INTERNATIONAL STANDARD 1634

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Wrought copper and copper alloys — Rolled flat products (plate, sheet, strip) — Mechanical properties

Cuivre et alliages de cuivre corroyés — Produits laminés plats (plaques, tôles, bandes) — Caractéristiques mécaniques

First edition — 1974-11-01

UDC 669.3-41 : 539.3/.6 **Ref. No. ISO 1634-1974 (E)**

Descriptors : copper, copper alloys, wrought products, metal plates, metal sheet, metal strip, mechanical properties.

Price based on 7 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

International Standard ISO 1634 was drawn up by Technical Committee ISO/TC 26, *Copper and copper alloys*, and circulated to the Member Bodies in December 1971.

It has been approved by the Member Bodies of the following countries :

Australia	Hungary	South Africa, Rep. of
Austria	India	Spain
Belgium	Italy	Sweden
Canada	Japan	Switzerland
Chile	Korea, Rep. of	Thailand
Czechoslovakia	Netherlands	Turkey
Denmark	New Zealand	U.S.A.
Egypt, Arab Rep. of	Norway	U.S.S.R.
Finland	Portugal	
France	Romania	

The Member Bodies of the following countries expressed disapproval of the document on technical grounds :

Germany
United Kingdom

Printed in Switzerland

Wrought copper and copper alloys — Rolled flat products (plate, sheet, strip) — Mechanical properties

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the mechanical properties of rolled flat products (plate, sheet, strip) in wrought copper and copper alloys the chemical compositions of which are listed in the appropriate International Standards (see 2.1).

NOTE — In order to overcome various national interpretations of the terms "plate", "sheet" and "strip", these manufactured forms are grouped under the general heading : "rolled flat products".

2 REFERENCES

2.1 Chemical composition and forms of semi-manufactured products

ISO 426, *Wrought copper-zinc alloys — Chemical composition and forms of wrought products —*

Part I : Non-leaded, special and high tensile alloys.

Part II : Leaded alloys.

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

ISO 428, *Wrought copper-aluminium 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/R 1187, *Special wrought copper alloys.*

ISO/R 1336, *Wrought alloyed coppers.*

ISO/R 1337, *Wrought coppers.*

2.2 Designations

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

Part I : Designation of materials.

Part II : Designation of tempers.

2.3 Test methods

ISO/R 399, *Vickers hardness test for copper and copper alloys (Test loads from 2.5 to 50 kgf).*

ISO/R 400, *Tensile testing of copper and copper alloys.*

ISO/R 1555, *Copper and copper alloy rolled flat products (Thickness less than 2,5 mm (0.1 in)) — Tensile test.*

ISO 2624, *Copper and copper alloys — Estimation of average grain size.*

ISO . . . , *Copper, copper alloys and alloyed copper — Selection of specimens and test pieces.* [1)]

1) In preparation.

3 ESSENTIAL PROPERTIES REQUIREMENTS

Table 1 embodies the principle that two properties are generally sufficient to define the condition of the material. The properties to be specified vary according to the temper and application of the material as set out in the table.

4 DIMENSIONAL LIMITS

Dimensional limitations which can have an effect on the properties obtained are given in table 2; products having dimensions outside these ranges may not comply with these properties.

Where the properties are not affected by dimensions or where the latter are unimportant, a dash (–) is inserted.

5 MECHANICAL PROPERTIES

Mechanical properties are given in table 2.

6 TEST METHODS

6.1 Tensile test

6.1.1 For thicknesses greater than or equal to 2,5 mm (0.1 in), according to ISO/R 400.

6.1.2 For thicknesses less than 2,5 mm (0.1 in), according to ISO/R 1555.

6.2 Vickers hardness test

According to ISO/R 399, for test loads within the range from 2,5 up to 50 kgf.

6.3 Estimation of average grain size

According to ISO 2624.

6.4 Selection of test pieces

According to ISO . . .

TABLE 1

Use	Temper designation	0,2 % proof stress $R_{p0,2}$	Tensile strength R_m	Elongation A	Vickers hardness HV	Average grain size
		N/mm²	N/mm²	%		mm
General purposes	M	–	approx.	approx.	max.	–
	O	–	–	min.	max.	–
	OS					min. – max.
	H	–	min. – max.	approx.	approx.	–
Structural purposes[1)]	M	min.	approx.	min.	–	–
	H					
	T	min.	approx.	min.	min.	–

1) Structural purposes are defined as those purposes where the load-bearing properties of the material are the most important.

TABLE 2

Designation		Thickness	Width	$R_{p0,2}$	R_m	$A^{1)}$	HV	Average grain size
Alloy	Temper	mm	mm	N/mm²	N/mm²	%		mm
Coppers, Alloyed coppers								
Cu-ETP	O[2)]	–	–	–	–	min. 30	max. 60	
Cu-FRHC	M	–	–	–	approx. 220	approx. 35	max. 75	
Cu-FRTP	HA	0,2 to 10	–	–	250 to 290	approx. 16	approx. 80	
Cu-OF	HB	0,2 to 6	–	–	280 to 330	approx. 8	approx. 100	
Cu-DHP	HC	0,2 to 1,5	–	–	340 to 390	approx. 4	approx. 110	
Cu Ag0,05	O[2)]	–	–	–	–	min. 30	max. 60	
Cu Ag0,1	HA	0,2 to 10	–	–	250 to 290	approx. 16	approx. 80	
Cu Ag0,05(P)	HB	0,2 to 6	–	–	280 to 330	approx. 8	approx. 100	
Cu Ag0,1(P)	HC	0,2 to 1,5	–	–	340 to 390	approx. 4	approx. 110	
Cu As(P)	O[2)]	–	–	–	–	min. 30	max. 60	
	M	–	–	–	approx. 220	approx. 35	max. 75	
	HA	0,2 to 10	–	–	250 to 290	approx. 16	approx. 80	
	HB	0,2 to 6	–	–	280 to 330	approx. 8	approx. 100	
	HC	0,2 to 1,5	–	–	340 to 390	approx. 4	approx. 110	
Copper-zinc-alloys (Brasses)								
Cu Zn5	O	0,2 to 10	–	–	–	min. 33	max. 75	
	HA	0,2 to 5	–	–	260 to 320	approx. 19	approx. 85	
	HB	0,2 to 5	max. 700	–	310 to 370	approx. 8	approx. 110	
Cu Zn10	O	0,2 to 10	–	–	–	min. 35	max. 75	
	OS35[3)]	0,2 to 5	max. 700	–	–	min. 35	max. 75	0,025 to 0,050
	HA	0,2 to 10	–	–	290 to 350	approx. 20	approx. 90	
	HB	5 to 10	max. 450	–	340 to 400	approx. 10	approx. 115	
		0,2 to 5	max. 700					
Cu Zn15	O	0,2 to 10	–	–	–	min. 35	max. 80	
	OS35[3)]	0,2 to 5	max. 700	–	–	min. 35	max. 80	0,025 to 0,050
	HA	0,2 to 10	–	–	310 to 370	approx. 30	approx. 95	
	HB	5 to 10	max. 450	–	360 to 420	approx. 12	approx. 120	
		0,2 to 5	max. 700					

1) The elongation values listed are valid
   – for thicknesses over 2,5 mm based on gauge length $5{,}65\sqrt{S_o}$;
   – for thicknesses between 0,2 and 2,5 mm based on a fixed gauge length of 50 mm.

2) Grain size or non-earing requirements are to be the subject of agreement between the interested parties.

3) Non-earing requirements are to be the subject of agreement between the interested parties.

TABLE 2 (*continued*)

Designation		Thickness	Width	$R_{p0,2}$	R_m	$A^{1)}$	HV	Average grain size
Alloy	Temper	mm	mm	N/mm²	N/mm²	%		mm
Cu Zn20	O	0,2 to 10		–	–	min. 40	max. 80	
	OS35[3)]	0,2 to 5	max. 700	–	–	min. 40	max. 85	0,025 to 0,050
	HA	0,2 to 10		–	320 to 390	approx. 30	approx. 100	
	HB	5 to 10	max. 450	–	380 to 450	approx. 12	approx. 125	
		0,2 to 5	max. 700					
Cu Zn30	O	0,2 to 30		–	–	min. 45	max. 80	
	OS25[3)]	0,2 to 2	max. 350	–	–	min. 35	max. 100	0,015 to 0,035
	OS35[3)]	0,2 to 5	max. 700	–	–	min. 45	max. 85	0,025 to 0,050
	HA	0,2 to 30		–	340 to 420	approx. 40	approx. 105	
	HB	5 to 10	max. 450	–	410 to 480	approx. 15	approx. 135	
		0,2 to 5	max. 700					
Cu Zn33	O	0,2 to 10		–	–	min. 45	max. 80	
	OS35[3)]	0,2 to 5	max. 700	–	–	min. 45	max. 85	0,025 to 0,050
	HA	0,2 to 10		–	360 to 430	approx. 35	approx. 110	
	HB	5 to 10	max. 450	–	420 to 490	approx. 15	approx. 140	
		0,2 to 5	max. 700					
Cu Zn37	O	0,2 to 30		–	–	min. 40	max. 80	
	OS25[3)]	0,2 to 2	max. 350	–	–	min. 30	max. 100	0,015 to 0,035
	OS35[3)]	0,2 to 5	max. 700	–	–	min. 40	max. 85	0,025 to 0,050
	HA	0,2 to 30		–	360 to 440	approx. 35	approx. 110	
	HB	5 to 10	max. 450	–	430 to 510	approx. 15	approx. 140	
		0,2 to 5	max. 700					
	HC	0,2 to 2	max. 350	–	520 to 610	approx. 8	approx. 170	
Cu Zn40	M	–	–	–	approx. 370	approx. 40	max. 105	
	O	0,2 to 5	–		–	min. 35	max. 100	
	HA	0,2 to 5	–		390 to 470	approx. 20	approx. 125	
Copper-zinc-lead alloys (Leaded brasses)								
Cu Zn35 Pb2	O	0,3 to 10	–	–	–	min. 35	max. 90	
	HB	0,3 to 5	max. 700	–	430 to 530	approx. 10	approx. 150	
Cu Zn36 Pb1	O	0,3 to 10	–	–	–	min. 35	max. 90	
	HB	0,3 to 5	max. 700	–	430 to 530	approx. 10	approx. 150	
Cu Zn38 Pb2	O	0,3 to 10	–	–	–	min. 35	max. 90	
	HB	0,3 to 5	max. 700	–	430 to 530	approx. 10	approx. 150	

1), 3) See page 3.

TABLE 2 (*continued*)

Designation		Thickness	Width	$R_{p0,2}$	R_m	$A^{1)}$	HV	Average grain size
Alloy	Temper	mm	mm	N/mm²	N/mm²	%		mm
Cu Zn40 Pb	M	–	–	–	approx. 370	approx. 40	max. 110	
	HA	0,2 to 5	–	–	390 to 470	approx. 20	approx. 125	
Cu Zn39 Pb2	HB	0,3 to 5	max. 700	–	500 to 600	approx. 8	approx. 160	
Special copper-zinc alloys (Special brasses)								
Cu Zn20 Al2	M	–	–	–	approx. 330	approx. 42	max. 100	
	HA	18 to 30	–	–	390 to 490	approx. 30	approx. 110	
Cu Zn28 Sn1	M	–	–	–	approx. 330	approx. 40	max. 100	
	HA	18 to 30	–	–	390 to 490	approx. 30	approx. 120	
Cu Zn38 Sn1	M	–	–	–	approx. 370	approx. 30	max. 120	
	HA	5 to 30	–	–	390 to 470	approx. 25	approx. 125	
Copper-tin alloys (Phosphor-bronzes) **Special copper-tin alloys (Special bronzes)**								
Cu Sn2	O	0,2 to 5	max. 350	–	–	min. 40	max. 75	
Cu Sn4	O	0,2 to 5	max. 700	–	–	min. 45	max. 90	
	HD	0,1 to 2	max. 350	min. 570	approx. 640	min. 1	–	
Cu Sn6	O	0,2 to 5	max. 700	–	–	min. 50	max. 95	
	HD	0,1 to 2	max. 350	min. 620	approx. 690	min. 1	–	
Cu Sn8	O	0,2 to 5	max. 350	–	–	min. 50	max. 110	
	HD	0,2 to 2	max. 350	min. 650	approx. 720	min. 1	–	
Cu Sn10	HB	5 to 25	max. 350	min. 440	approx. 540	min. 15	–	
	HD	0,1 to 2	max. 350	min. 670	approx. 740	min. 1	–	
Cu Sn4 Zn4	O	0,2 to 5	max. 700	–	–	min. 40	max. 100	
	HD	0,1 to 2	max. 350	min. 520	approx. 640	min. 3	–	
Copper-aluminium alloys (Aluminium bronzes) **Special copper-aluminium alloys (Special aluminium bronzes)**								
Cu Al5	M	–	–	–	approx. 410	approx. 45	max. 110	
	O	–	–	–	–	min. 45	max. 100	
Cu Al8	M	–	–	–	approx. 470	approx. 35	max. 125	
	O	–	–	–	–	min. 35	max. 115	
Cu Al8 Fe3	M	–	–	min. 195	approx. 510	min. 28	–	
Copper-nickel alloys								
Cu Ni20	M	–	–	min. 95	approx. 330	min. 35	–	
Cu Ni25	O	0,2 to 10	–	–	–	min. 35	max. 95	

1) See page 3.

TABLE 2 (*continued*)

Designation		Thickness	Width	$R_{p0,2}$	R_m	$A^{1)}$	HV	Average grain size
Alloy	Temper	mm	mm	N/mm²	N/mm²	%		mm
Cu Ni5 Fe1 Mn	O	0,3 to 5	max. 600	–	–	min. 30	max. 85	
Cu Ni10 Fe1 Mn	M	–	–	min. 95	approx. 330	min. 30	–	
Cu Ni20 Mn1 Fe	M	–	–	min. 115	approx. 350	min. 35	–	
Cu Ni30 Mn1 Fe	O	0,2 to 2	max. 600	–	–	min. 30	max. 105	
Cu Ni44 Mn1	O	0,2 to 5	–	–	–	min. 35	max. 100	
Copper-nickel-zinc alloys								
Cu Ni18 Zn20	OS25	0,2 to 2	max. 350	–	–	min. 30	max. 120	0,015 to 0,035
	OS35	0,2 to 5	max. 700	–	–	min. 35	max. 110	0,025 to 0,050
	HA	0,2 to 5	max. 450	–	460 to 560	approx. 8	approx. 160	
	HB	0,1 to 2	max. 350	–	560 to 690	approx. 3	approx. 190	
Cu Ni18 Zn27	HD	0,1 to 2	max. 350	–	690 to 830	approx. 2	approx. 210	
Cu Ni15 Zn21	O	0,2 to 5	max. 350	–	–	min. 36	max. 120	
	HB	0,2 to 5	max. 350	–	440 to 540	approx. 18	approx. 140	
Cu Ni12 Zn24	OS25	0,2 to 2	max. 350	–		min. 35	max. 110	0,015 to 0,035
	OS35	0,2 to 5	max. 700	–	–	min. 40	max. 100	0,025 to 0,050
	HA	0,2 to 5	max. 450	–	410 to 510	approx. 20	approx. 140	
Cu Ni10 Zn27	OS35	0,2 to 5	max. 700	–	–	min. 38	max. 100	
	HA	0,2 to 5	max. 450	–	410 to 510	approx. 15	approx. 140	
	HB	0,2 to 5	max. 350	–	540 to 640	approx. 5	approx. 180	
Cu Ni10 Zn28 Pb1	O	0,2 to 5	max. 350	–	–	min. 35	max. 100	
	HA	0,2 to 5	max. 450	–	410 to 510	approx. 10	approx. 150	
	HB	0,2 to 5	max. 350	–	550 to 650	approx. 4	approx. 180	
Special copper alloys								
Cu Si3 Mn1	M	–	–	min. 120	approx. 410	min. 40	–	
Cu Be1,7	TB	max. 5	max. 200	min. 200	approx. 440	min. 35	min. 85	
	TD			min. 590	approx. 740	min. 2	min. 210	
	TF			min. 980	approx. 1 180	min. 2	min. 340	
	TH			min. 1 080	approx. 1 280	–	min. 360	
Cu Be2	TB	max. 5	max. 200	min. 250	approx. 490	min. 35	min. 95	
	TD			min. 640	approx. 780	–	min. 220	
	TF			min. 1 080	approx. 1 280	–	min. 360	
	TH			min. 1 180	approx. 1 370	–	min. 380	

1) See page 3.

TABLE 2 (*concluded*)

Designation		Thickness	Width	$R_{p0,2}$	R_m	$A^{1)}$	HV	Average grain size
Alloy	Temper	mm	mm	N/mm²	N/mm²	%		mm
Cu Co2 Be	TB	max. 3	max. 200	min. 150	approx. 340	min. 25	min. 70	
	TD	max. 3	max. 200	min. 390	approx. 540	min. 3	min. 140	
	TF	max. 3	max. 200	min. 490	approx. 690	min. 8	min. 195	
	TH	max. 3	max. 200	min. 640	approx. 780	min. 5	min. 215	
Cu Ni1 Si	TD	max. 3	max. 200	min. 340	approx. 450	min. 8	min. 120	
	TH	max. 3	max. 200	min. 540	approx. 640	min. 10	min. 180	
Cu Ni2 Si	TD	max. 3	max. 200	min. 360	approx. 460	min. 6	min. 135	
	TH	max. 3	max. 200	min. 590	approx. 680	min. 8	min. 190	

1) See page 3.