INTERNATIONAL STANDARD

**ISO 17633**

Second edition
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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

*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*



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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.

ISO 17633 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 17633:2004), of which it constitutes a technical revision.



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 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 in accordance with this International Standard.

The classification according to system A is mainly based on EN 12073:1999[2]. The classification according to system B is mainly based upon standards used around the Pacific Rim.

# 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 nominal composition or utilizing a system based upon alloy type.

a) Clauses, subclauses, and tables which carry the suffix letter “A” are applicable only to products classified using the system based upon nominal composition.

b) Clauses, subclauses, and tables which carry the suffix letter “B” are applicable only to products classified using the system based upon alloy type.

c) Clauses, subclauses, and tables which do not have either the suffix letter “A” or the suffix letter “B” are applicable to all tubular cored electrodes classified in accordance with this International Standard.



It is recognized that the operating characteristics of tubular cored electrodes can be modified by the use of pulsed current. However, this International Standard does not use pulsed current 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 544, *Welding consumables — Technical delivery conditions for filler materials and fluxes — Type of product, dimensions, tolerances and markings*

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

ISO 6947:2010, *Welding and allied processes — Welding positions*

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

ISO 14175, *Welding consumables — Gases and gas mixtures for fusion welding and allied processes*

ISO 14344, *Welding consumables — Procurement of filler materials and fluxes*

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*

ISO 80000-1:2009, *Quantities and units — Part 1: General*

## 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.

This clause 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, in accordance with the symbols defined in Clause 4.

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

The classification is divided into five parts:

a) the first part gives a symbol indicating the product to be identified (see 4.1A);

b) the second part gives a symbol indicating the chemical composition of the all-weld metal (see Table 1A);

c) the third part gives a symbol indicating the type of electrode core (see Table 3A);

d) the fourth part gives a symbol indicating the shielding gas (see 4.4);

e) the fifth part gives a symbol indicating the welding position (see Table 4A).

### 3B Classification according to alloy type

The classification is divided into five parts:

a) the first part gives a symbol indicating the tubular cored electrode and rod (see 4.1B);

b) the second part gives a symbol indicating the chemical composition of the all-weld metal (see Tables 1B-1 to -4);

c) the third part gives a symbol indicating the type of tubular cored electrode or rod (see Table 3B);

d) the fourth part gives a symbol indicating the shielding gas (see 4.4);

e) the fifth part gives a symbol indicating the welding position (see Table 4B).



The full identification (see Clause 11) shall be used on packages and in the manufacturer's literature and data sheets.

## 4 Symbols and requirements

A given tubular cored electrode may be classified with more than one shielding gas. In such cases, each shielding gas results in a separate classification.

## 4.1 Symbol for the product

### 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 symbols in Table 1A identify 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 symbols in Table 1B-1 identify the chemical composition of all-weld metal for gas shielded flux cored electrodes determined in accordance with Clause 6.

The symbols in Table 1B-2 identify the chemical composition of all-weld metal for non-gas shielded flux cored electrodes determined in accordance with Clause 6.

The symbols in Table 1B-3 identify the chemical composition of all-weld metal for gas shielded metal cored electrodes determined in accordance with Clause 6.

The symbols in Table 1B-4 identify the chemical composition of all-weld metal for cored rods for gas tungsten arc welding determined in accordance with Clause 6.

The all-weld metal obtained with the tubular cored electrodes and rods in Tables 1B-1, 1B-2, 1B-3 and 1B-4 under conditions given in Clause 5 shall also fulfil the requirements given in Table 2B. (See Annex A.)

**Table 1A — Symbols and all-weld metal chemical composition requirements (classification according to nominal composition)**

| Alloy designation according to nominal composition | Chemical composition, % (by mass)[a, b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | Mn | Si | P[c] | S[c] | Cr | Ni | Mo | Nb + Ta[d] | Cu | N | Others |
| **Martensitic/ferritic types** | | | | | | | | | | | | |
| 13 | 0,12 | 1,5 | 1,0 | 0,030 | 0,025 | 11,0 to 14,0 | 0,3 | 0,3 | — | 0,5 | — | — |
| 13 Ti | 0,10 | 0,80 | 1,0 | 0,030 | 0,030 | 10,5 to 13,0 | 0,3 | 0,3 | — | 0,5 | — | Ti: 10 × C to 1,5 |
| 13 4 | 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 | — | 0,5 | — | — |
| 17 | 0,12 | 1,5 | 1,0 | 0,030 | 0,025 | 16,0 to 18,0 | 0,3 | 0,3 | — | 0,5 | — | — |
| **Austenitic types** | | | | | | | | | | | | |
| 19 9 L | 0,04 | 2,0 | 1,2 | 0,030 | 0,025 | 18,0 to 21,0 | 9,0 to 11,0 | 0,3 | — | 0,5 | — | — |
| 19 9 Nb | 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 | 0,5 | — | — |
| 19 12 3 L | 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 | — | 0,5 | — | — |
| 19 12 3 Nb | 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 | 0,5 | — | — |
| **Ferritic-austenitic types (sometimes referred to as austenitic-ferritic types)** | | | | | | | | | | | | |
| 22 9 3 N L | 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 | — | 0,5 | 0,08 to 0,20 | — |
| 23 7 N L | 0,04 | 0,4 to 1,5 | 1,0 | 0,030 | 0,020 | 22,5 to 25,5 | 6,5 to 10,0 | 0,8 | — | 0,5 | 0,10 to 0,20 | — |
| 25 9 4 N L | 0,04 | 2,5 | 1,2 | 0,030 | 0,025 | 24,0 to 27,0 | 8,0 to 10,5 | 2,5 to 4,5 | — | — | 0,20 to 0,30 | — |
| 25 9 4 Cu N L | 0,04 | 2,5 | 1,2 | 0,030 | 0,025 | 24,0 to 27,0 | 8,0 to 10,5 | 2,5 to 4,5 | — | 1,0 to 2,5 | 0,20 to 0,30 | — |
| **Fully austenitic types** | | | | | | | | | | | | |
| 18 16 5 N L[e] | 0,03 | 1,0 to 4,0 | 1,0 | 0,03 | 0,02 | 17,0 to 20,0 | 16,0 to 19,0 | 3,5 to 5,0 | — | 0,5 | 0,10 to 0,20 | — |
| 19 13 4 N L[e] | 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 | — | 0,5 | 0,08 to 0,20 | — |
| 20 25 5 Cu N L[e] | 0,03 | 1,0 to 4,0 | 1,0 | 0,03 | 0,02 | 19,0 to 22,0 | 24,0 to 27,0 | 4,0 to 6,0 | — | 1,0 to 2,0 | 0,10 to 0,20 | — |

**Table 1A** (*continued*)

| Alloy designation according to nominal composition | Chemical composition, % (by mass)[a, b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | Mn | Si | P[c] | S[c] | Cr | Ni | Mo | Nb + Ta[d] | Cu | N | Others |
| **Special types — Often used for dissimilar metal joining** | | | | | | | | | | | | |
| 18 8 Mn | 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 | — | 0,5 | — | — |
| 18 9 Mn Mo | 0,04 to 0,14 | 3,0 to 5,0 | 1,2 | 0,035 | 0,025 | 18,0 to 21,5 | 9,0 to 11,0 | 0,5 to 1,5 | — | — | — | — |
| 20 10 3 | 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 | — | 0,5 | — | — |
| 23 12 L | 0,04 | 2,5 | 1,2 | 0,030 | 0,025 | 22,0 to 25,0 | 11,0 to 14,0 | 0,3 | — | 0,5 | — | — |
| 23 12 Nb | 0,08 | 1,0 to 2,5 | 1,0 | 0,03 | 0,02 | 22,0 to 25,0 | 11,0 to 14,0 | 0,3 | 10 × C to 1,0 | 0,5 | — | — |
| 23 12 2 L | 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 | — | 0,5 | — | — |
| 29 9 | 0,15 | 2,5 | 1,2 | 0,035 | 0,025 | 27,0 to 31,0 | 8,0 to 12,0 | 0,3 | — | 0,5 | — | — |
| **Heat-resisting types** | | | | | | | | | | | | |
| 16 8 2 | 0,10 | 1,0 | 1,0 to 2,5 | 0,03 | 0,02 | 14,5 to 17,5 | 7,5 to 9,5 | 1,0 to 2,5 | — | 0,5 | — | Cr + Mo: 18,5 |
| 19 9 H | 0,04 to 0,08 | 1,0 | 1,0 to 2,5 | 0,03 | 0,02 | 18,0 to 21,0 | 9,0 to 11,0 | 0,3 | — | 0,5 | — | — |
| 21 10 N | 0,06 to 0,09 | 0,3 to 1,0 | 1,0 to 2,0 | 0,02 | 0,01 | 20,5 to 22,5 | 9,5 to 11,0 | 0,5 | — | 0,5 | 0,10 to 0,20 | Ce: 0,05 |
| 22 12 H | 0,15 | 2,5 | 1,2 | 0,030 | 0,025 | 20,0 to 23,0 | 10,0 to 13,0 | 0,3 | — | 0,5 | — | — |
| 25 4 | 0,15 | 2,0 | 1,0 to 2,5 | 0,03 | 0,02 | 24,0 to 27,0 | 4,0 to 6,0 | 0,3 | — | 0,5 | — | — |

**Table 1A** (*continued*)

| Alloy designation according to nominal composition | Chemical composition, % (by mass)[a, b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | C | Mn | Si | P[c] | S[c] | Cr | Ni | Mo | Nb + Ta[d] | Cu | N | Others |
| 25 20[e] | 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 | — | 0,5 | — | — |
| Z[f] | Any other agreed composition | | | | | | | | | | | |

[a] Single values are maximum values.

[b] "No requirement for analysis" is indicated by a dash.

[c] The sum of P and S shall not exceed 0,050 % (by mass), except for 18 16 5 N L, 18 8 Mn, and 29 9.

[d] Up to 20 % (by mass) of the amount of Nb can be replaced by Ta.

[e] The all-weld metal is in most cases fully austenitic and therefore can be susceptible to microfissuring or hot cracking. The occurrence of fissuring or cracking is reduced by increasing the weld metal manganese level and in recognition of this the manganese range is extended for a number of grades.

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