INTERNATIONAL STANDARD

ISO 16069

Second edition
2017-11

Graphical symbols — Safety signs — Safety way guidance systems (SWGS)

Symboles graphiques — Signaux de sécurité — Systèmes de guidage pour cheminement d'évacuation de sécurité

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Reference number
ISO 16069:2017(E)

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

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

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

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

This document was prepared by Technical Committee ISO/TC 145, *Graphical symbols*, Subcommittee SC 2, *Safety identifications, signs, shapes, symbols, and colours*.

This second edition cancels and replaces the first edition (ISO 16069:2004) which has been technically revised.

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

a) the component luminance requirements of the electrical systems have been updated;

b) the component luminance and dimensions of non-electrical phosphorescent systems have been updated;

c) the document and its requirements have been simplified to improve ease of use and eliminate ambiguity;

d) all example figures which by definition could not cover all arrangements have been removed;

e) an informative annex for designers of non-electrical phosphorescent systems regarding observation distances has been added.

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Introduction

Safety way guidance systems need to be standardized so that they communicate the information necessary to allow people to be able to evacuate a building efficiently and, if necessary, to assemble in designated safe areas in cases of fire or other emergencies.

Through the consistent and uniform international application of common SWGS design principles, persons in all countries will be better able to recognize and follow the directional information provided by such systems to assist in providing a safe evacuation. As an additional benefit, a standardized SWGS will assist fire fighters and other rescue teams to evacuate occupied areas during emergency situations.

In order to communicate safety way guidance information efficiently across language barriers, the systems defined in this document incorporate the use of graphical symbols and markings such as arrows, conforming to ISO 7010 and ISO 3864-3.

Illumination of escape routes is not part of the SWGS and is therefore not covered by this document; a SWGS is not intended to replace emergency escape lighting. There will be certain situations where emergency escape lighting is not needed, and other situations, for example where smoke is present, where emergency escape lighting can lose its efficiency and a SWGS will be more effective in assisting emergency evacuation, but it is generally recommended that SWGS be used in combination with the illumination of escape routes to provide additional benefits for the whole system.

The principles given in this document are intended to provide consistent design elements irrespective of whether they use electrically powered or phosphorescent components. Consistent use will improve public awareness of the systems and assist rapid recognition and effectiveness in the case of an emergency.

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Graphical symbols — Safety signs — Safety way guidance systems (SWGS)

IMPORTANT — The colours represented in the electronic file of this document can be neither viewed on screen nor printed as true representations. For the purposes of colour matching, see ISO 3864-4 which provides colorimetric and photometric properties together with, as a guideline, references from colour order systems.

1 Scope

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

This document 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 document 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 document also does not include the special considerations of possible tactile or audible components of SWGS, nor does it include requirements for high mounted components of the emergency escape route lighting, especially the design and application of emergency escape route lighting.

This document 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 document is not to be used for ships falling under regulations of the International Maritime Organization (IMO).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3864-1, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs and safety markings*

ISO 3864-3, *Graphical symbols — Safety colours and safety signs — Part 3: Design principles for graphical symbols for use in safety signs*

ISO 3864-4:2011, *Graphical symbols — Safety colours and safety signs — Part 4: Colorimetric and photometric properties of safety sign materials*

ISO 7010:2011, *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 23601, *Safety identification — Escape and evacuation plan signs*

IEC 60364-5-56, *Low-Voltage electrical Installations — Part 5-56: Selection and erection of electrical equipment — Safety services*

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

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3 Terms and definitions

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

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

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

— IEC Electropedia: available at http://www.electropedia.org/

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

3.2
dead end
corridor, or part of a corridor whose depth is greater than its width from which there is only one escape route

[SOURCE: ISO 15370:2010, 3.5]

3.3
emergency escape lighting
that part of *emergency lighting* (3.4) that provides illumination for the safety of people leaving a location or attempting to terminate a potentially dangerous process before doing so

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

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

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

[SOURCE: ISO 3864-1:2011, 3.2]

3.6
guidance line
line of luminous material on or close to the floor provided to clearly delineate an escape route or define an escape path through an open area

3.7
high location
installation position above doors or at or close to ceiling level for safety signs and other safety way guidance components

3.8
intermediate location
installation position between a *low location* (3.9) and a *high location* (3.7) especially at eye level for safety signs and other safety way guidance components

3.9
low location
installation position at or close to floor level for safety signs and other safety way guidance components

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3.10
luminance contrast
<SWGS> luminance of the brightest element of the safety way guidance component divided by the luminance of the surrounding environment

3.11
marking
method of highlighting and identifying specific building components or equipment

3.12
observation distance
l
<sign> distance from which a sign is identifiable and conspicuous

3.13
observation distance
l
<guidance lines, door frames> distance from which *guidance lines* (3.6) and door frames are visible

3.14
period of use
time over which the safety way guidance system is expected to be operational

3.15
phosphorescent material
material incorporating phosphors that, if excited by UV or visible radiation, store energy, which is emitted as light over a period of time

Note 1 to entry: A phosphorescent sign is the same as "photoluminescent" commonly used in the literature of the photoluminescent safety sign industry.

[SOURCE: ISO 3864-4:2011, 3.12, modified — Note 1 to entry has been added.]

3.16
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

[SOURCE: ISO 3864-1:2011, 3.12]

3.17
safety way guidance system
SWGS
system that provides luminous markings and direction information for the safety of people leaving a location

3.18
sign height
diameter of a circular geometric shape or height of a rectangular or triangular geometric shape

Note 1 to entry: Registered safety sign originals in ISO 7010 are in a uniform 70 mm size with corner marks to enable accurate enlargement and reduction scaling. A border is not shown.

[SOURCE: ISO 3864-1:2011, 3.13, modified — Note 1 to entry has been added.]

3.19
supplementary sign
sign that is supportive of a safety sign and the main purpose of which is to provide additional clarification

[SOURCE: ISO 3864-1:2011, 3.14]

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4 Planning a SWGS

This document provides guidelines for the installation of the guidance system in buildings where it has been decided as the result of risk assessment to install a luminous safety way guidance system.

Since SWGS 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:

a) the characteristics of the exit path of the horizontal and stairwell sections of the defined escape route and exit paths to them, including through open areas;

b) the location of emergency exit doors and how the door frame can be marked and the placement of escape route signs;

c) the location of assembly stations and refuge areas;

d) the location of all possible escape routes (emergency stairwell, escape windows, ladders);

e) the location of escape and evacuation plan signs at a prominent place;

f) the location of hazards such as machinery, dangerous goods, steps and obstacles;

g) the location of safety equipment and fire equipment;

h) the characteristics of the installed emergency lighting in terms of designed illuminance performance and duration;

i) the location and type of high mounted emergency exit signs installed as part of the emergency lighting system;

j) for phosphorescent systems, the type of light source of the normal and emergency lighting and designed/*in situ* illuminance at potential placement of guidance lines and safety signs;

k) for phosphorescent systems, the time management of the normal light sources in the location (occupancy floor and stairwells) for phosphorescent components to be sufficiently exposed to an illumination source in order to function in dark surroundings;

l) for electrically powered systems, the potential locations for the independent power supply, the potential locations for routing of the power cables and devices for detection of failure of power supply and/or smoke;

m) 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;

n) the fire compartmentalization provisions;

o) the location of opening devices for doors, e.g. sliding doors, door handle, push bars, emergency push buttons;

p) the design of existing escape route signs.

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5 Basic principles for the design of SWGS

5.1 Design objectives

5.1.1 General

Safety way guidance systems shall provide the users of the building with consistent, coherent information so that they can be evacuated efficiently from any occupancy unit to a safe area.

Luminous safety way guidance systems can be installed in addition to high located emergency lighting and its associated high located escape route signs. Safety way guidance systems shall be installed and activated in all risk situations that have been defined by risk assessments. Examples of situations include blackout of the exit path and escape route signs due to potential failure of the power supply to the escape route lighting or the risk of smoke obscuring the exit path and emergency exit doors.

The approach of both phosphorescent or electrically powered safety way guidance systems is luminous marking of the exit path and changes of level of the emergency exit path, not the illumination of the floor or steps. Consequently, for the safety way guidance systems specified in this document there is not a requirement to specify the horizontal illuminance on the centre line of the escape path or vertical illuminance at safety equipment.

Activation/charging of phosphorescent components to produce light emission in dark surroundings requires pre-exposure of the components to the installed light sources. The luminance performance during the decay mode of the phosphorescent components depends upon the light spectral characteristics of the light source, the excitation illuminance at the location of the phosphorescent component and the duration of the excitation.

All the components of an activated safety way guidance system shall have a luminance contrast with the surroundings of >3 when in use and for at least the time allocated for escape in clear air conditions.

For the same performance of luminous material, the observation distance for visibility of emergency exit door marking is longer than the distance for identification of the escape route sign at the exit door.

In conditions of smoke on the emergency exit path, the light from luminous way guidance components is attenuated exponentially with smoke density and light is scattered producing a luminous veil. As the smoke density increases, an emergency exit door may no longer be visible but the guidance lines and escape route signs in short distance from the evacuee can be visible to direct evacuees towards an emergency exit door. In smoke conditions evacuees may bend forward or crawl, reducing their speed of movement and increasing the evacuation time to a safe area.

The technical design of the different luminous safety way guidance systems is discussed in Clause 6 for electrically powered systems and in Clause 7 for phosphorescent systems.

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 a final point of the escape route and shall preferably be a complete delineation of the boundaries of the escape route.

NOTE 1 Four dots or chevrons per linear metre with diameter of at least 100 mm can be accepted as continuous line.

NOTE 2 The final point of the escape route can be inside or outside the building, depending on the evacuation strategy.

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5.1.3 Visual reinforcement

Escape route signs shall be placed at intervals sufficient to provide consistency and continuity of information.

The frequency and visual reinforcement of escape route signs at intermediate and low location shall be determined by the risk assessment.

Escape route signs positioned at low location shall be close to the way guidance lines or be incorporated in the guidance line, Wherever practical, escape route signs located at 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 of 10 m. The height of the low location guidance lines shall be no higher than 300 mm from the floor, and lower may be preferred.

Intermediate 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.

Escape route signs 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.

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 Destination

Final and intermediary destinations along the escape route such as exit doors on the route and assembly/refuge areas/escape windows shall be given specific emphasis by using SWGS components. Other doors shall not be marked.

5.1.6 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 escape route signs some distance away from the equidistant point.

5.1.7 Dead ends

The frequency of escape route signs at any location shall be increased in dead end areas to progress occupants away from the dead end towards the escape route.

5.1.8 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.

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5.1.9 Multi-level facilities

SWGS in multi-level facilities shall include a floor/level numbering and stair identification system on all levels at each level adjacent to the access point and exit points within the stairwell.

5.2 Guidance lines

Guidance lines together with the luminous marking of the full frame of emergency exit doors are the prime components of a SWGS.

Guidance lines shall be realized by line sources of different sizes and luminances or luminous intensities.

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 300 mm. If a low-located wall guidance line is interrupted, it may be continued at floor level for the duration of that interruption.

An additional horizontal luminous line can be located on the wall at a height between 0,9 m and 1,1 m from the floor to show the configuration of the exit 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.

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 Escape route signs

5.3.1 Design

SWGS designed to this document shall use the safety signs ISO 7010:2011, E001 or ISO 7010:2011, E002 for emergency exit together with the appropriate supplementary arrow type D from ISO 3864-3 for directional purposes (see Figure 1).

The escape route sign does not indicate the decisions or direction that should be made on the other side of the door. Meanings of escape route signs are given in Figure 1 and Figure 2.

NOTE 1 The addition of supplementary text to a safety sign increases the size and can make the sign more conspicuous.

The colour of escape route signs shall meet the colorimetric and photometric specifications of ISO 3864-4 under its specified test conditions related to escape route signs being externally illuminated or being internally illuminated by electrical power.

NOTE 2 ISO 3864-4 defines colour under certain test conditions and not all conditions of observation of safety signs. Phosphorescent escape route signs during the luminance decay mode lack colour recognition of the green, however they are designed such the luminance contrast enables the graphical symbols to be /remain identifiable.

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NOTE 3 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.

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 at door (indicating direction of travel). c) Proceed forward and up from here (indicating change of level).			

Figure 1 *(continued)*

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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 to the right from here (indicating direction of travel).			
Proceed to the left from here (indicating direction of travel).			
Proceed down from here (indicating change of level).			

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

Figure 2 — Example of escape route sign for floor marking

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5.3.2 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 in Figure 1 and Figure 2) shall be used exclusively to indicate the direction to be followed by occupants. The safety signs E001 and E002 specified in ISO 7010 shall always be used with a supplementary arrow and shall be consistently displayed at all installed positions on the escape route according to be meanings give in Figure 1. All exit signs at emergency exit doors on the escape route shall be used with an arrow pointing upward, meaning "forward and through from here".

5.3.3 Installed position

The exact meaning of an escape route sign is dependent 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.

Escape route signs at intermediate height location 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 escape route sign at an emergency exit door is not possible within the observation distance, a series of escape route signs shall be provided to assist progression toward the emergency exit. For escape route signs in intermediate location, between 1,2 m and 1,8 m height above the floor, the maximum distance between these escape route signs shall be 10 m.

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Escape route signs at emergency exit doors shall be mounted on the door frame or the wall next to the door opening device at a height between 1,2 m and 1,5 m above the floor.

Escape route signs shall not be mounted on the door leaf of an exit door. Near the door leaf of an exit door an escape route sign shall be mounted on or adjacent to the guidance line.

Where escape route signs below 1,2 m from the floor are provided to accompany the guidance line, escape route signs, 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. Where these accompanying escape route signs are installed on a wall, the centre of the escape route sign shall be not higher than 0,7 m above the floor.

Escape route signs can be mounted directly on the wall, when the floor guidance line is not more than 0,5 m from the wall. The position of the escape route sign shall be in this case not higher than 0,3 m from the floor.

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

5.4 Signs, markings and plans

5.4.1 Marking of stairs, ramps and ladders

All nosing of steps, including single steps, shall be marked across the stair width. On ramps, the location of changes of level shall be marked.

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

5.4.2 Marking of emergency exits

The door frame of emergency exit doors in the course of escape routes and final emergency exit doors shall be marked.

The frame of emergency windows shall be marked.

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

Doors other than emergency exit doors shall not be marked.

If an escape route sign is incorporated in a door marking system it shall be positioned at the height of the door-opening device.

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

Safety signs for fire-fighting equipment and safety equipment shall conform to ISO 7010 and 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.

5.4.4 Marking of hazards along the escape route

Warning signs conforming to ISO 7010 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.

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5.4.5 Marking 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 identified by the safety sign in accordance with ISO 7010 (see ISO 7010:2011, E007). Escape route signs shall lead occupants from all exits to assembly areas.

5.4.6 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 in accordance with ISO 7010 (e.g. ISO 7010:2011, E024, "Evacuation temporary refuge" or ISO 7010:2011, E060, "Evacuation chair").

5.4.7 Escape and evacuation plan signs

The escape and evacuation plan sign shall be designed in accordance with the evacuation strategy of the facility and address the specific needs of the occupants of the premises or part thereof. Escape and evacuation plan signs shall be in phosphorescent material of luminance properties no less than luminance values in Tables 1 and 2.

The Installation, location and the design principles for displayed escape and evacuation plan signs shall follow ISO 23601.

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 exit.

Escape and evacuation plan signs shall be located so that they are conspicuous in their environment of use and sited to ensure that they are accessible and readable to the intended user. These plans shall be permanently fixed.

5.4.8 Access platforms

On industrial access platforms around machinery, piping, which are on an escape route, SWGS shall be installed on the edge/shovel plate or on the grating. The position of escape ladders, escape hatches and other evacuation facilities shall be clearly marked.

6 Specific requirements for electrically powered components

6.1 General

Safety way guidance systems based on electrically powered components shall be provided with an alternative safety power source 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.

The design of the guidance line and escape route signs shall be in accordance with the design principles of 5.2 and 5.3. Where there is direct line of sight along the length of the guidance line and a marked emergency exit door, the guidance line shall be visible for a distance of at least 10 m and the emergency exit door shall be visible from a distance of at least 30 m.

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6.2 Requirements for guidance lines and escape route signs

6.2.1 Escape route sign luminaire

The minimum height of the escape route sign shall be 50 mm. The average luminance of the white contrast colour shall be no less than 500 cd/m^2. If smoke penetration and/or bright surroundings are not primary considerations, the luminance may be reduced to 20 cd/m^2.

6.2.2 Guidance lines made by point sources and accompanying escape route signs

The spacing between the point sources shall be ≤200 mm. Point sources are light sources with a light emitting area of less than 100 mm^2.

The luminous intensity of point sources used for guidance lines shall be ≥100 mcd. If smoke penetration and/or bright surroundings are not primary considerations, the luminous intensity shall be reduced to ≥30 mcd.

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

Escape route signs shall be placed adjacent to or integrated in the guidance lines.

6.2.3 Guidance lines made by line sources and accompanying escape route signs

The luminance of line sources used for guidance lines shall be ≥ 20 cd/m^2.

If smoke penetration and/or bright surroundings are not primary considerations, the luminance may be reduced to 2 cd/m^2.

The colour of the guidance line shall be green or white.

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

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

Escape route signs may be placed adjacent to or integrated in the guidance lines. If the width of the line source is ≥30 mm the graphical symbols of the escape route sign may be placed directly on the line source.

In connection with white line sources the white colour of the escape route sign shall have at least the same luminance as the line source.

6.2.4 Guidance lines made of discrete luminaires

The discrete luminaires shall have minimum dimensions of 50 mm × 100 mm.

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.

6.3 Marking

6.3.1 Marking of stairs and ramps

All nosings of steps shall be marked across the stair width by light-emitting strips consisting of line or point sources.

On ramps, the locations of the changes in level shall be marked across the ramp width by light-emitting strips consisting of line or point sources.

On stairs and ramps, handrails or balustrades shall be marked by a continuous line of light emitting material, with no gap greater than 100 mm to aid the use of the handrails.

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The top of guarding on open stairways or ramps shall be marked by a continuous line of light emitting material, with no gap greater than 100 mm.

An additional horizontal light-emitting strip can be located on the wall of the landing to aid identifying the wall boundaries and configuration of the stairway.

6.3.2 Marking of emergency exits

Exit doors in the course of escape routes and final emergency exit doors shall be marked. The top and vertical sides of the door frame shall be marked by a continuous line of luminous performance in accordance with 6.2.1 and 6.2.2. Where the door moulding does not provide enough flat surface on which to locate the marking, the marking may be located on the wall surrounding the frame.

The door frames of other doors (non-emergency exit doors) shall not be marked.

An escape route sign shall be positioned at the emergency exit door, on the wall on side of the door opening device and at a height between 1,2 m and 1,5 m the floor. An escape route sign shall not be fixed on a door leaf.

Where the angle of viewing of the escape route sign is not predominantly normal to the escape route sign, the effect of angle of viewing should be taken into account, see ISO 3864-1:2011, Table A.2. For luminance based escape route signs, the factor of distance, z_0, shall be multiplied by the cosine of the angle of viewing to the normal to the escape route sign.

Other doors (non-emergency exit doors) shall not be signed with an escape route sign or other marking signs.

6.3.3 Marking of hazards along the escape route

The exit path guidance line shall lead occupants around obstacles and any protruding architectural features. Additionally a vertical luminous line shall mark protrusions.

6.4 Emergency power supply and operating conditions for the electrical components

The power supply to the safety way guidance system shall be independent of that for the escape route lighting. The system shall function when an alarm is given either by automatic detection or by manual switching. In addition, risk assessment shall determine whether the system is to function in the event of activation of the emergency lighting system and/or in the event of failure of the power supply to the escape route lighting.

The emergency power supply and operating conditions shall conform to IEC 60598-2-22 and IEC 60364-5-56.

If a central power supply is used, the components shall be fed alternatively from at least two circuits according to IEC 60364-5-56.

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

6.5 Documentation and logbook

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

— acceptance protocol;

— installation plan for SWGS;

— type and capacity of power supply and lamps;

— all modifications and results of inspection/maintenance;

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— supportive supplier data (e.g. certificates and test data);

— inspection protocol.

6.6 Inspection and maintenance

Inspection and maintenance shall be carried out in accordance with IEC 60364-5-56.

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.

Safety way guidance systems based on phosphorescent components shall be charged by the *in situ* lighting to enable the components to emit light during any occurrence of a black-out for a duration defined by the risk assessments. The charging shall be by the normal lighting or emergency lighting for a minimum length of time to ensure appropriate luminance performance of the phosphorescent components in any subsequent occurrence of a darkened environment. During the black-out, low location guidance lines on the emergency exit path shall be visible all the way from the working or occupied area to the safe area.

Escape route signs located along the exit path shall display the direction to exit doors which shall be identified by an escape route sign and door frame marking.

When the SWGS is charged, the minimum luminance requirements given in 7.2 shall be met during the defined duration period. Components used in the escape route system shall have at least the same luminance performance as the exit path guidance lines.

Light sources with a large blue light component are preferable for excitation/charging; lamps with a large red light component and sodium-vapour lamps are less suitable. The manufacturer's information shall be taken into account when selecting suitable phosphorescent products for excitation.

7.2 Luminance requirements for phosphorescent components of a SWGS

7.2.1 Minimum luminance properties

When tested in accordance with Annex A, 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	140
60	20
1 800	0,3

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7.2.2 Minimum luminance required in installed position

The minimum luminance values specified in Table 2 shall be achieved after 10 min, 60 min and 90 min from the withdrawal of the *in situ* excitation illumination. The manufacturer's information from testing according to Annex A using a type of lamp representative of the in-site luminaires and duration of excitation illuminance shall be taken into account or *in situ* luminance measurements shall be made according to Annex B.

Table 2 — Minimum requirements for luminance of installed components

Time from withdrawal of excitation illumination min	Luminance mcd/m^2
10	≥30
60	≥7
90	≥5

NOTE The luminance properties of installed components depends on the inherent performance of the phosphorescent material and the level and type of excitation illumination and its duration provided immediately prior to use.

7.3 Guidance lines and escape route signs and their location within a SWGS

7.3.1 Guidance lines

Phosphorescent materials shall be used in guidance lines on floors or on walls to delineate the entire length of the escape route. These (phosphorescent) materials shall meet the specifications set out in Clause 5 (in particular those in 5.2) and the requirements for minimum luminance performance set out in 7.2.

The minimum width of a guidance line on the floor or wall shall be 50 mm. In stairwells the minimum width shall be 20 mm due to the reduced viewing distances. Along large open areas or where one boundary of the area has a drop such as train platforms, a guidance line of not less than 100 mm may be installed along the centre of the escape path.

NOTE The visible length of a guidance line depends on the luminance, width and orientation/location of the guidance line with respect to the eye-level of the observer, see Annex C.

An additional horizontal phosphorescent strip of width not less than 20 mm can be located on the wall at a height of 0,9 m to 1,1 m to aid identifying the wall boundaries and configuration of the exit route.

7.3.2 Escape route signs

Escape route signs shall be installed with phosphorescent materials in accordance with Clause 5, specifically 5.3 and minimum luminance performance given in 7.2 on floors, walls and at emergency exit doors.

Escape route signs on the floor or within a floor guidance line shall have a sign height of not less than 50 mm. An escape route sign shall be positioned at exit doors, on the wall on side of the door opening device and at a height of not less than 1,2 m from the floor. The minimum sign height shall be not less than 150 mm.

NOTE The identification distance of an escape route sign depends on the luminance, height and orientation/location of the escape route sign with respect to the eye-level of the observer, see Annex C.

An escape route sign shall not be fixed on a door leaf. Other doors (non-emergency exit doors) shall not be signed with an escape route sign.

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7.4 Marking

7.4.1 Marking of stairs, ramps and ladders

All nosings of steps shall be marked across the stair width by phosphorescent strips of width of 20 mm to 50 mm and minimum luminance performance as specified in 7.2. Such markings shall be produced to provide neither trip nor slip hazards.

On ramps, the locations of the changes in level shall be marked across the ramp width by a strip of phosphorescent material of width not less than 20 mm.

On stairs and ramps, handrails or balustrades shall be marked by a continuous strip of phosphorescent material of width of 20 mm to 50 mm, with no gap greater than 100 mm to aid the use of the handrails.

An additional horizontal phosphorescent strip of width not less than 20 mm can be located on the wall of the landing to aid identifying the wall boundaries and configuration of the stairway.

The top of guarding on open stairways or ramps shall be marked by a continuous strip of phosphorescent material of width not less than 20 mm, with no gap greater than 100 mm.

Ladders shall be marked on both sides of the inside vertical parts between the rungs or by one vertical line on the bulkhead behind the ladder.

7.4.2 Marking of door frames of emergency exits

Emergency exit doors in the course of escape routes and final emergency exit doors shall be marked. The top and vertical sides of the door frame shall be marked by a continuous strip of phosphorescent material of not less than 20 mm width of minimum luminance performance in accordance with 7.2. Where the door moulding does not provide enough flat surface on which to locate the marking, the marking may be located on the wall surrounding the frame.

NOTE The visibility distance of a vertical door frame marking depends on the luminance, width and location of the vertical marking with respect to the position of the observer, see Annex C.

The door frames of other doors (non-emergency exit doors) shall not be marked.

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

7.4.3 Marking of hazards along the route

The sign height of the warning signs shall be at least 150 mm and minimum luminance performance as specified in 7.2.

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.

The exit path guidance line shall lead occupants around obstacles and any protruding architectural features.

7.4.4 Marking of fire-fighting, emergency and safety equipment along the escape route

Safety signs in phosphorescent material shall be provided to locate fire-fighting equipment according to ISO 7010. The sign height of the safety sign shall be at least 150 mm and minimum luminance performance as specified in 7.2.

7.4.5 Floor numbering and stairwell identification for multi-storey building

Phosphorescent stairwell indication signs shall have luminescent properties as for phosphorescent guidance lines in 7.3.1 and not less than luminance values in Tables 1 and 2.

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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 B. The illuminance shall be measured at 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 7.2 or higher values specified for the installed width of phosphorescent guidance line.

Manufacturers and installers shall provide luminance performance data for all installed components as tested in accordance with Annex A 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 includes, for example:

— acceptance protocol;

— installation plan for SWGS;

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

— all modifications and results of inspection/maintenance;

— supportive supplier data (e.g. certificates and test data);

— inspection protocol;

— reference samples of the materials used.

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.

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Further procedures for maintenance of safety-related luminaires are to be in accordance with national requirements. Further information and methodology are given in IEC 60364-5-56.

The *in situ* luminance performance shall be measured, according to Annex B. The luminance values shall be checked against the minimum luminance values at 10 min, 60 min and 90 min according to Table 2. If the luminance values are below the values according to 7.2, 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.

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Annex A
(normative)

Measurement of photopic luminance of phosphorescent components in the laboratory

A.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.

A.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.

A.3 Ambient conditions

The ambient temperature during preconditioning of test specimens, excitation and luminance testing shall be 23° C ± 2° C. The relative humidity shall be (50 ± 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.

A.4 Illuminance and luminance instrumentation

A.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: $f_1' \leq 5$ % (with f_1' as defined in ISO/CIE 19476);

— UV response: $u \leq 0{,}5$ % (with u as defined in ISO/CIE 19476);

— resolution: 1,0 lx;

— linearity error: $f_3 \leq 0{,}5$ % (with f_3 as defined in ISO/CIE 19476);

— measuring range: 10 lx ≤ range ≤ 10 klx;

— light entry diameter of the photometer-head: ≤1 cm.

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A.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 A.6.2) or the contact method (see A.6.3) is used, and shall have the following minimum features:

— spectral error: $f_1' \leq 5$ % (with f_1' as defined in ISO/CIE 19476);

— UV response: $u \leq 0{,}5$ % (with u as defined in ISO/CIE 19476);

— resolution: at least 0,01 mcd/m^2;

— linearity error: $f_3 \leq 0{,}5$ % (with f_3 as defined in ISO/CIE 19476);

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

— measuring range: 10^{-5} cd/m^2 ≤ range ≤ 10 cd/m^2;

— display: ≥3,5 digits, range: 0,001 × 10^{-2} cd/m^2 ≤ range ≤ 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.

A.5 Excitation light conditions

A.5.1 Excitation light conditions for classification purposes for Table 1

Excitation of the phosphorescent test specimens shall be made until full saturation is reached. Starting from saturation measurement of the luminance values are the same for different light sources of sufficient intensity. Excitation can be achieved using a non-diffusing, unfiltered, continuous short Xenon-arc source of 500 W or less, providing a mean luminance of 1 000 lx on the surface of the sample. 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 maximum illuminance divided by the minimum illuminance of the test patch shall be less than 1,1. The illuminance shall be measured using the illuminance meter as specified in A.4.1.

The excitation duration shall be 5 min. or at least until saturation is reached. Using other light sources than Xenon, such as fluorescent lamps or LED lamps with colour temperatures of about 6500 K, excitation levels and times shall be adapted to obtain full saturation.

The test specimen body shall not exceed 25° C, 1 min after excitation.

A.5.2 Excitation light conditions for product description purposes for Table 2

Excitation of the phosphorescent test specimens shall be carried out according to a specified lamp source of specified colour temperature for a specified duration of illuminance excitation.

The test specimen body temperature shall not exceed 25° C, 1 min after excitation. No ambient or stray light shall be present during excitation. The illuminance shall be measured using the illuminance meter specified in A.4.1.

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 as specified. The ratio of maximum illuminance to minimum illuminance of the test patches shall be less than 1,1.

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A.6 Luminance measurements

A.6.1 General

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

A.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.

A.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.

The luminance shall be determined by measuring illuminance and converting to luminance, according to Formula (A.1):

$$\bar{L} = E / \Omega_p \tag{A.1}$$

where

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

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

Ω_p is the projected solid angle which the tested surface of the measuring object takes viewed from the middle of the light incidence area of the photometer head, in sr.

The projected solid angle, Ω_p, follows Formula (A.2):

$$\Omega_p = \pi \left[1 + \left(r / R \right)^2 \right]^{-1} \Omega_0 \tag{A.2}$$

where

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

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

R is the radius of the plane of the tested surface of the measuring object, in mm.

A.6.4 Luminance recordings

A.6.4.1 Luminance recordings for classification purposes for Table 1

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.

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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 ± 10 s, 10 min ± 10 s, 30 min ± 10 s and 60 min ± 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). log L shall be plotted against log 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 formula is:

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

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:

$$\log t = \frac{\log\left(0,3\right) - k}{p}$$

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). log L shall be plotted against log 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 formula is:

$$\log L = m\left(\log t\right)^2 + n \log t + c$$

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:

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

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.

A.6.4.2 Luminance recordings for product description purposes for Table 2

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.

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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 90 min after the excitation light is removed and shall include measurements (which shall be recorded in mcd/m^2) at 2 min ± 10 s, 10 min ± 10 s, 30 min ± 10 s, 60 min ± 10 s and 90 min ± 10 s for each of the three test specimens.

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

A.7 Determination of the colour under daylight conditions

The colour under daylight conditions shall be tested and verified as specified in ISO 3864-4:2011, Annex B in a separate procedure.

A.8 Test report

A.8.1 Test report for classification purposes for Table 1

The test report shall include the following information:

a) a reference to this document ("Testing/measurement in accordance with ISO 16069:2017");

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

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

d) the classification of emission colour according to ISO 3864-4:2011, Annex B;

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

f) the date of measurement;

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

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

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

j) the photometric luminance measurements results. Luminance in mcd/m^2 at 10 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) the test performed by (person's name and title);

l) signature;

m) the test location;

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

A.8.2 Test report for product description purposes for Table 2

The test report shall include the following information:

a) a reference to this document ("Testing/measurement in accordance with ISO 16069:2017");

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

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

d) the beginning and end of conditioning (day and time);

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e) the date of measurement;

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

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

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

i) the photometric luminance measurements results. Luminance Rating (LR): Luminance in mcd/m^2 at 10 min after excitation has ceased, 60 min after excitation has ceased and 90 min after excitation has ceased; list separately for all test specimens and list mean values;

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

k) signature;

l) the test location;

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

A.9 Marking of phosphorescent materials

A.9.1 Marking for classification purposes for Table 1

Phosphorescent materials shall be marked by the aspects as follows.

a) the number and year of this document;

b) the luminance in mcd/m^2 for 10 min and 60 min after excitation.

EXAMPLE Marking, based on the number of this document (ISO 16069:2017), based on value at 10 min (140), value on 60 min (20):

ISO 16069:2017 – 140 –20

A.9.2 Marking for product description purposes for Table 2

Phosphorescent materials shall be marked by the aspects as follows.

a) the number and year of this document;

b) the code for the condition of illumination;

c) the luminance in mcd/m^2 for 10 min, 60 min and 90 min after excitation.

EXAMPLE Marking, based on the number of this document (ISO 16069:2017), using illumination conditions coded LR (10,4 lx cool white fluorescent for 1 h), based on value at 10 min (30), value on 60 min (7) and value on 90 min (5):

ISO 16069:2017 LR: 30 – 7 – 5

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Annex B
(normative)

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

B.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.

B.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 in 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 incandescent lamps, halogen lamps and 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.

B.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 or as considered appropriate for the type of building, occupation conditions, and the normal lighting conditions.

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

B.4 Illuminance and luminance measurement instrumentation

B.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: $f_1' \leq 5$ % (with f_1' as defined in ISO/CIE 19476);

— UV response: $u \leq 0{,}5$ % (with u as defined in ISO/CIE 19476);

— resolution: 1,0 lx;

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— linearity error: f_3 ≤ 0,5 % (with f_3 as defined in ISO/CIE 19476);

— measuring range: 10 lx ≤ range ≤ 10 klx;

— light entry diameter of the photometer-head ≤1 cm.

B.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' ≤ 5 % (with f_1' as defined in ISO/CIE 19476);

— UV response: u ≤ 0,5 % (with u as defined in ISO/CIE 19476);

— resolution: at least 0,01 mcd/m^2;

— linearity error: f_3 ≤ 0,5 % (with f_3 as defined in ISO/CIE 19476);

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

— measuring range: 10^{-5} cd/m^2 ≤ range ≤ 10 cd/m^2;

— display: ≥3,5 digits, range: 0,001 × 10^{-2} cd/m^2 ≤ range ≤ 19,99 cd/m^2.

B.4.3 Calibration of measurement instruments

The illuminance and luminance instruments shall have been calibrated.

B.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 B.4.1.

B.6 Luminance measurements

B.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. If the surrounding temperature is <15 °C, a thermo-stated photometer head should be used.

B.6.2 Measurement of luminance

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

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B.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.

B.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 Formula (B.1):

$$\bar{L} = E / \Omega_{\mathrm{p}} \tag{B.1}$$

where

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

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

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

The projected solid angle, Ω_{p}, follows the Formula (B.2):

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

where

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

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

R is the radius of the plane of the tested surface of the measuring object, in mm.

B.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.

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B.6.4 Measurement procedure

The luminance of the phosphorescent product shall be measured 10 min, 60 min and 90 min after the excitation period and shall be recorded for each measuring point/test sample.

B.7 Test report

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

a) a reference to this document, i.e. ISO 16069:2017 ("Measurement in accordance with ISO 16069:2017");

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

c) the place of measurement according to measurement point list;

d) the type of phosphorescent product;

e) the exact location of the measurement point;

f) the width of the guidance line;

g) the size of measuring area;

h) the surrounding temperature at the time of measuring;

i) the illuminance in lux on the phosphorescent product;

j) the time of excitation (see B.5);

k) the light source at the place of measurement;

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

m) the measuring instrument used, calibration certificate, manufacturer, type;

n) the date and time of measurement;

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

p) notes.

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Annex C
(informative)

Visibility and identifiability of phosphorescent safety way guidance components and their sizing and location

C.1 Overview

The zone of influence of each component of the SWGS is a visual space which encompasses/contains/encloses the eye positions of people from where a person is able to correctly identify the graphical symbol elements of an escape route sign or line components are visible from a distance.

The size of the viewing sphere depends upon a factor of distance, z_0, the value of which depends on a range of conditions (for example, type of component, luminance of the phosphorescent component in dark conditions and adaptation). Although observers outside the spherical zone of influence may be able to perceive and some correctly identify the graphical symbol of the escape route sign or line component is detectable/visible at and within the spherical zone, a high proportion of observers should be able to correctly identify the graphical symbol elements and detect lengths of line components on walls or floors or at the emergency exit door.

NOTE A spherical zone applies to components with Lambertian luminous characteristics.

The spherical zone is a consequence of the apparent size of detail of the graphical symbol or detail of the line component depending upon the cosine of the observation angle α, measured as the angle from the normal to the detail. As the observation angle becomes further away from the normal/perpendicular to the detail, the distance between the position of the observer's eye and the detail decreases, i.e. the observer needs to move closer to the detail. The spherical zone touches the detail and has a diameter which depends upon the multiplication of the direction indicator height, h, (or width of line component, w), and the value of factor of distance, z_0, appropriate to the detail and luminance (see Figure C.1). For an escape route sign, the sphere has a diameter of z_0h centred at a perpendicular distance of $z_0h/2$ from the escape route. For a line component, the sphere has a diameter of z_0w centred at a perpendicular distance of $z_0w/2$ from the line component.

In the horizontal plane, the zones for visibility of the line components or identification of escape route signs are circular, that is circular horizontal slices through the spherical space of Figure C.1. In the horizontal plane perpendicular to the detail, the radius of the circle, r_0, is given by $z_0h/2$ or $z_0w/2$, as appropriate, and the centre of the circle is at a distance of r_0 perpendicularly from the detail.

When the eye height of the person is above or below the plane containing the radius, r_0, the radius of the horizontal circular zone, r, is smaller than r_0. The value of r, therefore, depends upon the location of detail such as on the floor or wall and height above the floor and the eye-level and position from which the detail is viewed. Values for phosphorescent components are given in Table C.1.

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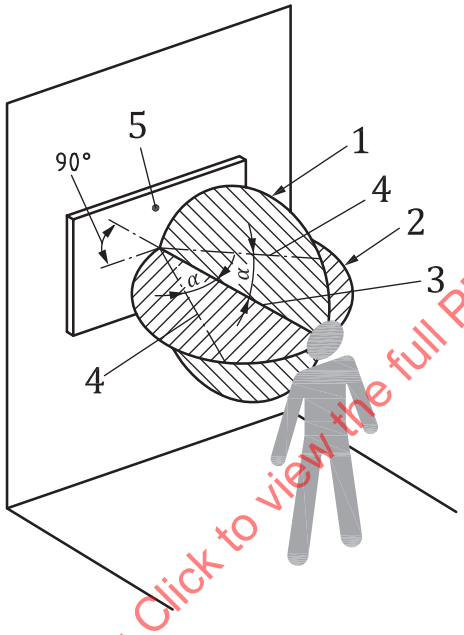
Table C.1 — Values of distance factor, z_0, for phosphorescent components

Luminance	Distance factor z_0	
mcd/m²	**Line component**	**Escape route signs** ISO 7010:2011, E001 **and** ISO 7010:2011, E002
30	1 063	53
7	513	20,5
5	434	16
NOTE 1 For the line component: $z_0 = 194\sqrt{L}$ (L is in mcd/m²).		
NOTE 2 For the escape route sign: For $L \geq 5{,}89$ $z_0 = 16{,}66 + 51{,}3 \log_{10}(L/5{,}89)$.		
For $L < 5{,}89$ $z_0 = 16{,}66 + 9{,}72 \log_{10}(L/5{,}89)$.		



Key

1 vertical ring of diameter z_0h or z_0w
2 horizontal ring of diameter z_0h or z_0w
3 observation distance normal to safety sign or vertical door frame marking, z_0h or z_0w
4 observation distance at angle α to normal $z_0h\cos\alpha$ or $z_0w\cos\alpha$
5 plane of safety sign or vertical door frame marking

Figure C.1 — Spherical zone of influence for identification of escape route sign or visibility of vertical door frame marking

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C.2 Examples of circular visibility areas for phosphorescent line components

C.2.1 Vertical door frame marking (full height)

Figures C.2 a) and C.2 b) show the circular visibility areas for vertical door frame marking (full height) of 20 mm width and luminance of 30 mcd/m² and 7 mcd/m², respectively. The vertical door marking is positioned at coordinates (1,5 m, 0 m) and the viewing height is 1,7 m (eye-level) above the floor. The circles have a radius r_0 (in m) of $z_0w/2\,000$, where w is in mm and centred on coordinate (1,5, r_0). The appropriate value for z_0 is given in Table C.1. Figures C.2 a) and C.2 b) show the circular visibility areas after 10 min and 60 min of decay time, respectively, for door frame marking of 20 mm meeting the luminance performance in Table 2. In this example, the viewing is horizontal and level with the eye.

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