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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 gaz de protection 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*.

This second edition cancels and replaces the first edition (ISO 21952:2007) which has been technically revised. The main changes compared to the previous edition are:

a) three new symbols have been added in 4.3B;

b) the gases designations in 4.4B have been updated in accordance with the latest edition of ISO 14175;

c) six new alloys have been added in Tables 1 and 2 on the B side;

d) Clause 6 has been revised to make it clearer;

e) the examples in Clause 10 have been 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 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[1]. The classification in accordance with system B is mainly based upon standards used around the Pacific Rim.

This International Standard proposes a classification system for 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 does 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 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.

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.

a) 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.

b) 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.

c) 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 544, *Welding consumables — Technical delivery conditions for filler materials and fluxes — Type of product, dimensions, tolerances and markings*

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

ISO 14175:2008, *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, *Welding consumables — Test methods — Part 1: Test methods for all-weld metal test specimens in steel, nickel and nickel alloys*

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

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 is clear from the following subclauses. 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 or 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 or 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 or 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 (gas shielded arc welding with non-consumable tungsten electrode).

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, and 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 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 tensile strength for the all-weld metal deposit produced by the gas shielded metal arc welding process and the tungsten inert-gas welding process shall be the following:

— 49 for 490 MPa minimum tensile strength;

— 52 for 520 MPa minimum tensile strength;

— 55 for 550 MPa minimum tensile strength;

— 57 for 570 MPa minimum tensile strength;

— 62 for 620 MPa minimum tensile strength;

— 69 for 690 MPa minimum tensile strength;

— 78 for 780 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 for shielding gases shall be in accordance with ISO 14175:2008, for example:

— the symbol I1 shall be used when the classification has been performed with shielding gas ISO 14175-I1, 100 % argon;

— the symbol M12, for mixed gases, shall be used when the classification has been performed with shielding gas ISO 14175-M12, but without helium;

— the symbol M13 shall be used when the classification has been performed with shielding gas ISO 14175-M13;

— the symbol M20, for mixed gases, shall be used when the classification has been performed with shielding gas ISO 14175-M20, but without helium.

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

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

— the symbol Z is used for an unspecified shielding gas.

Table 1 — Symbols and chemical composition requirements of wire electrodes, wires and rods

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	—	—
	2CMWV	0,12	0,10 to 0,70	0,20 to 1,00	0,020	0,010	—	2,00 to 2,60	0,40 to 0,65	0,40	—	0,10 to 0,50	Nb 0,01 to 0,08 W 1,00 to 2,00
	2CMWV−Ni	0,12	0,10 to 0,70	0,80 to 1,60	0,020	0,010	0,30 to 1,00	2,00 to 2,60	0,05 to 0,30	0,40	—	0,10 to 0,50	Nb 0,01 to 0,08 W 1,00 to 2,00
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	—	—	—

Table 1 (*continued*)

Symbol for classification in accordance with: chemical composition[c] ISO 21952-A	tensile strength and chemical composition[d] ISO 21952-B	Chemical composition % (by mass)[a,b] C	Si	Mn	P	S	Ni	Cr	Mo	Cu	Ti	V	Other elements
(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	—	—	—
(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
	9C1MV1	0,12	0,50	0,50 to 1,25	0,025	0,025	0,10 to 0,80	8,00 to 10,50	0,80 to 1,20	0,40	—	0,10 to 0,35	Nb 0,01 to 0,12 N 0,01 to 0,05
	9C1MV2	0,12	0,10 to 0,60	1,20 to 1,90	0,025	0,025	0,20 to 1,00	8,00 to 10,50	0,80 to 1,20	0,40	—	0,15 to 0,50	Nb 0,01 to 0,12 N 0,01 to 0,05
	10CMV	0,05 to 0,15	0,10 to 0,70	0,20 to 1,00	0,025	0,025	0,30 to 1,00	9,00 to 11,50	0,40 to 0,65	0,40	—	0,10 to 0,50	Nb 0,04 to 0,16 N 0,02 to 0,07
	10CMWV−Co	0,12	0,10 to 0,70	0,20 to 1,00	0,020	0,020	0,30 to 1,00	9,00 to 11,50	0,20 to 0,55	0,40	—	0,10 to 0,50	Co 0,80 to 1,20 Nb 0,01 to 0,08 W 1,00 to 2,00 N 0,02 to 0,07
	10CMWV−Co1	0,12	0,10 to 0,70	0,80 to 1,50	0,020	0,020	0,30 to 1,00	9,00 to 11,50	0,25 to 0,55	0,40	—	0,10 to 0,50	Co 1,00 to 2,00 Nb 0,01 to 0,08 W 1,00 to 2,00 N 0,02 to 0,07