class 5a, in addition the bending mandrel diameters specified in Table 5 apply to the angle to which the specimens have to be bent in the bendover test either across or along the direction of rolling, through 180° or 90°, without cracks appearing.

8.5.2 ● For the cold rolled + soft annealed + cold rolled as-delivered condition (G + K), when ordering to requirement class 5, the values to be met for tensile strength and elongation at break should be agreed ¹⁾ (see also Section 8.5.4 and Section 8.5.5).

8.5.3 ● For the cold rolled + hardened + tempered as-delivered condition (H + A), when ordering to requirement class 5, the values for tensile strength given in Table 6 apply, but within the ranges there specified for the delivery, a narrower range of tensile strength (not less than 200 N/mm² however) can be specified by the customer at the time of ordering if he so requires.

8.5.4 ● When ordering to requirement class 5 or 5a, a maximum value for the dispersion of the tensile strength or the hardness within a roll may be agreed at the time of ordering.

8.5.5 Strip to be delivered in the cold rolled + soft annealed (G) or cold rolled + soft annealed + cold rolled (G + K) condition must be capable of achieving the values for tensile strength and hardness specified in Table 6 or Table 7, after hardening and tempering under the conditions specified in Table 8 (see however footnote 2 in Table 7). Table 8 in addition contains approximate values

for the minimum hardness likely to be achieved after hardening under the conditions specified in Table 8.

8.5.6 The modulus of elasticity of the steels is about 206 kN/mm², and the shear modulus about 78 kN/mm².

8.6 Surface condition

8.6.1 Strip to be supplied in the cold rolled + soft annealed (G) or cold rolled + soft annealed + cold rolled (G + K) condition must have a bright, metallic clean surface. For this purpose, unsatisfactory patches on the first inner and outer turns of a roll do not constitute grounds for objection.

8.6.2 ● Cold rolled + hardened + tempered (H + A) strip is supplied, as agreed at the time of ordering, with

- a) grey-blue (GR),
- b) bright (BK),
- c) polished (P) or
- d) polished and colour-tempered (P & AF) surface.

Note: Springs for the most rigorous applications should as far as possible exhibit a polished surface.

8.6.3 ● Requirements regarding surface roughness should if necessary be specially agreed at the time of ordering.

8.7 Edge decarburization

8.7.1 The depth of decarburization (see Section 9.5.5) must not exceed the following values, related to the wide side, in the test in accordance with Section 9.4.2 and Section 9.5.5.

For steels with a maximum permissible content (in % by wt.) of phosphorus and sulphur of $\leq 0.035\%$ each alloyed with silicon $\leq 3\%$ of the strip thickness, others $\leq 2\%$ of the strip thickness, for steels with a maximum permissible phosphorus and sulphur content of $\leq 0.045\%$ each $\leq 4\%$ of the strip thickness (see also Section 8.7.3).

8.7.2 Steels may not exhibit any complete depletion of carbon, i.e. they may not have any purely ferritic edge layers (see also DIN 50 192).

8.7.3 ● Requirements going beyond those stipulated in Section 8.7.1 for edge decarburization, as may be desirable in special cases, e.g. for steels for springs subject to particularly high stresses, must be agreed at the time of ordering.

¹⁾ *Note:* The strength properties of cold rolled + soft annealed (G) or cold rolled + soft annealed + cold rolled (G + K) strip are important for subsequent processing. According to whether more value is attached for example to burr-free stamping or suitability for deep drawing and bending, so a higher or lower value of hardness in the cold rolled + soft annealed + cold rolled condition (G + K) or cold rolled + soft annealed condition (G) will be selected. For this reason, the customer should inform the manufacturer of the type of processing intended.

8.8 ● Absence of non-metallic inclusions

If, in the case of high quality steels, particular requirements regarding the maximum permissible content of non-metallic inclusions are stipulated, special agreements must be reached on these at the time of ordering.

9 Testing**9.1 ● Acceptance testing and test certificates**

For any delivery, agreement may be made at the time of ordering for submission of a test certificate according to DIN 50 049. If acceptance tests have to be carried out pursuant to such an agreement, the specifications in Sections 9.2 to 9.6 apply.

The acceptance tests are normally carried out by the manufacturer's inspectors, but by special agreement at the time of ordering, they may also be carried out by outside inspectors commissioned by the customer.

9.2 Test unit

The specifications in Table 9, column 3 apply for constitution of the test units.

9.3 Extent of testing

9.3.1 ● Unless otherwise agreed at the time of ordering, all the requirements contained in the requirement class ordered in accordance with Section 8.2.1 shall be proved in acceptance tests by testing to the extent shown in Table 9, columns 4 to 6.

9.3.2 ● If, in special cases, proof of compliance with the requirements in Sections 8.4.2, 8.5.4, 8.5.5, 8.6 or 8.8 has to be supplied, the extent of testing and all other details relating to sampling, testing procedure and assessment of the test results shall be agreed at the time of ordering unless information is given on them in the following paragraphs.

9.4 Sampling and sample preparation

9.4.1 The chemical composition according to the ladle analysis shall be made known by the manufacturer.

If a sample analysis has to be carried out (see Section 9.3.2.), the chips shall be taken uniformly over the complete cross-section of the product being tested.

9.4.2 Specimens for the tension test or hardness test, the bendover test and the test for edge decarburization shall be taken as shown in Fig. 1.

The following specifications apply to the sample preparation.

9.4.2.1 For tensile samples, the specifications in DIN 50 114 and, in cases of doubt, samples of 80 mm gauge length and if possible a width of 20 mm shall be used.

9.4.2.2 For samples for the hardness test, the specifications in DIN 50 133 Part 1 and Part 2, particular care being taken to remove any decarburized edge layers by suitable measures.

9.4.2.3 For bendover test samples, the specifications in DIN 50 111.

9.4.2.4 For samples for testing for edge decarburization, the specifications in DIN 50 192 for preparation of polished sections, the samples being taken from deliveries that have not been cold rolled + hardened + tempered (H + A), and hardened in oil, under conditions not resulting in decarburization or carburization, from the temperatures given in Table 8.

9.4.2.5 For samples for determining the content of non-metallic inclusions, the specifications in Stahl-Eisen-Prüfblatt (Steel-Iron Test Sheet) 1570 – 71 and Stahl-Eisen-Prüfblatt 1570 – 71 supplement 1.

9.4.3 The general conditions for sampling and sample preparation for steel should be taken from DIN 1605 Part 1.

9.5 Test methods to be used

9.5.1 The chemical composition shall be determined by the methods²⁾ given by the Chemical Committee of the Verein Deutscher Eisenhüttenleute (Association of German Ferrous Metallurgists).

9.5.2 The tensile test shall be carried out according to DIN 50 145.

9.5.3 The Vickers hardness test shall be carried out according to DIN 50 133 Part 1 and Part 2. (See note on Fig. 1 under e.)

9.5.4 The bendover test shall be carried out according to DIN 50 111.

9.5.5 The test for edge decarburization shall be carried out microscopically according to DIN 50 192 at the upper and lower longitudinal edges of the ground surface (see note on Fig. 1 under e). The decarburization depth is the thickness of the layer in which ferrite still occurs in the structure even if only in isolated grains.

9.5.6 The content of non-metallic inclusions shall be determined according to Stahl-Eisen-Prüfblatt 1570 – 71 and Stahl-Eisen-Prüfblatt 1570 – 71 supplement 1.

9.6 Repeat tests

9.6.1 If an unsatisfactory result in a test is obviously due to some shortcomings in the testing techniques or faulty manufacture of a sample but not to defects in the steel itself, the erroneous result should be ignored in deciding whether the requirements have been complied with and the test repeated.

9.6.2 If an unsatisfactory test result is attributable to unsatisfactory heat treatment, the heat treatment can be repeated and then the complete test should be repeated on the test unit.

²⁾ *Note:* Handbuch für das Eisenhüttenlaboratorium (Handbook for steelworks laboratories), Vol. 2: Die Untersuchung der metallischen Stoffe (Testing of metallic materials), Düsseldorf 1966; Vol. 5 (supplementary volume): A 4.1 – List of recommended arbitration procedures, B – Sampling procedure, C – Analytical procedure, in each case the latest edition; Verlag Stahleisen mbH, Düsseldorf

9.6.3 If products do not satisfy the prescribed requirements in a properly conducted test, a repeat test can be carried out, i.e. two further tests on one other test piece of the same test unit for each unsatisfactory test result. Test pieces given unsatisfactory results should be rejected.

9.6.4 The test unit is regarded as meeting the requirements, if both repeat tests give satisfactory results. It can be rejected if one of the repeat tests is not satisfactory.

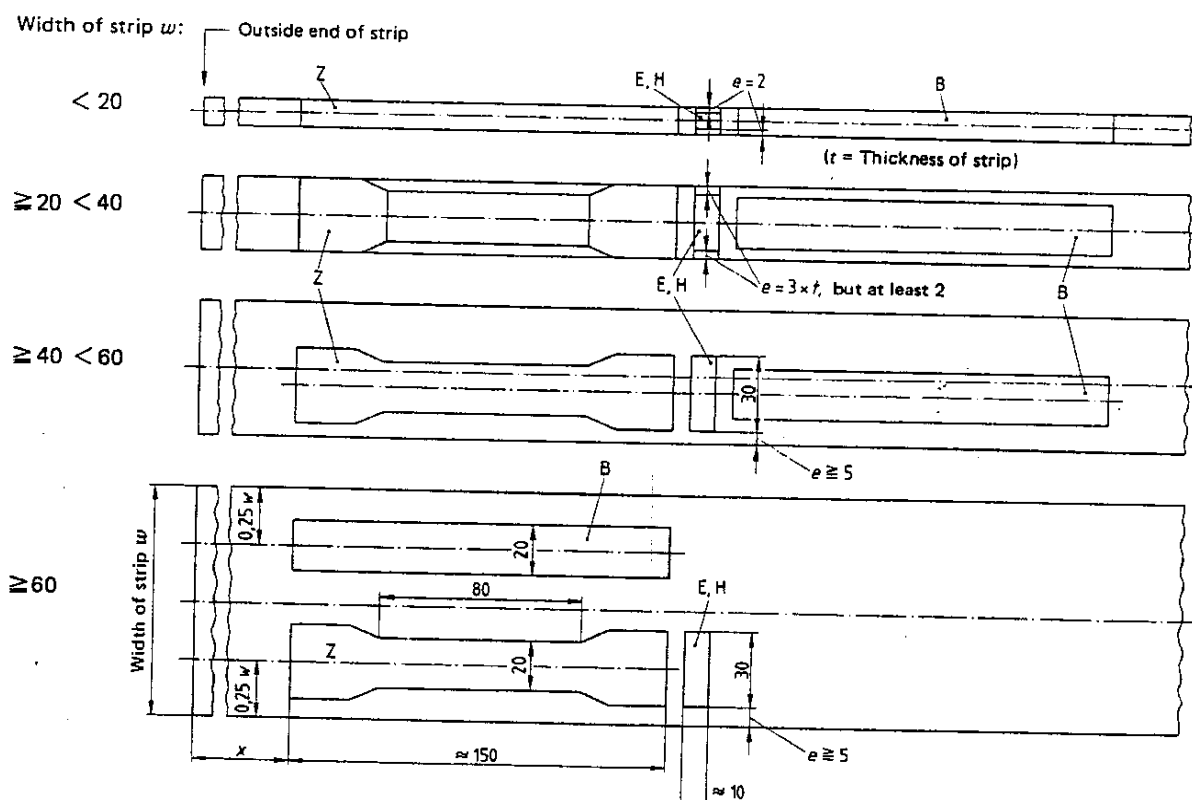
10 Objections³⁾

10.1 External or internal defects may only be objected to if they impair to an appreciable extent working and

utilization appropriate to the grade of steel and the type of product.

10.2 The customer must give the supplier an opportunity to satisfy himself of the validity of the complaint, where possible by submitting the material complained of together with samples of the material supplied.

3) *Note:* For explanations on this objections clause in quality Standards for iron and steel see DIN Mitt. (DIN News) Vol. 40 (1961), No. 2, pp. 111/112.



Note:

- Z Tension sample with a gauge length $L_0 = 80$ mm and, if possible, a width of 20 mm according to DIN 50 114.
- E, H, e Samples for preparing polished sections for testing the edge decarburization (E) and hardness (H). If hardness measurements are stipulated, these should be carried out on the flat side of the samples. The hardness measurements and the decarburization test should be carried out at a distance $\geq e$ from the original longitudinal edge of the cold rolled strip.
- B Bendover sample if possible with a width of 20 mm according to DIN 50 111.
- x In arbitration cases, the samples are to be taken at a distance of at least 1 circumference from the inner or outer end of the roll.

Figure 1. Position of samples (dimensions in mm)

Table 1. Steel grades and chemical composition (ladle analysis) ¹⁾

Steel grade		Chemical composition in % by wt						
Code number	Material number	C	Si	Mn	P at most	S at most	Cr	V
Quality steels								
C 55	1.0535	0,52 to 0,60	0,15 to 0,35	0,60 to 0,90	0,045	0,045	—	—
C 60	1.0601	0,57 to 0,65	0,15 to 0,35	0,60 to 0,90	0,045	0,045	—	—
C 67	1.0603	0,65 to 0,72	0,15 to 0,35	0,60 to 0,90	0,045	0,045	—	—
C 75	1.0605	0,70 to 0,80	0,15 to 0,35	0,60 to 0,80	0,045	0,045	—	—
55 Si 7	1.0904	0,52 to 0,60	1,50 to 1,80	0,70 to 1,00	0,045	0,045	—	—
High quality steels								
Ck 55	1.1203	0,52 to 0,60	0,15 to 0,35	0,60 to 0,90	0,035	0,035	—	—
Ck 60	1.1221	0,57 to 0,65	0,15 to 0,35	0,60 to 0,90	0,035	0,035	—	—
Ck 67	1.1231	0,65 to 0,72	0,15 to 0,35	0,60 to 0,90	0,035	0,035	—	—
Ck 75	1.1248	0,70 to 0,80	0,15 to 0,35	0,60 to 0,80	0,035	0,035	—	—
Ck 85	1.1269	0,80 to 0,90	0,15 to 0,35	0,45 to 0,65	0,035	0,035	—	—
Ck 101	1.1274	0,95 to 1,05	0,15 to 0,35	0,40 to 0,60	0,035	0,035	—	—
71 Si 7	1.5029	0,68 to 0,75	1,50 to 1,80	0,60 to 0,80	0,035	0,035	—	—
67 SiCr 5	1.7103	0,62 to 0,72	1,20 to 1,40	0,40 to 0,60	0,035	0,035	0,40 to 0,60	—
50 CrV 4	1.8159	0,47 to 0,55	0,15 to 0,40	0,70 to 1,10	0,035	0,035	0,90 to 1,20	0,10 to 0,20
¹⁾ Note: Elements not listed in this Table may not be deliberately added to the steel except for final treatment of the melt. All reasonable precautions should be taken to avoid addition of such elements from scrap or other materials used in manufacture; additional elements are however permissible, provided the specified values for the mechanical properties and hardenability are complied with and the usability of the product is not impaired.								

Table 2. Permissible deviations from the limits given for the ladle analysis in Table 1, in the case of sample analysis

Element	Permissible maximum content in the ladle analysis % by wt	Permissible deviation from the limits for the ladle analysis ¹⁾ in the sample analysis % by wt
C	≤ 1,05	± 0,03
Si	≤ 0,40 > 0,40 ≤ 1,80	± 0,03 ± 0,05
Mn	≤ 1,10	± 0,04
P	≤ 0,045	+ 0,005
S	≤ 0,045	+ 0,005
Cr	≤ 1,20	± 0,05
V	≤ 0,20	± 0,02
¹⁾ Note: In a melt, the deviation for an element may either be only below the minimum value or only above the maximum value of the range given for the ladle analysis but not both simultaneously.		

Table 3. Treatment conditions on delivery

Treatment condition	Code letters
cold rolled + soft annealed 1), 2)	G 1), 2)
cold rolled + hardened + tempered	H + A
<p>1) Note: In special cases, in order to achieve an improvement in the subsequent processing properties, the condition "cold rolled + soft annealed + cold rolled (G + K)" may also be ordered (see also footnote 1 in Section 8.5.2).</p> <p>2) Note: This condition can include subsequent polishing in the case of smaller thicknesses, provided the requirements in Table 5 are complied with. If subsequent polishing is expressly required, the condition "cold rolled + soft annealed + cold rolled (G + K)" (see footnote 1) should be specified.</p>	

Table 4. Requirement classes

Type of quality requirement	Treatment condition on delivery 1)				
	G		G + K		H + A
	Requirement classes concerned 2)				
	5	5a	1	5	5
Chemical composition	X	X	X	X	X
Mechanical properties in the tensile test	X	X	—	X	X
Bending properties	—	X	—	—	—
Decarburization depth	X	X	X	X	X
1) <i>Note</i> : See Table 3.					
2) <i>Note</i> : The identification letters and code letters for the various requirement classes are to be considered as provisional until a system for designating requirement classes has been devised.					

Table 5. Mechanical properties in the cold rolled + soft annealed condition (G) 1)

Steel grade		Tensile strength N/mm ² maximum	Elongation at break (L ₀ = 80 mm) % minimum	Vickers hardness 2) maximum	D _{T180°} or D _{L90°} 3) maximum for strip thicknesses t		
Code number	Material number				< 1,0 mm	≥1,0<2,0mm	≥2,0≤3,0mm
C 55	1.0535	610	13	180	1 mm	2 t	3 t
Ck 55	1.1203						
C 60	1.0601	620	13	185			
Ck 60	1.1221						
C 67	1.0603	640	12	190			
Ck 67	1.1231						
C 75	1.0605	640	12	190	2 t	3 t	4 t
Ck 75	1.1248						
Ck 85	1.1269	670	11	200			
Ck 101	1.1274	690	11	205			
55 Si 7	1.0904	740	10	220			
71 Si 7	1.5029	800	9	240			
67 SiCr 5	1.7103	800	9	240			
50 CrV 4	1.8159	740	10	220			

1) Note: ● The data given in this Table apply to strip thicknesses up to 3 mm. For thicker strips, the values to be met shall, if necessary, be agreed at the time of ordering.

2) Note: In arbitration cases, the tensile strength values apply.

3) Note: D_{T180°} or D_{L90°} = the diameter of the bending mandrel around which the sample must be capable of being bent through 180° or 90° in the bendover test according to DIN 50 111, without cracking. D_T applies to samples bent transverse to the rolling direction and D_L to samples bent along the rolling direction.

Table 6. Tensile strength in the cold rolled + hardened + tempered condition (H + A)

Steel grade		Tensile strength 1) N/mm ²	Strip thickness up to which the tensile strength values apply 2) mm maximum
Code number	Material number		
C 55	1.0535	1150 to 1650	2,0
Ck 55	1.1203		
C 60	1.0601	1180 to 1680	2,0
Ck 60	1.1221		
C 67	1.0603	1230 to 1770	2,5
Ck 67	1.1231		
C 75	1.0605	1320 to 1870	2,5
Ck 75	1.1248		
Ck 85	1.1269	1400 to 1950	2,5
Ck 101	1.1274	1500 to 2100	2,0
55 Si 7	1.0904	1300 to 1800	2,0
71 Si 7	1.5029	1500 to 2200	3,0
67 SiCr 5	1.7103	1500 to 2200	3,0
50 CrV 4	1.8159	1400 to 2000	3,0

1) **Note:** ● Within the tensile strength ranges specified here, a narrower range of tensile strength values generally of $\geq 200 \text{ N/mm}^2$ may be stipulated by the customer to meet his requirements at the time of ordering. If in special cases, for example for supply of springs to be bent, it is necessary to comply with a tensile strength range narrower than 200 N/mm^2 , this should be specially agreed at the time of ordering. For a given tensile strength, the grade of steel should be selected mainly on the basis of the thickness and the conditions of use of the springs.

2) **Note:** ● For larger thicknesses, the tensile strength values should be agreed at the time of ordering.

Table 7. Approximate values for Vickers hardness in the cold rolled + hardened + tempered condition (H + A)

Steel grade		Vickers hardness 1), 2)	Strip thickness up to which the hardness values apply 3) mm maximum
Code number	Material number		
C 55	1.0535	340 to 490	2,0
Ck 55	1.1203		
C 60	1.0601	350 to 500	2,0
Ck 60	1.1221		
C 67	1.0603	365 to 525	2,5
Ck 67	1.1231		
C 75	1.0605	390 to 555	2,5
Ck 75	1.1248		
Ck 85	1.1269	415 to 580	2,5
Ck 101	1.1274	445 to 620	2,0
55 Si 7	1.0904	385 to 535	2,0
71 Si 7	1.5029	445 to 650	3,0
67 SiCr 5	1.7103	445 to 650	3,0
50 CrV 4	1.8159	415 to 590	3,0

1) Note: ● Within the hardness ranges given here a narrower hardness range generally of ≥ 66 HV may be stipulated by the customer to meet his requirements at the time of ordering. If in special cases, for example for supply of springs to be bent, it is necessary to comply with narrower hardness ranges than 66 HV, this should be specially agreed at the time of ordering.

2) Note: In arbitration cases, the tensile strength values in Table 6 apply.

3) Note: ● For larger thicknesses, the hardness values should be agreed at the time of ordering.

Table 8. Approximate values ¹⁾ for heat treatment and minimum hardness values in the hardened condition of cold rolled steel strips for springs

Steel grade		Annealed °C	Hardened and tempered		Vickers hardness in hardened condition minimum	Strip thickness up to which the minimum hardness values apply ⁴⁾ mm maximum
Code number	Material number		Hardened ²⁾ in oil at °C	Tempered ³⁾ to °C		
C 55	1.0535	650 to 690	830 to 860	300 to 500	650	2,0
Ck 55	1.1203					
C 60	1.0601		825 to 855		670	2,0
Ck 60	1.1221					
C 67	1.0603		815 to 845		680	2,5
Ck 67	1.1231					
C 75	1.0605		810 to 840		700	2,5
Ck 75	1.1248					
Ck 85	1.1269		800 to 830		730	2,5
Ck 101	1.1274		790 to 820		750	2,0
55 Si 7	1.0904		830 to 860		650	2,0
71 Si 7	1.5029		810 to 840		680	3,0
67 SiCr 5	1.7103		845 to 875		680	3,0
50 CrV 4	1.8159		845 to 875		680	3,0

¹⁾ Note: See Section 8.5.5.
²⁾ Note: In some cases an intermediate stage of hardening is also usual.
³⁾ Note: According to the range of tensile strength required.
⁴⁾ Note: ● For larger thicknesses, the hardness values should be agreed at the time of ordering.

Table 9. Test units and extent of testing for acceptance tests

1	2	3		4		5	6
No.	Quality requirement	Test unit ¹⁾		Number of test pieces per test unit		Number of samples per test piece	Measurements per samples
		2)	3)	2)	3)		
1	Chemical composition	S	Delivery	see Section 9.4.1			
2	Mechanical properties in the tensile test	S+W+A	W+A	1	2	1	1
3	Bending properties	S+W+A	W+A	1	2	1	1
4	Decarburization depth	S+W	W ⁴⁾	1	2	1	see Section 9.5.5

¹⁾ Note: S, W or A = separate testing by melts (S), heat treatment batches (W) or according to the dimension ranges (A) in Tables 5 to 7 specified for the appropriate quality requirement. A heat treatment batch in the case of heat treatment in a continuous feed furnace is a quantity of a maximum of 25 t in the case of unalloyed steels and 15 t in the case of alloy steels treated in sequence.
²⁾ Note: For deliveries by separate melts (see Section 8.3).
³⁾ Note: For deliveries not by separate melts (see Section 8.3).
⁴⁾ Note: If necessary, an additional test should be carried out separately by rolling lots.

Explanations

The contents of this Standard are closely modelled on **EURONORM 132**, approved within Euronorm Working Group 23, – Cold rolled steel strips for springs; quality specifications, but its layout is assimilated to that of recent DIN Standards. The only material difference compared with **EURONORM 132** is the information on permissible decarburization depth in high grade steels; whilst in **EURONORM 132** in principle a maximum of 3 % of the strip thickness is allowed for these steels, this value applies in this Standard only to high grade steels alloyed with silicon, whilst for the other high grade steels only a decarburization depth of a maximum of 2 % of the strip thickness is allowed.

Compared with DIN 17 222 (preliminary Standard) of April 1955, in this issue the quality steels C 53 (replaced by) C 55, material number 1.0535, M 75, M 85, 65 Si 7 and 60 SiMn 5 and high grade steels Ck 53 (replaced by Ck 55, material number 1.1203), MK 75 (replaced by Ck 75, material code number 1.1248), MK 101 (replaced by Ck 101, material number 1.1274), 66 Si 7 and 58 CrV 4 are no longer included.

Steel grade Ck 85 (material number 1.1269) has been newly adopted.

In the Table below, the steel grades in **EURONORM 132** are listed against those of this Standard and the degree of agreement with respect to the chemical composition is indicated.

Steel grade according to DIN 17 222		Comparable grade according to EURONORM 132	Degree of agreement 1)
Code number	Material number		
C 55	1.0535	1 CS 55	●
C 60	1.0601	1 CS 60	●
C 67	1.0603	1 CS 67	●
C 75	1.0605	1 CS 75	●
55 Si 7	1.0904	—	—
Ck 55	1.1203	2 CS 55	●
Ck 60	1.1221	2 CS 60	●
Ck 67	1.1231	2 CS 67	●
Ck 75	1.1248	2 CS 75	●
Ck 85	1.1269	2 CS 85	●
Ck 101	1.1274	CS 100	●
71 Si 7	1.5029	—	—
67 SiCr 5	1.7103	67 SiCr 5	○
50 CrV 4	1.8159	50 CrV 4	●

1) The symbols have the following meanings: ● = slight discrepancies; ○ = significant discrepancies.

As can be seen from this Table, DIN 17 222 contains all the grades in **EURONORM 132**, with some deviations in the limits for chemical composition, usually only minor, and also contains the Si-alloyed steels 55 Si 7 (1.0904) and 71 Si 7 (1.5029) which are preferred for many spring applications in Germany but are not widely used internationally.