INTERNATIONAL STANDARD

ISO 17672

First edition
2010-06-01

Brazing — Filler metals

Brasage fort — Métaux d'apport

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Reference number
ISO 17672:2010(E)

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Published in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17672 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*.

Requests for official interpretations of any aspect of this International Standard should be directed to the Secretariat of ISO/TC 44/WG 3 via your national standards body, a complete listing which can be found at http://www.iso.org/.

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Brazing — Filler metals

1 Scope

This International Standard specifies the compositional ranges of a series of filler metals used for brazing. The filler metals are divided into seven classes, related to their composition, but not necessarily to the major element present.

NOTE 1 For the major element(s) present, see Annex A.

In the case of composite products, such as flux-coated rods, pastes or plastics tapes, this International Standard covers only the filler metal that forms part of such products. The melting temperatures given in the tables are only approximate, as they necessarily vary within the compositional range of the filler metal. Therefore, they are 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 2 For some applications, e.g. precious metal jewellery, aerospace and dental, filler metals other than those included in this International Standard are often used and these are covered by other International Standards to which reference can be made.

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2 Normative references

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The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3677:1992, *Filler metal for soft soldering, brazing and braze welding — Designation*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

3 Composition

The filler metal shall have a composition in accordance with Tables 5 to 13 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 International 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,

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

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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. For the purposes of determining compliance with the requirements of this International Standard, the actual test values obtained shall be subjected to the rounding-off instructions given in ISO 80000-1:2009, Annex B.

NOTE The chemical analysis is of the bulk material, but the material can be composed of discrete powders with different individual compositions or multiple layers of roll-clad foils where each layer can have a different individual composition.

4 Special vacuum requirement

In a few instances, which are most likely to apply to Ag 272, Pd 287, Pd 387, Pd 388, Pd 481, Pd 483, Pd 484, Pd 587, Pd 647 and Au 295, Au 375, Au 625, Au 752, Au 801 and Au 827, 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[a]	0,005	0,005
Cd	0,001	0,002
P	0,002	0,002[b]
Pb	0,002	0,002
Zn	0,001	0,002
Mn[c]	0,001	0,002
In[c]	0,002	0,003
All other elements where vapour pressure at 500 °C is $> 1{,}3 \times 10^{-5}$ Pa[d]	0,001	0,002

[a] For filler metal Ag 272 (see Table 6), lower levels may be available by agreement between the purchaser and the supplier.

[b] For filler metal Ag 272, 0,02 % maximum.

[c] Except where otherwise specified in Tables 5 to 13.

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

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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 the 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.

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6 Designation

The filler metal shall be designated by the description “filler metal”, the number of this International Standard, i.e. ISO 17672, and a code. Details of the two 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 International Standard, can be made in one of the following ways:

EXAMPLE 1 Filler metal ISO 17672-Al 112

where

“Filler metal” is the description;

“ISO 17672” is the number of this International Standard;

“Al 112” is the short code given in Tables 5 to 13.

EXAMPLE 2 Filler metal ISO 17672-B-Al88Si-575/585

where

“Filler metal” is the description;

“ISO 17672” is the number of this International Standard;

“B” denotes brazing;

“Al88Si-575/585” is the code in accordance with ISO 3677.

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7 Technical delivery conditions

7.1 Types of product

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 can be completely or partially coated with flux.

7.2 Dimensions

7.2.1 General

Dimensions and tolerances for foils (see 7.2.2), rods (see 7.2.3) and, to a lesser extent, wires (see 7.2.4) are defined. For other forms and dimensions not listed in the respective tables, the purchaser and the manufacturer/supplier shall agree on the dimensions and tolerances at the time of placing the order.

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7.2.2 Foils

The tolerances for thickness, width and camber are given in Tables 2, 3 and 4.

Table 2 — Thickness tolerance for foils

Thickness nominal size mm		Limits of thickness related to width (nominal size) mm
over	to	over 1 mm
—	0,05	± 10 %
0,05	0,1	± 0,005
0,1	0,2	± 0,010
0,2	0,3	± 0,015
0,3	0,4	± 0,018
0,4	0,5	± 0,020
0,5	0,8	± 0,025
0,8	1,2	± 0,030
1,2	2,0	± 0,035

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Table 3 — Width tolerance for foils

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Thickness nominal size mm		Limits of width related to width (nominal size) mm		
over	to	to 50 mm	over 50 mm to 100 mm	Over 100 mm
—	0,1	$^{+2}_{0}$	$^{+3}_{0}$	$^{+4}_{0}$
0,1	1,0	$^{+2}_{0}$	$^{+3}_{0}$	$^{+4}_{0}$
1,0	2,0	$^{+3}_{0}$	$^{+4}_{0}$	$^{+5}_{0}$

Table 4 — Camber tolerance for foils

Thickness nominal size mm		Max. camber for width nominal size mm/m				
over	to	3 mm to 10 mm	over 10 mm to 15 mm	over 15 mm to 30 mm	over 30 mm to 50 mm	over 50 mm
—	0,5	10	7	4	3	3
0,5	2,0	15	10	6	4	4

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7.2.3 Rods

For rods, 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 rods and ± 0,3 mm for other fabrication processes. The tolerance on length shall be ± 5 mm.

7.2.4 Wires

For wires, 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. Welds, when present, shall have been made so as not to interfere with uniform, uninterrupted feeding of filler metal on automatic and semiautomatic brazing.

7.4 Marking

Since in many cases the marking of brazing filler metals themselves is impracticable, reliance shall be placed on the 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;

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b) the name of the manufacturer/supplier;

c) the trade name (if any);

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d) the quantity of material and, if 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 (like those specified in ISO 14344) of conformity and/or analysis are required, the purchaser and the manufacturer/supplier shall agree on the details at the time of placing the order.

8 Metal hazards

Although not directly relevant to the requirements of this International Standard, any national requirements for limiting exposure to metal hazards, e.g. fume, should be observed. This is particularly important when using brazing filler metals containing cadmium as an alloying element.

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Table 5 — Class Al: aluminium and magnesium brazing filler metals

Code	**Composition**, % by mass												**Melting temperature** (approximate)	
	Si	Fe	Cu	Mn	Mg	Zn	Cd	Pb	Others	Non-defined elements		Al		
										Each	Total		Solidus	Liquidus
	min./max.	max.	min./max.	max.	min./max.	max.	max.	max.	min./max.	max.	max.		°C	°C
Al-Si alloys														
Al 105	4,5/6,0	0,6	—/0,30	0,15	—/0,20	0,10	0,010	0,025	Ti: —/0,15	0,05	0,15	Remainder	575	630
Al 107	6,8/8,2	0,8	—/0,25	0,10	—/—	0,20	0,010	0,025	—/—	0,05	0,15	Remainder	575	615
Al 110	9,0/11,0	0,8	—/0,30	0,05	—/0,05	0,10	0,010	0,025	Ti: —/0,20	0,05	0,15	Remainder	575	590
Al 112	11,0/13,0	0,8	—/0,30	0,15	—/0,10	0,20	0,010	0,025	—/—	0,05	0,15	Remainder	575	585
Al-Si-Cu alloys														
Al 210	9,3/10,7	0,8	3,3/4,7	0,15	—/0,15	0,20	0,010	0,025	Cr: —/0,15	0,05	0,15	Remainder	520	585
Al-Si-Mg alloys														
Al 310	9,0/10,5	0,8	—/0,25	0,10	1,0/2,0	0,20	0,010	0,025	—/—	0,05	0,15	Remainder	555	590
Al 311	9,0/10,5	0,8	—/0,25	0,10	1,0/2,0	0,20	0,010	0,025	Bi: 0,02/0,20	0,05	0,15	Remainder	555	590
Al 315	9,5/11,0	0,8	—/0,25	0,10	0,20/1,0	0,20	0,010	0,025	—/—	0,05	0,15	Remainder	559	591
Al 317	11,0/13,0	0,8	—/0,25	0,10	0,10/0,50	0,20	0,010	0,025	—/—	0,05	0,15	Remainder	562	582
Al 319	10,5/13,0	0,8	—/0,25	0,10	1,0/2,0	0,20	0,010	0,025	—/—	0,05	0,15	Remainder	559	579
Al-Si-Zn alloys														
Al 410	9,0/11,0	0,8	—/0,3	0,05	—/0,05	0,50/3,0	0,010	0,025	—/—	0,05	0,15	Remainder	576	588
Al 415	10,5/13,0	0,8	—/0,25	0,10	—/—	0,50/3,0	0,010	0,025	—/—	0,05	0,15	Remainder	576	609
Mg alloys														
Mg 001	0,05	0,005	0,05	0,15/1,5	Remainder	1,7/2,3	0,010	0,025	Be: 0,0002/0,0008 Ni: —/0,005	0,05	0,30	8,3/9,7	443	599

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Table 6 — Class Ag: silver brazing filler metals

Code	Composition, % by mass								Melting temperature (approximate)	
	Ag min./max.	Cu min./max.	Zn min./max.	Cd min./max.	Sn min./max.	Si min./max.	Ni min./max.	Mn min./max.	Solidus °C	Liquidus °C
Ag-Cu-Zn-Sn alloys										
Ag 125	24,0/26,0	39,0/41,0	31,0/35,0	—/0,010	1,5/2,5	—/0,05	—/—	—/—	680	760
Ag 130	29,0/31,0	35,0/37,0	30,0/34,0	—/0,010	1,5/2,5	—/0,05	—/—	—/—	665	755
Ag 134	33,0/35,0	35,0/37,0	25,5/29,5	—/0,010	2,0/3,0	—/0,05	—/—	—/—	630	730
Ag 138	37,0/39,0	31,0/33,0	26,0/30,0	—/0,010	1,5/2,5	—/0,05	—/—	—/—	650	720
Ag 140	39,0/41,0	29,0/31,0	26,0/30,0	—/0,010	1,5/2,5	—/0,05	—/—	—/—	650	710
Ag 145	44,0/46,0	26,0/28,0	23,5/27,5	—/0,010	2,0/3,0	—/0,05	—/—	—/—	640	680
Ag 155	54,0/56,0	20,0/22,0	20,0/24,0	—/0,010	1,5/2,5	—/0,05	—/—	—/—	630	660
Ag 156	55,0/57,0	21,0/23,0	15,0/19,0	—/0,010	4,5/5,5	—/0,05	—/—	—/—	620	655
Ag 160	59,0/61,0	29,0/31,0	—/—	—/0,010	9,5/10,5	—/0,05	—/—	—/—	600	730
Ag-Cu-Zn alloys										
Ag 205	4,0/6,0	54,0/56,0	38,0/42,0	—/0,010	—/—	0,05/0,25	—/—	—/—	820	870
Ag 212	11,0/13,0	47,0/49,0	38,0/42,0	—/0,010	—/—	0,05/0,25	—/—	—/—	800	830
Ag 225	24,0/26,0	39,0/41,0	33,0/37,0	—/0,010	—/—	—/0,05	—/—	—/—	700	790
Ag 230	29,0/31,0	37,0/39,0	30,0/34,0	—/0,010	—/—	—/0,05	—/—	—/—	680	765
Ag 235	34,0/36,0	31,0/33,0	31,0/35,0	—/0,010	—/—	—/0,05	—/—	—/—	685	755
Ag 244	43,0/45,0	29,0/31,0	24,0/28,0	—/0,010	—/—	—/0,05	—/—	—/—	675	735
Ag 245	44,0/46,0	29,0/31,0	23,0/27,0	—/0,010	—/—	—/0,05	—/—	—/—	665	745
Ag 250	49,0/51,0	33,0/35,0	14,0/18,0	—/0,010	—/—	—/0,05	—/—	—/—	690	775
Ag 265	64,0/66,0	19,0/21,0	13,0/17,0	—/0,010	—/—	—/0,05	—/—	—/—	670	720
Ag 270	69,0/71,0	19,0/21,0	8,0/12,0	—/0,010	—/—	—/0,05	—/—	—/—	690	740
Ag 272[a]	71,0/73,0	27,0/29,0	—/—	—/0,010	—/—	—/0,05	—/—	—/—	780	780
Ag-Cu-Zn-Cd alloys										
Ag 326	24,0/26,0	29,0/31,0	25,5/29,5	16,5/18,5	—/—	—/0,05	—/—	—/—	605	720
Ag 330	29,0/31,0	27,0/29,0	19,0/23,0	19,0/23,0	—/—	—/0,05	—/—	—/—	600	690
Ag 335	34,0/36,0	25,0/27,0	19,0/23,0	17,0/19,0	—/—	—/0,05	—/—	—/—	605	700
Ag 340	39,0/41,0	18,0/20,0	19,0/23,0	18,0/22,0	—/—	—/0,05	—/—	—/—	595	630
Ag 345	44,0/46,0	14,0/16,0	14,0/18,0	23,0/25,0	—/—	—/0,05	—/—	—/—	605	620
Ag 350	49,0/51,0	14,5/16,5	14,5/18,5	17,0/19,0	—/—	—/0,05	—/—	—/—	625	635
Ag 351	49,0/51,0	14,5/16,5	13,5/17,5	15,0/17,0	—/—	—/0,05	2,5/3,5	—/—	635	655

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