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Wrought copper and copper alloy wire — Technical conditions of delivery

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

Reference number
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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 1638 was prepared by Technical Committee ISO/TC 26, *Copper and copper alloys.*

This second edition cancels and replaces the first edition (ISO 1638 : 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.

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Wrought copper and copper alloy wire — 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 wire, 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 wire 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 rod and bar, see ISO 1637.

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 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 1637, *Wrought copper and copper alloy rod and bar — 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 Technological testing

ISO 7800, *Metallic materials — Wire — Simple torsion test.*

ISO 7801, *Metallic materials — Wire — Reverse bend test.*

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)]

2.6 Dimensional tolerances

ISO 3492, *Wrought copper and copper alloys — Drawn round wire — Tolerances on diameter.*

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);

1) At present at the stage of draft.

c) dimensions, i.e.,

- diameter or distance across flats,
- length or weight of the coil;

d) the tests to be carried out, including those to be agreed upon, for exampie technological tests (see clause 5).

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-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 tensile strength and elongation are generally sufficient to define the condition of the material.

Mechanical properties are given in table 2.

Wire having dimensions outside the given ranges may not comply with the properties given in table 2.

4.2.2 Subject to agreement between the purchaser and the supplier, copper-zinc alloy wire 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 submit it to all the relevant tests.

4.3 Dimensions and tolerances

For drawn round wire, the tolerances specified in ISO 3492 apply.

4.4 Surface quality

The wire 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.

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 wire shall be one test piece per lot for each of the tests referred to in 5.2 to 5.4, as appropriate.

5.2 Tensile testing

The test shall be made in accordance with ISO 6892.

5.3 Technological testing

The technological tests and their requirements shall be agreed upon between supplier and purchaser, for example the reverse bend test according to ISO 7801, the simple torsion test according to ISO 7800.

5.4 Stress corrosion test

If required, the test is only carried out on copper-zinc alloys as listed in table 2.

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 wire from which the failed test piece was originally taken, unless that wire 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, the lot represented by the test pieces shall be deemed not to comply with this International Standard.

Table 2 — Mandatory mechanical properties

Temper	Diameter or distance across flats	Tensile strength R_m N/mm² min.	Elongation		
			A_{200} % min.	A_{100} % min.	A_{50} % min.
Coppers (min. 99,85 % Cu) : Cu-ETP, Cu-FRHC, Cu-OF[1)] **Coppers (min. 97,5 % Cu) : Cu-Ag0,05, Cu-Ag0,1, Cu-Ag0,05(P), Cu-Ag0,1(P)[1)]**					
O	3 to 8	210	30	32	—
	8 to 12	210	32	35	—
HB	3 to 8	290	—	—	—
	8 to 12	270	—	—	—
HD	3 to 8	350	—	—	—
	8 to 12	320	—	—	—
CuZn15					
O	0,1 to 8	260	28	30	—
HA	0,1 to 8	310	—	12	—
HB	0,1 to 8	370	—	—	—
HD	0,1 to 8	460	—	—	—
CuZn20					
O	0,1 to 8	270	35	38	—
HC	0,1 to 8	460	—	—	—
HF	0,1 to 8	590	—	—	—
CuZn30					
O	0,1 to 8	280	35	40	—
HA	0,1 to 8	340	—	20	—
HB	0,1 to 8	460	—	—	—
HC	0,1 to 8	550	—	—	—
CuZn35/CuZn37					
O	0,1 to 8	290	25	30	—
HA	0,5 to 8	370	8	10	—
HB	0,5 to 8	460	—	—	—
HC	0,5 to 8	550	—	—	—
CuZn34Pb2					
HB	0,5 to 12	360	15	15	15
HD	0,5 to 12	440	—	5	5
CuZn37Pb2/CuZn38Pb2					
HA	3 to 12	350	15	15	15
HB	0,5 to 12	400	12	12	12
HC	0,5 to 12	460	7	7	7
CuZn36Pb3					
HB	1 to 12	400	8	8	8
HD	1 to 6	550	—	—	—
	6 to 12	480	—	—	—

1) Wire under 3 mm diameter for electrical application (for example widing wire conductors) will be the subject of a separate International Standard.

Table 2 — Mandatory mechanical properties (*continued*)

Temper	Diameter or distance across flats	Tensile strength R_m N/mm² min.	Elongation		
			A_{200} % min.	A_{100} % min.	A_{50} % min.
CuZn39Pb1					
HB	3 to 12	380	20	20	20
CuZn39Pb3					
HB	3 to 12	430	15	15	15
CuZn38Pb4					
HB	3 to 12	430	12	12	12
CuSn5					
HB	0,5 to 10	550	—	—	—
HD	0,5 to 10	750	—	—	—
HE	0,5 to 3	890	—	—	—
	3 to 6	850	—	—	—
CuSn6					
O	0,5 to 10	350	—	40	—
HA	0,5 to 10	420	—	10	—
HB	0,5 to 10	520	—	—	—
HC	0,5 to 10	650	—	—	—
HD	0,5 to 6	800	—	—	—
CuSn8					
O	0,5 to 10	380	—	45	—
HA	0,5 to 10	470	—	10	—
HB	0,5 to 10	570	—	—	—
HC	0,5 to 10	710	—	—	—
HD	0,5 to 6	850	—	—	—
CuNi18Zn20					
O	0,5 to 8	410	—	23	—
HA	0,5 to 8	500	—	5	—
HB	0,5 to 8	580	—	—	—
HC	0,5 to 8	660	—	—	—
HE	0,5 to 8	770	—	—	—
CuNi12Zn24					
O	0,5 to 8	360	—	25	—
HA	0,5 to 8	450	—	5	—
HB	0,5 to 8	540	—	—	—
HC	0,5 to 8	630	—	—	—
HE	0,5 to 8	740	—	—	—
CuBe1,7					
TB	1 to 12	390	—	—	20
TD	1 to 12	700	—	—	—
TH	1 to 12	1 230	—	—	—

Table 2 — Mandatory mechanical properties (*concluded*)

Temper	Diameter or distance across flats	Tensile strength R_m N/mm² min.	Elongation		
			A_{200} % min.	A_{100} % min.	A_{50} % min.
CuCo2Be/CuNi2Be					
TB	1 to 12	240	—	—	20
TD	1 to 12	450	—	—	8
TF	1 to 12	680	—	—	8
TH	1 to 12	740	—	—	5
CuSi1					
O	1 to 12	260	—	—	40
HA	1 to 12	340	—	—	20
HD	1 to 12	620	—	—	8