

INTERNATIONAL STANDARD



Equipment for general lighting purposes – EMC immunity requirements

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**EQUIPMENT FOR GENERAL LIGHTING PURPOSES –
EMC IMMUNITY REQUIREMENTS**

FOREWORD

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International Standard IEC 61547 has been prepared by IEC technical committee 34: Lamps and related equipment.

This third edition cancels and replaces the second edition, published in 2009. This edition constitutes a technical revision

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

- a) extension of scope with end-user replaceable modules and the combination of end-user replaceable module and independent auxiliary;
- b) clarification of module testing in a host system;
- c) increased ESD and surge test levels for road and street lighting equipment;
- d) the introduction of ESD testing under normal operation and handling conditions;
- e) removal of line to ground surge test for self-ballasted lamps ≤ 25 W.

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

FDIS	Report on voting
34/676/FDIS	34/689/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This document is to be read in conjunction with the relevant basic and/or product standard(s).

A list of all parts in the IEC 61547 series, published under the general title *Equipment for general lighting purposes – EMC immunity requirements*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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EQUIPMENT FOR GENERAL LIGHTING PURPOSES – EMC IMMUNITY REQUIREMENTS

1 Scope

This part of IEC 61547 which deals with electromagnetic immunity requirements, applies to lighting equipment which is within the scope of IEC technical committee 34, including apparatus such as lamps, ~~auxiliaries and luminaires, intended either for connecting to a low voltage electricity supply or for battery operation~~ luminaires and modules.

~~Excluded from the scope of this standard is equipment for which the immunity requirements are formulated in other IEC or CISPR standards such as:~~

- ~~— lighting equipment for use in transport vehicles;~~
- ~~— entertainment lighting control equipment for professional purposes;~~
- ~~— lighting devices built into other equipment such as:~~
 - ~~• scale illumination or indicators;~~
 - ~~• photocopiers;~~
 - ~~• slide and overhead projectors;~~
 - ~~• multimedia equipment.~~

Excluded from the scope of this document are:

- components or modules intended to be built into lighting equipment and which are not end-user replaceable;
- equipment for which the electromagnetic compatibility requirements in the radio-frequency range are explicitly formulated in other product immunity standards, even if they incorporate a built-in lighting function.

NOTE Examples of exclusions are:

- equipment with built-in lighting devices for display back lighting, scale illumination and signaling;
- SSL-displays;
- range hoods, refrigerators, freezers;
- photocopiers, projectors;
- electronic switches for fixed installations;
- lighting equipment for road vehicles (within the scope of CISPR 12);
- lighting equipment for aircraft and airfield facilities.

However, in multi-function equipment where the lighting ~~part~~ function operates independently from other ~~parts~~ functions, the electromagnetic immunity requirements of this document apply to the lighting ~~part~~ function only.

Lighting equipment with a wireless control function are also within the scope of this document. However, the test is limited to the control of the lighting function only. Radio properties like frequency stability or spurious emissions are not assessed.

EXAMPLE Colour/light level control via a wireless interface are meant to stay intact after an immunity test.

Also included in the scope of this document is lighting equipment that interfaces with systems or installations other than common power supply networks.

The requirements of this document are based on the requirements for domestic, commercial and light-industrial environments as given in IEC 61000-6-1:2016, but modified to lighting engineering practice.

It can be expected that lighting equipment complying with the requirements of this document will operate satisfactorily in other environments. In some special cases, measures ~~have to~~ can be taken to provide higher immunity. In this document it is impracticable to deal with all these possibilities. Such requirements ~~may~~ can be established by contractual agreement between supplier and purchaser.

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 60050-161, *International Electrotechnical Vocabulary – Part 161: Electromagnetic Compatibility* (available at <http://www.electropedia.org>)

IEC 60050-845, *International Electrotechnical Vocabulary – Part 845: Lighting* (available at <http://www.electropedia.org>)

IEC 60598-1:2008/2014, *Luminaires – Part 1: General requirements and tests*

~~IEC 60598-2-22, Luminaires – Part 2-22: Particular requirements – Luminaires for emergency lighting~~

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio frequency, electromagnetic field immunity test*⁴
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2004/2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2005/2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2008/2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:1993/2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*²
~~Amendment 1 (2000)~~

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity*

⁴—There exists a consolidated edition 3.1 (2008) that comprises IEC 61000-4-3 and its Amendment 1.

²—There exists a consolidated edition 1.1 (2001) that comprises IEC 61000-4-8 and its Amendment 1.

tests

IEC 61000-4-11:2004/AMD1:2017

~~IEC 61000-6-1:2005, Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity for residential, commercial and light industrial environments~~

IEC CISPR 15:2018, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 and IEC 60050-845 and the following apply.

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

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

3.1

enclosure port

physical boundary of the equipment through which electromagnetic fields may radiate or penetrate ~~(see Figure 1)~~

3.2

AC power port

port at which a conductor or cable, intended to supply AC power from a mains network to the equipment, is connected to the equipment

3.3

DC power port

port at which conductor or cable, intended to supply DC power from a network to the equipment, is connected to the equipment

3.4

load port

port at which the power cable of the load is connected to the equipment

3.5

end-user replaceable module

electronic or electrical part which serves a specific function or functions of a lighting application, which is intended for application in a luminaire or in an installation by an end-user and which is intended to be marketed and/or sold separately from a lighting equipment or system

EXAMPLE Starter, controlgear, ELV lamps, control unit, LEDni module, LEDsi module.

Note 1 to entry: End-user replaceable modules are replaceable modules excluding non-user replaceable modules.

3.6

port

~~particular electrical interface of the specified equipment with the external electromagnetic environment~~

category of an interface of an EUT which provides a coupling path for electromagnetic disturbances from the electromagnetic environment into the EUT

Note 1 to entry: Figure 1 shows examples of ports. The AC/DC power port may include the protective earth conductor.

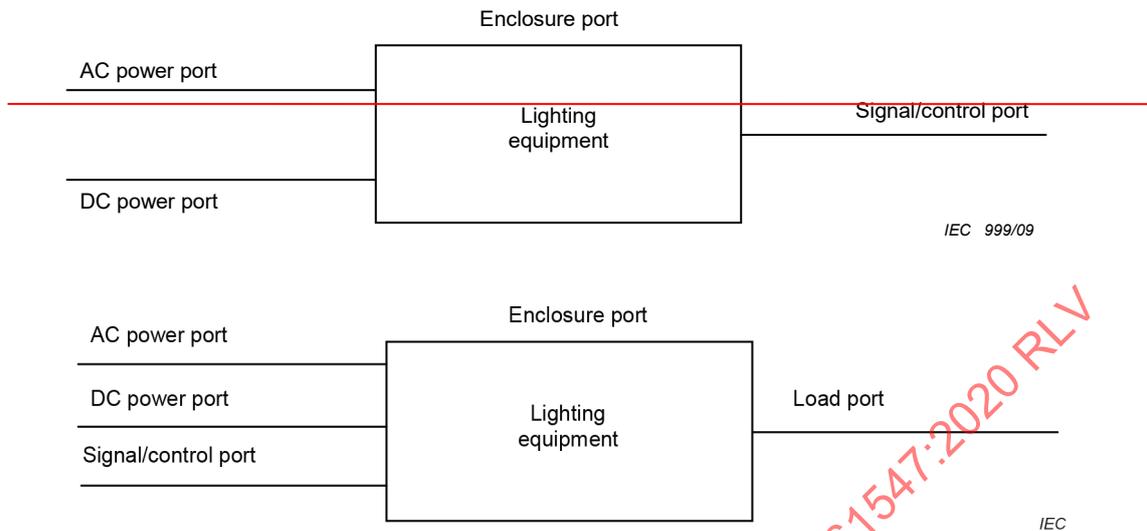


Figure 1 – Examples of ports

3.7

signal port control port

port at which a signal cable is connected to the equipment

3.8

road and street lighting equipment

lighting equipment for illuminating roads, streets, tunnels and other public outdoor areas at a minimum total height above normal ground level of 2,5 m

3.9

lighting equipment

equipment with a primary function of generating and/or regulating and/or distributing optical radiation

EXAMPLE

- light sources and luminaires;
- the lighting part of multi-function equipment where one of the primary functions of this is illumination;
- modules like ELV lamps, self-ballasted lamps and controlgear;
- ultraviolet (UV) and infrared (IR) radiation equipment.

3.10

non-integrated LED lamp

LEDni lamp

LED lamp which needs a separate controlgear to operate

3.11

semi-integrated LED lamp

LEDsi lamp

LED lamp which carries the control unit of the controlgear, and is operated by the separated power supply of the controlgear

3.12**ELV****extra-low voltage**

voltage not exceeding the relevant voltage limit of band I specified in IEC 60449

[SOURCE: IEC 60050-826:2004, 826-12-30]

3.13**self-ballasted lamp****integrated lamp**

electric lamp that cannot be dismantled without being permanently damaged, incorporating controlgear, and all additional elements necessary for starting and stable operation of the light source, designed for direct connection of the supply voltage

[SOURCE: IEC 60050-845:—, 845-27-009, modified – Addition of "self-ballasted lamp" as a preferred term.]

3.14**standby mode**

mode in which the light source is switched off while still connected to a power supply

[SOURCE: IEC 60050-845:—, 845-27-125]

4 Performance criteria**4.1 General**

~~A functional description of performance criteria, during or as a consequence of the immunity testing, shall be provided by the manufacturer and noted in the test report.~~

~~The performance of lighting equipment shall be assessed by monitoring:~~

- ~~— the luminous intensity of the luminaire or of the lamp(s);~~
- ~~— the functioning of the control in the case of equipment which includes a regulating control or concerns the regulating control itself;~~
- ~~— the functioning of the starting device, if any.~~

~~The performance criteria given hereafter apply to lighting equipment.~~

For the various immunity tests that apply, the performance of the following functions shall be assessed, as far as applicable or specified by the manufacturer:

- the luminous intensity of the luminaire or of the light source(s);
- the control function, for example on/off switching, light level setting, colour adjustment, wireless control.

For these functions, three different levels of performance criteria are specified in 4.2. The functions assessed and the performance criteria for each individual test shall be noted in the test report.

The effects of electromagnetic disturbances on the life of the equipment under test are excluded from this document.

4.2 Categorization of performance criteria

The following three categories of performance criteria apply.

a) Performance criterion A

During the test, no change of the luminous intensity shall be observed and the regulating control, if any, shall operate during the test as intended.

b) Performance criterion B

During the test, the luminous intensity may change to any value. After the test, the luminous intensity shall be restored to its initial value within 1 min (30 min for high pressure gas discharge lamps). Regulating controls need not function during the test, but after the test, the mode of the control shall be the same as before the test, provided that during the test no mode changing commands were given.

c) Performance criterion C

During and after the test, any change of the luminous intensity is allowed and the lamp light source(s) may be extinguished. After the test, within 30 min, all functions shall return to normal, if necessary by temporary interruption of the mains supply and/or operating the regulating control.

The following additional requirement ~~for~~ applies to lighting equipment incorporating a starting device: after the test, the lighting equipment is switched off. ~~After half an hour, it is switched for 30 min and back on again.~~ The lighting equipment shall start and operate as intended.

The application of the different performance criteria for the various types of tests and for different lighting equipment are specified in Clause 6.

4.3 Objective assessment of luminous intensity performance

A change of luminous intensity ~~may~~ shall be checked by ~~visual observation but, in case of doubt, the following applies~~ either one of the following requirements:

- no change of luminous intensity by visual observation, or
- the luminous intensity of a lighting equipment by measurement.

When being measured, the luminous intensity of ~~a luminaire or of the lamp(s)~~ lighting equipment shall be measured by means of an illuminance (lux) meter which is positioned in an axis perpendicular to the main plane of the ~~luminaire or lamp(s)~~ lighting equipment, in its centre and at a distance for proper operation of the lux meter. The luminous intensity shall be deemed to be unchanged if the measured intensities during and after the test do not deviate by more than 15 %. In stand-by mode the change of the luminous intensity shall be less than 5 % of the maximum luminous intensity (100 % light output).

Care shall be taken to ensure the ambient light level does not influence the measurement results.

Precautions to achieve reproducible results given in the relevant ~~lamp~~ light source performance standards shall be observed.

~~4.4 The effects of electromagnetic phenomena (as described in this standard) upon the life of the equipment under test are excluded from this standard.~~

5 Test specifications

5.1 General

Immunity requirements for lighting equipment ~~defined within the scope concern~~ are specified in 5.2 to 5.8 on a port by port basis for the following disturbances:

- electrostatic discharges;
- continuous and transient disturbances;
- radiated and conducted disturbances;
- mains supply-related disturbances.

~~They are given in Subclauses 5.2 to 5.9 on a port by port basis.~~

Tests are applied to the relevant ports of the equipment as indicated in the respective clauses. For the purposes of this document, DC power ports for supplying regulating controls are considered to be signal ports. Tests shall be conducted in a well-defined and reproducible manner. Tests shall be carried out as single tests in sequence. The sequence of testing is optional.

It may be determined from consideration of the electrical characteristics and usage of particular equipment that some of the tests are inappropriate and therefore unnecessary. In such cases it is required that the decision not to test be recorded in the test report.

The description of the test, the test generator, the test methods and the test set-up are given in the basic standards, which are referred to in the relevant clauses.

~~Test levels are generally based on level 2 values as recommended in the basic standards.~~

In this document, in most cases, the selected test levels are based on level 2 values as given in the basic test and measurement immunity standards, these standards are referred to in the respective clauses.

Further explanation on the methodology and criteria why certain test phenomena, test levels and performance criteria are chosen for certain types of lighting equipment are given in Annex A.

Modules are tested as any other lighting equipment but shall be mounted in a representative host and the port(s) of the module being assessed shall be terminated accordingly. A representative host is a reference luminaire or reference system that enables proper functioning of the EUT. The functions of the host that are specific to the module being assessed shall be exercised during the tests. The host shall also incorporate essential EMI protection means or mitigation measures if these are explicitly specified by the manufacturer for application of such a module. A representative host shall also include the safety Class I or II features, whichever is applicable. If the module is tested in a host, the correct functioning of the combination shall be verified prior to the application of the disturbance. A detailed description of the host shall be given in the test report. Self-ballasted lamps shall be tested in hosts (reference luminaires) as specified in CISPR 15:2018, Annex A.

For modules, the length of the cables between the module and other devices that are part of the host shall be 3 m unless the manufacturer specifies another length.

NOTE 1 Depending on the type of lighting equipment, for ESD tests deviating requirements for using representative hosts can apply (see 5.2.2).

NOTE 2 The word module in this document refers to end-user replaceable modules as defined in 3.5.

5.2 Electrostatic discharges

5.2.1 General

Electrostatic discharge tests ~~are~~ shall be carried out according to IEC 61000-4-2:2008, with test levels as given in Table 1 for all lighting equipment and additional test levels as given in 5.2.3 for road and street lighting equipment. Contact discharge is the preferred test method. Twenty discharges (10 with positive and 10 with negative polarity) shall be applied on each accessible metallic part of the enclosure, ~~(including terminals ~~are excluded~~)~~ for connecting end-user replaceable modules. Air discharges shall be used where contact discharges cannot be applied. In addition, discharges shall be applied on the horizontal ~~or~~ and vertical coupling planes, as specified in IEC 61000-4-2:2008.

5.2.2 Electrostatic discharge to touchable surfaces

The electrostatic discharge (ESD) test shall be executed for the following use cases:

- 1) During normal operation: Electrostatic discharges shall be applied only to points and surfaces of the EUT which are expected to be touched during normal operation. Modules and self-ballasted lamps are tested in a representative host as described in 5.1.
- 2) During handling: Electrostatic discharges shall be applied to interconnecting pins, terminals or any metal parts of end-user replaceable modules which are accessible during installation and maintenance by the end-user. Tests shall be carried out without the host whereas the assessment of the performance of the module may be done inside the host configuration.

NOTE "Accessible" means accessible under normal operating conditions including user maintenance. The EUT is not powered during the handling of ESD tests.

Table 1 – Electrostatic discharges – Test levels at enclosure port

Characteristics	Test levels voltage
Air discharge	±8 kV
Contact discharge	±4 kV

5.2.3 Road and street lighting equipment

In addition to the requirements in 5.2.2, road and street lighting equipment shall be tested for air discharge at ±15 kV and for contact discharge at ±8 kV. This is to simulate the phenomenon of static charging during thunderstorms.

End-user replaceable modules that are accessible during installation and maintenance shall be tested according to 5.2.2. The term "road and street lighting equipment" signifies the combination of the module(s) and the luminaire as installed in the final application.

5.3 Radio-frequency electromagnetic fields

Radio frequency (RF) electromagnetic field tests ~~are~~ shall be carried out according to IEC 61000-4-3:2006, IEC 61000-4-3:2006/AMD1:2007 and IEC 61000-4-3:2006/AMD2:2010 with test levels as given in Table 2.

NOTE In contrast to generic immunity standards, the frequency range in this document is limited to 1 GHz, since lighting equipment generally complies with the test levels above 1 GHz, provided it also complies below 1 GHz.

Table 2 – Radio-frequency electromagnetic fields – Test levels at enclosure port

Characteristics	Test levels
Frequency range	80 MHz to 1 000 MHz
Test level field strength	3 V/m (unmodulated) See Note
Modulation	1 kHz, 80 % AM, sine wave
NOTE For information regarding situations with a high concentration of mobile transmitters see for example IEC TR 61000-2-5:2017, 9.3.	

5.4 Power frequency magnetic fields

Power frequency magnetic field tests ~~are~~ shall be carried out according to IEC 61000-4-8:2009, with test levels as given in Table 3 and need only to be applied to equipment containing components susceptible to magnetic fields, such as Hall elements or magnetic field sensors. In case of mains-operated devices, the test frequency shall be locked to the mains frequency.

Table 3 – Power frequency magnetic fields – Test levels at enclosure port

Characteristics	Test levels
Field Test frequency	50/60 Hz
Test level Magnetic field strength	3 A/m

5.5 Fast transients

Fast transient tests ~~are~~ shall be carried out according to IEC 61000-4-4:2012, with test levels as given in Table 4, Table 5 and Table 6. Fast transients are carried out with a minimum duration of 2 min with a positive polarity and a minimum of 2 min with a negative polarity.

Table 4 – Fast transients – Test levels at ports for signal ~~and~~ /control lines and load ports

Characteristics	Test levels
Test level Voltage peak	±0,5 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz
NOTE 1 Only applicable to ports interfacing with cables whose total length, according to the manufacturer's specification, may can exceed 3 m.	
NOTE 2 Change of state commands are not applied during the test.	

Table 5 – Fast transients – Test levels at input and output DC power ports

Characteristics	Test levels
Test level Voltage peak	±0,5 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz
NOTE Not applicable to equipment not connected to the mains while in use.	

Table 9 – Radio-frequency common mode – Test levels at input and output AC power ports

Characteristics	Test levels
Frequency range	0,15 MHz to 80 MHz
Test Voltage level	3 V RMS (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave
Source impedance	150 Ω
NOTE Only applicable to ports interfacing with cables whose total length, according to the manufacturer's specification, may can exceed 3 m.	

5.7 Surges

Surge tests shall be carried out according to IEC 61000-4-5:2014 and IEC 61000-4-5:2014/AMD1:2017, with test levels as given in Table 10. Pulses shall be applied to the AC voltage wave as follows: five positive polarity pulses at the 90° phase angle, five negative polarity pulses at the 270° phase angle. Two test levels are given for different types of lighting equipment.

Table 10 – Surges – Test levels at input AC power ports

Characteristics	Test levels			
	Device			
	Self-ballasted lamps and semi-luminaires	Luminaires and independent auxiliaries		
		Input power		
	≤25 W	>25 W		
Wave-shape data	1,2/50 µs	1,2/50 µs	1,2/50 µs	
Test levels				
line to line	±0,5 kV	±0,5 kV	±1,0 kV	
line to ground	±1,0 kV	±1,0 kV	±2,0 kV	
NOTE In addition to the specified test level, all lower test levels as detailed in IEC 61000-4-5 should also be satisfied.				

Characteristics	Test levels ^a	
	Device	
	Self-ballasted lamps ≤ 25 W	Lighting equipment (except self-ballasted lamps ≤ 25 W)
Wave-shape data	1,2/50 µs	1,2/50 µs
line to line	±0,5 kV	±1,0 kV
line to ground	N.A.	±2,0 kV ^b
^a In addition to the specified test level, all lower test levels as detailed in IEC 61000-4-5:2014 shall also be satisfied.		
^b Line to ground and neutral to ground surge tests also apply to class II lighting equipment with metal enclosures which may be connected to earth potential via, for example, the pole or conductive ceiling. Therefore, during the test the metal enclosure of the host or the luminaire shall be connected to the ground. For self-ballasted lamps (> 25 W) the conical housing as specified in Annex A of CISPR 15:2018 shall be used as metal enclosure.		

In addition to the levels in Table 10, road and street lighting equipment shall comply with ±2,0 kV line to line and ±4,0 kV line to ground voltages.

In the case where a manufacturer declares an increased surge test level, the basic standard IEC 61000-4-5:2014 shall be used for this additional test by using the same test procedure as defined in 5.7.

WARNING – A common mode filter at the input of a driver can double the surge voltage to ground at the output terminals of the driver. Adequate mitigation measures should be applied, or the manufacturer of the connected light sources should be notified of the increased surge voltage to ground at the output terminals.

5.8 Voltage dips and short interruptions

Voltage dip and short interruption tests ~~are~~ shall be carried out according to IEC 61000-4-11:2004 and IEC 61000-4-11:2004/AMD1:2017, with test levels as given in Table 11 and Table 12. Changes to the voltage level shall occur at a zero-crossing point in the AC voltage waveform.

Table 11 – Voltage dips – Test levels at input AC power ports

Characteristics	Test levels
Test voltage level	70 %
Number of periods	10

Table 12 – Voltage short interruptions – Test levels at input AC power ports

Characteristics	Test levels
Test voltage level	0 %
Number of periods	0,5

5.9 ~~Voltage fluctuations~~

~~Tests regarding voltage fluctuations are part of equipment product standards.~~

6 Application of test specifications

6.1 ~~General~~

~~The test requirements apply to the following lighting equipment:~~

- ~~— self-ballasted lamps and semi-luminaires;~~
- ~~— independent auxiliaries;~~
- ~~— luminaires or equivalent appliances.~~

~~Immunity requirements do not apply to lamps other than self-ballasted lamps, nor to auxiliaries incorporated in luminaires, in self-ballasted lamps or in semi-luminaires. However, if separate tests have proven that built-in auxiliaries such as ballasts or converters comply with the requirements set for independent auxiliaries, the luminaire is deemed to comply and need not be tested.~~

6.2 ~~Non-electronic lighting equipment~~

~~Lighting equipment, with the exception of emergency lighting luminaires, in which the light source is mains frequency or battery-operated and which does not contain any active electronic component, is deemed to fulfil the immunity requirements without testing.~~

6.3 — Electronic lighting equipment

6.3.1 — General

For lighting equipment containing active electronic components which, for example, convert or regulate the operating voltage and/or the frequency of the light source, the requirements are given in Subclauses 6.3.2 to 6.3.4.

6.3.2 — Self-ballasted lamps

Electronic self-ballasted lamps shall be tested in accordance with Clause 5 and comply with the performance criteria of Table 13.

Table 13 — Application of tests for self-ballasted lamps

	Test (subclause) and performance criterion							
	5.2	5.3	5.4	5.5	5.6	5.7	5.8 Table 11	5.8 Table 12
Self-ballasted lamps	B	A	A	B	A	C	C	B

6.3.3 — Independent auxiliaries

Those auxiliaries which are independent as defined in their relevant product standard shall be tested in accordance with Clause 5 and comply with the performance criteria of Table 14.

Table 14 — Application of tests for independent auxiliaries

	Test (subclause) and performance criterion							
	5.2	5.3	5.4	5.5	5.6	5.7	5.8 Table 11	5.8 Table 12
Independent electronic auxiliary	B	A	A	B	A	C	C	B ^a

^a— For ballasts where the lamp is not able to restart within 1 min, due to the physical constraints of the lamp, performance criterion C applies.

6.3.4 — Luminaires

Luminaires shall be tested in accordance with Clause 5 and comply with the performance criteria of Table 15.

Table 15 — Application of tests for luminaires

	Test (subclause) and performance criterion							
	5.2	5.3	5.4	5.5	5.6	5.7	5.8 Table 11	5.8 Table 12
Luminaire including active electronic components	B	A	A	B	A	C	C	B ^a
Luminaire for emergency lighting ^c	B ^b	A	A	B ^b	A	B ^b	^d	^d

^a— For luminaires where the lamp is not able to restart within 1 min, due to the physical constraints of the lamp, performance criterion C applies.

^b— For emergency luminaires designed to operate in high-risk task areas, after the test, the luminous intensity shall be restored to its initial value within 0,5 s.

^c— Luminaires for emergency lighting shall be tested in both the normal and emergency mode of operation.

^d— These tests do not apply as they are covered by the test in IEC 60598-2-22.

6.1 General

For lighting equipment containing active electronic components (which, for example, convert or regulate the operating voltage and/or the frequency of the light source) the requirements are given in 6.2.

Lighting equipment without active electronic components are deemed to comply without testing.

Modules that are not end-user replaceable are not in the scope of this document but may be tested according to this document for information purposes (for instance, of luminaire manufacturers).

6.2 Applicability of tests and associated performance criterion

Lighting equipment shall be tested in accordance with Clause 5 and comply with the performance criteria of Table 13.

Lighting equipment applying only modules which are pretested, installed and used in accordance with the component manufacturer's instructions, are deemed to comply with this document without testing.

Table 13 – Test applicability and associated performance criterion

	Test applicability (Clause 5) and associated performance criterion (4.2)							
	5.2	5.3	5.4	5.5	5.6	5.7	5.8 Table 11	5.8 Table 12
Self-ballasted lamps	B	A	A	B	A	C	B	B
Lighting equipment (excluding self-ballasted lamps)	B ^e	A	A	B	A	C	B	B ^a
Module in host								
Lighting equipment for emergency lighting ^c	B ^b	A	A	B ^b	A	B ^b	d	d
^a For lighting equipment where the light source is not able to restart within 1 min, due to the physical constraints of the light source, performance criterion C applies. ^b For emergency lighting equipment designed to operate in high-risk task areas, after the test, the luminous intensity shall be restored to its initial value within 0,5 s. ^c Lighting equipment for emergency lighting shall be tested in both the normal and emergency mode of operation. ^d These tests do not apply as they are covered by the test in IEC 60598-2-22. ^e Criterion C applies to lighting equipment (and/or modules) for road and street lighting.								

7 Conditions during testing

The tests shall be applied while the equipment is operated as intended under the normal operating conditions as laid down in the relevant product standard at stabilized luminous (radiant) flux and at normal laboratory conditions. Testing is only required at one combination of supply voltage and frequency, as specified by the manufacturer.

Lighting equipment which is dimmable by means of a separate phase cut dimmer is assessed without a dimmer.

Equipment including a regulating control shall be tested at a light output level of closest to 50 % ~~± 10 %~~. If two steps equally distant to 50 % are available, the lower level shall be used

for the test. The ~~lamp~~ light source load of the equipment under test shall be the maximum allowed.

The standby mode of operation, if available, shall be tested separately.

~~Luminaires and independent auxiliaries~~ Lighting equipment shall be tested with ~~lamps~~ light sources for which they are intended. Where equipment can operate with ~~lamps~~ light sources of different wattages, ~~lamps~~ light sources of maximum wattage shall be applied. ~~Lamps~~ Light sources shall be test ~~lamps~~ light sources as described in IEC 60598-1:2014, Annex B.

~~For independent auxiliaries, the length of the cables between device and lamp shall be 3 m unless the manufacturer prescribes another length.~~

The configuration and mode of operation during the tests shall be ~~precisely~~ noted in the test report.

8 Assessment of conformity

Equipment manufactured in series shall be verified by performing type-testing on one representative model, or on one series-produced ~~equipment~~ model. The manufacturer or supplier shall ensure by means of his quality control system that the tested model or equipment is representative of the series-produced equipment.

All equipment not produced in series shall be tested on an individual basis.

Annex A (informative)

Rationale and criteria for tests and performance criteria

A.1 Types and levels of disturbances

Generally, a variety of electromagnetic disturbances can couple to lighting equipment through its wired interfaces (power-, signal/control- and load ports) or through radiated coupling (enclosure port). See Figure 1.

The types and levels of EM disturbances that can couple to lighting equipment depend on various factors (see Figure A.1):

- the typical application and location of the lighting equipment;
- the number and type of interfaces that can be connected and how they are installed;
- local/regional installation practices or building codes;
- statistics and time.

For instance, lighting equipment that is typically applied outdoors on poles and which is fed through a low-voltage mains network may suffer coupling of higher levels of surges compared to lighting equipment that is typically located indoors.

Also, the probability that certain phenomena and levels of EM disturbances occur at its interfaces varies with time and is generally also region dependent.

A.2 Electromagnetic interference effects

The impact or effect of a failure resulting from an electromagnetic interference (EMI) event depends on (see Figure A.3):

- a) the criticality of the function(s) of the lighting equipment;
- a) the operational impact, in case of (temporary) malfunctions.

For instance, due to the criticality of the function of emergency lighting (safety critical), additional performance criteria apply.

Another example is that the operational impact of malfunction or damage of road and street lighting equipment is generally high as the effort and cost involved with replacement or repair of the equipment is high. This justifies increased ESD and surge test levels for road and street lighting equipment.

However, for a self-ballasted lamp < 25 W, the operational effect (effort and cost) of a damage due to an EM disturbance is generally low, as they are generally applied indoors in application environments where they can easily be replaced. Moreover, such lamps have often also form and cost constraints which simply do not enable inclusion of EM mitigation measures.

A.3 Selection test phenomena, levels and criteria

Depending on the impact, more severe test phenomena, test levels and performance criteria are applied. Basically, the choice of phenomena, levels and performance criteria that are specified in this immunity standard (see Figure A.2) are based on a failure-mode and effect considerations as described above. As a consequence:

- conservative/higher test levels and/or more severe performance criteria are applied for lighting equipment for which the loss of a function has a high impact;
- normal test levels and moderate performance criteria are applied for lighting equipment for which the loss of a function has a low impact.



Figure A.1 – Lighting equipment in an application



Figure A.2 – EUT in a test



Figure A.3 – Failure mode and effects

Bibliography

IEC 60050-826, *International Electrotechnical Vocabulary – Part 826: Electrical installations* (available at <http://www.electropedia.org>)

IEC 60050-845:—³, *International Electrotechnical Vocabulary – Part 845: Lighting*

IEC 60598-2-22, *Luminaires – Part 2-22: Particular requirements – Luminaires for emergency lighting*

IEC TR 61000-2-5:2017, *Electromagnetic compatibility (EMC) – Part 2-5: Environment – Description and classification of electromagnetic environments*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

CISPR 12, *Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of off-board receivers*

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³ Second edition under preparation. Stage at the time of publication IEC CFDIS 60050-845:2020.

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INTERNATIONAL STANDARD

NORME INTERNATIONALE



Equipment for general lighting purposes – EMC immunity requirements

Équipements pour l'éclairage à usage général – Exigences concernant l'immunité CEM

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

EQUIPMENT FOR GENERAL LIGHTING PURPOSES – EMC IMMUNITY REQUIREMENTS

FOREWORD

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International Standard IEC 61547 has been prepared by IEC technical committee 34: Lamps and related equipment.

This third edition cancels and replaces the second edition, published in 2009. This edition constitutes a technical revision

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

- a) extension of scope with end-user replaceable modules and the combination of end-user replaceable module and independent auxiliary;
- b) clarification of module testing in a host system;
- c) increased ESD and surge test levels for road and street lighting equipment;
- d) the introduction of ESD testing under normal operation and handling conditions;
- e) removal of line to ground surge test for self-ballasted lamps ≤ 25 W.

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

FDIS	Report on voting
34/676/FDIS	34/689/RVD

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This document is to be read in conjunction with the relevant basic and/or product standard(s).

A list of all parts in the IEC 61547 series, published under the general title *Equipment for general lighting purposes – EMC immunity requirements*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

EQUIPMENT FOR GENERAL LIGHTING PURPOSES – EMC IMMUNITY REQUIREMENTS

1 Scope

This part of IEC 61547 which deals with electromagnetic immunity requirements, applies to lighting equipment which is within the scope of IEC technical committee 34, including apparatus such as lamps, luminaires, and modules.

Excluded from the scope of this document are:

- components or modules intended to be built into lighting equipment and which are not end-user replaceable;
- equipment for which the electromagnetic compatibility requirements in the radio-frequency range are explicitly formulated in other product immunity standards, even if they incorporate a built-in lighting function.

NOTE Examples of exclusions are:

- equipment with built-in lighting devices for display back lighting, scale illumination and signaling;
- SSL-displays;
- range hoods, refrigerators, freezers;
- photocopiers, projectors;
- electronic switches for fixed installations;
- lighting equipment for road vehicles (within the scope of CISPR 12);
- lighting equipment for aircraft and airfield facilities.

However, in multi-function equipment where the lighting function operates independently from other functions, the electromagnetic immunity requirements of this document apply to the lighting function only.

Lighting equipment with a wireless control function are also within the scope of this document. However, the test is limited to the control of the lighting function only. Radio properties like frequency stability or spurious emissions are not assessed.

EXAMPLE Colour/light level control via a wireless interface are meant to stay intact after an immunity test.

Also included in the scope of this document is lighting equipment that interfaces with systems or installations other than common power supply networks.

The requirements of this document are based on the requirements for domestic, commercial and light-industrial environments as given in IEC 61000-6-1:2016, but modified to lighting engineering practice.

It can be expected that lighting equipment complying with the requirements of this document will operate satisfactorily in other environments. In some special cases, measures can be taken to provide higher immunity. In this document it is impracticable to deal with all these possibilities. Such requirements can be established by contractual agreement between supplier and purchaser.

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 60050-161, *International Electrotechnical Vocabulary – Part 161: Electromagnetic Compatibility* (available at <http://www.electropedia.org>)

IEC 60050-845, *International Electrotechnical Vocabulary – Part 845: Lighting* (available at <http://www.electropedia.org>)

IEC 60598-1:2014, *Luminaires – Part 1: General requirements and tests*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio frequency, electromagnetic field immunity test*
IEC 61000-4-3:2006/AMD1:2007
IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*
IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8:2009, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*
IEC 61000-4-11:2004/AMD1:2017

IEC CISPR 15:2018, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-161 and IEC 60050-845 and the following apply.

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

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

3.1 enclosure port

physical boundary of the equipment through which electromagnetic fields may radiate or penetrate

3.2 AC power port

port at which a conductor or cable, intended to supply AC power from a mains network to the equipment, is connected to the equipment

3.3 DC power port

port at which conductor or cable, intended to supply DC power from a network to the equipment, is connected to the equipment

3.4 load port

port at which the power cable of the load is connected to the equipment

3.5 end-user replaceable module

electronic or electrical part which serves a specific function or functions of a lighting application, which is intended for application in a luminaire or in an installation by an end-user and which is intended to be marketed and/or sold separately from a lighting equipment or system

EXAMPLE Starter, controlgear, ELV lamps, control unit, LEDn module, LEDsi module.

Note 1 to entry: End-user replaceable modules are replaceable modules excluding non-user replaceable modules.

3.6 port

category of an interface of an EUT which provides a coupling path for electromagnetic disturbances from the electromagnetic environment into the EUT

Note 1 to entry: Figure 1 shows examples of ports. The AC/DC power port may include the protective earth conductor.

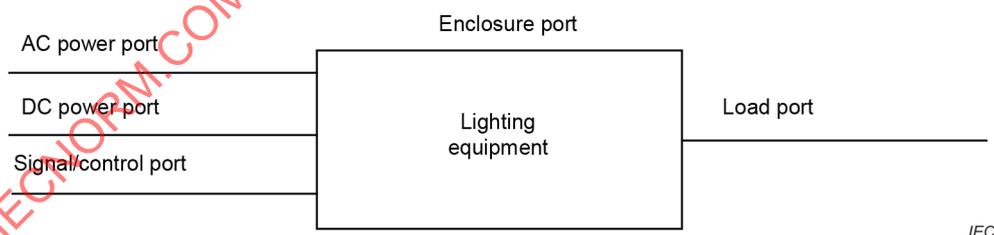


Figure 1 – Examples of ports

3.7 signal port control port

port at which a signal cable is connected to the equipment

3.8 road and street lighting equipment

lighting equipment for illuminating roads, streets, tunnels and other public outdoor areas at a minimum total height above normal ground level of 2,5 m

3.9 lighting equipment

equipment with a primary function of generating and/or regulating and/or distributing optical radiation

EXAMPLE

- light sources and luminaires;
- the lighting part of multi-function equipment where one of the primary functions of this is illumination;
- modules like ELV lamps, self-ballasted lamps and controlgear;
- ultraviolet (UV) and infrared (IR) radiation equipment.

3.10 non-integrated LED lamp

LEDni lamp

LED lamp which needs a separate controlgear to operate

3.11 semi-integrated LED lamp

LEDsi lamp

LED lamp which carries the control unit of the controlgear, and is operated by the separated power supply of the controlgear

3.12 ELV extra-low voltage

voltage not exceeding the relevant voltage limit of band I specified in IEC 60449

[SOURCE: IEC 60050-826:2004, 826-12-30]

3.13 self-ballasted lamp integrated lamp

electric lamp that cannot be dismantled without being permanently damaged, incorporating controlgear, and all additional elements necessary for starting and stable operation of the light source, designed for direct connection of the supply voltage

[SOURCE: IEC 60050-845:—, 845-27-009, modified – Addition of "self-ballasted lamp" as a preferred term.]

3.14 standby mode

mode in which the light source is switched off while still connected to a power supply

[SOURCE: IEC 60050-845:—, 845-27-125]

4 Performance criteria

4.1 General

For the various immunity tests that apply, the performance of the following functions shall be assessed, as far as applicable or specified by the manufacturer:

- the luminous intensity of the luminaire or of the light source(s);
- the control function, for example on/off switching, light level setting, colour adjustment, wireless control.

For these functions, three different levels of performance criteria are specified in 4.2. The functions assessed and the performance criteria for each individual test shall be noted in the test report.

The effects of electromagnetic disturbances on the life of the equipment under test are excluded from this document.

4.2 Categorization of performance criteria

The following three categories of performance criteria apply.

a) Performance criterion A

During the test, no change of the luminous intensity shall be observed and the regulating control, if any, shall operate during the test as intended.

b) Performance criterion B

During the test, the luminous intensity may change to any value. After the test, the luminous intensity shall be restored to its initial value within 1 min (30 min for high pressure gas discharge lamps). Regulating controls need not function during the test, but after the test, the mode of the control shall be the same as before the test, provided that during the test no mode changing commands were given.

c) Performance criterion C

During and after the test, any change of the luminous intensity is allowed and the light source(s) may be extinguished. After the test, within 30 min, all functions shall return to normal, if necessary by temporary interruption of the mains supply and/or operating the regulating control.

The following additional requirement applies to lighting equipment incorporating a starting device: after the test, the lighting equipment is switched off for 30 min and back on again. The lighting equipment shall start and operate as intended.

The application of the different performance criteria for the various types of tests and for different lighting equipment are specified in Clause 6.

4.3 Objective assessment of luminous intensity performance

A change of luminous intensity shall be checked by either one of the following requirements:

- no change of luminous intensity by visual observation, or
- the luminous intensity of a lighting equipment by measurement.

When being measured, the luminous intensity of lighting equipment shall be measured by means of an illuminance (lux) meter which is positioned in an axis perpendicular to the main plane of the lighting equipment, in its centre and at a distance for proper operation of the lux meter. The luminous intensity shall be deemed to be unchanged if the measured intensities during and after the test do not deviate by more than 15 %. In stand-by mode the change of the luminous intensity shall be less than 5 % of the maximum luminous intensity (100 % light output).

Care shall be taken to ensure the ambient light level does not influence the measurement results.

Precautions to achieve reproducible results given in the relevant light source performance standards shall be observed.

5 Test specifications

5.1 General

Immunity requirements for lighting equipment are specified in 5.2 to 5.8 on a port by port basis for the following disturbances:

- electrostatic discharges;
- continuous and transient disturbances;
- radiated and conducted disturbances;
- mains supply-related disturbances.

Tests are applied to the relevant ports of the equipment as indicated in the respective clauses. For the purposes of this document, DC power ports for supplying regulating controls are considered to be signal ports. Tests shall be conducted in a well-defined and reproducible manner. Tests shall be carried out as single tests in sequence. The sequence of testing is optional.

It may be determined from consideration of the electrical characteristics and usage of particular equipment that some of the tests are inappropriate and therefore unnecessary. In such cases it is required that the decision not to test be recorded in the test report.

The description of the test, the test generator, the test methods and the test set-up are given in the basic standards, which are referred to in the relevant clauses.

In this document, in most cases, the selected test levels are based on level 2 values as given in the basic test and measurement immunity standards; these standards are referred to in the respective clauses.

Further explanation on the methodology and criteria why certain test phenomena, test levels and performance criteria are chosen for certain types of lighting equipment are given in Annex A.

Modules are tested as any other lighting equipment but shall be mounted in a representative host and the port(s) of the module being assessed shall be terminated accordingly. A representative host is a reference luminaire or reference system that enables proper functioning of the EUT. The functions of the host that are specific to the module being assessed shall be exercised during the tests. The host shall also incorporate essential EMI protection means or mitigation measures if these are explicitly specified by the manufacturer for application of such a module. A representative host shall also include the safety Class I or II features, whichever is applicable. If the module is tested in a host, the correct functioning of the combination shall be verified prior to the application of the disturbance. A detailed description of the host shall be given in the test report. Self-ballasted lamps shall be tested in hosts (reference luminaires) as specified in CISPR 15:2018, Annex A.

For modules, the length of the cables between the module and other devices that are part of the host shall be 3 m unless the manufacturer specifies another length.

NOTE 1 Depending on the type of lighting equipment, for ESD tests deviating requirements for using representative hosts can apply (see 5.2.2).

NOTE 2 The word module in this document refers to end-user replaceable modules as defined in 3.5.

5.2 Electrostatic discharges

5.2.1 General

Electrostatic discharge tests shall be carried out according to IEC 61000-4-2:2008, with test levels as given in Table 1 for all lighting equipment and additional test levels as given in 5.2.3 for road and street lighting equipment. Contact discharge is the preferred test method. Twenty discharges (10 with positive and 10 with negative polarity) shall be applied on each accessible metallic part of the enclosure, including terminals for connecting end-user replaceable modules. Air discharges shall be used where contact discharges cannot be applied. In addition, discharges shall be applied on the horizontal and vertical coupling planes, as specified in IEC 61000-4-2:2008.

5.2.2 Electrostatic discharge to touchable surfaces

The electrostatic discharge (ESD) test shall be executed for the following use cases:

- 1) During normal operation: Electrostatic discharges shall be applied only to points and surfaces of the EUT which are expected to be touched during normal operation. Modules and self-ballasted lamps are tested in a representative host as described in 5.1.
- 2) During handling: Electrostatic discharges shall be applied to interconnecting pins, terminals or any metal parts of end-user replaceable modules which are accessible during installation and maintenance by the end-user. Tests shall be carried out without the host whereas the assessment of the performance of the module may be done inside the host configuration.

NOTE "Accessible" means accessible under normal operating conditions including user maintenance. The EUT is not powered during the handling of ESD tests.

Table 1 – Electrostatic discharges – Test levels at enclosure port

Characteristics	Test voltage
Air discharge	±8 kV
Contact discharge	±4 kV

5.2.3 Road and street lighting equipment

In addition to the requirements in 5.2.2, road and street lighting equipment shall be tested for air discharge at ±15 kV and for contact discharge at ±8 kV. This is to simulate the phenomenon of static charging during thunderstorms.

End-user replaceable modules that are accessible during installation and maintenance shall be tested according to 5.2.2. The term "road and street lighting equipment" signifies the combination of the module(s) and the luminaire as installed in the final application.

5.3 Radio-frequency electromagnetic fields

Radio frequency (RF) electromagnetic field tests shall be carried out according to IEC 61000-4-3:2006, IEC 61000-4-3:2006/AMD1:2007 and IEC 61000-4-3:2006/AMD2:2010 with test levels as given in Table 2.

NOTE In contrast to generic immunity standards, the frequency range in this document is limited to 1 GHz, since lighting equipment generally complies with the test levels above 1 GHz, provided it also complies below 1 GHz.

Table 2 – Radio-frequency electromagnetic fields – Test levels at enclosure port

Characteristics	Test levels
Frequency range	80 MHz to 1 000 MHz
Test field strength	3 V/m (unmodulated) See Note
Modulation	1 kHz, 80 % AM, sine wave
NOTE For information regarding situations with a high concentration of mobile transmitters see for example IEC TR 61000-2-5:2017, 9.3.	

5.4 Power frequency magnetic fields

Power frequency magnetic field tests shall be carried out according to IEC 61000-4-8:2009, with test levels as given in Table 3 and need only to be applied to equipment containing components susceptible to magnetic fields, such as Hall elements or magnetic field sensors. In case of mains-operated devices, the test frequency shall be locked to the mains frequency.

Table 3 – Power frequency magnetic fields – Test levels at enclosure port

Characteristics	Test levels
Test frequency	50/60 Hz
Magnetic field strength	3 A/m

5.5 Fast transients

Fast transient tests shall be carried out according to IEC 61000-4-4:2012, with test levels as given in Table 4, Table 5 and Table 6. Fast transients are carried out with a minimum duration of 2 min with a positive polarity and a minimum of 2 min with a negative polarity.

Table 4 – Fast transients – Test levels at ports for signal/control lines and load ports

Characteristics	Test levels
Voltage peak	±0,5 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz
NOTE 1 Only applicable to ports interfacing with cables whose total length, according to the manufacturer's specification, can exceed 3 m.	
NOTE 2 Change of state commands are not applied during the test.	

Table 5 – Fast transients – Test levels at input and output DC power ports

Characteristics	Test levels
Voltage peak	±0,5 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz
NOTE Not applicable to equipment not connected to the mains while in use.	

Table 6 – Fast transients – Test levels at input and output AC power ports

Characteristics	Test levels
Voltage peak	±1 kV (peak)
Rise time/hold time	5/50 ns
Repetition frequency	5 kHz

5.6 Injected currents (radio-frequency common mode)

Injected current tests shall be carried out according to IEC 61000-4-6:2013, with test levels as given in Table 7, Table 8 and Table 9. Examples of coupling and decoupling networks (CDN) are:

- AC mains: CDN – Mn
- Screened signal cables: CDN – Sn
- Unscreened signal cables: CDN – AFn / CDN – Tn

For cables where a CDN is not defined the EM-clamp specified in IEC 61000-4-6:2013 can be used.

Table 7 – Radio-frequency common mode – Test levels at ports for signal and control lines

Characteristics	Test levels
Frequency range	0,15 MHz to 80 MHz
Voltage level	3 V RMS (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave
Source impedance	150 Ω
NOTE Only applicable to ports interfacing with cables whose total length, according to the manufacturer's specification, can exceed 3 m.	

Table 8 – Radio-frequency common mode – Test levels at input and output DC power ports

Characteristics	Test levels
Frequency range	0,15 MHz to 80 MHz
Voltage level	3 V RMS (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave
Source impedance	150 Ω
NOTE 1 Only applicable to ports interfacing with cables whose total length, according to the manufacturer's specification, can exceed 3 m.	
NOTE 2 Only applicable to equipment that is connected to the mains while in use.	

**Table 9 – Radio-frequency common mode –
Test levels at input and output AC power ports**

Characteristics	Test levels
Frequency range	0,15 MHz to 80 MHz
Voltage level	3 V RMS (unmodulated)
Modulation	1 kHz, 80 % AM, sine wave
Source impedance	150 Ω
NOTE Only applicable to ports interfacing with cables whose total length, according to the manufacturer's specification, can exceed 3 m.	

5.7 Surges

Surge tests shall be carried out according to IEC 61000-4-5:2014 and IEC 61000-4-5:2014/AMD1:2017, with test levels as given in Table 10. Pulses shall be applied to the AC voltage wave as follows: five positive polarity pulses at the 90° phase angle, five negative polarity pulses at the 270° phase angle.

Table 10 – Surges – Test levels at input AC power ports

Characteristics	Test levels ^a	
	Device	
	Self-ballasted lamps ≤ 25 W	Lighting equipment (except self- ballasted lamps ≤ 25 W)
Wave-shape data	1,2/50 μ s	1,2/50 μ s
line to line	$\pm 0,5$ kV	$\pm 1,0$ kV
line to ground	N.A.	$\pm 2,0$ kV ^b
^a In addition to the specified test level, all lower test levels as detailed in IEC 61000-4-5:2014 shall also be satisfied.		
^b Line to ground and neutral to ground surge tests also apply to class II lighting equipment with metal enclosures which may be connected to earth potential via, for example, the pole or conductive ceiling. Therefore, during the test the metal enclosure of the host or the luminaire shall be connected to the ground. For self-ballasted lamps (> 25 W) the conical housing as specified in Annex A of CISPR 15:2018 shall be used as metal enclosure.		

In addition to the levels in Table 10, road and street lighting equipment shall comply with $\pm 2,0$ kV line to line and $\pm 4,0$ kV line to ground voltages.

In the case where a manufacturer declares an increased surge test level, the basic standard IEC 61000-4-5:2014 shall be used for this additional test by using the same test procedure as defined in 5.7.

WARNING – A common mode filter at the input of a driver can double the surge voltage to ground at the output terminals of the driver. Adequate mitigation measures should be applied, or the manufacturer of the connected light sources should be notified of the increased surge voltage to ground at the output terminals.

5.8 Voltage dips and short interruptions

Voltage dip and short interruption tests shall be carried out according to IEC 61000-4-11:2004 and IEC 61000-4-11:2004/AMD1:2017, with test levels as given in Table 11 and Table 12. Changes to the voltage level shall occur at a zero-crossing point in the AC voltage waveform.

Table 11 – Voltage dips – Test levels at input AC power ports

Characteristics	Test levels
Test voltage level	70 %
Number of periods	10

Table 12 – Voltage short interruptions – Test levels at input AC power ports

Characteristics	Test levels
Test voltage level	0 %
Number of periods	0,5

6 Application of test specifications

6.1 General

For lighting equipment containing active electronic components (which, for example, convert or regulate the operating voltage and/or the frequency of the light source) the requirements are given in 6.2.

Lighting equipment without active electronic components are deemed to comply without testing.

Modules that are not end-user replaceable are not in the scope of this document but may be tested according to this document for information purposes (for instance, of luminaire manufacturers).

6.2 Applicability of tests and associated performance criterion

Lighting equipment shall be tested in accordance with Clause 5 and comply with the performance criteria of Table 13.

Lighting equipment applying only modules which are pretested, installed and used in accordance with the component manufacturer's instructions, are deemed to comply with this document without testing.

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Table 13 – Test applicability and associated performance criterion

	Test applicability (Clause 5) and associated performance criterion (4.2)							
	5.2	5.3	5.4	5.5	5.6	5.7	5.8 Table 11	5.8 Table 12
Self-ballasted lamps	B	A	A	B	A	C	B	B
Lighting equipment (excluding self-ballasted lamps) Module in host	B ^e	A	A	B	A	C	B	B ^a
Lighting equipment for emergency lighting ^c	B ^b	A	A	B ^b	A	B ^b	^d	^d
^a For lighting equipment where the light source is not able to restart within 1 min, due to the physical constraints of the light source, performance criterion C applies. ^b For emergency lighting equipment designed to operate in high-risk task areas, after the test, the luminous intensity shall be restored to its initial value within 0,5 s. ^c Lighting equipment for emergency lighting shall be tested in both the normal and emergency mode of operation. ^d These tests do not apply as they are covered by the test in IEC 60598-2-22. ^e Criterion C applies to lighting equipment (and/or modules) for road and street lighting.								

7 Conditions during testing

The tests shall be applied while the equipment is operated as intended under the normal operating conditions as laid down in the relevant product standard at stabilized luminous (radiant) flux and at normal laboratory conditions. Testing is only required at one combination of supply voltage and frequency, as specified by the manufacturer.

Lighting equipment which is dimmable by means of a separate phase cut dimmer is assessed without a dimmer.

Equipment including a regulating control shall be tested at a light output level closest to 50 %. If two steps equally distant to 50 % are available, the lower level shall be used for the test. The light source load of the equipment under test shall be the maximum allowed.

The standby mode of operation, if available, shall be tested separately.

Lighting equipment shall be tested with light sources for which they are intended. Where equipment can operate with light sources of different wattages, light sources of maximum wattage shall be applied. Light sources shall be test light sources as described in IEC 60598-1:2014, Annex B.

The configuration and mode of operation during the tests shall be noted in the test report.

8 Assessment of conformity

Equipment manufactured in series shall be verified by performing type-testing on one representative model, or on one series-produced model. The manufacturer or supplier shall ensure by means of his quality control system that the tested model or equipment is representative of the series-produced equipment.

All equipment not produced in series shall be tested on an individual basis.

Annex A (informative)

Rationale and criteria for tests and performance criteria

A.1 Types and levels of disturbances

Generally, a variety of electromagnetic disturbances can couple to lighting equipment through its wired interfaces (power-, signal/control- and load ports) or through radiated coupling (enclosure port). See Figure 1.

The types and levels of EM disturbances that can couple to lighting equipment depend on various factors (see Figure A.1):

- the typical application and location of the lighting equipment;
- the number and type of interfaces that can be connected and how they are installed;
- local/regional installation practices or building codes;
- statistics and time.

For instance, lighting equipment that is typically applied outdoors on poles and which is fed through a low-voltage mains network may suffer coupling of higher levels of surges compared to lighting equipment that is typically located indoors.

Also, the probability that certain phenomena and levels of EM disturbances occur at its interfaces varies with time and is generally also region dependent.

A.2 Electromagnetic interference effects

The impact or effect of a failure resulting from an electromagnetic interference (EMI) event depends on (see Figure A.3):

- a) the criticality of the function(s) of the lighting equipment;
- b) the operational impact, in case of (temporary) malfunctions.

For instance, due to the criticality of the function of emergency lighting (safety critical), additional performance criteria apply.

Another example is that the operational impact of malfunction or damage of road and street lighting equipment is generally high as the effort and cost involved with replacement or repair of the equipment is high. This justifies increased ESD and surge test levels for road and street lighting equipment.

However, for a self-ballasted lamp < 25 W, the operational effect (effort and cost) of a damage due to an EM disturbance is generally low, as they are generally applied indoors in application environments where they can easily be replaced. Moreover, such lamps have often also form and cost constraints which simply do not enable inclusion of EM mitigation measures.

A.3 Selection test phenomena, levels and criteria

Depending on the impact, more severe test phenomena, test levels and performance criteria are applied. Basically, the choice of phenomena, levels and performance criteria that are specified in this immunity standard (see Figure A.2) are based on a failure-mode and effect considerations as described above. As a consequence:

- conservative/higher test levels and/or more severe performance criteria are applied for lighting equipment for which the loss of a function has a high impact;
- normal test levels and moderate performance criteria are applied for lighting equipment for which the loss of a function has a low impact.



Figure A.1 – Lighting equipment in an application



Figure A.2 – EUT in a test



Figure A.3 – Failure mode and effects

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CISPR 12, *Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of off-board receivers*

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¹ Second edition under preparation. Stage at the time of publication IEC CFDIS 60050-845:2020.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

ÉQUIPEMENTS POUR L'ÉCLAIRAGE À USAGE GÉNÉRAL – EXIGENCES CONCERNANT L'IMMUNITÉ CEM

AVANT-PROPOS

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La Norme internationale IEC 61547 a été établie par le comité d'études 34 de l'IEC: Lampes et équipements associés.

Cette troisième édition annule et remplace la deuxième édition parue en 2009. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) extension du domaine d'application des modules remplaçables par l'utilisateur final et de la combinaison d'un module remplaçable par l'utilisateur final et d'un accessoire indépendant;
- b) clarification de l'essai du module dans un système hôte;

- c) augmentation des niveaux d'essai des décharges électrostatiques et d'ondes de choc des appareils d'éclairage public;
- d) introduction d'un essai de décharge électrostatique dans des conditions normales de fonctionnement et des conditions de manutention;
- e) retrait de l'essai d'ondes de choc entre phase et terre pour les lampes à ballast intégré ≤ 25 W.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
34/676/FDIS	34/689/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Le présent document doit être lu conjointement avec les normes fondamentales et/ou celles applicables aux produits correspondants.

Une liste de toutes les parties de la série IEC 61547, publiées sous le titre général *Équipements pour l'éclairage à usage général – Exigences concernant l'immunité CEM*, peut être consultée sur le site web de l'IEC.

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ÉQUIPEMENTS POUR L'ÉCLAIRAGE À USAGE GÉNÉRAL – EXIGENCES CONCERNANT L'IMMUNITÉ CEM

1 Domaine d'application

La présente partie de l'IEC 61547 qui traite des exigences d'immunité électromagnétique s'applique aux appareils d'éclairage relevant du domaine d'application du comité d'études 34 de l'IEC, tels que les lampes, les luminaires et les modules.

Sont exclus du domaine d'application du présent document:

- les composants ou modules destinés à être incorporés dans des appareils d'éclairage et qui ne sont pas remplaçables par l'utilisateur final;
- les appareils pour lesquels les exigences de compatibilité électromagnétique dans la plage de radiofréquences sont formulées explicitement dans d'autres normes d'immunité des produits, même s'ils intègrent une fonction d'éclairage incorporée.

NOTE Exemples d'exclusions:

- appareils avec des dispositifs d'éclairage incorporés pour le rétroéclairage, appareils pour échelle de mise au point de l'éclairage et appareils pour la signalisation;
- affichages SSL;
- hottes, réfrigérateurs, congélateurs;
- photocopieurs, projecteurs;
- commutateurs électroniques pour installations fixes;
- appareils d'éclairage des véhicules routiers (relevant du domaine d'application de la CISPR 12);
- appareils d'éclairage aéronautiques et des installations aériennes.

Cependant, dans les appareils multifonctions pour lesquels la fonction éclairage fonctionne indépendamment du reste, les exigences d'immunité électromagnétique du présent document s'appliquent à la fonction éclairage uniquement.

Les appareils d'éclairage comportant une fonction de commande sans fil relèvent également du domaine d'application du présent document. Cependant, l'essai est limité à la commande de la fonction éclairage uniquement. Les propriétés radio, comme la stabilité de la fréquence ou les émissions parasites, ne sont pas évaluées.

EXEMPLE La commande du niveau de couleur/lumière au moyen d'une interface sans fil est censée rester intacte après un essai d'immunité.

Sont également inclus dans le domaine d'application du présent document les appareils d'éclairage qui s'interfaçent avec des systèmes ou des installations autres que des réseaux d'alimentation communs.

Les exigences du présent document sont fondées sur les exigences de l'environnement domestique, commercial et de l'industrie légère, comme cela est indiqué dans l'IEC 61000-6-1:2016, mais modifiées en fonction de la pratique de la science de l'éclairage.

Il peut être attendu que l'appareil d'éclairage satisfaisant aux exigences du présent document fonctionne de manière satisfaisante dans d'autres environnements. Dans des cas spéciaux, des mesures peuvent être prises afin d'assurer une plus grande immunité. Il n'est pas possible, dans le présent document, de tenir compte de toutes ces possibilités. De telles exigences peuvent être établies par accord contractuel entre le fournisseur et l'acheteur.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-161, *Vocabulaire Électrotechnique International – Partie 161: Compatibilité électromagnétique* (disponible à l'adresse <http://www.electropedia.org>)

IEC 60050-845, *Vocabulaire Électrotechnique International – Partie 845: Éclairage* (disponible à l'adresse <http://www.electropedia.org>)

IEC 60598-1:2014, *Luminaires – Partie 1: Exigences générales et essais*

IEC 61000-4-2:2008, *Compatibilité électromagnétique (CEM) – Partie 4-2: Techniques d'essai et de mesure – Essai d'immunité aux décharges électrostatiques*

IEC 61000-4-3:2006, *Compatibilité électromagnétique (CEM) – Partie 4-3: Techniques d'essai et de mesure – Essai d'immunité aux champs électromagnétiques rayonnés aux fréquences radioélectriques*

IEC 61000-4-3:2006/AMD1:2007

IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Compatibilité électromagnétique (CEM) – Partie 4-4: Techniques d'essai et de mesure – Essai d'immunité aux transitoires électriques rapides en salves*

IEC 61000-4-5:2014, *Compatibilité électromagnétique (CEM) – Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de choc*

IEC 61000-4-5:2014/AMD1:2017

IEC 61000-4-6:2013, *Compatibilité électromagnétique (CEM) – Partie 4-6: Techniques d'essai et de mesure – Immunité aux perturbations conduites, induites par les champs radioélectriques*

IEC 61000-4-8:2009, *Compatibilité électromagnétique (CEM) – Partie 4-8: Techniques d'essai et de mesure – Essai d'immunité au champ magnétique à la fréquence du réseau*

IEC 61000-4-11:2004, *Compatibilité électromagnétique (CEM) – Partie 4-11: Techniques d'essai et de mesure – Essais d'immunité aux creux de tension, coupures brèves et variations de tension*

IEC 61000-4-11:2004/AMD1:2017

IEC CISPR 15:2018, *Limites et méthodes de mesure des perturbations radioélectriques produites par les appareils électriques d'éclairage et les appareils analogues*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions de l'IEC 60050-161 et de l'IEC 60050-845 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

3.1

accès par l'enveloppe

frontière physique de l'appareil à travers laquelle les champs électromagnétiques peuvent rayonner ou pénétrer

3.2

accès par l'alimentation alternative

accès sur lequel est connecté à l'appareil un conducteur ou un câble destiné à alimenter en courant alternatif un appareil depuis un réseau d'alimentation

3.3

accès par l'alimentation continue

accès sur lequel est connecté à l'appareil un conducteur ou un câble destiné à alimenter en courant continu un appareil depuis un réseau d'alimentation

3.4

accès de charge

accès sur lequel le câble d'alimentation de la charge est connecté à l'appareil

3.5

module remplaçable par l'utilisateur final

partie électronique ou électrique servant une ou des fonctions spécifiques d'une application d'éclairage, destinée à l'application par un utilisateur final dans un luminaire ou dans une installation, et destinée à être commercialisée séparément d'un système ou d'un appareil d'éclairage

EXEMPLE Starters, appareillages de commande, lampes alimentées en TBT, unités de commande, modules LEDni, modules LEDsi.

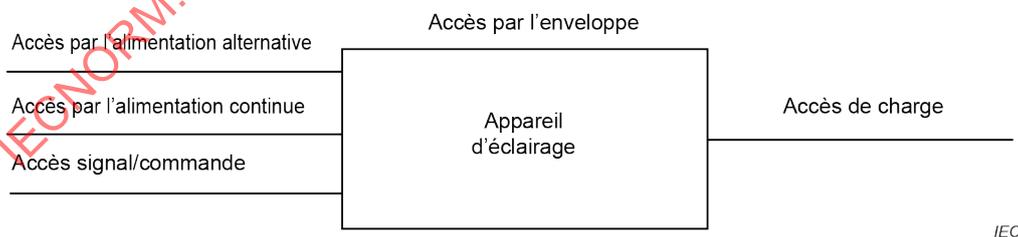
Note 1 à l'article: Les modules remplaçables par l'utilisateur final sont des modules remplaçables à l'exclusion des modules non remplaçables par l'utilisateur.

3.6

accès

catégorie d'interface d'un matériel en essai (EUT – *equipment under test*) qui fournit un trajet de couplage pour les perturbations électromagnétiques entre l'environnement électromagnétique et l'EUT.

Note 1 à l'article: La Figure 1 donne des exemples d'accès. Les accès par l'alimentation alternative/continue peuvent inclure le conducteur de terre de protection.



IEC

Figure 1 – Exemples d'accès

3.7

accès signal

accès commande

accès sur lequel un câble signal est connecté à l'appareil

3.8

appareil d'éclairage public

appareil d'éclairage qui illumine les routes, rues, tunnels et autres zones extérieures publiques à une hauteur minimale totale supérieure au niveau normal du sol de 2,5 m

3.9

appareil d'éclairage

appareil ayant la fonction première de générer et/ou réguler et/ou distribuer un rayonnement optique

EXEMPLE

- des sources lumineuses et des luminaires;
- la partie lumineuse d'un appareil multifonction pour lequel l'une des fonctions premières est l'éclairage;
- des modules tels que des lampes alimentées en TBT, des lampes à ballast intégré et des appareillages de commande;
- des appareils de rayonnement ultraviolet (UV) et infrarouge (IR).

3.10

lampe à LED non intégrée

lampe LEDni

lampe à LED qui nécessite un appareillage de commande séparé pour fonctionner

3.11

lampe à LED semi-intégrée

lampe LEDsi

lampe à LED qui porte l'unité de commande de l'appareillage de même nature et fonctionne au moyen de l'alimentation séparée dudit appareillage

3.12

TBT

très basse tension

tension ne dépassant pas les limites spécifiées dans le domaine I de l'IEC 60449

[SOURCE: IEC 60050-826:2004, 826-12-30]

3.13

lampe à ballast intégré

lampe intégrée

lampe électrique ne pouvant être démontée sans subir de dommage permanent, qui intègre un appareillage de commande, et tous les éléments complémentaires nécessaires pour l'amorçage et le fonctionnement stable de la source de lumière, conçue pour un raccordement direct à la source de tension d'alimentation

[SOURCE: IEC 60050-845:—, 845-27-009, modifié – Ajout de "lampe à ballast intégré" en tant que terme privilégié.]

3.14

mode veille

mode de mise hors tension de la source de lumière toujours raccordée à une source d'alimentation

[SOURCE: IEC 60050-845:—, 845-27-125]

4 Critères d'aptitude à la fonction

4.1 Généralités

Pour les différents essais d'immunité qui s'appliquent, l'aptitude des fonctions suivantes doit être évaluée dans la mesure du possible, ou comme cela est spécifié par le fabricant:

- l'intensité lumineuse du luminaire ou de la ou des sources lumineuses;

- la fonction de commande, par exemple la commutation, les réglages du niveau de luminosité, l'ajustement des couleurs, la commande sans fil.

Pour ces fonctions, trois niveaux différents de critères d'aptitude à la fonction sont spécifiés en 4.2. Les fonctions évaluées et les critères d'aptitude à la fonction de chaque essai individuel doivent être notés dans le rapport d'essai.

Les effets des perturbations électromagnétiques sur la durée de vie du matériel en essai sont exclus du présent document.

4.2 Catégorisation des critères d'aptitude à la fonction

Les trois catégories de critères d'aptitude suivantes s'appliquent.

a) Critère d'aptitude A

Pendant l'essai, aucune variation de l'intensité lumineuse ne doit être observée et la commande de régulation, si elle existe, doit réagir comme prévu.

b) Critère d'aptitude B

Pendant l'essai, l'intensité lumineuse peut varier. Après l'essai, elle doit revenir à sa valeur initiale en moins de 1 min (30 min pour les lampes à décharge dans un gaz à haute pression). Il n'est pas nécessaire que les commandes de régulation fonctionnent pendant l'essai, mais après celui-ci, le mode de la commande doit être identique à l'état initial, à condition qu'aucune modification de mode n'ait été opérée pendant l'essai.

c) Critère d'aptitude C

Pendant et après l'essai, toute variation de l'intensité lumineuse est admise et la ou les sources lumineuses peuvent s'éteindre. Après l'essai, toutes les fonctions doivent redevenir normales en moins de 30 min, si nécessaire par interruption temporaire du réseau d'alimentation et/ou par action sur la commande de régulation.

L'exigence supplémentaire suivante s'applique à l'appareil d'éclairage incorporant un dispositif d'amorçage: après l'essai, l'appareil d'éclairage est éteint pendant 30 min, puis rallumé. L'appareil d'éclairage doit s'allumer et fonctionner comme prévu.

L'application des différents critères d'aptitude aux différents types d'essais et pour des appareils d'éclairage différents est spécifiée à l'Article 6.

4.3 Évaluation objective de la performance de l'intensité lumineuse

Une variation d'intensité lumineuse doit être vérifiée par l'une des exigences suivantes:

- pas de variation d'intensité lumineuse par observation visuelle, ou
- intensité lumineuse d'un appareil d'éclairage par mesurage.

Lorsqu'elle est mesurée, l'intensité lumineuse de l'appareil d'éclairage doit l'être au moyen d'un luxmètre (lux) positionné selon un axe perpendiculaire au plan principal de l'appareil d'éclairage, dans son centre et à une distance permettant un fonctionnement correct du luxmètre. L'intensité lumineuse doit être considérée comme stable si le mesurage ne dévie pas de plus de 15 % pendant et après l'essai. En mode veille, la variation d'intensité lumineuse doit être inférieure à 5 % de l'intensité lumineuse maximale (100 % du flux lumineux).

Des précautions doivent être prises afin de vérifier que le niveau de lumière ambiant n'influence pas les résultats de mesure.

Les précautions indiquées dans les normes d'aptitude à la fonction des sources lumineuses concernées doivent être observées afin d'obtenir des résultats reproductibles.