
**Ships and marine technology — Low-
location lighting (LLL) on passenger
ships — Arrangement**

*Navires et technologie maritime — Éclairage situé en bas sur les
navires à passagers — Disposition*

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 1, *Maritime safety*.

This third edition cancels and replaces the second edition (ISO 15370:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

- the Introduction has been clarified to better explain the purpose of the system;
- in [Clause 2](#), the normative references have been updated;
- in [Clause 3](#), definitions have been added, and some of the existing ones have been clarified;
- in [Clause 4](#), performance requirements for LLL system components have been reviewed and updated;
- in [Clause 6](#), clarification on how and where escape routes shall be marked by the LLL system has been made;
- in [6.5](#), further details have been provided for the LLL signage system for both arrangement and characteristics;
- in [Clause 8](#) and in [Annexes A](#), [B](#), and [E](#), maintenance and testing procedures have been clarified;
- in [Annexes F](#) and [G](#), the examples of installation have been reviewed; and
- in the Bibliography, the informative references have been updated.

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

This document is intended to supplement International Maritime Organization (IMO) requirements for low-location lighting used on passenger ships complying with the 1974 *Safety of Life at Sea Convention* (SOLAS 74), as amended.

The LLL system was made mandatory on passenger ships by IMO Resolution MSC.24(60), adopted on 10 April 1992, and by Resolution MSC.27(61), adopted on 11 December 1992, following the fire that occurred on the passenger ship *Scandinavian Star*, in 1990. Both resolutions require that the means of escape relevant to passenger and crew accommodation areas – including stairways and exits – be marked by lighting or phosphorescent strip indicators placed not more than 0,3 m above the deck. Following IMO Res. A.752(18), adopted on 4 November 1993, provided for relevant guidelines for its application.

The purpose of such a system is given by IMO resolutions A.752(18) and SOLAS regulation II-2/13.3.2.5: i.e. it shall enable passengers and crew to clearly identify the routes of escape and the relevant exits when the normal emergency lighting is less effective due to smoke.

This extensive revision of the standard has been prepared in order to provide more details and clarifications on the arrangement and performance of the LLL system so to better assist designers and manufacturers, as well as the representatives of the competent authority who are requested to verify the compliance of the on board system with this document.

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Ships and marine technology — Low-location lighting (LLL) on passenger ships — Arrangement

1 Scope

This document specifies the requirements for the approval, installation and maintenance of low-location lighting systems as defined in Chapter II-2, Regulation 13.3.2.5.1 of the *International Convention for the Safety of Life at Sea, 1974 (SOLAS 74)*, as amended in 2000, and detailed in Chapter 11 of the *International Code for Fire Safety Systems (FSS Code)*.

2 Normative references

The following referenced 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 2919:2012, *Radiological protection — Sealed radioactive sources — General requirements and classification*

ISO 3795, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 16069:2017, *Graphical symbols — Safety signs — Safety way guidance systems (SWGS)*

ISO 24409-1, *Ships and marine technology — Design, location and use of shipboard safety signs, fire control plan signs, safety notices and safety markings — Part 1: Design principles*

ISO 24409-2, *Ships and marine technology — Design, location, and use of shipboard safety signs, fire control plan signs, safety notices and safety markings — Part 2: Catalogue of shipboard safety signs and fire control plan signs*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60598-2-22, *Luminaires — Part 2-22: Particular requirements — Luminaires for emergency lighting*

IEC 60945, *Marine navigation and radiocommunication equipment and systems — General requirements — Methods of testing and required test results*

IMO, *International Convention for the Safety of Life at Sea, 1974 (SOLAS 74)*, as amended

3 Terms and definitions

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

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

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

3.1

accommodation spaces

passenger and crew spaces used for public spaces, cabins, offices, hospitals, cinemas, lounges, barber shop, pantries containing no cooking appliances, corridors, toilets and similar spaces

Note 1 to entry: This definition is consistent with the one given by IMO SOLAS II-2/3.1.

3.2

approval

formal acceptance of the product and arrangement issued by the *competent authority* (3.4)

3.3

assembly station

distinct and designated internal or external space for mustering and marshalling passengers and crew arranged in the vicinity of, and permitting ready access for the passengers and crew to, the embarkation stations

Note 1 to entry: The assembly station can also be the embarkation station.

3.4

competent authority

administration whose flag the ship is entitled to fly, or an organization authorized by that administration to perform functions required by this document

3.5

dead-end corridor

corridor, or part of a corridor, whose depth is greater than its width, and from which there is only one *escape route* (3.7)

3.6

EP system

electrically powered system

LLL system (3.12) that requires electrical power for its operation, such as systems using incandescent bulbs, light-emitting diodes, electroluminescent strips or lamps, electrofluorescent lamps, or other electrically powered light-emitting material

3.7

escape route

designated route, principally along corridors, stairways and through exits, by which people can be directed to an *assembly station* (3.3) and/or to a lifesaving appliances embarkation station

Note 1 to entry: The escape routes are shown on the approved escape plan.

3.8

excitation

effect of UV and visible light in the absorption spectrum that allows the materials to be activated and store energy

3.9

exit

egress along the *escape route* (3.7) that can lead into a safe space, or to another escape route, not affected by smoke

3.10

fire-fighting equipment

fixed or portable manually operated equipment that can be used to suppress fire

Note 1 to entry: Smoke detectors and fire-fighters' outfit are not part of the fire-fighting equipment for the purposes of this document.

EXAMPLE Fire hydrants and hoses, portable fire extinguishers.

3.11**installation plan**

plan consisting of a ship's general arrangement showing the layout of the *LLL system* (3.12) using different kinds of lines, colours, and various symbols

3.12**LLL system****low-location lighting system**

electrically powered lighting or phosphorescent guidance lines or indicators and relevant *signs* (3.17) placed as continuous as practicable along the *escape routes* (3.7) relevant to passenger and crew *accommodation spaces* (3.1) to readily identify such routes when the normal or the emergency light is less effective due to smoke

3.13**luminance**

luminous intensity per unit area of phosphorescent materials

Note 1 to entry: The luminance is measured in millicandelas per square metre.

3.14**maintenance**

measures for the preservation and/or restoration of the original conditions of the technical elements of a system as well as all measures for the determination and evaluation of the actual conditions

3.15**PL system****phosphorescent lighting system**

LLL system (3.12) based on material incorporating phosphors that, if excited by UV or visible radiation, store energy that is emitted as light over a period of time

3.16**phosphorescent****PL**

photoluminescent delayed by storage of energy in an intermediate energy level

Note 1 to entry: SOLAS 74 (as amended), Chapter II-2, Regulation 13.3.2.5.1, uses the word "photoluminescent". In this document, the word phosphorescent is used in place of photoluminescent and should be considered synonymous for the purpose of applying this standard to SOLAS 74, as amended.

3.17**sign**

safety sign used in conjunction with *LLL systems* (3.12), indicating the *escape routes* (3.7) to the *assembly stations* (3.3) and/or to embarkation stations, and the location of the *fire-fighting equipment* (3.10)

Note 1 to entry: These safety signs are defined in ISO 24409-1 and ISO 24409-2.

3.18**visible delineation**

identification of the boundaries of the *escape route* (3.7) by a series of conspicuous, continuous lighting lines

4 Performance requirements**4.1 General**

4.1.1 The competent authority shall ensure that LLL systems and their components meet the requirements set out in this document, as verified through the presentation of relevant documents issued by laboratories recognized by the competent authority.

4.1.2 The supplementary emergency lighting for ro-ro passenger ships required by Chapter II-1, Regulation 42-1 of SOLAS 74, as amended, may be accepted to form partly or wholly the LLL system, provided that such a system complies with the requirements of this document.

4.1.3 The LLL system consists of the following components: the guidance lines at low-location, the marking of exit doors, and the signs at low-location relevant to escape routes and fire-fighting equipment.

4.1.4 For EP systems, the colour of the line sources or point sources of light shall be green, white or yellow.

4.1.5 Escape route signs shall be placed adjacent to, or integrated in, the low-location guidance lines.

4.1.6 LLL guidance lines shall be as continuous as practicable in order to provide a visible delineation of the escape routes. Interruption of the LLL system due to constructional practicalities such as corridors, doors, small protrusions, as well as to the ship's plants and systems (ducts, cables, pipes, etc.), fixed furniture or artworks shall be permitted provided that they neither exceed 2 m in length nor impair the visible delineation of the escape route.

4.1.7 The LLL system shall function continuously for at least 60 min after its activation.

4.1.8 LLL products shall not contain radioactive materials unless such materials are designated "sealed radioactive materials" and are tested in accordance with ISO 2919. Materials containing radionuclides as given in ISO 2919:2012, Annex A, are considered sealed radioactive materials that should be tested in accordance with ISO 2919.

4.2 Phosphorescent systems

4.2.1 Phosphorescent (PL) materials shall provide a luminance of at least 15 mcd/m² measured 10 min after the removal of all external illuminating sources. The system shall continue to provide luminance values greater than 2 mcd/m² for 60 min. The luminance shall be measured at the surface of the materials.

4.2.2 For excitation from an 8 W tubular fluorescent lamp of standard F2 cool white with a colour temperature of 4 100 °K, [Annex A](#) specifies the method of test for determining the minimum illuminance, measured at the surface of the phosphorescent material, which would enable the phosphorescent material to meet the minimum luminance requirements at 10 min and 60 min. For a different excitation lamp and luminaire, the test procedure of [Annex A](#) can be used to determine the minimum illuminance for the particular lamp and luminaire.

4.2.3 PL guidance lines shall have a width of 75 mm or greater. PL guidance lines having a width less than 75 mm shall only be used if the luminance is increased to compensate for the reduced width in accordance with [Annex D](#).

4.2.4 Escape route signs shall have minimum height of 50 mm or the width of guidance line if greater, and be made of phosphorescent material, and use graphical symbols in accordance with ISO 24409-1 and ISO 24409-2.

A supplementary direction arrow graphical symbol cannot be used on its own; it shall be in combination with a safety sign (e.g. exit, lifeboat, assembly station, as given in ISO 24409-2).

4.2.5 PL materials shall be flame-retardant in accordance with ISO 3795 with the contact of 38 mm flame for 15 s and classified as F1.

4.2.6 [Annex A](#) specifies testing methods on phosphorescent low-location lighting materials.

4.3 Electrically powered systems

4.3.1 Electrically powered systems shall be connected to the emergency switchboard as required by Regulation II-1/42 of SOLAS 74, as amended, so as to be powered by the main source of electrical power under normal circumstances and also by the emergency source(s) of electrical power (as identified by Regulation II-1/42.3) when the latter is in operation. Alternatively, for passenger ships carrying more than 36 passengers and built before 1994-10-01, EP systems may be connected to the main lighting system so that independent batteries provide a backup of at least 60 min and are charged from the main lighting system.

4.3.2 The components of EP LLL systems can consist of planar light sources or point light sources or a combination of both.

4.3.3 The minimum luminance of planar line sources used for LLL guidance lines shall be 20 cd/m². The minimum width of the line source shall be 10 mm. The ratio of the maximum luminance to the minimum luminance along a line source shall not be greater than 2:1.

The 10 mm line width may be realized by two lines of 5 mm with a separation no greater than 1 mm.

Where the line source is horizontal bulkhead mounted, the perceived width of the line may be increased by sloping the horizontal line slightly out at its base so that it faces upwards and inwards towards the line of sight of an escapee. The minimum width of the line source shall remain 10 mm.

4.3.4 The luminance performance of the components of the LLL system, as described in 4.1.3, shall be the same as that of the guidance line.

4.3.5 Escape route signs made of electrically powered planar light sources shall use graphical symbols in accordance with Figure 1 of ISO 16069:2017 or with modified geometry if on the floor; see Figure 2 of ISO 16069:2017. The minimum height of the escape route sign shall be 30 mm. The minimum luminance of the green colour shall be 20 cd/m². The contrast colour shall be either white with a luminance at least five times greater than the luminance of the green colour, or be black.

4.3.6 The luminous intensity of point sources used for LLL guidance lines shall be not less than 30 mcd. The spacing between the point sources shall be no greater than 200 mm. The luminous intensity of a point source can be produced by a cluster of point sources. Where the line source is horizontal bulkhead mounted, the direction of peak intensity of the point light sources shall be pointing upwards and inwards towards the line of sight of an escapee.

4.3.7 Escape door frame marking shall be formed by continuation of the point source line. The luminous intensity of point sources used for door frame marking shall be 100 mcd or greater; the direction of peak intensity pointing normally into the corridor. The spacing between the point sources shall be no greater than 200 mm.

4.3.8 Escape route signs made of point sources can be used to outline the graphical symbol of the escape route signs in accordance with Figure 1 of ISO 16069:2017, or with a modified geometry if on the floor; see Figure 2 of ISO 16069:2017. The colour of the outlining point sources shall be green. The height of the graphical symbols shall be in accordance with 6.5.2. The maximum spacing between the point sources shall be 5 mm. The luminous intensity of every single point source used for the escape route sign shall be ≥ 100 mcd.

4.3.9 The power-supply arrangements to the EP system shall be arranged so that a single break in the cabling does not result in the system becoming ineffective. This can be achieved by using at least two battery power supplies in each single main vertical fire zone.

4.3.10 Entire systems, including those that are automatically activated, shall be capable of being manually activated by a single action either from the continuously manned central control station or from the safety centre.

4.3.11 EP systems shall meet the relevant requirements for emergency luminaires in accordance with IEC 60598-2-22 when tested at a reference temperature of 40 °C.

4.3.12 EP systems shall meet the requirements for vibration and electromagnetic interference in accordance with IEC 60945.

4.3.13 EP systems shall provide a minimum degree of ingress protection of at least IP 55 in accordance with IEC 60529.

4.3.14 EP materials shall be flame-retardant in accordance with IEC 60092-101.

4.3.15 The luminance of the EP materials shall be tested in accordance with [Annex E](#).

5 Technical product documentation

5.1 The technical product documentation for LLL systems shall comprise the following documents:

- installation plan, or plans, which should include the wiring layout and a general arrangement;
- list of items depicted in the legend on the installation plan;
- description of installation;
- material certificates;
- measurement reports of the installed system in accordance with [Annex C](#);
- measurement record; and
- maintenance requirements.

5.2 Approval documentation for PL materials shall include test data showing the type and minimum level of incident light that, when illuminated for 24 h, is required to charge the PL material to meet the required luminance specified in [4.2](#) or to meet the requirements for narrower width specified in [Annex D](#).

6 Installation on board

6.1 General

6.1.1 The LLL system shall be installed along the escape routes in accommodation spaces as described in the approved escape plan for movement to leave individual zones to exits, assembly stations and/or embarkation stations. Other accommodation spaces, unless forming part of the escape route described by the approved escape plan, are not considered as part of the escape routes.

6.1.2 To enhance the effectiveness of the LLL system to guide people to any exit, the arrangement shall be made such that people do not cross over LLL guidance lines. This applies particularly to door thresholds or across stairway landings. In order to provide for a continuous and visible delineation of the escape route along corridors, LLL guidance lines can be fitted on the deck at, or in way of, cabin door thresholds.

6.1.3 LLL arrangements are normally fitted along escape routes as in [6.1.1](#). Risk assessment shall be used to justify extension of the system for smaller isolated accommodation spaces normally occupied by less than 4 persons, such as toilets, pantries, small offices arranged in provision or in galley areas, or in similar working or occupied areas; see Figure G.1 for an example of such smaller isolated spaces. Small lobbies such as the ones used to separate accommodation spaces from stairways, or public spaces from open decks, or the ones between accommodation spaces are considered not to need LLL provisions; see Figure G.3 for an example.

6.1.4 The arrangement of LLL systems shall be such that the fire boundary of divisions, i.e. of bulkheads and decks, is not impaired.

6.1.5 LLL arrangements shall be fitted in accordance with the manufacturer's or installer's specification. When the LLL arrangement is installed on decks, it shall be arranged in such a way that the LLL guidance lines are not directly on the main walk surface. Generally, LLL guidance lines should be installed on or close to bulkheads or when necessary as flush with the walking surface as possible.

6.1.6 Combinations of PL and EP systems may be used throughout decks or stairway enclosures. However, the two systems shall be separated, e.g. by normally closed doors or by doors that can be closed, locally or remotely, in case of emergency; see [Figure G.2](#) for an example. Signs made of PL materials are used with both PL and EP systems as described in [6.5](#).

6.1.7 For each main vertical zone (MVZ) and water-tight zone (WTZ), only escape routes relevant to accommodation spaces shall be marked by an LLL system; e.g. when two MVZ or WTZ are adjacent to each other, but only one of the two contains accommodation spaces, the escape routes of the other zone need not be marked by the LLL system even if they are part of the means of escape of the zone with accommodation spaces. See [Figure G.4](#) for an example.

6.2 Corridors

6.2.1 In all corridors, the LLL system shall appear to be continuous, except as otherwise permitted by [4.1.6](#). LLL guidance lines loops around blocks of cabins or similar shall be avoided; see [Figure G.5](#) for an example of how to avoid an LLL guidance lines loop. In way of local enlargements or recesses, the maximum interruption permitted in LLL systems shall not exceed 2 m, in accordance with [Figure F.1](#).

6.2.2 The LLL system shall be installed on at least one side of the corridor. In general, the side of the corridor where the escape door or the door handle is located is the preferred location; see [Figure G.6](#) for an example. In case the LLL guidance line is hidden and obscured by normally open doors (e.g. fire door in MVZ boundaries), an additional LLL guidance line shall be fitted on the opposite side of the corridor; its length shall be not less than the width of the door and shall be installed along the corridor starting from the door frame. In corridors more than 2 m wide, the LLL system shall be installed on both sides. Small individual recesses, less than 2 m long in the line of the corridor or with a combined total length less than 50 % of the length of the corridor, shall not be included when calculating the width of a corridor.

6.2.3 The LLL system shall be located either on the bulkhead within 300 mm of the deck, or on the deck within 150 mm of the bulkhead. The LLL guidance line may be installed at a distance greater than 150 mm from the bulkhead in way of recesses, or where the escape routes cross lobbies exceeding 2 m in the line of escape, or when fixed furniture, such as chairs, sofas, counters or cabinets, is fitted adjacent to bulkheads: in this latter case, the LLL system shall follow the perimeter of the furniture so that the continuity of the guidance line, as well as the visual delineation of the escape route, is not impaired. Steps in corridors shall comply with [6.4](#).

6.2.4 In dead-end corridors, the LLL system shall include escape route signs at intervals of no more than 1 m, pointing away from the dead end.

6.3 Doors

6.3.1 Exit doors which are part of the escape route from the approved escape plan (i.e. doors in corridors and in stairway enclosures) shall be marked with the LLL arrangement. It shall include those doors on the escape routes leading to open decks from which an alternative escape route is available.

6.3.2 Exit doors that can be used in both directions (e.g. the ones along cabin corridors in way of MVZ boundary) in the escape route shall be marked by the LLL system on both sides. Transparent glass doors along the escape route need not be marked by the LLL system if they are of the swinging type and are without fixed means to lock them closed.

6.3.3 For doors which form part of the escape route, the LLL guidance line shall be installed at the door frame up to the exit door handle or opening device. The door handle vertical marking shall be installed on the handle, or opening device, side also when the LLL guidance lines are arranged in the corridor side opposite to the exit door handle. In addition, for doors more than 2 m wide, LLL guidance lines shall be fitted on the doorframe up to the height of the handles, on both sides of the door.

Such marking need not be installed on the door leaf except for doors that are normally kept closed, are provided with self-closing device, and are not provided with hold-back devices (e.g. magnets) to keep them open.

Alternatively, an escape route doorframe marking may comprise complete outlining of the doorframe. Escape doorframe markings shall be formed by a continuous planar line source; for phosphorescent guidance lines, the width shall not be less than 20 mm and of the same material as the LLL guidance lines.

6.3.4 Any opening devices of sliding doors and watertight doors which form part of the escape route shall be marked with an arrow sign in PL material showing how the door opens and the direction to turn to open for any handles.

6.4 Stairways

6.4.1 In all stairways on the escape route, LLL guidance lines installed on the bulkhead, or on the vertical or horizontal side of the stairs, shall be at a height no more than 300 mm above the forward edge (nosing) of each step. The LLL guidance lines shall be installed on both sides of the stairway if the width of the stair is greater than 2 m, and not on the centre handrail, if fitted.

6.4.2 The top and the bottom of each set of stairs (flight of stairs) shall be marked to show that there are no further steps. Such marking can be done either on the step itself or on the LLL guidance line.

6.4.3 Within stairway enclosures, when the distance between the entry door and the LLL guidance line fitted on the stair flight, or the one between two set of stairs, exceeds 2 m, the most direct route between the entry door and the stair, or between the two set of stairs, shall be marked by the LLL guidance line along the bulkhead and/or the deck in accordance with [Figure E.2](#). Only the portion of the stairway part of the escape route from accommodation spaces shall be marked, except when requested as the result of a risk assessment. In any case, the continuity of the LLL system in direction of escape shall not be impaired. See [Figure G.7](#).

6.5 Signs and escape route signs

6.5.1 The display of any sign or escape route signs installed on board shall conform to the design principles given in ISO 24409-1 and in ISO 24409-2.

6.5.2 LLL signs shall be not less than 50 mm in height and shall be either incorporated with the LLL system or in the lower 300 mm of the bulkhead, or the vertical side of the stair. LLL signs shall be made of phosphorescent material with the same performance as the LLL system or shall be illuminated by the

emergency lighting. The direction arrow graphical symbol can be used only if in conjunction with other safety signs.

6.5.3 LLL escape route signs shall be used in dead-end corridors as described in [6.2.4](#) and in stairways to indicate the direction of escape and to assembly stations. In addition, assembly station signs shall be used to identify the access doors to the assembly stations, but not along the escape routes. On the survival crafts embarkation deck, signs shall be used to identify the direction to access to the lifesaving appliances embarkation stations.

6.5.4 In order to improve their visibility, the colour of the background where signs are located shall contrast with the specified colours of the signs and markings of the LLL system.

6.5.5 Along the escape route, exit signs shall be provided at all exit doors and shall be installed on the same side as the door handle, or operating mechanism. The minimum height of the exit sign shall be 50 mm; such signs may be supplemented by the wording "Exit" that can be fitted within the guidance line or be part of the exit sign. Doors in stairway enclosures shall be marked by exit signs only on the side consistent with the direction of escape, except for the ones leading to open decks from which an alternative escape is available (see [6.3.1](#)). Exit doors leading to open decks from which there are no alternative means of escape shall not be marked; see [Figure G.10](#). To be consistent with the requirements in [6.3.3](#), for doors more than 2 m wide the exit sign shall be installed at each side of the door; see [Figures G.8](#) and [G.9](#) for examples.

6.5.6 The signs and the markings described in [6.3.4](#) shall be of PL material or illuminated. In case such doors are normally kept open, and the handle is recessed into the bulkhead, in such a way that the PL material cannot be charged by the ambient light, proper means to charge the PL material within the bulkhead shall be provided.

When each leaf of double-leaf doors is provided with a handle, a PL marking shall identify the active door handle (i.e. the one that can provide the opening of the door).

6.5.7 When the width of the sliding door leaf is greater than 2 m, i.e. when the distance from the end of the LLL guidance line, adjacent to the door, and the handle is greater than 2 m, a horizontal LLL guidance line on the lower side of the door leaf, as well as a door handle vertical marking, should be provided. If the door is kept normally open and recessed into the bulkhead, proper means to charge the phosphorescent LLL system, if any, should be provided.

6.5.8 Along the escape route, fire-fighting equipment signs according to ISO 24409-1 and ISO 24409-2 shall be fitted on or near the installed equipment, in the lower 300 mm of the bulkhead, or incorporated within the LLL guidance line, for the equipment to be located and identified. The signs shall be of phosphorescent material with the same performance as the material prescribed for the LLL system and shall not be less than 50 mm in height. The signs shall be located on the same side as of the equipment, even if the LLL guidance line is fitted on the opposite side of the corridor.

7 Approval of the installation

7.1 The arrangement of LLL systems shall be approved by the competent authority. For this purpose, the manufacturer or the installer shall submit the installation plan and description, including documentation and data to support a certificate of conformance that the materials and components of the PL and EP systems meet the requirements of [Clause 4](#), as the basis for the validation of the system after its completion.

7.2 For PL arrangements, the ambient (excitation) lighting within the proposed installation area shall be measured and shown to be capable of producing the required minimum illuminance at the surface for the type of phosphorescent material installed. After installation, PL systems shall be tested at the place of use in accordance with [Annex B](#) at least twice on each deck, and the results of the measurements shall be recorded; the minimum information that should be recorded is shown in the example given in

[Annex C](#). The testing shall be conducted under any different luminous conditions that might exist. In addition, system measurements, including the number of tests to be done on each deck, shall be carried out under the judgment of the competent authority, e.g. in case of identical arrangements of decks and of relevant ambient light the number of the tests can be reduced.

7.3 At the installation, it shall be ensured that the documents as specified in [Clause 5](#) are provided.

8 Maintenance

8.1 A copy of the technical product documentation specified in [Clause 5](#), as well as the records of the measurements described in [Clause 7](#), shall be kept on board to be available to surveyors and inspectors.

8.2 LLL systems shall be visually examined and spot-checked to ensure proper operation and condition at least once a week, and the area and results recorded. The entire vessel shall be covered within a six-month period. Damaged or missing components of the LLL system shall be repaired or replaced immediately.

8.3 For PL systems, the measurements described in [Clause 7](#) shall be repeated and recorded whenever the normal lighting system, walls, floor or ceiling linings and decorations in the area are substantially changed. Since the performance of PL systems depends on the ambient normal lighting, it is important that relevant lighting reflectors and/or diffusers be kept clean. At the test location, measurements of the illuminance at the surface of the phosphorescent material shall be taken in accordance with [Annex B](#), and the luminance of the phosphorescent material shall be taken during the decay mode for 60 min. Results shall be recorded in a form, an example of which is provided in [Annex C](#), and kept for examination by the competent authority, if requested.

8.4 The LLL system shall be checked and tested for proper operation and the light emitted from EP systems and luminance for PL system should be measured. Results shall be recorded and kept for inspection by the competent authority. The competent authority shall ensure that the complete LLL system has been tested within a five-year period.

8.5 For PL systems, if the luminance for a particular reading does not meet the requirements of this document, additional readings shall be taken. The readings shall be taken adjacent to the location of the non-compliant readings. The installation is acceptable when the spacing of the non-compliant readings does not exceed 2 m. Otherwise, the LLL component shall be replaced or the illumination increased to meet the requirements of this document.

Annex A (normative)

Testing of phosphorescent low-location lighting materials

A.1 Purpose

This annex shall be used to assess the required excitation (4.2.2) for phosphorescent materials to comply with the required luminance (4.2.1) performance under controlled laboratory conditions.

A.2 Testing to ISO 16069

A.2.1 General

The testing shall be in accordance with ISO 16069:2017, with the following modifications.

A.2.2 Subclause A.5.2

A.2.2.1 The test in ISO 16069:2017, A.5.2, is required; however, it shall be replaced by: "Excitation of the phosphorescent test specimens shall be by an 8 W tubular fluorescent lamp of standard F2 cool white with a colour temperature of 4 100 °K, providing a mean illuminance of 25 lx on the surface of the test specimen. The excitation duration shall be 24 h. The illuminance shall be measured using the illuminance meter specified in A.4.1. The test specimen body temperature shall not exceed 25 °C, 1 min after excitation. No ambient or stray light shall be present during excitation."

A.2.2.2 Test patches for measurement of illuminance shall be positioned in the centre of the illuminated area of the test specimen and at each of the four points 90° on the outer rim of the surface of the test specimen. The illuminance on the five test patches shall be $(25 \pm 0,1)$ lx.

A.2.2.3 When the intended or installed lamp differs from that specified in A.2.2.1 of this document, such lamp with luminaire shall be used in the test.

A.2.3 Subclause A.6.4.2

The luminance recording in in ISO 16069:2017, A.6.4.2, is required, however the measurement period is limited to 60 min.

A.2.4 Subclause A.9.2

Report the excitation illuminance and excitation light source and minimum excitation illuminance for the declared light source and the luminance in mcd/m^2 for 10 min and 60 min after excitation.

Annex B **(normative)**

Assessment of installations on board

B.1 Purpose

The purpose of this annex is to ensure that installed phosphorescent materials are capable of providing the required luminance performance following excitation from the normal installed electrical lighting.

B.2 Luminance measurements

B.2.1 All measurements shall be carried out on the installed material following a period of excitation of at least 24 h. Measurements shall be taken in areas where the material is not subject to excitation due to daylight.

B.2.2 Measurements shall be taken, and relevant records made as specified in [Clauses 7](#) and [8](#).

B.3 Testing to ISO 16069

B.3.1 The testing shall be in accordance with ISO 16069:2017, Annex B, except that for the tests specified in B.3, the sources of illumination shall be switched on for at least 24 h, and for those specified in B.6.4, the 2 min and 30 min luminance measurements need not be taken.

B.3.2 The results of the measurements shall be recorded in a table (see [Annex C](#) of this document for an example) and stored for examination by the competent authority.

B.3.3 All LLL systems shall have their luminance tested at least every five years.

Annex C

(informative)

Measurement record for phosphorescent materials

Measurement record					Record no.		
Measurement in accordance with ISO 15370					Page of		
Name of ship:							
Call sign:							
Flag state:							
Measure- ment num- ber	Product identifica- tion	Location of measure- ment (deck, frame, etc.)	Width of guidance line mm	Illuminance lx	Type of light source	Luminance at 10 min mcd/m ²	Luminance at 60 min mcd/m ²
Measurement meter: _____				Manufacturer: _____		Model: _____	
Measurement meter: _____				Manufacturer: _____		Model: _____	
Date of calibration							
Notes:							
Measurement carried out by: _____				Signature: _____		Date: _____	
Competent authority (if pres- ent): _____				Signature: _____		Date: _____	

Annex D (normative)

Minimum width and required luminance

PL guidance lines with the minimum requirements specified in 4.2.1 and 4.2.2 shall have a minimum width of 75 mm, as specified in 4.2.3, except where the luminance of the phosphorescent material in low-location PL guidance lines is increased according to the formula below, in which case the minimum width may be reduced. Both luminance at 10 min and 60 min shall be met, as per Table D.1.

$$L' = L(75/d')^2$$

where

L' is the increased value of luminance, in millicandelas per square meter;

L is the minimum luminance in accordance with 4.2.1, in millicandelas per square meter;

d' is the reduced width of the PL guidance line, in millimetres.

Table D.1 — Width versus luminance

Width	Luminance at 10min	Luminance at 60min
mm	mcd/m ²	mcd/m ²
75	15	2,00
70	17,22	2,30
65	19,97	2,66
60	23,44	3,13
55	27,89	3,72
50	33,75	4,50
45	41,67	5,56
40	52,73	7,03
35	68,88	9,18
30	93,75	12,50

Annex E (normative)

Testing of electrically powered low-location lighting systems

E.1 Purpose

The purpose of this annex is to ensure that installed EP LLL systems are capable of providing the relevant luminous performance when powered by the dedicated power supply for the system.

E.2 Test specimens

E.2.1 Three specimens of representative commercial materials shall be tested. Specimens shall be at least 1 m long or contain sufficient sections to make up 1 m.

E.2.2 The test specimens shall be mounted such that luminous measurements can be made normal to planar light test specimens or, in the case of point source test specimens, in the direction of peak intensity of the point source.

E.2.3 The test specimens shall be connected to the dedicated power supply for the EP LLL system.

E.2.4 The width of planar line light sources shall be measured. For point light source lines, the maximum distance between point sources of light shall be measured.

E.3 Ambient conditions

The ambient temperature during testing shall be $(23 \pm 2)^\circ\text{C}$. The relative humidity shall be $(50 \pm 10)\%$. Testing shall be performed in a room or chamber whose ambient light level is at least one order of magnitude lower than the lowest luminous measurement to be made.

E.4 Luminance instrumentation

E.4.1 A luminance meter shall be provided and calibrated to measure photopic luminance. The luminance meter shall be a telephotometer/non-contact luminance meter and shall have the following minimum features:

- a) spectral error: $f'_1 \leq 8\%$ (with f'_1 as defined in CIE 069);
- b) measuring range: 10^{-3} cd/m^2 to $45 \times 10^3 \text{ cd/m}^2$.

E.4.2 The luminance instrument shall have been calibrated. This shall be confirmed by a certificate, traceable to a certified reference measure.

E.5 Measurement conditions

E.5.1 Measurements shall be made when the EP LLL system has been powered by the dedicated battery power supply for at least 1 h.

E.5.2 Due to the powering of long sections of line sources, luminous performance can reduce along the line. Measurements shall be made in at least three positions on the light line as follows:

- a) near to the two ends of the light line;
- b) at the approximate centre of the light line;
- c) at any other positions close to power supply connections to the light line; and
- d) at positions observed to be noticeably brighter or dimmer.

E.6 Luminous measurements

E.6.1 General

The measurements shall be carried out using the luminance meter specified in [E.4](#), using the method in [E.6.2](#) for planar light lines, or the method in [E.6.3](#) for point light source lines.

E.6.2 Luminance of planar light lines

E.6.2.1 Measurements shall be taken normal/perpendicular to the surface/plane of the planar light source.

NOTE This might not be the same as the mounting surface if the planar light source is tilted.

E.6.2.2 The distance between the luminance meter and the measured test specimen and the aperture of the luminance meter shall be chosen in such a way that the test spot size shall be within the width of the planar light source.

The test spot size should be as large as practical but not extend beyond the dimensions of the planar light source.

E.6.2.3 The positions of measurement and luminance values shall be recorded.

E.6.3 Luminous intensity of point light source lines

E.6.3.1 Measurements shall be taken normal/perpendicular to the surface/plane of the point light source or, in the case of point light sources with beam-like luminous intensity characteristics, in the axis/direction of peak intensity.

EXAMPLE 1 An example of measurement normal to plane is when measuring miniature incandescent lamps.

EXAMPLE 2 An example of measurement in the direction of peak intensity is when measuring LEDs. This might not be the same as the mounting surface if the point light source is tilted. This is normally the axis of the LED but can be determined by varying the angle of measurement, with luminance meter at fixed distance, until a peak value is obtained.

E.6.3.2 The distance between the luminance meter and the measured test specimen and the aperture of the luminance meter shall be chosen in such a way that the test spot size is larger than the dimensions of the LED and includes it. The dimensions of the test spot size shall be measured and its area, A , calculated.

E.6.3.3 The luminous intensity shall be determined by converting luminance to luminous intensity according to the following formula:

$$I = 1000 L \times A$$

where

- I is the luminous intensity, in mcd;
- L is luminance, in cd/m^2 ;
- A is a test spot area, in m^2 .

E.6.3.4 The positions of measurement, test spot size, luminance and calculated luminous intensity values shall be recorded.

E.7 Test report

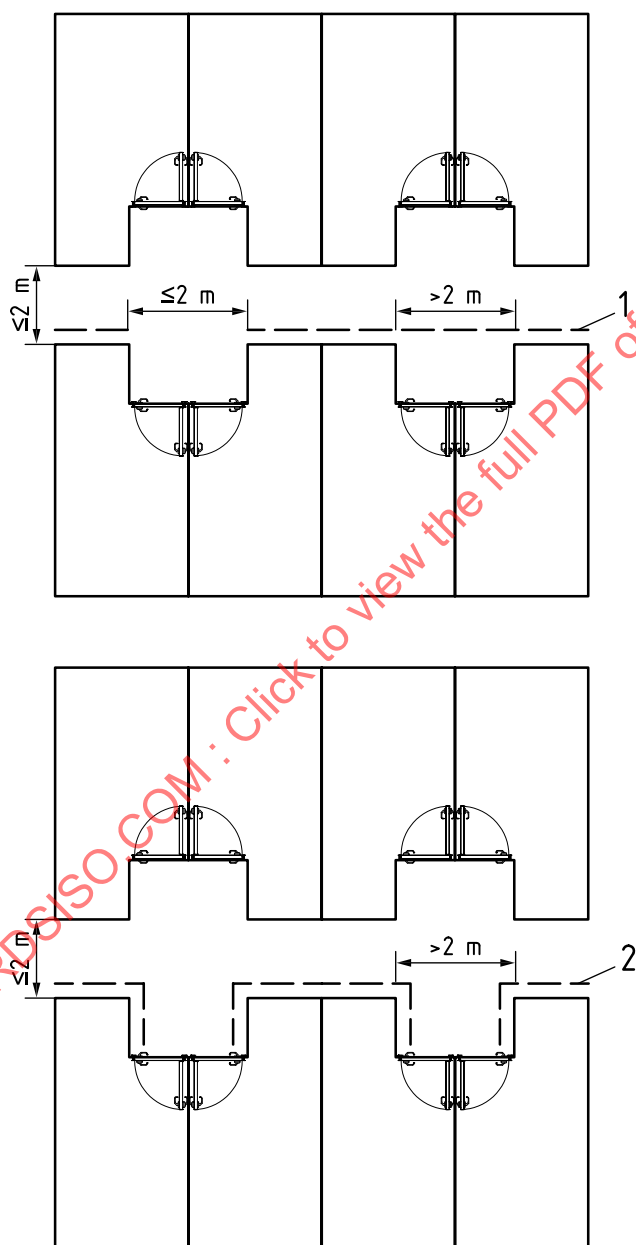
The test report shall include the following information:

- a) statement that testing has been carried out in accordance with this document;
- b) manufacturer of tested product (name, address, phone, fax, etc.);
- c) specimen description (clear item identification to make specimens traceable to manufacturer's production batch code);
- d) instrument parameters, photometer serial number and expiry date of calibration;
- e) colour of light source;
- f) for planar light sources, width (mm) of line light source; for point sources of light, maximum distance (mm) between point sources of light;
- g) for planar light sources, number of measurements, maximum luminance, minimum luminance and ratio of maximum luminance to minimum luminance;
- h) for point light sources, number of measurements and minimum luminous intensity value, in mcd; and
- i) compliance checked against relevant minimum specifications given in this document.

Annex F (normative)

Corridor recess and stairway arrangement diagrams

Dimensions in metres



Key

- 1 LLL guidance line, deck arrangement
- 2 LLL guidance line, bulkhead arrangement

Figure F.1 — LLL arrangement for corridor recess

Dimensions in metres

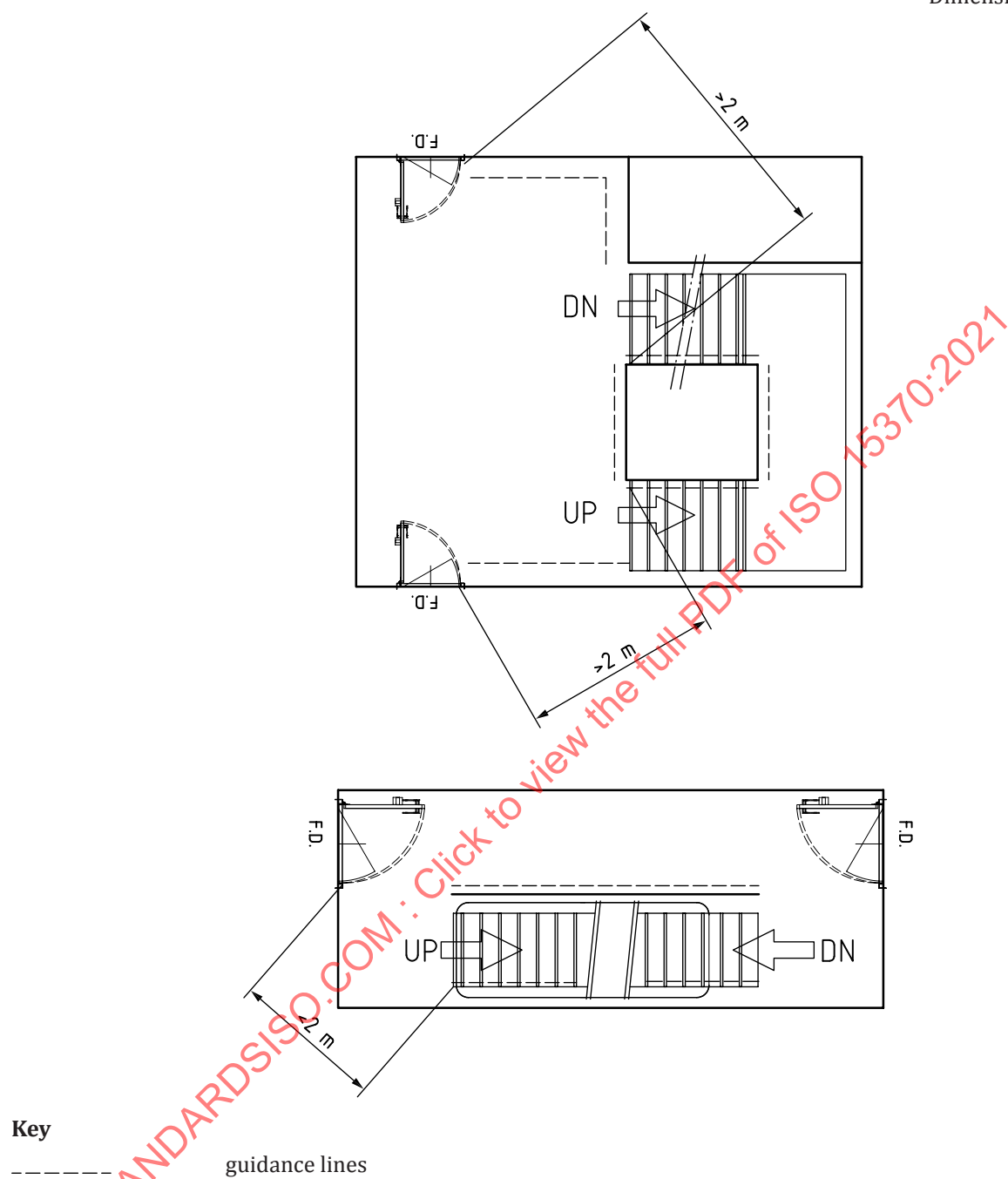


Figure F.2 — LLL arrangement for stairway landings

Annex G (informative)

LLL installation and arrangement examples

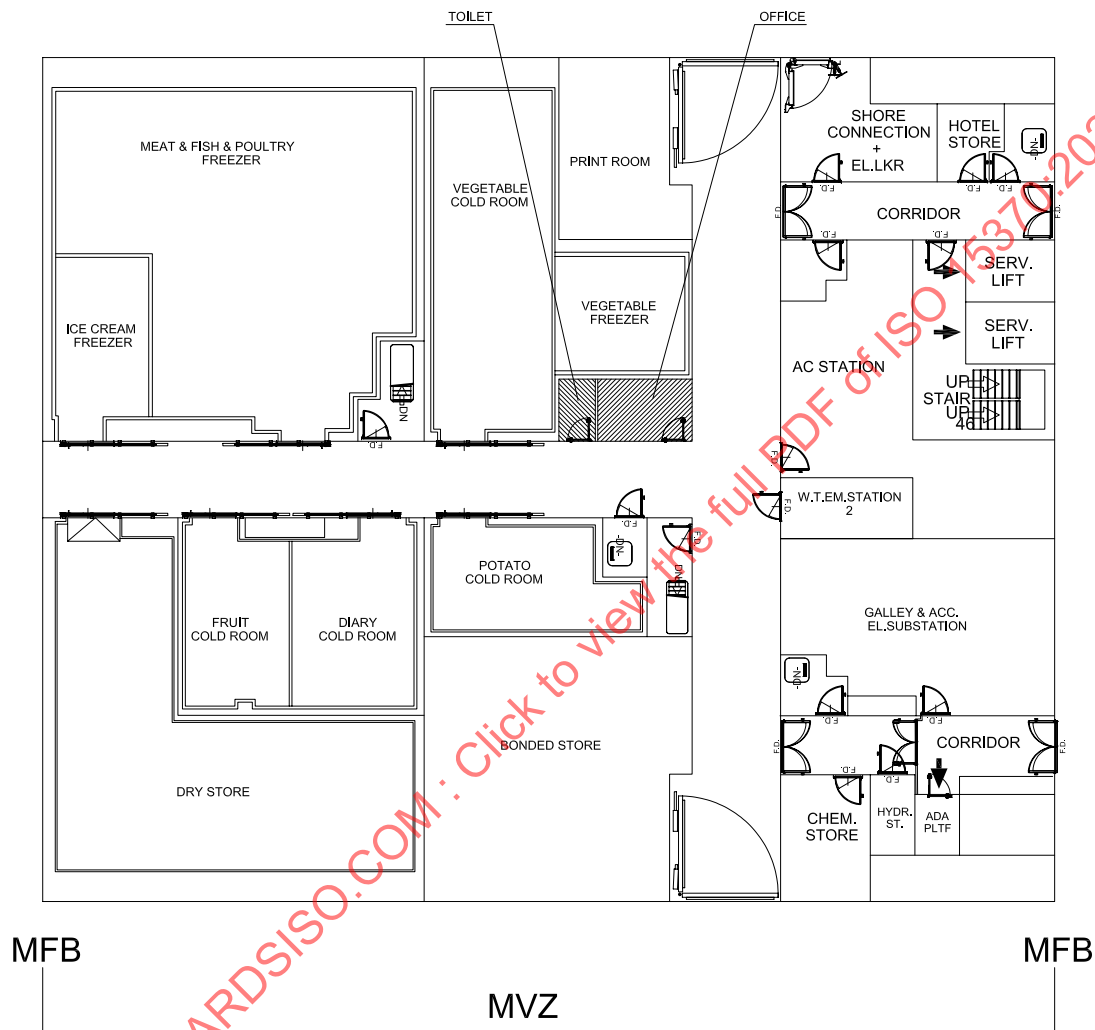


Figure G.1 — Example relating to 6.1.3 of small accommodation spaces within a main vertical zone occupied by service spaces only

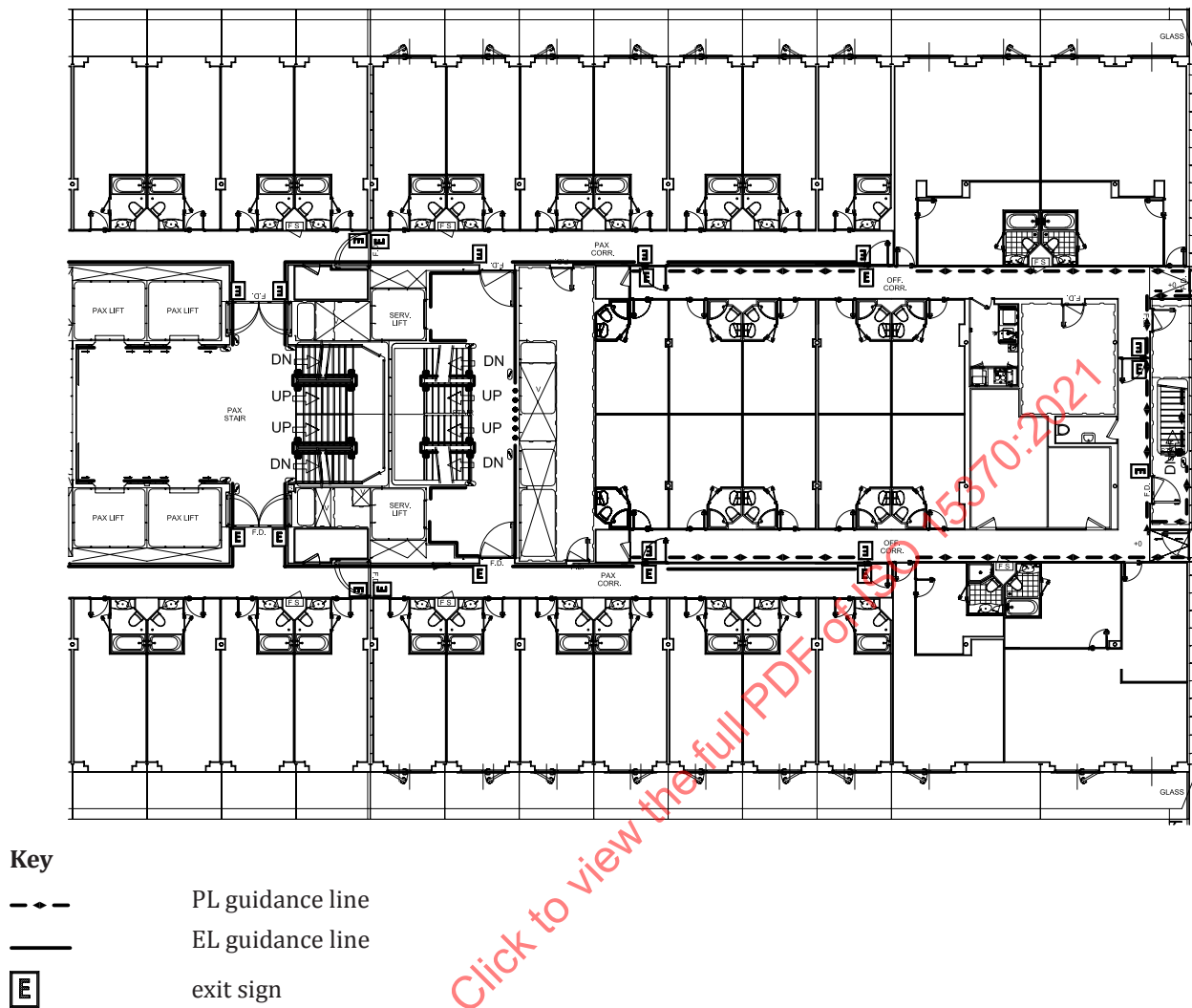


Figure G.2 — Example relating to 6.1.6, arrangement of EP and PL systems on the same deck: PL system is shown in the crew accommodation spaces, and EP system in the passenger accommodation spaces; the two systems are separated by normally closed doors or by doors that can be closed in case of emergency

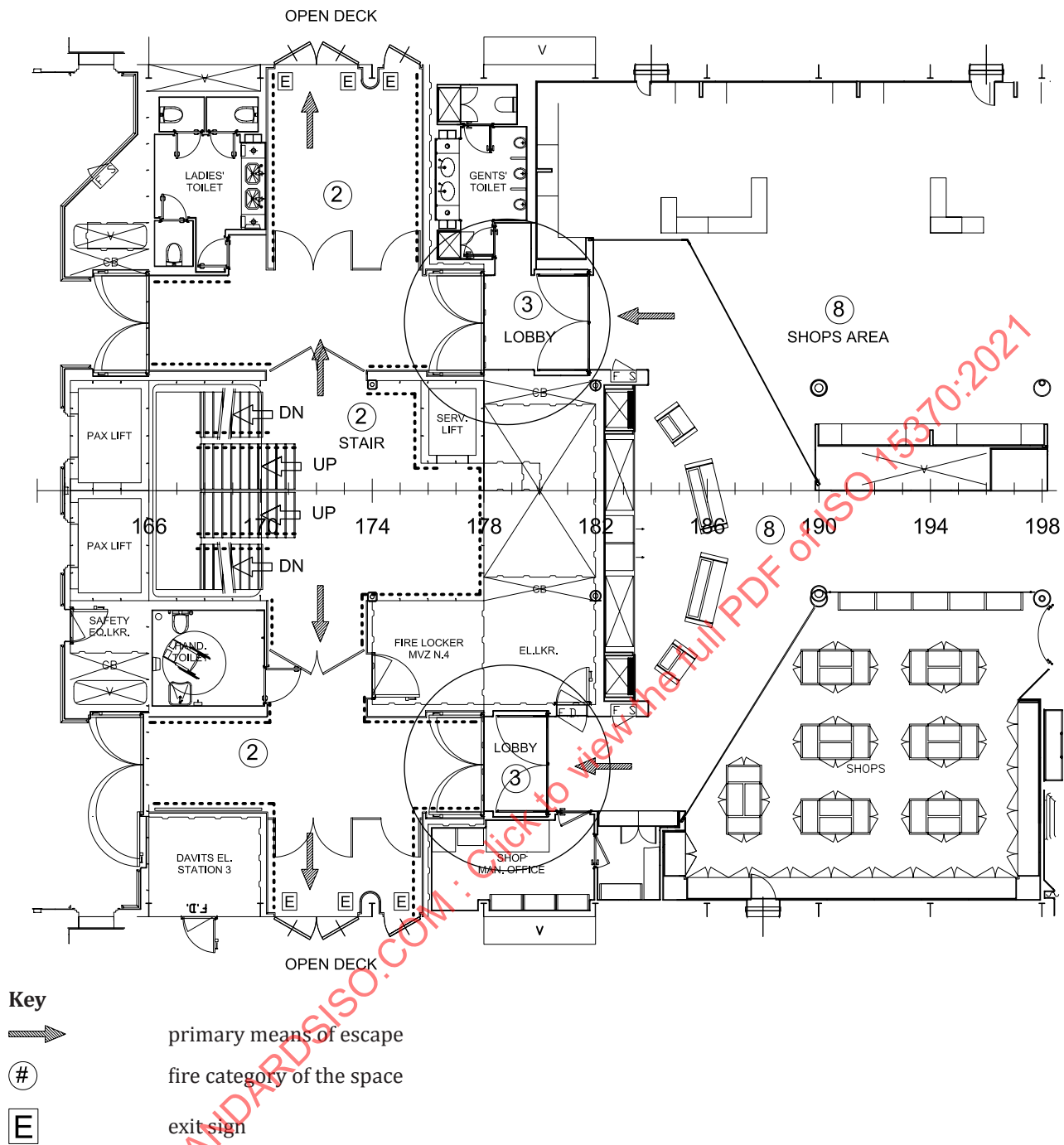


Figure G.3 — Example relating to 6.1.3 of a small (cat. 3) lobby where the LLL is not needed

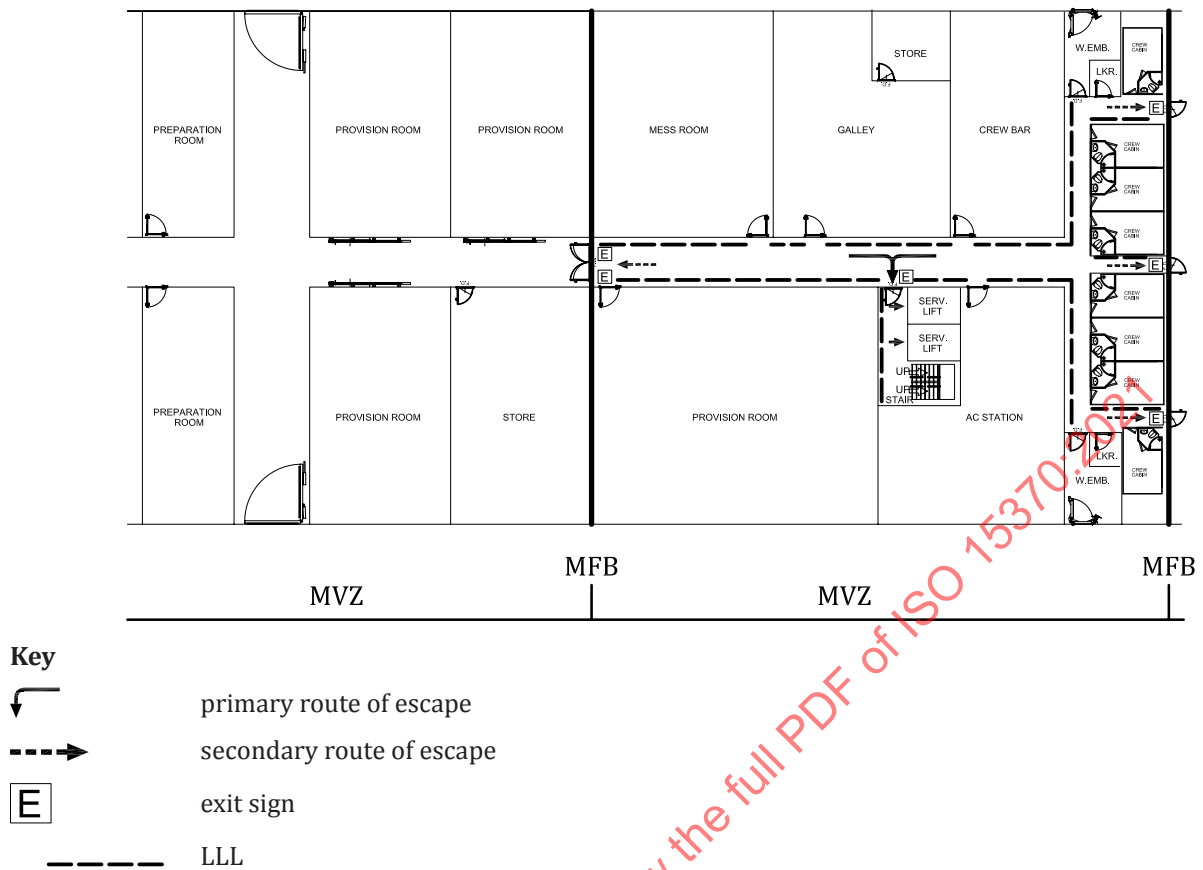


Figure G.4 — Example relating to 6.1.7 of LLL installed within a main vertical zone (MVZ) with accommodation spaces which is adjacent to another MVZ with no accommodation spaces

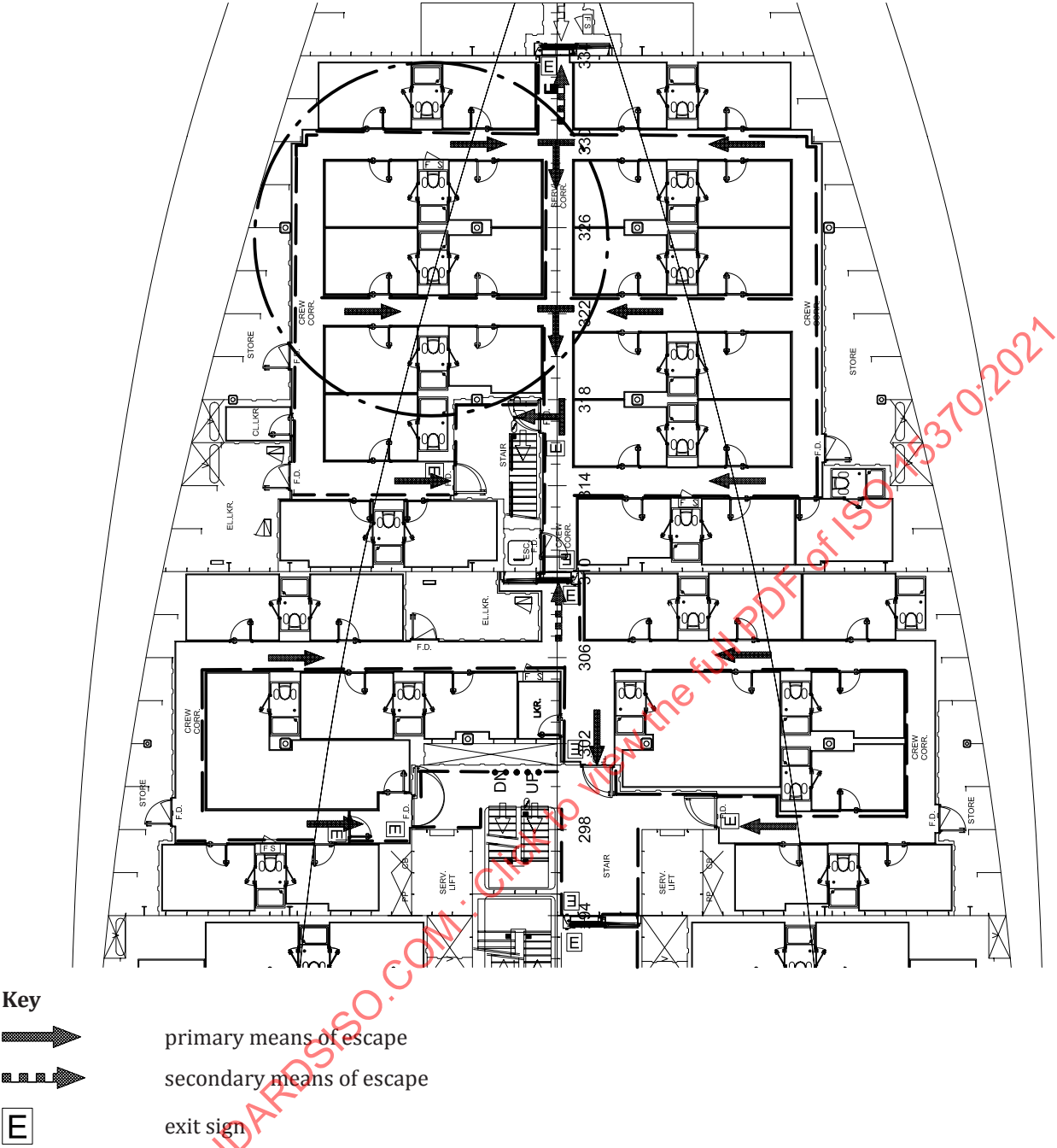


Figure G.5— Example relating to 6.2.1 of a typical arrangement of LLL avoiding circulation around the same accommodation space