

Copper and copper alloys — Compendium of compositions and products

ICS 77.120.30; 77.150.30

National foreword

This Published Document reproduces verbatim CR 13388:1998.

The UK participation in its preparation was entrusted to Technical Committee NFE/34, Copper and copper alloys, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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 and ii, the CR title page, pages 2 to 41 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments
12064	July 2001	Corrections to Table 10, Table 11, Table 12, and Table 14

This Published Document, having been prepared under the direction of the Engineering Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 February 1999

© BSI 07-2001

ISBN 0 580 32139 8

Contents

	Page
National foreword	Inside front cover
Foreword	2
Text of CR 13388	5

ICS77.120.30; 77.150.30

Descriptors:

English version

Copper and copper alloys — Compendium of compositions and products

This CEN Report was approved by CEN on 3 September 1998. It has been drawn up by the Technical Committee CEN/TC 133.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

© 1998 CEN All rights of exploitation in any form and by any means reserved worldwide for CEN national Members.

 **Documents**
Ref. No. CR 13388:1998 E
Document Sharing Hub

Foreword

This CEN Report has been prepared by Technical Committee CEN/TC 133 “Copper and copper alloys”, the Secretariat of which is held by DIN.

Within its programme of work, Technical Committee CEN/TC 133 prepared the following CEN Report:

CR 133/91

Copper and copper alloys — Compendium of compositions and products

In the course of its plenary meeting on 30/31 October 1997, CEN/TC 133 “Copper and copper alloys” agreed by Resolution No. 4, see document CEN/TC 133 N 830, to submit this document for BT approval.

Contents

	Page
Foreword	2
Introduction	5
1 Scope	5
2 Compositions of coppers and copper alloys standardized by CEN/TC 133	5
2.1 Composition of coppers	5
2.2 Composition of copper alloys	5
2.3 Composition of master alloys	5
2.4 Composition of ingots and castings	6
2.5 Composition of filler metals	6
2.6 Composition of copper and copper alloy scrap	6
3 Available product forms of copper and copper alloys standardized by CEN/TC 133	6
3.1 Wrought coppers and copper alloys	6
3.2 Master alloys	6
3.3 Ingots and castings	6
3.4 Filler metals	6
3.5 Scrap	6
4 Copper and copper alloys registered by CEN/TC 133	6
Annex A Bibliography	40
Table 1.1 — Composition of unalloyed copper grades made from Cu-CATH-1 (CR001A) according to EN 1978	7
Table 1.2 — Composition of unalloyed copper grades, other than those made from Cu-CATH-1 (CR001A) according to EN 1978	8
Table 1.3 — Composition of phosphorus-containing copper grades	8
Table 1.4 — Composition of silver-containing copper grades (silver-bearing coppers)	9
Table 2 — Composition of copper alloys, low alloyed (less than 5 % alloying elements)	10
Table 3 — Composition of copper-aluminium alloys	12
Table 4 — Composition of copper-nickel alloys	12
Table 5 — Composition of copper-nickel-zinc alloys	13
Table 6 — Composition of copper-tin alloys	14
Table 7 — Composition of copper-zinc alloys, binary	15
Table 8 — Composition of copper-zinc-lead alloys	16
Table 9 — Composition of copper-zinc alloys, complex	17

	Page
Table 10 — Wrought coppers and copper alloys specified in European product standards prepared by CEN/TC 133	19
Table 11 — Master alloys — Composition	25
Table 12.1 — Ingots and castings — Copper and copper-chromium alloys — Composition and casting processes	27
Table 12.2 — Ingots and castings — Copper-zinc alloys — Composition and casting processes	28
Table 12.3 — Ingots and castings — Copper-tin alloys — Composition and casting processes	30
Table 12.4 — Ingots and castings — Copper-tin-lead alloys — Composition and casting processes	31
Table 12.5 — Ingots and castings — Copper-aluminium alloys — Composition and casting processes	32
Table 12.6 — Ingots and castings — Copper-manganese-aluminium alloys — Composition and casting processes	33
Table 12.7 — Ingots and castings — Copper-nickel alloys — Composition and casting processes	33
Table 13.1 — Filler metals — Composition of copper	34
Table 13.2 — Filler metals — Composition of miscellaneous copper alloys	34
Table 13.3 — Filler metals — Composition of copper-zinc alloys	35
Table 13.4 — Filler metals — Composition of copper-tin alloys	36
Table 13.5 — Filler metals — Composition of copper-aluminium alloys	36
Table 13.6 — Filler metals — Composition of copper-nickel-zinc alloys	36
Table 14 — Scrap — Composition	37

Introduction

CEN/TC 133 “Copper and copper alloys” was established in 1988 to prepare and maintain standards in the field of unwrought, wrought and cast products made from copper and copper alloys. Its responsibilities included developing, defining, specifying and giving guidance on, as appropriate, material compositions, designations, terminology, dimensions and tolerances, mechanical and physical characteristics, conditions of delivery and methods of testing peculiar to copper and copper alloys.

During the development of standards for copper and copper alloy products, the experts realized the necessity and seized the opportunity:

- a) to co-ordinate and in some cases also to rationalize the composition limits which already existed for the various product forms;
- b) to establish unique, new and identifiably European designations for copper and copper alloys including a numerical option to be particularly convenient for computerized handling;
- c) to confirm, clarify and re-define where necessary, the terminology which already existed in common usage, at the International level or in customs nomenclature.

CEN/TC 133 decided, in view of the new form of presentation and new parameters for the description and provision of information on copper and copper alloy products, to prepare and publish the present consolidation and summary of essential details.

1 Scope

This document provides a summary of material designations, compositions and the product forms in which they are available, for coppers and copper alloys standardized in European Standards by CEN/TC 133 “Copper and copper alloys”.

It also includes copper alloys which are not standardized by CEN/TC 133 but by other CEN Technical Committees responsible for products in copper alloys, and other copper alloys not yet standardized. These alloys have been registered by CEN/TC 133 in accordance with the procedures laid down in CEN Report CR 12776.

2 Compositions of coppers and copper alloys standardized by CEN/TC 133

2.1 Composition of coppers

The symbol and number designations and compositions of copper grades are given in the following tables:

Table 1.1: Composition of unalloyed copper grades made from Cu-CATH-1 (CR001A)

Table 1.2: Composition of unalloyed copper grades, other than those made from Cu-CATH-1 (CR001A)

Table 1.3: Composition of phosphorus-containing copper grades

Table 1.4: Composition of silver-containing copper grades (silver-bearing coppers)

2.2 Composition of copper alloys

The symbol and number designations and compositions of copper alloys are given in the following tables:

Table 2: Composition of copper alloys, low alloyed (less than 5 % alloying elements)

Table 3: Composition of copper-aluminium alloys

Table 4: Composition of copper-nickel alloys

Table 5: Composition of copper-nickel-zinc alloys

Table 6: Composition of copper-tin alloys

Table 7: Composition of copper-zinc alloys, binary

Table 8: Composition of copper-zinc-lead alloys

Table 9: Composition of copper-zinc alloys, complex

2.3 Composition of master alloys

The symbol and number designations and compositions of master alloys in accordance with EN 1981 are given in Table 11.

2.4 Composition of ingots and castings

The symbol and number designations and compositions of ingots and castings in accordance with EN 1982 are given in the following tables:

Table 12.1: Ingots and castings — Composition of copper and copper-chromium alloys and casting processes

Table 12.2: Ingots and castings — Composition of copper-zinc alloys and casting processes

Table 12.3: Ingots and castings — Composition of copper-tin alloys and casting processes

Table 12.4: Ingots and castings — Composition of copper-tin-lead alloys and casting processes

Table 12.5: Ingots and castings — Composition of copper-aluminium alloys and casting processes

Table 12.6: Ingots and castings — Composition of copper-manganese-aluminium alloys and casting processes

Table 12.7: Ingots and castings — Composition of copper-nickel alloys and casting processes

2.5 Composition of filler metals

The symbol and number designations and compositions of filler metals in accordance with prEN 13347 are given in the following tables:

Table 13.1: Filler metals — Composition of copper

Table 13.2: Filler metals — Composition of miscellaneous copper alloys

Table 13.3: Filler metals — Composition of copper-zinc alloys

Table 13.4: Filler metals — Composition of copper-tin alloys

Table 13.5: Filler metals — Composition of copper-aluminium alloys

Table 13.6: Filler metals — Composition of copper-nickel-zinc alloys

2.6 Composition of copper and copper alloy scrap

The symbol and number designations and compositions of copper and copper alloy scrap in accordance with prEN 12861 are given in Table 14.

3 Available product forms of copper and copper alloys standardized by CEN/TC 133

3.1 Wrought coppers and copper alloys

The product forms and applicable standards are given in Table 10.

3.2 Master alloys

The product forms are given in Table 11.

3.3 Ingots and castings

The product forms are given in Table 12.1 to Table 12.7.

3.4 Filler metals

The product forms are given in Table 13.1 to Table 13.6.

3.5 Scrap

The product forms are given in Table 14.

4 Copper and copper alloys registered by CEN/TC 133

The symbol and number designations of copper grades and copper alloys registered by CEN/TC 133 in accordance with the procedures laid down in CR 12776 will be given in Table 15.

NOTE At the time of publication of this Report, no requests for registration of copper grades or copper alloys had been received.

Table 1.1 — Composition of unalloyed copper grades made from Cu-CATH-1 (CR001A) according to EN 1978

Material designation			Composition in % (m/m)																								
Symbol	Number		Element	Cu	Ag	As	Bi	Cd	Co	Cr	Fe	Mn	Ni	O	P	Pb	S	Sb	Se	Si	Sn	Te	Zn	Elements listed in this table other than copper			
	unwrought copper	wrought copper																						total	excluding		
Cu-ETP1	CR003A	CW003A	min. max.	— —	— 0,002 5	— 0,000 5 ^a	— 0,000 20 ^b	— — ^a	— — ^c	— — ^a	— 0,001 0 ^c	— — ^a	— — ^c	— 0,040	— — ^a	— 0,000 5	— 0,001 5	— 0,000 4 ^a	— 0,000 20 ^b	— — ^c	— — ^c	— 0,000 20 ^b	— — ^c	— 0,006 5	— 0		
Cu-OF1	CR007A	CW007A	min. max.	— —	— 0,002 5	— 0,000 5 ^a	— 0,000 20 ^b	— — ^a	— — ^c	— — ^a	— 0,001 0 ^c	— — ^a	— — ^c	— — ^d	— — ^a	— 0,000 5	— 0,001 5	— 0,000 4 ^a	— 0,000 20 ^b	— — ^c	— — ^c	— 0,000 20 ^b	— — ^c	— 0,006 5	— 0		
Cu-OFE	CR009A	CW009A	min. max.	99,99 —	— 0,002 5	— 0,000 5	— 0,000 20	— 0,000 1	— —	— —	— 0,001 0	— 0,000 5	— 0,001 0	— — ^d	— 0,000 3	— 0,000 5	— 0,001 5	— 0,000 4	— 0,000 20	— —	— 0,000 2	— 0,000 20	— 0,000 1	— —	— —		
Cu-PHCE	CR022A	CW022A	min. max.	99,99 —	— 0,002 5	— 0,000 5	— 0,000 20	— 0,000 1	— —	— —	— 0,001 0	— 0,000 5	— 0,001 0	— — ^d	— 0,001	— 0,000 5	— 0,001 5	— 0,000 4	— 0,000 20	— —	— 0,000 2	— 0,000 20	— 0,000 1	— —	— —		
^a (As+Cd+Cr+Mn+P+Sb) max. 0,001 5 % ^b (Bi+Se+Te) max. 0,000 3 %, of which (Se+Te) max. 0,000 30 % ^c (Co+Fe+Ni+Si+Sn+Zn) max. 0,0002 0 % ^d The oxygen content shall be controlled by the manufacturer so that the material conforms to the hydrogen embrittlement requirements of EN 1976.																											

Table 1.2 — Composition of unalloyed copper grades, other than those made from Cu-CATH-1 (CR001A) according to EN 1978

Material designation			Composition in % (m/m)						
Symbol	Number		Element	Cu ^a	Bi	O	Pb	Other elements (see note)	
	unwrought copper	wrought copper						total	excluding
Cu-ETP	CR004A	CW004A	min. max.	99,90 —	— 0,000 5	— 0,040 ^b	— 0,005	— 0,03	Ag, O
Cu-FRHC	CR005A	CW005A	min. max.	99,90 —	— —	— 0,040 ^b	— —	— 0,04	Ag, O
Cu-FRTP	CR006A	CW006A	min. max.	99,90 —	— —	— 0,100	— —	— 0,05	Ag, Ni, O
Cu-OF	CR008A	CW008A	min. max.	99,95 —	— 0,000 5	— — ^c	— 0,005	— 0,03	Ag

^a Including silver, up to a maximum of 0,015 %.

^b Oxygen content up to 0,060 % is permitted, subject to agreement between the purchaser and the supplier.

^c The oxygen content shall be controlled by the manufacturer so that the material conforms to the hydrogen embrittlement requirements of EN 1976.

NOTE The total of other elements (than copper) is defined as the sum of Ag, As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, P, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any individual elements indicated.

Table 1.3 — Composition of phosphorus-containing copper grades

Material designation			Composition in % (m/m)						
Symbol	Number		Element	Cu ^a	Bi	P	Pb	Other elements (see note)	
	unwrought copper	wrought copper						total	excluding
Cu-PHC	CR020A	CW020A	min. max.	99,95 —	— 0,000 5	0,001 0,006	— 0,005	— 0,03 ^b	Ag, P
Cu-HCP	CR021A	CW021A	min. max.	99,95 —	— 0,000 5	0,002 0,007	— 0,005	— 0,03 ^b	Ag, P
Cu-DLP	CR023A	CW023A	min. max.	99,90 —	— 0,000 5	0,005 0,013	— 0,005	— 0,03	Ag, Ni, P
Cu-DHP	CR024A	CW024A	min. max.	99,90 —	— —	0,015 0,040	— —	— — ^c	—
Cu-DXP	CR025A	—	min. max.	99,90 —	— 0,000 5	0,04 0,06	— 0,005	— 0,03	Ag, Ni, P

^a Including silver, up to a maximum of 0,015 %.

^b The oxygen content shall be controlled by the manufacturer so that the material conforms to the hydrogen embrittlement requirements of EN 1976.

^c If required, the permitted total of elements, other than silver and phosphorus, should be agreed between the purchaser and the supplier.

NOTE The total of other elements (than copper) is defined as the sum of Ag, As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, P, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any individual elements indicated.

Table 1.4 — Composition of silver-containing copper grades (silver-bearing coppers)

Material designation			Composition in % (m/m)							
Symbol	Number		Element	Cu	Ag	Bi	O	P	Other elements (see note)	
	unwrought copper	wrought copper							total	excluding
CuAg0,04	CR011A	CW011A	min. max.	Rem. —	0,03 0,05	— 0,000 5	— 0,040	— —	— 0,03	Ag, O
CuAg0,07	CR012A	CW012A	min. max.	Rem. —	0,06 0,08	— 0,000 5	— 0,040	— —	— 0,03	Ag, O
CuAg0,10	CR013A	CW013A	min. max.	Rem. —	0,08 0,12	— 0,000 5	— 0,040	— —	— 0,03	Ag, O
CuAg0,04P	CR014A	CW014A	min. max.	Rem. —	0,03 0,05	— 0,000 5	— — ^a	0,001 0,007	— 0,03	Ag, P
CuAg0,07P	CR015A	CW015A	min. max.	Rem. —	0,06 0,08	— 0,000 5	— — ^a	0,001 0,007	— 0,03	Ag, P
CuAg0,10P	CR016A	CW016A	min. max.	Rem. —	0,08 0,12	— 0,000 5	— — ^a	0,001 0,007	— 0,03	Ag, P
CuAg0,04(OF)	CR017A	CW017A	min. max.	Rem. —	0,03 0,05	— 0,000 5	— — ^a	— —	— 0,006 5	Ag, O
CuAg0,07(OF)	CR018A	CW018A	min. max.	Rem. —	0,06 0,08	— 0,000 5	— — ^a	— —	— 0,006 5	Ag, O
CuAg0,10(OF)	CR019A	CW019A	min. max.	Rem. —	0,08 0,12	— 0,000 5	— — ^a	— —	— 0,006 5	Ag, O

^a The oxygen content shall be controlled by the manufacturer so that the material conforms to the hydrogen embrittlement requirements of EN 1976.

NOTE The total of other elements (than copper) is defined as the sum of Ag, As, Bi, Cd, Co, Cr, Fe, Mn, Ni, O, P, Pb, S, Sb, Se, Si, Sn, Te and Zn, subject to the exclusion of any individual elements indicated.

Table 2 — Composition of copper alloys, low alloyed (less than 5 % alloying elements)

Material designation		Composition in % (m/m)																		Density ^a g/cm ³ approx.
Symbol	Number	Element	Cu	Al	Be	Co	Cr	Fe	Mn	Ni	P	Pb	S	Si	Sn	Te	Zn	Zr	Others total	
CuBe1,7	CW100C	min. max.	Rem. —	— —	1,6 1,8	— 0,3	— —	— 0,2	— —	— 0,3	— —	— —	— —	— —	— —	— —	— —	— —	— 0,5	8,3
CuBe2	CW101C	min. max.	Rem. —	— —	1,8 2,1	— 0,3	— —	— 0,2	— —	— 0,3	— —	— —	— —	— —	— —	— —	— —	— —	— 0,5	8,3
CuBe2Pb	CW102C	min. max.	Rem. —	— —	1,8 2,0	— 0,3	— —	— 0,2	— —	— 0,3	— —	0,2 0,6	— —	— —	— —	— —	— —	— —	— 0,5	8,3
CuCo1Ni1Be	CW103C	min. max.	Rem. —	— —	0,4 0,7	0,8 1,3	— —	— 0,2	— —	0,8 1,3	— —	— —	— —	— —	— —	— —	— —	— —	— 0,5	8,8
CuCo2Be	CW104C	min. max.	Rem. —	— —	0,4 0,7	2,0 2,8	— —	— 0,2	— —	— 0,3	— —	— —	— —	— —	— —	— —	— —	— —	— 0,5	8,8
CuCr1	CW105C	min. max.	Rem. —	— —	— —	— —	0,5 1,2	— 0,08	— —	— —	— —	— —	— —	— 0,1	— —	— —	— —	— —	— 0,2	8,9
CuCr1Zr	CW106C	min. max.	Rem. —	— —	— —	— —	0,5 1,2	— 0,08	— —	— —	— —	— —	— —	— 0,1	— —	— —	— —	0,03 0,3	— 0,2	8,9
CuFe2P	CW107C	min. max.	Rem. —	— —	— —	— —	— —	2,1 2,6	— —	— —	0,015 0,15	— 0,03	— —	— —	— —	— —	0,05 0,20	— —	— 0,2	8,8
CuNi1P	CW108C	min. max.	Rem. —	— —	— —	— —	— —	— —	— —	0,8 1,2	0,15 0,25	— —	— —	— —	— —	— —	— —	— —	— 0,1	8,9
CuNi1Si	CW109C	min. max.	Rem. —	— —	— —	— —	— 0,2	— 0,1	— 1,6	1,0 1,6	— —	— 0,02	— —	0,4 0,7	— —	— —	— —	— —	— 0,3	8,8
CuNi2Be	CW110C	min. max.	Rem. —	— —	0,2 0,6	— 0,3	— —	— 0,2	— —	1,4 2,4	— —	— —	— —	— —	— —	— —	— —	— —	— 0,5	8,8
CuNi2Si	CW111C	min. max.	Rem. —	— —	— —	— —	— 0,2	— 0,1	— 2,5	1,6 2,5	— —	— 0,02	— —	0,4 0,8	— —	— —	— —	— —	— 0,3	8,8
CuNi3Si1	CW112C	min. max.	Rem. —	— —	— —	— —	— 0,2	— 0,1	— 4,5	2,6 4,5	— —	— 0,02	— —	0,8 1,3	— —	— —	— —	— —	— 0,5	8,8
CuPb1P	CW113C	min. max.	Rem. —	— —	— —	— —	— —	— —	— —	— —	0,003 0,012	0,7 1,5	— —	— —	— —	— —	— —	— —	— 0,1	8,9