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Utgåva

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SVENSK MATERIAL- & MEKANSTANDARD, SMS

1998-06-12

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Copper and copper alloys – Strip for springs and connectors

The European Standard EN 1654:1997 has the status of a Swedish Standard. This document contains the official English version of EN 1654:1997.

This standard replaces the delivery condition for strip in Swedish standard as in the table below.

Swedish Standards corresponding to documents referred to in this Standard are listed in "Catalogue of Swedish Standards", issued by SIS. The Catalogue lists, with reference number and year of Swedish approval, International and European Standards approved as Swedish Standards as well as other Swedish Standards.

Koppar och kopparlegeringar – Band för fjädrar och kontaktdon

Europastandarden EN 1654:1997 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av EN 1654:1997.

Denna standard ersätter leveransformen band i svensk standard enligt tabell nedan.

Motsvarigheten och aktualiteten i svensk standard till de publikationer som omnämns i denna standard framgår av "Katalog över svensk standard", som ges ut av SIS. I katalogen redovisas internationella och europeiska standarder som fastställts som svenska standarder och övriga gällande svenska standarder.

Svensk standard <i>Swedish standard</i>	Materialbeteckning i denna standard <i>Material designation in this standard</i>	
	Symbol	Nummer
5112	CuZn15	CW502L
5122	CuZn30	CW505L
5150	CuZn36	CW507L
5243	CuNi12Zn24	CW403J
5246	CuNi18Zn20	CW409J
5428	CuSn6	CW452K

ICS 77.150.30; 77.150.00

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EUROPEAN STANDARD

EN 1654

NORME EUROPÉENNE

EUROPÄISCHE NORM

December 1997

ICS 77.150.30

Descriptors: Copper, copper alloys, rolled products, steel strips, springs, connectors, designation, chemical composition, mechanical properties, dimensions, dimensional tolerances, sampling, tests

English version

Copper and copper alloys — Strip for springs and connectors

Cuivre et alliages de cuivre — Bandes pour
ressorts et connecteursKupfer und Kupferlegierungen — Bänder für
Federn und Steckverbinder

This European Standard was approved by CEN on 6 November 1997.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENEuropean Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 133, Copper and copper alloys, of which the secretariat 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 June 1998, and conflicting national standards shall be withdrawn at the latest by June 1998.

Within its programme of work, Technical Committee CEN/TC 133 requested CEN/TC 133/WG 2, Rolled flat products, to prepare the following standard:

EN 1654 *Copper and copper alloys — Strip for springs and connectors*

This is one of a series of European Standards for copper and copper alloy rolled flat products. Other products are, or will be, specified as follows:

EN 1172, *Copper and copper alloys — Sheet and strip for building purposes*

EN 1652, *Copper and copper alloys — Plate, sheet, strip and circles for general purposes*

EN 1653, *Copper and copper alloys — Plate, sheet and circles for boilers, pressure vessels and hot water storage units*

EN 1758, *Copper and copper alloys — Strip for lead frames*

Copper and copper alloys — Copper plate, sheet and strip for electrical purposes

(WI: 00133022)

This standard gives information, which might be useful to the user, on physical properties of the product contained in annex A.

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.

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1 Scope

This European Standard specifies the composition, property requirements and tolerances on dimensions and form for copper alloy strip intended for the fabrication of springs and connectors, with thicknesses from 0,1 mm up to and including 1,0 mm and with widths up to and including 350 mm.

The sampling procedures, the methods of test for verification of conformity to the requirements of this standard, and the delivery conditions are also specified.

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 1655, *Copper and copper alloys — Declarations of conformity*

EN 10002-1, *Metallic materials — Tensile testing — Part 1: Method of test (at ambient temperature)*

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

prEN 12384, *Copper and copper alloys —*

Determination of spring bending limit on strip

ISO 1811-2, *Copper and copper alloys — Selection and preparation of samples for chemical analysis —*

Part 2: Sampling of wrought products and castings

ISO 6507-2, *Metallic materials — Hardness test —*

Vickers test — Part 2: HV 0,2 to less than HV 5

ISO 6507-3, *Metallic materials — Hardness test —*

Vickers test — Part 3: Less than HV 0,2

ISO 7438, *Metallic materials — Bend test*

NOTE Informative references to documents used in the preparation of this standard, and cited at the appropriate places in the text, are listed in a bibliography (see annex B).

3 Definitions

For the purposes of this standard, the following definition, based on ISO 197-3, applies.

3.1

strip

flat rolled product of rectangular cross section with uniform thickness from at least 0,10 mm, supplied level wound as coils, or on cores or spools, or traverse wound on cores or spools, usually with slit edges; the thickness does not exceed one tenth of the width

4 Designations

4.1 Material

4.1.1 General

The material is designated either by symbol or number (see Table 1).

4.1.2 Symbol

The material symbol designation is based on the designation system given in ISO 1190-1.

NOTE Although material symbol designations used in this standard might be the same as those in other standards using the designation system given in ISO 1190-1, the detailed composition requirements are not necessarily the same.

4.1.3 Number

The material number designation is in accordance with the system given in EN 1412.

4.2 Material condition

For the purposes of this standard, the following designations, which are in accordance with the system given in EN 1173, apply for the material condition:

- R... material condition designated by the minimum value of tensile strength requirement for the product with mandatory tensile strength and elongation requirements;
- H... material condition designated by the minimum value of hardness requirement for the product with mandatory hardness and bending radius requirements;
- Y... material condition designated by the minimum value of 0,2 % proof strength requirement for the product with mandatory 0,2 % proof strength and elongation requirements;
- B... material condition designated by the minimum value of spring bending limit for the product with mandatory spring bending limit requirements and in some cases also with bending radius requirements.

Exact conversion between material conditions designated R..., H..., Y..., B... is not possible.

Material condition is designated by only one of the above designations.

4.3 Product

The product designation provides a standardized pattern of designation from which a rapid and unequivocal description of a product is conveyed in communication. It provides mutual comprehension at the international level with regard to products which meet the requirements of the relevant European Standard.

The product designation is no substitute for the full content of the standard.

The product designation for products to this standard shall consist of:

- denomination (strip);
- number of this European Standard (EN 1654);
- material designation, either symbol or number (see Table 1);
- material condition designation (see Table 2);
- nominal dimensions (thickness × width) and tolerance classes for thickness and width (A or B);
- strip condition ["as rolled" (N) or "as flattened" (G)].

The derivation of a product designation is shown in the following example.

EXAMPLE

Strip conforming to this standard, in material designated either CuSn6 or CW452K, in material condition H180, nominal thickness 0,500 mm, tolerance class A for thickness, nominal width 199,6 mm, tolerance class A for width, in strip condition "as flattened", shall be designated as follows:

5 Ordering information

In order to facilitate the enquiry, order and confirmation of order procedures between the purchaser and the supplier, the purchaser shall state on his enquiry and order the following information:

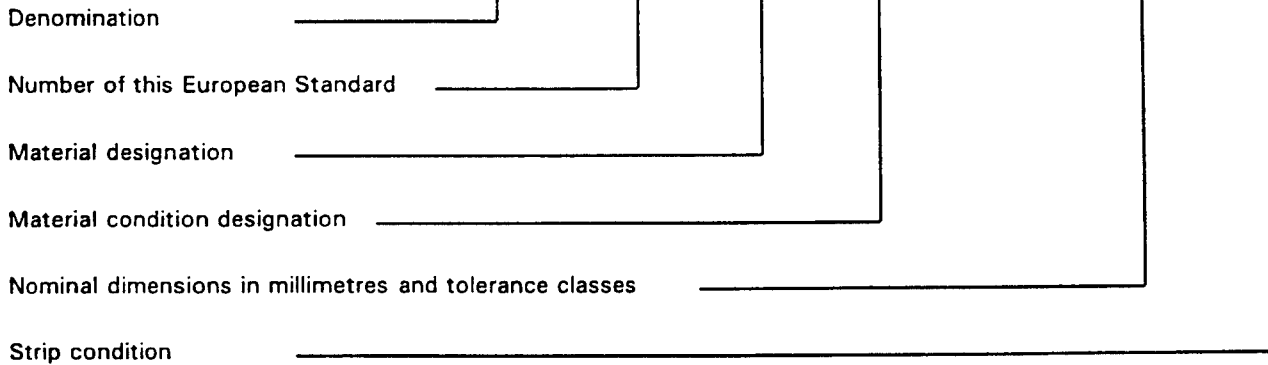
- a) quantity of product required (mass);
- b) denomination (strip);
- c) number of this European Standard (EN 1654);
- d) material designation (see Table 1);
- e) material condition designation (see 4.2 and Table 2);
- f) nominal thickness;
- g) tolerance class for thickness (see Table 3);
- h) nominal width;
- i) tolerance class for width (see Table 4);
- j) strip condition (N or G);
- k) coil size requirements: nominal inside diameter in millimetres and maximum outside diameter in millimetres, and either maximum mass in kilograms or approximate specific coil weight (mass per width) in kilograms per millimetre;
- l) spool size: type or dimensions.

NOTE It is recommended that the product designation, as described in 4.3, is used for items b) to j).

Strip EN 1654 - CuSn6 - H180 - 0,500A × 199,6A - G

or

Strip EN 1654 - CW452K - H180 - 0,500A × 199,6A - G



EXAMPLE

Ordering details for 1 500 kg strip conforming to EN 1654, in material designated either CuSn6 or CW452K, in material condition H180, nominal thickness 0,500 mm, tolerance class A for thickness, nominal width 199,6 mm, tolerance class A for width, in strip condition "as flattened", nominal inside diameter of coil 400 mm, maximum outside diameter 900 mm, approximate specific coil weight (mass per width) 4 kg/mm:

- 1 500 kg strip EN 1654 - CuSn6 - H180 - 0,500A × 199,6A - G
- nominal inside diameter of coil 400 mm
 - maximum outside diameter of coil 900 mm
 - approximate specific coil weight 4 kg/mm

or

- 1 500 kg strip EN 1654 - CW452K - H180 - 0,500A × 199,6A - G
- nominal inside diameter of coil 400 mm
 - maximum outside diameter of coil 900 mm
 - approximate specific coil weight 4 kg/mm

In addition, the purchaser shall state on the enquiry and order any of the following, if required:

- m) whether edgewise curvature for strip condition “as rolled” shall be measured over a length of 2 000 mm (see 6.4.2.1);
- n) whether strip is required to meet roughness requirements R_a , R_z or R_{max} . (see 6.5.2). If so, the test method and the acceptance criteria required;
- o) which measuring device is to be used for the determination of transverse cross bow (see 8.7);
- p) whether a declaration of conformity is required (see 9.1);
- q) whether an inspection document is required, and if so, which type (see 9.2);
- r) whether there are any special requirements for marking, packaging or labelling (see clause 10).

6 Requirements

6.1 Composition

The composition shall conform to the requirements for the appropriate material given in Table 1.

Percentage content of elements shown as “remainder” (Rem.) is usually calculated by difference from 100 %.

6.2 Mechanical properties

The mechanical properties shall conform to the appropriate requirements given in Table 2. The tests shall be carried out in accordance with 8.2 to 8.5.

6.3 Dimensions and tolerances

6.3.1 Tolerances on thickness

The thickness shall conform to the tolerances given in Table 3.

6.3.2 Tolerances on width

The width shall conform to the tolerances given in Table 4.

6.4 Form tolerances

6.4.1 General

Strip to this standard is available in two strip conditions:

- N: “as rolled”;
- G: “as flattened”.

Strip of the alloys CuBe1,7 (CW100C), CuBe2 (CW101C), CuCo2Be (CW104C) and CuNi2Be (CW110C) in the material condition precipitation hardened is available only in the “as rolled” strip condition.

6.4.2 Strip “as rolled” (N)

6.4.2.1 Edgewise curvature c

For the straightness of the longitudinal edge, which unless otherwise agreed between the purchaser and the supplier shall be based on a measuring length of 1 000 mm, the edgewise curvature c (see Figure 1) shall not exceed the values given in Table 6.

If the purchaser and the supplier agree on a measuring length of 2 000 mm, the edgewise curvature c shall not exceed the values given in Table 6 multiplied by 4.

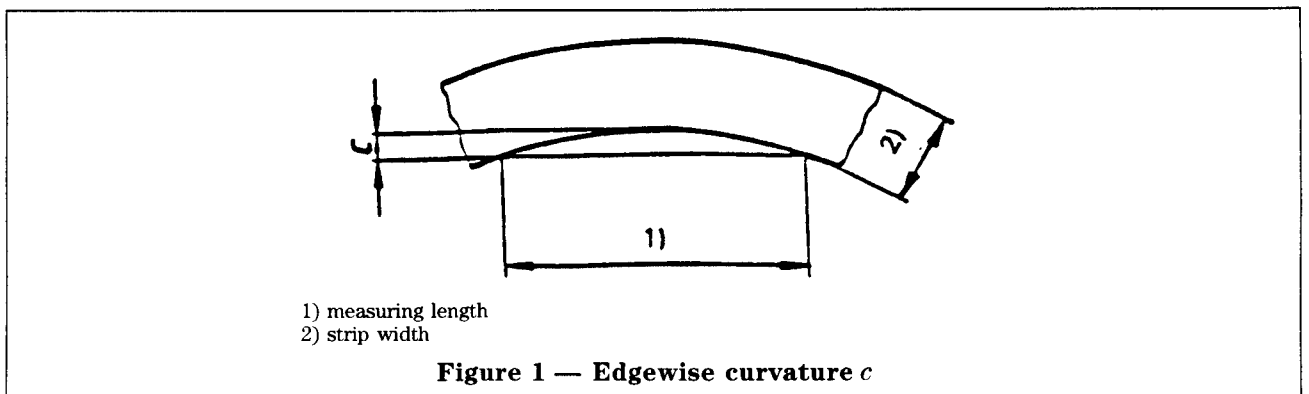
6.4.2.2 Transverse cross bow q

The transverse cross bow q (see Figure 2) including edge burr for strips with widths up to and including 100 mm shall not exceed the values given in Table 7.

Transverse cross bow $q = d - t$

where

- d is the distance of the upper point of the cross section from the reference plane;
- t is the thickness;
- \bar{w} is the width.



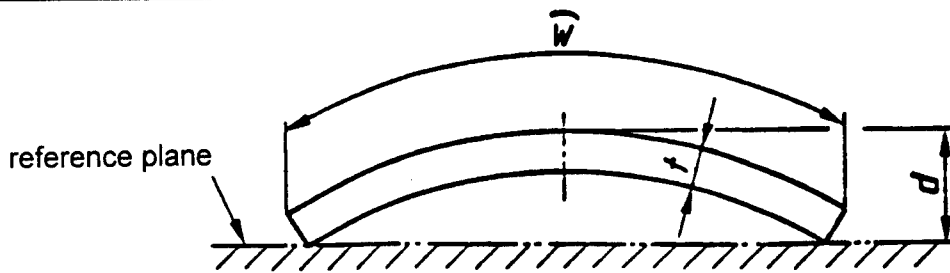


Figure 2 — Transverse cross bow q

6.4.3 Strip "as flattened" (G)

6.4.3.1 Edgewise curvature c

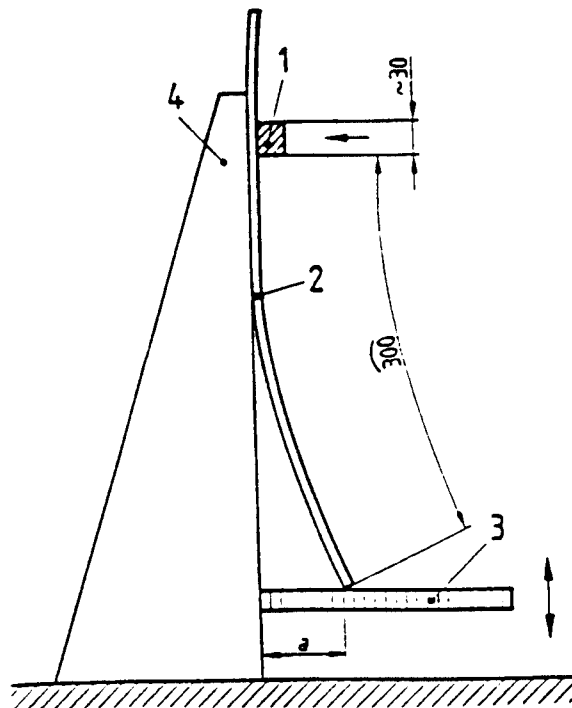
For the straightness of the longitudinal edge, which unless otherwise agreed between the purchaser and the supplier shall be based on a measuring length of 1 000 mm, the maximum edgewise curvature c (see Figure 1) shall not exceed the values given in Table 8.

If the purchaser and the supplier agree on a measuring length of 2 000 mm, the edgewise curvature c shall not exceed the values given in Table 8 multiplied by 4.

6.4.3.2 Coil set

The coil set is measured as the deflection a from the vertical of a 300 mm long portion of a strip (see Figure 3), for widths equal to or greater than 10 mm. The test shall be carried out in accordance with 8.6. The deflection shall not exceed the values given in Table 9.

The limitation of coil set is not applicable to traverse wound strip on spools.



Dimensions in millimetres

- 1) holder
- 2) strip
- 3) scale
- 4) stand

Figure 3 — Coil set as measured by deflection a

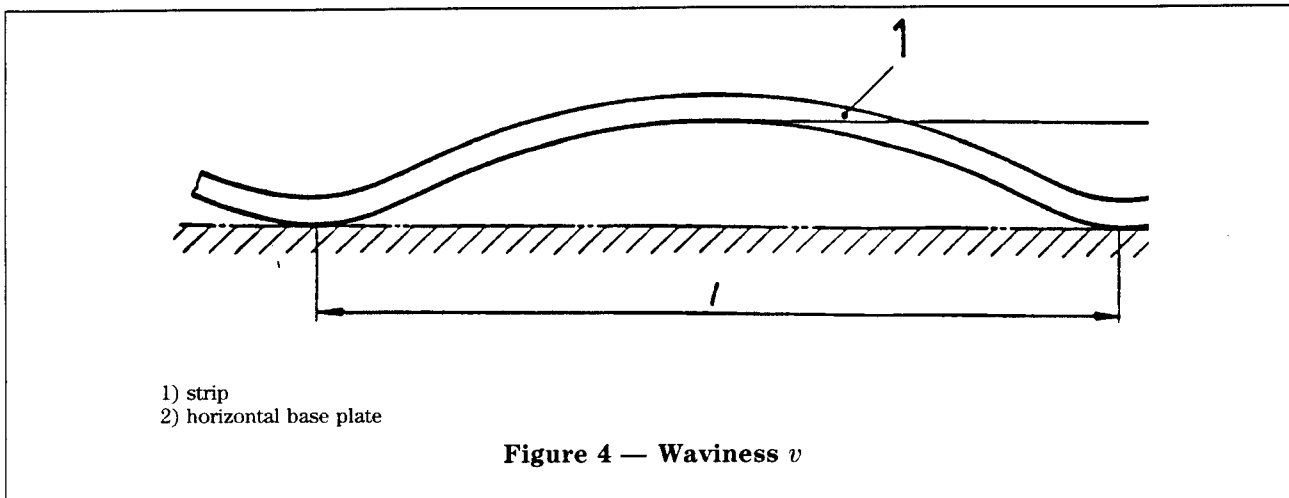


Figure 4 — Waviness *v*

6.4.3.3 Waviness *v*

The waviness *v* (see Figure 4) for widths up to and including 200 mm shall conform to the values given in Table 10.

$$\text{Waviness } v = \frac{h}{l}$$

where

- h* is the height of wave;
- l* is the length of wave.

6.4.3.4 Transverse cross bow *q*

The transverse cross bow *q* (see Figure 2), including edge burr for strips with widths up to and including 100 mm shall not exceed the values given in Table 11.

6.5 Surface properties

6.5.1 Condition

Strip shall be clean and free from injurious defects, which shall be specified by agreement between the purchaser and the supplier at the time of enquiry and order. A superficial film of residual lubricant is normally present on cold rolled products and is permissible unless otherwise specified.

6.5.2 Roughness

If agreed between the purchaser and the supplier the surface roughness shall be defined by roughness criteria R_a , R_z or R_{max} . The test method and the acceptance criteria shall be the subject of agreement between the purchaser and the supplier at the time of enquiry and confirmation of order.

7 Sampling

7.1 General

When required (e.g. if necessary in accordance with specified procedures of a supplier's quality system, or when the purchaser requests inspection documents with test results, or for use in cases of dispute), an inspection lot shall be sampled in accordance with 7.2 and 7.3.

7.2 Analysis

The sampling rate shall be in accordance with ISO 1811-2. A test sample, depending on the analytical technique to be employed, shall be prepared from each sampling unit and used for the determination of the composition.

NOTE 1 When preparing the test sample, care should be taken to avoid contaminating or overheating the test sample. Carbide tipped tools are recommended; steel tools, if used, should be made of magnetic material to assist in the subsequent removal of extraneous iron. If the test samples are in finely divided form (e.g. drillings, millings), they should be treated carefully with a strong magnet to remove any particles of iron introduced during preparation.

NOTE 2 In cases of dispute concerning the results of analysis, the full procedure given in ISO 1811-2 should be followed.

Results may be used from analyses carried out at an earlier stage of manufacturing the product, e.g. at the casting or master coil stage, if the material identity is maintained and if the quality system of the manufacturer is certified as conforming to EN ISO 9001 or EN ISO 9002.

7.3 Mechanical and other tests

The sampling rate for tensile, hardness, bend and spring bending tests shall be one test sample per master coil. Sampling units shall be selected from the finished products. The test samples shall be cut from the sampling units. Test samples, and test pieces prepared from them, shall not be subjected to any further treatment, other than any machining operations necessary in the preparation of the test pieces.

8 Test methods

8.1 Analysis

Analysis shall be carried out on the test pieces, or test portions, prepared from the test samples obtained in accordance with 7.2. Except in cases of dispute, the analytical methods used shall be at the discretion of the supplier. For expression of results, the rounding rules given in 8.9 shall be used.

NOTE In cases of dispute concerning the results of analysis, the methods of analysis to be used should be in accordance with the appropriate ISO standards agreed between the disputing parties.

8.2 Hardness test

The Vickers hardness shall be determined in accordance with ISO 6507-2 or ISO 6507-3 as appropriate, on the test pieces prepared from the test samples obtained in accordance with 7.3.

For the Vickers test according to ISO 6507-2 a test force selected from one of those given in ISO 6507-2 shall be used.

For the Vickers test according to ISO 6507-3 a test force selected from one of those given in ISO 6507-3 shall be used.

8.3 Bend test

A 90° bend test in both directions (parallel and transverse) shall be carried out in accordance with ISO 7438.

To verify the bending properties, test strips shall be taken both parallel with and at right angles to the rolling direction. The test pieces shall be at least 10 mm wide and at least 20 mm long. The properly deburred test pieces shall be bent through 90° using the bending radii stated in Table 2 as multiples of strip thickness t ; $0 \times t$ means a bending radius less than or equal to 0,1 mm.

The bending radii for this purpose are the radii of the bending punch. There shall be no evidence of cracks on the tension side of the specimens, examined with a maximum magnification of $\times 10$.

8.4 Tensile test

The tensile properties shall be determined in accordance with EN 10002-1 on the test pieces prepared from the test samples obtained in accordance with 7.3.

8.5 Spring bending test

The spring bending limit shall be determined in accordance with prEN 12384 on the test pieces prepared from the test samples obtained in accordance with 7.3.

8.6 Coil set

A test piece, with a length greater than 300 mm, shall be fixed in the apparatus shown diagrammatically in Figure 3. From the holder the strip shall hang vertically above the base plate of the test equipment. The scale shows the coil set as the shortest distance between the holder and the middle of the lower end of the test piece.

8.7 Transverse cross bow q

The transverse cross bow q is the difference between d and t . The thickness t of the strip and the distance d shall be measured by appropriate measuring devices, as agreed between the purchaser and the supplier.

8.8 Retests

If there is a failure of one, or more than one, of the tests in 8.1 to 8.7, two test samples from the same inspection lot shall be permitted to be selected for retesting the failed property (properties). One of these test samples shall be taken from the same sampling unit as that from which the original failed test piece was taken, unless that sampling unit is no longer available, or has been withdrawn by the supplier.

If the test pieces from both test samples pass the appropriate test(s), then the inspection lot represented shall be deemed to conform to the particular requirements of this standard. If a test piece fails a test, the inspection lot represented shall be deemed not to conform to this standard.

8.9 Rounding of results

For the purpose of determining conformity to the limits specified in this standard, an observed or a calculated value obtained from a test shall be rounded in accordance with the following procedure, which is based upon the guidance given in annex B of ISO 31-0:1992. It shall be rounded in one step to the same number of figures used to express the specified limit in this standard, except that for tensile strength, proof strength and spring bending limit, the rounding interval shall be 10 N/mm², and for elongation the value shall be rounded to the nearest 1 %.

The following rules shall be used for rounding:

- a) if the figure immediately after the last figure to be retained is less than 5, the last figure to be retained shall be kept unchanged;
- b) if the figure immediately after the last figure to be retained is equal to or greater than 5, the last figure to be retained shall be increased by one.

9 Declaration of conformity and inspection documentation

9.1 Declaration of conformity

When requested by the purchaser [see 5p)] and agreed with the supplier, the supplier shall issue for the products the appropriate declaration of conformity in accordance with EN 1655.

9.2 Inspection documentation

When requested by the purchaser [see 5q)] and agreed with the supplier, the supplier shall issue for the products the appropriate inspection document in accordance with EN 10204.

10 Marking, packaging, labelling

Unless otherwise specified by the purchaser and agreed by the supplier, the marking, packaging and labelling shall be left to the discretion of the supplier [see 5r)].

Table 1 — Composition of copper alloys

Material designation		Composition % (m/m)													
Symbol	Number	Element	Cu	Al	Be	Co	Fe	Mn	Ni	P	Pb	Si	Sn	Zn	Others total
CuBe1,7	min.	Rem.	—	—	1,6	—	—	—	—	—	—	—	—	—	—
	max.	—	—	1,8	0,3	—	0,2	—	0,3	—	—	—	—	—	0,5
CuBe2	min.	Rem.	—	—	1,8	—	—	—	—	—	—	—	—	—	—
	max.	—	—	2,1	0,3	—	0,2	—	0,3	—	—	—	—	—	0,5
CuCo2Be	min.	Rem.	—	—	0,4	2,0	—	—	—	—	—	—	—	—	—
	max.	—	—	0,7	2,8	—	0,2	—	0,3	—	—	—	—	—	0,5
CuFe2P	min.	Rem.	—	—	—	—	2,1	—	—	0,015	—	—	—	0,05	—
	max.	—	—	—	—	—	2,6	—	—	0,15	0,03	—	—	0,20	0,2
CuNi2Be	min.	Rem.	—	—	0,2	—	—	—	1,4	—	—	—	—	—	—
	max.	—	—	0,6	0,3	—	0,2	—	2,2	—	—	—	—	—	0,5
CuNi2Si	min.	Rem.	—	—	—	—	—	—	1,6	—	—	0,4	—	—	—
	max.	—	—	—	—	—	0,2	0,1	2,5	—	0,02	0,8	—	—	0,3
CuNi9Sn2	min.	Rem.	—	—	—	—	—	—	8,5	—	—	—	1,8	—	—
	max.	—	—	—	—	—	0,3	0,3	10,5	—	0,03	—	2,8	0,1	0,1
CuNi12Zn24	min.	63,0	—	—	—	—	—	—	11,0	—	—	—	—	Rem.	—
	max.	66,0	—	—	—	—	0,3	0,5	13,0	—	0,03	—	0,03	—	0,2
CuNi12Zn29	min.	57,0	—	—	—	—	—	—	11,0	—	—	—	—	Rem.	—
	max.	60,0	—	—	—	—	0,3	0,5	13,5	—	0,03	—	0,03	—	0,2
CuNi18Zn20	min.	60,0	—	—	—	—	—	—	17,0	—	—	—	—	Rem.	—
	max.	63,0	—	—	—	—	0,3	0,5	19,0	—	0,03	—	0,03	—	0,2
CuNi18Zn27	min.	53,0	—	—	—	—	—	—	17,0	—	—	—	—	Rem.	—
	max.	56,0	—	—	—	—	0,3	0,5	19,0	—	0,03	—	0,03	—	0,2