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Welding consumables — Solid wire electrodes, solid strip electrodes, solid wires and solid rods for fusion welding of nickel and nickel alloys — Classification

Produits consommables pour le soudage — Fils-électrodes pleins, feuillards pleins, fils pleins et baguettes pleines pour le soudage par fusion du nickel et des alliages de nickel — Classification

Reference number
ISO 18274:2010(E)

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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 18274 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 18274:2004), of which it constitutes a technical revision. It also incorporates the Technical Corrigenda ISO 18274:2004/Cor.1:2005 and ISO 18274:2004/Cor.2:2006.

Requests for official interpretation 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

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

Welding consumables — Solid wire electrodes, solid strip electrodes, solid wires and solid rods for fusion welding of nickel and nickel alloys — Classification

1 Scope

This International Standard specifies requirements for classification of solid wire electrodes, solid strip electrodes, solid wires and solid rods for fusion welding of nickel and nickel alloys. The classification of the solid wire electrodes, solid strip electrodes, solid wires and solid rods is based on their chemical composition.

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 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 Classification

The classification is divided into two parts:

a) the first part indicates the product form, being solid wire electrode, solid strip electrode, solid wire or solid rod, see 4.1;

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

4 Symbols and requirements

4.1 Symbols for the product form

The symbol for the solid wire electrode, solid wire or solid rod shall be “S”. The symbol for the solid strip electrode shall be “B”.

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

4.2 Symbol for the chemical composition

The initial symbol “Ni" in Table 1 identifies the welding consumable as a nickel base alloy. The following four digits indicate the chemical composition of the solid wire electrode, solid strip electrode, solid wire or solid rod, determined under conditions given in Clause 6. The first digit is an indicator of the alloy group as follows:

— 1 significant molybdenum addition without significant chromium addition (nickel-molybdenum alloys);

— 2 no significant alloy addition;

— 4 significant copper addition (nickel-copper alloys);

— 5 significant copper additions with aluminium and titanium for precipitation hardening;

— 6 significant chromium addition, with iron less than 25 % (by mass) (nickel-chromium-iron and nickel-chromium-molybdenum alloys);

— 7 same as 6, but with aluminium and titanium for precipitation hardening;

— 8 significant chromium addition, with iron more than 25 % (by mass) (nickel-iron-chromium alloys).

The remaining digits indicate the alloy composition of the welding consumable. A description of common uses of each welding consumable alloy is given in Annex A. The basis of the system of designation is described in Annex B.

NOTE In addition, the chemical symbol can be used.

Table 1 — Symbols and chemical composition requirements for solid wire electrodes, solid strip electrodes, solid wires and solid rods

Alloy symbols		Chemical composition, % (by mass)[a]													
Numerical	Chemical	C	Mn	Fe	Si	Cu	Ni[b]	Co	Al	Ti	Cr	Nb[c]	Mo	W	Others[d, e]
Nickel															
Ni 2061	NiTi3	0,15	1,0	1,0	0,7	0,25	⩾92,0	—	1,5	2,0 to 3,5	—	—	—	—	P 0,03
Nickel-Copper															
Ni 4060	NiCu30Mn3Ti	0,15	4,0	2,5	1,2	28,0 to 32,0	⩾62,0	—	1,2	1,5 to 3,0	—	0,3	—	—	—
Ni 4061	NiCu30Mn3Nb	0,15	4,0	2,5	1,25	28,0 to 32,0	⩾60,0	—	1,0	1,0	—	3,0	—	—	—
Ni 5504	NiCu25Al3Ti	0,25	1,5	2,0	1,0	⩾20,0	63,0 to 70,0	—	2,0 to 4,0	0,3 to 1,0	—	—	—	—	P 0,03
Nickel-Chromium															
Ni 6072	NiCr44Ti	0,01 to 0,10	0,20	0,50	0,20	0,50	⩾52,0	—	—	0,3 to 1,0	42,0 to 46,0	—	—	—	—
NI 6073	NiCr38AlNbTi	0,03	0,50	1,0	0,30	0,30	⩾63,0	1,0	0,75 to 1,20	0,25 to 0,75	36,0 to 39,0	0,25 to 1,00	0,50	—	P 0,02 S 0,015 B 0,003 Zr 0,02
Ni 6076	NiCr20	0,08 to 0,15	1,0	2,00	0,30	0,50	⩾75,0	—	0,4	0,15 to 0,50	19,0 to 21,0	—	—	—	P 0,03
Ni 6082	NiCr20Mn3Nb	0,10	2,5 to 3,5	3,0	0,5	0,5	⩾67,0	—	—	0,7	18,0 to 22,0	2,0 to 3,0	—	—	P 0,03
Nickel-Chromium-Iron															
Ni 6002	NiCr21Fe18Mo9	0,05 to 0,15	1,0	17,0 to 20,0	1,0	0,5	⩾44,0	0,5 to 2,5	—	—	20,5 to 23,0	—	8,0 to 10,0	0,2 to 1,0	P 0,04 S 0,03
Ni 6025	NiCr25Fe10AlY	0,15 to 0,25	0,5	8,0 to 11,0	0,5	0,1	⩾59,0	1,0	1,8 to 2,4	0,1 to 0,2	24,0 to 26,0	—	—	—	Y 0,05 to 0,12; Zr 0,01 to 0,10

Table 1 (*continued*)

Alloy symbols		**Chemical composition**, % (by mass)[a]													
Numerical	Chemical	C	Mn	Fe	Si	Cu	Ni[b]	Co	Al	Ti	Cr	Nb[c]	Mo	W	Others[d, e]
Ni 6030	NiCr30Fe15Mo5W	0,03	1,5	13,0 to 17,0	0,8	1,0 to 2,4	⩾36,0	5,0	—	—	28,0 to 31,5	0,3 to 1,5	4,0 to 6,0	1,5 to 4,0	P 0,04 S 0,02
Ni 6043	NiCr30Fe9Nb2	0,04	3,0	7,0 to 12,0	0,5	0,30	⩾54,0	—	0,50	0,5	28,0 to 31,5	1,0 to 2,5	0,50	—	—
Ni 6045	NiCr28Fe23Si3	0,05 to 0,12	1,0	21,0 to 25,0	2,5 to 3,0	0,3	⩾40,0	1,0	0,30	—	26,0 to 29,0	—	—	—	P 0,020 S 0,010
Ni 6052	NiCr30Fe9	0,04	1,0	7,0 to 11,0	0,5	0,3	⩾54,0	—	1,1	1,0	28,0 to 31,5	0,10	0,5	—	Al + Ti < 1,5
Ni 6054	NiCr29Fe9	0,04	1,0	7,0 to 11,0	0,50	0,30	⩾51,0	0,12	1,10	1,0	28,0 to 31,5	0,5 to 1,0	0,50	—	P 0,02 S 0,015
Ni 6055	NiCr29Fe5Mo4Nb3	0,03	1,0	14,4	0,50	0,30	52,0 to 62,0	0,10	0,50	0,50	28,5 to 31,0	2,1 to 4,0	3,0 to 5,0	—	P 0,02 S 0,015 B 0,003 Zr 0,02
Ni 6062	NiCr15Fe8Nb	0,08	1,0	6,0 to 10,0	0,3	0,5	⩾70,0	—	—	—	14,0 to 17,0	1,5 to 3,0	—	—	P 0,03
Ni 6176	NiCr16Fe6	0,05	0,5	5,5 to 7,5	0,5	0,1	⩾76,0	0,05	—	—	15,0 to 17,0	—	—	—	—
Ni 6601	NiCr23Fe15Al	0,10	1,0	20,0	0,5	1,0	58,0 to 63,0	—	1,0 to 1,7	—	21,0 to 25,0	—	—	—	P 0,03
Ni 6693	NiCr29Fe4Al3	0,15	1,0	2,5 to 6,0	0,5	0,5	⩾53,0	—	2,5 to 4,0	1,0	27,0 to 31,0	0,5 to 2,5	—	—	P 0,03 S 0,01
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 6975	NiCr25Fe13Mo6	0,03	1,0	10,0 to 17,0	1,0	0,7 to 1,2	⩾47,0	—	—	0,70 to 1,50	23,0 to 26,0	—	5,0 to 7,0	—	P 0,03 S 0,03
Ni 6985	NiCr22Fe20Mo7Cu2	0,01	1,0	18,0 to 21,0	1,0	1,5 to 2,5	⩾40,0	5,0	—	—	21,0 to 23,5	0,50	6,0 to 8,0	1,5	P 0,04 S 0,03

Table 1 (continued)

Alloy symbols		Chemical composition, % (by mass)[a]													
Numerical	Chemical	C	Mn	Fe	Si	Cu	Ni[b]	Co	Al	Ti	Cr	Nb[c]	Mo	W	Others[d, e]
Ni 7069	NiCr15Fe7Nb	0,08	1,0	5,0 to 9,0	0,50	0,50	⩾70,0	—	0,4 to 1,0	2,0 to 2,7	14,0 to 17,0	0,70 to 1,20	—	—	P 0,03
Ni 7092	NiCr15Ti3Mn	0,08	2,0 to 2,7	8,0	0,3	0,5	⩾ 67,0	—	—	2,5 to 3,5	14,0 to 17,0	—	—	—	P 0,03
Ni 7718	NiCr19Fe19Nb5Mo3	0,08	0,3	24,0	0,3	0,3	50,0 to 55,0	—	0,2 to 0,8	0,7 to 1,1	17,0 to 21,0	4,8 to 5,5	2,8 to 3,3	—	B 0,006 P 0,015
Ni 8025	NiFe30Cr29Mo	0,02	1,0 to 3,0	30,0	0,5	1,5 to 3,0	35,0 to 40,0	—	0,2	1,0	27,0 to 31,0	—	2,5 to 4,5	—	—
Ni 8065	NiFe30Cr21Mo3	0,05	1,0	⩾22,0	0,5	1,5 to 3,0	38,0 to 46,0	—	0,2	0,6 to 1,2	19,5 to 23,5	—	2,5 to 3,5	—	P 0,03 S 0,03
Ni 8125	NiFe26Cr25Mo	0,02	1,0 to 3,0	30,0	0,5	1,5 to 3,0	37,0 to 42,0	—	0,2	1,0	23,0 to 27,0	—	3,5 to 7,5	—	—
Nickel-Molybdenum															
Ni 1001	NiMo28Fe	0,08	1,0	4,0 to 7,0	1,0	0,5	⩾55,0	2,5	—	—	1,0	—	26,0 to 30,0	1,0	V 0,20 to 0,40 S 0,03
Ni 1003	NiMo17Cr7	0,04 to 0,08	1,0	5,0	1,0	0,50	⩾65,0	0,20	—	—	6,0 to 8,0	—	15,0 to 18,0	0,50	V 0,50 S 0,02
Ni 1004	NiMo25Cr5Fe5	0,12	1,0	4,0 to 7,0	1,0	0,5	⩾62,0	2,5	—	—	4,0 to 6,0	—	23,0 to 26,0	1,0	V 0,60 P 0,04 S 0,03
Ni 1008	NiMo19WCr	0,1	1,0	10,0	0,50	0,50	⩾60,0	—	—	—	0,5 to 3,5	—	18,0 to 21,0	2,0 to 4,0	—
Ni 1009	NiMo20WCu	0,1	1,0	5,0	0,5	0,3 to 1,3	⩾65,0	—	1,0	—	—	—	19,0 to 22,0	2,0 to 4,0	—
Ni 1024	NiMo25	0,03	0,80	2,0	0,80	0,50	⩾59,0	1,0	0,50	—	7,0 to 9,0	—	24,0 to 26,0	—	P 0,030 S 0,015

Table 1 (*continued*)

Alloy symbols		Chemical composition, % (by mass)[a]													
Numerical	Chemical	C	Mn	Fe	Si	Cu	Ni[b]	Co	Al	Ti	Cr	Nb[c]	Mo	W	Others[d, e]
Ni 1062	NiMo24Cr8Fe6	0,01	1,0	5,0 to 8,0	0,1	0,5	⩾62,0	—	0,5	—	6,0 to 10,0	—	21,0 to 25,0	—	—
Ni 1066	NiMo28	0,02	1,0	2,0	0,1	0,5	⩾64,0	1,0	—	0,5	1,0	—	26,0 to 30,0	1,0	P 0,04 S 0,03
Ni 1067	NiMo30Cr	0,01	3,0	1,0 to 3,0	0,1	0,2	⩾65,0	3,0	0,5	0,2	1,0 to 3,0	0,2	27,0 to 32,0	3,0	V 0,20 P 0,03
Ni 1069	NiMo28Fe4Cr	0,01	1,0	2,0 to 5,0	0,1	0,5	⩾65,0	1,0	0,1 to 0,5	0,3	0,5 to 1,5	0,5	26,0 to 30,0	—	—
Nickel-Chromium-Molybdenum															
Ni 6012	NiCr22Mo9	0,05	1,0	3,0	0,5	0,5	⩾58,0	—	0,4	0,4	20,0 to 23,0	1,5	8,0 to 10,0	—	—
Ni 6022	NiCr21Mo13Fe4W3	0,01	0,5	2,0 to 6,0	0,08	0,5	⩾49,0	2,5	—	—	20,0 to 22,5	—	12,5 to 14,5	2,5 to 3,5	V 0,3
Ni 6035	NiCr33Mo8	0,05	0,5	2,0	0,6	0,30	⩾49,0	1,00	0,40	0,20	32,25 to 34,25	0,50	7,60 to 9,00	0,60	V 0,20 P 0,030 S 0,015
Ni 6057	NiCr30Mo11	0,02	1,0	2,0	1,0	—	⩾53,0	—	—	—	29,0 to 31,0	—	10,0 to 12,0	—	V 0,4 P 0,04 S 0,03
Ni 6058	NiCr21Mo20	0,01	0,5	1,5	0,10	0,50	⩾52,0	0,3	0,4	—	20,0 to 23,0	—	19,0 to 21,0	0,3	N 0,02 to 0,15 P 0,015 S 0,010
Ni 6059	NiCr23Mo16	0,01	0,5	1,5	0,1	0,5	⩾56,0	0,3	0,1 to 0,4	0,5	22,0 to 24,0	—	15,0 to 16,5	—	V 0,3
Ni 6200	NiCr23Mo16Cu2	0,01	0,5	3,0	0,08	1,3 to 1,9	⩾52,0	2,0	0,5	—	22,0 to 24,0	—	15,0 to 17,0	—	P 0,025
Ni 6205	NiCr25Mo16	0,03	0,5	1,0	0,5	0,2	⩾55,0	0,2	0,4	0,4	24,0 to 26,0	—	14,0 to 16,0	0,3	—

Table 1 (*continued*)

Alloy symbols		Chemical composition, % (by mass)[a]													
Numerical	Chemical	C	Mn	Fe	Si	Cu	Ni[b]	Co	Al	Ti	Cr	Nb[c]	Mo	W	Others[d, e]
Ni 6276	NiCr15Mo16Fe6W4	0,02	1,0	4,0 to 7,0	0,08	0,5	⩾50,0	2,5	—	—	14,5 to 16,5	—	15,0 to 17,0	3,0 to 4,5	V 0,35 P 0,04 S 0,03
Ni 6452	NiCr20Mo15	0,01	1,0	1,5	0,1	0,5	⩾56,0	—	—	—	19,0 to 21,0	0,4	14,0 to 16,0	—	V 0,4
Ni 6455	NiCr16Mo16Ti	0,01	1,0	3,0	0,08	0,5	⩾56,0	2,0	—	0,7	14,0 to 18,0	—	14,0 to 18,0	0,5	P 0,04 S 0,03
Ni 6625	NiCr22Mo9Nb	0,1	0,5	5,0	0,5	0,5	⩾58,0	—	0,4	0,4	20,0 to 23,0	3,2 to 4,1	8,0 to 10,0	—	—
Ni 6650	NiCr20Fe14Mo11WN	0,03	0,5	12,0 to 16,0	0,5	0,3	⩾44,0	1,0	0,05 to 0,50	—	19,0 to 21,0	0,05 to 0,50	9,5 to 12,5	0,5 to 2,5	N 0,05 to 0,20; S 0,010 V 0,30
Ni 6660	NiCr22Mo10W3	0,03	0,5	2,0	0,5	0,3	⩾58,0	0,2	0,4	0,4	21,0 to 23,0	0,2	9,0 to 11,0	2,0 to 4,0	—
Ni 6686	NiCr21Mo16W4	0,01	1,0	5,0	0,08	0,5	⩾49,0	—	0,5	0,25	19,0 to 23,0	—	15,0 to 17,0	3,0 to 4,4	S 0,02
Ni 7725	NiCr21Mo8Nb3Ti	0,03	0,3	⩾8,0	0,20	—	55,0 to 59,0	—	0,35	1,0 to 1,7	19,0 to 22,5	2,75 to 4,00	7,0 to 9,5	—	—
Nickel-Chromium-Cobalt															
Ni 6160	NiCr28Co30Si3	0,02 to 0,10	1,0	3,5	2,4 to 3,0	0,5	⩾30,0	27,0 to 32,0	0,40	0,2 to 0,6	26,0 to 29,0	0,3	0,7	0,5	P 0,03
Ni 6617	NiCr22Co12Mo9	0,05 to 0,15	1,0	3,0	1,0	0,5	⩾44,0	10,0 to 15,0	0,8 to 1,5	0,6	20,0 to 24,0	—	8,0 to 10,0	0,5	P 0,03
Ni 7090	NiCr20Co18Ti3	0,13	1,0	1,5	1,0	0,2	⩾50,0	15,0 to 18,0	1,0 to 2,0	2,0 to 3,0	18,0 to 21,0	—	—	—	[f]

Table 1 (*continued*)

Alloy symbols		Chemical composition, % (by mass)[a]													
Numerical	Chemical	C	Mn	Fe	Si	Cu	Ni[b]	Co	Al	Ti	Cr	Nb[c]	Mo	W	Others[d, e]
Ni 7263	NiCr20Co20Mo6Ti2	0,04 to 0,08	0,6	0,7	0,4	0,2	⩾47,0	19,0 to 21,0	0,3 to 0,6	1,9 to 2,4	19,0 to 21,0	—	5,6 to 6,1	—	Al+Ti 2,4 to 2,8, S ⩽0,007, Ag ⩽0,000 5, B ⩽0,005, Bi ⩽0,000 1
Nickel-Chromium-Tungsten															
Ni 6231	NiCr22W14Mo2	0,05 to 0,15	0,3 to 1,0	3,0	0,25 to 0,75	0,50	⩾48,0	5,0	0,2 to 0,5	—	20,0 to 24,0	——	1,0 to 3,0	13,0 to 15,0	P 0,03
Any other agreed composition															
	Ni Z[g]	Any other agreed composition with a minimum nickel content greater than the minimum value for any other element													

[a] Single values for all elements are maxima except where the ⩾ sign is used.

[b] Up to 1 % (by mass) 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 % (by mass) of the niobium content can be tantalum.

[d] The total of unspecified elements shall not exceed 0,5 % (by mass).

[e] Phosphorus 0,020 % (by mass) maximum and sulfur 0,015 % (by mass) maximum unless otherwise stated.

[f] Ag ⩽ 0,000 5 % (by mass), B ⩽0,020 % (by mass), Bi ⩽0,000 1 % (by mass), Pb ⩽0,002 0 % (by mass), Zr ⩽0,15 % (by mass).

[g] Consumables for which the chemical composition is not listed shall be symbolized similarly and prefixed by the letters Ni Z. The chemical composition ranges are not specified and it is possible that two electrodes with the same Z-classification are not interchangeable.

NOTE Corresponding national classifications are shown in Annex C.

5 Mechanical properties of the weld metal

Mechanical properties of the weld metal are not part of the classification.

NOTE Information on typical weld metal tensile strengths, where they exist, can be found in Annex C.

6 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.

NOTE 1 The shielding gas or flux can influence the chemical composition of the all-weld metal as compared to the chemical analysis of the product or stock.

NOTE 2 See Annex B.

7 Rounding procedure

For purposes of determining compliance with the requirements of this International Standard, the actual test values obtained shall be subjected to the rounding rules of ISO 80000-1:2009, 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 testing 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 testing standard shall apply. The rounded results shall fulfil the requirements of the appropriate table for the classification under test.

8 Retest

If any test fails to meet the 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, retest 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 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 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.

9 Technical delivery conditions

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

10 Designation

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

EXAMPLE 1 A solid wire (S) for gas shielded metal arc welding having a chemical composition within the limits for the alloy symbol 6625 (NiCr22Mo9Nb) of Table 1 is designated:

ISO 18274 – S Ni 6625

or alternatively

ISO 18274 – S Ni 6625 (NiCr22Mo9Nb)

EXAMPLE 2 A solid rod (S) for gas tungsten arc welding is designated:

ISO 18274 – S Ni 6625

or alternatively

ISO 18274 – S Ni 6625 (NiCr22Mo9Nb)

EXAMPLE 3 A solid strip (B) for submerged arc or electroslag welding is designated:

ISO 18274 – B Ni 6625

or alternatively

ISO 18274 – B Ni 6625 (NiCr22Mo9Nb)

where:

ISO 18274	is the number of this International Standard;
S or B	is the product form (see 4.1);
Ni 6625	is the chemical composition of the welding consumable (see Table 1);
NiCr22Mo9Nb	is the optional chemical symbol of the welding consumable (see Table 1).

Annex A
(informative)

Description and uses of welding consumable alloys

A.1 General

The following non-exhaustive details are included to provide an indication of the typical application for which individual classes of consumables are commonly used. More particular information on welding consumable selection, information, and techniques to be applied when using consumables depositing nickel-base alloys should be sought from the manufacturer.

A.2 Nickel

Ni 2061

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

A.3 Nickel-Copper

Ni 4060, Ni 4061

Consumables of these classifications are used for welding nickel-copper alloys (e.g. UNS N04400) to each other, welding the clad side of nickel-copper alloy-clad steel, and surfacing of steel.

Ni 5504

Consumables of this classification are used for welding age-hardening nickel-copper alloy (UNS N05500) to itself using gas tungsten arc welding, gas shielded metal arc welding, submerged arc welding, and plasma arc welding. The weld metal age hardens on heat treatment.

A.4 Nickel-Chromium

Ni 6072

Consumables of this classification are used for gas shielded metal arc welding and gas tungsten arc welding of 50/50 (by mass) nickel-chromium alloy, overlaying steel, cladding nickel-chromium alloy on to nickel-iron-chromium tubing, and casting repair. The weld metal is resistant to high-temperature corrosion, including fuel-ash corrosion in atmospheres containing sulfur and vanadium.

Ni 6073

The nominal composition of this classification is 60 Ni, 38 Cr, 0,9 Al, 0,5 Nb, where the numbers are percentages by mass. Consumables of this classification are used for overlay cladding of ferrous materials used in high-temperature applications, and welding of nickel-chromium-iron alloy having UNS number N06690 to itself and to steels. Welds made with this composition are particularly resistant to high-temperature oxidation, carburization, and sulfidation.

Ni 6076

Consumables of this classification are used for welding nickel-chromium-iron alloys (e.g. UNS N06600, N06075) to each other, for the clad side of joints in steel clad with nickel-chromium-iron alloy, for surfacing steel with nickel-chromium-iron weld metal, and for joining steel to nickel-base alloys using gas tungsten arc welding, gas shielded metal arc welding, submerged arc welding, and plasma arc welding.

Ni 6082

Consumables of this classification are used for welding nickel-chromium alloys (e.g. UNS N06075, UNS N07080), nickel-chromium-iron alloys (e.g. UNS N06600, UNS N06601), and nickel-iron-chromium alloys (e.g. UNS N08800 and UNS N08801). They are also used for cladding and for welding dissimilar metal joints. They may be used for welding nickel steels for cryogenic applications.

A.5 Nickel-Chromium-Iron

Ni 6002

Consumables of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys (especially UNS N06002) 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 6025

Consumables of these classifications are used for welding nickel-base alloys of similar composition (e.g. UNS N06025, UNS N06603). Welds exhibit resistance to oxidation, carburization, and sulfidation and are used at temperatures up to 1 200 °C.

Ni 6030

Consumables of this classification are used for welding nickel-chromium-molybdenum alloy (e.g. UNS N06030) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using gas tungsten arc welding, gas shielded metal arc welding, and plasma arc welding.

Ni 6043

Consumables of this classification are used for producing corrosion-resistant overlays on low-alloy and stainless steels. They may also be used for welding high chromium-nickel base alloys (e.g. UNS N06690) and for dissimilar metal joints.

Ni 6045

The nominal chemical composition of consumables of this classification is 46 Ni, 28 Cr, 23 Fe, 2,7 Si, where the numbers are percentages by mass. Filler metal of this classification is used for welding nickel-chromium-iron alloy having UNS number N06045 to itself, to steel, and to other nickel-base alloys.

Ni 6052

Consumables of this classification are used for welding high chromium-nickel base alloys (e.g. UNS N06690). They may also be used for producing corrosion-resistant overlays on low-alloy and stainless steels and for dissimilar metal joints.

Ni 6054

The nominal composition of consumables of this classification is 60 Ni, 29 Cr, 9 Fe, 0,75 Nb, where the numbers are percentages by mass. Consumables of this classification are used for welding nickel-chromium-iron alloy having UNS number N06690 to itself, to steels, and to weld overlay steels. Welds made with this composition are particularly resistant to ductility-dip cracking (DDC), and oxide inclusions.

Ni 6055

The nominal composition of this classification is 57 Ni, 29 Cr, 8 Fe, 4 Mo, 2,5 Nb, where the numbers are percentages by mass. Consumables of this classification are used for welding nickel-chromium-iron alloy having UNS number N06690 to itself, to steels, and to weld overlay steels. Welds made with this composition are particularly resistant to ductility-dip cracking (DDC), and oxide inclusions.

Ni 6062

Consumables of this classification are used for welding nickel-chromium-iron alloy (e.g. UNS N06600) to itself using gas tungsten arc welding, gas shielded metal arc welding, submerged arc welding, and plasma arc welding. The higher niobium content of these consumables is intended to minimize cracking where high welding stresses are encountered, as in thick-section base metal.

Ni 6176

Consumables of this classification are used for welding nickel-chromium-iron alloys (e.g. UNS N06600 and UNS N06601) for the clad side of joints in steel 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 980 °C but their weld metal does not exhibit optimum oxidation resistance and strength above 820 °C.

Ni 6601

Consumables of this classification are used for welding nickel-chromium-iron-aluminium alloy (e.g. UNS N06601) to itself and to other high-temperature compositions using gas tungsten arc welding. It is used for severe applications where the exposure temperature can exceed 1 150 °C.

Ni 6693

The nominal composition of consumables of this classification is 59 Ni, 29 Cr, 4 Fe, 3 Al, where the numbers are percentages by mass. Consumables of this classification are used for welding nickel-chromium-iron alloy having UNS number N06693 to itself, to steels, and to weld overlay steels. Welds made with this composition are particularly resistant to metal dusting in chemical and petrochemical applications. The alloy is resistant to carburization, sulfidation, and other high-temperature corrosion forms.

Ni 6701

Consumables of this classification are used for welding matching nickel-chromium-iron alloys to each other and to high-temperature alloys for application temperatures up to 1 200 °C.

Ni 6975

Consumables of this classification are used for welding nickel-chromium-molybdenum alloy (UNS N06975) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal using gas tungsten arc welding, gas shielded metal arc welding, submerged arc welding, and plasma arc welding.

Ni 6985

Consumables of this classification are used for welding nickel-chromium-iron-molybdenum alloys (UNS N06007, UNS N06985) to each other, steel, other nickel-base alloys, and for cladding steel with nickel-chromium-iron-molybdenum weld metal.

Ni 7069

Consumables of this classification are used for cladding steel with nickel-chromium-iron weld metal and for joining steel to nickel-base alloys using gas tungsten arc welding, gas shielded metal arc welding, submerged arc welding, and plasma arc welding. The weld metal age hardens on heat treatment.

Ni 7092

Consumables 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 has particular application to dissimilar material welds. They may be used for applications at temperatures up to about 980 °C but their weld metal does not exhibit optimum oxidation resistance and strength above 820 °C.

Ni 7718

Consumables of this classification are used for welding nickel-chromium-niobium-molybdenum alloy (e.g. UNS N07718) to itself using gas tungsten arc welding. The weld metal age hardens on heat treatment. For specific information concerning age hardening, consult the manufacturer or the accompanying technical literature.

Ni 8025

Consumables of this classification deposit weld metals of higher chromium content than Ni 8125 or Ni 8065 consumables. They are used for welding copper alloyed chromium-nickel-molybdenum alloys (e.g. UNS N08904) and nickel-iron-chromium molybdenum alloys (e.g. UNS N08825). They may also be used for surfacing of steel.

Ni 8065, Ni 8125

Consumables of these classifications are used for welding copper alloyed chromium-nickel-molybdenum alloys (e.g. UNS N08904) and nickel-iron-chromium-molybdenum alloys (e.g. UNS N08825). They may also be used for surfacing of steel; a nickel alloy barrier layer is typically applied prior to weld overlay.

A.6 Nickel-Molybdenum

Ni 1001

Consumables of this classification are used for welding nickel-molybdenum alloy UNS N10001.

Ni 1003

Consumables of this classification are used for welding nickel-molybdenum alloy (e.g. UNS N10003) to itself, to steel, to other nickel-base alloys, and for cladding steel with nickel-molybdenum weld metal using gas tungsten arc welding, and gas shielded metal arc welding.

Ni 1004

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

Ni 1008, Ni 1009

Consumables of this classification are used for welding 9 % (by mass) nickel steel (e.g. UNS K81340) to itself using gas tungsten arc welding, gas shielded metal arc welding and submerged arc welding.

Ni 1024

The nominal composition of consumables of this classification is 65 Ni, 25 Mo, 8 Cr, where the numbers are percentages by mass. Consumables of this classification are used for welding nickel-molybdenum alloy having UNS number N10242 to itself and for cladding steel with nickel-molybdenum weld metal using gas tungsten arc welding and gas metal arc welding processes.

Ni 1062

Consumables 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

Consumables 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

Consumables of this classification are used for welding nickel-molybdenum alloy (e.g. UNS N10675) to itself, for welding the clad side of joints in steel clad with nickel-molybdenum alloy, and for welding nickel-molybdenum alloys to steel and to other nickel-base alloys using gas tungsten arc welding, gas shielded metal arc welding, and plasma arc welding.

Ni 1069

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

A.7 Nickel-Chromium-Molybdenum

Ni 6012

Consumables intended for welding high alloyed austenitic stainless steels of the 6 Mo type. The weldments exhibit very good resistance to pitting and crevice corrosion in chloride-containing environments. The low niobium content improves weldability.

Ni 6022

Consumables of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys (especially UNS N06022) and chromium-nickel-molybdenum austenitic stainless steels; for welding the clad side in steel clad with low-carbon nickel-chromium-molybdenum alloy, and joining low-carbon nickel-chromium-molybdenum alloys to steel and other nickel-based alloys, as well as for surfacing of steel with nickel-chromium-molybdenum alloys.

Ni 6035

The nominal composition of consumables of this classification is 58 Ni, 33 Cr, 8 Mo, where the numbers are percentages by mass. Consumables of this classification are used for welding nickel-chromium-molybdenum alloy having UNS number N06035 to itself and for cladding steel with nickel-chromium-molybdenum weld metal.

Ni 6057

The nominal composition of consumables of this classification is 60 Ni, 30 Cr, 10 Mo, where the numbers are percentages by mass. Consumables of this classification are used for corrosion-resistant (especially excellent to crevice corrosion) overlaying with gas tungsten arc welding, gas shielded metal arc, and plasma arc welding processes.

Ni 6058

The nominal composition of consumables of this classification is 58 Ni, 21 Cr, 20 Mo, 1 Fe, where the numbers are percentages by mass. Consumables of this classification are used for welding nickel-chromium-molybdenum alloys (especially UNS N06058) to each other, to steel, to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metal.

Ni 6059

Consumables 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

Consumables of this classification are used for welding the nickel-chromium-molybdenum alloy UNS N06200 to itself, to steel, to other nickel-base alloys, and for cladding steel.

Ni 6205

Consumables of this classification are used for welding nickel-chromium-molybdenum alloys (especially UNS N06058) to each other and welding chromium-nickel-molybdenum austenitic stainless steels to steel to other nickel-base alloys, and for cladding steel with nickel-chromium-molybdenum weld metals.

Ni 6276

Consumables of this classification are used for welding low-carbon 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

Consumables 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 6625

Consumables of this classification are used for welding nickel-chromium-molybdenum alloys (especially UNS N06625) to each other and to steel, and for surfacing steel with nickel-chromium-molybdenum alloys. The weld metal is comparable with UNS N06625 in resistance to corrosion.

Ni 6650

Consumables of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys and chromium-nickel-molybdenum austenitic stainless steels for offshore and chemical industry applications (e.g. UNS N08926). They are also used for cladding and for welding dissimilar metal joints, e.g. low-carbon nickel-chromium-molybdenum alloys welded to carbon steel or nickel-base alloys. They may also be used for the welding of 9 % nickel steel.

Ni 6660

Consumables of this classification are used for gas shielded metal arc welding and gas tungsten arc welding of superduplex, superaustenitic, cryogenic 9 % nickel steels and for coating of low-alloyed steels. Compared to Ni 6625, the weld metal shows a good or better corrosion resistance, no hot cracking problem, and a good toughness at low temperature for cryogenic applications.

Ni 6686

Consumables of this classification are used for welding low-carbon nickel-chromium-molybdenum alloys (especially UNS N06686) and chromium-nickel-molybdenum austenitic 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, as well as for surfacing of steel with nickel-chromium-molybdenum-tungsten alloys.

Ni 7725

Consumables of this classification are used for welding high-strength corrosion-resistant nickel alloys (especially UNS N07725 and UNS N09925) to each other and to steel, and for surfacing with high-strength nickel-chromium-molybdenum alloy. Post-weld precipitation hardening is required to develop maximum strength; a variety of heat treatments can be used.

A.8 Nickel-Chromium-Cobalt

Ni 6160

Consumables of this classification are used for welding the nickel-cobalt-chromium-silicon alloy (UNS N12160) to itself using gas tungsten arc welding, gas shielded metal arc welding, and plasma arc welding. This alloy is sensitive to iron pickup. Alternative filler metals are required to weld the base alloy to iron-bearing alloys. The weld metal has excellent resistance to sulfidation and chloride attack in both reducing and oxidizing environments, and can withstand temperatures up to 1 200 °C.

Ni 6617

Consumables of this classification are used for welding low-carbon nickel-chromium-cobalt-molybdenum alloys (especially UNS N06617) to each other and to steel, and for surfacing steel. They are also used for joining dissimilar alloys where high-temperature strength and oxidation resistance are required up to about 1 150 °C (e.g. for UNS N08800, UNS N08811, and cast high-nickel alloys).

Ni 7090

Consumables of this classification are used for welding nickel-chromium-cobalt alloys (e.g. UNS N07090) to each other using gas tungsten arc welding. The weld metal age hardens on heat treatment. For specific information concerning age hardening, consult the manufacturer or the accompanying technical literature.

Ni 7263

Consumables of this classification are used for welding nickel-chromium-cobalt-molybdenum alloys (e.g. UNS N07263) to each other and others using gas tungsten arc welding. The weld metal age hardens on heat treatment. For specific information concerning age hardening, consult the manufacturer or the accompanying technical literature.

A.9 Nickel-Chromium-Tungsten

Ni 6231

Consumables of this classification are used for welding nickel-chromium-cobalt-molybdenum alloy (e.g. UNS N06617) to itself with gas tungsten arc welding, gas shielded metal arc welding, and plasma arc welding.

Annex B
(informative)

System for designation of welding consumables

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 [8] and [9]. The aim is to develop internationally accepted designations for welding consumables, since national designation systems are not readily changed and a generic system allows comparability among the various national specifications.

The system provides for one or two initial alpha designators, the first letter representing the type of filler metal and the second, the alloy system. A four-digit numeric designator follows the initial letters and, for a number of alloy welding consumables, this designator is similar to those assigned by the Unified Numbering System (UNS). In this way, the welding consumables are frequently related to the base metals with which they are often used (see Annex A).[1)]

1) For further information, see Bibliography.

Annex C
(informative)

Corresponding national classifications and typical weld metal tensile strengths

Table C.1 — Corresponding national classifications

Numerical symbol	Chemical symbol designation	AWS A5.14/ A5.14M:2005[1]	BS 2901-5:1990[2]	DIN 1736:1985[4]	JIS Z 3334:1999[6]	Typical tensile strength MPa[c]
Nickel						
Ni 2061	NiTi3	ERNi-1	NA32	2.4155	YNi-1	380
Nickel-Copper						
Ni 4060	NiCu30Mn3Ti	ERNiCu-7	NA33	2.4377	YNiCu-7	480
Ni 4061	NiCu30Mn3Nb	—	—	—	YNiCu-1	480
Ni 5504	NiCu25Al3Ti	ERNiCu-8	—	2.4373[a]	—	690[d]
Nickel-Chromium						
Ni 6072	NiCr44Ti	ERNiCr-4	—	—	—	690
Ni 6073	NiCr38AlNbTi	ERNiCr-7	—	—	—	690
Ni 6076	NiCr20	ERNiCr-6	NA34	2.4639	—	550
Ni 6082	NiCr20Mn3Nb	ERNiCr-3	NA35	2.4806	YNiCr-3	550
Nickel-Chromium-Iron						
Ni 6002	NiCr21Fe18Mo9	ERNiCrMo-2	NA40	2.4613[b]	YNiCrMo-2	690
Ni 6025	NiCr25Fe10AlY	ERNiCrFe-12	—	2.4649[b]	—	660
Ni 6030	NiCr30Fe15Mo5W	ERNiCrMo-11	—	2.4659[a]	—	690
Ni 6043	NiCr30Fe9Nb2	—	—	—	—	—
Ni 6045	NiCr28Fe23Si3	ERNiCrFeSi-1	—	2.4889[b]	—	620
Ni 6052	NiCr30Fe9	ERNiCrFe-7	—	2.4642[b]	—	550
Ni 6054	NiCr29Fe9	ERNiCrFe-7A	—	2.4642[b]	—	590
Ni 6055	NiCr29Fe5Mo4Nb3	ERNiCrFe-13	—	—	—	590
Ni 6062	NiCr16Fe8Nb	ERNiCrFe-5	—	—	YNiCrFe-5	550
Ni 6176	NiCr16Fe6	—	—	2.4817[b]	—	550
Ni 6601	NiCr23Fe15Al	ERNiCrFe-11	NA49	2.4626	—	650

Table C.1 (*continued*)

Numerical symbol	Chemical symbol designation	AWS A5.14/ A5.14M:2005[1]	BS 2901-5:1990[2]	DIN 1736:1985[4]	JIS Z 3334:1999[6]	Typical tensile strength MPa[c]
Ni 6693	NiCr29Fe4Al3	ERNiCrFeAl-1	—	—	—	590
Ni 6701	NiCr36Fe7Nb	—	—	—	—	—
Ni 6975	NiCr25Fe13Mo6	ERNiCrMo-8	—	2.4693[b]	YNiCrMo-8	590
Ni 6985	NiCr22Fe20Mo7Cu2	ERNiCrMo-9	—	2.4619[b]	—	590
Ni 7069	NiCr15Fe7Nb	ERNiCrFe-8	—	2.4669[b]	—	860[e]
Ni 7092	NiCr15Ti3Mn	ERNiCrFe-6	NA39	—	YNiCrFe-6	550
Ni 7718	NiFe19Cr19Nb5Mo3	ERNiFeCr-2	NA51	2.4667	—	1 140[f]
Ni 8025	NiFe30Cr29Mo	—	—	2.4656	—	550
Ni 8065	NiFe30Cr21Mo3	ERNiFeCr-1	NA41	2.4858[b]	YNiFeCr-1	550
Ni 8125	NiFe26Cr25Mo	—	—	2.4655	—	550
Nickel-Molybdenum						
Ni 1001	NiMo28Fe	ERNiMo-1	NA44[b]	—	YNiMo-1	690
Ni 1003	NiMo17Cr7	ERNiMo-2	—	—	—	690
Ni 1004	NiMo25Cr5Fe5	ERNiMo-3	—	—	YNiMo-3	690
Ni 1008	NiMo19WCr	ERNiMo-8	—	—	—	660
Ni 1009	NiMo20WCu	ERNiMo-9	—	—	—	660
Ni 1024	NiMo25	ERNiMo-12	—	2.4710[b]	—	690
Ni 1062	NiMo24Cr8Fe6	—	—	2.4702[b]	—	690
Ni 1066	NiMo28	ERNiMo-7	—	2.4615	YNiMo-7	760
Ni 1067	NiMo30Cr	ERNiMo-10	—	2.4600[b]	—	760
Ni 1069	NiMo28Fe4Cr	ERNiMo-11	—	2.4701[b]	—	690

Table C.1 (*continued*)

Numerical symbol	Chemical symbol designation	AWS A5.14/ A5.14M:2005[1]	BS 2901-5:1990[2]	DIN 1736:1985[4]	JIS Z 3334:1999[6]	Typical tensile strength MPa[c]
Nickel-Chromium-Molybdenum						
Ni 6012	NiCr22Mo9	—	—	—	—	—
Ni 6022	NiCr21Mo13Fe4W3	ERNiCrMo-10	—	2.4635[b]	—	690
Ni 6035	NiCr33Mo8	ERNiCrMo-22	—	2.4643[b]	—	590
Ni 6057	NiCr30Mo11	ERNiCrMo-16[a]	—	—	—	590
Ni 6058	NiCr21Mo20	ERNiCrMo-19	—	—	—	830
Ni 6059	NiCr23Mo16	ERNiCrMo-13	—	2.4607[b]	—	760
Ni 6200	NiCr23Mo16Cu2	ERNiCrMo-17[a]	—	2.4698[b]	—	690
Ni 6205	NiCr25Mo16	ERNiCrMo-21	—	—	—	780
Ni 6276	NiMo16Cr15Fe6W4	ERNiCrMo-4	NA48	2.4886	YNiCrMo-4	690
Ni 6452	NiCr20Mo15	—	—	2.4839	—	690
Ni 6455	NiCr16Mo16Ti	ERNiCrMo-7	NA45	2.4611	—	690
Ni 6625	NiCr22Mo9Nb	ERNiCrMo-3	NA43	2.4831	YNiCrMo-3	760
Ni 6650	NiCr20Fe14Mo11WN	ERNiCrMo-18[a]	—	2.4849[b]	—	660
Ni 6660	NiCr22Mo10W3	ERNiCrMo-20	—	—	—	750
Ni 6686	NiCr21Mo16W4	ERNiCrMo-14	—	2.4606[b]	—	760
Ni 7725	NiCr21Mo8Nb3Ti	ERNiCrMo-15	—	—	—	1 200[g]
Nickel-Chromium-Cobalt						
Ni 6160	NiCr28Co30Si3	ERNiCoCrSi-1	—	2.4880[b]	—	760
Ni 6617	NiCr22Co12Mo9	ERNiCrCoMo-1	NA50	2.4627	—	620
Ni 7090	NiCr20Co18Ti3	—	NA36	2.4632[b]	—	—
Ni 7263	NiCr20Co20Mo6Ti2	—	NA38	2.4650[b]	—	760

Table C.1 (*continued*)

Numerical symbol	Chemical symbol designation	AWS A5.14/ A5.14M:2005[1]	BS 2901-5:1990[2]	DIN 1736:1985[4]	JIS Z 3334:1999[6]	Typical tensile strength MPa[c]
Nickel-Chromium-Tungsten						
Ni 6231	NiCr22W14Mo2	ERNiCrWMo-1	—	2.4733[b]	—	760

a At the time of publication, these alloys had been accepted for the next revisions of the relevant national standards.

b These alloys are the nearest equivalent of the relevant national standards.

c Tensile strength in the as-welded condition, where available, unless otherwise specified.

d Age hardened condition: heat treated 800 °C for 2 h plus 600 °C for 16 h, then furnace cool at 15 °C/h to 500 °C, then furnace cooled.

e Age hardened condition: heat to 1 060 °C for 2 h plus 700 °C for 20 h, then air cooled.

f Age hardened condition: heat treated at 720 °C for 8 h, then furnace cooled at 50 °C/h to 620 °C and held for 8 h, then air cooled.

g Age hardened condition: heat treated at 1 040 °C for 1 h plus 730 °C for 8 h, then furnace cooled at 50 °C/h to 620 °C and held for 8 h, then air cooled.

Bibliography

[1] AWS A5.14/A5.14M:2005, *Specification for nickel and nickel alloy bare welding electrodes and rods*[2)]

[2] BS 2901-5:1990, *Filler rods and wires for gas-shielded arc welding — Specification for nickel and nickel alloys*[3)]

[3] BS 6783 (all parts), *Sampling and analysis of nickel, ferronickel and nickel alloys*

[4] DIN 1736:1985, *Welding filler metals for nickel and nickel alloys — Composition, application and technical delivery conditions* [4)]

[5] IIW Document XII-1141-89, *Generic system for designating welding filler metals — Proposal for submission to ISO*

[6] JIS Z 3334:1999, *Nickel and nickel alloy filler rods and solid wires for arc welding*

[7] CHEMIKERAUSSCHUSS DER GESELLSCHAFT DEUTSCHER METALLHÜTTEN UND BERGLEUTE [Chemical committee of the German Society of Metalworkers and Miners]. *Analyse der Metalle: Band 1 — Schiedsanalysen* [Metals analysis: Vol 1 — Separation analyses], 1966 (146 p.) or *Ergänzungsband zu den Bänden: 1 — Schiedsanalysen; 2 — Betriebsanalysen; 3 — Probenahme* [Supplement to volumes: 1 — Separation analyses; 1 — Working analyses; 3 — Sampling], 1980, (214 p.). Berlin: Springer

[8] THOMAS, R.D., JR. Generic system for designation of welding filler metals. *Weld. World* 1996, **37**(3), pp. 155-160

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2) Superseded by ANSI/AWS A5.14/A5.14M:2009.

3) Superseded by ISO 18274:2004.

4) Superseded by ISO 14172:2003 and ISO 18274:2004.

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