
**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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Contents

Page

Foreword.....	iv
Introduction	v
1 Scope.....	1
2 Normative references	1
3 Classification.....	1
4 Symbols and requirements	1
4.1 Symbol for the product/process.....	1
4.2 Symbol for the chemical composition of the all-weld metal	2
5 Chemical analysis	2
6 Mechanical properties of the all-weld metal.....	2
7 Retests	2
8 Technical delivery conditions.....	3
9 Designation.....	3
Annex A (informative) System for designation of welding filler metals.....	8
Annex B (informative) Description of consumables classes.....	9
Annex C (informative) Equivalent national specifications	14

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

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Introduction

This International Standard has been prepared with the assistance of the International Institute of Welding, Commission II.

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.

Requests for an official interpretation of technical aspects of this international Standard should be directed to the secretariat of ISO/TC 44/SC 3 via the user's national standardization body. A listing of these bodies can be found at www.iso.org.

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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 according to 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:

- 2 No significant alloy addition.
- 4 Significant copper addition (nickel-copper alloys).
- 6 Significant chromium addition, with iron less than 25 % (nickel-chromium-iron and nickel-chromium-molybdenum alloys).
- 8 Significant chromium addition, with iron more than 25 % (nickel-iron-chromium alloys).
- 10 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 may be used.

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.

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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 be only 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 specification 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	=	number of this International Standard
E	=	covered electrode/manual metal-arc welding (see 4.1)
Ni 6182	=	Chemical composition of all-weld metal (Table 1)
NiCr15Fe6Mn	=	Optional chemical symbol of covered electrode (see Table 1)

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

Alloy symbol		Chemical composition % by mass ^{a, b}													Notes ^{e, f}	
Numerical symbol	Chemical symbol	C	Mn	Fe	Si	Cu	Ni ^c	Co	Al	Ti	Cr	Nb ^d	Mo	V		W
Nickel																
NI 2061	NI Ti3	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	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 6092	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 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 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	—	—	—
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	NiCr25Fe16CoNbW	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	—	min. 55,0	—	1,8 to 2,8	0,3	24,0 to 26,0	—	—	—	—	0,15Y
NI 8025	NiCr29Fe30Mo	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	NiCr25Fe30Mo	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	—	—	—

Table 1 (continued)

Alloy symbol		Chemical composition % by mass ^{a, b}													Notes ^{e, f}	
Numerical symbol	Chemical symbol	C	Mn	Fe	Si	Cu	Ni ^c	Co	Al	Ti	Cr	Nb ^d	Mo	V		W
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	NiMo25Cr16Fe5	0,12	1,0	4,0 to 7,0	1,0	0,5	min. 60,0	—	—	—	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	—	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	
NI 1069	NiMo28Fe4Cr	0,02	1,0	2,0 to 5,0	0,7	—	min. 65,0	1,0	0,6	—	0,5 to 1,5	—	26,0 to 30,0	—	—	
Nickel-Chromium-Molybdenum																
NI 6002	NiCr22Fe18Mo	0,05 to 0,15	1,0	17,0 to 20,0	1,0	0,5	min. 45,0	0,5 to 2,5	—	—	20,0 to 23,0	—	8,0 to 10,0	—	0,2 to 1,0	
NI 6012	NiCr22Mo9	0,03	1,0	3,5	0,7	0,5	min. 58,0	—	0,4	0,4	20,0 to 23,0	1,5	8,5 to 10,5	—	—	
NI 6022	NiCr21Mo13W3	0,02	1,0	2,0 to 6,0	0,2	0,5	min. 49,0	2,5	—	—	20,0 to 22,5	—	12,5 to 14,5	0,4	2,5 to 3,5	
NI 6024	NiCr26Mo14	0,02	0,5	1,5	0,2	0,5	min. 55,0	—	—	—	25,0 to 27,0	—	13,5 to 15,0	—	—	
NI 6030	NiCr29Mo5F10Se15W2	0,03	1,5	13,0 to 17,0	1,0	1,0 to 2,4	min. 36,0	5,0	—	—	28,0 to 31,5	0,3 to 1,5	4,0 to 6,0	—	1,5 to 4,0	
NI 6059	NiCr23Mo16	0,02	1,0	1,5	0,2	—	min. 56,0	—	—	—	22,0 to 24,0	—	15,0 to 16,5	—	—	
NI 6200	NiCr23Mo16Cu2	0,02	1,0	3,0	0,2	1,3 to 1,9	min. 45,0	2,0	—	—	20,0 to 24,0	—	15,0 to 17,0	—	—	
NI 6205	NiCr25Mo16	0,02	0,5	5,0	0,2	2,0	min. 50,0	—	0,4	—	22,0 to 27,0	—	13,5 to 16,5	—	—	
NI 6275	NiCr15Mo16Fe5W3	0,10	1,0	4,0 to 7,0	1,0	0,5	min. 50,0	2,5	—	—	14,5 to 16,5	—	15,0 to 18,0	0,4	3,0 to 4,5	