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ISO 24373

Second edition
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Welding consumables — Solid wires and rods for fusion welding of copper and copper alloys — Classification

Produits consommables pour le soudage — Fils pleins et baguettes pleines pour le soudage par fusion du cuivre et des alliages de cuivre — Classification

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*.

Any feedback, question or request for official interpretation related to any aspect of this document should be directed to the Secretariat of ISO/TC 44/SC 3 via your national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html

This second edition cancels and replaces the first edition (ISO 24373:2008), which has been technically revised. The main changes compared to the previous edition are as follows:

— a new alloy, CuSn6MnSi, has been added to Table 1;

— chemistries in Table 1 have been updated for a number of alloys;

— wording regarding Z options has been revised in footnote to Table 1;

— an example showing a Z option has been added;

— Clauses 7, 8 and 9 have been updated to reflect agreed text for all ISO/TC 44/SC 3 standards.

Introduction

For copper-welding consumables, there is no unique relationship between the product form (solid wire or rod) and the welding process used (e.g. gas-shielded metal arc welding, gas tungsten arc welding, plasma arc or other welding processes). For this reason, the solid wires or rods can be classified on the basis of any of the product forms and can be used, as appropriate, for more than one of the above welding processes.

This document was originally based on EN 14640:2005[1].

Welding consumables — Solid wires and rods for fusion welding of copper and copper alloys — Classification

1 Scope

This document specifies requirements for classification of solid wires and rods for fusion welding of copper and copper alloys. The classification of the solid wires and rods is based on their chemical composition.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 544, *Welding consumables — Technical delivery conditions for filler materials and fluxes — Type of product, dimensions, tolerances and markings*

ISO 14344, *Welding consumables — Procurement of filler materials and fluxes*

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

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Classification

The classification is divided into two parts:

a) the first part indicates the product form, solid wires or rods (see 5.1);

b) the second part gives a numerical symbol indicating the chemical composition of the solid wire or rod (see Table 1).

5 Symbols

5.1 Symbol for the product form

The symbol for the solid wire and rod shall be S.

NOTE One product form may be used for more than one welding process.

5.2 Symbol for the chemical composition

The numerical symbol in Table 1 indicates the chemical composition of a solid wire or rod, determined under conditions given in Clause 7.

NOTE 1 In addition the chemical symbol may be used.

NOTE 2 Corresponding national classifications are shown in Annex A, Table A.1.

NOTE 3 Annex B gives recommendations for select alloys for use with oxyfuel gas welding and gas-shielded metal arc welding.

6 Mechanical properties of the weld metal

The mechanical properties of the weld metal are not part of the classification.

7 Chemical analysis

Chemical analysis shall be performed on specimens of the product or the stock from which it is made. Any analytical technique can be used; but, in case of dispute, reference shall be made to established published methods, agreed between the contracting parties.

8 Rounding procedure

For purposes of determining compliance with the requirements of this document, the actual test values obtained shall be subject to ISO 80000-1:2009, B.3, Rule A. If the measured values are obtained by equipment calibrated in units other than those of this document, the measured values shall be converted to the units of this document before rounding. If an arithmetic average value is to be compared with the requirements of this document, rounding shall be done only after calculating the arithmetic average. The rounded results shall fulfil the requirements of the appropriate table for the classification under test.

9 Retest

If any test fails to meet a requirement, that test shall be repeated twice. The results of both retests shall meet the requirement. Specimens for the retest may be taken from the original test sample or from a new test sample. For chemical analysis, retests need only be for those specific elements that failed to meet their test requirement. If the results of one or both retests fail to meet the requirement, the material under test shall be considered as not meeting the requirements of this document for that classification.

In the event that, during preparation or after completion of any test, it is clearly determined that prescribed or proper procedures were not followed in preparing the sample or test specimen(s), or in conducting the tests, the test shall be considered invalid, without regard to whether the test was actually completed, or whether the test results met, or failed to meet, the requirement. That test shall be repeated, following proper prescribed procedures. In this case, the requirement for doubling the number of test specimens does not apply.

10 Technical delivery conditions

Technical delivery conditions shall meet the requirements given in ISO 544 and ISO 14344.

Table 1 — Symbol for the chemical composition of solid wires and rods

Alloy symbols		Chemical composition, % (by mass)[a,b]														
Numerical	Chemical	Cu	Al	Fe	Mn	Ni incl. Co	P	Pb	Si	Sn	Zn	As	C	Ti	S	Others total
COPPER-LOW ALLOYED																
Cu 1897	CuAg1	min. 99,5 incl. Ag	0,01	0,05	0,2	0,3	0,01 to 0,05	0,01	0,1	—	—	0,05	—	—	—	0,2 Ag:0,8 to 1,2
Cu 1898	CuSn1	min. 98,0	0,01	—	0,50	—	0,15	0,02	0,50	1,0	—	—	—	—	—	0,50
Cu 1898A	CuSn1MnSi	bal.	0,01	0,03	0,1 to 0,4	0,1	0,015	0,01	0,1 to 0,4	0,5 to 1,0	—	—	—	—	—	0,2
COPPER-SILICON (SILICON BRONZE)																
Cu 6511	CuSi2Mn1	bal.	0,01	0,1	0,5 to 1,5	—	0,02	0,02	1,5 to 2,0	0,1 to 0,3	0,2	—	—	—	—	0,5
Cu 6560	CuSi3Mn1	bal.	0,01	0,50	1,5	—	—	0,02	2,8 to 4,0	1,0	1,0	—	—	—	—	0,50
Cu 6561	CuSi2Mn1Sn1Zn1	bal.	—	0,5	1,5	—	—	0,02	2,0 to 2,8	1,5	1,5	—	—	—	—	0,5
COPPER-TIN (INCLUDING PHOSPHOR BRONZE)																
Cu 5180	CuSn5P	bal.	0,01	—	—	—	0,10 to 0,35	0,02		4,0 to 6,0	—	—	—	—	—	0,50
Cu 5180A	CuSn6P	bal.	0,01	0,1	—	—	0,01 to 0,45	0,02	—	4,0 to 7,0	0,1	—	—	—	—	0,2
Cu 5285	CuSn6MnSi	bal.	0,01	—	0,1 to 0,5	—	—	—	0,1 to 0,5	5,0 to 6,0	—	—	—	—	—	0,5
Cu 5210	CuSn8P	bal.	0,01	0,10	—	—	0,10 to 0,35	0,02	—	7,0 to 9,0	0,20	—	—	—	—	0,50
Cu 5211	CuSn10MnSi	bal.	0,01	0,1	0,1 to 0,5	—	0,1	0,02	0,1 to 0,5	9,0 to 10,0	0,1	—	—	—	—	0,5
Cu 5410	CuSn12P	bal.	0,005	—	—	—	0,01 to 0,4	0,02	—	11,0 to 13,0	0,05	—	—	—	—	0,4

[a] Analysis shall be made for the elements for which specific values are shown in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analyses shall be carried out to determine that the total of these other elements does not exceed the given maximum level.

[b] Single values shown are maxima, unless otherwise noted.

[c] (and *) The total of all other elements, including those for which the maximum value or an asterisk (*) is shown, shall not exceed the value specified in "Others total".

[d] Consumables for which the chemical composition is not listed in this table shall be symbolized similarly and prefixed by the letter Z. The chemical composition ranges are not specified. Therefore, it is possible that two electrodes with the same Z classification are not interchangeable.

Table 1 *(continued)*

Alloy symbols		Chemical composition, % (by mass)[a,b]														
Numerical	Chemical	Cu	Al	Fe	Mn	Ni incl. Co	P	Pb	Si	Sn	Zn	As	C	Ti	S	Others total
COPPER-ZINC (BRASS)																
Cu 4641	CuZn40SnSi	58,0 to 62,0	0,01	0,2	0,3	—	—	0,03	0,1 to 0,5	1,0	bal.	—	—	—	—	0,2
Cu 4700	CuZn40Sn	57,0 to 61,0	0,01*	*	*	—	—	0,05*	*	0,25 to 1,00	bal.	—	—	—	—	0,50[c]
Cu 4701	CuZn40SnSiMn	58,5 to 61,5	0,01	0,25	0,05 to 0,25	—	—	0,02	0,15 to 0,45	0,2 to 0,5	bal.	—	—	—	—	0,2
Cu 6800	CuZn40Ni	56,0 to 60,0	0,01*	0,25 to 1,20	0,01 to 0,50	0,20 to 0,80	—	0,05*	0,04 to 0,20	0,80 to 1,10	bal.	—	—	—	—	0,50[c]
Cu 6810	CuZn40Fe1Sn1	56,0 to 60,0	0,01*	0,25 to 1,20	0,01 to 0,50	—	—	0,05*	0,04 to 0,15	0,80 to 1,10	bal.	—	—	—	—	0,50[c]
Cu 7730	CuZn40Ni10	46,0 to 50,0	0,01*	—	—	9,0 to 11,0	0,25	0,05*	0,04 to 0,25	—	bal.	—	—	—	—	0,50[c]
COPPER-ALUMINIUM (ALUMINIUM-BRONZE)																
Cu 6061	CuAl5Ni2Mn	bal.	4,5 to 5,5	0,5	0,1 to 1,0	1,0 to 2,5	—	0,02	0,1	—	0,2	—	—	—	—	0,5
Cu 6100	CuAl7	bal.	6,0 to 8,5	*	0,50	*	—	0,02	0,10	*	0,20	—	—	—	—	0,50[c]
Cu 6180	CuAl10Fe	bal.	8,5 to 11,0	0,5 to 1,5	—	—	—	0,02	0,10	—	0,02	—	—	—	—	0,50
Cu 6240	CuAl11Fe3	bal.	10,0 to 11,5	2,0 to 4,5	—	—	—	0,02	0,10	—	0,10	—	—	—	—	0,50
Cu 6325	CuAl8Fe4Mn2Ni2	bal.	7,0 to 9,0	1,8 to 5,0	0,5 to 3,0	0,5 to 3,0	—	0,02	0,1	—	0,1	—	—	—	—	0,4
Cu 6327	CuAl8Ni2Fe2Mn2	bal.	7,0 to 9,5	0,5 to 2,5	0,5 to 2,5	0,5 to 3,0	—	0,02	0,2	—	0,2	—	—	—	—	0,4
Cu 6328	CuAl9Ni5Fe3Mn2	bal.	8,50 to 9,50	3,0 to 5,0	0,60 to 3,50	4,0 to 5,5	—	0,02	0,10	—	0,10	—	—	—	—	0,50

[a] Analysis shall be made for the elements for which specific values are shown in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analyses shall be carried out to determine that the total of these other elements does not exceed the given maximum level.

[b] Single values shown are maxima, unless otherwise noted.

[c] (and *) The total of all other elements, including those for which the maximum value or an asterisk (*) is shown, shall not exceed the value specified in "Others total".

[d] Consumables for which the chemical composition is not listed in this table shall be symbolized similarly and prefixed by the letter Z. The chemical composition ranges are not specified. Therefore, it is possible that two electrodes with the same Z classification are not interchangeable.

Table 1 *(continued)*

Alloy symbols		Chemical composition, % (by mass)[a,b]														
Numerical	Chemical	Cu	Al	Fe	Mn	Ni incl. Co	P	Pb	Si	Sn	Zn	As	C	Ti	S	Others total
COPPER-MANGANESE																
Cu 6338	CuMn13Al8Fe3Ni2	bal.	7,0 to 8,5	2,0 to 4,0	11,0 to 14,0	1,5 to 3,0	—	0,02	0,10	—	0,15	—	—	—	—	0,50
COPPER-NICKEL																
Cu 7061	CuNi10	bal.	—	0,5 to 2,0	0,5 to 1,5	9,0 to 11,0	0,02	0,02	0,2	—	—	—	0,05	0,1 to 0,5	0,02	0,4
Cu 7158	CuNi30Mn1FeTi	bal.	—	0,40 to 0,70	1,0	29,0 to 32,0	0,02	0,02	0,25	—	—	—	—	0,20 to 0,50	0,01	0,50
Cu Z		Any other chemical composition[d].														

[a] Analysis shall be made for the elements for which specific values are shown in this table. If, however, the presence of other elements is indicated in the course of routine analysis, further analyses shall be carried out to determine that the total of these other elements does not exceed the given maximum level.

[b] Single values shown are maxima, unless otherwise noted.

[c] (and *) The total of all other elements, including those for which the maximum value or an asterisk (*) is shown, shall not exceed the value specified in "Others total".

[d] Consumables for which the chemical composition is not listed in this table shall be symbolized similarly and prefixed by the letter Z. The chemical composition ranges are not specified. Therefore, it is possible that two electrodes with the same Z classification are not interchangeable.

11 Designation

The designation of solid wires and rods shall follow the principle given in the examples below.

EXAMPLE 1 A solid wire (S) for fusion welding that has a chemical composition within the limits of the alloy symbol Cu 6560 (CuSi3Mn1) of Table 1 is designated:

ISO 24373 - **S Cu 6560**

or

ISO 24373 - **S Cu 6560 (CuSi3Mn1)**

where:

ISO 24373 is the number of this document;

S is the product form (see 5.1);

Cu 6560 is the chemical composition of the welding consumable (see Table 1);

CuSi3Mn1 is the optional chemical composition of the welding consumable (see Table 1).

EXAMPLE 2 A solid wire (S) for fusion welding with a chemical composition of 12 % Sn, 0,5 % Mn, 0,5 % Si is designated:

ISO 24373 - **S Cu Z CuSn12MnSi**

where:

ISO 24373 is the number of this document;

S is the product form (see 5.1);

Cu Z is the chemical composition, agreed between the manufacturer and customer;

CuSn12MnSi is the chemical composition of the welding consumable.

Annex A
(informative)

Corresponding national classifications

Table A.1 — Corresponding national classifications

Numerical symbol	Chemical symbol	USA		Japan	Europe		Germany
		AWS A5.7/A5.7M:2007 AWS A5.8M/ A5.8:2011-AMD1	UNS	JIS Z3341:2007 JIS Z3202:2007	EN 13347:2002	EN 14640:2005	DIN 1733-1:1998
COPPER-(LOW ALLOYED)							
Cu 1897	CuAg1	—	—	—	—	CuAg1	2.1211
Cu 1898	CuSn1	ERCu	C18980	YCu	—	—	—
Cu 1898A	CuSn1MnSi	—	—	—	CuSn1MnSi	CuSn1	2.1006
COPPER-SILICON (silicon bronze)							
Cu 6511	CuSi2Mn1	—	—	—	—	CuSi2Mn1	—
Cu 6560	CuSi3Mn1	ERCuSi-A	C65600	YCuSi B	CuSi3Mn1	CuSi3Mn1	2.1461
Cu 6561	CuSi2Mn1Sn1Zn1	—	—	YCuSi A	—	CuSi2Mn1Sn	—
COPPER-TIN (including phosphor bronze)							
Cu 5180	CuSn5P	ERCuSn-A	C51800	YCuSn A	CuSn5, CuSn6	—	2.1022
Cu 5180A	CuSn6P	ERCuSn-A	C51800	—	CuSn5, CuSn6	CuSn6P	2.1022
Cu 5210	CuSn8P	ERCuSn-C	—	YCuSn B	CuSn8	CuSn9P	—
Cu 5211	CuSn10MnSi	—	—	—	—	CuSn10	—
Cu 5410	CuSn12P	—	—	—	CuSn12	CuSn12P	2.1056
COPPER-ZINC (brass)							
Cu 4641	CuZn40SnSi	—	—	—	CuZn40FeSiSn	CuZn40SnSi	—
Cu 4700	CuZn40Sn	RBCuZn-A	C47000	GCuZnSn	CuZn40Sn1	CuZn40	—
Cu 4701	CuZn40SnSiMn	—	—	—	CuZn40MnSiSn	CuZn40SnSiMn	—
Cu 6800	CuZn40Ni	RBCuZn-B	C68000	—	CuZn39Fe1Sn1MnNiSi	CuZn40Ni	—
Cu 6810	CuZn40Fe1Sn1	RBCuZn-C	C68100	—	CuZn40FeSiSn	CuZn40SnSi	2.0366
Cu 7730	CuZn40Ni10Sn1	RBCuZn-D	C77300	GCuZnNi	—	CuZn40Ni10	—
COPPER-ALUMINIUM (aluminium bronze)							
Cu 6061	CuAl5Ni2Mn	—	—	—	—	CuAl5Mn1Ni1	—
Cu 6100	CuAl7	ERCuAl-A1	C61000	—	CuAl8	CuAl8	2.0921
Cu 6180	CuAl10Fe1	ERCuAl-A2	C61800	YCuAl	CuAl10Fe1	CuAl10	2.0937
Cu 6240	CuAl11Fe3	ERCuAl-A3	C62400	—	—	CuAl11Fe	—
Cu 6325	CuAl8Fe4Mn2Ni2	—	—	YCuAlNi B	—	CuAl8Fe4Ni2	—