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INTERNATIONAL STANDARD

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Electrical installations for lighting and beaconing of aerodromes – Part 3-4: Safety secondary circuits in series circuits – General safety requirements

Installations électriques pour l'éclairage et le balisage des aérodromes – Partie 3-4: Circuits secondaires de sécurité dans les circuits série – Exigences générales de sécurité

IEC 61820-3-4:2023-05(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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Installations électriques pour l'éclairage et le balisage des aérodromes – Partie 3-4: Circuits secondaires de sécurité dans les circuits série – Exigences générales de sécurité

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ELECTRICAL INSTALLATIONS FOR LIGHTING AND BEACONING OF AERODROMES –

Part 3-4: Safety secondary circuits in series circuits – General safety requirements

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

Draft	Report on voting
97/253/FDIS	97/256/RVD

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

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

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

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Future documents in this series will carry the new general title as cited above. Titles of existing documents in this series will be updated at the time of the next edition.

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INTRODUCTION

With a few exceptions, aeronautical ground lighting is designed for series circuit technology operating with a constant current and a maximum input voltage of 5 000 V AC RMS, including tolerances. The input voltage to the series circuit is constantly adjusted by the constant current regulator to maintain the series circuit current irrespective of the variations in the load. The properties and characteristics of the constant current regulators are provided in IEC 61822. Due to the structure of the series circuit, i.e., a series connection of all loads, the usual protective devices for personnel protection of an IT, TT or TN network cannot be applied.

Aeronautical ground lighting is defined as any light provided as an aid to air navigation and as such is subject to specific requirements with respect to its resilience, availability, and serviceability levels. Therefore, insulation faults in the series circuit are often tolerated, and do not lead to the automatic disconnection of the electrical supply to the series circuit.

In view of the above, IEC 61821 states that no work of any kind is normally permitted on live series circuits without first conducting a suitable and sufficient risk assessment and using appropriate protective equipment according to IEC 61821.

The electrical characteristics of the constant current series circuits are often confused with those of IT, TT or TN networks, i.e., constant input voltage, equipment connected in parallel, and a load-dependent current. In practice, it is not always easy to assign rated voltages correctly to individual components of the series circuit or to determine possible touch voltages. In a constant current series circuit, the rated voltage of the equipment in the series circuit and the maximum touch voltage frequently exceed the normal mains input voltage.

In a series circuit installation, the series circuit input voltage is divided in proportion to the internal resistances of the various loads. The rated voltage, i.e., the voltage between the input lines of the equipment, is defined by the series circuit current that flows through the equipment and its input impedance. Since input impedance depends on the equipment design and the series circuit current is constant, the input voltage remains the same for each item of equipment. As a result of the provision of current control in the series circuit, the series circuit input voltage is load-dependent and corresponds to the sum of all partial voltages in the series circuit.

This is different to determining the maximum possible touch voltage to earth in a series circuit. Since one or more earth faults of varying resistance to earth may be present, the touch voltage to earth may assume any value up to the maximum series circuit input voltage depending on the location of the earth fault and the equipment installed in the series circuit. Therefore, when determining the dielectric strength against earth potential, it is usual to take the maximum series circuit input voltage. Such peculiarities of the series circuit have been considered in the requirements for lamp systems in this document.

Since there are only a few effective safety features available for personnel protection in series circuit technology, the protective measure "safety extra low voltage (SELV)" and "protective extra low voltage (PELV)" is applied in this document for the supply of lamp systems. This measure is common practice and can resort to the application of well-known and accepted methodology. The introduction of SELV/PELV in this type of application has been made possible by the introduction of new illumination technology that has lower power requirements and hence requires a lower voltage supply.

NOTE This document is based on SELV specification according to IEC 60364-4-41 and IEC 61558-1.

ELECTRICAL INSTALLATIONS FOR LIGHTING AND BEACONING OF AERODROMES –

Part 3-4: Safety secondary circuits in series circuits – General safety requirements

1 Scope

This part of IEC 61820 specifies protective provisions for the operation of lamp systems powered by series circuits in aeronautical ground lighting.

The protective provisions described here refer only to secondary supply systems for loads that are electrically separated from the series circuit.

This document specifies the level of SELV, and alternatively PELV, under consideration of additional personnel protection during work on live secondary circuits by electrically skilled persons. This document also covers the special operational features of aeronautical ground lighting and addresses the level of training and the requirements for maintenance procedures detailed in IEC 61821 and other national or regional regulation.

The requirements and tests are intended to set a specification framework for system designers, system installers, users, and maintenance personnel to ensure a safe and economic use of electrical systems in installations for the beaconing of aerodromes.

This document complements existing IEC aeronautical ground lighting (AGL) standards and can be used as a design specification.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

IEC 60417, *Graphical symbols for use on equipment,* available at http://www.graphicalsymbols.info/equipment

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 61000-6-2:2016, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

IEC 61000-6-4:2018, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61558-2-6:2021, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers for general applications*

IEC 61820-1:2019, *Electrical installations for aeronautical ground lighting at aerodromes – Part 1: Fundamental principles*

IEC 61821:2011, *Electrical installations for lighting and beaconing of aerodromes – Maintenance of aeronautical ground lighting constant current series circuits*

IEC 61822:2009, *Electrical installations for lighting and beaconing of aerodromes – Constant current regulators*

IEC 61823:2002, *Electrical installations for lighting and beaconing of aerodromes – AGL series transformers*

IEC 63067:2020, *Electrical installations for lighting and beaconing of aerodromes – Connecting devices – General requirements and tests*

CISPR 11:2015, *Industrial, scientific, and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016
CISPR 11:2015/AMD2:2019

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*

3 Terms, definitions, and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1.1
assembly
self-contained, closed functional unit forming a light system together with other assemblies

3.1.2
basic insulation
insulation of hazardous live parts providing basic protection

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-581:2008, 581-21-24]

3.1.3
electrically skilled person
person with relevant education and experience to enable that person to perceive risks and to avoid hazards which electricity can create

[SOURCE: IEC 60050-195:2021,195-04-01]

3.1.4
extra-low voltage
ELV
voltage not exceeding the relevant voltage limit specified in 4.7.3

3.1.5
safety extra-low voltage
SELV
voltage values which do not exceed values in 4.7.3, between conductors, or between any conductor and reference earth, in an electric circuit which has galvanic separation from the supplying electric power system by such means as a separate-winding transformer

3.1.6
SELV system
electrical system in which the voltage cannot exceed the value of extra-low voltage:

– under normal conditions, and
– under single-fault conditions, including earth faults in other electric circuits

Note 1 to entry: SELV is the abbreviation for safety extra-low voltage.

[SOURCE: IEC 60050-195:2021, 195-06-28]

3.1.7
PELV system
electric system in which the voltage cannot exceed the value of extra-low voltage:

– under normal conditions, and
– under single fault conditions, including earth faults in other electric circuits

Note 1 to entry: PELV is the abbreviation for protective extra low voltage

[SOURCE: IEC 60050-195:2021, 195-06-29]

3.1.8
SELV/PELV power supply
single physical unit or assembly of physical units performing as the power supply according to SELV/PELV definitions

3.1.9
protective separation
separation of one electric circuit from another by means of

– double insulation, or
– basic insulation and electrically protective screening, or
– reinforced insulation

3.1.10
power supply unit
components for the supply and transfer of energy used to operate a lighting unit in a series circuit

3.1.11
electric shock
physiological effect resulting from an electric current passing through a human or animal body

[SOURCE: IEC 60050-195:2021, 195-01-04, modified – Words "human body or livestock" replaced with "human or animal body".]

3.1.12
hazardous live part
live part which, under certain conditions, can give a harmful electric shock

[SOURCE: IEC 60050-195:2021, 195-06-05, modified – Note to entry deleted.]

3.1.13
touch voltage
voltage between conductive parts when touched simultaneously by a person or an animal

Note 1 to entry: The value of the effective touch voltage may be appreciably influenced by the impedance of the person or the animal in electric contact with these conductive parts.

[SOURCE: IEC 60050-195:2021, 195-05-11, modified – Words "a human being or livestock" replaced with "person or animal"; "effective" and "appreciably" added in Note 1 to entry.]

3.1.14
single fault condition
condition in which there is a fault of a single protection (but not a reinforced protection) or of a single component or a device

[SOURCE: IEC 60050-903:2013, 903-01-15, modified – Note 1 to entry deleted.]

3.1.15
light fixture (US)
light fitting (UK)
luminaire
electrical device used to create artificial light by use of an electric lamp/LED/light source above ground or within the pavement

Note 1 to entry: The luminaire is an apparatus which distributes, filters or transforms the light transmitted from one or more lamps and which includes all the parts necessary for supporting, aiming, fixing and protecting the lamps, but not the lamps themselves and, where necessary, circuit auxiliaries together with the means for connecting them to supply.

3.1.16
limiter
device which limits the safety transformer output voltage to a defined maximum value

Note 1 to entry: The probability of electric shock increases with voltage level, surface area of the accessible conductive part or circuit in contact with the skin and the humidity condition of skin.

3.1.17
safety transformer
isolating transformer with protective separation between the input winding(s) and output winding(s)

[SOURCE: IEC 61558-1:2017, 3.1.2, modified – Word "isolating" replaced with "safety" in the term, and "isolating" added to the definition.]

3.1.18
dry condition
skin condition of a surface area of contact with regards to humidity of a living person being at rest under normal indoor condition

3.2 Abbreviated terms

AGL	aeronautical ground lighting
IP	code to define the degree of protection of an enclosure
ELV	extra low voltage
EMC	electromagnetic compatibility
CISPR	International Special Committee on Radio Interference
AC	alternating current
DC	direct current
CCR	constant current regulator
DUT	device under test
ISO	International Standard Organization
IEC	International Electrotechnical Commission
ILCMS	integrated lamp control and monitoring system

4 Requirements for the SELV/PELV supply

4.1 General

Light fittings for use in aeronautical ground lighting shall be designed for use in a series circuit. The maximum power ratings of the series circuit supply are given by the constant current regulators according to IEC 61822. If the light systems are designed for other current ranges, such information shall be provided by the manufacturer.

The series circuit shall be designed for a nominal system voltage of class V2: nominal system voltage up to and including 1 000 V AC according to IEC 61820-1:2019, 6.3.

The design of the safety secondary circuit shall support safe working conditions for electrically skilled persons.

The maintenance practices shall follow IEC 61821. Applicable national or regional regulations can exist. When considering live work on the secondary circuit, the risk assessment should consider the nature of the work (fault finding, testing, and repair), the nature of the hazards present, and the provision of SELV/PELV designs.

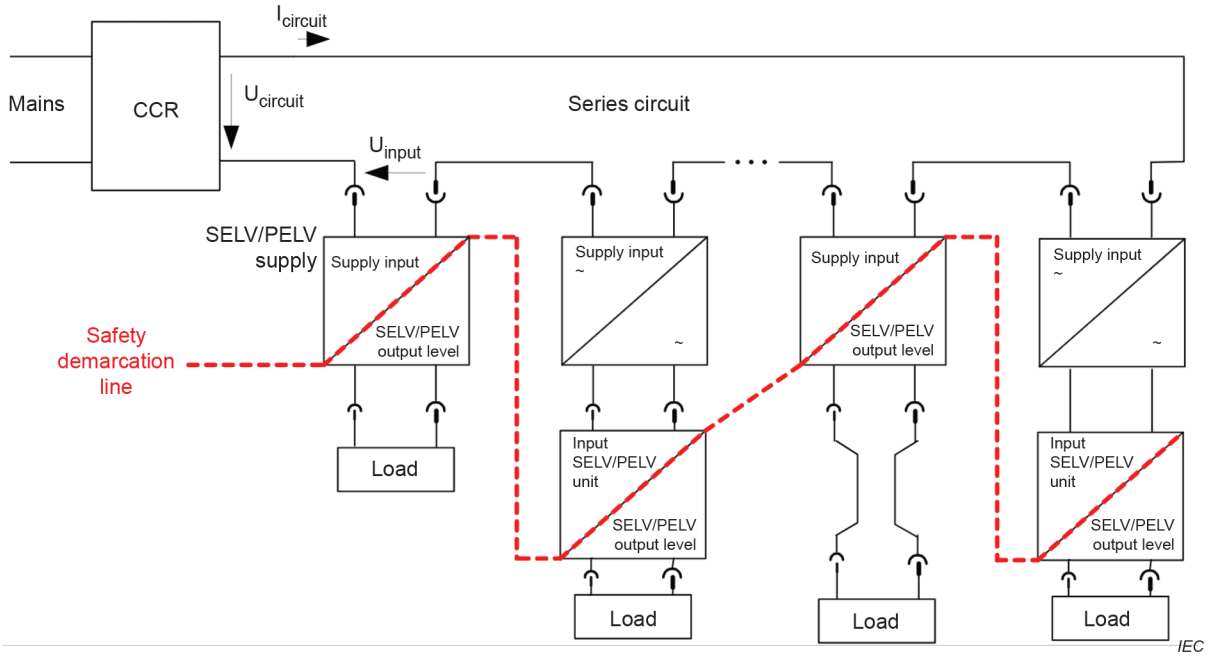
The recommendation is to implement a PELV design because it is considered the more practical solution over complete lifetime of the installation but with the same safety level as a SELV design. If this recommendation cannot be fulfilled, then it shall be considered that a maintenance effort needs to be enforced to achieve a suitable insulation level to implement the SELV design.

In Annex A, Table A.1 gives comparison information of characteristics of PELV and SELV installations.

NOTE This document does not consider any specific requirements regarding the lightning over voltages. The SELV/PELV voltage is no more guaranteed in case of lightning that can happen on or at proximity of any of the component of the system.

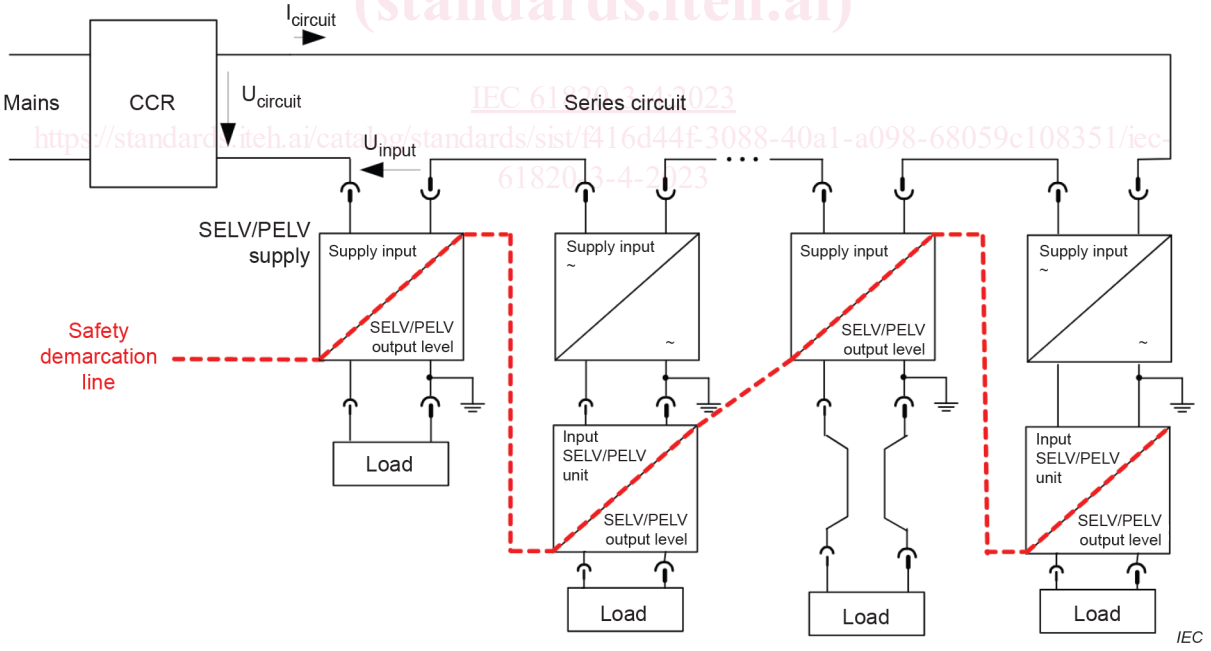
4.2 SELV/PELV-safety demarcation line in an AGL series circuit

Figure 1 and Figure 2 show the extent of the safety secondary system. The safety secondary system (limit defined in 4.7.3) is all circuitry below the dashed red safety demarcation line.



U_{input} shall not exceed 1 kV AC RMS.

Figure 1 – Safety demarcation line in a safety extra low voltage system (SELV system)



U_{input} shall not exceed 1kV AC RMS.

Figure 2 – Safety demarcation line in a protective extra-low voltage system (PELV system)

NOTE The given earthing in Figure 2 is an example. The earthing connection can be performed anywhere in the secondary circuit.

The PELV system can be used where local regulations require an earth (bonding of a live conductor) to be provided.

It is strongly recommended that SELV and PELV systems are not mixed on a single circuit.