

**INTERNATIONAL
STANDARD**

**IEC
60335-2-76**

Second edition
2002-08

**Household and similar electrical appliances –
Safety –**

**Part 2-76:
Particular requirements for electric fence
energizers**

*Appareils électrodomestiques et analogues –
Sécurité –*

*Partie 2-76:
Règles particulières pour les électrificateurs
de clôtures*



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES –
SAFETY –**
Part 2-76: Particular requirements for electric fence energizers

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
- 5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

This part of International Standard IEC 60335 has been prepared by subcommittee 61H: Safety of electrically operated farm appliances, of IEC technical committee 61: Safety of household and similar electrical appliances.

This second edition cancels and replaces the first edition published in 1997 and its amendment 1 (1999). It constitutes a technical revision.

The text of this part of IEC 60335 is based on the following documents:

| FDIS | Report on Voting |
|--------------|------------------|
| 61H/173/FDIS | 61H/174/RVD |

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

This Part 2 is to be used in conjunction with the latest edition of IEC 60335-1 and its amendments. It was established on the basis of the fourth edition (2001) of that standard.

NOTE 1 When "Part 1" is mentioned in this standard, it refers to IEC 60335-1.

This part 2 supplements or modifies the corresponding clauses in IEC 60335-1, so as to convert that publication into the IEC standard: Safety requirements for electric fence energizers.

When a particular subclause of Part 1 is not mentioned in this Part 2, that subclause applies as far as is reasonable. When this standard states “addition”, “modification” or “replacement”, the relevant text in Part 1 is to be adapted accordingly.

NOTE 2 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.

NOTE 3 The following print types are used:

- requirements: in roman type
- *test specifications: in italic type*
- notes: in small roman type.

Words in **bold** in the text are defined in Clause 3. When a definition concerns an adjective, the adjective and associated noun are also in bold.

The committee has decided that the contents of this publication will remain unchanged until 2004. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

The following differences exist in the countries indicated below:

- 6.101: Only energy limited energizers are allowed (Austria, Denmark, France, Germany, Netherlands, Norway, Switzerland and United Kingdom).

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

It has been assumed in the drafting of this International Standard that the execution of its provisions is entrusted to appropriately qualified and experienced persons.

This standard recognizes the internationally accepted level of protection against hazards such as electrical, mechanical, thermal, fire and radiation of appliances when operated as in normal use taking into account the manufacturer's instructions. It also covers abnormal situations that can be expected in practice.

This standard takes into account the requirements of IEC 60364 as far as possible so that there is compatibility with the wiring rules when the appliance is connected to the supply mains. However, national wiring rules may differ.

If an appliance within the scope of this standard also incorporates functions that are covered by another part 2 of IEC 60335, the relevant part 2 is applied to each function separately, as far as is reasonable. If applicable, the influence of one function on the other is taken into account.

This standard is a product family standard dealing with the safety of appliances and takes precedence over horizontal and generic standards covering the same subject.

An appliance that complies with the text of this standard will not necessarily be considered to comply with the safety principles of the standard if, when examined and tested, it is found to have other features that impair the level of safety covered by these requirements.

An appliance employing materials or having forms of construction differing from those detailed in the requirements of this standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be considered to comply with the standard.

HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – SAFETY –

Part 2-76: Particular requirements for electric fence energizers

1 Scope

This clause of Part 1 is replaced by the following.

This International Standard deals with the safety of **electric fence energizers**, the **rated voltage** of which is not more than 250 V and by means of which fence wires in agricultural, feral animal control and security fences may be electrified or monitored.

NOTE 101 Examples of **electric fence energizers** coming within the scope of this standard are:

- **mains-operated energizers**;
- **battery-operated electric fence energizers suitable for connection to the mains**, as shown in Figure 101;
- **electric fence energizers** operated by non-rechargeable batteries either incorporated or separate.

This standard does not in general take into account

- the use of appliances by young children or infirm persons without supervision;
- the playing with appliances by young children.

NOTE 102 Attention is drawn to the fact that

- for appliances intended to be used on board ships or aircraft, additional requirements may be necessary;
- in many countries additional requirements are specified by the national health authorities, the national authorities responsible for the protection of labour, the national water supply authorities and similar authorities.

NOTE 103 This standard does not apply to

- appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapour or gas);
- separate battery chargers (IEC 60335-2-29);
- electric fishing machines (IEC 60335-2-86);
- electric animal-stunning equipment (IEC 60335-2-87);
- appliances for medical purposes (IEC 60601).

2 Normative references

This clause of Part 1 is applicable except as follows.

Addition:

IEC 60068-2-52, *Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

3 Definitions

This clause of Part 1 is applicable except as follows.

3.1.1 *Addition:*

For **type D energizers**, the **rated voltage** of the **energizer** is the **rated voltage** for battery supply.

3.1.6 Addition:

For **battery-operated electric fence energizers** not for connection to the mains, it is the average input current assigned to the **energizer** by the manufacturer.

3.1.9 Replacement:

normal operation

operation of the appliance under the following conditions: the **electric fence energizer** is operated as in normal use when connected to the supply, with no load connected to the output terminals

3.6.3 Addition:

NOTE 101 It also includes terminals for the connection of the battery and other metal parts in a battery compartment that become accessible when replacing batteries even with the aid of a **tool**.

3.6.4 Replacement:

live part

conductive part that may cause an electric shock

3.101

electric fence energizer

appliance that is intended to deliver periodically voltage impulses to a fence connected to it

NOTE **Electric fence energizers** are hereinafter also referred to as **energizers**.

3.102

mains-operated energizer

energizer designed for direct connection to the mains

3.103

battery-operated energizer suitable for connection to the mains energizer

- operated by batteries and having, or being designed for connection to, facilities for charging these batteries from the mains, or
- designed for operation from the mains and from batteries

3.104

type A energizer

battery-operated energizer suitable for connection to the mains consisting of an impulse generating circuit, a battery charging circuit and a battery, the impulse generating circuit being connected to the mains or the battery when the energizer is in operation

NOTE **Type A energizers** are shown schematically in Figure 101.

3.105

type B energizer

battery-operated energizer suitable for connection to the mains consisting of an impulse generating circuit, a battery charging circuit and a battery, the impulse generating circuit being connected to the battery and disconnected from the battery charging circuit and the mains when the **energizer** is in operation. For recharging the battery the impulse generating circuit is disconnected and rendered inoperable

NOTE **Type B energizers** are shown schematically in Figure 101.

3.106**type C energizer**

battery-operated energizer suitable for connection to the mains consisting of an impulse generating circuit and a battery, the impulse generating circuit being connected to the mains or the battery when the energizer is in operation, and where it is necessary to remove the battery to recharge it using a separate **battery charger** or, in the case of a non-rechargeable battery, to replace it with a new battery

NOTE **Type C energizers** are shown schematically in Figure 101.

3.107**type D energizer**

battery-operated energizer suitable for connection to the mains consisting of an impulse generating circuit intended to be powered by a battery, the impulse generating circuit being connected to the battery when the **energizer** is in operation and the **energizer** or the battery being connected to a separate **battery charger** for recharging the battery

NOTE **Type D energizers** are shown schematically in Figure 101.

3.108**battery-operated energizer**

energizer deriving its energy solely from batteries or other sources of energy and not designed for connection to the mains

3.109**battery charger**

appliance to be connected to the mains and intended for charging one or more batteries

3.110**fence**

barrier for animals or for security purposes, comprising one or more conductors, such as metal wires, rods or rails

3.111**fence circuit**

all conductive parts or components within an **energizer**, that are connected or intended to be connected galvanically to the output terminals

3.112**earth electrode**

metal structure that is driven into the ground near an **energizer** and connected electrically to the output earth terminal of the **energizer**, and that is independent of other earthing arrangements

3.113**prospective peak voltage**

peak output voltage of the impulse generator specified in Clause 14 that would be obtained with the **energizer** not connected to the test circuit

3.114**rated voltage for battery supply**

voltage for battery supply, for **types A, B, C and D energizers**, assigned to the **energizer** by the manufacturer

3.115**rated voltage range for battery supply**

voltage range for battery supply, for **types A, B, C and D energizers**, assigned to the **energizer** by the manufacturer, expressed by its lower and upper limits

3.116

impulse duration

duration of that part of the impulse that contains 95 % of the overall energy and is the shortest interval of integration of $I^2(t)$ that gives 95 % of the integration of $I^2(t)$ over the total impulse

NOTE $I(t)$ is the impulse current as a function of time.

3.117

output current

r.m.s. value of the **output current** per impulse calculated over the impulse duration

3.118

standard load

load consisting of a non-inductive resistor of $500 \Omega \pm 2,5 \Omega$ and a variable resistor that is adjusted so as to maximize the energy per impulse or **output current** in the 500Ω resistor, as applicable. The variable resistor is connected in series or parallel with the 500Ω resistor, whichever gives the more unfavourable result

3.119

electric fence

a barrier that includes one or more electric conductors, insulated from earth, to which electric pulses are applied by an **energizer**

3.120

connecting lead

an electric conductor, used to connect the **energizer** to the **electric fence** or the **earth electrode**

3.121

electric animal fence

an **electric fence** used to contain animals within or exclude animals from a particular area

3.122

electric security fence

a fence used for security purposes that comprises an **electric fence** and a physical barrier electrically isolated from the **electric fence**

3.123

physical barrier

a barrier not less than 1,5 m high intended to prevent inadvertent contact with the **pulsed conductors** of the **electric fence**

NOTE **Physical barriers** are typically constructed from vertical sheeting, rigid vertical bars, rigid mesh, rods or chainwire mesh.

3.124

public access area

any area where persons are protected from inadvertent contact with **pulsed conductors** by a **physical barrier**

3.125

pulsed conductors

conductors that are subjected to high voltage pulses by the **energizer**

3.126

secure area

an area where a person is not separated from **pulsed conductors** below 1,5 m by a **physical barrier**

4 General requirement

This clause of Part 1 is applicable.

5 General conditions for the tests

This clause of Part 1 is applicable except as follows.

5.2 Modification:

Replace the test specification by the following:

*The tests are made on two **energizers** as delivered, one being subjected to all the tests with the exception of that of Clause 18, and the other to the tests of clause 5 and Clause 18. However, the tests of Clauses 22 to 28 may be made on separate samples.*

*For **types A and C energizers**, an additional sample is required for the test of Clause 18.*

Addition:

NOTE 101 Where **electronic circuits**, **electronic components** or other devices are normally encapsulated, specially prepared samples may be needed for the tests of 19.11 and 19.101.

5.3 Addition:

The measurements of 22.108 shall be carried out before the tests of Clause 14. The tests specified in 14.101 shall be carried out on all appliances.

*If any **electronic component** has been damaged during the tests of Clause 14, the tests of Clause 19 are made twice, once before and once after the damaged **electronic components** have been replaced by new **electronic components**.*

5.5 Addition:

*The **energizer** is mounted in a normal position such that the deviation from the position for which it is designed does not exceed 15°. However, if the **energizer** is provided with means for adjustment to the normal position, such as a spirit level, the **energizer** shall be adjusted to within ±2° of the normal position.*

*The earthing terminal of the **fence circuit** is connected to earth. However, if there is no indication as to which of the output terminals is to be connected to earth, the terminal that gives the most unfavourable result is earthed.*

5.8.1 Addition:

*For **types A, B, C and D energizers** where the terminals for the connection of the battery have no indication of polarity, the more unfavourable polarity of the voltage source replacing the battery shall be applied.*

*For **battery-operated energizers** where the supply terminals for the connection of the battery have no indication of polarity, the more unfavourable polarity shall be applied.*

*For **mains-operated energizers and battery-operated energizers suitable for connection to the mains**, the reference source impedance of the mains supply shall be $0,4 \Omega + j0,25 \Omega$.*

5.101 *All **energizers** are tested as **motor-operated appliances**.*

6 Classification

This clause of Part 1 is applicable except as follows.

6.1 Replacement:

Mains-operated energizers and **battery-operated energizers suitable for connection to the mains** shall be **class II** with respect to protection against electric shock.

Compliance is checked by inspection and by the relevant tests.

6.2 Addition:

Energizers shall be of at least IPX4.

6.101 Energizers are classified as being either **energy limited energizers** or **current limited energizers**.

Compliance is checked by the appropriate tests.

7 Marking and instructions

This clause of Part 1 is applicable except as follows.

7.1 Addition:

Energizers shall be marked with symbol 1641 of ISO 7000.

Types A, B and C energizers shall be marked with the **rated voltage for battery supply** or **rated voltage range for battery supply**, in volts.

Battery-operated energizers shall be marked with the substance of the following:

WARNING: Do not connect to mains-operated equipment.

Energy limited energizers that are marked with a maximum energy/impulse exceeding 5 J shall also be marked with the corresponding load resistance at which maximum energy/impulse is obtained.

7.6 Addition:



[symbol 5036 of IEC 60417] Dangerous voltage



[symbol 5017 of IEC 60417] Earth (ground)

The symbols for output (**Fence**) and output (Earth) shall be in accordance with symbols 5036 and 5017 of IEC 60417 respectively.

7.12 Addition:

Instructions for **types A, B and D energizers** shall

- include a warning against using non-rechargeable batteries;
- state that, during charging, lead-acid batteries must be placed in a well-ventilated area.

The instructions for **battery-operated energizers** shall in particular emphasize the warning marked on the **energizer** that states the substance of the following:

WARNING: Do not connect to mains-operated equipment.

7.101 Unless the correct mode of connection is obvious, the output terminals shall be clearly and indelibly identified by marking with the words EARTH and FENCE, or with symbols 5017 and 5036 of IEC 60417 respectively.

Where alternative output terminals are provided they shall be similarly marked, or marked with the words FULL POWER, REDUCED POWER or REDUCED VOLTAGE, as appropriate.

If a switch to control the output energy is provided, the various positions of the switch shall be marked with the appropriate symbols, or with the words FULL POWER, REDUCED POWER or REDUCED VOLTAGE, as appropriate.

The lettering of the marking shall have a height of at least 3 mm and the symbols a height of at least 6 mm.

Compliance is checked by inspection and measurement.

7.102 For **types A, B, C and D energizers** and **battery-operated energizers** the supply terminals for connection of the battery shall be clearly indicated by the symbol “+” or the colour red, if of positive polarity, and by the symbol “-” or the colour black, if of negative polarity, unless the polarity is irrelevant.

Compliance is checked by inspection.

7.103 Energizers shall be supplied with instructions that contain information regarding

- the installation of **electric fences**;
- the means of connecting the **energizer** to the **electric fence**.

Such information shall contain the substance of the wording given in BB.1 (**electric animal fences**) or Annex BB.2 (**electric security fences**), as appropriate.

NOTE It is recommended that **energizers** intended for use with **electric security fences** also be supplied with the information given in Annex CC.

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of Part 1 is applicable except as follows.

8.1.4 Addition:

*The means for the connection of the **fence** is not considered to be a **live part**.*

9 Starting of motor-operated appliances

This clause of Part 1 is not applicable.

10 Power input and current

This clause of Part 1 is applicable except as follows.

10.101 For **energy limited energizers** that are marked with a maximum energy/impulse exceeding 5 J, the value so marked shall not deviate from that delivered by more than $\pm 10\%$ and the load resistance at which it is obtained shall not deviate from the value marked on the **energizer** by more than $\pm 5\%$.

Compliance is checked by the following test.

*The **energizer** is supplied at **rated voltage** or **rated voltage for battery supply**, as appropriate, under conditions of **normal operation** but with a variable resistive load connected across its output terminals.*

*The energy per impulse dissipated in the resistive load connected across the **energizer** output terminals is measured using the measuring arrangement described in 22.108. The resistive load value is measured after it is adjusted to maximize the energy per impulse measured.*

11 Heating

This clause of Part 1 is applicable except as follows.

11.2 Addition:

*For **type A energizers** when connected for mains supply, **type D energizers** when connected for **battery charger** supply and **type B energizers** when connected for mains supply with battery charge operation, a battery of the largest type for which the **energizer** is designed is connected to the terminals for the connection of the battery supply. Before starting the test, the battery is discharged to such an extent that the voltage delivered by the battery does not exceed 0,75 times its nominal value.*

11.5 Replacement:

*The **energizer** is operated under **normal operation**, supplied as follows.*

*A **mains-operated energizer** is supplied with the most unfavourable supply voltage between 0,85 and 1,1 times **rated voltage**.*

***Types A and C energizers**, when they are connected for mains supply, are supplied with the most unfavourable supply voltage between 0,85 and 1,1 times **rated voltage**.*

*A **type B energizer**, when it is connected for mains supply with battery charge operation, is supplied with the most unfavourable supply voltage between 0,85 and 1,1 times **rated voltage**.*

***Types A, B, C and D energizers**, when they are connected for battery supply, and **battery-operated energizers** are supplied at the terminals for the connection of the battery with the most unfavourable supply voltage between*

- 0,55 and 1,1 times **rated voltage for battery supply**, if the **energizer** can be used with non-rechargeable batteries;
- 0,75 and 1,1 times **rated voltage for battery supply**, if the **energizer** is designed for use with rechargeable batteries only.

The values specified in Table 101 for the internal resistance per cell of the battery shall be taken into account.

Table 101 – Battery source impedance

| Supply to the terminals for the connection of the battery | Internal resistance per cell Ω | |
|---|--|------------------------|
| | Non-rechargeable batteries | Rechargeable batteries |
| 1,1 times rated voltage for battery supply | 0,08 | 0,0012 |
| 1,0 times rated voltage for battery supply | 0,10 | 0,0015 |
| 0,75 times rated voltage for battery supply | 0,75 | 0,0060 |
| 0,55 times rated voltage for battery supply | 2,00 | – |

NOTE When determining the internal resistance of a battery, two or more cells connected in parallel are considered to be one cell.

Type D energizers, when they are connected for **battery charger** supply, are supplied from a source incorporating a series resistance of 1 Ω and having the form of

- a half-wave rectified sine-wave with an r.m.s. value equal to the **rated voltage for battery supply**,
- a full-wave rectified sine-wave with an r.m.s. value equal to the **rated voltage for battery supply**,

whichever is the more onerous.

11.7 Replacement:

The **energizer** is operated until steady conditions are established.

12 Void

13 Leakage current and electric strength at operating temperature

This clause of Part 1 is applicable except as follows.

13.1 Modification:

Compliance is checked by the tests of 13.2 and 13.3 for **mains-operated energizers** and **battery-operated energizers suitable for connection to the mains** only.

Addition:

The **energizer** is operated under **normal operation** when supplied as specified in 11.5 for mains operation.

14 Transient overvoltages

14.101 Energizers shall be resistant to atmospheric surges entering from the fence.

Compliance is checked by the tests of

- 14.102 to 14.104 for **mains-operated energizers and types A, B and C energizers**;
- 14.102 to 14.104 for **type D energizers**;
- 14.104 for **battery-operated energizers with a rated voltage exceeding 42,4 V**.

NOTE The value of U_0 is the peak value of the **energizer** output voltage obtained during the test of 22.111.

Unless otherwise specified, during the tests, no disruptive discharges shall occur but surge protection devices are allowed to operate.

Mains-operated energizers and types A, B, C and D energizers are fixed to a metal plate having dimensions that are at least 150 mm in excess of those of the orthogonal projection of the **energizer** on the plate, and are then installed as in normal use.

Battery-operated energizers are installed as in normal use.

The tests are made by means of an impulse generator producing positive and negative full lightning impulses having a front time of 1,2 μ s and a time to half-value of 50 μ s, the tolerances being

- ± 5 % for the peak value;
- ± 30 % for the front time;
- ± 20 % for the time to half-value.

Small oscillations in the impulse are allowed, provided their amplitude near the peak of the impulse is less than 5 % of the peak value. For oscillations during the first half of the front time, amplitudes up to 10 % of the peak value are allowed.

The shape of the impulses is adjusted with the **energizer** connected to the impulse generator. The adjustment shall be made at approximately 50 % of the test voltage specified. If, for the test of 14.104, it is not possible to obtain the correct shape of the impulses, it is only necessary to ascertain that the front time has the required value at approximately 50 % of the **prospective peak voltage** specified.

The impulse generator to be used for the tests shall have an energy content of at least 125 J at the test voltage.

14.102 Five positive and five negative impulses, each having a **prospective peak voltage** of $2U_0$ but not less than 25 kV, are applied between

- the output terminals and a.c. input terminals connected together and the metal plate, for **mains-operated energizers and types A, B and C energizers**,
- the output terminals and the metal plate, for **type D energizers**,

the interval between consecutive impulses being at least 10 s.

14.103 Five positive and five negative impulses, each having a **prospective peak voltage** of $2U_0$ but not less than 25 kV, are applied between the output terminals connected together and

- the a.c. input terminals connected together, for **mains-operated energizers and types A, B and C energizers**,
- the terminals for connection of the external **battery charger**, for **type D energizers**,

the interval between consecutive impulses being at least 10 s.

If, during this test, a surge protection device operates, the test is repeated with the surge protection device rendered inoperative. During the repeat test no disruptive discharges are allowed.

If the **energizer** has more than one **fence circuit**, each **fence circuit** is subjected to this test in turn, the other **fence circuits** being open-circuited.

14.104 Five positive and five negative impulses, each having a **prospective peak voltage** of $2U_0$ but not less than 25 kV, are applied between the output terminals, the interval between the impulses being at least 10 s. The input terminals are open-circuited.

15 Moisture resistance

This clause of Part 1 is applicable.

16 Leakage current and electric strength

This clause of Part 1 is applicable except as follows.

16.1 Modification:

Compliance is checked by the tests of

- 16.2, 16.3 and 16.102 for **mains-operated energizers** and **battery-operated energizers** suitable for connection to the mains;
- 16.101 and 16.102 for **battery-operated energizers**.

16.2 Modification:

The test voltage is the upper limit of the voltage in 11.5.

16.3 Addition:

Other values of the test voltages and the points of application are shown in Table 102.

Table 102 – Additional test voltages

| <i>Points of application</i> | <i>Test voltage</i> ^a |
|--|-----------------------------------|
| <i>Between the supply circuit and accessible parts for metal-encased class II energizers</i> | $2U_0$ but not less than 10 000 V |
| <i>Between the fence circuit and accessible parts</i> ^b | $2U_0$ but not less than 10 000 V |
| <i>Between the supply circuit and the fence circuit</i> | $2U_0$ but not less than 10 000 V |
| <p>^a The value $2U_0$ is a peak value equal to twice the maximum peak value of the output voltage measured in 22.111.</p> <p>^b A gap of 50 mm around the output terminal shall be provided in the metal foil in contact with accessible parts.</p> | |

16.101 For **battery-operated energizers** the supply terminals are connected for 10 min to a voltage between 1,1 and 1,5 times **rated voltage for battery supply**, that is so chosen that the output voltage, without a load connected, has the maximum value, protective spark gaps, if any, being disconnected.

The insulation between the poles of the supply circuit is then subjected for 1 min to a d.c. voltage of approximately 500 V. Before this test is made, capacitors, resistors, inductors, transformer windings and **electronic components** that are connected between the poles of the supply circuit are disconnected. When a capacitor forms part of an integrated circuit and cannot be disconnected separately, the circuit as a whole is disconnected.

No breakdown shall occur during the test.

16.102 Immediately after the tests of 16.3 and 16.101, the output characteristics are measured as specified in 22.108.

The values measured shall be within the limits specified in 22.108 and shall not deviate in an unfavourable way by more than 10 % from the values measured during the tests of 22.108.

17 Overload protection of transformers and associated circuits

This clause of Part 1 is not applicable.

18 Endurance

Energizers shall be so constructed that they are able to endure extreme temperatures that may be encountered in normal use. Moreover, overload **protection devices** shall not operate under these conditions.

Compliance is checked by the following test.

Mains-operated energizers, and **types A and C energizers** when they are connected for mains supply are operated under conditions of **normal operation**. The voltage applied is the **rated voltage**.

Type D energizers, when connected for **battery charger** supply, are operated under conditions of **normal operation**. The voltage applied is as specified in 11.5.

Battery-operated energizers and **type B energizers** connected for battery operation are placed in their normal position and are fitted with a battery having a nominal voltage equal to the **rated voltage for battery supply** of the **energizer**. The battery shall be of the largest type for which the **energizer** is designed. The battery shall be fully charged at the beginning of the test and shall be replaced by a fresh one as soon as, during the test, the voltage of the battery decreases to 0,75 times its nominal voltage for a rechargeable battery or to 0,55 times its nominal voltage for a non-rechargeable battery.

For **types A and D energizers**, a battery of the largest type for which the **energizer** is designed is connected and placed in the battery compartment. Before starting the test the battery is discharged to such an extent that the voltage delivered does not exceed 0,75 times its nominal value.

The other sample, for **types A and C energizers**, is to be connected for battery supply and supplied from a battery of the largest type for which the **energizer** is designed. The battery shall be fully charged at the beginning of the test, and shall be replaced by a fresh one as soon as, during the test, the voltage of the battery decreases to 0,75 times its nominal voltage for a rechargeable battery or to 0,55 times its nominal voltage for a non-rechargeable battery.

The **energizer** is operated continuously for 168 h (seven days) at an ambient temperature of $-15\text{ °C} \pm 2\text{ °C}$ and then for 168 h (seven days) at an ambient temperature of $50\text{ °C} \pm 2\text{ °C}$.

The output terminals are loaded with a non-inductive resistor of $500\ \Omega \pm 2,5\ \Omega$ during the first 84 h of each period of 168 h and the load is removed for the remainder of these periods.

At the end of each of the periods of 168 h, the output characteristics are measured, as specified in 22.108, at the ambient temperature prescribed for the relevant period.

The values measured shall be within the limits specified in 22.108 and shall not deviate in an unfavourable way by more than 10 % from the values measured during the test of 22.108.

During the test, the **energizer** shall show no change impairing its further use, the sealing compound, if any, shall not flow out to such an extent that **live parts** are exposed and the **energizer** shall still meet the requirements of Clause 8.

19 Abnormal operation

This clause of Part 1 is applicable except as follows.

19.1 Modification:

Instead of the indication of the subclauses applicable to the various types of appliances, the following applies.

Energizers are subjected to the tests of 19.11, 19.12, 19.101, 19.102, 19.103 and 19.104.

Addition:

The **energizer** is mounted as in 11.2, except that the battery, where applicable, is fully charged.

During the tests, fuses that are accessible to the user are short-circuited.

19.11.1 Addition:

Components, except the major switching device, directly related to the pulse interval timing of the major switching device where this is an **electronic component**, are exempt from the tests of 19.11.2.

19.11.3 Not applicable.

19.12 Addition:

If, for any of the fault conditions, the impulse repetition rate is greater than 1 Hz and the safety of the **energizer** depends upon the operation of a non-self-resetting **protective device** incorporating an internal fuse, the test is carried out three times to ensure that this fuse operates reliably and that internal parts are not damaged at the increased impulse repetition rate.

19.13 Addition:

During the tests the output characteristics shall be as specified in 22.108, except for the impulse repetition rate.

If the impulse repetition rate is greater than 1,34 Hz, the discharge energy per second into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2,5 J/s for a period exceeding 3 min before the **energizer** is rendered inoperative by a non-self-resetting **protective device**.

The temperature rises of the windings shall not exceed the values shown in Table 8.

19.101 Energizers are subjected to each of the following conditions in turn, while being supplied with the voltage specified in 11.5, including those associated with such other fault conditions that are an actual consequence of the condition chosen:

- the **energizer** is placed in its most unfavourable position even if it is not likely to be installed in this position in normal use;
- parts intended for adjusting the **energizer**, other than those that are adjustable from the outside of the **energizer** without the aid of a **tool**, are adjusted to their most unfavourable position, even if these parts are not intended to be adjusted by the user, unless they are effectively sealed against further adjustment;
- the earthing conductor is removed from the earthing terminal of the **fence circuit** and connected to any other output terminal;
- the output terminals are short-circuited;
- switches, relay-contacts and the like, that form part of the impulse device, are short-circuited or open-circuited, whichever is the more unfavourable;
- fuses that are accessible without the aid of **tools**, series spark gaps in the **fence circuit**, discharging valves and thermal relays are short-circuited;
- except for **electronic circuits**, any **creepage distance** or **clearance** between **live parts** of different potential that is less than 5 mm for the **fence circuit**, or 2 mm or less for other circuits, is short-circuited, and any unlocked connection is loosened;
- the switching speed of an **electronic component** used as the major pulse switching device shall be varied in the range 0,1 Hz to twice the **rated frequency**, in approximately a 1:2:5 progression sequence over three decades, by referencing the gate signal of this device to the voltage across it using an external independent control.

NOTE Details of a simple comparator circuit that has been found suitable for controlling the switching speed of the major pulse switching device are given in Annex AA.

19.102 Types A, C and D energizers are subjected to each of the following conditions in turn, while being supplied with the voltage specified in 11.5:

- with the **energizer** connected for battery supply, terminals for the connection of the battery having an indication of polarity are connected to the opposite polarity, unless such a connection is unlikely to occur in normal use;
- with the **energizer** connected for mains operation, terminals for the connection of the battery supply are connected to the most unfavourable load, including a short circuit.

19.103 Type B energizers connected for mains supply with battery charge operation are subjected to each of the following conditions in turn, while being supplied with the voltage specified in 11.5:

- the terminals for the connection of the battery having an indication of polarity are connected to the opposite polarity, unless such a connection is unlikely to occur in normal use;
- the terminals for the connection of the battery supply are connected to the most unfavourable load, including a short circuit.

19.104 Battery-operated energizers and type B energizers connected for battery supply are supplied with the voltage specified in 11.5. The supply terminals having an indication of polarity are connected to the opposite polarity, unless such a connection is unlikely to occur in normal use.

20 Stability and mechanical hazards

This clause of Part 1 is not applicable.

21 Mechanical strength

This clause of Part 1 is applicable except as follows.

21.101 The **energizer** shall withstand the effect of being dropped.

Compliance is checked by the following test.

*The **energizer** is bolted centrally to a board 1 000 mm ± 5 mm long by 225 mm ± 5 mm wide and approximately 25 mm thick. The board is supported at each end on a rigid table by baulks of timber of such a size that the **energizer** is held clear of the table surface. One end of the board is lifted through a distance of 200 mm ± 5 mm and allowed to fall freely. The test is repeated 20 times. This procedure is then repeated with the board placed on each of its other longitudinal edges in turn.*

*After the test, the **energizer** shall show no damage within the meaning of this standard.*

22 Construction

This clause of Part 1 is applicable except as follows.

22.31 *Modification:*

The requirement applies only to **mains-operated energizers** and **battery-operated energizers suitable for connection to the mains**.

22.32 *Modification:*

The requirement applies only to **mains-operated energizers** and **battery-operated energizers suitable for connection to the mains**.

22.101 For **mains-operated energizers** and **battery-operated energizers suitable for connection to the mains**, internal connections shall be so fixed or protected, and **energizers** shall be so designed that, even in the event of the loosening or breaking of wires, a conductive connection cannot be formed between the mains supply and the **fence circuit**, and no other hazardous condition shall arise.

The input winding and the output windings of transformers used to isolate the **fence circuit** from the supply circuit shall be separated by an insulating barrier, and the construction shall be such that there is no possibility of any connection between these windings, either directly or indirectly through other metal parts.

In particular, precautions shall be taken to prevent

- displacement of input or output windings, or the turns thereof;

- undue displacement of parts of windings, or of internal wiring, in the event of a rupture or loosening of connections.

Compliance is checked by inspection and by the tests of the other clauses of this standard.

NOTE 1 Isolation between the mains and the **fence circuit** may be achieved by the incorporation of a double-wound transformer situated either in the input circuit or in the **fence circuit**. If such transformers are incorporated in both circuits, at least one of these transformers should provide the required degree of isolation.

NOTE 2 Circuits connected between the input terminals and the primary side of the transformer providing the required degree of isolation are considered to be connected to the mains, and circuits connected between the output terminals and the secondary side of this transformer are considered to belong to the **fence circuit**.

NOTE 3 Examples of constructions that comply with the requirements of this subclause for windings are

- windings on separate spools of adequate insulating material, rigidly fixed with respect to each other and to the core of the transformer;
- windings on a single spool with a partition wall, both of adequate insulating material, provided that the spool and partition wall are pressed or moulded in one piece, or that, in the case of a pushed-on partition wall, there is an intermediate sheath or covering over the joint between the spool and the partition wall;
- concentric windings on cheekless formers, provided that
 - each layer of the winding is interleaved with adequate insulating material projecting beyond the end turns of each layer,
 - one or more separate sheets of insulating material of adequate thickness are provided between the input winding and the output windings, and
 - the windings are impregnated with a hard-baked or other suitable material that fully penetrates the interstices and effectively seals off the end turns.

NOTE 4 It is not to be expected that two independent fixings will become loose at the same time.

22.102 For **mains-operated energizers** and **battery-operated energizers suitable for connection to the mains**, transformers in the **fence circuit** shall be placed in a separate compartment. This compartment shall not contain any part that is, or can come, in contact with the mains, with the exception of the input winding of the transformer. The bushings referred to in 22.105 shall be in the wall of this compartment.

Compliance is checked by inspection and by the tests of the other clauses of this standard.

22.103 For metal-encased **class II energizers**, the output terminals shall be placed so that external conductors connected to these terminals are not likely to come into contact with the enclosure.

Compliance is checked by inspection.

22.104 **Energizers** shall be so designed that

- the conductors for the connection of the **fence** and the **earth electrode** can be easily connected;
- it is possible to actuate switches and other controls, if this is necessary in normal use, after the **energizer** has been mounted and connected to the supply, without opening or removing any enclosure that provides protection against harmful ingress of water or unintended electric shock.

Compliance is checked by inspection.

22.105 For **mains-operated energizers** and **battery-operated energizers suitable for connection to the mains**, any assembly gap in **supplementary insulation** shall not be co-incident with any such gap in **basic insulation**, neither shall any such gap in **reinforced insulation** give straight access to **live parts**.

Compliance is checked by inspection.

22.106 In **types A, B and C energizers**, terminals for the connection of the battery and other metal parts in a battery compartment that become accessible when replacing batteries, even with the aid of a **tool**, shall be insulated from **live parts** by **double insulation** or **reinforced insulation**.

In **type D energizers** and **battery-operated energizers**, parts in a battery compartment that become accessible when replacing batteries, even with the aid of a **tool**, shall not be **live parts**.

*Compliance is checked by inspection, measurement and by the tests specified for **double insulation** or **reinforced insulation**.*

22.107 Battery-operated energizers and **battery-operated energizers suitable for connection to the mains** shall be provided with means to prevent the user from being subjected to an electric shock due to the **energizer** output voltage, when connecting a battery to the **energizer**.

Compliance is checked by inspection.

NOTE Examples of such means are:

- a switch that isolates the terminals for the connection of the battery;
- a control that enables the output voltage to be reduced to zero;
- insulated crocodile clips or similar devices.

22.108 Energizer output characteristics shall be such that

- the impulse repetition rate shall not exceed 1 Hz;
- the **impulse duration** of the impulse in the 500 Ω component of the **standard load** shall not exceed 10 ms;
- for **energy limited energizers** the energy/impulse in the 500 Ω component of the **standard load** shall not exceed 5 J;
- for **current limited energizers** the **output current** in the 500 Ω component of the **standard load** shall not exceed for
 - an **impulse duration** of greater than 0,1 ms, the value specified by the characteristic limit line detailed in Figure 102;
 - an **impulse duration** of less than 0,1 ms, 15 700 mA.

*Compliance is checked by measurement when the **energizer** is supplied with the voltage in 11.5, the **energizer** being operated under conditions of **normal operation** but with the **standard load** connected to its output terminals. When measuring the impulse repetition rate the **standard load** is not connected.*

The measurements are made using a measuring arrangement with an input impedance consisting of a non-inductive resistance of not less than 1 M Ω in parallel with a capacitance of not more than 100 pF.

22.109 If the **energizer** is provided with more than one **fence circuit**, the output characteristics shall be within the limits specified in 22.108 for any possible connection of the **fence circuits**.

The impulses for the individual sets of output terminals shall be synchronized and

- the **impulse duration** shall not exceed the value specified in 22.108;
- the impulse repetition rate shall not exceed the value specified in 22.108;

for any possible combination of individual impulses.

Compliance is checked by the measurements specified in 22.108

22.110 For **types A and B energizers** that have terminals for the connection of the battery, the no-load d.c. output voltage shall not exceed 42,4 V.

*Compliance is checked by measuring the no-load d.c. output voltage appearing at the terminals for the connection of the battery when the **energizer** is connected for mains supply and is supplied at **rated voltage**.*

22.111 The peak value of the output voltage, U_0 , shall be measured and recorded to enable the tests and measurements of 14.102, 14.103, 14.104 and 16.3 to be carried out.

Compliance is checked by the following test.

*The peak value of the output voltage is measured, using a measuring arrangement described in 22.108 with the **energizer** supplied with the voltage in 11.5 under conditions of **normal operation**, but with a load connected to the output terminals consisting of a capacitor having a capacitance that can be varied between 0 and 200 nF in steps of approximately 10 nF.*

23 Internal wiring

This clause of Part 1 is applicable except as follows.

23.7 Replacement:

For **mains-operated energizers** and **battery-operated energizers suitable for connection to the mains**, conductors identified by the colour combination green/yellow shall not be used.

Compliance is checked by inspection.

24 Components

This clause of Part 1 is applicable.

25 Supply connection and external flexible cords

This clause of Part 1 is applicable except as follows.

25.1 Addition:

Type D energizers shall be provided with a non-detachable flexible cord with connecting means that are not suitable for connection to the mains, or an appliance inlet, having at least the same degree of protection against moisture as required for the **energizer**, that is not compatible with appliance couplers complying with the standard sheets of IEC 60320.

Compliance is checked by inspection.

25.5 Addition:

The flexible leads or flexible cord used to connect the battery in **battery-operated energizers** shall be assembled with the **energizer** by a **type X attachment**.

25.7 Replacement:

Supply cords, other than the flexible leads or flexible cord connecting an external battery or battery box with an **energizer**, shall not be lighter than

- ordinary polyvinyl chloride sheathed cord (code designation 60227 IEC 53);
- ordinary polychloroprene sheathed cord (code designation 60245 IEC 57).

The ordinary polychloroprene sheathed cord shall be used where, for climatic reasons, the ordinary polyvinyl chloride sheathed cord is not suitable.

Compliance is checked by inspection.

25.8 Addition:

The conductors in flexible leads or flexible cords used to connect the battery in **battery-operated energizers** shall have a nominal cross-sectional area of not less than 0,75 mm².

25.13 Addition:

This requirement is not applicable to the flexible leads or flexible cord connecting external batteries or a battery box with an **energizer**.

25.23 Addition:

In **types A, B, C, D** and **battery-operated energizers**, if the battery is placed in a separate box, the flexible lead or flexible cord connecting the box with the **energizer** is considered to be an **interconnection cord**.

25.101 Battery-operated energizers shall have suitable means for connection of the battery. If the type of battery is marked on the **energizer**, the means of connection shall be suitable for this type of battery.

Compliance is checked by inspection.

26 Terminals for external conductors

This clause of Part 1 is applicable except as follows.

26.1 Addition:

The second sentence of the requirement does not apply to the **energizer** output terminals.

26.5 Addition:

Terminal devices in an **energizer** for the connection of the flexible leads or flexible cord with **type X attachment** connecting an external battery or battery box shall be so located or shielded that there is no risk of accidental connection between supply terminals.

26.9 Addition:

The requirement does not apply to the **energizer** output terminals.

26.101 Output terminals shall be so designed or located that it is not possible to connect the **fence** or the **earth electrode** to the **energizer** by means of a plug that is designed for connection to a socket-outlet for mains supply.

Compliance is checked by inspection and by manual test.

26.102 Output terminals shall be fixed so that they will not work loose when external conductors are connected or disconnected.

Compliance is checked by inspection and by manual test.

26.103 Devices for clamping the conductors connecting the **fence** or the **earth electrode** to the **energizer** shall not serve to fix any other component.

Compliance is checked by inspection.

27 Provision for earthing

This clause of Part 1 is applicable except as follows.

27.1 Addition:

NOTE 101 In **class II energizers** provision may be made for connecting at least one of the output terminals to the **earth electrode**.

28 Screw and connections

This clause of Part 1 is applicable.

29 Clearances, creepage distances and solid insulation

This clause of Part 1 is applicable except as follows.

Addition:

Compliance is also checked by the requirements and measurements of 29.101.

29.101 Clearances between

- **live parts** of the **fence circuit** and other metal parts, or
- metal enclosures and other metal parts of the **energizer**, including foil wrapped around the **supply cord** inside inlet bushings, cord guards, cord anchorages and similar parts,

shall not be less than 25 mm.

The **clearances** between the poles of the supply circuit in **battery-operated energizers** shall be not less than 2 mm, when the **energizer** is fitted with conductors as in normal use.

Compliance is checked by measurement.

30 Resistance to heat and fire

This clause of Part 1 is applicable except as follows.

30.2.1 Modification:

The glow-wire test is made at a temperature of 650 °C.

30.2.2 Not applicable.

31 Resistance to rusting

This clause of Part 1 is replaced by the following.

The enclosure of metal-encased **class II energizers** shall be adequately protected against corrosion.

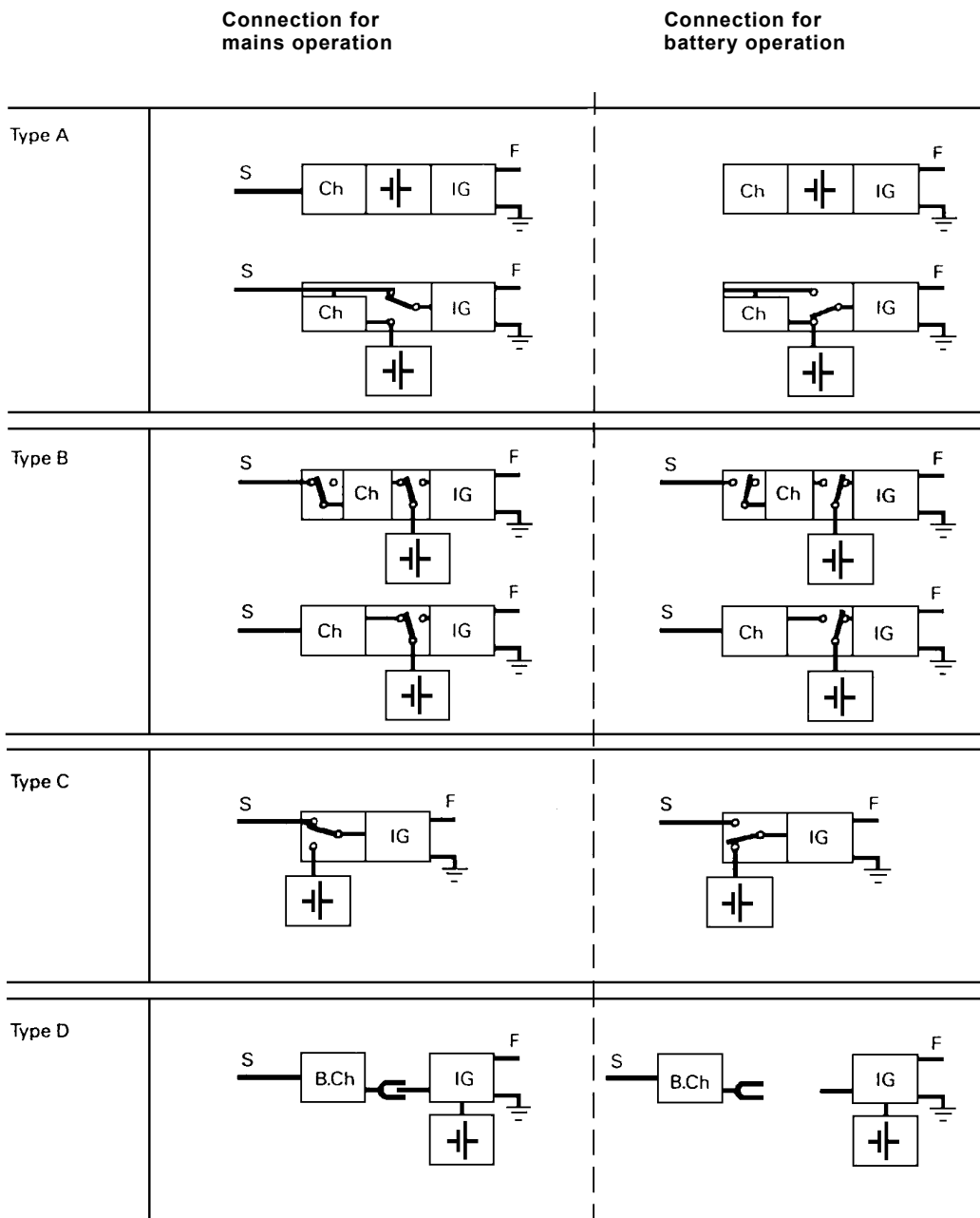
Compliance is checked by the salt mist test of IEC 60068-2-5. Severity 2 is applicable.

Before the test, coatings are scratched by means of a hardened steel pin, the end of which has the form of a cone with an angle of 40°. Its tip is rounded with a radius of 0,25 mm ± 0,02 mm. The pin is loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches are made by drawing the pin along the surface of the coating at a speed of approximately 20 mm/s. Five scratches are made at least 5 mm apart and at least 5 mm from the edge.

After the test, the appliance shall not have deteriorated to such an extent that compliance with this standard is impaired. The coating shall not have broken and shall not have loosened from the metal surface.

32 Radiation, toxicity and similar hazards

This clause of Part 1 is applicable.



IEC 425/97

Key

S = supply mains

Ch = **battery charger** circuit

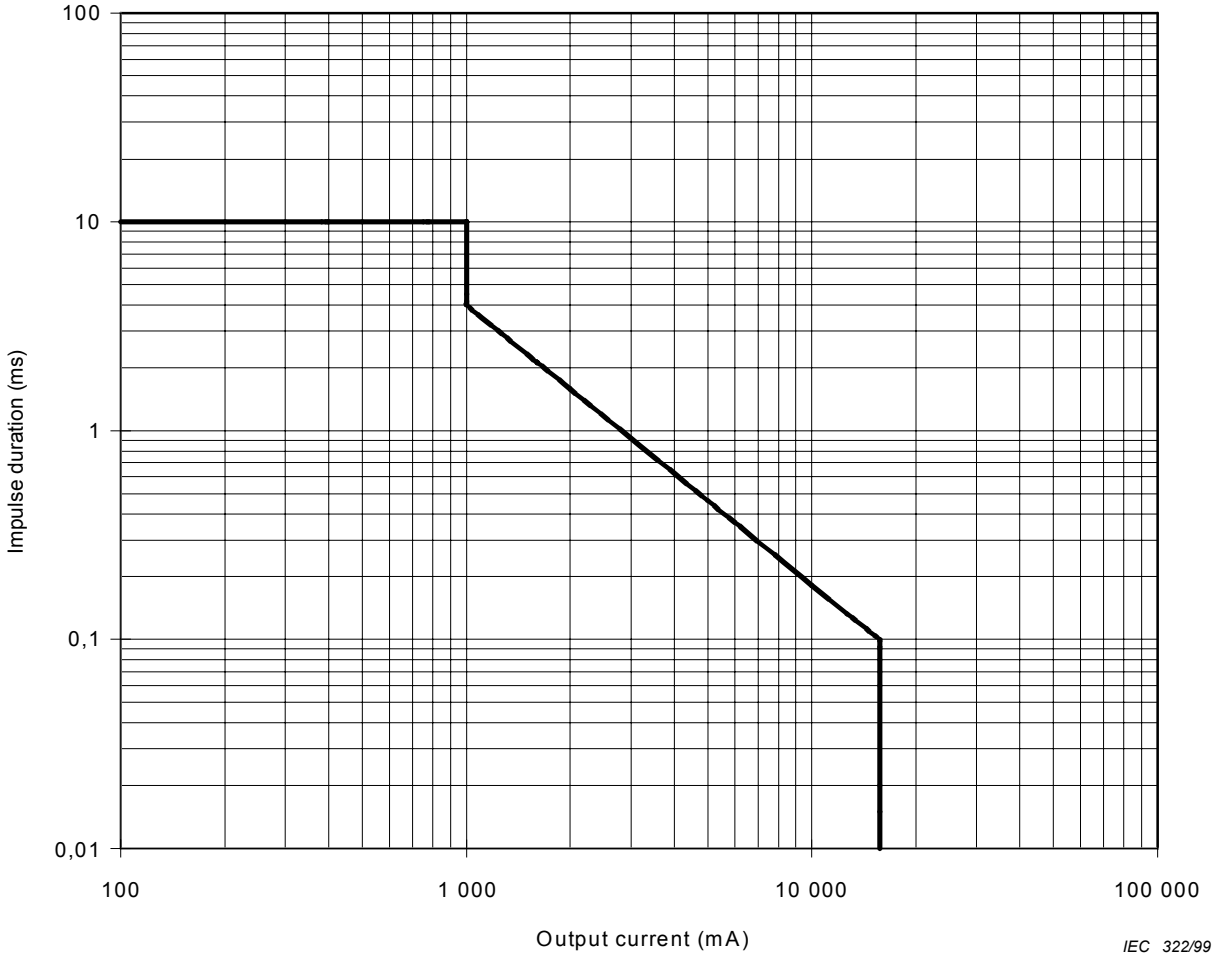
IG = impulse generating circuit

B.Ch = separate **battery charger**

= **battery**

F = **fence** connection

Figure 101 – Schematic examples of the different types of battery-operated energizers suitable for connection to the mains



NOTE The equation of the line relating impulse duration (ms) to output current (mA) for 1 000 mA < output current < 15 700 mA, is given by $\text{impulse duration} = 41,885 \times 10^3 \times (\text{output current})^{-1,34}$

Figure 102 – Current limited energizer characteristic limit line

Annexes

The Annexes of Part 1 are applicable except as follows.

Annex A (informative)

Routine tests

This Annex of Part 1 is applicable except as follows.

A.2 Electric strength test

Addition:

For mains-operated energizers and battery-operated energizers suitable for connection to the mains, an electric strength test is carried out between the mains supply circuit and the fence circuit, the test voltage being 10 000 V, a.c., 50 Hz or 60 Hz for 1 s.

A.3 Functional test

Addition:

The energizer output characteristic shall be checked by operating the energizer at rated voltage with a 500 Ω load connected across the fence terminals.

The energizer output characteristic shall be such that

- the impulse repetition rate shall not exceed 1 Hz;*
- the impulse duration of the impulse shall not exceed 10 ms;*
- for energy limited energizers, the energy/impulse shall not exceed 5 J;*
- for current limited energizers, the output current shall not exceed*
 - the value specified by the characteristic limit line detailed in Figure 102;*
 - for an impulse duration of less than 0,1 ms, 15 700 mA.*

Annex B
(normative)

Appliances powered by rechargeable batteries

This Annex of Part 1 is applicable except as follows.

Addition:

The modifications to 3.19, 11.7, 19 and 30.2 are not applicable.

Annex AA
(informative)

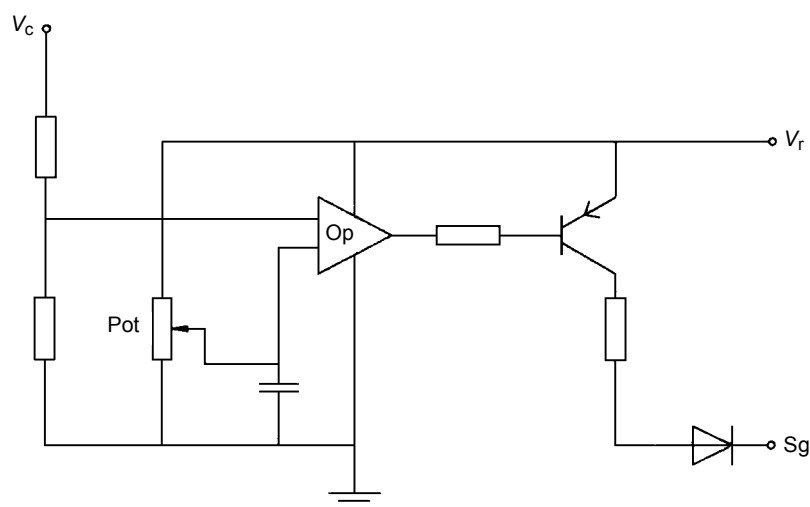
Circuit for the independent control of the switching speed of the major pulse-switching device

A suitable circuit for external independent control of the switching speed of semiconductor devices used as the major pulse-switching device in the **energizer**, in accordance with the eighth dashed item of 19.101, is shown in Figure AA.1.

The circuit is used to reference the gate signal of the major pulse-switching device to the voltage across this device so that it can be triggered at the same point in the charging cycle.

The reference voltage should be of such a value that the comparator is adjustable over the whole range of the **energizer** charging voltage, thereby allowing the switching speed to be set at any desired frequency.

The input impedance of the comparator circuit should be such that it does not influence the results of the test.



Key

V_c = Charging voltage

V_r = Reference voltage

S_g = Gate signal

Pot = Switching speed adjustor

Op = Comparator

Figure AA.1 – Circuit for the independent control of the switching speed of the major pulse-switching device

Annex BB (normative)

Instructions for installation and connection of electric fences

BB.1 Requirements for electric animal fences

Electric animal fences and their ancillary equipment shall be installed, operated and maintained in a manner that minimizes danger to persons, animals or their surroundings.

Electric animal fence constructions that are likely to lead to the entanglement of animals or persons shall be avoided.

An **electric animal fence** shall not be supplied from two separate **energizers** or from independent **fence circuits** of the same **energizer**.

For any two separate **electric animal fences**, each supplied from a separate **energizer** independently timed, the distance between the wires of the two **electric animal fences** shall be at least 2 m. If this gap is to be closed, this shall be effected by means of electrically non-conductive material or an isolated metal barrier.

Barbed wire or razor wire shall not be electrified by an **energizer**.

A non-electrified fence incorporating barbed wire or razor wire may be used to support one or more off-set electrified wires of an **electric animal fence**. The supporting devices for the electrified wires shall be constructed so as to ensure that these wires are positioned at a minimum distance of 150 mm from the vertical plane of the non-electrified wires. The barbed wire and razor wire shall be earthed at regular intervals.

Follow the energizer manufacturer's recommendations regarding earthing.

A distance of at least 10 m shall be maintained between the **energizer earth electrode** and any other earthing system connected parts such as the power supply system protective earth or the telecommunication system earth.

Connecting leads that are run inside buildings shall be effectively insulated from the earthed structural parts of the building. This may be achieved by using insulated high voltage cable.

Connecting leads that are run underground shall be run in conduit of insulating material or else insulated high voltage cable shall be used. Care must be taken to avoid damage to the **connecting leads** due to the effects of animal hooves or tractor wheels sinking into the ground.

Connecting leads shall not be installed in the same conduit as the mains supply wiring, communication cables or data cables.

Connecting leads and **electric animal fence** wires shall not cross above overhead power or communication lines.

Crossings with overhead power lines shall be avoided wherever possible. If such a crossing cannot be avoided it shall be made underneath the power line and as nearly as possible at right angles to it.

If **connecting leads** and **electric animal fence** wires are installed near an overhead power line, the clearances shall not be less than those shown in Table BB1.

Table BB1 – Minimum clearances from power lines for electric animal fences

| Power line voltage V | Clearance m |
|-------------------------|----------------|
| ≤ 1 000 | 3 |
| > 1 000 and ≤ 33 000 | 4 |
| > 33 000 | 8 |

If **connecting leads** and **electric animal fence** wires are installed near an overhead power line, their height above the ground shall not exceed 3 m

This height applies to either side of the orthogonal projection of the outermost conductors of the power line on the ground surface, for a distance of

- 2 m for power lines operating at a nominal voltage not exceeding 1 000 V;
- 15 m for power lines operating at a nominal voltage exceeding 1 000 V.

Electric animal fences intended for deterring birds, household pet containment or training animals such as cows need only be supplied from low output **energizers** to obtain satisfactory and safe performance.

In **electric animal fences** intended for deterring birds from roosting on buildings, no **electric fence** wire shall be connected to the **energizer earth electrode**. A warning sign shall be fitted to every point where persons may gain ready access to the conductors.

Where an **electric animal fence** crosses a public pathway, a non-electrified gate shall be incorporated in the **electric animal fence** at that point or a crossing by means of stiles shall be provided. At any such crossing, the adjacent electrified wires shall carry warning signs.

Any part of an **electric animal fence** that is installed along a public road or pathway shall be identified at frequent intervals by warning signs securely fastened to the fence posts or firmly clamped to the fence wires.

The size of the warning sign shall be at least 100 mm × 200 mm.

The background colour of both sides of the warning sign shall be yellow. The inscription on the sign shall be black and shall be either

- the symbol of Figure BB1, or
- the substance of “CAUTION: **Electric animal fence**”.

The inscription shall be indelible, inscribed on both sides of the warning sign and have a height of at least 25 mm.

Ensure that all mains-operated, ancillary equipment connected to the **electric animal fence circuit** provides a degree of isolation between the fence circuit and the supply mains equivalent to that provided by the **energizer**.

NOTE 1 Ancillary equipment that complies with the requirements relating to isolation between the **fence circuit** and the supply mains in Clauses 14, 16 and 29 of the standard for the **electric fence energizer** is considered to provide an adequate level of isolation.

Protection from the weather shall be provided for the ancillary equipment unless this equipment is certified by the manufacturer as being suitable for use outdoors, and is of a type with a minimum degree of protection IPX4.

BB.2 Requirements for electric security fences

Electric security fences and their ancillary equipment shall be installed, operated and maintained in a manner that minimizes danger to persons, and reduces the risk of persons receiving an electric shock unless they attempt to penetrate the **physical barrier**, or are in the **secure area** without authority.

Electric security fence constructions that are likely to lead to the entanglement of persons shall be avoided.

Gates in **electric security fences** shall be capable of being opened without the person receiving an electric shock.

An **electric security fence** shall not be supplied from two separate **energizers** or from independent **fence circuits** of the same **energizer**.

For any two separate **electric security fences**, each supplied from a separate **energizer** independently timed, the distance between the wires of the two **electric security fences** shall be at least 2,5 m. If this gap is to be closed, this shall be effected by means of electrically non-conductive material or an isolated metal barrier.

Barbed wire or razor wire shall not be electrified by an **energizer**.

Follow the energizer manufacturer's recommendations regarding earthing.

The distance between any **electric security fence earth electrode** and other earth systems shall be not less than 2 m, except when associated with a graded earth mat.

NOTE 1 Where possible the distance between any electric **security fence earth electrode** and other earth systems should preferably be at least 10 m.

Exposed conductive parts of the **physical barrier** shall be effectively earthed.

Where an **electric security fence** passes below bare power line conductors, the highest metallic element shall be effectively earthed for a distance of not less than 5 m on either side of the crossing point.

Connecting leads that are run inside buildings shall be effectively insulated from the earthed structural parts of the building. This may be achieved by using insulated high voltage cable.

Connecting leads that are run underground shall be run in conduit of insulating material or else insulated high voltage cable shall be used. Care must be taken to avoid damage to the **connecting leads** due to the effects of vehicle wheels sinking into the ground.

Connecting leads shall not be installed in the same conduit as the mains supply wiring, communication cables or data cables.

Connecting leads and **electric security fence wires** shall not cross above overhead power or communication lines.

Crossings with overhead power lines shall be avoided wherever possible. If such a crossing cannot be avoided it shall be made underneath the power line and as nearly as possible at right angles to it.

If **connecting leads** and **electric security fence** wires are installed near an overhead power line, the clearances shall not be less than those shown in Table BB2.

Table BB2 – Minimum clearances from power lines for electric security fences

| Power line voltage V | Clearance m |
|-------------------------|----------------|
| ≤1 000 | 3 |
| >1 000 and ≤33 000 | 4 |
| >33 000 | 8 |

If **connecting leads** and **electric security fence** wires are installed near an overhead power line, their height above the ground shall not exceed 3 m

This height applies to either side of the orthogonal projection of the outermost conductors of the power line on the ground surface, for a distance of

- 2 m for power lines operating at a nominal voltage not exceeding 1 000 V;
- 15 m for power lines operating at a nominal voltage exceeding 1 000 V.

A spacing of 2,5 m shall be maintained between uninsulated **electric security fence** conductors or uninsulated **connecting leads** supplied from separate **energizers**. This spacing may be less where conductors or connecting leads are covered by insulating sleeving, or consist of insulated cables rated to at least 10 kV.

This requirement need not apply where the separately energized conductors are separated by a **physical barrier** that does not have any openings greater than 50 mm.

A vertical separation of not less than 2 m shall be maintained between **pulsed conductors** fed from separate **energizers**.

Electric security fences shall be identified by prominently placed warning signs.

The warning signs shall be legible from the **secure area** and the **public access area**.

Each side of the **electric security fence** shall have at least one warning sign.

Warning signs shall be placed

- at each gate;
- at each access point;
- at intervals not exceeding 10 m;
- adjacent to each sign relating to chemical hazards for the information of the emergency services.

Any part of an **electric security fence** that is installed along a public road or pathway shall be identified at frequent intervals by warning signs securely fastened to the fence posts or firmly clamped to the fence wires.

The size of the warning sign shall be at least 100 mm × 200 mm.

The background colour of both sides of the warning sign shall be yellow. The inscription on the sign shall be black and shall be either

- the symbol of Figure BB1, or
- the substance of “CAUTION: **Electric security fence**”.

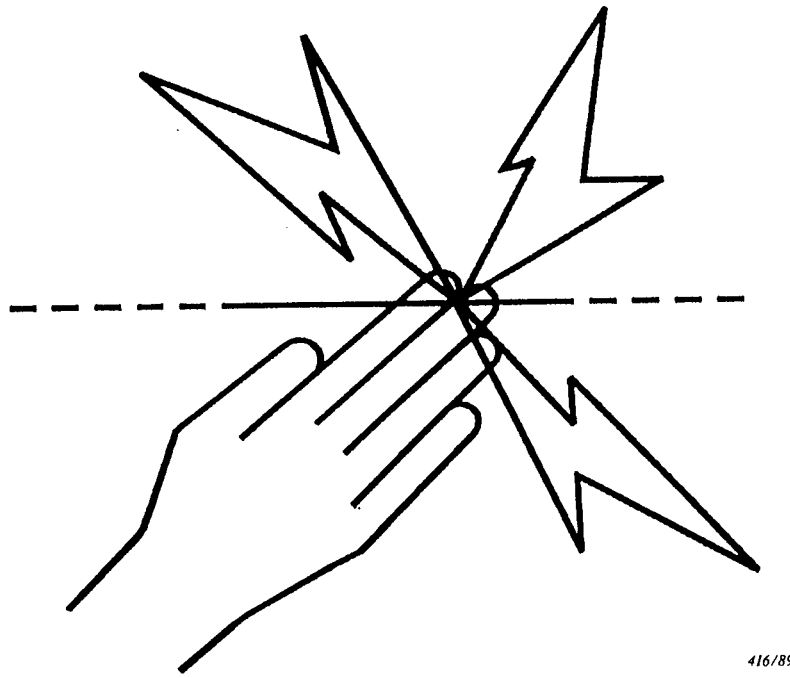
The inscription shall be indelible, inscribed on both sides of the warning sign and have a height of at least 25 mm.

Ensure that all mains operated, ancillary equipment connected to the **electric security fence circuit** provides a degree of isolation between the **fence circuit** and the supply mains equivalent to that provided by the **energizer**.

NOTE 2 Ancillary equipment that complies with the requirements relating to isolation between the **fence circuit** and the supply mains in Clauses 14, 16 and 29 of the standard for the **electric fence energizer** is considered to provide an adequate level of isolation.

Mains supply wiring shall not be installed in the same conduit as signalling leads associated with the **electric security fence** installation.

Protection from the weather shall be provided for the ancillary equipment unless this equipment is certified by the manufacturer as being suitable for use outdoors, and is of a type with a minimum degree of protection IPX4.



416/89

Figure BB1 – Symbol for warning sign

Annex CC (informative)

Installation of electric security fences

CC.1 General

An **electric security fence** should be installed so that, under normal conditions of operation, persons are protected against inadvertent contact with **pulsed conductors**.

NOTE 1 This requirement is primarily intended to establish that a desirable level of safety is present or is being maintained in the **physical barrier**.

NOTE 2 When selecting the type of **physical barrier**, the likely presence of young children should be a factor in considering the size of openings.

CC.2 Location of electric security fence

The **electric fence** should be separated from the **public access area** by means of a **physical barrier**.

Where an **electric fence** is installed in an elevated position, such as a window or skylight, the **physical barrier** may be less than 1,5 m high where it covers the whole of the **electric fence**.

CC.3 Prohibited zone for pulsed conductors

Pulsed conductors shall not be installed within the shaded zone shown in Figure CC1.

NOTE 1 Where an **electric security fence** is planned to run close to a site boundary, the relevant government authority should be consulted before installation begins.

NOTE 2 Typical **electric security fence** installations are shown in Figure CC2 and Figure CC3.

CC.4 Separation between electric fence and physical barrier

Where a **physical barrier** is installed in compliance with CC.3 at least one dimension in any opening should be not greater than 130 mm and the separation between the **electric fence** and the **physical barrier** should be

- within the range of 100 mm to 200 mm or greater than 1 000 mm where at least one dimension in each opening in the **physical barrier** is not greater than 130 mm;
- greater than 1 000 mm where any opening in the **physical barrier** has all dimensions greater than 50 mm;
- less than 200 mm or greater than 1 000 mm where the **physical barrier** does not have any openings.

NOTE 1 These restrictions are intended to reduce the possibility of persons making inadvertent contact with the **pulsed conductors** and to prevent them from becoming wedged between the **electric fence** and the **physical barrier**, thereby being exposed to multiple shocks from the **energizer**.

NOTE 2 The separation is the perpendicular distance between the **electric fence** and the **physical barrier**.

CC.5 Prohibited mounting

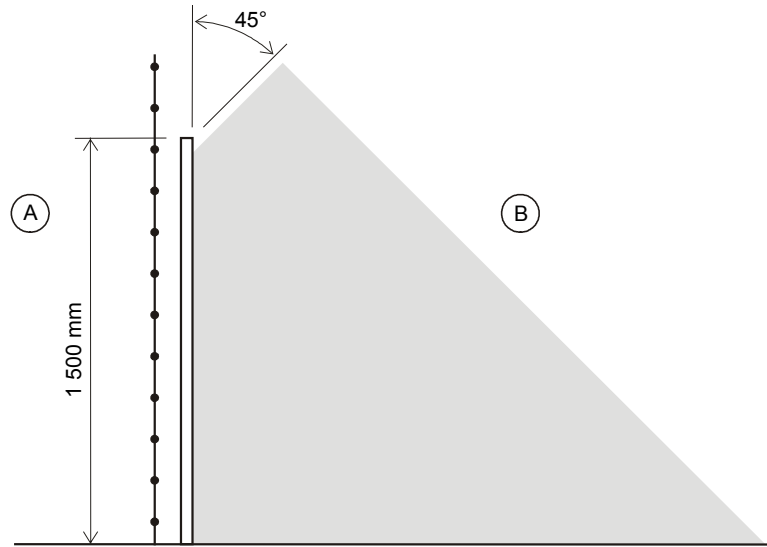
Electric fence conductors should not be mounted on a support used for any overhead power line.

CC.6 Operation of electric security fence

The conductors of an **electric fence** should not be energized unless all authorized persons, within or entering the **secure area**, have been informed of its location.

Where there is a risk of persons being injured by a secondary cause, appropriate additional safety precautions should be taken.

NOTE An example of a secondary cause is where a person may be expected to fall from a surface if contact is made with **pulsed conductors**.



Key



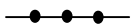
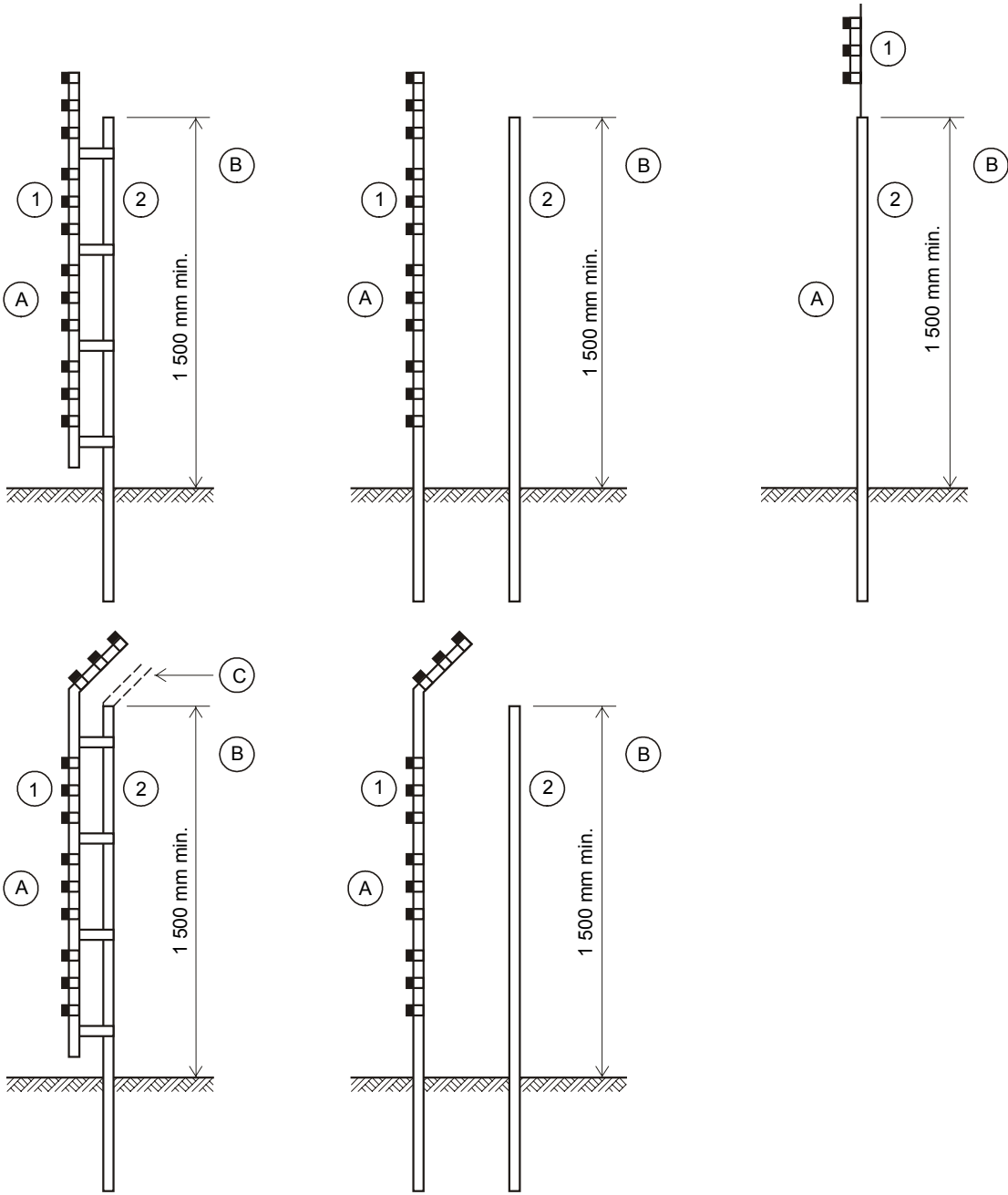
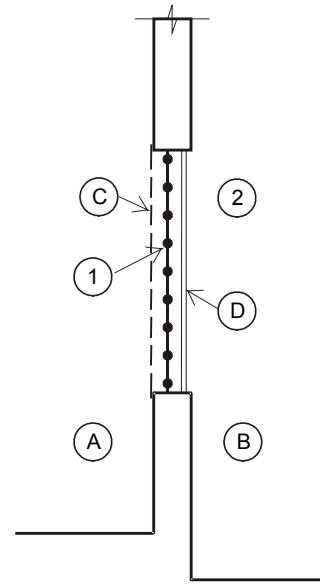
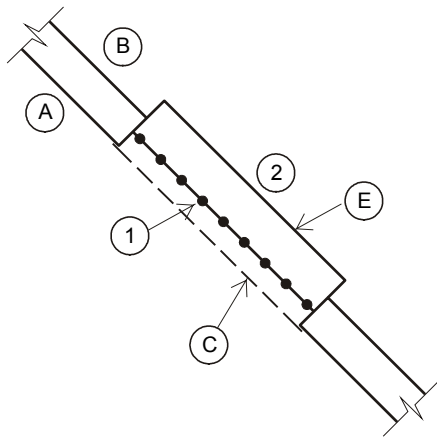
- A = **Secure area**
- B = **Public access area**
-  **Physical barrier**
-  **Prohibited area**
-  **Electric security fence**

Figure CC1 – Prohibited area for pulse conductors



- Key**
- A = Secure area
 - B = Public access area
 - C = Barrier where required
 - 1 = Electric security fence
 - 2 = Physical barrier

Figure CC2 – Typical constructions where an electric security fence is exposed to the public



Key

A = **Secure area**

B = **Public access area**

C = **Barrier where required**

D = **Glass window pane**

E = **Skylight in roof**

1 = **Electric security fence**

2 = **Physical barrier**

Figure CC3 – Typical fence constructions where the electric security fence is installed in windows and skylights

Bibliography

The bibliography of Part 1 is applicable except as follows.

Addition:

IEC 60335-2-86, *Household and similar electrical appliances – Safety – Part 2-86: Particular requirements for electric fishing machines*

IEC 60335-2-87, *Household and similar electrical appliances – Safety – Part 2-87: Particular requirements for electric animal stunning equipment*



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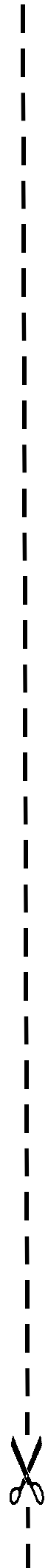
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