
**Welding consumables — Covered
electrodes, wires, rods and tubular
cored electrodes for fusion welding of
cast iron — Classification**

*Produits consommables pour le soudage — Electrodes enrobées, fils
d'apport, baguettes et fils fourrés pour le soudage par fusion de la
fonte — 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 3, *Welding consumables*.

This third edition cancels and replaces the second edition (ISO 1071:2003), which has been technically revised.

Introduction

This International Standard classifies welding consumables for fusion welding of various types of unalloyed cast irons.

Applications for welding consumables classified to this International Standard:

- production welding, that means welding of cast materials during the process of production. In that way, the quality of the casting shall be ensured in accordance with the guaranteed properties and to the requirements of the application;
- repair welding of castings which are damaged during service;
- welding for construction purposes where cast irons are joined to themselves or to other ferrous or non-ferrous metals.

The following methods are used for the welding of cast irons:

- using a welding consumable which produces a weld metal similar to the parent metal. High preheating is required (typical temperature range 550 °C to 650 °C);
- using a welding consumable which produces a weld metal dissimilar to the parent metal. No or only low preheating is required.

This International Standard contains different types of welding consumables because the chemical composition of welding rods and wire electrodes, as well as the all-weld metal of the corresponding covered electrodes and tubular cored electrodes, is similar.

Additionally, to the welding consumables specified in this International Standard, consumables classified to other standards can be used (see Annex A).

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Welding consumables — Covered electrodes, wires, rods and tubular cored electrodes for fusion welding of cast iron — Classification

1 Scope

This International Standard specifies requirements for classification of covered electrodes for manual metal arc welding, wire electrodes for metal arc welding, tubular cored electrodes for metal arc welding with and without a gas shield, rods for TIG-welding, and rods for oxy-fuel gas welding of unalloyed cast irons. Classification is based on the chemical composition of wires and rods and on the all-weld metal deposit for tubular cored and covered electrodes.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 2401, *Covered electrodes — Determination of the efficiency, metal recovery and deposition coefficient*

ISO 6847, *Welding consumables — Deposition of a weld metal pad for chemical analysis*

ISO 14175, *Welding consumables — Gases and gas mixtures for fusion welding and allied processes*

ISO 80000-1:2009, *Quantities and units — Part 1: General*. Corrected by ISO 80000-1:2009/Cor 1:2011

3 Classification

3.1 Wire electrodes and rods

For wire electrodes and rods classified in accordance with their chemical composition (see [Table 2](#) and [Table 3](#)), the classification is divided into three parts.

- a) The first part gives a symbol indicating the product to be identified.
- b) The second part indicates the type of alloy (C for cast iron).
- c) The third part gives a symbol indicating the chemical composition of the wire electrode or of the rod.

3.2 Tubular cored electrodes

For tubular cored electrodes classified in accordance with the all-weld metal chemical composition produced with an appropriate shielding gas, the classification is divided into four parts.

- a) The first part gives a symbol indicating the product to be identified.
- b) The second part indicates the type of alloy (C for cast iron).
- c) The third part gives a symbol indicating the chemical composition of the all-weld metal.
- d) The fourth part gives a symbol indicating the shielding gas.

3.3 Covered electrodes

For covered electrodes classified in accordance with the all-weld metal chemical composition, the classification is based on an electrode diameter of 4 mm. The classification is divided into four parts.

- a) The first part gives a symbol indicating the product to be identified.
- b) The second part indicates the type of alloy (C for cast iron).
- c) The third part gives a symbol indicating the chemical composition of the all-weld metal.
- d) The fourth part gives a symbol indicating the effective electrode efficiency and the type of current.

3.4 Tubular cored and covered electrodes

The following classification of tubular cored and covered electrodes is split into two sections.

a) Compulsory section

This section includes the symbol for the type of product, type of alloy, the chemical composition, and the shielding gas as defined in [4.1](#), [4.2](#), [4.3](#), and [4.4](#).

b) Optional section

This section includes the symbol for the effective electrode efficiency and/or type of current for which the consumable is suitable as defined in [4.5](#).

The full designation (see examples in [Clause 10](#)) shall be used on packages and in the manufacturer's literature and data sheets.

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4 Symbols and requirements (standards.iteh.ai)

4.1 Symbols for the product form ISO 1071:2015

The symbol for the covered electrode shall be the letter E. <https://standards.iteh.ai/catalog/standards/sist/fb92c5e3-baf5-49b6-aaad-260100000000/iso-1071-2015>

The symbol for the solid wire and rod shall be the letter S and the symbol for the tubular cored wire shall be T.

The symbol for the cast rod shall be R.

4.2 Symbol for the type of alloy

The symbol C as the second symbol shall be used to indicate the welding of cast iron as the main application.

4.3 Symbol for the chemical composition

4.3.1 General

The symbols in [Table 2](#) and [Table 3](#) indicate the chemical composition of rods and wire electrodes, as well as the chemical composition of the all-weld metal of covered electrodes and tubular cored electrodes in accordance with [Clause 6](#).

A distinction has to be made between consumables producing similar and dissimilar weld metal.

4.3.2 Consumables producing similar weld metal

The consumables in this group are classified in accordance with the alloy type in [Table 1](#). The symbols in [Table 2](#) indicate the chemical composition of similar rods and similar all-weld metal of covered electrodes and tubular cored electrodes. The description of each consumable and examples for their application are given in Annex A.

Table 1 — Welding consumables producing weld metal similar to parent metal

| Symbol | Microstructure | Product form ^a |
|--------------------|---|---------------------------|
| FeC-1 ^b | lamellar graphite | E, R |
| FeC-2 ^c | lamellar graphite | E, T |
| FeC-3 | lamellar graphite | E, T |
| FeC-4 | lamellar graphite | R |
| FeC-5 | lamellar graphite | R |
| FeC-GF | ferritic microstructure, spheroidal graphite | E, T |
| FeC-GP1 | pearlitic microstructure, spheroidal graphite | R |
| FeC-GP2 | pearlitic microstructure, spheroidal graphite | E, T |
| ^a | See 4.1. | |
| ^b | Covered electrode with core rod of cast iron. | |
| ^c | Covered electrode with core rod of unalloyed steel. | |

4.3.3 Consumables producing dissimilar weld metal

The consumables in this group are classified in accordance with the chemical composition of the wire electrode or of the all-weld metal of the covered electrode and of the tubular cored electrode (see [Table 3](#)). The description of each consumable and examples for their application are given in Annex A.

4.4 Symbol for shielding gas (tubular cored electrode)

The symbols for shielding gases shall be in accordance with ISO 14175 except that the symbol NO shall be used for non-gas shielded tubular cored electrodes.

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Table 2 — Chemical composition of similar rods and of similar all-weld metal of covered electrodes and tubular cored electrodes

| Symbol | Product form | Chemical composition % ^{a, b} | | | | | | | | | | | Sum of other elements |
|---------|--------------|--|------------|--------------|--------------|-------|-----------|-----------------|-----------------|--------|------------------------------|-----|-----------------------|
| | | C | Si | Mn | P | S | Fe | Ni ^c | Cu ^d | Remark | | | |
| FeC-1 | E, R | 3,0 to 3,6 | 2,0 to 3,5 | 0,8 | 0,5 | 0,1 | Remainder | - | - | - | Al: 3,0 | 1,0 | |
| FeC-2 | E, T | 3,0 to 3,6 | 2,0 to 3,5 | 0,8 | 0,5 | 0,1 | Remainder | - | - | - | Al: 3,0 | 1,0 | |
| FeC-3 | E, T | 2,5 to 5,0 | 2,5 to 9,5 | 1,0 | 0,20 | 0,04 | Remainder | - | - | - | - | 1,0 | |
| FeC-4 | R | 3,2 to 3,5 | 2,7 to 3,0 | 0,60 to 0,75 | 0,50 to 0,75 | 0,10 | Remainder | - | - | - | - | 1,0 | |
| FeC-5 | R | 3,2 to 3,5 | 2,0 to 2,5 | 0,50 to 0,70 | 0,20 to 0,40 | 0,10 | Remainder | 1,2 to 1,6 | - | - | Mo: 0,25 to 0,45 | 1,0 | |
| FeC-GF | E, T | 3,0 to 4,0 | 2,0 to 3,7 | 0,6 | 0,05 | 0,015 | Remainder | 1,5 | - | - | Mg: 0,02 to 0,10 Ce: 0,20 | 1,0 | |
| FeC-GP1 | R | 3,2 to 4,0 | 3,2 to 3,8 | 0,10 to 0,40 | 0,05 | 0,015 | Remainder | 0,50 | - | - | Mg: 0,04 to 0,10 Ce: 0,20 | 1,0 | |
| FeC-GP2 | E, T | 2,5 to 3,5 | 1,5 to 3,0 | 1,0 | 0,05 | 0,015 | Remainder | 2,5 | 1,0 | - | Mg: 0,02 to 0,10 Ce: 0,20 | 1,0 | |
| Ze | R, E, or T | Any other agreed composition | | | | | | | | | | | |

^a Single values are maximum values.

^b The weld metal or filler metal as specified should be analysed for specific elements for which values are shown in this table. If the presence of other elements is indicated in the course of this work, the amount of those elements shall be determined to ensure that their total does not exceed the limit specified for "sum of other elements" in the last column of the table.

^c Nickel limit can include incidental cobalt.

^d Copper limit can include incidental silver.

^e Consumables for which the chemical composition is not listed in this table shall be symbolized indicating the chemical composition and prefixed by the letter Z. The chemical composition ranges are not specified and therefore, it is possible that two electrodes with the same Z classification might not be interchangeable.

Table 3 — Chemical composition of dissimilar rods, wire electrodes, and of dissimilar all-weld metal of covered electrodes and of tubular cored electrodes

| Symbol | Product form | Chemical composition in % (by mass) ^{a, b, c} | | | | | | | | | | | Sum of other elements |
|-----------|--------------|--|------|------------|------|-------|------------|-----------------|-----------------|--------|--|---|-----------------------|
| | | C | Si | Mn | P | S | Fe | Ni ^d | Cu ^e | Remark | | | |
| Fe-1 | E, S, T | 2,0 | 1,5 | 0,5 to 1,5 | 0,04 | 0,04 | Remainder | — | — | — | — | — | 1,0 |
| St | E, S, T | 2,0 | 1,0 | 1,0 | 0,04 | 0,04 | Remainder | — | 0,35 | — | — | — | 1,0 |
| Fe-2 | E, T | 0,2 | 1,5 | 0,3 to 1,5 | 0,04 | 0,04 | Remainder | — | — | — | Nb + V: 5,0 to 10,0 | — | 1,0 |
| Ni-CI | E | 2,0 | 4,0 | 2,5 | — | 0,03 | 8,0 | min 85 | 2,5 | — | Al: 1,0 | — | 1,0 |
| | S | 1,0 | 0,75 | 2,5 | — | 0,03 | 4,0 | min 90 | 4,0 | — | — | — | 1,0 |
| Ni-CI-A | E | 2,0 | 4,0 | 2,5 | — | 0,03 | 8,0 | min 85 | 2,5 | — | Al: 1,0 to 3,0 | — | 1,0 |
| NiFe-1 | E, S, T | 2,0 | 4,0 | 2,5 | 0,03 | 0,03 | Remainder | 45 to 75 | 4,0 | — | Al: 1,0 | — | 1,0 |
| NiFe-2 | E, S, T | 2,0 | 4,0 | 1,0 to 5,0 | 0,03 | 0,03 | Remainder | 45 to 60 | 2,5 | — | Al: 1,0 Carbide producing elements: 3,0 | — | 1,0 |
| NiFe-CI | E | 2,0 | 4,0 | 2,5 | — | 0,03 | Remainder | 45 to 60 | 2,5 | — | Al: 1,0 | — | 1,0 |
| NiFeT3-CI | T | 2,0 | 1,0 | 3,0 to 5,0 | — | 0,03 | Remainder | 45 to 60 | 2,5 | — | Al: 1,0 | — | 1,0 |
| NiFe-CI-A | E | 2,0 | 4,0 | 2,5 | — | 0,03 | Remainder | 45 to 60 | 2,5 | — | Al: 1,0 to 3,0 | — | 1,0 |
| NiFeMn-CI | E | 2,0 | 1,0 | 10 to 14 | — | 0,03 | Remainder | 35 to 45 | 2,5 | — | Al: 1,0 | — | 1,0 |
| | S | 0,50 | 1,0 | 10 to 14 | — | 0,03 | Remainder | 35 to 45 | 2,5 | — | Al: 1,0 | — | 1,0 |
| NiCu | E, S | 1,7 | 1,0 | 2,5 | — | 0,04 | 5,0 | 50 to 75 | Remainder | — | — | — | 1,0 |
| NiCu-A | E, S | 0,35 to 0,55 | 0,75 | 2,3 | — | 0,025 | 3,0 to 6,0 | 50 to 60 | 35 to 45 | — | — | — | 1,0 |
| NiCu-B | E, S | 0,35 to 0,55 | 0,75 | 2,3 | — | 0,025 | 3,0 to 6,0 | 60 to 70 | 25 to 35 | — | — | — | 1,0 |

^a Single values are maximum percentages, unless otherwise noted.

^b The weld metal or filler metal as specified shall be analysed for specific elements for which values are shown in this table. If the presence of other elements is indicated in the course of this work, the amount of those elements shall be determined to ensure that their total does not exceed the limit specified for "sum of other elements" in the last column of the table.

^c Certain bronze filler metals are not included in this table, but can be used to braze weld cast iron very effectively. Colour match will not be the same as cast iron

^d Nickel limit can include incidental cobalt.

^e Copper limit can include incidental silver.

^f Consumables for which the chemical composition is not listed in this table shall be symbolized indicating the chemical composition and prefixed by the letter Z. The chemical composition ranges are not specified and therefore, it is possible that two electrodes with the same Z classification might not be interchangeable.