International Standard 4738

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Copper drawing stock (wire rod)

Fil-machine en cuivre

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Foreword

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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 4738 was developed by Technical Committee ISO/TC 26, *Copper and copper alloys*, and was circulated to the member bodies in February 1981.

It has been approved by the member bodies of the following countries :

Australia	Finland	Poland
Austria	France	Romania
Belgium	Germany, F. R.	South Africa, Rep. of
Brazil	Hungary	Spain
Canada	India	Sweden
Chile	Iran	Switzerland
China	Japan	Turkey
Cuba	Korea, Dem. P. Rep. of	USA
Czechoslovakia	Netherlands	USSR
Egypt, Arab Rep. of	Norway	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Italy
United Kingdom

Printed in Switzerland

Copper drawing stock (wire rod)

1 Scope and field of application

This International Standard specifies the requirements of refined copper listed in table 1 in the form of drawing stock suitable for further fabrication by cold drawing into wire preferably for electrical conductors. Copper drawing stock according to this International Standard is an intermediate solid wrought product of uniform cross-section along its whole length supplied in coils. The normal cross-section is approximately round with diameters from 6 to 35 mm.

Table 1 — Designation and terms of copper

Designation	Term
Cu-ETP	Electrolytically refined tough pitch copper
Cu-FRHC	Fire-refined high-conductivity copper
Cu-CRTP	Chemically refined tough-pitch copper
Cu-PHC	High conductivity phosphorus-containing copper
Cu-HCP	High conductivity phosphorus-containing copper
Cu-PHCE	High conductivity phosphorus-containing copper (electronic grade)
Cu-OF	Oxygen-free electrolytically refined copper
Cu-OFE	Oxygen-free electrolytically refined copper (electronic grade)
Cu-Ag(OF)	Oxygen-free copper-silver
Cu-Ag	Tough-pitch copper-silver

2 References

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

— *Part 1 : Materials.*[1)]

— *Part 3 : Wrought products.*[2)]

ISO 1190/1, *Copper and copper alloys — Code of designation — Part 1 : Designation of materials.*

ISO 1553, *Unalloyed copper containing not less than 99,90 % of copper — Determination of copper content — Electrolytic method.*

ISO 1811, *Chemical analysis of copper and copper alloys — Sampling of copper refinery shapes.*[3)]

ISO 2626, *Copper — Hydrogen embrittlement test.*

ISO 4746, *Oxygen-free copper — Scale adhesion test.*

ISO 6892, *Mechanical testing of metals — Tensile testing.*[4)]

IEC Publication 28, *International standard of resistance for copper.*

IEC Publication 468, *Method of measurement of resistivity of metallic materials.*

3 Definitions

For the purpose of this International Standard the definitions for refined copper in ISO 197/1 and for drawing stock in ISO 197/3 as well as the principles for the designation of copper in ISO 1190/1 apply.

1) At present at the stage of draft. (Revision of ISO/TR 197/1.)

2) At present at the stage of draft. (Revision of ISO/TR 197/3.)

3) Under revision.

4) At present at the stage of draft. (Revision of ISO/R 402.)

4 Requirements

4.1 Composition and properties

4.1.1 Chemical composition

The chemical composition of refined copper in drawing stock (see table 1) shall conform to the requirements specified in tables 2 and 3.

4.1.2 Tensile properties

The minimum elongation of hot-finished drawing stock in continuous lengths shall be 30 % in 200 mm. For drawing stock which has been cold finished and joined, the elongation requirements shall, if necessary, be agreed between the purchaser and the supplier.

4.1.3 Electrical properties

The electrical properties of refined copper in drawing stock (see table 1) shall conform to the requirements specified in table 2, measured at 20 °C in the annealed temper.

Table 3 — Maximum impurity limits

Values as a percentage by mass

Element \ Copper	Cu-OFE	Cu-PHCE
Arsenic	1)	1)
Antimony	1)	1)
Bismuth	0,001 1)	0,001 1)
Cadmium	0,000 1	0,000 1 1)
Iron	2)	2)
Lead	0,001	0,001
Manganese	1) 2)	1) 2)
Mercury	0,000 1	0,000 1
Nickel	2)	2)
Oxygen	0,001	0,003 3)
Phosphorus	0,000 3	0,003 3)
Selenium	0,001 1)	0,001 1)
Silver	2)	2)
Sulphur	0,001 8	0,001 8
Tellurium	0,001 1)	0,001 1)
Tin	1)	1)
Zinc	0,000 1	0,000 1

1) Total of these seven elements not to exceed 0,004 %.

2) Analysis required. No limit established.

3) Approximate values.

Table 2 — Requirements

Designation 1)	Chemical composition		Electrical properties			
	Copper plus silver % min.	Other elements %	Mandatory value	Equivalent values for guidance only 2)		
			Volume resistivity Ω·mm²/m max.	Mass resistivity Ω·g/m² max.	Conductivity	
					MS/m min.	% IACS min.
Cu-ETP	99,90		0,017 24	0,153 28	58,00	100,0
Cu-FRHC	99,90		0,017 24	0,153 28	58,00	100,0
Cu-CRTP	99,90		0,017 24	0,153 28	58,00	100,0
Cu-HCP	99,95	P 0,001 to 0,005 3)	0,017 56	0,156 14	56,93	98,16
Cu-PHC	99,95	P ~ 0,003	0,017 24	0,153 28	58,00	100,0
Cu-PHCE	99,99 (excl. Ag)	see table 3	0,017 07	0,151 76	58,58	101,0
Cu-OF	99,95		0,017 24	0,153 28	58,00	100,0
Cu-OFE	99,99 (excl. Ag)	see table 3	0,017 07	0,151 76	58,58	101,0
Cu-Ag (OF)	99,95	4)	0,017 24	0,153 28	58,00	100,0
Cu-Ag	99,90	4)	0,017 24	0,153 28	58,00	100,0

1) According to ISO 1190/1.

2) See the annex.

3) When made from an oxygen-free base copper, the oxygen content of HCP copper shall be less than 0,001 %.

4) Specific ranges of silver content between 0,01 and 0,25 % by agreement between the interested parties.