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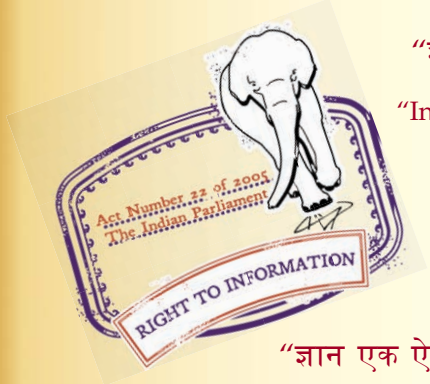
IS 1458 (1965): Railway bronze ingots and casting [MTD 8: Copper and Copper Alloys]



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Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS : 1458 - 1965
(Reaffirmed 1996)

REAFFIRMED
2006

Indian Standard
SPECIFICATION FOR RAILWAY BRONZE INGOTS AND CASTINGS
(Revised)

Sixth Reprint MARCH 1997
(Incorporating Amendments No. 1, 2, 3 and 4)

UDC 669.35.6 - 412

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

Gr 4

January 1966

Indian Standard

SPECIFICATION FOR RAILWAY BRONZE INGOTS AND CASTINGS

(Revised)

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Indian Standard

SPECIFICATION FOR RAILWAY BRONZE INGOTS AND CASTINGS

(Revised)

0. FOREWORD

0.1 This Indian Standard (Revised) was adopted by the Indian Standards Institution on 1 October 1965, after the draft finalized by the Copper and Copper Alloys Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 This standard specifies the requirements for railway bronze ingots and sand castings under five classifications based on the use to which the material is put.

0.3 In view of some of the special requirements of bronze ingots and castings not being exactly met by IS : 28-1958*, IS : 306-1951† and IS : 318-1952‡, the necessity was felt that there should be a separate standard for covering the requirements of bronze ingots and castings used by the railways. Accordingly this standard was first published in 1959.

0.4 In this revision the main changes introduced are as follows:

a) Amendment No. 1 is incorporated which deals with relaxation of tin content up to 7 percent *Max* in the production of class V ingots

b) In Table 1 chemical composition, residual antimony contents are increased to 0·4 percent in cases of class III and class IV Bronze and the iron plus antimony contents restricted to 0·6 percent in cases of classes I, II and V and 0·7 percent in cases of classes III and IV bronzes.

c) Shape of class III ingots is changed to suit their easy production.

d) Provisions are included in regard to sampling and criteria for conformity based on statistical principles.

e) Information to be given by the purchaser is also included.

f) Reference is given to IS : 2654-1964§ in place of IS : 497-1953‖ which has been withdrawn.

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*Phosphor bronze ingots and castings (*revised*). (Since revised).
†Tin bronze ingots and castings (*tentative*). (Since revised).
‡Leaded tin bronze ingots and castings (*tentative*). (Since revised).
§Method of tensile test for copper and copper alloys.
‖Tensile testing of metals (*non-ferrous*).

0.5 It may be noted that IRS Specification No. N 6-49 ' Bronze castings ' covered only the requirements of bronze castings, whereas this Indian Standard has been enlarged to cover requirements of bronze ingots also.

0.6 In the preparation of this standard, the Sectional Committee kept in view the manufacturing and trade practices followed in the country in this field. Furthermore, due consideration was also given to the need for international co-ordination among standards prevailing in different countries of the world. These considerations led the Sectional Committee to derive assistance from the following standards:

JIS H 5111 Bronze casting. Japanese Industrial Standards Committee.

JIS H 5113 Phosphor bronze casting. Japanese Industrial Standards Committee.

B.S. 1400 : 1948 Copper alloy ingots and castings. British Standards Institution.

ASTM Designation : B 61-52 Steam or valve bronze castings. American Society for Testing and Materials.

ASTM Designation : B 62-52 Composition brass or ounce metal castings. American Society for Testing and Materials.

ASTM Designation : B 66-52 Bronze castings in the rough for locomotive wearing parts. American Society for Testing and Materials.

ASTM Designation : B 67-52 Car and tender journal bearings, lined. American Society for Testing and Materials.

ASTM Designation : B 143-52 Tin bronze and leaded tin-bronze sand castings. American Society for Testing and Materials.

ASTM Designation : B 144-52 High-leaded tin-bronze sand castings. American Society for Testing and Materials.

INDIA. MINISTRY OF RAILWAYS, IRS N 6-49 Bronze castings.

0.7 This revised standard contains clauses **3.1, 4.1, 6.4, 8.2, 9.1** and **10** in which the purchaser is allowed to exercise an option. The list of information to be given by the purchaser in respect of these clauses is given in Appendix A.

0.8 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*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard covers the requirements of the following five classes of

*Rules for rounding off numerical values (*revised*).

bronze ingots and sand castings which are mostly used in Indian Railways:

a) Phosphor bronze	Class I
b) Gunmetal	Class II
c) Leaded bronze (78-7-15)	Class III
d) Leaded bronze (83-7-10)	Class IV
e) Leaded gunmetal (85-5-5-5)	Class V

2. TERMINOLOGY

2.0 For the purpose of this revised standard, the following definition shall apply.

2.1 Melt — The quantity of metal melted in a crucible or a furnace at one time and cast into ingots or castings.

3. CLASSIFICATION

3.1 For general guidance, the typical purposes for which these various classes of bronzes are usually employed are as shown below:

Class of Bronze	*Typical Purpose*
Class I	Castings for heavily loaded details subjected to friction for which a durable non-ferrous metal is required and with which anti-friction metal is not employed, such as locomotive slide valves, oil-lubricated side rod and motion bushes, steel axle-box side and boss liners, pony pivot bushes, bogie centre plates, oil-lubricated connecting rod, small end bushes slippers for bridge girders, etc.
Class II	Castings for boiler mountings and steam and water pressure fittings, such as injector starting valve body, fusible plugs, relief valve, drifting valve body, whistle valve body, steam stand, stuffing box, and also castings for which a high grade non-ferrous metal is required and with which (when subjected to friction) anti-friction metal may be employed, such as locomotive oil-lubricated non-ferrous axle-boxes, oil-lubricated steel axle-box crown bearings, oil-lubricated connecting rod large end bearings, tender bearings.
Class III	Castings for locomotive grease-lubricated non-ferrous axle-boxes, grease-lubricated side rod and motion bushes, etc.
Class IV	Castings for locomotive grease-lubricated connecting rod bearings, grease-lubricated side rod and motion bushes, etc.

Class V General castings required for fair strength, soundness and good machining properties, such as carriage and wagon bearing shells.

3.2 Normally, the class of bronze that is to be employed in the manufacture of a casting shall be shown in the drawing supplied by the purchaser. Wherever such reference has not been given, the supplier shall obtain the correct class of bronze, to be used in the manufacture of the castings, in writing, from the purchaser.

4. GENERAL REQUIREMENTS FOR THE SUPPLY OF MATERIAL

4.1 The general requirements relating to the supply of material are laid down in IS : 1387-1959*.

5. CHEMICAL COMPOSITION

5.1 The material, when analysed in accordance with IS : 441-1955†, shall have the chemical composition as given in Table 1.

TABLE 1 CHEMICAL COMPOSITION

Constituent	Percent				
	Class I	Class II	Class III	Class IV	Class V
Tin	6·0 to 8·0	5·0 to 7·0	6·0 to 8·0	6·0 to 8·0	4·0 to 6·0*
Lead	0·5 *Max*	1·0 to 3·0	14·0 to 16·0	9·0 to 11·0	4·0 to 6·0
Zinc	0·5 *Max*	2·0 to 3·0	0·5 *Max*	0·5 *Max*	4·0 to 6·0
Phosphorus	0·4 to 0·6	0·05 *Max*	0·05 *Max*	0·05 *Max*	0·05 *Max*
Iron, *Max*	0·3	0·3	0·3	0·3	0·3
Antimony, *Max*	0·1	0·1	0·4	0·4	0·3
Iron and antimony, *Max*	—	—	0·5	0·5	0·5
Aluminium, *Max*	0·01	0·01	0·01	0·01	0·01
Total of other elements including iron and antimony, *Max*	0·6	0·6	0·7	0·7	0·6
Copper plus incidental nickel	Balance	Balance	Balance	Balance	Balance

*For the purpose of utilizing scrap containing a high percentage of tin, it shall be permissible for the supplier to supply ingots containing tin up to a maximum of 7·0 percent.

5.2 The manufacturer shall, when required, supply free of charge a copy of his works analysis of the material.

Note — The works analysis is defined as the routine analysis carried out by the manufacturer in order to control the quality of material.

*General requirements for the supply of metals and metal products. (Since revised).

†Methods of chemical analysis of brasses and bronzes. (Since withdrawn and superseded by IS : 4027-1967 Methods of chemical analysis of bronzes.)

6. PHYSICAL PROPERTIES

6.0 General — The material shall satisfy the following physical requirements. There shall be no physical test so far as bronze ingots are concerned except for fracture test (*see* **6.3**).

6.1 Tensile Test — The material, when tested in accordance with IS : 2654-1964* shall have the tensile properties given in Table 2.

TABLE 2 PHYSICAL PROPERTIES

Sl No.	Mode of Casting of Test Pieces	Property and Unit	Class I	Class II	Class III	Class IV	Class V
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Sand Cast (Cast-On)	Tensile strength, *Min*, kgf/mm²	19·00	20·00	14·00	16·00	19·00
		Elongation percent, *Min*	3	8	2	2	8
		Brinell hardness HB, *Min*	60	—	—	—	—
ii)	Sand Cast (Separately Cast)	Tensile strength, *Min* kgf/mm²	21·00	22·00	16·00	18·00	21·00
		Elongation percent, *Min*	5	12	4	4	12
		Brinell hardness HB, *Min*	65	—	—	—	—

6.1.1 Should a tensile test piece break outside the middle third of its gauge length and the elongation percentage obtained is lower than the minimum specified, the test may, at the option of the manufacturer, be discarded and another test made.

6.2 Hardness — The Brinell hardness number, when determined by applying a load of 1 000 kg for 10 seconds and using a ball of 10 mm diameter, in accordance with IS : 3054-1965† be as given in Table 2.

6.3 Fracture Test — The sample of casting (*see* **B-5**) shall be broken in the presence of the purchaser in such a manner that the area of fracture is as large as practicable in order to determine the uniformity of the grain structure of the metal. If the fracture shows segregation or dross or dirt spots, or any other defects, all castings produced from the same melt shall be rejected.

*Tensile testing of copper and copper alloys.

†Method for Brinell hardness test for copper and copper alloys.

6.3.1 The ingot samples selected as specified in **B-5** shall be broken at the notch to find the nature of fracture. The fracture shall not show segregation, dross, dirt spots or overheated metal.

6.4 Pressure Test — Class II castings (wherever specified in the drawing or in the contract) or assembled component parts of valves, flanges or fittings thereof, shall conform to such requirements of pressure test as may be prescribed by mutual agreement between the supplier and the purchaser.

6.4.1 Such pressure castings shall not be plugged, welded, burned in or impregnated.

7. FREEDOM FROM DEFECTS

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

7.2 The castings shall be clean, sound and free from blow holes, flaws and shrinkage cracks.

7.2.1 The casting shall not be repaired, plugged, impregnated, welded or 'burned in', unless permission has been obtained in writing from the purchaser.

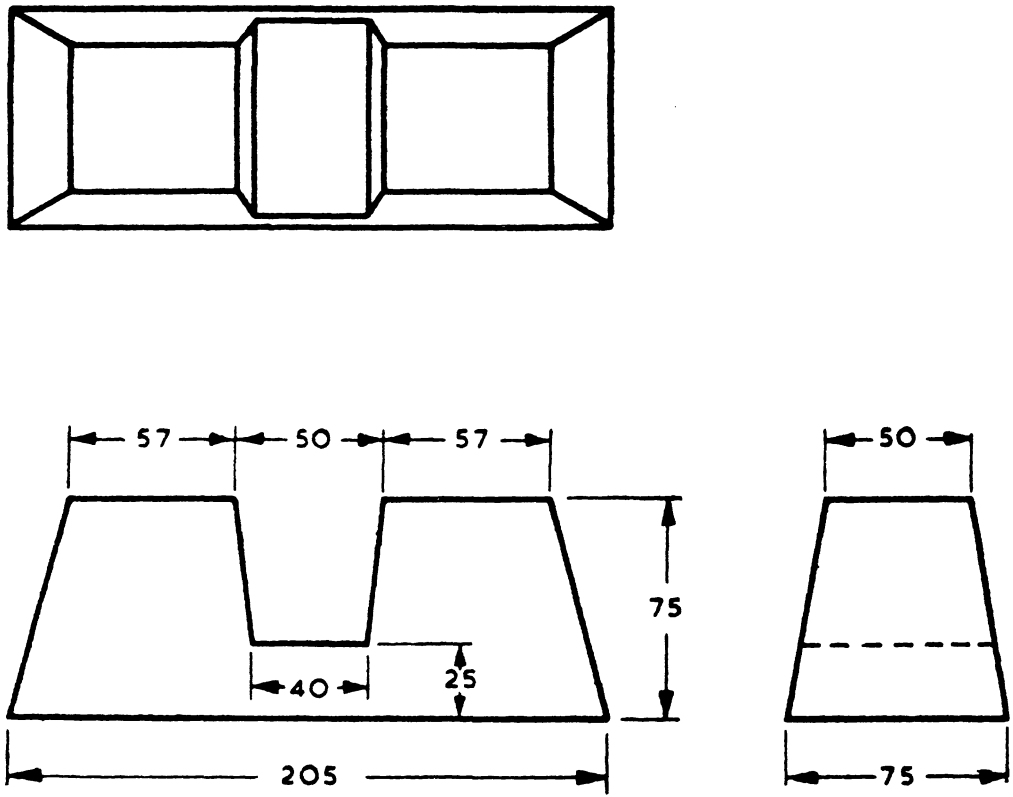
8. SIZE, SHAPE AND WEIGHT

8.1 Unless otherwise specified, ingots shall be of the size, shape and weight as shown in Fig. 1 to 5.

8.2 The dimensions of the castings shall be in accordance with the drawings supplied by the purchaser. All surfaces marked for machining shall have sufficient allowance for that purpose but it shall not be too excessive resulting in more machining and unnecessary increase in the weight of the casting. For those surfaces which are not to be machined and unless otherwise specified in the contract, the sectional thickness shall not exceed by more than five percent of the specified thickness or two millimetres, whichever is more.

9. MARKING

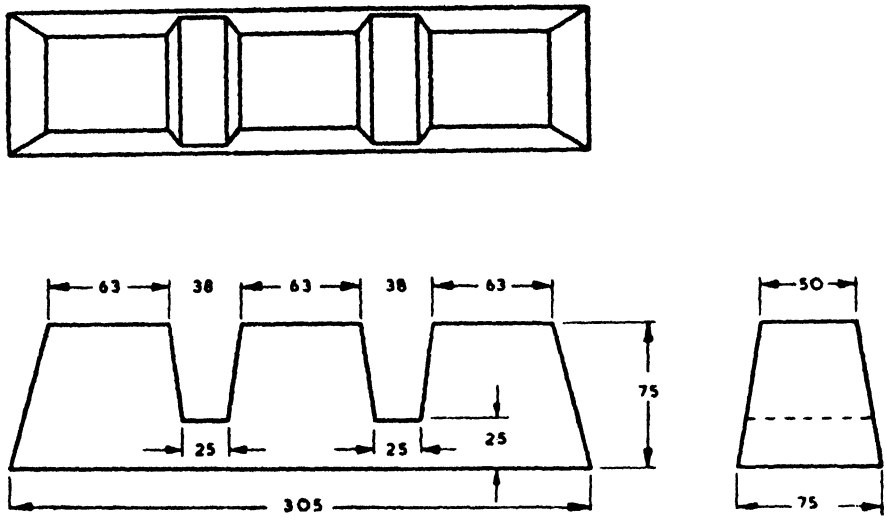
9.1 The name, initials or trade-mark of the manufacturer and the cast number and grade of the material shall be cast or otherwise legibly marked by stamping on each ingot or casting, by which the manufacturer and the grade of the material may be identified. In the case of small castings where it is difficult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



(Weight 6 kg with a tolerance of ± 15 percent in weight)

All dimensions in millimetres.

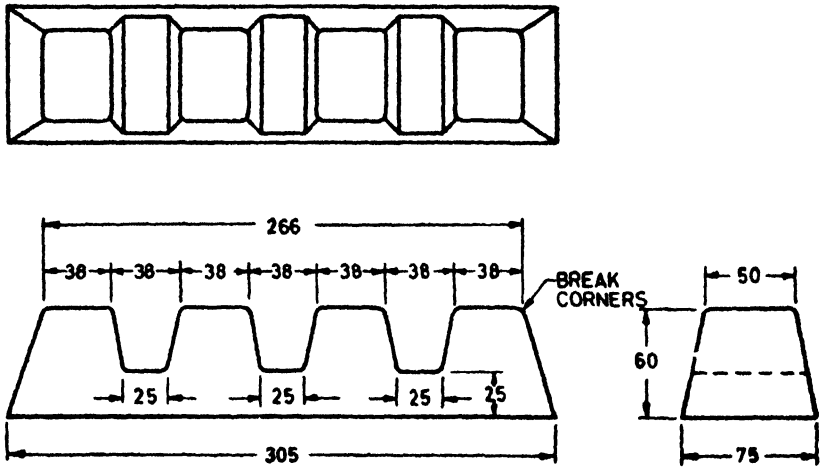
FIG. 1 BRONZE INGOTS, CLASS I



(Weight 9 kg with a tolerance of ± 15 percent in weight)

All dimensions in millimetres.

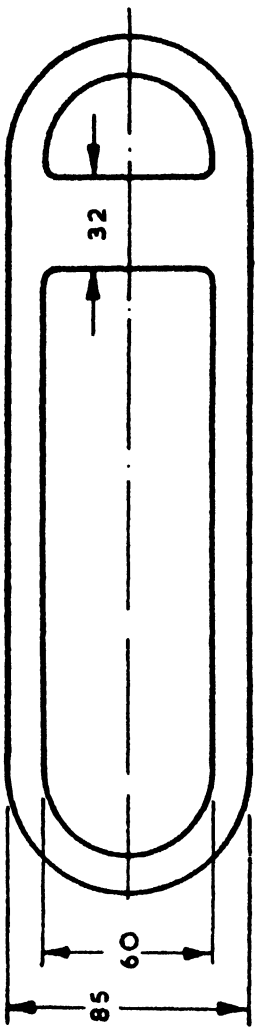
FIG. 2 BRONZE INGOTS, CLASS II

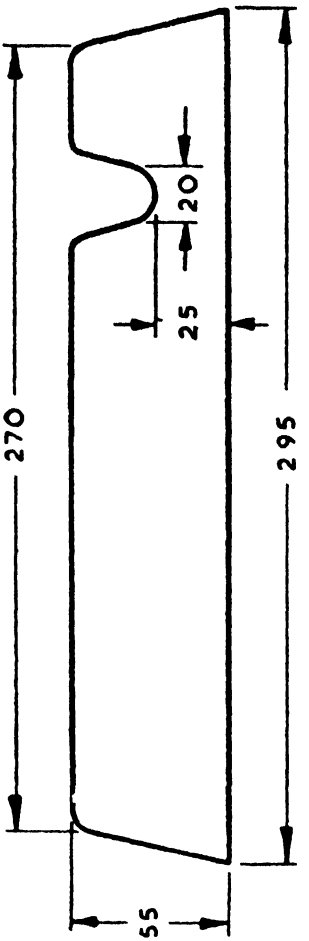


(Weight 8 kg with a tolerance of ± 15 percent in weight)

All dimensions in millimetres.

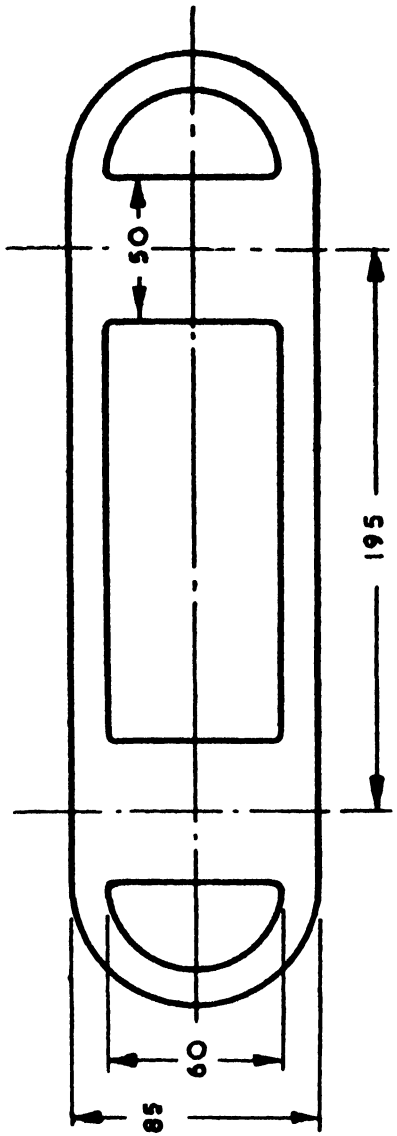
FIG. 3 BRONZE INGOTS, CLASS III





(Weight 8 kg with a tolerance of ± 15 percent in weight)
All dimensions in millimetres.

FIG. 4 BRONZE INGOTS, CLASS IV



(Weight 10 kg with a tolerance of ± 15 percent in weight)
All dimensions in millimetres.

FIG. 5 BRONZE INGOTS, CLASS V

9.1.1 The material may also be marked with the Standard Mark.

NOTE — The use of the Standard Mark is governed by the provisions of the Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

10. SAMPLING AND CRITERIA FOR CONFORMITY

10.1 The method of drawing representative samples of the material and the criteria for conformity shall be as prescribed in Appendix B.

APPENDIX A

(*Clause* 0.7)

INFORMATION TO BE GIVEN BY THE PURCHASER

A-1. The following information shall be given by the purchaser:

a) Classifications of ingots and castings (*see* **3.1**).

b) General requirements relating to supply of materials (*see* **4.1** and IS : 1387-1959*).

c) Chemical composition (*see* Table 1).

d) Pressure test (*see* **6.4**).

e) Dimensional drawings for castings (*see* **8.2**).

f) Marking details (*see* **9.1**).

g) Sampling and criteria for conformity (*see* **10**).

APPENDIX B

(*Clause* 10.1)

SAMPLING AND CRITERIA FOR CONFORMITY

B-1. SAMPLING

B-1.1 Lot — In any consignment all the ingots/castings of the same class and manufactured at the same place shall be grouped together to constitute a lot.

*General requirements for the supply of metals and metal products. (Since revised).

B-2. FREEDOM FROM DEFECTS AND SIZE

B-2.1 The number of ingots/castings to be inspected from a lot for freedom from defects (*see* **7**) and size, shape and weight (*see* **8**) shall be in accordance with cols 1 and 2 of Table 3 given below. The lot shall be considered as conforming to the requirements of this specification if the number of defectives (those failing to satisfy the requirements of **7** or **8**) is less than or equal to the permissible number given in col 3 of Table 3.

TABLE 3 NUMBER OF INGOTS/CASTINGS TO BE INSPECTED AND PERMISSIBLE NUMBER OF DEFECTIVES

No. of Ingots/ Castings in the Lot	No. of Ingots/ Castings to be Inspected	Permissible No. of Defectives*
(1)	(2)	(3)
Up to 50	all	†
51 „ 150	50	1
151 „ 300	80	2
301 „ 500	125	3
501 and above	200	5

*This ensures that lots containing only one percent defective ingots/castings or less will be accepted most of the times.

†The defectives encountered shall be removed and only the remaining ingots/castings shall be accepted.

B-2.1.1 In the case of those lots which have been found unsatisfactory according to **B-2.1**, all the ingots/castings may be inspected for freedom from defects and size, shape and weight subject to agreement between the supplier and the purchaser.

B-3. CHEMICAL COMPOSITION

B-3.1 In the case of ingots, one sample for chemical analysis shall be drawn from each melt and shall be obtained from the drillings or sawings from a minimum of 3 ingots selected at random from the melt. In the case of castings obtained from pre-analysed ingots weighing less than 10 kg, one sample for chemical analysis shall be drawn for every 100 castings or part thereof. For the castings weighing more than 10 kg but less than 100 kg, one test for chemical analysis shall be done for every 50 castings or part thereof. These samples for chemical analysis may be obtained from test bars on sufficient number of castings so as to make it representative of the batch. Heavy castings like axle boxes weighing more than 100 kg each shall be tested individually for chemical analysis by means of cast on test bar. The cast on samples shall be separated only in the presence of the purchaser. The ingots or test bars from castings so selected shall be drilled or sawn right through the section. The drill or saw used for taking the samples

shall be thoroughly clean and no lubricant shall be used in the operation. The drillings or sawings shall be treated with a magnet to remove any ferrous particles introduced while taking the sample. The drillings or sawings after being thoroughly mixed constitute the sample for chemical analysis.

B-3.1.1 When there is only one sample representing the lot for chemical analysis the lot shall be considered as conforming to the chemical requirements of this specification, if the result of testing that sample for each of the chemical characteristics satisfies the corresponding requirement specified in Table 1. If the test result fails to satisfy the requirements for any of the characteristics, two more tests for that characteristic shall be done on the same sample in order to confirm that the analysis has been done properly. If both of the test results satisfy the relevant requirements given in Table 1, the lot shall be considered as conforming to the chemical requirements of this specification; otherwise not.

B-3.1.1.1 When there are more than one sample representing a lot for chemical analysis, the lot shall be considered as conforming to the chemical requirements of this specification if the mean and the range calculated from the test results for each of the chemical characteristics satisfy the conditions given below:

a) (Mean + 0·6 Range) shall be less than or equal to the corresponding maximum specification limit.

b) (Mean — 0·6 Range) shall be greater than or equal to the corresponding minimum specification limit.

NOTE — Mean is obtained by dividing the sum of the test results by the number of test results. Range is the difference between the maximum and minimum values of test results.

B-4. SAMPLING FOR PHYSICAL PROPERTIES

B-4.1 Tensile Test — In the case of castings weighing less than 10 kg each, one test for tensile properties shall be done for every 1 000 kg or part thereof. In the case of castings weighing more than 10 kg but less than 100 kg each, one test for tensile properties shall be done for every 5 000 kg or part thereof. In both these cases three test bars (that is, one test block) cast to shape in accordance with IS : 1408-1959* shall be separately cast in the presence of the inspector. In the case of castings weighing more than 100 kg, each casting shall be provided with a cast on test bar, the shape of the test bar being in accordance with IS : 1408-1959*.

B-4.1.1 The cast on test bars shall be separated only in the presence of the purchaser. The cast-on as well as separately cast test bars shall not be given any kind of heat-treatment. When test bars are separately cast they shall be cast in moulds of the same material as used for the casting they represent.

*Recommended procedure for inspection of copper-base alloy sand castings. (Since revised).

B-4.2 Hardness Test — The hardness test shall be carried out on one percent of castings or part thereof. For this purpose, either extra casting shall be provided by the manufacturer at his own expense or a test couple coupon of identical thickness as of the average thickness of the castings shall be left over on at least 10 percent of the castings of each melt, from which the purchaser shall draw the samples at random.

B-4.3 Criteria for Conformity — When only one test is to be done on a lot for tensile and/or hardness requirements, the lot shall be considered as conforming to the requirements of this specification, if the result so obtained satisfies the corresponding requirements specified in Table 1. If the sample fails in regard to either of the requirements, then the two additional test bars from the same block shall be tested in the case of castings weighing less than 100 kg in order to confirm that the test has been done properly. If both of these test results satisfy the relevant requirements given in Table 1, the lot shall be considered as conforming to the requirements of this specification; otherwise not. In the case of castings weighing more than 100 kg each, the failure of the 'cast-on test bar' in the physical properties shall entail the rejection of the casting without any further testing.

B-4.3.1 When there are more than one test bars representing a lot for physical properties, the lot shall be considered as conforming to the requirements of this specification if the mean and the range calculated from the test results for each of the physical properties specified in Table 1 satisfy the conditions given below:

a) (Mean +0·6 Range) shall be less than or equal to the corresponding maximum specification limit.

b) (Mean —0·6 Range) shall be greater than or equal to the corresponding minimum specification limit.

B-5. FRACTURE TEST

B-5.1 In the case of ingots one test shall be performed for each of the 100 ingots or fraction thereof poured from a melt. In the case of castings weighing less than 100 kg one test shall be performed for each melt. For castings weighing more than 100 kg test shall be performed at the rate of 1 for every 100 castings or part thereof.

B-5.1.1 The lot shall be declared as conforming to the requirements of fracture test if each of the test results (*see* **6.3**) is found to be satisfactory.

B-6. PRESSURE TEST

B-6.1 The number of castings to be subjected to pressure test (*see* **6.4**) and the corresponding criteria for conformity shall be subject to agreement between the supplier and the purchaser.

B-6.1.1 The cost of extra castings/ingots required in accordance with the sampling clauses **B-1** to **B-6** for carrying out different tests shall be borne by the manufacturer.

BUREAU OF INDIAN STANDARDS

Headquarters:
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Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	323 76 17
*Eastern : 1/14 CIT Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	337 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43
Southern : C.I.T. Campus, IV Cross Road, MADRAS 600113	235 23 15
†Western : Manakalaya, E9, Behind Marol Telephone Exchange, Andheri (East), MUMBAI 400093	832 92 95
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'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMEDABAD 380001	550 13 48
‡Peenya Industrial Area, 1st Stage, Bangalore-Tumkur Road, BANGALORE 560058	839 49 55
Gangotri Complex, 5th Floor, Bhadbhada Road, T.T. Nagar, BHOPAL 462003	55 40 21
Plot No. 62-63, Unit VI, Ganga Nagar, BHUBANESHWAR 751001	40 36 27
Kalaikathir Buildings, 670 Avinashi Road, COIMBATORE 641037	21 01 41
Plot No. 43, Sector 16 A, Mathura Road, FARIDABAD 121001	8-28 88 01
Savitri Complex, 116 G.T. Road, GHAZIABAD 201001	8-71 19 96
53/5 Ward No. 29, R.G. Barua Road, 5th By-lane, GUWAHATI 781003	54 11 37
5-8-56C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001	20 10 83
E-52, Chitaranjan Marg, C-Scheme, JAIPUR 302001	37 29 25
117/418 B, Sarvodaya Nagar, KANPUR 208005	21 68 76
Seth Bhavan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226001	23 89 23
Patliputra Industrial Estate, PATNA 800013	26 23 05
T.C. No. 14/1421, University P.O. Palayam, THIRUVANANTHAPURAM 695034	6 21 17
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Institution of Engineers (India) Building, 1332 Shivaji Nagar, PUNE 411005	32 36 35

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