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ISO 14172

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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

Reference number
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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*.

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.

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;
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]														
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	—	—	

Table 1 (*continued*)

Alloy symbol		Chemical composition % (by mass) [a]														
Numerical symbol	**Chemical symbol**	C	Mn	Fe	Si	Cu	Ni [b]	Co	Al	Ti	Cr	Nb [c]	Mo	V	W	Notes [d, e]
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	—	min. 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 to7,5	—	—	
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	

Table 1 (*continued*)

Alloy symbol		Chemical composition % (by mass) [a]													
Numerical symbol	**Chemical symbol**	C	Mn	Fe	Si	Cu	Ni [b]	Co	Al	Ti	Cr	Nb [c]	Mo	V	W	Notes [d, e]
Ni 1069	NiMo28Fe4Cr	0,02	1,0	2,0 to 5,0	0,7	—	min. 65,0	1,0	0,5	—	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	NiCr29Mo5Fe15W2	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 6058	NiCr22Mo20	0,02	1,5	1,5	0,2	0,5	min. 51,0	0,3	0,4	—	20,0 to 23,0	—	19,0 to 21,0	—	0,3	
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	0,3	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	
Ni 6276	NiCr15Mo15Fe6W4	0,02	1,0	4,0 to 7,0	0,2	0,5	min. 50,0	2,5	—	—	14,5 to 16,5	—	15,0 to 17,0	0,4	3,0 to 4,5	
Ni 6452	NiCr19Mo15	0,025	2,0	1,5	0,4	0,5	min. 56,0	—	—	—	18,0 to 20,0	0,4	14,0 to 16,0	0,4	—	
Ni 6455	NiCr16Mo15Ti	0,02	1,5	3,0	0,2	0,5	min. 56,0	2,0	—	0,7	14,0 to 18,0	—	14,0 to 17,0	—	0,5	

Table 1 (*continued*)

Alloy symbol		Chemical composition % (by mass) [a]														
Numerical symbol	**Chemical symbol**	C	Mn	Fe	Si	Cu	Ni [b]	Co	Al	Ti	Cr	Nb [c]	Mo	V	W	Notes [d, e]
Ni 6620	NiCr14Mo7Fe	0,10	2,0 to 4,0	10,0	1,0	0,5	min. 55,0	—	—	—	12,0 to 17,0	0,5 to 2,0	5,0 to 9,0	—	1,0 to 2,0	
Ni 6625	NiCr22Mo9Nb	0,10	2,0	7,0	0,8	0,5	min. 55,0	—	—	—	20,0 to 23,0	3,0 to 4,2	8,0 to 10,0	—	—	
Ni 6627	NiCr21MoFeNb	0,03	2,2	5,0	0,7	0,5	min. 57,0	—	—	—	20,5 to 22,5	1,0 to 2,8	8,8 to 10,0	—	0,5	
Ni 6650	NiCr20Fe14Mo11WN	0,03	0,7	12,0 to 15,0	0,6	0,5	min. 44,0	1,0	0,5	—	19,0 to 22,0	0,3	10,0 to 13,0	—	1,0 to 2,0	0,15 N 0,02 S
Ni 6686	NiCr21Mo16W4	0,02	1,0	5,0	0,3	0,5	min. 49,0	—	—	0,3	19,0 to 23,0	—	15,0 to 17,0	—	3,0 to 4,4	
Ni 6985	NiCr22Mo7Fe19	0,02	1,0	18,0 to 21,0	1,0	1,5 to 2,5	min. 45,0	5,0	—	—	21,0 to 23,5	1,0	6,0 to 8,0	—	1,5	
Nickel-Chromium-Cobalt-Molybdenum																
Ni 6117	NiCr22Co12Mo	0,05 to 0,15	3,0	5,0	1,0	0,5	min. 45,0	9,0 to 15,0	1,5	0,6	20,0 to 26,0	1,0	8,0 to 10,0	—	—	

a Single values for all elements except nickel are maxima. Two values shown indicate minimum and maximum limits for a range.

b Up to 1 % of the nickel content can be cobalt unless otherwise specified. For certain applications, lower cobalt levels may be required and should be agreed between contracting parties.

c Up to 20 % of the niobium content can be tantalum.

d The total of unspecified elements shall not exceed 0,5 %, excluding cobalt and tantalum.

e Phosphorus 0,020 max., sulfur 0,015 max. unless otherwise stated.

Table 2 — Minimum tensile properties of the all-weld metal

Numerical symbol	Minimum 0,2 % proof strength MPa	Minimum tensile strength MPa	Minimum elongation $5d$ [a] %
Nickel			
Ni 2061	200	410	18
Nickel-Copper			
Ni 4060; Ni 4061	200	480	27
Nickel-Chromium			
Ni 6082	360	600	22
Ni 6231	350	620	18
Nickel-Chromium-Iron			
Ni 6025	400	650	15
Ni 6062	360	550	27
Ni 6093; Ni 6094; Ni 6095	360	650	18
Ni 6133; Ni 6152; Ni 6182	360	550	27
Ni 6333	360	550	18
Ni 6701; Ni 6702	450	650	8
Ni 6704	400	690	12
Ni 8025; Ni 8165	240	550	22
Nickel-Molybdenum			
Ni 1001; Ni 1004	400	690	22
Ni 1008; Ni 1009	360	650	22
Ni 1062	360	550	18
Ni 1066	400	690	22
Ni 1067	350	690	22
Ni 1069	360	550	20
Nickel-Chromium-Molybdenum			
Ni 6002	380	650	18
Ni 6012	410	650	22
Ni 6022; Ni 6024	350	690	22
Ni 6030	350	585	22
Ni 6058	450	830	18
Ni 6059	350	690	22
Ni 6200; Ni 6275; Ni 6276	400	690	22
Ni 6205; Ni 6452	350	690	22
Ni 6455	300	690	22
Ni 6620	350	620	32
Ni 6625	420	760	27
Ni 6627	400	650	32
Ni 6650	450	650	30
Ni 6686	350	690	27
Ni 6985	350	620	22
Nickel-Chromium-Cobalt-Molybdenum			
Ni 6117	400	620	22

[a] Elongation determined from gauge length equal to five times gauge diameter, $5d$.

Annex A
(informative)

System for designation of welding filler metals

The designations used in this International Standard derive from the project of the International Institute of Welding described in Reference [5], and subsequently updated and published in References [6] and [7]. See also Reference [8]. The aim is to develop internationally accepted designations for welding filler metals, since national designation systems are not readily changed and a generic system will allow comparability among the various national specifications.

The system provides for one or two initial alpha designators, the first letter describing the type of filler metal and the second letter describing the alloy system. A four-digit numeric designator follows the initial letters and, for a number of alloy filler metals, this designator is similar to those assigned by the Unified Numbering System (UNS). In this way, the filler metals are frequently related to the base metals with which they are often used (see Annex B).

The system as proposed uses “E” as the initial alpha designator for covered electrodes and “N” for nickel-base alloys. However, because the combination “EN” may cause confusion with the European “EN” standards prepared by CEN, “Ni” has been adopted for the second alpha designator.

Annex B
(informative)

Description of consumables classes

B.1 General

This annex does not constitute a normative element of this International Standard, but is included to provide an indication of the use for which individual classes of electrodes are intended. More particular information on techniques to be applied when using electrodes depositing nickel-base alloys should be sought from the manufacturer.

B.2 Nickel

Ni 2061

Electrodes of this classification are used for welding wrought and cast forms of commercially pure nickel (UNS N02200 or UNS N02201), welding the clad side of nickel-clad steel and surfacing of steel, as well as for dissimilar metal welding.

B.3 Nickel-Copper

Ni 4060, Ni 4061

Electrodes of these classifications are used for welding nickel-copper alloys (UNS N04400) to each other, welding the clad side of nickel-copper alloy-clad steel, and surfacing of steel. Ni 4060 is preferred for some environments where a significant proportion of niobium is detrimental to corrosion resistance.

B.4 Nickel-Chromium

Ni 6082

Electrodes of this classification are used for welding nickel-chromium alloys (e.g. UNS N06075, UNS N07080) and nickel-chromium-iron alloys (e.g. UNS N06600, UNS N06601), and weld metals are distinguished from other alloys for these applications by their relatively high chromium content. They are also used for cladding and for welding dissimilar metal joints. They may be used for welding nickel steels for cryogenic applications.

Ni 6231

Electrodes of this classification are used to weld nickel-chromium-tungsten-molybdenum alloy UNS N06230.

B.5 Nickel-Chromium-Iron

Ni 6025

Electrodes of these classifications are used for welding nickel-base alloys of similar composition such as UNS N06025 and UNS N06603. Welds exhibit resistance to oxidation, carburization, and sulfidization and are used at temperatures up to 1 200 °C.

Ni 6062

Electrodes of this classification are used for welding nickel-chromium-iron alloys (e.g. UNS N06600, UNS N06601), for the clad side of joints in steel clad with nickel-chromium-iron alloy, and for surfacing steel. They have good dissimilar metal welding capability. They may be used for applications at temperatures up to about 980 °C, but do not exhibit optimum oxidation resistance and strength above 820 °C.

Ni 6093, Ni 6094, Ni 6095

Electrodes of these classifications are used for welding 9 % nickel steel (UNS K81340) and weld deposits have higher strength than those from Ni 6133 electrodes.

Ni 6133

Electrodes of this classification are used for welding nickel-iron-chromium alloys (e.g. UNS N08800) and nickel-chromium-iron alloys (e.g. UNS N06600) and have particular application to dissimilar material welds. They may be used for applications at temperatures up to about 980 °C, but do not exhibit optimum oxidation resistance and strength above 820 °C.

Ni 6152

Electrodes of this classification deposit weld metals of higher chromium content than other nickel-chromium-iron electrodes specified in this International Standard. They are used for welding high-chromium nickel-base alloys such as UNS N06690. They may also be used for producing corrosion-resistant overlays on low-alloy and stainless steels and for dissimilar metal joints.

Ni 6182

Electrodes of this classification are used for welding nickel-chromium-iron alloys (e.g. UNS N06600), for welding the clad side of joints in steel clad with nickel-chromium-iron alloy, and for surfacing steel. They can also be used for welding steel to other nickel-base alloys. The temperature of application is up to about 480 °C in the latter application, but otherwise the electrode may be used at high temperatures under the conditions for the preceding classification. Resistance to hot cracking is superior to other weld metals in this group.

Ni 6333

Electrodes of this classification are used for welding nickel-base alloys of similar composition (particularly UNS N06333). Welds exhibit resistance to oxidation, carburization, and sulfidization and are used at temperatures up to and exceeding 1 000 °C.

Ni 6701, Ni 6702

Electrodes of these classifications are used for welding cast nickel-base alloys of similar composition. Welds exhibit resistance to oxidation and are used at temperatures up to 1 200 °C.

Ni 6704

Electrodes of these classifications are used for welding nickel-base alloys of similar composition such as UNS N06025 and UNS N06603. Welds exhibit resistance to oxidation, carburization, and sulfidization and are used at temperatures up to 1 200 °C.

Ni 8025, Ni 8165

Electrodes of these classifications are used for welding copper-alloyed austenitic stainless chromium-nickel-molybdenum alloys (e.g. UNS N08904) and nickel-chromium molybdenum alloys (e.g. UNS N08825). They may also be used for surfacing steel, provided that a barrier layer of nickel-chromium-iron alloy is deposited first.

B.6 Nickel-Molybdenum

Ni 1001

Electrodes of this classification are used for welding nickel-molybdenum alloys of similar composition, particularly UNS N10001, for welding the clad side of joints in steel clad with nickel-molybdenum alloys, and for welding nickel-molybdenum alloys to steel and other nickel-base alloys.

Ni 1004

Electrodes of this classification are used for welding dissimilar metal combinations of nickel-base, cobalt-base, and iron-base alloys.

Ni 1008, Ni 1009

Electrodes of these classifications are used for welding 9 % nickel steel (UNS K81340) and weld deposits have higher strength than those from Ni 6133 electrodes.

Ni 1062

Electrodes of this classification are used for welding nickel-molybdenum alloys, especially UNS N10629, for welding the clad side in steel clad with a nickel-molybdenum alloy, and for welding nickel-molybdenum alloys to steel and other nickel-base alloys.

Ni 1066

Electrodes of this classification are used for welding nickel-molybdenum alloys, especially UNS N10665, for welding the clad side in steel clad with a nickel-molybdenum alloy, and for welding nickel-molybdenum alloys to steel and other nickel-base alloys.

Ni 1067

Electrodes of this classification are used for welding nickel-molybdenum alloys, particularly UNS N10665 and N10675, and for welding nickel-molybdenum alloys to steel and other nickel-base alloys.

Ni 1069

Electrodes of this classification are used for welding dissimilar metal combinations of nickel-base, cobalt-base and iron-base alloys.

B.7 Nickel-Chromium-Molybdenum

Ni 6002

Electrodes of this classification are used for welding nickel-chromium-molybdenum alloys, especially UNS N06002, for welding the clad side in steel clad with nickel-chromium-molybdenum alloy, and for welding nickel-chromium-molybdenum alloys to steel and other nickel-base alloys.

Ni 6012

Electrodes of this classification are used for welding high austenitic stainless steels of 6 Mo type. The weldments exhibit very good resistance to pitting and crevice corrosion in chloride-containing environments. The low Nb content improves weldability.

Ni 6022

Electrodes of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys, especially UNS N06022, for welding the clad side in steel clad with low-carbon nickel-chromium-molybdenum alloy, and for welding low-carbon nickel-chromium-molybdenum alloys to steel and other nickel-base alloys.

Ni 6024

Electrodes of this classification are used to weld stainless steels having a duplex ferritic-austenitic structure and weld metals have a strength and corrosion resistance that make them particularly suitable for joining the "super-duplex" stainless steels, such as UNS S32750.

Ni 6030

Electrodes of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys, especially UNS N06030, for welding the clad side in steel clad with low-carbon nickel-chromium-molybdenum alloy, and for welding low-carbon nickel-chromium-molybdenum alloys to steel and other nickel-base alloys.

Ni 6058

Electrodes of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys, especially UNS N06058, and for welding the clad side of joints in steel clad with nickel-chromium-molybdenum alloy to steel and to other nickel base alloys.

Ni 6059

Electrodes of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys, especially UNS N06059 and chromium-nickel-molybdenum austenitic stainless steels, for welding the clad side in steel clad with low-carbon nickel-chromium-molybdenum alloy, and for welding low-carbon nickel-chromium-molybdenum alloys to steel and other nickel-base alloys.

Ni 6200, Ni 6205

Electrodes of these classifications are used to weld nickel-chromium-molybdenum-copper alloy UNS N06200.

Ni 6275

Electrodes of this classification are used for welding nickel-chromium-molybdenum alloys, especially UNS N10002, to each other and to steel, and for surfacing steel with nickel-chromium-molybdenum alloys.

Ni 6276

Electrodes of this classification are used for welding nickel-chromium-molybdenum alloys, especially UNS N10276, for welding the clad side in steel clad with low-carbon nickel-chromium-molybdenum alloy, and for welding low-carbon nickel-chromium-molybdenum alloys to steel and other nickel-base alloys.

Ni 6452, Ni 6455

Electrodes of these classifications are used for welding low-carbon nickel-chromium-molybdenum alloys, especially UNS N06455, for welding the clad side in steel clad with low-carbon nickel-chromium-molybdenum alloy, and for welding low-carbon nickel-chromium-molybdenum alloys to steel and other nickel-base alloys.

Ni 6620

Electrodes of this classification are used for welding 9 % nickel steel (UNS K81340) and weld metals have a linear coefficient of expansion similar to that of the steel. They can be operated on alternating current to combat "arc blow".