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Edition 5.1 2026-02

INTERNATIONAL STANDARD

CONSOLIDATED VERSION

**Safety in installations for electroheating and electromagnetic processing -
Part 4: Particular requirements for arc furnace installations**

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**Safety in installations for electroheating and electromagnetic processing -
Part 4: Particular requirements for arc furnace installations**

FOREWORD

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 60519-4 edition 5.1 contains the fifth edition (2021-12) [documents 27/1141/FDIS and 27/1143/RVD] and its amendment 1 (2026-02) [documents 27/1209/CDV and 27/1225/RVC].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

IEC 60519-4 has been prepared by IEC technical committee 27: Industrial electroheating and electromagnetic processing. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the structure has been redrafted according to IEC 60519-1:2020;
- b) the scope and object have been redrafted;
- c) the terms and definitions, normative references and bibliography have been updated and completed;
- d) the requirements have been redrafted according to IEC 60519-1:2020;
- e) all provisions have been redrafted and the text is more concise with respect to submerged arc furnace installations;
- f) the annexes have been restructured, with respect to details concerning high voltage designs and non-electrical issues, however to be aware of in those installations;
- g) the aspect of noise has been removed from the scope;
- h) the EMC requirements have been clarified;
- i) risk classification of hazards have been based on emission;
- j) the boundaries to ISO 13577 (all parts) and ISO 13578 have been clarified.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
27/1141/FDIS	27/1143/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60519 series, published under the general title *Safety in installations for electroheating and electromagnetic processing*, can be found on the IEC website.

The clauses of this standard supplement or modify the corresponding clauses of IEC 60519-1:2020 (*General Requirements* hereinafter called "Part 1").

This part of IEC 60519 is to be read in conjunction with Part 1. It supplements or modifies the corresponding clauses of Part 1. Where the text indicates an "addition" to or a "replacement" of the relevant provision of Part 1, these changes are made to the relevant text of Part 1. Where no change is necessary, the words "This clause of Part 1 is applicable" are used. When a particular subclause of Part 1 is not mentioned in this part, that subclause applies as far as is reasonable.

Additional specific provisions to those in Part 1, given as individual clauses or subclauses, are numbered starting from 101.

NOTE The following numbering system is used:

- subclauses, tables and figures that are numbered starting from 101 are additional to those in Part 1;
- unless notes are in a new subclause or involve notes in Part 1, they are numbered starting from 101, including those in a replaced clause or subclause;
- additional annexes are lettered AA, BB, etc.

In this standard, the following print types are used:

- requirements and definitions: in roman type;
- NOTES: in smaller roman type;
- terms used throughout this standard which have been defined in Clause 3: in bold type.

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

This fifth edition of IEC 60519-4 is a product safety publication and is intended to:

- include all types of installations or equipment that are in the scope of IEC TC 27/MT 21 dealing with **arc furnace** installations;
- give requirements on electrical safety, **touch currents**, electric fields, magnetic fields and radiation;
- give means for verification of the requirements;
- make extensive use of the standards developed by IEC committees with horizontal or group safety functions and of relevant ISO standards, most of them being developed by ISO TC 244;
- include all material, references and requirements suitable for risk assessment and list of significant hazards.

This document addresses mainly **manufacturers** making made-to-order equipment on a single project base. The **manufacturer** is well aware that it is his responsibility to make equipment safe through adequate risk reduction and it is the responsibility of the **user** to assess **exposure** of the **operator** in line with applicable health and safety regulations. Looking at projects providing single pieces of equipment or single installations, this clear division of responsibilities tends to blur, caused by inter alia:

- development of the process (**normal operation**) through the **manufacturer** and **user**,
- shared definition of working procedures for the **operator** by the **manufacturer** and **user**,
- the scope of delivery often including all protective means,
- individual sales contracts where **users** require an assessment of **exposure** through the **manufacturer**.

Thus, this document provides information on electrical hazards and limits where relevant, despite being well aware that this is exceeding the scope of a product standard.

Annexes I and J provide orientation with respect to the application of ISO 13577-1 in combination with this document.

The rated voltage of an **arc furnace** Installation can be in the range of low voltage or high voltage; details are given in 4.2.

This document presumes that the installation or equipment is operated and maintained only by personnel consisting of **skilled** or **instructed persons**.

This document is intended for verifying whether the **arc furnace** installation meets the safety requirements of this document through design, site acceptance tests, routine tests or inspection.

1 Scope

This clause of Part 1 is replaced by the following.

Replacement:

This part of IEC 60519 provides particular safety requirements for arc furnace installations. This document deals with the significant hazards, hazardous situations or hazardous events relevant to industrial **arc furnace** installations, as listed in Annex A, for **normal operation** and for **single fault condition** as well as under conditions of reasonably foreseeable misuse.

This document specifies the requirements intended to be met by the **manufacturer** to ensure the safety of persons and property during the complete life cycle of the equipment from design through commissioning, operation, maintenance, inspection, to decommissioning, as well as in the event of foreseeable **single fault condition** that can occur in the equipment.

The rated voltage of **arc furnace** installation can be in the range of low voltage or high voltage, details are given in 4.2.

This standard is applicable to **arc furnace** installations such as:

- a) furnaces for direct arc heating, forming arcs between the electrode and metal such as the electric **arc furnace** using alternating current (**EAF AC**) or direct current (**EAF DC**), and the ladle furnace (**LF**);
- b) furnaces for arc-resistance heating forming arcs between the electrode and the charge material or heating the charge material by the Joule effect, such as the **submerged arc-resistance** furnace using alternating current (**SAF AC**), or direct current (**SAF DC**).

NOTE 1 In some documents, the terms "smelter" or "electrical reduction furnace" are used.

Furnace installation for unattended operation is not covered by this document.

This document does not provide requirements for type testing.

NOTE 2 Industrial equipment covered by this document is typically produced as a single unit or a very small number of units; such unit usually has a very high value and can cause severe harm at disintegration.

This document does not address data security and hazards arising from neglect of security.

With respect to noise of electrical an **arc furnace**, ISO 13578:2017, 6.1.23 applies.

EAF DC and **SAF DC** are classified as zero frequency (0 Hz) equipment types. **EAF AC**, **SAF AC** and **LF** are classified as mains frequency (50 Hz or 60 Hz) equipment types. Furnaces being operated at frequencies outside of the above-mentioned equipment types are not covered by this document.

2 Normative references

This clause of Part 1 is applicable except as follows.

Replacement:

IEC 61936-1:2021, *Power installations exceeding 1 kV AC and 1,5 kV DC - Part 1: AC*

Additions:

IEC 60060-3, *High-voltage test techniques – Part 3: Definitions and requirements for on-site testing*

IEC 60519-1:2020, *Safety in installations for electroheating and electromagnetic processing – Part 1: General requirements*

ISO 13577-1:2016, *Industrial furnaces and associated processing equipment – Safety – Part 1: General requirements*

ISO 13578:2017, *Industrial furnaces and associated processing equipment – Safety requirements for machinery and equipment for production of steel by electric arc furnaces*

3 Terms, definitions and abbreviated terms

3.1 General concepts

This subclause of Part 1 is applicable with the following additions.

Addition:

NOTE General definitions can be found in the IEC 60050 series, *International Electrotechnical Vocabulary*. Terms relating to industrial electro heating are defined in IEC 60050-841. Terms relating to EAF and SAF are also defined in IEC 60676 and IEC 60683.

3.1.101

intended use

use of a machine in accordance with the information for use provided in the instructions

[SOURCE: ISO 12100:2010, 3.23]

3.2 Equipment and state of equipment

This subclause of Part 1 is applicable with the following additions.

Addition:

3.2.101

AC current converter

device, which controls the secondary alternating current for EAF or SAF

3.2.102

arc furnace

furnace with a vessel, in which metal or other charged conducting material is heated mainly by electric arc or joule effect using alternating current (AC) or direct current (DC)

[SOURCE: IEC 60050-841:2004, 841-26-05, modified – The definition has been entirely reworded for better accuracy.]

3.2.103

arc furnace transformer

transformer changing high voltage electrical supply to a lower voltage and higher current for an arc furnace process

[SOURCE: IEC 60050-841:2004, 841-26-55, modified – The definition has been entirely reworded for better accuracy.]

3.2.104
electric arc furnace using alternating current
EAF AC

furnace, in which electric arcs between the electrodes and conducting material are formed, using alternating current

[SOURCE: IEC 60050-841:2004, 841-26-07, modified – The term has been modified and the definition has been entirely reworded for better accuracy.]

3.2.105
electric arc furnace using direct current
EAF DC

furnace, in which the direct current is conducted via bottom electrode(s) (anode) to the material to be processed, forming arcs between the material and the electrode(s) from top (cathode)

[SOURCE: IEC 60050-841:2004, 841-26-06, modified – The term has been modified and the definition has been entirely reworded for better accuracy.]

3.2.106
EAF electrode
LF electrode

part produced from high density graphite to transfer the electrical energy forming arcs between tip and charged material

[SOURCE: IEC 60050-841:2004, 841-26-38, modified – The terms and the definition have been made specific to EAF and LF.]

3.2.107
electrode clamp

metallic, water cooled device to hold the electrode and supply current for arcing to the electrode

[SOURCE: IEC 60050-841:2004, 841-26-39]

3.2.108
ladle furnace
LF

arc furnace for secondary treatment of liquid metals which uses a ladle instead of a furnace vessel

[SOURCE: IEC 60050-841:2004, 841-26-10, modified – The abbreviated term "LHF" has been removed and the definition has been entirely reworded for better accuracy.]

3.2.109
rectifier for direct current

device which converts alternating current into direct current for **EAF DC** or **SAF DC**

3.2.110
submerged arc-resistance furnace
SAF

furnace, in which material melting is carried out as a result of combined arc and resistance heating

[SOURCE: IEC 60050-841:2004, 841-26-12, modified – The word "charge" has been replaced by "material".]

3.2.111

submerged arc-resistance furnace using alternating current

SAF AC

furnace, in which material melting is carried out as a result of combined arc and resistance heating, using alternating current

3.2.112

submerged arc-resistance furnace using direct current

SAF DC

furnace, in which material melting is carried out as a result of combined arc and resistance heating, using direct current

3.2.113

SAF electrode

part produced from conductive material to transfer the electric current to the process

Note 1 to entry: There are different types of SAF electrodes, i.e.:

- a) prebaked electrodes,
- b) self-baking electrodes (e.g. Soederberg electrodes),
- c) extrusion/composite electrodes, which are a combination of Soederberg electrodes with a prebaked electrode as a core,
- d) hollow electrode system, which allow charging of fines via the centre hole (prebaked, self-baking).

3.2.114

single fault condition

condition in which there is a fault of a single protection (but not a reinforced protection) or of a single component or device .

Note 1 to entry: If a single fault condition results in one or more other fault conditions, all are considered as one single fault condition.

Note 2 to entry: Reinforced protection is defined in IEC 60050-903:2013, 903-02-08.

[SOURCE: IEC GUIDE 104:2019, 3.8]

3.2.115

furnace ON of an arc furnace installation

normal arc furnace conditions during status "furnace breaker ON" and disconnector CLOSE and grounding switch OPEN

3.2.116

furnace OFF of an arc furnace installation

normal arc furnace conditions during status "furnace breaker OFF" and disconnector CLOSE and grounding switch OPEN

3.2.117

furnace shut down of an arc furnace installation

normal arc furnace condition during status "furnace breaker OFF" and disconnector OPEN and grounding switch CLOSED

3.3 Parts and accessories

This subclause of Part 1 is applicable.

3.4 Safety related concepts

This subclause of Part 1 is applicable with the following addition.

Addition:

3.4.101

emergency stop matrix

matrix indicating the relation of locations of emergency stop devices and related safety functions

3.5 Abbreviated terms

This subclause of Part 1 is applicable with the following addition.

Addition:

DRI: Direct reduced iron

EBT: Eccentric bottom tapping

HBI: Hot briquetted iron

OBT: Oval bottom tapping

4 Classification and subdivision of equipment and installations

4.1 Classification by processing frequency

This subclause of Part 1 is applicable.

4.2 Classification by voltage

This subclause of Part 1 is applicable with the following additions:

Additions:

Arc furnaces can be operated with a secondary voltage above 1 000 V (rms) at mains frequency or 1 500 V direct current; state of technology are **arc furnaces** with a secondary voltage of up to 3 600 V (rms) at mains frequency or 5 000 V DC.

High current supply part of **arc furnaces** with the secondary voltage up to 3 600 V (rms) or up to 5 000 V DC shall exceptionally be handled according to LV requirements, taking into account special requirements mentioned in this document.

NOTE High current supply part starting from the secondary side terminals of the **arc furnace transformer** mainly consist of secondary outlets of the **arc transformer**, high current bus bars, high current cables, flexibles, electrode support arms, electrode columns, electrodes and where applicable **AC current converter**, **rectifier for direct current**, reactor and/or bottom anode.

4.3 Subdivision of installation and equipment

This subclause of Part 1 is applicable.

4.4 Classification of hazards and risks

This subclause of Part 1 is applicable.

5 Risk assessment

This clause of Part 1 is applicable, with the following addition.

Addition:

Due to the different designs of **arc furnace** installations, an individual risk assessment shall be carried out in any case, taking into account the specific characteristics of the **arc furnace**