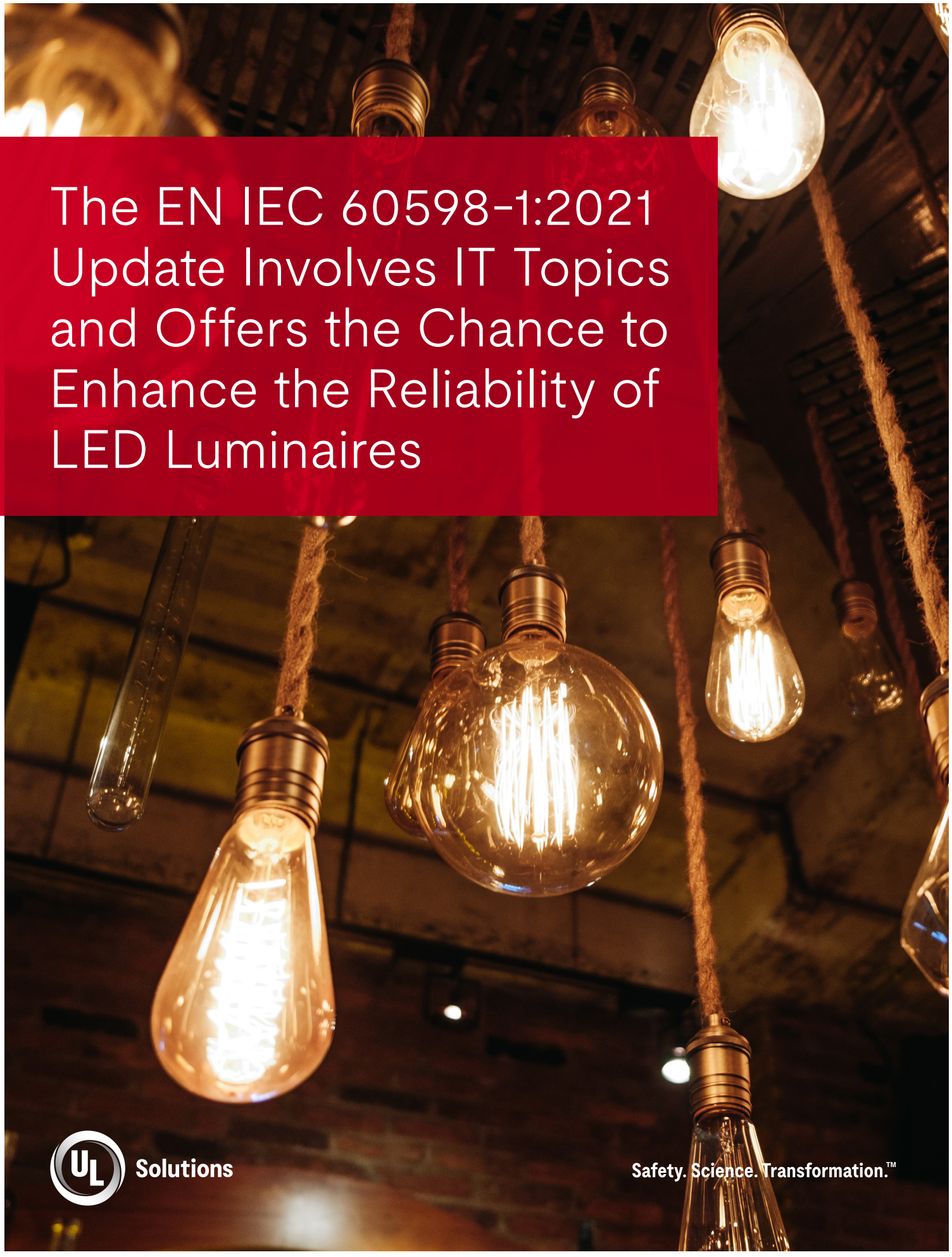
The EN IEC 60598-1:2021 Update Involves IT Topics and Offers the Chance to Enhance the Reliability of LED Luminaires



UL Solutions

Safety. Science. Transformation.™

Executive summary

Staying informed about upcoming changes to standards makes the development of new products and modifications to existing ones easier and quicker. Sometimes these changes enable potential cost savings or deliver new guidelines for developing innovative products.

As stated by the International Electrotechnical Commission (IEC) on their website, “The IEC is a global, not-for-profit membership organization that brings together more than 170 countries and coordinates the work of 20,000 experts” to set standards and issue Certification Bodies (CB) Scheme to test products and verify their safety. In some ways, the work of the IEC, founded in London in 1906, resembles the work we do within the UL Enterprise. We support the design of safe products by issuing international standards through our UL Standards & Engagement organization, we research ongoing and emerging human-safety risks through our UL Research Institutes, and we deliver testing, inspection and certification services through UL Solutions.

The European Committee for Electrotechnical Standardization (CENELEC) usually adopts IEC standards and develops frameworks with national deviations for specific European countries — commonly known as the EN standards. Specifically, we will be discussing the standard for safe lighting products, EN IEC 60598-1, Luminaires - Part 1: General requirements and tests.

There are 39 recent modifications to the standard: 14 revisions, six additions, three introductions, two removals, two cross-references, and 12 minor changes. While we will mention all the changes, this paper will focus on and discuss the three introductions:

- **Protective Extra Low Voltage (PELV) —** The use and design of PELV circuits will increase the reliability of LED solutions, even in the presence of transients disturbing or destroying the LED module.
- **Power over Ethernet (PoE) or USB —** By bringing together IT and lighting, this technology enables luminaires to be powered by the IT power supply.
- **Ingress Protection (IP) X9 —** This new level of protection against the ingress of water is important for cleaning tunnel lights and others.

Protective Extra Low Voltage

What is PELV?

PELV refers to a circuit in which the output of a control gear, an extra low voltage (ELV) output, is connected to the earth for functional purposes only. Since approximately 2010, when light-emitting diode (LED) technology started to be widely used in lighting applications as a light source, adding this circuit type to the standard has been discussed because it enhances the reliability of LED light sources in the presence of unavoidable transients.

Safety Extra Low Voltage (SELV) circuits should not be connected to earth, while PELV allows this connection. The connection of one pole to the ELV output to the earth is allowed, but only under specific conditions as outlined in IEC/TR 63139. Among the requirements, the most relevant is the limitation of the maximum voltage of the accessible PELV poles.

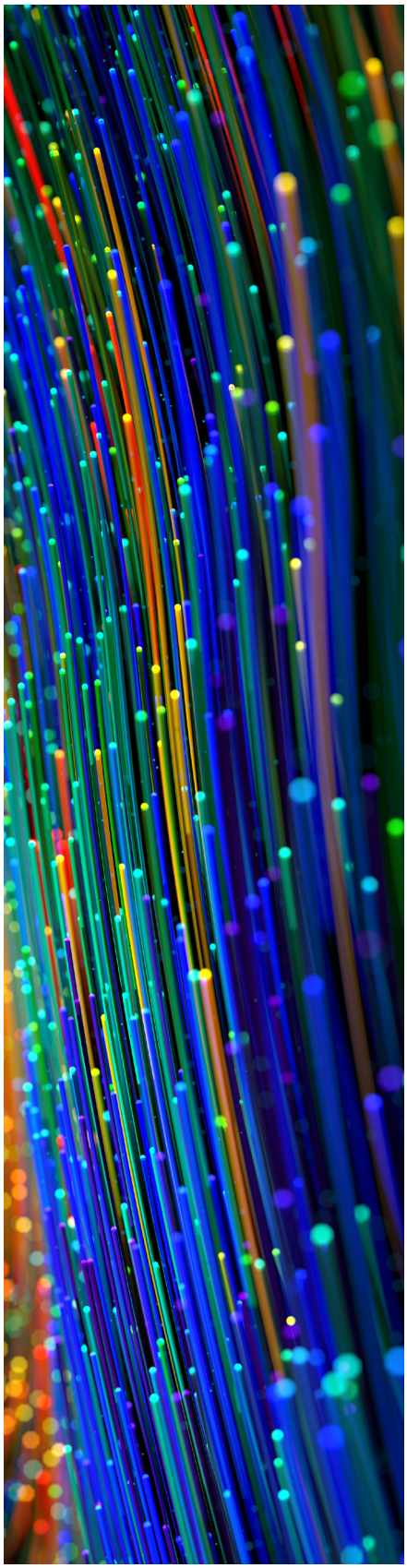
In normal use, due to the failure of other appliances connected to the same supply network, it's possible for the earth potential to be raised. Earthed circuits can reach voltage levels up to 50 V before any circuit protection operates, and this should be taken into consideration. This means that, in practice, the pole connected to earth may always be accessible while the other pole may have the potential to create a hazard due to the sum of the voltages. The new requirements set voltage limits for accessibility to the circuit: the pole connected to earth may always be accessible, while the other may only be accessible in case of a circuit voltage below 12 V AC or 30 V ripple free DC.

Why do we would need PELV in our luminaires?

The main idea is to protect LEDs from transients and for electromagnetic compatibility (EMC) reasons. When LED modules or other types of LEDs are supplied by a SELV source, they are floating because the SELV is doubled or reinforced insulated from the mains. One condition could result in damaging voltages due to the different electric potentials between the LED modules and other parts of the luminaire, such as a metallic enclosure. A way to solve this situation is to establish a grid in which all parts — the LED circuit and the enclosure — are connected so that the LEDs are more protected and not subjected to extra voltages.

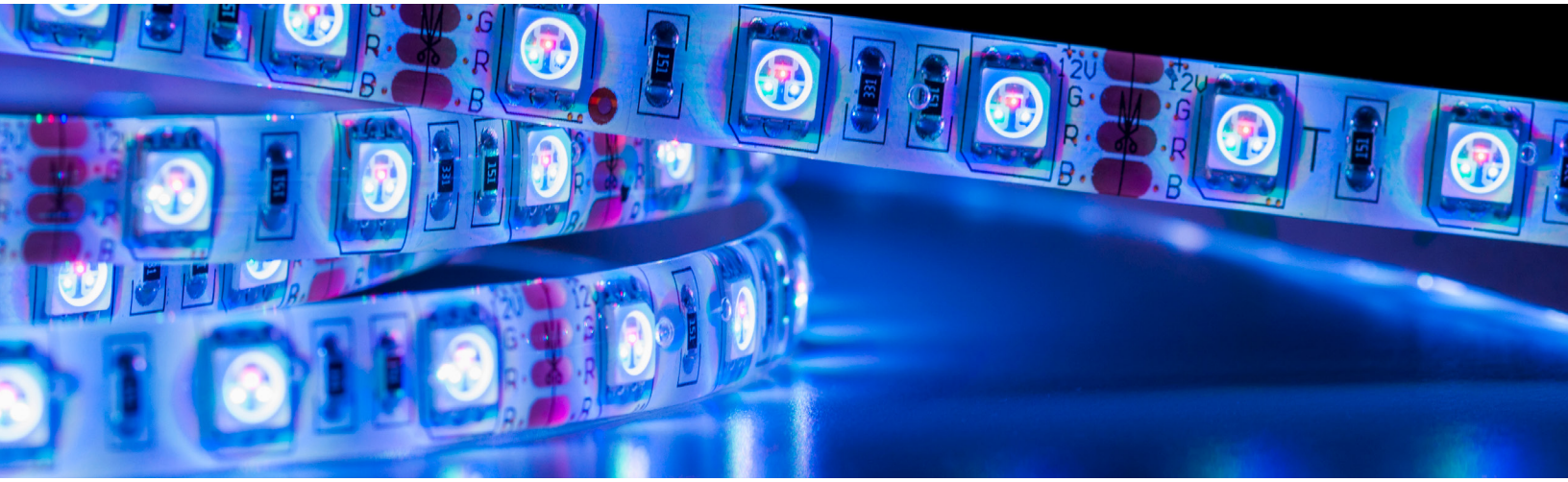
Wherever SELV is mentioned in the standard already, PELV has also been introduced. But we will face a few exceptions in which different requirements from SELV are called for. When one pole of the PELV connected to the earth fulfills the requirements of functional earth, the touch current and double or reinforced insulation from live parts needs to be realized.

To realize earthing, the connection to the protective earth of a PELV circuit must not be interconnected with other luminaires to avoid overloading the circuit conductor. The voltages of touchable exposed circuits are reduced to 12 V rms and 30 V rms. Class III luminaires can then be supplied by PELV in addition to SELV.



Power over Ethernet and USB power source equipment

Even though PoE has been used in the IT world for years and powers many technologies, such as telephone infrastructure and webcams, no path has been established for its use in lighting. However, the use of PoE in lighting is the next logical step as connected luminaires promise double-digit growth and have an ideal position in a room for many data-sensing applications. The new version of the standard sets levels for the use of such technology in lighting. PoE could be used to power luminaires up to 100 Watts, so a wide variety of applications exist. At the same time, the standard opens up the use of USB-powered equipment. We will discuss both topics in detail.



Class III luminaires are required

A safe IT power supply should comply with IEC 62368-3 Audio/video, information and communication technology equipment - Part 3: Safety aspects for DC power transfer through communication cables and ports. Also, as the Power Source Equipment (PSE), it should be classified as ES1. ES1 is new to lighting but could easily be understood as equivalent to separated or SELV. Such a power supply can be used to supply a Class III luminaire (ES1 = SELV).

The latest version of the standard addresses requirements for the verification of luminaires and not for the PSE. Due to the introduction of PELV, the definition of a Class III luminaire has been modified and extended from SELV to SELV and PELV protection against electric shock. In addition, new definitions for PSE, PoE, USB and IT communication cabling are introduced (1.2.24 to 1.2.97-100).

Marking

The marking of a Class III luminaire supplied via an external PSE, according to the requirement of Clause 3.2.2, shall include the voltage related to the type of voltage provided by the external PSE, and it shall be within the range for the type of communication chosen for the luminaire. Annex Y presents a table with all possible parameters.

This introduction also modifies some requirements related to tests: for example, the chain test outlined in Clause 4.26.2. If a Class III luminaire is supplied by an external ES1 PSE, the test is not required. Clause 4.31.3 confirms SELV circuits could be supplied by a PSE that provides ES1 level of voltage.

PoE connections for luminaires

In the newly created clause 4.33, we find a summary of requirements for Class III luminaires supplied via IT cables. As already mentioned, the luminaire shall fulfill the requirements of a Class III luminaire. The rated voltage shall not exceed the maximum voltage related to the used connector and must also be designed in line with the limits of the electrical parameters of a PSE, as outlined in Annex Y. Additionally, the Class III luminaire shall not create any hazard:

- When supplied with 130% of the rated input voltage for circuits with a voltage greater than 5 V DC, as when a type C connector is used
- When supplied with 150% of the rated input voltage when the circuit is supplied with a voltage equal to or less than 5 Vdc

These conditions shall be verified with the tests outlined in Section 12: thermal, endurance and others.

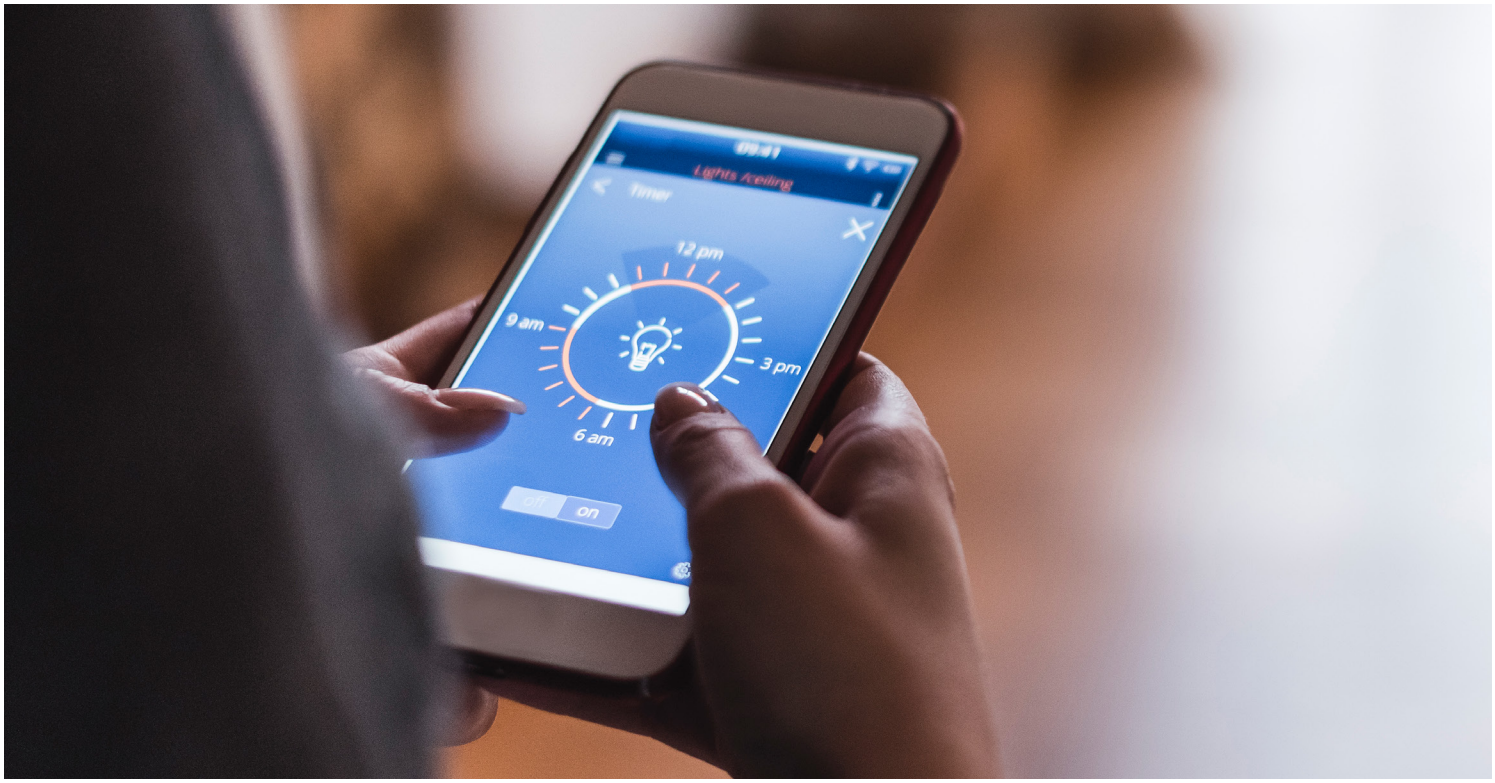
New requirements for connection have been introduced in paragraph 5 regarding how to connect this kind of luminaire to the PSE. If a cable is provided by the manufacturer, the same requirements apply for fixed or portable luminaires. The IT communication cable shall have the appropriate connectors as described in IEC 60603 or IEC 62680, and the connector shall be in compliance with the same standards.

Endurance and thermal tests in normal and abnormal operations

Clauses related to tests have been modified introducing a test condition for when a Class III luminaire is designed to be supplied by an ES1 PSE.

The endurance test is conducted over seven cycles. Since abnormal operation for the first six cycles is possible, the voltage is adjusted at 110% of the rated input voltage, and for the seventh cycle, the voltage is adjusted at 130 or 150%, according to the voltage of the input port.

The thermal test for normal operation is conducted at 106% of the rated voltage, and in abnormal operation, again at 130 or 150%, depending on the rated voltage.



Ingress protection, level X9 (IP X9)

The first digit of the IP code indicates the level of protection against solid particles like dust. The second digit indicates the level of liquid ingress protection. With the verification of the IP X9 code, water projected at high pressure and high temperature has been introduced to a colder variant with respect to those proposed by the IEC 60529.

- Water temperature of 80 (± 5) degrees Celsius : IP X9
- Water temperature of 15 (± 10) degrees Celsius : IP X9 (15 degrees Celsius)

According to Annex B of IEC 60529, the horizontal standard that outlines the degree of protection, the relevant technical committee is responsible for specifying all details concerning the application of the IP Code to a particular type of equipment in their relevant product standards. For this reason, we have two different degrees: one with the same temperature of 80 degrees Celsius as in IEC 60529 and the other with a lower temperature at 15 degrees Celsius.

Ingress protection testing

The verification shall be conducted with a high pressure and high or low temperature. The test is performed by spraying the luminaire with a stream from a standard test nozzle for two minutes for small enclosures (largest dimension 250 mm). For dimensions greater than or equal to 250 mm, the test duration is 1 min/m² of the calculated surface area of the enclosure (excluding any mounting surface), with a minimum duration of three minutes. The impact force shall be from 0.9 and 1.2 N with a flow rate of 15 liters per minute and a pressure between 80 and 100 bar.

There are three categories of IP degrees based on the second characteristic digit. The first consists of the IP degrees from one to six. The second includes seven and eight. The third category is new and consists of nine only. The extension of an IP degree can only be done within each category. So an IP X6 degree can extend an IP X5, but an IP X9 degree cannot extend an IP X6.

Tunnel luminaires are a good example of an application that requires a high degree of water ingress protection. Such luminaires are cleaned by hot water and high pressure during operation, so the new IP X9 rating might become a differentiator giving users greater trust in such products.

The new IP X9 *rating might* BECOME *a differentiator giving* the users greater ***trust in a*** PRODUCT

Overview of changes

Revisions	
Clause 4.30	Fixing cover live parts of non-user replaceable light source
Subclause 1.2.73 – 1.2.73.1/1.2.73.2	Revision of the requirements for functional earth and protective earth
Clause 3.2	Rated voltage marking
Subclause 5.2.10	Cord anchorage
Annex G	For touch current and protective conductor current test set-up
Subclause 8.2.3 c)	Touch voltage limits for interrupted DC voltage
Annex D	Introducing alternative thermal tests for luminaires with ta marking higher than 25°C
Table 10.3 and Subclause 3.3.19	For protective conductor current limits
Subclause 10.2.2	Alternative DC electric strength test
Annex D	For recessed luminaires
Subclause 4.12.5: revision of Table 4.2	For torque test on metal glands
Subclause 4.10.4 Protective impedance device	Use of bridging capacitors in luminaires
Subclause 5.2.14	Electrical connection to class III plugs

Additions	
Subclause 5.2.16	Additional requirements for AC mains appliance inlets related to IEC 61984
Subclause 3.3.25	UV protection of cable
Subclause 4.34	Inclusion of EMF safety requirements (IEC 62493)
Subclause 4.35	Protection against fast rotating parts
Subclause	Addition of requirements for constant light output function and programmable current output
Subclause 3.3.26	For wall mounted luminaires

Removals	
Subclause 4.24.2	Blue Light Hazard: removal of Risk Group 0
Clause 1.2.21	Definition of class 0 luminaire

Cross References	
Subclause 1.2.101	Track-mounted luminaires: cross reference to Annex A of IEC 60570:2003/AMD2:2019
Annex R	Edition 8 (2014) and Amendment 1 (2017) to Edition 9 (2020)

Minor changes	
	Alignment with Annex X
Clause 9.2	IP rating for recessed luminaires
Clause 4.7.1 c)	Wire anchoring
	Revision of Annex B.5
Subclause 8.2.1	
Clause 4.13	Mechanical Strength
	Tumbling Barrel Test
Subclause 3.2.21	Symbol for luminaires not suitable to be covered with thermally insulated material
Table 11.1	
Clause 3.2	Marking on luminaire

Global market access and the European situation

Globally — IEC 60598:2020

We can issue a CB based on IEC 60598-1:2020, which can be used to show compliance with this new international standard.

Europe – EN IEC 60598-1:2021 + A11:2022

European market access is different due to mandatory European Conformity (CE) marketing, which is based on the self-declaration of the manufacturer. From a legal perspective, the manufacturer needs to fulfill not a standard, but the Low Voltage Directive (2014/35/EU). This directive provides two options:

Option one: If you are in compliance with a European harmonized standard published in the Official Journal of the European Union (OJ), a “presumption of conformity” covers you.

Option two: If you do not comply with a harmonized standard, you need to have an extensive risk assessment in your CE documentation that shows how you meet the essential requirements.

Our recommendation
Current version EN IEC 60598-1:2021 + A11:2022 was harmonized in the EU in January 2023. Amendment 11 was developed to introduce European common modifications and European special national conditions. Use this version immediately for all your certification topics. It offers you the presumption of conformity so that your CE declaration is valid and correct, even after this date. According to the new standard, the old version from 2015 will be withdrawn by March 19, 2024. The ENEC License can be issued based on EN IEC 60598-1:2021 + A11:2022.

How UL Solutions can help

IEC-based CB certificates, important components of global market access and the basis for all EN standards, shouldn't be older than three years. We offer a special service to analyze your existing certificates to see if they need updating or retesting so that your product complies with the new version of the standard.

For more information on the upcoming changes to lighting standards, visit UL.com/lighting or contact your local UL Solutions team:

In the Americas: LightingInfo@UL.com
In Europe: AppliancesLighting.EU@UL.com
In GC: GC.LightingSales@UL.com
In ANZ: CustomerService.ANZ@UL.com
In ASEAN: UL.ASEAN.AHLSales@UL.com
In Japan: ULJ.AHL@ul.com
In South Korea: Sales.KR@UL.com
In MEA: UL.MEA@UL.com
In South Asia: Sales.IN@UL.com

UL.com/Solutions

AHL22CS26668460