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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 15370 was prepared by Technical Committee ISO/TC 8, *Ships and marine technology*, Subcommittee SC 1, *Lifesaving and fire protection*.

This second edition cancels and replaces the first edition (ISO 15370:2001), which has been technically revised.

Introduction

This International Standard 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.

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

1 Scope

This International Standard 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 the IMO *International Code for Fire Safety Systems*.

2 Normative references

The following referenced documents are indispensable for the application 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 3864-1:2002, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas*

ISO 16069:2004, *Graphical symbols — Safety signs — Safety way guidance systems (SWGS)*

IEC 60092-101, *Electrical installations in ships — Part 101: Definitions and general requirements*

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 in 2000

3 Terms and definitions

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

3.1
approval
formal acceptance of the product and arrangement issued by the competent authority

3.2
assembly station
distinct, designated internal or external space for mustering passengers in the vicinity of, and permit ready access for the passengers to, the embarkation stations for survival craft unless in the same location as the embarkation station

3.3
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

3.4
competent authority
administration whose flag the ship is entitled to fly, or an organization authorized by that administration to perform functions required by this International Standard

3.5
dead-end corridor
corridor, or part of a corridor, whose depth is greater than its width from which there is only one escape route

3.6
EP systems
electrically powered systems
LLL systems that require electrical power for their 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, constituted in general by corridors, lobbies and stairways, through which people are intended to move from an occupied space to the lifeboat and liferaft embarkation deck and/or to the assembly stations

3.8
excitation
effect of visible light in the appropriate spectrum which allows the materials to store energy

3.9
installation plan
plan consisting of a ship's general arrangement showing the layout of the LLL system using different kinds of lines, colours, and various symbols, as appropriate

3.10
LLL systems
low-location lighting systems
electrically powered lighting or phosphorescent strips or indicators placed as continuous as practicable along the escape routes to readily identify such routes when the normal or emergency light is less effective due to smoke

3.11
PL system
phosphorescent lighting system
LLL system based on material incorporating phosphors that, if excited by UV or visible radiation, store energy, which is emitted as light over a period of time

3.12
signs
safety signs, as defined in ISO 3864-1, used in conjunction with LLL systems in corridors and stairwells, indicating the escape routes to the assembly stations or to the lifeboat embarkation stations, and the location of the fire-fighting equipment, such as fire hydrants, hoses, and fire extinguishers

3.13
visible delineation
portrayal of the escape route by a series of continuous strips or indicators that can be clearly seen during egress

3.14
normal condition
internal ambient conditions of the ship when in service and not affected by a fire or smoke

3.15
luminance
luminous intensity per unit area of phosphorescent materials

NOTE The luminance is measured in millicandelas per square metre.

3.16
luminescence
emission, by atoms, molecules or ions in a material, of optical radiation that for certain wavelengths or regions of the spectrum is in excess of the radiation due to thermal emission from that material at the same temperature, as a result of these particles being excited by energy other than thermal agitation

3.17
photoluminescence
luminescence caused by absorption of optical radiation

3.18
phosphorescence
photoluminescence delayed by storage of energy in an intermediate energy level

NOTE SOLAS 74 (as amended), Chapter II-2, Regulation 13.3.2.5.1 uses the word “photoluminescent”. In this International Standard 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.

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 International Standard, as verified through the presentation of relevant certificates issued by recognized laboratories.

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 International Standard.

4.1.3 The components of an LLL system comprise guidance lines at low-location, directional indicators, marking of the escape route doors and escape route signs.

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

4.1.5 Escape route door frame marking shall comprise complete outlining of the door frame or vertical marking up to the height of the door opening device. The marking shall not be mounted on the door. The door frame marking shall be contiguous with the low-location line. See 6.3.3.

4.1.6 Directional indicators shall be placed adjacent to or integrated in the low-location guidance lines.

4.1.7 Interruption of the LLL system due to constructional practicalities (corridors, cabin doors, etc.) shall not exceed 1 m, with the exception described in 6.2.1.

4.1.8 The LLL system shall function at all times for at least 60 min after its activation.

4.1.9 LLL products shall not contain radioactive materials unless such materials are designated “sealed radioactive materials” tested in accordance with ISO 2919. However, materials containing radioactive radionuclides, as shown in ISO 2919:1999, Annex A, are considered as sealed radioactive materials which should be tested in accordance with ISO 2919.

4.1.10 LLL systems shall not release toxic materials under normal conditions.

4.2 Phosphorescent systems

4.2.1 Phosphorescent (PL) materials shall provide a luminance of at least 15 mcd/m^2 measured 10 min after the removal of all external illuminating sources. The system shall continue to provide luminance values greater than 2 mcd/m^2 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 gives 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 strips should have a width of 75 mm or greater. PL strips 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 door frame marking of not less than 20 mm width shall be formed by continuation of the planar line source. The luminance performance of the phosphorescent material shall be the same as that of the guidance line.

4.2.5 Directional indicators made of phosphorescent material shall use graphical symbols in accordance with Figure 1 of ISO 16069:2004 or with modified geometry if on the floor; see Figure 2 of ISO 16069:2004. The direction arrow graphical symbol can be used on its own. The minimum height of the directional indicator shall be 50 mm. The luminance performance of the phosphorescent material shall be the same as that of the guidance line.

4.2.6 The minimum height of the exit sign, as defined by ISO 3864-1, shall be 50 mm. The luminance performance of the phosphorescent material shall be the same as that of the guidance line.

NOTE Symbols to be used on exit signs made of phosphorescent material will be specified in a future International Standard (ISO 24409-2).

4.2.7 PL materials shall be flame-retardant in accordance with IEC 60092-101.

4.2.8 PL materials shall be tested in accordance with Annex A.

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, provided independent batteries provide a backup of at least 60 min and are charged from the main lighting system. Performance of the system while powered by batteries shall meet all the requirements given in 4.3.

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 luminance of planar line sources used for low-location lines shall be $\geqslant$ 20 cd/m^2. 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 Escape door frame marking of not less than 20 mm width shall be formed by continuation of the planar line source. The luminance shall be the same as that of the guidance line.

4.3.5 Directional indicators made of planar light sources shall use graphical symbols in accordance with Figure 1 of ISO 16069:2004 or with modified geometry if on the floor; see Figure 2 of ISO 16069:2004. The minimum height of the directional indicator 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.

NOTE The black contrast colour automatically provides a contrast to the green colour.

4.3.6 The luminous intensity of point sources used for low-location 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 $\geqslant$ 100 mcd, the direction of peak intensity pointing normally into the corridor. The spacing between the point sources shall be $\leqslant$ 200 mm.

4.3.8 Directional indicators made of point sources may be used to outline the graphical symbol of the directional indicators in accordance with Figure 1 of ISO 16069:2004, or with a modified geometry if on the floor; see Figure 2 of ISO 16069:2004. The direction arrow graphical symbol can be used on its own. 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 directional indicator shall be $\geqslant$ 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.

NOTE This requirement can be achieved by using at least two battery power supplies in each single main vertical fire zone or by using fire-resistant cables, in accordance with IEC 60331, from the emergency switchboard to the input of the LLL system.

4.3.10 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.

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

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

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

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

4.3.15 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, which should include the wiring layout and a general arrangement;

— list of items depicted in the installation plan;

— description of installation;

— maintenance specifications.

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 Positioning of the LLL system and of the relevant signs in corridors, lobbies and stairways shall be such that persons can readily identify all escape routes and exits. Therefore, LLL is not intended for installation in public spaces, cabins, offices, toilets, changing rooms, beauty salons, gym rooms and in similar enclosed accommodation spaces and along open deck escape routes.

6.1.2 To prevent escaping persons from having to cross LLL strips, lighting need not be fitted along thresholds or across stairway landings, except as prescribed in 6.4.3. In order to provide a continuous and visible delineation of the escape route, LLL strips can be fitted along door thresholds of cabin doors. However, LLL systems need not be fitted along escape routes relevant to small isolated accommodation spaces not normally manned or manned by not more than two persons, such as small offices in provision or galley areas; see Figure G.1.

6.1.3 Lobbies used to separate accommodation spaces from stairways, other accommodation spaces or open decks need not be marked by LLL systems; see Figure G.3.

6.1.4 When fitted on bulkheads, the arrangement shall be such that the fire boundary of divisions is not impaired.

NOTE This does not imply a requirement to test LLL arrangements to Annex 1, Part 5, of the IMO's FTP Code[11], rather that the installation of the LLL arrangement through possibly cutting holes, removing/altering insulation, etc. on a deck or bulkhead forming part of a fire boundary does not have an impact on the effectiveness of that fire boundary.

6.1.5 LLL systems shall be fitted in accordance with the manufacturer's specification. When the LLL system is installed on decks, it shall be arranged in such a way that the LLL strips do not constitute a danger for the free circulation of people. Generally, LLL strips should be flush with the walking surface.

6.1.6 Combinations of PL and EP systems may be used. However, only one system shall be applied for each deck or stairway enclosure unless the deck or stairway enclosure is separated by normally closed doors or by doors which can be remotely closed in case of emergency; see Figure G.2 for an example. In addition, signs and directional indicators made of PL materials may be used with EP systems.

6.1.7 Escape routes in main vertical zones (MVZs) or watertight zones (WTZs) not containing accommodation spaces but that are adjacent to similar zones containing accommodation spaces and for which these constitute a means of escape need not be marked by LLL systems. When not adjacent to a WTZ or MVZ containing accommodation spaces, LLL shall be installed; see Figure G.4 for an example.

6.2 Corridors

6.2.1 In all corridors the visual effect of the LLL system shall be continuous, except where interrupted by intersections with other corridors, doors, or local enlargements or recesses, to provide a visible delineation along the escape routes. However, LLL loops around blocks of cabins or similar spaces are to be avoided; see Figure G.5 for an example of how an LLL strip loop is avoided. In way of local enlargements or recesses, the maximum interruption permitted in LLL systems shall not exceed 2 m; see Figure F.1.

6.2.2 The LLL shall be installed on at least one side of the corridor and, in general, the side of the corridor where the escape door or the door handle is located is the preferred installation side; see Figure G.6 for an example. In corridors more than 2 m wide, LLL 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. LLL may be installed at a distance greater than 150 mm from the bulkhead in way of recesses, or where the escape routes cross lobbies or landings exceeding 4 m in the line of escape. Steps in corridors shall comply with 6.4. See Figure F.2.

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

NOTE Graphical symbols suitable for directional indicators will be specified in a future International Standard (ISO 24409-2).

6.3 Doors

6.3.1 Doors which form part of the escape route (e.g. doors in corridors or in stairways), or doors leading to open decks, shall be marked by LLL in accordance with this International Standard.

6.3.2 Transparent doors along the escape route need not be marked if they are a swinging type without fixed means for their closure. Where a door is used in both directions as a primary or secondary means of escape (e.g. a door at the main vertical zone boundary) it shall be marked on both sides. To prevent confusion, only exit doors shall be marked with the LLL.

6.3.3 For doors which form part of the escape route, the LLL shall be installed at the door frame or at the door leaf up to the exit door handle, even when, for any practical reason, the LLL system is arranged in the corridor side opposite to the exit door handle. In addition, for double-leaf doors more than 2 m wide, LLL strips shall be fitted up to the height of the handles on the door frame. The LLL guidance shall not be installed across the threshold of escape route doors.

6.3.4 For doors which do not form part of the escape route, a floor-mounted LLL guidance line should cross the threshold of the door.

6.4 Stairways

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

6.4.2 The top and the bottom of each set of stairs shall be identified to show that there are no further steps.

6.4.3 Within the stairway enclosure, only the stairway needs to be marked except where the distance exceeds 2 m between the entry doors and the stairs, or between any sequential set of stairs; see Figure F.2. When that distance exceeds 2 m, the most direct route shall be marked along the bulkhead. Stairs shall be marked only in the direction of escape, i.e. the portion of the stairway not part of the means of escape from accommodation spaces need not be marked; see Figure G.7 for an example.

6.5 Signs and directional indicators

6.5.1 The display of any sign or directional indicators installed on board shall conform to the design principles given in ISO 24409-1.

6.5.2 Where signs, or directional indicators, are incorporated into LLL, they shall be of phosphorescent material or illuminated by lighting with the same performance as the LLL and incorporated with the LLL or in the lower 300 mm of the bulkhead. Where signs are incorporated into LLL strips, the dimensions of the signs shall match those of the LLL strips, but in no case shall the signs be less than 50 mm in height.

6.5.3 Directional arrows shall only be incorporated into LLL strips if they are located in dead-end corridors or in stairways to indicate the direction of escape. LLL strips shall be accompanied by directional assembly station signs at the assembly station deck and by directional lifeboat signs at the embarkation deck.

6.5.4 The colour of the background shall contrast with the prescribed colours of the signs and markings incorporated in LLL systems.

6.5.5 Exit signs shall be provided at all exits from the escape route and shall be installed at the same side as the door handle or operating mechanism. For double-leaf doors, an exit sign shall be installed at each leaf; see Figures G.8 and G.9 for examples. Where an exit door leads to an open deck with no alternative escape route, no exit sign shall be affixed to that door; see Figure G.10.

6.5.6 Sliding fire and watertight doors which are indicated by LLL shall be marked with signs adjacent to their opening handles to show the direction and means of opening. In addition, the primary opening handle on double-leaf doors shall be clearly marked.

6.5.7 Local control handles on watertight doors shall be marked with signs indicating the direction in which they must be moved.

6.5.8 Fire-fighting equipment signs (in accordance with ISO 24409) shall be of phosphorescent material of the same performance as the LLL and mounted on or near the equipment in order for the fire-fighting equipment to be located and identified.

6.6 Information placard

In all passenger cabins, a placard, also referred to as a mimic sign, explaining the purpose of the LLL system and the actions to be taken in case of reduced visibility due to smoke, shall be affixed to the inside of the cabin door. Such placards shall also contain a scale diagram showing the location of the cabin with respect to the ship, the deck, or of the main vertical zone, and the way to the two closest exit doors on the deck, or main vertical zone, which are the two designated means of escape from the cabin. See ISO 24409-1:—[1)], Annex A for examples of mimic signs.

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 certificates which state that the materials and components of PL and EP systems meet the requirements of Clause 4, which will become the basis for the checking of the system after its completion.

7.2 For PL systems, the ambient (excitation) lighting within the proposed installation area shall be capable of producing the required minimum illuminance at the surface for the type of phosphorescent material installed. After the installation, PL systems shall be tested at the place of use in accordance with Annex B at least twice on each deck and the measurements shall be recorded in accordance with Annex C. In addition, system measurements, including the number of tests to be done on each deck, shall be carried out under the

1) To be published.

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.

NOTE Currently, there are no suitable instruments available for on board testing of luminance intensity of point source LLL systems.

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.

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 decorations in the area are substantially changed. The performance of PL systems depends on the ambient lighting and, therefore, it is important that the lighting reflectors/diffusers to the normal lighting are kept clean. At the test location, measurements according to Annex B shall be taken of the illuminance at the surface of the phosphorescent material and the luminance of the phosphorescent material during the decay mode up to 60 min. Results shall be recorded using the form in Annex C and kept for inspection by the competent authority, if requested.

8.4 At least once per year LLL systems should be inspected and tested, where possible, on one deck in each main vertical zone. The system should be checked for operation and the light emitted from electroluminescent EP systems should be measured. Results shall be recorded and kept for inspection by the competent authority. The competent authority shall ensure that the complete system has been tested over a five-year period. See 7.2, note.

8.5 For PL systems, if the luminance for a particular reading does not meet the requirements of this International Standard, readings shall be taken in at least ten locations approximately 10 m apart in the specific area. If measured values are below the minimum specifications, the component shall be replaced or the illumination increased to meet the requirements of this International Standard.

Annex A
(normative)

Testing of phosphorescent low-location lighting materials

A.1 Purpose

This annex shall be used to assess the required excitation (3.8) for phosphorescent materials to comply with the required luminance (3.15) performance under controlled laboratory conditions.

A.2 Testing to ISO 16069

The testing shall be in accordance with ISO 16069:2004, Annex B with the following modifications.

A.2.1 Clause B.5

A.2.1.1 The test in B.5 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 illuminance shall be measured using the illuminance meter specified in B.4.1. The excitation duration shall be 24 h. 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.2.1.2 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 ± 0,1) lx.

A.2.1.3 When the intended or installed lamp differs from that specified in A.3.1.1, such lamp with luminaire shall be used in the test.

A.2.2 Subclause B.6.4

A.2.2.1 B.5 shall be repeated with different illuminances until the excitation illuminance is established in compliance with 4.2.1.

A.2.2.2 The measurement or calculation of time to reach 0,3 mcd/m^2 is not required.

A.2.3 Clause B.8

A.2.3.1 Report the minimum excitation illuminance for the declared light source that results in compliance with the luminance performance specification given in 4.2.1.

A.2.3.2 Report of the measurement or calculation of time to reach 0,3 mcd/m^2 is not required.

A.2.4 Clause B.9

A.2.4.1 Add the requirement for the minimum excitation illuminance for the tested light source that results in compliance with the luminance performance specification given in 4.2.1 to be marked on the product.

A.2.4.2 Declaration of the measurement or calculation of time to reach 0,3 mcd/m^2 is not required.

Annex B
(normative)

Assessment of installations on board

B.1 Purpose

The purpose of this annex is to ensure that installed phosphorescent materials will be 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 16069:2004, Annex C except that for the tests specified in C.3, the sources of illumination will be switched on for at least 24 h and for those specified in C.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 for an example) and stored for examination by the competent authority.

Annex C
(normative)

Measurement record for phosphorescent materials

Measurement record **Measurement in accordance with ISO 15370**	Record no. _____ Page ____ of _____

Name of ship: _____

Call sign: _____

Flag state: _____

Measurement number	**Product identification**	**Location of measurement (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 present): _____ Signature: _____ Date: _____

Annex D
(normative)

Width versus luminance

PL strips with the minimum requirements specified in 4.2.1 and 4.2.2 shall have a minimum width of 75 mm, except where the luminance of the phosphorescent material in low-location PL strips is increased according to the equation below, in which the minimum width may be reduced. Both luminance at 10 min and 60 min shall be met.

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

where

L' is the increased value of luminance;

L is the minimum luminance in accordance with 4.2.1;

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

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 will be 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 ± 2) °C. The relative humidity shall be (50 ± 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, calibrated to measure photopic luminance. The luminance meter shall be a telephotometer/non-contact luminance meter, and shall have the following minimum features:

E.4.1.1 spectral error: $f_1' \leqslant 8$ % (with f_1' as defined in CIE 069);

E.4.1.2 measuring range: 10^{-3} cd/m^2 to 45×10^3 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) approximate centre of the light line;

c) at any other positions close to power supply connections to the light line;

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 also 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 would be when measuring miniature incandescent lamps.

EXAMPLE 2 An example of measurement in the direction of peak intensity would be 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 also 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 equation:

$$l = 1\,000\ L^{*}A$$

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 International Standard;

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 slight 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;

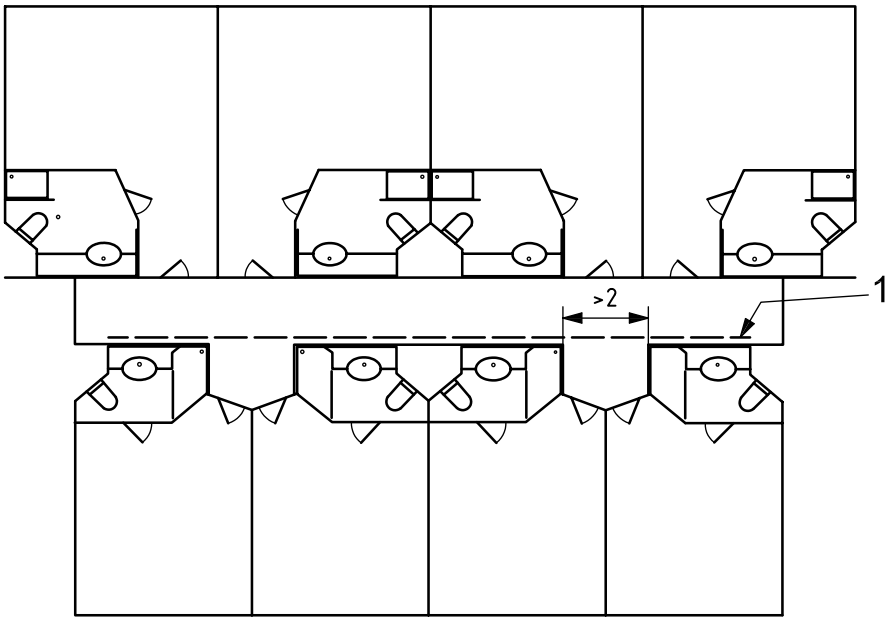
h) for point light sources, number of measurements and minimum luminous intensity value in mcd;

i) compliance checked against relevant minimum specifications given in this International Standard.

Annex F
(normative)

Corridor recess and stairway arrangement diagrams

Dimensions in metres

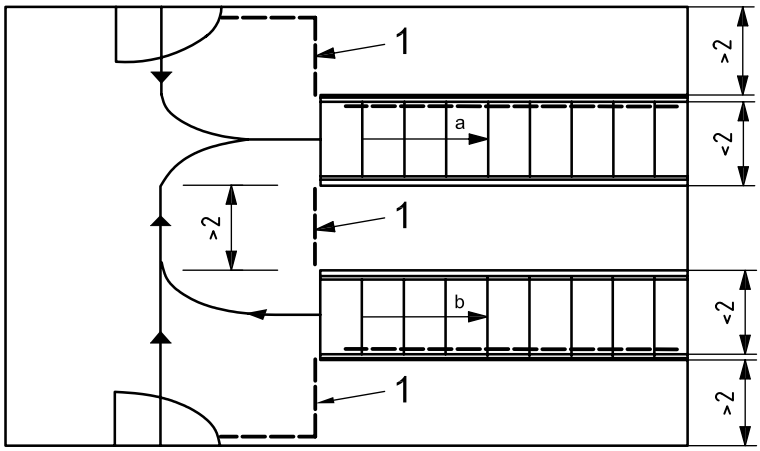


Key

1 light strips

Figure F.1 — Lighting arrangement for corridor recess

Dimensions in metres



Key

1 light strips

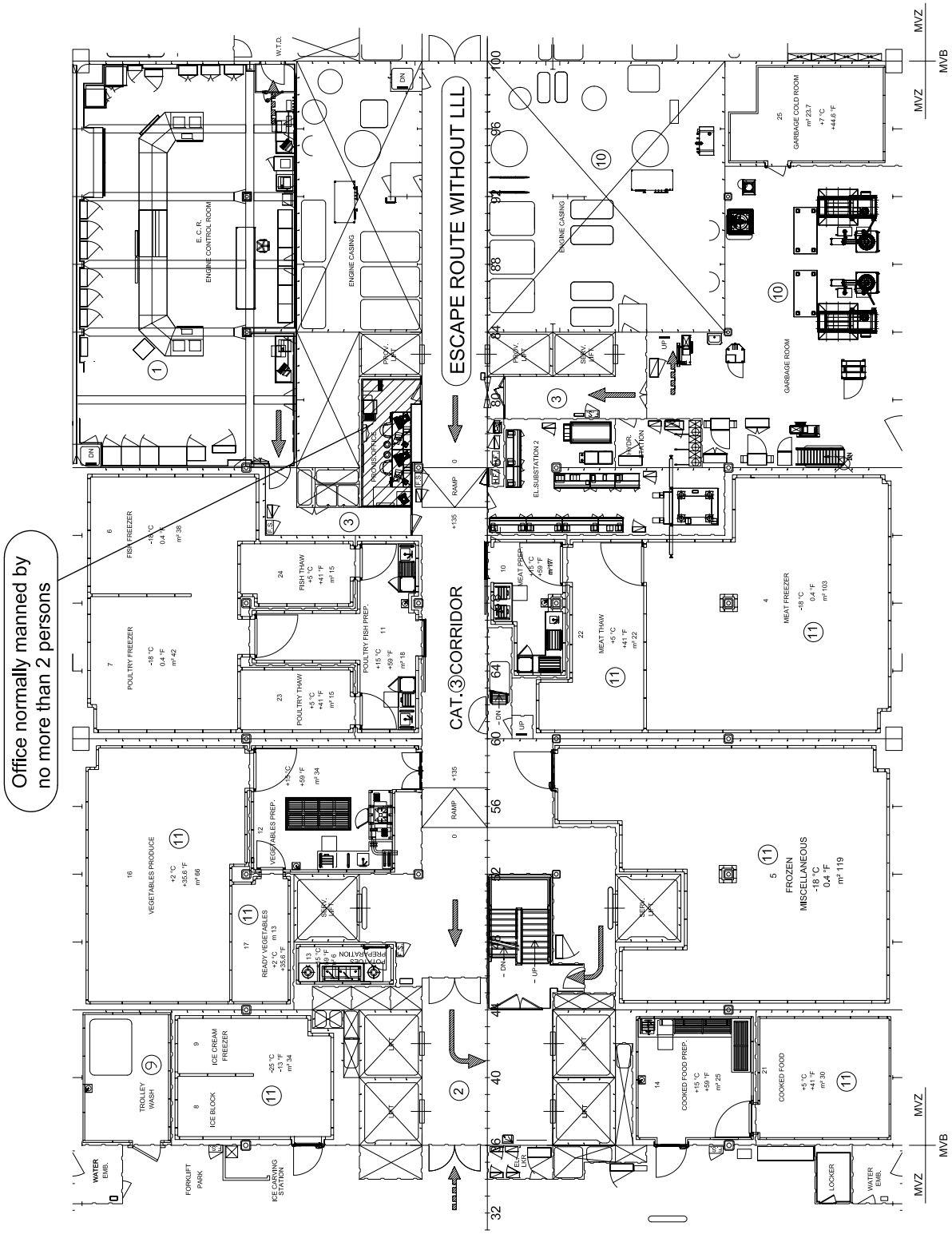
a Up.

b Down.

Figure F.2 — Lighting arrangement for stairway landings

Annex G
(informative)

LLL installation and arrangement examples



Key

Primary means of escape

Secondary means of escape

(#) Fire category of the space

Figure G.1 — Example relating to 6.1.2 of a small accommodation space or office within a main vertical zone occupied by service spaces only

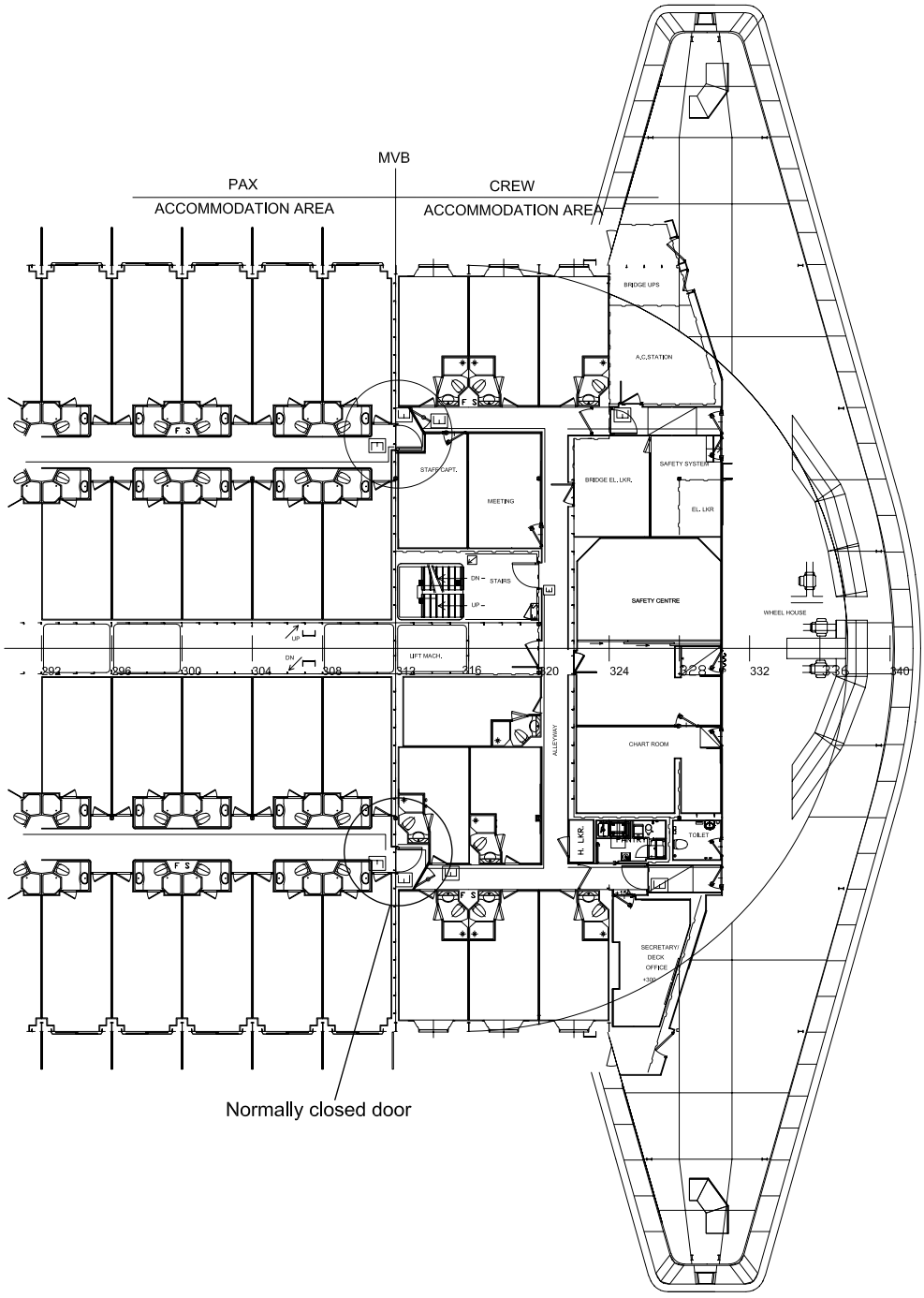
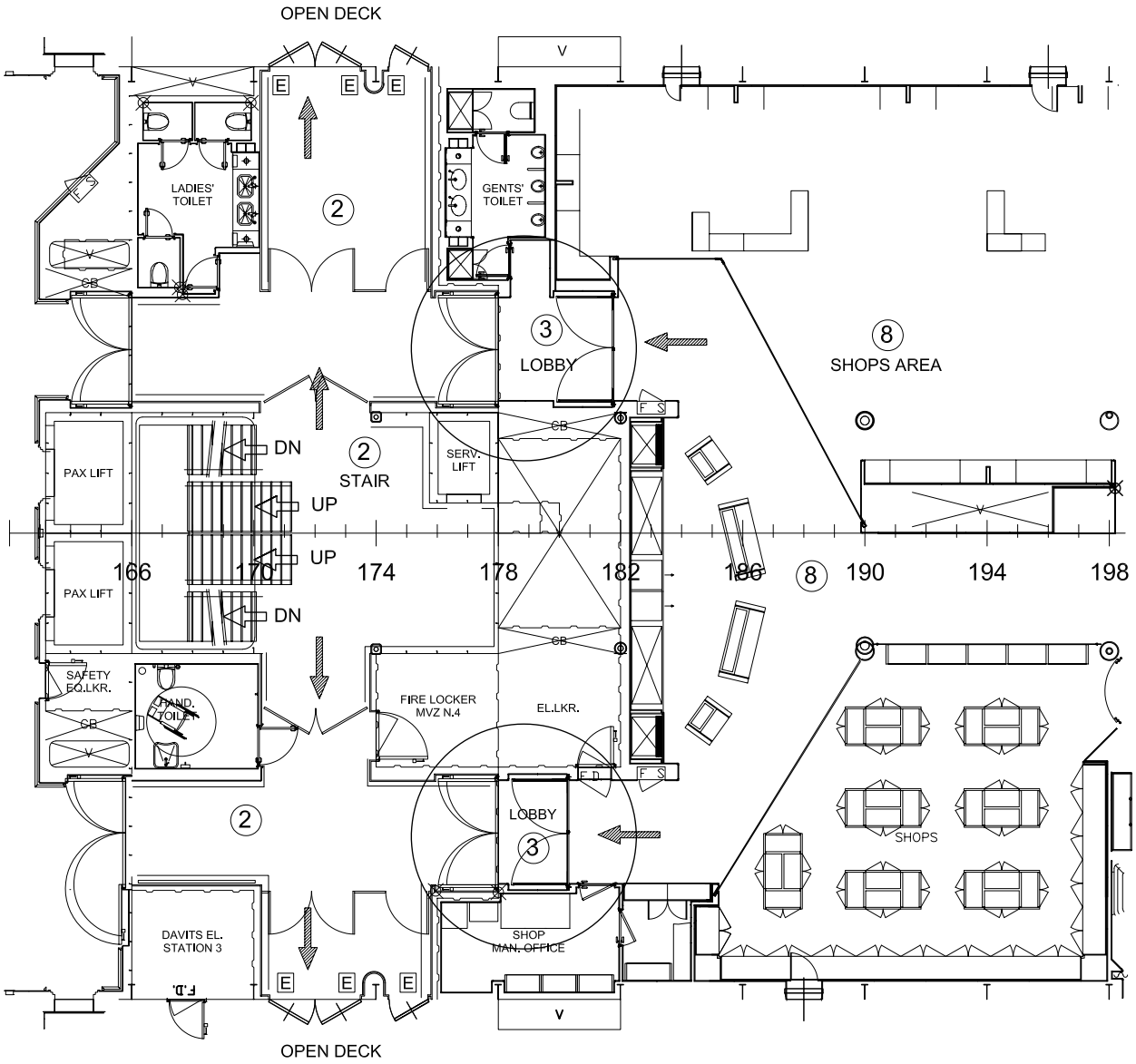


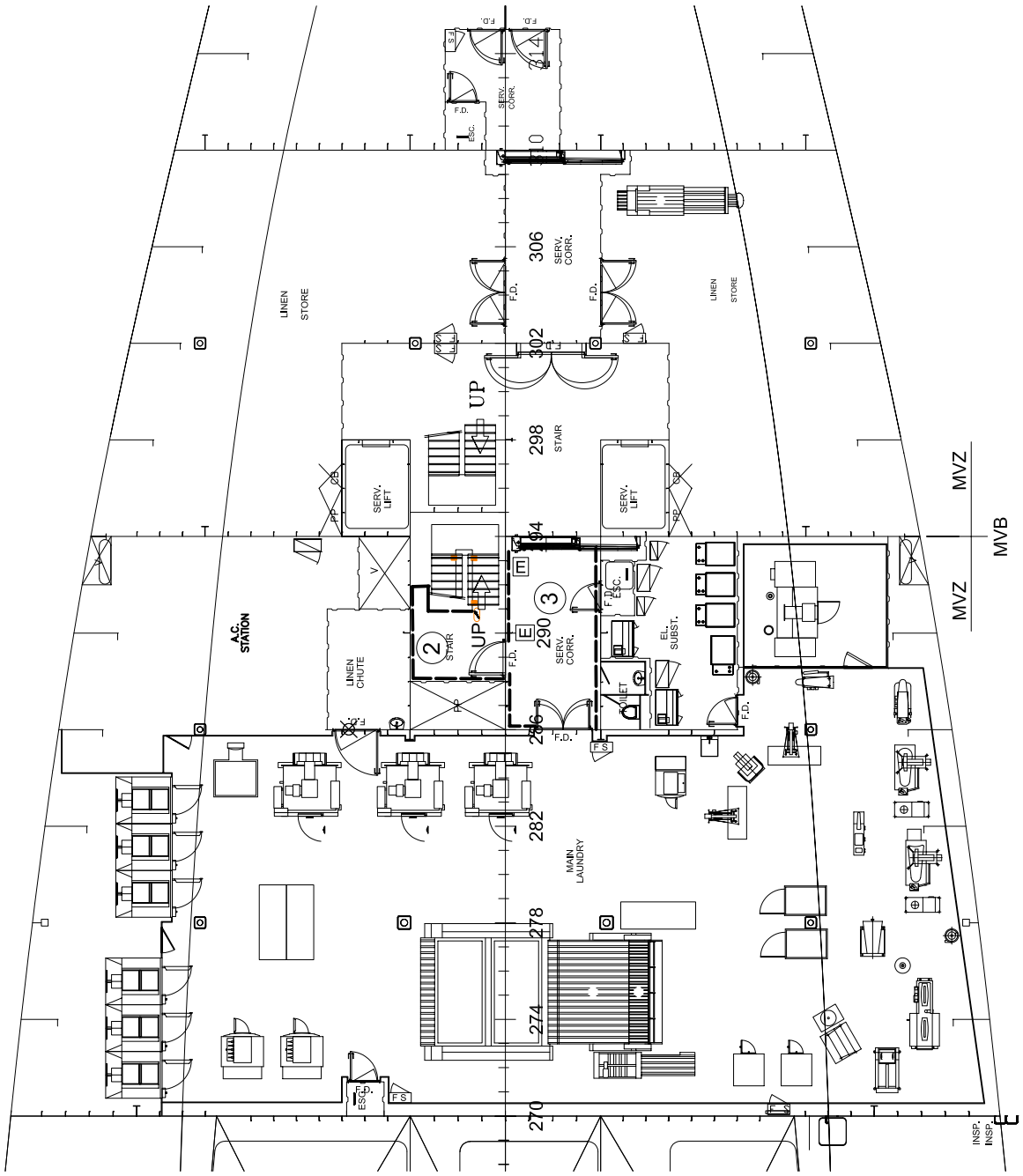
Figure G.2 — Example relating to 6.1.6, arrangement of EP and PL LLL systems on the same deck: phosphorescent lighting is shown in the crew accommodation spaces and becomes electrically powered lighting when passing into passenger accommodation spaces



Key

⟶	Primary means of escape
(#)	Fire category of the space
E	Exit sign

Figure G.3 — Example relating to 6.1.3 of a small isolated category 3 lobby without LLL installed

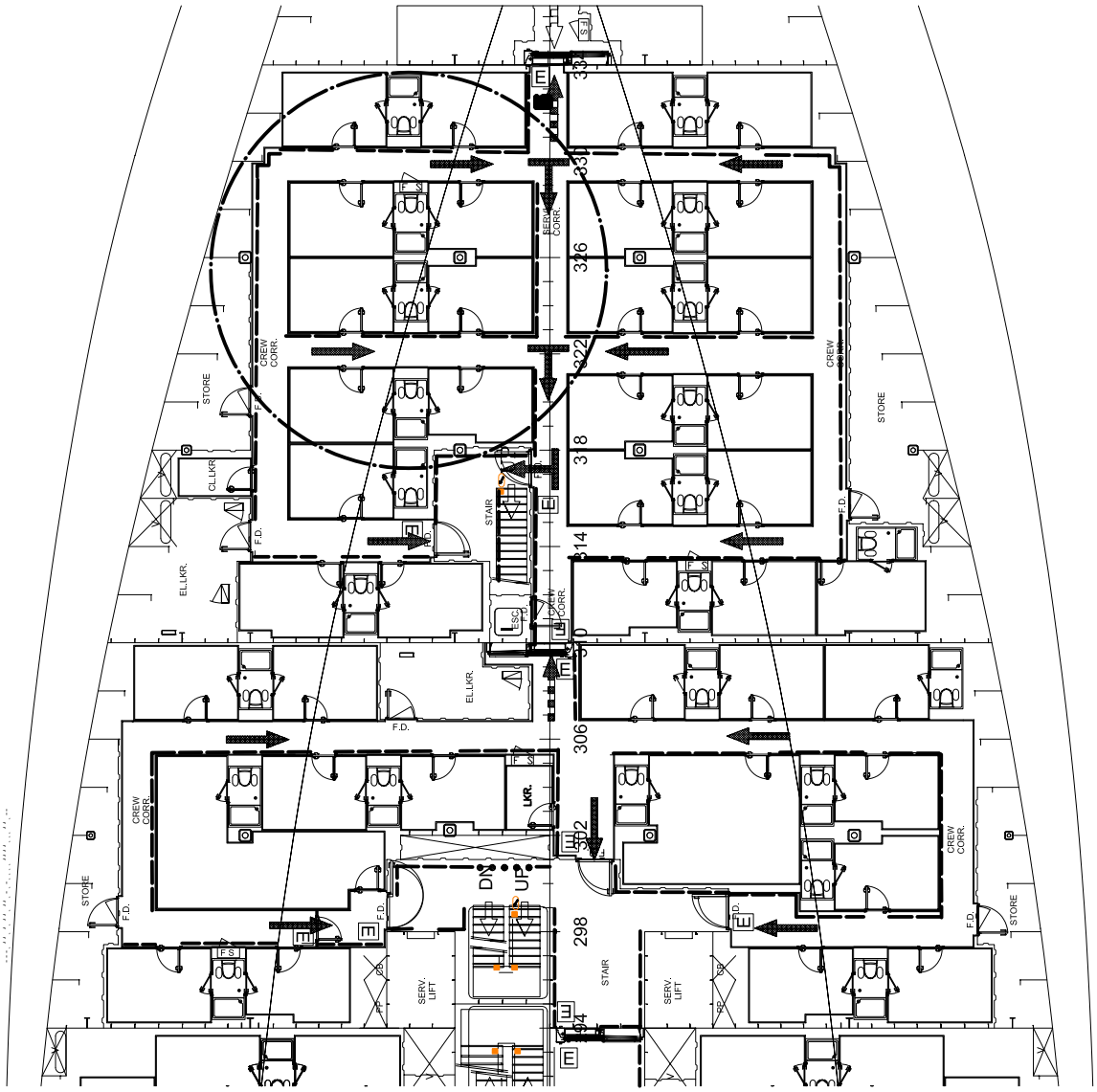


Key

(#) Fire category of the space

E Exit sign

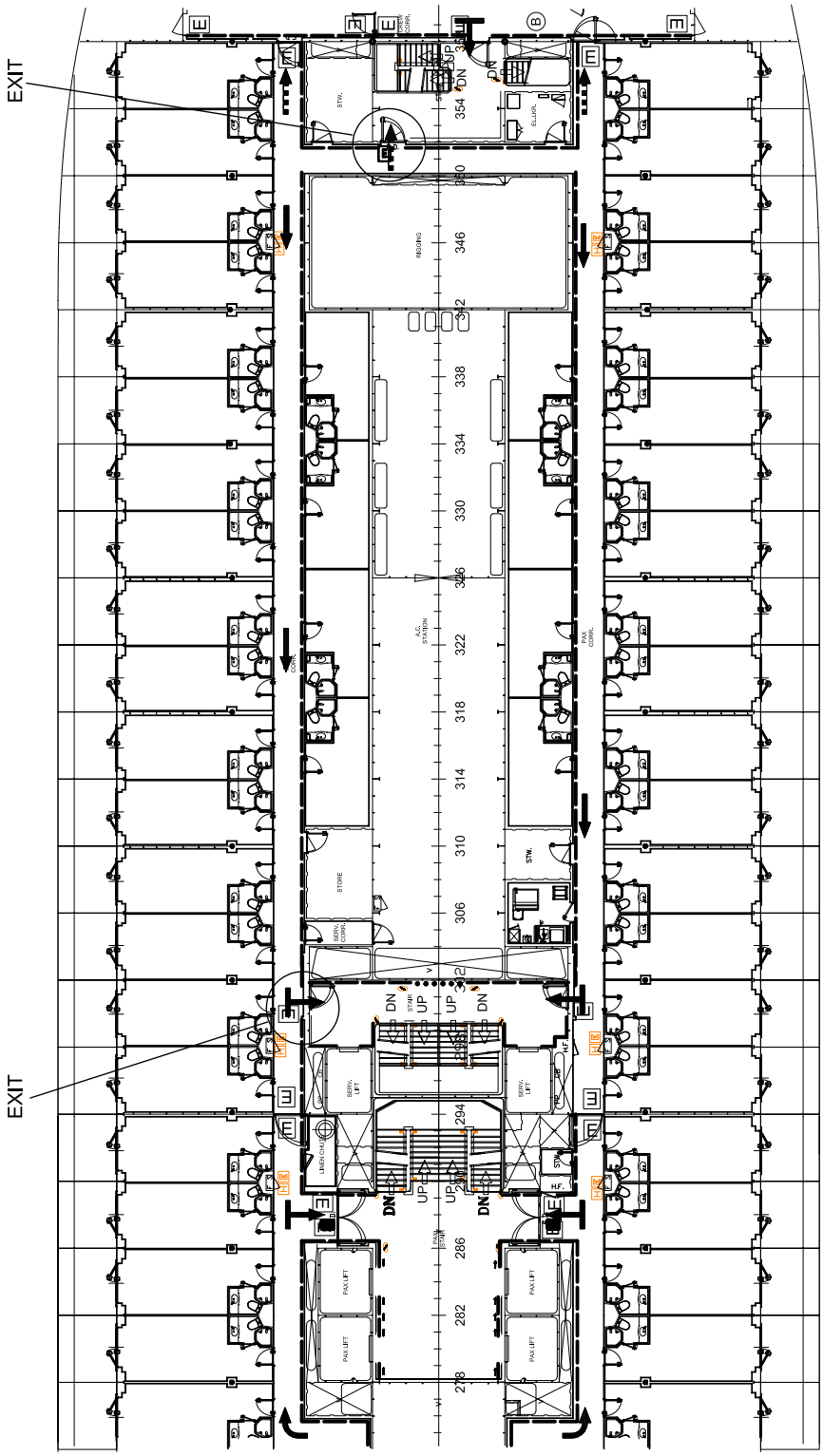
Figure G.4 — Example relating to 6.1.7 of an arrangement of LLL installed within a watertight zone which is not adjacent to an accommodation space



Key

——→	Primary means of escape
– – –→	Secondary means of escape
E	Exit sign

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



Key

Primary means of escape

Secondary means of escape

E Exit sign

Figure G.6 — Example relating to 6.2.2 of LLL strips located *only* on the exit side of a corridor

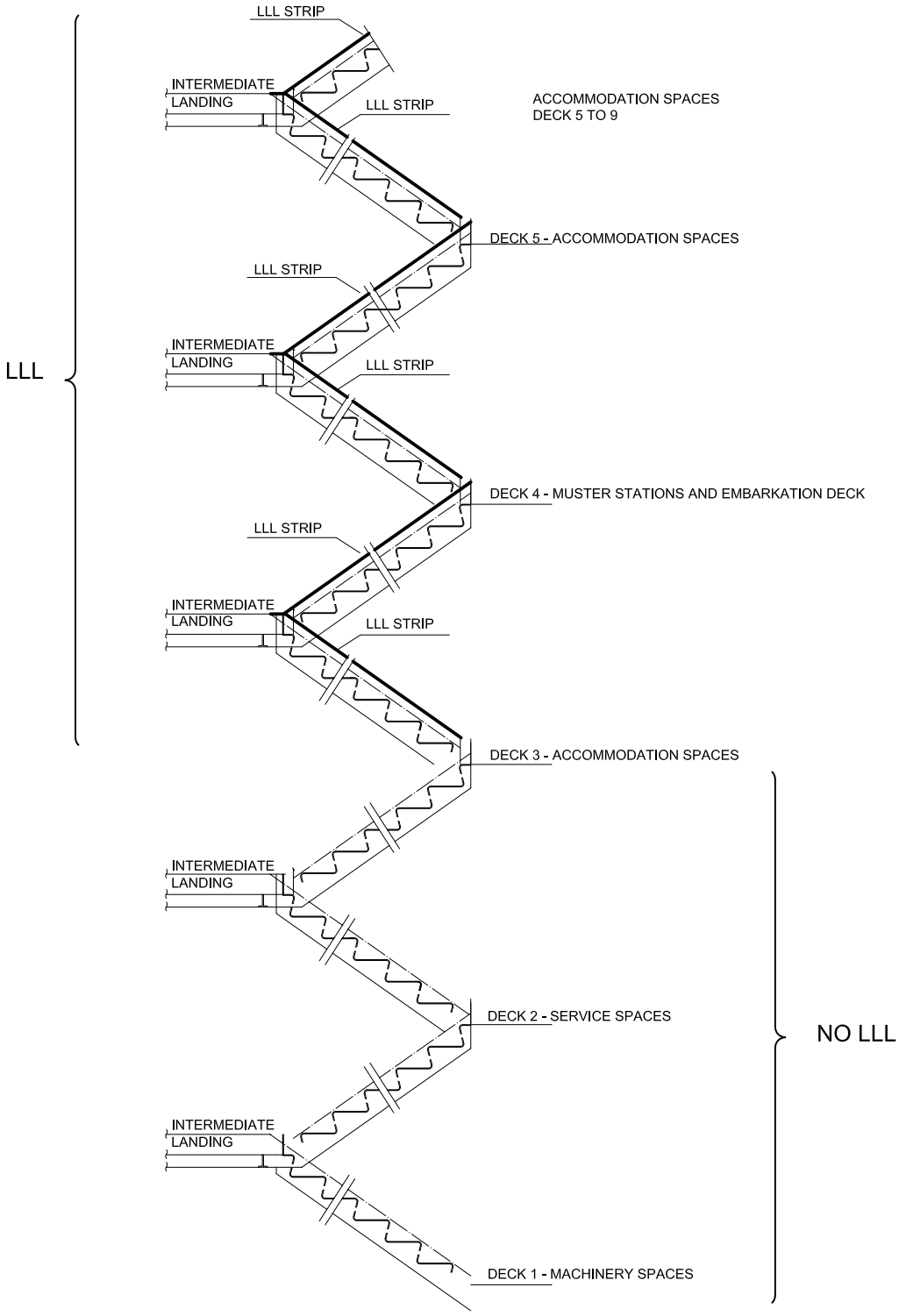
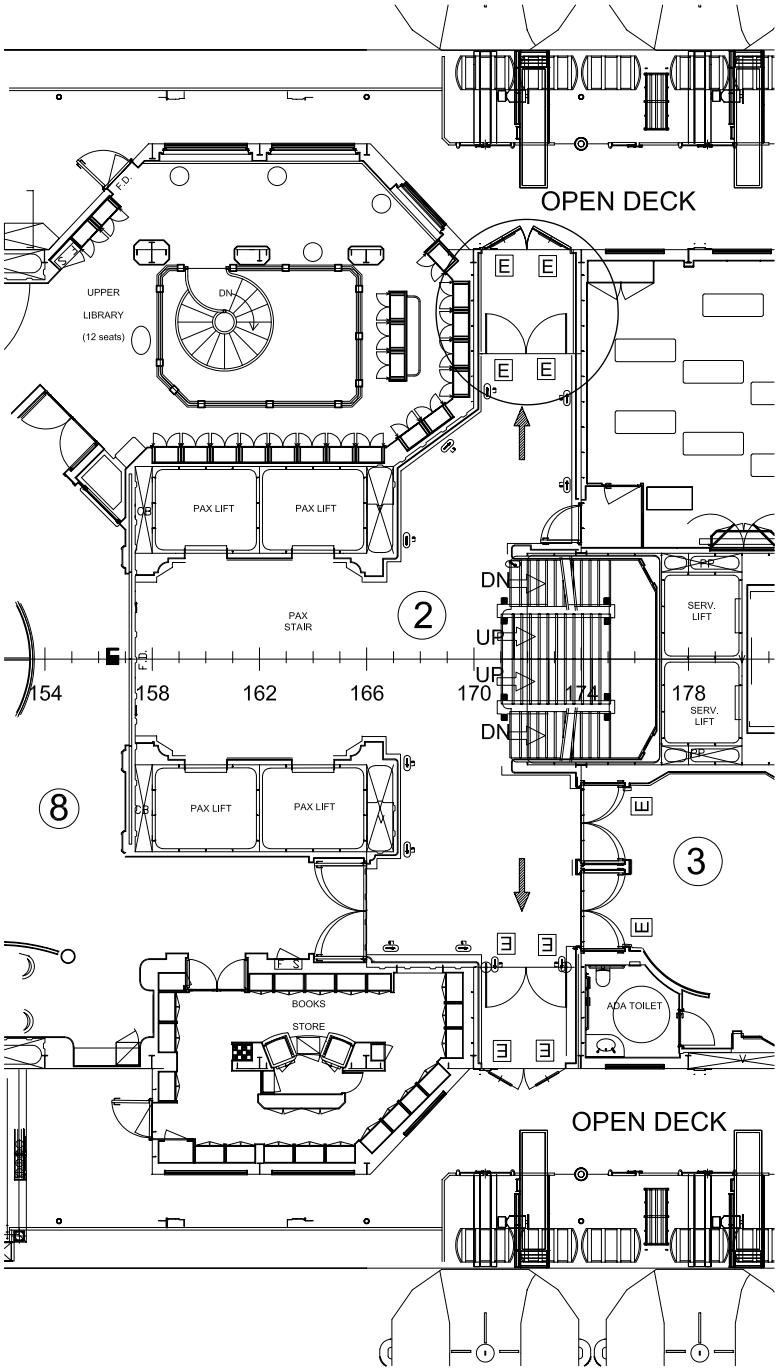


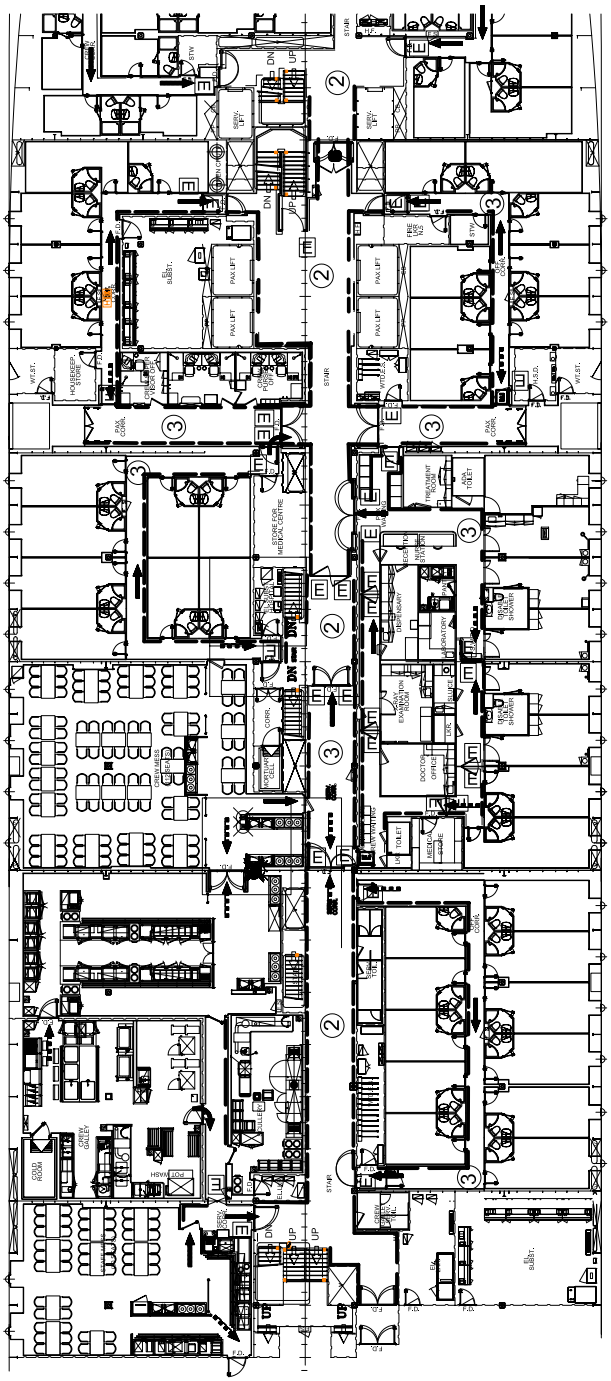
Figure G.7 — Example relating to 6.4.3 of a single stairway connecting machinery, service and accommodation spaces where LLL is installed and where it is not installed



Key

⟶	Primary means of escape
(#)	Fire category of the space
E	Exit sign

Figure G.8 — Example relating to 6.5.5 of the arrangement of two exit signs for double-leaf doors leading to an open deck



Key

——→	Primary means of escape
– – –→	Secondary means of escape
E	Exit sign
(#)	Fire category of the space

Figure G.9 — Example relating to 6.5.5 of the arrangement of two exit signs on double-leaf doors within a stair enclosure

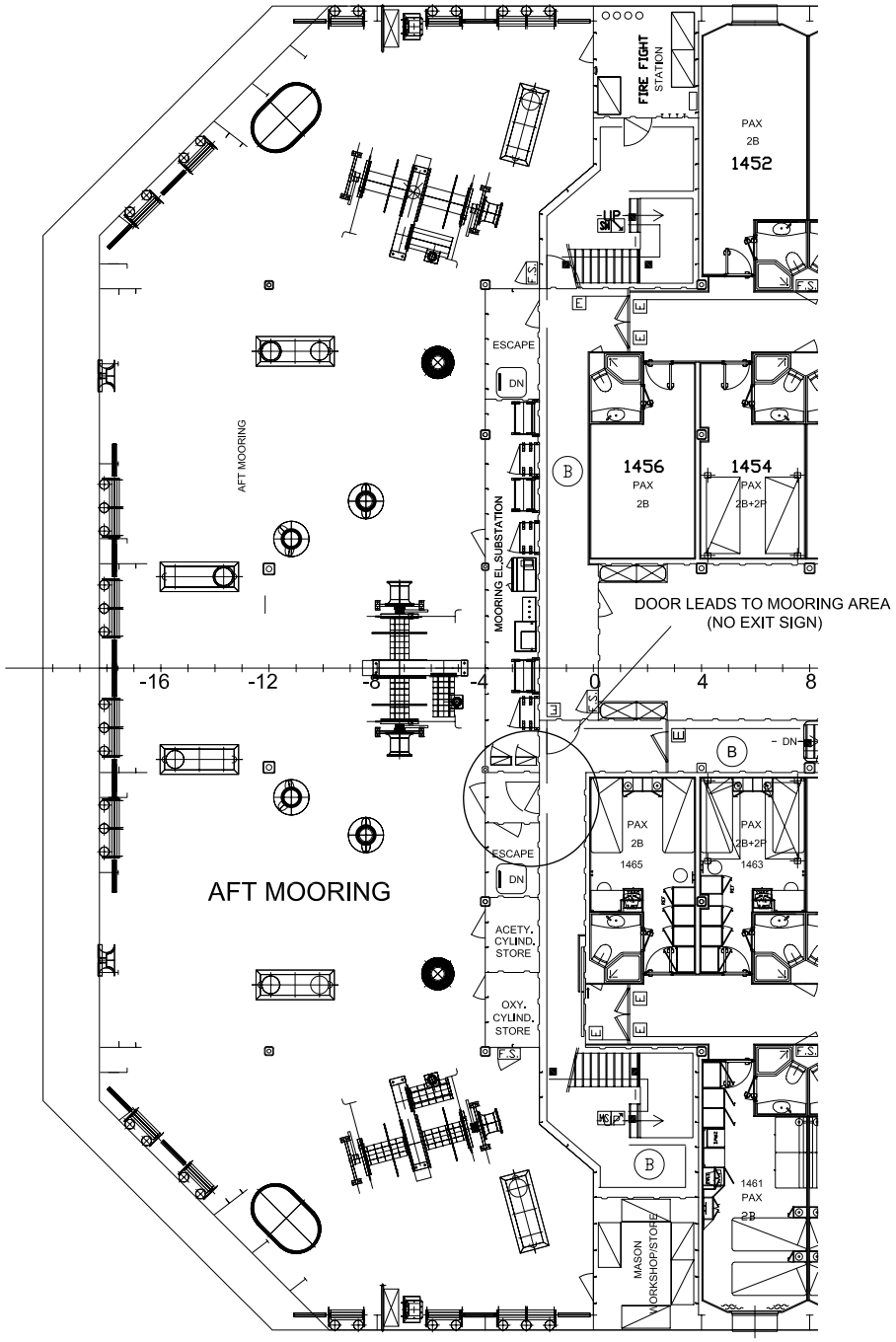


Figure G.10 — Example relating to 6.5.5 of an arrangement where a door is not marked with exit sign when leading to an open deck where no alternative of escape exists

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2) To be published.

3) Under preparation.

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