

## भारतीय मानक ब्यूरो

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*भारतीय मानक मसौदा*

## तांबा मिश्रधातु सिल्लियां और ढलाई — विशिष्टि

*(आईएस 28 का पाँचवा पुनरीक्षण)*

*Draft Indian Standard*

## Copper Alloy Ingots and Castings — Specification

*(Fifth Revision of IS 28)*

ICS 77.120.30

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

Last date of comment:  
20/11/2023

### FOREWORD

*(Formal clauses will be added later)*

This standard was originally published in 1950 and subsequently revised in 1958, 1969, 1975 and 1985. This revision has been brought out to formulate a standard for Copper alloy ingots and castings by merging IS 292, IS 304, IS 305, IS 306, IS 318, IS 1028 and IS 11109 into IS 28. It also incorporates one amendment issued to the last version of the standard.

In this revision, following modifications have been made:

- A new clause on references has been incorporated.
- Clause for chemical composition has been updated by merging chemical composition table containing grades of different copper alloys in respective Indian Standards;
- Clauses on mechanical properties, size, shape and mass has also been updated;
- Clauses on sampling and criteria for conformity have been modified;
- Marking clause has been updated to the latest version.

In preparation of this standard, the sectional committee kept in view the manufacturing and trade practices being followed in the country in this field.

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 Alloy Ingots and Castings — Specification**  
**(*Fifth Revision*)**

## **1 SCOPE**

This standard covers the requirements of different grades of copper alloy ingots and castings.

## **2 REFERENCES**

The following standards 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 agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

<i>IS No.</i>	<i>Title</i>
IS 1387 : 1993	General requirements for the supply of metallurgical materials ( <i>second revision</i> )
IS 1408 : 1968	Recommended procedure for inspection of copper-base alloy sand castings ( <i>first 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 1817 : 1961	Methods of sampling non-ferrous metals for chemical analysis
IS 3288 (Part 2) : 1986	Glossary of terms relating to copper and copper alloys: Part 2 Unwrought and cast form
IS 3685 : 1966	Methods of chemical analysis of brasses
IS 4027 (All parts)	Methods of chemical analysis of bronzes

## **3 TERMINOLOGY**

**3.1** For the purpose of this standard, the following definitions, as given in IS 3288 (Part 2), shall apply.

### **3.2 Ingot**

A cast product in a form suitable for remelting primarily for the production of copper and copper alloys.

### **3.3 Casting**

A general term for products at or near net shape, formed by solidification of a molten metal or alloy in a mould.

#### **4 SUPPLY OF MATERIAL**

General requirements relating to the supply of material shall be as laid down in IS 1387.

#### **5 CHEMICAL COMPOSITION**

**5.1** The material shall have the chemical composition as given in Table 1.

**5.2** The chemical composition shall be determined either by the method specified in IS 4027 (relevant parts) and IS 3685 or any other established instrumental/chemical method. In case of dispute the procedure specified in IS 4027 and IS 3685 for chemical analysis shall be the referee method.

**Table 1 Chemical Composition**  
( *Clause 5.1* )

Grades			Constituent (Percent)													
			Copper	Sn	P	Pb	Zn	Ni	Fe	Al	Sb	Si	Mn	Mg	Bi	Remarks
Copper Zinc alloys (Brasses)																
Leaded brass ingots and castings	LCB 1	Ingots	70.0-77.0	1.0-3.0	—	2.0-5.0	Remainder	—	0.50 <i>Max</i>	0.01 <i>Max</i>	—	—	—	—	—	—
		Castings	70.0-80.0	1.0-3.0	—	2.0-5.0	Remainder	—	0.75 <i>Max</i>	0.01 <i>Max</i>	—	—	—	—	—	—
	LCB 2	Ingots	63.0-67.0	1.50 <i>Max</i>	—	1.0-3.0	Remainder	—	0.50 <i>Max</i>	0.01 <i>Max</i>	—	—	—	—	—	—
		Castings	63.0-70.00	1.50 <i>Max</i>	—	1.0-3.0	Remainder	—	0.75 <i>Max</i>	0.01 <i>Max</i>	—	—	—	—	—	—
High tensile brass ingots and castings	HTB 1		55 <i>Min</i>	1.0 <i>Max</i>	—	0.50 <i>Max</i>	Remainder	—	0.7-2.0	0.5-2.5	—	0.10 <i>Max</i>	3.0 <i>Max</i>	—	—	Total of other elements < 0.2
	HTB 2		55 <i>Min</i>	0.20 <i>Max</i>	—	0.20 <i>Max</i>	Remainder	—	1.5-3.25	3.0-6.0	—	0.10 <i>Max</i>	4.0 <i>Max</i>	—	—	Total of other elements < 0.2
Silicon brass ingots and castings	Grade 1	Ingots	79.0 <i>Min</i>	—	—	0.50 <i>Max</i>	12.5-16.0	—	0.30 <i>Max</i>	0.50 <i>Max</i>	—	3.2-5.0	—	—	—	Total other impurities < 0.50
		Castings	79.0 <i>Min</i>	—	—	0.50 <i>Max</i>	12.0-16.0	—	0.30 <i>Max</i>	0.50 <i>Max</i>		3.0-5.0	—	—	—	Total other impurities < 0.50
	Grade 2	Ingots	88.0 <i>Min</i>	—	—	0.50 <i>Max</i>	4.5-7.0	—	0.30 <i>Max</i>	—	—	3.7-5.5	—	—	—	Total other impurities < 0.50
		Castings	88.0 <i>Min</i>	—	—	0.50 <i>Max</i>	4.0-7.0	—	0.30 <i>Max</i>	—	—	3.5-5.5	—	—	—	Total other impurities < 0.50
	Grade 3	Ingots	80-83	—	—	0.40 <i>Max</i>	Remainder	—	0.30 <i>Max</i>	0.05 <i>Max</i>	—	4.1-4.7	—	—	—	Total other impurities < 0.50
		Castings	80-83	—	—	0.40 <i>Max</i>	Remainder	—	0.30 <i>Max</i>	0.05 <i>Max</i>	—	3.9-4.7	—	—	—	Total other impurities < 0.50
Other copper alloys (Bronzes)																
Phosphor bronze ingots and castings	Grade 1		Remainder	6.0-8.0	0.30-0.50	0.25 <i>Max</i>	0.50 <i>Max</i>	0.70 <i>Max</i>	0.30 <i>Max</i>	0.01 <i>Max</i>	0.10 <i>Max</i>	0.02 <i>Max</i>	—	—	—	Total impurities (Zn, Ni,Fe, Al, Sb, Si)should not be greater than 1.2
	Grade 2		Remainder	10.0 <i>Min</i>	0.50 <i>Min</i>	0.25 <i>Max</i>	0.05 <i>Max</i>	0.10 <i>Max</i>	0.10 <i>Max</i>	0.01 <i>Max</i>	—	0.02 <i>Max</i>	—	—	—	Total impurities (Pb, Zn, Ni,Fe, Al, Si)should not be greater than 0.6
	Grade 3		Remainder	6.5-8.5	0.30 <i>Min</i>	2.0-5.0	2.0 <i>Max</i>	1.0 <i>Max</i>	—	—	—	—	—	—	—	Total impurities should not be greater than 0.5
	Grade 4		Remainder	9.0-11.0	0.15 <i>Max</i>	0.25 <i>Max</i>	0.05 <i>Max</i>	0.25 <i>Max</i>	—	—	—	—	—	—	—	Total impurities (P, Pb, Zn, Ni)should not be greater than 0.8
	Grade 5		Remainder	11.0-13.1	0.15 <i>Min</i>	0.50 <i>Max</i>	0.30 <i>Max</i>	0.50 <i>Max</i>	0.15 <i>Max</i>	0.01 <i>Max</i>	—	0.02 <i>Max</i>	—	—	—	Total impurities should not be greater than 0.2

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Aluminium bronze ingots and castings	Grade AB 1		Remainder	0.10 <i>Max</i>	—	0.05 <i>Max</i>	0.50 <i>Max</i>	1.0 <i>Max</i>	1.5 to 3.5	8.5 to 10.5	—	0.25 <i>Max</i>	1.0 <i>Max</i>	0.05 <i>Max</i>	—	Total of Sn, Pb, Si and Mg < 0.30
	Grade AB 2		Remainder	0.10 <i>Max</i>	—	0.05 <i>Max</i>	0.50 <i>Max</i>	4.0-5.5	4.0 to 5.5	8.8 to 10.0	—	0.10 <i>Max</i>	1.5 <i>Max</i>	0.05 <i>Max</i>	—	Total of Sn, Pb, Si and Mg < 0.30
Tin bronze ingots and castings	Grade SnB	Ingots	Remainder	9.5-10.5	—	1.5 <i>Max</i>	1.75-3.25	1.0 <i>Max</i>	0.15 <i>Max</i>	0.01 <i>Max</i>	—	0.02 <i>Max</i>	—	—	0.03 <i>Max</i>	Total impurities, (includes Fe, Al, As, Sb, Si, Bi) < 0.50
		Castings	Remainder	9.5-10.5	—	1.5 <i>Max</i>	1.5-3.0	1.0 <i>Max</i>	0.15 <i>Max</i>	0.01 <i>Max</i>	—	0.02 <i>Max</i>	—	—	0.03 <i>Max</i>	Total impurities, (includes Fe, Al, As, Sb, Si, Bi) < 0.50
Silicon bronze ingots and castings	Grade SiB		89.0 <i>Min</i>	1.0 <i>Max</i>	—	0.5 <i>Max</i>	5.0 <i>Max</i>	—	2.5 <i>Max</i>	1.5 <i>Max</i>	—	1.0-5.0	1.5 <i>Max</i>	—	—	—
Leaded tin bronze ingots and castings	LTB 1		Remainder	6.0-8.0	—	2.5-3.5	1.5-3.0	2.0 <i>Max</i>	0.30 <i>Max</i>	0.01 <i>Max</i>	0.3 <i>Max</i>	0.01 <i>Max</i>	—	—	—	Total of all impurities < 0.70 (excluding Ni)
	LTB 2		Remainder	4.0-6.0	—	4.0-6.0	4.0-6.0	2.0 <i>Max</i>	0.35 <i>Max</i>	0.01 <i>Max</i>	0.4 <i>Max</i>	0.02 <i>Max</i>	—	—	—	Total of all impurities < 0.80 (excluding Ni)
	LTB 3		Remainder	6.0-8.0	—	9.0-11.0	0.75 <i>Max</i>	2.0 <i>Max</i>	0.35 <i>Max</i>	0.01 <i>Max</i>	0.5 <i>Max</i>	0.02 <i>Max</i>	—	—	—	Total of all impurities < 0.80 (excluding Ni + Zn)
	LTB 4		Remainder	6.0-8.0	—	14.0-16.0	0.75 <i>Max</i>	2.0 <i>Max</i>	0.35 <i>Max</i>	—	0.5 <i>Max</i>	0.02 <i>Max</i>	—	—	—	Total of all impurities < 0.80 (excluding Ni + Zn)
	LTB 5		Remainder	9.0-11.0	—	8.5-11.0	1.0 <i>Max</i>	2.0 <i>Max</i>	0.35 <i>Max</i>	0.01 <i>Max</i>	0.5 <i>Max</i>	0.02 <i>Max</i>	—	—	—	Total of all impurities < 0.80 (excluding Ni + Zn)
	LTB 6		Remainder	4.0-6.0	—	18.0-23.0	1.0 <i>Max</i>	2.0 <i>Max</i>	0.35 <i>Max</i>	—	0.5 <i>Max</i>	0.01 <i>Max</i>	—	—	—	Total of all impurities < 0.80 (excluding Ni + Zn)

## 6 MECHANICAL PROPERTIES

### 6.1 Tensile Test

The castings, when tested in accordance with IS 1608 (Part 1), shall have the tensile properties as given in Table 2.

Table 2 Mechanical Properties of Castings ( Clause 6.1 )					
DESCRIPTION			TENSILE STRENGTH MPa	ELONGATION PERCENT ON GAUGE LENGTH OF $5.65 \sqrt{A}$	*0.2 PERCENT, PROOF STRESS, MPa
			Min	Min	Min
Copper Zinc alloys (Brasses)					
High tensile brass ingots and castings	HTB 1	Sand cast (separately cast)	470	18	170
		Chill cast	500	18	210
	HTB 2	Sand cast (separately cast)	740	11	400
		Chill cast	—	—	—
Silicon brass ingots and castings	Grade 1	Sand cast (separately cast)	414	16	165
	Grade 2	Sand cast (separately cast)	414	16	207
	Grade 3	Sand cast (separately cast)	390	25	175
Other copper alloys (Bronzes)					
Phosphor bronze ingots and castings	Grade 1	Sand cast	190	3	—
		Chill cast	205	5	—
		Continuously cast	275	8	—
	Grade 2	Sand cast	220	3	—
		Chill cast	310	2	—
		Continuously cast	360	7	—

	Grade 3	Sand cast	190	3	—
		Chill cast	220	2	—
		Continuously cast	270	5	—
	Grade 4	Sand cast	230	6	—
		Chill cast	270	5	—
		Continuously cast	310	9	—
	Grade 5	Sand cast	220	5	—
		Chill cast	270	3	—
		Continuously cast	310	5	—
Aluminium bronze ingots and castings	Grade AB 1	Sand cast (separately cast)	500	18	170
		+Chill cast	540	18	200
	Grade AB 2	Sand cast (separately cast)	640	13	250
		+Chill cast	650	13	250
Tin bronze ingots and castings	Grade SnB	Sand casting (separately cast)	210	3	120
		Chill casting (separately cast)	260	13	120
Silicon bronze ingots and castings	Grade SiB		310	20	—
Leaded tin bronze ingots and castings	LTB 1	Sand cast (separately cast)	250	16.0	130
		Chill cast	250	5.0	130
	LTB 2	Sand cast (separately cast)	190	13.0	100
		Chill cast	190	6.0	100
	LTB 3	Sand cast (separately cast)	175	4.0	75
		Chill cast	200	3.0	75
	LTB 4	Sand cast	160	4.0	70



		(separately cast)			
		Chill cast	190	3.0	70
	LTB 5	Sand cast (separately cast)	190	5.0	80
		Chill cast	220	3.0	140
	LTB 6	Sand cast (separately cast)	140	5.0	60
		Chill cast	150	5.0	60
+Chill cast test specimen is applicable for ingots when they are required for chill casting purposes.					

## **7 PRESSURE TEST**

If the purchaser required castings to be tested for pressure, this shall be stated with enquiry and order. The number of tests, the nature of the test, test pressure and the testing fluid shall be subjected to agreement between the supplier and the purchaser.

## **8 FREEDOM FROM DEFECTS**

### **8.1 Ingots**

The ingots shall be of uniform quality and reasonably free from slag, dross and other harmful contaminations.

### **8.2 Castings**

Castings shall be clean, and free from harmful defects, such as blow holes, gas cavities etc. Castings shall not be repaired unless permission in writing has been obtained previously from the purchaser or his representative. Any casting may be subsequently rejected for faults in manufacture revealed by machining operation notwithstanding that it has passed previously for chemical and mechanical properties.

## **9 SAMPLING AND CRITERIA FOR CONFORMITY**

**9.1** Unless otherwise agreed between the purchaser and the supplier, the following sampling procedure and criteria for conformity shall hold good.

### **9.2 Lot**

In any consignment, ingots/castings of the same grade and same shape (*see* Table 1) manufactured at the same place under similar condition shall be grouped together to constitute a lot.

### **9.3 Sampling for Chemical Analysis**

One sample shall be taken and analysed from each cast of 1000 kg or part thereof of the ingots/castings. However, in case more frequent chemical analysis is required, the same shall be agreed

to between the supplier and the purchaser. The sampling for chemical analysis shall be taken by drilling or sawing in such a manner as to be representative of the entire cross-section. Drillings and sawings from ingots/castings shall be obtained in accordance with the appropriate procedure specified in IS 1817.

**9.3.1** If the test results of chemical analysis as obtained for each of the constituent satisfy the corresponding requirements, the lot shall be considered as conforming to the chemical requirement of the specification.

#### **9.4 Sampling for Mechanical Properties**

Three test bars shall be separately cast along with the castings for tensile strength for every 1000 kg or part thereof of the casting. These test bars shall be cast to shape in accordance with 4.3.1 and Appendix B of IS 1408. These test bars shall be of suitable size for turning them to the standard dimensions of the test piece as laid down in IS 1608 (Part 1).

**9.4.1** Out of three test bars, one bar shall be tested for mechanical test for every 1000 kg or part thereof of ingots/castings. If the test results satisfy the requirements of mechanical properties, the lot shall be considered as conforming to the mechanical properties.

#### **9.5 Retest**

**9.5.1** If the sample drawn for chemical analysis fails to meet the requirements stipulated in the standard, two more tests shall be conducted on the same 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 accepted; and if either of the retest fails, the lot represented shall be deemed as not complying with the standard.

**9.5.2** Should a test piece fail to meet the tensile test requirements specified in the standard, two further test pieces which represent the same cast may be tested in the same manner. If one of the further test pieces meet the requirements of the tensile test, the ingots or castings represented thereby shall be deemed to comply with the standard, otherwise the lot shall be rejected.

### **10 PACKING**

Castings shall be suitably packed to prevent corrosion and damage during transit. Machined surfaces shall be properly protected with anticorrosive compounds.

### **11 MARKING**

**11.1** The name or trade-mark of the manufacturer and the cast number and grade of the material shall be cast or otherwise legibly marked by stamping on each ingot or casting, by which the manufacturer and the grade of the material may be identified. In the case of small castings where it is difficult to cast on or stamp all the details, the marking shall be as agreed to between the purchaser and the supplier.

#### **11.2 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.

## **12 TEST CERTIFICATE**

The supplier shall provide test certificate for each consignment giving information like cast number, relevant chemical composition and mechanical test results.

## **13 INFORMATION TO BE GIVEN BY THE PURCHASER**

The standard contains a number of clauses in which the purchaser is allowed to exercise an option. The list of information to be given by the purchaser in respect to these clauses is given in Appendix A.

**APPENDIX A**

*(Clause 13)*

**INFORMATION TO BE GIVEN BY THE PURCHASER**

**A-1** The alloy grade required.

**A-2** Whether information is required concerning the works analysis.

**A-3** Detailed drawings of castings.

**A-4** In case of ingots whether purchaser prefers any special size, shape and mass of the ingots.

**A-5** Preparation of test piece for tensile testing.

**A-6** Marking Details.