ANSI/CPLSO 60335-2-76:2020

Standards Publication

Electric Fence

Restraint/Control/Energy

CPLSO Standard for Electric Fences, ANSI/CPLSO 60335-2-76

First Edition, Dated June 15, 2020

Summary of Topics

The first edition of the Standard for high voltage Electric Fences. This standard specifies the minimum characteristic electrical requirements for effective and safe performance.

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ANSI/CPLSO-17

Standard for Electric Fences

First ANSI Edition

June 15, 2020

ANSI/CPLSO 60335-2-76

This CPLSO Standard consists of the first Edition of ANSI/CPLSO 60335-2-76

CPLSO approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, or effective date information.

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This ANSI Version alters a part of the IEC Standard

There are non-technical changes:

- to add Imperial units (soft).
- to use American English such as “Local utility” rather than “mains”.
- to use American English spelling.
- to reformat for clarity such as 3.5.104 to 3.5.107

There are some technical changes based upon updated references:

3.1.9	“Resistive” is added for clarification since normal operation has a reactive load due to the long wires of the electric fence.
3.1.104	The 2nd half of the sentence is removed due to its redundancy.
3.1.105	RMS measurements are removed since they are obsolete regarding electrical safety of pulses.
3.5.113	Clarified definition using 19.13
3.5.114	Clarified definition using 19.13
3.8.101	The 500 Ω test load is already a conservative low value for human resistance and thus gives a conservative reading for safety. Varying the resistance around 500 Ω adds no safety information.
3.8.101 Note 1	Ceramic high-voltage resistors are ideal non-inductive loads so this note spares unwanted experimentation.
6.101	IEC 60479-2 is being updated to use charge for short pulses instead of RMS current. The “transition” comment is added to allow for flexibility in modern energizers so that they can transition between energy-limited pulses (for burning away vegetation) and charge-limited pulses (for stimulation).
19.	Definition of Rapid-fire is added.
19.12	Removing language referring to obsolete designs. Adding aggregate current in keeping with IEC 60479-2.
19.13	This adds a safe current limit during charge-based rapid-fire operation reduced to 1 Hz for consistency and applied to all of 19.13
22.107	Since the standard test load is non-inductive, there is no need to segregate a resistive component.
22.107 Note	Change to use a charge-limit instead of current formulas
22.112	The 500 Ω test load is already a conservative low value for human resistance and thus gives a conservative reading for safety. Varying the resistance around 500 Ω adds no safety information.
22.113	Clarifying that this applies to normal and not rapid-fire operation.
22.114	Change to use a charge-limit instead of current formulas.
Figure 103	RMS measurements are removed since charge is used regarding electrical safety of pulses.
A3	RMS measurements are removed since charge is used regarding electrical safety of pulses.
ANNEX AA	This standard does not require any “informative” help from an obsolete designs.
BB1	This standard is not directed towards animal control.

CONTENTS

FORWARD

Requirements for electric fence energizers

1 Scope

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

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

– **Local utility-powered energizers**;

– **battery-operated electric fence energizers suitable for connection to the local utility**, as shown in Figure 101 and Figure 102;

– **electric fence energizers** operated by 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 can be necessary;

NOTE 103 This standard does not apply to

– electromagnetically coupled animal trainer collars;

– appliances intended to be used in locations where special conditions prevail, such as the presence of a corrosive or explosive atmosphere (dust, vapor or gas);

– separate battery chargers (IEC 60335-2-29);

– electric fishing machines (IEC 60335-2-86);

– electric animal-stunning equipment (IEC 60335-2-87);

– electric fences used for animal containment (IEC 60335-2-76);

– appliances for medical purposes (IEC 60601).

2 Normative references

This clause of IEC 60335-1 is applicable except as follows.

Addition:

IEC 60068-2-52:2017, *Environmental testing – Part 2: Tests – Test Kb: Salt mist, cyclic (sodium chloride solution)*

IEC 60320-3, *Appliance couplers for household and similar general purposes – Part 3: Standard sheets and gauges*

ISO 3864-1, *Graphical symbols – Safety colors and safety signs – IEC 60335-1 : Design principles for safety signs and safety markings*

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

IEC 60335-1, *Household and similar electrical appliances – Safety – IEC 60335-1 : General requirements*

3 Terms and definitions

This clause of IEC 60335-1 is applicable except as follows.

3.1 Definitions relating to physical characteristics

3.1.1 *Addition:*

Note 1 to entry: For **type D energizers**, the **rated voltage** of the **energizer** is the **rated voltage** for battery supply.

Replacement:

3.1.9
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 resistive load connected to the output terminals

Note 1: It is noted that with long wires (> 0.6 miles (1 km)) the load does become resistive as it approaches the 377 Ω of free space.

3.1.101
prospective peak voltage
peak output voltage of the impulse generator specified in Clause 14 obtained with the **energizer** not connected to a resistive test circuit

3.1.102
rated voltage for battery supply
voltage for battery supply, for **type A energizers**, **type B energizers**, **type C energizers** and **type D energizers** assigned to the **energizer** by the manufacturer

3.1.103
rated voltage range for battery supply
voltage range for battery supply, for **type A energizers**, **type B energizers**, **type C energizers** and **type D energizers** assigned to the **energizer** by the manufacturer, expressed by its lower and upper limits

3.1.104
impulse duration
duration of that part of the impulse that contains 95 % of the overall energy with the resistive standard load.

3.1.105

3.5 Definitions relating to types of appliances 3.5.101
electric fence energizer
appliance that is intended to deliver voltage impulses to a **fence** connected to it

Note 1 to entry: **Electric fence energizers** are hereinafter also referred to as **energizers**.

3.5.102
Local utility-powered energizer
energizer designed for direct connection to the local utility

3.5.103
battery-operated energizer suitable for connection to the local utility energizer
– operated by batteries and having, or being designed for connection to, facilities for charging these batteries from the local utility, or
– designed for operation from the local utility and from batteries
–

3.5.104
type A energizer

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

Note 1 to entry: **Type A energizers** are shown schematically in Figure 101.

3.5.105
type B energizer

- **battery-operated energizer suitable for connection to the local utility** 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 local utility when the **energizer** is in operation.

Note 1 to entry: For recharging the battery, the impulse generating circuit is disconnected and rendered inoperable.

Note 2 to entry: **Type B energizers** are shown schematically in Figure 101.

3.5.106
type C energizer

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

Note 1 to entry: **Type C energizers** are shown schematically in Figure 101.

3.5.107
type D energizer

- **battery-operated energizer suitable for connection to the local utility** consisting of an impulse generating circuit
- intended to be powered by a battery, or a **detachable supply unit**, when the **energizer** is in operation.
- The impulse generating circuit or the battery may be connected to a **detachable supply unit** with or without incorporated battery charging circuitry for recharging the battery when the **energizer** is in operation.

Note 1 to entry: Examples of **Type D energizers** are shown schematically in Figure 102.

3.5.108
battery-operated energizer
energizer deriving its energy solely from batteries or other sources of energy and not designed for connection to the local utility

3.5.109
security electric fence energizer
energizer containing **fence circuits** that are intended to periodically deliver voltage impulses into **electric security fences**

Note 1 to entry: A **security electric fence energizer** is hereinafter also referred to as a **security energizer**.

3.5.110
independently timed security energizer
security energizer that includes an internal **impulse timing signal source** to set the timing of the voltage impulses it delivers to an **electric security fence**

Note 1 to entry: An **independently timed security energizer** is hereinafter also referred to as **an independent security energizer**.

3.5.111
dependently timed security energizer
security energizer that is dependent on an external **impulse timing signal** to set the timing of the voltage impulses it delivers to an **electric security fence**

Note 1 to entry: A **dependently timed security energizer** is hereinafter also referred to as **dependent security energizer**.

Note 2 to entry: Some types of **security energizer** may be configured either as an **independent security energizer** or a **dependent security energizer** at the time of installation.

3.5.112
security energizer group
A group of 1 or 2 **security energizers** with a group total of 2 **fence circuits** used to supply adjacent **electric security fences** in a **security energizer fence system** that allows the 2 **fence circuits** to be contacted at the same time

Note 1 to entry: The **fence circuits** in a **security energizer group** may be galvanically connected.

3.5.113
type R security energizer
security energizer with 1 or 2 **fence circuits where the energy per impulse delivered by each fence circuit into the standard load shall not exceed 2.5 J and is only** suitable for use in a **type R security energizer group**

3.5.114
type R security energizer group
security energizer group containing only **type R security energizers**

3.5.115
type S security energizer
security energizer with 1 or 2 **fence circuits** where the energy shall not exceed 5J and is only suitable for use in a **type S security energizer group**

3.5.116
type S security energizer group
security energizer group containing at least one **type S security energizer**

Note 1 to entry: A **type S security energizer group** may contain a **type R security energizer**.

3.6 Definitions relating to parts of an appliance

3.6.3 *Addition:*

Note 101 to entry: 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**.

Replacement:

3.6.4
live part
conductive part that may cause an electric shock

3.6.101
fence circuit
all conductive parts or components within an **energizer**, that are connected or intended to be connected galvanically to the output terminals

3.6.102
security energizer impulse timing signal
signal that is used to determine the timing of the periodic voltage impulses delivered by a **security energizer** to an **electric security fence**

Note 1 to entry: A **security energizer impulse timing signal** is hereinafter also referred to as an **impulse timing signal**.

Note 2 to entry: Examples of a **security energizer impulse timing signal** include wired (RS-485), wired with latency (internet clock, secure TCP/IP), wireless with latency (LAN, PAN), optical, GPS.

3.6.103
impulse timing signal source
signal source that generates the **impulse timing signal** required by a **dependent security energizer** to set the timing of the voltage impulses it delivers to an **electric security fence**

Note 1 to entry: An **impulse timing signal source** may be used by one or more **dependent security energizers**.

Note 2 to entry: An example of an **impulse timing signal source** is an impulse signal from an adjacent **electric security fence** that is powered by an **independent security energizer** that belongs to the same **security energizer fence system**.

Note 3 to entry: An impulse signal from an adjacent **electric security fence** powered by an **independent security energizer** not belonging to the same **security energizer fence system** is not an example of a possible **impulse timing signal source**.

3.8 Definitions relating to miscellaneous matters

3.8.101
standard load
load consisting of a non-inductive resistor of 500 ± 2.5 Ω

Note 1 Ceramic high-voltage resistors are recommended.

3.8.102
ground electrode
metal structure that is driven into the ground near an **energizer** and connected electrically to the output ground terminal of the **energizer**, and that is independent of other grounding arrangements

3.8.103
pulsed conductors
conductors that are subjected to high voltage pulses by the **energizer**

3.8.104
connecting lead
electric conductor, used to connect the **energizer** to the **electric fence** or the **ground electrode**

3.8.105
fence
barrier for animals or for security purposes, comprising one or more conductors, such as metal wires, rods or rails

3.8.106
electric fence
barrier that includes one or more electric conductors, insulated from ground, to which electric pulses are applied by an **energizer**

3.8.107

3.8.108
electric security fence
fence used for security purposes that comprises an **electric fence** and a physical barrier electrically isolated from the **electric fence**

3.8.109
physical barrier
barrier not less than 5ft (1.5m) high intended to prevent inadvertent contact with the **pulsed conductors** of the **electric fence**

Note 1 to entry: **Physical barriers** are typically constructed from vertical sheeting, rigid vertical bars, rigid mesh, rods or chain-wire mesh.

3.8.110
public access area
any area where persons are protected from inadvertent contact with **pulsed conductors** by a **physical barrier**

3.8.111
secure area
area where a person is not protected from **pulsed conductors** by a **physical barrier**

3.8.112
security energizer fence system
electric security fence installation where the **fences** are energized by one or more **security energizers** containing one or more **security energizer groups** that can be **type R security energizer groups** or **type S security energizers groups**

Note 1 to entry: An **independent impulse timing signal source** used in a **security energizer fence system** may be used to set the timing of **dependent security energizers** in multiple **security energizer groups**.

4 General requirement

This clause of IEC 60335-1 is applicable.

5 General conditions for the tests

This clause of IEC 60335-1 is applicable except as follows.

5.2 *Modification:*

Replace the test specification by the following:

The tests are made on 2 ***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 22.108 and Clause 18. However, the tests of Clauses 22 to 28 may be made on separate samples.*

*For **type A energizers** and **type 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 can be used 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.

*If any **electronic component** has been damaged during the tests of Clause 14, the tests of Clause 19 are made 2x (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 grounding terminal of the **fence circuit** is connected to ground. However, if there is no indication as to which of the output terminals is to be connected to ground, the terminal that gives the most unfavorable result is grounded.*

5.8.1 *Addition:*

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

*For **Local utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility**, the reference source impedance of the local utility supply shall be 0.4 + j0.25 Ω.*

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

6 Classification

This clause of IEC 60335-1 is applicable except as follows.

6.1 *Replacement:*

Local utility-powered energizers and **battery-operated energizers suitable for connection to the local utility** 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, see IEC 60529 water splash rating.

6.101 Energizers are classified as being either **energy limited energizers** or **charge limited energizers**. An energizer is allowed to transition between energy and charge limited pulses.

Compliance is checked by the appropriate tests.

7 Marking and instructions

This clause of IEC 60335-1 is applicable except as follows.

7.1 *Addition:*

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

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

Energizers shall be marked with symbol ISO 7000-0790 (2004-01).

Type R security energizers shall be marked with symbol IEC 60417-6406 (2018-02).

Type S security energizers shall be marked with symbol IEC 60417-6407 (2018-02).

7.6 *Addition:*

	[symbol IEC 60417-5036 (2002-10)]	dangerous voltage
	[symbol IEC 60417-5017 (2006-08)]	ground
	[symbol IEC 60417-6406 (2018-02)]	time synchronized type R security energizer
	[symbol IEC 60417-6407 (2018-02)]	time synchronized type S security energizer

The symbols for output (**fence**) and output (ground) shall be in accordance with symbols IEC 60417-5036 (2002-10) and IEC 60417-5017 (2006-08) respectively.

7.12 *Addition:*

Instructions for battery-operated energizers suitable for connection to the local utility shall

– include a warning against using non-rechargeable batteries while the **energizer** is powered by the local utility;
– state that, during charging, vented rechargeable-batteries shall be placed in a well ventilated area.

Instructions for **type D energizers** shall list accessories made available by the manufacturer.

7.14 *Addition:*

The outer diameter of the circle of symbol IEC 60417-6406 (2018-02) and symbol IEC 60417-6407 (2018-02) shall be at least 0.6 inch (15 mm).

7.101 Unless the correct mode of connection is obvious or irrelevant, the output terminals of the **energizer**, other than dedicated output ground terminals, shall be clearly and indelibly identified using symbol IEC 60417-5036 (2002-10). Dedicated output ground terminals shall be clearly and indelibly identified using symbol IEC 60417-5017 (2006-08).

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 height of characters in the marking shall not be less than that given by an 18 point font and the symbols shall have a height of at least 0.6 inch (15 mm).

Compliance is checked by inspection and measurement.

7.102 For **battery-operated energizers suitable for connection to the local utility**, the supply terminals for connection to the battery shall be clearly indicated by symbol IEC 60417-5005 (2002-10) for positive polarity, and by symbol IEC 60417-5006 (2002-10) for negative polarity, unless the polarity is irrelevant.

Compliance is checked by inspection.

7.103 **Energizers** shall be supplied with instructions that contain the information given in Annex BB 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 Clause BB.1 (electric animal fences), Clause BB.2 (electric security fences not supplied from a security energizer group) or Clause BB.3 (electric security fences supplied from a security energizer group), as appropriate.

Energizers intended for use with **electric security fences** may also be supplied with the information given in Annex CC.

Compliance is checked by inspection.

7.104 The instructions for a **security energizer** that is suitable for use in a **security energizer group** shall contain the substance of the following:

– only type R security energizers or type S security energizers can be used in security energizer groups;

– a type S security energizer shall not be used in a type R security energizer group;

– a type R security energizer may be used in a type S security energizer group;

– identification of the model or type reference of security energizers that are permitted to be used in the security energizer group;

– security energizer groups shall only include security energizers that are identified in the instructions;

– the permitted configurations and connections of security energizers that may be used in the security energizer groups;

– identification of the model or type reference of the device producing the impulse timing signal source that is suitable for use in the security energizer group;

– a security energizer fence system must be configured and installed by, or under the responsibility of an authorized installer;

– a security energizer fence system shall be serviced and maintained by, or under the responsibility of an authorized installer;

– after installation, a label shall be attached to each energizer in a security energizer group that provides the authorized installer's name, contact details and the installation date;

– after servicing, a label shall be attached to each energizer in a security energizer group that provides the authorized installer's name, contact details and the service date;

– an authorized installer is a person suitably trained by the manufacturer to be able to safely configure, install and maintain a **security energizer fence system** on the basis of professional training, knowledge, experience and familiarity of the relevant equipment.

The instructions for a **security energizer** that is suitable for use in a **security energizer group** shall

– provide an explanation of the hazards of not using **security energizer groups** in locations where 2 electric security fences can be contacted at the same time;

– provide an explanation of the hazards of not correctly configuring a **security energizer** when used in a **security energizer group**. These hazards include:

  - receiving a too large impulse;
  - receiving consecutive 2 impulses that are not spaced apart enough in time;
  - touching an electric security fence whose isolation from the supply local utility has been compromised;

– explain the meaning of the time synchronized symbols IEC 60417-6406 (2018-02) and IEC 60417-6407 (2018-02), if they are used;

– provide a general explanation of the safety objectives and technical requirements of a **security energizer group** that can be properly understood by an authorized installer;

– provide a general explanation of the safety objectives and technical requirements of a **security energizer fence system** that can be correctly understood by an authorized installer.

The front section of the instructions shall include the substance of the following warnings:

IMPORTANT WARNINGS

WARNING: These instructions must be fully complied with in every respect

WARNING: A security energizer group must be used at any point where 2 electric security fences can be contacted by a person at the same time

WARNING: Give special attention to the correct type selection and connection of security energizers used in a security energizer group

WARNING: A security energizer fence system should be checked for safety by an authorized installer prior to operation

DANGER: Failure to comply fully with the instructions could lead to a fatal electric shock

Compliance is checked by inspection.

8 Protection against access to live parts

This clause of IEC 60335-1 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 IEC 60335-1 is not applicable.

10 Power input and current

This clause of IEC 60335-1 is applicable except as follows.

10.101 For **energy limited energizers** that are marked with a maximum energy per impulse exceeding 5 J, the value so marked shall not deviate from that delivered by more than ± 10 % and the load resistance at which it is obtained shall not deviate from the value marked on the **energizer** by more than ± 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 IEC 60335-1 is applicable except as follows.

11.2 *Addition:*

*For **type A energizers** when connected for local utility supply, **type D energizers** when connected for battery charging supply and **type B energizers** when connected for local utility supply with battery charge operation, a battery of the largest capacity 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 a voltage of 75% of its nominal value.*

11.5 *Replacement:*

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

*A **Local Utility-powered energizer** is supplied with the most unfavorable supply voltage between 85%-110% of the **rated voltage**.*

Type A energizers *and* ***type C energizers****, when they are connected for local utility supply, are supplied with the most unfavorable supply voltage between 85%-110% of the* ***rated voltage****.*

A ***type B energizer****, when it is connected for local utility supply with battery charge operation, is supplied with the most unfavorable supply voltage between 85%-110% of the* ***rated voltage****.*

Type A energizers*,* ***type B energizers****,* ***type C energizers*** *and* ***type D energizers****, when they are connected for battery supply, are supplied at the terminals for the connection of the battery with the most unfavorable supply voltage between*

- *55% - 110% of the* ***rated voltage for battery supply****, if the* ***energizer*** *can be used with non-rechargeable batteries;*
- *75% - 110% of the* ***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***	
	Non-rechargeable batteries	***Rechargeable batteries***
110% of the rated voltage for battery supply	*80 mΩ*	*1.2 mΩ*
100% of the rated voltage for battery supply	*100 mΩ*	*1.5 mΩ*
75% of the rated voltage for battery supply	*750 mΩ*	*6 mΩ*
55% of the rated voltage for battery supply	*2 Ω*	*–*
NOTE When determining the internal resistance of a battery, 2 or more cells connected in parallel are considered to be 1 (a single) cell.		

Type D energizers *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 RMS value equal to the* ***rated voltage for battery supply****,*
- *a full-wave rectified sine-wave with an RMS value equal to the* ***rated voltage for battery supply****,*

whichever is the more unfavorable.

Security energizers *used in a* ***security energizer group*** *shall be tested together in any permitted configuration and connection that may be allowed in the group.*

The maximum and minimum supply voltage values are set in accordance with Table 102 using multiplier factors based on the ***rated voltage*** *or* ***rated voltage range*** *of the appliance.*

Table 102 – Rated supply voltage maximum and minimum value multiplier factors

Supply voltage value	***Local utility***	***Battery (rechargeable)***	***Battery (non-rechargeable)***
Minimum	*85%*	*75%*	*55%*
Maximum	*110%*	*110%*	*110%*

*The **security energizer** feeding the 1st **fence circuit** is operated, for a given supply voltage type, on 3 supply voltage value settings in turn, the minimum value, the maximum value and one freely selected value between the minimum and maximum values, while the **security energizer** feeding the 2nd **fence circuit** is supplied, for a given supply voltage type, with any supply voltage varied between the maximum and minimum values that is selected to produce the most unfavorable result.*

*The above tests are repeated, but with the first and second **security energizer** settings reversed. Refer to Table 103.*

Table 103 – Supply voltage value test settings

Test	*1st fence circuit supply*	*2nd fence circuit supply*
1	*Maximum value*	*Selected for worst case*
2	*Minimum value*	*Selected for worst case*
3	*Freely selected value*	*Selected for worst case*
4	*Selected for worst case*	*Maximum value*
5	*Selected for worst case*	*Minimum value*
6	*Selected for worst case*	*Freely selected value*

The above tests are repeated for both local utility and battery supply voltage operation as applicable in accordance with Table 104.

Table 104 – Test supply sequence for different supply type

Test	*1st fence circuit supply*	*2nd fence circuit supply*
MM	*Local utility*	*Local utility*
MB	*Local utility*	*Battery*
BM	*Battery*	*Local utility*
BB	*Battery*	*Battery*

NOTE 101 For a typical **security energizer group**, based on 2 **security energizers** that both can run on local utility or rechargeable battery, there would be a total of 24 tests performed. However, in some cases where only local utility or battery operation is indicated, the number can be less or in the case where a non-rechargeable battery option is also included, the number of tests could be doubled.

11.7

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

12 Void

13 Leakage current and electric strength at operating temperature

This clause of IEC 60335-1 is applicable except as follows.

***13.1** Modification:*

*Compliance is checked by the tests of 13.2 and 13.3 for **Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility** only.*

Addition:

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

14 Transient over-voltages

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 **Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility**.*

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.

***Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility** are fixed to a metal plate having dimensions that are at least 6 inch (150mm) in excess of those of the orthogonal projection of the **energizer** on the plate, and are then installed as in normal use.*

The tests are made by means of an impulse generator producing positive and negative full lightning impulses having an upslope rise time of 1.2 µs and a time to 50% decay of 50 µs, the tolerances being

- *± 5 % for the peak value;*
- *± 30 % for the rise time;*
- *± 20 % for the time to 50% decay.*

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 1/2 of the upslope, 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 upslope 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** A total of 5 positive and 5 negative impulses, each having a **prospective peak voltage** of $2U_0$ but not less than 25 kV, are applied between*

- *the output terminals and AC input terminals connected together and the metal plate, for **Local Utility-powered energizers** and **type A energizers**, **type B energizers** and **type C energizers**,*
- *the output terminals and the metal plate, for **type D energizers**, the*

interval between consecutive impulses being at least 10 s.

***Type D energizers** are further tested as follows.*

*Each specified **detachable supply unit** is connected to the impulse generating circuit of the **energizer** in turn. The impulse voltages are applied between the **energizer** output terminals and the AC input terminals of the specified **detachable supply unit** connected together and the metal plate.*

14.103 *A total of 5 positive and 5 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 AC input terminals connected together, for* ***Local Utility-powered energizers*** *and* ***type A energizers****,* ***type B energizers*** *and* ***type 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 a single* ***fence circuit****, each* ***fence circuit*** *is subjected to this test in turn, the other* ***fence circuits*** *being open-circuited.*

Type D energizers *are further tested as follows.*

Each specified ***detachable supply unit*** *is connected to the impulse generating circuit of the* ***energizer*** *in turn. The impulse voltages are applied between the* ***energizer*** *output terminals and the AC input terminals of the specified* ***detachable supply unit*** *connected together and the metal plate.*

14.104 *A total of 5 positive and 5 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. For* ***type D energizers****, the input terminals of the impulse generating circuit are open-circuited.*

15 Moisture resistance

This clause of IEC 60335-1 is applicable.

16 Leakage current and electric strength

This clause of IEC 60335-1 is applicable except as follows.

16.1 *Modification:*

Compliance is checked by the tests of 16.2, 16.3 and 16.101 for ***Local Utility-powered energizers*** *and* ***battery-operated energizers suitable for connection to the local utility****.*

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 105.

Table 105 – Additional test voltages

Points of application	*Test voltage*[a]
Between the local utility supply circuit and ***accessible parts*** *for metal-encased* ***class II energizers***	*$2U_0$ but not less than 10k V $2U_0$*
Between the ***fence circuit*** *and* ***accessible parts***[b]	*but not less than 10k V*
Between the local utility supply circuit and the ***fence circuit***	*$2U_0$ but not less than 10 k V*

[a] The value $2U_0$ is a peak value equal to twice (2 x) the maximum peak value of the output voltage measured in 22.111.

[b] A gap of 2in (50 mm) around the output terminal shall be provided in the metal foil in contact with **accessible parts**.

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

The values measured shall be within the limits specified in 22.108.

17 Overload protection of transformers and associated circuits

This clause of IEC 60335-1 is not applicable.

18 Endurance

This clause of IEC 60335-1 is replaced by the following.

Local Utility-powered energizers and **battery-operated energizers suitable for connection to the local utility** 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.

Local Utility-powered energizers*,* ***type A energizers*** *and* ***type C energizers*** *when they are connected for local utility supply are operated under conditions of* ***normal operation****. The voltage applied is the* ***rated voltage****.*

Type D energizers *are operated under conditions of* ***normal operation****. The voltage applied is as specified in 11.5.*

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 capacity 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 75% of its nominal voltage for a rechargeable battery or to 55% of its nominal voltage for a non-rechargeable battery or until the* ***energizer*** *ceases to function due to low battery voltage.*

For ***type A energizers****, a battery of the largest capacity 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 75% of its nominal value.*

*The other sample, for **type A energizers** and **type C energizers**, is to be connected for battery supply and supplied from a battery of the largest capacity 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 75% of its nominal voltage for a rechargeable battery or to 55% of its nominal voltage for a non- rechargeable battery.*

*The **energizer** is operated continuously for 168 h (7 days) at an ambient temperature of –15 ± 2 °C and then for 168 h (7 days) at an ambient temperature of 50 ± 2 °C.*

The output terminals are loaded with a non-inductive resistor of 500 ± 2.5 Ω 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.

*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 Rapid Fire operation

This clause of IEC 60335-1 is applicable except as follows.
Rapid-fire operation refers to the delivery of pulses at a rate > 1 Hz.

19.1 *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.

***Energizers** are also subjected to the tests of 19.101, 19.102, 19.103, 19.104 and 19.105.*

***Security energizer groups** are also subjected to the tests of 19.106 and 19.107 as if they were an **energizer** supplied in one or more parts.*

19.12 *Addition:*

The aggregate current is calculated as:

I_{agg} *= Qf where Q is the charge per pulse and f is the pulse rate. For example, if each pulse has a charge of 100 µC and the pulse rate is 10 Hz then*

I_{agg} *= 100 µC • 10 Hz = 1 mA*

19.13 *Addition:*

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

*For a **type R security energizer**, during the tests the output characteristics of each **fence circuit** shall be as specified in 22.108 except for the impulse repetition rate and 22.113. For an energy rated device (or during energy-defined operation), if the impulse repetition rate is greater than 1.0 Hz, the discharge into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 1.25 W.*

For a charge rated device (or during charge-defined operation), If the impulse repetition rate is greater than 1.0 Hz, the aggregate discharge current into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2.2 mA.

*For all other **energizers**, during the tests the output characteristics of each **fence circuit** shall be as specified in 22.108 except for the impulse repetition rate. For an energy rated device (or during energy-defined operation), if the impulse repetition rate is greater than 1.0 Hz, the discharge power into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2.5 W. For a charge rated device (or during charge-defined operation), if the impulse repetition rate is greater than 1.0 Hz, the aggregate discharge current into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2.2 mA.*

*For a **type R security energizer group**, during the tests the impulse synchronization shall be as specified in 22.114. For an energy rated device (or during energy-defined operation), if the impulse repetition rate is greater than 1.0 Hz, the discharge power into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2.5 W. For a charge rated device (or during charge-defined operation), if the impulse repetition rate is greater than 1.0 Hz, the aggregate discharge current into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2.2 mA.*

*For a **type S security energizer group**, during the tests the combined **fence circuit** output characteristics measured in the 500 Ω resistor R_T shall be as specified in 22.115 for test configurations 5 and 6 except for the impulse repetition rate. For an energy rated device (or during energy-defined operation), if the impulse repetition rate is greater than 1.0 Hz, the discharge power into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2.5 W. For a charge rated device (or during charge-defined operation), if the impulse repetition rate is greater than 1.0 Hz, the aggregate discharge current into a load consisting of a non-inductive resistor of 500 Ω shall not exceed 2.2 mA.*

***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 unfavorable 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 unfavorable position, even if these parts are not intended to be adjusted by the user, unless they are effectively sealed against further adjustment;*
- *the grounding conductor is removed from the grounding 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 generating circuit, are short-circuited or open-circuited, whichever is the more unfavorable;*
- *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 0.20 inch (5 mm) for the **fence circuit**, or 0.08 inch (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 impulse-switching device shall be varied from 1 pulse per 10 seconds to 2 x (twice) the **rated pulse-rate**, in approximately a 1:2:5 progression sequence over 3 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 impulse-switching device are given in Annex AA.

19.102 ***Type A energizers***, ***type C energizers*** *and* ***type 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 local utility operation, terminals for the connection of the battery supply are connected to the most unfavorable resistive load, including a short circuit.*

19.103 ***Type B energizers*** *connected for local utility 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 unfavorable resistive load, including a short circuit.*

19.104 ***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.*

19.105 ***Battery operated energizers suitable for connection to the local utility*** *having a* ***rated voltage for battery supply*** *of less than 12 V are operated under* ***normal operation*** *when supplied with an input voltage of 13.2 V DC.*

During the test, the ***energizer*** *shall be connected to the voltage source via a 1 Ω series resistor.*

This test is only applicable if the supply may be connected without modification of the ***energizer****.*

19.106 ***Type S security energizer groups*** *are tested for every permitted configuration and connection specified in the instructions. As such, during the tests only a single fault is applied at a time in any one of the parts.*

19.107 ***Security energizer groups*** *are subjected to fault testing of the* ***impulse timing signal source****. All possible* ***impulse timing signal*** *outputs are considered for faults occurring within the* ***impulse timing signal source*** *such as stopping, intermittent operation, low level, high level, variable rate, high rate. Whenever possible when an external* ***impulse timing signal source*** *is used, a fault shall be introduced such that the* ***impulse timing signal source*** *is no longer a viable method of synchronization. However, if it can be shown that a particular fault condition is unlikely to occur then it should not be considered.*

20 Stability and mechanical hazards

This clause of IEC 60335-1 is not applicable.

21 Mechanical strength

This clause of IEC 60335-1 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 wooden board 4 ± 0.2 inches (100± 0.5 mm) long by 1 ± 0.2 inches (22.5 ± 5 mm) wide and approximately 1 inch (25 mm) thick. The board is supported at each end on a rigid table by spacers 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 1 ± 0.2 inches (20 ± 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 IEC 60335-1 is applicable except as follows.

22.12 *Addition:*

The requirement is not applicable to the **energizer** output terminal assembly including the terminal knob and washers.

22.31 *Addition:*

The requirement applies only to **Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility**.

22.32 *Addition:*

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 local utility supply and the fence circuit, and no other hazardous condition shall arise.

22.46 *Addition:*

If programmable **protective electronic circuits** alone are used to ensure compliance with the output characteristics specified in 19.13, the software shall contain measures to control the fault or error conditions specified in Table R.2.

22.56 *Replacement:*

For **type D energizers**, a **detachable supply unit** shall be a listed accessory made available by the manufacturer.

Compliance is checked by inspection.

22.101 For **Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility**, 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 local utility 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.

Isolation between the local utility 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 shall provide the required degree of isolation.

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

NOTE 1 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 local utility, and circuits connected between the output terminals and the secondary side of this transformer are considered to belong to the **fence circuit**.

NOTE 2 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 central core bobbins, 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 3 It is not to be expected that two independent fixings will become loose at the same time.

22.102 For **Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility**, 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 local utility, with the exception of the input winding of the transformer.

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 **ground 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 **Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility**, any assembly gap in **supplementary insulation** shall not be co-incidental 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 **type A energizers**, **type B energizers** and **type 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**, 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 suitable for connection to the local utility 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 For normal (not rapid-fire) operation, 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 **standard load** shall not exceed 10 ms;

– for **energy limited energizers**, the energy per impulse in the 500 Ω **standard load** shall not exceed 5 J;

NOTE The energy/impulse is the energy measured in the impulse over the **impulse duration**.

– for **charge limited energizers**, the **output charge** in the 500 Ω **standard load** shall not exceed a total delivered charge of 4mC

*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. For **energizers** with more than one set of output terminals, the **standard load** is connected to each set of output terminals in turn. 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 MΩ in parallel with a capacitance of not more than 100 pF.

22.109 If the **energizer** is provided with more than one set of output terminals, the output characteristics shall be within the limits specified in 22.108 for any possible configuration of the output terminals connected to the **standard load**.

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 **type A energizers** and **type B energizers** that have terminals for the connection of the battery, the no-load DC output voltage shall not exceed 42,4 V.

*Compliance is checked by measuring the no-load DC output voltage appearing at the terminals for the connection of the battery when the **energizer** is connected for local utility 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 tests:

*When the **energizer** is a **security energizer** marked as being permitted for use in a **security energizer group**, the peak value of the output voltage, U_0, should be the highest value of voltage measured when it is connected in a **security energizer group** and tested in any permitted configuration and connection of **security energizers** that may be used in the*
***security energizer group** given in the instructions. The **security energizer group** is supplied with the voltage in 11.5 under conditions of **normal operation**, but with a load connected to the output terminals of the **security energizer** or **security energizer group**, consisting of a capacitor having a capacitance that can be varied between 0 nF and 200 nF in steps of approximately 10 nF.*

*These **security energizer group** tests are not applicable to a **type R security energizer group** where all the **type R energizers** in the group are exactly the same model.*

*For all other **energizers**, the peak value of the output voltage, U_0, is measured, using an 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 nF and 200 nF in steps of approximately 10 nF.*

22.112 The **clearance** between parts of opposite polarity for connecting the battery in **battery operated energizers suitable for connections to the local utility** shall not be less than 0.08 inch (2mm) when the **energizer** is fitted with conductors as in normal use.

Compliance is checked by measurement.

22.113 For a **type R security energizer**, the energy per impulse delivered by each **fence circuit** into the **standard load** shall not exceed 2.5 J.

*Compliance is checked by measuring the energy per impulse over the **impulse duration** with 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 each **fence circuit**.*

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

22.114 Type R security energizer group output characteristics measured in the 500 Ω **standard load (under normal operation)** shall be such that

- the impulse repetition rate shall not exceed 1 Hz;
- the **impulse duration** of the impulse shall not exceed 10 ms.

*Compliance is checked by measurement when the **type R security energizer group** is supplied with the voltage in 11.5, being operated under conditions of **normal operation** but with the **standard load** connected to the output terminals as shown in Figure 104, Test*

*configuration A and the test repeated with the **standard load** connected to the output terminals as shown in Figure 104, Test configuration B.*

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

22.115 **Type S security energizer group** output characteristics (for normal operation) measured in the standard 500 Ω load 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 per impulse shall not exceed 5 J;

NOTE The energy/impulse is the energy measured in the impulse over the **impulse duration**.

- for **charge limited energizers**, the **output charge** shall not exceed a total delivered charge of 4 mC.

*Compliance is checked with the **type S security energizer group** supplied with the voltage specified in 11.5, and operated with the 6 test configurations shown in Figure 105, in turn. For each configuration, the test loads are varied as follows.*

a) With resistor R_T connected, for test configurations 1 to 6, vary resistor R_A and resistor R_B to maximize the group output characteristics measured in resistor R_T;

b) With resistor R_T disconnected, for test configuration 1, vary resistor R_B to maximize the output characteristics measured in resistor R_B then reconnect resistor R_T and measure the group output characteristics in resistor R_T;

c) With resistor R_T disconnected, for test configuration 2, vary resistor R_A to maximize the output characteristics measured in resistor R_A then reconnect resistor R_T and measure the group output characteristics in resistor R_T;

d) With resistor R_T disconnected, for test configuration 6, vary resistor R_A and resistor R_B to maximize the output characteristics measured in resistor R_A and resistor R_B then reconnect resistor R_T and measure the group output characteristics in resistor R_T;

e) With resistor R_T disconnected, for test configurations 3, 4 and 5, vary resistor R_A and resistor R_B to maximize the output characteristics measured in resistor R_A and resistor R_B then reconnect resistor R_T and measure the group output characteristics in resistor R_T.

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

*For each test, the **type S security energizer group** output characteristics measured in the 500 Ω resistor R_T shall not be exceeded.*

23 Internal wiring

This clause of IEC 60335-1 is applicable except as follows.

23.7 *Replacement:*

For **Local Utility-powered energizers and battery-operated energizers suitable for connection to the local utility**, conductors identified by the color combination green/yellow shall not be used.

Compliance is checked by inspection.

24 Components

This clause of IEC 60335-1 is applicable.

25 Supply connection and external flexible cords

This clause of IEC 60335-1 is applicable except as follows.

25.1 *Addition:*

For **Type D energizers** that are provided with a non-detachable flexible cord, the connecting means shall not be suitable for connection to the local utility.

An appliance inlet, on a **type D energizer**, shall have at least the same degree of protection against moisture as required for the **energizer** and shall not be compatible with appliance couplers complying with the standard sheets of IEC 60320-3.

Compliance is checked by inspection.

25.7 *Replacement:*

Supply cords 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 **type D energizers** shall have a nominal cross-sectional area of not less than 0.001 inch^2 (0.75 mm^2).

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 **battery-operated energizers suitable for connection to the local utility**, 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**.

26 Terminals for external conductors

This clause of IEC 60335-1 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 **ground electrode** to the **energizer** by means of a plug that is designed for connection to a socket-outlet for local utility 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 **ground electrode** to the **energizer** shall not serve to fix any other component.

Compliance is checked by inspection.

27 Provision for grounding

This clause of IEC 60335-1 is applicable except as follows.

28 Screws and connections

This clause of IEC 60335-1 is not applicable.

29 Clearances, creepage distances and solid insulation

This clause of IEC 60335-1 is applicable.

30 Resistance to heat and fire

This clause of IEC 60335-1 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 IEC 60335-1 is replaced by the following.

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

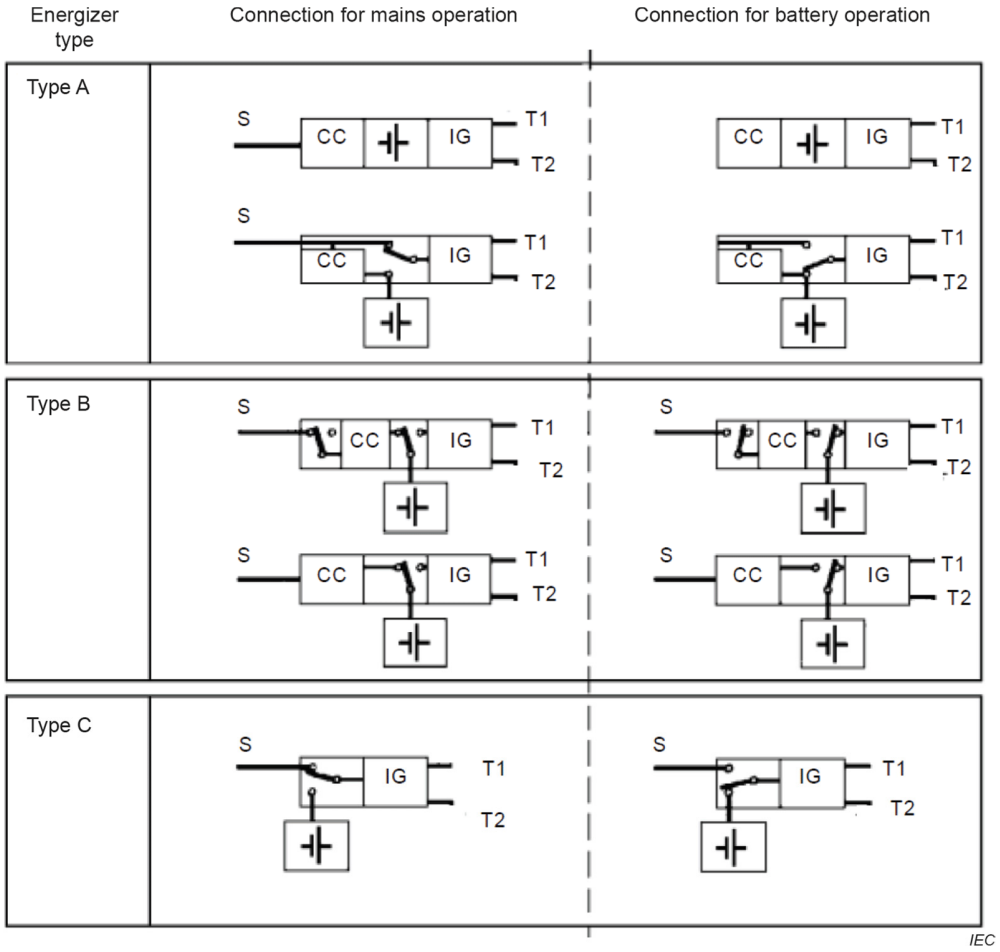
Compliance is checked by the salt mist test of IEC 60068-2-52. Test method 2 is applicable.

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 0.001 ±0.0001 inch (0.25 ±0.02 mm). The pin is loaded so that the force exerted along its axis is 2.5 ±0.1 Lbf (10 ±0.5 N). The scratches are made by drawing the pin along the surface of the coating at a speed of approximately 0.8 inch/s (20 mm/s). A total of 5 scratches are made at least 0.2 inch (5 mm) apart and at least 0.2 inch (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

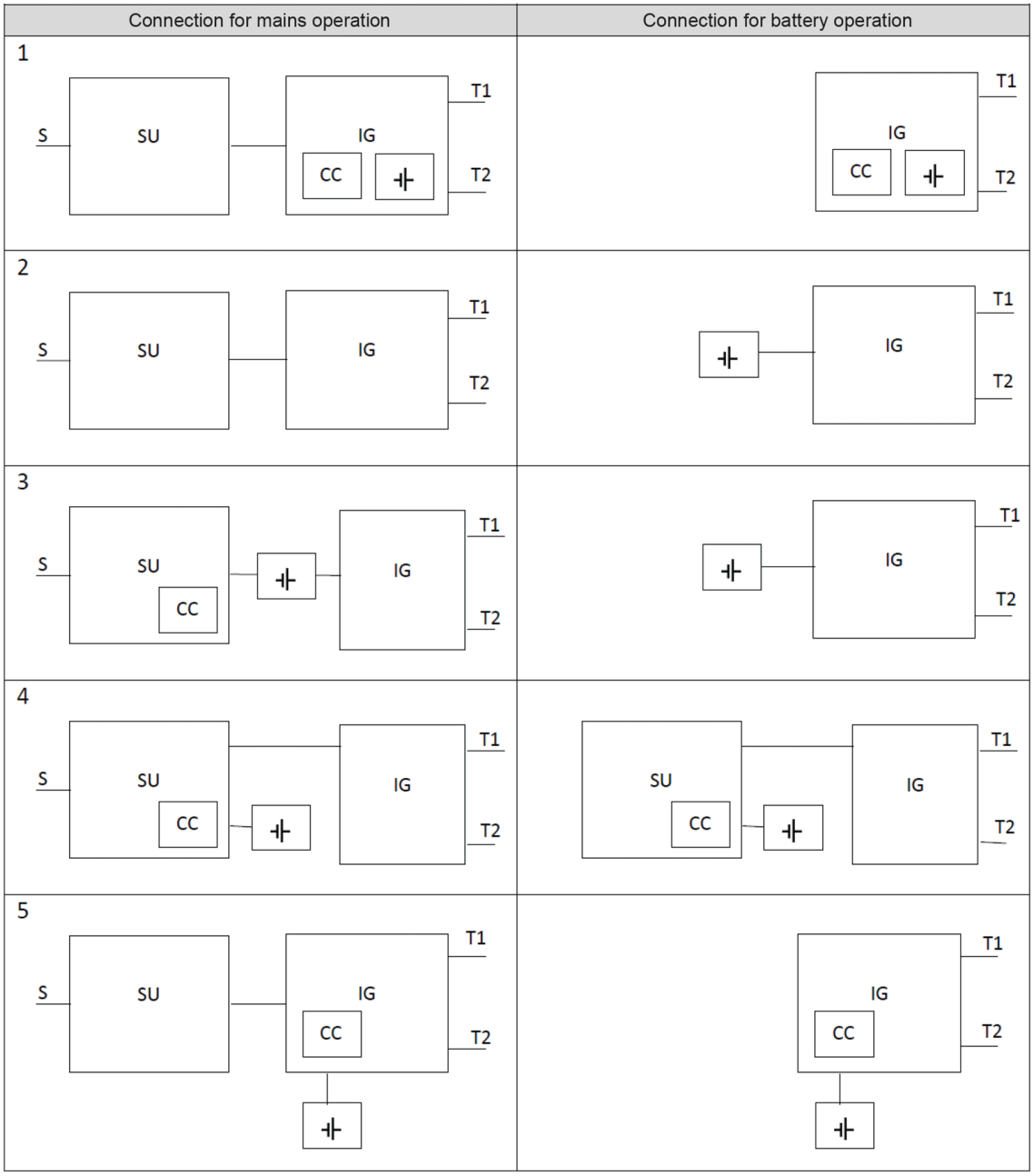
This clause of IEC 60335-1 is not applicable.



Key

S	supply local utility
CC	battery charging circuit
IG	impulse generating circuit
⊣⊢	battery
T1, T2	output terminals

Figure 101 – Schematic examples of type A energizers, type B energizers and type C energizers

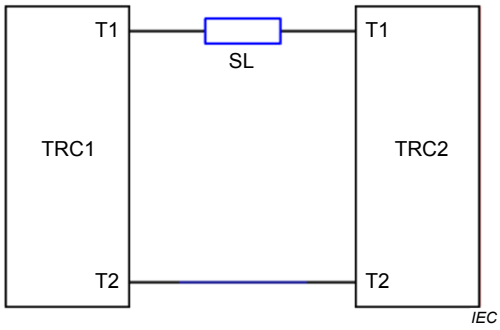


IEC

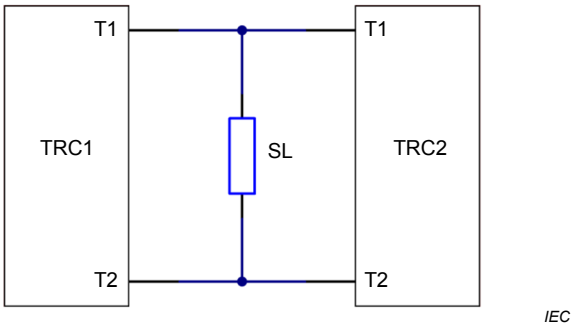
Key

S	supply local utility
SU	detachable supply unit
CC	battery charging circuit
IG	impulse generating circuit
⊣⊢	battery
T1, T2	output terminals

Figure 102 – Schematic examples of the different types of type D energizers



Test configuration A



Test configuration B

Key

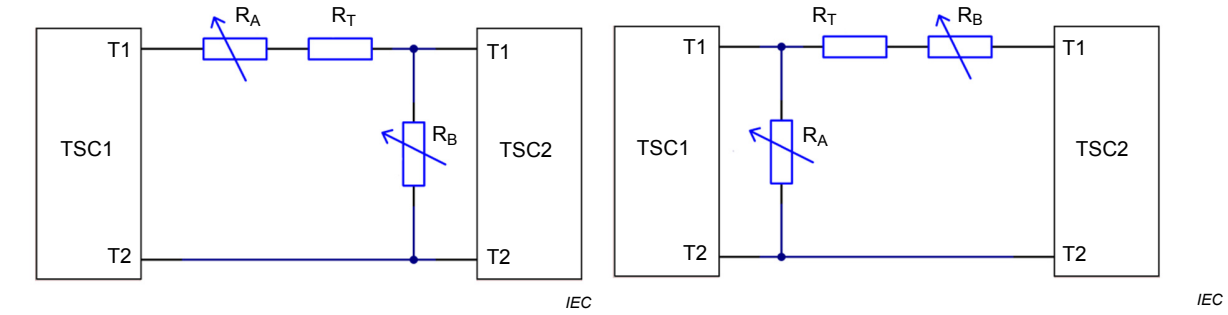
TRC1 type R fence circuit 1

TRC2 type R fence circuit 2 SL

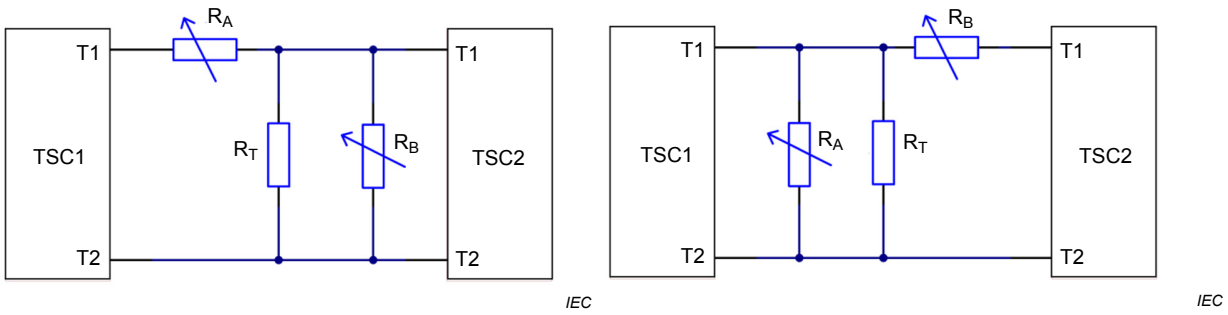
SL **standard load**

T1, T2 **type R security energizer group** output terminals

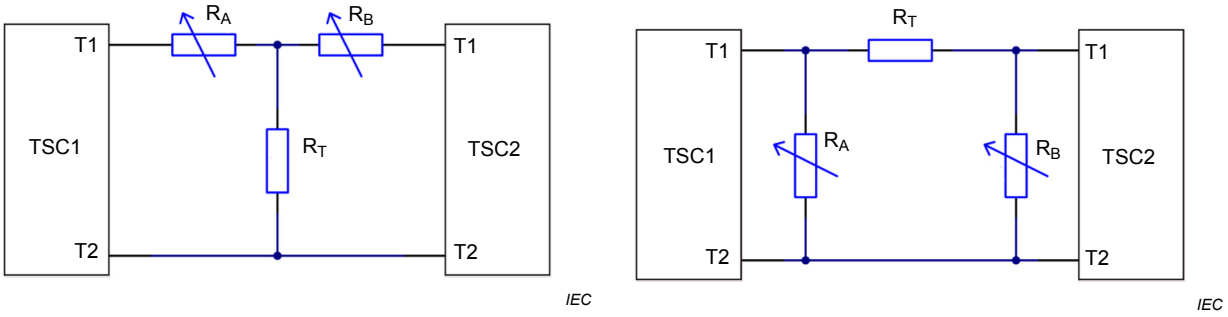
Figure 104 – Type R security energizer group test configurations



Test configuration 1 Test configuration 2



Test configuration 3 Test configuration 4



Test configuration 5 Test configuration 6

Key

TSC1 type S fence circuit 1

TSC2 type S fence circuit 2

R_A variable resistor

R_B variable resistor

R_T 500 Ω resistor

T1, T2 **type S security energizer group** output terminals

Figure 105 – Type S security energizer group test configurations

Annexes

The annexes of IEC 60335-1 are applicable except as follows.

Annex A (informative)

Routine tests

This annex of IEC 60335-1 is applicable except as follows.

A.2 Electric strength test

Addition:

*For **Local Utility-powered energizers** and **battery-operated energizers suitable for connection to the local utility**, an electric strength test is carried out between the supply circuit and the **fence circuit**, the test voltage being 10 kV AC, 50 Hz or 60 Hz, or 15 kV DC 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 output 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;*

Annex B (normative)

Appliances powered by rechargeable batteries that are recharged in the appliance

This annex of IEC 60335-1 is applicable along with the following additions and modifications.

NOTE B.101 Rechargeable batteries that are recharged while connected to the appliance are considered to be recharged in the appliance.

7 Marking and instructions

7.1 *Addition:*

Energizers supplied by other sources of energy and not suitable for connection to the supply local utility shall be marked with the symbol for “connection to Local utility-powered equipment prohibited” or with the substance of the following warning:

WARNING: Do not connect to Local Utility-powered equipment such as battery chargers.

The rules for a prohibition sign in ISO 3864-1, except for colors, apply to the symbol for connection to Local Utility-powered equipment prohibited.

Modification:

The text referring to the **detachable supply unit** is not applicable.

7.6 *Addition:*

connection to Local Utility-powered equipment prohibited

7.12 *Addition:*

If the symbol for “connection to Local utility-powered equipment prohibited” is used, its meaning shall be explained.

Modification:

The warning referring to the **detachable supply unit** shall be:

WARNING: Use only a detachable supply unit that is listed as an accessory made available by the manufacturer.

Add the following subclause:

7.14 *Addition:*

If the symbol for “connection to Local Utility-powered equipment prohibited” is marked on the appliance, the outer diameter of the circle shall be at least 0.6 inch (15 mm).

7.15 Not applicable.

30 Resistance to heat and fire

30.2 This subclause of IEC 60335-1 is not applicable.

Annex S (normative)

Battery-operated appliances powered by batteries that are non-rechargeable or not recharged in the appliance

This annex of IEC 60335-1 is applicable along with the following additions and modifications.

7 Marking and instructions

7.1 *Addition:*

Battery-operated energizers shall be marked with the symbol for “connection to Local utility-powered equipment prohibited” or with the substance of the following warning:

WARNING: Do not connect to Local Utility-powered equipment such as battery chargers.

The rules for a prohibition sign in ISO 3864-1, except for colors, apply to the symbol for connection to Local utility-powered equipment prohibited.

7.6 *Addition:*

connection to Local Utility-powered equipment prohibited

7.12 *Addition:*

If the symbol for “connection to Local Utility-powered equipment prohibited” is used, its meaning shall be explained.

Add the following subclause.

7.14 *Addition:*

If the symbol for “connection to Local Utility-powered equipment prohibited” is marked on the appliance, the outer diameter of the circle shall be at 0.6 inch (15 mm).

Add the following clause.

14 Transient voltages

14.1 *Addition:*

Battery-operated energizers *having a* ***rated voltage*** *exceeding 42.4 V are installed as in normal use and are then subjected to the test of 14.S.101.*

14.S.101 *5 positive and 5 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.*

Add the following clause.

16 Leakage current and electric strength

16.1 *Addition:*

Battery-operated energizers *are subjected to the tests of 16.S.101.*

16.S.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.*

No breakdown shall occur during the test.

Immediately after the tests, the output characteristics are measured as specified in 22.108. The values

measured shall be within the limits specified in 22.108.

Add the following clause.

18 Endurance

Addition:

Battery-operated 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.

Battery-operated energizers *are placed in their normal position and are fitted with a battery having a nominal voltage equal to the **rated voltage** of the energizer. The battery shall be of the largest capacity 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 or until the **energizer** ceases to function due to low battery voltage.*

*The **energizer** is operated continuously for 168 h (seven days) at an ambient temperature of – 15 ± 2 °C and then for 168 h (seven days) at an ambient temperature of 50 ± 2 °C.*

The output terminals are loaded with a non-inductive resistor of 500 ± 2,5 Ω 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.

*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

19.S.103 ***Battery operated energizers*** *having a rated voltage of less than 12 V are operated under* ***normal operation*** *when supplied with an input voltage of 13.2 V DC.*

During the test, the ***energizer*** *shall be connected to the voltage source via a 1 Ω series resistor.*

This test is only applicable if the supply may be connected without modification of the ***energizer****.*

Add the following clause.

22 Construction

22.S.101 For **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.S.102 **Battery-operated energizers** 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.S.103 The **clearance** between parts of opposite polarity for connecting the battery in **battery operated energizers** shall not be less 0.08 inch (2mm), when the **energizer** is fitted with conductors as in normal use.

Compliance is checked by measurement.

25 Supply connection and external flexible cords

Add the following new subclauses.

25.7 *Addition:*

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

25.23 *Addition:*

In **battery-operated energizers**, if the battery is placed in a box, the flexible lead or flexible cord connecting the box with the **energizer** is considered to be an **interconnection cord**.

25.S.101 *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 0.001 inch^2 (0.75 mm^2).

Annex BB (normative)

Instructions for installation and connection of electric fences

BB.2 Instructions for electric security fences not supplied from a security energizer group

For the purpose of these instructions, the term:

– **connecting leads** means electric conductor, used to connect the **energizer** to the **electric fence** or the **ground electrode**;

– **physical barrier** means a barrier not less than 5ft (1.5 m) high intended to prevent inadvertent contact with the **pulsed conductors** of the **electric fence**;

– **secure area** means an area where a person is not separated from **pulsed conductors** below 5ft (1.5 m) by a **physical barrier**;

– **public access area** means any area where persons are protected from inadvertent contact with **pulsed conductors** by a **physical barrier**;

– **pulsed conductors** means conductors that are subjected to high voltage pulses by the **energizer**.

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 2 separate **electric security fences**, each supplied from a separate **energizer**, the distance between the wires of the 2 separate **electric security fences** shall be at least 9ft (2.5 m). If this gap is to be closed, this shall be affected by means of a physical barrier of high voltage insulating material or grounded conducting material such that the 2 separate **electric security fences** cannot be contacted at the same time.

A spacing of 9ft (2.5 m) shall be maintained between uninsulated **connecting leads** supplied from separate **energizers**. This spacing may be less where

– the connecting leads are covered by insulating sleeving rated to at least 10 kV at local utility frequency; or

– the connecting leads consist of insulated cables rated to at least 10 kV at local utility frequency.

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

For grounding recommendations, follow the relevant national standard for **electric security fence** grounding. If this does not exist then follow the **energizer** manufacturer's instructions and recommendations.

The distance between any **electric security fence ground electrode** and other ground systems shall be not less than 7ft (2 m), except when associated with a graded ground mat.

Where possible, the distance between any electric **security fence ground electrode** and other ground systems should preferably be at least 33ft (10 m) .

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

Where an **electric security fence** passes below bare power line conductors, the highest metallic element shall be effectively grounded for a distance of not less than 17ft (5 m) on either side of the crossing point.

Connecting leads that are run inside buildings shall be effectively insulated from the grounded 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 shall 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 local utility 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 BB.2.

Table BB.2 – Minimum clearances from power lines for electric security fences not supplied from a security energizer group

Power line voltage	Clearance
≤ 1 kV	10 ft (3 m)
1 kV - 33 kV	14 ft (4m)
> 33 kV	27ft (8m)

If **connecting leads** and **electric security fence** wires are installed near an overhead power line, their height above the ground shall not exceed 10ft (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

– 7ft (2 m) for power lines operating at a nominal voltage not exceeding 1 kV;
– 50ft (15 m) for power lines operating at a nominal voltage exceeding 1 kV.

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 33ft (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 4 x 8 inches (100 x 200 mm).

The background color 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 BB.1, or
– the substance of "CAUTION: **Electric fence**".

The inscription shall be indelible, inscribed on both sides of the warning sign and have a height of at least 1 inch (25 mm).

Ensure that all local utility-powered, ancillary equipment connected to the **electric security fence circuit** provides a degree of isolation between the **fence circuit** and the supply local utility 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 local utility in Clauses 14, 16 and 29 of the standard for the **electric fence energizer** is considered to provide an adequate level of isolation.

Local utility supply wiring shall not be installed in the same conduit as signaling 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.

BB.3 Instructions for electric security fences supplied from a security energizer group

For the purpose of these instructions the term:

– **connecting leads** means electric conductor, used to connect the **energizer** to the **electric fence** or the **ground electrode**;
– **physical barrier** means a barrier not less than 5 ft (1.5 m) high intended to prevent inadvertent contact with the **pulsed conductors** of the **electric fence**;
– **secure area** means an area where a person is not separated from **pulsed conductors** below 5ft (1.5 m) by a **physical barrier**;
– **public access area** means any area where persons are protected from inadvertent contact with **pulsed conductors** by a **physical barrier**;
– **pulsed conductors** means the conductors that are subjected to high voltage pulses by the **energizer**.

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 2 separate **energizers** unless they are **type R security energizers** or **type S security energizers** configured and connected to operate in a **type R security energizer group** or **type S security energizer group**.

For any 2 separate **electric security fences**, each supplied from a separate **energizer**, the distance between the wires of the 2 separate **electric security fences** shall be at least 9 ft (2.5 m). If this gap is to be closed, this shall be affected by means of a physical barrier of high voltage insulating material or grounded conducting material such that the 2 separate security fences cannot be contacted at the same time.

This gap can also be closed if the **electric security fences** are supplied by **type R security energizers** or **type S security energizers** that are part of a **type R security energizer group** or **type S security energiser group** configured and connected in accordance with the instructions.

A spacing of 9ft (2.5 m) shall be maintained between uninsulated **connecting leads** supplied from separate **energizers**. This spacing may be less where

– the **connecting leads** are covered by insulating sleeving rated to at least 10 kV at local utility frequency; or
– the **connecting leads** consist of insulated cables rated to at least 10 kV at local utility frequency; or
– the **connecting leads** are powered by **energizers** that are part of a **type R security energizer group** or **type S security energizer group** configured and connected in accordance with the instructions.

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

For grounding recommendations, follow the relevant national standard for **electric security fence** grounding. If this does not exist then follow the **energizer** manufacturer's instructions and recommendations.

The distance between any **electric security fence ground electrode** and other ground systems shall be not less than 7 ft (2 m), except when associated with a graded ground mat.

Where possible, the distance between any electric **security fence ground electrode** and other ground systems should preferably be at least 33ft (10 m).

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

Where an **electric security fence** passes below bare power line conductors, the highest metallic element shall be effectively grounded for a distance of not less than 17 ft (5 m) on either side of the crossing point.

Connecting leads that are run inside buildings shall be effectively insulated from the grounded 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 shall 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 local utility 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 BB.3.

Table BB.3 – Minimum clearances from power lines for electric security fences supplied from a security energizer group

Power line voltage	Clearance
≤ 1 kV	10 ft (3 m)
1 kV - 33 kV	14 ft (4m)
> 33 kV	27ft (8m)

If **connecting leads** and **electric security fence** wires are installed near an overhead power line, their height above the ground shall not exceed 10ft (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

– 7ft (2 m) for power lines operating at a nominal voltage not exceeding 1 kV;
– 50ft (15 m) for power lines operating at a nominal voltage exceeding 1 kV.

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 33ft (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 4 x 8 inches (100 x 200 mm)

The background color 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 BB.1, or
– the substance of “CAUTION: **Electric fence**”.

The inscription shall be indelible, inscribed on both sides of the warning sign and have a height of at least 1 inch (25 mm).

Ensure that all Local utility-powered, ancillary equipment connected to the **electric security fence circuit** provides a degree of isolation between the **fence circuit** and the supply local utility 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 local utility in Clauses 14, 16 and 29 of the standard for the **electric fence energizer** is considered to provide an adequate level of isolation.

Local utility supply wiring shall not be installed in the same conduit as signaling 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.

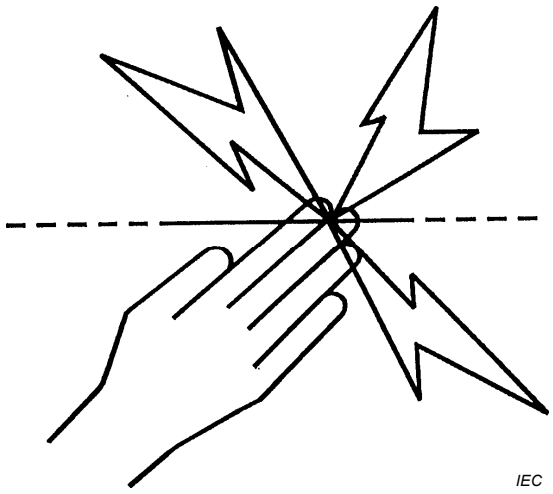


Figure BB.1 – Symbol for warning sign

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**.

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

When selecting the type of **physical barrier**, the likely presence of young children should be a factor in considering the size of openings and a risk assessment shall be made prior to installation.

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 on the inner side of a window or skylight, the **physical barrier** may be less than 5 ft (1.5m) high where it covers the whole of the **electric fence**. If the bottom of the window or skylight is within a distance of 5 ft (1.5m)from the floor or access level then the **physical barrier** need only extend up to a height of 5 ft (1.5m) above the floor or access level.

CC.3 Prohibited zone for pulsed conductors

Pulsed conductors should not be installed within the shaded zone shown in Figure CC.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.

Typical **electric security fence** installations are shown in Figure CC.2 and Figure CC.3.

CC.4 Separation between electric fence and physical barrier

Where a **physical barrier** is installed in compliance with Clause CC.3, at least one dimension in any opening should be not greater than 6 inches (130 mm) and the separation between the **electric fence** and the **physical barrier** should be

– within the range of 4 to 8 inches (100 to 200 mm) or greater than 4ft (1m) where at least one dimension in each opening in the **physical barrier** is not greater than 6 inches (130 mm);

– less than 8 inches (200 mm) or greater than 4ft (1m) 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

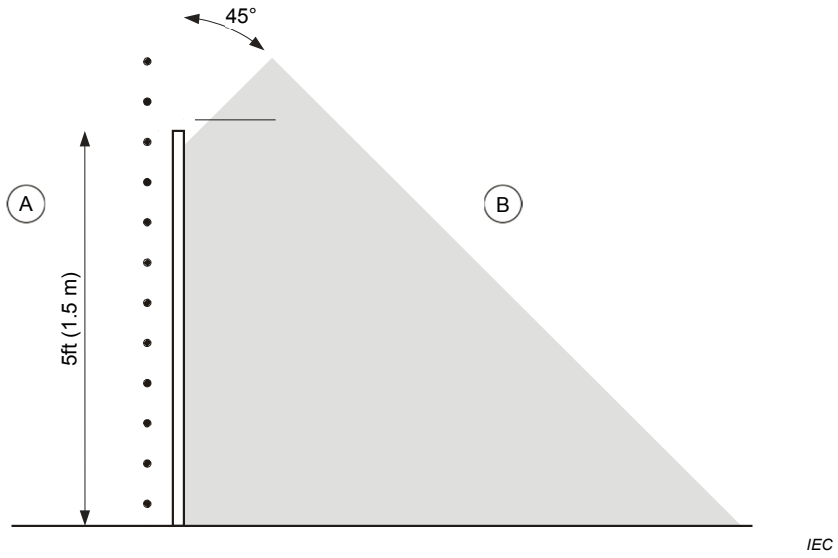
Electric fence conductors should not be mounted on a support used for any overhead power line.

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.

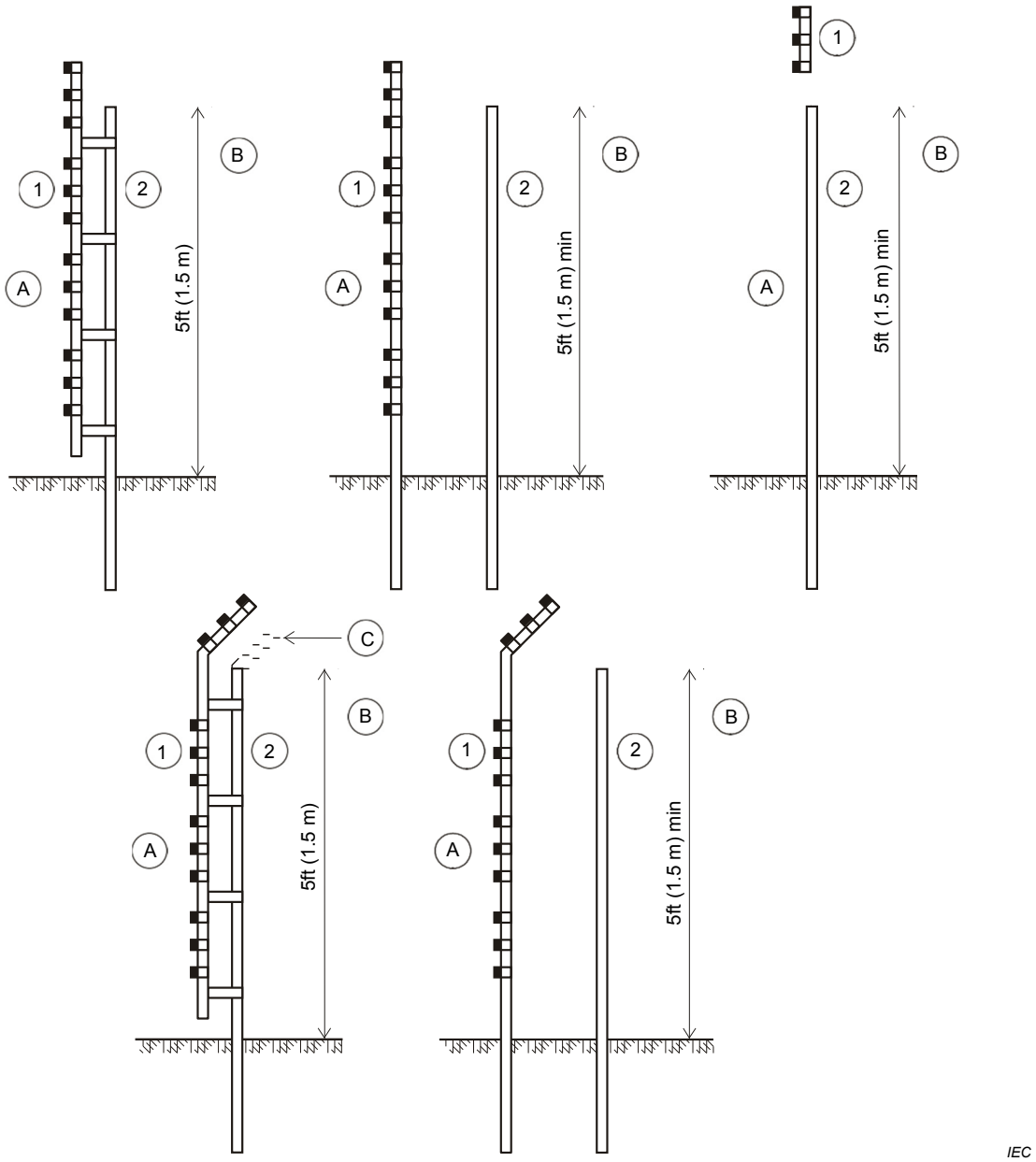
NOTE An example of a secondary cause is where a person can be expected to fall from a surface if contact is made with **pulsed conductors**.



Key

A	secure area
B	public access area
	physical barrier
	Prohibited area
	electric security fence

Figure CC.1 – Prohibited area for pulse conductors



Key

A **secure area**

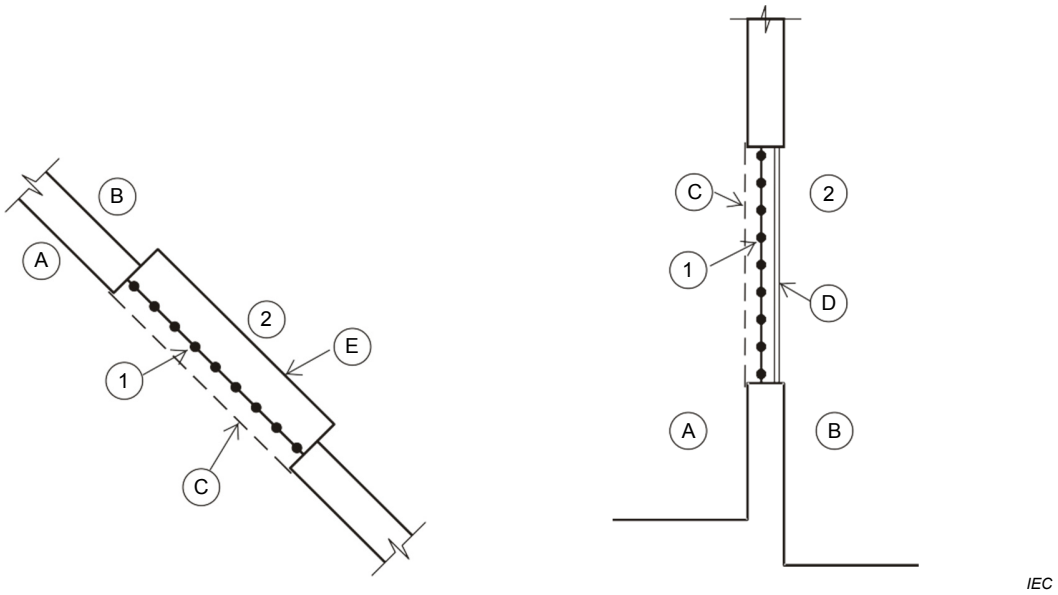
B **public access area**

C barrier where required

1 **electric security fence**

2 **physical barrier**

Figure CC.2 – 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 CC.3 – Typical fence constructions where the electric security fence is installed in windows and skylights

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