BRITISH STANDARD

BS EN
60519-2:2006

Safety in electroheat installations —

Part 2: Particular requirements for resistance heating equipment

The European Standard EN 60519-2:2006 has the status of a British Standard

ICS 25.180.10

National foreword

This British Standard was published by BSI. It is the UK implementation of EN 60519-2:2006. It is identical with IEC 60519-2:2006. It supersedes BS EN 60519-2:1994 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PEL/27, Electroheating.

A list of organizations represented on PEL/27 can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Safety in electroheat installations Part 2: Particular requirements for resistance heating equipment

(IEC 60519-2:2006)

Sécurité dans les installations électrothermiques
Partie 2: Exigences particulières pour les installations de chauffage par résistance
(CEI 60519-2:2006)

Sicherheit in Elektrowärmeanlagen
Teil 2: Besondere Anforderungen an Einrichtungen mit Widerstandserwärmung
(IEC 60519-2:2006)

This European Standard was approved by CENELEC on 2006-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

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Foreword

The text of document 27/525/FDIS, future edition 3 of IEC 60519-2, prepared by IEC TC 27, Industrial electroheating equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60519-2 on 2006-09-01.

This European Standard supersedes EN 60519-2:1993.

Significant changes with respect to EN 60519-2:1993 are as follows:

– the structure has been adjusted to the latest ISO/IEC Directives;

– the latest edition of EN 60519-1 has been taken into account;

– definitions have been brought into line with the second edition of IEC 60050-841.

This standard shall be used in conjunction with EN 60519-1:2003. It is intended to modify, replace or make additions to EN 60519-1 for particular requirements for resistance heating equipment.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2007-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2009-09-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 60519-2:2006 was approved by CENELEC as a European Standard without any modification.

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CONTENTS

SAFETY IN ELECTROHEAT INSTALLATIONS –

Part 2: Particular requirements for resistance heating equipment

1 Scope and object

This part of IEC 60519 is applicable to the indirect resistance heating equipment and the direct resistance heating equipment specified in items a) and b) below respectively, operating in voltage bands 1 and 2.

The object of this standard is the standardization of safety requirements for both indirect and direct resistance heating equipment described below.

a) Indirect resistance heating equipment

These particular requirements apply to equipment for indirect resistance heating, such equipment being energized with d.c. voltage or with single-phase or multiphase a.c. voltage of frequency up to 60 Hz.

Heat generation is effected by current flow in

- solid metallic heating conductors;
- solid non-metallic heating conductors;
- radiant tubes and immersion heaters.

Examples of indirect resistance heating equipment in general use include

- discontinuous furnaces such as batch-type furnaces, muffle furnaces, pot-type furnaces (crucible furnaces), pit-type furnaces, bell-type furnaces, bogie-hearth furnaces, fluidized-bed furnaces, immersion heater metal baths;
- continuous furnaces with continuous or discontinuous charge conveyors, such as roller-hearth furnaces, pusher furnaces, walking-beam furnaces, rotary-retort furnaces, rotary-hearth furnaces, tunnel furnaces (kilns), continuous muffle furnaces.

Indirect resistance heating equipment in general use also includes

- equipment for heating solids, liquids or gases;
- equipment for melting and holding;
- individual heating-element assemblies (movable or fixed heaters).

Indirect resistance heating equipment where particular hazards are likely to occur includes

- nitrite bath furnaces;
- indirect resistance heating equipment where an explosive atmosphere is likely to occur inside the furnace during heat treatment: furnaces for carburizing in gas atmospheres consisting of the mixture of hydrogen and methane or propane and carbon monoxide;

- indirect resistance heating equipment with protective gas and/or reaction gas atmosphere: furnaces for gas carburizing, gas nitriding, carbo-nitriding (protective gas, for example, argon);
- equipment with infrared heating elements.

These requirements do not apply to trace heating systems dealt with in IEC 60519-10.

b) Direct resistance heating equipment

These particular requirements also apply to equipment for direct resistance heating by means of current introduced by electrodes passing through the charge or a fluid to be heated. Such equipment includes, for example,

- salt-bath electrode furnaces;
- glass-melting furnaces;
- furnaces for graphitizing;
- furnaces for production of silicon carbide.

These requirements do not apply to equipment for direct resistance heating, where, owing to the technology used, IEC 60519-3, IEC 60519-4, IEC 60519-8 and IEC 60519-21 are applicable. Moreover, they do not apply to electrode-steam-boiler instantaneous water heaters and electrode pressure vessels.

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.

IEC 60050-841:2004, *International Electrotechnical Vocabulary (IEC) – Part 841: Industrial electroheat*

IEC 60335-1:2000, *Household and similar electrical appliances – Safety – Part 1: General requirements*
Amendment 1 (2004)[1]

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-42:2001, *Electrical installations of buildings – Part 4-42: Protection for safety – Protection against thermal effects*

IEC 60398:1999, *Industrial electroheating installations – General test methods*

IEC 60479-1:2005, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC 60519-1:2003, *Safety in electroheat installations – Part 1: General requirements*

[1] There exists a consolidated edition 4.1 (2004) that includes edition 4 and its amendment 1.

IEC 60519-3:2005, *Safety in electroheat installations – Part 3: Particular requirements for induction and conduction heating and induction melting installations*

IEC 60519-4:2000, *Safety in electroheat installations – Part 4: Particular requirements for arc furnace installations*

IEC 60519-8:2005, *Safety in electroheat installations – Part 8: Particular requirements for electroslag remelting furnaces*

IEC 60519-10:2005*, Safety in electroheat installations – Part 10: Particular requirements for electrical resistance trace heating systems for industrial and commercial applications*

IEC 60519-21:1998, *Safety in electroheat installations – Part 21: Particular requirements for resistance heating equipment – Heating and melting glass equipment*

IEC 60529:2001, *Degrees of protection provided by enclosures (IP Code*)

IEC 60990:1999, *Methods of measurement of touch current and protective conductor current*

IEC 61140:2001, *Protection against electric shock – Common aspects for installation and equipment*

3 Terms and definitions

For the purposes of this document, the following terms and definitions, as well as those given in IEC 60519-1 and IEC 60050-841, apply.

3.1
electrode (for direct resistance heating)
part of direct resistance heating which, being in contact with the charge, transfers the current to it

3.2
heating conductor
conductor used for conversion of electric energy into heat

NOTE The term "heating conductor" is often used interchangeably with "heating resistor" [IEV 841-23-13].

3.3
glass-melting furnace (direct resistance heating)
furnace in which the melting of glass is effected by the heat generated by the direct flow of current in the bath, in which the electrodes are immersed

3.4
salt-bath furnace
furnace in which a salt bath is principally used as a heat-transfer fluid

NOTE Heating may be effected by direct or indirect heating. Direct heating is effected when the heating-element assemblies (heaters) are located in the salt bath (immersed heaters, electrodes). Indirect heating is effected when the heating-element assemblies (heaters) are located outside the tank or crucible.

3.5
nitrite and nitrate bath furnace
salt-bath furnace containing, in metallic tanks or crucibles, potassium or sodium nitrate or nitrite baths or baths composed of a mixture of these salts

3.6
pre-heating equipment (for bath furnaces)
auxiliary heating devices which ensure that the upper layer of the bath is melted first when the bath has reached a state of solidification

3.7
melting furnace
furnace used for melting solid charges

3.8
holding-temperature furnace
furnace used for maintaining in a molten state, at predetermined temperature, charges introduced in the furnace in a melted state

3.9
heat transfer fluid
liquid or gas used for transferring heat from the heating-element assembly (heater) to the charge

3.10
removable heating element, removable heating-element assembly (heater)
heating element and/or heating-element assembly (heater), which can be removed or replaced by the user without dismantling any other parts, for example, thermal insulation, refractories of the furnace

NOTE Heating elements and/or heating-element assemblies (heaters) are "removable in service" when they can be removed in service without interrupting the operating process.

3.11
thermal cut-out and temperature protector
devices which switch off the heating equipment when pre-determined temperatures are exceeded

NOTE Thermal cut-outs are resettable; temperature protectors are not resettable and are replaced each time they have operated.

3.12
pre-selected temperature limiter
device which switches off the heating equipment when the pre-selected temperature of the equipment (working temperature) is exceeded by a predetermined value and which retains the equipment in the de-energized state

NOTE Pre-selected temperature limiters are set, locked or reset only by a skilled person.

3.13
pre-selected temperature controller
device which controls the furnace temperature so that it does not exceed or fall below the pre-selected temperature by a predetermined value

NOTE Pre-selected temperature controllers are set or locked only by a skilled person.

3.14
leakage current (in an installation)
electric current which flows to earth or to extraneous conductive parts under normal operating conditions

[IEV 195-05-15, modified]

NOTE 1 This current may have capacitive components including that resulting from the deliberate use of capacitors.

NOTE 2 The value of the leakage current may differ in the hot and the cold state of the installation.

3.15
touch current
electric current passing through a human body or through an animal body when it touches one or more accessible parts of an installation or equipment

[IEV 195-05-21]

3.16
protective conductor current
current which flows in a protective conductor

[IEC 60990, 3.2]

3.17
immersion heater
electrical heating element in which the heat is transmitted to the bath through the insulation and protective sheath

NOTE The immersion heater may be stationary or movable.

4 Classification of electroheat equipment according to voltage bands

Subclauses 4.2.1 and 4.2.2 of IEC 60519-1 apply.

5 Classification of electroheat equipment according to frequency bands

Clause 5 of IEC 60519-1 applies.

6 General requirements

The requirements of Clause 6 of IEC 60519-1 apply except as follows.

Additional subclauses:

6.7 Resistivity

In some cases changes of resistance of the heating conductors (in the case of indirect resistance heating) or resistance of the charge (in the case of direct resistance heating) during operation, shall be taken into account when dimensioning and choosing electroheat equipment.

6.8 Auxiliary equipment

Precautions shall be taken to ensure that auxiliary equipment, for example, handling, transport and charging devices, does not constitute a source of danger.

6.9 Bare heating conductors

In general, bare heating conductors shall be so placed that under normal operating conditions, they cannot come into contact with persons, the charge or the charge handling equipment. Exception can be made for those bare conductors supplied from sources which comply with the requirements for safety extra-low voltage (SELV) supplied in accordance with IEC 60364-4-41.

6.10 Leakage current

Protective measures adopted shall be so chosen that persons are not exposed to the risk of electrical hazards due to leakage current arising under normal operating conditions.

Effective measures shall be taken to ensure that the leakage current which flows either through the furnace including the charge or through the charge does not cause electrical hazards of any kind.

6.11 Vapours, precipitates and sediments from the charge

If vapours, precipitates, sediments and the like are produced from the charge, their possible physical and chemical effects on persons and/or on the heating equipment shall be taken into account.

6.12 Salt-bath furnaces and melting furnaces

6.12.1 In the case of furnaces with salt bath and other baths such as galvanizing or aluminium holding baths, the maximum permissible rated voltage for immersed heaters shall be 400 V.

6.12.2 The maximum permissible temperature of the bath shall be clearly indicated on the temperature indicator or on the temperature controller (see 13.9.1).

6.12.3 Nitrite bath furnaces intended for the treatment of aluminium or wrought aluminium alloys shall not be used for charges made of

– cast aluminium alloys;
– aluminium alloys of unknown composition;
– other light metals or alloys thereof;
– heavy metals or alloys thereof;
– steel.

Where a furnace temperature of 550 °C can be exceeded during operation, a warning notice reading "Do not use for light metals" shall be placed on the furnace casing in a clearly visible position.

6.12.4 In the case of internally heated furnaces, immersed heating-element assemblies (heaters) shall be so arranged that they are kept free from deposits.

6.12.5 In the case of baths of a depth exceeding 1,5 m, pre-heating devices, which ensure pre-heating without causing risks of any kind, shall be provided for the purpose of melting vertical channels into the solidified charge, unless other precautionary measures are taken.

6.12.6 In the case of externally heated furnaces, the heating-element assemblies (heaters) shall be normally installed on the sidewalls of the furnace only, in order to avoid any localized overheating at the bottom of the furnace.

6.12.7 If, in the case of large externally heated melting furnaces, it is not possible to avoid the use of heating at the bottom of the furnace, then

– the heating surface power density at the bottom of the furnace shall be lower than that on the sidewalls by a factor specified by the manufacturer for the particular application;
– it shall be possible to control the bottom heating separately;
– the circuits shall be so designed that, when pre-heating the bath, the sidewall heating is switched on first;
– the bottom heating shall only be switched on when the contents of the bath have been partly melted by the sidewall heating alone.

6.13 Heating-up solidified contents of the bath

When the solidified contents of the bath are being preheated, care shall be taken that the contents of the bath first liquefy on the surface so as to prevent surface eruption.

In the case of salt bath electrode furnaces the preheating devices shall enable sufficient current to flow during the start-up period to ensure that the contents of the bath are prevented from being ejected due to surface eruption.

6.14 Vacuum furnaces

In the particular case of vacuum furnaces, the voltage applied to the parts subjected to sub-atmospheric pressure shall be chosen in such a way that no flashover or breakdown occurs.

7 Isolation and switching

The requirements of Clause 7 of IEC 60519-1 apply except as follows.

7.1 *Addition:*

Provision shall be made that the heating equipment may be switched off by hand only from a place where no hazards are likely to occur.

8 Connection to the supply network and internal connections

The requirements of Clause 8 of IEC 60519-1 apply.

9 Protection against electric shock

The requirements of Clause 9 of IEC 60519-1 apply except as follows.

Additional subclauses:

9.5 Protection against direct contact

9.5.1 Electroheat equipment with bare conductors, for use at voltages exceeding 25 V a.c. or 60 V d.c., which, after the opening of the door or similar closing devices such as a cover or bottom plate, can be touched by the charge or by tools, shall be equipped with a means which reliably ensures that all non-earthed heating conductors are switched off when the door is open.

9.5.2 The same requirement applies in the case of electroheat equipment in which accessible parts (for example, ceramic) are liable to become electrically conductive under normal operating conditions.

9.5.3 Contacts belonging to the safety switch shall be reliably opened mechanically by the actuating tappet.

9.5.4 The safety device shall be so designed and arranged that its protective effect cannot be deliberately counteracted and that its function is maintained even when a resetting spring in the operating mechanism breaks.

9.5.5 If a safety momentary-contact limit switch is used, then the switching-off of all conductors (except earthed conductors) shall be reliably effected by a separate circuit breaker, for example a contactor. Should several safety systems exist, then these may actuate one and the same device.

9.5.6 Where, of necessity, other control devices are used instead of safety switches with mechanically actuated NC contacts, then the same degree of protection shall be ensured.

NOTE The protective function should be maintained in the case of faults occurring in the control devices or in associated circuits, or in the case of failure of power supply of these control devices.

9.5.7 Supplementary protection against electric shock in normal service in electroheat equipment may be dispensed with, provided that the protective measure "safety extra-low voltage" (SELV) complies with IEC 60364-4-41.

9.6 Protection against direct and indirect contact

9.6.1 In the case of equipment which, for operative reasons, is required to remain switched on during periods in which the door may be opened, for example, enamelling furnaces, forge furnaces, hearth furnaces for melting light metals and the like, particular attention should be paid to ensure the continuing integrity of suitable protective measures, for example, insulation or earthing, for charging devices which are introduced inside the furnace, and to the protection of the operating staff (suitable shoes, gloves and a dry workstand). In addition, the operating staff should be warned by the display of danger notices.

9.6.2 In the case of continuous furnaces where, owing to their mode of operation, it is not possible to provide electrical protection against contact with bare heating conductors, the service openings of the furnace shall be constructed so that contact with bare heating conductors is prevented when charges are inserted or withdrawn.

9.6.3 Special precautions (for example, a display of danger notices) should be taken in the case of furnaces where the earthing of components which can be removed from the furnace is disconnected before the voltage is switched off by contacts. This may be the case, for instance, in pit furnaces, where the pot, which is removable under normal operating conditions, itself constitutes the end-plate of the heating chamber, without a special cover being available.

9.6.4 If there is a risk that the protective conductor can be interrupted, then appropriate particular measures shall be taken, including, for example,

– measures as laid down in 9.2 and 9.3 of IEC 60519-1;

– a second, separately laid protective conductor;

– isolation from the power supply system by means of a transformer with a separate winding;
– residual-current operated circuit-breakers;
– insulation monitoring.

9.6.5 Where touch voltages likely to cause electric shock hazards may occur, in normal operating conditions or in the case of a fault, on sensors such as temperature sensors with their measuring circuits, appropriate protective measures shall be taken in accordance with IEC 60364-4-41.

9.6.6 For immersed heaters used in electroheat installations for heating liquids or other conductive media, Class II equipment (see IEC 61140) is not allowed.

9.6.7 Relating to safety appropriate levels of leakage current, touch current and protective conductor current should be taken into account (see IEC 60990 and IEC 60479-1).

9.6.8 The leakage current detection system shall be installed to ensure that any faults or failure in the electrical insulation system are detected and appropriate action is initiated.

10 Protection against overcurrent

The requirements of Clause 10 of IEC 60519-1 apply.

11 Equipotential bonding

The requirements of Clause 11 of IEC 60519-1 apply.

12 Control circuits and control functions

The requirements of Clause 12 of IEC 60519-1 apply.

13 Protection against thermal influences

The requirements of Clause 13 of IEC 60519-1 apply except as follows.

Additional subclauses:

13.6 Surface temperature of resistance heating equipment

Electroheat equipment shall be so designed, installed and operated that, even when the equipment is unattended or switched on inadvertently, no danger due to the temperature is likely to be caused to the operating staff, the environment or the charge.

At variance with requirements as laid down in IEC 60364-4-42 the following shall apply here.

a) Parts of electroheat equipment which are located within arm's reach and which, in normal operation, do not need to become accessible may attain higher temperatures than those given in Table 42A of IEC 60364-4-42.
b) In such a case a warning of this effect shall be given in the operating manual and a suitable notice placed on the electroheat equipment.

13.7 Special measures

Where under fault conditions the risk of danger is likely to occur, for example due to failure of the temperature controller, temperature-limiting safety devices shall be provided. These devices shall be both functionally and electrically independent.

In the case of both electronic power controllers and circuit-breakers, as well as in the case of electromagnetically operated contactors with a high operation frequency, the heating shall be cut off via a separate safety switching means.

Furnace control systems shall be operated through separate contactors enabling to cut off the supply to the furnaces.

13.8 Temperature safety devices

In order to ensure the necessary degree of safety in the case of a fault condition in the temperature control circuit, appropriate safety devices and safety measures specified in Table 1 shall be applied.

The temperature safety devices include the following:

– thermal cut-outs (A);
– temperature protectors (B);
– pre-selected temperature controllers (C);
– pre-selected temperature controllers (D).

Table 1 – Thermal safety

<table>
<tr><th>Class</th><th>Protection objective</th><th>Extent of protection</th><th>Safety device</th><th>Safety measures</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Electroheat equipment and environment thereof</td><td rowspan="2">-</td><td rowspan="2">-</td><td>Attended operation with non-hazardous charge only</td></tr>
<tr><td>Overheating precluded by constructional measures</td></tr>
<tr><td>1</td><td>Electroheat equipment and environment thereof</td><td>In the case of a fault no danger caused by electroheat equipment</td><td>A or B</td><td rowspan="2">Depending on utilization and site of installation</td></tr>
<tr><td>2</td><td>Electroheat equipment, environment thereof and charge</td><td>In the case of a fault no danger caused by electroheat equipment or charge</td><td>C or D</td></tr>
<tr><td colspan="5">NOTE 1 In the case of attended operation, the operating state of the electroheat equipment shall be checked at reasonably limited intervals.
NOTE 2 Safety classes applicable for the electroheat equipment in question should be given in the operating instruction; for example, thermal class 2 according to 13.8 of this standard.</td></tr>
</table>

13.9 Nitrite and nitrate bath furnaces

13.9.1 In the case of heat treatment of light metals for the purpose of temperature control and the prevention of overheating, furnaces shall be provided with the following:

– automatic temperature control equipment;

– a separately-acting temperature-limiting device which switches off the equipment when the maximum temperature permissible for the respective charge has been exceeded;
– a separately-acting temperature safety device according to 13.8 which switches off the heating equipment when the temperature of the salt bath of 550 °C has been exceeded;
– temperature-recording equipment (multiple recorders for several baths may be used).

The temperature-limiting safety devices according to 13.8 shall, in addition, operate an alarm system.

13.9.2 In the case of heat treatment of steel, temperature-recording and one of the temperature safety devices according to 13.9.1 can be dispensed with.

14 Risk of fire and danger of explosion

The requirements of Clause 14 of IEC 60519-1 apply except as follows.

Additional subclause:

14.1 Nitrite and nitrate bath furnaces

In the case of nitrite and nitrate bath furnaces for light metal heat treatment, when with no charge, the salt bath temperature shall not exceed 550 °C.

The maximum permissible salt bath temperatures in the case of magnesium-alloy light metals are specified in Table 2.

Table 2 – Maximum permissible salt bath temperatures

Magnesium content %	**Maximum permissible temperature of nitrite and nitrite bath** °C
Up to 0,5	550
Above 0,5 up to 2,0	540
Above 2,0 up to 4,0	490
Above 4,0 up to 5,5	435
Above 5,5 up to 10,0	380
NOTE Determination of intermediate values by means of interpolation is not permitted.	

Overheating of the bath may, in the case of iron components, lead to ignition and calcination, and, in particular, in the case of light metals and slime sediments lying in the salt bath, cause an explosion.

15 Marking, labelling and technical documentation

The requirements of Clause 15 of IEC 60519-1 apply except as follows.

15.1.1 *Addition:*

l) rated temperature;

m) maximum power

When the power absorbed by the electroheat equipment in the cold state exceeds by more than 30 %, that absorbed at rated temperature, the maximum power shall also be given on the rating plate;

n) manufacturer's or component manufacturer's name, type reference, rated voltage and rated power

Spare and individual heating-element assemblies (heaters), for example, sheathed heating conductors, shall be indelibly marked with the manufacturer's or component manufacturer's name, type reference, rated voltage and rated power;

o) degree of protection against moisture where applicable (see IEC 60529).

15.2 Labelling

Additional subclause:

15.2.5 Heating hoods (bells) and similar heating equipment which may be used at temperatures exceeding 250 °C, and where protective measures according to IEC 60519-1 cannot be fulfilled with regard to the inner surface facing the charge, shall be provided with durably fixed warning signs.

15.3 Technical documentation

Addition:

Operating instructions shall include all important parameters, e.g. the maximum permissible operating temperature and also draw attention to the hazards as mentioned in 15.2.5.

16 Information on inspection and commissioning and instructions for utilization and maintenance of electroheat installations

Clause 16 of IEC 60519-1 applies, except as follows.

16.2 Information on inspection and commissioning

Addition:

Special attention shall be paid to the dielectric test and leakage current measurement.

16.2.1 Dielectric test

16.2.1.1 The dielectric test shall be carried out according to IEC 60398, 7.1.3.

16.2.1.2 Electroheat equipment with a rated voltage exceeding 25 V a.c. or 60 V d.c. shall be subjected to a dielectric test on the completed electroheat equipment after complete drying-out when it is commissioned or on the manufacturer’s site before delivery, with the customer's agreement.

16.2.1.3 Tests on Class I equipment (equipment with earthing provision) according to IEC 61140 and IEC 60364-4-41 shall first be carried out in the cold state, in which case the test voltage shall be 1 500 V a.c. (r.m.s. value).

16.2.1.4 Tests on Class I equipment are thereafter repeated at working temperature; the test voltage value here shall be equal to that of the rated voltage of the electroheat installation.

16.2.1.5 Tests on Class II equipment (equipment with double insulation) according to IEC 61140 and IEC 60364-4-41 shall be carried out at working temperature, in which case the test voltage shall be 3 750 V a.c.(r.m.s. value) according to IEC 60335-1.

16.2.2 Leakage current

16.2.2.1 The general provisions of Clause 16 of IEC 60335-1 apply.

16.2.2.2 Leakage current measurement shall be carried out at rated temperature, immediately after completion of the electroheat equipment and after complete and thorough heat-through and drying-out of the equipment.

16.2.2.3 Indications on touch currents and protective conductor currents are given in IEC 60990. Furthermore, information on effects of current on human body and livestock are given in IEC 60479-1.

16.3 Instructions for utilization to be given in the technical documentation

Additional subclauses:

16.3.4 Electrodes and pre-heating equipment shall be inserted, removed and replaced only when the equipment is in cold state and not supplied. This also applies to equipment operated at rated voltages below 25 V a.c. and/or 60 V d.c.

16.3.5 Pre-heating equipment shall be mounted so that no sparks are likely to be produced on the contacts.

16.3.6 In the case of nitrite and nitrate bath furnaces any overheating of the bath which is liable to cause ignition of steel parts or explosions in the case of light metals shall be prevented. Deposits shall be regularly removed to avoid the risk of overheating.

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-841	2004	International electrotechnical vocabulary Part 841: Industrial electroheat	-	-
IEC 60335-1 (mod) A1	2001 2004	Household and similar electrical appliances - Safety Part 1: General requirements	EN 60335-1 A1 A11 A12 + corr. July	2002 2004 2004 2006 2006
IEC 60364-4-41	2005	Low-voltage electrical installations Part 4-41: Protection for safety - Protection against electric shock	-	-
IEC 60364-4-42	2001	Electrical installations of buildings Part 4-42: Protection for safety - Protection against thermal effects	-	-
IEC 60398	1999	Industrial electroheating installations - General test methods	EN 60398	1999
IEC/TS 60479-1	2005	Effects of current on human beings and livestock Part 1: General aspects	-	-
IEC 60519-1	2003	Safety in electroheat installations Part 1: General requirements	EN 60519-1	2003
IEC 60519-3	2005	Safety in electroheat installations Part 3: Particular requirements for induction and conduction heating and induction melting installations	EN 60519-3	2005
IEC 60519-4 A1	1995 2000	Safety in electroheat installations Part 4: Particular requirements for arc furnace installations	EN 60519-4 A1	1997 2000
IEC 60519-8	2005	Safety in electroheat installations Part 8: Particular requirements for electroslag remelting furnaces	EN 60519-8	2005
IEC 60519-10	2005	Safety in electroheat installations Part 10: Particular requirements for electrical resistance trace heating systems for industrial and commercial applications	-	-

Publication	Year	Title	EN/HD	Year
IEC 60519-21	1998	Safety in electroheat installations Part 21: Particular requirements for resistance heating equipment - Heating and melting glass equipment	EN 60519-21	1998
IEC 60529 - A1	1989 - 1999	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May A1	1991 1993 2000
IEC 60990	1999	Methods of measurement of touch current and protective conductor current	EN 60990	1999
IEC 61140	2001	Protection against electric shock - Common aspects for installation and equipment	EN 61140	2002

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