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**Light and lighting – Commissioning
of lighting systems in buildings –
Explanation and justification of ISO/
TS 21274**

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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This document was prepared by Technical Committee ISO/TC 274, *Light and lighting*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The increasing use of solid-state lighting technology e.g. LED lighting, the growing scientific insight on the impact of light on humans and the diverse individual demands for lighting function bring a significant incentive for the application of lighting control. However, the resulting complexity of installed systems needs more professional skills to design, install, and maintain.

Commissioning is a very important measure that can be taken to guarantee the quality of lighting systems as close as possible to its design intent. ISO/TS 21274:2020 specifies requirements for the commissioning of lighting systems in buildings to meet design specifications, including roles and responsibilities, commissioning activities, documentation requirements and system handover.

This document presents explanation and justification to support the correct understanding, use and national implementations of ISO/TS 21274:2020.

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Light and lighting – Commissioning of lighting systems in buildings – Explanation and justification of ISO/TS 21274

1 Scope

This document provides information to support the correct understanding, use and national implementations of ISO/TS 21274:2020. It gives explanations on the procedures and background information. It also provides justifications of the choices that have been made. It gives detailed examples to illustrate the overall workings of ISO/TS 21274.

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.

ISO/TS 21274, *Light and lighting — Commissioning of lighting systems in buildings*

ISO 52000-1, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures*

CIE S 017, *ILV: International Lighting Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 52000-1, ISO/TS 21274 and CIE S 017 and the following apply.

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

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

3.1

lighting system

system designed to provide lighting

Note 1 to entry: A 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: A 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 ca/n 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: CIE S 017:2020, 17-27-010]

4 General aspects

4.1 Benefits of commissioning for lighting systems

For traditional lighting solutions of interior spaces using discharge, halogen and incandescent lighting technology, the systems are relatively simple, so commissioning can be implemented after appropriate preparation. LEDs' capabilities of instantaneous response, dimming, colour tuning, and stable performance under frequent switching conditions, offer good opportunity to create a lighting environment of high quality with more energy efficient solutions.

The integration of new technology including IoT, digital control and IT into lighting systems, and better knowledge on the influence of light on human wellbeing, means that lighting technology continues its advance into IoT and advanced digital applications, adaptive lighting and integrative lighting. The transformation of lighting from simple to complex systems, providing tailored lighting conditions for diverse individual needs and demanding tasks, the trend for more hardware functions to be realized with software, and interactions with other building automation systems make the lighting system complex to design, install and put into service.

In a perfect situation, the owners/tenants clearly communicate their needs and desires, the design team is united around a concept and clearly express design intent, and installation and startup occur without error. The owners/tenants benefit from a high-quality control system. But in reality, a deficiency in one or more components can prevent the correct operation of the lighting system. If something goes wrong during the construction process, measures can be taken to assure that the final lighting system will satisfy the owners/tenants needs.

According to ISO/TS 21274:2020, commissioning is necessary to manage the growing complexity of lighting systems. Commissioning for a lighting system is more than just an energy saving strategy, but also a quality control process ensuring that the operation of a lighting system meets the design specification, by integrating the functions of design, construction, and operation, with the involvement of the project team during each phase of the project.

4.2 The need for commissioning

With the discovery of ipRGCs and the non-image-forming pathway, the aim of lighting in buildings has been expanding from visual performance and visual comfort to integrative lighting for producing physiological and/or psychological benefits for humans, which means that the design specification can differ from project to project for the reason of different occupant profiles, activity profiles, daylight conditions, and design philosophy etc.

So the scope of commissioning can be decided according to the owner or tenants requirements, and the complexity and scale of the lighting system, design specification, and budget.

This document gives some general principles for commissioning regarding roles and responsibilities, activities, documentation, but not technical specification of lighting systems, which are supplemented by design specification as [Annex A](#) shows.

4.3 Content of commissioning for lighting systems

Commissioning is a very important measure to ensure the lighting system can work as close to the design specification as possible. The strategy of commissioning can be different from system to system. The content of commissioning can include but is not limited to the following items:

- Installation check: The commissioning team can develop equipment installation checklists on the basis of design documents, with which they can conduct the inspection to ensure that all equipment are of the correct type and quantity, and located and connected correctly as the design documents

specify. For sensors and adjustable luminaires, ISO/TS 21274:2020 also recommends to check the aiming of these devices, with no blocking in the specified direction.

- Operation check: The operating function of a sampled proportion of devices (including luminaires, solar shading systems, daylight redirecting systems and other systems in the building connected with the lighting systems) is checked to ensure all the control functions of local and remote-control devices operate correctly. For lighting systems with sensors, the simulated sensing signal can be used to verify the activation of different design control modes. The communication and control logics are verified during this stage.
- Performance test: Performance testing involves ensuring the installed system meets the design specification under the designed operating conditions and control modes. A step-by-step test procedure is used from components, systems to points of interaction between technical building systems, and all the problems discovered during this stage are recorded in the issue log. The possible reasons for these problems is analysed and confirmed as the basis of further calibration and configuration.
- Calibration and configuration: Calibration and configuration is a very important measure for problem solving during the commissioning process. A systematic analysis of any problems found during check and test is made with all related stakeholders, and design assumptions, device performance, and control parameters are verified. On the basis of these analysis and verification, calibration and configuration can be made accordingly.

4.4 The acceptance of commissioning deliverables

The process for each activity and deliverable includes an acceptance step as defined in the commissioning plan (Cx plan). This step formalizes the acceptance of the commissioning deliverable by the owner or tenant.

5 Commissioning methods and selection

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5.1 Classification of commissioning methods

The term commissioning comes from the shipbuilding industry. A commissioned ship is a ship with all the equipment installed and tested, problems identified and corrected, and the prospective crew extensively trained.

Since its adoption by the building industry, commissioning has been widely recognized as a valuable mechanism for quality assurance, ensuring building systems are fully integrated, tested, and function properly.

Initial commissioning can be conducted during the installation stage and operation stage. It helps ensure that the performance of the lighting system meets the design specification. This type of commissioning is specified in Method 1, the basic method, in ISO/TS 21274:2020.

The growing demand on the building environment has resulted in moving from simple to complex lighting systems, which enables one to develop more efficient and flexible solutions, but also leads to a higher level of complexity.

With the increasing complexity of building systems, a lack of familiarity by the designers, installers, or end-users can lead to the misapplication of technologies and result in poor performance. How to ensure the commissionability of the lighting system and reduce the potential cost of further modification and commissioning due to minor defects in the lighting system design has become more challenging. According to ISO/TS 21274:2020, the commissionability of lighting systems is designed so that when installed, all designed control logic can be accessed and checked easily, which requires that the cause and effect relation of control logic of lighting systems should be provided to the commissioning team, and they should have all the necessary access authorization to make configuration and calibration on the lighting systems.

A broader concept of commissioning has been introduced, which starts from the pre-design phase, goes through the installation phase, and continues during the post-occupancy phase, and is a quality assurance process to ensure the performance of the building meets the design documents. This type of commissioning is specified in Method 2, the full life-cycle commissioning method, in ISO/TS 21274:2020.

5.2 Selection of commissioning methods

According to CIE 222:2017, lighting controls are electrical devices added to the installed lighting circuit to adjust the light output of the luminaires according to a pre-planned program or automatic detection regime or to operator managed actions. They play an essential role in all lighting systems, providing the functions of switching and/or dimming. In past decades, fast advancement of technology, higher requirement on energy saving and deeper understanding on the influence of light for human wellbeing, all push the lighting control strategy from simple to complicated. According to the control strategy, the lighting controls can be classified into the following types:

Manual control

These respond to human commands and are typically operated by hand. The forms of manual control can vary from simple switches used to turn the lights on, to dimmer switches and remote-control devices. It is the most popular control strategy in lighting application at the moment, and relatively simple for installation. So, the basic method for commissioning can be sufficient, and one point for consideration during the commissioning process is to ensure that users of the system can readily understand the function of any such control devices.

Automatic control

Here, the lighting system can switch or dim designated loads automatically in response to events such as a time schedule, illuminance, or occupancy, etc. The automatic control lighting system can have some manual control interface.

At the very beginning, the control function is realized by hardware such as a relay, which is pre-set during the manufacturing stage. The function of controls is more product-dependent, and relatively simple. The control parameters are generally difficult to modify in the field. The difficulty for design, installation and commissioning of the system is relatively low, so there is no high demand for a full life-cycle commissioning method.

With the fast development of IT technology, software is playing a more and more important role in realizing the function of automatic control. Advanced performance can be achieved with the improved processing capacity of programmable control devices in lighting systems. It also gives much more flexibility, and the control function can be updated by reconfiguring the program or updating the control software without change in any of the hardware of the lighting systems. This is a very big step for lighting application, it is also the foundation for connected lighting and integrative lighting.

However, this also increases the complexity of lighting systems, and multidisciplinary knowledge to realize the system. A lack of familiarity by the designers, installers, or end-users can lead to the misapplication of technologies and result in poor performance. So, ISO/TS 21274:2020 recommends a full life-cycle commissioning method, which starts from the pre-design phase, goes through the installation phase, and continues during the post-occupancy phase.

6 Roles and responsibilities

6.1 General

Lighting systems are becoming more sophisticated. The design, installation and operation complexities increase along with capabilities and benefits. There is a need for cooperation between the owner, design team, contractors (including subcontractors and suppliers) and commissioning team in a highly collaborative way. ISO/TS 21274 specifies the roles and responsibilities of all the responsible parties related to commissioning, including the owner or tenant, the design team, the contractors and subcontractors, suppliers and Cx team.

6.2 Owner or tenant

Owner or tenant acts as a coordinator and final decision maker in the commissioning process. They make the final decision on the scope and targets of the commissioning task, the selection of the commissioning team regarding the balance of budget, and level of performance assurance and lighting system complexity, typically with input from the design team.

They review and approve the documents such as the commissioning plan and training plan.

They make the decision on the following-up procedures for any reported items that cannot achieve the design specification in a timely and economic way during the commissioning process.

They also coordinate actions among the relevant participants during the Cx process.

6.3 Design team

The lighting system design process is an iterative process to design lighting system solutions for sustainable lighting quality and energy efficiency based on specifications in the relevant lighting application standards, for the wellbeing of users and for a pleasant built environment.

Note see CEN/TS 17165:2018 for more information.

As the design is the basis for the entire project and defines how effectively it can be commissioned, it is important that the design team is aware of the commissioning requirements of the lighting systems.

So, two-way communication and coordination between design team and commissioning team is very important and necessary in the following aspects.

- a) The design team shares the design documents with the commissioning team as the basis for the development of the commissioning plan and commissioning specification, and also for their comments to maximize the functionality, operability, maintainability and ease of commissioning of the lighting system.
- b) The design team makes a review of the commissioning plan and commissioning specification to ensure that these documents comply with the design documents. ISO/TS 21274:2020 recommends that they should participate all the relevant activities during the commissioning process.
- c) The design team also transfers all the information on the functionality, operability, maintainability, and ease of commissioning of the designed lighting system into design documents, so that all related contractors, subcontractors and suppliers for implementing the Cx plan during the installation stage can provide the necessary support including the access to hardware, software or onsite technical support to assist the Cx effort.

6.4 Contractors, subcontractors and suppliers

The role of the (sub)contractors is to execute the installation process, and they are responsible for proper installation, and functional testing of all of the components and equipment of the lighting systems according to the design documents. The (sub)contractors should manage their functions in the commissioning process and work closely with the Cx team to document the performance of the commissioned lighting systems.

The equipment documentation includes the instructions for installation, testing, operations, and maintenance. Suppliers are also responsible for providing the necessary operating interface for hardware, software or onsite technical support. On some complex lighting systems the supplier participates in the start-up and testing of the system and training.

6.5 Commissioning team

The commissioning team manages the commissioning process. ISO/TS 21274:2020 recommends that the commissioning team should be selected at an early stage of the project. The commissioning team