
**Welding consumables — Covered
electrodes for manual metal arc welding
of stainless and heat-resisting steels —
Classification**

*Produits consommables pour le soudage — Électrodes enrobées pour
le soudage manuel à l'arc des aciers inoxydables et résistant aux
températures élevées — Classification*

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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 3581 was prepared in collaboration with the International Institute of Welding which has been approved by the ISO Council as an international standardizing body in the field of welding.

This second edition cancels and replaces the first edition (ISO 3581:1976), which has been technically revised.

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Introduction

This International Standard provides a classification system for stainless steel, covered welding electrodes in terms of chemical composition of deposited weld metal and type of electrode covering. Other properties of the electrodes are specified by reference to tables.

This International Standard has been prepared by the International Institute of Welding, Commission II "Arc Welding", Subcommittee II-E. It recognizes that there are two somewhat different approaches in the global market, for classifying a given stainless steel, covered electrode, and allows for either or both to be used to suit a particular need. Application of either (or both) type(s) of classification designation identifies a product as classified according to this International Standard. It should be noted that the two systems are not exactly equivalent, therefore each system must be used independent of the other, without combining designators in any way.

The classification according to ISO 3581, system A, is mainly based upon EN 1600; the classification according to ISO 3581, system B, is mainly based upon standards used around the Pacific Rim.

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Welding consumables — Covered electrodes for manual metal arc welding of stainless and heat-resisting steels — Classification

1 Scope

This International Standard specifies requirements for classification of covered electrodes, based on the all-weld metal chemical composition, the type of electrode covering and other electrode properties, and the all-weld metal mechanical properties, in the as-welded or heat-treated conditions, for manual metal arc welding of stainless and heat-resisting steels.

This International Standard is a combined standard providing for classification utilizing a system based upon classification according to nominal composition, or utilizing a system based upon classification according to alloy type.

- a) Paragraphs and tables which carry the label “classification according to nominal composition” or “ISO 3581-A” are applicable only to products classified to that system.
- b) Paragraphs and tables which carry the label “classification according to alloy type” or “ISO 3581-B” are applicable only to products classified to that system.
- c) Paragraphs and tables which carry neither label are applicable to products classified according to either or both systems.

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 metals — Type of product, dimensions, tolerances and markings*

ISO 2401, *Covered electrodes — Determination of the efficiency, metal recovery and deposition coefficient*

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

ISO 6947, *Welds — Working positions — Definitions of angles of slope and rotation*

ISO 8249, *Welding — Determination of Ferrite Number (FN) in austenitic and duplex ferritic-austenitic Cr-Ni stainless steel weld metals*

ISO 13916, *Welding — Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature*

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

ISO 3581:2003(E)

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

ISO 15792-3, *Welding consumables — Test methods — Part 3: Classification testing of positional capacity and root penetration of welding consumables in a fillet weld*

3 Classification

Classification designations are based upon two approaches for indicating the chemical composition of the all-weld metal deposit obtained with a given electrode.

The “nominal composition” approach uses designation components indicating directly the nominal levels of certain alloying elements, given in a particular order, and some symbols for low but significant levels of other elements, whose levels are not conveniently expressed as integers. The “alloy type” approach uses tradition-based three- or four-digit designations for alloy families, and an occasionally additional character or characters for compositional modifications of each original alloy within the family. Both designation approaches include additional designators for some other classification requirements, but not entirely the same classification requirements, as will be clear from the following sections.

Table 1 lists the tests required for classification of an electrode in each approach.

In many cases, a given commercial product can be classified using both approaches. Then either or both classification designations can be used for the product.

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Table 1 — Summary of test requirements

Electrode designation		Size ^a mm	Position of welding ^b					
			Chemical analysis test		All-weld metal tension test		Fillet weld test	
ISO 3581-A	ISO 3581-B		ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B	ISO 3581-A	ISO 3581-B
Coating type symbol B and position symbols 1 and 2	Position and coating type symbol - 15	3,2 or 3,0	PA	PA	Not required	Not required	PB, PF, PD	Not required
		4,0	PA	PA	PA	PA	Not required	PB, PF, PD
		5,0 or 4,8	Not required	PA	Not required	Not required	Not required	PB
		6,0 (or 5,6 or 6,4)	Not required	PA	Not required	Not required	Not required	PB
All coating types and position symbol 3	Not applicable	3,2 or 3,0	PA	Not applicable	Not required	Not applicable	PB	Not applicable
		4,0	PA		PA		Not required	
		5,0 or 4,8	Not required		Not required		Not required	
All coating types and position symbol 4	Position symbol - 4 and all coating types	2,4 or 2,5	Not required	PA	Not required	Not required	Not required	PG
		3,2 or 3,0	PA	PA	Not required	Not required	Not required	PG
		4,0	PA	PA	PA	PA	Not required	PG
		5,0 or 4,8	Not required	PA	Not required	Not required	Not required	PG
All coating types and position symbol 5	Not applicable	3,2 (or 3,0)	PA	Not applicable	Not required	Not applicable	PB, PG	Not applicable
		4,0	PA		PA		Not required	
		5,0 (or 4,8)	Not required		Not required		Not required	
Coating type symbol R and position symbols 1 and 2	Position and coating type symbols - 16 and - 17	3,2 (or 3,0)	PA	PA	Not required	Not required	PB, PF, PD	Not required
		4,0	PA	PA	PA	PA	Not required	PB, PF, PD
		5,0 (or 4,8)	Not required	PA	Not required	Not required	Not required	PB
		6,0 (or 5,6 or 6,4)	Not required	Not required	Not required	Not required	Not required	PB
Not applicable	Position and coating type symbols - 26 and - 27	3,2 (or 3,0)	Not applicable	PA	Not applicable	Not required	Not applicable	Not required
		4,0		PA		PA		PB
		5,0 (or 4,8)		PA		Not required		PB
		6,0 (or 5,6 or 6,4)		PA		Not required		PB

^a If the size is not manufactured, the next nearest size may be substituted (provided that the substituted size is different from those specified in this table).

^b The abbreviation PA, PB, PD, PF and PG indicate welding positions in accordance with ISO 6947, as follows:

PA = flat	PF = vertical up
PB = horizontal vertical	PG = vertical down
PD = horizontal overhead	

3A Classification according to nominal composition

The classification includes all-weld metal properties obtained with a covered electrode as given below. The classification is based on an electrode diameter of 4 mm with the exception of testing for welding position.

The classification is divided into five parts:

- 1) the first part gives a symbol indicating the product/process to be identified (see 4.1A);
- 2) the second part gives a symbol indicating the chemical composition of all-weld metal (see Table 2);
- 3) the third part gives a symbol indicating the type of electrode covering (see 4.3A);
- 4) the fourth part gives a symbol indicating the effective electrode efficiency and type of current (see Table 4A);
- 5) the fifth part gives a symbol indicating the welding position (see Table 5A).

In order to promote the use of this International Standard, the classification to ISO 3581-A is split into two sections:

a) Compulsory section

This section includes the symbols for the type of product, the chemical composition and the type of covering, i.e. symbols defined in 4.1A, 4.2 and 4.3A.

b) Optional section

This section includes the symbols for the weld metal recovery, the type of current and the welding positions for which the electrode is suitable, i.e. the symbols defined in 4.4A and Table 5A.

The full designation (compulsory and optional sections) shall be used on packages and in the manufacturer's literature and data sheets.

NOTE The composition of the core wire, which may be substantially different from the weld metal composition, is not considered a classification criterion.

3B Classification according to alloy type

The classification includes all-weld metal properties obtained with a covered electrode as given below. The classification is based on an electrode diameter of 4 mm for mechanical properties, with the exception of testing for welding position and for chemical analysis of the weld metal.

The classification is divided into four parts:

- 1) the first part gives a symbol indicating the product/process to be identified (see 4.1B);
- 2) the second part gives a symbol indicating the chemical composition of all-weld metal (see Table 2);
- 3) the third part gives a symbol indicating the welding position (See Table 5B);
- 4) the fourth part gives a symbol indicating the type of electrode covering. This also serves to define the type of current which can be used with the electrode classified (see 4.3B).

In classifying welding electrodes to ISO 3581-B, the symbols for all four parts – product/process, alloy type, welding position and type of electrode covering, as defined in 4.1B, 4.2, 4.3 and Table 5B – are compulsory.

The full designation shall be used on packages and in manufacturer's literature and data sheets.

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4 Symbols and requirements

NOTE See Annex A for examples of classifications in both systems.

4.1 Symbol for the product/process

4.1A Classification according to nominal composition

The symbol for the covered electrode used in the manual metal arc welding process for stainless and heat-resisting steels in accordance with ISO 3581-A shall be the letter E.

4.1B Classification according to alloy type

The symbol for the covered electrode used in the manual metal arc welding process for stainless and heat-resisting steels in accordance with ISO 3581-B shall be the letters ES. The initial letter "E" indicates a covered electrode; the letter "S" indicates stainless and heat-resisting steels.

4.2 Symbol for the chemical composition of all-weld metal

The symbol in Table 2 indicates the chemical composition of all-weld metal determined in accordance with Clause 5. The all-weld metal obtained with the covered electrodes in Table 2, in accordance with Clause 6, shall also fulfil the mechanical property requirements for that electrode as specified in Table 3.

4.3 Symbol for type of electrode covering ¹⁾

The type of covering of the electrodes determines, to a large extent, usability characteristics of the electrode and properties of the weld metal.

4.3A Classification according to nominal composition

Two symbols are used to describe the type of covering:

B denotes a basic covering;

R denotes a rutile based covering.

4.3B Classification according to alloy type

Three symbols are used to define the type of covering on the electrode:

5 denotes a basic covering, intended for d.c. welding;

6 denotes a rutile based coating, intended for d.c. or a.c. welding (except that position and coating type - 46 is d.c.);

7 denotes a modified rutile based coating containing a considerable amount of silica, intended for d.c. or a.c. welding (except that position and coating type - 47 is d.c.).

1) See Annex A for information on coating types.

Table 2 — Chemical composition requirements

Symbol classification by		Chemical composition ^{a, b}										
		%										
nominal composition ^{c,d,e} (ISO 3581-A)	alloy type ^{e,f} (ISO 3581-B)	C	Si	Mn	P	S	Cr	Ni	Mo	Cu	Nb + Ta	N
—	409Nb	0,12	1,00	1,00	0,040	0,030	11,0 to 14,0	0,60	0,75	0,75	0,50 to 1,50	—
13	(410)	0,12	1,0	1,5	0,030	0,025	11,0 to 14,0	0,60	0,75	0,75	—	—
(13)	410	0,12	0,90	1,0	0,04	0,03	11,0 to 14,0	0,70	0,75	0,75	—	—
13 4	(410NiMo)	0,06	1,0	1,5	0,030	0,025	11,0 to 14,5	3,0 to 5,0	0,4 to 1,0	0,75	—	—
(13 4)	410NiMo	0,06	0,90	1,0	0,04	0,03	11,0 to 12,5	4,0 to 5,0	0,40 to 0,70	0,75	—	—
17	(430)	0,12	1,0	1,5	0,030	0,025	16,0 to 18,0	0,60	0,75	0,75	—	—
(17)	430	0,10	0,90	1,0	0,04	0,03	15,0 to 18,0	0,6	0,75	0,75	—	—
—	430Nb	0,10	1,00	1,00	0,040	0,030	15,0 to 18,0	0,60	0,75	0,75	0,50 to 1,50	—
19 9	(308)	0,08	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—
(19 9)	308	0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—
19 9 H	(308H)	0,04 to 0,08	1,2	2,0	0,03	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—
(19 9 H)	308H	0,04 to 0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—
19 9 L	(308L)	0,04	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	—	—
(19 9 L)	308L	0,04	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 12,0	0,75	0,75	—	—
(20 10 3)	308Mo	0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 12,0	2,0 to 3,0	0,75	—	—
—	308LMo	0,04	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 12,0	2,0 to 3,0	0,75	—	—
—	349 ^g	0,13	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	8,0 to 10,0	0,35 to 0,65	0,75	0,75 to 1,20	—
19 9 Nb	(347)	0,08	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,75	0,75	8 × C to 1,1	—
(19 9 Nb)	347	0,08	1,00	0,5 to 2,5	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,75	0,75	8 × C to 1,00	—
—	347L	0,04	1,00	0,5 to 2,5	0,040	0,030	18,0 to 21,0	9,0 to 11,0	0,75	0,75	8 × C to 1,00	—
19 12 2	(316)	0,08	1,2	2,0	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,0 to 3,0	0,75	—	—
(19 12 2)	316	0,08	1,00	0,5 to 2,5	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	0,75	—	—
(19 12 2)	316H	0,04 to 0,08	1,00	0,5 to 2,5	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	0,75	—	—
(19 12 3 L)	316L	0,04	1,00	0,5 to 2,5	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	0,75	—	—