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Welding consumables — Wire electrodes, wires, rods and deposits for gas-shielded arc welding of high strength steels — Classification

Produits consommables pour le soudage — Fils-électrodes, fils, baguettes et dépôts pour le soudage à l'arc sous flux gazeux des aciers à haute résistance — 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.

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 16834 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*.

Introduction

This International Standard recognizes that there are two somewhat different approaches in the global market to classifying a given wire electrode, wire, rod or deposit, 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 in accordance with system A is mainly based on EN 12534, *Welding consumables — Wire electrodes, wires, rods and deposits for gas shielded metal arc welding of high strength steels — Classification.* The classification in accordance with system B is mainly based upon standards used around the Pacific Rim.

Future revisions will aim to merge the two systems into a single classification system.

This International Standard provides a classification in order to designate wire electrodes, wires, rods and deposits in terms of their chemical composition and, where required, in terms of the yield strength, tensile strength and elongation of the all-weld metal. The ratio of yield to tensile strength of weld metal is generally higher than that of the parent metal. Users should note that matching weld-metal yield strength to parent-metal yield strength will not necessarily ensure that the weld-metal tensile strength matches that of the parent material. Where the application requires matching tensile strength, therefore, selection of the consumable should be made by reference to column 3 of Table 1A or 1B.

It should be noted that the mechanical properties of all-weld metal test specimens used to classify the electrodes, wires and rods will vary from those obtained in production joints because of differences in welding procedure, such as electrode size, width of weave, welding position and material composition.

Requests for official interpretations of technical aspects of this International Standard should be directed to the Secretariat of ISO/TC 44/SC 3 via the user's national standardization body; a listing of these bodies can be found at www.iso.org.

Welding consumables — Wire electrodes, wires, rods and deposits for gas-shielded arc welding of high strength steels — Classification

1 Scope

This International Standard specifies requirements for classification of wire electrodes, wires, rods and weld deposits in the as-welded condition and in the post-weld heat-treated (PWHT) condition for gas-shielded metal arc welding and tungsten inert-gas welding of high strength steels with a minimum yield strength greater than 500 MPa, or a minimum tensile strength greater than 570 MPa. One wire electrode can be tested and classified with different shielding gases.

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

a) Subclauses and Tables which carry the suffix letter "A" are applicable only to wire electrodes, wires, rods and deposits classified according to the system based upon the yield strength and the average impact energy of 47 J of all-weld metal under this International Standard.

b) Subclauses and Tables which carry the suffix letter "B" are applicable only to wire electrodes, wires, rods and deposits classified according to the system based upon the tensile strength and the average impact energy of 27 J of all-weld metal under this International Standard.

c) Subclauses and Tables which do not have either the suffix letter "A" or the suffix letter "B" are applicable to all wire electrodes, wires, rods and deposits classified under this International Standard.

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 markings*

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

ISO 14175, *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*

3 Classification

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

A wire electrode, wire or rod shall be classified in accordance with its chemical composition in Table 3A or Table 3B. A weld deposit shall be classified with additional symbols in accordance with the mechanical properties of its all-weld metal, using a shielding gas from a specific group.

3A Classification by yield strength and 47 J impact energy

The classification is divided into six parts:

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

2) the second part gives a symbol indicating the strength and elongation of all-weld metal (see Table 1A);

3 the third part gives a symbol indicating the impact properties of all-weld metal (see Table 2);

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

5) the fifth part gives a symbol indicating the chemical composition of the wire electrode, wire and rod used (see Table 3A);

6) the sixth part gives a symbol indicating the post-weld heat treatment in case this is applied (see 4.6A).

3B Classification by tensile strength and 27 J impact energy

The classification is divided into five parts:

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

2) the second part gives a symbol indicating the strength and elongation of the all-weld metal in either the as-welded or post-weld heat-treated condition (see Table 1B);

3) the third part gives a symbol indicating the impact properties of all-weld metal in the same condition as specified for the tensile strength (see Table 2). 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 shielding gas used (see 4.4);

5) the fifth part gives a symbol indicating the chemical composition of the wire electrode, wire and rod used (see Table 3B).

4 Symbols and requirements

4.1 Symbol for the product/process

The symbol for the wire electrode, wire or rod used in the arc welding process shall be the letter G (gas-shielded metal arc welding) and/or W (tungsten inert gas welding).

4.2 Symbol for strength and elongation properties of all-weld metal

4A Classification by yield strength and 47 J impact energy

The symbol in Table 1A indicates yield strength, tensile strength and elongation of the all-weld metal in the as-welded condition determined in accordance with Clause 5.

4B Classification by tensile strength and 27 J impact energy

The symbol in Table 1B indicates 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 Clause 5.

Table 1A — Symbol for tensile properties of all-weld metal (Classification by yield strength and 47 J impact energy)

Symbol	Minimum yield [a] strength	Tensile strength	Minimum[b] elongation
	MPa	MPa	%
55	550	640 to 820	18
62	620	700 to 890	18
69	690	770 to 940	17
79	790	880 to 1 080	16
89	890	940 to 1 180	15

[a] For yield strength, the lower yield (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 — Symbol for tensile properties of all-weld metal (Classification by tensile strength and 27 J impact energy)

Symbol [a]	Minimum yield [b] strength	Tensile strength	Minimum [c] elongation
	MPa	MPa	%
59X	490	590 to 790	16
62X	530	620 to 820	15
69X	600	690 to 890	14
76X	680	760 to 960	13
78X	680	780 to 980	13
83X	745	830 to 1 030	12

[a] X is "A", "P" or "AP" (see 4.6B).

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

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

NOTE Post-weld heat treatment can alter the strength of the weld metal from that obtained in the as-welded condition.

4.3 Symbol for impact properties of all-weld metal

4.3A Classification by yield strength and 47 J impact energy

The symbol in Table 2 indicates the temperature at which an impact energy of 47 J is achieved under the conditions given in Clause 5A. 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

The symbol in Table 2 indicates the temperature at which an impact energy of 27 J is achieved in the as-welded condition or in the post-weld heat-treated condition under the conditions given in Clause 5B. 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. Three test specimens shall be tested when the optional supplemental designator "U" is used to indicate that the weld deposit will meet a minimum impact energy of 47 J at the test temperature. The impact value shall be determined by the average of the three test specimens. The average of three values shall be 47 J or greater.

When an all-weld metal or a welded joint has been classified for a certain temperature, it automatically covers any higher temperature in Table 2.

Table 2 — Symbol for impact properties of all-weld metal or welded joint

Symbol	Temperature for minimum average impact energy of 47 J [a, b] 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

[a] See 4.3A.

[b] See 4.3B.

4.4 Symbol for shielding gas

The symbols M, A and C indicate shielding gas as described in ISO 14175. No symbol shall be used for tungsten inert gas welding when argon shielding gas in accordance with ISO 14175 is used.

The symbol C shall be used when the classification has been performed with the shielding gas ISO 14175 - C1, carbon dioxide.

The symbol A shall be used when the classification has been performed with Ar + 1 to 5 % O_2.

The symbol G shall be used to indicate that some other shielding gas was used, as agreed between the purchaser and supplier.

4.4A Classification by yield strength and 47 J impact energy

The symbol M, for mixed gases, shall be used when the classification has been performed with the shielding gas ISO 14175 - M21, but without helium.

4.4B Classification by tensile strength and 27 J impact energy

The symbol M shall be used when the classification has been performed with the shielding gas ISO 14175 - M21, but restricted to Ar + 20 to 25 % CO_2, but without helium.

4.5 Symbol for the chemical composition of wire electrodes, wires and rods

The symbol in Table 3A or Table 3B indicates the chemical composition of the wire electrode, wire and rod and includes an indication of characteristic alloying elements.