

Brazing – Filler metals

English version of DIN EN 1044

DIN
EN 1044

ICS 25.160.50

Hartlöten – Lotzusätze

Supersedes DIN 8513-1 and
DIN 8513-2, October 1979 editions,
DIN 8513-3, July 1986 edition,
DIN 8513-4, February 1981 edition, and
DIN 8513-5, February 1983 edition.

European Standard EN 1044 : 1999 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been prepared by CEN/TC 121.

The responsible German body involved in its preparation was the *Normenausschuß Schweißtechnik* (Welding Standards Committee), Technical Committee *Löten*.

For ease of reference, a national annex is provided below in which the filler metal grades specified in this standard and in DIN EN ISO 3677 are correlated with those previously used in Germany.

National Annex NA

List of filler metal grades used in European Standards correlated with those used previously in Germany

Symbol used in		
DIN EN 1044	DIN EN ISO 3677	DIN 8513 series
AL 101	B-Al95Si-575/630	—
AL 102	B-Al92Si-575/615	L-AlSi7,5
AL 103	B-Al90Si-575/590	L-AlSi10
AL 104	B-Al88Si-575/585	L-AlSi12
AL 201	B-Al86SiCu-520/585	—
AL 301	B-Al89SiMg-555/590	—
AL 302	B-Al89SiMg(Bi)-555/590	—
AG 101	B-Ag60CuZnSn-620/685	L-Ag60Sn
AG 102	B-Ag56CuZnSn-620/655	L-Ag55Sn
AG 103	B-Ag55ZnCuSn-630/660	L-Ag55Sn
AG 104	B-Ag45CuZnSn-640/680	L-Ag45Sn
AG 105	B-Ag40CuZnSn-650/710	L-Ag40Sn
AG 106	B-Cu36AgZnSn-630/730	L-Ag34Sn
AG 107	B-Cu36ZnAgSn-665/755	L-Ag30Sn
AG 108	B-Cu40ZnAgSn-680/760	L-Ag25Sn
AG 201	B-Ag63CuZn-690/730	—
AG 202	B-Ag60CuZn-695/730	L-Ag60
AG 203	B-Ag44CuZn-675/735	L-Ag44
AG 204	B-Cu38ZnAg-680/765	L-Ag30
AG 205	B-Cu40ZnAg-700/790	L-Ag25
AG 206	B-Cu44ZnAg(Si)-690/810	L-Ag20
AG 207	B-Cu48ZnAg(Si)-800/830	L-Ag12
AG 208	B-Cu55ZnAg(Si)-820/870	L-Ag5

(continued)

Continued on pages 2 and 3.
EN comprises 24 pages.

(continued)

DIN EN 1044	DIN EN ISO 3677	DIN 8513 series
AG 301	B-Ag50CdZnCu-620/640	L-Ag50Cd
AG 302	B-Ag45CdZnCu-605/620	L-Ag45Cd
AG 303	B-Ag42CdCuZn-610/620	—
AG 304	B-Ag40ZnCdCu-595/630	L-Ag40Cd
AG 305	B-Ag35CuZnCd-610/700	L-Ag34Cd
AG 306	B-Ag30CuCdZn-600/690	L-Ag30Cd
AG 307	B-Cu30ZnAgCd-605/720	L-Ag25Cd
AG 308	B-Cu36ZnAgCd(Si)-610/750	—
AG 309	B-Cu40ZnAgCd-605/765	L-Ag20Cd
AG 351	B-Ag50CdZnCuNi-635/655	L-Ag50CdNi
AG 401	B-Ag72Cu-780	L-Ag72
AG 402	B-Ag60CuSn-600/730	—
AG 403	B-Ag56CuInNi-600/710	L-Ag56InNi
AG 501	B-Ag85Mn-960/970	L-Ag85
AG 502	B-Ag49ZnCuMnNi-680/705	L-Ag49
AG 503	B-Cu38AgZnMnNi-680/830	L-Ag27
CP 101	B-Cu75AgP-645	—
CP 102	B-Cu80AgP-645/800	L-Ag15P
CP 103	B-Cu87PAg(Ni)-645/725	—
CP 104	B-Cu89PAg-645/815	L-Ag5P
CP 105	B-Cu92PAg-645/825	L-Ag2P
CP 201	B-Cu92P-710/770	L-CuP8
CP 202	B-Cu93P-710/820	L-CuP7
CP 203	B-Cu94P-710/890	L-CuP6
CP 301	B-Cu92PSb-690/825	—
CP 302	B-Cu86SnP-650/700	—
CU 101	B-Cu100-1085	L-Cu
CU 102	B-Cu100-1085	L-Cu
CU 103	B-Cu99-1085	—
CU 104	B-Cu100(P)-1085	L-SFCu
CU 105	B-Cu97Ni(B)-1085/1100	—
CU 106	B-Cu99(Ag)-1070/1080	—
CU 201	B-Cu94Sn(P)-910/1040	L-CuSn6
CU 202	B-Cu88Sn(P)-825/990	L-CuSn12
CU 301	B-Cu60Zn(Si)-875/895	L-CuZn40
CU 302	B-Cu60Zn(Sn)(Si)-875/895	L-CuZn40
CU 303	B-Cu60Zn(Si)(Mn)-870/900	L-CuZn40
CU 304	B-Cu60Zn(Sn)(Si)(Mn)-870/900	L-CuZn39Sn
CU 305	B-Cu48ZnNi(Si)-890/920	L-CuNi10Zn42
CU 306	B-Cu59ZnSn(Ni)(Mn)(Si)-870/870	L-CuZn39Sn
NI 101	B-Ni73CrFeSiB(C)-980/1060	L-Ni1
NI 1A1	B-Ni74CrFeSiB-980/1070	L-Ni1a
NI 102	B-Ni82CrSiBFe-970/1000	L-Ni2
NI 103	B-Ni92SiB-980/1040	L-Ni3
NI 104	B-Ni95SiB-980/1070	L-Ni4
NI 105	B-Ni71CrSi-1080/1135	L-Ni5
NI 106	B-Ni89P-875	L-Ni6
NI 107	B-Ni76CrP-890	L-Ni7
NI 108	B-Ni66MnSiCu-980/1010	L-Ni8
NI 109	B-Ni81CrB-1055	—
NI 110	B-Ni63WCrFeSiB-970/1105	—
NI 111	B-Ni67WCrSiFeB-970/1095	—
NI 112	B-Ni65CrP-880/950	—

(continued)

(concluded)

DIN EN 1044	DIN EN ISO 3677	DIN 8513 series
CO 101	B-Co51CrNiSiW(B)-1120/1150	—
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-1 235	—
PD 202	B-Ag75PdMn-1 000/1 120	—
PD 203	B-Cu82Pd-1 080/1 090	—
PD 204	B-Ag95Pd-970/1 010	—
AU 101	B-Au80Cu(Fe)-905/910	—
AU 102	B-Au62Cu-930/940	—
AU 103	B-Cu62Au-980/1 000	—
AU 104	B-Cu70Au-995/1 020	—
AU 105	B-Au82Ni-950	—
AU 106	B-Au75Ni-950/990	—

Amendments

DIN 8513-1 and DIN 8513-2, October 1979 editions, DIN 8513-3, July 1986 edition, DIN 8513-4, February 1981 edition, and DIN 8513-5, February 1983 edition, have been superseded by the specifications of EN 1044.

Previous editions

DIN 1710: 1925-04; DIN 1734: 1944-06; DIN 1735: 1944-08; DIN 8512: 1963-02; DIN 8513-1: 1964-04, 1973-02, 1979-10; DIN 8513-2: 1966-04, 1976-01, 1979-10; DIN 8513-3: 1966-04, 1969-12, 1976-01, 1979-10, 1986-07; DIN 8513-4: 1981-02; DIN 8513-5: 1983-02.

**EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM**

EN 1044

May 1999

ICS 25.160.50

English version

Brazing – Filler metals

Brasage fort – Métaux d'apport

Hartlöten – Lotzusätze

This European Standard was approved by CEN on 1999-04-16.

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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

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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.

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
<p>1) For filler metal AG 401 (see table 3), lower levels may be available by agreement between purchaser and supplier.</p> <p>2) For filler metal AG 401, 0,02 % maximum</p> <p>3) Except where otherwise specified in tables 2 to 8.</p> <p>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 %.</p>		

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 1000 mm. The tolerance on diameter shall be $\pm 3\%$ for drawn rod and $\pm 0,2$ 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 $\pm 3\%$.

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	Fe	Cu	Mn	Mg	Zn	Ti	Bi	Other elements		Al	Solidus	Liquidus
		min. max.	max.	min. max.	max.	min. max.	max.	max.	min. max.	each max.	total max.			
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 0,05; of all impurities 0,15.									
1) Any national requirements for exposure to cadmium fume have to be observed.									
2) Unless otherwise specified.									
continued									

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.									
continued									

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.									
continued									

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

Code	Short	EN ISO 3677: 1995	Composition (% by mass)					Melting range (approximate)	
			Ag min. max.	Cu min. max.	Zn min. max.	Cd ¹⁾ min. max.	Other min. max.	Solidus °C	Liquidus °C
AG 401³⁾		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 ³⁾ 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)	1085	1085
CU 102	B-Cu100-1085	99,95	-	-	-	-	-	0,03 (excluding Ag)	1085	1085
CU 103	B-Cu99-1085	99,00	-	-	-	-	-	0,30 (excluding O)	1085	1085
CU 104	B-Cu100(P)-1085	99,90	-	-	-	0,015 0,040	-	0,060 (excluding Ag, As and Ni)	1085	1085
CU 105	B-Cu97Ni(B)-1085/1100	Remainder	-	-	2,5 3,5	-	0,02 0,05	0,15 (excluding Ag)	1085	1100
CU 106	B-Cu99(Ag)-1070/1080	Remainder	-	0,8 1,2	-	-	-	0,3 (including Bi 0,1 max.)	1070	1080
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,	910	1040
CU 202	B-Cu88Sn(P)-825/990	Remainder	11,0 13,0	-	-	0,01 0,40	-	Zn 0,05, others 0,1; total 0,4	825	990

Table 5.2: CU 300 series

Code		EN ISO 3677: 1995	Composition (% by mass)							Melting range (approximate)	
Short	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	Short	EN ISO 3677: 1995	Composition (% by mass)										Melting range (approximate)	
			Ni	Cr	Si	B	Fe	C	P	W	Cu	Mn	Solidus °C	Liquidus °C
			min. max.	min. max.	min. max.	min. max.	min. max.	min. max.	min. max.	min. max.	min. max.	min. max.		
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	1060
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	1070
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	1000
NI 103		B-Ni92SiB-980/1040	Remainder	-	4,0 5,0	2,75 3,50	- 0,5	- 0,06	- 0,02	-	-	-	980	1040
NI 104		B-Ni95SiB-980/1070	Remainder	-	3,0 4,0	1,50 2,20	- 1,5	- 0,06	- 0,02	-	-	-	980	1070
NI 105		B-Ni71CrSi-1080/1135	Remainder	18,5 19,5	9,75 10,50	- 0,03	-	0,06	0,02	-	-	-	1080	1135
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.														
continued														

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

Code	Short	EN ISO 3677: 1995	Composition (% by mass)										Melting range (approximate)	
			Ni	Cr	Si	B	Fe	C	P	W	Cu	Mn	Solidus °C	Liquidus °C
NI 108		B-Ni66MnSiCu-980/1010	Remainder	-	6,0 8,0	-	-	-	-	-	4,0 5,0	21,5 24,5	980	1010
NI 109		B-Ni81CrB-1055	Remainder	13,5 16,5	-	3,25 4,0	-	-	-	-	-	-	1055	1055
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	-	15,0 17,0	-	-	970	1105
NI 111		B-Ni67WCrSiFeB-970/1095	Remainder	9,0 11,7 5	3,35 4,25	2,2 3,1	2,5 4,0	0,30 0,50	-	11,5 12,7 5	-	-	970	1095
NI 112		B-Ni65CrP-880/950	Remainder	24,0 26,0	-	-	-	-	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	-	0,35 0,45	-	3,5 4,5	Co remainder	1120	1120	1150

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	1235	1235	
PD 202	B-Ag75PdMn-1000/1120	74,5 75,5	-	19,5 20,5	4,5 5,5	-	1000	1120	
PD 203 ¹⁾	B-Cu82Pd-1080/1090	-	81,5 82,5	17,5 18,5	-	-	1080	1090	
PD 204	B-Ag95Pd-970/1010	94,5 95,5	-	4,5 5,5	-	-	970	1010	
NOTE: For PD101 - 106 and PD203 and 204, maximum impurity limits applicable are (% by mass) Al 0,0010, P 0,008, Ti 0,002, Zr 0,0028 total of all impurities 0,15.									
For PD201 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	EN ISO 3677: 1995	Composition (% by mass)				Melting range (approximate)	
		Au min. max.	Cu min. max.	Ni min. max.	Fe min. max.	Solidus °C	Liquidus °C
AU 101¹⁾	B-Au80Cu(Fe)-905/910	79,5 80,5	18,5 19,5	-	0,5 1,5	905	910
AU 102¹⁾	B-Au62Cu-930/940	62,0 63,0	37,0 38,0	-	-	930	940
AU 103¹⁾	B-Cu62Au-980/1000	37,0 38,0	62,0 63,0	-	-	980	1000
AU 104¹⁾	B-Cu70Au-995/1020	29,5 30,5	69,5 70,5	-	-	995	1020
AU 105¹⁾	B-Au82Ni-950	81,5 82,5	-	17,5 18,5	-	950	950
AU 106¹⁾	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
continued		

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
continued		

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	—

continued

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	—