
**Welding consumables — Tubular cored
electrodes and rods for gas shielded and
non-gas shielded metal arc welding of
stainless and heat-resisting steels —
Classification**

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*Produits consommables pour le soudage — Fils et baguettes fourrés
pour le soudage à l'arc avec ou sans protection gazeuse des aciers
inoxydables et des aciers résistant aux températures élevées —
Classification*

[ISO 17633:2004](#)

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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 17633 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 provides a classification system for tubular cored electrodes and rods for welding stainless steels. It recognizes that there are two somewhat different approaches in the global market, to classifying a given tubular stainless steel welding consumable, and allows for either or both to be used, to suit a particular market need. Application of either type of classification designation (or of both where suitable) identifies a product as classified according to this International Standard.

The classification according to system A is mainly based on EN 12073:1999, *Welding consumables — Tubular cored electrodes for metal arc welding with or without a gas shield of stainless and heat-resisting steels — Classification*. The classification according to system B is mainly based upon standards used around the Pacific Rim.

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 which can be found at www.iso.org.

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Welding consumables — Tubular cored electrodes and rods for gas shielded and non-gas shielded metal arc welding of stainless and heat-resisting steels — Classification

1 Scope

This International Standard specifies requirements for classification of tubular flux and metal cored electrodes and rods, based on the all-weld metal chemical composition, the type of electrode core, shielding gas, welding position and the all-weld metal mechanical properties, in the as welded or heat treated conditions, for gas shielded and non-gas shielded 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.

- 1) Paragraphs and tables which carry the label “classification according to nominal composition” are applicable only to products classified to that system.
- 2) Paragraphs and tables which carry the label “classification according to alloy type” are applicable only to products classified to that system.
- 3) Paragraphs and tables which carry neither label are applicable to products classified according to either or both systems.

It is recognized that the operating characteristics of tubular cored electrodes can be modified by the use of pulsed current, but for the purposes of this International Standard, pulsed current is not permitted for determining the electrode classification.

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 marking*

ISO 3690, *Welding and allied processes — Determination of hydrogen content in ferritic steel arc weld metal*

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

ISO 6947:1990, *Welds — Working positions — Definitions of angles of slope and rotation*

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

ISO 14175:1997, *Welding consumables — Shielding gases for arc welding and cutting*

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*

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 to indicating the chemical composition of the all-weld metal deposit obtained with a given electrode or rod.

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 occasional additional character or characters for compositional modifications of each original alloy within the family. The two designation approaches include additional designators for all other classification requirements, but not entirely the same classification requirements, as will be clear from the following.

In most cases, a given commercial product can be classified in both systems. Then either or both classification designations can be used for the product.

3A Classification according to nominal composition

3B Classification according to alloy type

The classification is divided into five parts:

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 the all-weld metal (see Table 1A);
- 3) The third part gives a symbol indicating the type of electrode core (see Table 3A);
- 4) The fourth part gives a symbol indicating the shielding gas (see 4.4);
- 5) The fifth part gives a symbol indicating the welding position (see Table 4A).

- 1) The first part gives a symbol indicating the tubular cored electrode and rod (see 4.1B);
- 2) The second part gives a symbol indicating the chemical composition of the all-weld metal (see Table 1B);
- 3) The third part gives a symbol indicating the type of tubular cored electrode or rod (see Table 3B);
- 4) The fourth part gives a symbol indicating the shielding gas (see 4.4);
- 5) The fifth part gives a symbol indicating the welding position (see Table 4B).

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

a) Compulsory section

This section includes the symbols for the type of product, the chemical composition of all-weld metal, the type of electrode core and the shielding gas, viz, the symbols defined in Clause 4.

This section includes the symbols for the type of product, the chemical composition of all-weld metal, the type of electrode core, the shielding gas and the welding position, viz, the symbols defined in Clause 4.

b) Optional section

This section includes the symbol for the welding position for which the electrode is suitable, viz, the symbols defined in Table 4A.

The full identification (see Clause 10) shall be used on packages and in the manufacturer's literature and data sheets.

4 Symbols and requirements

4.1 Symbol for the product/process

4.1A Classification according to nominal composition

The symbol for the tubular cored electrode used in the metal arc welding process shall be the letter "T".

4.1B Classification according to alloy type

The symbol for the tubular cored electrode or rod used in the metal arc welding process shall be the letters "TS". The initial letter, "T", indicates tubular cored electrode or rod as distinguished from covered electrodes and from solid electrodes and rods. The second letter, "S", indicates that the alloy system is stainless or heat-resisting steel.

4.2 Symbol for the chemical composition of all-weld metal

4.2A Classification according to nominal composition

The symbol in Table 1A identifies the chemical composition of all-weld metal determined in accordance with Clause 6. The all-weld metal obtained with the tubular cored electrodes in Table 1A under conditions given in Clause 5 shall also fulfil the requirements given in Table 2A. (See Annex A.)

4.2B Classification according to alloy type

The symbol in Table 1B identifies the chemical composition of all-weld metal determined in accordance with Clause 6. The all-weld metal obtained with the tubular cored electrodes and rods in Table 1B under conditions given in Clause 5 shall also fulfil the requirements given in Table 2B. (See Annex A.)

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Table 1A — Symbol for chemical composition requirements for all-weld metal (classification according to nominal composition)

Alloy designation according to nominal composition	Chemical composition (percentage mass fraction) ^{a, b, c}												
	Shielding gas ^d	C	Mn	Si	P ^e	S ^e	Cr	Ni	Mo	Nb + Ta ^f	Cu	N	Ti
13	M, C, N	0,12	1,5	1,0	0,030	0,025	11,0 to 14,0	0,3	0,3	—	0,3	—	—
13 Ti	M, C, N	0,10	0,80	1,0	0,030	0,030	10,5 to 13,0	0,3	0,3	—	0,3	—	10 × C to 1,5
13 4	M, C, N	0,06	1,5	1,0	0,030	0,025	11,0 to 14,5	3,0 to 5,0	0,4 to 1,0	—	0,3	—	—
17	M, C, N	0,12	1,5	1,0	0,030	0,025	16,0 to 18,0	0,3	0,3	—	0,3	—	—
19 9 L	M, C, N	0,04	2,0	1,2	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,3	—	0,3	—	—
19 9 Nb	M, C, N	0,08	2,0	1,2	0,030	0,025	18,0 to 21,0	9,0 to 11,0	0,3	8 × C to 1,1	0,3	—	—
19 12 3 L	M, C, N	0,04	2,0	1,2	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,5 to 3,0	—	0,3	—	—
19 12 3 Nb	M, C, N	0,08	2,0	1,2	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,5 to 3,0	8 × C to 1,1	0,3	—	—
19 13 4 N L	M, C, N	0,04	1,0 to 5,0	1,2	0,030	0,025	17,0 to 20,0	12,0 to 15,0	3,0 to 4,5	—	0,3	0,08 to 0,20	—
22 9 3 N L	M, C, N	0,04	2,5	1,2	0,030	0,025	21,0 to 24,0	7,5 to 10,5	2,5 to 4,0	—	0,3	0,08 to 0,20	—
18 16 5 N L	M, C, N	0,04	1,0 to 4,0	1,2	0,035	0,025	17,0 to 20,0	15,5 to 19,0	3,5 to 5,0	—	0,3	0,08 to 0,20	—
18 8 Mn	M, C, N	0,20	4,5 to 7,5	1,2	0,035	0,025	17,0 to 20,0	7,0 to 10,0	0,3	—	0,3	—	—
20 10 3	M, C, N	0,08	2,5	1,2	0,035	0,025	19,5 to 22,0	9,0 to 11,0	2,0 to 4,0	—	0,3	—	—
23 12 L	M, C, N	0,04	2,5	1,2	0,030	0,025	22,0 to 25,0	11,0 to 14,0	0,3	—	0,3	—	—
23 12 2 L	M, C, N	0,04	2,5	1,2	0,030	0,025	22,0 to 25,0	11,0 to 14,0	2,0 to 3,0	—	0,3	—	—
29 9	M, C, N	0,15	2,5	1,2	0,035	0,025	27,0 to 31,0	8,0 to 12,0	0,3	—	0,3	—	—
22 12 H	M, C, N	0,15	2,5	1,2	0,030	0,025	20,0 to 23,0	10,0 to 13,0	0,3	—	0,3	—	—
25 20	M, C, N	0,06 to 0,20	1,0 to 5,0	1,2	0,030	0,025	23,0 to 27,0	18,0 to 22,0	0,3	—	0,3	—	—

a Single values shown in the table are maximum values.
 b Tubular cored electrodes not listed in the table shall be symbolized similarly and prefixed by the letter "Z".
 c The results shall be rounded to the same number of significant figures as in the specified value using the rules in accordance with Annex B, Rule A of ISO 31-0:1992.
 d The symbol N shall be used for tubular cored electrodes without a gas shield.
 e The sum of P and S shall not exceed 0,050 %, except for 18 16 5 L, 18 8 Mn and 29 9.
 f Up to 20 % of the amount of Nb can be replaced by Ta.

**Table 1B-1 — Symbol for chemical composition requirements for all-weld metal of gas shielded flux cored electrodes
(classification according to alloy type)**

Alloy designation according to alloy type	Chemical composition (percentage mass fraction) ^{a, b, c}												
	Shielding gas (see 4.4)	C	Mn	Si	P	S	Cr	Ni	Mo	Nb + Ta	Cu	N	Ti
307	M, B, C, G	0,13	3,30 to 4,75	1,0	0,04	0,03	18,0 to 20,5	9,0 to 10,5	0,5 to 1,5	—	0,5	—	—
308	M, B, C, G	0,08	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,5	—	0,5	—	—
308L	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	9,0 to 12,0	0,5	—	0,5	—	—
308H	M, B, C, G	0,04 to 0,08	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,5	—	0,5	—	—
308Mo	M, B, C, G	0,08	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	9,0 to 11,0	2,0 to 3,0	—	0,5	—	—
308LMo	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	9,0 to 12,0	2,0 to 3,0	—	0,5	—	—
309	M, B, C, G	0,10	0,5 to 2,5	1,0	0,04	0,03	22,0 to 25,0	12,0 to 14,0	0,5	—	0,5	—	—
309L	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	22,0 to 25,0	12,0 to 14,0	0,5	—	0,5	—	—
309Mo	M, B, C, G	0,12	0,5 to 2,5	1,0	0,04	0,03	21,0 to 25,0	12,0 to 16,0	2,0 to 3,0	—	0,5	—	—
309LMo	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	21,0 to 25,0	12,0 to 16,0	2,0 to 3,0	—	0,5	—	—
309LNb	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	22,0 to 25,0	12,0 to 14,0	0,5	0,7 to 1,0	0,5	—	—
310	M, B, C, G	0,20	1,0 to 2,5	1,0	0,03	0,03	25,0 to 28,0	20,0 to 22,5	0,5	—	0,5	—	—
312	M, B, C, G	0,15	0,5 to 2,5	1,0	0,04	0,03	28,0 to 32,0	8,0 to 10,5	0,5	—	0,5	—	—
316	M, B, C, G	0,08	0,5 to 2,5	1,0	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	—	0,5	—	—
316L	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	—	0,5	—	—
316H	M, B, C, G	0,04 to 0,08	0,5 to 2,5	1,0	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	—	0,5	—	—
316LCu	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	17,0 to 20,0	11,0 to 16,0	1,25 to 2,75	—	1,0 to 2,5	—	—

Table 1B-1 (continued)

Alloy designation according to alloy type	Chemical composition (percentage mass fraction) ^{a, b, c}												
	Shielding gas (see 4.4)	C	Mn	Si	P	S	Cr	Ni	Mo	Nb + Ta	Cu	N	Ti
317	M, B, C, G	0,08	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	12,0 to 14,0	3,0 to 4,0	–	0,5	–	–
317L	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	12,0 to 16,0	3,0 to 4,0	–	0,5	–	–
318	M, B, C, G	0,08	0,5 to 2,5	1,0	0,04	0,03	17,0 to 20,0	11,0 to 14,0	2,0 to 3,0	8 × C to 1,0	0,5	–	–
347	M, B, C, G	0,08	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,5	8 × C to 1,0	0,5	–	–
347L	M, B, C, G	0,04	0,5 to 2,5	1,0	0,04	0,03	18,0 to 21,0	9,0 to 11,0	0,5	8 × C to 1,0	0,5	–	–
409	M, B, C, G	0,10	0,80	1,0	0,04	0,03	10,5 to 13,5	0,6	0,5	–	0,5	–	10 × C to 1,5
409Nb	M, B, C, G	0,12	1,2	1,0	0,04	0,03	10,5 to 14,0	0,6	0,5	8 × C to 1,5	0,5	–	–
410	M, B, C, G	0,12	1,2	1,0	0,04	0,03	11,0 to 13,5	0,6	0,5	–	0,5	–	–
410NiMo	M, B, C, G	0,06	1,0	1,0	0,04	0,03	11,0 to 12,5	4,0 to 5,0	0,4 to 0,7	–	0,5	–	–
430	M, B, C, G	0,10	1,2	1,0	0,04	0,03	15,0 to 18,0	0,6	0,5	–	0,5	–	–
430Nb	M, B, C, G	0,10	1,2	1,0	0,04	0,03	15,0 to 18,0	0,6	0,5	0,5 to 1,5	0,5	–	–
16-8-2	M, B, C, G	0,10	0,5 to 2,5	0,75	0,04	0,03	14,5 to 16,5	7,5 to 9,5	1,0 to 2,0	–	0,5	–	–
2209	M, B, C, G	0,04	0,5 to 2,0	1,0	0,04	0,03	21,0 to 24,0	7,5 to 10,0	2,5 to 4,0	–	0,5	0,08 to 0,20	–
2553	M, B, C, G	0,04	0,5 to 1,5	0,75	0,04	0,03	24,0 to 27,0	8,5 to 10,5	2,9 to 3,9	–	1,5 to 2,5	0,10 to 0,20	–

a “–” signs in the table are used to indicate that these elements are not required to be analysed.

b Single values shown in the table are maximum values.

c The results shall be rounded to the same number of significant figures as in the specified value using the rules in accordance with Annex B, Rule A of ISO 31-0:1992.