

Specification for

# Copper and copper alloys —

Wire

UDC 669.3-426

## 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:

Aluminium Federation	Institution of Mining and Metallurgy
Association of Bronze and Brass Founders	Institution of Production Engineers
Association of Consulting Engineers, Incorporated	Institution of Structural Engineers
Board of Trade	Lead Development Association
British Bronze and Brass Ingot Manufacturers' Association	Light Metal Founders' Association
British Electrical and Allied Manufacturers' Association*	London Metal Exchange
British Lead Manufacturers' Association	Magnesium Industry Council
British Non-ferrous Metals Federation*	Ministry of Defence (Army Dept)*
British Non-ferrous Metals Research Association*	Ministry of Defence (Navy Dept)
Copper Development Association*	National Brassfoundry Association
Crown Agents for Oversea Governments and Administrations	Non-ferrous Metal Stockists*
Electric Cable Makers' Confederation*	Post office*
Institute of British Foundrymen	Royal Institute of British Architects
Institute of Metals	Society of British Aerospace Companies
Institution of Mechanical Engineers (Automobile Division)	Society of Motor Manufacturers and Traders Ltd.*
	Tin Research Institute
	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 Clock and Watch Manufacturers' Association	Spring Research Association
Electronic Engineering Association	Telephone Manufacturers Technical Development Committee
Institute of Sheet Metal Engineering	Individual manufacturers
National physical Laboratory (Ministry of Technology)	

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## Foreword

This standard makes reference to the following British Standards and to those listed in Appendix C.

BS 18, *Methods for tensile testing of metals.*

BS 1559, *Reels and wooden drums for bare wire, stranded conductors and trolley wire, for use in the United Kingdom.*

BS 1957, *Presentation of numerical values (fineness of expression; rounding of numbers).*

BS 2870, BS 2871, BS 2872, BS 2874, BS 2875. *Specifications for copper and copper alloys.*

This British Standard is the first revision in metric terms of one of a series for copper and copper alloy in various wrought forms, the preparation of which was authorized by the Non-ferrous Metals Industry Standards Committee. Others in the series are:

BS 2870, *Copper and copper alloys. Sheet, strip and foil.*

BS 2871, *Copper and copper alloys. Tubes.*

BS 2872, *Copper and copper alloys. Forging stock and forgings.*

BS 2874, *Copper and copper alloys. Rods and sections.*

BS 2875, *Copper and copper alloys. Plate.*

In preparing the metric standard only materials for general engineering purposes have been included and all references to electrical properties have been deleted. Where materials included in this standard are required with specified electrical properties the appropriate references have been quoted in Appendix C.

In the case of material NS 110 the demand has dropped to a point where inclusion is no longer warranted and it has, therefore, been withdrawn. Alloys not covered by this standard which are available in other product forms have been included in Appendix A.

Attention is drawn to the fact that existing individual standards (listed in Appendix C) will not be revised in metric terms but will be retained in imperial units during the transition period from imperial to metric units. It is anticipated that these individual standards will be progressively withdrawn, so that by not later than 1975, all these standards will have been withdrawn.

In this revised specification, metric units of the *Système International d'Unités* (SI) have been used with the exception of values for tensile strength and proof stress, for which the hbar has been used (1hbar = 10 MN/m<sup>2</sup>). These have been adopted by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). It is expected that they will become the generally accepted metric units throughout the world and their adoption in the United Kingdom at the present time will thus avoid the necessity for two separate changes, first from traditional imperial units to metric technical units, and then later to SI units. In the case of tensile strengths and proof stresses, conversion factors and direct comparisons between the three sets of units have been included in Appendix B.

Particular attention has been paid to the recommendations issued by the International Organization for Standardization in respect of chemical compositions. Where the technical committee has agreed to accept the ISO recommendations the appropriate requirements have been written in, and in the case of alloys which comply with, or fall within, ISO recommended ranges, the comparable ISO designation has been included.

Some reduction in size of this standard has been achieved by tabulation of chemical composition and mechanical properties instead of setting out each individual alloy on separate pages as in the previous issue.

All tables of tolerances have been reviewed, and revised values in accordance with the latest agreed practice have been inserted.

Throughout this standard, and the others in the series, a unified system of symbols has been used to designate the alloys and suffix letters have been used to indicate the temper or condition of heat treatment in which the materials are available.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### **Summary of pages**

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 20 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.



## 1 Scope

This British Standard specifies requirements for copper and copper alloy wire for general purposes supplied in forms other than straight lengths.

## 2 General

The wire shall comply with the general requirements set out below and with the requirements of Table 4–Table 9.

## 3 Definitions

For the purposes of this British Standard the following definition applies:

### wire

a solid product, other than strip, rod or foil, supplied in coils or on spools, reels or drums

## 4 Information to be supplied by the purchaser

The purchaser shall state on his enquiry and order the following information:

- 1) The designation of the material required (selected from Table 4–Table 9).
- 2) The condition of the material (selected from Table 4–Table 9).
- 3) For other than round, square and hexagonal wire the tolerances required (see **9.3**).
- 4) Whether mechanical or embrittlement tests are required (see **10.1** and **10.2**).
- 5) Whether a certificate of compliance is required (see Clause **14**).
- 6) Whether it is the purchaser's intention to inspect the material at the supplier's works (see Clause **15**).
- 7) The method of packaging (see Clause **18**).

## 5 Freedom from defects

The material shall be clean, smooth and free from harmful defects.

## 6 Chemical composition

The chemical composition shall comply with the requirements given in Table 4–Table 9.

## 7 Condition

The material shall be supplied in one of the following conditions as specified by the purchaser and selected from Table 3–Table 9.

0	Annealed (soft)	
½ H	½ Hard	} The various harder tempers produced by cold working. For certain of the materials in this standard these tempers may be produced by partial annealing.
H	Hard	
EH	Extra hard	
W	Material which has been solution-heat-treated and will respond effectively to precipitation treatment.	
W(H)	Material which has been solution-heat-treated and subsequently cold-worked to various harder tempers.	
WP	Material which has been solution-heat-treated and precipitation-treated.	
W(H)P	Material which has been solution-heat-treated, cold-worked to hard temper and then precipitation-treated.	

## 8 Joints

There shall be no joints in the wire except those made in the base rod or wire before final drawing.

## 9 Dimensions and tolerances

**9.1 Round wire.** The diameter of round wire determined by means of a suitable micrometer and by taking the mean of the two measurements at right angles made at the same cross section of a sample taken from any part of a coil, reel, spool or drum, shall be as ordered within the tolerances specified in Table 1 and Table 2.

The difference between the maximum and minimum measurements, taken at the same cross section, shall not exceed the amount specified in Table 1 and Table 2.

**9.2 Square and hexagonal wire.** For square and hexagonal wire the tolerances shall be as specified in Table 3.

**9.3 For wire other than round, square and hexagonal.** The tolerances shall be agreed between the purchaser and the supplier and shall be stated on the enquiry and the order.

## 10 Selection of test samples

**10.1 Mechanical tests.** When tests are specifically called for by the purchaser the selection of test samples and the number of tests to be made shall be agreed between the purchaser and the supplier.

**10.2 Gassing or hydrogen embrittlement test. Materials C103, C106.** When a gassing or hydrogen embrittlement test is required the selection of test samples and the number of tests to be made shall be agreed between the purchaser and the supplier.

## 11 Mechanical tests

**11.1 Tensile test.** The tensile test shall be made in accordance with BS 18<sup>1)</sup> Elongation shall be measured on an original gauge length of 200 mm or 100 mm as indicated in the table headings.

The values obtained shall comply with the requirements given in Table 4–Table 9.

**11.2 Wrapping test.** Wire in the materials, conditions and sizes specified below shall be wrapped around a wire of its own diameter to form a close helix of eight turns. This shall then be un-wrapped and closely re-wrapped in the same direction as the first wrapping for the number of turns listed. The wire shall not break when subjected to this test.

Material	Condition	Diameter up to and including mm	Numbers of turns	
			Un-wrapped	Re-wrapped
C101, C102	H	6.0	6	6
CZ102, CZ103, CZ106	H	6.0	6	Nil
CZ107, CZ108, PB102, PB103	H and EH			
CB101	W(H)	1.5	6	Nil

## 12 Gassing or hydrogen embrittlement test

The gassing or hydrogen embrittlement test shall be made on test pieces of convenient length selected as specified in Clause 10. After being exposed to an atmosphere of hydrogen for 30 min at 825 °C to 875 °C and subsequently cooled out of contact with air, the test pieces shall be subjected to a close bend test as described below and examined for cracking. The test piece AB is bent by steadily applying pressure or a succession of blows at right angles to the length AC and flattened close until A assumes the position indicated by D (see Figure 1).

The test piece shall not crack when subjected to this test.

<sup>1)</sup> BS 18, "Methods for tensile testing of metals".



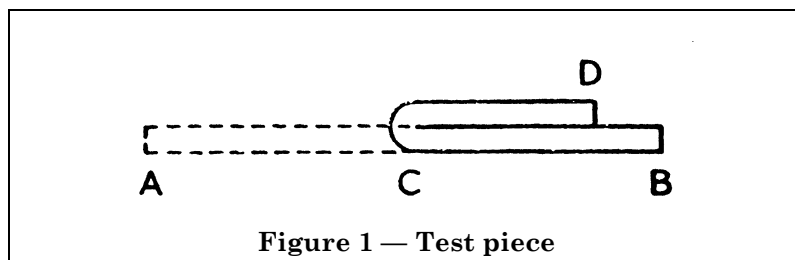


Figure 1 — Test piece

### 13 Retests

Where one test is required per batch the following shall apply.

Should any one of the test pieces first selected by the purchaser or his representative fail to pass any of the prescribed tests, two further pieces samples from the same batch shall be selected for testing, one of which shall be from the same coil, spool, reel or drum from which the original test sample was taken, unless that coil, spool, reel or drum has been withdrawn by the supplier.

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

### 14 Certificate of compliance

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

### 15 Inspection

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 material selected in accordance with Clause 10 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 the requirements for the appropriate material.

### 16 Facilities for testing

For making tests on samples selected in accordance with Clause 10 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. In the absence of facilities at his own works for making the prescribed tests, the supplier shall make the necessary arrangement for making the tests elsewhere.

### 17 The rounding of numbers rules

Values between the limits of composition and mechanical properties shown (NOT dimensional tolerances) are subject to the application of the "rounding" rule in accordance with BS 1957<sup>2)</sup>. Under this rule the determined values are "rounded" to the last place of figures stated as limits.

### 18 Packaging

The method of packaging shall be specified by the purchaser.

When the wire is supplied in coils, the eye diameter and the weight of the coils shall be the subject of agreement between the purchaser and the supplier.

<sup>2)</sup> BS 1957, "Presentation of numerical values (fineness of expression; rounding of numbers)".

When the wire is supplied on spools, reels or drums, these shall be of wood, metal or plastics as agreed between the purchaser and the supplier and they should preferably comply with the requirements of BS 1559<sup>3)</sup>.

**Table 1 — Tolerances on round wire  
(for materials other than C101, C102,  
C103 and C108)**

Specified diameter		Tolerance plus and minus	Difference between max. and min. measurements not to exceed
Over	Up to and including		
mm	mm	mm	mm
—	0.25	0.005	0.005
0.25	0.50	0.008	0.008
0.50	1.00	0.012	0.012
1.00	2.00	0.020	0.020
2.00	4.00	0.030	0.030
4.00	8.00	0.040	0.040
8.00	12.5	0.050	0.050
12.5	—	By agreement	

**Table 2 — Tolerances on round wire  
(for materials C101, C102, C103 and C108)**

Specified diameter		Tolerance plus and minus	Difference between max. and min. measurements not to exceed
Over	Up to and including		
mm	mm	mm	mm
—	0.10	0.002	0.002
0.10	0.40	0.004	0.004
0.40	4.00	1 %	1 %
4.00	8.00	0.05	0.05
8.00	—	By agreement	

**Table 3 — Tolerances on square and  
hexagonal wire**

Specified width across flats		Tolerance plus and minus
Over	Up to and including	
mm	mm	mm
0.25	0.50	0.015
0.50	1.00	0.025
1.00	2.00	0.035
2.00	4.00	0.050
4.00	8.00	0.065

<sup>3)</sup> BS 1559, "Reels and wooden drums for bare wire, stranded conductors and trolley wire, for use in the United Kingdom".

**Table 4 — Chemical composition and mechanical properties of copper and copper alloy wire**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Copper	Tin	Lead	Iron	Nickel	Arsenic	Antimony	Bismuth	Phosphorus	Selenium + Tellurium	Tellurium
		%	%	%	%	%	%	%	%	%	%	%
C101	Electrolytic tough pitch high conductivity copper	99.90 min. (Incl. silver)	—	0.005	—	—	—	—	0.0010	—	—	—
C102	fire refined tough pitch high conductivity copper	99.90 min. (incl. silver)	—	0.005	—	—	—	—	0.0025	—	—	—
C103	Oxygen-free high conductivity copper	99.95 min. (incl. silver)	—	0.005	—	—	—	—	0.0010	—	—	—
C106	Phosphorus deoxidized non-arsenical copper	99.85 min. (Incl. silver)	0.01	0.010	0.030	0.10 <sup>a</sup>	0.05	0.005	0.0030	0.013/0.050	0.020	0.010
C108	Copper-cadmium	REM	—	—	—	—	—	—	—	—	—	—

For wrapping test requirements see 11.2.

NOTE 1 C101. The limitation of oxygen to 0.06 % for vertically cast shapes may be the subject of agreement between the purchaser and the supplier.

NOTE 2 C101, C102—Silver-bearing copper. Silver may be present in specific amounts between 0.03 % and 0.2 %. If silver is to be present as an alloying element the purchaser should specify the silver content he requires at the time of the enquiry and order.

NOTE 3 C101, C102. For special requirements the limitation of other individual impurities or special elements may be the subject of agreement.

NOTE 4 C103, C106. Oxygen limitation is defined by the hydrogen embrittlement clause. (See 10.2)

NOTE 5 C106. Should the copper be required to undergo severe fabrication in the temperature range 400–700 °C, this fact shall be indicated by the purchaser and in such cases the bismuth content shall not exceed 0.0015 %.

<sup>a</sup> Impurity or optional addition.

Cadmium	Total impurities	Condition	Diameter		Tensile strength min.	Elongation on 200 mm min.		Complies with or falls within ISO recommendation
			Over	Up to and incl.				
%	%		mm	mm	hbar <sup>a</sup>	%		
—	0.03 (excluding oxygen and silver)	O	— 0.125 0.50 0.90 1.25	0.125 0.50 0.90 1.25 10.0	— — — — —	10 15 20 25 30		—
—	0.04 (excluding oxygen and silver)	H	— 1.60 2.50	1.60 2.50 —	45.5 44.5 —	— — —	— — —	— — —
—	0.03 (excluding oxygen and silver)	—	—	—	—	—	—	—
—	0.06 (excluding Ag, As, Ni, P)	—	—	—	—	—	—	—
.5/1.2	0.05	H	—	—	—	—	—	—

<sup>a</sup> For conversion to MN/m<sup>2</sup>, kgf/mm<sup>2</sup>, tonf/in<sup>2</sup> see Appendix B.

**Table 5 — Chemical composition and mechanical properties of brass wire**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Copper	Lead	Iron	Zinc	Total impurities	Condition	Diameter		Tensile strength	Tensile strength	Elongation on 100 mm	Complies with or falls within ISO recommendation
								Over	Up to and incl.				
								mm	mm	min.	max.	min.	
CZ 101	90/10 brass	<b>89.0/91.0</b>	0.10	0.10	<b>REM.</b>	0.40	<b>O</b> <b>½H</b> <b>H</b>	} To be agreed between purchaser and supplier		hbar <sup>a</sup>	hbar <sup>a</sup>	%	R426 CuZn10
CZ 102	85/15 brass	<b>84.0/86.0</b>	0.10	0.10	<b>REM.</b>	0.40	<b>O</b> <b>½H</b> <b>H</b>	0.5 0.5 0.5	10.0 10.0 10.0	29.0 43.0 59.0	— 59.0 —	25 — —	R426 CuZn15
CZ 103	80/20 brass	<b>79.0/81.0</b>	0.10	0.10	<b>REM.</b>	0.40	<b>O</b> <b>½H</b> <b>H</b>	0.5 0.5 0.5	10.0 10.0 10.0	31.0 46.0 62.0	— 62.0 —	30 — —	R426 CuZn20
CZ 106	70/30 brass	<b>68.5/71.5</b>	0.05	0.05	<b>REM.</b>	0.30	<b>O</b> <b>½H</b> <b>H</b>	0.5 0.5 0.5	10.0 10.0 10.0	31.0 46.0 62.0	— 62.0 —	45 — —	R426 CuZn30
CZ 107	2/1 brass	<b>64.0/67.0</b>	0.10	0.10	<b>REM.</b>	0.40	<b>O</b> <b>½H</b> <b>H</b> <b>EH</b> <b>EH</b>	0.5 0.5 0.5 2.5	10.0 10.0 10.0 2.5 6.0	32.0 46.0 62.0 74.0 70.0	— 62.0 74.0 82.0 77.0	35 — — — —	R426 CuZn33
CZ 108	Common brass	<b>62.0/65.0</b>	0.30	—	<b>REM.</b>	0.60	<b>O</b> <b>½H</b> <b>H</b> <b>EH</b> <b>EH</b>	0.5 0.5 0.5 2.5	10.0 10.0 10.0 2.5 6.0	32.0 46.0 62.0 74.0 70.0	— 62.0 77.0 — —	35 — — — —	R426 CuZn37
CZ 119	Leaded brass 62% copper 2% lead	<b>61.0/64.0</b>	<b>1.0/2.5</b>	—	<b>REM.</b>	0.30	<b>O</b> <b>½H</b> <b>H</b>	} To be agreed between purchaser and supplier					—

For wrapping test requirement see 11.2.

<sup>a</sup> For conversion to MN/m<sup>2</sup>, kgf/mm<sup>2</sup>, tonf/in<sup>2</sup>, see Appendix B.

**Table 6 — Chemical composition and mechanical properties of phosphor bronze  
(copper-tin-phosphorus) wire**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Copper	Tin	Lead	Phosphorus	Total impurities	Condition	Diameter		Tensile strength	Tensile strength	Elongation on 100 mm	Complies with or falls within ISO recommendation
								Over	Up to and incl.				
								min.	mix.	min.			
PB 102	5 % phosphor bronze (copper-tin-phosphorus)	REM.	4.5/6.0	0.02	0.02/0.40	0.20	O ½H H EH EH	0.5	10.0	34.0	—	40	—
								0.5	10.0	54.0	70.0	—	
								0.5	10.0	70.0	85.0	—	
								2.5	6.0	85.0	—	—	
								2.5	6.0	80.0	—	—	
PB 103	7 % phosphor bronze (copper-tin-phosphorus)	REM.	6.0/7.5	0.02	0.02/0.40	0.20	O ½H H EH EH	0.5	10.0	37.0	—	50	R427 CuSn7
								0.5	10.0	59.0	74.0	—	
								0.5	10.0	74.0	90.0	—	
								2.5	6.0	90.0	—	—	
								2.5	6.0	85.0	—	—	

For wrapping test requirements see 11.2.

<sup>b</sup> For conversion to MN/m<sup>2</sup>, kgf/mm<sup>2</sup>, tonf/in<sup>2</sup>, see Appendix B.

**Table 7 — Chemical composition of nickel silver wire**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Copper	Lead	Iron	Nickel	Zinc	Manganese	Total impurities	Condition	Complies with or falls within ISO recommendation
NS 103	10 % nickel silver (copper-nickel-zinc)	<b>60.0/65.0</b>	0.04	0.25	<b>9.0/11.0</b>	REM.	<b>0.05/0.30</b>	0.50	O ½H H	—
NS 104	12 % nickel silver (copper-nickel-zinc)	<b>60.0/65.0</b>	0.04	0.25	<b>11.0/13.0</b>	REM.	<b>0.05/0.30</b>	0.50	O ½H H	—
NS 105	15 % nickel silver (copper-nickel-zinc)	<b>60.0/65.0</b>	0.04	0.30	<b>14.0/16.0</b>	REM.	<b>0.05/0.50</b>	0.50	O ½H H	—
NS 106	18 % nickel silver (copper-nickel-zinc)	<b>60.0/65.0</b>	0.03	0.30	<b>17.0/19.0</b>	REM.	<b>0.05/0.50</b>	0.50	O ½H H	R430 CuNi 8 Zn 20
NS 107	18 % nickel silver (copper-nickel-zinc)	<b>54.0/56.0</b>	0.03	0.30	<b>17.0/19.0</b>	REM.	<b>0.05/0.35</b>	0.50	O ½H H	R430 CuNi 8 Zn 27
NS 108	20 % nickel silver (copper-nickel-zinc)	<b>60.0/65.0</b>	0.025	0.30	<b>19.0/21.0</b>	REM.	<b>0.05/0.50</b>	0.50	O ½H H	—
NS 109	25 % nickel silver (copper-nickel-zinc)	<b>55.0/60.0</b>	0.025	0.30	<b>24.0/26.0</b>	REM.	<b>0.05/0.75</b>	0.50	O ½H H	—

Mechanical properties to be agreed between the purchaser and the suppliers

**Table 8 — Chemical composition of silicon bronze wire**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Copper	Iron	Silicon	Manganese	Total impurities	Complies with or falls within ISO recommendation
CS101	Silicon bronze (copper-silicon)	% REM.	% 0.25	% 2.75/3.25	% 0.75/1.25	% 0.50 excl. Fe	—

The condition of the material and the mechanical properties required are to be agreed between the purchaser and the supplier.

**Table 9 — Chemical composition and mechanical properties of copper-beryllium wire**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Copper	Nickel + cobalt	Beryllium	Total impurities	Condition	Diameter		Tensile strength min	Elongation on 100 mm min	Complies with or falls within ISO recommendation
							Over	Upto and incl.			
CB101	Copper-beryllium	REM.	0.05/0.40	1.7/1.9	0.50	W W(H) WP <sup>b</sup> W(H)P <sup>b</sup>	0.5	10.0	39.0	30	—
								3.0	77.0	—	
							0.5	10.0	105.0	—	
							3.0	124.0	—		

For wrapping test requirements see 11.2.

<sup>a</sup> For conversion to MN/m<sup>2</sup>, kgf/mm<sup>2</sup>, tonf/in<sup>2</sup>, see Appendix B.

<sup>b</sup> The precipitation heat treatment to be applied for test purposes to material in the WP and W(H)P conditions shall be 335 ± 5 °C for 2 hours. This heat treatment procedure is not necessarily the optimum treatment for all tempers of material intended for practical applications.



## Appendix A Alloys not included in this standard but available in other product forms (see BS 2870, BS 2871, BS 2872, BS 2874, BS 2875<sup>4)</sup>)

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Available as sheet and strip Tube Wire	Copper	Tin	Lead	Iron	Nickel	Zinc	Arsenic	Antimony	
		S T W									FS P
		Forging stock and forgings plate									
			%	%	%	%	%	%	%	%	
C104	Tough pitch non-arsenical copper	S, P	<b>99.85</b> min. (incl. silver)	0.01	0.010	0.01	0.05 <sup>a</sup>	—	0.02	0.005	
C105	Tough pitch arsenical copper	S, R & S, P	<b>99.20</b> min. (incl. silver)	0.03	0.02	0.02	0.15	—	<b>0.30/0.50</b>	0.005	
C107	Phosphorus deoxidized arsenical copper	S, T, R & P	<b>99.20</b> min. (incl. silver)	0.01	0.10	0.030	0.15 <sup>a</sup>	—	<b>0.30/0.50</b>	0.01	
C109	Copper-tellurium	W, P	<b>REM.</b>	—	—	—	—	—	—	—	
C111	Copper-sulphur	R & S	<b>REM.</b>	—	—	—	—	—	—	—	
CZ104	Leaded 80/20 brass	R & S	<b>79.0/81.0</b>	—	<b>0.10/1.0</b>	—	—	<b>REM.</b>	—	—	
CZ105	70/30 arsenical brass	T, P	<b>70.0/73.0</b>	—	0.075	—	—	<b>REM.</b>	<b>0.02/0.06</b>	—	
CZ109	Lead free 60/40 brass	FS, R & S	<b>59.0/62.0</b>	—	0.10	—	—	<b>REM.</b>	—	0.02 <sup>b</sup>	
CZ110	Aluminium brass	T, P	<b>76.0/78.0</b>	—	0.07	0.06	—	<b>REM.</b>	<b>0.02/0.06</b>	—	
CZ111	Admiralty brass	T	<b>70.0/73.0</b>	<b>1.0/1.5</b>	0.075	0.06	—	<b>REM.</b>	<b>0.02/0.06</b>	—	

NOTE The compositions listed in this table are correct at the time of printing, but the relevant Specification must be referred to ensure that modification to these values has not been made subsequently.

<sup>a</sup> Impurity or optional addition.

<sup>b</sup> If required.

<sup>4)</sup> BS 2870, BS 2871, BS 2872, BS 2874, BS 2875 "Specification for copper and copper alloys".

Aluminium	Silicon	Cadmium	Manganese	Magnesium	Sulphur	Phosphorus	Selenium	Tellurium	Bismuth	Oxygen — Carbon	Total impurities
%	%	%	%	%	%	%	%	%	%	%	%
—	—	—	—	—	—	—	0.020	0.010	0.0030	Oxygen 0.10	0.50 (excl. oxygen and silver)
—	—	—	—	—	—	—	Se + Te 0.030		0.0050	Oxygen 0.10	—
—	—	—	—	—	—	<b>0.013/0.050</b>	Se + Te	0.020 0.010	0.0030	—	0.07 (excl. silver, arsenic, nickel, phosphorus)
—	—	—	—	—	—	—	—	<b>0.30/0.70</b>	—	—	0.20
—	—	—	—	—	<b>0.3/0.6</b>	—	—	—	—	—	0.20
—	—	—	—	—	—	—	—	—	—	—	0.60
—	—	—	—	—	—	—	—	—	—	—	0.30
—	—	—	—	—	—	—	—	—	—	—	0.30 (excl. lead)
<b>1.8/2.3</b>	—	—	—	—	—	—	—	—	—	—	0.30
—	—	—	—	—	—	—	—	—	—	—	0.30

**Appendix A Alloys not included in this standard but available in other product forms (see BS 2870, BS 2871, BS 2872, BS 2874, BS 2875<sup>a</sup>)**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Available as sheet and strip Tube Wire Forging stock and forgings plate	S T W FS P	Copper	Tin	Lead	Iron	Nickel	Zinc	Arsenic	Antimony
CZ112	Naval brass	S, FS, R&S, P		61.0/63.5	1.0/1.4	—	—	—	REM.	—	—
CZ113	Naval brass (special mixture)	R&S		57.5/60.5	0.6/1.25	—	—	—	REM.	—	—
CZ114 <sup>b</sup>	High tensile brass	FS, R&S		56.0/60.0	0.2/1.0	0.5/1.5	0.25/1.2	—	REM.	—	0.02 <sup>c</sup>
CZ115 <sup>b</sup>	High tensile brass (soldering quality)	FS, R&S		56.0/59.0	0.6/1.1	0.5/1.5	0.25/1.2	—	REM.	—	—
CZ116	High tensile brass	FS, R&S		64.0/68.0	—	—	0.25/1.2	—	REM.	—	—
CZ118	Leaded brass 64 % copper 1 % lead	S		63.0/66.0	—	0.75/1.5	—	—	REM.	—	—
CZ120	Leaded brass 59 % copper 2 % lead	S		58.0/60.0	—	1.5/2.5	—	—	REM.	—	—
CZ121	Leaded brass 58 % copper 3 % lead	R&S		56.0/59.0	—	2.0/3.5	—	—	REM.	—	0.02 <sup>c</sup>
CZ122	Leaded brass 58 % copper 2 % lead	FS, R&S		56.5/60.0	—	1.0/2.5	0.30	—	REM.	—	0.02 <sup>c</sup>
CZ123	60/40 brass	S, FS, R&S, P		59.0/62.0	—	0.3/0.8	—	—	REM.	—	0.02 <sup>c</sup>
CZ124	Leaded brass 62 % copper 3 % lead	R&S		60.0/63.0	—	2.5/3.7	0.35	—	REM.	—	—
CZ125	Cap copper	S		95.0/98.0	—	0.02	0.05	—	REM.	—	—

NOTE The compositions listed in this table are correct at the time of printing, but the relevant specification must be referred to to ensure that modification to these values has not been made subsequently.

<sup>a</sup> BS 2870, BS 2871, BS 2872, BS 2874, BS 2875, Specification for copper and copper alloys.

<sup>b</sup> If material is required with a lower lead content than that specified, it may be ordered with a maximum lead content of 0.1 % or 0.5 %.

<sup>c</sup> If required.

Aluminium	Silicon	Cadmium	Manganese	Magnesium	Sulphur	Phosphorus	Selenium	Tellurium	Bismuth	Oxygen — Carbon	Total impurities
%	%	%	%	%	%	%	%	%	%	%	%
—	—	—	—	—	—	—	—	—	—	—	0.75
—	—	—	—	—	—	—	—	—	—	—	0.75
1.5	—	—	<b>0.3/2.0</b>	—	—	—	—	—	—	—	0.50 (excl. Al)
0.2	—	—	<b>0.3/2.0</b>	—	—	—	—	—	—	—	0.50
<b>4.0/5.0</b>	—	—	<b>0.3/2.0</b>	—	—	—	—	—	—	—	0.50
—	—	—	—	—	—	—	—	—	—	—	0.30
—	—	—	—	—	—	—	—	—	—	—	0.30
—	—	—	—	—	—	—	—	—	—	—	0.75
—	—	—	—	—	—	—	—	—	—	—	0.75
—	—	—	—	—	—	—	—	—	—	—	0.30
—	—	—	—	—	—	—	—	—	—	—	0.50 (excl. iron)
—	—	—	—	—	—	—	—	—	—	—	0.25

**Appendix A Alloys not included in this standard but available in other product forms (see BS 2870, BS 2871, BS 2872, BS 2874, BS 2875<sup>a</sup>)**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Available as sheet and strip Tube Wire Forging stock and forgings plate	S T W  FS P	Copper	Tin	Lead	Iron	Nickel	Zinc	Arsenic	Antimony
				%	%	%	%	%	%	%	%
CN101	95/5 copper-nickel-iron	S, T, P		REM.	0.01	0.01	1.05/1.35	5.0/6.0	—	—	—
CN102	95/10 copper-nickel-iron	S, T, P		REM.	—	0.01	1.00/2.00	10.0/11.0	—	—	—
CN103	85/15 copper-nickel	S		84.0/86.0	—	0.01	0.25	14.0/16.0	—	—	—
CN104	80/20 copper-nickel	S, P		79.0/81.0	—	0.01	0.30	19.0/21.0	—	—	—
CN105	75/25 copper-nickel	S		REM.	—	—	0.30	24.0/26.0	0.20	—	—
CN106	70/30 copper-nickel	S, P		69.0/71.0	—	0.01	0.30	29.0/31.0	—	—	—
CN107	70/30 copper-nickel	S, T, P		REM.	—	0.01	0.40/1.00	30.0/32.0	—	—	—
PB101	3 % phosphor bronze (copper-tin-phosphorus)	S, P		REM.	3.0/4.5	0.02	—	—	—	—	—
PB103	7 % phosphor bronze (copper-tin-phosphorus)	S, W		REM.	6.0/7.5	0.02	—	—	—	—	—
CA101	5 % aluminium bronze (copper-aluminium)	S, T		REM.	—	0.02	—	—	—	—	—
CA102	7 % aluminium bronze (copper-aluminium)	T, P		REM.	—	—	Fe + Mn + Ni 1.0/2.5 optional but between these limits if present	—	—	—	—

NOTE The compositions listed in this table are correct at the time of printing, but the relevant Specification must be referred to ensure that modification to these values has not been made subsequently.

<sup>a</sup> BS 2870, BS 2871, BS 2872, BS 2874, BS 2875, Specification for copper and copper alloys

Aluminium	Silicon	Cadmium	Manganese	Magnesium	Sulphur	Phosphorus	Selenium	Tellurium	Bismuth	Oxygen — Carbon	Total impurities
%	%	%	%	%	%	%	%	%	%	%	%
—	—	—	<b>0.30/0.80</b>	—	0.05	—	—	—	—	Carbon 0.05	0.30
—	—	—	<b>0.50/1.0</b>	—	0.05	—	—	—	—	Carbon 0.05	0.30
—	—	—	<b>0.05/0.50</b>	—	0.02	—	—	—	—	Carbon 0.05	0.30
—	—	—	<b>0.05/0.50</b>	—	0.02	—	—	—	—	Carbon 0.05	0.1
—	—	—	<b>0.05/0.40</b>	—	0.02	—	—	—	—	Carbon 0.05	0.35
—	—	—	<b>0.05/0.50</b>	—	0.03	—	—	—	—	Carbon 0.06	0.1
—	—	—	<b>0.50/1.50</b>	—	0.08	—	—	—	—	Carbon 0.06	0.30
—	—	—	—	—	—	<b>0.02/0.40</b>	—	—	—	—	0.20
—	—	—	—	—	—	<b>0.02/0.40</b>	—	—	—	—	0.20
4.5/5.5	—	—	—	—	—	—	—	—	—	—	0.50
6.0/7.5	—	—	See Fe + Ni	—	—	—	—	—	—	—	0.50

**Appendix A Alloys not included in this standard but available in other product forms (see BS 2870, BS 2871, BS 2872, BS 2874, BS 2875<sup>a</sup>)**

For essential alloying elements, limits are in heavy type. Unless otherwise stated, figures in total impurities column include those in lighter type. Unless otherwise indicated, all limits are maxima.

Designation	Material	Available as sheet and strip Tube Wire Forging stock and forgings plate	S T W FS P	Copper	Tin	Lead	Iron	Nickel	Zinc	Arsenic	Antimony
CA103	9 % aluminium bronze (copper-aluminium)	R&S		REM.	0.10	0.05	% Fe + Ni 4.0	%	0.40	—	—
CA104	10 % aluminium bronze (copper-aluminium-nickel-iron)	R&S		REM.	0.10	0.05	4.0/6.0	4.0/6.0	0.40	—	—
CA105	10 % aluminium bronze (copper-aluminium-nickel-iron-manganese)	P		78.0/85.0	0.10	0.05	1.5/3.5	4.0/7.0	0.40	—	—
CA106	7 % aluminium bronze (copper-aluminium-iron)	R&S, P		REM.	0.10	0.05	2.0/3.5	0.50	0.40	—	—
NS101	Leaded 10 % nickel brass	FS, R&S		44.0/47.0	—	1.0/2.5	0.4	9.0/11.0	REM.	—	—
NS102	Leaded 14 % nickel brass	R&S		39.0/42.0	—	1.0/2.25	0.3	13.0/15.0	REM.	—	—
NS111	10 % leaded nickel silver	R&S		58.0/63.0	—	1.0/2.0	—	9.0/11.0	REM.	—	—
NS112	15 % leaded nickel silver	R&S		60.0/63.0	—	0.5/1.0	—	14.0/16.0	REM.	—	—
NS113	18 % leaded nickel silver	R&S		60.0/63.0	—	0.4/0.8	0.3	17.0/19.0	REM.	—	—

NOTE The compositions listed in this table are correct at the time of printing but the relevant specification must be referred to to ensure that modification to these values has not been made subsequently.

<sup>a</sup> BS 2870, BS 2871, BS 2872, BS 2874, BS 2875, Specification for copper and copper alloys

Aluminium	Silicon	Cadmium	Manganese	Magnesium	Sulphur	Phosphorus	Selenium	Tellurium	Bismuth	Oxygen — Carbon	Total impurities
%	%	%	%	%	%	%	%	%	%	%	%
<b>8.8/10.0</b>	0.10	—	0.50	0.05	—	—	—	—	—	—	0.50 (excl. manganese)
<b>8.5/11.0</b>	0.10	—	0.50	0.05	—	—	—	—	—	—	0.50 (excl. manganese)
<b>8.0/11.0</b>	0.15	—	<b>0.5/2.0</b>	0.05	—	—	—	—	—	—	0.50
<b>6.5/8.0</b>	0.15	—	0.50	0.05	—	—	—	—	—	—	0.50 (excl. nickel and manganese)
—	—	—	<b>0.2/0.5</b>	—	—	—	—	—	—	—	0.30 (excl. iron)
—	—	—	<b>1.5/3.0</b>	—	—	—	—	—	—	—	0.30 (excl. iron)
—	—	—	<b>0.1/0.5</b>	—	—	—	—	—	—	—	0.50
—	—	—	<b>0.1/0.5</b>	—	—	—	—	—	—	—	0.50
—	—	—	<b>0.1/0.5</b>	—	—	—	—	—	—	—	0.50 (excl. iron)



## Appendix B Conversion of stress in hbar to kgf/mm<sup>2</sup> and tonf/in<sup>2</sup>

NOTE Conversions given below have been rounded to the following degree of accuracy: kgf/mm<sup>2</sup>, tonf/in<sup>2</sup> to the nearest 0.5 unit; lbf/in<sup>2</sup> to the nearest 500 lbf/in<sup>2</sup>.

hbar	kgf/mm <sup>2</sup>	tonf/in <sup>2</sup>	lbf/in <sup>2</sup>
29.0	29.5	18.5	41 500
31.0	31.5	20.0	44 500
32.0	32.5	20.5	45 500
34.0	34.5	22.0	49 000
37.0	37.5	24.0	54 000
39.0	40.0	25.5	55 000
43.0	44.0	28.0	63 000
44.5	45.5	29.0	65 000
45.5	46.5	29.5	66 000
46.0	47.0	30.0	67 000
54.0	55.0	35.0	78 500
59.0	60.0	38.0	85 000
62.0	63.0	40.0	89 000
70.0	71.5	45.5	90 000
74.0	75.5	48.0	107 500
77.0	78.5	50.0	112 000
80.0	81.5	52.0	116 500
85.0	86.5	55.0	123 000
90.0	92.0	58.5	131 000
105.0	107.0	68.0	152 500
124.0	126.5	80.5	180 000

### Conversion factors

1 hbar = 100 bar = 10 MN/m<sup>2</sup> = 10 N/mm<sup>2</sup> = 0.647 49 tonf/in<sup>2</sup> = 1450.38 lbf/in<sup>2</sup> = 1.019 72 kgf/mm<sup>2</sup>.

For more detailed conversions see BS 350, "Conversion factors and tables".

## Appendix C Individual British Standard specifications which should be referred to when other than metric specifications are required

NOTE Attention is drawn to the fact that the existing individual standards in imperial units listed below (except those with specified electrical properties) will not be revised in metric terms, but will be retained in imperial units during the transition period from imperial to metric units. It is anticipated that these individual standards will be progressively withdrawn so that, by not later than 1975, all these standards will be obsolete.

Designation	Material	Number and title of British Standard for wire	Equivalent British Standard for raw material
C101	Electrolytic tough pitch high conductivity copper	BS 4109 <sup>a</sup> Copper for electrical purpose: wire for general electrical purpose and for insulated cables and flexible cords	BS 1036 <sup>a</sup>
C102	Fire refined tough pitch high conductivity copper		BS 1037 <sup>a</sup>
C103	Oxygen-free high conductivity copper	—	BS 1861 <sup>a</sup>
C106	Phosphorus deoxidised non-arsenical copper	—	BS 1172 <sup>a</sup>
C108	Copper-cadmium	—	—
CZ101	90/10 brass	—	—
CZ102	85/15 brass	—	—
CZ103	80/20 brass	—	—
CZ106	70/30 brass	—	—
CZ107	2/1 brass	BS 2786. Brass wire for springs, 2/1 brass.	—
CZ119	Leaded brass 62 % Cu 2 % Pb	—	—
PB102	5 % phosphor bronze (copper-tin-phosphorus)	BS 384. Phosphor bronze wire.	—
PB103	7 % phosphor bronze (copper-tin-phosphorus)		—
NS103	10 % nickel silver	—	—
NS104	12 % nickel silver	—	—
NS105	15 % nickel silver	—	—
NS106	18 % nickel silver	—	—
NS107	18 % nickel silver	—	—
NS108	20 % nickel silver	—	—
NS109	25 % nickel silver	—	—
CS101	copper-silicon	—	—
CB101	Copper-beryllium	—	—

<sup>a</sup> Specifies electrical properties.



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