British Standard

BRITISH STANDARD

BS EN
12070:2000

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

The European Standard EN 12070:1999 has the status of a British Standard

ICS 25.160.20

National foreword

This British Standard is the English language version of EN 12070:1999.

The UK participation in its preparation was entrusted to Technical Committee WEE/39, Welding consumables,which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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Produits consommables pour le soudage - Fils-électrodes, fils d'apport et baguettes d'apport pour le soudage à l'arc des aciers résistant au fluage - Classification

Schweißzusätze - Drahtelektroden, Drähte und Stäbe zum Lichtbogenschweißen von warmfesten Stählen - Einteilung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 121, Welding, the Secretariat of which is held by DS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by April 2000, and conflicting national standards shall be withdrawn at the latest by April 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Introduction

For creep-resisting steel welding consumables it should be noted that the mechanical properties of all-weld metal test specimens used for classification will vary from those obtained in production joints because of differences in welding conditions, material composition and shielding gas or flux.

Although combinations of wires and fluxes supplied by individual companies can have the same grading, the individual wires and fluxes from different companies are not interchangeable unless verified in accordance with this standard.

1 Scope

This standard specifies requirements for classification of wire electrodes, wires and rods for gas tungsten arc welding, gas shielded metal arc welding and submerged arc welding of creep-resisting and low alloy elevated temperature steels. The classification of the wire electrodes, wires and rods is based on their chemical composition.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 759, Welding consumables - Technical delivery conditions for welding filler metals - Type of product, dimensions, tolerances and marking.

EN 1597-1, Welding consumables - Test methods - Part 1: Test piece for all-weld metal test specimens in steel, nickel and nickel alloys.

EN ISO 13916, Welding - Guidance on the measurement of preheating temperature, interpass temperature and preheat maintenance temperature (ISO 13916:1996).

ISO 31-0:1992, Quantities and units - Part 0: General principles.

3 Classification

A wire electrode, wire or rod is classified in accordance with its chemical composition in Table 1.

When the wire electrode, wire or rod is classified in combination with a gas or flux for welding the classification shall be prefixed with a symbol in accordance with clause **4** as appropriate.

As a consequence the classification is divided into two parts:

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

b) the second part gives a symbol indicating the chemical composition of the wire electrode, wire or rod.

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), S (submerged arc welding) and/or W (gas tungsten arc welding).

The all-weld metal deposited in combination with a shielding gas or a flux shall meet the requirements in Table 2.

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 conditions given in clause **6**.

Table 1: Symbols for the chemical composition of wire electrodes, wires and rods

Alloy symbols	Chemical composition in % (m/m) [1)2)3)]								
	C	Si	Mn	P	S	Cr	Mo	V	Other elements
Mo	0,08 to 0,15	0,05 to 0,25	0,80 to 1,20	0,025	0,025	-	0,45 to 0,65	-	-
MoSi	0,08 to 0,15	0,50 to 0,80	0,70 to 1,30	0,020	0,020	-	0,40 to 0,60	-	-
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	-	-
MoV	0,08 to 0,15	0,10 to 0,30	0,60 to 1,00	0,020	0,020	0,30 to 0,60	0,50 to 1,00	0,25 to 0,45	-
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	-
CrMo1	0,08 to 0,15	0,05 to 0,25	0,60 to 1,00	0,020	0,020	0,90 to 1,30	0,40 to 0,65	-	-
CrMo1Si	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	-	-
CrMoV1	0,08 to 0,15	0,05 to 0,25	0,80 to 1,20	0,020	0,020	0,90 to 1,30	0,90 to 1,30	0,10 to 0,35	-
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	-
CrMo2	0,08 to 0,15	0,05 to 0,25	0,30 to 0,70	0,020	0,020	2,2 to 2,8	0,90 to 1,15	-	-
CrMo2Si	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	-	-
CrMo2Mn[4)]	0,10	0,50	0,50 to 1,20	0,020	0,015	2,0 to 2,5	0,90 to 1,20	-	-
CrMo2L	0,05	0,05 to 0,25	0,30 to 0,70	0,020	0,020	2,2 to 2,8	0,90 to 1,15	-	-
CrMo2LSi	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	-	-
CrMo5	0,03 to 0,10	0,20 to 0,50	0,40 to 0,75	0,020	0,020	5,5 to 6,5	0,50 to 0,80	-	-
CrMo5Si	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	-	-
CrMo9	0,06 to 0,10	0,30 to 0,60	0,30 to 0,70	0,025	0,025	8,5 to 10,0	0,80 to 1,20	0,15	Ni 1,0
CrMo9Si	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	8,0 to 10,5	0,80 to 1,20	0,15 to 0,30	Ni 0,4 to 1,0 Nb 0,03 to 0,10 N 0,02 to 0,07 Cu 0,25
CrMoWV12	0,22 to 0,30	0,05 to 0,40	0,40 to 1,20	0,025	0,020	10,5 to 12,5	0,80 to 1,20	0,20 to 0,40	Ni 0,8 W 0,35 to 0,80
CrMoWV12Si	0,17 to 0,24	0,20 to 0,60	0,40 to 1,00	0,025	0,020	10,5 to 12,0	0,80 to 1,20	0,20 to 0,40	Ni 0,8 W 0,35 to 0,80
Z	Any other agreed composition								

[1)] If not specified: Ni < 0,3, Cu < 0,3, V < 0,03, Nb < 0,01, Cr < 0,2.

[2)] Single values shown in the table are maximum values.

[3)] The results shall be rounded to the same number of significant figures as in the specified value using the rules in accordance with annex B, Rule A of ISO 31-0:1992.

[4)] A Mn/Si ratio of > 2,0 is desirable.

Table 2: Mechanical properties of all-weld metal

Alloy symbols	Minimum proof strength $R_{p0.2}$ N/mm^2	Minimum tensile strength R_m N/mm^2	Minimum [1] elongation A %	Impact energy K_V (J) at +20 °C		Heat treatment of all-weld metal		
				Minimum average from three test specimens	Minimum single [2] value	Preheat and interpass temperature °C	Post weld heat treatment of test assembly	
							Temperature[3] °C	Time[4] min
Mo/MoSi	355	510	22	47	38	< 200	none	-
MnMo	355	510	22	47	38	< 200	none	-
MoV/MoVSi	355	510	18	47	38	200 to 300	690 to 730	60
CrMo1/ CrMo1Si	355	510	20	47	38	150 to 250	660 to 700	60
CrMoV1/ CrMoV1Si	435	590	15	24	21	200 to 300	680 to 730	60
CrMo2/ CrMo2Si/ CrMo2Mn	400	500	18	47	38	200 to 300	690 to 750	60
CrMo2L/ CrMo2LSi	400	500	18	47	38	200 to 300	690 to 750	60
CrMo5/ CrMo5Si	400	590	17	47	38	200 to 300	730 to 760	60
CrMo9/ CrMo9Si	435	590	18	34	27	200 to 300	740 to 780	120
CrMo91	415	585	17	47	38	250 to 350	750 to 760	180
CrMoWV12/ CrMoWV12Si	550	690	15	34	27	250 to 350[5] or 400 to 500[5]	740 to 780	120
Z	Any other agreed mechanical properties							

[1] Gauge length is equal to five times the test specimen diameter.
[2] Only one single value lower than minimum average is permitted.
[3] The test piece shall be cooled in the furnace to 300 °C at a rate not exceeding 200 °C/h.
[4] Tolerance ± 10 min.
[5] Immediately after welding the test specimen shall be cooled down to 120 °C to 100 °C and kept at this temperature for at least 1 h.

5 Mechanical tests

Tensile and impact tests and any required retests shall be carried out in the post weld heat treated condition as specified in Table 2 using an all-weld metal test piece prepared in accordance with EN 1597-1, as described below in **5.1** and **5.2**. The shielding gas or flux used in a classification test shall be reported.

5.1 Preheating and interpass temperatures

Preheating and interpass temperatures shall be selected for the appropriate all-weld metal type from Table 2.

The preheating and interpass temperatures shall be measured using temperature indicator crayons, surface thermometers or thermocouples, in accordance with EN ISO 13916.

The interpass temperature shall not exceed the maximum temperature indicated in Table 2. If, after any pass, the interpass temperature is exceeded, the test piece shall be cooled in air to a temperature within the limits of the interpass temperature.

5.2 Pass sequence and welding conditions

The pass sequence shall be as indicated in Table 3 and welding conditions as given in Table 4.

The direction of welding to complete a layer consisting of two passes shall not vary, but the direction of welding of layers shall be alternated.

Table 3: Pass sequence

Process	Type of test assembly EN 1597-1	Diameter mm	Passes per layer	Number of layers
G	3	1,2	2 [1)]	6 to 10
S	3	4,0	2 [1)]	6 to 10
S	3	3,0/3,2	2 [1)]	6 to 10
W	1	2,4	2 [2)]	8 to 11

[1)] The top layer can be completed with three passes.
[2)] The top layer can be completed with three or four passes.

Table 4: Welding conditions

Process	Diameter mm	Welding current A	Welding voltage V	Contact tube distance mm	Travel speed mm/min
G	1,2	280 ± 10	[1)]	20 ± 3	450 ± 50
S	4,0	580 ± 20	29 ± 2	30 ± 5	550 ± 50
S	3,0/3,2	380 ± 20	29 ± 2	24 ± 3	550 ± 50
W	2,4	200 ± 20	[2)]	-	150 ± 20

[1)] The welding voltage will depend on the choice of shielding gas.
[2)] It is not possible to set the voltage on a TIG welding equipment.

6 Chemical analysis

Chemical analysis is performed on any suitable specimen of the product. Any analytical technique may be used, but in case of dispute reference shall be made to established published methods.

NOTE: See Bibliography.

7 Technical delivery conditions

Technical delivery conditions shall meet the requirements of EN 759.

8 Designation

The designation of wire electrodes, wires and rods shall follow the principle given in the examples below.

EXAMPLE 1:

A wire electrode for gas shielded metal arc welding with the chemical composition within the limits of the alloy symbol CrMo1Si of Table 1 is designated:

Wire electrode EN 12070 - G CrMo1Si

EXAMPLE 2:

A wire electrode for submerged arc welding with the chemical composition within the limits of the alloy symbol CrMo1 of Table 1 is designated:

Wire electrode EN 12070 - S CrMo1

EXAMPLE 3:

A rod for tungsten arc welding with a similar chemical composition is designated:

Welding rod EN 12070 - W CrMo1

where:

EN 12070 = standard number;

W = product/arc welding, W for TIG welding (see **4.1**);

CrMo1 = chemical composition of the rod (see Table 1).

Bibliography

[1] Handbuch für das Eisenhüttenlaboratorium, VdEh, Düsseldorf.

[2] BS 6200-3 Sampling and analysis of iron, steel and other ferrous metals - Part 3: Methods of analysis.

[3] CEN/CR 10261 ECISS Information Circular 11 - Iron and Steel - Review of available methods of chemical analysis.

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