
**Welding consumables — Covered
electrodes for manual metal arc welding
of nickel and nickel alloys —
Classification**

*Produits consommables pour le soudage — Électrodes enrobées pour
le soudage manuel à l'arc du nickel et des alliages de nickel —
Classification*

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ISO 14172:2008

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 14172 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*.

This second edition cancels and replaces the first edition (ISO 14172:2003), which has been technically revised. It also incorporates the Technical Corrigenda ISO 14172:2003/Cor.1:2004 and ISO 14172:2003/Cor.2:2005.

Requests for official interpretations of any aspect of this International Standard 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.

Introduction

This International Standard has been prepared with the assistance of Commission II of the International Institute of Welding (IIW).

This International Standard has been revised to assist an alignment between the documents prepared by CEN/TC 121/SC 3 in their work towards a CEN standard for covered electrodes for nickel-base alloys and those drawn up by Commission II of the IIW. The classifications in the IIW proposals remain largely unaltered, but the designations now allow for the optional use of a chemical symbol in the form widely favoured in Europe.

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Welding consumables — Covered electrodes for manual metal arc welding of nickel and nickel alloys — Classification

1 Scope

This International Standard prescribes requirements for the classification of nickel- and nickel-alloy-covered electrodes for manual metal arc welding and overlaying. It includes those compositions in which the nickel content exceeds that of any other element.

2 Normative references

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 31-0:1992, *Quantities and units — Part 0: General principles*

ISO 544, *Welding consumables — Technical delivery conditions for welding filler materials — Type of product, dimensions, tolerances and markings*

ISO 6847, *Welding consumables — Deposition of a weld metal pad for chemical analysis*

ISO 14344, *Welding and allied processes — Flux and gas shielded electrical welding processes — Procurement guidelines for consumables*

ISO 15792-1:2000, *Welding consumables — Test methods — Part 1: Test methods for all-weld metal test specimens in steel, nickel and nickel alloys*

3 Classification

A covered electrode shall be classified in accordance with the chemical composition of the all-weld metal as given in Table 1 and the mechanical properties listed in Table 2. The symbol for the classification is divided into two parts:

- a) the first part gives a symbol indicating the product/process to be used;
- b) the second part gives a symbol indicating the chemical composition of the all-weld metal.

4 Symbols and requirements

4.1 Symbol for the product/process

The symbol for covered electrodes used for manual metal arc welding shall be the letter “E”.

4.2 Symbol for the chemical composition of the all-weld metal

The symbol for the chemical composition of the all-weld metal shall comprise “Ni” plus four digits, as shown in Table 1. The first digit is an indicator of the class of alloy deposited, where

- 2 indicates no significant alloy addition,
- 4 indicates significant copper addition (nickel-copper alloys),
- 6 indicates significant chromium addition, with iron less than 25 % (nickel-chromium-iron and nickel-chromium-molybdenum alloys),
- 8 indicates significant chromium addition, with iron more than 25 % (nickel-iron-chromium alloys),
- 10 indicates significant molybdenum addition without significant chromium addition (nickel-molybdenum alloys).

The remaining digits indicate the particular alloy deposited. The basis of the system of designation is described in Annex A.

NOTE In addition, the chemical symbol can be used.

4.3 Rounding-off procedure

For the purposes of determining compliance with the requirements of this International Standard, the actual test values obtained shall be rounded using ISO 31-0:1992, Annex B, Rule A. If the measured values are obtained by equipment calibrated in units other than those of this International Standard, the measured values shall be converted to the units of this International Standard before rounding. If an average value is to be compared to the requirements of this International Standard, rounding shall be done only after calculating the average. In the case where the test method standard cited in the normative references of this International Standard contains instructions for rounding that conflict with the instructions of this International Standard, the rounding requirements of the test method standard shall apply. The rounded results shall fulfil the requirements of the appropriate table for the classification under test.

5 Chemical analysis

Chemical analysis shall be performed on any suitable all-weld metal test specimen. In case of dispute, the test specimen specified in ISO 6847 shall be used. The test results shall meet the requirements of Table 1 for the classification under test. Any analytical technique may be used, but, in case of dispute, reference shall be made to established published methods.

6 Mechanical properties of the all-weld metal

Mechanical properties are not part of the designation, but they are required for classification. The mechanical properties of the all-weld metal, deposited using covered electrodes in accordance with Table 1, shall be determined using a test coupon in accordance with ISO 15792-1:2000, type 1.0. The minimum tensile properties shall be in accordance with Table 2.

7 Retests

If any test fails to meet the requirement, that test shall be repeated twice. The results of both retests shall meet the requirements. Specimens for retesting may be taken from the original test assembly or from a new test assembly. 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 not to meet the requirements of this International Standard 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 weld test assembly 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.

8 Technical delivery conditions

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

9 Designation

The designation of covered electrodes shall follow the principle given in the example below.

EXAMPLE A covered electrode for manual metal arc welding (E) depositing a nickel-base alloy weld metal (Ni) with a chemical composition of 67 % Ni, 15 % Cr, 7 % Mn and 2 % Nb and all other requirements for the alloy 6182 in Table 1 is designated

Covered electrode ISO 14172 - E Ni 6182

or alternatively

Covered electrode ISO 14172 - E Ni 6182 (NiCr15Fe6Mn)

where

ISO 14172	designates the number of this International Standard; https://standards.iteh.ai/catalog/standards/sist/0b956ac9-1f77-4665-9a98-35e67d8771a1/iso-14172-2008
E	designates covered electrode manual metal arc welding (see 4.1);
Ni 6182	designates the chemical composition of all-weld metal (Table 1);
NiCr15Fe6Mn	designates the optional chemical symbol of the covered electrode (see Table 1).

Table 1 — Symbols and all-weld metal chemical composition requirements

Alloy symbol		Chemical composition % (by mass) ^a											Notes ^{d,e}			
Numerical symbol	Chemical symbol	C	Mn	Fe	Si	Cu	Ni ^b	Co	Al	Ti	Cr	Nb ^c	Mo	V	W	Notes ^{d,e}
Nickel																
Ni 2061	NiTi3	0,10	0,7	0,7	1,2	0,2	min. 92,0	—	1,0	1,0 to 4,0	—	—	—	—	—	—
Nickel-Copper																
Ni 4060	NiCu30Mn3Ti	0,15	4,0	2,5	1,5	27,0 to 34,0	min. 62,0	—	1,0	1,0	—	—	—	—	—	—
Ni 4061	NiCu27Mn3NbTi	0,15	4,0	2,5	1,3	24,0 to 31,0	min. 62,0	—	1,0	1,5	—	3,0	—	—	—	—
Nickel-Chromium																
Ni 6082	NiCr20Mn3Nb	0,10	2,0 to 6,0	4,0	0,8	0,5	min. 63,0	—	—	0,5	18,0 to 22,0	1,5 to 3,0	2,0	—	—	—
Ni 6231	NiCr22W14Mo	0,05 to 0,10	0,3 to 1,0	3,0	0,3 to 0,7	0,5	min. 45,0	5,0	0,5	0,1	20,0 to 24,0	—	1,0 to 3,0	—	13,0 to 15,0	—
Nickel-Chromium-Iron																
Ni 6025	NiCr25Fe10AlY	0,10 to 0,25	0,5	8,0 to 11,0	0,8	—	min. 55,0	—	1,5 to 2,2	0,3	24,0 to 26,0	—	—	—	—	0,15Y
Ni 6062	NiCr15Fe8Nb	0,08	3,5	11,0	0,8	0,5	min. 62,0	—	—	—	13,0 to 17,0	0,5 to 4,0	—	—	—	—
Ni 6093	NiCr15Fe8NbMo	0,20	1,0 to 5,0	12,0	1,0	0,5	min. 60,0	—	—	—	13,0 to 17,0	1,0 to 3,5	1,0 to 3,5	—	—	—
Ni 6094	NiCr14Fe4NbMo	0,15	1,0 to 4,5	12,0	0,8	0,5	min. 55,0	—	—	—	12,0 to 17,0	0,5 to 3,0	2,5 to 5,5	—	1,5	—
Ni 6095	NiCr15Fe8NbMoW	0,20	1,0 to 3,5	12,0	0,8	0,5	min. 55,0	—	—	—	13,0 to 17,0	1,0 to 3,5	1,0 to 3,5	—	1,5 to 3,5	—
Ni 6133	NiCr16Fe12NbMo	0,10	1,0 to 3,5	12,0	0,8	0,5	min. 62,0	—	—	—	13,0 to 17,0	0,5 to 3,0	0,5 to 2,5	—	—	—
Ni 6152	NiCr30Fe9Nb	0,05	5,0	7,0 to 12,0	0,8	0,5	min. 50,0	—	0,5	0,5	28,0 to 31,5	1,0 to 2,5	0,5	—	—	—

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Table 1 (continued)

Alloy symbol		Chemical composition % (by mass) ^a													Notes ^{d, e}	
Numerical symbol	Chemical symbol	C	Mn	Fe	Si	Cu	Ni ^b	Co	Al	Ti	Cr	Nb ^c	Mo	V	W	
Ni 6182	NiCr15Fe6Mn	0,10	5,0 to 10,0	10,0	1,0	0,5	min. 60,0	—	—	1,0	13,0 to 17,0	1,0 to 3,5*	—	—	—	*0,3 max. Ta where specified
Ni 6333	NiCr25Fe16CoMo3W	0,10	1,2 to 2,0	min. 16,0	0,8 to 1,2	0,5	44,0 to 47,0	2,5 to 3,5	—	—	24,0 to 26,0	—	2,5 to 3,5	—	2,5 to 3,5	
Ni 6701	NiCr36Fe7Nb	0,35 to 0,50	0,5 to 2,0	7,0	0,5 to 2,0	—	42,0 to 48,0	—	—	—	33,0 to 39,0	0,8 to 1,8	—	—	—	
Ni 6702	NiCr28Fe6W	0,35 to 0,50	0,5 to 1,5	6,0	0,5 to 2,0	—	47,0 to 50,0	—	—	—	27,0 to 30,0	—	—	—	4,0 to 5,5	
Ni 6704	NiCr25Fe10Al3YC	0,15 to 0,30	0,5	8,0 to 11,0	0,8	—	55,0	—	1,8 to 2,8	0,3	24,0 to 26,0	—	—	—	—	0,15Y
Ni 8025	NiCr29Fe26Mo	0,06	1,0 to 3,0	30,0	0,7	1,5 to 3,0	35,0 to 40,0	—	0,1	1,0*	27,0 to 31,0	1,0	2,5 to 4,5	—	—	*or Nb
Ni 8165	NiFe30Cr25Mo	0,03	1,0 to 3,0	30,0	0,7	1,5 to 3,0	37,0 to 42,0	—	0,1	1,0	23,0 to 27,0	—	3,5 to 7,5	—	—	
Nickel-Molybdenum																
Ni 1001	NiMo28Fe5	0,07	1,0	4,0 to 7,0	1,0	0,5	min. 55,0	2,5	—	—	1,0	—	26,0 to 30,0	0,6	1,0	
Ni 1004	NiMo25Cr3Fe5	0,12	1,0	4,0 to 7,0	1,0	0,5	min. 60,0	2,5	—	—	2,5 to 5,5	—	23,0 to 27,0	0,6	1,0	
Ni 1008	NiMo19WCr	0,10	1,5	10,0	0,8	0,5	min. 60,0	—	—	—	0,5 to 3,5	—	17,0 to 20,0	—	2,0 to 4,0	
Ni 1009	NiMo20WCu	0,10	1,5	7,0	0,8	0,3 to 1,3	min. 62,0	—	—	—	—	—	18,0 to 22,0	—	2,0 to 4,0	
Ni 1062	NiMo24Cr8Fe6	0,02	1,0	4,0 to 7,0	0,7	—	min. 60,0	—	—	—	6,0 to 9,0	—	22,0 to 26,0	—	—	
Ni 1066	NiMo28	0,02	2,0	2,2	0,2	0,5	min. 64,5	1,0	—	—	1,0	—	26,0 to 30,0	—	1,0	
Ni 1067	NiMo30Cr	0,02	2,0	1,0 to 3,0	0,2	0,5	min. 62,0	3,0	—	—	1,0 to 3,0	—	27,0 to 32,0	—	3,0	