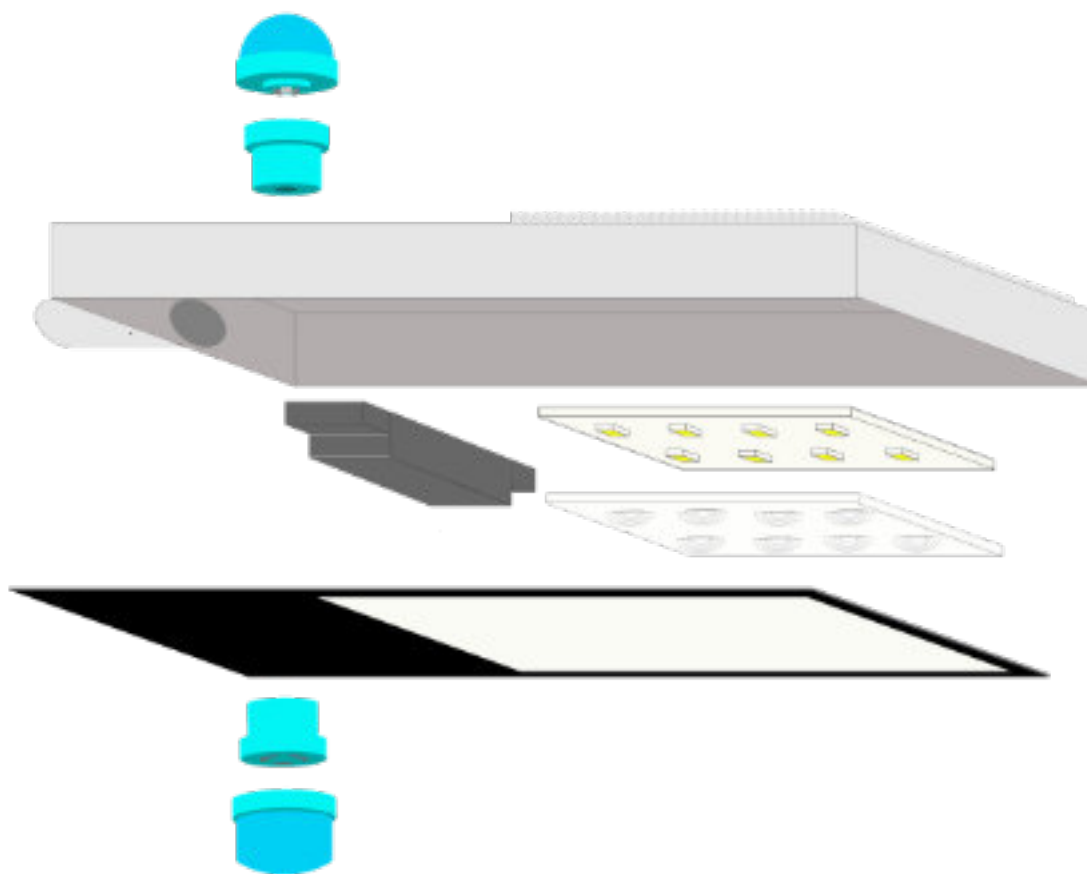


Beoordelingsrichtlijn

Herstelbaarheid van openbareverlichtingstoestellen



Preface

The Dutch Assessment Guideline for public lighting luminaires, has been developed in collaboration with clients/government authorities, contractors, and suppliers. The intention is to make a significant contribution to the realization of greater circularity.

For suppliers, the Assessment Guideline provides guidance for the (re)design of products that meet the circular criteria for lifespan extension. Suppliers can also use the Assessment Guideline to assess to what extent their product aligns with the circular ambitions required by the client in this regard. The Assessment Guideline can be used by clients to request and assess a specific level of circularity.

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This document contains sections that may exhibit partial or complete similarity to statements found in other standards, such as those established by ISO (International Organization for Standardization) or Zhaga (an industry consortium). Specifically, the portions of text pertaining to definitions, the artwork utilized for standard tools, and the design of the interoperability model have been adopted from these respective standards or committee documents.

While efforts have been made to ensure consistency and alignment with established industry practices, it is important to acknowledge the influence of existing standards in shaping the content and structure of this document. By incorporating relevant elements from these recognized standards, this document aims to foster compatibility, promote best practices, and enhance interoperability within the given domain.

It should be noted, however, that this document is not a verbatim replication of the standards or committee documents from which it draws inspiration. Instead, it incorporates selected elements while also providing additional context, examples, or modifications tailored to the specific requirements of the intended audience or purpose.

The intention behind borrowing concepts, definitions, artwork, and design elements from established standards is to ensure consistency, facilitate adoption, and leverage the expertise accumulated by the broader industry. Any verbatim usage or direct reproduction of copyrighted material from these standards is done in accordance with applicable laws, permissions, or licenses.

We acknowledge the original sources and provide appropriate credit to the respective standards or committees. This approach ensures transparency and integrity in the development of this document while upholding the principles of intellectual property and collaboration within the standards community.

It is important for readers and users of this document to recognize the collaborative nature of standardization efforts and appreciate the contributions made by various organizations and committees in shaping the content and structure of industry standards.

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Introduction

This standard has been meticulously prepared to provide an in-depth analysis of the factors that significantly impact the repairability of luminaires used in street lighting. Within this document, we will focus on three primary issues: ability to repair, availability of spare parts, and communication/programming. Each of these factors play a crucial role in determining the overall repairability of a luminaire system.

1. Ability to Repair:

The first factor, "ability to repair," centers on the accessibility of the luminaire's internal components. The ease with which repair personnel can access and manipulate the parts within the luminaire significantly influences its repairability. A luminaire that allows convenient access to its components will receive a higher score in this category, whereas those with limited accessibility will receive a lower score.

2. Availability of Spare Parts:

The availability of spare parts is a critical aspect of repairability and is divided into two distinct categories: mechanical parts and electrical parts. While the component level of electrical parts (such as capacitors, resistors, etc.) is not considered in this evaluation, the availability of mechanical and electrical spare parts plays a pivotal role. Luminaires that have a readily available supply of both types of spare parts will receive higher scores in this category.

3. Communication/Programming:

The third factor, "communication/programming," evaluates the interfaces and software associated with the luminaire system. Effective communication interfaces and accessible programming methods contribute to the repairability of the luminaire. A luminaire system that offers user-friendly interfaces and comprehensive programming capabilities will receive a higher score in this category.

The scoring system employed in this document ranges from A to E, with A representing the highest score and E representing the lowest score for each specific issue related to repairability. It is important to note that the final score, which determines the overall repairability, cannot exceed the lowest score obtained in any of the individual categories.

0. Scope

This document presents a method for assessment of the ability to repair luminaires for use in the public area. Products covered by this document are defined in the standards;

- EN 60598-2-1
- EN 60598-2-2
- EN 60598-2-3
- EN 60598-2-5
- EN 60598-2-13

This document is only applicable to those products that are used for the purpose of illuminating public area's like streets, parks, tunnels, squares, bridges, monuments etc.

This document is specifically written for luminaires with LED. Conventional light sources are not considered in this document.

0.1 General test requirements and verification

0.1.1 Type test

Tests according to this document are type tests. For the definition of type test see section 1 of this document.

The requirements and tolerances permitted by this document are related to testing a type test sample submitted for that purpose. Compliance of the type test sample does not ensure compliance for the whole production of a manufacturer. Compliance of the production is the sole responsibility of the manufacturer and may include routine test and quality assurance in addition to type testing.

0.1.2 Conditions for testing

Except if other wise specified, luminaires shall be tested as delivered and installed as for normal use, in an ambient temperature of 10 °C and 30 °C, having regard to the manufacturer's installation instructions. The light source (or light sources) is (are) not included except where essential for the test.

In general, the tests are made on a single sample luminaire or, where a range of similar luminaires is involved, on a representative selection from the range as agreed with the manufacturer. This selection shall be representative for all different combinations of options as defined in the luminaire range by the manufacturer.

0.1.3 Controlgear

For luminaires used with an external controlgear, but not normally supplied with a controlgear, the manufacturer shall provide a controlgear, typical of the type that may be used with the luminaire. The controlgear it self will not be part of the evaluation.

1. Terms and definitions

This sections gives general definitions applicable to reparability of luminaires.

1.2 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

For the definitions the following sources have been used as far as possible.

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>

1.2.1 Luminaire

Apparatus which distributes, filters or transforms the light transmitted from one or more light sources and which includes all the parts necessary for supporting, fixing and protecting the light sources, but not the light sources themselves and where necessary, circuit auxiliaries together with the means for connecting them to the supply.

A luminaire with an integral non-replaceable light source is regarded a luminaire for the purpose of this document.

1.2.2 Type test

Test or series of test made on a type test sample, for the purpose of checking compliance of the design of a given products with the requirements of this document.

1.2.3. Type test sample

Sample consisting of one or more similar units submitted by the manufacturer or the responsible vendor for the purpose of a type test.

1.2.4 Part

Hardware, firmware or software constituent of a product.

1.2.5 Disassembly

Process whereby a product is taken apart in such a way that it could subsequently be reassembled and made operational.

1.2.6. Reuse

Process by which a product or its parts, having reached the end of their first use, are used for the same purpose for which they were conceived.

1.2.7 Repair

Process of returning a faulty product to a condition where it can fulfill its intended use.

Note 1:

This document covers only the ability to repair a product and not the complete process i.e. fault finding, replacement, testing and returning to operational state.

1.2.8 Upgrade

Process of enhancing the functionality, performance, capacity or aesthetics of a product.

Note 1: An upgrade to a product may involve changes to its software, firmware and/or hardware

Note 2: Refer to the “Blue Guide” for conditions under which a product is considered as a new product when placing it on the market after upgrading it.

1.2.9 Light source

Lamp, provided with a lamp-cap, or module (LED) or other light source made in order to produce an optical visible radiation to be used incorporated into the luminaire.

Note 1: In this document only products with LED light sources are addressed.

1.2.10 Replaceable light source

Lamp, provided with a lamp-cap according to IEC 60061, or light source designed to be connected by terminals, connector or similar devices and designed to be replaced during normal use or maintenance of the luminaire.

1.2.11 Non replaceable light source

Light source which is a non replaceable part of the luminaire either because it cannot be replaced without breaking or destroying the luminaire or because it is enclosed under a cover fixed by screw or similar fixing means designed to be used only once and which is not possible to be opened.

1.2.12 Non-user replaceable light source

Light source which can only be replaced by the manufacturer, his service agent, or similar qualified person.

1.2.13 LED Module

Unit supplied as a light source. In addition to one or more LEDs, it may contain further components, e.g. optical, mechanical, electrical and electronic but excluding controlgear.

1.2.14 Self-ballasted LED module

LED module, designed for connection to the supply voltage.

1.2.15 Controlgear

Controlgear means one or more devices, that may or may not be physically integrated in a light source, intended to prepare the mains for the electric format required by one or more specific light sources.

It may include transforming the supply and starting voltage, limiting operational and preheating current, preventing cold starting, correcting the power factor and/or reducing radio interference.

1.2.16 Commonly available tools

Common available tools are defined in Annex 2.

1.2.17 Special service tool

These are tools that are not available for purchase by the general public or for which any applicable patents are not available to license under fair, reasonable, and non-discriminatory terms.

1.2.18 Spare part

Item, part or material required to repair and maintain an item of equipment.

1.2.19 Layman

Person who does not repair in the performance of his profession and may have little or no formal instruction on repairing of luminaires.

1.2.20 Generalist

A person competent in the field of repair of electrical equipment. A generalist has received formal instruction on repairing of electrotechnical products and/or luminaires.

1.2.21 Specialist

A person highly skilled in the field of repair of electrical equipment specialized luminaire repair. A specialist has received detailed training and instruction on repairing of luminaires. In many cases this expertise limited to a certain brand or type of luminaires.

1.2.22 Physical interchangeability

The ability of a system component to replace the form and fit of another system component.

See also Figure 1; Interoperability and interchangeability model.

1.2.23 Functional Interchangeability

The ability of a system component to perform in an equivalent manner as another system component.

See also Figure 1; Interoperability and interchangeability model.

1.2.24 Interchangeability

The ability of a system part to replace the form and fit of another system component and perform in an equivalent way.

See also Figure 1; Interoperability and interchangeability model.

1.2.25 Interoperability

A luminaire part is interoperable with other parts if their combination can function as intended.

According to this definition, interoperability requires a match of the parts on all aspects of all relevant part interfaces. These can be mechanical, electrical, photometrical, thermal and communication interfaces.

See also Figure 1; Interoperability and interchangeability model.

1.2.26 Function as intended

Means that the replacement part is capable to function in such a way that the original equipment specification is met.

This also implies that using these components will not block meeting safety or regulatory requirements.

1.2.27 Open standard

An open standard is a standard that is openly accessible and usable by anyone. It is also a prerequisite to use open license, non-discrimination and extensibility.

Typically, anybody can participate in the development.

For example; IEC standards are open and anyone can participate in its development. Also ZHAGA standards, NEN standards, ISO standards etc are considered open standards.

1.2.28 Firmware

Ordered set of instructions and data stored in a way that is functionally independent of main storage, usually in a read-only storage.

1.2.29 Software

Assembly of programs, procedures, rules, documentation and data, pertaining to the operation of an information processing device or system.

Notes:

Software is an intellectual creation that is independent of the medium upon which it is recorded.

Software requires hardware to execute programs, and to store and transmit data.

1.2.30 Application software

Application software

Software that is specific to the solution of a problem submitted by an end user.

1.2.32 Outdoor Luminaire Controller (OLC)

Functional component of an outdoor luminaire system which controls one or more luminaires.

1.2.33 Operating system

Software that controls the management and the execution of users programs in a computer system.

1.2.34 Refurbish

Functional or aesthetical maintenance or repair of an item to restore it to its original, or upgraded or other, predetermined form and functionality.

1.2.35 Sealed for life

The product cannot be opened for repair without destroying part of the housing.

1.2.36 Sensor

Device which, when excited by a physical phenomenon, produces an electric signal characterizing the physical phenomenon.

1.2.37 OSI Model

Open Systems Interconnection reference model.

Conceptual model that characterizes and standardizes the communication functions of a network or computing system without regard to its underlying internal structure and technology.

2. Classification

2.1 Identification of parts to be assessed

In this document the following presumptions have been taken into account;

A luminaire can consist of the following mayor parts;

- Main housing (Including Spigot)
- Translucent cover
- Light source
- Controlgear
- Heat sink
- Lenses and/or reflectors
- Sensors and/or OLC's
- Sealing

Other parts used in luminaires such as wiring, terminalblocks etc are also considered in this document.

Note:

OLC's/Sensor are only considered spare part when they are integrated in the luminaire.

2.2 Classification according to ability to be repaired

Luminaires shall be classified based on the possibility to open, remove and replace parts.

2.2.1 Sealed for life

Luminaires that can not be opened for repair without destroying part of the housing are classified sealed for life.

2.2.2 Workshop access

Luminaires that require the product to be return to the factory of a specialized workshop for repair

Note 1:

For some organizations it is common practice to remove and replace a luminaire and carry out repair in a workshop. This classification is only intended for those luminaires where it is required to do so. How organizations handle repair is not part of the consideration.

2.2.3 Specialist access

Luminaires that can only be opened by special service tools. The manufacturer/supplier may provide special service tools to open the luminaire for repair purposes or may require the product to be returned to the factory or specialized workshop for repair.

2.2.4 Generalist access

The luminaire can be opened by means of commonly available tools.

2.2.5 Toolless access

The luminaire can be opened without the use of tools.

2.3 Classification according to the probability of a defect

Parts shall be classified based on their chance of a defect. Parts have to be designed for the specific purpose and conditions in which they will be used.

2.3.1 Low probability defective parts

Parts generally considered in this category are:

- Housing parts
- Translucent cover
- Terminal blocks
- Wiring

Housing parts, translucent covers used in the public areas and fitted within arms reach, less than IK08 rated are considered medium probability defective parts.

2.3.2 Medium probability defective parts

Parts generally considered in this category are:

- Low density and low complexity electronics
- LED modules
- Seals

2.3.3 High probability defective parts

Parts generally considered in this category are:

- High density and complex electronics
- Drivers
- Integrated sensors
- Overvoltage protectors
- Integrated OLC's
- Integrated sensors

3. Luminaire assessment

Luminaires shall be assessed according to the following clauses.

3.1 Ability to repair

Luminaires shall be categorized based on the ease of opening the luminaire for repair and the ease in which the parts can be replaced.

3.1.1 Category A

Luminaires in categorie A are:

classified as toolless access

- or -

for luminaires used in the public areas and expected to be fitted within arms reach; classified as generalist access and where only one common available tool is required for opening the luminaire.

All parts can be replaced without the use of a tool.

For parts that are considered low probability for defects as defined in clause 2.3 it is acceptable that common available tools are needed for their replacement.

3.1.4 Category B

Luminaires classified as toolless access or generalist access and:

- High and medium defect probability parts can be replaced by commonly available tools.
- Only 2 commonly available tools are needed to acces the luminaire and conduct the replacement of high and medium defect probability parts.
- Low defect probability parts can be replaced by means of commonly available tools.

3.1.5 Category C

Luminaires classified as toolless access or generalist access and replacement of parts can be conducted by means of commonly available tools.

3.1.6 Category D

Luminaires classified as specialist access.

3.1.7. Category E

Luminaires classified as sealed for life.

These luminaires are considered non-repairable.

3.2 Availability of spare parts

The availability of spare parts on the short and long term shall be assured.

Spare parts are typically supplied by the manufacturer of the original equipment. However for repairability it is important that also future supply of parts is assured even though the original equipment manufacturer might not be able to supply the parts or is no longer in operation.

Parts shall be assessed on criticality of availability and whether they can be sourced from multiple independent sources.

For assurance of supply of spare parts the following shall be considered:

- Parts designed based upon open standards
- Alternative interoperable parts
- Sufficient information available for determining possibility to use an alternative part.
- Availability of design specifications, drawings etc.

3.2.1 Electrical part classification

The manufacturer shall show evidence to support the selected electrical part status and category. For this clause the mayor electrical parts are considered. Wiring, terminalblocks etc are excluded from this classification.

The manufacturer can choose to create an exchangeable unit. This shall consist of a construction on which one or more major components are fitted. The intention is to exchange this unit with all electrical parts fitted onto it.

The unit can be repaired in a later stage.

All used parts shall be assessed and classified. The part that is classified lowest determines the category for all parts considered in this clause.

Requirements for exchangeable units are under consideration.

3.2.1.1 Category A

- The part used in the product is build according to open standards covering all the elements of interoperability.
- A repair manual is available detailing all the necessary information for selecting

alternative parts in case of replacement needed.

- The repair manual also contains a list of alternative parts that can be selected and used.

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 20 years after supplying the product.

3.2.1.2 Category B

- The part used in the product is build according to open standards covering the all the elements of interchangeability.
- A repair manual is available detailing all the necessary information for selecting alternative parts in case of replacement needed.

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 10 years after supplying after supplying the product.

3.2.1.3 Category C

- The part used in the product is build according to open standards covering the all the elements of functional interchangeability.
- A repair manual is available detailing all the necessary information for selecting alternative components in case of replacement needed.

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 8 years after supplying the product.

3.2.1.4 Category D

- The part used in the product is build according to open standards covering the all the elements of physical interchangeability.
- A repair manual is available detailing all the necessary information for selecting alternative components in case of replacement needed.

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 5 years after supplying the product.

3.2.1.5 Category E

- The part used is build according to proprietary standards.

3.2.2 Mechanical part classification

The manufacturer shall show evidence to support the selected mechanical part status and category. For this clause the major parts are considered like housing and

translucent cover.

The mechanical part that is classified lowest determines the category for all parts considered in this clause.

3.2.2.1 Category A

The construction drawings, design specification and material properties are publicly available or will be made available by the supplier as soon as he is no longer able or willing to produce the parts. This might need the involvement of a third party safe keeping to prevent the loss of information after the supplier is no longer active.

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 20 years after supplying the product.

3.2.2.2 Category B

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 10 years after supplying the last version of this product.

3.2.2.3 Category C

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 8 years after supplying the last version of this product.

3.2.2.4 Category D

The manufacturer/supplier provides a written and signed statement in which he pledges to supply the parts for at least 5 years after supplying the last version of this product.

3.2.2.5 Category E

The manufacturer/supplier does not provide the spare part.

The manufacturer is also not prepared to provide the technical specifications needed to manufacture the part at an alternative location.

3.3 Firmware, software and applications

Parts can be provided with firmware, software and applications.

In most cases firmware / software is used in drivers and Outdoor Luminaire Controllers.

To be able to repair a luminaire containing these elements the functionality must be replaceable by alternatives. This mainly means that the communication interfaces must communicate in the same way.

For assurance of supply of spare parts the following shall be considered:

- Parts designed based upon open standards
- Alternative interoperable parts are available
- Sufficient information available for determining possibility to use an alternative part.
- Availability of design specifications, settings etc.

The model in figure 2 is used to determine which interfaces are to be considered.

With interface in this chapter is meant the OSI layers 1 through 7 except for the mechanical aspects that are already covered by other parts of this standard.

It should be noted that OLCs, such as those connected to a Zhaga socket, are not to be considered as part of the evaluation. These separate OLCs, when detached from the luminaire, do not form an integral or fixed part of the overall lighting system. Therefore, their inclusion in the evaluation process is deemed unnecessary and should be excluded.

However, it is crucial to distinguish the interface between the luminaire's driver and the Zhaga socket from the separate OLCs mentioned above. The interface (Interface 2) responsible for connecting the driver to the OLC is fitted within the luminaire and, consequently, forms an intrinsic and integral part of the lighting system. As a result, this specific interface must be included in the evaluation process.

3.4.1 Category A

All interfaces (IF1 - IF4) used in the system shall be open standards.

The OLC shall be able to interoperate with backends of multiple vendors.

OLC - During commissioning of the OLC a possibility to verify correct functioning is possible. This verification can be done during/immediately after the installation. Successful and unsuccessful installation will be logged in the system.

Configuration of the driver can be done without providing power to the driver.

A manual is available detailing all the necessary information for creating the correct configuration settings and detailing the needed options to create interoperability.

If applicable a configuration setting files are available or will be made available by the supplier as soon as he is no longer able to supply the parts. This might need the involvement of a third party safe keeping to prevent the loss of information after the

supplier is no longer active.

3.4.2 Category B

Interfaces (IF2 - IF4) used in the system shall be open standards.

Configuration of the driver can be done without providing power to the driver.

A manual is available detailing all the necessary information for creating the correct configuration settings and detailing the needed options to create interoperability. If applicable a configuration setting files are available or will be made available by the supplier as soon as he is no longer able to supply the parts. This might need the involvement of a third party safe keeping to prevent the loss of information after the supplier is no longer active.

3.4.3 Category C

Interfaces (IF3 - IF4) used in the system shall be open standards.

A manual is available detailing all the necessary information for creating the correct configuration settings and detailing the needed options to create interoperability.

3.4.4 Category D

Driver is configurable using a proprietary protocol / proprietary programming tool.

3.4.5 Category E

All interfaces are proprietary.

Configuration only possible by the manufacturer.

4. Assessment result evaluation

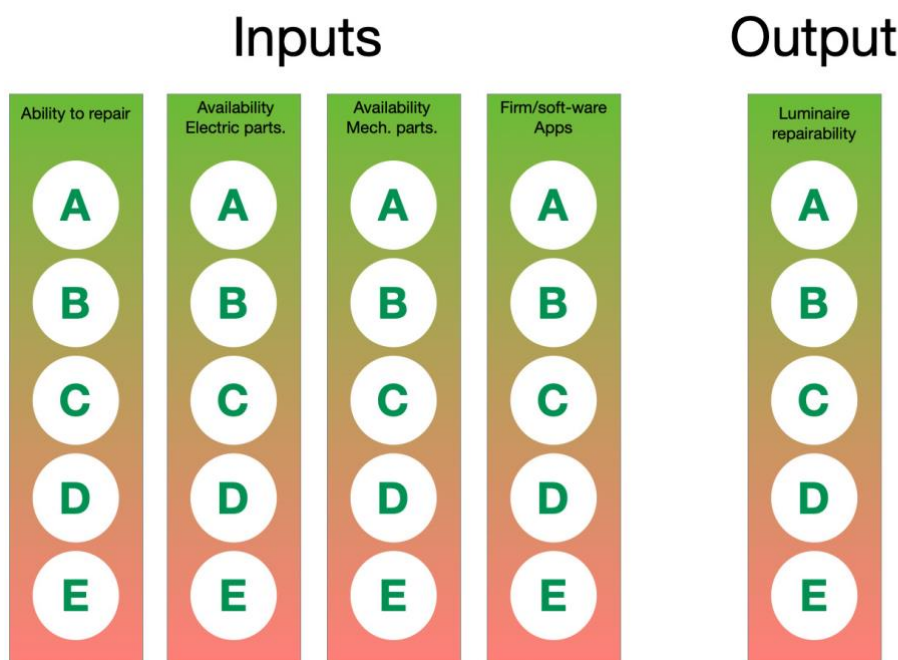
This clause contains the criteria for the assessing the ability of a luminaire to be repaired.

The luminaire repairability score is determined by lowest score on one of the categories.

Example:

Score on ability to repair is B, score on availability of electric parts is C, availability of mechanical parts is B, score of firm/software apps is B. Repairability score for the luminaire is C.

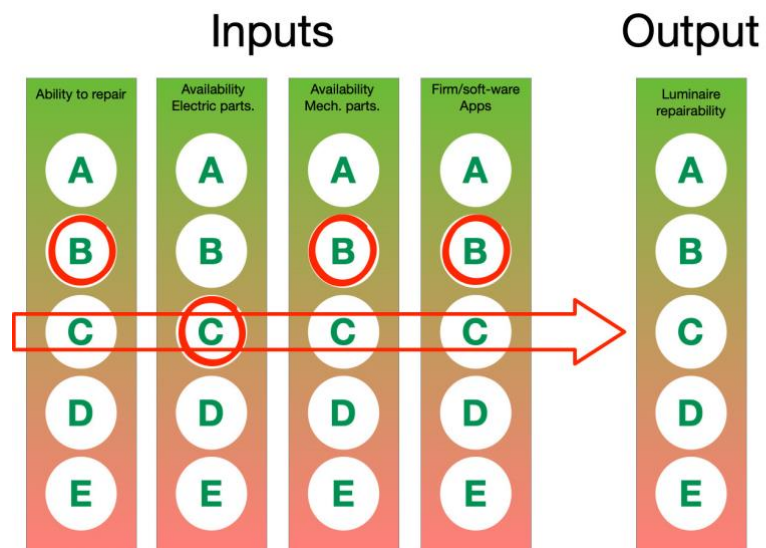
A organization/user can request different categories for different topics of repairability depending on its own demand.



Example:

Results applying this model.

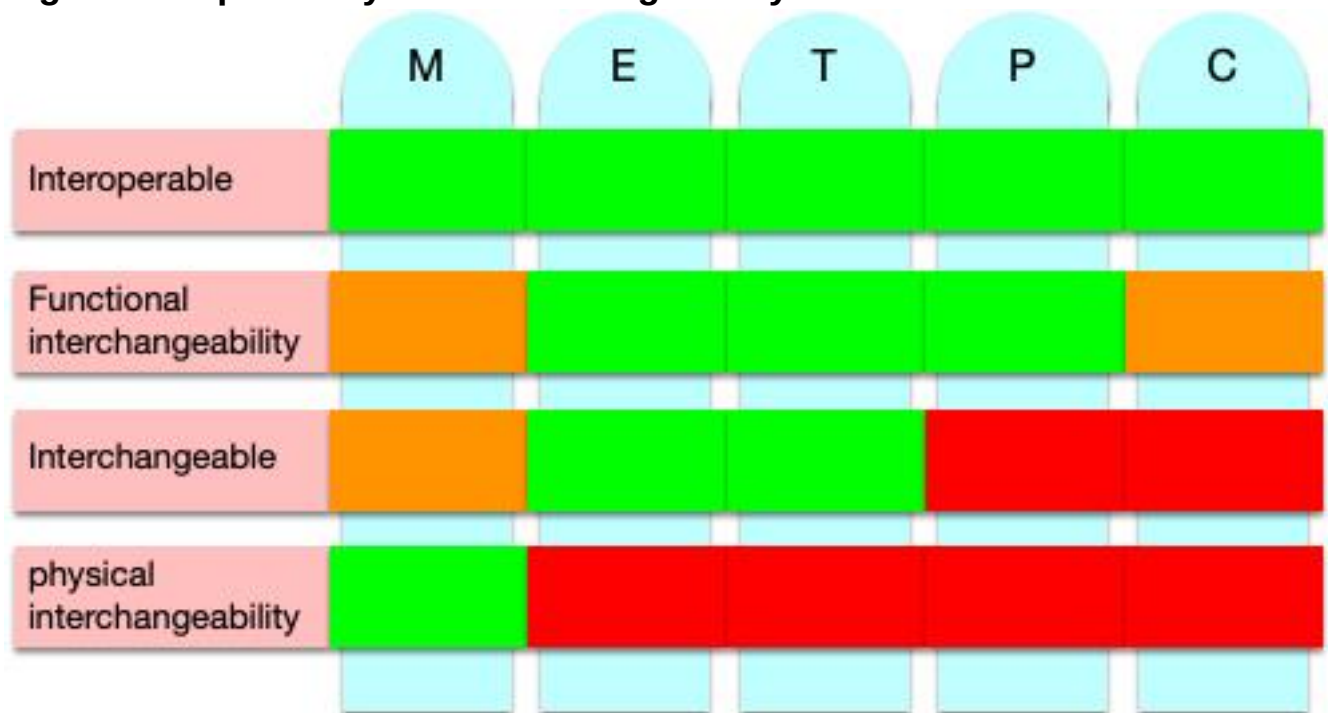
Red circles in the inputs are the results of the evaluations and the red arrow points to the conclusion for the whole product in the output column.



Example 1

Annex 1: Figures

Fig. 1 Interoperability and interchangeability model



M Mechanical
E Electrical
T Thermal
P Photometric
C Communication

Figure 1: Interoperability and interchangeability model

Fig. 2 Interfaces model

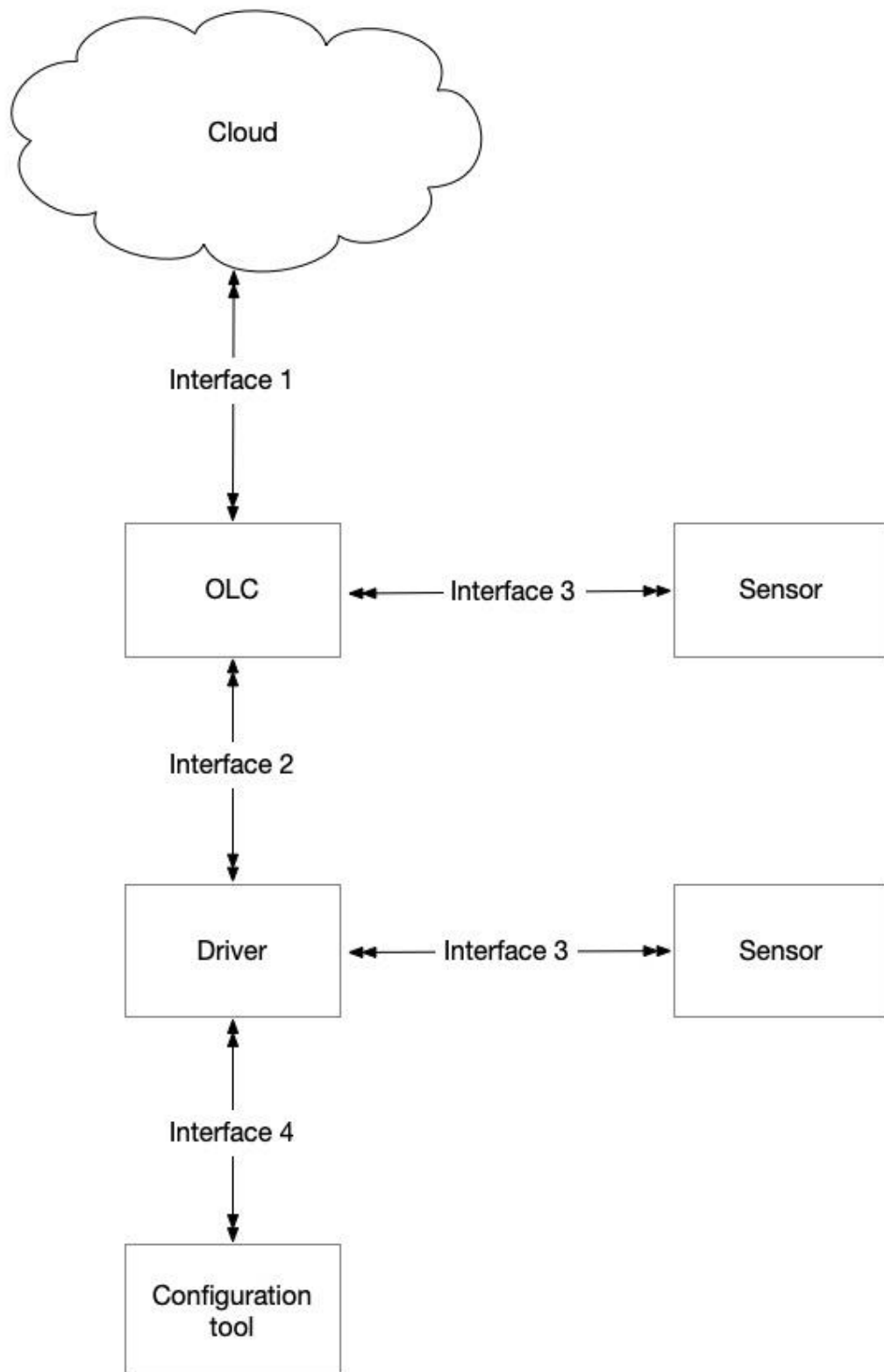
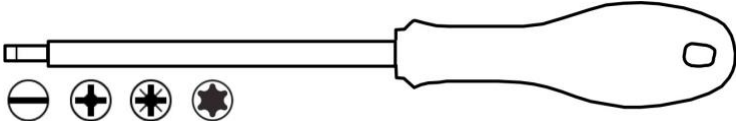
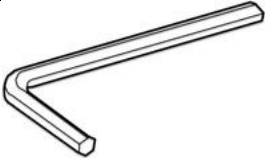
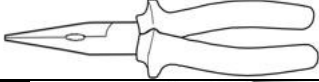
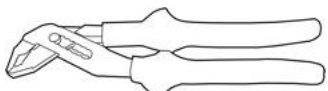
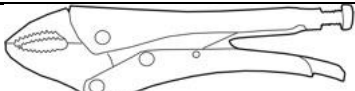
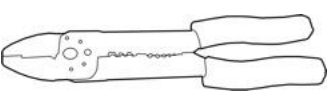
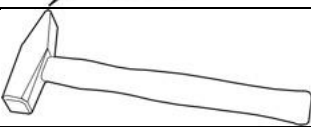
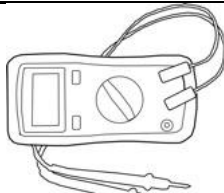
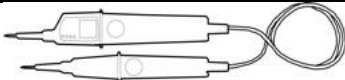
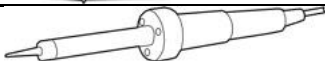
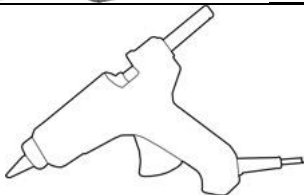
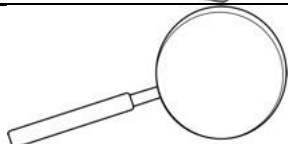


Figure 2: Interfaces model

Annex 2: Commonly available tools

This table contains a selection of hand-operated tools that can be used for repairing.

Tool type	Illustration (informative example)	Reference
Screwdriver for slotted heads, cross recess or for hexalobular recess heads		ISO 2380, ISO 8764, ISO 10664
Hexagon socket key		ISO 2936
Combination wrench		SO 7738
Combination pliers		ISO 5746
Half round nose pliers		ISO 5745
Diagonal cutters		ISO 5749
Multigrip pliers (multiple slip joint pliers)		ISO 8976
Locking pliers		
Combination pliers for wire stripping and terminal crimping		
Prying lever		
Tweezers		
Hammer, steel head		ISO 15601
Utility knife (cutter) with snap-off blades		
Multimeter		

Voltage tester		
Soldering iron		
Hot glue gun		
Magnifying glass		
NOTE: Most tools come in different sizes. This list only refers to the tool type. Although some sizes are more common than others, for practical purposes, any size of the listed tools is considered to be a basic tool.		

Annex 3: Guidance on skills needed for repair

The skill set needed to repair a luminaire is to be considered.

For the scope of the standard only professional luminaires are considered. These kind of luminaires are generally prepared by a generalist or higher.

Layman repair

The luminaire has the following features:

- Classified toolless access
- Ability to repair is category A
- All parts can be safely exchanged by a layman.

Generalist repair

The luminaire has the following features:

- Ability to repair is category A - D

Specialist repair

The manufacturer only allows a specialist to repair the luminaire.

and/or

Ability to repair is category E - G

Annex 4: Considerations

Annex 5: Bibliografy

The following documents have been used as a reference for this document.

EN 45554: 2020, General methods for the assessment of the ability to repair, reuse and upgrade energy-related products

EN 45552, General method for the assessment of the durability of energy-related products;

EN 45559, Methods for providing information relating to material efficiency aspects of energy-related products

EN 60598-1, Luminaires - Part 1: General requirements and tests

EN 60598-2-1, Luminaires - Part 2-1: Particular requirements - Fixed general purpose luminaires

EN 60598-2-2, Luminaires - Part 2-2: Particular requirements - Recessed luminaires

EN 60598-2-3, Luminaires - Part 2-3: Particular requirements - Luminaires for road and street lighting

EN 60598-2-5, Luminaires - Part 2-5: Particular requirements - Floodlights

EN 60598-2-13, Luminaires - Part 2-13: Particular requirements - Ground recessed luminaires

EN 62262, Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)

“Blue Guide on the implementation of the product rules 2022” <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:C:2022:247:TOC>

IEC Electropedia: available at <http://www.electropedia.org>

ISO Online browsing platform: available at <http://www.iso.org/obp>

Zhaga book 1 and White paper on interoperability.