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*भारतीय मानक मसौदा*

**विद्युत अनुप्रयोगों के लिए ताँबे की प्लेट, चादर, पत्ती, और पन्नी — विशिष्टि**

*( आई एस 1897 का चौथा पुनरीक्षण )*

*Draft Indian Standard*

**COPPER PLATE, SHEET, STRIP AND FOIL FOR ELECTRICAL PURPOSES —  
SPECIFICATION**

*( Fourth Revision of IS 1897 )*

ICS 77.150.30

Ores and Feed Stock for Copper Industry, its  
Metals/ Alloys and Products Sectional  
Committee, MTD 08

Last date of comments  
**13 October 2024**

**FOREWORD**

*(Formal foreword clauses will be added later)*

This standard was first published in 1962 and was subsequently revised in 1971, 1983 and 2008. The significant changes in this revision are as follows:

- a) Scope of the standard has been modified to cover copper plate, sheet and foil (*see 1*);
- b) Terminologies for plate, sheet and foil have been added and thickness of strip has been modified (*see 3*);
- c) Clause on condition of supply has been updated (*see 5*);
- d) Table 1 for chemical composition has been added (*see 6*);
- e) Edgewise bending test has been removed; and
- f) Clause on optional test for controlled proof resistance has been removed.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Draft Indian Standard***COPPER PLATE, SHEET, STRIP AND FOIL FOR ELECTRICAL PURPOSES — SPECIFICATION***( Fourth Revision )***1 SCOPE**

This standard specifies the composition, mechanical properties, electrical properties and other requirements of copper plate, sheet, strip and foil for electrical purposes with thickness from 0.025 mm up to and including 25 mm and width from 10 mm up to and including 1 000 mm.

**2 REFERENCES**

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of these standards:

<i>IS No.</i>	<i>Title</i>
IS 191 : 2007	Copper — Specification ( <i>fourth revision</i> )
IS 440 : 1964	Methods of chemical analysis of copper ( <i>revised</i> )
IS 613 : 2000	Copper rods and bars for electrical purposes — Specification ( <i>third revision</i> )
IS 1387 : 1993	General requirements for the supply of metallurgical materials ( <i>second revision</i> )
IS 1501 (Part 1) : 2020 / ISO 6507-1 : 2018	Metallic materials — Vickers hardness test: Part 1 Test method ( <i>fifth revision</i> )
IS 1599 : 2023 / ISO 7438 : 2020	Metallic materials — Bend test ( <i>fifth revision</i> )
IS 1608 (Part 1) : 2022 / ISO 6892-1 : 2019	Metallic materials — Tensile testing Part 1 Method of test at room temperature ( <i>fifth revision</i> )
IS 3052 : 1986	Dimensions and tolerances for wrought copper and copper alloys sheet, strip and foil (for general engineering purposes) ( <i>second revision</i> )
IS 3288	Glossary of terms relating to copper and copper alloys
(Part 1) : 1986	Materials ( <i>third revision</i> )
(Part 3) : 1986	Wrought forms
IS 3635 : 1966	Methods of test for resistance of metallic electrical resistance material

### 3 TERMINOLOGY

For the purpose of this standard, the definition given in IS 3288 (Parts 1 and 3) and the following shall apply.

**3.1 Foil** — Flat Product of thickness up to and including 0.10 mm of any width generally not cut to length; usually in coil form but may also be in flat or folded form.

**3.2 Plate** — Flat Product over 6 mm thick, and over 300 mm wide.

**3.3 Sheet** — Flat product, of exact length over 0.10 mm thick and up to and including 6 mm thick and over 300 mm wide. It may be supplied flat or folded or in coiled form.

**3.4 Strip** — Flat product over 0.10 mm thick and up to and including 6 mm thick, of any width and generally not cut to length; usually in coil, but may be flat or folded.

### 4 SUPPLY OF MATERIAL

The general requirements relating to the supply of material shall conform to IS 1387.

### 5 CONDITION OF SUPPLY

The material shall be supplied in one of the following conditions, as specified by the purchase:

- a) M — As manufacture
- b) O — Annealed (Soft)
- c) HA — Quarter hard
- d) HB — Half-hard
- e) HC — Hard
- f) HD — Spring hard.

NOTE — A, B, C and D represent various stages of strain hardening. The designations are in alphabetical order and in ascending order of tensile strength.

### 6 CHEMICAL COMPOSITION

The materials when analysed as per IS 440 or any other established instrumental (spectrometer)/ chemical method shall conform to the requirements of Grades as given in Table 1. In case of dispute, the procedure given in IS 440 shall be the referee method. However, when the method is not given in IS 440 the referee method shall be as agreed to between the purchaser and the manufacture.

**Table 1 Composition of Copper Plate, Sheet, Strip and Foil**

(Clause 6)

Grades	Composition in Percent (Mass Fraction)						
	Cu <i>Min</i>	Ag	Bi <i>Max</i>	O <i>Max</i>	P	Pb <i>Max</i>	Total of all elements <i>Max</i>
Cu-ETP	99.90 <sup>1)</sup>	—	0.0005	0.040 <sup>2)</sup>	—	0.005	0.03(excluding Ag, O)

Grades	Composition in Percent (Mass Fraction)						
	Cu <i>Min</i>	Ag	Bi <i>Max</i>	O <i>Max</i>	P	Pb <i>Max</i>	Total of all elements <i>Max</i>
Cu-FRHC	99.90 <sup>1)</sup>	—	—	0.040 <sup>2)</sup>	—	—	0.06 <sup>4)</sup> (excluding Ag, O)
Cu-OF	99.95 <sup>1)</sup>	—	0.0005	— <sup>3)</sup>	—	0.005	0.03(excluding Ag)
CuAg 0,10	Rem.	0.08 to 0.12	0.0005	0.040	—	—	0.03(excluding Ag, O)
CuAg 0,10P	Rem.	0.08 to 0.12	0.0005	— <sup>3)</sup>	0.001 to 0.007	—	0.03(excluding Ag, P)
CuAg0,10(OF)	Rem.	0.08 to 0.12	0.0005	— <sup>3)</sup>	—	—	0.0065(excluding Ag, O)
Cu-PHC	99.95 <sup>1)</sup>	—	0.0005	— <sup>3)</sup>	0.001 to 0.006	0.005	0.03(excluding Ag, P)
Cu-HCP	99.95 <sup>1)</sup>	—	0.0005	— <sup>3)</sup>	0.002 to 0.007	0.005	0.03(excluding Ag, P)

NOTE — The total of all elements (than copper) is defined as sum of Ag, As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, P, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any mentioned elements.

<sup>1)</sup> Including Ag, up to maximum of 0.015 percent.  
<sup>2)</sup> Oxygen content up to 0.06 percent is permitted, subject to agreement between the purchaser and the supplier.  
<sup>3)</sup> The oxygen content shall be such that the material confirms to the hydrogen embrittlement requirements of ISO 2626.  
<sup>4)</sup> Higher total impurity content is permissible subject to agreement between the purchaser and the supplier.

## 7 FREEDOM FROM DEFECTS

The material shall be clean, bright, smooth and free from harmful defects. Foil, Sheet and Strips not supplied in coils shall be reasonably flat and free from twists.

## 8 MECHANICAL PROPERTIES

8.1 The material when tested in accordance with IS 1608 (Part 1) and IS 1501 (Part 1) shall have the mechanical properties as given in Table 2.

**Table 2 Mechanical Properties of Plate, Sheet, Strip and Foil**

(Clause 8.1)

Sl No.	Temper	Thickness,		Tensile strength		Elongation Percent on 50 mm Gauge Length, <i>Min</i>	Hardness, HV
		mm		MPa			
		Over	Upto and Including	Min	Max		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	O	0.10	1.8	200	250	25	40 to 65
		1.8	6	200	250	35	40 to 65
ii)	HA	0.10	1.8	220	275	15	60 to 75

Sl No.	Temper	Thickness, mm		Tensile strength MPa		Elongation Percent on 50 mm Gauge Length, <i>Min</i>	Hardness, HV
		Over	Upto and Including	Min	Max		
		1.8	6	220	275	30	60 to 75
iii)	HB	0.10	1.8	245	290	8	75 to 90
		1.8	6	245	290	10	75 to 90
iv)	HC	0.10	1.8	290	360	2	90 to 110
		1.8	6	290	360	5	90 to 110
v)	HD	0.10	2	345	—	—	110 <i>Min</i>
vi)	M	6	—	—	—	—	—

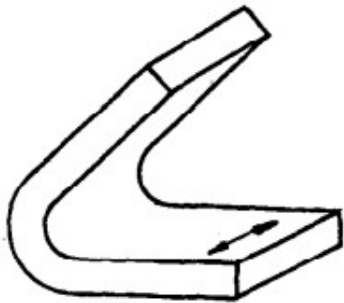
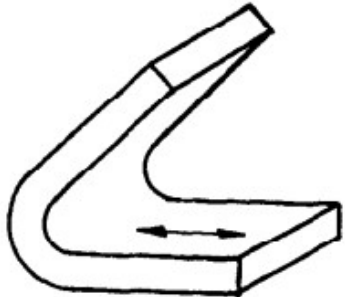
NOTE — For thickness less than 0.1 mm and greater than 6 mm the mechanical properties shall be agreed between the purchaser and the supplier.

## 8.2 Bend Test

The material is to be tested for bend test in accordance with IS 1599. The test piece shall not fracture or crack on the convex surface of the bend portion, when bent once through the angle and bend radius as specified in Table 3.

**Table 3 Bend Test**

(Clause 8.2)

Thickness	Condition	Transverse Bend Test		Longitudinal Bend Test	
					
	Upto and Including 6 mm	Angle	Radius	Angle	Radius
	O	180°	Close	180°	Close
	HB	180°	Close	180°	Close
	HD	90°	Close	90°	Close

## 9 ELECTRICAL RESISTIVITY TEST

The electrical resistivity of the strip shall be measured in accordance with IS 3635 and shall conform to the values given in Table 4.

The electrical resistivity shall be determined by direct measurement either at  $20\text{ }^{\circ}\text{C} \pm 1\text{ }^{\circ}\text{C}$  or at any other temperature, when the result shall be corrected to the equivalent value at  $20\text{ }^{\circ}\text{C}$ , on the product in the as delivered condition.

**Table 4 Electrical Properties (at  $20\text{ }^{\circ}\text{C}$ )**

(Clause 9)

Descriptions		Volume resistivity	Mass resistivity <sup>1)</sup>	Conductivity	
Grades	Temper	$\frac{\Omega \times \text{mm}^2}{\text{m}}$	$\frac{\Omega \times \text{g}}{\text{m}^2}$	MS/m	percent IACS <sup>2)</sup>
		<i>Max</i>	<i>Max</i>	<i>Min</i>	<i>Min</i>
Cu-ETP	M	0.017 54	0.155 9	57.0	98.3
Cu-FRHC	O	0.017 24	0.153 3	58.0	100.0
Cu-OF	HA				
CuAg0,10	HB	0.017 54	0.155 9	57.0	98.3
CuAg0,10 (OF)	HC				
Cu-PHC	HD	0.017 86	0.158 8	56.0	96.6
CuAg0,10P Cu-HCP	M	0.017 86	0.158 8	56.0	96.6
	O	0.017 54	0.155 9	57.0	98.3
	HA				
	HB	0.017 86	0.158 8	56.0	96.6
	HC				
HD	0.018 18	0.161 6	55.0	94.8	

NOTES

**1** The percent IACS values are calculated as percentages of the standard value for annealed high conductivity copper as laid down by the International Electrotechnical Commission. Copper having a volume resistivity of  $0.017\ 24\ \mu\Omega\text{m}$  at  $20\text{ }^{\circ}\text{C}$ , is defined as corresponding to a conductivity of 100 percent.

**2** The constant for converting the resistance at standard temperature of  $20\text{ }^{\circ}\text{C}$  to any other temperature and vice-versa is provided in Annex A.

**3**  $1\ \text{MS/m}$  is equivalent to  $1\ \text{m}/(\Omega \times \text{mm}^2)$ .

<sup>1)</sup> Calculated with a density of copper  $8.89\ \text{g/cm}^3$ .

<sup>2)</sup> IACS: International Annealed Copper Standard.

## 10 DIMENSIONS AND TOLERANCES

**10.1** The strip shall be supplied in dimensions specified in IS 3052 subject to the tolerance specified in the same standard.

**10.2** The strip shall have corners or edges either radiused or square. In the former case, the radius of curvature shall be in accordance with Table 5, unless otherwise stated.

### 10.3 Straightness

The tolerances on straightness and/or edgewise curvature shall not vary from a straight line by more than 3 mm in any 1 000 mm length.

**Table 5 Radius on Edges or Corner of Strip**

(Clause 10.2)

All dimensions in millimetres.

Sl No.	Thickness of Strip		Nominal Radius on Edges	Tolerances
	Over	Up to and Including		
(1)	(2)	(3)	(4)	(5)
i)	—	1.0	Semicircular	± 0.06
ii)	1.0	1.6	0.6	+ 0.15 - 1.10
iii)	1.6	2.25	0.8	± 0.15
iv)	2.25	3.55	1.0	± 0.20
v)	3.55	—	1.25	± 0.25

## 11 SAMPLING AND CRITERIA FOR CONFORMITY

**11.1** Unless otherwise agreed to between the purchaser and the manufacturer, the following sampling procedure and criteria for conformity shall apply.

### 11.2 Lot

In a consignment the copper strips of the same width and thickness, and of the same temper shall be grouped together to form a lot not exceeding 2 000 kg. One or more lots may be formed from the material submitted for inspection depending on the weight. Each lot shall be separately sampled for acceptance purposes.

### 11.3 Visual and Dimensional Requirements

The material shall be individually examined for freedom from defects and dimensional tolerance. At least one sample or coil from each bundle shall be selected for dimensional inspection. No failure shall occur if the lot is to be accepted under this clause.

### 11.4 Chemical Composition and Mechanical Properties Requirements

From each lot, one sample at the rate of 2 000 kg or part thereof for chemical test and one sample at the rate of 500 kg or part thereof shall be tested for mechanical properties requirements of this standard. The sample shall be cut-off cold and shall receive no further treatment (except that they may be machined to the shape of the test piece) before being tested. The lot shall be accepted under this clause if the samples tested meet all the chemical composition and mechanical properties requirements of the specification.

### 11.5 Electrical Resistivity Test

For this test at least one sample for each bundle or from 500 kg or single coil weight, whichever is higher shall be taken from different boxes or crates or bundles as the case may be and shall be individually subjected to electrical resistivity test. The samples shall meet the requirements if the lot is to be accepted under this clause.

## **12 RETEST**

**12.1** If a test result of chemical analysis fails to satisfy the requirements for any element, two more tests for that element, shall be done on the sample in order to confirm that the analysis has been done properly. If both the test results satisfy the relevant requirements, the lot shall be considered conforming to the specification, otherwise not.

**12.2** Should anyone of the test pieces first selected fail to pass the mechanical tests, two further samples from the same batch shall be selected for testing one of which shall be from the strip from which original test sample was taken, unless that strip has been withdrawn by the supplier.

**12.2.1** Should the test pieces from both additional samples pass, the batch represents the test sample shall be deemed to comply with standard. Should the test pieces from either of additional sample fail, the batch represented test sample shall be deemed not to comply with standard.

## **13 PACKING**

The strip shall be packed in bundles, boxes, crates so as to ensure safe transportation of material.

## **14 MARKING**

**14.1** Each package shall be marked with the grade and temper of the material, name of the manufacturer, the mass, size, lot number, date of manufacturing any other information required by the purchaser.

### **14.2 BIS Certification Marking**

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.