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Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels — Classification

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

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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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 14171 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 14171:2002), which has been technically revised.

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 recognizes that there are two somewhat different approaches in the global market to classifying a given 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 International Standard.

This International Standard provides a classification system 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 and elongation 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 material yield strength does not necessarily ensure that the weld metal tensile strength matches that of the parent material. Thus, where the application of the material requires matching tensile strengths, selection of the consumable should be made by reference to column 3 of Table 1A or 1B, as appropriate.

Although combinations of electrodes and fluxes supplied by individual companies may have the same classification, the individual wire electrodes and fluxes from different companies are not interchangeable unless verified in accordance with this International Standard.

The mechanical properties of 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 and parent material composition.

Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels — Classification

1 Scope

This International Standard specifies requirements for the classification of electrode/flux combinations and weld metal in the as-welded condition and in the post-weld heat-treated condition for submerged arc welding of non alloy and fine grain steels with a minimum yield strength of up to 500 MPa or a minimum tensile strength of up to 570 MPa. One flux can be classified with different solid wire electrodes and tubular cored electrodes. The solid wire electrode is also classified separately based on chemical composition.

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

a) Clauses, subclauses, and tables which carry the suffix letter “A” are applicable only to electrode/flux combinations and wire electrodes classified using the system based upon the yield strength and the average impact energy for weld metal of 47 J, in accordance with this International Standard.

b) Clauses, subclauses, and tables which carry the suffix letter “B” are applicable only to electrode/flux combinations and wire electrodes classified using the system based upon the tensile strength and the average impact energy for weld metal of 27 J, in accordance with this International Standard.

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

Fluxes for the single-run and two-run techniques are classified on the basis of the two-run technique.

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

ISO 15792-2:2000, *Welding consumables — Test methods — Part 2: Preparation of single-run and two-run technique test specimens in steel*

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

3 Classification

Classification designations are based upon two approaches to indicate the tensile properties and the impact properties of the weld metal obtained with a given electrode/flux combination. The two designation approaches include additional symbols for some other classification requirements, but not all, as is clear from the following clauses. In most cases, a given commercial product can be classified in accordance with both systems. Then either or both classification designations can be used for the product.

A solid wire electrode shall be classified in accordance with its chemical composition as given in Table 4A or 4B.

An all-weld metal deposit from a tubular cored electrode shall be classified in accordance with the all-weld metal composition, as given in Table 5A or 5B, obtained with a particular 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 4 as appropriate.

The electrode/flux classification includes weld metal properties obtained with a manufacturer's specific electrode/flux combination as given below. A wire electrode may be separately classified with the symbol for its chemical composition in Table 4A or 4B.

3A Classification by yield strength and 47 J impact energy

The classification is divided into five mandatory parts and an optional sixth part:

1) the first part gives a symbol indicating the process to be identified;

2) the second part gives a symbol indicating the strength and elongation of all-weld metal for multi-run technique or the strength of the parent material used in classification for the two-run technique (see Table 1A or 2A);

3B Classification by tensile strength and 27 J impact energy

The classification is divided into five mandatory parts and an optional sixth part:

1) the first part gives a symbol indicating the process to be identified;

2) the second part gives a symbol indicating the strength and elongation of all-weld metal in either the as-welded or post-weld heat-treated condition for a multi-run technique or the specified minimum tensile strength of the parent material or the weld metal used in classification for the two-run technique (see Table 1B or 2B);

3) the third part gives a symbol indicating the impact properties of all-weld metal or welded joint (see Table 3);

4) the fourth part gives a symbol indicating the type of flux used in accordance with ISO 14174 (see 4.4);

5) the fifth part gives a symbol indicating the chemical composition of the solid wire electrode used (see Table 4A) or the chemical composition of the all-weld metal obtained with a tubular cored electrode/flux combination (see Table 5A);

6) the sixth part gives an optional symbol indicating the diffusible hydrogen content of the weld metal obtained in accordance with ISO 3690 (see Table 6).

3) the third part gives a symbol indicating the impact properties of all-weld metal or welded joint in the same condition as specified for the tensile strength (see Table 3). The letter "U" after this designator indicates that the deposit meets an average optional requirement of 47 J at the designated Charpy test temperature;

4) the fourth part gives a symbol indicating the type of flux used in accordance with ISO 14174 (see 4.4);

5) the fifth part gives a symbol indicating the chemical composition of the solid wire electrode used (see Table 4B) or the chemical composition of the all-weld metal obtained with a tubular cored electrode/flux combination (see Table 5B);

6) the sixth part gives an optional symbol indicating the diffusible hydrogen content of the weld metal obtained in accordance with ISO 3690 (see Table 6).

4 Symbols and requirements

4.1 Symbol for the process

The symbol for an electrode/flux combination used in the submerged arc welding process shall be the letter S at the beginning of the designation.

4.2 Symbol for tensile properties

4.2.1 Multi-run technique

4.2.1A Classification by yield strength and 47 J impact energy

For products suitable for multi-run welding, the symbols in Table 1A indicate yield strength, tensile strength and elongation of the all-weld metal in the as-welded condition determined in accordance with 5.1A.

4.2.1B Classification by tensile strength and 27 J impact energy

For products suitable for multi-run welding, the symbols in Table 1B indicate yield strength, tensile strength and elongation of the all-weld metal in the as-welded condition or in the post-weld heat-treated condition determined in accordance with 5.1B.

Table 1A — Symbols for tensile properties by multi-run technique
(Classification by yield strength and 47 J impact energy)

Symbol	Minimum yield strength[a] MPa	Tensile strength MPa	Minimum elongation[b] %
35	355	440 to 570	22
38	380	470 to 600	20
42	420	500 to 640	20
46	460	530 to 680	20
50	500	560 to 720	18

[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.

Table 1B — Symbols for tensile properties by multi-run technique
(Classification by tensile strength and 27 J impact energy)

Symbol[a]	Minimum yield strength[b] MPa	Tensile strength MPa	Minimum elongation[c] %
43X	330	430 to 600	20
49X	390	490 to 670	18
55X	460	550 to 740	17
57X	490	570 to 770	17

[a] 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.

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

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

4.2.2 Two-run technique

For products suitable for two-run welding, the symbols in Table 2A or 2B indicate the minimum tensile strength of the welded joint in relation to the specified minimum strength of the parent material used in two-run welding tests satisfactorily completed in accordance with 5.2.

Table 2A — Symbols for tensile properties by two-run technique
(Classification by yield strength and 47 J impact energy)

Symbol	Minimum parent material yield strength MPa	Minimum tensile strength of the welded joint MPa
2T	275	370
3T	355	470
4T	420	520
5T	500	600

Table 2B — Symbols for tensile properties by two-run technique
(Classification by tensile strength and 27 J impact energy)

Symbol	Minimum tensile strength of the parent material and of the welded joint MPa
43S	430
49S	490
55S	550
57S	570

4.3 Symbol for the impact properties of all-weld metal or two-run welded joint

The symbols in Table 3 indicate the temperature at which an impact energy of 47 J or 27 J is achieved under the conditions given in Clause 5.

4.3A Classification by yield strength and 47 J impact energy

Three test specimens shall be tested. Only one individual value may be lower than 47 J but not lower than 32 J.

4.3B Classification by tensile strength and 27 J impact energy

Five test specimens shall be tested. The lowest and highest values obtained shall be disregarded. Two of the three remaining values shall be greater than the specified 27 J level, one of the three may be lower, but shall not be less than 20 J. The average of the three remaining values shall be at least 27 J.

The addition of the optional symbol U, immediately after the symbol for condition of heat treatment, indicates that the supplemental requirement of 47 J impact energy at the normal 27 J impact test temperature has also been satisfied. For the 47 J impact requirement, the number of specimens tested and values obtained shall meet the requirement of 4.3A.

When an all-weld metal or a welded joint has been classified for a certain temperature, it automatically covers any higher temperature in Table 3.

Table 3 — Symbols for impact properties of all-weld metal or welded joint

Symbol	Temperature for minimum average impact energy of 47 J[ab] or 27 J[b] °C
Z	No requirements
A[a] or Y[b]	+20
0	0
2	–20
3	–30
4	–40
5	–50
6	–60
7	–70
8	–80
9	–90
10	–100

[a] See 4.3A.

[b] See 4.3B.

4.4 Symbol for type of welding flux

The symbol for welding flux type shall be in accordance with ISO 14174.