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

Produits consommables pour le soudage — Fils-électrodes, fils, baguettes et dépôts pour le soudage à l'arc sous protection gazeuse des aciers résistant au fluage — 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 21952 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*.

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 listing of these bodies can be found at http://www.iso.org.

Introduction

This International Standard provides a classification in order to designate wire electrodes, wires and rods in terms of their chemical composition and, where required, 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 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 4 of Table 2.

It should be noted that the mechanical properties of all-weld metal test pieces 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.

This International Standard was prepared in collaboration with the International Institute of Welding. It 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 12070:1999. 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 approaches into a single classification system.

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

1 Scope

This International Standard specifies requirements for classification of wire electrodes, wires and rods for gas-shielded metal arc welding and tungsten inert-gas welding of creep-resisting steels, and for their deposits in the as-welded or post-weld heat-treated condition. 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 chemical composition of wire electrodes, wires and rods with requirements for yield strength and average impact energy of 47 J of all-weld metal, or utilizing a system based upon the tensile strength of the all-weld metal deposits and the chemical composition of wire electrodes, wires and rods.

1) Clauses, subclauses and tables which carry the suffix letter “A” are applicable only to wire electrodes, wires, rods and deposits classified in accordance with the system based upon the chemical composition with requirements for yield strength and the average impact energy of 47 J of all-weld metal deposits under this International Standard.

2) Clauses, subclauses and tables which carry the suffix letter “B” are applicable only to wire electrodes, wires, rods and deposits classified in accordance with the system based upon the tensile strength of all-weld metal deposits and the chemical composition of wire electrodes, wires and rods under this International Standard.

3) Clauses, 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 4063, *Welding and allied processes — Nomenclature of processes and reference numbers*

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 and allied processes — Flux and gas shielded electrical welding processes — Procurement guidelines for consumables*

ISO 15792-1, *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 chemical composition of the wire electrode, wire or rod, and tensile properties and impact properties of the all-weld metal deposits 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 in accordance with 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 as given in Table 1.

When the wire electrode, wire, rod or deposit is classified in combination with a shielding gas, the classification shall be prefixed with a symbol in accordance with Clause 4 as appropriate.

3A Classification by chemical composition

The classification is divided into two parts:

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

2) the second part gives a symbol indicating the chemical composition of the wire electrode, wire or rod used (see Table 1).

3B Classification by tensile strength and chemical composition

The classification is divided into four 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 deposit in the post-weld heat-treated condition (see Table 2);

3) the third part gives a symbol indicating the shielding gas used (see 4.4);

4) the fourth part gives a symbol indicating the chemical composition of the wire electrode, wire or rod used (see Table 1).

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 metal arc welding, process 135, in accordance with ISO 4063) and/or W (tungsten inert-gas welding, process 141, in accordance with ISO 4063) placed at the beginning of the designation.

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

The symbol in Table 1 indicates the chemical composition of the wire electrode, wire or rod, determined under the conditions given in Clause 6.

4.3 Symbol for the mechanical properties of all-weld metal

4.3A Classification by chemical composition

No symbol shall be used for the mechanical properties of the all-weld metal. The all-weld metal deposit obtained with the wire electrodes, wires and rods in Table 1 under the conditions given in Clause 5 shall also fulfil the mechanical property requirements specified in Table 2.

4.3B Classification by tensile strength and chemical composition

The symbol for the tensile strength of the all-weld metal deposit produced by the gas-shielded metal arc welding process and the tungsten inert-gas welding process shall be 49 for 490 MPa minimum tensile strength, 52 for 520 MPa minimum tensile strength, 55 for 550 MPa minimum tensile strength and 62 for 620 MPa minimum tensile strength. The complete mechanical property requirements that shall be fulfilled by the various compositions are specified in Table 2.

4.4 Symbol for shielding gas

4.4A Classification by chemical composition

No symbol shall be used for the shielding gas.

4.4B Classification by tensile strength and chemical composition

The symbols C and M indicate shielding gas as described in ISO 14175. No symbol shall be used for tungsten inert-gas welding when argon shielding gas as per 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 M shall be used when the classification has been performed with the shielding gas ISO 14175 – M21, but restricted to Ar + 18 % to 25 % CO_2.

The symbol A shall be used when the classification has been performed with Ar + 1 % to 5 % O_2. This range of gas mixtures is not described in ISO 14175.

4.5 Rounding-off procedure

For the purposes of determining compliance with the requirements of this International Standard, the actual test values obtained shall be subjected to the rounding-off instructions given in ISO 31-0:1992, Annex B, Rule A. If the measured values are obtained by equipment calibrated in units other than those of this International Standard, the measured values shall be converted to the units of this International Standard before rounding off. If an average value is to be compared to the requirements of this International Standard, rounding off shall be done only after calculating the average. In the case where the testing standard cited in the normative references of this International Standard contains instructions for rounding off that conflict with the instructions of this International Standard, the rounding off requirements of the testing standard shall apply. The rounded-off results shall fulfil the requirements of the appropriate table for the classification under test.

Table 1 — Symbols and all-weld metal chemical composition requirements

Symbol for classification in accordance with		Chemical composition % (by mass) [a, b]											
chemical composition [c] ISO 21952-A	tensile strength and chemical composition [d] ISO 21952-B	C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Ti	V	Other elements
MoSi	(1M3)	0,08 to 0,15	0,50 to 0,80	0,70 to 1,30	0,020	0,020	—	—	0,40 to 0,60	—	—	—	—
(MoSi)	1M3	0,12	0,30 to 0,70	1,30	0,025	0,025	0,20	—	0,40 to 0,65	0,35	—	—	—
MnMo		0,08 to 0,15	0,05 to 0,25	1,30 to 1,70	0,025	0,025	—	—	0,45 to 0,65	—	—	—	—
	3M3 [e]	0,12	0,60 to 0,90	1,10 to 1,60	0,025	0,025	—	—	0,40 to 0,65	0,50	—	—	—
	3M3T [e]	0,12	0,40 to 1,00	1,00 to 1,80	0,025	0,025	—	—	0,40 to 0,65	0,50	0,02 to 0,30	—	—
MoVSi		0,06 to 0,15	0,40 to 0,70	0,70 to 1,10	0,020	0,020	—	0,30 to 0,60	0,50 to 1,00	—	—	0,20 to 0,40	—
	CM	0,12	0,10 to 0,40	0,20 to 1,00	0,025	0,025	—	0,40 to 0,90	0,40 to 0,65	0,40	—	—	—
	CMT [e]	0,12	0,30 to 0,90	1,00 to 1,80	0,025	0,025	—	0,30 to 0,70	0,40 to 0,65	0,40	0,02 to 0,30	—	—
CrMo1Si	(1CM3)	0,08 to 0,14	0,50 to 0,80	0,80 to 1,20	0,020	0,020	—	0,90 to 1,30	0,40 to 0,65	—	—	—	—
CrMoV1Si		0,06 to 0,15	0,50 to 0,80	0,80 to 1,20	0,020	0,020	—	0,90 to 1,30	0,90 to 1,30	—	—	0,10 to 0,35	—
	1CM	0,07 to 0,12	0,40 to 0,70	0,40 to 0,70	0,025	0,025	0,20	1,20 to 1,50	0,40 to 0,65	0,35	—	—	—
	1CM1	0,12	0,20 to 0,50	0,60 to 0,90	0,025	0,025	—	1,00 to 1,60	0,30 to 0,65	0,40	—	—	—
	1CM2	0,05 to 0,15	0,15 to 0,40	1,60 to 2,00	0,025	0,025	—	1,00 to 1,60	0,40 to 0,65	0,40	—	—	—
(CrMo1Si)	1CM3	0,12	0,30 to 0,90	0,80 to 1,50	0,025	0,025	—	1,00 to 1,60	0,40 to 0,65	0,40	—	—	—
	1CML	0,05	0,40 to 0,70	0,40 to 0,70	0,025	0,025	0,20	1,20 to 1,50	0,40 to 0,65	0,35	—	—	—
	1CML1	0,05	0,20 to 0,80	0,80 to 1,40	0,025	0,025	—	1,00 to 1,60	0,40 to 0,65	0,40	—	—	—
	1CMT	0,05 to 0,15	0,30 to 0,90	0,80 to 1,50	0,025	0,025	—	1,00 to 1,60	0,40 to 0,65	0,40	0,02 to 0,30	—	—
	1CMT1	0,12	0,30 to 0,90	1,20 to 1,90	0,025	0,025	—	1,00 to 1,60	0,40 to 0,65	0,40	0,02 to 0,30	—	—
CrMo2Si	(2C1M3)	0,04 to 0,12	0,50 to 0,80	0,80 to 1,20	0,020	0,020	—	2,3 to 3,0	0,90 to 1,20	—	—	—	—
CrMo2LSi	(2C1ML1)	0,05	0,50 to 0,80	0,80 to 1,20	0,020	0,020	—	2,3 to 3,0	0,90 to 1,20	—	—	—	—
	2C1M	0,07 to 0,12	0,40 to 0,70	0,40 to 0,70	0,025	0,025	0,20	2,30 to 2,70	0,90 to 1,20	0,35	—	—	—
	2C1M1	0,05 to 0,15	0,10 to 0,50	0,30 to 0,60	0,025	0,025	—	2,10 to 2,70	0,85 to 1,20	0,40	—	—	—
	2C1M2	0,05 to 0,15	0,10 to 0,60	0,50 to 1,20	0,025	0,025	—	2,10 to 2,70	0,85 to 1,20	0,40	—	—	—
(CrMo2Si)	2C1M3	0,12	0,30 to 0,90	0,75 to 1,50	0,025	0,025	—	2,10 to 2,70	0,90 to 1,20	0,40	—	—	—
	2C1ML	0,05	0,40 to 0,70	0,40 to 0,70	0,025	0,025	0,20	2,30 to 2,70	0,90 to 1,20	0,35	—	—	—

Table 1 (*continued*)

Symbol for classification in accordance with		Chemical composition % (by mass) [a, b]											
chemical composition [c] **ISO 21952-A**	**tensile strength and chemical composition** [d] **ISO 21952-B**	**C**	**Si**	**Mn**	**P**	**S**	**Ni**	**Cr**	**Mo**	**Cu**	**Ti**	**V**	**Other elements**
(CrMo2LSi)	2C1ML1	0,05	0,30 to 0,90	0,80 to 1,40	0,025	0,025	—	2,10 to 2,70	0,90 to 1,20	0,40	—	—	—
	2C1MV	0,05 to 0,15	0,10 to 0,50	0,20 to 1,00	0,025	0,025	—	2,10 to 2,70	0,85 to 1,20	0,40	—	0,15 to 0,50	—
	2C1MV1	0,12	0,10 to 0,70	0,80 to 1,60	0,025	0,025	—	2,10 to 2,70	0,90 to 1,20	0,40	—	0,15 to 0,50	—
	2C1MT	0,05 to 0,15	0,35 to 0,80	0,75 to 1,50	0,025	0,025	—	2,10 to 2,70	0,90 to 1,20	0,40	0,02 to 0,30	—	—
	2C1MT1	0,04 to 0,12	0,20 to 0,80	1,60 to 2,30	0,025	0,025	—	2,10 to 2,70	0,90 to 1,20	0,40	0,02 to 0,30	—	—
	3C1M	0,12	0,10 to 0,70	0,50 to 1,20	0,025	0,025	—	2,75 to 3,75	0,90 to 1,20	0,40	—	—	—
	3C1MV	0,05 to 0,15	0,5	0,20 to 1,00	0,025	0,025	—	2,75 to 3,75	0,90 to 1,20	0,40	—	0,15 to 0,50	—
	3C1MV1	0,12	0,10 to 0,70	0,80 to 1,60	0,025	0,025	—	2,75 to 3,75	0,90 to 1,20	0,40	—	0,15 to 0,50	—
CrMo5Si	(5CM)	0,03 to 0,10	0,30 to 0,60	0,30 to 0,70	0,020	0,020	—	5,5 to 6,5	0,50 to 0,80	—	—	—	—
(CrMo5Si)	5CM	0,10	0,50	0,40 to 0,70	0,025	0,025	0,60	4,50 to 6,00	0,45 to 0,65	0,35	—	—	—
CrMo9		0,06 to 0,10	0,30 to 0,60	0,30 to 0,70	0,025	0,025	1,0	8,5 to 10,0	0,80 to 1,20	—	—	0,15	—
CrMo9Si	(9C1M)	0,03 to 0,10	0,40 to 0,80	0,40 to 0,80	0,020	0,020	—	8,5 to 10,0	0,80 to 1,20	—	—	—	—
CrMo91		0,07 to 0,15	0,60	0,4 to 1,5	0,020	0,020	0,4 to 1,0	8,0 to 10,5	0,80 to 1,20	0,25	—	0,15 to 0,30	Nb: 0,03 to 0,10 N: 0,02 to 0,07
(CrMo9Si)	9C1M	0,10	0,50	0,40 to 0,70	0,025	0,025	0,50	8,00 to 10,50	0,80 to 1,20	0,35	—	—	—
	9C1MV	0,07 to 0,13	0,15 to 0,50	1,20	0,010	0,010	0,80	8,00 to 10,50	0,85 to 1,20	0,20	—	0,15 to 0,30	Nb: 0,02 to 0,10 Al: 0,04 N: 0,03 to 0,07 Mn + Ni: 1,50