International Standard

ISO 17633

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

Fourth edition
2025-03

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ISO 17633:2025
https://standards.iteh.ai/catalog/standards/iso/ee72b11d-8c47-4f87-adf3-1039342a3b61/iso-17633-2025

Reference number
ISO 17633:2025(en)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 17633:2017) which has been technically revised. It also incorporates the Amendment ISO 17633:2017/Amd 1:2021

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The main changes are as follows:

— document has been reformatted in single column showing System A and System B in tables and separate clauses and subclauses, some which are new;

— normative references have been updated;

— new footnotes have been added to Tables 2 to 6 regarding specialized applications;

— 0,50 maximum cobalt has been added to all classifications in Tables 2 to 6;

— compositions of 16 8 2 and 19 9 H and 25 4 have been updated in Tables 4 and 5;

— examples in Clause 11 have been updated.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations of ISO/TC 44 documents, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

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Introduction

This document provides a classification system for tubular cored electrodes and rods for welding stainless and heat resisting 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 document. The classification in accordance with system A was mainly based on EN 12073:1999 which has been withdrawn and replaced by this standard. The classification in accordance with system B is mainly based upon standards used around the Pacific Rim.

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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 document specifies requirements for classification of tubular flux and metal cored electrodes and rods, based on the all-weld metal chemical composition, the type of 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 document 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 “System A” are applicable only to products classified using the system based upon nominal composition.

b) Clauses, subclauses, and tables which carry the suffix “System 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 “System A” or “System B” are applicable to all products classified in accordance with this document.

This document does not use pulsed current for determining the product classification, neither does it address ferrite numbers (see Annex D and ISO/TR 22824).

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2 Normative references

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The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 6947:2019, *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 15792-1:2020, *Welding consumables — Test methods — Part 1: Preparation of all-weld metal test pieces and specimens in steel, nickel and nickel alloys*

ISO 80000-1:2022, *Quantities and units — Part 1: General*

3 Terms and definitions

No terms and definitions are listed in this document.

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ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Classification

4.1 General

Classification designations are based upon two approaches to indicate 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 core, the shielding gas and the welding position, in accordance with the symbols defined in Clause 5.

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.

4.2 Classification systems

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Each classification system, A and B, is split into five parts as given in Table 1.

Table 1 — Parts of the classification systems, A and B

Part of classification designation	Classification system	
	System A **Classification according to nominal composition**	**System B** **Classification according to alloy type**
1	symbol indicating the product to be identified (see 5.2);	symbol indicating the tubular cored electrode and rod (see 5.2);
2	symbol indicating the chemical composition of the all-weld metal (see Table 2);	symbol indicating the chemical composition of the all-weld metal (see Table 3 to Table 6);
3	symbol indicating the type of core (see Table 9);	symbol indicating the type of core (see Table 10);
4	symbol indicating the shielding gas (see 5.5);	
5	symbol indicating the welding position (see Table 11).	

The full identification (see Clause 10 and examples in Clause 11) shall be used on packages and in the manufacturer’s literature and data sheets.

5 Symbols and requirements

5.1 General

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.

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5.2 Symbol for the product

5.2.1 Classification according to nominal composition – System A

The symbol for tubular cored product used in the metal arc welding process shall be the letter “T”.

5.2.2 Classification according to alloy type – System B

The symbol for tubular cored product used in the metal arc welding process shall be the letters “TS”. The initial letter, where:

a) T indicates tubular cored electrode or rod as distinguished from covered electrodes and from solid electrodes and rods;

b) S indicates that the alloy system is stainless or heat-resisting steel.

5.3 Symbol for the chemical composition of all-weld metal

5.3.1 Classification according to nominal composition – System A

The symbols in Table 2 identify the chemical composition of all-weld metal determined in accordance with Clause 7.

The all-weld metal obtained with the tubular cored product in Table 2 under conditions given in Clause 6 shall also fulfil the requirements given in Table 7. (See Annex A.)

5.3.2 Classification according to alloy type – System B

The symbols in Table 3 identify the chemical composition of all-weld metal for gas shielded flux cored electrodes determined in accordance with Clause 7.

The symbols in Table 4 identify the chemical composition of all-weld metal for non-gas shielded flux cored electrodes determined in accordance with Clause 7.

The symbols in Table 5 identify the chemical composition of all-weld metal for gas shielded metal cored electrodes determined in accordance with Clause 7.

The symbols in Table 6 identify the chemical composition of all-weld metal for cored products for gas tungsten arc welding determined in accordance with Clause 7.

The all-weld metal obtained with the tubular cored electrodes and rods in Table 3, Table 4, Table 5 and Table 6 under conditions given in Clause 6 shall also fulfil the requirements given in Table 8. (See Annex A.).

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Table 2 — Symbols and all-weld metal chemical composition requirements – Classification according to nominal composition – System A

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	Co [e]	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	0,50	—	—
13 Ti	0,10	0,80	1,0	0,030	0,030	10,5 to 13,0	0,3	0,3	—	0,5	0,50	—	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	0,50	—	—
17	0,12	1,5	1,0	0,030	0,025	16,0 to 18,0	0,3	0,3	—	0,5	0,50	—	—
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	0,50	—	—
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	0,50	—	—
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	0,50	—	—
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	0,50	—	—
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	0,50	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	0,50	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	—	—	0,50	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	0,50	0,20 to 0,30	—
Fully austenitic types													
18 16 5 N L [f]	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	0,50	0,10 to 0,20	—
19 13 4 N L [f]	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	0,50	0,08 to 0,20	—
20 25 5 Cu N L [f]	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	0,50	0,10 to 0,20	—
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	0,50	—	—
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	—	—	0,50	—	—

[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] For certain specialized applications, including but not limited to medical and nuclear power applications, a significantly lower Co limit than 0,50 % may be necessary. A lower limit should be specified in the purchase order in accordance with ISO 14344.

[f] 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.

[g] 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 products with the same Z classification are not interchangeable.

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Table 2 *(continued)*

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	0,50	—	—
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	0,50	—	—
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	0,50	—	—
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	0,50	—	—
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	0,50	—	—
Heat-resisting types													
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	Co [e]	N	Others
16 8 2	0,10	1,0 to 2,5	1,0	0,03	0,02	14,5 to17,5	7,5 to 9,5	1,0 to 2,5	—	0,5	0,50	—	Cr+Mo: 18,5
19 9 H	0,04 to 0,08	1,0 to 2,5	1,0	0,03	0,02	18,0 to 21,0	9,0 to 11,0	0,3	—	0,5	0,50	—	—
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	0,50	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	0,50	—	—
25 4	0,15	1,0 to 2,5	2,0	0,03	0,02	24,0 to 27,0	4,0 to 6,0	0,3	—	0,5	0,50	—	—
25 20[f]	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	0,50	—	—
Other compositions													
Z [g]	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] For certain specialized applications, including but not limited to medical and nuclear power applications, a significantly lower Co limit than 0,50 % may be necessary. A lower limit should be specified in the purchase order in accordance with ISO 14344.

[f] 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.

[g] 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 products with the same Z classification are not interchangeable.

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