BRITISH STANDARD

BS EN
1044:1999

Incorporating
Corrigendum No. 1

Brazing — Filler metals

The European Standard EN 1044:1999 has the status of a British Standard

ICS 25.160.50

National foreword

This British Standard is the English language version of EN 1044:1999. It supersedes BS 1845:1984 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee WEE/19, Brazing and braze welding, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible 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.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 23 and a back cover.

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EUROPEAN STANDARD **EN 1044**

NORME EUROPÉENNE

EUROPÄISCHE NORM May 1999

ICS 25.160.50

English version

Brazing — Filler metals

Brasage fort — Métaux d'apport Hartlöten — Lötzusätze

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CEN

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

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

Ref. No. EN 1044:1999 E

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 121, Welding, the Secretariat of which is held by DS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 1999, and conflicting national standards shall be withdrawn at the latest by November 1999.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association. This European Standard is considered to be a supporting standard to those application and product standards which in themselves support an essential safety requirement of a New Approach Directive and which make reference to this European Standard.

Contents

1 Scope

This European Standard specifies the compositions of a range of filler metals used for brazing. The filler metals have been divided into eight classes, related to their composition but not necessarily to the major element present, see annex A. In the case of composite products such as flux-coated rods, pastes or plastics tapes, the standard only covers the filler metal that forms part of such products. Although the melting range is given in the tables, it will necessarily vary within the compositional range of the filler metal and can only be regarded as approximate. Therefore, it does not form part of the specification and is given only for information. Technical delivery conditions are given for brazing filler metals and products containing brazing filler metals with other constituents such as flux and/or binders.

NOTE For some applications, e.g. precious metal jewellery, aerospace and dental, filler metals other than those included in this standard will often be used and these are covered by other standards to which reference should be made.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN ISO 3677:1995, *Filler metal for soft soldering, brazing and braze welding — Designation.* (ISO 3677:1992)

3 Composition

The filler metal shall have a composition in accordance with Tables 2 to 8 for the particular type, except as modified for special vacuum requirements (see clause **4** and Table 1).

For the purposes of determining compliance with composition limits, any value obtained from the analysis shall be rounded to the same number of decimal places as used in this standard in expressing the specified limit. The following rules shall be used for rounding.

a) When the figure immediately after the last figure to be retained is less than five, then the last figure to be retained shall be kept unchanged.

b) When the figure immediately after the last figure to be retained is either:

1) greater than five; or

2) equal to five and followed by at least one figure other than zero;

then the last figure to be retained shall be increased by one.

c) When the figure immediately after the last figure to be retained is equal to five, and followed by zeros only, then the last figure to be retained shall be left unchanged if even, and increased by one if odd.

4 Special vacuum requirements

In a few instances, which are most likely to apply to AG 401, PD 101 to PD 106, PD 201, PD 203 and AU 101 to AU 106, lower impurity limits can be required for brazing in vacuum or service in vacuum and these limits shall be as given in Table 1.

Filler metals complying with Table 1 shall have the letter “V” added as a suffix to the codification plus the digit 1 or 2 to indicate the grade.

NOTE Grade 1 is intended for the most demanding duties, Grade 2 for less demanding.

Table 1 — Impurity limits for special vacuum requirements

Impurity	Limit (% by mass, max.)	
	Grade 1	Grade 2
C[1)]	0,005	0,005
Cd	0,001	0,002
P	0,002	0,002[2)]
Pb	0,002	0,002
Zn	0,001	0,002
Mn[3)]	0,001	0,002
In[3)]	0,002	0,003
All other elements where vapour pressure at 500 °C is $>1{,}3 \times 10^{-10}$ bar[4)]	0,001	0,002

[1)] For filler metal AG 401 (see Table 3), lower levels may be available by agreement between purchaser and supplier.

[2)] For filler metal AG 401, 0,02 % maximum

[3)] Except where otherwise specified in Tables 2 to 8.

[4)] Examples of such elements are Ca, Cs, K, Li, Mg, Na, Rb, S, Sb, Se, Sr, Te, Tl. For such elements (including Cd, Pb and Zn), the total is limited to 0,010 %.

5 Chemical analysis

Chemical analyses shall be carried out by any suitable method, but it should be noted that in the case of many brazing alloys, the use of reference standards may be essential, as agreed between the purchaser and supplier. Analysis is only required to be carried out routinely for those elements for which specific limits are shown. If, however, the presence of other elements is suspected, or in the course of routine analysis is indicated, to be in excess of the limits laid down for unnamed elements or would bring the total of impurities above the specified limit, further analyses shall be carried out for such elements.

6 Designation

The filler metal shall be designated by the description “filler metal”; the number of this standard “EN 1044” and a code. Details of the three options for the code system used are given in annex A.

As an example, the designations of an aluminium filler metal containing 11% to 13 % Si, in accordance with this standard can be made in one of the following ways:

EXAMPLE 1

Filler metal EN 1044-AL 104

where “Filler metal” is the description
“EN 1044” is the number of this standard
“AL 104” is the short code given in Tables 2 to 8

EXAMPLE 2

Filler metal EN 1044-B-Al88Si-575/585

where “Filler metal” is the description
“EN 1044” is the number of this standard
“B” denotes brazing
“Al88Si-575/585” is the code in accordance with EN ISO 3677

EXAMPLE 3

Filler metal EN 1044-AW4047A

where "Filler metal" is the description
"EN 1044" is the number of this standard
"AW4047A" is the European material designation

7 Technical delivery conditions

7.1 Types of products

The form of the material shall be agreed between the purchaser and the manufacturer/supplier at the time of placing the order.

NOTE Brazing filler metals are available as rod, wire, foil (or preforms made from them) or powder, although not all filler metals are necessarily available in every type of product. They are also available as a constituent of brazing pastes or, particularly in the case of aluminium brazing filler metals, clad onto one or both sides of an alloy sheet. Rods may be completely or partially coated with flux.

7.2 Dimensions

7.2.1 General

As it is only possible to specify dimensions and tolerances for rod (see **7.2.2**) and to a lesser extent wire (see **7.2.3**), for other forms the dimensions and tolerances shall be agreed between the purchaser and the manufacturer/supplier at the time of placing the order.

7.2.2 Rod

For rod the preferred diameters are 1 mm, 1,5 mm, 2 mm, 2,5 mm, 3 mm and 5 mm and the preferred lengths are 500 mm and 1 000 mm. The tolerance on diameter shall be ±3 % for drawn rod and ±0,2 mm for other fabrication processes. The tolerance on length shall be ±5 mm.

7.2.3 Wire

For wire there are no preferred diameters and the tolerance on diameter shall be ±3 %.

7.3 Condition

The surface of brazing filler metals shall be free from contamination which could adversely affect brazing. With flux-coated rods, the coating shall firmly adhere to the rod and shall not break off during proper handling and usage.

7.4 Marking

Since in many cases, marking of brazing filler metals themselves is impracticable, reliance shall be placed on marking of packets. The outside of each smallest unit package shall be clearly marked with the following information:

a) the designation in accordance with clause **6**;

b) the name of the manufacturer/supplier;

c) the trade name (if any);

d) the quantity of material and, as applicable, the dimensions ;

e) the supplier's batch number;

f) health and safety warnings (as required by national regulations).

7.5 Packaging

Brazing filler metals or products containing them shall be packed to provide sufficient safeguard against damage and deterioration during transportation and storage.

7.6 Product certificates

If certificates of conformity and/or analysis are required, details shall be agreed between the purchaser and the manufacturer/supplier at the time of placing the order.

Table 2 — Class AL: aluminium brazing filler metals

Code		Composition % by mass											Melting range (approximate)	
Short	EN ISO 3677:1995	Si min. max.	Fe max	Cu min. max.	Mn max.	Mg min max.	Zn max.	Ti max.	Bi min. max.	Other elements each max.	Other elements total max.	Al	Solidus °C	Liquidus °C
AL 101	B-Al95Si-575/630	4,5 6,0	0,6	- 0,30	0,15	- 0,20	0,10	0,15	-	0,05	0,15	Remainder	575	630
AL 102	B-Al92Si-575/615	6,8 8,2	0,8	- 0,25	0,10	- -	0,20	-	-	0,05	0,15	Remainder	575	615
AL 103	B-Al90Si-575/590	9,0 11,0	0,8	- 0,30	0,05	- 0,05	0,10	0,20	-	0,05	0,15	Remainder	575	590
AL 104	B-Al88Si-575/585	11,0 13,0	0,6	- 0,30	0,15	- 0,10	0,20	0,15	-	0,05	0,15	Remainder	575	585
AL 201	B-Al86SiCu-520/585	9,0 11,0	0,6	3,0 5,0	0,15	- 0,10	0,20	0,15	-	0,05	0,15	Remainder	520	585
AL 301	B-Al89SiMg-555/590	9,0 10,5	0,8	- 0,25	0,10	1,0 2,0	0,20	-	-	0,05	0,15	Remainder	555	590
AL 302	B-Al89SiMg(Bi)-555/590	9,0 10,5	0,8	- 0,25	0,10	1,0 2,0	0,20	-	0,02 0,20	0,05	0,15	Remainder	555	590

Table 3 — Class AG: silver brazing filler metals

Code		Composition % by mass					Melting range (approximate)	
Short	**EN ISO 3677: 1995**	**Ag** min. max.	**Cu** min. max.	**Zn** min. max.	**Cd**[1] min. max.	**Other** min. max.	**Solidus** °C	**Liquidus** °C
AG 101	B-Ag60CuZnSn-620/685	59,0 61,0	22,0 24,0	12,0 16,0	-	Sn 2,0 4,0	620	685
AG 102	B-Ag56CuZnSn-620/655	55,0 57,0	21,0 23,0	15,0 19,0	-	Sn 4,0 6,0	620	655
AG 103	B-Ag55ZnCuSn-630/660	54,0 56,0	20,0 22,0	20,0 24,0	-	Sn 1,5 2,5	630	660
AG 104	B-Ag45CuZnSn-640/680	44,0 46,0	26,0 28,0	23,5 27,5	-	Sn 2,0 3,0	640	680
AG 105	B-Ag40CuZnSn-650/710	39,0 41,0	29,0 31,0	26,0 30,0	-	Sn 1,5 2,5	650	710
AG 106	B-Cu36AgZnSn-630/730	33,0 35,0	35,0 37,0	25,5 29,5	-	Sn 2,0 3,0	630	730
AG 107	B-Cu36ZnAgSn-665/755	29,0 31,0	35,0 37,0	30,0 34,0	-	Sn 1,5 2,5	665	755
AG 108	B-Cu40ZnAgSn-680/760	24,0 26,0	39,0 41,0	31,0 35,0	-	Sn 1,5 2,5	680	760

NOTE Maximum impurity limits applicable to all types are (% by mass) Al 0,001, Bi 0,030, Cd[2] 0,030, P 0,008, Pb 0,025, Si[2] 0,05; of all impurities 0,15.

[1] Any national requirements for exposure to cadmium fume have to be observed.

[2] Unless otherwise specified.

Table 3 — Class AG: silver brazing filler metals (*continued*)

Code		Composition % by mass					Melting range (approximate)	
Short	**EN ISO 3677:1995**	**Ag** min. max.	**Cu** min. max.	**Zn** min. max.	**Cd**[1] min. max.	**Other** min. max.	**Solidus** °C	**Liquidus** °C
AG 201	B-Ag63CuZn-690/730	62,0 64,0	23,0 25,0	11,0 15,0	-	-	690	730
AG 202	B-Ag60CuZn-695/730	59,0 61,0	25,0 27,0	12,0 16,0	-	-	695	730
AG 203	B-Ag44CuZn-675/735	43,0 45,0	29,0 31,0	24,0 28,0	-	-	675	735
AG 204	B-Cu38ZnAg-680/765	29,0 31,0	37,0 39,0	30,0 34,0	-	-	680	765
AG 205	B-Cu40ZnAg-700/790	24,0 26,0	39,0 41,0	33,0 37,0	-	-	700	790
AG 206	B-Cu44ZnAg(Si)-690/810	19,0 21,0	43,0 45,0	34,0 38,0	-	Si 0,05 0,25	690	810
AG 207	B-Cu48ZnAg(Si)-800/830	11,0 13,0	47,0 49,0	38,0 42,0	-	Si 0,05 0,25	800	830
AG 208	B-Cu55ZnAg(Si)-820/870	4,0 6,0	54,0 56,0	38,0 42,0	-	Si 0,05 0,25	820	870

NOTE Maximum impurity limits applicable to all types are (% by mass) Al 0,001, Bi 0,030, Cd[2] 0,030, P 0,008, Pb 0,025, Si[2] 0,05; total of all impurities 0,15.

[1] Any national requirements for exposure to cadmium fume have to be observed.
[2] Unless otherwise specified.

Table 3 — Class AG: silver brazing filler metals (*continued*)

Code		Composition % by mass					Melting range (approximate)	
Short	**EN ISO 3677:1995**	**Ag** min. max.	**Cu** min. max.	**Zn** min. max.	**Cd**[1] min. max.	**Other** min. max.	**Solidus** °C	**Liquidus** °C
AG 301	B-Ag50CdZnCu-620/640	49,0 51,0	14,0 16,0	14,0 18,0	17,0 21,0	-	620	640
AG 302	B-Ag45CdZnCu-605/620	44,0 46,0	14,0 16,0	14,0 18,0	22,0 26,0	-	605	620
AG 303	B-Ag42CdCuZn-610/620	41,0 43,0	16,0 18,0	14,0 18,0	23,0 27,0	-	610	620
AG 304	B-Ag40ZnCdCu-595/630	39,0 41,0	18,0 20,0	19,0 23,0	18,0 22,0	-	595	630
AG 305	B-Ag35CuZnCd-610/700	34,0 36,0	25,0 27,0	19,0 23,0	16,0 20,0	-	610	700
AG 306	B-Ag30CuCdZn-600/690	29,0 31,0	27,0 29,0	19,0 23,0	19,0 23,0	-	600	690
AG 307	B-Cu30ZnAgCd-605/720	24,0 26,0	29,0 31,0	25,5 29,5	15,5 19,5	-	605	720
AG 308	B-Cu36ZnAgCd(Si)-610/750	20,0 22,0	34,5 36,5	24,5 28,5	14,5 18,5	Si 0,3 0,7	610	750
AG 309	B-Cu40ZnAgCd-605/765	19,0 21,0	39,0 41,0	23,0 27,0	13,0 17,0	-	605	765
AG 351	B-Ag50CdZnCuNi-635/655	49,0 51,0	14,5 16,5	13,5 17,5	14,0 18,0	Ni 2,5 3,5	635	655

NOTE Maximum impurity limits applicable to all types are (% by mass) Al 0,001, Bi 0,030, Cd[2] 0,030, P 0,008, Pb 0,025, Si[2] 0,05 ; total of all impurities 0,15.

[1] Any national requirements for exposure to cadmium fume have to be observed.

[2] Unless otherwise specified.

Table 3 — Class AG: silver brazing filler metals (*concluded*)

Code		Composition % by mass					Melting range (approximate)	
Short	**EN ISO 3677:1995**	**Ag** min. max.	**Cu** min. max.	**Zn** min. max.	**Cd**[1] min. max.	**Other** min. max.	**Solidus** °C	**Liquidus** °C
AG 401[3]	B-Ag72Cu-780	71,0 73,0	27,0 29,0	-	-	-	780	780
AG 402	B-Ag60CuSn-600/730	59,0 61,0	29,0 31,0	-	-	Sn 9,0 11,0	600	730
AG 403	B-Ag56CuInNi-600/710	55,0 57,0	26,25 28,25	-	-	In 13,5 15,5 Ni 2,0 2,5	600	710
AG 501	B-Ag85Mn-960/970	84,0 86,0	-	-	-	Mn 14,0 16,0	960	970
AG 502	B-Ag49ZnCuMnNi-680/705	48,0 50,0	15,0 17,0	21,0 25,0	-	Mn 6,5 8,5 Ni 4,0 5,0	680	705
AG 503	B-Cu38AgZnMnNi-680/830	26,0 28,0	37,0 39,0	18,0 22,0	-	Mn 8,5 10,5 Ni 5,0 6,0	680	830

NOTE Maximum impurity limits applicable to all types are (% by mass) Al 0,001, Bi 0,030, Cd[2] 0,030, P 0,008, Pb 0,025, Si[2] 0,05 ; total of all impurities for AG 401 to AG 403 = 0,15, total of all impurities for AG 501 to AG 503 = 0,30.

[1] Any national requirements for exposure to cadmium fume have to be observed.

[2] Unless otherwise specified.

[3] For special vacuum applications see Table 1.

Table 4 — Class CP: copper-phosphorus brazing filler metals

Code		Composition % by mass				Melting range (approximate)		Indicative minimum brazing temperature[1] °C
Short	EN ISO 3677:1995	Cu	P min. max.	Ag min. max.	Other min. max.	Solidus °C	Liquidus °C	
CP 101	B-Cu75AgP-645	Remainder	6,6 7,5	17,0 19,0	-	645	645	650
CP 102	B-Cu80AgP-645/800	Remainder	4,7 5,3	14,5 15,5	-	645	800	700
CP 103	B-Cu87PAg(Ni)-645/725	Remainder	7,0 7,6	5,5 6,5	Ni 0,05 0,15	645	725	690
CP 104	B-Cu89PAg-645/815	Remainder	5,7 6,3	4,5 5,5	-	645	815	710
CP 105	B-Cu92PAg-645/825	Remainder	5,9 6,7	1,5 2,5	-	645	825	740
CP 201	B-Cu92P-710/770	Remainder	7,5 8,1	-	-	710	770	720
CP 202	B-Cu93P-710/820	Remainder	6,6 7,4	-	-	710	820	730
CP 203	B-Cu94P-710/890	Remainder	5,9 6,5	-	-	710	890	760
CP 301	B-Cu92PSb-690/825	Remainder	5,6 6,4	-	Sb 1,8 2,2	690	825	740
CP 302	B-Cu86SnP-650/700	Remainder	6,4 7,2	-	Sn 6,5 7,5	650	700	700

NOTE 1 Maximum impurity limits applicable to all types are (% by mass) Al 0,01, Bi 0,030, Cd 0,025, Pb 0,025, Zn 0,05, Zn + Cd 0,05; total of all impurities 0,25.

[1] Unlike the majority of filler metals in this standard which only flow satisfactorily at, around or above the liquidus, most copper phosphorus filler metals are sufficiently fluid for brazing at a temperature significantly below the liquidus.

NOTE 2 These filler metals should never be used on ferrous metals, nickel alloys or copper alloys containing nickel.

Table 5 — Class CU: copper brazing filler metals

Table 5.1 — CU 100 and CU 200 series

Code		Composition % by mass							Melting range (approximate)	
Short	**EN ISO 3677:1995**	**Cu** (including Ag) min max	**Sn** min. max.	**Ag** min. max.	**Ni** min max	**P** min. max.	**B** min. max	**Total impurity limits** max.	**Solidus** °C	**Liquidus** °C
CU 101	B-Cu100-1085	99,90	-	-	-	-	-	0,04 (excluding O and Ag)	1 085	1 085
CU 102	B-Cu100-1085	99,95	-	-	-	-	-	0,03 (excluding Ag)	1 085	1 085
CU 103	B-Cu99-1085	99,00	-	-	-	-	-	0,30 (excluding O)	1 085	1 085
CU 104	B-Cu100(P)-1085	99,90	-	-	-	0,015 0,040	-	0,060 (excluding Ag, As and Ni)	1 085	1 085
CU 105	B-Cu97Ni(B)-	Remainder	-	-	2,5 3,5	-	0,02 0,05	0,15 (excluding Ag)	1 085	1 100
CU 106	B-Cu99(Ag)-1070/1080	Remainder	-	0,8 1,2	-	-	-	0,3 (including Bi 0,1 max.)	1 070	1 080
CU 201	B-Cu94Sn(P)-910/1040	Remainder	5,5 7,0	-	-	0,01 0,40	-	Al 0,005, Cd 0,025, Pb 0,02, Zn 0,05, others 0,1; total 0,4	910	1 040
CU 202	B-Cu88Sn(P)-825/990	Remainder	11,0 13,0	-	-	0,01 0,40	-		825	990

Table 5.2 — CU 300 series

Code		Composition % by mass						Melting range (approximate)	
Short	**EN ISO 3677:1995**	**Cu** min. max.	**Zn**	**Sn** min. max.	**Si** min. max.	**Mn** min. max.	**Ni** min. max.	**Solidus** °C	**Liquidus** °C
CU 301	B-Cu60Zn(Si)-875/895	58,5 61,5	Remainder	- 0,2	0,2 0,4	-	-	875	895
CU 302	B-Cu60Zn(Sn)(Si)-875/895	58,5 61,5	Remainder	0,2 0,5	0,2 0,4	-	-	875	895
CU 303	B-Cu60Zn(Si)(Mn)-870/900	58,5 61,5	Remainder	- 0,2	0,15 0,4	0,05 0,25	-	870	900
CU 304	B-Cu60Zn(Sn)(Si)(Mn)-870/900	58,5 61,5	Remainder	0,2 0,5	0,15 0,4	0,05 0,25	-	870	900
CU 305	B-Cu48ZnNi(Si)-890/920	46,0 50,0	Remainder	- 0,2	0,15 0,4	- 0,2	8,0 11,0	890	920
CU 306	B-Cu59ZnSn (Ni) (Mn)(Si)-870/890	56,0 62,0	Remainder	0,5 1,5	0,1 0,5	0,2 1,0	0,2 1,5	870	890
NOTE Maximum impurity limits applicable to all types are (% by mass) Al 0,01, As 0,01, Bi 0,01, Cd 0,025, Fe 0,25, Pb 0,02, Sb 0,01; total impurities excluding Fe 0,2.									

Table 6 — Classes NI and CO: nickel and cobalt brazing filler metals

Code		Composition % by mass										Melting range (approximate)	
Short	**EN ISO 3677:1995**	**Ni** min. max.	**Cr** min. max.	**Si** min. max.	**B** min. max.	**Fe** min. max.	**C** min. max.	**P** min. max.	**W** min. max.	**Cu** min. max.	**Mn** min. max.	**Solidus** °C	**Liquidus** °C
NI 101	B-Ni73CrFeSiB(C)-980/1060	Remainder	13,0 15,0	4,0 5,0	2,75 3,50	4,0 5,0	0,60 0,90	- 0,02	-	-	-	980	1 060
NI 1A1	B-Ni74CrFeSiB-980/1070	Remainder	13,0 15,0	4,0 5,0	2,75 3,50	4,0 5,0	- 0,06	- 0,02	-	-	-	980	1 070
NI 102	B-Ni82CrSiBFe-970/1000	Remainder	6,0 8,0	4,0 5,0	2,75 3,50	2,5 3,5	- 0,06	- 0,02	-	-	-	970	1 000
NI 103	B-Ni92SiB-980/1040	Remainder	-	4,0 5,0	2,75 3,50	- 0,5	- 0,06	- 0,02	-	-	-	980	1 040
NI 104	B-Ni95SiB-980/1070	Remainder	-	3,0 4,0	1,50 2,20	- 1,5	- 0,06	- 0,02	-	-	-	980	1 070
NI 105	B-Ni71CrSi-1080/1135	Remainder	18,5 19,5	9,75 10,50	- 0,03	-	- 0,06	- 0,02	-	-	-	1 080	1 135
NI 106	B-Ni89P-875	Remainder	-	-	-	-	- 0,06	10,0 12,0	-	-	-	875	875
NI 107	B-Ni76CrP-890	Remainder	13,0 15,0	- 0,10	- 0,01	- 0,2	- 0,06	9,7 10,5	-	-	-	890	890

NOTE Maximum impurity limits applicable to all types are (% by mass) Al 0,05, Co 0,10 (not CO 101), S 0,02, Se 0,005, Ti 0,05, Zr 0,05; total of other impurities 0,50.

Table 6 — Classes NI and CO: nickel and cobalt brazing filler metals (*concluded*)

Code		Composition % by mass										Melting range (approximate)	
Short	**EN ISO 3677: 1995**	**Ni** min. max.	**Cr** min. max.	**Si** min. max.	**B** min. max.	**Fe** min. max.	**C** min. max.	**P** min. max.	**W** min. max.	**Cu** min. max.	**Mn** min. max.	**Solidus** °C	**Liquidus** °C
NI 108	B-Ni66MnSiCu-980/1010	Remainder	-	6,0 8,0	-	-	- 0,06	- 0,02	-	4,0 5,0	21,5 24,5	980	1 010
NI 109	B-Ni81CrB-1055	Remainder	13,5 16,5	- -	3,25 4,0	- 1,5	- 0,06	- 0,02	-	-	-	1 055	1 055
NI 110	B-Ni63WCrFeSiB-970/1105	Remainder	10,0 13,0	3,0 4,0	2,0 3,0	2,5 4,5	0,40 0,55	- 0,02	15,0 17,0	-	-	970	1 105
NI 111	B-Ni67WCrSiFeB-970/1095	Remainder	9,0 11,75	3,35 4,25	2,2 3,1	2,5 4,0	0,30 0,50	- 0,02	11,5 12,75	-	-	970	1 095
NI 112	B-Ni65CrP-880/950	Remainder	24,0 26,0	- 0,10	- 0,01	- 0,2	- 0,06	9,0 11,0	-	-	-	880	950
CO 101	B-Co51CrNiSiW(B)-1120/1150	16,0 18,0	18,0 20,0	7,5 8,5	0,70 0,90	- 1,0	0,35 0,45	- 0,02	3,5 4,5	Co remainder		1 120	1 150

NOTE Maximum impurity limits applicable to all types are (% by mass) Al 0,05, Co 0,10 (not CO 101), S 0,02, Se 0,005, Ti 0,05, Zr 0,05; total of other impurities 0,50.

Table 7 — Class PD : palladium bearing brazing filler metals

Code		Composition % by mass					Melting range (approximate)	
Short	**EN ISO 3677:1995**	**Ag** min. max.	**Cu** min. max.	**Pd** min. max.	**Mn** min. max.	**Ni** min. max.	**Solidus** °C	**Liquidus** °C
PD 101[1)]	B-Ag54PdCu-900/950	53,5 54,5	20,5 21,5	24,5 25,5	-	-	900	950
PD 102[1)]	B-Ag52CuPd-875/900	51,5 52,5	27,5 28,5	19,5 20,5	-	-	875	900
PD 103[1)]	B-Ag65CuPd-850/900	64,5 65,5	19,5 20,5	14,5 15,5	-	-	850	900
PD 104[1)]	B-Ag68CuPd-830/860	67,0 68,0	22,0 23,0	9,5 10,5	-	-	830	860
PD 105[1)]	B-Ag58CuPd-825/850	58,0 59,0	31,0 32,0	9,5 10,5	-	-	825	850
PD 106[1)]	B-Ag68CuPd-805/810	68,0 69,0	26,0 27,0	4,5 5,5	-	-	805	810
PD 201[1)]	B-Pd60Ni-1235	-	-	59,5 60,5	-	39,5 40,5	1 235	1 235
PD 202	B-Ag75PdMn-1000/1120	74,5 75,5	-	19,5 20,5	4,5 5,5	-	1 000	1 120
PD 203[1)]	B-Cu82Pd-1080/1090	-	81,5 82,5	17,5 18,5	-	-	1 080	1 090
PD 204	B-Ag95Pd-970/1010	94,5 95,5	-	4,5 5,5	-	-	970	1 010

NOTE For PD 101 - 106 and PD 203 and 204, maximum impurity limits applicable are (% by mass) Al 0,0010, P 0,008, Ti 0,002, Zr 0,002; total of all impurities 0,15.
For PD 201 and 202, maximum impurity limits are (% by mass) Al 0,010, P 0,010, Ti 0,01, Zr 0,01; total of all impurities 0,30.

[1)] For special vacuum applications see Table 1.

Table 8 — Class AU: gold bearing brazing filler metals

Code		Composition % by mass				Melting range (approximate)	
Short	**EN ISO 3677: 1995**	**Au** min. max.	**Cu** min. max.	**Ni** min. max.	**Fe** min. max.	**Solidus** °C	**Liquidus** °C
AU 101[1)]	B-Au80Cu(Fe)-905/910	79,5 80,5	18,5 19,5	-	0,5 1,5	905	910
AU 102[1)]	B-Au62Cu-930/940	62,0 63,0	37,0 38,0	-	-	930	940
AU 103[1)]	B-Cu62Au-980/1000	37,0 38,0	62,0 63,0	-	-	980	1 000
AU 104[1)]	B-Cu70Au-995/1020	29,5 30,5	69,5 70,5	-	-	995	1 020
AU 105[1)]	B-Au82Ni-950	81,5 82,5	-	17,5 18,5	-	950	950
AU 106[1)]	B-Au75Ni-950/990	74,5 75,5	-	24,5 25,5	-	950	990

NOTE Impurity limits applicable to all types are (% by mass) Al 0,0010, P 0,008, Ti 0,002, Zr 0,002; total of all impurities 0,15.

[1)] For special vacuum applications see Table 1.

Annex A (normative)
Codification

Three systems for the codification of filler metals are used in this standard. For the purpose of identifying a filler metal complying with this standard e.g. in other standards, in orders, in brazing procedures or on drawings, any of these systems can be used.

The first system divides the filler metals into eight classes. The class to which a filler metal is assigned is based in most cases on the major element present but in some instances, it has been decided by the similarity of the filler metal to others in the same class.

The eight classes are as follows.

1) AL: filler metals containing aluminium as the major element.

2) AG: filler metals containing silver as a significant addition, even if not the major element.

3) CP: filler metals containing copper as the major element with an addition of phosphorus.

4) CU: filler metals containing copper as the major element, not elsewhere classified.

5) NI: filler metals containing nickel as the major element.

6) CO: filler metals containing cobalt as the major element.

7) PD : filler metals containing palladium, in any amount.

8) AU: filler metals containing gold, in any amount.

The code for each filler metal consists of the two letters for the class followed by three digits, allocated sequentially, starting at 101. Some classes have been sub-divided, with the digits starting at 101 for the first sub-division, 201 for the second, etc.

NOTE For class NI, the second (where relevant) and third digits have been chosen to be the same as those currently used in three national standards. All three of these standards have both a grade 1 and a grade 1a. It is desirable for this standard to conform with the practice, but it is also desirable for the codes to be of consistent length, to aid entry into computer-based record systems. As a compromise, the code NI 1A1 has been chosen for the filler metal graded 1a in the national standards.

The second system is that given in EN ISO 3677:1995. However, this system can assign the same code to filler metals which differ only slightly in chemical composition but significantly in behaviour. In addition, there is a third system using the European designations for aluminium alloys and copper alloys. A similar system will be used for nickel alloys. It is assumed that similar systems will ultimately exist for precious metals.

The relationship between these three systems is given in Table A.1.

Table A.1 — Codification systems

Short	EN ISO 3677:1995	European material designation
Aluminium brazing filler metals		
AL 101	B-Al95Si-575/630	AW4043A
AL 102	B-Al92Si-575/615	AW4343
AL 103	B-Al90Si-575/590	AW4045
AL 104	B-Al88Si-575/585	AW4047A
AL 201	B-Al86SiCu-520/585	AW4145A
AL 301	B-Al89SiMg-555/590	AW4004
AL 302	B-Al89SiMg(Bi)-555/590	AW4104
Silver brazing filler metals		
AG 101	B-Ag60CuZnSn-620/685	–
AG 102	B-Ag56CuZnSn-620/655	–
AG 103	B-Ag55ZnCuSn-630/660	–
AG 104	B-Ag45CuZnSn-640/680	–
AG 105	B-Ag40CuZnSn-650/710	–
AG 106	B-Cu36AgZnSn-630/730	CF 229 E
AG 107	B-Cu36ZnAgSn-665/755	CF 739 R
AG 108	B-Cu40ZnAgSn-680/760	CF 740 R
AG 201	B-Ag63CuZn -690/730	–
AG 202	B-Ag60CuZn-695/730	–
AG 203	B-Ag44CuZn-675/735	–
AG 204	B-Cu38ZnAg-680/765	CF 738 R
AG 205	B-Cu40ZnAg-700/790	CF 741 R
AG 206	B-Cu44ZnAg(Si)-690/810	CF 742 R
AG 207	B-Cu48ZnAg(Si)-800/830	CF 744 R
AG 208	B-Cu55ZnAg(Si)-820/870	CF 743 R

Table A.1 — Codification systems *(continued)*

Short	EN ISO 3677: 1995	European material designation
AG 301	B-Ag50CdZnCu-620/640	–
AG 302	B-Ag45CdZnCu-605/620	–
AG 303	B-Ag42CdCuZn-610/620	–
AG 304	B-Ag40ZnCdCu-595/630	–
AG 305	B-Ag35CuZnCd-610/700	–
AG 306	B-Ag30CuCdZn-600/690	–
AG 307	B-Cu30ZnAgCd-605/765	CF 737 R
AG 308	B-Cu36ZnAgCd(Si)-610/750	CF 736 R
AG 309	B-Cu40ZnAgCd-605/765	CF 735 R
AG 351	B-Ag50CdZnCuNi-635/655	–
AG 401	B-Ag72Cu-780	–
AG 402	B-Ag60CuSn-600/730	–
AG 403	B-Ag56CuInNi-600/710	–
AG 501	B-Ag85Mn-960/970	–
AG 502	B-Ag49ZnCuMnNi-680/705	–
AG 503	B-Cu38AgZnMnNi-680/830	CF 228 E
Copper-phosphorus brazing filler metals		
CP 101	B-Cu75AgP-645	CF 238 E
CP 102	B-Cu80AgP-645/800	CF 237 E
CP 103	B-Cu87PAg(Ni)-645/725	CF 225 E
CP 104	B-Cu89PAg-645/815	CF 224 E
CP 105	B-Cu92PAg-645/825	CF 223 E
CP 201	B-Cu92P-710/770	CF 222 E
CP 202	B-Cu93P-710/820	CF 221 E
CP 203	B-Cu94P-710/890	CF 220 E
CP 301	B-Cu92PSb-690/825	CF 226 E
CP 302	B-Cu86SnP-650/700	CF 227 E

Table A.1 — Codification systems *(continued)*

Short	EN ISO 3677: 1995	European material designation
Copper brazing filler metals		
CU 101	B-Cu100-1085	CF032A
CU 102	B-Cu100-1085	CF033A
CU 103	B-Cu99-1085	CF010A
CU 104	B-Cu100(P)-1085	CF034A
CU 105	B-Cu97Ni(B)-1085/1100	CF125C
CU 106	B-Cu99(Ag)-1070/1080	CF126C
CU 201	B-Cu94Sn(P)-910/1040	CF462K
CU 202	B-Cu88Sn(P)-825/990	CF461K
CU 301	B-Cu60Zn(Si)-875/895	CF724R
CU 302	B-Cu60Zn(Sn)(Si)-875/895	CF725R
CU 303	B-Cu60Zn(Si)(Mn)-870/900	CF726R
CU 304	B-Cu60Zn(Sn)(Si)(Mn)-870/900	CF727R
CU 305	B-Cu48ZnNi(Si)-890/920	CF411J
CU 306	B-Cu59Zn(Sn)(Ni)(Mn)(Si)-870/890	CF731R
Nickel and cobalt brazing filler materials		
NI 101	B-Ni73CrFeSiB(C)-980/1060	–
NI 1A1	B-Ni74CrFeSiB-980/1070	–
NI 102	B-Ni82CrSiBFe-970/1000	–
NI 103	B-Ni92SiB-980/1040	–
NI 104	B-Ni95SiB-980/1070	–
NI 105	B-Ni71CrSi-1080/1135	–
NI 106	B-Ni89P-875	–
NI 107	B-Ni76CrP-890	–
NI 108	B-Ni66MnSiCu-980/1010	–
NI 109	B-Ni81CrB-1055	–
NI 110	B-Ni63WCrFeSiB-970/1105	–
NI 111	B-Ni67WCrSiFeB-970/1095	–
NI 112	B-Ni65CrP-880/950	–
CO 101	B-Co51CrNiSiW(B)-1120/1150	–

Table A.1 — Codification systems *(concluded)*

Short	EN ISO 3677:1995	European materials designation
Palladium bearing brazing filler metals		
PD 101	B-Ag54PdCu-900/950	–
PD 102	B-Ag52CuPd-875/900	–
PD 103	B-Ag65CuPd-850/900	–
PD 104	B-Ag68CuPd-830/860	–
PD 105	B-Ag58CuPd-825/850	–
PD 106	B-Ag68CuPd-805/810	–
PD 201	B-Pd60Ni-1235	–
PD 202	B-Ag75PdMn-1000/1120	–
PD 203	B-Cu82Pd-1080/1090	–
PD 204	B-Ag95Pd-970/1010	–
Gold bearing brazing filler metals		
AU 101	B-Au80Cu(Fe)-905/910	–
AU 102	B-Au62Cu-930/940	–
AU 103	B-Cu62Au-980/1000	–
AU 104	B-Cu70Au-995/1020	–
AU 105	B-Au82Ni-950	–
AU 106	B-Au75Ni-950/990	–

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