भारतीय मानक

Indian Standard

IS 16452 : 2018
ISO 16069 : 2004

रैखिक प्रतीक — सुरक्षा चिन्ह — सुरक्षा तरीकों का मार्गदर्शन सिस्टम (SWGS)

Graphical Symbols — Safety Signs — Safety Way Guidance Systems (SWGS)

ICS 01.080.10;01.080.20

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NATIONAL FOREWORD

This Indian Standard which is identical with ISO 16069 : 2004 ‘Graphical symbols — Safety signs — Safety way guidance systems (SWGS)’ issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Basic Standards Sectional Committee and approval of the Production and General Engineering Division Council.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminology and conventions are however not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words ‘International Standard’ appear referring to this standard, they should be read as ‘Indian Standard’.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In the adopted standard, reference appears to following International Standards for which Indian Standards also exist. The corresponding Indian Standards which is to be substituted in its place are listed below along with its degree of equivalence for the edition indicated

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 3864 – 1 : 2002 Graphical symbols — Safety colours and safety signs — Part 1 Design principles for safety signs and safety markings	IS 16449 (Part 1) : 2018 Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings	Identical to ISO 3864-1 : 2011
ISO 7010 Graphical symbols — Safety colours and safety signs — Registered safety signs	PGD 01 (1594) Graphical symbols — Safety colours and safety signs — Registered safety signs	Identical ISO 7010 : 2011

The technical committee has reviewed the provisions of the following International Standards referred in this adopted standard and has decided that they are acceptable for use in conjunction with this standard:

International Standard	*Title*
IEC 60050-845	International electro technical vocabulary (IEV) — Chapter 845: Lighting
IEC 60364-5-55	Electrical installations of buildings — Part 5-55 : Selection and erection of electrical equipment — Other equipment[1)]
IEC 60598-2-22	Luminaires — Part 2-22 : Particular requirements — Luminaires for emergency lighting
CIE Publication 15.2 : 1986	Colorimetry, 2nd ed.
CIE Publication 69 : 1987	Methods of characterizing luminance meters and luminance meters : Performance, characteristics and specification

[1)] This document and its separate amendments continue to be valid together with the consolidated version.

Indian Standard

GRAPHICAL SYMBOLS — SAFETY SIGNS — SAFETY WAY GUIDANCE SYSTEMS (SWGS)

IMPORTANT — The colours represented in the electronic file of this International Standard can be neither viewed on screen nor printed as true representations. Although the copies of this International Standard printed by ISO have been produced to correspond (with an acceptable tolerance as judged by the naked eye) to the requirements of ISO 3864-1, it is not intended that these printed copies be used for colour matching. Instead consult ISO 3864-1 which provides colorimetric and photometric properties together with, as a guideline, references from colour order systems.

1 Scope

This International Standard describes the principles governing the design and application of visual components used to create a safety way guidance system (SWGS).

This International Standard contains general principles valid both for electrically powered and for phosphorescent components. Special information which is related to the type of component is given to assist in defining the environment of use, choice of material, layout, installation and maintenance of SWGS.

This International Standard does not cover risk assessment. Applications with different risks to the occupants typically require different layouts and types of SWGS. The specific application and exact final design of SWGS is entrusted to those persons responsible for this task.

This International Standard also does not include the special considerations of possible tactile or audible components of SWGS, nor does it include requirements concerning the emergency escape route lighting, especially the design and application of emergency escape route lighting, unless illumination is used to mark safety equipment or special features of the escape route like the emergency exit doors or stairs.

This International Standard is intended, by collaboration and coordination, to be used by all other Technical Committees within ISO and IEC charged with developing SWGS for their specific requirements. This International Standard is not to be used for ships falling under regulations of the International Maritime Organization (IMO).

NOTE For example, some national regulations do not allow the use of the exit signs specified in this International Standard. These signs cannot therefore be used in those countries until such time as the relevant regulations are amended.

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*, corrected and reprinted in 2003

ISO 7010, *Graphical symbols — Safety colours and safety signs — Safety signs used in workplaces and public areas*

IEC 60050-845, *International electrotechnical vocabulary (IEV) — Chapter 845: Lighting*

IEC 60364-5-55, *Electrical installations of buildings — Part 5-55: Selection and erection of electrical equipment; — Other equipment* [1)]

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

CIE Publication 15.2:1986, *Colorimetry, 2nd ed.*

CIE Publication 69:1987, *Methods of characterizing illuminance meters and luminance meters: Performance, characteristics and specification*

3 Terms and definitions

For the purpose of this document, the terms and definitions in IEC 60050-845 and the following apply.

3.1
assembly area
designated safe area outside the occupied area where occupants are expected to assemble

NOTE Adapted from ISO 17724.

3.2
dead end corridor
corridor or part of a corridor from which there is only one route of escape

[ISO 17724]

3.3
emergency escape lighting
that part of emergency lighting that provides illumination for the safety of people leaving a location or attempting to terminate a potentially dangerous process before doing so

[ISO 17724]

3.4
emergency lighting
lighting provided for use when the supply to the normal lighting fails

[ISO 17724]

3.5
factor of distance
z
relationship between the height (h) of a sign and observation distance (l), used to determine observation distances of signs

$$z = \frac{l}{h}$$

[ISO 17724]

3.6
guidance line
highly visible linear markers forming part of the safety way guidance system provided to clearly delineate an escape route or define an escape path through an open area

NOTE Adapted from ISO 17724.

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1) This document and its separate amendments continue to be valid together with the consolidated version.

3.7
high location
⟨safety way guidance system⟩ installation position at ceiling level or no less than 1,8 m above floor level for safety signs and other safety way guidance components

[ISO 17724]

3.8
intermediate location
⟨safety way guidance system⟩ installation position between a low location and a high location especially at eye level for safety signs and other safety way guidance components

[ISO 17724]

3.9
low location
⟨safety way guidance system⟩ installation position at floor level or at a short distance above floor level for safety signs and other safety way guidance components

[ISO 17724]

3.10
marking
⟨safety way guidance system⟩ method of highlighting and identifying specific building components or equipment by means of light emitting material fixed to building components or illumination provided by separate light sources

3.11
observation distance
l
greatest distance from which a sign is legible and conspicuous

[ISO 17724]

3.12
period of use
⟨safety way guidance system⟩ time over which the safety way guidance system is expected to be operational

[ISO 17724]

3.13
phosphorescence
photoluminescence delayed by storage of energy in an intermediate energy level

[ISO 17724]

3.14
safety sign
sign which gives a general safety message, obtained by a combination of colour and geometric shape and which, by the addition of a graphical symbol, gives a particular safety message

[ISO 17724]

3.15
safety way guidance system
SWGS
system to provide conspicuous and unambiguous information and sufficient visual cues to enable people to evacuate an occupied area in an emergency along a specified escape route by using a comprehensive arrangement of visual components, signs and markings

[ISO 17724]

3.16
supplementary sign
sign that is supportive of another sign and the main purpose of which is to provide additional clarification

[ISO 17724]

4 Planning a SWGS

4.1 General

Since SWGS are complex and can consist of a variety of possible components, steps shall be taken at the planning stage to determine appropriate designs.

The SWGS shall take into account the following factors:

— anticipated number of people who will use the escape route;

— demographic characteristics of the people occupying the building;

— type of activity being carried out in the occupied area;

— expected delay time for the commencement of the evacuation;

— type, size, occupation and location of the building;

— complexity of the escape routes and the possibility for confusion at changes of direction and floor level;

— specific hazards likely to be encountered;

— specific risk conditions in which use of the escape routes will be necessary;

— any existing emergency escape route features, such as floor plans;

— the possible combinations of components in SWGS to assist evacuation under specific risk conditions such as presence of diffused or stratified smoke, earthquakes, and presence of obstacles or specific crowding conditions.

NOTE Visual elements in smoke will be visible at greater observation distances if the luminance or the intensity is higher. Background illumination in smoke will tend to obscure many elements and render visibility poor. Transilluminated elements emitting light from the surface will be more visible for these reasons.

4.2 Selection of components

The final selection of components for SWGS shall be influenced by the following factors:

— the need for both high location and low location components, which are the primary visual components of a SWGS;

NOTE 1 The general design principle is that safety way guidance elements will be more conspicuous in peripheral vision and that signs and information are more legible and understandable in direct line of sight when luminance, luminance contrast and size are increased.

— the minimum photometric properties and sizes for components specified in this International Standard.

NOTE 2 Conspicuity, recognizability and legibility will increase with the size, luminance or intensity and frequency of the components under all conditions.

— the need for phosphorescent components to be exposed to an illumination source in order to function;

— the need for an emergency back-up power supply that automatically powers electrically operated components, such as lighting and signs, in the event of a failure of the normal power source in order to function;

— the need for high-located escape route signs to be operational at all times when the area is occupied and also in the event of a failure of the normal power supply;

— the need for the minimum requirements of low and intermediate located escape route signs and guidance lines to be operational in a dark surrounding for a period of use after failure of illumination in the case of phosphorescent components and after a failure of the power supply of the general lighting in the case of electrically powered components.

SWGS according to this International Standard should be effective for at least 60 min considerably exceeding the normally expected evacuation time. For most buildings, a SWGS can be required to meet longer periods of use such as the duration requirements of emergency escape route lighting.

5 Basic principles for the design of SWGS

5.1 Design objectives

5.1.1 General

SWGS shall provide consistent and coherent information to occupants so that they can be evacuated in an orderly manner from any place within an occupied area to an assembly area.

Various components may be employed to communicate safety way guidance information as part of SWGS such as those given in Clauses 5, 6 and 7.

NOTE SWGS is intended to be installed throughout a building but may be restricted to certain parts of the escape route where supported by a risk analysis.

5.1.2 Continuity

SWGS components shall be arranged as continuously and unbroken as possible from within the occupied area to the assembly area. Way guidance lines shall be used to provide a visually continuous, conspicuous line from within the building to the final point of the escape route and shall preferably be a complete delineation of the boundaries of the escape route.

5.1.3 Visual reinforcement

Safety signs and directional indicators shall be placed at intervals sufficient to provide consistency and continuity of information.

The frequency and visual reinforcement of directional signs at high, intermediate and low location shall be determined by the risk assessment.

Directional signs positioned at low location shall be incorporated in, or be close to, the way guidance lines. Wherever practical, directional signs located at high and intermediary level shall be repeated at low location.

5.1.4 Location

Low location shall be the principal position for guidance lines giving perspective over distances up to 30 m as well as directional signs up to observation distances of 5 m.

Additional escape route marking and guidance lines may be placed at up to 1,20 m from the floor to provide visual reinforcement and to assist in the identification of guide rails, handrails or other architectural elements along the escape route. This adds further to the perspective of the escape route over medium observation distances of approximately 10 m to 20 m.

High-located safety signs and directional indicators shall be located to ensure visual reinforcement at medium to long observation distances of between approximately 10 m and 30 m and to indicate change of escape route direction or intermediate and final destinations on the escape route and shall be installed at all emergency exit doors along the escape route and at the final exit.

The visual field between 1,20 m and 1,80 m on the walls of the escape route may be used for visually reinforcing directional information for medium observation distances of approximately 10 m to 20 m.

5.1.5 Visibility and colour

The colour, shape and graphical symbols of safety signs shall conform to ISO 3864-1 and ISO 7010. All components of an activated SWGS shall have a luminance contrast to the surrounding of $\geqslant 3$ under all designed operating conditions.

All components of a SWGS shall use the appropriate safety colour green or white or contrast colour in accordance with ISO 3864-1.

NOTE 1 For low and intermediate located components with luminances less than 2 cd/m^2 see ISO 3864-1:2002, Clause 10, Note 2.

NOTE 2 For specific colours of electrical and non-electrical components, see Clauses 6 and 7.

5.1.6 Destination

Final and intermediary destinations along the escape route such as emergency exit doors on the route and assembly/refuge areas shall be given specific emphasis by using SWGS components.

5.1.7 Avoidance of confusion at decision points

SWGS shall avoid the presentation to occupants of alternative routes to follow which might create uncertainty and confusion during evacuation. In the case of equal distances between alternative routes then, occupants shall be encouraged to move either way by the location of directional signs some distance away from the equidistant point.

5.1.8 Dead ends and changes of direction

The frequency of directional signs, at high, intermediate and low location, shall be increased in dead end areas to progress occupants away from the dead end towards the escape route.

NOTE A typical layout of a SWGS in dead ends is given in Figure A.11.

5.1.9 Minimization of potentially competing or confusing information in the visual field on escape routes

Public information signs and general building facilities signs shall be subordinate and of distinctively different colour to components of the SWGS along designated escape routes.

NOTE This can be achieved by increasing size, frequency or luminance of safety way guidance components or similarly reducing size or luminance of potentially competing information.

5.1.10 Multi-storey buildings

SWGS in multi-storey buildings shall include a floor numbering system on all stairwells. On each floor or main corridor leading to emergency exits there shall be a floor plan to assist orientation.

5.1.11 Signs for marking the location of fire-fighting and emergency equipment

The location of fire-fighting and emergency equipment along and adjacent to escape routes shall be marked with the appropriate safety signs as given in ISO 3864-1 and ISO 7010. Arrows shall not be used for the marking of the location of such equipment along or adjacent to escape routes.

The areas around fire-fighting and emergency equipment may also be marked with the appropriate safety marking in accordance with ISO 3864-1.

NOTE These signs and markings provide supplementary visual orientation cues to occupants.

5.2 Consistent and unambiguous use of escape route signs and directional indicators

5.2.1 General

SWGS designed to this International Standard shall use the safety signs specified in ISO 3864-1 and ISO 7010 for emergency exit and the use of the appropriate supplementary arrow sign for directional purposes (see Figure 1).

All exit signs at emergency exit doors on the escape route shall be used with an arrow pointing upward, meaning “straight on from here”.

NOTE 1 A supplementary sign with text will make the sign more conspicuous.

NOTE 2 The family of directional signs to be used in SWGS and their safety meaning are called “escape route signs”.

NOTE 3 Escape route signs positioned at low and intermediate location may be substituted by directional indicators using the graphical symbol of ISO 7010 but not all the colour requirements of ISO 3864-1. Examples are given in Figure 1 and Figure 2.

Meaning as viewed from in front of the sign	Using graphical symbol and supplementary arrow only	Example using supplementary text	Example using dual language supplementary text
Proceed down to the right (indicating change of level).			
a) Proceed up to the right (indicating change of level). b) Proceed forward and across to the right from here when suspended within an open area.			
Proceed down to the left (indicating change of level).			
a) Proceed up to the left (indicating change of level). b) Proceed forward and across to the left from here when suspended within an open area.			
a) Proceed forward from here (indicating direction of travel). b) Proceed forward and through from here; when sign is sited above door (indicating direction of travel). c) Proceed forward and up from here (indicating change of level).			
Proceed to the right from here (indicating direction of travel).			
Proceed to the left from here (indicating direction of travel).			
Proceed down from here (indicating direction of travel).			

Figure 1 — Examples of escape route signs or directional indicators to be used with or without a supplementary sign with text

Figure 2 — Example of a directional indicator for floor marking

5.2.2 Consistency of use

The direction given by the arrow is used exclusively to indicate the direction of movement of evacuation. Directional “escape route signs” (such as those given as examples in Figure 1 and Figure 2) shall be used exclusively to indicate the direction to be followed by occupants. The graphical symbol in a directional sign at high, intermediate or low location shall always be used in combination with the appropriate arrow.

5.2.3 Installed position

The exact meaning of a directional sign is dependant on the installed position. Particular attention shall be paid to changes of direction, the signing at intermediate doors through which occupants pass along the escape route and for escape routes requiring movement to an upper level in a building.

5.3 Principles of layout using the different visual components

5.3.1 Escape route signs and directional indicators to the nearest exit or safe area

5.3.1.1 General

During the expected period of use, escape route signs and directional indicators shall provide clear, conspicuous and unambiguous directional information visible from all possible locations in the escape route and in adjacent areas along the escape route. These escape route signs and directional indicators shall continue to a safe area or assembly area. To avoid confusion and hesitation, the visual presentation of the guidance lines shall be as continuous as possible and the number of break points shall be minimized.

The components of the guidance system shall be positioned in such a way as to help avoid possible hazards for the occupants.

NOTE The technical design parameters of the individual components are dealt with in Clause 6 for electrically powered systems and in Clause 7 for phosphorescent systems.

5.3.1.2 Escape route signs

High-located exit signs shall be provided at all exits intended to be used in an emergency and where necessary along escape routes to indicate the direction to the next exit, emergency exit, safe area or assembly area as well as to indicate the position of the escape route for occupants in adjacent areas.

Where direct sight of an emergency exit sign is not possible within the observation distance, a series of exit direction signs shall be provided to assist progression toward the emergency exit. For escape route signs in intermediate location the maximum distance between these signs shall be 10 m.

5.3.1.3 Guidance lines and accompanying directional indicators

Guidance lines shall be realized by:

— point sources: sources with a light emitting area $< 100\ mm^2$ which are arranged in a chain with intervals of at most 0,2 m;

— discrete luminaires: sources with a light emitting area of at least 50 mm × 100 mm which are arranged in a chain with spaces of a maximum distance given in 6.2.3 between luminaires;

— line sources of different sizes and luminances: uninterrupted guidance line.

Low-located guidance lines with directional information shall be provided in addition to high-located escape route signs along escape routes to clearly delineate the escape route. The guidance lines shall be as continuous as possible. No break shall exceed 0,2 m, unless there are doors along the escape route, in which case the wall or floor guidance line may be interrupted with a maximum break of 1 m or the lines shall be continued on the floor in front of the door. Door leafs shall never be marked with a guidance line.

Wall guidance lines which are interrupted by intersecting corridors should be continued by using floor lines or by continuing the guidance line on the opposite side of the corridor starting the guidance line with directional signs.

The maximum height of low-located wall guidance lines above floor level shall be 0,4 m. If a low-located wall guidance line is interrupted, it may be continued at floor level for the duration of that interruption.

Directional indicators, as shown in Figure 1 and Figure 2, shall be positioned at maximum intervals of every 5 m and at critical points such as junctions and changes of direction, along the length of the guidance line.

Directional indicators can be directly on the wall, when the floor guidance line is not more than 0,5 m from the wall. The position of the directional indicator shall be in this case not higher than 0,4 m from the floor.

5.3.1.4 Marking of the boundaries of the escape route

It is preferable to provide both sides of the escape route with guidance lines. On escape routes up to 2 m in width it may be sufficient to have only one guidance line. This line may be positioned either on the floor or on the wall.

In rooms or open areas escape routes shall be marked on both sides with guidance lines or the guidance lines shall be used to define a travel path through that area.

5.3.1.5 Marking of stairs, ramps and ladders

The guidance line shall indicate by wall marking the outline or pitchline of stairs, single steps or ramps. The beginning, continuation and end of change of level shall be clearly marked. The horizontal portion of steps shall be marked or illuminated and additionally it is recommended to mark or illuminate the vertical portion.

A guidance line should be installed on the handrail and central supports.

5.3.2 Marking of emergency exit doors

Emergency exit doors in the course of escape routes and final emergency exit doors shall be marked.

NOTE This can be done by marking the doorframe, the door handle, and other opening devices of the door or by illumination of the exit.

The area of the door opening mechanism and the method and direction of operation shall be clearly identified.

If a directional indicator is incorporated in a door marking system it shall be positioned at the height of the door-opening device.

5.3.3 Marking of fire-fighting, emergency and safety equipment and alarm-initiating devices

Fire-fighting equipment safety signs and emergency equipment safety signs conforming to ISO 7010 shall be placed at the location of each piece of equipment. All communication devices intended for use in an emergency shall be made conspicuous by the use of the appropriate safety sign and shall be placed at the location of each call point and telephone. The area behind the equipment shall be marked or illuminated.

5.3.4 Identification of particular hazards along and adjacent to the escape route

Warning signs shall be placed to identify the nature and location of hazards such as location of electrical equipment, and location of pressure vessels.

Obstacles in escape routes such as wall projections, pillars and obstructing fitments shall be marked by the appropriate warning marking in accordance with ISO 3864-1.

The guidance line should lead occupants around obstacles and any protruding architectural features.

5.3.5 Identification of assembly areas and safe areas at the end of the escape route

Areas intended to be used for the assembly of occupants shall be provided with the appropriate safe condition safety sign in accordance with ISO 3864-1 and ISO 7010. Directional signs shall lead occupants from the exit, fire exit and emergency exits to the assembly area.

5.3.6 Plans

A floor plan or plans shall be provided on each floor at a prominent place to give information for the orientation of occupants and to indicate the escape routes and the route to the nearest emergency exit.

Floor plans shall be marked or illuminated.

5.3.7 Marking of escape routes for the specific use of disabled persons

If there are escape routes designated for the specific use of disabled persons, they shall be specifically signed as such. If refuges and equipment for the assistance of persons with special needs are provided then these shall be specifically signed as such.

6 Specific requirements for electrically powered components

6.1 General

SWGS which use electrically powered components shall be provided with an alternative source of power in addition to the main power supply in case of failure of the main power supply. The alternative source of power shall be capable of powering all electrical components of the SWGS for at least the duration of the expected period of use, so that the components remain visible. Furthermore the SWGS using electrically powered components shall be capable of being activated in all risk situations defined by the risk assessments.

When the SWGS is activated, the minimum photometric requirements given in 6.2 should be reached in 5 s.

NOTE The basis of the design of a SWGS with electrically powered components is to maintain good visibility of all visual components within the escape route and adjacent areas. This visibility depends on the lighting properties, position and geometry of the components.

SWGS using the principles of this International Standard may contain additional flashing lights, additional (alarm-) sound signals, dynamic systems with “moving effects” and remote controlled escape route signs giving appropriate information depending upon the emergency situation.

6.2 Requirements for guidance lines, high-located safety signs and directional indicators

6.2.1 Guidance lines made by point sources and accompanying directional indicators

The spacing between the point sources shall be $\leqslant$ 200 mm.

The luminous intensity of point sources used for guidance lines shall be $\geqslant$ 30 mcd. If smoke penetration and/or the requirement to be conspicuous in bright surroundings are the prime consideration, the luminous intensity shall be $\geqslant$ 100 mcd.

NOTE 1 The luminous intensity of a point source can be produced by a cluster of point sources.

Directional indicators shall be placed adjacent to or integrated in the guidance lines.

Directional indicators made of luminance sources shall use graphical symbols in accordance with ISO 3864-1 (see Figure 1) or with modified geometry if on the floor (see Figure 2). The minimum height of the directional indicator shall be 30 mm. The minimum luminance of the green colour shall be 20 cd/m^2. 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 2 The black contrast colour automatically provides a contrast to the green colour.

Directional indicators made of point sources may be used to outline the graphical symbol of the directional indicators in accordance with ISO 3864-1 (see Figure 1), or with a modified geometry if on the floor (see Figure 2). The colour of the outlining point sources shall be green. The minimum height of the graphical symbols shall be 80 mm. 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 $\geqslant$ 30 mcd. If smoke penetration and/or the requirement to be conspicuous in bright surrounding are the prime consideration, the luminous intensity shall be $\geqslant$ 100 mcd.

6.2.2 Guidance lines made by line sources and accompanying directional indicators

The luminance of line sources used for guidance lines shall be $\geqslant$ 20 cd/m^2. In a dark surrounding and if smoke is not the prime consideration, the luminance may be reduced to 2 cd/m^2.

To provide a sufficient conspicuity in bright surrounding, the colour of the guidance line shall be green unless the background is also green or the luminance of the line source is at least 2 times greater than the surrounding, in which case a sufficient contrast to the surrounding can also be provided by contrast strips with a minimum width of 5 mm added on both sides of the line source. Where contrast strips are used, they shall be black for white line sources or white or black for green line sources.

The minimum width of the line source shall be 10 mm.

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

Directional indicators may be placed adjacent to or integrated in the guidance lines. The minimum dimension of the separate directional indicators shall be 30 mm. If the width of the line source is $\geqslant$ 30 mm the graphical symbol of the directional indicator may be placed directly on the line source.

The graphical symbols of the directional indicator shall be according to ISO 3864-1 (see Figure 1) or with modified geometry if on the floor (see Figure 2).

In connection with white line sources the white colour of the directional indicator shall have at least the same luminance as the line source.

In connection with green line sources the green colour of the directional indicator shall have at least the same luminance as the green colour of the line source. The white colour of the directional indicator may be replaced by black contrast colour.

Directional indicators made of point sources according to 6.2.1 may be used.

6.2.3 Guidance lines made of discrete luminaires

The average luminance of the green colour of discrete luminaires used for guidance lines shall be $\geqslant$ 20 cd/m^2, except in dark surroundings and if smoke is not of prime consideration, in which case the luminance of the green colour may be reduced to a minimum of 2 cd/m^2. The contrast colour shall be white with a luminance five times greater than the luminance of the green colour.

The discrete luminaires shall have minimum dimensions of 50 mm $\times$ 100 mm containing graphical symbols according to ISO 3864-1 (see Figure 1) or with a modified geometry if on the floor (see Figure 2).

The maximum spacing between the discrete luminaires shall be 4 m. If the SWGS is to be observed through smoke, the maximum spacing shall be reduced to 2 m. If a gap of more than 2 m is caused due to a door, an extra luminaire shall be installed immediately after the door in direction of the escape route.

6.2.4 High-located safety signs

High-located safety signs shall be in accordance with ISO 3864-1 and ISO 7010. If smoke penetration and/or the requirement to be conspicuous in bright surrounding is the prime consideration, the average luminance of the white contrast colour shall be not less than 500 cd/m^2 with a factor of distance z of 200 for a smoke-free atmosphere. These safety signs shall be dimmed in dark surrounding automatically in case of power failure when combined with phosphorescent components to avoid glare and ensure a good visibility of the system.

6.3 Marking

6.3.1 Marking of stairs and ramps

Guidance lines shall be provided as specified in 5.3.1.3 and 5.3.1.5. The marking of the nosings of steps shall be realized in one of the following ways:

— light-emitting strips consisting of line or point sources provided at all the nosings;

— illumination of all the nosings by the guidance line(s) or by additional stair luminaires to provide a minimum illuminance of 1 lx on the centreline of the stair treads.

Stair luminaires may be located on the wall adjacent to the stair within a maximum distance of 400 mm from the pitchline or in all risers of the stair. The luminaires should be shielded in the horizontal directions and above to avoid glare.

The floor of ramps shall be illuminated by the guidance line(s) or by additional luminaires to provide a minimum illuminance of 1 lx on the floor on the centre line of the ramp.

For purely practical reasons, the measurement of the illuminance may be made at a height of up to 20 mm above the actual floor level.

6.3.2 Marking of doors and emergency exits

Emergency exit doors in the course of escape routes and final emergency exit doors shall be marked as specified in 5.3.2. If smoke is the prime consideration, the door frame shall be marked by light emitting strip as specified in 5.3.2.

If smoke is not the prime consideration, the illuminance at the floor in front of the door at floor level shall be at least 1 lx.

Where illumination is used to mark the emergency exit door, the illuminance at the floor in front of the door at floor level shall be at least 1 lx.

For purely practical reasons, measurement may be made at a height of up to 20 mm above the floor level.

NOTE The required illumination can be provided from a high-located transilluminated safety sign located above the door or from a high-mounted luminaire.

6.4 Fire-fighting, emergency and safety equipment

6.4.1 Identification and location of fire-fighting, emergency and safety equipment along and adjacent to the escape route

Fire-fighting and emergency equipment should be highlighted from behind by a light source of at least 50 cd/m^2 or be illuminated at the front by at least 5 lx vertical illuminance. See also Clause 5.

6.4.2 Identification and location of alarm initiating devices and telephones

All communication devices intended for use in an emergency shall be made conspicuous by the use of the appropriate safety or fire safety sign and shall be placed at the location of each call point and telephone. In addition, the equipment should be highlighted from behind by a light source of at least 50 cd/m^2 or be illuminated at the front by at least 5 lx vertical illuminance.

6.4.3 Identification of particular hazards along and adjacent to the escape route

Warning signs shall be placed to identify the nature and location of the hazard.

Obstacles in the course of escape routes, e. g. wall protections, pillars and obstructing fitments, are to be marked by the appropriate warning marking in accordance with ISO 3864-1 with an illuminance of at least 1 lx.

Guidance lines shall assist to help avoid any obstacles.

6.5 Emergency power supply and operating conditions for the electrical components

The emergency power supply and operating conditions shall conform to IEC 60598-2-22 and IEC 60364-5-55.

If a central power supply is used, the components shall be fed alternatively from at least two circuits according to IEC 60364-5-55.

NOTE The IEC 60364-7 series provides further information for specific types of buildings.

6.6 Documentation and logbook

A logbook shall be provided to record the dates and proofs as required by risk assessment and shall include for example:

— acceptance protocol;

— installation plan;

— type and capacity of power supply and lamps;

— all modifications and results of inspection/maintenance;

— supportive supplier data;

— inspection protocol.

6.7 Inspection and maintenance

Inspection and maintenance shall be carried out in accordance with IEC 60364-5-55.

NOTE National regulations might require additional inspection/maintenance.

7 Specific requirements for phosphorescent components

7.1 General

The phosphorescent components shall be visible at the designed viewing distance during a period of use of at least 1 h.

NOTE During this time period, users become adapted to the darkened environment.

Phosphorescent components of the SWGS shall contrast sufficiently with the surroundings to maintain their visual characteristics, whether or not emergency illumination is provided.

Phosphorescent SWGS shall be provided with adequate illumination at their surface prior to an emergency.

7.2 Phosphorescent components and their location within a SWGS

7.2.1 General

In bright normal lighting conditions the phosphorescent signs shall be designed to meet the colorimetric and photometric performance recommendations of ISO 3864-1.

NOTE 1 When no other external lighting is present, these signs and markers will lose colour recognition as luminance falls below 2 cd/m^2, however contrast and dark adaptation of the human eye will allow the signs and markers to remain conspicuous and legible at the designed viewing distances.

NOTE 2 Phosphorescent SWGS are made up of an array of phosphorescent components including guidance lines, safety signs and directional indicators. In bright surroundings or emergency lighting conditions, these components are conspicuous by providing contrast with the mounting surface or by phosphorescent borders to provide contrast with safety colours. When no other external lighting is present, all components are conspicuous by their luminance properties and characteristic yellow-green phosphorescent colour.

NOTE 3 The frequency and amount of phosphorescent components installed in the SWGS will depend on the complexity of the escape route. All additional directional indicators and signs will produce visual cues in the escape path space and hence provide additional comfort and confidence for egress.

7.2.2 Continuous guidance lines

Guidance lines shall be produced in phosphorescent materials in accordance with Clause 5, specifically 5.3.1.2 and 5.3.1.3, and 7.4 as line sources on floors or on walls to delineate the entire length of the escape route.

7.2.3 Hazard markings

Phosphorescent hazard markings shall be used to provide highlights to pillars, buttresses and corners. Obstacles or obtrusions on the escape path shall be marked with phosphorescent safety marking of the design given in ISO 3864-1 for hazard.

7.2.4 Floor markings

Supplementary phosphorescent floor markings such as footprints, chevrons or dots may be used to give perspective to the escape path to be followed. These elements shall be located within the boundaries of the escape path but shall not replace directional indications given in Figures 1 and 2 belonging to the guidance lines.

7.2.5 Stair and ramp markings

7.2.5.1 General

In addition to guidance lines following the pitch of the stairs or ramp, stair risers and/or stair sides shall be marked with phosphorescent material to provide perspective and outline to all steps or the ramp. Additional markers may be provided on handrails and balustrade and particularly at each turn. For multi-storey stairwells, a phosphorescent sign shall be posted at each floor landing, indicating the stair designation, the floor number, whether re-entry is possible and, if it is not, the closest floor above and below on which re-entry is possible.

7.2.5.2 Stair nosing markings

Each tread edge shall be marked with stair nosing of not less than 20 mm strips of phosphorescent material. Such markings shall be produced to provide neither trip nor slip hazards.

7.2.5.3 Handrail markings

Wall-mounted handrails shall be highlighted with phosphorescent material. Central handrails shall be optionally marked on handrail or supporting bars.

7.2.6 Marking of emergency exit door frames

7.2.6.1 General

The final emergency exit door and emergency exit doors provided within the escape route shall have frames marked with strips of phosphorescent material of not less than 25 mm in width. The door handle side of the frame shall have a continuous phosphorescent marking from the floor up to the height of the door handle. Where observation distances are greater than 20 m the whole door frame should be outlined with phosphorescent material.

7.2.6.2 Door handles and opening device markers

Any door handles or opening devices on emergency exit doors shall be highlighted with phosphorescent material and a sign shall be provided to give appropriate instructions for opening.

7.2.7 Directional indicators

Directional indicators using phosphorescent material shall be as shown in Figure 1 at intermediate and low locations, and may be wall-mounted or suspended to provide accurate directional information. Floor-mounted directional indicators shall be as shown in Figure 2.

Supplementary information such as distance to exits and secondary route markings may be provided in guidance lines.

The size of directional indicators in low-location guidance lines shall be the size of the way guidance line as a function of luminance given in 7.4 and shall not be less than 50 mm.

NOTE For high-located safety signs, see 6.2.4.

7.2.8 Safety equipment marking/backing

Fire-fighting and emergency equipment if installed on the escape route shall be silhouetted or framed with phosphorescent material using safety marking according to ISO 3864-1. Safety signs in phosphorescent material shall be provided to locate fire-fighting equipment according to ISO 7010.

7.2.9 Other visual markers and safety information

Phosphorescent signs providing information such as actions to be followed in case of emergency, plans of the escape route, mandatory notices and instructions may be provided to offer further visual information and light sources in dark surroundings.

7.3 Luminance requirements for phosphorescent components of a SWGS

7.3.1 Minimum luminance properties

When tested in accordance with Annex B, the minimum requirement for the luminance decay properties of phosphorescent materials used as components of a SWGS shall be as given in Table 1.

NOTE An increase in the luminance properties of the material, the area and frequency of application of SWGS components and the excitation illumination is considered as an increase in the effectiveness of the system.

Table 1 — Minimum requirements for luminance decay properties

Time from withdrawal of excitation illumination min	**Luminance** mcd/m^2
10	20
60	2,8
340	0,3

7.3.2 Minimum luminance required in installed position

In normal safety management practice escape routes should be illuminated at all times with normal lighting to provide an average illuminance of 50 lx at the centre line of the escape path and 25 lx on the lowest wall-mounted components or as considered appropriate for the type of building, occupation conditions, and the normal lighting conditions. The luminance values specified in Table 2 shall be achieved as a result of 15 min excitation with the *in situ* illumination.

The period of use of SWGS is 60 min if the luminance of components in the installed position meets the values given in Table 2.

NOTE 1 The luminance properties of installed components will depend on the inherent performance of the phosphorescent material and the level and type of illumination provided immediately prior to use.

NOTE 2 The visibility of components in dark surroundings in a phosphorescent SWGS will depend on the luminance and the area of the components.

NOTE 3 See Annex C for the places where luminance measurements are to be made.

Table 2 — Minimum requirements for luminance of installed components

Time from withdrawal of excitation illumination min	**Luminance** mcd/m^2
10	$\geqslant$ 15
60	$\geqslant$ 2
Requirements given in this table are minimum requirements; an increase in the luminance properties of the material, the area and frequency of application of SWGS components and the excitation illumination is considered as an increase in the effectiveness of the system.	

7.4 Width of low location guidance lines

Guidance lines with the minimum luminance requirements specified in 7.3.1 and 7.3.2 shall have a minimum width of 100 mm, except where the luminance of the phosphorescent material in low-located guidance lines is increased according to Equation (1), in which case the minimum width may be reduced. Both luminance values, luminance at 10 min and luminance at 60 min shall be met.

$$L' = L\left(\frac{100}{d'}\right)^2 \quad (1)$$

where

L' is the increased value of luminance;

L is the minimum luminance according to Table 2;

d' is the reduced width of guidance line.

NOTE 1 See Annex C for the places where luminance measurements are to be made.

The effectiveness of a phosphorescent SWGS is a function of luminance and area of installed material and a greater area of material should be provided in design to improve the comfort factor for occupants.

NOTE 2 National legislation can give other minimum values.

It is advisable that all components of a discrete part of SWGS should be of the same luminance performance as chosen for the guidance lines.

NOTE 3 In some countries, the width of the guidance line may be limited to 50 mm or more.

7.5 Illumination requirements

To ensure that the necessary illumination is provided at all times, the following provisions shall be made as part of the safety management system of the building.

NOTE 1 All components of a phosphorescent SWGS require adequate excitation illumination prior to use.

NOTE 2 Illuminance and time are factors which influence the *in situ* luminance performance of the phosphorescent component.

After installation, the type and level of illuminance shall be recorded, together with details of the light fixtures and fittings, including diffusers.

The safety management system of the building shall require illumination to be maintained at all times of occupation and not less than 15 min prior to full occupation of the building or according to the installers' instructions.

In particular, action shall be taken to prevent the accidental and/or unauthorized removal or switching off of the excitation illumination.

7.6 Verification of illumination and luminance

At the time of installation, the excitation illuminance and photopic luminance of the phosphorescent material in darkness shall be measured in accordance with Annex C. The illuminance shall be measured at high, intermediate and low location and the luminance shall be measured on way guidance lines. Particular attention should be paid to areas where the lowest excitation illumination occurs. The measured luminance shall reach the minimum values necessary to achieve luminance according to 7.4 for phosphorescent materials.

Manufacturers and installers shall provide luminance performance data for all installed components as tested in accordance with Annex B and predicted luminance performance data for the *in situ* illumination conditions.

7.7 Documentation and logbook

A logbook shall be provided to record the dates and proofs as required by risk assessment and shall include, for example:

— acceptance protocol;

— installation plan;

— type and level of illumination and precautions taken to assure availability;

— all modifications and results of inspection/maintenance;

— supportive supplier data;

— inspection protocol;

— reference samples of the used materials.

7.8 Inspection and maintenance

The phosphorescent components shall be visually inspected and cleaned at appropriate intervals by a competent person using a reference sample for comparison. Any deterioration, discoloration or missing component shall be recorded in the logbook for immediate replacement. The illuminating sources shall be checked as to whether the sources are working or not. Any missing or failed lamp and luminaire shall be noted for repair or replacement.

Further procedures for maintenance of safety-related luminaires are to be in accordance with national requirements. Further information and methodology are given in IEC 60364-5-55.

The *in situ* luminance performance shall be measured, according to Annex C. The luminance values shall be checked against the minimum luminance values at 10 min and 60 min according to Equation (1), given in 7.4 for the relevant width of phosphorescent material. If the luminance values are below the values according to 7.4, the component shall be replaced.

When installing phosphorescent components, reference samples identical to the installed material shall be stored in a light-safe box together with the product documentation.

Annex A
(informative)

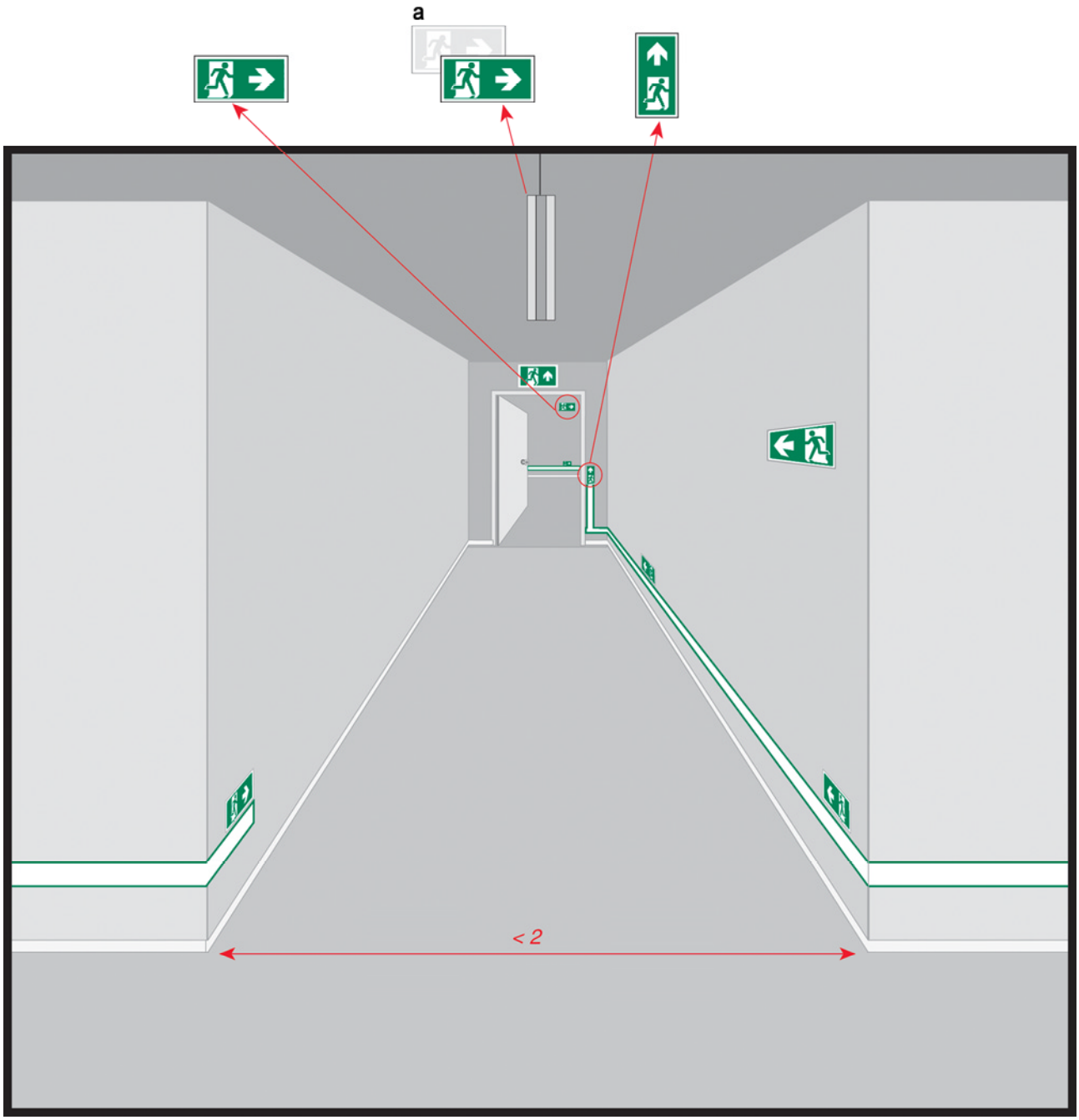
Examples of SWGS layouts

The example layouts in this annex are provided to illustrate an assembly of components that represents good SWGS principles.

The examples given in this annex should not be assumed to be exhaustive. Other layouts using different components may be used where determined necessary by risk assessment or the particular design criteria of the escape route.

The different components of SWGS illustrated in the examples are partly described only for the purpose of assisting comprehension of the drawings.

Dimensions in metres

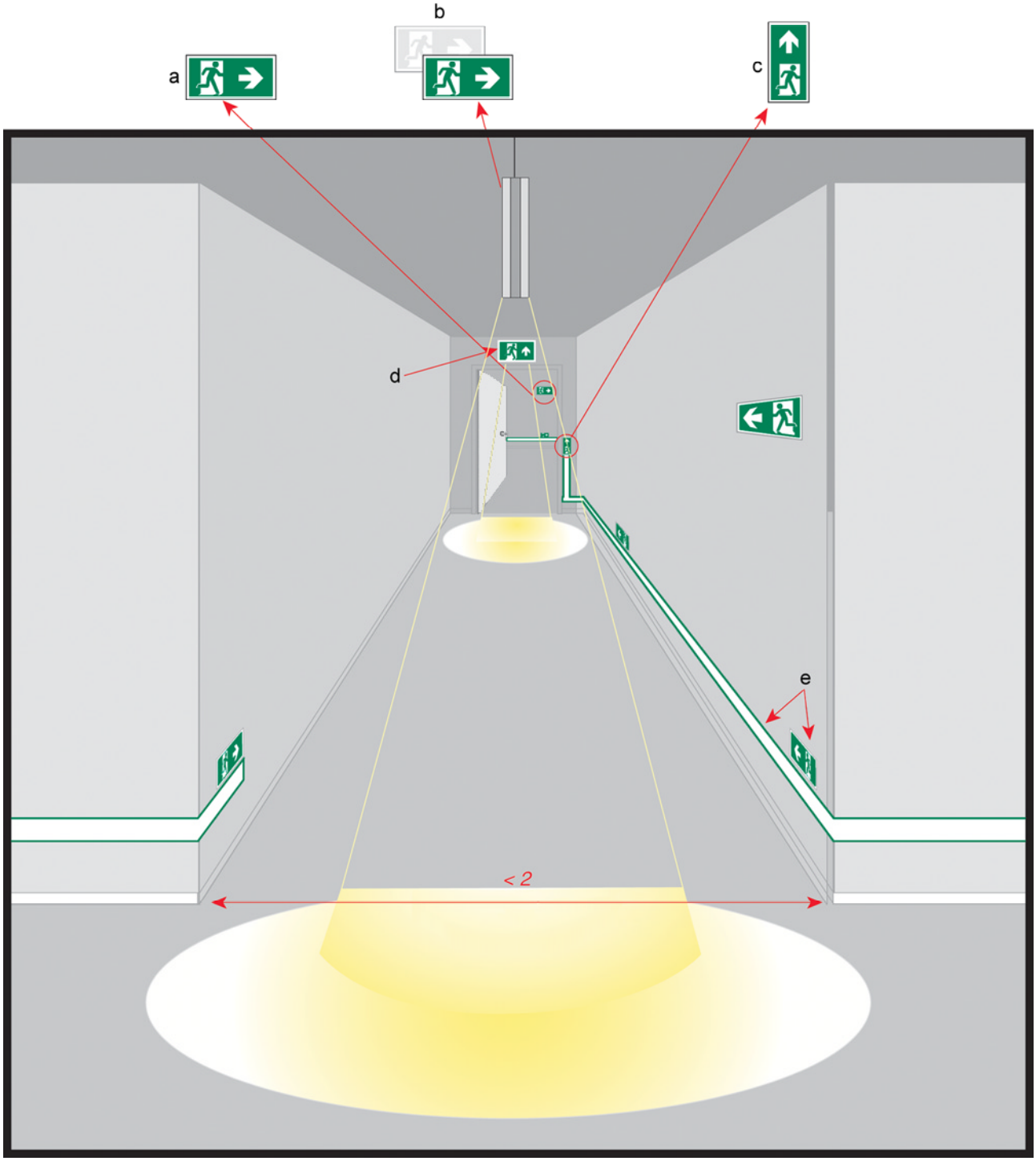


This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted double-sided safety sign (suspended from the ceiling).

Figure A.1 — Example layout of a T-junction leading into a straight corridor no wider than 2 m and no longer than 10 m

Dimensions in metres



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted single-sided transilluminated safety sign.

b High-mounted double-sided transilluminated safety sign (suspended or at the ceiling) with illumination to highlight the T-junction.

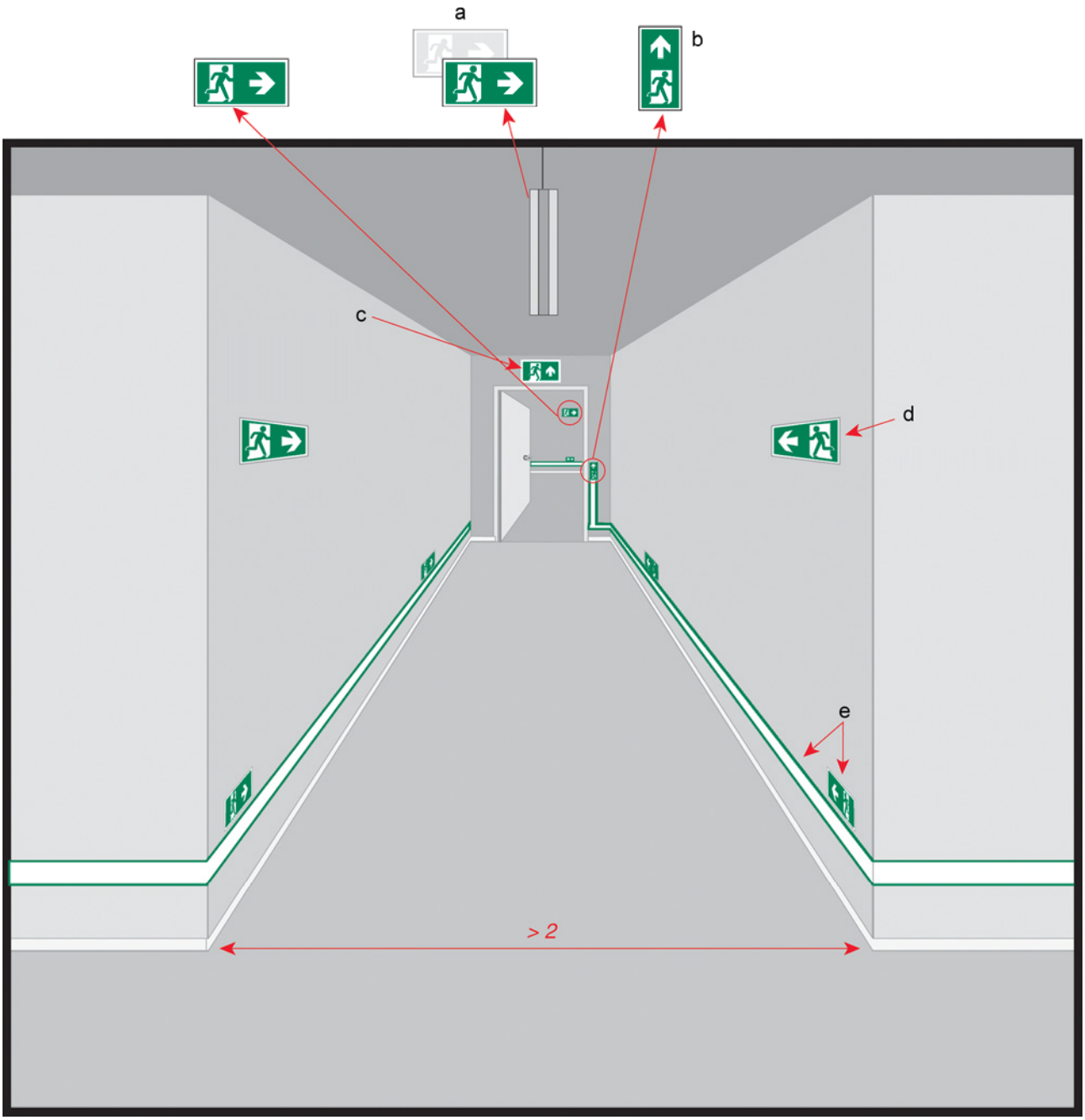
c Transilluminated indicator at height of the door handle.

d High-mounted single-sided transilluminated safety sign with illumination to highlight the door.

e Guidance line with directional indicator.

Figure A.2 — Example layout of a T-junction leading into a straight corridor no wider than 2 m with illumination to highlight the door and the T-junction

Dimensions in metres



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted double-sided transilluminated or externally illuminated safety sign (suspended or at the ceiling).

b Indicator of the frame and door handle.

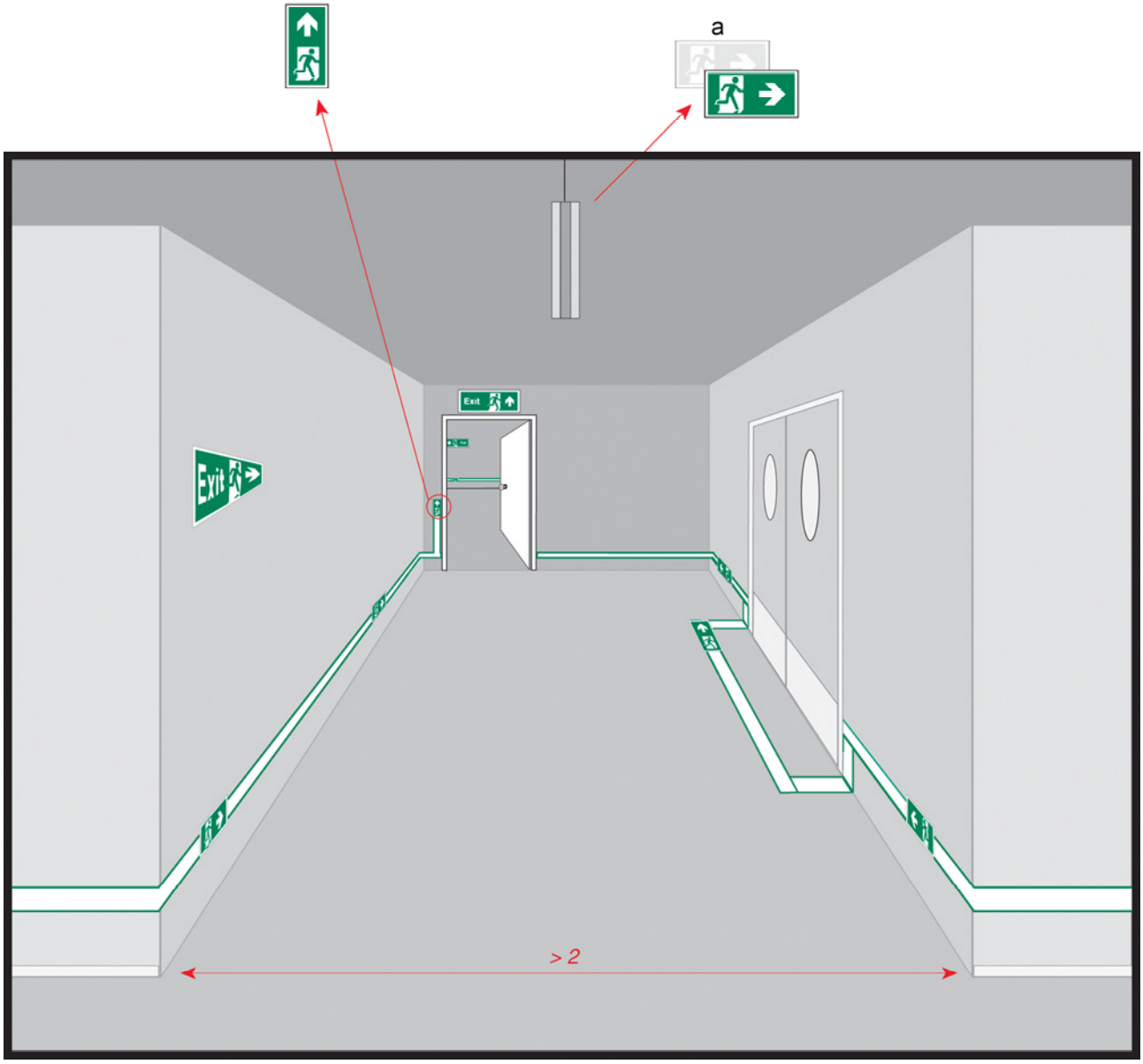
c High-mounted single-sided transilluminated or externally illuminated safety sign.

d Escape route sign at intermediate position.

e Guidance line with directional indicator.

Figure A.3 — Example layout of a corridor wider than 2 m with low mounted guidance lines on both sides

Dimensions in metres

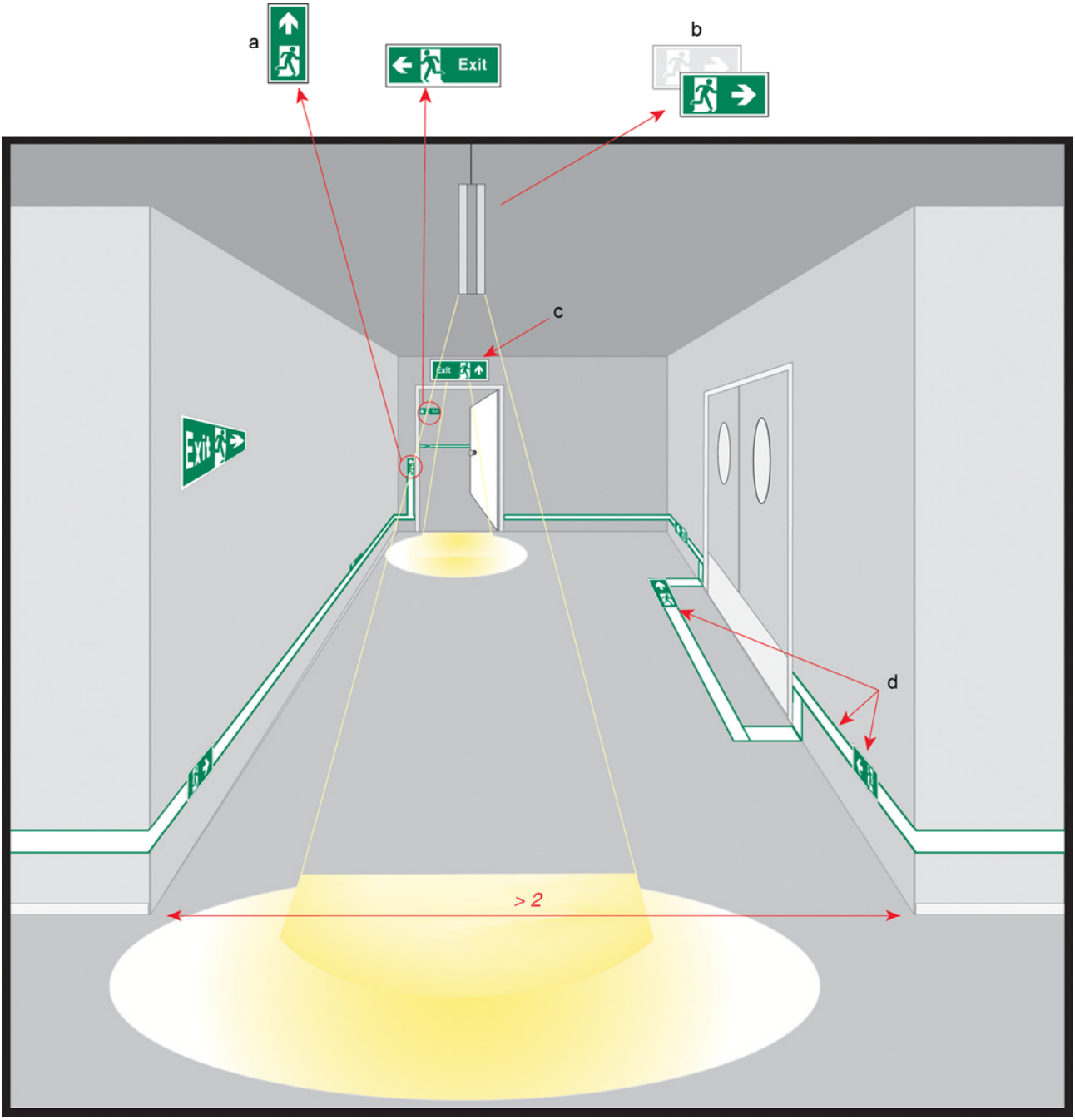


This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted double-sided safety sign (suspended from the ceiling).

Figure A.4 — Example layout of a T-junction leading into a straight corridor wider than 2 m with an adjoining door (demarked by a floor guidance line)

Dimensions in metres



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a Transilluminated indicator at height of the door handle.

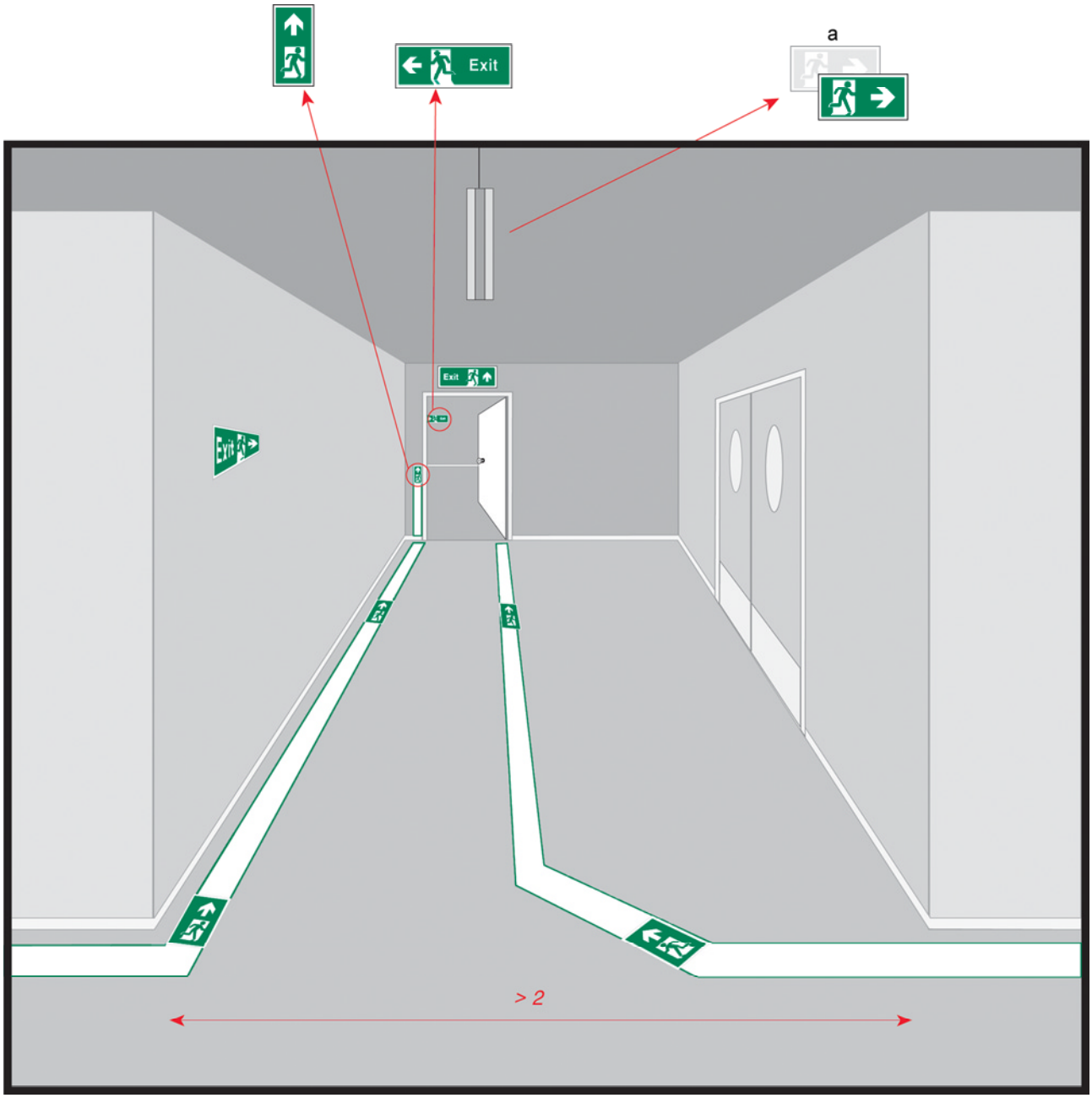
b High-mounted double-sided transilluminated safety sign (suspended or at the ceiling) with illumination to highlight the T-junction.

c High-mounted single-sided transilluminated safety sign with illumination to highlight the door.

d Guidance line with integrated directional indicator.

Figure A.5 — Example layout of a T-junction leading into a straight corridor wider than 2 m with focused illumination on T-junction and door

Dimensions in metres

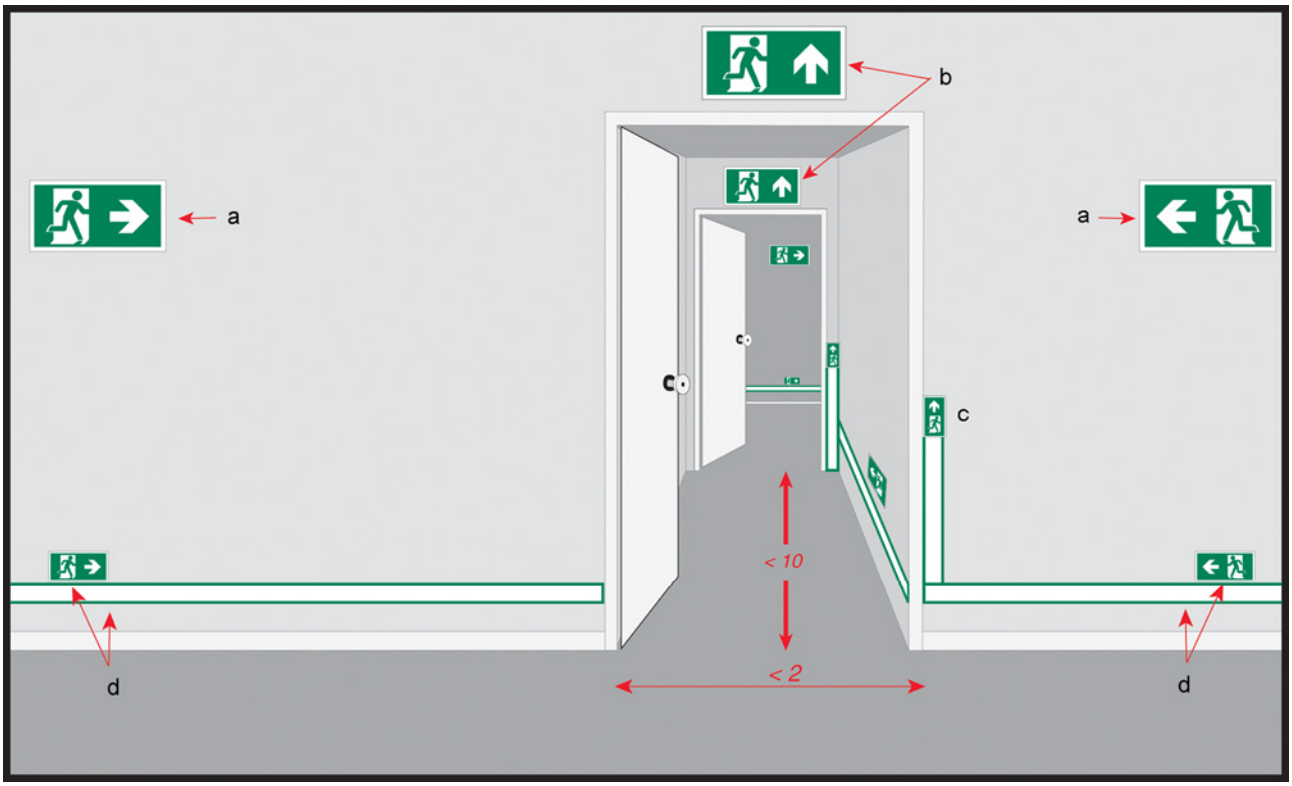


This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted double-sided safety sign (suspended from the ceiling).

Figure A.6 — Example layout of a T-junction leading into a straight corridor wider than 2 m with adjoining door using floor guidance lines and integrated directional indicators

Dimensions in metres



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a Escape route sign at intermediate position.

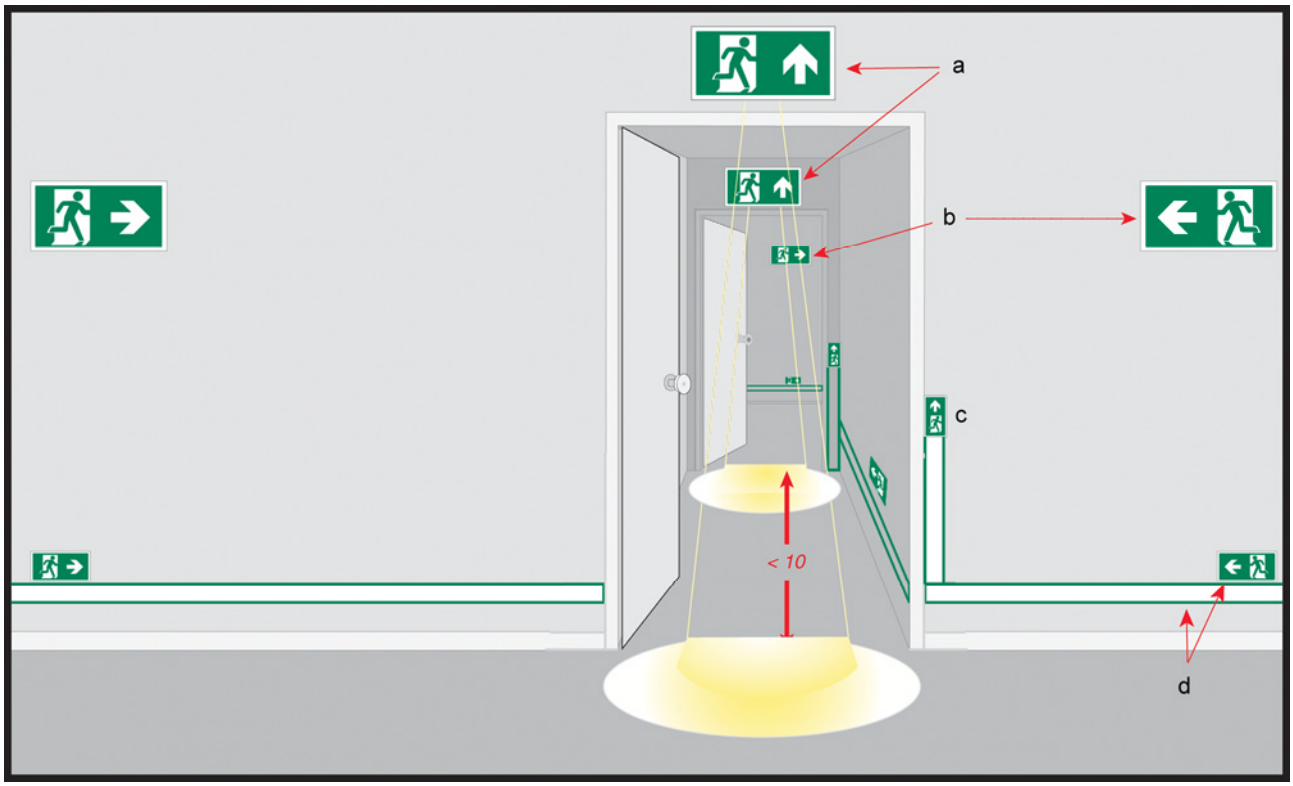
b High-mounted single-sided transilluminated or externally illuminated safety sign.

c Indicator of the frame and door handle.

d Guidance line with directional indicator.

Figure A.7 — Example layout of a T-junction leading into a straight corridor (with more than one door) showing continuity of signing

Dimensions in metres



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

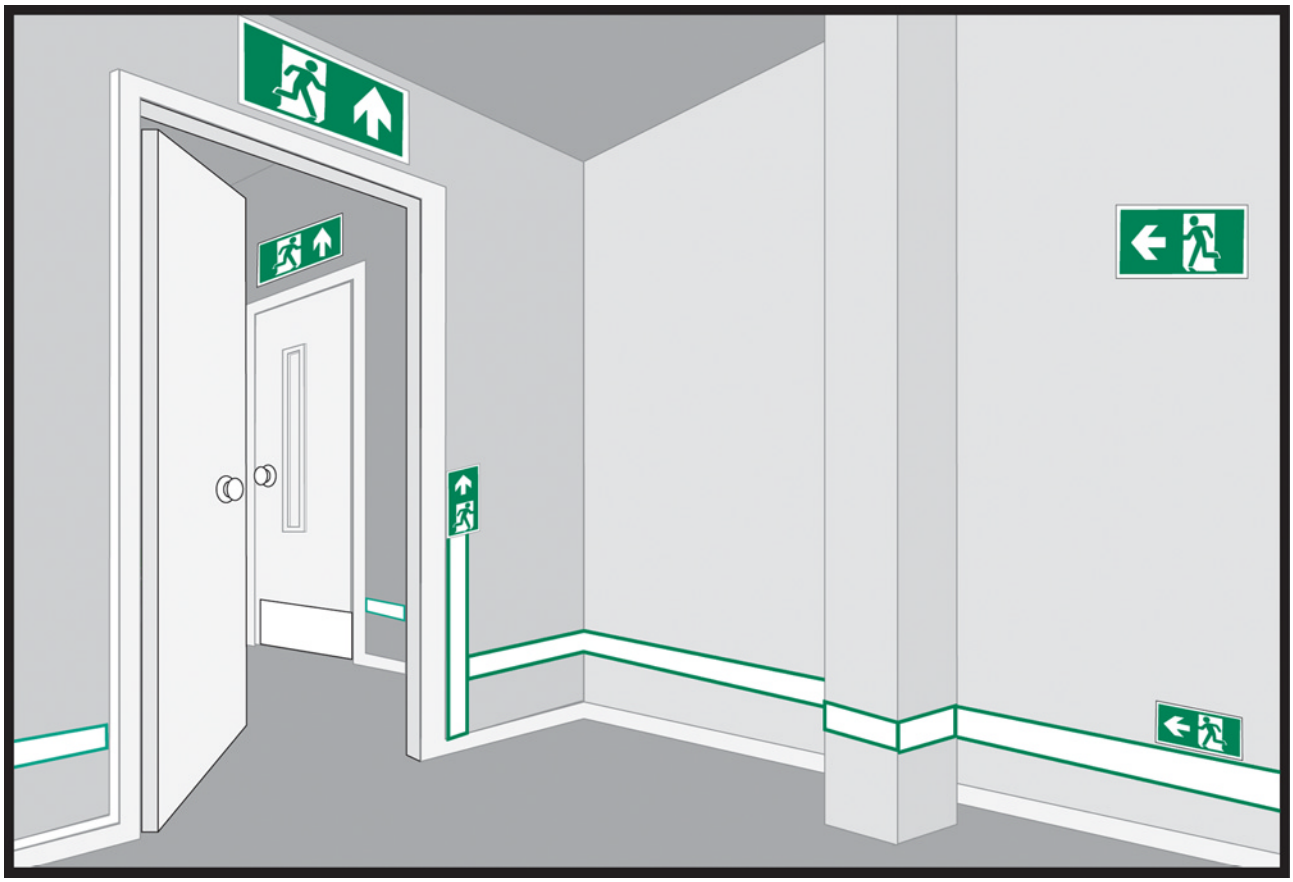
a Focused illumination provided by high-mounted single-sided transilluminated safety signs.

b Escape route sign at intermediate position.

c Indicator of the frame and door handle.

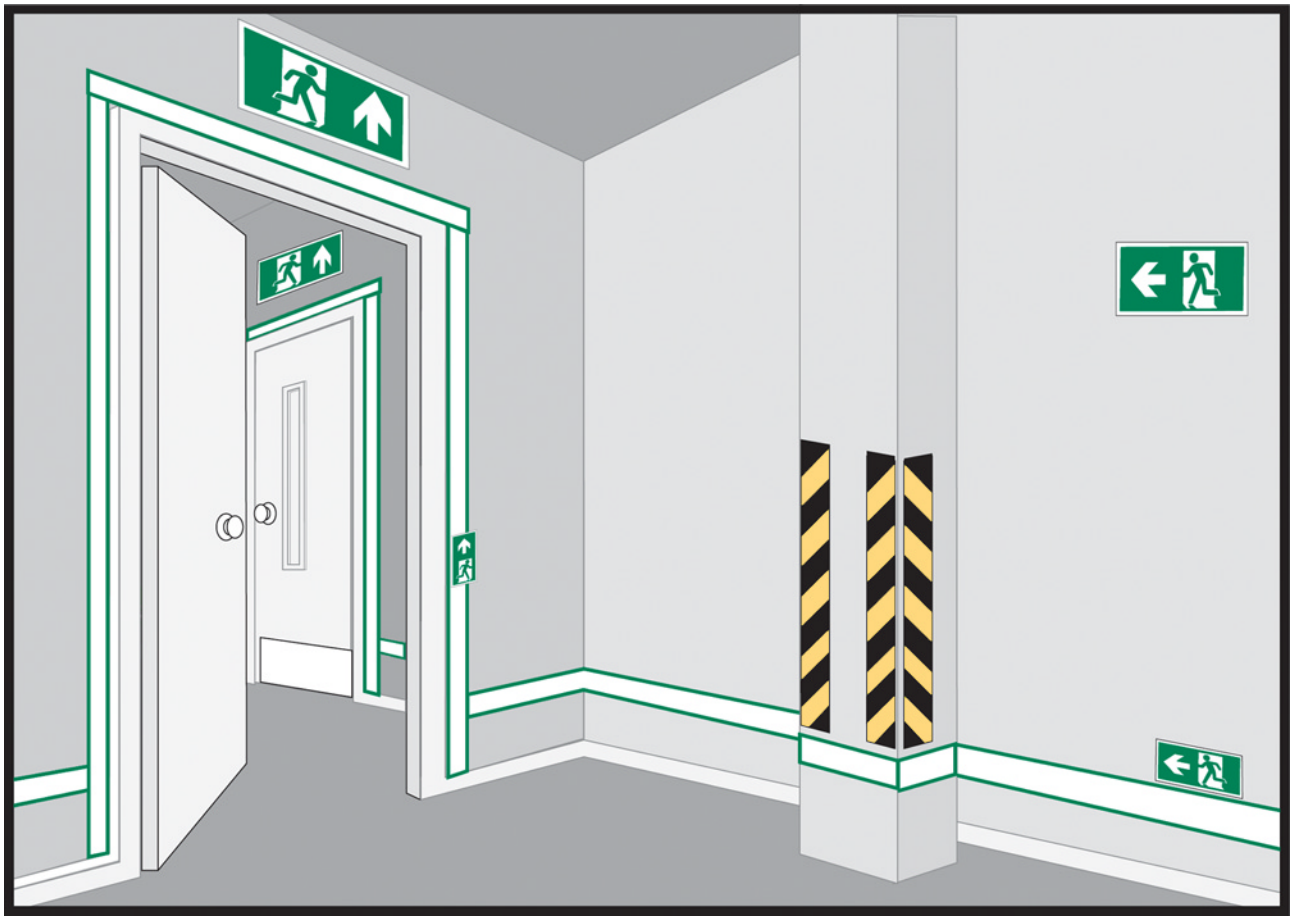
d Guidance line with directional indicator.

Figure A.8 — Example layout of a T-junction leading into a straight corridor less than 2 m with focused illumination at the doors, provided by high-mounted single-sided transilluminated safety signs



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

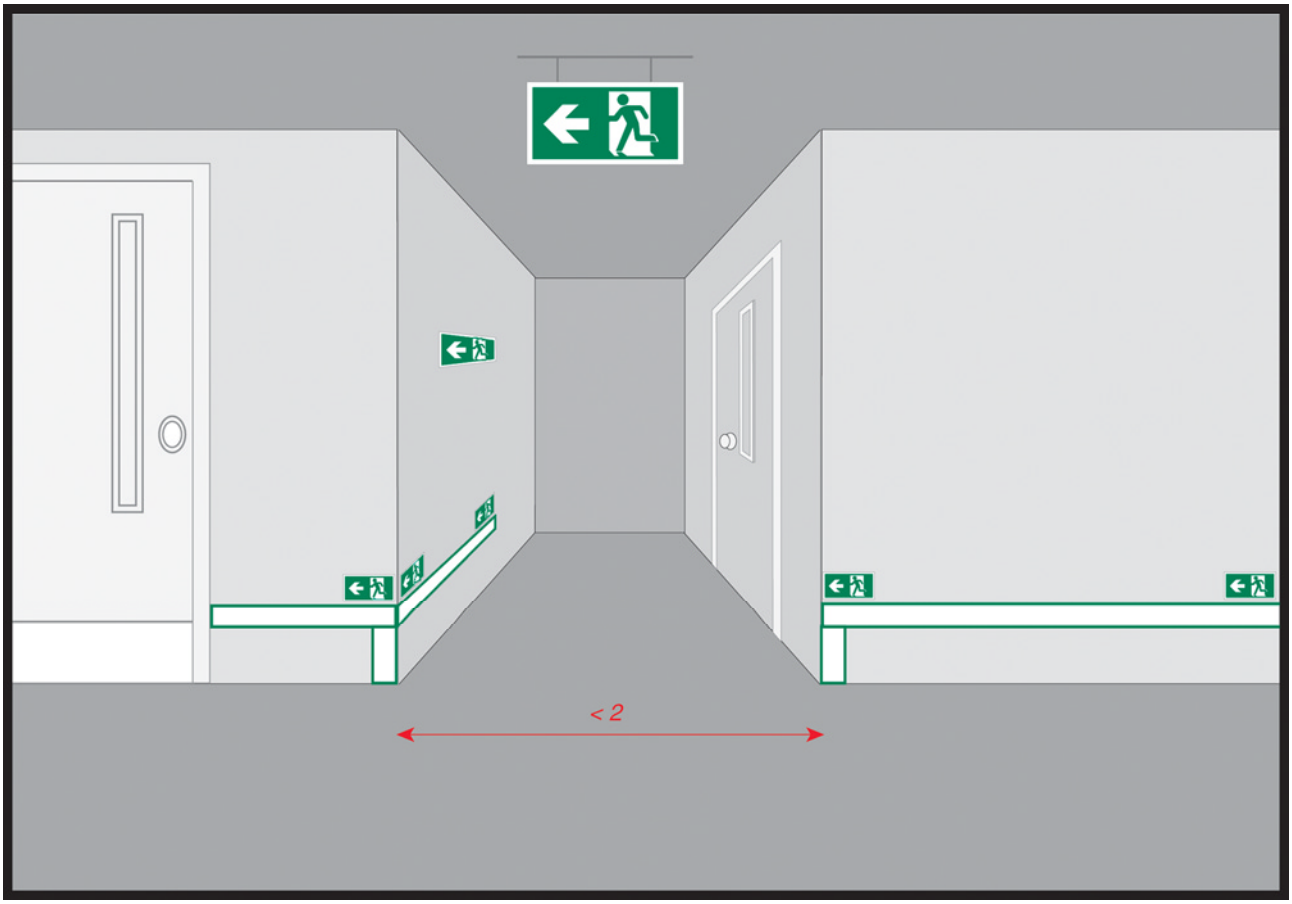
Figure A.9 — Example layout of a building feature marking and directional marking through doors



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

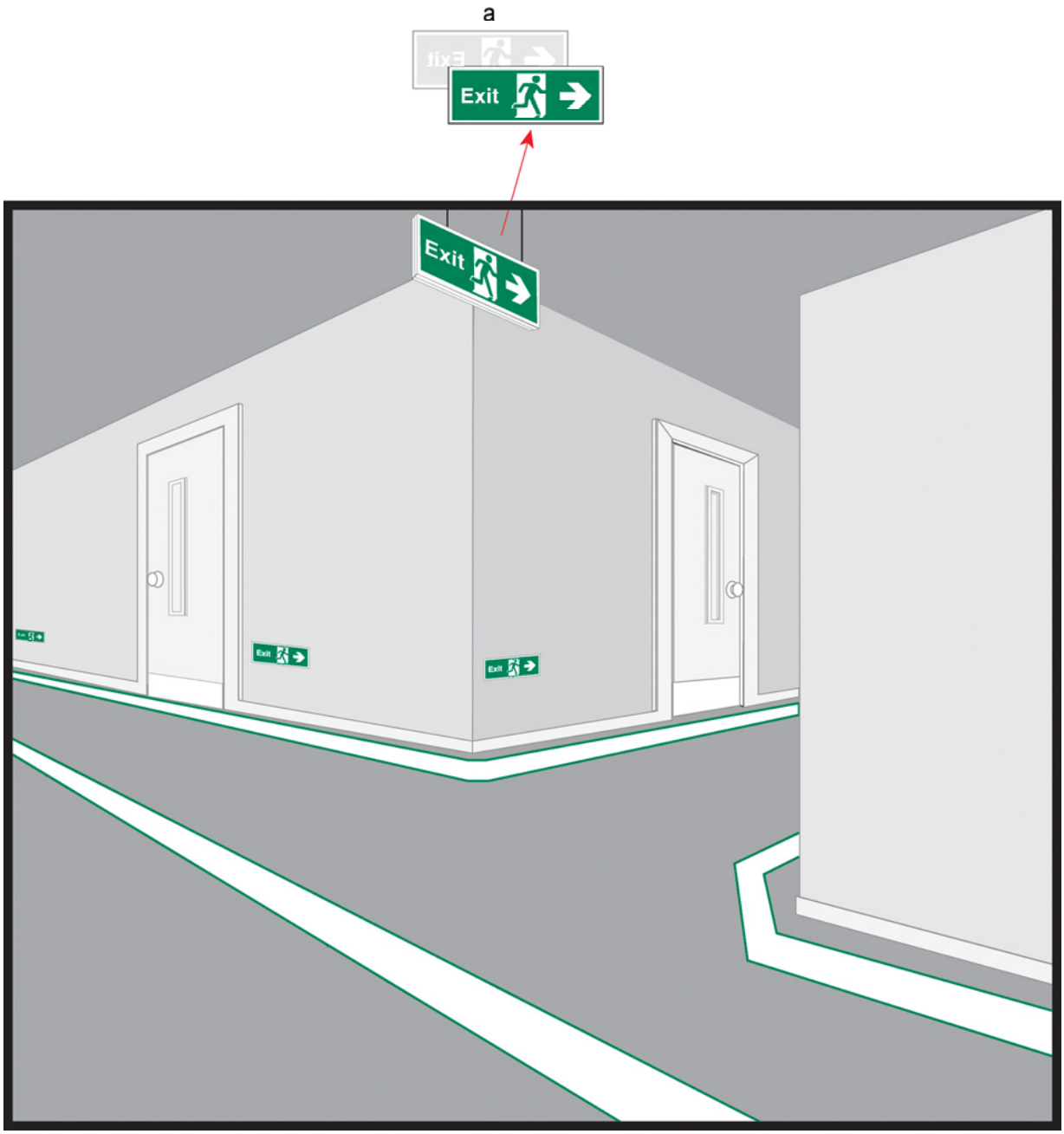
Figure A.10 — Example layout of an alternative building feature marking and full frame door marking

Dimensions in metres



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

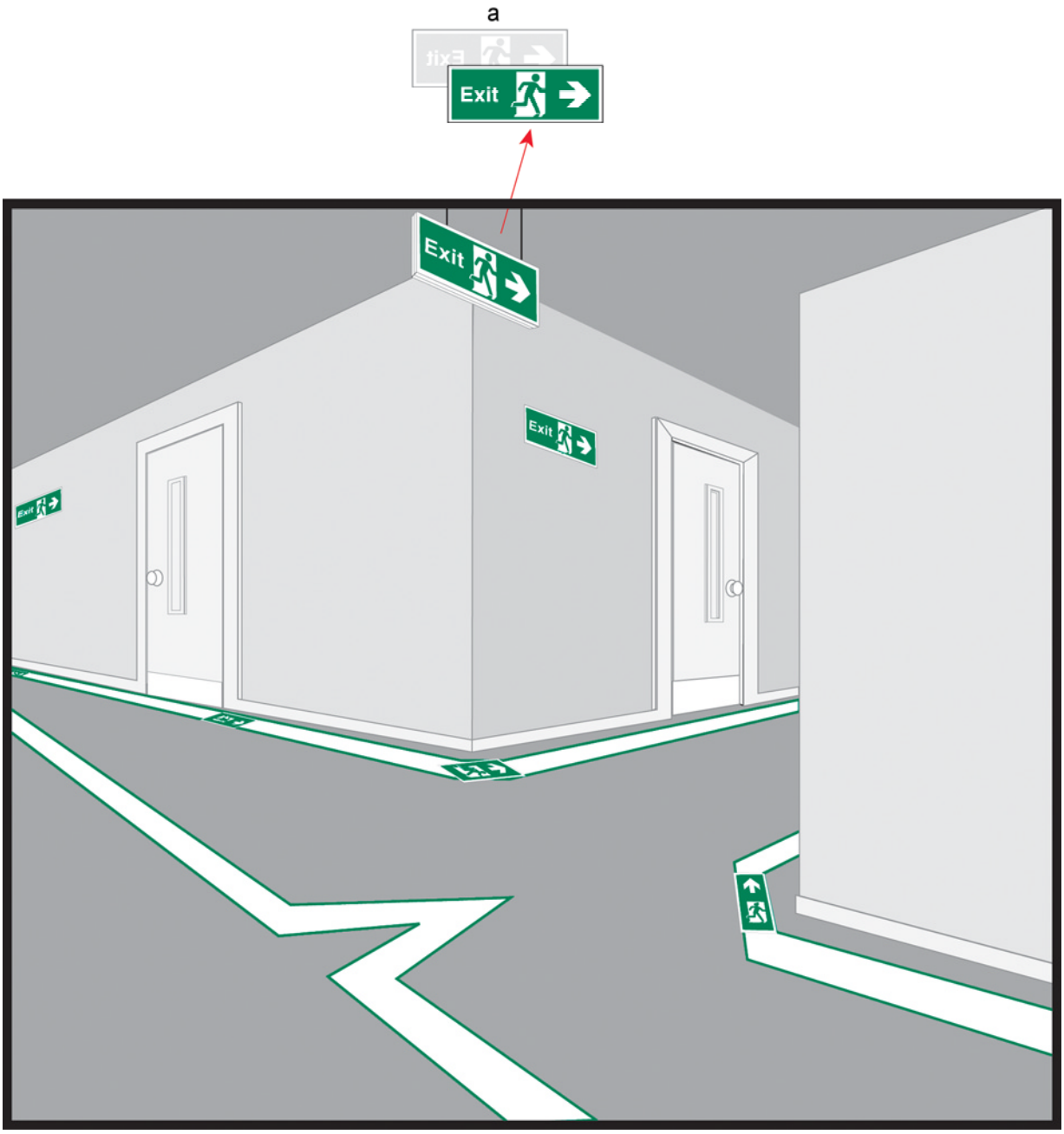
Figure A.11 — Example layout of markings for a dead end corridor no wider than 2 m



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted double-sided safety sign (suspended from the ceiling).

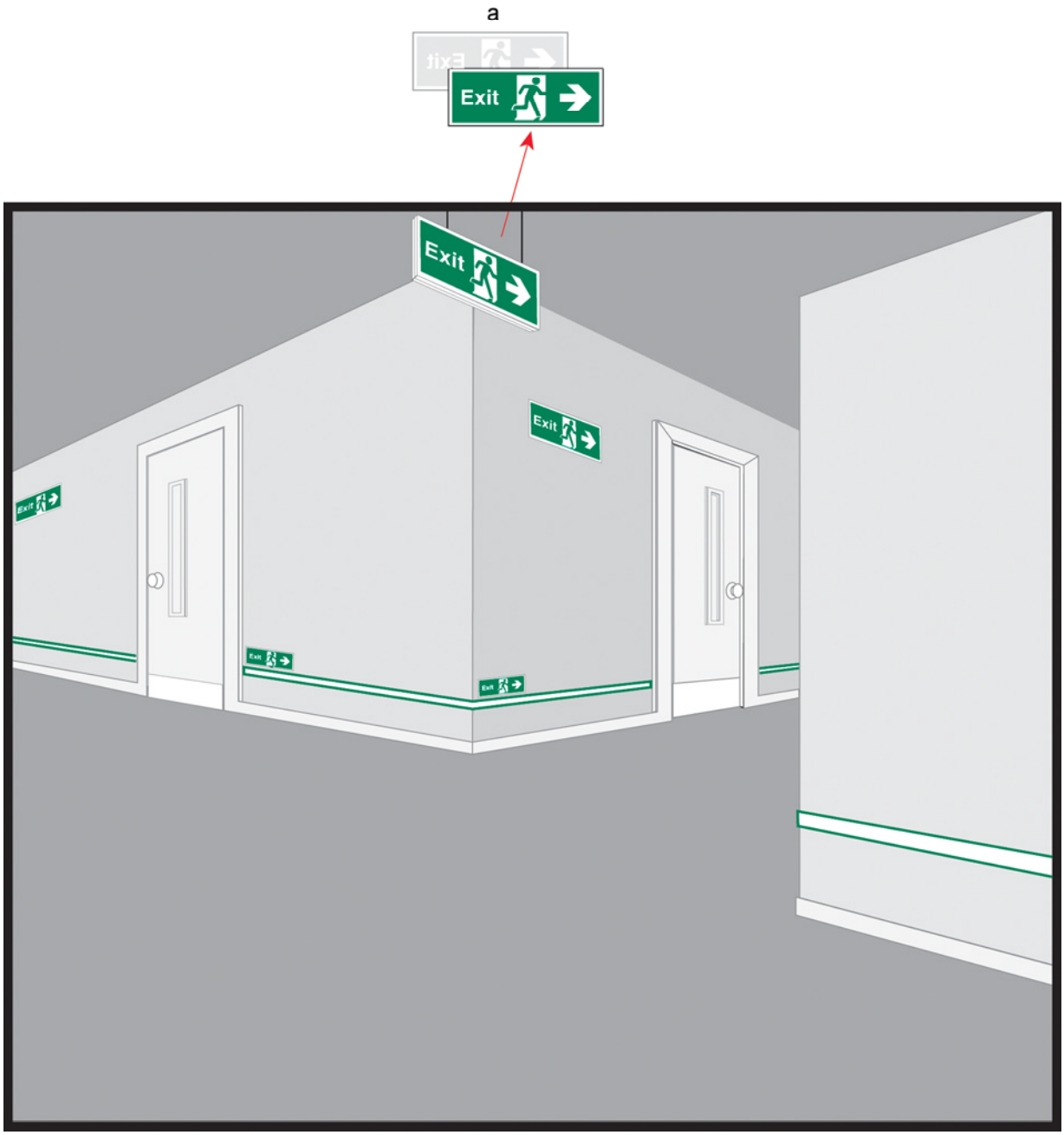
Figure A.12 — Example layout of an intersection marked by floor guidance lines



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted double-sided safety sign (suspended from the ceiling).

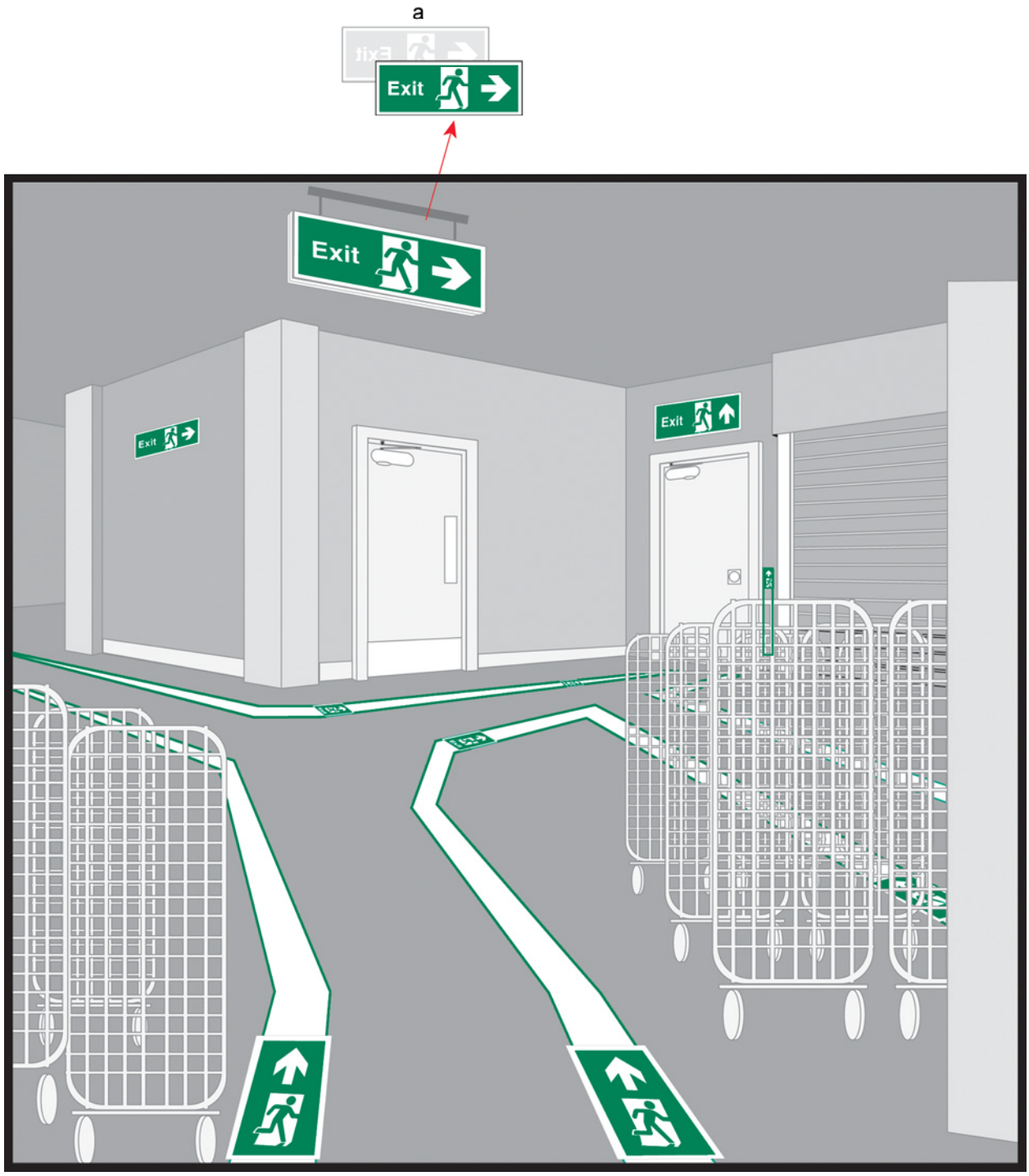
Figure A.13 — Example layout of an intersection illustrating floor guidance lines with integrated directional indicators



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted double-sided safety sign (suspended from the ceiling).

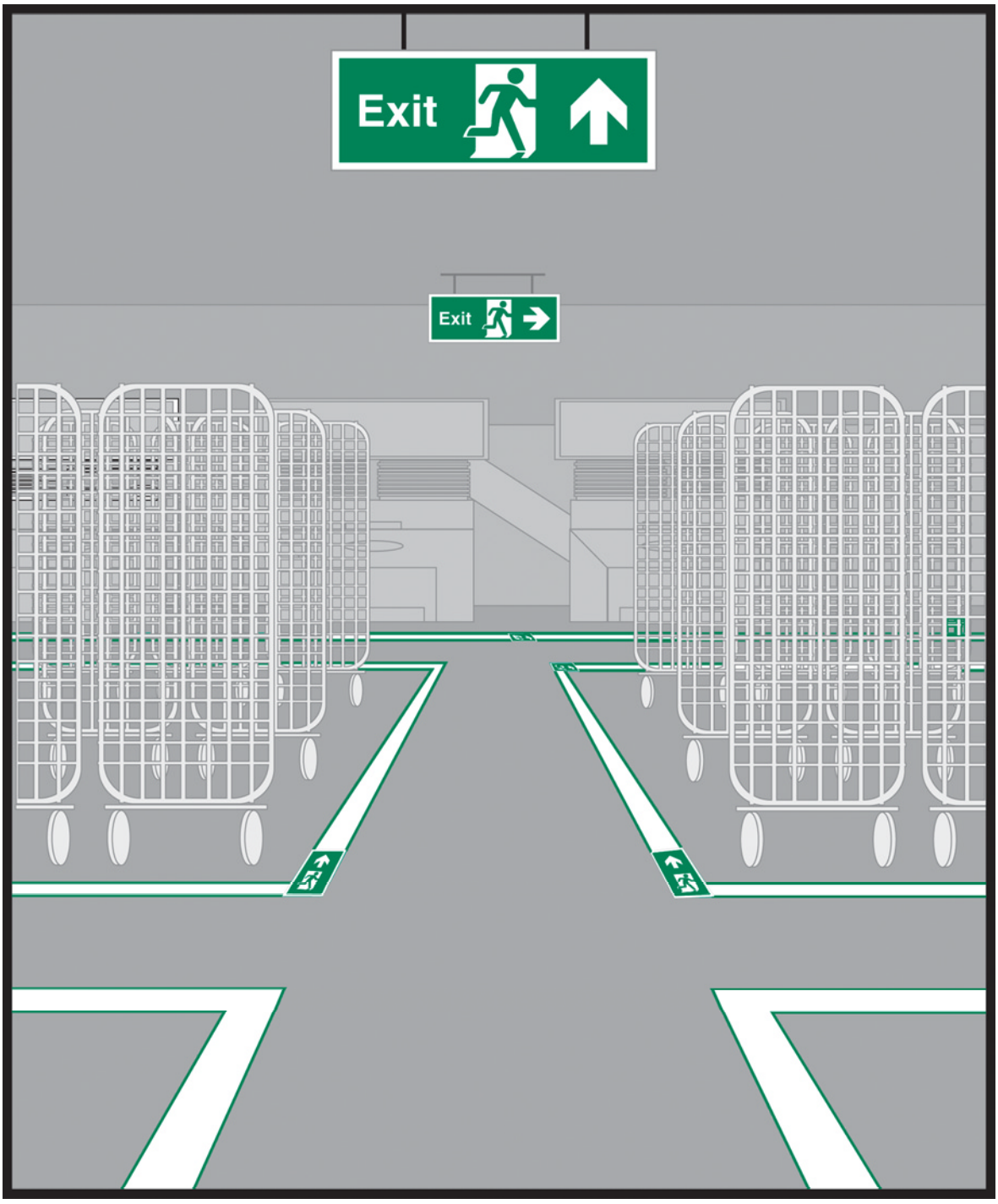
Figure A.14 — Example layout of an intersection with a wall-mounted guidance line



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

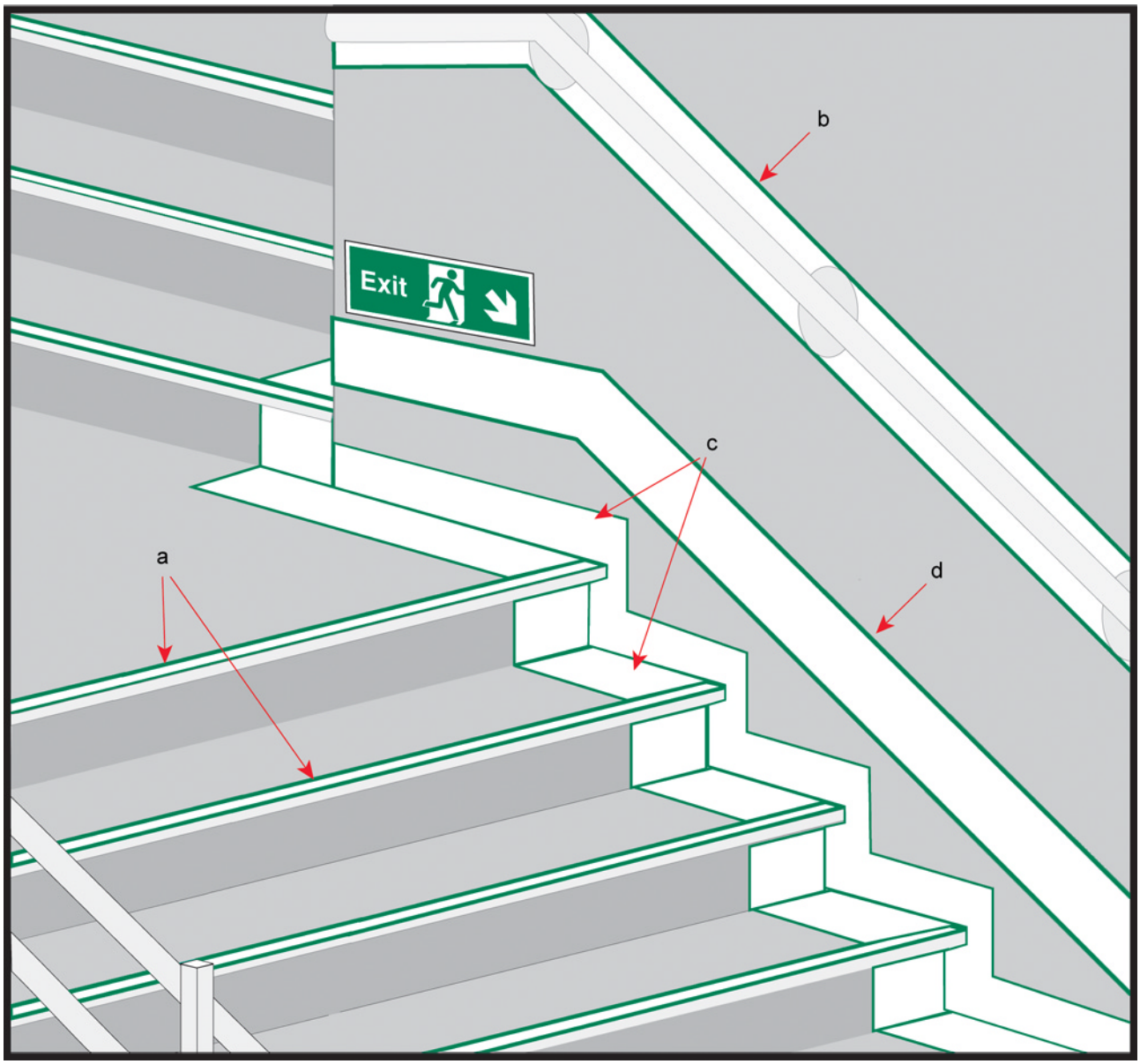
a High-mounted double-sided safety sign (suspended from the ceiling).

Figure A.15 — Example layout of an open space illustrating floor guidance lines with integrated directional indicators



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

Figure A.16 — Example layout of an open space with intersection and floor guidance line with intersection



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

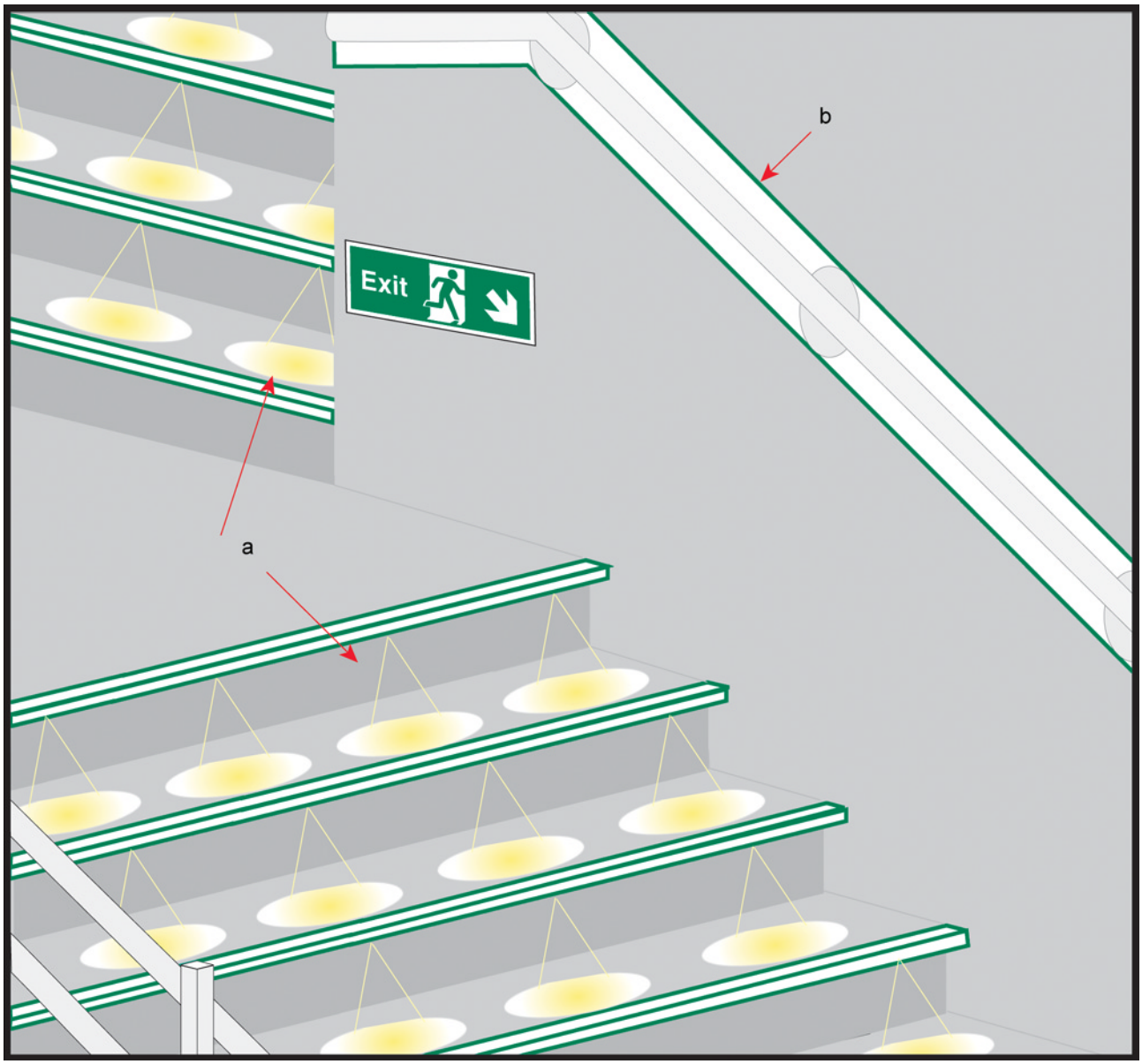
a Stair nosing: highlight edge of steps.

b Guidance line to highlight handrail.

c Guidance line to outline stair shape.

d Wall-mounted guidance line.

Figure A.17 — Example layout of a collection of different marking of stairs and handrails

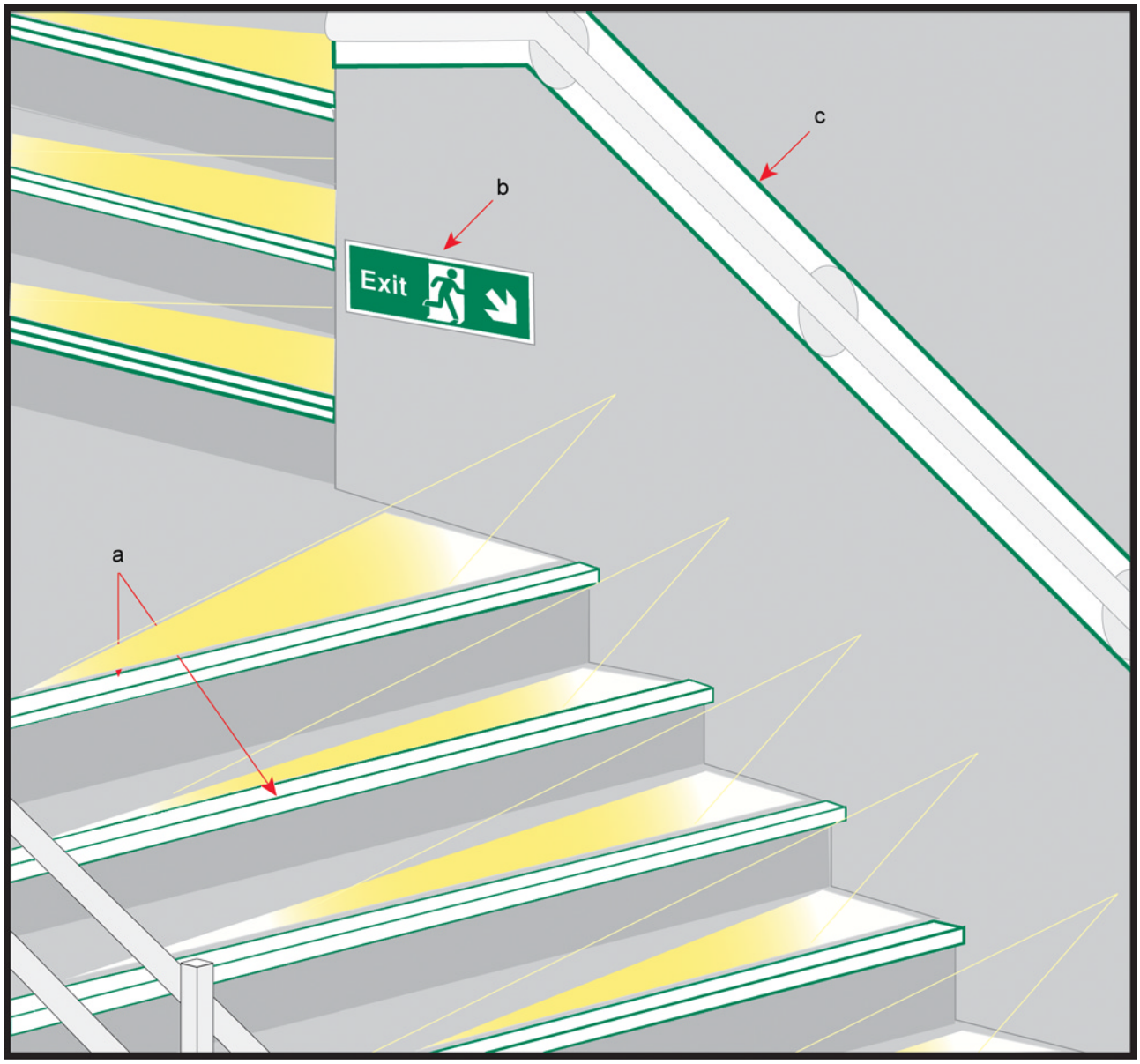


This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a Luminaires to illuminate the tread of stairs.

b Handrail may be highlighted.

Figure A.18 — Example layout of stairs where the stair treads are illuminated with luminaires



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a Stair nosing: highlight edge of steps.

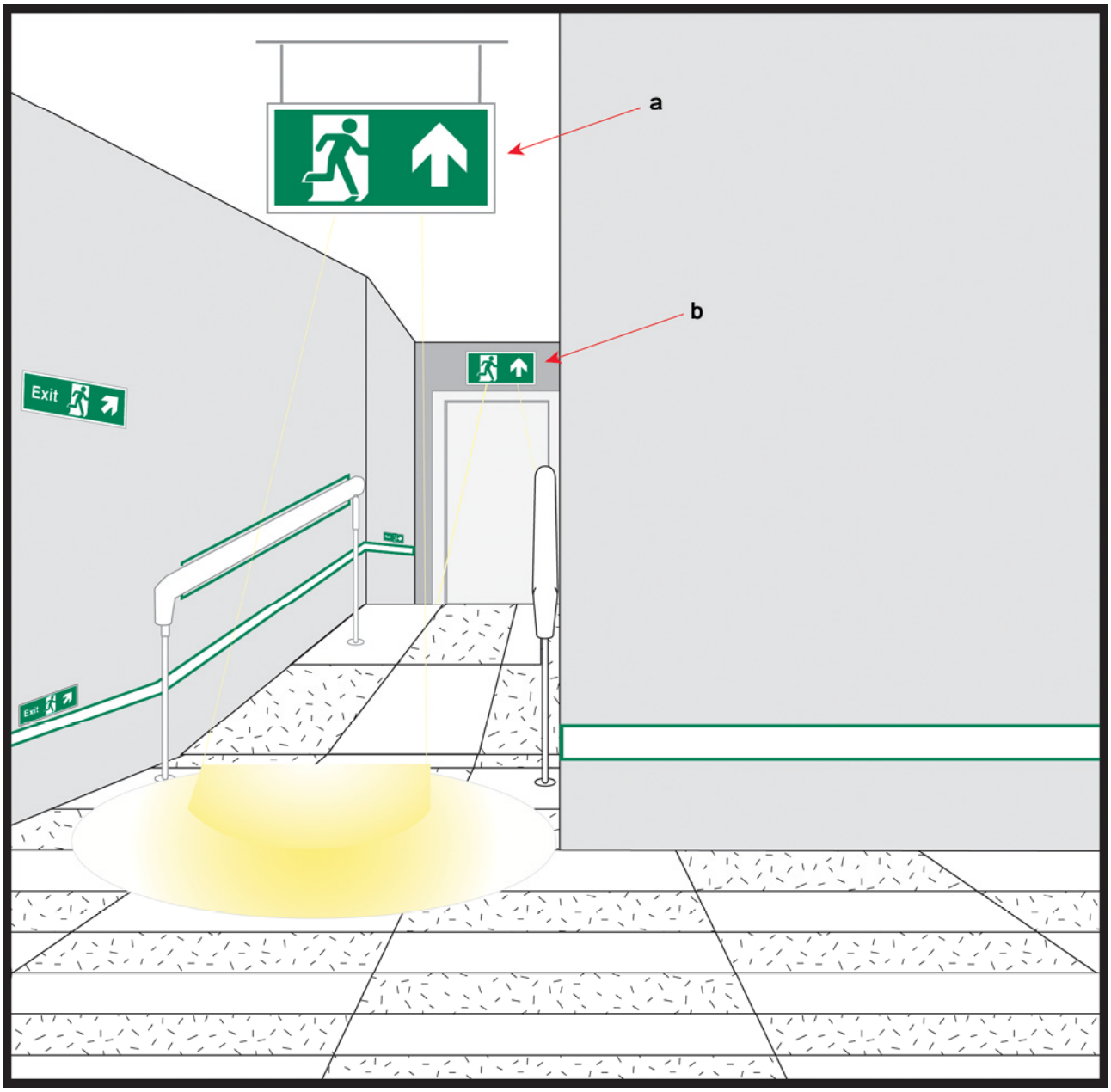
b Directional indicator.

c Handrail may be highlighted.

Figure A.19 — Example layout of stairs where the treads are illuminated by low mounted luminaires on the wall

This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

Figure A.20 — Example layout of signing and marking of ramp (change of level)



This illustration depicts an example of components used to convey one of several possible layouts of a safety way guidance system for a typical detail of the escape route.

a High-mounted single-sided transilluminated safety sign with illumination to mark the ramp.

b High-mounted single-sided transilluminated safety sign (suspended or at the ceiling) with illumination down lighting from the escape route sign luminaire to highlight the door and the end of the ramp.

Figure A.21 — Example layout of signing and marking of ramp (change of level)

Annex B
(normative)

Measurement of photopic luminance of phosphorescent components in the laboratory

B.1 Test specimens

Three specimens shall be tested. Each test specimen shall have an area of phosphorescent material at least 35 mm in diameter, sufficient for the proper operation of the luminance meter used.

The test specimens shall be final products complete with UV protection where applicable and specified. The graphical symbols shall be sufficiently large to provide the minimum test diameter or a test specimen shall be from a production batch without printing of the graphical symbols but with any UV protection applied.

Samples shall be representative of the production batch, coded and identified to correspond to manufacturers production batch codes, and shall be numbered consecutively. Paints shall be applied in compliance with the manufacturer's application instructions.

B.2 Conditioning

All test specimens shall be pre-conditioned by being placed in a completely dark enclosure for at least 48 h. The specimens shall not be removed from the dark enclosure until immediately prior to the tests.

B.3 Ambient conditions

The ambient temperature during preconditioning of test specimens, excitation and luminance testing shall be 23 °C $\pm$ 2 °C. The relative humidity shall be (50 $\pm$ 10) %. All luminance testing shall be performed in a room/chamber whose ambient light level is at least one order of magnitude lower than the lowest luminance measurement to be made.

B.4 Illuminance and luminance instrumentation

B.4.1 Illuminance instrumentation

A cosine photopic $V(\lambda)$ corrected illuminance meter shall be provided, calibrated to measure illuminance in lux (lx), with the following features:

— spectral error: $f_1' \leqslant$ 5 % (with f_1' as defined in CIE 69);

— UV response: $u \leqslant$ 0,5 % (with u as defined in CIE 69);

— resolution: 1,0 lx;

— linearity error: $f_3 \leqslant$ 0,5 % (with f_3 as defined in CIE 69);

— measuring range: 10 lx $\leqslant$ range $\leqslant$ 10 klx;

— light entry diameter of the photometer-head: $\leqslant$ 1 cm.

B.4.2 Luminance instrumentation

A luminance meter shall be provided, calibrated to measure photopic luminance. The luminance meter shall be either a telephotometer, or a contact luminance meter, depending on whether the telephotometer method (see B.6.2) or the contact method (see B.6.3) is used, and shall have the following minimum features:

— spectral error: $f_1' \leqslant 5$ % (with f_1' as defined in CIE 69);

— UV response: $u \leqslant 0{,}5$ % (with u as defined in CIE 69);

— resolution: at least 0,01 mcd/m^2;

— linearity error: $f_3 \leqslant 0{,}5$ % (with f_3 as defined in CIE 69);

— signal-to-noise ratio: at least 10:1 for all measurements;

— measuring range: 10^{-5} cd/m^2 $\leqslant$ range $\leqslant$ 10 cd/m^2;

— display: $\geqslant$ 3,5 digits, range: $0{,}001 \times 10^{-2}$ cd/m^2 $\leqslant$ range $\leqslant$ 19,99 cd/m^2.

The illuminance and luminance instruments shall have been calibrated. This shall be confirmed by a certificate, traceable to a certified reference measure.

B.5 Excitation light conditions

Excitation of the phosphorescent test specimens shall be by a non-diffusing, unfiltered, continuous short xenon-arc source of light of 500 W or less, providing a mean illuminance of 1 000 lx on the surface of the test specimen. The illuminance shall be measured using the illuminance meter specified in B.4.1. Shields in front of the lamp that would provide protection, such as heat-protection, shall not be used. No filter shall be placed in front of the light source. The excitation duration shall be 5 min. The test specimen body temperature shall not exceed 25 °C, 1 min after excitation. No ambient or stray light shall be present during excitation.

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 mean illuminance on the five test patches shall be 1 000 lx. The maximum illuminance divided by the minimum illuminance of the test patches shall be less than 1,1.

B.6 Luminance measurements

B.6.1 General

The luminance measurements shall be carried out using the luminance meter specified in B.4.2, using either the telephotometer method given in B.6.2 or the contact method given in B.6.3.

B.6.2 Telephotometer method

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 area of the test specimen to be evaluated shall be sufficient for the luminance meter to give a luminance reading at low luminance levels.

NOTE Where possible, an area of the test specimen at least 30 mm in diameter should be evaluated.

B.6.3 Contact method

The measurement head of the luminance meter shall be placed on the surface of the test specimen. The influence of ambient light shall be avoided by covering the test specimen's surface outside/around the luminance measurement head with a light protecting material. The area of the test specimen to be evaluated shall be sufficient for the luminance meter to give a luminance reading at low luminance levels.

NOTE Where possible, an area of the test specimen at least 30 mm in diameter should be evaluated.

The luminance shall be determined by measuring illuminance and converting to luminance, according to the following equation:

$$\bar{L} = E/\Omega_{\mathrm{p}}$$

where

$\bar{L}$ is the average luminance, expressed in cd/m^2, of the test specimen measured;

E is the illuminance, expressed in lux (lx), of the place determined on the light incidence area of the photometer head used;

Ω_{p} is the projected solid angle which the tested surface of the measuring object takes, expressed in steradians (sr), viewed from the middle of the light incidence area of the photometer head.

The projected solid angle, Ω_{p}, follows the equation:

$$\Omega_{\mathrm{p}} = \pi\left[1+\left(r/R\right)^2\right]^{-1}\Omega_0$$

where

Ω_0 is the unit solid angle, Ω_0 = 1 sr;

r is the distance, expressed in millimetres (mm), between the light incidence area of the photometer head and the measuring object;

R is the radius, expressed in millimetres (mm), of the plane of the tested surface of the measuring object.

B.6.4 Luminance recordings

The luminance meter shall be zeroed prior to start of measurement, then checked immediately after the final measurement. A measurement shall be rejected if the zero has drifted by more than 5 % of the measured value.

The luminance shall be measured at least every 2 min after the excitation light is removed. In all cases, the measurements shall include the time period up to 60 min after the excitation light is removed and shall include measurements (which shall be recorded in mcd/m^2) at 2 min $\pm$ 10 s, 10 min $\pm$ 10 s, 30 min $\pm$ 10 s and 60 min $\pm$ 10 s for each of the three test specimens.

The luminance performance shall be based on the mean values of the three test specimens.

The time for the luminance to reach 0,3 mcd/m^2 shall be either measured by continuing the measurements until a luminance of 0,3 mcd/m^2 is reached and the time in minutes recorded or the time to reach 0,3 mcd/m^2 is estimated using one of the following procedures as appropriate.

a) If the measured time to 3 mcd/m^2 is less than 80 min, luminance measurements shall be continued until the luminance is 2 mcd/m^2 or less. The values of time (t) and luminance (L) shall be transformed to logarithm (to base 10). lg L shall be plotted against lg t. A first order polynomial curve using least square regression methods shall be fitted to the data in the time range from 20 min to the last recorded time. The form of the first order polynomial equation is:

$$\lg L = p \lg t + k$$

where p and k are the coefficients obtained from the least square curve fit to the data.

The logarithm of the time to 0,3 mcd/m^2 shall be determined by:

$$\lg t = \frac{\lg(0{,}3) - k}{p}$$

The estimated time to 0,3 mcd/m^2 shall be recorded.

The estimated time to 0,3 mcd/m^2 shall be based on the mean value of the three specimens.

b) If the measured time to 3 mcd/m^2 is 80 min or longer, luminance measurements shall be continued until the luminance is 2 mcd/m^2 or less. The values of time (t) and luminance (L) shall be transformed to logarithm (to base 10). lg L shall be plotted against lg t. A second order polynomial curve using least square regression methods shall be fitted to the data in the time range from 20 min to the last recorded time. The form of the second order polynomial equation is:

$$\lg L = m(\lg t)^2 + n \lg t + c$$

where m, n and c are the coefficients obtained from the least square curve fit to the data.

The logarithm of the time to 0,3 mcd/m^2 shall be determined by:

$$\lg t = \frac{-n - \left\{ n^2 - 4m\left[c - \lg(0{,}3) \right] \right\}^{0{,}5}}{2m}$$

The estimated time to 0,3 mcd/m^2 shall be recorded.

Whether the times to 0,3 mcd/m^2 are measured or estimated, the time to 0,3 mcd/m^2 shall be based on the mean value of the three specimens.

B.7 Determination of the colour under daylight conditions

The colour under daylight conditions shall be tested and verified as specified in ISO 3864-1 in a separate procedure.

The measurements of the xy-chromaticity coordinates may need to be continued until the measurements are stable. This may take up to 20 min.

B.8 Test report

The test report shall include the following information:

a) reference to this International Standard (“Testing/measurement in accordance with ISO 16069:2004”);

b) manufacturer of tested phosphorescent product (name, address, phone, fax);

c) specimen description (clear item identification to make specimens traceable to manufacturer's production batch code);

d) the colour coordinates as measured according to ISO 3864-1;

e) beginning and end of conditioning (day and time);

f) date of measurement;

g) instrument parameters, photometer serial number and the expiry date of calibration;

h) excitation (fill in minutes, type of excitation light source, illuminance in lx);

i) ambient temperature, the surface temperature of the specimen and relative humidity;

j) photometric luminance measurements results. Luminance in mcd/m^2 at 10 min after excitation has ceased, 30 min after excitation has ceased, 60 min after excitation has ceased and the measured or the estimated time in min to reach 0,3 mcd/m^2; list separately for all test specimens and list mean values;

k) test performed by (person's name and title);

l) signature;

m) test location;

n) company performing test (full name, address, phone, fax).

B.9 Marking of phosphorescent materials

Phosphorescent materials shall be marked by the aspects as follows.

a) luminance in mcd/m^2 for 10 min and 60 min after excitation;

b) measured or estimated time to reach 0,3 mcd/m^2;

EXAMPLE Marking, based on the number of this International Standard (ISO 16069), based on value at 10 min (20), value on 60 min (2,8), measured or estimated time to 0,3 mcd/m^2 (340):

ISO 16069 – 20 – 2,8 – 340

Annex C
(normative)

On-site measurement of luminance performance of phosphorescent components of a SWGS

C.1 General

This annex is applicable to the on-site measurement of the luminescence of phosphorescent products.

The excitation illuminance at the phosphorescent product is measured as well as the variation of the luminance with time during the decay period.

C.2 Position of measurement

The measurement positions shall be agreed by the parties involved in the acceptance procedure. The places defined shall be representative in the aspect of illumination and shall cover each of the different types of phosphorescent products used in the installation.

Measurements shall be taken at at least two positions of the same phosphorescent product. These two positions shall be located in areas illuminated by the same type of light source. The same number of measurements shall be taken for each phosphorescent product used in the installation and where the excitation illumination is from a different type of light source.

NOTE Types of illumination are e.g. incandescent lamps, halogen lamps, fluorescent light tubes. For fluorescent light tubes and their colour temperature, it can be necessary to measure per each type of installed temperature of colour.

The width of the guidance line at the points of luminance measurement shall also be measured.

C.3 Measurement conditions

Measurement shall be carried out in the normal conditions on-site, especially in the given conditions of illumination and temperature. The sources of illumination shall be switched on at least 15 min before taking the measurements.

The measuring instrument shall be zeroed prior to start of measurement, then checked immediately after the final measurement.

C.4 Illuminance and luminance measurement instrumentation

C.4.1 Illuminance instrumentation

The illuminance and uniformity shall be determined with a cosine photopic V(λ) corrected illuminance meter calibrated to measure illuminance in lux, with the following features:

— spectral error: $f_1' \leqslant 5$ % (with f_1' as defined in CIE 69);

— UV response: $u \leqslant 0{,}5$ % (with u as defined in CIE 69);

— resolution: 1,0 lx;

— linearity error: $f_3 \leqslant 0{,}5$ % (with f_3 as defined in CIE 69);

— measuring range: 10 lx $\leqslant$ range $\leqslant$ 10 klx;

— light entry diameter of the photometer-head $\leqslant$ 1 cm.

C.4.2 Luminance instrumentation

The luminance shall be determined by a luminance meter calibrated to measure photopic luminance, with the following minimum features:

— spectral error: $f_1' \leqslant 5$ % (with f_1' as defined in CIE 69);

— UV response: $u \leqslant 0{,}5$ % (with u as defined in CIE 69);

— resolution: at least 0,01 mcd/m^2;

— linearity error: $f_3 \leqslant 0{,}5$ % (with f_3 as defined in CIE 69);

— signal-to-noise ratio: at least 10:1 for all measurements;

— measuring range: 10^{-5} cd/m^2 $\leqslant$ range $\leqslant$ 10 cd/m^2;

— display: $\geqslant$ 3,5 digits, range: $0{,}001 \times 10^{-2}$ cd/m^2 $\leqslant$ range $\leqslant$ 19,99 cd/m^2.

C.4.3 Calibration of measurement instruments

The illuminance and luminance instruments shall have been calibrated.

C.5 Excitation light source and illumination measurement

Excitation of the phosphorescent specimens shall be by the in-site installed light source. The excitation duration shall be 15 min or as considered appropriate for the type of building, occupation conditions, and the normal lighting conditions.

In order to measure the illuminance at the phosphorescent product, the light incidence area of the photometer head shall be placed in front of the phosphorescent product, parallel to its surface, at the place where the luminance shall be measured next. The illuminance meter shall meet the specifications of C.4.1.

C.6 Luminance measurements

C.6.1 General

After finishing the illuminance measurement and before starting the luminance measurement, a waiting period of 5 min shall be observed. In this period the phosphorescent product shall be again exposed to the existing illumination conditions for excitation.

An analogue comport and/or a computer interface for report-generation are useful. The use of a thermo-stated photometer head is recommended, provided that the surrounding temperature is $<$ 15 °C.

C.6.2 Measurement of luminance

The luminance measurements shall be carried out using the luminance meter specified in C.4.2, using either the telephotometer method given in C.6.2.1 or the contact method given in C.6.2.2.

C.6.2.1 Telephotometer method

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 area of the test specimen to be evaluated shall be sufficient for the luminance meter to give a luminance reading at low luminance levels.

Where possible, an area of the test specimen at least 30 mm in diameter should be evaluated.

C.6.2.2 Contact method

The measurement head of the luminance meter shall be placed on the surface of the test specimen. The influence of ambient light shall be avoided by covering the test specimen's surface outside/around the luminance measurement head with a light protecting material. The area of the test specimen to be evaluated shall be sufficient for the luminance meter to give a luminance reading at low luminance levels.

Where possible, an area of the test specimen at least 30 mm in diameter should be evaluated.

The luminance shall be determined by measuring illuminance and converting to luminance, according to the following equation:

$$\bar{L} = E/\Omega_{\mathrm{p}}$$

where

$\bar{L}$ is the average luminance, expressed in cd/m^2, of the test specimen measured;

E is the illuminance, expressed in lux (lx), of the place determined on the light incidence area of the photometer head used;

Ω_{p} is the projected solid angle which the tested surface of the measuring object takes, expressed in steradians (sr), viewed from the middle of the light incidence area of the photometer head.

The projected solid angle Ω_{p} follows the equation:

$$\Omega_{\mathrm{p}} = \pi\left[1+\left(r/R\right)^2\right]^{-1}\Omega_0$$

where

Ω_0 is the unit solid angle, Ω_0 = 1 sr;

r is the distance, expressed in millimetres (mm), between the light incidence area of the photometer head and the measuring object;

R is the radius, expressed in millimetres (mm), of the plane of the tested surface of the measuring object.

C.6.3 Effect of extraneous light

Extraneous light shall not be allowed to enter the light aperture of the photometer head or the surface of the phosphorescent product being measured unless it is not possible to exclude it or its influence can be corrected.

NOTE Extraneous light is caused by artificial light or daylight on the measured object and reflection or transmission respectively through it. This causes the impression that the luminance of the measured object is higher than that from the phosphorescence. Additional extraneous light can also be caused by the incidence of artificial light or daylight falling on the light aperture surface of the photometer head used for the measurement.

C.6.4 Measurement procedure

The luminance of the phosphorescent product shall be measured 2 min, 10 min, 30 min and 60 min after the excitation period and shall be recorded for each measuring point/test sample.

C.7 Test report

A test report containing at least the following data shall be drawn up for each measuring point:

a) reference to this International Standard (“Measurement in accordance with ISO 16069:2004”);

b) place of measuring (e. g. address, building, plan indication);

c) place of measurement according to measurement point list;

d) type of phosphorescent product;

e) exact location of the measurement point;

f) width of the guidance line;

g) size of measuring area;

h) surrounding temperature at the time of measuring;

i) illuminance in lux on the phosphorescent product;

j) time of excitation (see C.5);

k) light source of at the place of measurement;

l) luminance in mcd/m^2 with relevant time in minutes;

m) measurement instrument, manufacturer, type;

n) date and time of measurement;

o) signature, auditors name, and address of the institution carried out the measurement;

p) notes.

Bibliography

[1] ISO 17724, *Graphical symbols — Vocabulary*

[2] IEC 60364-7, *Electrical installations of buildings — Part 7: Requirements for special installations or locations*

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