

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Horticultural lighting - Luminaires for horticultural lighting - Safety

Éclairage horticole - Luminaires pour éclairage horticole - Sécurité

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Horticultural lighting - Luminaires for horticultural lighting - Safety

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

Draft	Report on voting
34/1419/FDIS	34/1432/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.

This document is to be used in conjunction with the relevant corresponding document of the IEC 60598-2 series for general lighting purpose, as follows:

- IEC 60598-2-1 Fixed general purpose luminaires, or
- IEC 60598-2-2 Recessed luminaires, or
- IEC 60598-2-4 Portable general purpose luminaires, or
- IEC 60598-2-5 Floodlights, or
- IEC 60598-2-20 Lighting chains, or
- IEC 60598-2-21 Rope lights.

Note that for each particular use case and for the purposes of this document, one single relevant reference document from the IEC 60598-2 series shall be applied, and no mixing between the various documents in the IEC 60598-2 series shall occur.

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INTRODUCTION

This document acknowledges the need for safety specifications for horticultural luminaires, which are considered as additional requirements or different requirements when comparing with the similar type of luminaires used for general lighting purposes.

Compared with the safety requirements for general lighting purpose luminaires, the differences for horticultural luminaires are mainly derived based on the following considerations:

- change of environmental conditions for the application: Horticultural luminaires are normally used indoors, but with the purpose of horticulture cultivation, the environmental conditions are normally severe.
- change of application purpose from vision sensation to horticulture use. Photobiological safety requirements and UV resistance requirements are developed based on this change in application purposes.

The provisions in this document represent the technical knowledge of experts from the field of horticultural lighting and are developed in close context with IEC 60598-1 and the corresponding document of the IEC 60598-2 series.

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1 Scope

This document specifies safety requirements for horticultural luminaires, incorporating electric light sources for operation from supply voltage up to 1 000 V.

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 60068-2-11, *Environmental testing - Part 2-11: Tests - Test Ka: Salt mist*

IEC 60598-1:2024, *Luminaires - Part 1: General requirements and tests*

IEC 60598-2-1, *Luminaires - Part 2-1: Particular requirements - Fixed general purpose luminaires*

IEC 60598-2-2, *Luminaires - Part 2-2: Particular requirements - Recessed luminaires and recessed air-handling luminaires*

IEC 60598-2-4, *Luminaires - Part 2-4: Particular requirements - Portable general purpose luminaires*

IEC 60598-2-5, *Luminaires - Part 2-5: Particular requirements - Floodlights*

IEC 60598-2-20, *Luminaires - Part 2-20: Particular requirements - Lighting chains*

IEC 60598-2-21, *Luminaires - Part 2-21: Particular requirements - Rope lights*

IEC 60730-1:2022, *Automatic electrical controls - Part 1: General requirements*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

IEC 62471-7:2023, *Photobiological safety of lamps and lamp systems - Part 7: Light sources and luminaires primarily emitting visible radiation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60598-1, and IEC 60598-2-1, or IEC 60598-2-2, or IEC 60598-2-4, or IEC 60598-2-5, or IEC 60598-2-20, or IEC 60598-2-21, and the following 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

horticultural lighting

application of optical radiation to stimulate biological response of plants and the plant tissues

Note 1 to entry: Examples of the application scenarios are plant factory, greenhouse, field application and home application.

Note 2 to entry: Examples of the application manners are top lighting and inter-plant lighting.

3.2

inter-plant lighting

horticultural lighting applied among the foliage of plants

Note 1 to entry: Supplemental inter-plant lighting is normally used in greenhouses.

3.3

horticultural luminaire

luminaire designed to incorporate sources of optical radiation for horticultural lighting

3.4

skilled person

<photobiological safety> person with relevant education and experience to enable him or her to perceive risks and to avoid photobiological hazards

3.5

instructed person

<photobiological safety> person advised or supervised by optical radiation skilled persons to enable him or her to perceive risks and to avoid photobiological hazards

3.6

ordinary person

person who is neither a skilled person nor an instructed person

[SOURCE: IEC 60050-195:2021, 195-04-03]

3.7

industrial and professional use

use intended only for skilled or instructed persons

[SOURCE: IEC 60050-851:2008, 851-11-12, modified – the word "experts" has been replaced by "skilled".]

3.8

without restriction for use

use applicable for skilled persons, instructed persons, and also ordinary persons

3.9

critical control function

function performed by a discrete component or a component network whose primary purpose is to allow the luminaire to be in compliance with the maximum allowed emission, but whose failure could cause the luminaire to exceed the exposure limits for normal operation

EXAMPLE A function that controls the on-state or maintains the duty cycle of a source, where a circuit fault causes the source to unexpectedly energize or to emit higher doses than what is permissible.

[SOURCE: UL 8802:2023, B2.2, modified – "normal operation of the product" has been replaced by "to allow the luminaire to be in compliance with the maximum allowed emission", and the wording "the device to exceed the electrical, thermal or exposure limits for normal operation defined in this standard and the additional safety standards that apply to the product; see 1.7" has been replaced by "the luminaire to exceed the exposure limits for normal operation".]

3.10

critical failure mode

software or hardware fault which can result in a risk

[SOURCE: UL 8802:2023, B2.3, modified – the word in brackets "(mode)" in the term name has been replaced by "mode", and the word "a" in the beginning of the definition has been removed.]

3.11

protective component

discrete component or component network that has been separately evaluated to reliably perform a protective function

EXAMPLE Such components include thermal protectors evaluated in accordance with IEC 60730-2-9 and fuses evaluated in accordance with IEC 60127.

[SOURCE: UL 8802:2023, B2.6, modified – the example has been moved to EXAMPLE; "to UL 60730-2-9" and "to the UL 248, series of standards" have been replaced by "in accordance with IEC 60730-2-9" and "in accordance with IEC 60127".]

3.12

protective function

function that operates after the occurrence of a failure in the equipment so as to prevent harm to persons or damage to property

[SOURCE: IEC 60050-904:2014, 904-03-05, modified – Note 1 to entry and Note 2 to entry have been removed.]

3.13

safety-related software

software that is used to implement safety functions

[SOURCE: IEC TS 63394:2023, 3.1.53, modified – "in a safety-related system" is removed from the definition.]

3.14**safety-related electronic circuit
SREC**

electronic circuit that implements one or more control or protective functions

Note 1 to entry: Safety-related electronic circuits can incorporate any combination of active, passive, programmable, and protective components or semiconductors.

[SOURCE: UL 8802:2023, B2.10, modified – "SREC" has been added as the abbreviated term, the example in the definition has been changed to a note to entry and the wording "These circuits may" has been replaced by "Note 1 to entry: Safety-related electronic circuits can".]

4 General requirements

Requirements given in this document are additional to the requirements given in the relevant corresponding document of the IEC 60598-2 series for general lighting purpose luminaires except where in this document alternative requirements or measurement methods are specified.

NOTE At the time of publication of this document, examples of the corresponding document of the IEC 60598-2 series for general lighting purpose luminaires are as follows:

IEC 60598-2-1	Fixed general purpose luminaires
IEC 60598-2-2	Recessed luminaires
IEC 60598-2-4	Portable general purpose luminaires
IEC 60598-2-5	Floodlights
IEC 60598-2-20	Lighting chains
IEC 60598-2-21	Rope lights

The test sequences specified in the relevant corresponding document of the IEC 60598-2 series are applicable. Note that for each particular use case, a single reference document from the IEC 60598-2 series shall be applied and no mixing shall occur.

5 Classification of horticultural luminaires**5.1 General**

The classification of luminaires specified in the relevant corresponding document of the IEC 60598-2 series applies with the additions of 5.2 to 5.3.

5.2 Intended use classification

Horticultural luminaires shall be classified according to the intended use as follows:

- a) Without restriction for use;
- b) Industrial or professional use.

NOTE The installation for horticultural luminaires classified for "industrial or professional use" is intended to be supervised by instructed or skilled persons.

Portable horticultural luminaires shall be classified as without restriction for use.

5.3 Installation classification

Fixed horticultural luminaires for industrial or professional use shall be classified according to installation as follows:

- a) Horticultural luminaires used as inter-plant lighting.
- b) Horticultural luminaires used as horticultural lighting other than inter-plant lighting.

NOTE Classification according to the installation for fixed horticultural luminaires is specified to determine the requirement for the level of protection against dust and moisture.

6 Marking

6.1 General

Marking requirements specified in the relevant corresponding document of the IEC 60598-2 series apply with the additions from 6.2 to 6.3.

Compliance to 6.2 is checked by inspection and the test of marking according to IEC 60598-1:2024, 6.5.

Compliance to 6.3 is checked by inspection.

6.2 Marking on horticultural luminaires

Horticultural luminaires for industrial or professional use that do not comply with IEC 62471-7, shall be labelled with the risk group classification according to the assessment performed in 7.4. The label shall be clearly visible to instructed and skilled persons during installation and maintenance.

Risk group labels shall comply with the requirements of Annex A.

6.3 Instruction manual

6.3.1 Safety instructions

This Subclause 6.3 is only applicable to horticultural luminaires for industrial and professional use only, which do not comply with IEC 62471-7.

The safety instructions shall contain the essence of the following information:

- a) This luminaire is designed for horticultural application. Do not use this luminaire for purposes other than its intended use.
- b) Optical radiation emitted by this luminaire can pose a risk of personal injury. Overexposure can result in damage to eyes and exposed skin. To reduce the risk of overexposure, this equipment shall be installed in accordance with the installation recommendations.

NOTE The installation recommendations can include instructions on the relative location of each system component, the minimum distances between radiation generating devices and other objects or surfaces, and protection from line-of-sight exposure to the optical radiation in occupied spaces located above the equipment mounting area (e.g. upper floor balconies, open staircases, etc.).

- c) The optical radiation emitted can be reflected by surrounding surfaces such as ceilings and walls.
- d) Persons shall not be exposed to excessive optical radiation during luminaire operation in the installation. An assessment of irradiance or illuminance levels in the surrounding occupiable spaces prior to occupancy is necessary.
- e) This luminaire should be mounted in locations where it will not readily be subjected to tampering by unauthorized persons.

- f) Installation and maintenance of this luminaire shall be performed by authorized persons (skilled persons or instructed persons). Service personnel shall wear appropriate personal protective equipment (PPE) if the equipment will be in operation during the maintenance or servicing work. Contact the equipment manufacturer for PPE recommendations and guidance.

[SOURCE: UL 8802:2023¹ for list items b) to f).]

6.3.2 Operating conditions

Operational conditions of the horticultural luminaires shall be explained in the instruction manual, including the instructions for the mode switch between general lighting mode and mode especially intended for horticulture, if applicable.

6.3.3 Symbols and labels

All symbols required in 6.2 shall be explained in the instruction manual.

Reproductions of all required labels shall be included and explained in the instruction manual.

6.3.4 Photobiological hazard information

All relevant information related to the photobiological hazards of the horticultural luminaire for industrial and professional use, according to 7.4.3, shall be provided in the instruction manual.

For industrial and professional use horticultural luminaires not complying with IEC 62471-7, to assist the installer with the site planning, the distance to achieve the level for the Exempt Group (RG0) for UV, and the distance for the blue light hazard to reach BLH-B limits in accordance with IEC 62471-7 shall be provided. If, in the installation, the distance between the luminaire and the human is lower than the provided distance, other protective measures can be necessary.

NOTE Examples for such protective measures are personal protective equipment and access control.

7 Construction

7.1 General

The construction requirements specified in the relevant corresponding document of the IEC 60598-2 series apply along with the additions and deviations given in 7.2 to 7.5.

7.2 IP rating

Horticultural luminaires shall have protection against dust and water of at least IP44.

NOTE 1 Horticultural luminaires for professional and industrial use are normally rated IP65.

Horticultural luminaires used for inter-plant lighting applications (e.g., fixed luminaires and rope lights), shall have protection against dust and water of at least IP66.

NOTE 2 Horticultural luminaires used for inter-plant lighting applications endure more severe conditions.

A higher IP level can be appropriate where different conditions of external influences occur, see IEC 60364-7-705.

¹ Reproduced and modified (from UL 8802:2023), with the permission of UL Standards & Engagement.

7.3 Environmental conditions

Horticultural luminaires for industrial and professional use shall have sufficient resistance against salt mist.

The resistance against salt mist of horticultural luminaires for industrial and professional use is tested in accordance with IEC 60068-2-11 with duration time as 168 h. All parts of the external enclosure of a horticultural luminaire including the fixing and assembly elements or anchoring shall resist the salt mist environmental stresses.

Compliance is checked by performing the test, and at the end of the test:

- there shall be no trace of salt solution inside the enclosure;
- perforating corrosion phenomena shall not occur;
- any traces of surface corrosion shall not cause the total detachment of portions of paint;
- there shall be no clear signs of corrosion which could affect safety and the operation of the horticultural luminaire.

7.4 Photobiological hazards

7.4.1 General

The photobiological hazard requirements of the relevant corresponding document of the IEC 60598-2 series apply with the following additions.

For assessment and test conditions:

- Controls intended to interrupt the emission (e.g. motion sensors, presence detector, etc.) are bypassed or disabled.
- Translucent covers or similar parts that are removable by hand shall be removed.
- If it is possible to change the emitted spectrum of the source, the spectrum creating the most onerous condition shall be tested.

If no indication of classification according to intended use is provided (5.2), the horticultural luminaire shall comply with requirements for horticultural luminaires without restriction for use.

7.4.2 Horticultural luminaires without restriction for use

7.4.2.1 General

Horticultural luminaires classified as being without restriction for use shall comply with IEC 62471-7 with the additions specified in 7.4.2.2.

NOTE More than one series of tests can be necessary to evaluate the horticultural luminaire according to the different operating conditions.

When the hazardous light output is contained in a grow box or propagator, the complete equipment as delivered and installed for normal use is tested for evaluation of the photobiological hazard.

Compliance is checked by subjecting the horticultural luminaire to the tests of photobiological hazard specified in IEC 60598-1.

For horticultural luminaires which are provided with controls that set the daily exposure to UV, blue light, infrared and thermal hazards for the skin and eye, the integrated product of the measured emission value and the exposure time shall not exceed the daily exposure limit as specified in IEC 62471:2006, Clause 4. In addition, the controls to operate the duty cycle or to vary the drive current or power, shall be additionally evaluated as a safety-related electronic circuit (SREC) in accordance with Annex B.

7.4.2.2 Retinal thermal hazard assessment – Weak visual stimulus (780 nm to 1 400 nm)

If the horticultural luminaire emits infrared radiation without a strong visual stimulus (i.e., less than $10 \text{ cd}\cdot\text{m}^{-2}$), the horticultural luminaire shall not exceed the RG0 classification limit for the retinal thermal hazard as specified in Clause 6 of IEC 62471:2006.

Compliance is checked by submitting the horticultural luminaire to the test and compliance criteria specified in IEC 62471:2006.

7.4.3 Horticultural luminaires for industrial or professional use only

If the horticultural luminaire fulfils the requirements of 7.4.2, this Subclause 7.4.3 is considered as being fulfilled without additional test.

If the horticultural luminaire is declared also suitable for general lighting, or has a mode declared to be suitable for general lighting, the provisions of 7.4.2 shall be met.

Compliance is checked by submitting the horticultural luminaire to the test as described in 7.4.2.

If the requirements of 7.4.2 are not fulfilled, then the horticultural luminaire shall be assessed according to IEC 62471:2006 considering all photobiological risks.

For horticultural luminaires that rely on controls or timing circuits to operate on a duty cycle, or to vary the drive current or power to the emitter over time, the photobiological risk group shall be determined under use conditions that maximize the emitted radiation with the control devices or timing circuits disabled.

For horticultural luminaires which are provided with controls that sets the daily exposure to UV, blue light, infrared and thermal hazards for the skin and eye, the integrated product of the measured emission value and the exposure time shall not exceed the daily exposure limit as specified in IEC 62471:2006, Clause 4. In addition, the controls to operate the duty cycle or to vary the drive current or power, shall be additionally evaluated as a safety-related electronic circuit (SREC) in accordance with Annex B.

Compliance is checked by submitting the horticultural luminaire to the tests as described in IEC 62471:2006 at an assessment distance of 200 mm.

7.5 Replaceable source

Sources in horticultural luminaires classified for industrial or professional use which do not comply with IEC 62471-7 shall be replaceable only with the aid of a tool.