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МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

Wrought copper and copper alloy plate, sheet and strip

Part 3:

Technical conditions of delivery for wrought copper alloy strip for springs

Plaques, tôles et bandes en cuivre et en alliages de cuivre corroyés —

Partie 2: Conditions techniques de livraison des bandes pour ressorts en alliages de cuivre corroyés

Reference number
ISO 1634-3 : 1987 (E)

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1634-3 was prepared by Technical Committee ISO/TC 26, *Copper and copper alloys*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

Wrought copper and copper alloy plate, sheet and strip —

Part 3:

Technical conditions of delivery for wrought copper alloy strip for springs

1 Scope and field of application

This part of ISO 1634 specifies the technical conditions of delivery for wrought copper alloy strip for springs, currently available in commercial quantities.

Strip according to this part of ISO 1634 shall be suitable for the manufacture of springs, for example leaf springs, contact springs for switches and connectors.

For the purpose of this part of ISO 1634, the definitions for copper and copper alloys in ISO 197-1 and for strip in ISO 197-3 as well as the principles for designation in ISO 1190-1 and ISO 1190-2 apply.

For technical conditions of delivery for plate, sheet and strip

- for general purposes, see ISO 1634-1;
- for boilers, pressure vessels and heat-exchangers, see ISO 1634-2.

2 References

2.1 Definitions

ISO 197, *Copper and copper alloys — Terms and definitions*

- *Part 1: Materials.*
- *Part 3: Wrought products.*

2.2 Designations

ISO 1190, *Copper and copper alloys — Code of designation*

- *Part 1: Designation of materials.*
- *Part 2: Designation of tempers.*

2.3 Chemical composition

ISO 426-1, *Wrought copper-zinc alloys — Chemical composition and forms of wrought products — Part 1: Non-lead and special copper-zinc alloys.*

ISO 427, *Wrought copper-tin alloys — Chemical composition and forms of wrought products.*

ISO 429, *Wrought copper-nickel alloys — Chemical composition and forms of wrought products.*

ISO 430, *Wrought copper-nickel-zinc alloys — Chemical composition and forms of wrought products.*

ISO 1187, *Special wrought copper alloys — Chemical composition and forms of wrought products.*

2.4 Technical conditions of delivery

ISO 1634, *Wrought copper and copper alloy plate, sheet and strip*

- *Part 1: Technical conditions of delivery for plate, sheet and strip for general purposes.*
- *Part 2: Technical conditions of delivery for plate and sheet for boilers, pressure vessels and heat-exchangers.*

2.5 Methods of test

2.5.1 Sampling

ISO 4739, *Wrought copper and copper alloy products — Selection and preparation of specimens and test pieces for mechanical testing.*

2.5.2 Tensile testing

ISO 6892, *Metallic materials — Tensile testing.*

2.5.3 Hardness testing

ISO 2712, *Copper and copper alloys — Rockwell superficial hardness test (N and T scales).*

ISO 6507-2, *Metallic materials — Hardness tests — Vickers test — Part 2: HV0,2 to less than HV5.*

2.5.4 Technological testing

ISO 7438, *Metallic materials — Bend test*

3 Ordering information

The purchaser shall state on his inquiry and order the following information:

- quantity;
- designation of the material and temper required (see tables 1, 2 and 3);
- the mandatory mechanical properties:
 - either hardness and bending radius,
 - or tensile strength and elongation;
- in case of hardness, whether Vickers or Rockwell hardness is mandatory;
- dimensions, i.e., thickness, width (see tables 5, 6 and 7);
- normal or special tolerances for thickness (see tables 6 and 7);
- normal or special requirements for flatness (see 4.6.2).

4 Requirements

4.1 Chemical composition

The chemical composition shall comply with the requirements as specified in the International Standards referred to in table 1.

4.2 Mandatory mechanical properties

This part of ISO 1634 embodies the principle that either

- hardness and bending radius for the 90° bend test or
- tensile strength and elongation

are generally sufficient to define the condition of the material. Exact conversion between tensile strength and hardness is not possible.

At the option of the purchaser, mandatory properties of the material may be either

- hardness and bending radius for the 90° bend test or
- tensile strength and elongation,

but not both.

In case of hardness, it shall be indicated whether the Vickers or the Rockwell hardness test method is mandatory.

When no value for elongation is stated in tables 2 and 3 and the tensile strength is determined, the 90° bend test shall be carried out if a bending radius has been specified.

If mandatory properties are not specified by the purchaser, the supplier may choose to meet either

- hardness and bending radius or
- tensile strength and elongation.

Mandatory properties are given in tables 2 and 3.

Dimensional limitations which can have an effect on the properties are indicated. Strip having thicknesses outside these ranges may not comply with the properties given in tables 2 and 3.

Table 1 — Chemical composition

	Designation	Chemical composition in accordance with
Non heat-treatable	CuZn15	ISO 426-1
	CuZn30	
	CuZn37	
	CuSn4	ISO 427
	CuSn5	
	CuSn6	
	CuSn8	
	CuNi9Sn2	ISO 429
	CuNi12Zn24	ISO 430
	CuNi12Zn29	
	CuNi18Zn20	
	CuNi18Zn27	
Heat-treatable	CuBe1,7	ISO 1187
	CuBe2	

Table 2 — Mandatory mechanical properties of non-heat-treatable alloys

Designation ¹⁾		Vickers hardness HV	Rockwell hardness 30 T 2)	Minimum bending radius bending edge				Tensile strength R_m N/mm ²	Elongation	
				parallel ³⁾		transverse ³⁾			A_{50} % min.	A_{100} % min.
				4)	5)	4)	5)			
CuZn15	HDS	150 to 180	69,5 to 75	$0 \times t$	$4 \times t$	$0 \times t$	$0 \times t$	480 to 580	—	—
	HES	min. 170	min. 73	$2 \times t$	$6 \times t$	$0 \times t$	$1 \times t$	min. 550	—	—
CuZn30	HCS	150 to 180	69,0 to 74	$1 \times t$	$2 \times t$	$0 \times t$	$0 \times t$	480 to 580	—	5
	HDS	170 to 200	73,0 to 78	$2 \times t$	$3 \times t$	$0 \times t$	$1 \times t$	550 to 640	—	—
	HES	min. 190	min. 76	—	—	—	—	min. 630	—	—
CuZn37	HCS	150 to 180	69,0 to 74	$1 \times t$	$2 \times t$	$0 \times t$	$0 \times t$	480 to 580	—	5
	HDS	170 to 200	73,0 to 78	$2 \times t$	$3 \times t$	$0 \times t$	$1 \times t$	550 to 640	—	—
	HES	min. 190	min. 76	—	—	—	—	min. 630	—	—
CuSn4	HCS	150 to 180	67,0 to 76	$0 \times t$	$1 \times t$	$0 \times t$	$0 \times t$	470 to 570	8	10
	HDS	170 to 200	74,0 to 78	$2 \times t$	$3 \times t$	$0 \times t$	$0 \times t$	540 to 630	—	—
	HES	min. 190	min. 77	$3 \times t$	$4 \times t$	$0 \times t$	$1 \times t$	min. 590	—	—
CuSn5	HBS	160 to 190	70,0 to 77	$0 \times t$	$1 \times t$	$0 \times t$	$0 \times t$	480 to 580	6	8
	HCS	180 to 210	76,0 to 80	$1 \times t$	$2 \times t$	$0 \times t$	$0 \times t$	560 to 650	—	5
	HDS	min. 200	min. 78	$3 \times t$	$4 \times t$	$0 \times t$	$1 \times t$	min. 630	—	—
CuSn6	HBS	160 to 190	70,0 to 77	$0 \times t$	$1 \times t$	$0 \times t$	$0 \times t$	480 to 580	13	16
	HCS	180 to 210	76,0 to 80	$1 \times t$	$2 \times t$	$0 \times t$	$0 \times t$	550 to 650	9	11
	HDS	200 to 230	78,0 to 82	$3 \times t$	$4 \times t$	$0 \times t$	$1 \times t$	630 to 740	—	5
	HES	min. 220	min. 81	—	—	—	—	min. 720	—	—
CuSn8	HBS	170 to 200	74,0 to 78	$1 \times t$	$2 \times t$	$0 \times t$	$0 \times t$	540 to 630	14	17
	HCS	190 to 220	77,0 to 81	$2 \times t$	$3 \times t$	$0 \times t$	$1 \times t$	590 to 690	5	7
	HDS	210 to 240	80,0 to 84	$4 \times t$	$5 \times t$	$1 \times t$	$2 \times t$	680 to 760	—	—
	HES	min. 230	min. 84	—	—	—	—	min. 740	—	—
CuNi9Sn2	HCS	160 to 190	70,0 to 75	$0 \times t$	$2 \times t$	$0 \times t$	$0 \times t$	500 to 600	—	—
	HDS	180 to 210	72,0 to 77	$2 \times t$	$4 \times t$	$1 \times t$	$2 \times t$	560 to 660	—	—
	HES	min. 195	min. 75	—	—	—	—	min. 610	—	—
CuNi12Zn24	HCS	160 to 190	69,0 to 76	$0 \times t$	$1 \times t$	$0 \times t$	$0 \times t$	490 to 580	8	10
	HDS	180 to 210	73,0 to 78	$1 \times t$	$2 \times t$	$0 \times t$	$1 \times t$	550 to 650	—	—
	HES	200 to 230	77,0 to 80	$2 \times t$	$4 \times t$	$1 \times t$	$2 \times t$	620 to 730	—	—
CuNi12Zn29	HBS	170 to 200	72,0 to 77	$1 \times t$	$2 \times t$	$0 \times t$	$1 \times t$	510 to 620	—	5
	HCS	190 to 220	76,0 to 79	$2 \times t$	$4 \times t$	$1 \times t$	$2 \times t$	600 to 720	—	—
	HDS	210 to 240	78,0 to 81	—	—	—	—	670 to 790	—	—
	HES	230 to 260	80,0 to 83	—	—	—	—	720 to 840	—	—
CuNi18Zn20	HCS	160 to 190	69,0 to 76	$0 \times t$	$1 \times t$	$0 \times t$	$0 \times t$	500 to 600	—	—
	HDS	180 to 210	73,0 to 78	$1 \times t$	$2 \times t$	$0 \times t$	$1 \times t$	580 to 670	—	—
CuNi18Zn27	HBS	170 to 200	72,0 to 77	$1 \times t$	$2 \times t$	$0 \times t$	$1 \times t$	540 to 620	—	5
	HCS	190 to 220	76,0 to 79	$2 \times t$	$4 \times t$	$1 \times t$	$2 \times t$	600 to 700	—	—
	HDS	220 to 250	79,0 to 82	—	—	—	—	700 to 820	—	—

1) HBS, HCS, HDS, HES are provisional temper designations for strip for springs to be taken into account in course of the later revision of ISO 1190-2.

2) For thicknesses from 0,3 mm and over.

3) The bending edge is either parallel or transverse to the direction of rolling. t = thickness of the strip.

4) For thicknesses t from 0,10 up to and including 0,25 mm.

5) For thicknesses t over 0,25 mm.

Table 3 — Mandatory mechanical properties of heat-treatable alloys

Alloy designation	Temper designation ¹⁾	Vickers hardness HV	Rockwell hardness 30 T or 30 N ²⁾	Minimum bending radius bending edge		Tensile strength R_m N/mm ²	Elongation A_{50} % min.
				parallel ³⁾	transverse ³⁾		
CuBe2	TB	90 to 140	T 46 to 67	$0 \times t$	$0 \times t$	410 to 540	35
	TF	350 to 400	N 56 to 61	—	—	1 140 to 1 340	—
	TD 01	120 to 180	T 62 to 75	$1 \times t$	$0 \times t$	520 to 610	10
	TH 01	380 to 410	N 58 to 63	—	—	1 210 to 1 410	—
	TD 02	180 to 225	T 74 to 79	$3 \times t$	$2 \times t$	590 to 690	5
	TH 02	370 to 430	N 59 to 63	—	—	1 270 to 1 480	—
	TD 04	215 to 260	T 79 to 83	$6 \times t$	$4 \times t$	690 to 830	—
	TH 04	380 to 450	N 60 to 65	—	—	1 310 to 1 500	—
	TM 04	300 to 345	N 50 to 55	$8 \times t$	$5 \times t$	930 to 1 040	8
	TM 06	345 to 390	N 52 to 58	$10 \times t$	$6 \times t$	1 100 to 1 250	—
CuBe1,7	TB	80 to 140	T 46 to 69	$0 \times t$	$0 \times t$	390 to 540	35
	TF	330 to 380	N 53 to 58	—	—	1 030 to 1 240	—
	TD 01	120 to 180	T 62 to 75	$1 \times t$	$0 \times t$	500 to 600	10
	TH 01	340 to 390	N 55 to 59	—	—	1 100 to 1 310	—
	TD 02	180 to 225	T 74 to 79	$3 \times t$	$2 \times t$	580 to 690	5
	TH 02	350 to 410	N 56 to 60	—	—	1 170 to 1 380	—
	TD 04	215 to 260	T 79 to 83	$6 \times t$	$4 \times t$	680 to 830	—
	TH 04	360 to 430	N 58 to 63	—	—	1 240 to 1 450	—

1) Provisional temper designations for strip for springs to be taken into account in course of the later revision of ISO 1190-2.

TB: Solution Heat Treated

TD: Solution Heat Treated and Cold Worked

TF: Solution Heat Treated and Precipitation Heat Treated

TH: Solution H.T., Cold Worked and Precipitation H.T.

TM: Mill hardened

Suffixes to TD, TH, TM: 01 = 1/4 hard, 02 = 1/2 hard, 04 = hard, 06 = extrahard.

2) For thicknesses from 0,3 mm and over.

3) The bending edge is either parallel or transverse to the direction of rolling. t = thickness of the strip.

4.3 Properties for guidance

The values given in table 4 are for information only, for example electrical conductivity, *E*-modulus, 0,2 % proof stress.

Table 4 — Properties for information

Alloy	<i>E</i> -Modulus kN/mm ² (approx.)	Electrical conductivity m/(Ω·mm ²) (approx.)	0,2 % proof stress ¹⁾ N/mm ² min.
CuZn15	120	22	430
CuZn30	110	17	430
CuZn37	110	15	430
CuSn4	110	11	440
CuSn5	115	10	450
CuSn6	115	9	450
CuSn8	115	7	470
CuNi9Sn2	140	6	450
CuNi12Zn24	125	4	—
CuNi12Zn29	125	4	—
CuNi18Zn20	135	3	—
CuNi18Zn27	135	3	—
CuBe2 TH... — tempers	135	12	—
CuBe1,7 TH... — tempers	135	13	—

1) Values have been listed for the lowest spring temper of those alloys only which are mainly used for connectors.

4.4 Spring bending limit

Values for spring bending limit (elastic limit of spring in bending) shall be agreed upon between supplier and purchaser (see 5.5).

4.5 Dimensional tolerances

4.5.1 Tolerance on thickness

Table 5 — Non heat-treatable alloys — Tolerances on thickness

Values in millimetres

Thickness		Plus/minus-tolerance on thickness for widths			
		up to and including 200 mm		over 200 mm up to and including 350 mm	
over	up to and incl.	normal tolerance	special tolerance ¹⁾	normal tolerance	special tolerance ¹⁾
> 0,1	0,2	0,010	0,007	0,015	by agreement
0,2	0,3	0,015	0,010	0,020	by agreement
0,3	0,5	0,020	0,015	0,025	by agreement
0,5	0,8	0,025	0,018	0,030	by agreement
0,8	1,2	0,030	0,022	0,040	by agreement

1) Special tolerances involve additional processing and shall be specified by agreement between supplier and purchaser.

Table 6 — Heat-treatable alloys — Tolerances on thickness

Values in millimetres

Thickness		Plus-/minus-tolerance on thickness for widths			
		up to and including 100 mm		over 100 mm up to and including 200 mm	
over	up to and incl.	normal tolerance	special tolerance ¹⁾	normal tolerance	special tolerance ¹⁾
≥ 0,1	0,2	0,010	0,007	0,015	by agreement
0,2	0,3	0,015	0,010	0,020	by agreement
0,3	0,5	0,020	0,015	0,025	by agreement
0,5	0,8	0,025	0,018	0,030	by agreement
0,8	1,2	0,030	0,022	0,040	by agreement

1) Special tolerances involve additional processing and shall be specified by agreement between supplier and purchaser.

4.5.2 Tolerances on widths

The tolerances given in table 7 apply for both non heat-treatable and heat-treatable alloys, but for heat-treatable alloys only up to and including 200 mm width.

Table 7 — Tolerances on width

Values in millimetres

Thickness		Tolerance on width for widths			
		from 3 up to and incl. 50	over 50 up to and incl. 100	over 100 up to and incl. 200	over 200 up to and incl. 350
over	up to and incl.				
≥ 0,10	1,0	+ 0,2	+ 0,3	+ 0,4	+ 0,6
1,0	1,2	+ 0,3	+ 0,4	+ 0,5	+ 0,7

4.6 Form tolerances

4.6.1 Edgewise curvature

For the straightness of the longitudinal edge of strip, the maximum edgewise curvatures c , in millimetres, based on a measuring length of 1 m in table 8 apply (see figure 1).

Table 8 — Edgewise curvature

Values in millimetres

Width		Edgewise curvature, c
over	up to and incl.	
≥ 3	10	10
10	15	6
15	80	3
80	350	2

4.6.2 Flatness

4.6.2.1 Normal requirements: as rolled

As rolled strip has a flatness which depends on the manufacturing process, i.e. the as rolled strip has not been flattened. No deflection shall reverse direction within one coil.

4.6.2.2 Special requirement: as rolled and flattened

When required by the customer, further processing may be carried out to improve flatness, in which case the following tests may be specified:

4.6.2.2.1 Deflection

For strip of width equal to or more than 10 mm, the deflection from the vertical of a 300 mm long portion of a strip shall not exceed the values indicated in table 9, tested by the method as indicated in figure 2.

Table 9 — Deflection

Values in millimetres

Thickness		Coil inside diameter min.	Maximum deflection $a^{1)}$
over	up to and incl.		
≥ 0,10	0,20	300	10
0,20	0,40	300	25
0,40	1,0	400	30
1,0	1,2	400	50

1) Except temper TB and TM for CuBe1,7 and CuBe2 (see table 2).

4.6.2.2.2 Waviness

For strip of width up to and including 200 mm, the waviness shall not exceed the values indicated in table 10. The waviness is the ratio of the height h in mm of the wave to the length l in mm of the wave and tested by the method as indicated in figure 3.

Table 10 — Waviness

Values in millimetres

Thickness		Maximum waviness $h/l \times 100$
over	up to and incl.	
> 0,10	0,20	1,3 %
0,20	1,0	0,9 %

Dimensions in millimetres

4.7 Surface quality

The strips shall be clean, sound and free from injurious defects. Discoloration which is characteristic of proper heat treatment shall not be cause for rejection. A superficial film or residual light lubricant is normally present and is permissible unless otherwise specified.

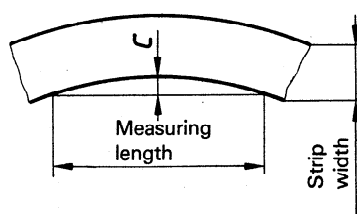
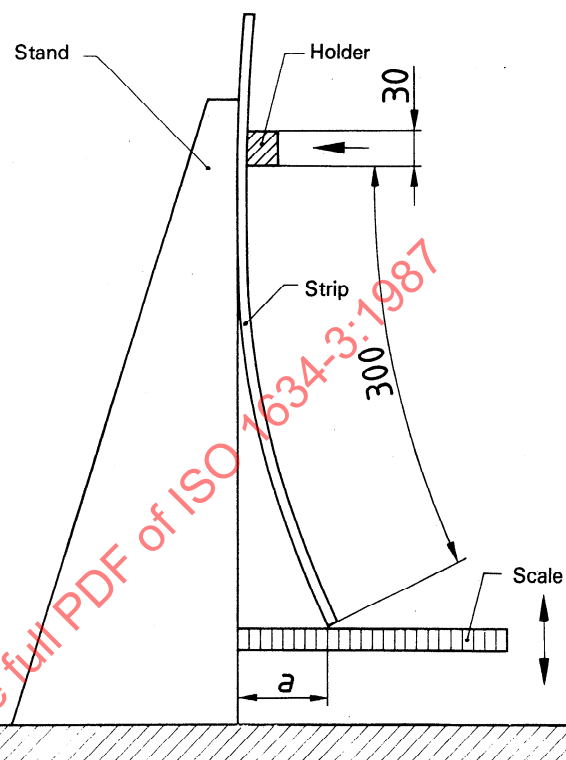
Figure 1 — Edgewise curvature, c 

Figure 2 — Deflection test

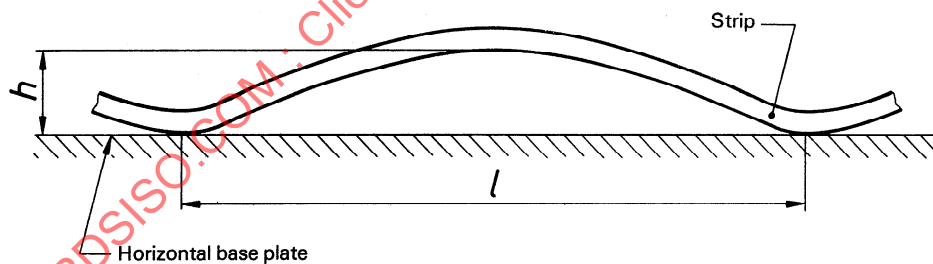


Figure 3 — Waviness test