Specification: Photoluminescent Safe Movement System for Stadiums and Arenas.

Section 10 45 00 – Photoluminescent Exit Specialties

A) BACKGROUND

Modern sports and entertainment venues are required to balance many, sometimes competing, factors. These include spectator experience, functionality, safety, flexibility and sustainability.

A well designed and installed Photoluminescent (PL) Safe Movement System will mitigate related issues and assist the balancing of these factors.

By providing continuous, highly visible cues, the PL Safe Movement System enhances safety and helps the stadium meet or exceed regulatory performance requirements for safe movement and egress.

This PL Safe Movement System is intended for international use and is specifically designed to mitigate non-compliance issues relating to NFPA 101 and the Green Guide (Guide to Safety at Sports Grounds). Local expert advice should be sought for compliance with local codes and regulations.

Issues Mitigated by a PL Safe Movement System

1) Visibility and Step Definition in Low-light or No-light Conditions

Traditional systems may not ensure that step edges and access routes are visible during events where lighting is extinguished or reduced. This is especially an issue for visually impaired patrons.

a) Concert Mode and Non-standard Operating Scenarios

During concerts or events where house lighting is intentionally extinguished or reduced for effect, standard wayfinding and step markings may become invisible increasing the risk of trips and falls. PL Safe Movement Systems maintain visibility of steps ensuring safe movement regardless of operational mode.

b) Safe Egress During Emergencies

In emergency mode, step visibility drops drastically, making traditional markings hard to see. PL Safe Movement Systems provide continuous, passive illumination, ensuring that evacuation routes, step edges, and handrails are clearly marked even if electrical systems fail.

The instant visibility of a PL Safe Movement System alleviates extended start-up or changeover times for emergency lighting. The periods of darkness, even if short can cause panic.

2) Shadows Created from High Bay Lighting

Shadows are a significant hazard in stadiums and arenas, particularly on stepped aisles, ramps, and stairs. Overhead lighting, while essential for general illumination,

often creates uneven lighting conditions, resulting in shadows that obscure step edges, changes in level, or obstacles. This can compromise safe movement by reducing visibility of edges of steps or platforms, obscuring handrails, barriers, and other wayfinding elements, and complicating wayfinding and evacuation during power outages or reduced lighting.

a) Shadows from Architectural Elements
Shadows cast by overhead fixtures can further reduce the effective visibility of critical features, particularly in areas with complex geometry or where patrons' sightlines are already challenged by crowding or architectural features.

b) Crowd Created Shadows
In densely populated aisles and stairways patrons prevent overhead lighting from reaching steps which can significantly slow egress speeds or cause trips and falls.

Both shadow scenarios are mitigated by increasing the visibility of all essential building elements with suitable PL markings.

3) Trip Hazards from Variable Riser Heights and Stepped Ramps
Variability in riser heights and the configuration of stepped ramps in both the upper and lower bowls pose trip hazards, especially when visibility is compromised.
PL markings directly address this by highlighting step edges and transitions, helping patrons adjust their movement and reducing the likelihood of missteps.

4) Long Runs of Steps Without Change in Direction
The upper bowl often features stepped aisles with steep gradients and lengths like "long run" stairs (exceeding 36 risers). This increases descent risk and fear, particularly in emergencies.
A PL Safe Movement System improves user confidence and reduces fall risk by maintaining clear, continuous visual cues along the entire egress route.

5) Visibility of Handrails and Balustrades
Continuous, graspable handrails are required but can be difficult to see in low light. The PL system includes marking of handrails, ensuring they are easily locatable and usable even in darkness, supporting safe movement and compliance with grasp ability requirements.

In particular, the following issues can be mitigated by installing PL markings on handrails and balustrades.

a) Height of Handrails or Balustrades
Physical constraints can restrict the ability to install handrails and balustrades at recommended heights.

b) Lack of Handrails or Balustrades
Some aisles are too narrow for handrails to be installed. Without handrails, patrons lack reliable support when ascending or descending stairs, especially on steep or long flights, increasing the likelihood of slips, trips, and falls. Clearly visible step edges will make movement safer.

6) Crowd Formation During Ingress
In concert mode lighting row and seat numbering can become difficult to see and understand. This can lead to patron hesitation and crowd build-up in aisles.

Photoluminescent row and seat markers make wayfinding easier and will mitigate hesitation and crowd build-up resulting in improved safety and improved customer experiences.

B) REFERENCES

Photoluminescent Lighting Council Ltd (PLC) Daylight Charging Simulation Test Method for Photoluminescent Egress Path Marking Systems.
(www.plcouncil.com.au)

Photoluminescent Lighting Council Ltd (PLC) Test Method for High Temperature Cured (HTC) Products.
(www.plcouncil.com.au)

Underwriters Laboratories, Inc. (UL) UL 1994 Standard for Safety, Luminous Egress Path Marking Systems.
(www.ul.com)

Underwriters Laboratories, Inc. (UL) UL 410 Standard for Slip Resistance of Floor Surface Materials.
(www.ul.com)

Standards Australia. AS 4586-2013 Slip Resistance Classification of New Pedestrian Surface Materials.
(www.standards.org.au)

C) DESCRIPTION

This document is to assist with specification and procurement of high-performance products to form a PhotoLuminescent Safe Movement system (PLSM system) and is offered as a guide to experienced and knowledgeable professionals who assume full responsibility for its interpretation and use.

A PL Safe Movement system can be used to enhance concert mode lighting and emergency lighting systems and to increase egress safety when smoke and shadows obscure overhead emergency lighting.

D) WORKS SUMMARY

Stair and Step Edge Markings
Handrail Markings
Egress Signage
Row and Seat Markers

E) WARRANTY

30 Year Warranty on photoluminescent performance when positioned indoors.
15 Year Warranty on photoluminescent performance when positioned outdoors.

F) PRODUCTS

Step Edge Markings

PLC Level 4 Luminance	- YES
UL1994	- YES
UL410	- YES OR AS 4586-2013 Appendix A
PLC HTC	- YES

<u>Product Codes for Lighter Coloured Surfaces</u>

F15-179 Step Nosing
ET14-079 Step Threshold

Product Codes for Darker Coloured Surfaces
F15-289 Step Nosing
ET14-089 Step Threshold

Step Return Markings

PLC Level 2 Luminance	- YES
UL1994	- YES
UL410	- YES
PLC HTC	- YES

Product Codes
G6-011
T2-1011

Handrail Markings

PLC Level 2 Luminance	- YES
UL1994	- YES
PLC HTC	- YES

Product Codes
H3-001 Handrail Strip
HREC3.WHT End Cap (non-HTC)
HRJC3.WHT Joiner Cap (non-HTC)
G3-001 Guidance Strip (for flat handrails)

Egress Signage

UL1994	- YES
PLC HTC	- YES

Product Codes
S5-RM2010
S5-RMUA2010
S5-RMDA2010
S5-RML2010
S5-RMR2010
S5-RMUL2010
S5-RMDL2010
S5-RMUR2010
S5-RMDR2010

Row and Seat Markers

PLC Level 2 Luminance	- YES
PLC HTC	- YES
Clear Protective Coat	- YES

Product Codes
SQ63RP-R Row Marker - 63mm x 63mm, round corners

SQ90RP-R Row Marker - 90mm x 90mm, round corners
SQ63RP-S Row Marker - 63mm x 63mm, straight corners
SQ90RP-S Row Marker - 90mm x 90mm, straight corners
SQ63RSP-R Row & Seat Marker - 63mm x 63mm, round corners
SQ90RSP-R Row & Seat Marker - 90mm x 90mm, round corners
SQ63RSP-S Row & Seat Marker - 63mm x 63mm, straight corners
SQ90RSP-S Row & Seat Marker - 90mm x 90mm, straight corners
SQ63RN-R Row Marker - 63mm x 63mm, round corners, PL letters/numbers on black background
SQ90RN-R Row Marker - 90mm x 90mm, round corners, PL letters/numbers on black background
SQ63RN-S Row Marker - 63mm x 63mm, straight corners, PL letters/numbers on black background
SQ90RN-S Row Marker - 90mm x 90mm, straight corners, PL letters/numbers on black background
SQ63RSN-R Row & Seat Marker - 63mm x 63mm, round corners, PL letters/numbers on black background
SQ90RSN-R. Row & Seat Marker - 90mm x 90mm, round corners, PL letters/numbers on black background
SQ63RSN-S Row & Seat Marker - 63mm x 63mm, straight corners, PL letters/numbers on black background
SQ90RSN-S Row & Seat Marker - 90mm x 90mm, straight corners, PL letters/numbers on black background
RE10063RSP-R Row & Seat Marker - 100mm x 63mm, round corners
RE10063RSP-S Row & Seat Marker - 100mm x 63mm, straight corners
RE10063RSN-R Row & Seat Marker - 100mm x 63mm, round corners, PL numbers/letters on black background
RE10063RSN-S Row & Seat Marker - 100mm x 63mm, straight corners, PL numbers/letters on black background
EL187567 Ellipse Seat Marker - 18.7mm x 56.7mm
DS40 Round Seat Marker - 40mm
DS30 Round Seat Marker - 30mm
OB1130S Obround Seat Marker - 30mm x 10.5mm

G) TESTING NOTES

PLC Level 4 Luminance Test

PLC Daylight Charging Simulation Test Method for Photoluminescent Egress Path Marking Systems.

The photoluminescent material in Step Edge Markings shall have its performance verified by independent testing with activation charging of D65, 5,000 lux for 60 minutes.

Pass Criteria

After charging ceases, minimum luminance readings shall not be less than:

54mcd/m2 after 120 minutes (2 hours)
23mcd/m2 after 240 minutes (4 hours)
18mcd/m2 after 300 minutes (5 hours)
10mcd/m2 after 480 minutes (8 hours)
8mcd/m2 after 600 minutes (10 hours)

PLC Level 2 Luminance Test
PLC Daylight Charging Simulation Test Method for Photoluminescent Egress Path Marking Systems.
The photoluminescent material in Step Return Markings, Handrail Markings and Row & Seat Markers shall have its performance verified by independent testing with activation charging of D65, 5,000 lux for 60 minutes.

Pass Criteria
After charging ceases, minimum luminance readings shall not be less than:

25.0mcd/m2 after 120 minutes (2 hours)
10.4mcd/m2 after 240 minutes (4 hours)
7.7mcd/m2 after 300 minutes (5 hours)
4.5mcd/m2 after 480 minutes (8 hours)
3.4mcd/m2 after 600 minutes (10 hours)

PLC HTC – High Temperature Curing
PLC Test Method for High Temperature Cured (HTC) Products.

Pass Criteria
The samples shall have no colour change, blistering or distortion.

Anti-slip surfaces must be manufactured using HTC technology.

UL 1994 Luminance
Standard for Luminous Egress Path Marking Systems

Pass Criteria
Passed by Underwriters Laboratory USA

UL 410 Slip Resistance
Standard for Slip Resistance for Floor Surface Materials

Pass Criteria
Passed by Underwriters Laboratory USA

AS 4586-2013 Slip Resistance
Slip Classification of New Pedestrian Surface Materials,
Appendix A Wet Pendulum Test

Pass Criteria
Classification P5

H) MANUFACTURER
Certified Zero Carbon Business Operations.
Certified ISO 9001-2015
At least 25 years' experience manufacturing HTC products

I) OPERATING INSTRUCTIONS – MINIMUM ACTIVATION CHARGING
Photoluminescent materials require light to provide activation charging. This light can be natural daylight or artificial light.

i) No Daylight Venues

An event with 4 hours of total darkness requires 100lx 4000K minimum CCT lighting for 60 minutes immediately prior to the event.
An event with 3 hours of total darkness requires 54lx 4000K minimum CCT lighting for 60 minutes immediately prior to the event.

ii) Daylight Venues

Venues with good daylight will be fully charged at sunset if the PL materials have received at least 2 hours of 300+ lux daylight. From fully charged the system will be visible for 6 hours.
If the venue, or parts of the venue, do not receive good daylight, or the low light event (and patrons exiting) finishes more than 6 hours after sunset then activation charging should be provided to that area as per No Daylight Venues (i).

J) ROUTINE TESTING
A 4” x 4” (100mm x 100mm) test plate representative of the photoluminescent material in the step nosings should be installed in the bowl. In daylight venues this should be installed to be exposed to maximum direct sun.

Once every 2 years the test plate shall be removed and tested in accordance with the PLC Daylight Charging Simulation Test Method for Photoluminescent Egress Path Marking Systems. Pass criteria – Level 4 as per the standard.