

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



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Executive summary

What's coming next? Being 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," in order to set standards and issue schemes (CB) to test products verifying their safety. The aim of this organization founded in London in 1906 compares to ours within UL Solutions: supporting the design of safe products by issuing international standards.

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

The IEC published the update of the IEC 60598-1:2020 in November 2020, expecting that some national deviations would occur for the update of the EN 60598-1:2021 - but these deviations have not yet been added or the standard

harmonized. In this paper we will provide an overview of the changes so that you can start thinking about how to leverage this knowledge, and discuss your options pending the harmonization of the new standard.

There are 39 modifications to the standard: 14 revisions, six additions, three introductions, two removals, two cross-references and finally 12 minor changes have been made.

While we will mention all of 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** — Brings together IT and lighting. The technology enables luminaires to be powered by the IT power supply.
- **IP X9** — A new level of protection against the ingress of water, important for cleaning of tunnel lights and others.

Protective Extra Low Voltage (PELV)

What is PELV?

It is 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 LED technology started to be widely used in lighting applications as a light source, adding this circuit type to the standard was discussed because it enhanced 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 condition 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 EMC reasons. When LED modules or other types of LEDs are supplied by a SELV source they are floating due to the fact that 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, for example 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 together 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 required. When the connection of one pole of the PELV to the earth shall fulfill the requirements of functional earth, the touch current and double or reinforced insulation from live parts needs to be realized.

In order to realize earthing, the connection to the protective earth of a PELV circuit shall not be used for interconnection with other luminaires to avoid overload of the circuit conductor. The voltages of touchable exposed circuits are reduced to 12 V rms and 30 V rms. Class III luminaires can now be supplied by PELV in addition to SELV.



Power over Ethernet and USB power source equipment

Even though PoE has been established in the IT world for years and already powers many technologies such as telephone infrastructure and webcams, no path has been established for its use in lighting, but the use of PoE is the next logical step. Connected luminaires promise double digit growth and for many data-sensing applications, have an ideal position in a room. 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 field of applications exists. At the same time, the standard opens up the use of USB power source 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 in order to supply a Class III luminaire (ES1 = SELV). So the new version of the standard addresses requirements to the verification of the luminaires and not to 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 – 1.2.97-100).

Marking

The marking of a Class III luminaire supplied via an external PSE, according to the requirement of the 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. In Annex Y, we have 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 a completely new clause 4.33, we find a summary of requirements about 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 also designed to be 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 percent 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 percent 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,

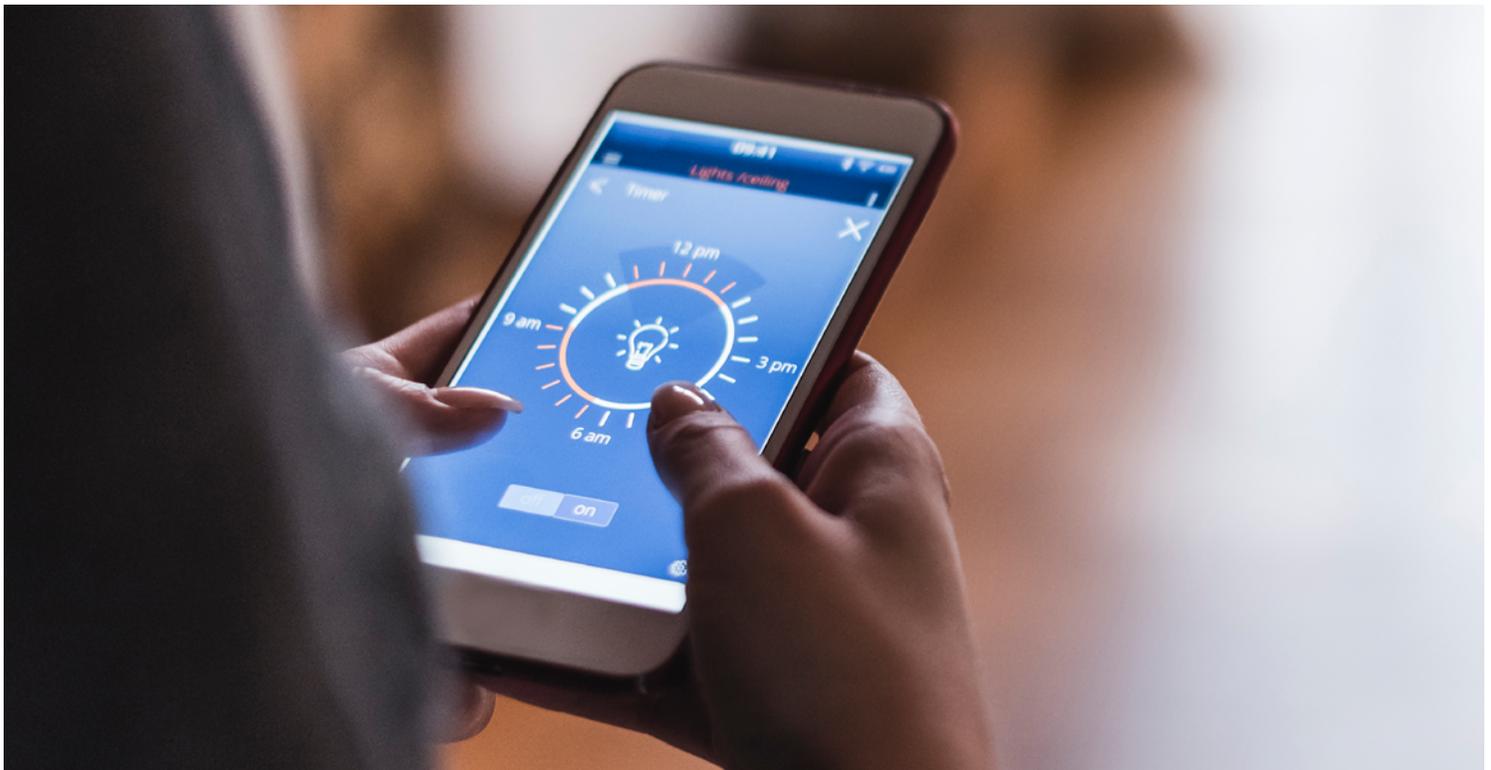
the same requirements apply for fixed or portable luminaires. The IT communication cable shall have the appropriate connectors as described in IEC 60603 or in the IEC 62680, and the connector shall be in compliance with the same standards.

Endurance and thermal tests in normal and abnormal operations

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

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

The thermal test for normal operation shall be conducted at 106 percent of the rated voltage and in abnormal operation again at 130 or 150 percent 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 Celcius : IP X9
- Water temperature of 15 (± 10) degrees Celcius : IP X9 (15 degrees Celcius)

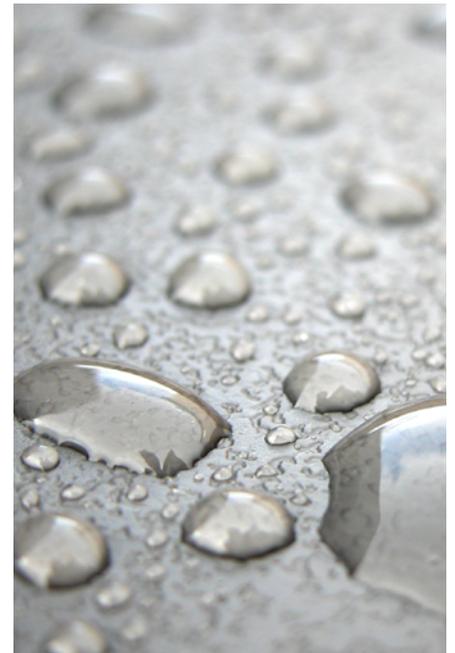
According to Annex B of the IEC 60529, the horizontal standard that outlines the degree of protection, the relevant technical committee is responsible for specifying all details concerning the application of the IP Code to a particular type of equipment in their relevant product standards. For this reason,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

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 larger 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.

With regard to different IP degrees considering the second characteristic digit, we have three different families. The first composes the IP degrees from one to six. The second composes seven and eight. The third family is new and composes nine only. The extension of the IP degree could only be done inside each family. So an IP X6 degree can extend the IP X5, but an IP degree X9 cannot extend an IP X6.

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



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BECOMES
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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

If you have already designed a luminaire that incorporates one of the features covered by the new standard (such as PoE or the USB interface), we can issue a CB based on the IEC 60598-1:2020, which can be used to show compliance with this new international standard.

Europe – EN IEC 60598-1:2021

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



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



Option two: If you do not use a harmonized standard, then you need to have an extensive “Risk assessment” in your CE documentation that shows how you achieved the essential requirements. In the official journal (OJ), as of June 2021, only the EN 60598-1:2015/A1:2018 version is noted.



Our recommendation: If there is no technical need right now for the new 2021 version of the standard to be used, stay with the most recent harmonized one which offers the “presumption of conformity” until the new standard has been harmonized.

For ENEC the confusion is even greater; the above mentioned EN IEC 60598-1:2021 does not contain national deviations as expected. We expect that all serious test houses will reject a certification based on this version of the standard. ETICS published on their web page in ENEC 301 Annex B, but this web page also has outdated information about issuing an ENEC based on EN 60598-1:2008, a standard that does not exist anymore and has been withdrawn by the CENELEC. The only remaining option as of the time of this publication for an ENEC is the previous EN 60598-1:2015/A1:2018, which also provides the above mentioned “presumption of conformity”.

How UL Solutions can help

IEC-based CB certificates — an important aspect 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 if they need to be updated or retested so that your product complies with the new version of the standard. In addition, as soon as the European deviations are added to the EN IEC 60598-1:2021 and it becomes harmonized by the European Union, we will update your CB to an ENEC for a special price.



For more information on the upcoming changes to lighting standards, visit us at [UL.com/lighting](https://www.ul.com/lighting) or contact our team at:

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