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BRITISH STANDARD 1400 : 1961

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**SCHEDULE OF
COPPER ALLOY
INGOTS AND
COPPER & COPPER ALLOY
CASTINGS**

BRITISH STANDARDS INSTITUTION

**SCHEDULE OF
COPPER ALLOY INGOTS AND
COPPER AND COPPER ALLOY
CASTINGS**

B.S. 1400 : 1961

Price 20/- net

BRITISH STANDARDS INSTITUTION

INCORPORATED BY ROYAL CHARTER

BRITISH STANDARDS HOUSE, 2 PARK ST., LONDON, W.1

TELEGRAMS: STANDARDS, AUDLEY, LONDON

TELEPHONE: MAYFAIR 9000

THIS BRITISH STANDARD, having been approved by the Non-ferrous Metals Industry Standards Committee and endorsed by the Chairman of the Engineering Divisional Council, was published under the authority of the General Council on 26th June, 1961.

First published March, 1948.
First revision June, 1961.

The Institution desires to call attention to the fact that this British Standard does not purport to include all the necessary provisions of a contract.

In order to keep abreast of progress in the industries concerned, British Standards are subject to periodical review. Suggestions for improvements will be recorded and in due course brought to the notice of the committees charged with the revision of the standards to which they refer.

A complete list of British Standards, numbering over 4000, indexed and cross-indexed for reference, together with an abstract of each standard, will be found in the Institution's Yearbook, price 15s.

This standard makes reference to the following British Standards:

- B.S. 18. Tensile testing of metals.
- B.S. 240. Brinell hardness testing.
- B.S. 381C. Colours for ready mixed paints
- B.S. 1367. Code of procedure in inspection of copper-base alloy sand castings.
- B.S. 1499. Sampling non-ferrous metals.
- B.S. 1610. Verification of testing machines.
- B.S. 1748. Methods of analysis of copper alloys.
- B.S. 3239. Determination of resistivity of metallic electrical conductor materials.

The following B.S.I. references relate to the work on this standard:
Committee reference NFE/14 Draft for comment CZ (NFE) 3620

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CO-OPERATING ORGANIZATIONS

The Non-ferrous Metals Industry Standards Committee, under whose supervision this British Standard was prepared, consists of representatives from the following Government departments and scientific and industrial organizations:

Admiralty
 Aluminium Development Association
 Aluminium Industry Council
 *Association of Bronze and Brass Founders
 Association of Consulting Engineers, Incorporated
 *British Bronze and Brass Ingot Manufacturers' Association
 *British Electrical and Allied Manufacturers' Association
 British Non-ferrous Metals Federation
 *British Non-ferrous Metals Research Association
 Cable Makers' Association
 *Copper Development Association
 Crown Agents for Oversea Governments and Administrations
 High Commission of India
 High Conductivity Copper Association
 *Institute of British Foundrymen
 Institute of Metals
 Institution of Mechanical Engineers (Automobile Division)
 Institution of Mining and Metallurgy
 Institution of Structural Engineers
 Lead Development Association
 Lead Sheet and Pipe Manufacturers' Federation
 Light Metal Founders' Association
 London Metal Exchange
 Magnesium Industry Council
 Ministry of Aviation
 *National Brassfoundry Association
 Non-ferrous Metal Stockists
 Post Office
 Royal Institute of British Architects
 Society of British Aircraft Constructors
 *Society of Motor Manufacturers and Traders Ltd.
 Tin Research Institute
 *War Office
 Zinc Development Association
 Individual manufacturers

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

British Valve Manufacturers' Association
 Institution of Mechanical Engineers
 National Physical Laboratory (D.S.I.R.)
 Oil Companies Materials Association
 Individual manufacturers

BRITISH STANDARD SCHEDULE OF COPPER ALLOY INGOTS AND COPPER AND COPPER ALLOY CASTINGS

FOREWORD

This British Standard schedule for ingots for casting, and for castings was first issued in 1948, when the individual general engineering British Standards for copper alloy ingots and castings were withdrawn, and the requirements from them, revised where necessary, were included in one volume.

In this revision the numbers of the obsolete British Standards are included, for convenience, only in the summary table.

The whole schedule has now been reviewed, and one alloy SB1 has been omitted. High conductivity coppers HCC1 and HCC2 and new alloys PB4, LB4, LB5, LB3, SCB4, SCB5, CMA1, CMA2 and DCB3, have been included. Three of these arise from an extension of the range of brasses previously designated 'B', and its sub-division into sand cast brasses (designated 'SCB') and die cast brasses (designated 'DCB'). For convenience the earlier superseded code numbers are included in the summary table.

A number of amendments have been made to the chemical compositions of the alloys, including differentiation between the limits specified for ingots and castings for certain of the elements.

Mechanical properties have also been reviewed and a number of amendments made. Throughout reference is made to 'permanent set stress' instead of 'proof stress' as the former is the test used with copper base casting alloys and is now defined in B.S. 18, 'Tensile testing of metals'. A definition is included in the relevant clause in the general section.

For the phosphor bronzes, leaded bronzes and gunmetals, properties for continuously cast material have been included.

Attention is drawn to the fact that where the specified minimum tensile properties apply to separately cast standard test bars, these properties may not be realized in all parts of the castings.

The general format of the schedule, and the wording of general and specific clauses have been brought into line as far as possible with the recommendations of PD 2436, 'Memorandum on the preparation of British Standards for non-ferrous metals'.

Particular attention is drawn to the fact that in the chemical composition clause essential elements and their limits are shown in heavy type. In addition limits are set for a number of optional elements and important impurities which are grouped together with the essential elements, and for all of these regular analysis is required. Limits are also set for a second group of 'other impurities'.

which are preceded by the expression 'The supplier shall ensure that the material does not contain other impurities in excess of the amounts stated'. It is intended that the supplier by his own quality control methods shall satisfy himself that the limits for these elements are not exceeded, and he will not be called upon to supply detailed analysis figures for these other impurities.

For the gunmetals and leaded gunmetals recent research on the effect of impurities has been taken into account in fixing limits only for those elements known to be harmful and likely to be present, and a total figure has not been included. This has not been possible for all other alloys in the schedule, as there is insufficient conclusive information available with regard to the effect of impurities, and of necessity the total impurity figure has been retained as a safeguard even though it is realized that it is not practicable to determine such a figure. As for individual impurity limits however, it is intended that this total impurity limit will be covered by the expression referred to in the previous paragraph.

For all alloys in the form of ingots a Colour Code (see Appendix B) has been introduced, although it was not possible to extend this scheme to include castings.

As in the earlier edition an appendix has been included giving information to be supplied by the purchaser when he is allowed an option.

NOTE. Where metric equivalents are stated the figures in British units are to be regarded as the standard. The metric conversions are approximate; more accurate conversions should be based on the tables in B.S. 350, 'Conversion factors and tables'.

SPECIFICATION

SCOPE

1. This British Standard specifies requirements for high conductivity copper castings and copper alloy ingots and castings in 33 alloys.

SECTION ONE : GENERAL CLAUSES APPLICABLE TO INGOTS

FREEDOM FROM DEFECTS

2. The ingots shall be free from harmful defects.

PROVISION OF TEST SAMPLES FOR MECHANICAL TESTING

3. Should test samples be required the number shall be stated with the enquiry and order. The test samples shall be of suitable size for machining to the dimensions of the British Standard tensile test pieces shown in Appendix A. The test samples shall be separately cast from the re-melted ingot in sand, except DCB1, DCB2 and DCB3, and other ingots ordered for die casting purposes, when chill moulds shall be used.

MECHANICAL TESTS

4. *a. Tensile test.* Tensile test pieces shall be prepared from test samples cast as specified in Clause 3, by machining to the dimensions of the British Standard proportional round test piece shown in Appendix A. Neither the test samples nor the test pieces shall be heat treated, or worked before they are tested.

The preparation of the test pieces, and the testing procedure shall be as laid down in B.S. 18, 'Tensile testing of metals'.

- b. 0.1 per cent permanent set stress.* The 0.1 per cent permanent set stress is defined as the stress which has produced a permanent extension of 0.1 per cent of the gauge length measured after removal of the load.

If it is desired to determine the permanent set stress it shall be determined as in Clause 19 of B.S. 18 but a small preliminary load of $\frac{1}{4}$ ton may be applied before setting the zero of the extensometer, in which case after loading it shall be unloaded to that datum.

In routine testing as a proving test, the test shall be carried out as Clause 20b of B.S. 18 (see Appendix A), but a small preliminary load of $\frac{1}{4}$ ton may be applied before setting the zero of the extensometer, in which case after loading it shall be unloaded to that datum.

The testing machine shall be calibrated in accordance with B.S. 1610, 'Verification of testing machines', and shall comply with Grade A.

CHEMICAL TEST

5. The supplier shall supply, when required, information concerning the number of heats per batch of ingots delivered and the proportion of heats analysed, for control purposes: he shall also supply, if required, a copy of the relevant analyses.

MICROSCOPIC EXAMINATION

6. Test pieces prepared from test samples provided as specified in Clause 3 shall be polished and etched and shall be subjected to microscopic examination.

RETESTS

7. Should a test piece fail to meet the requirements of the tensile test, two further test pieces which represent the same batch, shall be tested in the same manner. Should one of the further test pieces meet the requirements of the tensile test, the ingots represented thereby shall be deemed to comply with the standard. Should both of these test pieces fail to meet the requirements of the tensile test, the ingots represented thereby shall be deemed not to comply with the standard.

CERTIFICATE OF COMPLIANCE

8. The supplier shall, if required, certify that the material complies with the requirements of this standard appropriate to the material ordered.

INSPECTION

9. The purchaser shall notify the supplier when placing the order if it is his intention to inspect the material at the supplier's works. The supplier shall afford the purchaser all reasonable facilities to satisfy himself that the material is in accordance with this standard. For this purpose the purchaser or his representative may, by prior arrangement, attend to inspect the material, to select and identify the test samples for testing and to witness the tests being made.

The purchaser shall be at liberty to take samples from the ingots and have them analysed. The cost of such analysis shall be borne by the purchaser and the results shall be communicated to the supplier if they are not in accordance with Clause 14 of Section Two for the appropriate material.

INDEPENDENT TEST

10. Should there be a dispute about the compliance of the material with regard to the composition or the test requirements of this standard, the purchaser and the supplier shall have the right to have tests made by a mutually acceptable testing authority.

The results obtained by the independent testing authority shall be accepted as final. If the material does not comply with this standard, the cost of independent testing shall be borne by the supplier; if the material complies with this standard the cost shall be borne by the purchaser.

The method of preparing the samples for analysis shall be in accordance with B.S. 1499, 'Sampling non-ferrous metals' and the methods of analysis shall be in accordance with B.S. 1748, 'Methods for the analysis of copper alloys', where the appropriate method exists.

FACILITIES FOR TESTING

11. For making tests on samples cast as specified in Clause 3, the supplier shall provide and prepare the necessary test pieces, and supply labour and appliances for such testing as may be carried out on his premises in accordance with this standard. Unless otherwise agreed, material for testing shall remain the property of the supplier. Failing facilities at his own works for making the prescribed tests, the supplier shall make the necessary arrangements for making the tests elsewhere.

COLOUR MARKING

12. If colour marking is used, the colours shall be those appropriate to the material unless otherwise specified by the purchaser.

SECTION TWO : GENERAL CLAUSES APPLICABLE TO CASTINGS

NOTE. Attention is called to B.S. 1367, 'Code of procedure in inspection of copper-base alloy sand castings' which includes suggestions as to the number of test pieces to be taken. Details of a suitable form of test bar are also given.

FREEDOM FROM DEFECTS

2. The castings shall be clean, and free from harmful defects. Castings shall not be repaired unless permission in writing has been obtained previously from the purchaser or his representative.

Any casting may subsequently be deemed not to comply with the standard because of faults in manufacture, notwithstanding that it has been passed previously on chemical composition and mechanical tests.

Should radiological examination be required, this shall be stated with the enquiry and order.

DIMENSIONS

3. The dimensions of the castings shall conform to the pattern or the working drawing supplied by the purchaser or his representative.

PROVISION OF TEST SAMPLES FOR MECHANICAL TESTING

4. Should test samples be required the number shall be stated with the enquiry and order. The test samples shall be of suitable size for machining to the dimensions of the British Standard tensile test piece shown in Appendix A. For sand, chill and die castings the test samples shall be separately cast at the same time and from the same melt as the castings which they represent, and shall be cast into moulds of the same materials as those used for the manufacture of the castings, and treated in the same manner.

Alternatively a test piece may be taken from the casting. The location of such a test piece and the properties to be expected shall be agreed between supplier and purchaser.

For continuously cast sections the test pieces shall be taken from the actual castings and machined to the largest dimensions practicable, selected from those listed in Appendix A.

MECHANICAL TESTS

5. *a. Tensile test.* Tensile test pieces shall be prepared from test samples cast as specified in Clause 4, by machining to the dimensions of the British Standard proportional round test piece shown in Appendix A. Neither the test samples nor the test pieces shall be heat treated, or worked before they are tested except where specified.

The preparation of the test pieces, and the testing procedure shall be as laid down in B.S. 18, 'Tensile testing of metals'.

b. 0.1 per cent permanent set stress. The 0.1 per cent permanent set stress is defined as the stress which has produced a permanent extension of 0.1 per cent of the gauge length measured after removal of the load.

If it is desired to determine the permanent set stress it shall be determined as in Clause 19 of B.S. 18, but a small preliminary load of $\frac{1}{4}$ ton may be applied before setting the zero of the extensometer, in which case after loading it shall be unloaded to that datum.

In routine testing as a proving test, the test, shall be carried out as Clause 20 *b* of B.S. 18 (see Appendix A); but a small preliminary load of $\frac{1}{4}$ ton may be applied before setting the zero of the extensometer, in which case after loading it shall be unloaded to that datum.

The testing machine shall be calibrated in accordance with B.S. 1610, 'Verification of testing machines', and shall comply with Grade A.

c. Hardness test. Hardness tests shall be made on test pieces taken from samples cast as specified in Clause 4 and shall be made in accordance with B.S. 240, 'Brinell hardness testing', using a 10 mm ball and a 1000 kg load. The test shall consist of three determinations made upon separate pieces of material, the average of the three hardness numbers being regarded as the Brinell hardness number of the castings.

ELECTRICAL RESISTIVITY TEST

6. The resistivity shall be determined on a test casting the length of which shall be sufficient to give the accuracy required and suitable for the method of testing employed.

The measurement of resistance shall be carried out in accordance with B.S. 3239, 'Determination of resistivity of metallic electrical conductor materials', to the accuracy specified in Section Three. Resistivity shall be calculated from the measured resistance after it has been corrected to a temperature of 20°C.

TEST FOR PRESSURE TIGHTNESS

7. If the purchaser requires castings to be tested for pressure tightness, he shall state this and the nature of the test in his enquiry and order; the test pressure and testing fluid shall be the subject of agreement between the supplier and the purchaser. Castings shall not be impregnated or otherwise treated by a process designed to improve pressure tightness, except as agreed in writing with the purchaser.

CHEMICAL TEST

8. The supplier shall supply, when required, information concerning the number of heats per batch of castings delivered and the proportion of heats analysed, for control purposes: he shall also supply if required a copy of the relevant analyses.

MICROSCOPIC EXAMINATION

9. Test pieces prepared from test samples provided as specified in Clause 4 shall be polished and etched and shall be subjected to microscopic examination.

RETESTS

10. Should a test piece fail to meet the requirements of the electrical or tensile tests, two further test pieces which represent the same batch, shall be tested in the same manner. Should one of the further test pieces meet the requirements of the tests the castings represented thereby shall be deemed to comply with this standard. Should both of these test pieces fail to meet the requirements of the tests, the castings represented thereby shall be deemed not to comply with the standard.

CERTIFICATE OF COMPLIANCE

11. The supplier shall if required, certify that the material complies with the requirements of this standard appropriate to the material ordered.

INSPECTION

12. The purchaser shall notify the supplier when placing the order if it is his intention to inspect the material at the supplier's works. The supplier shall afford the purchaser all reasonable facilities to satisfy himself that the material is in accordance with this standard. For this purpose the purchaser or his representative may, by prior arrangement, attend to inspect the material, to select and identify the test samples for testing and to witness the tests being made.

The purchaser shall be at liberty to take samples from the castings and have them analysed. The cost of such analysis shall be borne by the purchaser and the results shall be communicated to the supplier if they are not in accordance with Clause 16 of Section Two for the appropriate material.

INDEPENDENT TEST

13. Should there be a dispute about the compliance of the material with regard to composition or the test requirements of this standard, the purchaser and the supplier shall have the right to have analyses or tests made by a mutually acceptable testing authority.

The results obtained by the independent testing authority shall be accepted as final. If the material does not comply with this standard, the cost of independent testing shall be borne by the supplier; if the material complies with this standard the cost shall be borne by the purchaser.

The method of preparing samples for analysis shall be in accordance with B.S. 1499, 'Sampling non-ferrous metals', and the methods of analysis shall be in accordance with B.S. 1800, 'Methods for the analysis of raw copper' and B.S. 1748, 'Methods for the analysis of copper alloys', where the appropriate method exists.

FACILITIES FOR TESTING

14. For making tests on samples cast as specified in Clause 4, the supplier shall provide and prepare the necessary test pieces, and supply labour and appliances for such testing as may be carried out on his premises in accordance with this standard. Unless otherwise agreed material for testing shall remain the property of the supplier. Failing facilities at his own works for making the prescribed tests, the supplier shall make the necessary arrangements for making the tests elsewhere.

SUMMARY TABLE

NOTE. Attention is drawn to the fact that where the specified minimum tensile properties apply to separately cast standard test bars, these properties may not be realized in all parts of the castings.

B.S. 1400 : 1961

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No.	Material	Sand cast			Chill cast			Continuously cast			Corresponding obsolete B.S. No.		Colour Code for ingots
		Ten-sile strength	0.1 per cent permanent set stress	Elongation	Ten-sile strength	0.1 per cent permanent set stress	Elongation	Ten-sile strength	0.1 per cent permanent set stress	Elongation	Ingot	Cast-ings	
		min.	min.	min.	min.	min.	min.	min.	min.	min.			
		ton/sq in	ton/sq in	per cent	ton/sq in	ton/sq in	per cent	ton/sq in	ton/sq in	per cent			
HCC1-C	High conductivity copper	10*	—	25*	—	—	—	—	—	—	—	—	—
HCC2-C	High conductivity copper	10*	—	25*	—	—	—	—	—	—	—	—	—
PB1-C	Phosphor bronze (copper-tin-phosphorus)	14	8*	3	20	11*	2	23	11*	7	1058	1059	Yellow
PB2-C	Phosphor bronze (copper-tin-phosphorus)	14	8*	5	17	11*	3	20	11*	5	—	421 for gear blanks	Yellow/red
PB3-C	Phosphor bronze (copper-tin-phosphorus)	15	8*	7	17	9*	5	20	10*	10	—	—	Yellow/black
PB4-C	Phosphor bronze (copper-tin-phosphorus)	12	6*	3	17	9*	2	21	10*	8	—	—	Black/red

* For information only.

19	LPB1-C Leaded phosphor bronze	12	5*	3	14	8*	2	17	8*	5	1060	1061	Black
	LB1-C 76/9/0/15 Leaded bronze	11	5*	4	13	8*	3	15	8*	9	964	965	White/black
	LB2-C 80/10/0/10 Leaded bronze	12	5*	5	14	9*	3	18	10*	9	962	963	White
	LB3-C 85/10/0/5 Leaded bronze	12	5*	5	13	9*	3	18	10*	9	960	961	White/aluminium
	LB4-C 85/5/0/10 Leaded bronze	10	4*	8	13	5*	5	15	8*	10	—	—	White/green
	LB5-C 75/5/0/20 Leaded bronze	10	4*	6	11	5*	6	12	6*	8	—	—	White/brown
	G1-C 88/10/2 Gunmetal	17	8*	15	15	8.5*	3	19	9*	10	382	383	Red
	G2-C 88/8/4 Gunmetal	16	7.5*	15	14	8*	3	18	9*	10	1021	1022	Red/white
	G3-C Nickel gunmetal	18	9*	18	—	—	—	22	11*	20	—	—	Blue/black
	G3-WP Nickel gunmetal	28	18*	3	—	—	—	28	18*	3	—	—	Blue/black
	LG1-C 83/3/9/5 Leaded gunmetal	11	—	12	—	—	—	—	—	—	1158	1159	Blue/red
	LG2-C 85/5/5/5 Leaded gunmetal	13	6*	15	13	7*	7	17	6.5*	15	897	898	Blue
	LG3-C 86/7/5/2 Leaded gunmetal	14	6.5*	12	15	7.5*	3	18	7.5*	12	1023	1024	Blue/white
	LG4-C 87/7/3/3 Leaded gunmetal	16	8*	18	16	8*	5	19	8*	15	—	—	Blue/brown
	AB1-C Aluminium bronze (copper-aluminium)	32	11*	20	35	13*	20	—	—	—	1031	1032	Aluminium

* For information only.

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Documents

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SUMMARY TABLE—continued.

NOTE. Attention is drawn to the fact that where the specified minimum tensile properties apply to separately cast standard test bars, these properties may not be realized in all parts of the castings.

20

No.	Material	Sand cast			Chill cast			Continuously cast			Corresponding obsolete B.S. No.		Colour Code for ingots
		Ten-sile strength	0.1 per cent permanent set stress	Elongation	Ten-sile strength	0.1 per cent permanent set stress	Elongation	Ten-sile strength	0.1 per cent permanent set stress	Elongation	Ingot	Cast-ings	
		min.	min.	min.	min.	min.	min.	min.	min.	min.			
		ton/sq in	ton/sq in	per cent	ton/sq in	ton/sq in	per cent	ton/sq in	ton/sq in	per cent			
AB2-C	High tensile aluminium bronze (copper-aluminium)	41	16	15	42	16	15	—	—	—	1072	1073	Aluminium/green
CMA1-C	Copper-manganese-aluminium	42	18	20	43	20	30	—	—	—	—	—	Aluminium/red
CMA2-C	Copper-manganese-aluminium	48	25	10	—	—	—	—	—	—	—	—	Aluminium/yellow
SCB1-C	Brass sand castings (formerly B1)	11	—	20	—	—	—	—	—	—	1025	1026	Green/blue
SCB2-C	Brass sand castings (formerly B2)	11	—	12	—	—	—	—	—	—	—	—	Green/red
SCB3-C	Brass sand castings (formerly B3)	12	—	12	—	—	—	—	—	—	1027	1028	Green

SCB4-C	Naval brass sand castings	16	4.5*	20	—	—	—	—	—	—	—	—	Green/yellow
SCB5-C	Brazable brass	12	—	20	—	—	—	—	—	—	—	—	Green/black
SCB6-C	Brazable brass (formerly B6)	11	—	20	—	—	—	—	—	—	—	—	Green/brown
DCB1-C	Brass die castings (formerly B4)	—	—	—	18	—	25	—	—	—	932	932	Yellow/blue
DCB2-C	Naval brass die castings (formerly B5)	—	—	—	20	7.5*	20	—	—	—	920	920	Yellow/white
DCB3-C	Brass die castings	—	—	—	19	—	15	—	—	—	—	—	Yellow/brown
21	HTB1-C	30	11	20	32	14	20	—	—	—	207	208	Brown
	HTB2-C	38	18	15	—	—	—	—	—	—			Brown/black
	HTB3-C	48	26	12	—	—	—	—	—	—			Brown/red

* For information only.

HCC1-C HIGH CONDUCTIVITY COPPER CASTINGS

SECTION THREE : SPECIFIC CLAUSES

GENERAL

15. The castings shall comply with the general requirements of Section Two and with the following chemical composition and electrical properties.

CHEMICAL COMPOSITION

16. The castings shall be made from the following material:
Copper Complying with B.S. 1035-37.
Added elements and impurities — not specified.

MECHANICAL PROPERTIES (For information only)

17. The following mechanical properties obtained from the separately cast test pieces selected and prepared as specified in Clauses 4 and 5 of Section Two are given for information only:

	Tensile strength	Elongation	Metric equivalent
	min.	min.	Tensile strength min.
Sand cast	ton/sq in 10.0	per cent 25	kg/mm ² 15.7

ELECTRICAL PROPERTIES

18. The electrical properties of a separately cast test piece measured in accordance with Clause 6, Section Two, shall be as follows determined to within an accuracy of ± 1 per cent.

Resistivity	Conductivity*
max.	min.
microhms/cm 1.81	per cent 95

* Expressed as percentage of the standard value for annealed high conductivity copper as laid down by the International Electrotechnical Commission.

HCC2-C HIGH CONDUCTIVITY COPPER CASTINGS

SECTION THREE: SPECIFIC CLAUSES

GENERAL

15. The castings shall comply with the general requirements of Section Two and with the following chemical composition and electrical properties.

CHEMICAL COMPOSITION

16. The castings shall be made from any suitable grade of Copper.

MECHANICAL PROPERTIES (For information only)

17. The following mechanical properties obtained from the separately cast test pieces selected and prepared as specified in Clauses 4 and 5 of Section Two are given for information only:

	Tensile strength	Elongation	Metric equivalent
	min.	min.	Tensile strength min.
Sand cast	ton/sq in 10.0	per cent 25	kg/mm ² 15.7

ELECTRICAL PROPERTIES

18. The electrical properties of a separately cast test piece measured in accordance with Clause 6, Section Two, shall be as follows determined to within an accuracy of ± 2 per cent.

Resistivity	Conductivity*
max.	min.
microhms/cm 2.30	per cent 75

* Expressed as percentage of the standard value for annealed high conductivity copper as laid down by the International Electrotechnical Commission.

PB1-I PHOSPHOR BRONZE (COPPER-TIN-PHOSPHORUS) INGOTS

SECTION THREE: SPECIFIC CLAUSES

GENERAL

13. The ingots shall comply with the general requirements of Section One and with the following chemical composition and mechanical properties.

CHEMICAL COMPOSITION

14. The chemical composition of the ingots shall be:

Tin	not less than 10.0 per cent
Phosphorus	not less than 0.60 per cent
Lead	not more than 0.25 per cent
Zinc	not more than 0.05 per cent
Copper	the remainder

The foregoing shall be determined analytically.

Other impurities. The supplier shall ensure that the material does not contain other impurities in excess of the amounts stated:

Total	0.30 per cent
Silicon	0.02 per cent
Iron	0.10 per cent
Aluminium	0.01 per cent

MECHANICAL PROPERTIES

15. The mechanical properties obtained from the separately cast test pieces selected and prepared as specified in Clauses 3 and 4 of Section One shall be as follows:

	Tensile strength	Elongation	Metric equivalent
	min.	min.	Tensile strength min.
	ton/sq in	per cent	kg/mm ²
Sand cast	14.0	3	22.0

PB1-C PHOSPHOR BRONZE (COPPER-TIN-PHOSPHORUS) CASTINGS

SECTION THREE: SPECIFIC CLAUSES

GENERAL

15. The castings (including solid and cored chill cast and continuously cast sticks) shall comply with the general requirements of Section Two and with the following chemical composition and mechanical properties.

CHEMICAL COMPOSITION

16. The chemical composition of the castings shall be:

Tin	not less than 10.0 per cent
Phosphorus	not less than 0.50 per cent
Lead	not more than 0.25 per cent
Zinc	not more than 0.05 per cent
Copper	the remainder.

The foregoing shall be determined analytically.

Other impurities. The supplier shall ensure that the material does not contain other impurities in excess of the amounts stated:

Total	0.30 per cent
Silicon	0.02 per cent
Iron	0.10 per cent
Aluminium	0.01 per cent

MECHANICAL PROPERTIES

17. The mechanical properties obtained from the separately cast or continuously cast test pieces selected and prepared as specified in Clauses 4 and 5 of Section Two shall be as follows:

	Tensile strength	0.1 per cent permanent set stress	Elongation	Metric equivalents	
	min.		min.	Tensile strength min.	0.1 per cent permanent set stress
	ton/sq in	ton/sq in	per cent	kg/mm ²	kg/mm ²
Sand cast	14.0	8*	3	22.0	12.5*
Chill cast	20.0	11*	2	31.5	17*
Continuously cast	23.0	11*	7	36.2	17*

* For information only.

PB2-I PHOSPHOR BRONZE (COPPER-TIN-PHOSPHORUS) INGOTS

SECTION THREE: SPECIFIC CLAUSES

GENERAL

13. The ingots shall comply with the general requirements of Section One and with the following chemical composition and mechanical properties.

CHEMICAL COMPOSITION

14. The chemical composition of the ingots shall be:

Tin	not less than 11.0 per cent nor more than 13.0 per cent
Phosphorus	not less than 0.25 per cent
Lead	not more than 0.50 per cent
Nickel	not more than 0.50 per cent
Zinc	not more than 0.30 per cent
Copper	the remainder.

The foregoing shall be determined analytically.

Other impurities. The supplier shall ensure that the material does not contain other impurities in excess of the amounts stated:

Total	0.20 per cent
Silicon	0.02 per cent
Iron	0.15 per cent
Aluminium	0.01 per cent

MECHANICAL PROPERTIES

15. The mechanical properties obtained from the separately cast test pieces selected and prepared as specified in Clauses 3 and 4 of Section One shall be as follows:

	Tensile strength	Elongation	Metric equivalent
			Tensile strength
	min.	min.	min.
	ton/sq in	per cent	kg/mm ²
Sand cast	14.0	5	22.0

PB2-C PHOSPHOR BRONZE (COPPER-TIN-PHOSPHORUS) CASTINGS

SECTION THREE: SPECIFIC CLAUSES

GENERAL

15. The castings (including solid and cored chill cast and continuously cast sticks) shall comply with the general requirements of Section Two and with the following chemical composition and mechanical properties.

CHEMICAL COMPOSITION

16. The chemical composition of the castings shall be:

Tin	not less than 11.0 per cent nor more than 13.0 per cent
Phosphorus	not less than 0.15 per cent
Lead	not more than 0.50 per cent
Nickel	not more than 0.50 per cent
Zinc	not more than 0.30 per cent
Copper	the remainder

The foregoing shall be determined analytically.

Other impurities. The supplier shall ensure that the material does not contain other impurities in excess of the amounts stated:

Total	0.20 per cent
Silicon	0.02 per cent
Iron	0.15 per cent
Aluminium	0.01 per cent