British Standard

BRITISH STANDARD

BS EN
12073:2000

Welding consumables — Tubular cored electrodes for metal arc welding with or without a gas shield of stainless and heat-resisting steels — Classification

The European Standard EN 12073:1999 has the status of a British Standard

ICS 25.160.20

National foreword

This British Standard is the English language version of EN 12073:1999.

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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Summary of pages

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English version

Welding consumables - Tubular cored electrodes for metal arc welding with or without a gas shield of stainless and heat-resisting steels - Classification

Produits consommables pour le soudage - Fils fourrés pour le soudage à l'arc avec ou sans protection gazeuse des aciers inoxydables et des aciers résistant aux températures élevées - Classification

Schweißzusätze - Fülldrahtelektroden zum Metall-Lichtbogenschweißen mit oder ohne Gasschutz von nichtrostenden und hitzebeständigen Stählen - Einteilung

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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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of an identical text or by endorsement, at the latest by April 2000, and conflicting national standards shall be withdrawn at the latest by April 2000.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.

1 Scope

This European Standard specifies requirements for classification in order to designate tubular cored electrodes with or without a gas shield for metal arc welding of steels, such as stainless and heat-resisting steels in terms of the chemical composition of the all-weld metal.

It is recognized that the operating characteristics of tubular cored electrodes can be modified by the use of pulsed current, but for the purposes of this standard, pulsed current is not used for determining the electrode classification.

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 439	Shielding gases for arc welding and cutting
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 1597-3	Welding consumables - Test methods - Part 3: Testing of positional capability of welding consumables in a fillet weld
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

The classification includes all-weld metal properties obtained with a tubular cored electrode and appropriate shielding gas combination as given below.

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 chemical composition of the all-weld metal;

3) the third part gives a symbol indicating the type of electrode core;

4) the fourth part gives a symbol indicating the shielding gas;

5) the fifth part gives a symbol indicating the welding position.

In order to promote the use of this standard, the classification is split into two sections:

a) Compulsory section

This section includes the symbols for the type of product, the chemical composition, the type of electrode core and the shielding gas, 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 welding positions for which the electrode is suitable, i.e. the symbol defined in **4.5**.

The full identification (see clause **8**) shall be used on packages and in the manufacturer's literature and data sheets.

4 Symbols and requirements

4.1 Symbol for the product/process

The symbol for the tubular cored electrode used in the metal arc welding process is the letter T.

4.2 Symbol for the chemical composition of all-weld metal

The symbol in Table 1 indicates the chemical composition of all-weld metal determined in accordance with clause **6**. The all-weld metal obtained with the tubular cored electrodes in Table 1 under conditions given in clause **5** shall also fulfil the requirements given in Table 2.

Table 1: Symbol for chemical composition of all-weld metal

Alloy symbols	Chemical composition in % (m/m) [1) 2) 3) 4)]								
	C	Si	Mn	P [5)]	S [5)]	Cr	Ni	Mo	Other elements
Martensitic/ferritic									
13	0,12	1,0	1,5	0,030	0,025	11,0 to 14,0	-	-	-
13 Ti	0,10	1,0	0,80	0,030	0,030	10,5 to 13,0	-	-	Ti [6)]
13 4	0,06	1,0	1,5	0,030	0,025	11,0 to 14,5	3,0 to 5,0	0,4 to 1,0	-
17	0,12	1,0	1,5	0,030	0,025	16,0 to 18,0	-	-	-
Austenitic									
19 9 L	0,04	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	-	-
19 9 Nb	0,08	1,2	2,0	0,030	0,025	18,0 to 21,0	9,0 to 11,0	-	Nb [7)]
19 12 3 L	0,04	1,2	2,0	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,5 to 3,0	-
19 12 3 Nb	0,08	1,2	2,0	0,030	0,025	17,0 to 20,0	10,0 to 13,0	2,5 to 3,0	Nb [7)]
19 13 4 N L [8)]	0,04	1,2	1,0 to 5,0	0,030	0,025	17,0 to 20,0	12,0 to 15,0	3,0 to 4,5	N 0,08 to 0,20
Austenitic-ferritic. High corrosion resistance									
22 9 3 N L [9)]	0,04	1,2	2,5	0,030	0,025	21,0 to 24,0	7,5 to 10,5	2,5 to 4,0	N 0,08 to 0,20
Fully austenitic. High corrosion resistance									
18 16 5 N L [8)]	0,04	1,2	1,0 to 4,0	0,035	0,025	17,0 to 20,0	15,5 to 19,0	3,5 to 5,0	N 0,08 to 0,20
Special types									
18 8 Mn [8)]	0,20	1,2	4,5 to 7,5	0,035	0,025	17,0 to 20,0	7,0 to 10,0	-	-
20 10 3	0,08	1,2	2,5	0,035	0,025	19,5 to 22,0	9,0 to 11,0	2,0 to 4,0	-
23 12 L	0,04	1,2	2,5	0,030	0,025	22,0 to 25,0	11,0 to 14,0	-	-
23 12 2 L	0,04	1,2	2,5	0,030	0,025	22,0 to 25,0	11,0 to 14,0	2,0 to 3,0	-
29 9	0,15	1,2	2,5	0,035	0,025	27,0 to 31,0	8,0 to 12,0	-	-
Heat resisting types									
22 12 H	0,15	1,2	2,5	0,030	0,025	20,0 to 23,0	10,0 to 13,0	-	-
25 20 [8)]	0,06 to 0,20	1,2	1,0 to 5,0	0,030	0,025	23,0 to 27,0	18,0 to 22,0	-	-

1) If not specified: Mo < 0,75 %, Cu < 0,75 % and Ni < 0,60 %.
2) Single values shown in the table are maximum values.
3) Tubular cored electrodes not listed in the table shall be symbolized similarly and prefixed by the letter Z.
4) 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.
5) The sum of P and S shall not exceed 0,050 %, except for 18 16 5 N L, 18 8 Mn and 29 9.
6) Ti min. 10 x % C, max. 1,5 %.
7) Nb min. 8 x % C, max. 1,1 %; up to 20 % of the amount of Nb can be replaced by Ta.
8) The all-weld metal is in most cases fully austenitic and therefore can be susceptable to microfissuring or hot cracking. The occurrence of fissuring/cracking is reduced by increasing the weld metal manganese level and in recognition of this the manganese range is extended for a number of the grades.
9) Electrodes under this symbol are usually selected for specific properties and may not be directly interchangeable.

Table 2: Tensile properties of all-weld metal

Alloy symbol	Minimum proof strength $R_{p0,2}$ N/mm^2	Minimum tensile strength R_m N/mm^2	Minimum[1] elongation A %	Post weld heat treatment
13	250	450	15	[2]
13 Ti	250	450	15	[2]
13 4	500	750	15	[3]
17	300	450	15	[4]
19 9 L	320	510	30	None
19 9 Nb	350	550	25	"
19 12 3 L	320	510	25	"
19 12 3 Nb	350	550	25	"
19 13 4 N L	350	550	25	"
22 9 3 N L	450	550	20	None
18 16 5 N L	300	480	25	"
18 8 Mn	350	500	25	None
20 10 3	400	620	20	"
23 12 L	320	510	25	"
23 12 2 L	350	550	25	"
29 9	450	650	15	"
22 12 H	350	550	25	"
25 20	350	550	20	"

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

[2] 840 °C to 870 °C for 2h. Furnace cooling down to 600 °C then air cooling.

[3] 580 °C to 620 °C for 2h. Air cooling.

[4] 760 °C to 790 °C for 2h. Furnace cooling down to 600 °C then air cooling.

NOTE: Weld metal can have elongation lower than that of the parent metal.

4.3 Symbol for type of electrode core

This symbol given in Table 3 indicates different types of tubular cored electrodes relative to their core composition and slag characteristics.

Table 3: Symbol for type of electrode core

Symbol	Characteristics
R	Rutile, slow freezing slag
P	Rutile, fast freezing slag
M	Metal powder
U	Selfshielding
Z	Other types

NOTE: A description of the characteristics of each of the types of core is given in annex A.

4.4 Symbol for shielding gas

The symbols M and C indicate shielding gas as described in EN 439.

The symbol M, for mixed gases, shall be used when the classification has been performed with shielding gas EN 439 - M2, but without helium.

The symbol C shall be used when the classification has been performed with shielding gas EN 439 - C1, carbon dioxide.

The symbol N shall be used for tubular cored electrodes without a gas shield.

4.5 Symbol for welding position

The welding positions are symbolized by a digit designating the positions for which the electrode is tested in accordance with EN 1597-3 as follows:

1 all positions;

2 all positions, except vertical down;

3 flat butt weld, flat fillet weld, horizontal-vertical fillet weld;

4 flat butt weld, flat fillet weld;

5 vertical down and positions according to symbol 3.

5 Mechanical tests

Tensile tests and any required retests shall be carried out on weld metal in the condition specified in Table 2 (as welded or post weld heat treatment) using an all-weld metal test assembly type 3 in accordance with EN 1597-1 using 1,2 mm, or if this diameter is not manufactured the next larger diameter manufactured as described below in **5.1** and **5.2**.

5.1 Preheating and interpass temperatures

Preheating and interpass temperatures shall be selected for the appropriate weld metal type from Table 4.

Table 4: Preheating and interpass temperatures

Alloy symbol according to Table 1	Type of weld metal	Preheating and interpass temperatures °C
13 13 Ti 17	Martensitic and ferritic chromium steel	200 to 300
13 4	Soft martensitic stainless steel	100 to 180
All others	Austenitic and austenitic-ferritic stainless steel	max. 150

The preheating and interpass temperature 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 4. If, after any pass, the interpass temperature is exceeded, the test assembly shall be cooled in air to a temperature within the limits of the interpass temperature.

5.2 Pass sequence

The total number of runs, the number of runs per layer and the total number of layers shall be as given in Table 5. 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 5: Pass sequence

Electrode diameter mm	Total number of passes	Passes per layer		Total number of layers
		First layer	Other layers[1)]	
1,2	12 to 19	1 or 2	2 or 3	6 to 9
1,4 to 2,0	10 to 17	1 or 2	2 or 3	5 to 8
2,4 to 3,2	7 to 14	1 or 2	2 or 3	4 to 7
[1)] The final layer can have four passes.				

6 Chemical analysis

Chemical analysis is performed on any suitable all-weld metal test specimen. Any analytical technique can 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 in EN 759.

8 Designation

The designation of tubular cored electrodes shall follow the principle given in the example below.

EXAMPLE:

A tubular cored electrode (T) for gas shielded arc welding deposits a weld metal with a chemical composition within the limits for the alloy symbol 19 12 3L of Table 1. The electrode with a rutile type core with slow freezing slag (R) was tested under mixed gas (M) and can be used in flat butt and flat fillet welds (4).

The designation shall be:

Tubular cored electrode EN 12073 - T 19 12 3L R M 4

Compulsory section:

Tubular cored electrode EN 12073 - T 19 12 3L R M

where:

EN 12073 = standard number;

T = tubular cored electrode/metal arc welding (see **4.1**);

19 12 3L = chemical composition of the all-weld metal (see Table 1);

R = type of electrode core (see **4.3**);

M = shielding gas (see **4.4**);

4 = welding position (see **4.5**).

Annex A (informative)

Description of types of electrode core

A.1 R type

Tubular cored electrodes of the R type are characterized by a spray metal transfer, low spatter loss, and a rutile-based slag that fully covers the weld bead. These tubular cored electrodes are designed for single and multiple pass welding in the flat and horizontal-vertical position. Tubular cored electrodes of the R type are generally designed for use with carbon dioxide as shielding gas; however, the use of argon/carbon dioxide mixtures, when recommended by the manufacturer, can be used to improve arc transfer and reduce spatter.

A.2 P type

Tubular cored electrodes of the P type are similar to the R type, but the rutile-based slag is designed for fast-freezing characteristics that enable welding in all positions. These tubular cored electrodes are generally produced in smaller diameters and exhibit spray metal transfer when using carbon dioxide shielding gas. The running characteristics can be improved with the use of argon/carbon dioxide mixtures when recommended by the manufacturer.

A.3 B type

Tubular cored electrodes of the B type are characterized by a globular metal transfer, slightly convex bead shape, and a slag that can or can not cover the weld bead surface. These tubular cored electrodes are primarily used in the flat and horizontal-vertical welding positions with carbon dioxide or argon-based shielding gas mixtures. The slag composition consists of fluorides and alkaline earth metal oxides. Weld deposits produced with these tubular cored electrodes have superior impact properties and crack resistance.

A.4 M type

Tubular cored electrodes of the M type are characterized by a very fine droplet spray metal transfer and minimal slag cover. The core composition of these tubular cored electrodes consists of metal alloys and iron powder along with other arc enhancers which enable these tubular cored electrodes to produce high deposition rates with an insensitivity to lack of fusion. These tubular cored electrodes are primarily used with argon/carbon dioxide shielding gas mixtures in the flat and horizontal-vertical positions; however, welds in other positions are also possible using the short-circuiting or pulsed arc modes of transfer.

A.5 U type

Tubular cored electrodes of the U type are used without a gas shield for single and multiple pass welding in the flat and horizontal-vertical welding positions. With some tubular cored electrodes, vertical down welding is possible.

A.6 Z type

Other types not covered by these descriptions.

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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