INTERNATIONAL STANDARD

ISO 1637

Second edition
1987-06-01

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

Wrought copper and copper alloy rod and bar — Technical conditions of delivery

Barres en cuivre et en alliages de cuivre corroyés — Conditions techniques de livraison

Reference number
ISO 1637 : 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 1637 was prepared by Technical Committee ISO/TC 26, *Copper and copper alloys.*

This second edition cancels and replaces the first edition (ISO 1637 : 1974), of which it constitutes a technical revision.

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.

Printed in Switzerland

Wrought copper and copper alloy rod and bar — Technical conditions of delivery

1 Scope and field of application

This International Standard specifies the technical conditions of delivery of wrought copper and copper alloy rod and bar, currently available in commercial quantities.

For the purpose of this International Standard, the definitions for copper and copper alloys in ISO 197-1 and for rod and bar 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 wire, see ISO 1638.

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

- *Part 1 : Non-leaded and special copper-zinc alloys.*
- *Part 2 : Leaded copper-zinc 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 1187, *Special wrought copper alloys — Chemical composition and forms of wrought products.*

ISO 1336, *Wrought coppers (having minimum copper content of 97,5 %) — Chemical composition and forms of wrought products.*

ISO 1337, *Wrought coppers (having minimum copper content of 99,85 %) — Chemical composition and forms of wrought products.*

2.4 Technical conditions of delivery

ISO 1638, *Wrought copper and copper alloy wire — Technical conditions of delivery.*

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 6506, *Metallic materials — Hardness test — Brinell test.*

ISO 6507, *Metallic materials — Hardness test — Vickers test*

- *Part 1 :* HV 5 *to* HV 100.

ISO 6508, *Metallic materials — Hardness test — Rockwell test (scales A — B — C — D — E — F — G — H — K).*

2.5.4 Stress corrosion testing

ISO 196, *Wrought copper and copper alloys — Detection of residual stress — Mercury(I) nitrate test.*

ISO 6957, *Copper and copper alloys — Ammonia test for stress corrosion resistance.*[1)]

1) At present at the stage of draft.

2.6 Dimensional tolerances

ISO 3488, *Wrought copper and copper alloys — Extruded round, square or hexagonal bars — Dimensions and tolerances.*

ISO 3489, *Wrought copper and copper alloys — Drawn round bars — All minus tolerances on diameter and form tolerances.*

ISO 3490, *Wrought copper and copper alloys — Drawn hexagonal bars — All minus tolerances on width across flats and form tolerances.*

ISO 3491, *Wrought copper and copper alloys — Drawn square bars — All minus tolerances on width across flats and form tolerances.*

ISO 6958, *Wrought copper and copper alloys — Drawn rectangular bars — Dimensions and tolerances.*

ISO 7756, *Wrought copper and copper alloys — Drawn round bars — Symmetric plus and minus tolerances on diameter and form tolerances.*

ISO 7757, *Wrought copper and copper alloys — Drawn hexagonal bars — Symmetric plus and minus tolerances on width across flats and form tolerances.*

ISO 7758, *Wrought copper and copper alloys — Drawn square bars — Symmetric plus and minus tolerances on width across flats and form tolerances.*

3 Ordering information

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

a) quantity;

b) designation of the material and temper required (see table 2);

c) the mandatory mechanical properties : tensile strength, hardness (see 4.2);

d) dimensions, i.e.

— diameter, width across flats, thickness, width,

— length;

e) in case of hardness, whether Vickers, Brinell or Rockwell hardness is mandatory;

f) the tests to be carried out, including those to be agreed upon.

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.

Table 1 — Chemical composition

Material	Chemical composition in accordance with
Coppers	ISO 1336, ISO 1337
Copper-zinc alloys	ISO 426-1 and ISO 426-2
Copper-tin alloys	ISO 427
Copper-aluminium alloys	ISO 428
Copper-nickel alloys	ISO 429
Copper-nickel-zinc alloys	ISO 430
Special copper alloys	ISO 1187

4.2 Mandatory mechanical properties

4.2.1 This International Standard embodies the principle that either

— tensile strength and elongation or

— hardness

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

— tensile strength and elongation or

— hardness,

but not both.

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

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

— tensile strength and elongation or

— hardness.

4.2.2 Mechanical properties are given in table 2.

Values shown in brackets are given for information only.

The elongation values listed are valid :

a) for diameter, width across flats, thickness over 2,5 mm based on gauge length $5{,}65\sqrt{S_o} \triangleq A_5$

b) for diameter, width across flats, thickness from 0,10 up to 2,5 mm based on

— either a gauge length $11{,}3\sqrt{S_o} \triangleq A_{10}$,

— or a fixed gauge length of 50 mm $\triangleq A_{50}$.

Rods and bars having dimensions outside the given ranges may not comply with the properties given in table 2.

4.2.3 Subject to agreement between the purchaser and the supplier, copper-zinc alloy rod and bar may be supplied in the stress-relieved condition and be subject to the stress corrosion test. Test pieces subjected to this test shall not crack.

Should a lot of material fail the test, the supplier shall have the option to restress relieve the lot and to resubmit it to all relevant tests.

4.3 Dimensions and tolerances

For rod and bar, the tolerances specified in table 2 apply :

Table 2 — Tolerances applicable to rod and bar

Cross-section	Tolerance	International Standard
Round (extruded)	Plus/minus	ISO 3488
Round (drawn)	All minus	ISO 3489
	Plus/minus symetric	ISO 7756
Square (drawn)	All minus	ISO 3491
	Plus/minus symetric	ISO 7758
Hexagonal (drawn)	All minus	ISO 3490
	Plus/minus symetric	ISO 7757
Rectangular (drawn)	Plus/minus symetric	ISO 6958

4.4 Surface quality

The rods and bars shall be clean, sound and free from injurious defects. Discoloration which is characteristic of hot working or 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.

5 Methods of test

5.1 Sampling

Selection and preparation of test specimens and test pieces for mechanical testing shall be carried out in accordance with ISO 4739.

The lot size shall be subject to the agreement between supplier and purchaser.

If not otherwise specified, the rate of sampling for plate, sheet and strip shall be one test piece per lot for each of the tests referred to in 5.2 to 5.7, as appropriate.

5.2 Tensile testing

The test shall be made in accordance with ISO 6892.

5.3 Hardness testing

5.3.1 Vickers

The test shall be made in accordance with ISO 6507-1.

5.3.2 Brinell hardness

The test shall be made in accordance with ISO 6506.

5.3.3 Rockwell hardness

The test shall be made in accordance with ISO 6508.

5.4 Stress corrosion test

If required, the test is only carried out on copper-zinc alloys as listed in table 3.

The method shall be the mercury(I) nitrate test according to ISO 196. By agreement between supplier and purchaser, an ammonia test according to ISO 6957 may be specified instead of the mercury(I) nitrate test.

5.5 Retests

5.5.1 If both of the two test pieces which were originally taken from a lot fail to meet the specification for any reason, the lot shall be deemed not to comply with this International Standard.

5.5.2 If one of the two test pieces taken originally from the lot fails to meet the specification for any reason, two further test pieces shall be taken. One of these two test pieces shall be taken from the rod or bar from which the failed test piece was originally taken, unless that rod or bar has been withdrawn from the lot by the supplier. The other test piece shall be taken from another sample from the same lot. All appropriate tests shall be carried out.

5.5.3 Should both of the new test pieces pass the tests, the lot represented by the test pieces shall be deemed to comply with this International Standard. Should either of the additional test pieces fail, then the lot represented by the test pieces shall be deemed not to comply with this International Standard.

Table 3 — Mandatory mechanical properties

Temper	Dimensions (mm)			Mechanical properties					Hardness		
	Diameter or distance across flats	Rectangles		Tensile strength R_m N/mm² min.	Proof stress $R_{p\,0,2}$ N/mm² min.	Elongation			Vickers HV10	Brinell HB	Rockwell HRB
		Thickness	Width			A_5 % min.	A_{10} % min.	A_{50} % min.			
Coppers (Cu min. 99,85 %) : Cu-ETP, Cu-FRHC, Cu-FRTP, Cu-OF, Cu-HCP, Cu-DLP, Cu-DHP											
M	—	—	—	Without specified properties							
O	min. 6	3 to 35	max. 150	max. 250	—	35	30	32	max. 65	—	—
HB	6 to 40	3 to 25	max. 150	250	(160)	15	12	15	min. 65	min. 60-	
HD	6 to 18	6 to 10	max. 100	290	(250)	5	—	5	min. 90	min. 80	min. 48
Coppers (Cu min. 97,5 %) : CuS, CuS(P), CuTe, CuTe(P), CuPb1											
HB	6 to 50	—	—	250	200	7	5	5	min. 80	min. 75	min. 25
CuCr1											
TF	6 to 80	6 to 50	max. 150	370	(260)	18	—	20	min. 120	min. 110	min. 70
TH	6 to 50	6 to 18	max. 50	440	(350)	10	—	12	min. 145	min. 130	min. 80
TL	6 to 30	—	—	500	(440)	5	—	7	min. 160	min. 145	min. 85
CuZn37											
O	10 to 40	—	—	290	—	45	40	45	max. 100	max. 90	max. 60
HB	10 to 40	—	—	370	—	27	22	27	min. 100	min. 90	min. 60
HC	10 to 40	—	—	440	—	14	11	14	min. 135	min. 120	min. 75
CuZn40											
M	—	—	—	Without specified properties							
O	10 to 40	—	—	340	—	35	30	35	max. 125	max. 110	max. 70
HB	10 to 40	—	—	390	—	20	17	20	min. 125	min. 110	min. 70
CuZn38Sn1											
M	6 to 80	—	—	Without specified properties							
HB	6 to 50	2 to 25	max. 100	400	(180)	20	15	20	min. 120	min. 110	min. 70
HD	6 to 30	2 to 25	2 to 50	460	(310)	13	10	13	min. 150	min. 130	min. 80
CuZn37Sn1Pb1											
M	6 to 80	—	—	Without specified properties							
HB	6 to 18	2 to 50	max. 100	420	(200)	15	12	15	min. 140	min. 125	min. 76
	18 to 40	2 to 50	max. 100	400	(180)	18	15	18	min. 120	min. 110	min. 67
	Over 40	2 to 50	max. 100	360	(160)	20	18	20	min. 110	min. 100	min. 62
CuZn37Mn2AlSi											
M	6 to 80	—	—	Without specified properties							
HB	6 to 18	—	—	600	(300)	12	—	12	min. 160	—	min. 84
	18 to 40	—	—	550	(270)	15	—	15	min. 140	—	min. 76
CuZn39AlFeMn											
M	6 to 80	—	—	Without specified properties							
HB	6 to 18	—	—	460	(270)	12	10	12	min. 150	min. 135	min. 80
	18 to 40	—	—	440	(250)	15	12	15	min. 140	min. 120	min. 75
	40 to 50	—	—	440	(210)	18	15	18	min. 120	min. 110	min. 65
HC	6 to 40	—	—	540	(290)	12	10	12	min. 150	min. 135	min. 80

Table 3 — Mandatory mechanical properties (*continued*)

Temper	Dimensions (mm)			Mechanical properties					Hardness		
	Diameter or distance across flats	Rectangles		Tensile strength R_m N/mm² min.	Proof stress $R_{p\,0,2}$ N/mm² min.	Elongation			Vickers HV10	Brinell HB	Rockwell HRB
		Thickness	Width			A_5 % min.	A_{10} % min.	A_{50} % min.			
CuZn34Pb2											
M	—	—	—	Without specified properties							
HA	6 to 40	—	—	350	(220)	25	22	25	min. 90	min. 85	min. 50
HB	6 to 40	—	—	400	(290)	20	16	20	min. 130	min.125	min. 70
CuZn36Pb3											
M	—	—	—	Without specified properties							
O	6 to 50	2 to 25	150	330	—	25	22	25	min. 105	min. 100	min. 45
HB	6 to 10	—	—	400	(180)	7	—	—	—	—	—
	10 to 30	—	—	380	(160)	10	—	—	min. 107	min. 94	min. 60
	30 to 50	—	—	350	(140)	15	—	—	min. 99	min. 87	min. 55
HD	Up to 6	—	—	550	(310)	—	—	—	—	—	—
	6 to 12	—	—	480	(240)	6	—	—	—	—	—
CuZn40Pb/CuZn39Pb1											
M	6 to 80	—	—	Without specified properties							
HB	6 to 40	2 to 6	—	380	—	25	20	25	min. 90	min. 85	min. 50
HD	6 to 18	2 to 4	—	460	330	10	7	10	min. 130	min. 125	min. 70
CuZn38Pb2/CuZn40Pb2/CuZn39Pb3											
M	6 to 80	—	—	Without specified properties							
HB	6 to 40	2 to 6	—	400	(210)	18	15	18	min. 120	min. 110	min. 65
HD	6 to 18	2 to 4	—	460	(360)	12	7	12	min. 130	min. 125	min. 70
CuZn38Pb4											
M	6 to 80	—	—	Without specified properties							
HB	6 to 18	2 to 6	—	420	—	15	12	15	min. 110	min. 95	min. 65
	18 to 40	2 to 6	—	400	—	18	15	18	min. 110	min. 95	min. 65
CuSn5											
HA	6 to 18	—	—	485	—	—	—	13	min. 150	—	min. 80
	18 to 30	—	—	415	—	—	—	15	min. 148	—	min. 79
HB	6 to 18	—	—	480	—	13	—	—	—	—	—
HE	6 to 10	—	—	700	—	5	—	—	—	—	—
	10 to 18	—	—	620	—	9	—	—	—	—	—
CuSn6											
HA	6 to 40	—	—	400	—	33	—	—	—	—	—
HB	6 to 18	—	—	500	—	15	—	—	—	—	—
HD	6 to 10	—	—	580	—	7	—	—	—	—	—
CuSn8											
HA	6 to 40	—	—	450	—	35	—	—	—	—	—
HB	6 to 18	—	—	530	—	15	—	—	—	—	—
HD	6 to 10	—	—	600	—	8	—	—	—	—	—

Table 3 — Mandatory mechanical properties (*continued*)

Temper	Dimensions (mm)			Mechanical properties					Hardness		
	Diameter or distance across flats	Rectangles		Tensile strength R_m N/mm² min.	Proof stress $R_{p\,0,2}$ N/mm² min.	Elongation			Vickers HV10	Brinell HB	Rockwell HRB
		Thickness	Width			A_5 % min.	A_{10} % min.	A_{50} % min.			
CuAl7Si2											
HB	6 to 18	—	—	520	(270)	15	—	15	min. 160	min. 140	min. 84
	18 to 40	—	—	520	(270)	18	—	18	min. 140	min. 120	min. 75
	Over 40	—	—	520	(240)	20	—	20	min. 130	min. 115	min. 72
CuAl8Fe3											
HB	10 to 80	—	—	470	(200)	25	—	30	min. 120	min. 110	min. 65
CuAl9Mn2											
M	6 to 80	—	—	Without specified properties							
HA	6 to 80	—	—	490	(200)	25	—	25	min. 100	min. 95	min. 65
HB	6 to 50	—	—	590	(250)	15	—	15	min. 135	min. 130	min. 75
CuAl9Ni3Fe2											
M	6 to 50	—	—	490	(180)	22	—	—	—	—	—
CuAl10Fe3											
M	6 to 80	—	—	Without specified properties							
HB	6 to 80	—	—	590	(250)	12	—	15	min. 135	min. 125	min. 75
CuAl10Ni5Fe4											
M	6 to 80	—	—	Without specified properties							
HB	6 to 50	—	—	700	(380)	10	—	12	min. 170	min. 150	min. 85
CuNi30Mn1Fe											
O	min. 6	—	—	max. 400	(120)	35	—	35	max. 120	max. 115	max. 70
HB	6 to 18	—	—	420	(300)	14	—	14	min. 110	min. 105	min. 65
CuNi18Zn19Pb1											
HB	3 to 18	—	—	430	(290)	25	20	25	min. 110	min. 105	min. 55
HC	3 to 10	—	—	530	(420)	6	—	6	min. 140	min. 130	min. 75
CuNi10Zn28Pb1											
HB	3 to 18	—	—	410	(240)	23	18	23	min. 110	min. 105	min. 55
HC	3 to 10	—	—	490	(370)	8	5	8	min. 145	min. 135	min. 75
CuBe2/CuBe2Pb											
TB	6 to 65	—	—	420	(140)	35	—	35	min. 90	—	min. 45
TD	6 to 50	—	—	600	(520)	10	—	10	min. 180	—	min. 90
TF	6 to 65	—	—	1 150	(1 000)	—	—	—	min. 350	—	min. C36
TH	6 to 50	—	—	1 210	(1 030)	—	—	—	min. 360	—	min. C38
CuCo2Be/CuNi2Be											
TB	6 to 65	—	—	240	(140)	20	—	20	min. 70	—	min. 20
TD	6 to 50	—	—	450	(380)	10	—	10	min. 130	—	min. 60
TF	6 to 65	—	—	660	(550)	10	—	10	min. 200	—	min. 90
TH	6 to 50	—	—	740	(650)	8	—	8	min. 220	—	min. 95

Table 3 — Mandatory mechanical properties (*concluded*)

Temper	Dimensions (mm)			Mechanical properties					Hardness		
	Diameter or distance across flats	Rectangles		Tensile strength R_m N/mm² min.	Proof stress $R_{p\,0,2}$ N/mm² min.	Elongation			Vickers HV10	Brinell HB	Rockwell HRB
		Thickness	Width			A_5 % min.	A_{10} % min.	A_{50} % min.			
CuNi1Si											
TD	6 to 30	—	—	410	(290)	9	—	9	min. 110	min. 100	min. 65
TH	6 to 30	—	—	590	(540)	12	—	12	min. 160	min. 150	min. 85
CuNi2Si											
TD	6 to 30	—	—	410	(340)	8	—	8	min. 140	min. 130	min. 80
TH	6 to 30	—	—	640	(590)	10	—	10	min. 170	min. 160	min. 90
CuSi1											
O	6 to 50	6 to 50	6 to 50	280	—	—	—	30	min. 90	—	min. 50
HA	6 to 50	6 to 50	6 to 50	380	—	—	—	17	min. 160	—	min. 84
HB	6 to 50	6 to 12	6 to 50	450	—	—	—	15	min. 170	—	min. 86
HC	6 to 30	6 to 12	6 to 50	520	—	—	—	13	min. 175	—	min. 88
CuSi3Mn1											
O	6 to 50	—	—	max. 490	(100)	40	—	40	max. 120	max. 110	max. 70
HB	6 to 50	—	—	490	(340)	12	—	12	min. 130	min. 120	min. 75