International Standard

ISO 26304

Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels — Classification

Produits consommables pour le soudage — Fils-électrodes pleins, fils-électrodes fourrés et couples électrodes-flux pour le soudage à l'arc sous flux des aciers à haute résistance — Classification

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Contents

Page

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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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 26304:2017), which has been technically revised.

The main changes are as follows:

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

— a new paragraph has been added to the end of Clause 1, Scope;

— normative references updated;

— Table 1 was updated;

— Table 3 values for System B were revised to reflect those in ISO 18275 and ISO 18276

— Table 7 and Table 8 were revised and new footnotes added; header of the last column was revised;

— Table 11, H8 was added;

— Table 12, System B was revised;

— Subclause 5.3 was revised;

— Subclause 6.2 was revised;

— Clause 11, examples updated and expanded.

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.

Introduction

This document recognizes that there are two somewhat different approaches in the global market to classifying a given solid wire electrode, tubular cored electrode, and electrode-flux combination, 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 originally based on EN 14295 which has been withdrawn and replaced by this document. The classification in accordance with system B is mainly based on standards used around the Pacific Rim. Future revisions aim to merge the two approaches into a single classification system.

This document provides a classification for the designation of solid wire electrodes in terms of their chemical composition, tubular cored electrodes in terms of the deposit composition obtained with a particular submerged arc flux, and, where required, electrode-flux combinations in terms of the yield strength, tensile strength, elongation, and impact properties of the all-weld metal deposit. The ratio of yield to tensile strength of weld metal is generally higher than that of parent material. Users should note that matching weld metal yield strength to parent metal yield strength does not necessarily ensure that the weld metal tensile strength matches that of the parent material. Thus, where the application requires matching tensile strength, selection of the consumable should be made by reference to columns 3 or 6 of Table 3, as appropriate.

Although combinations of electrodes and fluxes supplied by individual companies can have the same system A classification, it is possible that the combination of an electrode with a flux from one manufacturer and the same electrode with a flux from another manufacturer, both fluxes having the same classification, may not be interchangeable unless verified in accordance with this document. Two tubular cored wires of the same classification can likewise produce different results with the same flux.

The mechanical properties of the all-weld metal test specimens used to classify the electrode-flux combinations vary from those obtained in production joints because of differences in welding procedures such as electrode size, width of weave, welding position, and material composition.

Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels — Classification

1 Scope

This document specifies requirements for classification of solid wire electrodes, tubular cored electrodes, and electrode-flux combinations (the all-weld metal deposits) in the as-welded condition and in the post-weld heat-treated condition for submerged arc welding of high strength steels with a minimum yield strength greater than 500 MPa or a minimum tensile strength greater than 570 MPa. One flux can be tested and classified with different electrodes. One electrode can be tested and classified with different fluxes. The solid wire electrode is also classified separately based on its chemical composition.

This document is a combined specification providing for classification utilizing a system based on the yield strength and average impact energy of 47 J for the all-weld metal, or utilizing a system based on the tensile strength and average impact energy of 27 J for the all-weld metal.

a) Clauses, subclauses and tables which carry the suffix "system A" are applicable only to solid wire electrodes, tubular cored electrodes and the all-weld metal deposits classified to the system based on the yield strength and the average impact energy of 47 J for the all-weld metal obtained with electrode-flux combinations in accordance with this document.

b) Clauses, subclauses and tables which carry the suffix "system B" are applicable only to solid wire electrodes, tubular cored electrodes and the all-weld metal deposits classified to the system based on the tensile strength and the average impact energy of 27 J for the all-weld metal obtained with electrode-flux combinations in accordance with this document.

c) Clauses, subclauses and tables which do not have either the suffix "system A" or "system B" are applicable to all solid wire electrodes, tubular cored electrodes and electrode-flux combinations classified in accordance with this document.

For comparison purposes, some tables include requirements for electrodes classified in accordance with both systems, placing individual electrodes from the two systems, which are similar in composition and properties, on adjacent lines in the particular table. In a particular line of the table that is mandatory in one system, the symbol for the similar electrode from the other system is indicated in parentheses. By appropriate restriction of the formulation of a particular electrode, it is often, but not always, possible to produce an electrode that can be classified in both systems, in which case the electrode, or its packaging, can be marked with the classification in either or both systems.

For system B only, electrode flux combinations for the single-run and two-run techniques are classified on the basis of the two-run technique.

2 Normative references

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

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

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

ISO 14174, *Welding consumables — Fluxes for submerged arc welding and electroslag welding — Classification*

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 15792-2:2020, *Welding consumables — Test methods — Part 2: Preparation of single-run and two-run technique test pieces and specimens in steel*

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

3 Terms and definitions

No terms and definitions are listed in this document.

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 on two approaches to indicate the tensile properties and the impact properties of the all-weld metal obtained with a given electrode-flux combination. The two designation approaches include additional designators for the chemical composition of a solid wire electrode or the chemical composition of the all-weld metal deposit obtained with a tubular cored electrode and a specific flux. The two designation approaches include additional designators for some other classification requirements, but not all, as is clear from the following clauses. A given commercial product may be classified to the classification requirements in both systems; then either or both classification designations may be used for the product.

The classification includes the all-weld metal properties obtained with a specific electrode-flux combination as given in 4.2.

A solid wire electrode shall be classified in accordance with its chemical composition in Table 7.

A tubular cored electrode shall be classified in accordance with the all-weld metal deposit composition in Table 8, obtained with a specific flux.

When the solid wire electrode or tubular cored electrode is classified in combination with a flux for submerged arc welding, the classification shall be prefixed with a symbol in accordance with Clause 5 as appropriate.

4.2 Classification systems

Each classification system, A and B, is split into 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 by yield strength and 47 J impact energy**	**System B** **Classification by tensile strength and 27 J impact energy**
1	symbol indicating the product or process to be identified	
2	symbol indicating the strength and elongation of all-weld metal for multi-run technique (see Table 3).	symbol indicating the strength and elongation of all-weld metal, and whether it was tested in the as-welded or post-weld heat-treated condition. The symbol also indicates whether the weld metal was deposited in the multi-run or two-run technique. (see Table 3 and Table 4).
3	symbol indicating the impact properties of the all-weld metal (see Table 5).	symbol indicating the impact properties of the all-weld metal or welded joint in the same condition as specified for the tensile strength (see Table 5). The letter "U" after this designator indicates that the deposit meets an average optional requirement of 47 J at the designated impact test temperature;
4	symbol indicating the type of flux used (see 5.5).	symbol indicating the chemical composition of the solid wire electrode used (see Table 7), or of the all-weld metal deposited by a tubular cored electrode-flux combination (see Table 8);
5	symbol indicating the chemical composition of the solid wire electrode used (see Table 7) or of the all-weld metal deposited by a tubular cored electrode-flux combination (see Table 8).	optional symbol indicating the diffusible hydrogen content of the weld metal determined in accordance with ISO 3690.
6	symbol indicating the postweld heat treatment if this is applied.	—
7	optional symbol indicating the diffusible hydrogen content of the weld metal determined in accordance with ISO 3690.	—

5 Symbols and requirements

5.1 General

A solid wire electrode can be classified separately based on its chemical composition, as specified in Table 7. The all-weld metal deposit composition and mechanical properties obtained with a particular solid wire electrode or tubular cored electrode vary somewhat depending on the flux used. Accordingly, the classification of the all-weld metal deposit obtained with a particular solid wire electrode or tubular cored electrode can be different for different fluxes. However, deposit composition is only a classification requirement for tubular cored electrode-flux combinations.

5.2 Symbol for the product or process

The symbol for the electrode-flux combination or weld deposit produced by a solid wire electrode or by a tubular cored electrode using the submerged arc welding process with a specific flux, shall be the letter "S" placed at the beginning of the designation.

The additional symbols in Table 2 shall be applied respectively to system A and system B

Table 2 — Additional symbols for product or process

System A Classification by yield strength and 47 J impact energy	System B Classification by tensile strength and 27 J impact energy
The symbol for the solid wire electrode for use in the submerged arc welding process shall be the letter “S” placed at the beginning of the solid wire electrode designation.	The symbol for the solid wire electrode for use in the submerged arc welding process shall be the letters “SU” placed at the beginning of the solid wire electrode designation.
The symbol for the tubular cored electrode for use in the submerged arc welding process shall be the letter “T” placed at the beginning of the tubular cored electrode designation.	The symbol for the tubular cored electrode for use in the submerged arc welding process shall be the letters “TU” placed at the beginning of the tubular cored electrode designation.

5.3 Symbols for the tensile properties of the all-weld metal deposit

5.3.1 Multi-run technique

The symbols in Table 3 indicate:

a) System A – the yield strength, tensile strength, and elongation of the all-weld metal in the as-welded condition or in the post-weld heat treated condition in accordance with Table 3, and 5.7 determined in accordance with Clause 6

b) System B – the tensile strength, yield strength, and elongation of the all-weld metal in the as-welded condition or in the post-weld heat-treated condition in accordance with Table 3, and 5.7 determined in accordance with Clause 6

Table 3 — Symbols for the tensile properties of the all-weld metal deposit – multi-run technique

System A Symbol for the tensile properties by multi-run technique(Classification by yield strength and 47 J impact energy)				System B Symbol for the tensile properties by multi-run technique (Classification by tensile strength and 27 J impact energy)			
Symbol [a]	Minimum [a] yield strength MPa	Tensile strength MPa	Minimum [b] elongation %	Symbol [c]	Tensile strength MPa	Minimum yield strength [d] MPa	Minimum elongation [b] %
55	550	640 to 820	18	59X	590 to 790	490	16
62	620	700 to 890	18	62X	620 to 820	530	15
69	690	770 to 940	17	69X	690 to 890	600	14
79	790	880 to 1 080	16	76X	760 to 960	670	13
89	890	940 to 1 180	15	78X	780 to 980	690	13
				83X	830 to 1 030	740	12

[a] For yield strength, the lower yield strength, R_{eL}, is used when yielding occurs, otherwise the 0,2 % proof strength, $R_{p0,2}$, is used.

[b] Gauge length is equal to five times the test specimen diameter.

[c] X is “A” or “P”, where “A” indicates testing in the as-welded condition and “P” indicates testing in the post-weld heat-treated condition.

[d] For yield strength, the 0,2 % proof strength, $R_{p0,2}$, is used.