

Specification for

Copper and copper alloy forging stock and forgings

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- British Bathroom Council
- British Cable Makers' Confederation
- British Gas plc
- British Malleable Tube Fittings Association
- British Non-ferrous Metals Federation
- British Valve and Actuator Manufacturers' Association
- Copper Development Association
- London Metal Exchange
- Non-ferrous Metal Stockists
- Society of British Aerospace Companies Limited
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The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- British Plumbing Fittings Manufacturers' Association
- British Telecommunications plc
- British Turned-parts Manufacturers' Association
- Copper Smelters' and Refiners' Association
- Electronic Engineering Association
- Spring Research and Manufacturers' Association
- Telecommunication Engineering and Manufacturing Association

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Contents

	Page
Committees responsible	Inside front cover
Foreword	iii
Section 1. Forging stock and forgings	
1 Scope	1
2 Definitions	1
3 General requirements	1
4 Chemical composition	1
Section 2. Forging stock	
5 Material condition	2
6 Tensile properties	2
7 Resistance to dezincification (applicable to alloy CZ 132 only)	2
8 Tolerances on dimensions	2
9 Selection of test samples	2
10 Preparation of test samples	2
11 Retests for forging stock	3
Section 3. Forgings	
12 Material condition	4
13 Tensile properties	4
14 Residual stress	4
15 Resistance to dezincification (applicable to forgings in CZ 132 only)	4
16 Tolerances on dimensions	4
17 Selection and preparation of test samples	4
18 Retests for forgings	5
Appendix A Information to be supplied by the purchaser	12
Appendix B Designations, nominal compositions and product forms specified for alloys in the BS 2870 to BS 2875 series	13
Appendix C Conversion of stress units	16
Appendix D The rounding of numbers rule	17
Appendix E Methods for the determination of tensile properties	17
Appendix F Method of test to establish dezincification resistance of material designated CZ 132	17
Appendix G Method for the detection of residual stress by the mercurous nitrate test	19
Appendix H Quality tolerances for forgings	20
Figure 1 — Illustration of dezincification resistance test	19
Table 1 — Chemical composition and tensile properties of coppers	6
Table 2 — Chemical composition and tensile properties of alloyed coppers	7
Table 3 — Chemical composition and tensile properties of brasses	8
Table 4 — Chemical composition and tensile properties of aluminium bronzes and copper-nickel alloys	10
Table 5 — Alloy groups for tolerances on forging stock	11
Table 6 — Dimensional tolerances for round forging stock	11
Table 7 — Nominal batch sizes (masses) for sampling forging stock	11
Table 8 — Nominal batch sizes (masses) for sampling forgings	11
Table 9 — Designations, nominal compositions and product forms specified for alloys in the BS 2870 to BS 2875 series	13

	Page
Table 10 — Conversion of stress in N/mm ² to kgf/mm ² , tonf/in ² and lbf/in ²	16
Table 11 — Quantity tolerances for forgings	20
Publications referred to	Inside back cover

Foreword

This British Standard has been prepared under the direction of the Non-ferrous Metals Standards Policy Committee. It is the second metric revision of BS 2872, which was originally published in 1962 and subsequently revised in 1969 and it supersedes the 1969 edition, which is withdrawn. It is one in a series of standards for copper and copper alloys in various wrought forms, intended for general engineering purposes. The others in the series are:

BS 2870, *Specification for rolled copper and copper alloys: sheet, strip and foil.*

BS 2871, *Specification for copper and copper alloys. Tubes.*

BS 2873, *Specification for copper and copper alloys. Wire.*

BS 2874, *Specification for copper and copper alloy rods and sections (other than forging stock).*

BS 2875, *Specification for copper and copper alloys. Plate.*

In this revision, due regard has been given to the work of the International Organization for Standardization (ISO) and in particular to Technical Committee ISO/TC 26, Copper and copper alloys, in respect of chemical compositions, testing requirements, properties and dimensional tolerances. Whenever possible and appropriate, the requirements of this British Standard have been aligned with those of corresponding international standards.

Certain alloys that are considered to be in sufficient demand to warrant inclusion have been added. The additions are:

C 101, *electrolytic, tough pitch high conductivity copper.*

C 102, *fire refined, tough pitch high conductivity copper.*

C 106, *phosphorus deoxidized, non-arsenical copper.*

C 111, *copper-sulphur.*

C 112, *copper-cobalt-beryllium.*

C 113, *copper-nickel-phosphorus.*

CC 101, *copper-chromium.*

CC 102, *copper-chromium-zirconium.*

CA 107, *copper-aluminium-silicon.*

CN 102 90/10, *copper-nickel-iron.*

CN 107 70/30, *copper nickel-iron.*

CZ 135, *high tensile brass with silicon.*

CZ 136, *manganese brass.*

The alloy previously known as CZ 123 in BS 2872 has been redesignated CZ 137 to avoid confusion with the similar but purer alloy CZ 123 which is included in BS 2870 and BS 2875.

The demand for four of the alloys included in the last edition of this standard is considered to be insufficient to warrant their retention and they have consequently been withdrawn. The alloys withdrawn are CA 103, CA 106, NS 101 and CS 101.

In this revision the standard has been divided into three sections:

- a) section one specifies the general requirements applicable to both forging stock and forgings for the alloys in this standard;
- b) section two specifies those requirements which are specific to forging stock;
- c) section three specifies those requirements which are specific to forgings.

In this revision, and for the purposes of this standard only, each of the alloys has been placed in one of two alloy groups, designated A and B according to their difficulty of fabrication. This alloy grouping is shown in Table 5 and use has been made of the alloy groups in specifying the dimensional tolerances for forging rod in Table 6. Prior to this revision the dimensional tolerances for forging rod had not been specified, but were subject to agreement between the manufacturer and the purchaser. The dimensional tolerances specified in Table 6 for groups A and B are identical with the “normal” tolerances specified in BS 2874 for groups I and II alloys and for group III alloys respectively.

All mechanical properties have been reviewed and revised where appropriate.

The former Appendix C is now considered redundant and has been omitted from this revision. The forgeability test, which was a requirement of the previous edition, has been made an optional test in this edition.

In previous editions of this standard, clauses have been included entitled “Inspection” and “Facilities for testing”. As these clauses are contractual and not relevant to the standard for the product, they have been omitted from this revision.

Technical Committee TC133, Copper and copper alloy products, of the European Committee for Standardization (CEN) is about to embark on a programme of work to develop European Standards (ENs) for copper and copper alloy products. In due course, TC133 should produce an EN for forging stock and forgings. When this EN is approved by the CEN member bodies it will be fully implemented as a British Standard, either by amending or by revising this standard.

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, an inside back cover 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.

Section 1. Forging stock and forgings

1 Scope

This British Standard specifies requirements for the chemical composition, tensile properties and other characteristics for wrought or cast copper and copper alloy forging stock, having a diameter or width across flats greater than 6 mm, and for forgings of these materials.

It applies to forging stock and forgings supplied in the grades of copper and copper alloys listed in Table 1 to Table 4 and the material conditions given in clause 5 for forging stock and in clause 12 for forgings.

Details of information to be supplied by the purchaser are given in Appendix A.

NOTE 1 Table 9 in Appendix B indicates the alloys included in the whole series of copper and copper alloy standards, BS 2870 to BS 2875. This gives nominal compositions, product forms specified and related ISO designations.

NOTE 2 For the convenience of users of this standard, Table 10 in Appendix C gives conversion factors for stress values in SI and imperial units. Throughout this standard, values for the tensile strength and proof stress requirements are stated in newtons per square millimetre (N/mm²), this unit now being in common use in the industry.

NOTE 3 The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1

forging stock

extruded, rolled, drawn or cast material intended for the production of forgings, usually in the form of rod or sections

2.2

rod

a solid product of round, square, rectangular or regular polygonal cross section, uniform throughout its length, usually supplied in straight lengths, and which if rectangular in cross section has a thickness that exceeds one-tenth of the width

2.3

forging(s)

a shape produced by hammering or pressing, usually when hot, between open or closed dies, including hammering between flat surfaces. The term “forging” includes the processes of forging, drop forging, hot stamping, and hot pressing; the term “forgings” includes the products resulting from any of these processes of manufacture

2.4

wrought

a material is considered to be wrought when it has been subjected to sufficient mechanical and thermal treatment to eradicate or change substantially the original structure, usually cast

2.5

cast

cast material is material which has solidified from the liquid state in a mould, and which has not subsequently been worked to eradicate or change substantially the cast structure

3 General requirements

Forging stock shall comply with the general requirements specified in clause 4 and with the specific requirements for forging stock specified in clauses 5 to 8.

NOTE A forgeability test on the forging stock supplied may be requested by the purchaser (see item d) of A.2).

Forgings shall comply with the general requirements specified in clause 4 and with the specific requirements for forgings specified in clauses 12 to 16.

Where tests are carried out to verify that the forging stock or forgings comply with the requirements for chemical composition (see clause 4), tensile properties (see clauses 6 and 13), or resistance to dezincification (see clauses 7 and 15), the sampling and test methods shall be in accordance with clauses 9, 10 and 11 for forging stock and with clauses 17 and 18 for forgings.

The results obtained from chemical analysis and tensile tests shall be rounded to the last place of figures specified as limits, by the application of the rounding rule in accordance with BS 1957 (see Appendix D).

When mercurous nitrate testing for the residual stress in forgings is called for, the sampling shall be in accordance with 17.4.

4 Chemical composition

The chemical composition of the forging stock and forgings shall be as given for the appropriate material in Table 1 to Table 4.

Section 2. Forging stock

5 Material condition

Wrought forging stock shall be supplied in the condition resulting from one of the following final production processes:

- a) hot working;
- b) cold working;
- c) annealing.

NOTE At the request of the purchaser, the supplier should state whether the forging stock supplied is wrought or cast.

6 Tensile properties

The tensile properties of forging stock in the size range 6 mm to 80 mm shall be as given in Table 1 to Table 4 when tested in accordance with Appendix E.

NOTE 1 The tensile property requirements for forging stock outside this size range should be agreed between the purchaser and the supplier.

NOTE 2 Attention is drawn to the options available to the supplier of the forging stock concerning the preparation of the tensile test samples given in 10.1.

7 Resistance to dezincification (applicable to alloy CZ 132 only)

When a sample of forging stock in alloy CZ 132, prepared in accordance with 10.2, is subjected to the dezincification resistance test carried out in accordance with Appendix F, the maximum depth of penetration shall be as follows.

- a) For wrought forging stock:
 - parallel to the direction of extrusion, rolling or drawing: 200 µm
 - perpendicular to the direction of extrusion, rolling or drawing: 100 µm
- b) For cast forging stock:
 - in any direction: 100 µm

NOTE If a sample representative of the batch passes this test, it indicates that forgings produced from the batch of forging stock and correctly heat treated will pass the dezincification test requirement for forgings. The forging manufacturer should, however, still verify this by testing the forgings (see clause 15).

8 Tolerances on dimensions

NOTE 1 Each alloy in this standard has been allotted to one of two groups, designated A and B, for tolerancing purposes. A list of the alloys and groupings, which are specific to this standard, is given in Table 5.

The diameter of round forging stock shall be within the tolerances given in Table 6 for the appropriate alloy group and size.

NOTE 2 The dimensional tolerances to be applied to round forging stock outside the range of sizes given in Table 6, and to forging stock of other shapes, should be agreed between the purchaser and the supplier.

9 Selection of test samples

9.1 General

When tests are required to be carried out to verify that a batch of forging stock complies with this standard (see items a) and c) of A.2), samples for chemical analysis and tensile tests shall be taken in accordance with 9.2.

NOTE 1 If the supplier of the forging stock is also the producer of the forgings, the requirements of this clause may be dispensed with and those in clause 17 taken to apply.

NOTE 2 No sampling requirements for forging stock are specified in this standard for the dezincification resistance test (alloy CZ 132 only). When the purchaser requires this test to be carried out, the sampling requirements should be agreed between the supplier and the purchaser at the time of the enquiry and order (see item c) of A.2).

9.2 Samples for analysis and tensile testing

For sampling, the forging stock shall be grouped into the batch sizes (masses) given in Table 7.

For each test, i.e. analysis and tensile, one sample shall be taken at random from each batch and from any remaining part of a batch.

10 Preparation of test samples

10.1 Tensile test samples

10.1.1 *Materials other than C 112, C 113, CC 101, CC 102 and CZ 132.* Test samples in alloys other than C 112, C 113, CC 101, CC 102 and CZ 132, selected in accordance with 9.2, shall, at the option of the supplier, be prepared in accordance with a), b) or c) as follows:

- a) directly from wrought forging stock produced by hot working; or
- b) from wrought forging stock subsequently annealed at a temperature of not less than 500 °C for not less than 30 min; or
- c) from wrought, or cast, forging stock subsequently hot forged either to approximately 65 % of the original cross-sectional area, or upset forged by at least 50 % of its original length.

NOTE The method of preparation of the test sample, i.e. whether in accordance with a), b) or c) of 10.1.1, should be stated, together with the tensile test results obtained, on any Certificate of Conformity supplied with the forging stock (see a) of A.2 and b) of A.3).

10.1.2 *Materials C 112, C 113, CC 101 and CC 102.* Test samples in alloys C 112, C 113, CC 101 and CC 102, selected in accordance with 9.2 shall, at the option of the supplier, be prepared in accordance with a) or b) as follows:

- a) directly from wrought forging stock produced by hot working; or

b) from wrought or cast forging stock subsequently hot forged either to approximately 65 % of the original cross-sectional area, or upset forged by at least 50 % of its original length.

Samples prepared as in a) or b) above shall then be solution treated and precipitation hardened in conditions specified by the supplier before testing.

NOTE The method of preparation of the test sample, i.e. whether in accordance with a) or b) of 10.1.2, should be stated, together with the tensile test results obtained, on any Certificate of Conformity supplied with the forging stock (see a) of A.2 and b) of A.3).

10.1.3 Material CZ 132. Test samples in alloy CZ 132, selected in accordance with 9.2, shall be heat treated in the temperature range 450 °C to 550 °C before testing.

10.2 Dezincification resistance test samples

Test samples of forging stock in alloy CZ 132 shall be heat treated in the temperature range 450 °C to 550 °C before testing.

11 Retests for forging stock

11.1 Analysis and tensile properties

Should any of the test pieces fail the test for analysis or tensile properties two further samples from the same batch shall be permitted to be selected for retesting that particular property. One of these further samples shall be taken from the same length of forging stock as that from which the original failed test sample was taken, unless that length had been withdrawn by the supplier.

Should both of the further samples pass the retest, the batch represented shall be deemed to comply with that particular requirement of this standard. Should either of the further samples fail the test, the batch represented shall be deemed not to comply with this standard.

11.2 Dezincification resistance test (alloy CZ 132 only)

Should any of the test pieces fail the dezincification resistance test, further samples from the same batch shall be permitted to be taken for retests. The number of samples taken for the retests shall be twice the number first selected (see note 2 to 9.1).

Should all of the further samples pass the test, the batch represented shall be deemed to comply with the dezincification resistance requirements of this standard. Should any one of the further samples fail the test, the batch represented shall be deemed not to comply with this standard.