



PSA / PSPA Guide to the Use of Photoluminescent Safety Markings

Part One: Egress Markings In Stairwells

August 2008

Forward

The foundation of this guide is based on a recommendation submitted to the NYC Buildings Department on October 8, 2004 by the NYC Building Code Photoluminescent Egress Markings Taskforce. This taskforce was assembled to assist the NYC Buildings Department with the writing of a specification for the use of photoluminescent directional egress markings in stairwells to fulfill the legal mandate for such markings created by Local Law 26, a law that was a direct result of the World Trade Center 9/11 Taskforces' recommendations to improve the safety of high-rise buildings. After eight months of research, the NYC Buildings Department released the NYC Building Code's Reference Standard 6-1 on May 31, 2005. This standard incorporated much of the Taskforce recommendations' proposals. It is a credit to the City of New York that the combined knowledge and experience of the taskforce members in the field of photoluminescence and fire safety were recognized. The NYC code requirement for photoluminescent markings in all commercial high-rise buildings had a deadline for completed installation by July 1, 2006.

Subsequent to the installation of NYC's code requirement, members of the PSA and PSPA reviewed and updated the initial taskforce recommendation to reflect current best practice. Additionally, in October 2006 a field study was conducted by the National Research Council of Canada testing the effectiveness of various configurations of photoluminescent stairwell markings during a building evacuation as compared to emergency lighting (<http://www.plsafety.org/documents/CanadianStudy.pdf>).

This document is thus the result of an expert taskforce recommendation, practical installation knowledge gained from installing these systems in over 2000 high-rise buildings, and a highly regarded evacuation research study.

The publication of this guide by the PSA and PSPA is done with the intention that it will assist other building code writing authorities and building owners with the task of making their buildings safer and ultimately, in saving the lives of people during times of emergency evacuation.

Future parts in this series of guides will define best practices for photoluminescent safety markings in a variety of commercial/industrial spaces including corridors leading to the stairwells, office spaces, warehouses, sports arenas, and theaters/auditoriums.

About the PSA and PSPA

The Photoluminescent Safety Association was founded in 2006 as an industry organization dedicated to the goal of generating broad-based acceptance of safety-grade photoluminescent products by safety professionals. The Photoluminescent Safety Products Association was formed in 1991 and is the international industry organization for photoluminescent safety products.

NYC Building Code Photoluminescent Egress Markings Taskforce Members August – October 2004

The majority of this guideline was written by a multi-disciplinary taskforce set up in 2004 to provide a recommendation to the NYC Buildings Department concerning the placement and performance characteristics of photoluminescent markings in stairwells. The taskforce members listed below were chosen in 2004 on the basis of expertise demonstrated by their prominent roles on directly applicable standards-writing committees including NFPA, ASTM, ISO, ANSI and UL. The fields of research covered by the taskforce members include human behavior during egress, the visibility of photoluminescent materials, the design and standardization of safety signs and markings, the construction of stairwells, fire safety and emergency planning, the properties of photoluminescent materials, and the installation of safety markings.

Chair: Geoffrey Peckham, Chairman U.S. TAG to ISO/TC 145; Chair, ANSI Z535.1 Subcommittee; member ASTM E12 committee, liaison participant in NFPA 170 & UL 924 committees, President, Clarion Safety Systems, LLC.

James D. Amy, Jr., Consultant for Rolf Jensen & Associates, Inc., a subsidiary of The RJA Group, specializing in emergency egress, member U.S. TAG to ISO/TC 145

Marina Batzke, Chair of ASTM E 12.13 on 'Photoluminescent Safety Markings', ASTM 2030, 2072, 2073 standards; member UL924 STP; member ISPSC, General Manager, American Permalight, Inc.

Al Carlson, Chair, International Photoluminescent Safety Products Council (IPSPC); Member ASTM E12 and UL 924 STP , Jessup Manufacturing

Dr. Belinda Collins, Deputy Director, Technology Services, United States Department of Commerce, National Institute of Standards and Technology (NIST)

John Creak - Chair of ISO/TC 145 SC2 WG3 committee (ISO 16069 Safety Way Guidance Systems standard); Chair, British Standards Institute committee on safety signs; Vice-Chair, Photoluminescent Safety Products Association (PSPA), President, Jalite PLC

Jack Murphy, Vice Chairman NYC Fire Directors Association, Managing Director, JJM & Associates, LLC

Jake Pauls, Consultant/Researcher specializing in stairway egress, member NFPA 101 Life Safety Code committee

Guylène Proulx, Ph.D., Senior Researcher, Fire Research, National Research Council of Canada

Michael Shulman, Principle Engineer, Emergency Lighting and Power Equipment, Underwriters Laboratories Inc.

Dr. Gerry Webber, Consultant/Researcher in safety way guidance systems and emergency Lighting; UK expert on ISO/TC 145/SC2/WG 3 Safety Way Guidance Systems, Secretary to ISO/TC 145/SC 2/WG 2 and British Standards committee on material specifications for safety signs (ISO 17398).

Introduction

The specifications set forth in this guide center on the principle that uniform application of photoluminescent safety way guidance marking components will allow persons to better recognize and follow the directional information provided by such systems, thereby providing occupants of buildings with improved safety during times of emergency evacuation. In order to communicate safety way guidance information efficiently and across language barriers, several of the components defined in this code recommendation incorporate the use of graphical symbols that conform to both the NFPA and international ISO standards.

1 Scope

The scope of this specification is limited to the photoluminescent markings appearing immediately outside the entry door to the stairwell, and to the entire length of the egress path once inside a stairwell, including horizontal transfer areas and the final discharge door. The scope does not include electrical exit signs nor does it include the field of emergency lighting.

Note: This guide does not include corridors leading to stairwells in its scope. The use of low located photoluminescent directional safety way guidance sign markings in corridors is important, especially concerning smoke conditions, which are much more likely to occur in open areas than in stairwells at the beginning of incidents involving fire.

Note: This guideline may be amended as needed by local code.

2 Purpose

The purpose of photoluminescent directional safety way guidance sign markings is two-fold: First, during times of evacuation under full or emergency lighting, the directional safety way guidance sign information communicated by the markings will identify the egress path. The goal is to have uniform, consistent markings in buildings to give occupants a greater level of confidence concerning the direction of movement, which, in turn, can result in achieving faster egress speeds to the final exit with less risk of injury.

The second purpose of photoluminescent directional safety way guidance sign markings is to be a supplement to the normal lighting and emergency lighting systems should they fail. In these situations the photoluminescent markings will communicate the visual information necessary for egress during a crisis.

3 Luminance Properties of Photoluminescent Materials

Photoluminescent materials shall be certified by a Nationally Recognized Testing Laboratory as complying with a luminance laboratory test. The test shall be conducted in accordance with one of the standards listed in Annex C.

4 Labeling

All photoluminescent markings shall be permanently marked on the face with identification traceable to the product's technical datasheet. All photoluminescent products that are part of the safety way guidance system shall have technical datasheets available which list all applicable test

data including its luminance specification. On-product markings should be done in accordance with relevant codes or standards (see Annex C).

5 Design of door and directional signs

Unless otherwise specified, all photoluminescent door signs and directional signs referenced herein shall adhere to the following design rules (see Figure 1 and Annex B for illustrations):

5.1 Color

Signs shall be made with the non-photoluminescent portions in safety green as per ISO 3864 or relevant national standard (e.g. ANSI Z535.1-2006, American National Standard for Safety Colors).

5.2 Content

Signs shall include three components:

5.2.1 The word EXIT printed in sans serif letters at least 4" (100mm) high with strokes no less than 0.5" (13mm). 5.2.2 An emergency exit symbol at least 4" (100mm) high complying with E001 or E002 as per ISO 7010 (2003-10-01)/NFPA 170 – 2006.

5.2.3 When used an arrow at least 2.75" (70mm) high (chevron height), complying with E005 and E006 as per ISO 7010/NFPA 170 – 2006.

5.3 Orientation of symbol components

5.3.1 Signs shall show the emergency exit symbol in the correct direction of travel (right or left).

5.3.2 Signs using an arrow shall show the arrow in the correction direction of travel (see Annex B for the eight possible arrow orientations).

5.3.3 Signs shall always show the arrow immediately next to the emergency exit symbol (i.e. the word EXIT shall not be placed between the arrow and emergency exit symbol).



Figure 1 Sign format options: Mounted on entrance door format without arrow (left), Directional safety way guidance sign landscape format (middle), Directional safety way guidance sign portrait format (right)

Note: Sign designs using graphical symbols, arrows and supplementary text may also comply to ISO 3864-1 and/or National Standards where these differ from the recommendations outlined in this guide.

6 Marking of Doors Leading to Stairwells

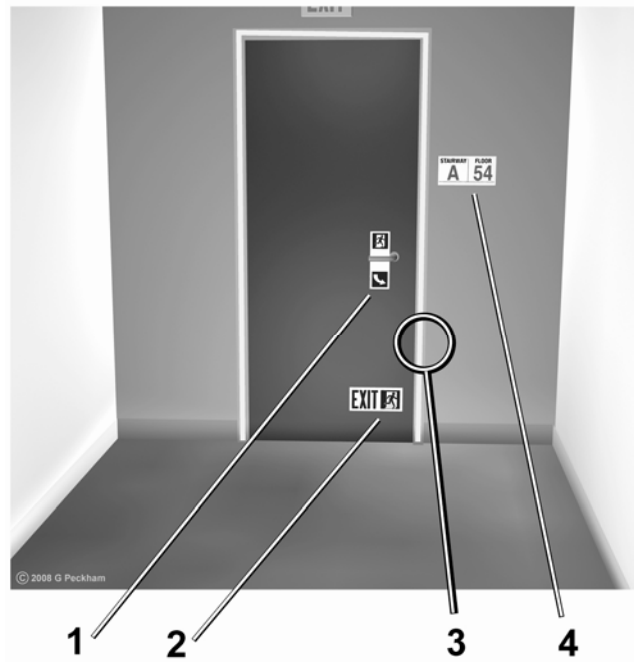


Figure 2a Stairwell Entry Door Photoluminescent Markings:

1. Marking of door handle (shown with optional symbols), 2. Directional safety way guidance sign on door without arrow, 3. Optional door perimeter marking, 4. Optional stairwell/floor identification sign

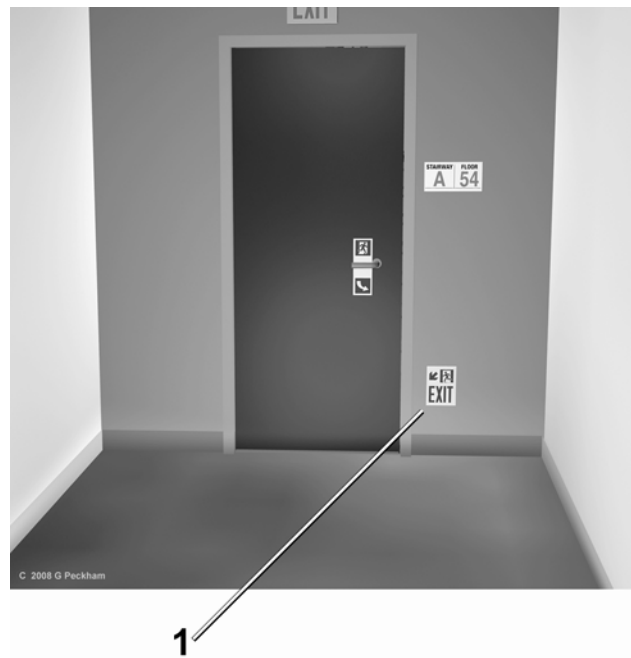


Figure 2b Stairwell Entry Door Photoluminescent Markings:

1. Directional safety way guidance sign on wall with arrow

6.1 Mandatory Components

All doors leading directly into egress stairwells shall be marked as follows (see Figure 2a and 2b):

6.1.1 Door handles shall be outlined with no less than 16 square inches (103 sq. cm) of photoluminescent material. This photoluminescent cutout or backplate shall be located behind or immediately adjacent to the door handle.

6.1.2 Panic bar door hardware shall be marked with a strip of photoluminescent material no less than 1" (25 mm) wide for the entire length of the activation (i.e. 'push') section of the bar. This marking shall be placed on the activation section on the face of the bar for maximum visibility from the direction of approach.

6.1.3 A photoluminescent sign designed in accordance with section 5 (see Figure 1 and Annex B) shall be placed either on the door or adjacent to the door, such that its bottom edge is 6-18" (152-457mm) from the floor. If located adjacent to the door, the sign shall be located on the handle (open) side of the door within 4" (100 mm) of the doorframe. Signs mounted on doors may be formatted with or without arrows. Signs mounted on walls shall have arrows.

6.2 Recommended Components

Doors leading directly into egress stairwells may also have the following additional recommended components.

6.2.1 Surround perimeter of stairwell entrance door with a strip of photoluminescent material no less than 1" (25 mm) wide (see Figure 8 for an example of a door surround perimeter marking). The strip should be placed on either side and on top of the door and may be located either on the door frame or immediately adjacent to the frame. The marking should not be located on the door.

6.2.2 A photoluminescent stairwell identification sign that identifies the stairwell and the floor level with a bold sans serif typeface (e.g. Helvetica, Arial) in characters a minimum of 5" high (127mm). This sign should be located either on the door or adjacent to the handle side of the door such that its bottom edge is 47-63" (1194-1600mm) from the floor.¹ This sign may also include tactile components in accordance with ICC/ANSI A117.1.

6.2.3 A photoluminescent stairwell re-entry door identification sign that identifies the stairwell and the floor level with a bold sans serif typeface (e.g. Helvetica, Arial) in characters a minimum of 3" high (76mm). This sign should be located adjacent to the handle side of the door such that its bottom edge is 47-63" (1194-1600mm) from the floor.² This sign includes information on re-entry floors and roof access in a bold sans serif typeface (e.g. Helvetica, Arial) in characters a minimum of 1/2" high (13mm), and may also include tactile components in accordance with ICC/ANSI A117.1 or relevant National Standard.

6.2.4 Door opening mechanism instructional markings such as the words "Push," "Pull," "Turn" and/or arrows for "Push," "Pull," "Turn."

¹ For more information on stairway marking, see NFPA 101 Life Safety Code 2006, section 7.2.2.5.4.

7 Markings in Stairwells

7.1 Mandatory Components

All stairwells shall be marked as follows (see Figures 3-5):

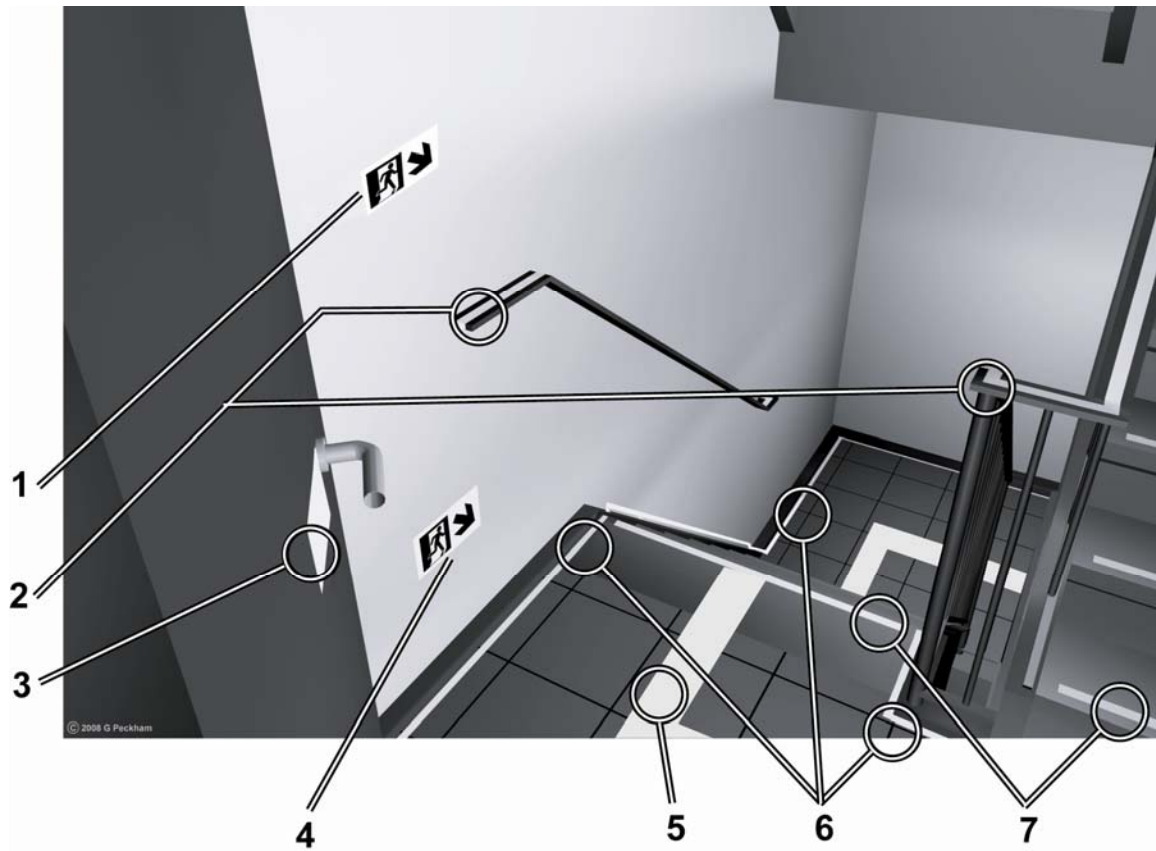


Figure 3 Stairwell Photoluminescent Markings:

1. Intermediate height located way guidance sign with the optional word “EXIT”, 2. Handrail marking on handrail, 3. Door handle marking, 4. Optional low located safety way guidance sign with the optional word “EXIT”, 5. Optional floor mounted center guidance line, 6. Guidance line (shown mounted on floor), 7. Step leading edge markings

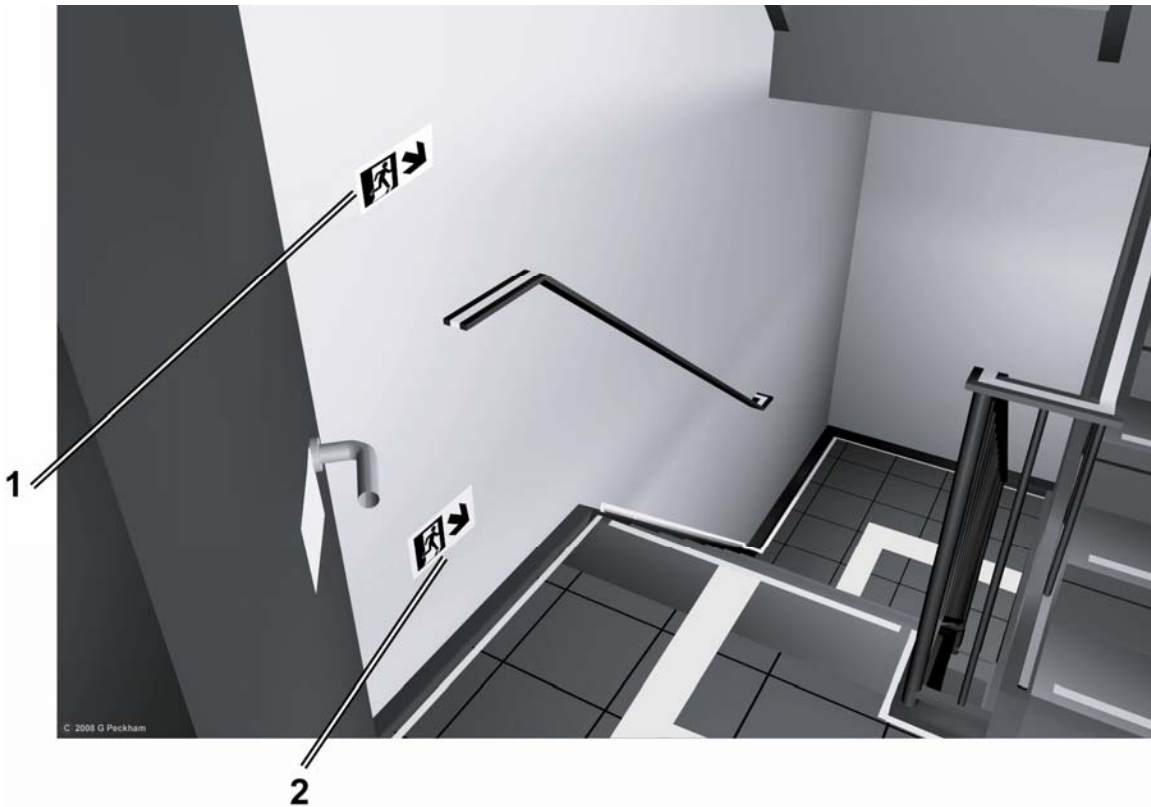


Figure 4 Stairwell Photoluminescent Markings:

- 1. Intermediate height located safety way guidance sign without the word "EXIT,"*
- 2. Optional low located safety way guidance sign without the word "EXIT"*

7.1.1.1 The horizontal leading edge of all stairs, including the horizontal leading edge of all landings, shall be marked with a 1" - 2" (25-50mm) wide strip of photoluminescent material. The length and width of the photoluminescent material shall be consistent for all steps. The photoluminescent stair edge marking shall extend to within 2" of the side edges of each step. The horizontal leading edge of the photoluminescent material shall be within a half inch of the vertical edge of the step.

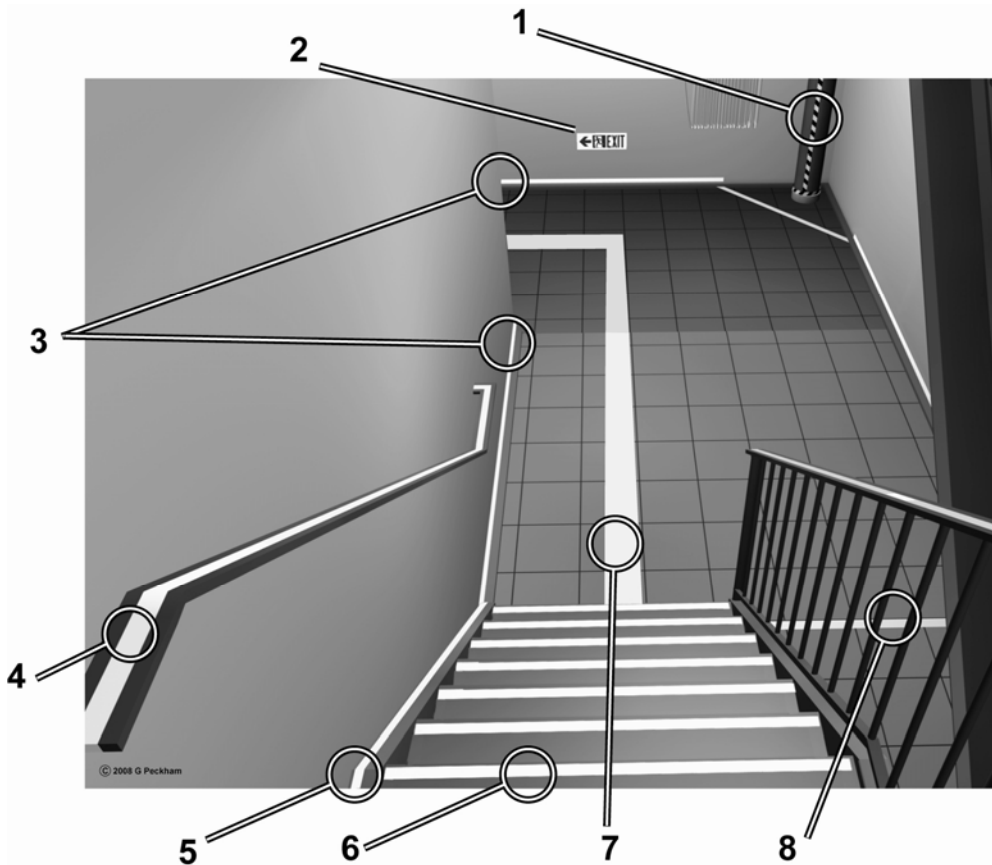


Figure 5 Stairwell/Transfer Corridor Photoluminescent Markings:

- 1. Obstacle marking, 2. Low located supplementary directional safety way guidance sign (an intermediate height located sign would be mounted above this optional sign), 3. Guidance line mounted to wall and transitioning to floor in front of obstacle, 4. Handrail marking, 5. Guidance line on slope of steps, 6. Leading edge step marking, 7. Optional floor mounted center guidance line, 8. Guidance line that prevents occupants from heading into a dead-end corridor.*

7.1.2 All stairwell handrails, including center handrails, shall be marked with photoluminescent material that extends the entire length of the handrail. The photoluminescent handrail marking shall stop at the end of each handrail. If the handrail turns the corner, the marking shall continue around the corner. Two marking options exist for marking the handrail: 1) A marking with a minimum 1" (25 mm) width of photoluminescent material located on the top surface of the handrail. 2) A marking with a minimum 2" (50 mm) wide strip of photoluminescent material placed on the wall immediately adjacent to the handrail such that its bottom edge is located within 1" (25mm) of the top of the handrail measured vertically. For purposes of continuity, where handrails or handrail extensions bend or turn corners, the stripe shall be as continuous as practicable with no more than a 4" (100 mm) gap without photoluminescent material permitted at such bends.

NOTE: Replacement of the existing handrail with a handrail that incorporates photoluminescent material with a minimum 1" (25mm) width on its top surface is also an option. When replacing handrails, note local building codes.

7.1.3 Where center handrails are present, the handrail's terminating posts shall be marked from both approach directions with a minimum 1" (25 mm) width of photoluminescent material or the entire width of the post for posts less than 1" (25mm) wide.

7.1.4 A continuous solid photoluminescent guidance line of minimum 1" (25 mm) width shall be located either mounted on the wall such that its bottom edge is within 4" (100mm) of floor height, or mounted on the floor within 2" (50mm) of the wall. The line shall extend for the entire length of the path of egress to the final exit discharge door. The guidance line can transition from floor to wall or vice versa as needed. The guidance line shall continue down the steps such that its bottom edge is within 4" (100mm) of floor height and at the same slope as the steps (the guidance line shall be a continuous straight line down the stairs, not a zig-zag line that follows the contour of the steps). See Annex D. The guidance line should be as continuous as possible (see ISO 16069, section 5.3.1.3). Breaks in the guidance line shall not exceed 8" (200mm). Doors NOT to be entered from the escape path (e.g. a door leading to a mechanical room, a re-entry door leading back into the tenant space) shall be marked with a guidance line that is identical to the guidance line that precedes the door. Guidance lines can transition onto the floor at landings, in horizontal transfer areas, and at doors. ISO 7010/NFPA 170 directional arrows with ISO 7010/NFPA 170 egress symbols may be placed adjacent to or within the guidance line. Guidance lines are to be located on both sides of the egress path wherever a wall or floor exists (e.g. on the open-railing side of a stairway, a guidance line is not required).

NOTE: Ramps are to be treated like corridors, with guidance lines installed on both sides of the ramp, either on the wall or on the floor as described in section 7.1.4.

NOTE: A series of dots, dashes, chevrons or shaped elements is not considered to be a continuous guidance line.

NOTE: In continuing the guidance line on doors NOT to be entered, consideration should be given to how the door is used or secured so as to avoid the possibility that the guidance line on the door, if left open, might lead evacuees into a non-egress space or area. Consideration should be given to continuing the guidance line on the floor rather than the door.

NOTE: A higher placement of the guidance line is acceptable if architectural details near the floor prevent placing the guidance line at the proscribed 4" (100mm) or less height. Near-the-floor height is recommended because in dark conditions, the low-located guidance line gives evacuees an idea of the floor height placing their steps on landing and transfer corridor walking surfaces.

7.1.5 Photoluminescent ISO 7010/NFPA 170 egress directional safety way guidance signs incorporating the ISO 7010/NFPA 170 directional arrow and ISO 7010/NFPA 170 egress symbol shall be placed in the stairwell such that they are visible upon opening the door into the stairwell (i.e. the opened door shall not obscure the sign). These safety way guidance signs shall indicate the direction of travel to the discharge exit door and shall be located such that their bottom edge is 47-63" (1194-1600mm) from the floor or immediately above the guidance line described in 7.1.4. The word EXIT shall appear on the sign in sans serif letters no less than 4" (100 mm) high. The word "EXIT" may appear in either all upper case (EXIT) or in mixed case letter (Exit) where the capital "E" is 4" (100mm) in height. The ISO 7010/NFPA 170 egress symbol shall be no less than 4" (100 mm) high. The color green used for directional safety way guidance signs shall be in compliance with the color green as per ISO 3864 or relevant national standard (e.g. ANSI Z535.1-2006, American National Standard for Safety Colors).. (See Annex B).

Note: There are two primary reasons for placing directional safety way guidance signs inside the stairwell near each entrance door. First, the sign will reinforce the correct direction of travel to persons entering the stairwell. Second, the sign will reinforce the correct egress path to persons already in the stairwell as they ascend or descend the stairs, reducing possible hesitation which could slow evacuation.

Note: The primary reason for installing the safety way guidance signs inside the stairwell at an intermediate level such that their bottom edge is 47-63" (1194-1600mm) from the floor is because it is assumed that once inside the stairwell, the egress path will be free of smoke. Compared to a lower level position, the intermediate level placement allows evacuees in a crowded stairwell to better see the signs. When planning the safety way guidance system, if smoke conditions are anticipated once inside the stairwell, a second low-located safety way guidance sign should be installed below the intermediate level safety way guidance sign such that the low-located sign's bottom edge is 6-18" (152-167mm) from the floor (see Figures 3, 4 and 5).

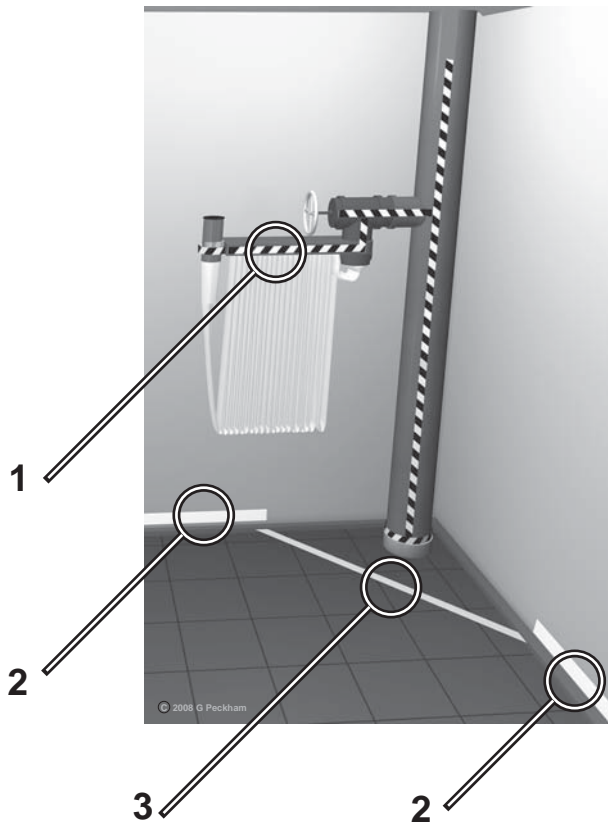
7.1.6 Photoluminescent ISO 7010/NFPA 170 egress directional safety way guidance signs incorporating the ISO 7010/NFPA 170 directional arrow and ISO 7010/NFPA 170 egress symbol shall be placed at locations when the direction to the discharge exit is other than down the stairs. Examples of the placement of directional safety way guidance signs include: At each transfer level, immediately after doors on the egress path that do not lead to the exit, immediately prior to and after paths along the escape route that lead to dead ends longer than 6' (see Figure 3, Figure 5, Figure 6 and Annex B). These safety way guidance signs shall indicate the direction of travel to the discharge exit door and shall be located such that their bottom edge is 47-63" (1194-1600mm) from the floor or immediately above the guidance line described in 7.1.4. The word EXIT shall appear on the sign in sans serif letters no less than 4" (100 mm) high. The ISO 7010/NFPA 170 egress symbol shall be no less than 4" (102 mm) high. The color green used for directional safety way guidance signs shall be in compliance with the color green as specified per ISO 3864 or relevant national standard (e.g. ANSI Z535.1-2006, American National Standard for Safety Colors).

7.1.7 Obstacles at or below 6'-6" (1981 mm) in height that project more than 4" (100 mm) into the egress path shall be marked in one of the following three ways:

7.1.7.1 Outlined with markings no less than 1" (25 mm) in width comprised of a pattern of alternating equal bands of photoluminescent material and black, with the alternating bands no more than 2" (50mm) thick and angled at 45 degrees. The marking can be in either a full vertical strip or as bands located at a minimum of three levels including low, intermediate and high positions (see ISO 16069).

7.1.7.2 Obstacles can be fully marked up to the height of 6'-6" (1981mm) with photoluminescent paint that is applied such that its luminance characteristics conform to section 3 of this document. For pipes, only the most visible "in-the-path" 180 degrees of the pipe surface needs to be painted. Obstacles that are fully marked with photoluminescent paint do not require black stripes since the entire object will be made visible and identifiable in dark conditions.

7.1.7.3 Obstacles that do not lend themselves to the 1" (25mm) width marking strip may be marked with a double-sided hang tag of a suitable size to mark the obstacle.



*Figure 6 Marking an obstacle with striped marking
 1. Striped obstacle marking, 2. Wall mounted guidance line,
 3. Transition of guidance line to floor in front of obstacle*

7.1.8 If intermediate exit doors exist on the escape path after entering the stairwell, such doors shall have the same mandatory photoluminescent components as described in section 5.1 of this document (see Figure 2a, 2b), as well as a surround perimeter consisting of a strip of photoluminescent material no less than 1” (25 mm) wide that is placed on either side and on top of the door. The surround perimeter may be located either on the door frame or immediately adjacent to the frame. The surround perimeter marking shall not be located on the door (see Figure 8).

7.2 Recommended Components

Stairwells may also be marked with the following recommended photoluminescent components. (Note: Consult local codes for current requirements).

7.2.1 The vertical edge of the stair (riser), including the vertical edge of landings, may be marked with photoluminescent material.

7.2.2 Floor level/stairway identification signs, re-entry door information signs, escape plan signs and other evacuation-related signs as may be required by applicable codes may also be photoluminescent. Such signs should be visible when the stairwell door is both in the open and closed position. (See NFPA 101 and NFPA 170 for signage specifications).

7.2.3 Signs with the words “NO EXIT” or “NOT AN EXIT” on all doors not to be entered from the escape path (e.g. a door leading to a mechanical room) (see figure 7).

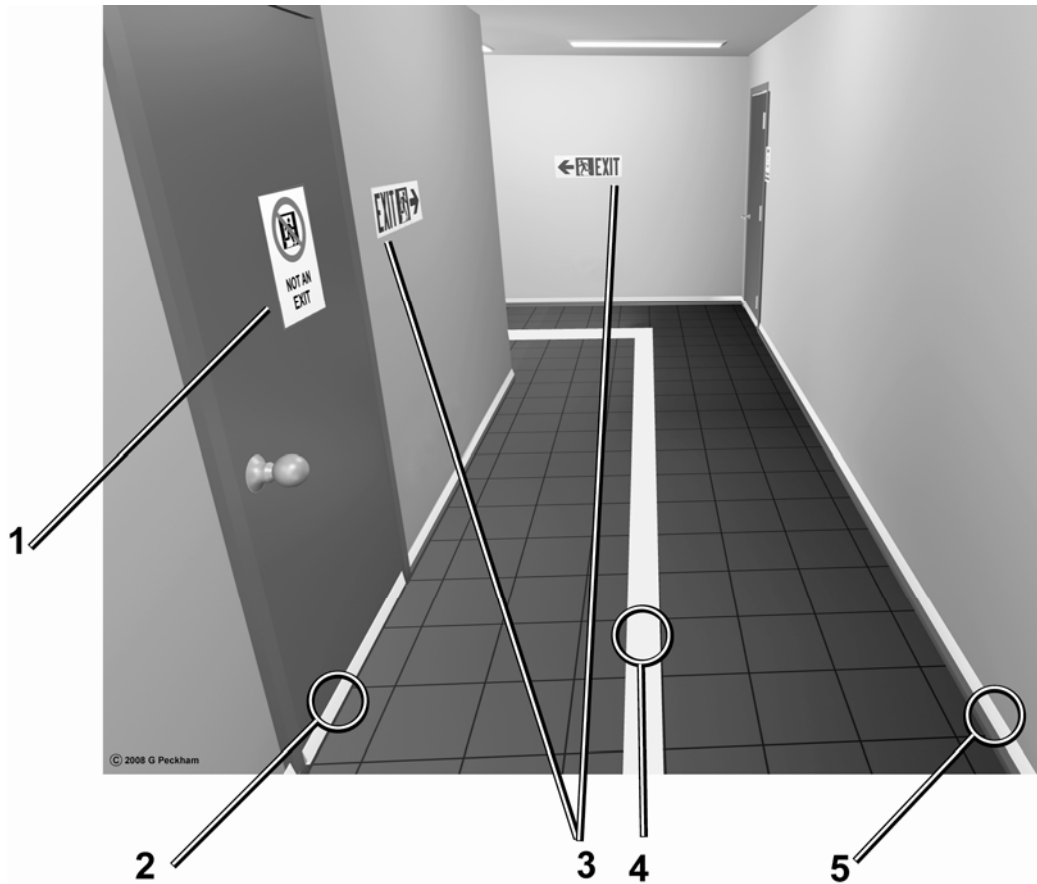


Figure 7 Photoluminescent Markings In Stairwell Horizontal Transfer Area:

- 1. "NOT AN EXIT" sign on door (shown with optional symbol),*
- 2. Transition of wall-mounted guidance line on to a "Non Exit" door, 3. Directional way-guidance sign after a "Non Exit" door and at a change in direction, 4. . Optional floor mounted center guidance line,*
- 5. Guidance line (shown wall mounted)*

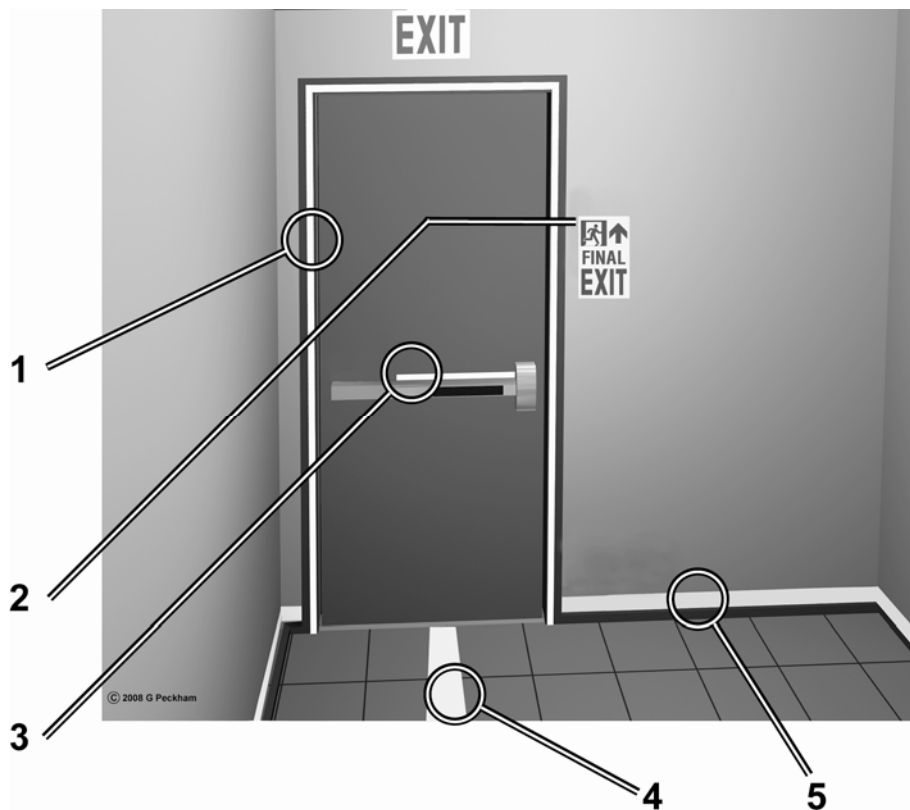
7.2.4 If roof access is prohibited for occupants, a photoluminescent "NO ROOF ACCESS" sign may appear immediately inside the door in the stairwell that is the last re-entry door found when occupants are traveling up stairwells. Such signs should be visible when the stairwell door is both in the open and closed position.

7.2.5 An intermediate level continuous solid photoluminescent guidance line of minimum 2" (50mm) width located such that its bottom edge is 34-38" (864-965mm) from floor height may be used on the stairwell landings. This intermediate level line should be separated from the ends of the handrail markings by a distance of 18-24" (457-610mm) so that it is clear to evacuees where the handrail begins and ends. ISO 7010/NFPA 170 directional arrows with ISO 7010/NFPA 170 egress symbols, in compliance with the color green as per ISO 3864 or relevant national standard (e.g. ANSI Z535.1-2006, American National Standard for Safety Colors). may be placed adjacent to or within this intermediate level guidance line.

7.2.6 A floor mounted continuous solid photoluminescent guidance line of minimum 4" (100mm) and maximum 6" (150mm) width located in the middle of landings and on the floor of all intermediate transfer corridors. The guidance line shall be centered on the landing/corridor and shall begin where the riser of the last step meets the landing and continues, changing direction as needed, until it meets or comes within 2" (25mm) of the leading edge of the first step in the next run of steps. The ISO 7010/NFPA 170 directional arrow (E005) may be added to this floor mounted guidance line to reinforce the intended direction of movement.

7.2.7 Photoluminescent markings and signs may be used to identify hazards and emergency equipment that exist along or adjacent to the escape path, (e.g. standpipes, hose cabinets emergency/fire fighters telephones).

8 Marking of Final Exit Doors



*Figure 8 Final Exit Door Photoluminescent Markings:
1. Door frame perimeter marking, 2. Intermediate height final exit sign,
3. Marking of activation portion of panic bar door hardware,
4. Optional floor mounted center guidance line, 5. Low located guidance line (shown wall mounted),*

8.1 Mandatory Components

All final exit doors in stairwells shall be marked as follows (see Figure 8):

8.1.1 Surround perimeter of door with a strip of photoluminescent material no less than 1" (25 mm) wide. The strip shall be placed on either side and on top of the door and may be located either on the door frame or the door buck. The marking shall not be located on the door.

8.1.2 Door handles shall be outlined with no less than 16 square inches (103 sq. cm) of photoluminescent material. This cutout or backplate shall be located behind or immediately adjacent to the door handle.

8.1.3 Panic bar door hardware shall be marked with a strip of photoluminescent material no less than 1" (25 mm) wide for the entire length of the activation (i.e. "push") section of the bar. This marking shall be placed on the activation section on the face of the bar for maximum visibility from the direction of approach.

8.1.4 A photoluminescent sign with the words "FINAL EXIT" appearing in sans serif letters with the word "FINAL" in no less than 2" (50 mm) high letters and the word "EXIT" in no less than 4" (100 mm) high letters. This sign shall be located on the handle (open) side of the door within 4" (100 mm) of the door frame at an intermediate height 47-63" (1194-1600mm) from the floor, either on the door or on the wall adjacent to the door. As an alternative to the word "FINAL," this sign may contain words to correctly orient the viewer, (e.g. "THROUGH LOBBY," "TO CHURCH STREET").



Figure 9 Positive and negative versions of the Photoluminescent Final EXIT Sign

Note: Sign designs using graphical symbols, arrows and supplementary text may also comply to ISO 3864-1 and/or National Standards where these differ from the recommendations outlined in this guide.

8.1.5 Gates, partitions, doors or other obstacles intended to dissuade egress below the level of egress shall be marked with photoluminescent/black angled stripe material no less than 1" (25 mm) in width and/or a "No EXIT" sign posted on the gate, partition or door. If practical, the entire object should be marked.

8.2 Recommended Components

Final discharge doors may also be marked with the following recommended components:

8.2.1 An escape plan sign which indicates the assembly point outside the final discharge door.

9. References

American National Standards Institute (ANSI), *ICC/ANSI A117.1 Accessible and Usable Buildings and Facilities* – 2003.

International Organization for Standardization. *ISO 3864-1 Graphical Symbols- Safety colours and safety signs - Part 1: Design principles for safety signs in workplaces and public areas* – 2002.

International Organization for Standardization (ISO), *ISO 7010 Graphical symbols — Safety colours and safety signs — Safety signs used in workplaces and public areas* – 2003.

International Organization for Standardization (ISO), *ISO 16069 Graphical symbols, safety signs - Safety way guidance systems (SWGS)* – 2004.

International Organization for Standardization (ISO), *ISO 17398 Safety colours and safety signs—Classification, performance and durability of safety signs* – 2004.

New York City Building Code, *Reference Standard RS 6-1 Photoluminescent exit path markings, as required by Local Law 26 of 2004, New York City Building Code § 27-383(b)*- 2005.

New York City Building Code, *Reference Standard RS 6-1A Additional Standards as Required by Reference Standard RS 6-1 for Photoluminescent Exit Path Markings* – 2005.

National Fire Protection Association (NFPA), *NFPA 170 Standard for Fire Safety and Emergency Symbols* – 2006.

National Fire Protection Association (NFPA), *NFPA 101 Life Safety Code* – 2006.

International Commission On Illumination, *CIE 69, Methods of Characterizing Illuminance Meters and Luminance Meters* - 1987.

Annex A

Additional/supplemental information on the recommendations for photoluminescent way guidance systems in stairwells

A1 General

The term “photoluminescent material” is used in this document as being in common use within the application industry. In strict lighting terminology terms (see IEC 60050-845-23: 1987 and ISO 3864-1) these materials are “phosphorescent materials.” Phosphorescence is photoluminescence delayed by storage of energy in an intermediate energy level. The luminescence of these materials is caused by absorption of optical radiation. The materials specified in this document do not use radioactive sources to function.

A2 Activation lighting

The recommendations presented in this document are based on the assumption of stairwells being lit by normal lighting for 24 hours at a minimum illuminance of 2 fc (21.6 lux) on the stair treads. It has also been assumed that the lighting is from fluorescent lamps with a color temperature of 4000-4500K.

Photoluminescent materials require activation by the lighting present for their proper functioning in circumstances when other lighting is no longer present. Factors which influence the luminance performance of photoluminescent materials include the duration of the activating lighting, the nature of the activating lighting and the activating illuminance at the location of the material.

Before an installation is designed, a lighting survey of the stairwell and transfer landings should be conducted to detail the light sources present and identify locations of lowest illuminances at the potential locations of photoluminescent components. The illuminance should be measured in the plane of the surface of the component (horizontal illuminance for floor mounted components, vertical illuminance for wall mounted components and for handrails in the plane of the slope).

Consideration should be given where necessary to changing the fluorescent lamps to daylight fluorescent lamps with a color temperature which would increase the luminance performance of photoluminescent materials. The change in lamps may be necessary for the recommended luminance performance to be met for a particular product and its luminance performance.

A3 Design principles

This document draws upon the principles for the design of photoluminescent safety way guidance systems given in various U.S. and international standards. A photoluminescent safety way guidance system is made up of a systematic (ordered) array of photoluminescent 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 the photoluminescent borders to provide contrast with safety colors. When no other lighting is present, all components are conspicuous by their luminance properties and characteristic phosphorescent color. *Technical Note: When no other external lighting is present, photoluminescent signs and guidance lines will lose their color recognition as luminances fall below 2000 mcd/m². However contrast and dark adaptation of the human eye will allow the photoluminescent signs and guidance lines to remain conspicuous and legible at the designed viewing distances.*

Directional safety way guidance signs that incorporate graphical symbols together with direction arrows are provided at decision points where information would aid evacuees in determining the correct egress path. *Technical Note: Legibility of the information on these signs is related to the product of the width of the essential detail of the sign's design and the square root of the luminance.*

Photoluminescent guidance lines provide a perspective ahead of the egress path giving evacuees visual information about the contours of the route and its changes in direction and level. When within view of the final exit door, the guidance line is seen to visually connect with the photoluminescent door frame marking. *Technical Note: In dark conditions, visibility of the guidance lines and door frame marking are related to the product of the width of the photoluminescent material and the square root of the luminance. This relationship for the visibility of guidance lines is the basis for the criteria in ISO 16069 that stipulates that the product of the square of the width of the line and luminance should meet certain minimum values at specified times in the luminance decay period.*

For stairs, the provision of a visible light emitting contrast strip across the full front width of the stair tread, to within 2 inches of either side of the step, assists people in placement of their feet in using the stair. The stair wall guidance line and marking of the handrail provide a visible indication of the presence of the stair and of its slope.

Components attached to stairs and landings should be produced and installed so that they do not present trip or slip hazards.

A4 Wall guidance lines

Wall guidance lines should not be recessed into the wall because this can reduce the available activation illuminance of the line and reduce the effective visual width of the strip since it can be masked by the projecting wall. The available activation illuminance and perceived visual width on the guidance line may be increased by sloping the wall guidance line slightly out at its base so that it faces slightly upwards.

A5 On-site measurement of luminance performance of photoluminescent components

Procedures for on-site measurement of luminance performance of installed components are given in Annex C of ISO 16069.

A6 Inspection and maintenance

All photoluminescent components should be visually inspected and cleaned at appropriate intervals using a reference sample of photoluminescent material for comparison. Any deterioration, discoloration or missing components should be recorded and steps taken for their immediate replacement. The illuminating sources should be checked as to whether the sources are working or not and any missing or failed lamps should be noted for repair or replacement. A Log Book should be used to document the egress system's installation plan, types and levels of illuminance in the egress path, modifications due to inspections and maintenance, supplier datasheets, sample materials, and the system inspection procedure.

Annex B

Directional Safety Way Guidance Signs

B1 General

Photoluminescent directional safety way guidance signs are a fundamental component of an egress marking system because they serve to communicate the proper choice for the direction of travel. Concerning their use in stairwells, they are to be used in three locations:

- 1) Inside each entrance to the stairwell. These signs serve to provide an immediate understanding of whether to go up or down the stairs to evacuees entering the stairwell and to provide reinforcement to those already in the stairwell to continue in their direction of travel and to not go through the stairwell entrance door.
- 2) At all locations when the direction to the discharge exit is other than down the stairs. Examples of such signs would be in transfer corridors with changes of direction and immediately prior to and after paths along the escape route that lead to dead ends longer than 6’.
- 3) On the wall immediately preceding all non-EXIT doors on the egress path. These signs reinforce the correct direction of travel so there is no hesitation near non-EXIT doors.

It is important that the use of arrows on these signs follows the definition set forth in the ISO 3864 Safety Signs and Safety Color Standard, which is identical to the definitions set forth in the 2006 edition of the NFPA 170 Fire Safety and Emergency Symbols Standard.

Directional safety way guidance signs must use the color green as per ISO 3864 or relevant national standards (e.g. ANSI Z535.1-2006, American National Standard for Safety Colors).^s Figure B1 illustrates the ISO Egress symbols also now included in the NFPA 170 Standard. Figure B2 illustrates “positive” and “negative” versions of these signs (note that the egress symbol does not change). Figure B3 illustrates the use of arrows on the landscape version of these signs.



Figure B1 ISO 7010 Egress Symbols E001 and E002



Figure B2 Directional safety way guidance signs
(Landscape versions shown)

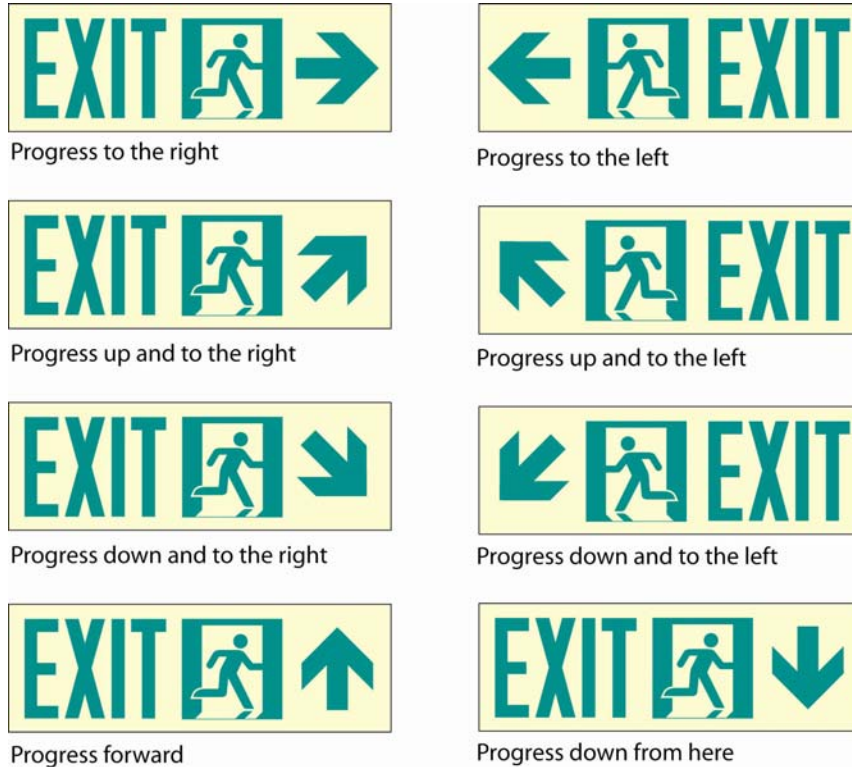


Figure B3 Directional safety way guidance sign: Use of Arrows (Landscape versions shown)

Annex C

Standards and Example Test method for the measurement of photopic luminance of photoluminescent materials

General

The following standards incorporate a test methodology for the measurement of photopic luminance of photoluminescent materials and may be referenced for the luminance specification of the materials specified in this guide :

ASTM E2073-07 Standard test method for photopic luminance of photoluminescent (phosphorescent) markings
DIN 67510-1 Luminance measurement of photoluminescent products
ISO 17398 Safety colours and safety signs—Classification, performance and durability of safety signs
New York City Building Code, Local Law 26, RS 6-1
UL 1994 Luminous Egress Path Marking Systems
UL 924 Emergency Lighting and Power Equipment

C1 Specimens to be tested

Three specimens shall be tested. Each test specimen shall have an area of photoluminescent material at least 1.38" (35 mm) in diameter, sufficient for the proper operation of the luminance meter used. The test specimens shall be final photoluminescent products complete with any protective overlaminates or coatings where applicable or specified. All test specimens shall be pre-conditioned by placing them in complete darkness until their residual luminance has fallen to 0.3 mcd/m² or less, tested utilizing the luminance meter specified under C.3.2. The specimens shall not be removed from the dark enclosure until immediately prior to the tests.

C2 Ambient conditions

The ambient temperature during preconditioning of test specimens, activation and luminance testing shall be 73.4 °F / 23°C (± 2°). 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.

C3 Illuminance and luminance instrumentation (see ISO 17398)

C3.1 Illuminance instrumentation (instrumentation to measure the light source used to activate the photoluminescent material).

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 CIE 69);

UV response: $u \leq 0.5 \%$ (with u as defined in CIE 69);

resolution: 1.0 lx;

linearity error: $f_3 \leq 0.5 \%$ (with f_3 as defined in CIE 69);

measuring range: ≥ 10 lx to 10 klx;

C3.2 Luminance instrumentation (instrumentation to measure the amount of light given off by the photoluminescent material)

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 C5.2) or the contact method (see C5.3) is used, and shall have the following minimum features:

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

UV response: $u \leq 0.5 \%$ (with u as defined in CIE 69);

resolution: at least 0.001 mcd/m²;

linearity error: $f_3 \leq 0.5 \%$ (with f_3 as defined in CIE 69);

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

measuring range: $\geq 10^{-5}$ cd/m² to 10 cd/m²;

display: ≥ 3.5 digits, range min $\geq 0.001 \times 10^{-2}$, max $\leq 1.999 \times 10$.

C4 Activation light conditions

For activation of the phosphorescent test specimens, see the list of standards at the beginning of Annex C.

C5 Luminance measurements

C5.1 General

The luminance measurements shall be carried out using the luminance meter specified in C3.2, using either the telephotometer method given in C5.2 or the contact method given in C5.3.

C5.2 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. Where possible, an area of the test specimen at least 1.18" (30 mm) in diameter should be evaluated.

C5.3 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.

Where possible, an area of the test specimen at least 1.18" (30 mm) in diameter should be evaluated. The luminance shall be determined by measuring illuminance and converting to luminance, according to the following equation:

$$\bar{L} = E/\Omega_p$$

where

\bar{L} is the average luminance, expressed in cd/m², 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, expressed in steradians (sr), which the tested surface of the measuring object takes viewed from the middle of the light incidence area of the photometer head.

The projected solid angle Ω_p follows the equation:

$$\Omega_p = \pi [1 + (r/R)^2]^{-1} \Omega_o$$

where

Ω_o is the unit solid angle, $\Omega_o = 1$ sr;

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

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

C6 Luminance recordings

C6.1 General

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.

C6.2 Luminance recordings for product

The luminance shall be recorded in mcd/m² and measured at the following times after the activation light is removed:

10 minutes \pm 10 seconds, 60 minutes \pm 10 seconds, and 90 minutes \pm 10 seconds, for each of the three test specimens. The mean shall be recorded for all three test specimens.

Annex D

Proper Placement of the Low Located Continuous Guidance Line on Stairs

D1 Placement

So that confusion on proper placement does not exist, the illustration below defines the proper location on the slope of the steps for the continuous solid photoluminescent guidance line of minimum 1" (25 mm) width in stairwells. Note that the illustration shows the maximum 4" (102mm) height from the floor/step level of a wall-mounted guidance line. Guidance lines may also be mounted on the floor on the landings and transition to the wall for the slope of the steps (see Figures 3 and 4 for such a configuration).

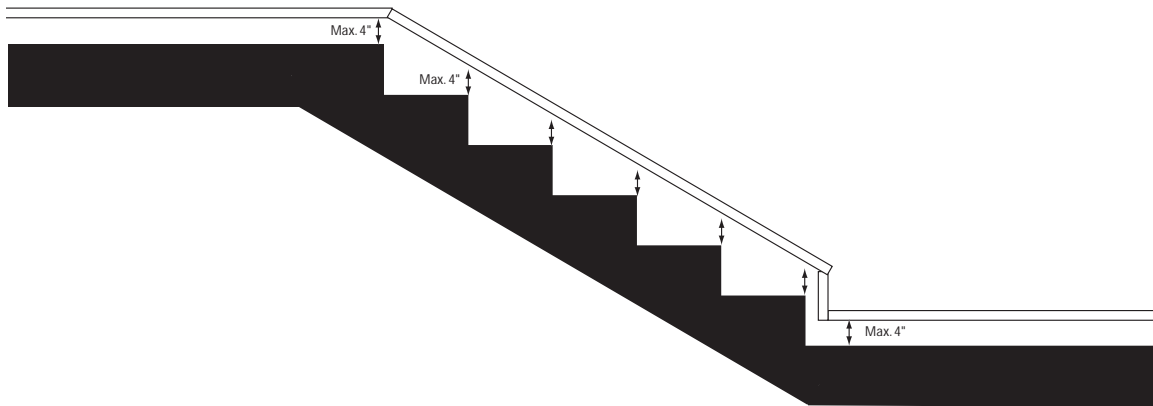


Figure D1 Placement of guidance line in stairwell (showing wall-mounted guidance line)

Annex E

Alternative Method of Marking Stairs

E1

For retrofit applications of photoluminescent egress markings in existing buildings the “L” marker method of delineating stairs may be used. The top steps and edge of all landings shall be marked as described in 7.1.1.1 and all other stairs may then be marked with “L” side edge markings. The L markers shall be a minimum of 9” (229mm) long, 1”-2” (25-50mm) in width, with a return portion that is a minimum of 2” (50mm) in length. The return portion shall have a width of between 1”-2” (25-50mm) and it may be different in width than the longer portion of the

L marker (see Figure 5). The return portion of the L marker shall be placed parallel with the leading edge of the step and shall extend to within 1" (25mm) of the leading edge of the step. The L marker shall be located within 2" (50mm) of the side of the step unless the step width extends more than 4" (100mm) outside the handrails. In this case, the L markers shall be located in a position under the handrail in such a way that they are visible to a person going down the steps and yet are not subject to being tread upon by persons using the stairs. The length, width and position of the L markers shall be consistent for all steps on which they are placed.

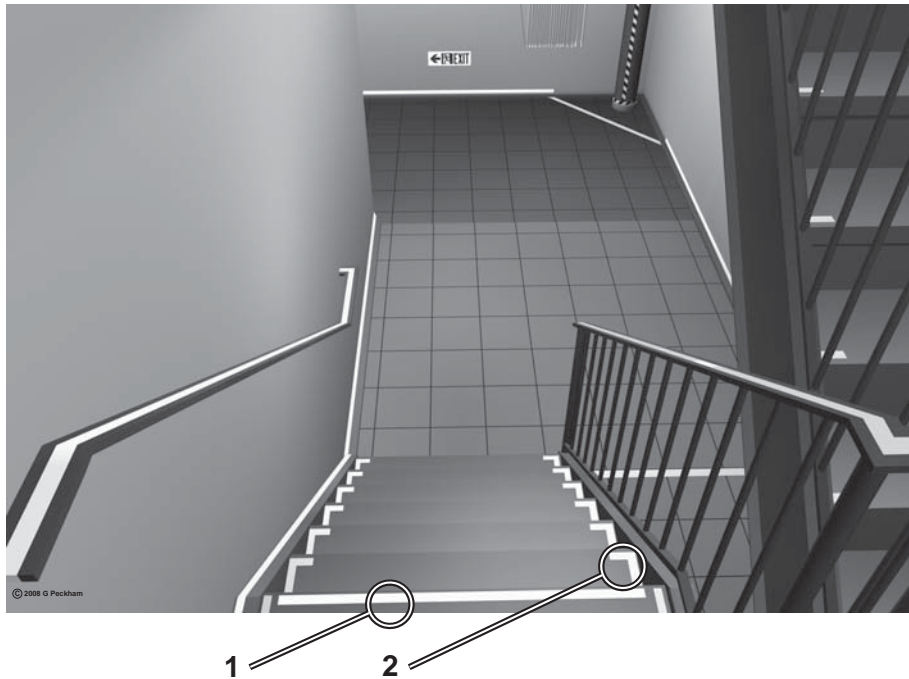


Figure E1 Stairwell/Transfer Corridor Photoluminescent Markings:
 1. Top step marking, 2. L-shaped step side edge markings

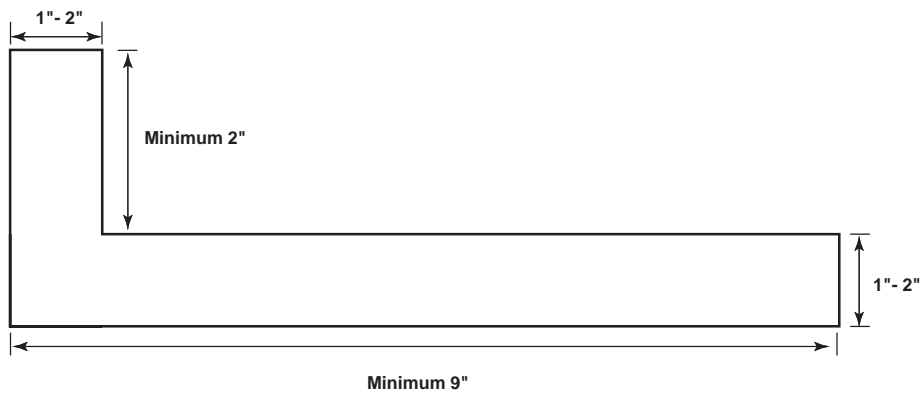


Figure E2 Side of step L marker dimensions