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Welding consumables — Fluxes for submerged arc welding and electroslag welding — Classification

Produits consommables pour le soudage — Flux pour le soudage à l'arc sous flux et le soudage sous laitier — Classification

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Foreword

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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 14174 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 14174:2004), 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 is based on EN 760:1996[1].

Welding consumables — Fluxes for submerged arc welding and electroslag welding — Classification

1 Scope

This International Standard specifies requirements for classification of fluxes for submerged arc welding and electroslag welding for joining and overlay welding using wire electrodes, tubular cored electrodes, and strip electrodes.

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

ISO 14171, *Welding consumables — Solid wire electrodes, tubular cored electrodes and electrode/flux combinations for submerged arc welding of non alloy and fine grain steels — Classification*

ISO 14343, *Welding consumables — Wire electrodes, strip electrodes, wires and rods for arc welding of stainless and heat resisting steels — Classification*

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

3 Classification

Fluxes for submerged arc welding and electroslag welding for joining and overlay welding are granular, fusible products of mainly mineral origin, which are manufactured by various methods. Fluxes influence the chemical composition and the mechanical properties of the weld metal.

The classification of the fluxes is divided into seven parts:

1) the first part gives a symbol indicating the product/process (see 4.1);
2) the second part gives a symbol indicating the method of manufacture (see 4.2);
3) the third part gives a symbol indicating the type of flux, characteristic chemical constituents (see Table 1);
4) the fourth part gives a symbol indicating the applications, flux class (see 4.4);
5) the fifth part gives a symbol indicating the metallurgical behaviour (see 4.5);
6) the sixth part gives a symbol indicating the type of current (see 4.6);
7) the seventh part gives a symbol indicating the diffusible hydrogen content of deposited weld metal (see Table 6) — only applicable for class 1 fluxes.

In order to promote the use of this International Standard, the classification is divided into two sections.

a) Compulsory section.

This section includes the symbols for process, method of manufacture, characteristic chemical constituents, and applications, i.e. the symbols defined in 4.1, 4.2, 4.3, and 4.4.

b) Optional section.

This section includes the symbols for the metallurgical behaviour, type of current, and diffusible hydrogen, i.e. the symbols defined in 4.5, 4.6, and 4.7.

4 Symbols

4.1 Symbol for the product/process

The symbol for the flux used in submerged arc welding for joining and overlay welding shall be the letter S and for the flux used in electroslag welding for joining and overlay welding shall be the letters ES.

4.2 Symbol for method of manufacture

The symbol below indicates the method of manufacture:

— F: fused flux;

— A: agglomerated flux;

— M: mixed flux.

Fused fluxes are made by melting and granulating. Agglomerated fluxes are bound, granular mixtures of finer raw materials. Mixed fluxes comprise all fluxes which, after fusing or agglomerating, are mixed with one or more additional components or fluxes.

For particle size requirements in marking, see Clause 5.

4.3 Symbol for type of flux, characteristic chemical constituents

The symbols in Table 1 indicate the type of flux in accordance with the characteristic chemical constituents. Elemental analysis shall be performed on representative samples of the flux. Any suitable analytical technique may be used, but in cases of dispute reference shall be made to established methods. Based on the elemental analysis of the flux, the characteristic chemical constituents of the flux can be determined.

Examples of such determinations are shown in Annex A.

4.4 Symbol for applications, flux class

4.4.1 General

A given flux may carry more than one class as specified in 4.4.2 to 4.4.5.

4.4.2 Flux class 1

These are fluxes for submerged arc welding of non alloy and fine grain steels, high-strength steels, creep-resisting steels, and atmospheric corrosion-resisting steels.

In general, the fluxes do not contain alloying elements, other than Mn and Si, thus the weld metal analysis is predominantly influenced by the composition of the wire/strip electrode and metallurgical reactions. The fluxes are suitable for joint welding and/or overlay welding. In the case of joint welding, some fluxes can be applied for both multi-run and single-run and/or two-run technique.

In the flux designation, the digit 1 indicates class 1.

Table 1 — Symbol for type of flux, characteristic chemical constituents[ab]

Symbol (description)	Characteristic chemical constituents	Limit of constituent % (by mass)
MS (Manganese-silicate)	$MnO + SiO_2$ CaO	≥50 ≤15
CS (Calcium-silicate)	$CaO + MgO + SiO_2$ $CaO + MgO$	≥55 ≥15
CG (Calcium-magnesium)	$CaO + MgO$ CO_2 Fe	5 to 50 ≥2 ≤10
CB (Calcium-magnesium basic)	$CaO + MgO$ CO_2 Fe	30 to 80 ≥2 ≤10
CG-I (Calcium-magnesium with iron)	$CaO + MgO$ CO_2 Fe	5 to 45 ≥2 15 to 60
CB-I (Calcium-magnesium basic with iron)	$CaO + MgO$ CO_2 Fe	10 to 70 ≥2 15 to 60
GS (Magnesium-silicate)	$MgO + SiO_2$ Al_2O_3 $CaO + CaF_2$	≥42 ≤20 ≤14
ZS (Zirconium-silicate)	$ZrO_2 + SiO_2 + MnO$ ZrO_2	≥45 ≥15
RS (Rutile-silicate)	$TiO_2 + SiO_2$ TiO_2	≥50 ≥20
AR (Aluminate-rutile)	$Al_2O_3 + TiO_2$	≥40
BA (Basic-alumina)	$Al_2O_3 + CaF_2 + SiO_2$ CaO SiO_2	≥55 ≥8 ≤20
AAS (Acid-aluminium-silicate)	$Al_2O_3 + SiO_2$ $CaF_2 + MgO$	≥50 ≥20
AB (Aluminate-basic)	$Al_2O_3 + CaO + MgO$ Al_2O_3 CaF_2	≥40 ≥20 ≤22
AS (Aluminate-silicate)	$Al_2O_3 + SiO_2 + ZrO_2$ $CaF_2 + MgO$ ZrO_2	≥40 ≥30 ≥5
AF (Aluminate-fluoride-basic)	$Al_2O_3 + CaF_2$	≥70
FB (Fluoride-basic)	$CaO + MgO + CaF_2 + MnO$ SiO_2 CaF_2	≥50 ≤20 ≥15
Z[c]	Any other agreed composition	

[a] Calculations are made as shown in Annex A.

[b] A description of the characteristics of each of the types of flux is given in Annex B.

[c] Fluxes for which the chemical composition is not listed shall be symbolized similarly and prefixed by the letter Z. The chemical composition ranges are not specified and it is possible that two fluxes with the same Z classification are not interchangeable.

4.4.3 Flux classes 2 and 2B

These are fluxes for joint welding of stainless and heat-resisting steels and/or nickel and nickel alloys and corrosion-resistant overlay welding[1]. Fluxes of these classes can contain alloying elements compensating for the burn-out.

In the flux designation, the digit 2 is used to indicate class 2 fluxes mainly suited for joint welding, but which can also be used for strip cladding. 2B is used for fluxes especially designed for strip cladding.

4.4.4 Flux class 3

These are fluxes mainly for hardfacing overlay welding by transfer of alloying elements from the flux, such as C, Cr or Mo.

In the flux designation, the digit 3 indicates class 3.

4.4.5 Flux class 4

These are other fluxes for which classes 1 to 3 are not applicable, e.g. fluxes for copper alloys.

In the flux designation, the digit 4 indicates class 4.

4.5 Symbol for metallurgical behaviour

4.5.1 General

The metallurgical behaviour of a flux is characterized by the contribution (pick-up and/or burn-out) of alloying elements. Concerning fluxes for joining, the contribution is the difference between the chemical composition of the all-weld metal deposit and the composition of the specified electrode. Concerning fluxes for overlay welding, the contribution is the difference between the chemical composition of the deposited weld metal of the last bead/layer and the chemical composition of the specified wire/strip electrode.

4.5.1.1 Metallurgical behaviour, flux class 1

For determining the pick-up and burn-out behaviour, a wire electrode ISO 14171-A - S2 or ISO 14171-B - SU22 shall be used in accordance with 4.5.2. The pick-up or burn-out of the elements Si and Mn shall be stated in this sequence.

The symbols in Table 2 indicate the metallurgical behaviour of a welding flux class 1.

1) Not all fluxes suitable for use with stainless steel filler metal are also suitable for nickel and nickel alloy filler metal.

Table 2 — Symbol for metallurgical behaviour of class 1 fluxes

Metallurgical behaviour	Symbol	Contribution from flux on all-weld metal % (by mass)
Burn-out[a]	1	>0,7
	2	0,5 to 0,7
	3	0,3 to 0,5
	4	0,1 to 0,3
Neutral	5	0,0 to 0,1
Pick-up	6	0,1 to 0,3
	7	0,3 to 0,5
	8	0,5 to 0,7
	9	>0,7
[a] For Si, symbols 1, 2, 3 and 4 are not used.		

4.5.1.2 Metallurgical behaviour, flux classes 2 and 2B

For determining the pick-up or burn-out behaviour, wire or strip electrodes shall be selected in accordance with Table 3 and shall be used in accordance with 4.5.2.

Table 3 — Electrodes used for determination of metallurgical behaviour for class 2 and class 2B fluxes

Product/process	Class	Electrode to be used[a]	
		ISO 14343-A	ISO 14343-B
S	2	S 19 9 L	SS308L
ES	2	S 19 9 L	SS308L
S	2B	B 19 9 L	BS308L
ES	2B	B 19 9 L	BS308L
[a] To determine carbon burn-out, electrodes with minimum 0,04 % (by mass) C shall be used. To determine niobium burn-out, 19 9 Nb/347 electrodes shall be used.			

The pick-up or burn-out of the elements C, Si, Cr, and Nb shall be stated in this sequence. If the flux adds other elements, these shall be indicated by stating the corresponding chemical symbols (e.g. Ni, Mo) immediately after the symbols for C, Si, Cr, and Nb.

The symbols in Table 4 indicate the metallurgical behaviour for class 2 and class 2B fluxes.

4.5.1.3 Metallurgical behaviour, flux class 3

The pick-up of alloying elements shall be indicated by stating the corresponding chemical symbols (e.g. C, Cr, Mo) and approximate amount without the % symbol. For determining the pick-up behaviour a wire electrode, ISO 14171-A - S2 or ISO 14171-B - SU22, shall be used in accordance with 4.5.2.

4.5.1.4 Metallurgical behaviour, flux class 4

The pick-up of alloying elements shall be indicated by stating the corresponding chemical symbols.