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STANDARD

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APTA PRESS Passenger Systems Working Group

Emergency Egress/Access Signage and Low-Location Exit Path Markings for Passenger Rail Equipment

Abstract: This standard contains minimum requirements for the physical characteristics, informational content and placement of all emergency signs, markings and instructions for passenger railcar egress/access points. This includes emergency low-location exit path marking (LLEPM) systems for all passenger railcars using passive and/or active means of marking the exit path(s) to safety.

Keywords: emergency exit path, high performance photoluminescent (HPPL), instructions, low-location exit path marking (LLEPM) system, luminescent, markings, photoluminescent (PL), retroreflective, signs

Summary: This standard requires that passenger railcars have interior emergency signage to assist passengers and train crew members in locating and operating emergency exits from the passenger railcar or train. It states requirements for exterior signage to assist emergency responders in locating and operating emergency access points. And it requires that each passenger railcar have an LLEPM system to direct passenger and crew member evacuation, especially during conditions of low visibility such as the presence of smoke.

Scope and purpose: This standard applies to all passenger railcars that operate on the general North American railroad system. It does not apply to rapid transit operations in an urban area that are not connected to the general railroad system of transportation, tourist, scenic, historic or excursion operations, or private railcars. This standard contains minimum requirements and guidance for the design, physical characteristics, informational content and placement of signs, markings, LLEPMs, and instructions for emergency egress and rescue access. This includes signs, LLEPMs and markings used to locate, reach and instruct on the operation of emergency exits and to promote the safe evacuation of passengers and crew members in the event of an emergency. This standard also requires tests to validate the design of the emergency egress and rescue access signs and markings, including LLEPMs. Complementary emergency systems, such as those providing emergency lighting, are covered in separate APTA standards.

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Participants

The American Public Transportation Association greatly appreciates the contributions of the **Emergency Systems TAG**, which provided the primary effort in the drafting of this document. This roster of this TAG contained the combined rosters of the **PRESS Electrical Working Group, Inspection and Maintenance Working Group,** and **Passenger Systems Working Group.**

At the time this standard was completed, the **PRESS Electrical Working Group** included the following members:

Tammy Krause, Atkins Global NA, *Chair*
Brian Ley, WAGO Corporation, *Vice Chair*

Ed Aberbach, *General Cable Co.*
Leith Al-Nazer, *Federal Railroad Administration*
Mark Anderson, *Huber + Suhner Inc.*
Carl Atencio, *American Rocky Mountaineer*
Andrew Aubert, *TDG Transit Design Group*
Charles Bisson, *Hatch LTK*
Asa Briggs, *Huber + Suhner Inc.*
James Brooks, *Utah Transit Authority*
Richard Bruss, *Retired*
Joshua Callen, *Hatch LTK*
Dennis Carlson, *Winchester Interconnect*
Andrew Clapham, *Network Rail Consulting, Ltd.*
Benjamin Claus, *Port Auth. Of Allegheny County*
Jacob Daly, *Amtrak*
Mark Delizio, *Retired*
Davinder Dhatt, *Metrolinx*
Wulf Dicke, *Siemens Mobility, Inc.*
James Dietz, *Hatch LTK*
Sebastian Durzynski, *TDG Transit Design Group*
Alain Emery, *SAFT*
Phillippe Etchessahar, *Alstom*
Gary Fairbanks, *Federal Railroad Administration*
Robert Fauvelle, *Atkins Global NA*
Steve Finegan, *Atkins Global NA*
Marc Gagne, *TDG Transit Design Group*
Robert Gagne, *TDG Transit Design Group*
Yakov Goldin, *Retired*
Lowell Goudge, *Alstom*
Patrick Groarke, *MTA Long Island Rail Road*
Klaus Gutzeit, *Hoppecke*
Lew Hoens, *MTA Metro-North Railroad*
Paul Jamieson, *Retired*
Piotr Jedraszczak, *Metra*
Andrew Jensen, *AMTRAK*
Nigel Jones, *Jacobs*
Robert Jones, *Stadler*
Praveen Kaul, *New Jersey Transit*
Victor Kelley, *Atkins Global NA*
Clifford Kim, *SEPTA*
Christian Knapp, *Denver Transit Operators*
Joerg Kuehne, *Huber + Suhner Inc.*
Daniel Lanoix, *Retired*
John Listar, *Wabtec*
Francesco Maldari, *MTA Long Island Rail Road*
Liam Martin, *ABB, Inc.*
Ted Mavronicolas, *Saft*
Chris Muhs, *Trimet*
Marisa Nakajima, *Atkins Global NA*
Thomas Newey, *Network Rail Consulting, Ltd.*
James Notarfrancesco, *RSCC*
Alfonso Perez, *Huber + Suhner Inc.*
Bryan Sawyer, *Utah Transit Authority*
Gerhard Schmidt, *Siemens Mobility, Inc.*
Martin Schroeder, *Jacobs*
Richard Seaton, *TDG Transit Design Group*
Sean Shim, *New Jersey Transit*
Gil Shoshani, *RSCC*
David Skillman, *Amtrak*
Frank Sokolow, *MTA Long Island Rail Road*
Jeffrey St. Jean, *New Jersey Transit*
Daniel Swieca, *New Jersey Transit*
Jonathan Syfu, *STV, Inc.*
Doug Warner, *Herzog Transit Services, Inc.*
Steve Zuiderveen, *Federal Railroad Administration*

At the time this standard was completed, the **PRESS Inspection and Maintenance Working Group** included the following members:

Jeff Thompson, Southeastern Pennsylvania Transportation Authority, *Chair*

Carl Atencio, *American Rocky Mountaineer*
Juan Barahona, *Talgo, Inc.*
Stephen Bonina, *WSP USA*
James Brooks, *Utah Transit Authority*
Julia Camacho, *Talgo, Inc.*
Gordon Campbell, *Crosslinx Transit Solutions*
David Carter, *New Jersey Transit*
John Condrasky, *Retired*
Josh Coran, *Talgo, Inc.*
Richard Curtis, *Curtis Engineering Services*
Ever Diaz, *Keolis*
Jeff Downey, *Metra*
Adam Eby, *Amtrak*
Paul Edwards, *Stacy + Witbeck*
Marc Gagne, *TDG Transit Design Group*
Juan Hernandez, *Mott McDonald*
Larissa James, *WSP USA*
Paul Jamieson, *Retired*
Tony Jones, *Retired*
Christian Knapp, *Denver Transit Operators*
Paul Kovacs, *Alstom*
Francesco Maldari, *MTA Long Island Railroad*
Maria Mauri, *Wabtec*
Ted Mavronicolas, *Saft*
Gerard McIntyre, *Knorr Brake Corp.*
Joe Patterson, *Amsted Rail*
Alan Rao, *Federal Transit Administration*
Bryan Sawyer, *Utah Transit Authority*
Gerhard Schmidt, *Siemens Mobility, Inc.*
Martin Schroeder, *Jacobs*
Richard Seaton, *TDG Transit Design Group*
Patrick Sheeran, *Hatch LTK*
Rick Spencer, *Knorr Brake Corp.*
Walt Stringer, *Walt Stringer & Associates*
Matthew Todt, *Amsted Rail*
Charles Turner, *STV, Inc.*
Michael Wetherell, *McKissack & McKissack*
Clifford Woodbury, *Hatch LTK*
Gregory Yovich, *NICTD*
Steve Zuiderveen, *Federal Railroad Administration*

At the time this standard was completed, the **PRESS Passenger Systems Working Group** included the following members:

Rony Philip, Denton County Transportation Authority, *Chair*
Nicholas Harris, Hatch LTK, *Vice Chair*

Mark Anderson, *Huber + Suhner, Inc.*
Carl Atencio, *American Rocky Mountaineer*
Andrew Aubert, *TDG Transit Design Group*
Charles Barlow, *EverGlow NA*
Jeffrey Bennett, *TTCI*
James Brooks, *Utah Transit Authority*
Bill Bruhn, *Jessup Manufacturing*
Paul Callaghan, *Transport Canada*
Ed Carruthers, *SEPTA*
Vlad Ciobanu, *Siemens Mobility, Inc.*
Melvin Clark, *Hatch LTK*
Sean Cronin, *Metra*
Miles Crumley, *TriMet*
Sebastian Durzynski, *TDG Transit Design Group*
Phillippe Etchessahar, *Alstom*
Steve Finegan, *Atkins Global NA*
Tom Freeman, *International Name Plate Supplies*
Muriel Friday, *Capital Metro. Trans. Authority*
Andre Gagne, *Alstom*
Marc Gagne, *TDG Transit Design Group*
Jeffrey Gordon, *Federal Railroad Administration*
Lowell Goudge, *Alstom*
Yosi Grunberg, *Atkins Global NA*
Robert Jones, *Stadler Rail Group*
Joseph Kenas, *Alstom*
Christian Knapp, *Denver Transit Operators*
Tammy Krause, *Atkins Global NA*
Peter Lapré, *Federal Railroad Administration*
Francesco Maldari, *MTA Long Island Rail Road*
Liam Martin, *ABB, Inc.*
Eloy Martinez, *Hatch LTK*
James Michel, *Marsh USA, Inc.*
Johnathan Michel, *Fourche Design*
Thomas Newey, *Network Rail Consulting, Ltd.*

Thomas Peacock, *Atkins Global NA*
Scott Rodda, *Virginkar & Associates, Inc.*
Thomas Rowbottom, *Port Authority Trans Hudson*
Mehrdad Samani, *Hatch LTK*
Bryan Sawyer, *Utah Transit Authority*
Duane Sayers, *Regional Transportation District*
Brian Schmidt, *San Joaquin Reg. Rail Commission*
Martin Schroeder, *Jacobs*
Richard Seaton, *TDG Transit Design Group*
Kiyotaka Seki, *Railway Technical Research Institute*
Melissa Shurland, *Federal Railroad Administration*
David Skillman, *Amtrak*
Blair Slaughter, *Amtrak*
Nick Sorenson, *Utah Transit Authority*
Walt Stringer, *Walt Stringer & Associates*
Lukasz Szmysiak, *VIA Rail Canada*
David Wade, *International Name Plate Supplies*
Gary Wagner, *Amsted Rail*
Andrew Wood, *Washington State DOT*

Project team
Nathan Leventon, *American Public Transportation Association*

Introduction

This introduction is not part of APTA PR-PS-S-006-23, "Emergency Egress/Access Signage and Low-Location Exit Path Markings for Passenger Rail Equipment."

Historically, there have been passenger railcar accidents and incidents that have required the emergency evacuation of passengers and/or train crew members. Review of passenger rail accidents involving passenger and train crew emergency evacuation has indicated that, in certain cases, both passengers and emergency responders lacked sufficient information necessary for expedient emergency egress and access because of the absence of clear markings and instructions. The lack of adequate signage in conjunction with lighting system failures and/or low levels of illumination during conditions of darkness when these accidents occurred were cited as a cause for confusion and as a contributing factor to the injuries and casualties that resulted.

To address these concerns, the National Transportation Safety Board (NTSB) made the following recommendations to the Federal Railroad Administration (FRA), after investigation of a 1996 passenger train accident:

> Issue interim standards for the use of luminescent material, retroreflective material, or both to mark all interior and exterior emergency exits in all passenger cars as soon as possible and incorporate the interim standards into minimum car standards (FRA R-97-16), and
>
> Require all passenger cars to contain reliable emergency lighting fixtures that are each fitted with a self-contained independent power source and incorporate the requirements into minimum passenger car safety standards (R-97-17).

In 1998, FRA issued passenger rail equipment regulations that require that the interior location of each door intended for emergency egress be lighted or conspicuously marked by luminescent material and that the interior location of emergency exit windows be conspicuously marked by luminescent material. Instructions for their use are also required at or near such door exits and windows. These regulations also require that doors and windows intended for rescue access be marked with retroreflective material on the exterior and have operational instructions posted. The FRA issued regulations in 1999 that require emergency lighting for new equipment.

Originally, three APTA standards were created to provide guidance for these regulations. Two of the standards (APTA SS-PS-002-98, "Emergency Signage for Egress/Access of Passenger Rail Equipment," and APTA SS-PS-004-99, "Low-Location Exit Path Marking") have been combined into this standard.

An effective systems approach uses this standard, as well as APTA PR-E-S-013-99, "Emergency Lighting System Design for Passenger Cars," to provide a means for passengers and train crew members to locate, reach and operate emergency exits and rescue access points to facilitate their safe evacuation in an emergency. Each railroad and car builder should carefully consider the options available to meet emergency evacuation requirements presented in these two standards.

This standard describes the requirements for emergency signs and markings such as LLEPMs on passenger railroad rolling stock for the purposes of emergency egress and emergency access. It applies to all:

1. Railroads that operate intercity or commuter passenger train service on the general railroad system of transportation; and
2. Railroads that provide commuter or other short-haul rail passenger train service in a metropolitan or suburban area, including public authorities operating passenger train service.

This standard may not apply to:

1. Rapid transit operations in an urban area that are not connected to the general railroad system of transportation;
2. Tourist, scenic, historic or excursion operations, whether on or off the general railroad system of transportation;
3. Operation of private cars, including business/office cars and circus trains; or
4. Railroads that operate only on track inside an installation that is not part of the general railroad system of transportation.

Each railroad has the responsibility to ensure that the design, installation and maintenance of the emergency egress/access signage and low-location exit path markings is compatible with its internal safety policies of emergency evacuation, while complying with the performance criteria specified in this standard. Railroads and car builders should carefully consider the options available to meet emergency evacuation requirements presented in the aforementioned standard.

Emergency Egress/Access Signage and Low-Location Exit Path Markings for Passenger Rail Equipment

1. General system requirements

Emergency signs/markings designated for emergency egress/access shall be designed to provide evacuation guidance for passengers and train crew members and rescue access guidance for emergency responders. The railroad shall review the adequacy of emergency egress/access signs and markings as part of the railroad's system safety program plan.

Included among these emergency signs and markings shall be a low-location exit path marking (LLEPM) system. This LLEPM system shall be designed to identify the location of exits and the exit path to be used to reach such exits by passengers and train crew members under conditions of darkness when normal and emergency sources of illumination are obscured by smoke or are inoperative.

1.1 Visual identity and recognition

Emergency egress signage, markings, and LLEPM systems shall enable passengers and train crew members to make positive identification of emergency exits. Each interior sign/marking/LLEPM shall be conspicuous (i.e., clearly recognizable/distinguishable) or become conspicuous immediately and automatically upon loss of power for normal lighting and shall remain conspicuous under the minimum general emergency light illumination levels as specified in APTA-PR-E-S-013-99, "Emergency Lighting System Design for Passenger Cars," as well as under total darkness should the emergency lighting systems fail. All emergency exit, rescue access and LLEPM signage/marking systems shall be designed and installed with consideration for useful field of view (UFOV) to enable passengers, train crew members and rescue responders to make positive visual identification of the exit path, door exits and rescue access without undue delay or confusion. The location of the signs, directional arrow(s) or wording shall guide passengers and train crew members to and along the emergency exit route (see Section 2.1).

All interior emergency signs, markings and LLEPMs shall operate independently of the car's normal and emergency lighting systems for a minimum of 90 minutes (except as noted in Appendix G) after loss of all power for normal lighting.

As per 49 CFR § 239.101(a)(7)(ii), Passenger Awareness Program Activities, each railroad shall conspicuously and legibly post emergency instructions inside all passenger cars (e.g., on car bulkhead signs, seatback decals, or seat cards). Among the ways to fulfill this requirement is the posting of exit orientation signs (for examples of exit orientation signs, see Appendix I.1) inside the car.

1.1.1 LLEPMs

The LLEPM system shall be conspicuous within a volume that includes the entire area of the floor, and which extends upward to a horizontal plane at 4 ft (1.22 m), also known as low location.

1.1.2 Emergency exit signage

All emergency exit and rescue access signage/marking systems shall contain brief and quickly understandable information. Signs/markings and instructions shall use, to the extent practical, commonly recognized/used information symbols, icons, graphics and pictograms, as well as standardized color, contrast, content and placement. Each interior emergency exit sign and emergency exit locator sign shall be visible within a UFOV from a minimum distance of 5 ft (1.52 m) and shall remain conspicuous under the minimum general emergency light illumination levels as specified in APTA PR-E-S-013-99, "Emergency Lighting System Design for Passenger Cars." An emergency exit locator sign shall be located in close proximity of each emergency exit and shall work in conjunction with the emergency exit sign, except as noted in Sections 2.1.4.1 and 2.1.4.2.

> **NOTE:** HPPL signs/markings should not be installed in shadowed locations, to the extent practicable. HPPL material is not meant to be exposed to the weather.

1.1.3 Rescue signage

Each emergency rescue access sign/marking shall be conspicuous on the exterior of the car (see Section 3). Rescue access signage/marking systems shall enable emergency responders to make positive identification of rescue access points without undue hesitation, delay or confusion.

1.2 Multilingual signs

At a minimum, any words included in emergency exit/rescue access signage shall be in English. However, when system-specific determinations are made or are otherwise mandated by local, municipal, state or other regulations, signage/instructions shall be written in designated languages in addition to English.

2. Design requirements

Emergency exit and evacuation information systems on the interior of the car shall, at a minimum, include the following:

- LLEPM markings/delineators indicating a path from all aisle seating and compartment locations, including the lavatory, in the passenger railcar to all the car's door exits (see Section 2.1.1)
- internal door exit locator signs/markings, if necessary (see Section 2.1.2)
- an internal exit sign at each door exit, visible from a low location (i.e., extending from the floor upward to 4 ft [1.22 m] and a horizontal distance of 6 ft [1.93 m] from the exit along the exit path) (see Section 2.1.3.1)
- LLEPM markings along the perimeter of the door or doorframe visible from a low location (i.e., extending from the floor upward to 4 ft [1.22 m], and a horizontal distance of 6 ft [1.93 m] from the exit along the exit path) (see Section 2.1.3.4)
- LLEPM markings on or around the door's operating handle (see Section 2.1.3.5)
- Emergency window exit signs / marking and instructions see Section 2.1.4).

2.1 Location

2.1.1 Exit path

The requirements in this section apply to LLEPMs and systems and electrical and HPPL components thereof, whether installed on walls, floors, seat assemblies or stairs.

The location of the exit path shall be marked using either electrically powered (active) marking/delineators or light fixtures, or HPPL (passive) marking/delineators, or a combination of these two systems.

The marking/delineator components shall be positioned so as to identify an exit path to all door exits that is clearly visible and easily recognizable from any seat or compartment in the car, when normal lighting and emergency lighting are unavailable in conditions of darkness and/or smoke.

The marking/delineator components shall be located on the floor or no higher than 18 in. (45.7 cm) on the seat assembly, or walls/partitions of aisles, passageways or stairways, above the plane of the floor or the nearest stair tread.

The LLEPM system components shall be properly protected to perform in their intended environment for the expected life of the components.

Changes in the direction of the exit path shall be indicated by the LLEPM. This indication must be placed within 4 in. (10.2 cm) of the change in direction of the exit path.

2.1.1.1 Electrically powered (active) systems

Gaps in strip marking/delineation segments/light fixtures shall be no more than 36 in. (91.4 cm) in length, to the extent practicable, provided that a clearly visible and recognizable path to the door exit(s) is maintained.

A. Aisles and passageways

The marking/delineator strip material shall be applied along the floor either as a continuous or intermittent strip, or upon seat assembly on one or both sides of the aisle/passageway.

If light fixtures mounted on a partition or seat assembly are used to delineate the path, then these shall be applied on one or both sides of the aisle/passageway.

A single step in an aisle or passageway that is not part of a multi-step stairway can be treated as part of the aisle for the purposes of this standard.

B. Interior stairways

The marking/delineator material shall be either a continuous strip applied along the walls/partitions of at least one side of the interior stairs, or intermittent strips applied to the riser and/or tread of each step.

When the marking/delineator material is applied to the stairway walls/partitions, it shall be applied as a continuous strip, to the extent practicable extending from the lowest to the highest step.

When the marking/delineator material is applied to the stairway treads, it shall, to the extent practicable, extend across the full width of each tread near the step nosing.

One or more wall-mounted light fixtures shall be installed on at least one side of the interior stairway to illuminate each step, from the lowest to the highest step.

2.1.1.2 HPPL (passive) systems

The width of each marking/delineator strip for aisles, passageways and interior stairways shall not be less than 1 in. (2.54 cm) and shall be applied either as a continuous or intermittent strip.

As an alternative, intermittently placed discs of not less than 1.25 in. (3.18 cm) in diameter may also be used. Strips with fully radiused ends are permitted, so long as they comply with the minimum 1 in. (2.54 cm) width.

If intermittent strips or discs are used, then they shall be placed on both sides of the aisle, passageway or stairway; on the floor or no higher than 18 in. (45.7 cm) above the floor; where practicable, any gaps on either side of the aisle, passageway or stairway shall be staggered.

Examples of the alternative LLEPM configuration can be found in Appendix I.5.

A. Aisles and passageways

HPPL marking/delineator material shall be applied continuously on the floor or no higher than 18 in. (45.7 cm) above the floor, to at least one side or down the middle of the aisle/passageway, or intermittently on both sides of the aisle/passageway, to provide a conspicuous delineation of the exit path to a person standing in the aisle/passageway.

A single step in an aisle or passageway that is not part of a multi-step stairway can be treated as part of the aisle for the purposes of this standard.

The width of marking/delineator strips may consist of multiple parallel strips (multi-strip), as long as the sum of the widths of the multiple strips is equal to or exceeds the 1 in. (2.54 cm) wide strip, and the light output (luminous intensity) per unit length of the multiple strips is equal to or exceeds that of the single 1 in. (2.54 cm) wide strip marking placement.

Intermittent marking/delineator strips shall total a minimum of 6 in. (15.2 cm) in length for every 42 in. (107 cm) segment of exit path. An example utilizing oblong discs can be found in Appendix I.3. Oblong discs shall not have a width less than 1 in.

Discs shall be arranged in a distinctive, recurrent pattern. The sum of the diameters of intermittently placed discs shall total a minimum of 6 in. (15.2 cm) for every 42 in. (107 cm) segment of exit path. Discs shall not have a diameter less than 1 in.

For grandfathered three-clustered disc configurations, see Appendix G.2.2.

B. Interior stairways

In all interior stairways, HPPL marking/delineator material shall be applied, either as a continuous strip applied on the walls of both sides of the stairs or as intermittent strips applied to the riser or tread of each step.

If the HPPL marking/delineator material is applied to the interior stairway walls, then the marking shall be applied as a continuous strip, to the extent practicable, extending from the lowest to the highest step.

If the HPPL marking/delineator material is applied to the stairway treads, then a strip of material at least 1 in. (2.5 cm) wide shall extend, to the extent practicable, across the full width of each tread near the step nosing.

Alternative configurations shall match any of the example configurations provided in Appendix I.5 or shall provide a clear and conspicuous visual delineation of the tread, riser, tread nose and edges of the stairway from the top and bottom landing, and all locations on the stairway.

2.1.2 Door exit locator signs/markings

If a door exit is not within sight of any seat or standee location (e.g., visibly blocked by a bulkhead or divider), then one or more door locator signs shall be provided to identify the location of door exits.

The locator sign(s) shall consist of brief text, graphic arrows or symbols placed in conspicuous areas to direct passengers toward the nearest door that can be used for emergency egress. The conspicuous areas may include the following:

- bulkheads
- dividers
- seat frames/pockets
- luggage racks
- ceilings

2.1.3 Door exits and rescue access doors

2.1.3.1 Door-mounted signs

Each vestibule door, end-frame door and side door leading to the exterior that is intended for emergency egress shall be clearly identified with, at a minimum, two interior exit signs/markings:

- An exit sign shall be located on the door or door glazing, or in the immediate proximity. The center of the sign shall be located on or immediately adjacent to the upper half of the door and shall be conspicuous (see Sections 2.2, 2.3, 2.4 and 2.5), containing the wording “EXIT,” “EMERGENCY EXIT,” or other similar wording in capital letters.
- An exit sign shall be located on or immediately adjacent to each door and placed between 6 and 18 in. (15.2 and 30.5 cm) above the floor. If traps are present, the traps are considered closed for the sake of this requirement.

2.1.3.2 Removable panels

For passenger cars ordered on or after Jan. 28, 2014, or placed in service for the first time on or after Jan. 29, 2018, removable panels or windows are required on doors as per 49 CFR § 238.112 (f)(2).

The openings around removable panels or windows shall have a 1 in. wide HPPL border outlining the outer edges of the panel on the opening surrounding the inside and outside of the door. Windows shall be marked as per Section 2.1.4.2.

Instructional signage on or directly above the inner and outer faces of the panel or window shall be made of HPPL material. Identification and operating instructions to remove the panel or window in case of an emergency shall be provided.

> **NOTE:** It is permissible to place an exit sign as required in the second bullet of Section 2.1.3.1 on the removeable panel. It is understood that once the removeable panel or window has been removed, there need not be an exit sign on the door at a height between 6 and 18 in. (15.2 and 30.5 cm) above the floor.

2.1.3.3 Routinely locked doors

When a door designated as an exit is locked (such as an end-frame door at the end of the train), additional measures shall be taken to provide emergency opening instructions for the door exit or to direct passengers to an alternative door exit and/or emergency window exit. These measures may include the following:

- PA announcements
- safety seatback cards
- permanent signage or markings

2.1.3.3.1 Failure enroute

When a door fails enroute and is rendered disabled as an emergency exit, additional measures shall be taken to direct passengers to an alternative door exit and/or emergency window exit, as required by 49 CFR § 238.305 (c)(10).

2.1.3.4 Door exit delineators/markings

Each door exit shall be clearly marked/delineated with HPPL marking/delineator material placed in close proximity to or on the door exit. A minimum of 1 in. (2.54 cm) wide strips shall be applied to the extent practicable to the left and right sides of the interior of each door exit or doorframe and shall extend from the floor to a minimum height of 12 in. (30.5 cm) above the floor. If unable to extend HPPL material from the floor directly, the marking/delineator shall start at the lowest location possible (within 6 in. [15.2 cm] of the floor) and extend at least 12 in. (30.5 cm) vertically from that point. If this is not possible, then sufficient HPPL material shall be placed on the door, doorframe or adjoining wall between the floor and an 18 in. (45.7 cm) vertical limit, so that the total area is at least 12 sq in. (77 cm^2) on both the left and right sides. The markings need not be visible when the door is open. Additional material placed above 18 in. off the floor is permitted but does not count toward this requirement.

The above also applies to the interior faces of any restroom doors for restrooms that are ADA compliant.

2.1.3.5 Door exit control locator signs/markings and instructions

Each exit door handle, latch or operating button shall be marked with HPPL material in the form of outline striping that is no less than 1 in. (2.54 cm) wide to the extent practicable (see Appendix I for applications) around the perimeter of or behind the opening device with the total surface area being no less than 16 sq in. (103 cm^2) to the extent practicable. For grandfathered door markings consisting of less than 16 sq in. of HPPL material, see Appendix G.2.1.

In addition, each power door equipped with a separate manual override device intended for emergency egress shall be marked with a sign/marking containing the words “Emergency Door Control,” “Manual Door Control,” or other similar wording/icons. These signs/markings shall be placed at the manual door control or at an appropriate location in its immediate proximity.

If the manual override device is not located in close proximity to the door handle, latch or operating button, then a door control locator sign shall be posted. The manual door control locator sign(s)/marking(s) shall consist of brief text, graphic arrows or symbols to direct passengers and crew members from the door control to the location of the manual door override.

If the method for opening a door intended for exit is not obvious, then operating instructions shall be posted at that door’s control or in its immediate vicinity.

Operating instructions shall be posted at or near each manual override device for a door intended for emergency egress.

2.1.4 Emergency window exits

2.1.4.1 Window exit locator signs/markings

Emergency window exit locator signs/markings directing passengers and crew members to the nearest emergency window exit location(s) shall be provided. The signage/marking shall use the words "EMERGENCY EXIT" or similar wording. This signage/marking may take the form of:

- signage/marking on walls;
- signage/markings on light fixtures located above the emergency window exit; and/or
- signage/markings located on the ceiling, window or seat frames.

One sign/marking may serve more than one emergency window exit if the sign/marking can readily identify each such exit. If all the side windows installed in the passenger compartment of the railcar can be used for emergency egress, then locator signs are not required.

An emergency window exit sign (see Section 2.1.4.2) may serve as a locator sign if it meets the minimum requirements for a locator sign. For examples, see Appendix I.2. If an additional locator sign is used when the emergency exit sign meets the requirements of a locator sign, the additional sign need not meet the requirements of this standard.

2.1.4.2 Exit signs/markings and instructions

Each interior emergency window exit shall be identified with a sign/marking located on or adjacent to each such window.

In addition, instructions, including pictorial diagrams, for exiting the window shall be posted on or adjacent to each such window.

Each emergency window exit equipped with a pull handle shall be identified with an "EMERGENCY EXIT PULL HANDLE" marking; either as an integral part of the handle marking, or with instructions/illustrations applied as a decal in the immediate vicinity, or a combination of these.

Locations that are space-limited, such as the emergency window pull handle, as well as supplemental operating instructions, shall have the characters as large as feasible for the allotted space.

A. Breakable emergency exit windows

If approved by the FRA, breakable emergency exit windows that require a readily accessible tool appropriate to break the glass shall have a pictogram type decal prominently displayed next to the tool/window location indicating the intended use of the tool. Each breakable window that is intended as an emergency exit shall have a dedicated removal device.

The location of the tool shall be outlined with a one-inch HPPL strip or equivalent.

2.2 Letter and sign size

2.2.1 Letter size

> **NOTE:** Requirements provided herein do not apply to instructional signage/marking unless otherwise noted below.

The letter characters on emergency exit signs and markings and emergency exit locator signs intended to be read by the general public shall have the following minimum character height using uppercase letters:

- 1 in. (2.54 cm) on emergency window exit signs and locator signs
- 1½ in. (3.81 cm) on door exit signs and locator signs

In addition, the characters shall have the following characteristics:

- a width-to-height ratio between 3:5 and 1:1;
- a stroke-to-width ratio between 1:4 and 1:6 (i.e., the width of the lines that are combined to produce a letter); and
- spacing between letters of a minimum of one-sixteenth the height of the uppercase letters.

NOTE: Raised letter characters may be utilized.

2.2.2 Sign size

A minimum sign area of 16 sq in. (103 cm^2) is required for all end and side door exit signs installed except as noted in Appendix G.3.1.

2.3 Color and contrast

Lettering and pictograms used on interior emergency exit signage/marking shall be designed to achieve a luminance contrast ratio of not less than 0.5, as measured by a color-corrected photometer.

2.4 Illuminance/luminance criteria

LLEPM and sign/marking component illumination or luminance levels, as applicable, shall be verified in accordance with Section 4 and tested, maintained and repaired in accordance with Section 6.

HPPL material shall be installed in locations and orientations that provide exposure to adequate charging light.

NOTE: Dual-mode LLEPM system components may be used to increase visibility.

Additional measures for addressing extenuating circumstances are described below and in Appendix B.

2.4.1 Electrically powered systems

The light sources used to comply with the criteria required in this section shall be electrically powered (e.g., incandescent, fluorescent, EL or LED).

2.4.1.1 Illuminance/luminous intensity

For signs/markings with exposed LEDs that spell out “EXIT,” each LED shall have a minimum peak intensity of 35 mcd, except as noted in Appendix G.3.2.

Where light fixtures are mounted on the walls or seat pedestals/frames or components, each light fixture shall provide an average illumination value of at least 0.1 fc, measured on the surface of the floor or step averaged at intervals of 30 in. (76.2 cm) or less along the center of the aisle, passageway or stairs.

Each point source/strip shall comply with the following criteria:

- **Incandescent:** Miniature lamps not less than 150 mcd mean spherical intensity with a maximum spacing of 4 in. (10.2 cm) between lamps
- **LED:** Minimum peak intensity of 35 mcd with a maximum spacing between lamps of 12 in. (30.5 cm)

For additional information regarding charging light, see Appendix B.2.

2.4.1.2 Luminance

The average luminance value of the electrically illuminated marking/delineator strip or sign/marking shall be at least 1000 mcd/m^2, as measured on the surface marking, delineator or sign.

> **NOTE:** Most electroluminescent signs have an initial luminance of more than 20,000 mcd/m^2, but they may show substantial luminance degradation (more than 80%) over their service lives. Service life estimates range from 30,000 hours to 100,000 hours (7 to 20 years) for stationary equipment.

2.4.2 Passive systems

2.4.2.1 Materials

Internal signs, markings and delineators constructed of HPPL material, including LLEPM components, shall be capable of providing a minimum luminance level of 7.5 mcd/m^2 for a duration of 90 minutes after the charging light has ceased, except as noted in Appendix G.

2.4.2.2 Charging light

The illuminance levels required to provide sufficient charging light vary according to the type of light source used.

For additional information regarding charging light, see Appendix B.

2.4.3 Dual mode systems

Dual-mode systems composed of active and passive components shall be designed so the HPPL material is adequately charged by an active light source in order to comply with the minimum luminance criterion of 7.5 mcd/m^2 for a duration of 90 minutes after activation lighting has been removed or ceased operating. For additional information regarding charging light, see Appendix B.

2.5 Component materials

Interior emergency exit signs/markings complying with Sections 2.2 and 2.3 shall be constructed of active electrically powered light sources, passive HPPL material, dual-mode systems or a combination, as specified in this section.

2.5.1 Vestibule, end-frame and side doors

Emergency exit signs/markings shall identify the location of all vestibule, end-frame and side doors leading to the exterior of the car and intended for emergency egress using:

- HPPL material, including dual mode; or
- electrically powered fixtures with an independent power source, located in or within each half car length, that can power the signs/markings for at least 90 minutes after power for normal lighting ceases.

For electrically powered illuminated signs that use a battery as an independent power source, an automatic self-diagnostic module shall be connected to such a power source and installed where its status indicator can be readily observed during the daily inspection (see Appendix D).

For grandfathered vestibule, end-frame and side door signs/markings, see Appendix G.2.3.

2.5.1.1 Additional requirements to mark side door exit locations without independently powered emergency lighting

Each side door opening intended for emergency egress leading to the exterior of the car shall be marked with a minimum of 144 sq in. (929 cm^2) of HPPL material placed no higher than 18 in. (45.7 cm) off the floor, with its lowest point no higher than 6 in. (15.2 cm) off the floor.

> **NOTE:** The marking may be composed of one or more panels placed either on the door and/or in its immediate vicinity. A door with two leaves that open for emergency egress is considered a single door opening. Therefore, 144 sq in. (929 cm^2) of HPPL material is sufficient for that door opening.
>
> To provide some illumination at the floor for passengers and crew members as they exit, to the extent practical, the material should not be placed on a door leaf that is intended to open for emergency egress or on the part of a wall or partition that would be covered by a trap door in any position (e.g., sliding doors).

Signs and markings used to comply with the LLEPM requirements may be counted toward this requirement to the extent that they meet the criteria noted above (e.g., HPPL door delineators required to meet the LLEPM requirements that are installed on the door 18 in. [45.7 cm] off the floor would count as 36 sq in. [232 cm^2] of the 144 sq in. [929 cm^2]).

3. Design requirements, exterior

Rescue access information systems on the exterior of the car shall, at a minimum, include the following:

- external rescue access door signs/markings (see Section 3.1.1.1.)
- rescue access door control locator signs/markings and instructions (see Section 3.1.1.2)
- external rescue access window signs/markings and instructions (see Section 3.1.2)
- external rescue access door emergency release mechanism locater signs/markings and instructions (see Section 3.1.3)

3.1 Location

3.1.1 Rescue access doors

3.1.1.1 Signs/markings

Each door intended for use by emergency responders for rescue access shall be externally identified with emergency access signs, symbols or other conspicuous marking consisting of retroreflective material that complies with Sections 3.3 and 3.4.

3.1.1.2 Control signs/markings and instructions

Each door intended for use by emergency responders for rescue access shall have operating instructions for opening the door from outside the car placed on the car body within a distance no greater than one and a half times the width of the door leaf from the door opening. If a power door does not function with an integral release mechanism, then the instructions shall indicate the location of the exterior manual door control.

Each power door intended for use by emergency responders for rescue access that has a non-integral release mechanism located away from the door shall have a door control sign/marking placed at the location of this control that provides instructions for emergency operation, either as part of the access sign/marking or as another sign/marking.

Each car equipped with manual doors shall have operating instructions for opening the door from the exterior, either as part of the access sign/marking or as another sign/marking.

All primary identification markings (e.g., emergency door release) shall be made of material consistent with Section 3.4.

3.1.2 Rescue access windows

Each rescue access window shall be identified externally with a unique retroreflective and easily recognizable sign, symbol or other conspicuous marking that complies with Sections 3.3 and 3.4.

Signs, symbols, or markings shall be placed externally at the bottom of each such window, on each window, or adjacent to each window, using arrows where necessary to clearly designate rescue access window locations. Legible and understandable window-access instructions, including any pictogram/instructions for removing the window, shall be posted at or near each rescue access window.

> **NOTE:** An emergency exit window and rescue access window may utilize the same window as long as the window is marked according to Section 2.1.4.1 on the inner face of the window and Section 3.1.2 on the outer face of the window.

3.1.3 Emergency roof access

The location of each emergency access point provided on the roof of a passenger car shall be clearly marked with retroreflective material of contrasting color that complies with Sections 3.3 and 3.4. Legible and understandable instructions shall be posted at or near each such location.

Signs at the access point shall have a total area of no less than 98 sq in. (632.3 cm^2) and shall contain appropriate text and/or icons for the method of access. The wording and icons on the signs shall have the same orientation and shall be entirely within the confines of the retroreflective border identifying the access point.

> **NOTE:** Concise wording and the use of icons where possible is recommended.

If emergency roof access is provided by means of a structural weak point:

- The line along which the roof skin is to be cut shall be clearly shown with retroreflective tape of contrasting color.
- A sign plate with a retroreflective border shall also state (unique to the vehicle and to the particular railroad):
    - “CAUTION: DO NOT USE FLAME CUTTING DEVICES.”
    - “CAUTION: WARN PASSENGERS BEFORE CUTTING. CUT ALONG DASHED LINE TO GAIN ACCESS.” or
    - “ROOF CONSTRUCTION: [state relevant details].”

If emergency roof access is provided by means of a hatch:

- A sign with a retroreflective border, or entirely retroreflective, in either case of a contrasting color, shall be applied to the outside of each hatch. This sign shall, at a minimum, state the following:
    - In large letters: “EMERGENCY ACCESS” or words to that effect.
    - In smaller letters, instructions for opening the hatch.

3.2 Letter size

All external primary identification markings (e.g., emergency door release) shall have letters no less than ⅜ in. in height. All external instructional signs shall have letters no less than 3⁄16 in. in height.

3.3 Color and contrast

Exterior signs/markings shall provide lettering-to-sign-background and sign-to-substrate luminance contrast ratio of not less than 0.5, as measured by a color-corrected photometer.

Characters and their background shall have a non-glare finish. Characters shall contrast with their background, with either light characters on a dark background, or dark characters on a light background.

NOTE: A contrasting border around the outer edge of the sign may also enhance visibility.

3.4 Materials

Exterior emergency rescue access locator signs/markings shall be constructed of retroreflective material that conforms to the specifications for Type I material sheeting, as specified in ASTM D-4956-07 1e, “Standard Specification for Retroreflective Sheeting for Traffic Control.” Retroreflective material shall be compatible with the type of mounting surface.

4. Evaluation measurements and tests

4.1 Interior signs/markings

To verify that emergency signage and LLEPM system component designs comply with the requirements of Section 2.4, railroads shall ensure that a qualification test of the normal lighting is conducted on at least one representative passenger car/area for each signage and LLEPM system layout, in accordance with this section and Appendices C and F.

Before equipment is placed in service for the first time, the first car to have an emergency signage and LLEPM system installed shall be tested, and this test shall be completed prior to the car’s release for operation in revenue service.

The railroads shall confirm that the emergency exit signage and LLEPM system components comply with the minimum required illumination or luminance criteria, as applicable, for the specified duration.

4.1.1 Electrically powered (active) systems

Test reports provided by the manufacturer/supplier with results certified by an independent laboratory shall show that electrically powered components have been photometrically tested as appropriate for the type of light source. These shall show:

- luminance for EL markings; and
- luminous intensity for point sources.

All results must comply with Section 2.4.1.

Railroads shall confirm that the power supply for electrically powered signage and LLEPM components will maintain the operating voltages specified by the sign/marking manufacturer/supplier for at least 90 minutes after the loss of primary power supply, except as noted in Appendix G.

To ensure compliance with Section 2.4.1, measurements of electrically illuminated signs/markings shall be conducted in accordance with Sections 3.2, 3.3, 3.4.1, and 3.4.2 of this document, as well as Table 1 in Section 2.2 of APTA PR-E-S-013-99, Rev. 2, "Emergency Lighting System Design for Passenger Cars."

For information on automatic testing of electrically powered systems, see Appendix D.

4.1.2 HPPL (passive) systems

4.1.2.1 Material luminance

Test reports provided by the manufacturer/supplier with results certified by an independent laboratory shall show that all tested samples of passive HPPL material, as used in the finished component configurations (including any cover or protective coating if used, but not including text or graphics) comply with the minimum luminance criterion of 7.5 mcd/m^2 after 90 minutes, when tested according to the provisions of ASTM E-2073-010 "Standard Test Method for Photopic Luminance of Photoluminescent (Phosphorescent) Markings" (www.astm.org) except as noted in Appendix G.

For more information on independent test laboratories, see Appendix E.

The manufacturer/supplier is required to have a minimum of one batch of material for signs/markings/delineators of a given type certified. Signs/markings/delineators of the same certified type of material can be sold to multiple customers.

4.1.2.2 Ambient light charge

To confirm that HPPL emergency sign/marking components are installed in locations that receive adequate charging light, illuminance measurements shall be taken. To take the measurement readings, the sensor is placed on the area of the HPPL sign/marking surface location where the light is brightest (or on the floor location as permitted in Appendix G.1.2). The observer records the reading(s) using a data collection form (see Appendix C.4).

The sensor and the readout device of the illuminance meter must be held in a manner so that the sensor is not affected by the observer's shadow. If light diffusers are used on the light fixtures, then the measurements shall be made with the light diffusers in place. This requirement applies to each representative car/area tested.

More information on representative samples can be found in Appendix F.

The charging light shall consist only of that provided by the car's normal lighting system. All natural or other external light shall be excluded. For suggested methods for eliminating extraneous light sources, see Section 3.2 of APTA PR-E-S-013-99, Rev. 2.

If the ambient light cannot be reduced to 0.01 fc, see Appendix B.3.

To take the measurement readings, the sensor is placed on the area of the HPPL sign/marking surface location where the light is brightest (or on the floor location as permitted in Appendix B.3). The observer records the reading(s) using a data collection form (see Appendix C.4).

If light diffusers are used on the light fixtures, then the measurements shall be made with the light diffusers in place.

> **NOTE:** If the ambient (normal charging light) illuminance is less than the required criteria specified (see Section 2.4.2.1), then railroads can take several actions described in Appendix B.2 to increase the charging light levels.

4.1.3 Testing equipment

To ensure accurate illuminance measurements including measurements on vertical surfaces at which the angle of incident light is large, the light meter must be designed to take such measurements and possess all of the following:

- **Basic accuracy:** ±3% of reading ±1 digit or better
- **Low-end sensitivity:** 0.01 fc or better
- **Cosine error:** No more than 6%, measured at 50 deg
- **Color correction:** Correction to CIE photopic curve

For additional HPPL material considerations, see Appendix B. For alternatives to increase charging light output, see Appendix B.2. For additional HPPL material testing technical considerations, see Appendix B.3. For additional details on charging light measurement procedures, see Appendix C.

4.2 Exterior signs/markings

Railroads shall ensure that retroreflective material meets the requirements for Type I sheeting materials, per ASTM D-4956-07.

4.3 Recordkeeping

Railroads shall retain copies of:

- test reports provided by the manufacturer/supplier with results certified by an independent laboratory showing that the illuminance or luminance measurements, as appropriate, on the active area of the signage/marking/delineator component comply with the criteria specified in Section 2.4, as applicable, of this standard (for HPPL systems, see Appendix C);
- railroad-approved illuminance test plan(s) and test results until the next periodic test, or other test specified in Appendix C, is conducted on a representative car/area; and
- test report results that certify that the retroreflective material complies with Type I materials per ASTM D-4956-07.

These reports shall be retained until all cars impacted by the above documents are retired, or are transferred, leased or conveyed to another railroad. A copy of such records shall be provided to the accepting railroads, along with any cars that are transferred, leased or conveyed.

5. Survivability requirements

Signs, markings and delineators, including LLEPMs, shall be conspicuous under all operating conditions, including buildup of dust and dirt as well as discoloration of the HPPL or light diffuser components.

All LLEPMs and emergency signs/markings shall be designed to operate without failure under the conditions typically found in passenger rail equipment, including expected mechanical vibrations (as defined by IEC 61373-1) and shock, as well as comply with electromagnetic interference and other criteria in 49 CFR §§ 238.225, 238.425, and 238.725.

All electrically powered LLEPM and emergency sign/marking components independent power sources in passenger cars shall be designed to operate in all equipment orientations and after the initial shock of a collision or derailment resulting in the following individually applied accelerations:

- **longitudinal:** 8g
- **lateral:** 4g
- **vertical:** 4g

6. Inspection

6.1 Daily inspections

As part of the daily interior and exterior inspections required in 49 CFR §§ 238.303 and 238.305, railroads shall visually inspect all emergency signage and LLEPM system components, and emergency markings/ delineators, except those for roof access, to determine that signs/marking components are present and conspicuous, and that signs and instructions are legible.

The status indication from automatic testing of electrically powered systems (see Appendix D) shall be observed to confirm that a unit is functioning normally.

6.2 Periodic inspections and tests

Railroads shall conduct periodic inspections and tests to verify that all emergency signage and LLEPM system components, including power sources, function as intended. Railroads shall test a representative sample of passenger railcars in accordance with Sections 6.2.1 and 6.2.2. For more detailed information, see Appendix B.3 and Appendices C, D and F.

6.2.1 Electrically powered (active) systems

Railroads shall perform periodic tests to confirm that electrical component(s), including the emergency power source, function as intended and comply with Sections 2.4.1.1 and 2.4.1.2. Tests shall be conducted no less frequently than once every eight years, with the first test conducted no later than eight years after the car was placed in service for the first time.

The tests shall verify the minimum illumination/luminance level and duration of all LLEPM system components. Electrically powered components shall be photometrically tested as appropriate to the type of light source:

- illuminance for internally illuminated signs/markings/delineators; and
- luminance for EL signs/markings/delineators.

If the electrically powered system design does not change, and at the same time components are replaced with like kind, then the periodic testing of an electrically powered system will not require reverification of minimum illumination levels.

Independent power sources using batteries shall be certified by their manufacturers/suppliers to be capable of maintaining operation of the sign/marking components to which they are connected for at least 90 minutes as required by Section 4.1.1.

For electrically powered illuminated interior door exit signs and LLEPM components that use a battery as an independent power source and have an automatic self-diagnostic module, the module shall perform discharge tests. (See Appendix D for additional guidance.)

For electrically powered LLEPM components that use capacitors as independent power sources, a functional test shall be conducted as part of the periodic inspection.

6.2.2 HPPL (passive) systems

Railroads shall also conduct tests specified in this section to verify that all HPPL (passive) interior emergency signage system components receive sufficient illuminance from the charging light to provide the required luminance for the required duration (see Section 4.1.2.1). Charging light shall be photometrically tested as appropriate to the type of light source.

If the normal lighting system of a car type is reconfigured, the illumination levels shall be retested on at least one example of all affected areas.

Railroads shall conduct periodic illuminance tests to confirm that HPPL components receive adequate charging light. These shall occur no less frequently than once every eight years, with the first test conducted no later than eight years after the car was placed in service for the first time, for only the following HPPL components:

- HPPL signs/markings/delineators placed in areas designed or maintained with normal light levels of less than 5 fc
- grandfathered HPPL materials, where the sign/marking/delineator is placed in an area designed or maintained with normal light levels of less than 10 fc

If the HPPL system design or normal lighting system design does not change, and at the same time components are replaced with like kind, then the periodic testing of the HPPL system will not require re-verification of minimum charging illumination levels.

If all of the illuminance levels in the first two randomly selected representative sample cars exceed the minimum required to charge the HPPL components required by this standard by at least a factor of two, then no further testing is required for the cars represented by the sample car tested for the periodic test cycle.

6.3 Defect reporting, repair and recordkeeping

Illegible, broken, damaged, missing or non-functioning components of emergency signage/markings or the LLEPM system, including the normal and emergency power systems, shall be reported and repaired in accordance with railroad procedures that comply with 49 CFR § 238.19 defect reporting procedures.

Recordkeeping shall be in accordance with railroad procedures that comply with 49 CFR § 238.19 recordkeeping procedures.

Related APTA standards

APTA PR-CS-S-012-02, "Passenger Car Door Systems for New and Rebuilt Passenger Cars"
APTA RP-E-RP-007-98, "Storage Batteries and Battery Compartments"
APTA RP-E-RP-012-99, "Normal Lighting System Design for Passenger Rail Equipment"
APTA PR-E-S-013-99, "Emergency Lighting System Design for Passenger Cars"
APTA PR-IM-RP-001-98, "Passenger Rail Equipment Battery System Periodic Inspection and Maintenance"
APTA PR-IM-S-005-98, "Passenger Compartment Periodic Inspection and Maintenance"
APTA PR-IM-S-007-98, "Passenger Car Exterior Periodic Inspection and Maintenance"
APTA PR-IM-S-008-98, "Passenger Car Electrical Periodic Inspection and Maintenance"
APTA PR-IM-S-013-99, "Passenger Car Periodic Inspection and Maintenance"
APTA PR-M-S-018, "Powered Exterior Side Door System Design for New Passenger Cars"
APTA PR-PS-S-001-98, "Passenger Railroad Emergency Communications"
APTA PR-PS-S-003-98, "Emergency Evacuation Units for Passenger Cars"

References

This standard shall be used in conjunction with the applicable sections of the following publications. When the following publications are superseded, the revision shall apply.

American National Standards Institute/American Society for Quality Control, ANSI/ASQC Z1.9-1993, Sampling Procedures and Tables for Inspection by Variables.

American Public Transportation Association:
PR-E-S-013-99, Rev. 2, "Emergency Lighting System Design for Passenger Cars"

ASTM International:
D-4956-07 1e, "Standard Specification for Retroreflective Sheeting for Traffic Control"
E-2073-010, "Standard Test Method for Photopic Luminance of Photoluminescent (Phosphorescent) Markings"

Code of Federal Regulations:
49 CFR § 223, Safety Glazing Standards
49 CFR § 238, Passenger Equipment Safety Standards
49 CFR § 239, Passenger Train Emergency Preparedness

Federal Railroad Administration (FRA):
Emergency Order Number 20, Notices 1 and 2

National Transportation Safety Board Recommendations to Federal Railroad Administration, FRA R-97-16 and R-97-17.

Definitions

active illumination: Illumination generated by electrical energy.

aisle: A path through a vehicle that is not bordered by walls, such as down the center of a coach car that has a row of seats on each side (may include a ramp or single step)

alternative door exit: Exit point (usually a side door) used by passengers and crew to egress from the affected car and/or the train in an emergency if the door exit is locked, unavailable or unsafe.

auxiliary power system: An onboard source of electrical power (e.g., alternator/generator/car battery) typically used under normal operating conditions to supply such functions as lighting, air conditioning, etc.

candela (cd): Unit of luminous intensity in both SI and English measurement systems. One candela is one lumen per steradian (lm/sr). It is almost exactly equal to the obsolete unit called the candle.

car body end door: A door located at the collision posts. A car body end door may be used as an exit when safe to do so or when the train is in motion to enable passengers to relocate to safety in another car.

car body side door: A door in a passenger compartment or vestibule exiting to the exterior of the car; useable after the train has stopped.

color temperature: A numerical descriptor of the hue of a light source. It is expressed in terms of degrees on the Kelvin scale and refers to the temperature of a black-body radiator that produces light of the same hue as the source specified. Low color temperatures correspond to reddish sources, such as candle flames or incandescent lamps. Higher color temperatures are associated with cool-white fluorescent lamps, LEDs, blue sky and several types of new lighting technology.

door exits: The normal (preferred) door exit points used by passengers and crew members to egress from the affected car in an emergency.

dual mode: Using a combination of active (electrically powered) and passive (PL) light sources.

electroluminescence (EL): Luminescence resulting from the application of an alternating electrical current to phosphor.

emergency exit: A door through which an exit path terminates.

emergency exit locator signs: Conspicuous emergency marking/signage used to identify and/or direct passengers to the nearest emergency exit location(s) that meet the pertinent requirements described in Section 2.

emergency window: A window designed for removal from the inside of the vehicle in case evacuation is necessitated.

emergency signage: Textual and graphic messages designed to assist passengers and train crew members in locating and using railcar emergency exits and to assist emergency responders in gaining access to railcars using doors and windows from the exterior.

end-frame door: An end-facing door located between or adjacent to collision posts or similar end-frame structural elements of a passenger car.

exit path: The path or corridor through a railcar that provides the preferred path of evacuation from the car.

exterior side door: A door used as the means of passenger boarding and disembarking from a passenger car and in the event of an emergency after the train has stopped.

externally illuminated: Illuminated by a light source outside the sign, device, legend, marking or path itself (e.g., a non-photoluminescent sign with a light source shining on its surface). This source may be designed to provide dedicated illumination for a specific location or general emergency illumination. Fluorescent lamps, LEDs or occasionally incandescent lamps are typically used.

foot-candle (fc): A unit of illuminance. One foot-candle is one lumen per square foot (lm/sq ft). In the SI system, the units of illuminance are lux (1 fc = 10.76 lux).

head-end power (HEP): A system by which electrical power is provided to railroad vehicles from a central source via a trainline system. The source of power can be a locomotive or a power car (wayside supply from catenary, third rail or trackside can also be transformed into HEP as it passes through the power system). HEP is used under normal operating conditions to provide electrical power to the passenger equipment systems, such as "normal" lighting. In the United States, 480 VAC, 60 Hz, three-phase systems are most common.

high-performance photoluminescent (HPPL) material: A photoluminescent material that is capable of emitting light at a very high rate and for an extended period of time. For this standard, the minimum luminance value for HPPL is 7.5 mcd/m^2, 90 minutes after removal of the charging light source. Unless otherwise permitted by this standard, for rating purposes, the charging light source required is a fluorescent lamp with a color temperature of 4000 to 4500 °K that provides an illuminance of no more than 1 fc for a duration of no more than 60 minutes.

HPPL material (former definition): A material capable of emitting light at a high rate and for an extended period of time. For this standard, the minimum luminance value for HPPL is 7.5 millicandelas per square meter (7.5 mcd/m^2), 90 minutes after removal of the charging light source. Unless otherwise permitted by this standard, for rating purposes, the charging light source is specified as a fluorescent lamp with a color temperature of 4000 to 4500 °K providing an illuminance of no more than 5 fc on the test sample for a duration of no more than 60 minutes.

icon: A sign or representation that stands for an object by virtue of a resemblance or analogy to it.

illuminance: The amount of light (luminous flux) falling on a specific (unit) surface area (e.g., 1 sq ft). English units are foot-candles (fc) or lumens per square foot (lm/sq ft). SI units are lumens per square meter (lm/m^2) or lux (lx) (1 fc = 10.76 lux).

independent power source: A sealed battery or other energy storage device located within the car body designed to power one or more emergency light fixtures or other devices when the normal HEP, main car battery, auxiliary power and/or wayside power are unavailable.

instructional signage: Textual and/or graphic message signs that simply express information and details about how something should be done or operated.

internally illuminated: Illuminated with a light source contained inside the sign, device, marking or legend itself, e.g., a light fixture with the word "EXIT" printed on the diffuser. The light source is typically incandescent, fluorescent, EL or LED.

lighting, emergency: A lighting mode that is available when power for the normal lighting and standby lighting (if equipped) becomes unavailable. The main car battery or one or more independent power sources can be used to supply the power to operate the fixtures that provide emergency lighting.

lighting, normal: A lighting mode that is available when the car is in operation with the normal power system.

low-location: The area of the railcar defined by a volume that includes the entire area of the floor, and which extends upward to a horizontal plane at 4 ft (1.22 m).

luminaire: A device to produce, control and distribute light. A complete unit typically consists of one or more lamps, sockets to hold and protect the lamps, optical devices to direct the light, and circuitry to provide the required electric power to the lamp(s) and/or LEDs. Commonly referred to as a light fixture.

luminance: The amount of light reflected from a unit area or surface, or the amount of light emitted from a surface, e.g., electroluminescent or LED material. English units are foot-lamberts (fl). SI units are candelas per square meter (cd/m^2) (also called "nits") and millicandelas per square meter (mcd/m^2). (1 fl = 3.426 cd/m^2 or 3426 mcd/m^2.)

luminescence: The emission of light other than incandescent, as in phosphorescence or fluorescence by processes that derive energy from essentially nonthermal sources through excitation by radiation.

luminous intensity: The luminous flux per unit solid angle in the direction measured. Expressed in candelas or lumens per steradian.

luminance contrast ratio: The relationship or difference between the object and its immediate background, defined by the following ratio:

$$\frac{L1 - L2}{L1}$$

Where: L1 = luminance of background
L2 = luminance of the object in question (e.g., lettering, pictogram, symbol)

marking/delineator: A visible notice, sign, symbol, line or trace.

passageway: A path through a vehicle that is bordered by walls to allow a passenger or crew member the ability to move from one location to another.

passenger car and/or car: Rail rolling equipment intended to provide transportation for members of the general public. Can be either self-propelled or locomotive hauled and is designed to carry passengers, baggage, mail or express.

passive illumination: Illumination generated without the use of direct electrical energy.

photoluminescent (PL) material: Material having the property of emitting light that continues for a length of time after excitation by visible or invisible light has been removed (i.e., self-illuminating).

pictogram/pictograph: A pictorial sign or symbol.

> **NOTE:** Both words share the same meaning. For the purposes of this standard, the term "pictogram" is used.

representative car: A car that shares relevant characteristics with the cars it represents (i.e., same LLEPM layout and charging light system for passive LLEPM systems, or same light fixtures and power system for electrically powered LLEPM systems).

rescue access window: A window designed for removal by first responders from the exterior of the car.

sign: A display board, poster placard or marking/delineator using text and/or graphics to convey information or direction.

spatial average: The average of all samples taken in the vicinity of a specific location. The area of a spatial average varies. For a stairway, it comprises only the area of the stair step(s). For an aisle, the entire length of the aisle is included.

stairway: A continuous set of steps (not interrupted by a landing).

symbol: A letter, figure, other character, arrow, mark or any combination thereof used for designating something else by association, resemblance or convention.

useful field of view (UFOV): The sensory, perceptual and attentional processes that address the ability to attend to one's surroundings, detect information and identify that which demands action. In terms of behavior, UFOV includes that information which can be extracted from a glance.

vestibule: An area of a passenger car that normally does not contain seating, is located adjacent to an exterior side door, and is used in passing from a seating area to an immediate exterior side door exit. In some cases used to pass from a seating area space adjacent to an immediate end-frame door exit.

vestibule door: A door separating a seating area from a vestibule and complying with 49 CFR § 238.112(f) if located in the passenger car's designated exit path. Doors separating sleeping compartments or similar private compartments are not vestibule doors.

Abbreviations and acronyms

ADA	Americans with Disabilities Act
ANSI	American National Standards Institute
ASQ	American Society for Quality
ASTM	ASTM International (formerly American Society for Testing and Materials)
CFR	Code of Federal Regulations
CIE	Commission Internationale de l'Eclairage (International Commission on Illumination)
EL	electroluminescent
FAA	Federal Aviation Administration
fc	foot-candles
fl	foot-lamberts
FRA	Federal Railroad Administration
ft	feet
HEP	head-end power
HPPL	high-performance photoluminescent
LED	light-emitting diode
LLEPM	low-location exit path marking
mcd	millicandelas
mcd/m²	millicandelas per square meter
NTSB	National Transportation Safety Board
PL	photoluminescent
PRESS	Passenger Rail Equipment Safety Standards
SI	Système International
sr	steradian
UFOV	useful field of view

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Appendix A (informative): Bibliography

1. ASTM International E-808-01, “Standard Practice for Describing Retroreflection.”
2. ASTM International E-809-02, “Standard Practice for Measuring Photometric Characteristics of Retroreflectors.”
3. ASTM International E-810-03, “Standard Test Method for SIA of Retroreflective Sheeting”
4. ASTM International E-2030-04, “Standard Guide for Recommended Uses of Photoluminescent Safety Markings”
5. ASTM International E-2072-04, “Standard Specification for Photoluminescent (Phosphorescent) Safety Markings”
6. Chesterfield, B.P., Rasmussen, P.G., and Dillon, R.D., “Emergency Cabin Lighting Installations: An Analysis of Ceiling- vs Lower Cabin-Mounted Lighting During Evacuation Trials,” Office of Aviation Medicine. Final Report No. FAA-AM-81-7.
7. Demaree, J. “Examination of Aircraft Interior Emergency Lighting in a Postcrash Fire Environment,” FAA Technical Center, Final Report No. FAA-DOT/FAA/ct-82/55.
8. Deutsche Industrie Norm (DIN), DIN 67510, Parts 1-4: German Standard: Phosphorescent Pigments and Products, January 1992.
9. DOT-FRA-ORD-93-24, FRA/Volpe Center, USDOT, Recommended Emergency Preparedness Guidelines for Passenger Trains, December 1993.
10. Federal Aviation Administration (FAA). Advisory Circular 25-812-1A, “Floor Proximity Emergency Escape Path Marking,” May 22, 1989.
11. Federal Aviation Administration (FAA). Advisory Circular 25-812-2, “Floor Proximity Emergency Escape Path Marking Systems Incorporating Photoluminescent Elements,” July 24, 1997.
12. Illuminating Engineering Society (IES), Handbook Reference and Applications, Chapter 29: Emergency, Safety and Security Lighting, 9th edition, 2000.
13. International Marine Organization (IMO), IMO Resolution A.752 (18), Nov. 4, 1993, “Guidelines for the Evaluation, Testing and Application of Low-Location Lighting on Passenger Ships.”
14. International Standards Organization (ISO) 3864-1: 2003, Graphical Symbols—Safety Colours and Safety Signs—Design Principles for Safety Signs Used in Workplaces and Public Areas (First edition 2002, Corrected version 2003)
15. International Standards Organization (ISO) 7010: 2002, Graphical Symbols—Safety Colours and Safety Signs—Safety Signs Used in Workplaces and Public Areas. 1st Edition.
16. International Standards Organization (ISO) 16069: 2004 Draft Graphical symbols—Safety Signs—Safety Way Guidance Systems. TC 145 /SC 2
17. International Standards Organization (ISO) 9186, 2001, Graphical Symbols—Test Methods for Judged Comprehensibility and for Comprehension. 2nd Edition.
18. International Standards Organization (ISO) 17398:2004, Safety Colours and Safety Signs – Classification, Performance and Durability of Safety Signs.
19. McLean, G.A., and C.B. Chittum. Performance Demonstration of Zinc Sulfide and Strontium Aluminate Photoluminescent Floor Proximity Escape Path Marking Systems. Federal Aviation Administration. Office of Aviation Medicine. Final Report. No. DOT/FAA/AM-92/2.
20. MIL Std 1472E, Department of Defense Design Criteria Standard Human Engineering, Section 5.5: Labeling, 31 October 1996.
21. National Bureau of Standards (NBS), Technical Note 11-80, National Bureau of Standards, Size of Letters Required for Visibility as a Function of Viewing Distance and Observer Visual Acuity, NBS Technical Note 11-80, July 1983.
22. National Fire Protection Association (NFPA) 70, National Electrical Code, Quincy, MA. 2006.
23. National Fire Protection Association (NFPA) 101 Life Safety Code, Chapter 7, Means of Egress. Quincy, MA, 2006.

24. National Fire Protection Association (NFPA) 130, Fixed Guideway and Passenger Rail Systems, NFPA, Quincy, MA, 2006.
25. Rasmussen, P.G., Chesterfield, B.P., and D.L. Lowrey. Readability of Self-Luminated Signs Obscured by Black Fuel-Fire Smoke, Federal Aviation Administration (FAA), Office of Aviation Medicine (OAM), Final Report. No. FAA-AM-80-13.
26. Rasmussen, P.G., Garner, J.D., Blethrow, J.G., and D.L. Lowrey. Readability of Self-Luminated Signs in a Smoke Obscured Environment, FAA/OAM. Final Report No. FAA-AM-79-108.
27. Underwriters' Laboratories 924, Standard for Emergency Lighting and Power Equipment, 9th Edition, dated Feb. 24, 2006. Effective Aug. 24, 2006.
28. Underwriters' Laboratories 1994, Standard for Luminous Egress Path Marking Systems, Third Edition, dated Jan. 30, 2004, including revision as of Feb. 14, 2005.
29. U.S. Architectural & Transportation Barriers Compliance Board, Commuter Rail Cars and Systems Technical Assistance Manual, Oct. 1992.
30. Federal Aviation Administration (FAA). 14 CFR Part 25, Airworthiness Standards, Transport Category Airplanes: Subpart D, Design and Construction, Subsection 25.811: Emergency Exit Marking.
31. Federal Aviation Administration (FAA). 14 CFR, Part 25, Airworthiness Standards, Transport Category Airplanes: Subpart D, Design and Construction, Subsection 25.812, Emergency Lighting, (e) floor proximity emergency exit path marking.
32. Federal Aviation Administration (FAA). 14 CFR, Part 121, (Special Federal Aviation Regulations) Operating Requirements: Domestic, Flag, and Supplemental Operations, Subpart K, Instrument and Equipment Requirements, Subsection 121.310, Additional Emergency Equipment.

Appendix B (informative): HPPL material technical considerations

B.1 Variables

Five variables affect the visibility of the HPPL material/component:

- location of the material in relation to the activating charging light
- illuminance charging levels provided by ambient light
- amount of time the HPPL material component is exposed to light
- type of activating light source
- energy-storage efficiency of the HPPL material

The location of the HPPL material in relation to the activating light source and any objects that cast shadows on the material have a great impact on the illuminance provided by the charging light. Accordingly, HPPL material should not be located in shadowed areas.

Cool-white fluorescent lamps producing an illuminance level of 2 fc have been shown to provide sufficient charging light for materials meeting the former definition of HPPL used in passenger railcars. Adequate charging light for HPPL materials/components is generally available at most locations, except directly under the seats, or if there are overhangs or other obstructions that block light from reaching the material/component. Signs/markings certified according to the former definition of HPPL (see “Definitions”) require at least twice as much illuminance as the currently defined HPPL material to deliver the same luminance. HPPL materials certified to the former definition were usually designed with a large safety factor, so they do not actually require five times as much light for charging as the HPPL material as per the current definition.

Another variable is the available HPPL charging time. The adequate charging time at 1 fc is at least 60 minutes from dark storage until departure.

The type of charging light that is used will affect the amount of illumination required to charge the emergency sign and LLEPM components adequately. Most of the visible spectrum (red, orange and yellow) of a light source is not useful for charging PL materials. Short-wavelength ultraviolet light is the most effective part of the light spectrum for charging PL materials. Photons of longer wavelength do not have enough energy to excite the electrons of the PL material. For example, 1 fc of illumination from a commonly available cool-white fluorescent lamp will provide sufficient illumination to meet the HPPL luminance criterion. However, 1 fc of illumination from commonly available warm-white fluorescent and incandescent lamps will not. If warm-white fluorescent lamps are used, then the minimum charging light level must be at least 50% higher. If incandescent lamps are used, then the minimum charging light level will be more than three times higher than is sufficient with cool-white fluorescent lamps.

White LED light contains a higher proportion of short-wavelength light, and is thus somewhat more effective than cool-white fluorescent light for charging. In addition, since LEDs are fundamentally unidirectional light emitters, luminaires that use them must be specifically designed to disperse light through the use of multiple emitters pointing in different directions, reflectors and/or diffusers. Therefore, it is important that procurement documents explicitly state the illuminance levels required on the surface of the PL signs/markings.

In addition to these five variables, an important consideration is the type of light meter used to measure the charging light illuminance and the placement of the meter sensor in relation to the HPPL material, both of which will have an impact on the ability to accurately measure the illuminance level provided by the activating light source. Light meters are designed to respond to light the same as the human eye does and thus measure only the visible light emitted by both the charging source and the PL material. Although invisible ultraviolet light is the most effective part of the light spectrum for charging PL materials, standard light meters do not register the ultraviolet light emitted by the charging light. Moreover, the weighting factor for

visible violet and blue light is small. Therefore, light meter readings of charging light can be misleading if the light source is different from the specified cool-white fluorescent source used for certification (i.e., laboratory) testing. See Appendix C.1 for further information relating to light meters.

B.2 Alternatives to increase charging light output

To ensure that the normal lighting system provides an adequate charge to the HPPL system, luminaires shall be oriented to ensure that the HPPL material is adequately exposed to charging light. This appendix contains information that railroads can use to ensure that sufficient light is available.

If, during the interior verification tests or periodic inspections, the normal charging light fails to meet the minimum illuminance criterion using normal lighting, there are several actions that can be taken to increase the charging light levels:

- Check the light fixtures near the test samples to ensure proper working order.
- Clean light fixtures and check to ensure that the diffusers are not yellowed with age. Old, dirty fixtures have been measured with less than half the light output of clean ones with new diffusers.
- Check fluorescent tubes to ensure that they are not near the ends of their service lives, when light output drops significantly.
- Relocate signs/markings/delineators.
- Replace warm-white fluorescent lamps with cool-white fluorescent lamps.
- Replace/supplement incandescent luminaires with fluorescent or LED luminaires.
- Replace frosted light diffuser lenses with clear lenses.
- Replace existing fluorescent tubes with those of recent design that provide 10% to 15% more light for the same wattage rating and double the service life.
- If the charging light performance criterion cannot be met after taking the above actions, then install either:
    - PL signs/markings/delineators verified by the manufacturer/supplier-provided independent laboratory certified test result to exceed HPPL requirements sufficiently that they can provide a luminance of 7.5 mcd/m^2 after 90 minutes, as applicable (for exceptions, see Appendix G), after charging with whatever normal lighting is available at the sign/marking/delineator location in question; or
    - dual-mode or actively illuminated components with an independent power supply.

B.3 Testing considerations

The difference between the physical characteristics of electrically powered light fixtures/strips and HPPL materials has an impact on their visibility and thus the performance criteria and installation location within various railcar configurations. For example, it is important that HPPL material be installed in locations and orientations that provide maximum exposure to adequate charging light. In addition, dual-mode LLEPM system components can be used to increase conspicuity. Additional measures for addressing extenuating circumstances are described below and in Appendix B.2.

If the ambient light cannot be reduced to 0.01 fc, there are two alternative measurements that can be used to meet the requirements (see Section 2.4.2.2):

1. Measure the ambient light at each location and subtract that value from the value measured with the charging light system operating.
2. If the charging light system is at least twice the required levels in **Table 1** plus the ambient light reading, consider the required levels to be met.

If the ambient (normal charging light) illuminance is less than the required criteria specified, railroads can take several actions described in this appendix to increase the charging light levels.

Unless the floor measurement value is known to be at least five times the value in **Table 1**, a 6½ ft (1.98 m) separation between the sensor head and the display must be used to ensure that the proximity of the person taking the measurements does not affect the readings.

TABLE 1
Minimum Illuminance Values for Charging HPPL Materials (Former and Current Definitions), Grandfathering

Illuminance Value, fc (lux)		Type of Luminaire (Charging Light)
Certified Under Former Definition of HPPL	Certified Under Current Definition of HPPL	
1.6 (10.8)	0.8 (8.6)	Cool-white LED (6500 ºK)
1.8 (19.4)	0.9 (9.7)	Warm-white LED (4700 ºK)
2.0 (21.5)	1.0 (10.8)	Cool-white fluorescent (4000–4500 ºK)
3.0 (32.3)	1.5 (16.1)	Warm-white fluorescent (3000–3500 ºK)
7.0 (75.3)	3.5 (37.7)	Incandescent (2900 ºK)

HPPL materials certified by an independent test laboratory to meet **Table 1** requirements with the lower amount of charging light are permitted for use at that location, as long as the specified amount of light is available.

To the extent practicable, avoid installing HPPL signs/markings in shadowed locations.

HPPL signs/markings certified by an independent test laboratory to be capable of meeting the minimum performance specifications of HPPL as defined in this standard that are located in partitioned vestibules/ compartments/passageways no longer than 5 ft (1.52 m) longitudinally (including partially portioned vestibules) are not subject to the illuminance requirements in **Table 1**.

Luminaires located in the proximity of each HPPL component shall be specified such that their light-dispersion patterns provide the above-listed minimum illuminance levels at the surface of the component.

Existing stocks of PL material held in inventory as of April 7, 2008, that meet the former definition of HPPL may be installed only in locations that qualify under one of the conditions listed above and that are not shadowed by structural elements or other permanent fixtures.

A list of independent test laboratories is contained in Appendix E.

The manufacturer/supplier is required to have a minimum of one batch of material for signs/markings/ delineators of a given type certified. Signs/markings/delineators of the same certified type of material can be sold to multiple customers, even with minor changes in text or typography.

Several methods can be used to eliminate ambient light for accurate data collection (e.g., work at night with cars parked away from bright yard lights; locate cars in a dark, windowless shop or carwash; mask windows and vestibules with roofing paper, flooring paper or similar opaque materials; or drape cars with opaque tarps).

To take the measurement readings, the sensor is placed on the area of the HPPL sign/marking surface location where the light is brightest (or on the floor location as permitted in Appendix G.1.2). The observer records the reading(s) using a data collection form (see Appendix C.4).

The sensor and the readout device of the illuminance meter must be held in a manner so that the sensor is not affected by the observer's shadow. If light diffusers are used on the light fixtures, then the measurements shall be made with the light diffusers in place.

Appendix C (informative): Procedures for measuring charging light illuminance

C.1 Equipment

Examples of handheld meters on the market with adequate accuracy and sensitivity for this application are illustrated in **Figure 1**.

FIGURE 1
Typical Meters for Illuminance Measurements

Hagner E4-X digital luxmeter

Minolta T-10A illuminance meter and A20 and A21 adapters and LAN cable

Gigahertz-Optik X1 with VL 3704 illuminance detector

Other meters that meet the performance specifications listed in Section 3 are also acceptable.

Illuminance sensors may need recalibration if they are dropped. Special care is required to avoid this. Gigahertz-Optik offers an optional foam rubber shock protector for its sensor.

Railroads with fleets consisting entirely of brightly illuminated cars may forgo the use of a meter with precise off-axis response, because high levels of floor illumination can be used to establish that illumination on vertical surfaces is adequate for charging PL emergency signage and LLEPM components. Low-cost meters that conform to CNS 5119, Class II (which permits unlimited errors for angles of incidence greater than 60 deg) may be used for floor and arm-rest level measurements of illumination. Because field data have shown that illuminance values on vertical surfaces are at least 20% of the illuminance on adjacent floors, the floor measurements made with inexpensive meters can be used to demonstrate compliance with this standard whenever the values at the floor are five times greater than required illuminance on the surface of the LLEPM component in question. Meters for this application are widely available from vendors such as Extech, TES, Tenmars, etc.

Other considerations: The Minolta meter can be set to read out in foot-candles or lux; the other meters read out in lux only. The Minolta and Gigahertz-Optik meters have USB data outputs. The Hagner meter has an analog data output and requires an external USB data-acquisition adapter. The Minolta meter has a detachable head that can be connected to the meter body with an ordinary LAN cable of 6½ ft (1.98 m), provided that the optional A20 and A21 adapters are purchased. The other meters have 6½ ft (1.98 m) cables permanently attached to the sensor.

C.2 Data recording and computerized data collection

To take the measurement readings, the sensor is placed on the area of the HPPL LLEPM component or emergency sign surface location where the light is brightest (or on the floor location as permitted in Appendix G.1.2). The observer simply records the reading(s) using a form similar to that shown in Appendix C.4.

The sensor and readout device of the illuminance meter should be held in a manner so that the readout device can be read without the observer's shadow affecting the readings.

The illuminance measurements described in Section 2.4 for the doors, vestibules, stairs, etc., must be performed by manually positioning the light sensor at each of the designated locations. However, the numerous aisle measurements to determine the minimum average illumination levels required in **Table 1** can be taken much more quickly and more accurately using a computer. The computer data collection technique is based on moving/dragging a sensor down the aisle at a slow, steady pace while readings are captured to a notebook computer or data logger at the rate of at least one reading per second.

Although no special apparatus is needed to collect floor-level measurements, it is strongly recommended that the notebook computer, light meter and any adapters be attached to a tray or similar carrying device with hook-and-loop tape so they can be easily and safely moved together.

The spatial average is calculated with spreadsheet software based on 60 or more samples, i.e., the data collector should walk at the rate of about one foot per second. The software will also find the minimum value in each set of readings and generate a graphic profile of illuminance levels along the length of the car.

As noted in Section 3.1.2.1, the minimum test period duration is 90 minutes. All illuminance light levels are measured and recorded immediately at the start of the test, at the halfway time point, and again at the end of the final time duration.

C.3 Timing of readings

Readings should be taken at least 15 minutes after the normal illumination charging light is placed in operation to allow the lamps to reach full output and per Section 3.

C.4 Sample illuminance charging light survey forms

C.4.1 Signage/marking sample illuminance/charging light survey form

Railroad Property/Location:		
Car Builder:		
Car Type/Series/Configuration/Year:		
Car Plate #:		
Date:		
Data Collector's Name:		
Light Meter Used:		
Start Time:	End Time:	
MEASUREMENTS (all measurements are expressed in foot-candles)		
Locations	**A-End**	**B-End**
End door sign/control/instructions		
Side door sign, location 1		
Side door sign, location 2		
Side door sign, location 1		
Side door sign, location 2		
Window exit locator signs (describe location and record measurement at each sign)	**Left Side**	**Right Side**

C.4.2 LLEPM sample illuminance/charging light survey form

Railroad Property/Location:		
Car Builder:		
Car Type/Series/Configuration/Year:		
Car Plate #:		
Date:		
Data Collector's Name:		
Light Meter Used:		
Start Time:	End Time:	
MEASUREMENTS (all measurements are expressed in foot-candles)		
Locations	**A-End**	**B-End**
End-frame door sign/control/instructions		
Vestibule door, location 1		
Vestibule door, location 2		
Stairs, location 1		
Stairs, location 2		
Aisle, location 1		
Aisle, location 2		
Crew area (if any)		
Other special area		
Passageway, if any		

C.4.3 Notes form

Use the following to describe the make, model, wattage rating and cleanliness of the emergency charging light fixtures, etc.

Appendix D (informative): Automatic testing of electrically powered systems

Electrically powered emergency signage and LLEPM components using independent power sources have important advantages since they are not vulnerable to loss of the main car battery power supply and/or damage to the main car battery power supply wiring.

All passenger cars equipped with electrically powered path markings/delineators that are not dual mode shall have an independent power source. Batteries that are used as independent power sources shall have automatic self-diagnostic modules designed to perform discharge tests (see below).

Finally, LED-based dual-mode signage/marking components should use either white or green charging light.

For the independent power supply to the emergency signage and LLEPM system to be reliable and operate when necessary, multiple individual batteries must be periodically tested for each railcar (for cars with only two such batteries, each one must be tested).

Manual testing requires that a worker first determine that all independent power sources using batteries have been connected to a source of charging power for the necessary amount of time to reach full charge. Then, car by car, the charging power must be disconnected and the LLEPM system and emergency signage switched into emergency mode. After the prescribed 90-minute time period for discharge (except as noted in Appendix F), the worker must then revisit each car and note which LLEPM and emergency signage components are working properly and which are not. While such tests are in progress, other kinds of maintenance work are effectively precluded by the lack of light inside the car. Frequency of testing is governed by OEM specifications.

To avoid the substantial labor costs of conducting periodic discharge tests of these independent power sources, manufacturers of door emergency exit sign systems for buildings have developed self-test modules for their battery ballasts that perform periodic discharge tests automatically. (A discharge test is necessary for independent batteries because they are sealed devices and therefore cannot be tested by the specific-gravity method used for the main car battery.)

These self-test modules display the results of the most recent test by means of a multicolor LED on the light fixture. For a typical fixture, the LED can indicate any of the following conditions:

Condition	Status Indication
Normal mode	Steady green
Self-testing	Flashing green
Emergency mode	Off
Insufficient charge	Flashing red/green
Battery pack failure	Single-flash red
Emergency lamp failure	Double-flash red
Self-diagnostic module failure	Triple-flash red
Under/over charge	Quadruple-flash red

The status indication remains displayed until the next scheduled periodic test or until a repair is performed. Only a momentary observation is required to see that a unit is functioning normally. Only failed components require action by maintenance staff.

Automatic testing offers the important advantage of allowing one worker to determine the condition of every LLEPM and emergency signage component in the time it takes to walk the length of an entire train and requires no special preparation. In addition, it is not necessary to turn off normal lighting, so there is no interference with other inspection and maintenance activities.

All the test modules on the market are microprocessor-based. The frequency and duration of the discharge tests are specified in software. Test modules for the commercial building market perform 5-minute discharge tests at 30-day intervals and 30-minute discharge tests at 6-month intervals.

Appendix E (informative): Test laboratories

E.1 ASTM International

At the time this document was authorized, the following independent test laboratories could perform the ASTM E-2073 test, as noted in Section 3.1.2.1 of this standard to measure the luminance of HPPL material:

- California Institute of Electronics and Material Science (www.ciems.com/)
- Intertek ETL Simko (www.intertek-etlsemko.com/)
- Gamma Scientific (www.gamma-sci.com)
- UL Inc. (www.ul.com)
- Hoffman Engineering Corp. (www.HoffmanEngineering.com)

E.2 UL

UL (formerly Underwriters Laboratories) has issued UL 1994, "Standard for Luminous Egress Path Marking Systems." UL 1994 includes requirements for egress path marking installed for buildings in accordance with NFPA 70, "National Electrical Code," and NFPA 101, "Life Safety Code." The NFPA 101 and UL 1994 requirements now reflect acceptance of PL signs for use in buildings.

While this APTA standard contains requirements consistent with the general concepts of UL 1994, the UL tests and performance criteria are not considered appropriate to evaluate passenger railcar emergency signage and LLEPM systems.

Appendix F: Sampling (normative)

F.1 Representative sample sizes

Either of the following two sampling methods is acceptable.

F.1.1 ANSI/ASQ

The American National Standards Institute (ANSI) and the American Society for Quality (ASQ) have developed detailed procedures for determining representative sampling plans for maintenance inspection operations. These may be found in "Sampling Procedures and Tables for Inspection by Variables for Percent Nonconforming" (ANSI/ASQC Z1.9-2003). In Appendix A7.1 of this standard, various inspection levels, which allow for alternative sample sizes, are explained. When operations do not permit the preferred inspection level of "General II" to be carried out, "Special Inspection Levels" (S3) may be used. If the total car fleet is smaller than the number of samples required by ANSI/ASQC Z1.9-2003, then the sample size is equal to the car fleet size.

In determining whether to accept or reject the fleet's emergency light performance, the methods of Appendix B, Form 2 should be used, since variability of the fleet, or "lot," is unknown. Additionally, a Quality Acceptance Limit of not more than 2.5% shall be used, per industry practices.

If the first sample has acceptable results, as defined by ANSI/ASQC Z1.9-2003, no further action is needed. If the sample fails, a new sample should be tested using "tightened" inspection procedures. If the new sample passes, document and correct any single car/area that failed to meet the criteria of Table 1, Section 6, of this standard. After completion of the repair, no further action is needed. If the second sample fails, determine the cause, document, and implement a fleet-wide redesign/repair to correct the defect. Upon completion of repairs, reinspect using tightened inspection procedures.

Areas of similarity within a vehicle do not require additional testing.

F.2.2 Determining fleet size for sampling purposes

Cars of different manufacturers or different marking/signage designs cannot be considered as part of the same fleet when considering sampling for periodic testing.

Justification shall be provided if a railroad elects to include similar yet different rolling stock within the same fleet for sampling purposes. Examples of this include, but are not limited to, the following:

- cab cars, trailer cars, power cars, MUs, and cab cars running as trailer cars
- different car orders
- identical areas across multiple variants of the same base design

Justification for the inclusion of similar yet different rolling stock within the same fleet for sampling purposes shall include either numerical or logical proof that the inclusion of the similar yet different cars shall not create a false positive sampling for any of the sub-fleets included. If sub-fleets are included within the same sample set, at least one sample from each sub-fleet shall be included within the sample set.

Appendix G (informative): Grandfathered systems and materials

The following grandfathered exceptions apply only as described below.

G.1 PL materials

Existing stocks of PL material held in inventory as of April 7, 2008, that meet the former definition of HPPL may be installed only in locations that qualify under one of the conditions listed in Appendices G.1.1 and G.1.2 and that are not shadowed by structural elements or other permanent fixtures.

PL materials that meet the luminance levels of at least 7.5 mcd/m^2 for at least 60 minutes following a charge with the illuminance values in **Table 1** (see Appendix B.3) are grandfathered. If PL materials certified by an independent laboratory to meet the former definition of HPPL are charged with the illuminance levels in the first column of **Table 1**, then such materials are presumed to meet these luminance levels.

G.1.1 Signs/markings

PL signs/markings installed in cars on or before April 7, 2008, and certified by an independent test laboratory to comply with the PL luminance criteria in Appendix G.1 are grandfathered if any of the following conditions are met:

1. The location where they are installed receives the minimum illuminance listed for the type of luminaire used for charging as specified in **Table 1** (see Appendix B.3). The illuminance values shall be measured with a light meter meeting the requirements in Section 3.1.3 and Appendix C and with the sensor placed flat against the surface of the sign/marking.
2. The illuminance values shall be measured with a light meter meeting the requirements in Appendix C, except that its cosine error may be as specified in CNS 5119 (see Appendix C) and with the sensor placed flat on the floor at any point within a horizontal distance of 3 ft (0.914 m) of the sign/marking. The illuminance values shall be at least five times greater than the values listed in **Table 1**.
3. The signs/markings are made of materials meeting the former definition of HPPL located in partitioned vestibules/compartments/passageways that are:
    - no longer than 5 ft (1.52 m) longitudinally (including partially partitioned vestibules); or
    - between 5 and 10 ft (1.52 and 3.05 m) in length measured longitudinally (including partially partitioned vestibules) that are charged by incandescent luminaires, and have:
        - locator signs in the seating area that comply with Sections 2.1.1.4 and 2.1.2.1, and:
        - dimensions of at least:
            - 2 in. (5.08 cm) in letter height; or
            - 21 sq in. (135 cm^2) in area.

NOTE: Some signs/markings may have to be replaced or some illumination levels increased. If the ambient illuminance (normal charging light) is less than the required criteria specified, then railroads can take several actions described in Appendix B to increase the charging light levels.

G.1.2 LLEPM components

PL LLEPMs installed in cars on or before April 7, 2008, and certified by an independent test laboratory to comply with these PL luminance criteria in Appendix G.1 are grandfathered if any of the following conditions are met:

1. The location where they are installed receives the minimum illuminance listed for the type of luminaire used for charging as specified in **Table 1** (see Appendix B.3). The illuminance values shall

be measured with a light meter meeting the requirements of Appendix 3.1.3 and Appendix C and with the sensor:
    - placed flat against the surface of the LLEPM sign/marking/delineator; or
    - dragged along the aisle while its data is recorded by a notebook computer or data logger, as described in Appendix C, for exit path marking/delineators installed near or in the floor.
2. The illuminance values shall be measured with a light meter meeting the requirements in Section 3.1.3, except that its cosine error may be as specified in CNS 5119 (see Appendix C) and with the sensor placed flat on the floor at any point within a horizontal distance of 3 ft (0.914 m) of the sign/marking/delineator. The illuminance values shall be at least five times greater than the values listed in **Table 1** (see Appendix B.3).
3. The signs/markings are made of materials meeting the former definition of HPPL located in partitioned vestibules/compartments/passageways that are:
    - no longer than 5 ft (1.52 m) longitudinally (including partially partitioned vestibules); or
    - between 5 and 10 ft (1.52 and 3.05 m) in length measured longitudinally (including partially partitioned vestibules) that are charged by incandescent luminaires, and have:
        - locator signs in the seating area that comply with Sections 2.1.2.1 and 2.1.2.2; and
        - dimensions of at least:
            - 2 in. (5.08 cm) in letter height; or
            - 21 sq in. (135 cm^2) in area.

NOTE: Some signs/markings may have to be replaced or some illumination levels increased. If the ambient illuminance (normal charging light) is less than the required criteria specified, then railroads can take several actions described in Appendix B to increase the charging light levels.

G.2 Alternative markings

G.2.1 Door control markings

Each door exit handle, latch, or operating button may be marked with HPPL material in the form of an area wide pad that is applied to the door or doorframe directly behind the handle or latch with either of the following dimensions:

- For equipment ordered before April 7, 2008, and placed in service before Jan. 1, 2011, no less than 6 sq in. (39 cm^2).
- For equipment ordered on or after April 7, 2008, or placed in service for the first time after Jan. 1, 2011, no less than 16 sq in. (103 cm^2).

G.2.2 Pathway and stairway markings

Previous revisions specifically cited the following three stairway marking alternatives as acceptable if the marking/delineator placement provides a clear and conspicuous visual delineation of the exit path to a person standing at the top landing, bottom landing and any tread:

- **Alternative 1:** 1 in. (2.54 cm) wide "L" shaped marking/delineators shall be installed on both sides of each tread nearest to the wall.
- **Alternative 2:** Materials applied to the step risers that consist of a minimum 2 in. (5.08 cm) wide strip or two 1 in. (2.54 cm) wide strips that extend, to the extent practicable, across the full width of the riser and placed at the lower half of the riser.
- **Alternative 3:** Discs of not less than 1.25 in. (3.18 cm) in diameter, placed either:
    - no more than 2.5 in. (6.35 cm) apart on each stair tread, near the step nosing; or
    - no more than 2.5 in. (6.35 cm) apart and no higher than 18 in. (45.7 cm) from the treads on both sides of the stairway walls/partitions.

Additionally, each passenger car ordered before April 7, 2008, and placed in service before Jan. 1, 2011, may have pathways marked by three discs clustered in a series with no gap between the clusters exceeding 30 in. (76.2 cm).

G.2.3 Vestibule, end-frame and side doors

Emergency exit signs/markings shall identify the location of all vestibule, end-frame and side doors leading to the exterior of the car and intended for emergency egress using the following:

1. For passenger cars ordered before April 7, 2008, and placed in service before Jan. 1, 2011:
    - HPPL material, including dual-mode; or
    - electrically powered fixtures with an independent power source that can power the signs for at least 60 minutes after power for normal lighting ceases.

For passenger cars ordered before April 7, 2008, and placed in service before Jan. 1, 2011, each electrically powered sign/marking that is not dual mode shall have an independent power source that can power the sign/marking in accordance with the requirements above.

G.3 Other grandfathered requirements

The following are other dated implementation requirements that have already passed. Existing installations are grandfathered only if installed before the implementation date of each requirement. Existing installations that are grandfathered are to be upgraded to become compliant upon replacement.

G.3.1 Sign size

A minimum sign area of 16 sq in. (103 cm^2) is required for all end and side door exit signs installed after April 7, 2008.

G.3.2 Exposed LED exit signs

For signs/markings installed on or after April 7, 2008, with exposed LEDs that spell out “EXIT,” each LED shall have a minimum peak intensity of 35 mcd.

G.3.3 Evaluation measurements and tests of interior signs/markings

For equipment placed in service before Jan. 1, 2008, the cars/areas shall be randomly selected and the qualification test(s) shall be conducted by Dec. 31, 2008. For equipment placed in service for the first time on or after Jan. 1, 2008, the first car to have the system installed may be tested and this test shall be completed prior to the car’s release for operation in revenue service.

G.3.4 Independent power sources for electrically powered systems

For passenger cars ordered before April 7, 2008, and placed in service before Jan. 1, 2011, electrically powered path markings/delineators that are not dual mode shall have an independent power source by Jan. 1, 2012. Batteries that are used as independent power sources shall have automatic self-diagnostic modules designed to perform discharge tests (see Appendix D.)

G.3.4.1 Semi-permanently connected trainsets

For passenger cars ordered before April 7, 2008, and placed in service before Jan. 1, 2011, independent power sources for LLEPM systems are not required in passenger cars that are part of semi-permanently coupled trainsets, if the power source is a sealed battery located above the underframe of the car.

G.3.5 Point source/strip illuminance/luminance intensity

For point sources/strips installed in each passenger car ordered on or after April 7, 2008, or placed in service for the first time on or after Jan. 1, 2011, each point source/strip shall comply with the following criteria:

- **Incandescent:** miniature lamps not less than 150 mcd mean spherical intensity with a maximum spacing of 4 in. (10 cm) between lamps.
- **LED:** minimum peak intensity of 35 mcd with a maximum spacing between lamps of 12 in. (30.5 cm). LED-based dual-mode components shall use either white or green charging light.

Appendix H (informative): APTA passenger rail emergency systems survey

H.1 Survey questions

Instructions/contact info

The survey below is intended to gather information on industry practices regarding emergency communication systems, in-car signs/maps, primary exit path operation and demarcation, in-car stairway emergency markings, and high-performance photoluminescent (HPPL) material testing.

1. Contact info:
    a) Name of primary filer
    b) Title
    c) Transit agency/organization
    d) Email address
2. Are you employed by a (select one):
    a) Railroad/transit agency
    b) Manufacturer

Crew-to-passenger communications systems

1. Indicate each of the following that are part of your railroad's crew-to-passenger emergency communication system:
    - Intercom
    - Public address systems
    - Brochures describing emergency egress procedures
    - Signage denoting a locked exit path
    - Automatic messaging
    - Other (write in)
2. Does your system use station, wayside, landline or block line phones in an emergency?
3. Does your system have a policy allowing for direct contact from train crew to emergency responders?
4. Does your railroad have any communication protocols between your OCC and passengers?

Emergency egress signs/maps

1. Do you post emergency egress signs/maps in your railcars?
2. Please identify your most common type of passenger rail vehicle (manufacturer, model name and year).
3. Indicate whether any of the following locations are where emergency egress signs/maps are posted in your most common type of passenger rail vehicle (check all that apply):
    - Vestibules
    - Doors
    - Stairways
    - Bulkheads
    - Other locations (please specify)
4. Please provide photos of example exit orientation signs or graphics and their placement within your most common railcar, if possible.
5. Please provide example pictures of various locator signs in one of your passenger vehicles. If possible, please provide dimensions for the locator signs pictured.
6. Please indicate the vehicle(s) that the pictures of your locator signs came from (manufacturer, model, year).

7. Please indicate how long, in minutes after activation, your backup power source is required to function to power emergency in car systems such as low-level exit path markings, signs and communication systems.
8. Please indicate which, if any, languages other than English are used in emergency egress signs posted in any of your railcars.

High-performance photoluminescent materials

1. What methods has your organization used for measuring performance of high performance photoluminescent (HPPL) material?
2. Would your organization be willing to measure performance of high performance photoluminescent material rather than measuring charging light intensity?
3. What is your organization's current practice regarding determining representative railcar areas?

Doors

1. Please provide photos of the emergency exit systems, including any signs/markings regarding operation, most commonly employed by your commuter railroad in your most common railcar indicated previously.
2. Do you indicate that a door is locked and is not a useable exit path (example: front- and rearmost doors in a multiple unit consist)? If alternative exit paths are indicated at the locked-door location, please provide photos of the indication.

Stairways

1. If you have stairways in your cars, please indicate the vehicle model and provide photos of your most common and most unusual LLEPM configuration around a car stairway. This includes any accompanying signage, stairway step and tread markings or lighting, stairway side markings or lighting, and upper and lower landing areas.

Kick-out panels

1. How do you interpret the current CFR requirement 49 CFR §238.439(c) regarding kick-out panels and markings?

H.2 Respondents

- ACE
- Alaska Railroad
- Amtrak
- Bombardier
- DCTA
- LIRR
- MARC
- Metra
- Nippon Sharyo
- RTD
- SCRRA
- SEPTA
- Siemens
- Sound Transit
- Talgo
- TriMet
- UTA

H.3 Results

Question		Percent Affirmative
Indicate each of the following that are part of your railroad's crew-to-passenger emergency communication system.	Intercom	77%
	PA	100%
	Brochure	85%
	Locked exit signage	85%
	Automatic messaging	38%
	Other	n/a
Do you post emergency egress signs/maps in your railcars?		94%
Indicate whether any of the following locations are where emergency egress signs/maps are posted in your most common type of passenger rail vehicle.	Vestibules	80%
	Doors	53%
	Bulkheads	26%
	Stairways	13%
	Other	n/a
Please indicate the how long, in minutes after activation, your backup power source is required to function to power emergency in car systems such as low-level exit path markings, signs and communication systems.		90 minutes (60 minutes for grandfathered systems)
Please indicate which, if any, languages other than English are used in emergency egress signs posted in any of your railcars.		Spanish 29% Braille 6% French 12%
Do you indicate that a door is locked and is not a useable exit path (example: front- and rearmost doors in a multiple unit consist)?		65%
Would your organization be willing to measure performance of high-performance photoluminescent material rather than measuring charging light intensity?		46%

Appendix I (informative): Photographic examples

I.1 Exit orientation signs

FIGURE 2
Emergency Evacuation Instructions Example (Metra)

FIGURE 3
Emergency Evacuation Instructions Example (Bombardier)

FIGURE 4
Emergency Evacuation Instructions Example (ACE)

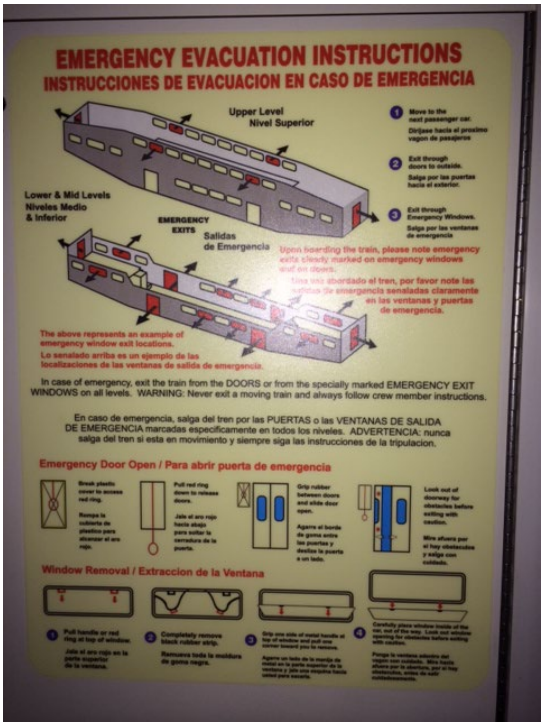


FIGURE 5
Emergency Evacuation Instructions Example (Alaska RR)

FIGURE 6
Emergency Evacuation Instructions Example (UTA)

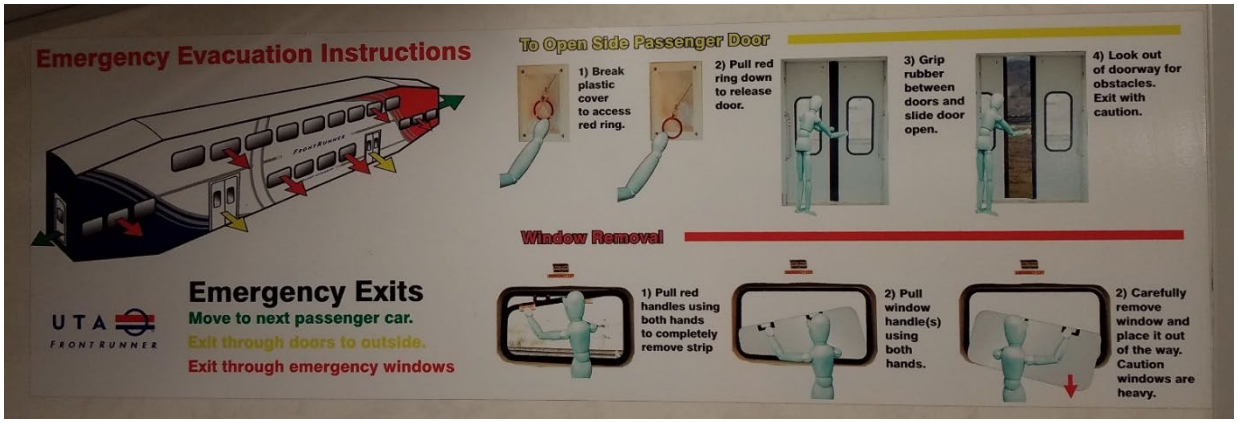


FIGURE 7
Emergency Evacuation Instructions Example (SCRRA)

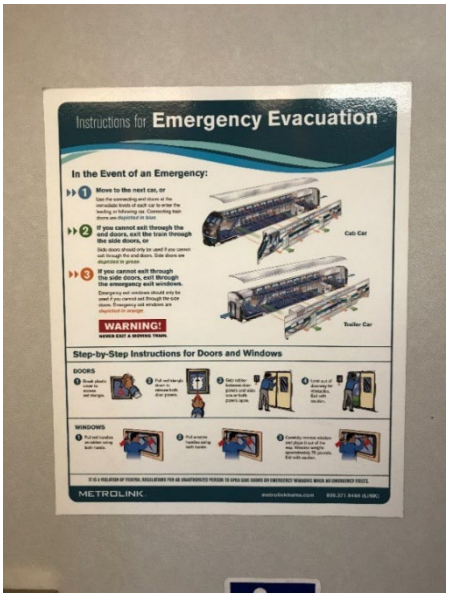


FIGURE 8
Emergency Evacuation Instructions Example (SEPTA)

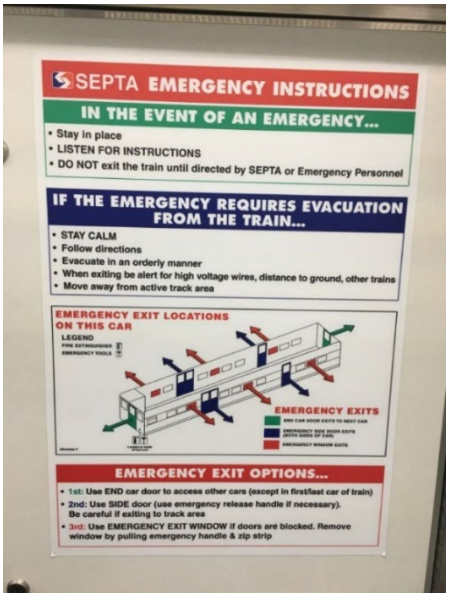
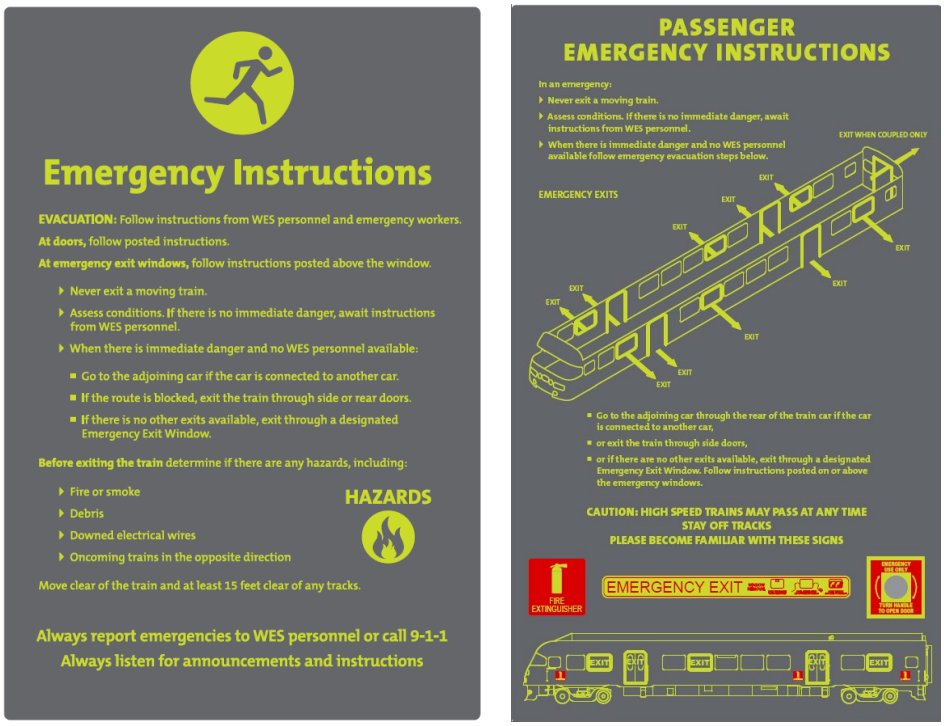


FIGURE 9
Emergency Evacuation Instructions Example (TriMet)



I.2 Locator signs (as described in Sections 2.1.2.1 and 2.1.2.2)

FIGURE 10
Exit Locator Sign Example (Bombardier)

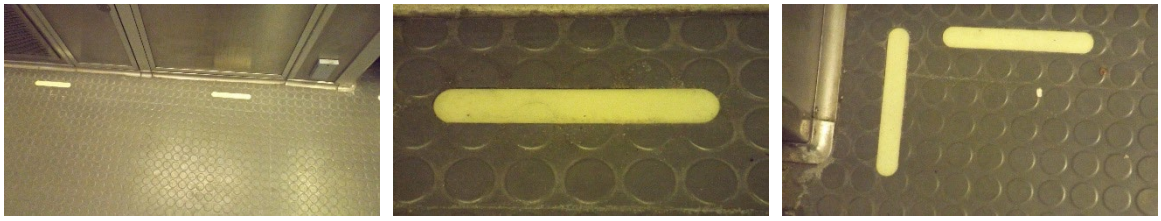
FIGURE 11
Exit Locator Sign Example (Nippon Sharyo)

FIGURE 12
Seat-Mounted LLEPM with Locator Sign (UTA)

I.3 Oblong disc LLEPM (as described in Section 2.1.1.2)

Figure 13 shows pictorial examples of LLEPMs using an oblong disc configuration to fulfill the minimum requirement for intermittent delineators as noted in Section 2.1.1.2.

FIGURE 13
Oblong Disc LLEPM Alternative (Scott Laps)



I.4 Door markings

I.4.1 Primary exit doors

FIGURE 14
Primary Door Exit Markings (Alaska RR)

FIGURE 15
Body End Door Markings and Signage (Amtrak)

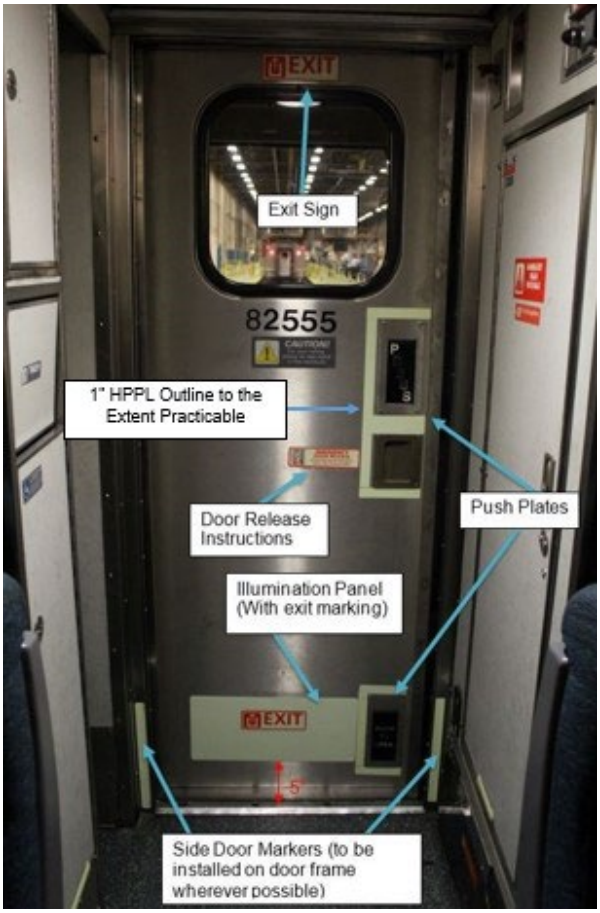
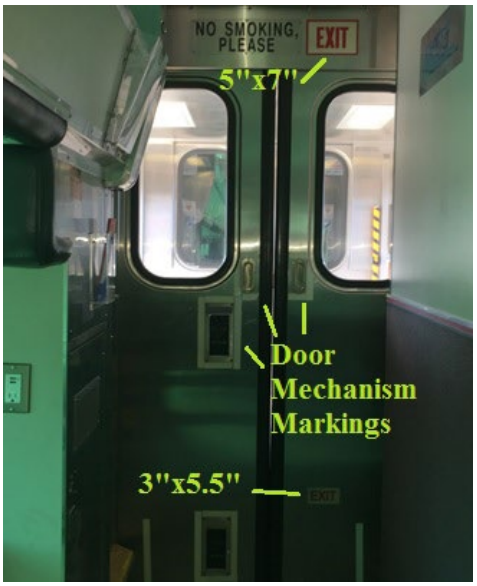


FIGURE 16
Primary Door Exit Markings (Metra)



I.4.2 Routinely locked doors (as described in Section 2.1.3.3)

FIGURE 17
Routinely Locked Door Sign Example (LIRR)

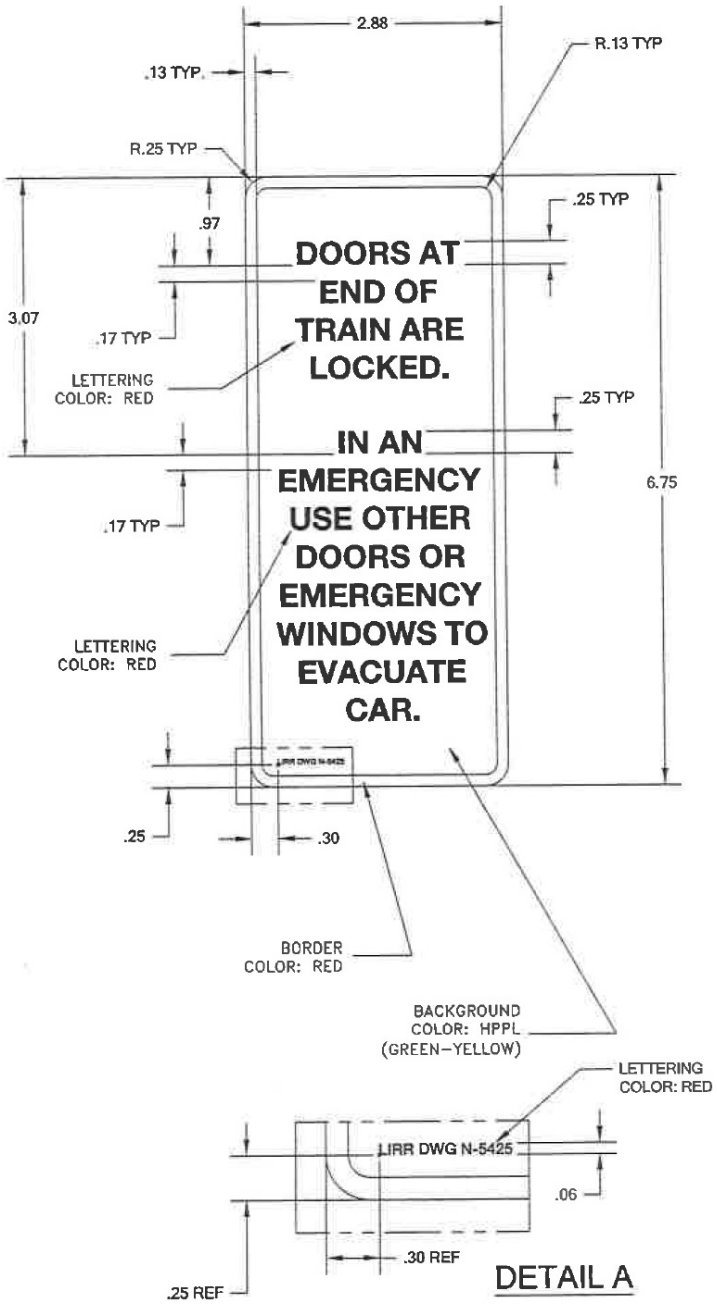


FIGURE 18
Routinely Locked Door Sign Example (Amtrak)

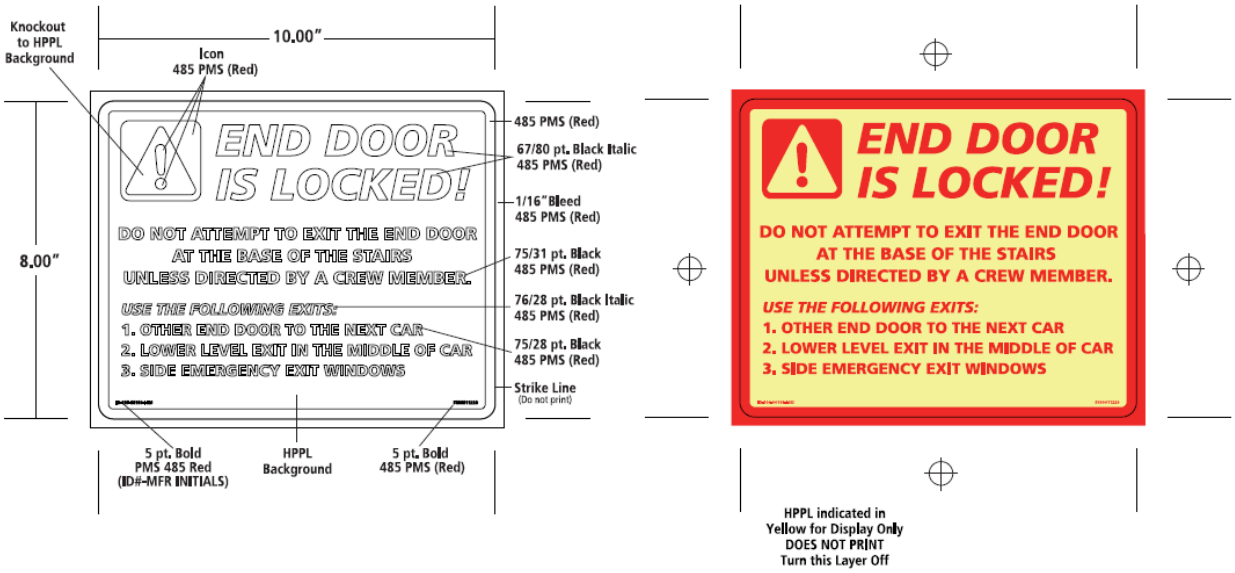


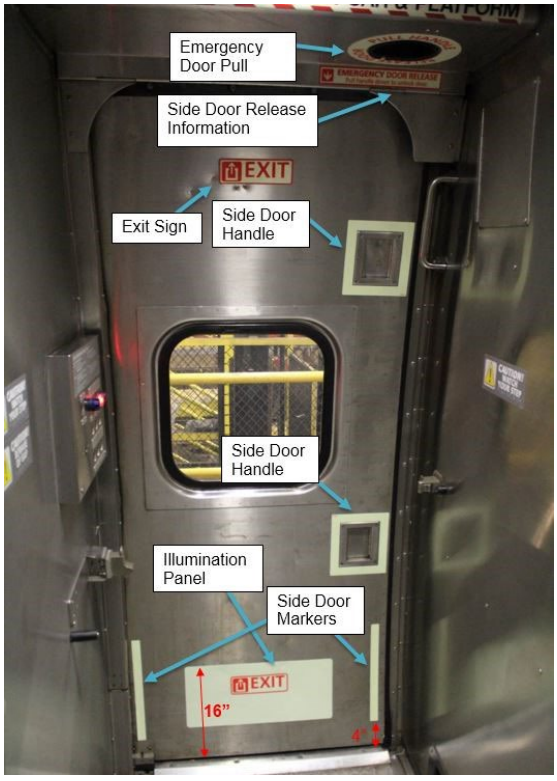
FIGURE 19
Routinely Locked Door Sign Example (ACE)

I.4.3 Secondary door exits

FIGURE 20
Secondary Door Exit Markings and Signage (Alaska RR)

FIGURE 21
Secondary Door Exit Markings and Signage (SCRRA)

FIGURE 22
Secondary Door Exit Signage and Markings (Amtrak)



I.4.4 Non-obvious door mechanisms

FIGURE 23
Non-Obvious Door Mechanisms Signage (SCRRA)

FIGURE 24
Non-Obvious Door Mechanisms Signage (Alaska RR)

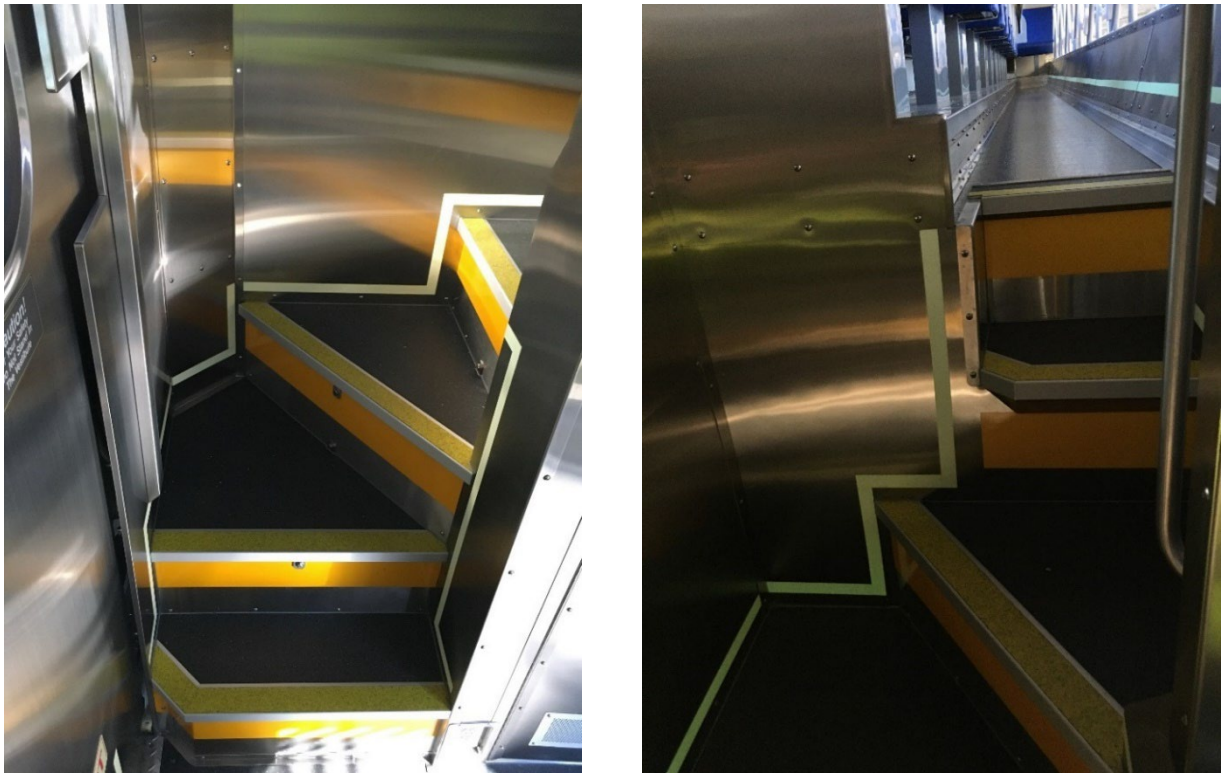
FIGURE 25
Non-Obvious Door Mechanisms Signage (UTA)

I.5 Stairway markings

I.5.1 Alternative 1 (as per Appendix G.2.2)

1 in. (2.5 cm) wide L-shaped marking/delineators shall be installed on both sides of each tread nearest to the wall.

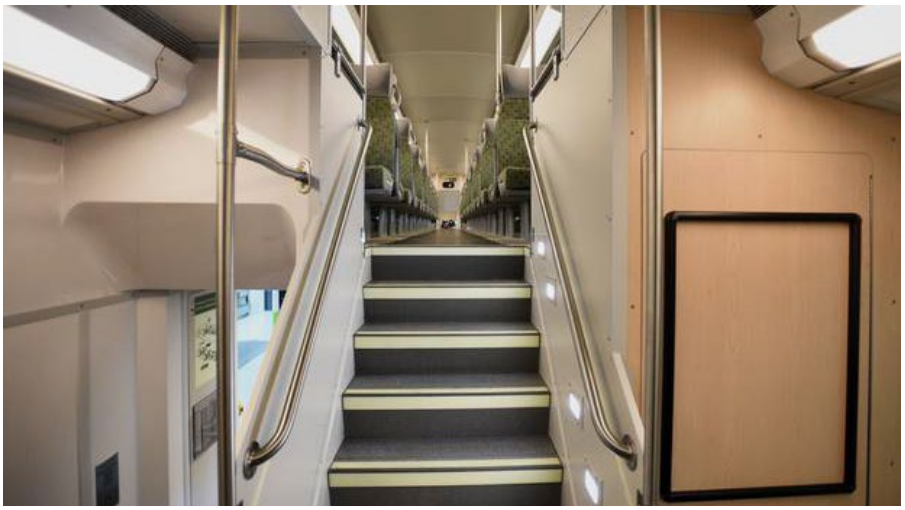
FIGURE 26
L-Shaped Stairway LLEPM Example (Nippon Sharyo)



I.5.2 Alternative 2 (as per Appendix G.2.2)

Materials applied to the step risers that consist of a minimum 2 in. (5.2 cm) wide strip or two 1 in. (2.5 cm) wide strips that extend, to the extent practicable, across the full width of the riser and placed at the lower half of the riser.

FIGURE 27
Wide Strip and Diagonal LLEPM Stairway Configuration (Bombardier)



I.5.3 Alternative 3 (as per Appendix G.2.2)

Discs of not less than 1.25 in. (3.18 cm) in diameter, placed either: 1) no more than 2½ in. (6 cm) apart on each stair tread, near the step nosing, or 2) no more than 2½ in. (6 cm) apart and no higher than 18 in. (45.7 cm) from the treads on both sides of the stairway walls/partitions.

FIGURE 28

Disc LLEPM Stairway Configuration (Bombardier)

I.6 External rescue signage

FIGURE 29
External Door Release (SEPTA)

FIGURE 30
Emergency Roof Access (SEPTA)

FIGURE 31
Rescue Window Demarcation (SEPTA)

Appendix J (informative): Section analysis

TABLE 2
Alignment Between Previous and Current APTA Signage and LLEPM Standards

Requirement	Signage Document (APTA PR-PS-S-002-99, Rev. 3) Section #	LLEPM Document (APTA PR-PS-S-004-99, Rev. 2) Section #	Current Document (PS-006) Section #
General system requirements	4	4	1
Visual identity and recognition, general system requirements	4.1	4.1	1.1
Multilingual signs, general system requirements	4.2	4.2	1.2
Design requirements, interior	5	5	2
Location, system design requirements	5.1 (interior only)	5.1	2.1
LLEPMs, design requirements and location	n/a	5.1.2	2.1.1
Electrically powered (active) LLEPM systems, design requirements and location	n/a	5.1.2.1	2.1.1.1
HPPL passive LLEPM systems, design requirements and location	n/a	5.1.2.2	2.1.1.2, G.2.2
Door exit locator signs, design requirements and location	5.1.1.2	n/a	2.1.2.
Door exits	5.1.1	5.1.1	2.1.3
Door-mounted signs, design requirements and location	5.1.1.1 (interior only)	n/a	2.1.3.1 (interior only)
Removeable panels	n/a	n/a	2.3.1.2
Routinely locked doors, door-mounted signs, design requirements and location	5.1.1.1	n/a	2.1.3.3
Failure en route, door-mounted signs, design requirements and location	5.1.1.1	n/a	2.1.3.3.1
Door exit delineators/markings, design requirements and location	5.1.1.1	5.1.1.2	2.1.3.4
Door exit control locator signs/markings and instructions, design requirements and location	5.1.1.3 (signs/markings), 5.1.1.4 (instructions)	n/a	2.1.3.5, G.2.1
Window exit locator signs/markings, emergency window exits, design requirements and location	5.1.2.1.	n/a	2.1.4.1
Window exit signs/markings and instructions, emergency window exits, design requirements and location	5.1.2.2.	n/a	2.1.4.2
Breakable emergency window exits	n/a	n/a	2.1.4.1.A
Grandfathered semi-permanently connected trainset LLEPMs	n/a	5.1.2	G.2.4
Letter and sign size, design requirements	5.2	n/a	2.2
Letter size, design requirements	5.2.1	n/a	2.2.1

TABLE 2

Alignment Between Previous and Current APTA Signage and LLEPM Standards

Requirement	Signage Document (APTA PR-PS-S-002-99, Rev. 3) Section #	LLEPM Document (APTA PR-PS-S-004-99, Rev. 2) Section #	Current Document (PS-006) Section #
Sign size, design requirements	5.2.2	n/a	2.2.2
Color and contrast, design requirements	5.3 (interior)	n/a	2.3
Illuminance/luminance criteria, design requirements	5.4	5.2	2.4
Electrically powered (active) systems, illuminance/luminance criteria, design requirements	5.4.1	5.2.1	2.4.1
LED minimum peak intensity and spacing, design requirements, electrically powered (active)	5.4.1.1	5.2.1.1	2.4.1.1
Individual light fixture average illuminance value, design requirements, electrically powered (active)	n/a	5.2.1.1	2.4.1.1
Incandescent mean spherical illumination and spacing, design requirements, electrically powered (active)	n/a	5.2.1.1	2.4.1.1
Average luminance, design requirements, electrically powered (active)	5.4.1.1	5.2.1.2	2.4.1.2
Externally illuminated minimum illuminance level, design requirements, electrically powered (active)	n/a	5.4.1.2	2.4.1.3
Passive HPPL systems, illuminance/ luminance criteria, design requirements	5.4.2	5.2.2	2.4.2
Materials, passive HPPL systems, illuminance/luminance criteria, design requirements	5.4.2.1	5.2.2.1	2.4.2.1
Charging light, passive HPPL systems, illuminance/luminance criteria, design requirements	5.4.2.2	5.2.2.2	2.4.2.2, Appendix B
Dual mode systems, illuminance/luminance criteria, design requirements	5.4.3.	5.2.3.	2.4.3.
Component materials, design requirements	5.5 (interior)	n/a	2.5
Vestibule, end-frame and side doors, component materials, design requirements	5.5.1	n/a	2.5.1., G.2.4
Additional requirements to mark side door exit locations without independently powered emergency lighting, component materials, design requirements	5.5.2	n/a	2.5.1.1.
Grandfathered systems and materials, design requirements	5.6	5.4	Appendix G
Design requirements, exterior	6	n/a	3

TABLE 2

Alignment Between Previous and Current APTA Signage and LLEPM Standards

Requirement	Signage Document (APTA PR-PS-S-002-99, Rev. 3) Section #	LLEPM Document (APTA PR-PS-S-004-99, Rev. 2) Section #	Current Document (PS-006) Section #
Rescue access door signs/markings, design requirements and location	6.1.1.1	n/a	3.1.1.1.
Rescue access door control signs/markings and instructions, design requirements and location	6.1.1.2	n/a	3.1.1.2
Rescue access windows, design requirements and location	6.1.2	n/a	3.1.2.
Roof emergency access, design requirements and location	6.1.3	n/a	3.1.3.
Letter size (exterior signs)	n/a	n/a	3.2
Color and contrast, exterior signs	6.2	n/a	3.3
Materials, exterior signs	6.3	n/a	3.4
Evaluation measurements and tests	7	6	4
Grandfathered systems, evaluation measurements and tests	7	6	G.1, G.3.3
Evaluation measurements and tests for interior signs/markings	7.1	6	4.1, B.3
Evaluation measurements and tests for Interior signs/markings, electrically powered (active) systems	7.1.1	6.1	4.1.1
Evaluation measurements and tests for Interior signs/markings, HPPL (passive) systems	7.1.2	6.2	4.1.2
Material luminance, evaluation measurements and tests for Interior signs/markings, HPPL (passive) systems	7.1.2.1	6.2.1	4.1.2.1
Ambient light charge, evaluation measurements and tests for Interior signs/markings, HPPL (passive) systems	7.1.2.2	6.2.2	4.1.2.2, B.3
Testing equipment, evaluation measurements and tests for Interior signs/markings, HPPL (passive) systems	7.1, Annex C	6, Annex C	4.1.3, Appendix C
Evaluation measurements and tests for exterior signs/markings	7.2	n/a	4.2
Recordkeeping for evaluation measurements and tests	7.3	6.3	4.3
Survivability requirements	9	8	5
Inspections	10	9	6
Daily inspections	10.1	9.1	6.1
Periodic inspections and tests	10.2, 10.2.1	9.2	6.2

TABLE 2

Alignment Between Previous and Current APTA Signage and LLEPM Standards

Requirement	Signage Document (APTA PR-PS-S-002-99, Rev. 3) Section #	LLEPM Document (APTA PR-PS-S-004-99, Rev. 2) Section #	Current Document (PS-006) Section #
Periodic inspections and tests for electrically powered (active) systems	10.2.1.1	9.2.1	6.2.1, E.1.1
Periodic inspections and tests for HPPL (passive) systems	10.2.1.2	9.2.2	6.2.2, E.1.2
Periodic inspections and tests for exterior signs/markings	10.2.2	n/a	Appendix E.1.2
Defect reporting, repair and recordkeeping	10.3	9.3	6.3

Appendix K (informative): Revision history of source documents

This standard is the combination of two previously existing standards. As it is a new document, it does not note the content changes in the body of the document. Instead, the revision histories of the component documents have been placed in this appendix.

K.1 Changes incorporated in this document

The original version of this standard contains the following changes from preceding standards, APTA PR-PS-S-002-98, “Emergency Signage for Egress/Access of Passenger Rail Equipment” and APTA PR-PS-S-004-99, “Low-Location Exit Path Marking":

1. Document formatted to the new APTA standard format.
2. Sections have been moved and renumbered.
3. Scope and summary moved to the front page.
4. Definitions, abbreviations and acronyms moved to the rear of the document.
5. New section added: “Document history.”
6. Some global changes to section headings and numberings resulted when sections dealing with references and acronyms were moved to the end of the document, along with other cosmetic changes, such as capitalization, punctuation, spelling, grammar and general flow of text.
7. Names of participants updated.
8. Combining of existing Emergency Signage and LLEPM requirements.
9. In Section 1.1.2: addition of note regarding HPPL materials used in areas exposed to weather
10. In Section 2: reordering of locational requirements to that which each are encountered on the exit path.
11. In Sections 2.1.1.1.A and 2.1.1.2.A: marking requirements for single steps in passageways added.
12. In Section 2.1.1.2.B: rewording of acceptable interior stairway markings.
13. In Section 2.1.3.2: addition of removeable panel marking requirements
14. In Section 2.1.3.5: Created alternate marking requirements for pull chain door releases.
15. In Section 2.1.4.2.A: Addition of breakable emergency window provisions.
16. In Section 3.1.3: Addition of Emergency Roof Access marking requirements from APTA PR-CS-RP-001-98, “Passenger Equipment Roof Emergency Access.”
17. In Section 3.2: addition of minimum sizing requirement for exterior emergency signage.
18. Removal of System Reliability requirements.
19. In Section 6: removed references to APTA inspection and maintenance standards.
20. Addition of definitions for “Alternative Door Exit,” “Car Body End Door,” “Car Body Side Door,” “Door Exits,” “Emergency Exit,” “Emergency Windows,” “End-Frame Door,” “Exterior Side Door,” “Instructional Signage,” “Rescue Access Window,” “Vestibule,” and “Vestibule Door.”
21. Addition of Appendix B.3, “Testing Considerations.”
22. In Appendix F: Changed ANSI minimum sampling category from general II to S3. Removed simplified sampling method. Added guidance on the determination of fleet sizing for sampling purposes.
23. PL markings and grandfathered markings moved to Appendix G.
24. Added APTA Passenger Rail Emergency Systems Survey materials to Appendix H.
25. Added Appendix I for photographic examples.
26. Added Appendix J detailing the location of requirements from APTA PR-PS-S-002-98, Rev. 3, “Emergency Signage for Egress/Access of Passenger Rail Equipment” and APTA PR-PS-S-004-99, Rev. 2, “Low-Location Exit Path Marking.”
27. Added Appendix K, Revision history from source documents.

K.2 APTA PR-PS-S-002-98, "Emergency Signage for Egress/Access of Passenger Rail Equipment"

Revision 1 of this standard included the following:

28. revisions to the Introduction
29. revisions to the Scope in Section 1, "Overview"
30. addition of the APTA emergency lighting standard (APTA PR-E-S-013-99) and other references to Section 2, "References"
31. renumbering of the bibliography to Section 3
32. renumbering of Section 3, "Definitions," and Section 4, "Emergency egress/access signage," to sections 4 and 5
33. addition and revision of certain definitions in renumbered Section 4
34. modifications to renumbered Section 5 that include revisions to increase the size, spacing and stroke-to-width ratio of sign letters; revision of sign color, contrast and legibility requirements; revision to require the use of high-performance photoluminescent (HPPL) material, if photoluminescent material is used for the interior door and emergency exit window signs and marking; and the inclusion of an ASTM test method reference for exterior signage/marking retroreflectivity.

Revision 2 of this standard included the following:

1. revision of Introduction
2. addition of a Table of Contents
3. reorganization of Scope in Section 1, "Overview"
4. addition of two 49 CFR citations in Section 2, "References"
5. relocation of the bibliography from Section 3 to a new Appendix A
6. renumbering of Section 4, "Definitions" to Section 3
7. renumbering of section headings and related text information formerly in Section 5 under two separate major headings: Section 4, "General system requirements," and Section 5, "Design requirements"
8. renumbering of the remaining subheadings accordingly (this reorganization and revision was consistent with the reorganization and revision of those similar sections in the related APTA PR-PS-S-004-99, Rev. 1, "Low-Location Exit Path Marking")
9. citation of an ASTM standard containing retroreflective material performance criteria Section 5
10. addition of three new Appendices, B–D, that provide guidance to railroads for evaluating HPPL material performance

Revision 3 of this standard included extensive modifications to facilitate the incorporation of the standard by reference by the FRA in 49 CFR, Part 238 (see explanation in next paragraph). In addition to the revision of the Introduction, these modifications included the following:

1. revision of Overview, Purpose and Scope in Section 1
2. addition and revision of definitions in Section 3
3. reorganization and extensive revision of Section 5, "Design requirements," that also addresses grandfathering of certain signs/markings
4. deletion of Section 6, "Material Safety"
5. relocation and revision of provisions for exterior signage/markings and instructions, formerly in Section 5, to a new Section 6 and revision of the retroreflectivity criteria
6. transfer and revision of light meter requirements and HPPL laboratory tests and charging light test provisions that were formerly in Annex B to a new Section 7, "Evaluation measurements and tests"
7. revision and renumbering of former sections 6–8 to sections 8–10

8. revisions to former Section 9 (renumbered 10), "Maintenance," to include additional and revised daily and periodic tests, as well as clarified defect reporting, repair and recordkeeping.

In addition, as part of Revision 3, the annexes were revised:

1. The technical considerations information formerly in Annex D was revised and relocated to Appendix B.
2. HPPL test laboratory information in Annex C was revised and relocated to Appendix D.
3. Three new Appendices have been added that contain guidance for measuring HPPL charging light illuminance (Appendix C); automatic testing of emergency sign systems that use independent power sources (Appendix D); and representative sampling (Appendix F).

When FRA issued the final rule addressing Passenger Equipment Safety Standards in 1999, it identified various issues for future rulemaking, including those to be addressed following the completion of additional research, the gathering of additional operating experience, the development of industry standards, or all three. Passenger rail equipment emergency signage/marking is one such issue. APTA proposed to the Railroad Safety Advisory Committee (RSAC) Passenger Safety Working Group/Emergency Preparedness Task Force that this APTA emergency signage standard be incorporated by reference into 49 CFR, Part 238. Accordingly, APTA worked with the FRA, railroads, car manufacturers and suppliers, labor organizations, passenger organizations, and NTSB as part of the FRA RSAC process to prepare this revision of the standard in order to address the NTSB recommendation and to facilitate incorporation by reference of the standard into the FRA regulations. The RSAC Task Force had little difficulty reaching consensus on the revisions as they apply to new equipment. However, the debate on how to handle existing equipment proved to be more difficult.

At the time of publication, the modifications comprising Revision 3 of this standard affected equipment currently in service and/or new equipment in the following ways:

1. The option to use accelerated compliance with this standard as a remedy for failure to meet the emergency light levels required by APTA PR-E-S-013-99, "Emergency Lighting System Design for Passenger Cars," was eliminated.
2. Section 1.1, "Scope." The scope was revised to clarify that the standard does not apply to tourist, scenic, historic, excursion operations or private rail cars.
3. Section 1.2, "Purpose." The purpose of the standard was revised to require tests to validate the design of the emergency sign/marking system.
4. Section 3.1, "Definitions." Several definitions were added, including auxiliary power system, car, color temperature, dual mode, foot-candle, head-end power, independent power source, emergency lighting, normal lighting, luminaire, luminous intensity, and representative car/area. These additional definitions were necessary to clearly define requirements contained in the standard.
5. Section 3.1.13, "High-performance photoluminescent (HPPL) material." The definition of HPPL material was changed. Railroads and manufacturers requested this change to eliminate the need for more than one type of HPPL product to comply with the requirements in this standard. After Revision 3 of this standard took effect, railroads had to procure material capable of HPPL performance when subjected to a lower level of charging light.
6. Section 5.1.1.1, "Door signs/markings." When a door is locked, secured or otherwise inoperative, passengers must be directed to an alternative exit or operating instructions must be provided to open the inoperative door.
7. Section 5.1.1.2, "Door exit locator signs/markings." Additional signs/markings were required for the emergency/manual door release controls.
8. Section 5.1.1.3, "Door exit control locator signs/markings." Door exit control locator signs must be highlighted with outline stripping or an area wide pad of HPPL material.

9. Section 5.4.1.1, “Internally illuminated signs/markings.” The terminology used to describe active signage/marking systems was changed to allow newer technology, actively powered marking/delineator components.
10. Sections 5.4.2.2, “Charging light,” and 5.6, “Grandfathering of PL signs/markings,” including tables 1 and 2. Because fluorescent light sources are much more effective for charging HPPL material, fluorescent charging light sources were used as the basis for charging requirements. Different charging light levels were required when using different light sources (e.g., higher light levels are required when using incandescent lighting).
11. Sections 5.4.2.2, “Charging light,” 5.6, “Grandfathering of PL signs/markings,” 7, “Evaluation measurements and tests,” and “Annex C (informative): Procedures for measuring charging light illuminance.” The specifications for the light meter required to confirm charging light levels were revised and moved to the body of the standard. This means railroads/suppliers may have been required to buy new meters or adapters.
12. Section 5.5.1, “Vestibule, end-frame and side doors.” For passenger cars ordered before April 7, 2008, and placed in service before Jan. 1, 2012, all end and side doors leading to the exterior of the car must be marked by electrically powered, HPPL or dual mode signs/markings. In addition, this also meant that, for passenger cars ordered before Jan. 1, 2007, and placed in service before Jan. 1, 2009, beginning on Jan. 1, 2012, all newly installed or replacement end and side door signs shall use HPPL material or electrically powered sign fixtures with an independent power source.
13. Electrically powered independent power sources, HPPL material or dual mode must be used for emergency signs/markings for all end and side doors leading to the exterior of the car in all passenger cars ordered on or after April 7, 2008, or placed in service for the first time on or after Jan. 1, 2011.
14. Batteries that are used as independent power sources shall have automatic self-diagnostic modules designed to perform discharge tests.
15. Section 5.5.2, “Additional requirements to mark side door exit locations without independently powered emergency lighting.” A requirement to mark side door locations that do not have independently powered emergency lights with additional HPPL material by Jan. 1, 2009, was added.
16. Section 5.6 “Grandfathering of PL signs/markings.” As of April 7, 2008, all passive signs/markings must achieve HPPL performance or be specifically grandfathered.
17. Zinc sulfide signs in cars currently in service must be replaced, and existing stocks of zinc sulfide signs are no longer acceptable for installation as replacement signs because they do not meet HPPL performance.
18. Existing stocks of non–zinc sulfide photoluminescent material held in inventory as of April 7, 2008, can be installed only as allowed by Section 5.6, “Grandfathering of PL signs/markings.”
19. Section 6.1.2, “Rescue access windows.” Instructions for emergency rescue access windows intended for removal by emergency responders must be placed on or near each such window. Location of the instructions solely at the midpoint as well as the ends of the car is no longer permitted.
20. Section 6.1.3, “Emergency roof access.” Retroreflective emergency roof access locator signs/markings and instructions must be used on all cars equipped with roof hatches or roof structural soft spots.
21. Section 6.3, “Materials.” Additional requirements for protective coatings and color contrast of exterior retroreflective signs/markings were added.
22. Section 7, “Evaluation measurements and tests.” Requirements were added to the body of the standard for illuminance/luminance measurements and tests to verify that passenger car designs comply with this standard. These requirements were developed from material contained in the Annexes of Revision 2 of the standard. Revision 3 made them mandatory.
23. Section 7.1, “Interior signs/markings.” For equipment placed in service before Jan. 1, 2008, if a verification of compliance test on a representative car signage/marking layout had not already been completed, as required by Section 7, “Evaluation measurements and tests,” it was to be completed by Dec. 31, 2008.

24. Section 7.1, “Interior signs/markings.” For new equipment, a verification of compliance test on a representative car/area, as required by Section 7, “Evaluation measurements and tests,” must be completed before the car is put into revenue operating service.
25. Section 7.3, “Recordkeeping.” A requirement to keep records of the illuminance/luminance measurements and tests made to verify initial designs was added.
26. Requirements for material safety contained in Section 6 of Revision 2 were deleted.
27. Section 8, “System reliability.” More details were added to the system reliability requirements.
28. Section 9, “Operating conditions.” For new passenger cars, a requirement for independent power sources to operate in all orientations as of Jan. 1, 2011, was added.
29. Section 10, “Maintenance.” Extensive revisions were made and detail added to the periodic tests and inspection requirements.
30. Section 10.2.1.2, “PL (passive) systems.” Testing of a representative sampling of cars comprising the fleet operated by the railroad must be done at an interval not to exceed eight years, to verify that the performance of the emergency signs remains in compliance with this standard.
31. All the informative annexes were extensively revised and reorganized, and new annexes containing new guidance information were added.

K.3 APTA PR-PS-S-004-99, “Low-Location Exit Path Marking”

Revision 1 of this standard included:

1. reorganization of Section 1, “Overview” (to include Scope)
2. renumbering of “References” to Section 2 and inclusion of citations for 49 CFR regulations, and ASTM and UL standards
3. addition of definition (marking) and inclusion of abbreviations and acronyms in Section 3
4. revision of Section 5 headings
5. movement of material safety to a separate Section 6 and renumbering of the remaining sections.
6. movement of the bibliography to Annex A
7. expansion of the information formerly contained in Annex A (now included in Annex D)
8. addition of two new annexes to provide railroads with extensive guidance for evaluating passive LLEPM material performance

Revision 2 of this standard includes extensive modifications to enable the incorporation of this APTA standard by reference by the FRA in 49 CFR, Part 238. These modifications included:

1. revision of the “Introduction”
2. revision of Purpose and Scope in Section 1, “Overview”
3. addition and revision of several definitions in Section 3
4. reorganization and revision of Section 4, “General requirements,” and Section 5, “System design requirements”
5. deletion of Section 6, “Material safety”
6. relocation and revision of light meter requirements and HPPL laboratory tests and charging light test provisions that were formerly in Annex B to a new Section 6, “Evaluation measurements and tests”
7. revisions to Section 9, “Maintenance,” to include additional and revised daily and periodic tests, and addition of defect reporting, repair and recordkeeping.

Finally, revisions were made to the annexes:

1. The technical considerations information formerly in Annex D was revised and relocated to Annex B.
2. Test laboratory information in Annex C was revised and relocated as Annex D.

3. Three new annexes were added that contain guidance for, HPPL charging light illuminance measurement (Annex C), automatic testing of LLEPM systems that use independent power sources (Annex E), and representative sampling (Annex F).

As FRA was considering requiring the installation of LLEPM systems on passenger rail equipment, APTA proposed to the Railroad Safety Advisory Committee (RSAC) Passenger Equipment Working Group/ Emergency Preparedness Task Force that this APTA LLEPM standard be incorporated as a reference into 49 CFR, Part 238. Accordingly, APTA worked with the FRA, railroads, car manufacturers and suppliers, labor organizations, passenger organizations, and NTSB, as part of the FRA RSAC process, to prepare Revision 2 of this standard in order to address an NTSB recommendation and to facilitate the incorporation by reference of the standard into the FRA regulations. The RSAC Task Force had little difficulty reaching consensus on the revisions as they apply to new equipment. However, the debate on how to handle equipment currently in service proved to be more difficult.

At the time of publication, the modifications comprising Revision 2 of this standard affected equipment currently in service and/or new equipment in the following ways:

1. Section 1.1, “Scope.” The date by which full compliance must be achieved was extended from Jan. 1, 2006, to Jan. 1, 2009. Exceptions were allowed in Section 5, “System design requirements.”
2. The option to accelerate installation of LLEPM systems to meet emergency light levels required by APTA SS-E-013-99, “Emergency Lighting System Design for Passenger Cars,” contained in Revision 1 of this standard was eliminated.
3. Section 1.1, “Scope.” The scope was revised to clarify that the standard does not apply to tourist, scenic, historic, excursion operations or private rail cars.
4. Section 1.2, “Purpose.” The purpose of the standard was revised to require tests to validate the design of the emergency sign/marking system.
5. Section 3.1, “Definitions.” Several definitions were added, including auxiliary power system, car, color temperature, dual mode, foot-candle, head-end power, independent power source, emergency lighting, normal lighting, luminaire, luminous intensity, representative car, secondary exit, sign, spatial average and useful field of view. These additional definitions were necessary to clearly define requirements contained in the standard.
6. Section 3.1.13, “High performance photoluminescent (HPPL) material.” The definition of HPPL material was changed. Railroads and manufacturers requested this change to eliminate the need for more than one type of HPPL product to comply with the requirements in this standard. Some passive LLEPM system components may have needed to be replaced or some illumination levels increased.
7. The equivalency review committee requirement contained in Revision 1 was eliminated and was replaced with greater flexibility in the installation of the LLEPM system.
8. Section 5, “System design requirements.” The requirement for the LLEPM system to visually mark an exit path in two directions was deleted and replaced with new requirements for alternate exits that must be followed when a car has only one primary exit. Railroads are required to use their passenger awareness programs to alert passengers in these cases.
9. For passenger cars ordered before April 7, 2008, and placed in service before Jan. 1, 2011, electrically powered path markings/delineators that are not dual mode shall have an independent power source by Jan. 1, 2012.
10. Section 5.1.2, “Exit path marking/delineators.” Batteries that are used as independent power sources shall have automatic self-diagnostic modules designed to perform discharge tests. An exception was allowed for certain semi-permanently coupled train sets by Jan. 1, 2012.
11. Sections 5.1.2.1, “Electrically powered (active) systems,” and 5.1.2.2, “HPPL (passive) systems.” Additional flexibility was included in cases where car interior configuration makes compliance with the maximum permitted spacing between markings/delineators/light fixtures not practicable.

12. Section 5.2.1, “Electrically powered systems.” The terminology used to describe active LLEPM systems was changed to allow newer technology, actively powered marking/delineator components.
13. Section 5.2.2.2, “Charging light,” Table 1. Because fluorescent light sources are much more effective for charging HPPL material, fluorescent charging light sources were used as the basis for charging requirements. Different charging light levels were required when using different light sources (e.g., higher light levels were required when using incandescent lighting.
14. Sections 5.2.2.2, “Charging light,” and 6, “Evaluation measurements and tests,” and “Annex C (informative): Procedures for measuring charging light illuminance.” The specifications for the light meter required to confirm charging light levels were revised and moved into the body of the standard. This means some railroads/suppliers may have had to buy new meters.
15. Section 5.3, “Grandfathering of LLEPM PL components.” As of April 8, 2008, all passive LLEPM system components must achieve HPPL performance or be specifically grandfathered.
16. Sections 3.1.13, “High performance photoluminescent (HPPL) material,” and 5.3, “Grandfathering of LLEPM PL components.” Zinc sulfide passive components in cars currently in service must be replaced and existing stocks of zinc sulfide components are no longer acceptable for installation as replacements because they do not meet HPPL performance
17. Existing stocks of non–zinc sulfide photoluminescent material held in inventory as of April 7, 2008, can be installed only as allowed by Section 5.3, “Grandfathering of LLEPM PL components.”
18. Sections 5.2, “Illuminance/luminance criteria,” and 6, “Evaluation measurements and tests.” Requirements were added to the body of the standard for illuminance/luminance measurements and tests to verify that passenger car designs comply with this standard. These requirements were developed from material contained in the annexes of Revision 1 of the standard. Revision 2 made these measurements and tests mandatory.
19. Section 6.1, “Electrically (active) powered systems.” For equipment placed in service before Jan. 1, 2008, if a verification of compliance test on a representative car LLEPM layout had not already been completed, as required by Section 6, “Evaluation measurements and tests,” it was to be done by Dec. 31, 2008.
20. Section 6.1, “Electrically (active) powered systems.” For new equipment, a verification of compliance test on a representative car/area, as required by Section 7, “System reliability,” must be completed before the car is put into revenue operating service.
21. Section 6.3, “Recordkeeping.” A requirement to keep records of the illuminance/luminance measurements and tests made to verify initial designs was added.
22. Requirements for material safety contained in Section 6 of Revision 1 were deleted.
23. Section 7, “System reliability.” More detail was added to the system reliability requirements, including a date extension for LLEPM components to function independently of the main car battery to on or after Jan. 1, 2012.
24. Section 8, “Operating conditions.” For passenger cars ordered on after April 7, 2008, or placed in service for the first time after Jan. 1, 2011, a requirement for batteries or other independent power sources to operate in all orientations was added.
25. Section 9, “Maintenance.” Extensive revisions were made and detail added to the periodic test and inspection requirements.
26. Sections 9.2.1, “Electrically powered (active) systems,” and 9.2.2, “PL (passive) systems.” Testing of a representative sample of the railroad car fleet must be done at an interval not to exceed eight years to verify that the performance of the LLEPM components remains in compliance with the standard.
27. Section 9.3, “Defect reporting, repair and recordkeeping.” An explicit requirement was added to repair LLEPM defects found during periodic inspections.
28. All the informative annexes in Revision 1 were extensively revised and reorganized, and new annexes containing guidance information were added.

