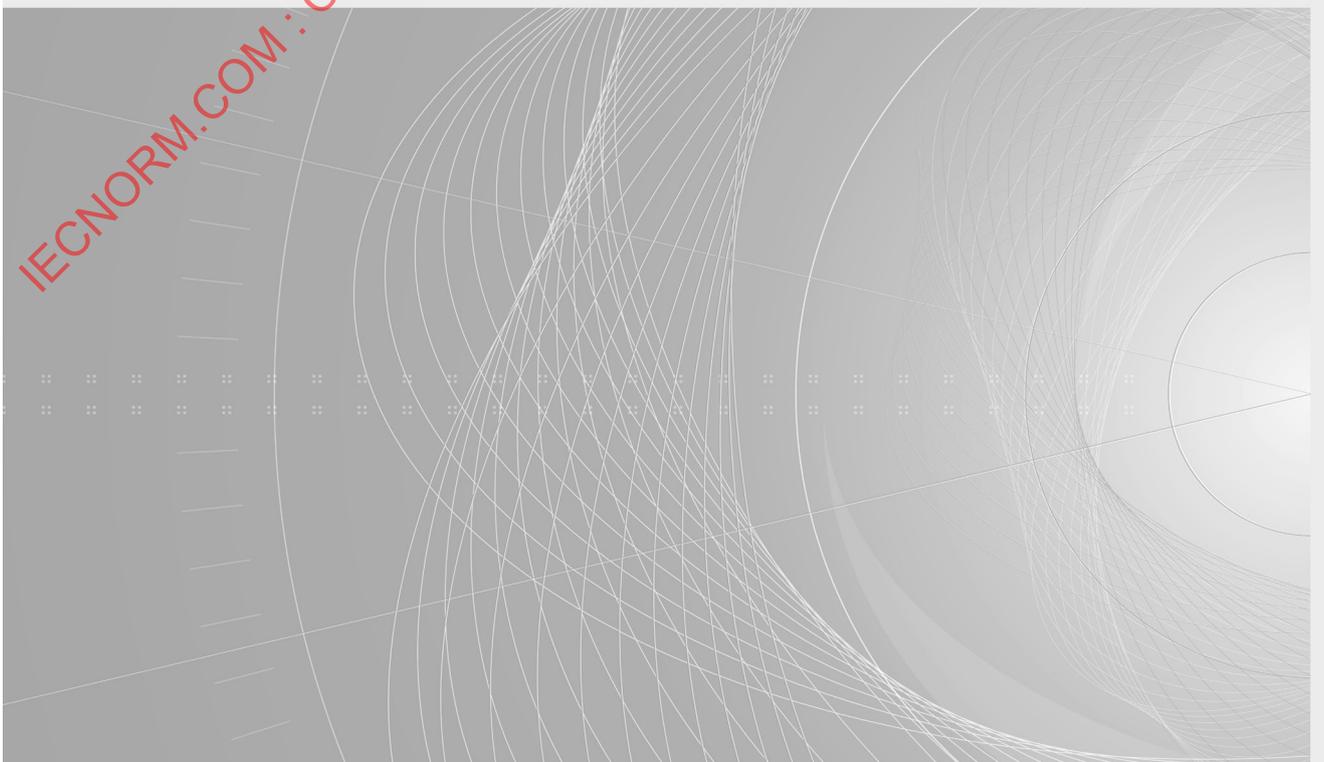


TECHNICAL SPECIFICATION



Lighting systems – General requirements

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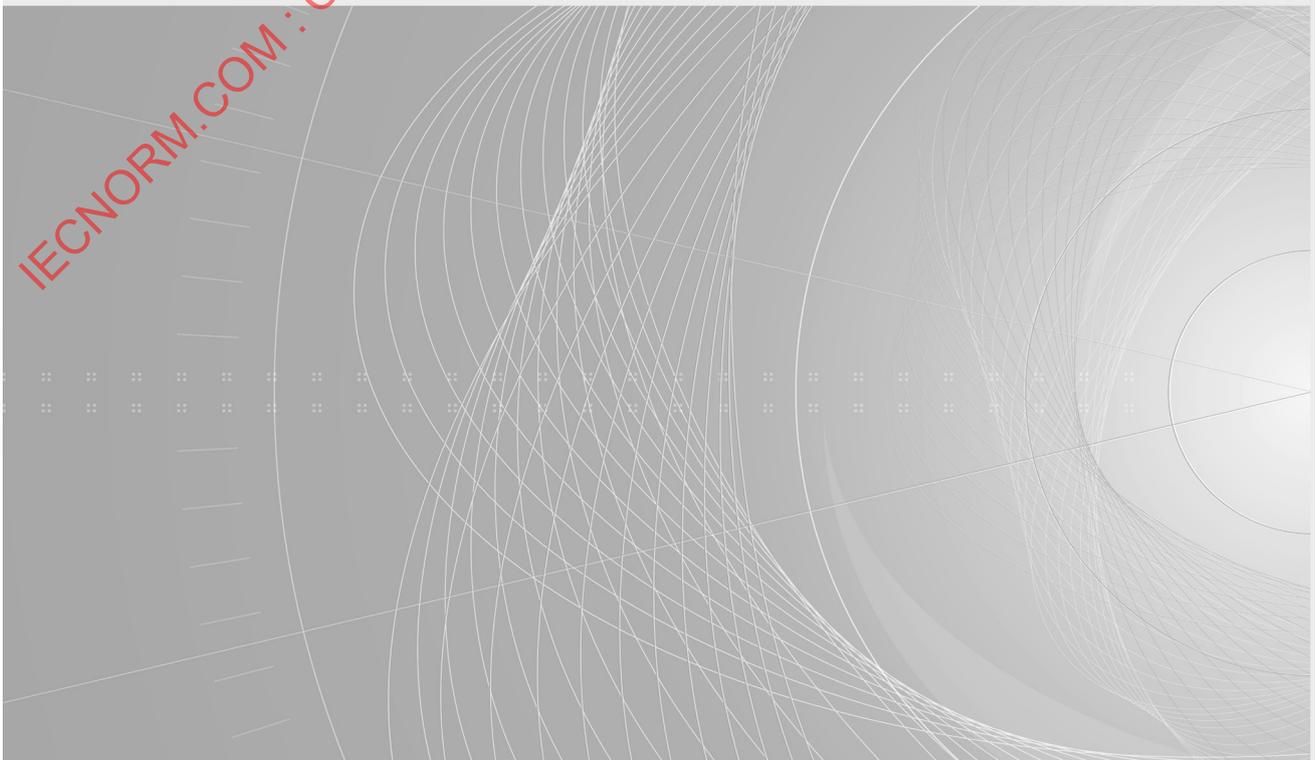
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LIGHTING SYSTEMS – GENERAL REQUIREMENTS

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LIGHTING SYSTEMS – GENERAL REQUIREMENTS

1 Scope

This document specifies general requirements for design, installation and maintenance of a lighting system.

A lighting system comprises a set of products. Requirements of the products are specified in product standards. For the general requirements of lighting systems, this document prevails.

Construction of lighting systems can vary in applications. This document is not intended to provide detailed technical specifications for the construction of lighting systems but to specify requirements in general that are necessary for lighting systems.

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 62504, *General lighting – Light emitting diode (LED) products and related equipment – Terms and definitions*

IEC TS 63105, *Lighting systems and related equipment – Vocabulary*

IEC TS 63117, *General requirements for lighting systems – Safety*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 63105 and IEC 62504 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 lighting system

system designed to provide lighting

Note 1 to entry: The lighting system can be dedicated to

- a) the support of one or more specified visual tasks under specified conditions considering other requirements such as human comfort, safety, the appearance of the surrounding environment and energy consumption;
- b) the support of other than human tasks.

Note 2 to entry: The lighting system can include a set of light sources, other physical components, communication protocols, user interfaces, software and networks to provide control and monitoring functions.

Note 3 to entry: The light source(s) and the related equipment can be integrated in a single item, e. g. an LED module, a lamp or a luminaire.

Note 4 to entry: A lighting system can be networked to provide central or remote control and monitoring functions.

Note 5 to entry: A lighting system can be connected to or integrated with other systems or devices.

[SOURCE: IEC 60050-845:2020, 845-27-010]

3.2 functional safety

part of the overall safety that depends on functional and physical units operating correctly in response to their inputs

[SOURCE: IEC 60050-351:2013, 351-57-06, modified – The Note 1 to entry has been deleted.]

3.3 information security

protection of information against unauthorized disclosure, transfer, modification, or destruction, whether accidental or intentional

Note 1 to entry: The term covers cyber-security.

[SOURCE: IEC 60050-721:1991, 721-08-57, modified – The Note 1 to entry has been added.]

3.4 communication protocol

set of rules for data transmission in a system interlinking several system components

Note 1 to entry: A communication protocol can define the conditions for establishing a connection to a transmission medium, the rules governing access to the medium, the procedures for error protection, the functional and procedural means of data exchange, the transport mechanisms, the communication control, the representation of data and the exchange of application data.

Communication protocols define, for example:

- data units transferred between system components,
- the meaning of data units (semantics),
- the format of data units (syntax) and
- the logic time sequence of data exchange.

Note 2 to entry: The communication protocols used in a system can be organized in accordance with industry-wide accepted reference models, e.g. the ISO-OSI seven-layer reference model.

[SOURCE: IEC 60050-351:2013, 351-56-14, modified – "protocol" has been replaced by "communication protocol", "participants" has been replaced by "system components", and the Note 2 to entry has been modified.]

3.5 adaptive characteristic

characteristic that responds to circumstances or predefined conditions

Note 1 to entry: The adaptive characteristic of a lighting system and its components is to provide adaptive lighting.

Note 2 to entry: See IEC 845-29-027 for the definition of "adaptive lighting".

4 General

The lighting systems shall be designed using products that:

- comply with product standards, such as, but not limited to safety requirements, performance requirements and interface requirements;
- are suitable for the environmental conditions to which the system is likely to be subjected, such as, but not limited to temperature range, humidity range, altitude and vibration;

- provide appropriate electrical insulation towards system integration for electrical safety assurance;
- provide appropriate protection measures towards system integration for functional safety and information security;
- provide appropriate interfaces, such as communication interfaces, towards system integration for the expected system performance and functionality.

Compliance is checked by inspection of the documentation and by carrying out the tests of Clause 5 to Clause ~~10~~ 11.

5 Electrical safety

Lighting systems require additional safety requirements at the system level. These requirements apply in addition to the product safety requirements that can be found in the product specific standards.

The electrical safety requirements of lighting systems at the system level shall follow IEC TS 63117.

6 Functional safety

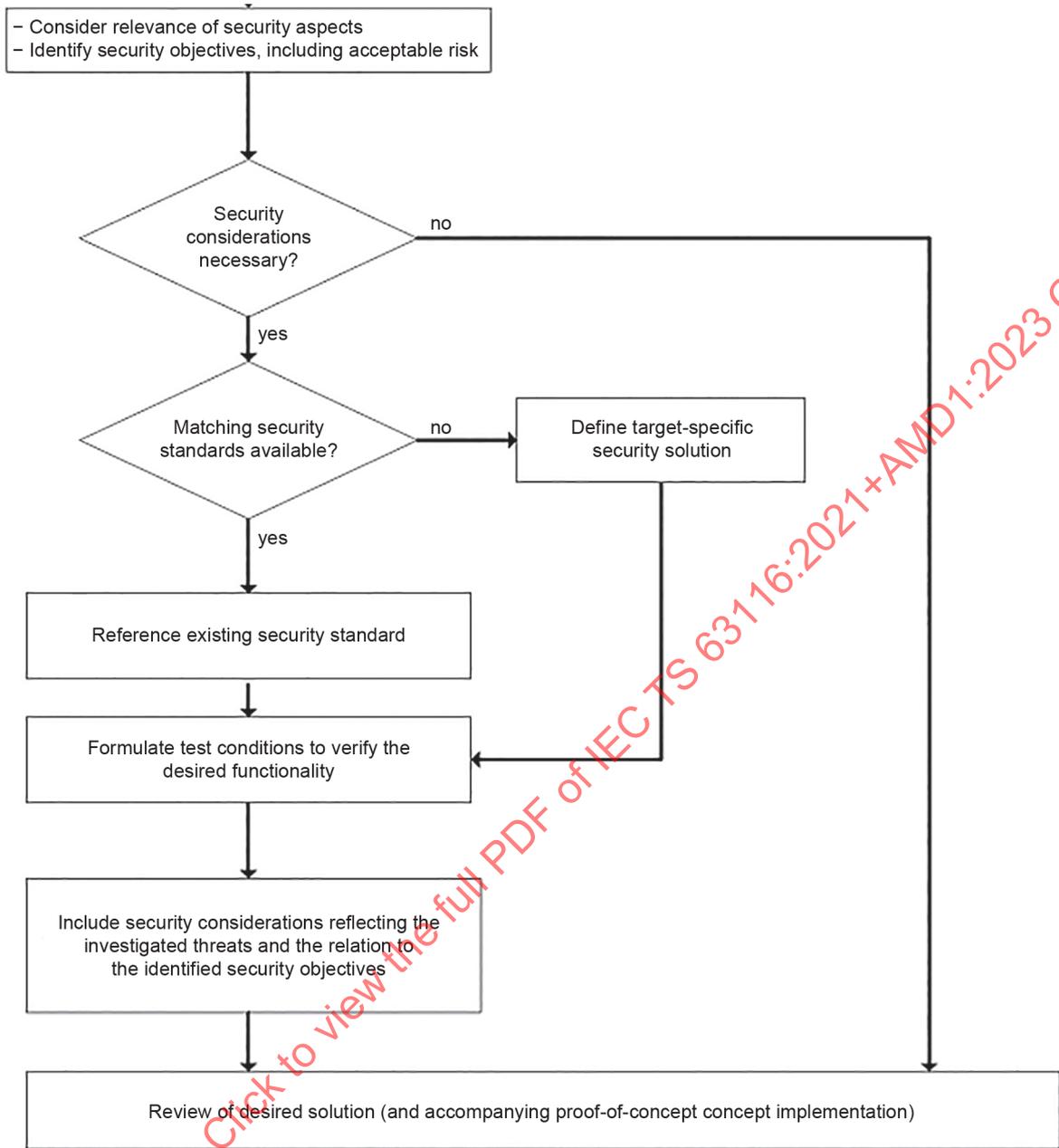
Lighting systems often comprise many different products (luminaire, sensor, controllers, touch panels and other human interfaces, etc.) which are connected through communication cabling or wirelessly, where the light output can be varied based on the input from sensors or users. Malfunction of the interaction of system components can create unsafe lighting conditions. When operating, they should incur no unacceptable risks.

Functional safety requirements of lighting systems shall follow IEC TS 63117.

7 Information security

Lighting systems often utilize communication, data transfer and data storage functions. The data and information can be sensitive and/or private. Lighting systems can also be applied within an environment demanding (a) higher security level(s). These lighting systems shall be applied with an appropriate level of information security.

Information security aspects shall be considered from the start of the design of a lighting system, throughout its service life, and at end-of-life-stage. Whether measures to provide information security are to be included should be checked against regulatory and application requirements, see Figure 1.



SOURCE: IEC Guide 120:2018

Figure 1 – Flow chart for decision of information security measures

A risk assessment process described in IEC 31010 can be used to perform this evaluation.

8 Installation, commissioning and maintenance

Lighting systems shall be installed in accordance with

- the instructions for use (see Clause 10), provided by the manufacturer or responsible vendor of the lighting system and the design details provided by the lighting system designer, and
- the installation instructions specified in the appropriate standards.

NOTE Local installation regulations provide relevant information that can also be consulted when preparing installation instructions.

Lighting systems should be commissioned to fulfil the designed system specifications. For a system with less complexity, the commissioning can be done according to the instructions for use. For lighting systems in highly complex buildings, the commissioning could follow ISO/TS 21274.

Lighting systems and its components shall be maintained in accordance with the instructions for use (see Clause 10), provided by the manufacturer or responsible vendor of the lighting system and the design details provided by the lighting system designer.

9 Performance and functionality

9.1 General

The lighting system performance parameters and functionalities shall comply with all claimed characteristics in the system documentation. Reporting of such characteristics shall comply with the requirements of Annex A.

9.2 Adaptive characteristics

The lighting system shall fulfill all claimed adaptive characteristics in the system documentation, which include but are not limited to the following:

- sensitivity to a specific stimulus (e.g. occupancy, natural light level, weather and traffic conditions);
- relevant response (e.g. ~~dimming (flux variation), changing colour and timing~~ adjustment of light output level (dimming and brightening); adjustment of light spectrum (colour or correlated colour temperature (CCT) tuning or both) and timing).

9.3 Functionality

The lighting system shall fulfill all claimed functionalities with specified accuracy in the system documentation, such as:

- fault detection,
- degradation compensation,
- remote monitoring,
- energy consumption monitoring.

NOTE 1 The type of functions of a lighting system depends on the application.

NOTE 2 A lighting system can also integrate functions other than lighting for enhanced performance, for example, monitoring of environmental and traffic conditions by a street lighting system. Other standards can apply for functions other than lighting.

9.4 Communication protocol

The communication protocol(s) employed within the lighting system shall be declared by the manufacturer or responsible vendor in the system documentation.

If the manufacturer or responsible vendor of a lighting system claims the capability of interfacing with other systems, they shall publish relevant substantiating information in the system documentation.

10 Instructions for use

Instructions for use shall be available for installation, commissioning, maintenance, disposal and all claimed performance characteristics and functionalities.

All available types and methods of user interfaces to control the lighting systems shall be provided in the instructions for use.

In case the system has been provided with measures to provide information security, corresponding information shall be provided by the manufacturer or responsible vendor to enable correct installation, use, data backup, software and firmware updates, maintenance and end-of-life treatment.

11 Classification of lighting systems

11.1 General

According to the system structure, lighting systems can be classified into three categories, as follows:

- lighting systems consisting of standalone luminaire(s);
- autonomous lighting systems;
- centrally controllable lighting systems.

See 11.2 to 11.4 for the description of the different categories.

See 11.5 for the typical capacities of lighting systems in different categories.

11.2 Lighting system consisting of standalone luminaire(s)

A lighting system consisting of a standalone luminaire is a luminaire that does not communicate with other luminaires or a central controller for setting light properties (e.g. on/off, dimming) or for the exchange of information. It can have the capability to communicate with other devices for setting configuration parameters or setting light properties (e.g. on/off, dimming) or exchange of information. An example of a lighting system consisting of one standalone luminaire is shown in Figure 2.

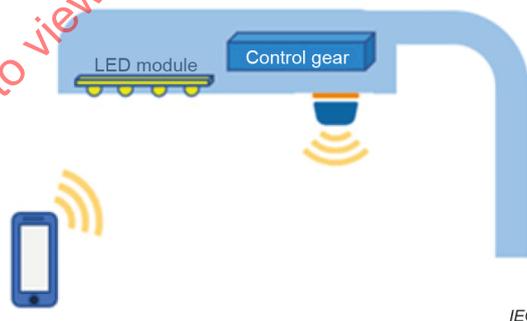


Figure 2 – Example of lighting system consisting of a standalone luminaire

11.3 Autonomous lighting system

The autonomous lighting system consists of two or more luminaires that can communicate with each other for the purpose of adjusting the light properties of the luminaires. This network of luminaires is characterized by having no central control possibilities.

These luminaires have at least one communication network that is intended to exchange information between luminaires to control the light properties. These luminaires can also have the communication capabilities of a standalone luminaire. An example of autonomous lighting system is shown in Figure 3.

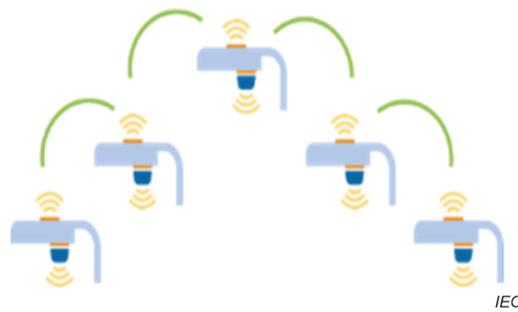


Figure 3 – Example of autonomous lighting system

11.4 Centrally controllable lighting system

The centrally controllable lighting system consists of one or more luminaires that can communicate with a central controller and in the case of multiple luminaires, can have the ability to communicate between luminaires directly like in an autonomous lighting system and can have the communication capabilities of a standalone luminaire. An example of centrally controllable lighting system is shown in Figure 4.



Figure 4 – Example of centrally controllable lighting system

11.5 Typical capacities of lighting systems in different categories

The implementations of adaptive lighting controls and functionalities on lighting systems are specified according to the purpose and environmental conditions of the application. Table 1 gives examples of such functionalities and characteristics for each category of lighting system.

Table 1 – Examples of functionalities and characteristics for each category of lighting system

	Lighting system with standalone luminaire	Autonomous lighting system	Centrally controllable lighting system
Timer-based light control	X	X	X
Sensor-based light control	X	X	X
Group-based light control		X	X
Centrally controllable light control			X
Systems configurable in field	X	X	X
Data exchange on local request	X	X	X
Automatic data exchange with central controller			X
Data exchange with external system			X (optional)

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Annex A (normative)

Lighting systems – Reporting of lighting system performance parameters and functionalities

A.1 General

The characteristics of products used in lighting systems related to functionality, connectivity and capability shall be presented in the lighting system technical documentation.

A.2 Adaptive characteristics

A.2.1 Sensors

The supported types of sensors for lighting products in the lighting system shall be reported. Such characteristics can include but are not limited to:

- purpose of the sensor(s);
- type of sensor(s);
- sensor technology(ies).

A.2.2 Adjustment of light output level

If applicable, the dimming methods and dimming range of lighting products in the lighting system shall be reported. Such dimming characteristics can include but are not limited to:

- continuous dimming;
- stepped dimming;
- scene selection;
- dimming curve;
- dimming range.

A.2.3 Adjustment of light spectrum

If applicable, the full colour changing or white CCT tuning range of lighting products in the lighting system shall be reported. Such characteristics can include but are not limited to:

- colour tuning;
- white CCT tuning;
- colour shift dimming (e.g. dim-to-warm);
- default setting;
- tuning range or setting;
- colour tuning protocol.

A.2.4 Lighting control functionality

If applicable, the lighting control of lighting products in the lighting system shall be reported. Such characteristics can include but are not limited to:

- individual control (device addressability);
- group control (device addressability);
- daylight harvesting;

- scene control;
- scheduling.

A.3 Diagnostics

If applicable, the functions related to diagnostics of lighting products shall be reported. Such characteristics can include but are not limited to:

- fault detection;
- device status monitoring;
- light level detection;
- light degradation compensation;
- remote monitoring;
- occupancy monitoring;
- energy consumption monitoring and reporting.

A.4 Communication protocol

The supported types of communication protocol for lighting products in the lighting system shall be reported. Such characteristics can include but are not limited to:

- supported communication protocol and version;
- type of networks.

A.5 User interface

If applicable, the types of user interface for lighting products in the lighting system shall be reported. Such characteristics can include but are not limited to:

- software application;
- wall panel;
- switch;
- other input devices.

A.6 Information security measures

If applicable, the characteristics of the information security aspects of lighting products shall be reported. Such characteristics can include but are not limited to:

- existence of information security measures;
- standards compliance for information security;
- certification for information security.

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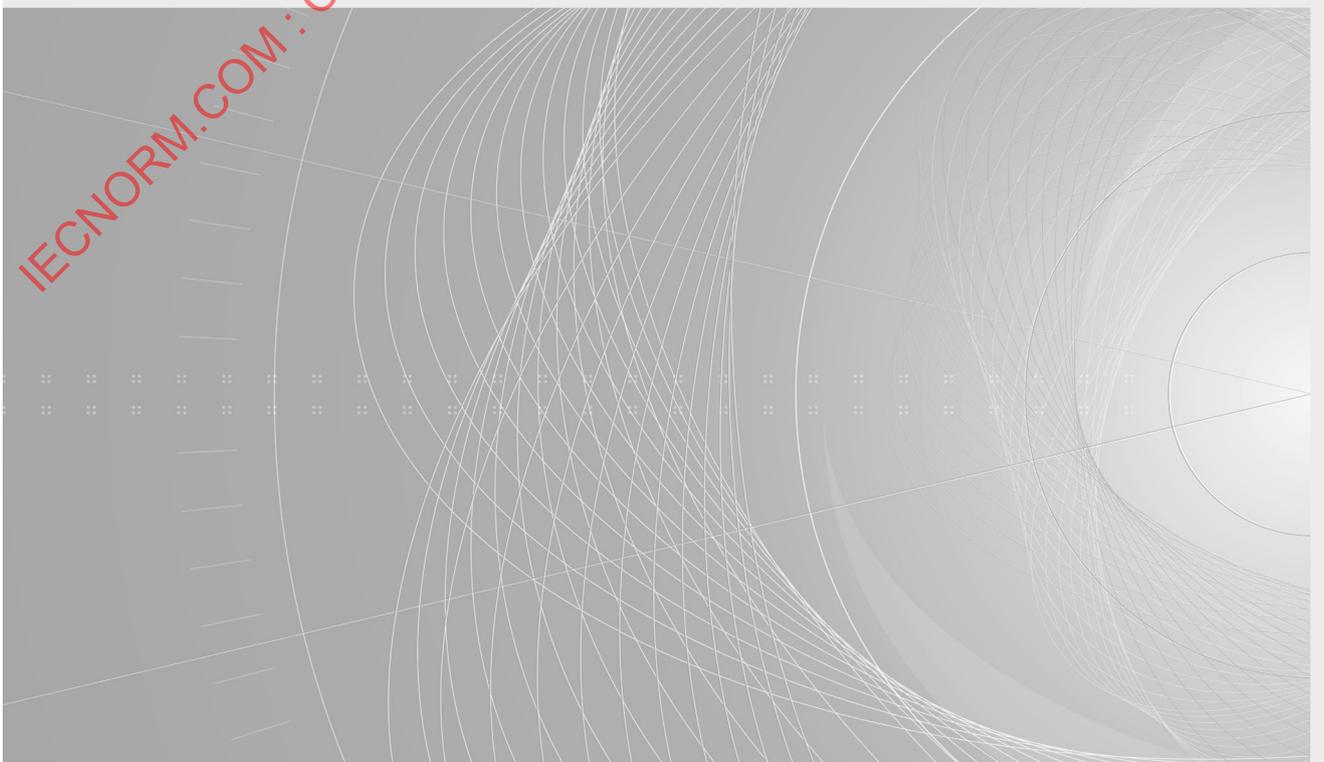
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This document specifies general requirements for design, installation and maintenance of a lighting system.

A lighting system comprises a set of products. Requirements of the products are specified in product standards. For the general requirements of lighting systems, this document prevails.

Construction of lighting systems can vary in applications. This document is not intended to provide detailed technical specifications for the construction of lighting systems but to specify requirements in general that are necessary for lighting systems.

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 62504, *General lighting – Light emitting diode (LED) products and related equipment – Terms and definitions*

IEC TS 63105, *Lighting systems and related equipment – Vocabulary*

IEC TS 63117, *General requirements for lighting systems – Safety*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 63105 and IEC 62504 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 lighting system

system designed to provide lighting

Note 1 to entry: The lighting system can be dedicated to

- a) the support of one or more specified visual tasks under specified conditions considering other requirements such as human comfort, safety, the appearance of the surrounding environment and energy consumption;
- b) the support of other than human tasks.

Note 2 to entry: The lighting system can include a set of light sources, other physical components, communication protocols, user interfaces, software and networks to provide control and monitoring functions.

Note 3 to entry: The light source(s) and the related equipment can be integrated in a single item, e. g. an LED module, a lamp or a luminaire.

Note 4 to entry: A lighting system can be networked to provide central or remote control and monitoring functions.

Note 5 to entry: A lighting system can be connected to or integrated with other systems or devices.

[SOURCE: IEC 60050-845:2020, 845-27-010]

3.2 functional safety

part of the overall safety that depends on functional and physical units operating correctly in response to their inputs

[SOURCE: IEC 60050-351:2013, 351-57-06, modified – The Note 1 to entry has been deleted.]

3.3 information security

protection of information against unauthorized disclosure, transfer, modification, or destruction, whether accidental or intentional

Note 1 to entry: The term covers cyber-security.

[SOURCE: IEC 60050-721:1991, 721-08-57, modified – The Note 1 to entry has been added.]

3.4 communication protocol

set of rules for data transmission in a system interlinking several system components

Note 1 to entry: A communication protocol can define the conditions for establishing a connection to a transmission medium, the rules governing access to the medium, the procedures for error protection, the functional and procedural means of data exchange, the transport mechanisms, the communication control, the representation of data and the exchange of application data.

Communication protocols define, for example:

- data units transferred between system components,
- the meaning of data units (semantics),
- the format of data units (syntax) and
- the logic time sequence of data exchange.

Note 2 to entry: The communication protocols used in a system can be organized in accordance with industry-wide accepted reference models, e.g. the ISO-OSI seven-layer reference model.

[SOURCE: IEC 60050-351:2013, 351-56-14, modified – "protocol" has been replaced by "communication protocol", "participants" has been replaced by "system components", and the Note 2 to entry has been modified.]

3.5 adaptive characteristic

characteristic that responds to circumstances or predefined conditions

Note 1 to entry: The adaptive characteristic of a lighting system and its components is to provide adaptive lighting.

Note 2 to entry: See IEV 845-29-027 for the definition of "adaptive lighting".

4 General

The lighting systems shall be designed using products that:

- comply with product standards, such as, but not limited to safety requirements, performance requirements and interface requirements;
- are suitable for the environmental conditions to which the system is likely to be subjected, such as, but not limited to temperature range, humidity range, altitude and vibration;

- provide appropriate electrical insulation towards system integration for electrical safety assurance;
- provide appropriate protection measures towards system integration for functional safety and information security;
- provide appropriate interfaces, such as communication interfaces, towards system integration for the expected system performance and functionality.

Compliance is checked by inspection of the documentation and by carrying out the tests of Clause 5 to Clause 11.

5 Electrical safety

Lighting systems require additional safety requirements at the system level. These requirements apply in addition to the product safety requirements that can be found in the product specific standards.

The electrical safety requirements of lighting systems at the system level shall follow IEC TS 63117.

6 Functional safety

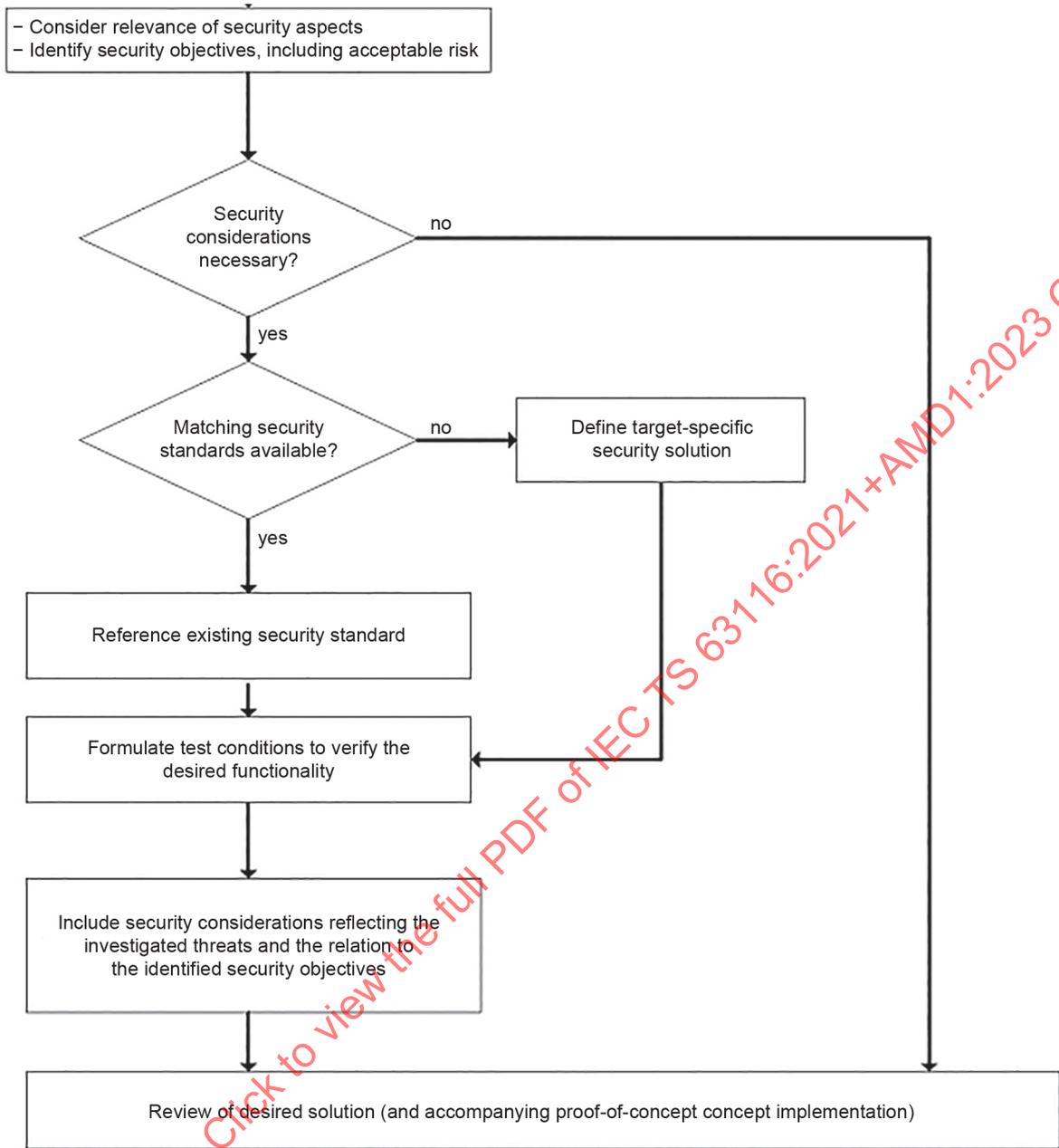
Lighting systems often comprise many different products (luminaire, sensor, controllers, touch panels and other human interfaces, etc.) which are connected through communication cabling or wirelessly, where the light output can be varied based on the input from sensors or users. Malfunction of the interaction of system components can create unsafe lighting conditions. When operating, they should incur no unacceptable risks.

Functional safety requirements of lighting systems shall follow IEC TS 63117.

7 Information security

Lighting systems often utilize communication, data transfer and data storage functions. The data and information can be sensitive and/or private. Lighting systems can also be applied within an environment demanding (a) higher security level(s). These lighting systems shall be applied with an appropriate level of information security.

Information security aspects shall be considered from the start of the design of a lighting system, throughout its service life, and at end-of-life-stage. Whether measures to provide information security are to be included should be checked against regulatory and application requirements, see Figure 1.



SOURCE: IEC Guide 120:2018

Figure 1 – Flow chart for decision of information security measures

A risk assessment process described in IEC 31010 can be used to perform this evaluation.

8 Installation, commissioning and maintenance

Lighting systems shall be installed in accordance with

- the instructions for use (see Clause 10), provided by the manufacturer or responsible vendor of the lighting system and the design details provided by the lighting system designer, and
- the installation instructions specified in the appropriate standards.

NOTE Local installation regulations provide relevant information that can also be consulted when preparing installation instructions.

Lighting systems should be commissioned to fulfil the designed system specifications. For a system with less complexity, the commissioning can be done according to the instructions for use. For lighting systems in highly complex buildings, the commissioning could follow ISO/TS 21274.

Lighting systems and its components shall be maintained in accordance with the instructions for use (see Clause 10), provided by the manufacturer or responsible vendor of the lighting system and the design details provided by the lighting system designer.

9 Performance and functionality

9.1 General

The lighting system performance parameters and functionalities shall comply with all claimed characteristics in the system documentation. Reporting of such characteristics shall comply with the requirements of Annex A.

9.2 Adaptive characteristics

The lighting system shall fulfill all claimed adaptive characteristics in the system documentation, which include but are not limited to the following:

- sensitivity to a specific stimulus (e.g. occupancy, natural light level, weather and traffic conditions);
- relevant response (e.g. adjustment of light output level (dimming and brightening), adjustment of light spectrum (colour or correlated colour temperature (CCT) tuning or both) and timing).

9.3 Functionality

The lighting system shall fulfill all claimed functionalities with specified accuracy in the system documentation, such as:

- fault detection,
- degradation compensation,
- remote monitoring,
- energy consumption monitoring.

NOTE 1 The type of functions of a lighting system depends on the application.

NOTE 2 A lighting system can also integrate functions other than lighting for enhanced performance, for example, monitoring of environmental and traffic conditions by a street lighting system. Other standards can apply for functions other than lighting.

9.4 Communication protocol

The communication protocol(s) employed within the lighting system shall be declared by the manufacturer or responsible vendor in the system documentation.

If the manufacturer or responsible vendor of a lighting system claims the capability of interfacing with other systems, they shall publish relevant substantiating information in the system documentation.

10 Instructions for use

Instructions for use shall be available for installation, commissioning, maintenance, disposal and all claimed performance characteristics and functionalities.

All available types and methods of user interfaces to control the lighting systems shall be provided in the instructions for use.

In case the system has been provided with measures to provide information security, corresponding information shall be provided by the manufacturer or responsible vendor to enable correct installation, use, data backup, software and firmware updates, maintenance and end-of-life treatment.

11 Classification of lighting systems

11.1 General

According to the system structure, lighting systems can be classified into three categories, as follows:

- lighting systems consisting of standalone luminaire(s);
- autonomous lighting systems;
- centrally controllable lighting systems.

See 11.2 to 11.4 for the description of the different categories.

See 11.5 for the typical capacities of lighting systems in different categories.

11.2 Lighting system consisting of standalone luminaire(s)

A lighting system consisting of a standalone luminaire is a luminaire that does not communicate with other luminaires or a central controller for setting light properties (e.g. on/off, dimming) or for the exchange of information. It can have the capability to communicate with other devices for setting configuration parameters or setting light properties (e.g. on/off, dimming) or exchange of information. An example of a lighting system consisting of one standalone luminaire is shown in Figure 2.

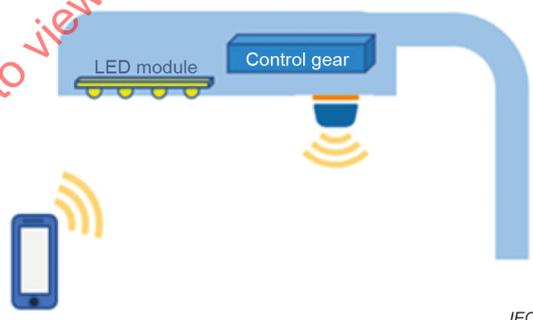


Figure 2 – Example of lighting system consisting of a standalone luminaire

11.3 Autonomous lighting system

The autonomous lighting system consists of two or more luminaires that can communicate with each other for the purpose of adjusting the light properties of the luminaires. This network of luminaires is characterized by having no central control possibilities.

These luminaires have at least one communication network that is intended to exchange information between luminaires to control the light properties. These luminaires can also have the communication capabilities of a standalone luminaire. An example of autonomous lighting system is shown in Figure 3.