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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

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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.

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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 ~~also individuals~~ 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 ~~Technical Report~~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 and ISO/TS 21274, and CIE S 017 and the following apply.

ISO and IEC maintain ~~terminological~~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:

- 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;
- the support of other than human tasks.

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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 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: 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 a 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.

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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

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.

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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 ~~defect~~defects in the lighting system design has become more challenging. ~~The~~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, ~~according to ISO/TS 21274:2020.~~

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

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