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मानक

IS 6912 (2005): Copper and copper alloy forging stock and forgings [MTD 8: Copper and Copper Alloys]



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### IS 6912:2005

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Indian Standard COPPER AND COPPER ALLOYS FORGING STOCK AND FORGING — SPECIFICATION (Second Revision)

ICS 77.120.30

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BUREAU OF INDIAN STANDARDS MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG NEW DELHI 110002

**Price Group 3** 

#### FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Copper and Copper Alloys Sectional Committee had been approved by the Metallurgical Engineering Division Council.

This standard was first published in 1973. In the first revision in 1988 forging stock was also included and accordingly title of the standard has been changed. In this revision, following modifications have been made:

- a) A new grade leaded manganese brass --- FMnB has been included, for the manufacture of L.P.G valves.
- b) Additional grades FHTB3, FHTB4 and FHDB5 are included for automobile industries.
- c) Chemical composition and mechanical properties of certain alloys have been modified.
- d) Dimensional tolerances to forging stock has been specified.

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 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

# Indian Standard COPPER AND COPPER ALLOYS FORGING STOCK AND FORGING — SPECIFICATION

### (Second Revision)

#### **1 SCOPE**

This standard specifies requirements for chemical composition, mechanical properties and other characteristics for wrought or cast copper and alloy forging stock and for forgings of these materials.

#### **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 agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
440 : 1964	Methods of chemical analysis of copper ( <i>revised</i> )
<b>1387</b> : 1993	General requirements for the supply of metallurgical materials (second revision)
1608 : 1995	Mechanical testing of metals — Tensile testing (second revision)
2305 : 1988	Method of mercurous nitrate test for copper and copper alloys ( <i>first revision</i> )
2826 : 1986	Dimensions and tolerances for copper and copper alloy, rods and bars for general engineering purposes (third revision)
3187 : 1965	Methods of chemical analysis of copper-nickel zinc alloys
3288 (Part 1) : 1986	Glossary of terms relating to copper and copper alloys: Part 1 Materials ( <i>third revision</i> )
3685 : 1966	Methods of chemical analysis of brasses
4027 : 1967	Methods of chemical analysis of bronzes

#### **3 TERMINOLOGY**

For the purpose of this standard the following definitions as given in IS 3288 (Part 1) shall apply.

3.1 Forging Stock — Extruded rolled, drawn or cast

material intended for the production of forgings usually in the form of rod/bar/hollow rods and sections.

**3.2 Forging** — A shape produced by hammering or pressing, when hot, between open or closed dies. The term forging includes the process of forging, drop forging, hot stamping and hot pressing.

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

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

#### **5 CONDITION OF DELIVERY**

5.1 Wrought forging stock may be supplied in one of the following conditions as specified by the purchaser:

- a) Hot worked, and
- b) Cold worked.

5.2 Unless otherwise specified by the purchaser, forging produced in all materials shall be supplied in the as manufactured (M) condition.

#### **6 FREEDOM FROM DEFECTS**

The forging stock and forging shall be sound and free from laps, cracks or other harmful defects.

#### 7 DIMENSIONS AND TOLERANCES

7.1 The tolerance on sizes of bars/rods of copper and brass shall be as per IS 2826 unless otherwise specified and agreed to between the purchaser and the manufacturer.

7.1.1 The tolerance on sizes of bars and rods of aluminium bronzes shall be as per Table 1 unless otherwise specified and agreed to between the purchasers and the manufacturer.

7.1.2 The tolerance for the hollow rods and sections of copper, brasses and bronzes shall be agreed to between the purchaser and the manufacturer and shall be stated in the order.

#### 7.2 Forgings

The forgings shall be made to dimensions specified on the drawing which forms a part of each contract or order subject to the tolerances agreed to between the purchaser and the manufacturer. The forgings shall be capable of being machined to the finished dimensions, if this requirement is set out in the drawing or order.

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#### **8 CHEMICAL COMPOSITION**

8.1 The chemical composition of the forging stock and forgings shall be as given for the appropriate material in Tables 2 to 4.

**8.2** The chemical composition shall be determined either by the method specified in IS 440, IS 3685, IS 4027 and IS 3187 for copper, brasses, bronzes and copper-nickel zinc alloys respectively or any other established instrumental/chemical method. In case of dispute the procedure specified in IS 440, IS 4027 and IS 3187 shall be the referee method.

#### **9 MECHANICAL PROPERTIES**

The tensile test shall be carried out in accordance with IS 1608. The test piece shall be machined from test samples selected in accordance with 12. The tensile properties of the forging stock and forgings shall comply with the appropriate requirements given in Tables 2 to 4.

#### **10 FORGEABILITY TEST**

10.1 The forge ability test shall be applicable to the forging stock.

10.1.1 A longitudinal test piece having a length equal to the diameter or width across flat of rods, bars and sections selected in accordance with 12 when gradually heated to red hot placed on end and compressed to 20 percent of its original length shall not show any sign of fracture or cracks on the free surface.

## 11 MERCUROUS NITRATE TEST (FOR FORGINGS)

When required by the purchaser, forgings made out of brasses and bronzes may be subjected to mercurous nitrate test as per IS 2305. One forging per batch of forging in accordance 12.1.2 should be tested for above test.

#### 12 SAMPLING

12.1 Material shall be grouped in batches as follows. One sample each for chemical analysis and mechanical test shall be selected from each batch or remaining part of a batch to provide the necessary test pieces. The test pieces shall be prepared as per 13.

#### 12.1.1 For Forging Stock

Specij (Diamete Across Flat	fied Size er or Width s) of Material 人	Mass of Batch
Over	Up to and Including	
mm	mm	kg
(1)	(2)	(3)
6	12	250
12	40	500
40	80	1 000
80	-	2 000

#### 12.1.2 For Forgings

Mass of Forging	Individual s in Batch	Mass of Batch
Over	Up to and Including	
kg	kg	kg
(1)	(2)	(3)
	0.5	250
0.5	2	500
2	10	1 000
10	-	2 000

Table 1	Dimensional	<b>Tolerance</b> for	<b>Bronze Rods</b>

(Clause 7.1.1)

Si No.		Size	Round Rods	Hexazonal Rods	Square Rods
	Over	Up to and Including			
	mm	mm	mm	mm	mm
(1)	(2)	(3)	(4)	(5)	(6)
i)	6	10	±0.10	- 0.15	±0.12
ii)	10	20	±0.15	- 0.25	±0.20
iii)	20	30	±0.20	- 0.35	±0.25
iv)	30	50	±0.30	- 0.40	±0.35
v)	50	80	±0.60	- 0.75	±0.65
vi)	80 and	l above	±1.0%	- 1.5 %	±1.25%

NOTE — When the size of the order does not permit of batching in above quantities, the frequency of testing shall be as agreed to between the purchaser and the supplier.

#### **13 PREPARATION OF TEST SAMPLES**

#### 13.1 Forging Stock

13.1.1 Test pieces selected in accordance with 12.1 shall be prepared as follows.

#### 13.1.2 Hot Worked Material

Test pieces shall be taken directly from the material or hot forged to cross-section approximately twothird of the original cross-section before testing.

#### 13.1.3 Cold Worked Material

Test piece shall either be annealed at a temperature not less than 500°C for 30 min or be hot forged to cross-section two-third of the original cross-section before testing.

#### 13.1.4 Cast Material

Test piece shall either be annealed at a temperature not less than 500°C for 30 min or be hot forged to cross-section two-third of the original cross-section before testing.

13.1.5 For test samples of diameter or width across flats greater than 28 mm, the longitudinal axis of the test piece shall be 14 mm from the outside of the test material.

#### 13.2 Forgings

13.2.1 Tensile test shall be done either on a test samples of the forging stock from which the forgings have been made or on the actual finished forgings, if these are of sufficient size. In practice, the tensile test is normally carried out on the forging stock from which the forgings are manufactured.

#### **14 RE-TEST**

14.1 If any of the test pieces first selected fail in any of the prescribed test, two further samples from the same batch be selected for testing one of which shall be from the forging stock or forging from which the original test sample was taken. Unless the forging stock or forging has been withdrawn by the suppliers.

14.1.1 If the test pieces from both these additional samples pass, the batch represented by the test samples shall be deemed to comply with this standard. In case the test piece from either of these additional samples fail, the batch represented by the test samples shall be deemed not to comply with this standard.

#### **15 MARKING**

15.1 Unless otherwise agreed to between the purchaser and the supplier, each forging shall be clearly marked with the manufacturer's name or trade-mark and identification mark, if any.

#### 15.2 BIS Certification Marking

15.2.1 The material may be marked with the Standard Mark.

15.2.2 The use of Standard Mark is governed by the provision of the *Bureau of Indian Standards Act*, 1986 and the Rules and Regulations made thereunder. The details of the conditions under which the licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

#### **16 TEST CERTIFICATE**

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

lair	Desig- nation				·	Chemical	Compos	ition Const	titucat, Per	cent				Mechan for F	ical Pro orging S I Forging	perties tock
		5	Sn	£	Fe	ż	2	) \$	<b>e</b> .	З	Ę	ian Ling	Total	Tensile Strength MPa	Proof Proof Stress	Percent Elonga- tion at Cauge Length
		Min		Max								Max	Max	Min	Mîn	Mîn
	(3)	(4)	(2)	(9)	6	(8)	(6)	(01)	(11)	(12)	(13)	(14)	(15)	(16)	(17) (17)	(18)
•	ETP	99.90 (including silver)	1	0.005	i	I	Ŧ	1	I	ļ	I	0.001 0	0.03 (excluding O <sub>2</sub> and Ag)	210	ł	4
٤ ۵	FRHC	99.90 (including silver)	1	0.005	i	I	I	I	I	ł	ł	0.002 5	0.04 (excluding O <sub>2</sub> and Ag)	210	I	4
ST 12	DPA	99.20 (including silver)	0.1 Max	0.010	0.030 Max	0.15 Max	0.20-	0.1 Max	0.02- 0.10	ł	0.020 Max	0:003 0	0.06 (excluding Ag, As, Ni and Pe)	215	ł	35

Table 2 Chemical Composition and Mechanical Properties of Copper

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 Table 3 Chemical Composition and Mechanical Properties of Brasses

 (Clauses 8.1 and 9)

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								(Lines)	20.1 4	16 m									1
₿. <mark>%</mark>	Material	Designatic	2			Che	mical Con	nposition	Constitue	ent, Percei	at				Ŵ	cchanical for Forgi	Propertie ng Stock	*	
			ł					$\langle \rangle$						I		and Fo	ngings A		
			JJ	£	5	Ę	R	ž	Ż	<del>ت</del>	ð	ප	Zn	Total Imp.	Tensile Strength MPa	0.2 Percent Proof Stress MPa	Percent Elonga- tion at Gauge Length S,65/S	Hard- ness HRB	De 5 De E
Ξ	ß	(3)	(4)	(2)	(9)	ε	(8)	(6)	(01)	(11)	(12)	(13)	(14)	Max (15)	Mîn (16)	Min (11)	Min (18)	<b>Min</b> (19)	<b>Min</b> (20)
-	Leaded Brass	819	56.5 60.0	0.6- 2.0	1	0:30	1	1	1	1	1	ŧ	Bal	0.75 (excl Fe)	310	ı	52	1	1
â	Leaded Mn Brass	FMnB	56.5 60	1.0	I	0.3	I	0.5- 1.20	I	1	I	1	le mainder	0.75 (excl Fe)	395	I	20	1	220
(III	Naval Brass	ENB	61.0 64.0	0.20	1.0	0.10	I	ı	ı	I	I .	1	Ba	0.50 (excl Fe+Pb)	340	t	15	1	1
iv)	H.T.Brass (Soldering Quality)	FHTBI	56.0 60.0	0.5 1.5	0.6 1.1	0.3 1.25	0.2	0.5- 2.0	I	i	ı	I	Bai	0.50	430	180	15	I	220
\$	H.T.Brass II	FHTB2	<b>56</b> .0 <b>6</b> 1.0	0.5 1.5	0.2 0.8	0.3 1.25	0.3 2.0	0.5- 2.0	1	ı	I	I	Bal	0.50	460	180	12	1	i.
vi)	H.T.Brass III	FHTB3	56.5 60.0	0.2 0.8	0.3	0.2 1.0	1.4 2.0	1.6- 2.2	1.0 0.20	0.5- 1.0	t .	1	Bal	0.50 ( excl Nickel)	009	325	10	85	I
vii)	H.T.Brass IV	FHTB4	60.0 63.0	0.15	0.15	0.50	2.5- 3.5	2.5- 3.5	0.2- 0.5	0.75- 1.25	0.1- 0.3	1	Bai	0.75	575	300	10	<b>8</b> 5	4
viii)	H.T.Brass V	FHTBS	59.0 62.0	0.10	0.10	0.30- 1.00	3.50 4.50	0.15	2.0- 3.0	0.75- 1.25	1	0.50 1.50	Bal	0.75	635	400	7	95	ł
(x)	Nickel Silver	ENS	44.0 48.0	1.0- 2.5	1	0.30	I	0.20 0.30	9.0- 11.0	ı	ł	١	Bal	0.50 (excl Fe)	460	I	90	ł	ł
Z	IOTE — All sin	ngle limits an	maximun	n unless oth	crwise stated														

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		(		-	_				
	7	kg/n		МîМ	(38)	4.0	5.0	2.7	22
	Propertie ing Stock rigings	Percent Elonga- tion at	S.65/3 MPa	Min	(11)	30	30	50	12
	fechanical for Forgi and Fo	Percent Proof	MPa	Mîn	(16)	175	190	215	310
		Tensile Strength		Mîn	(15)	485	460	520	630
		Total Imp. Percent		Max	(14)	0.5 (excl Iron, Nickel and Manganese)	0.50, <i>Max</i> (excl Manganese and Zinc)	0.50, Max (excl Manganese)	0.50, <i>Max</i> (excl Manganese)
		Mg		Max	(13)	0.05	0.05	0.05	0.05
		Si			(12)	1.5- 2.0	0.15 Max	0.10 Max	0.10 Max
1	Percent	5	-	Max	(11)	0.50	0.40	0.40	0.40
(Clauses 8.1 and 9)	nstituent, l	£		Мах	(10)	0.05	0.05	0.05	0.05
	Chemical Composition Co	N.		Max	6)	0.20	0.10	0.10	0.10
		чW		Max	(8)	0.10	0.50	0.50	0.50
		ż		Max	ε	0.25	0.50	1	4-6.0
		포			(9)	0.30 Max	2-3.5	4.0% (Fe + Ni )	4-6.0
		2			(3)	6.5 <b>-</b> 7.0	6.5- 8.0	8.5- 10	8.5- 11
		ç			(4)	Remainder	Remainder	Remainder	Remainder
	Desig- nation				(3)	FAB	FABI	FAB2	FAB3
	Material				ଅ	Al.Si Bronze	7% AI, Bronze	9% Al, Bronze	10% Al, Bronze
	N S				Ξ	6	Ē	(ii	iv)

Table 4 Chemical Composition and Mechanical Properties of Bronzes

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#### Amendments Issued Since Publication

Amend No	D. Date of Issue	Text Affected
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