U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: FLOOR PROXIMITY EMERGENCY ESCAPE PATH MARKING

Date: 5/22/89

AC No: 25.812-1A

Initiated by: ANM-110

1. PURPOSE. This advisory circular provides guidance material for use in demonstrating compliance with the provisions of Part 25 of the Federal Aviation Regulations (FAR) requiring floor proximity emergency escape path markings. Like all advisory circulars, it is not regulatory but is to provide guidance for applicants in demonstrating compliance with the objective safety standards set forth in the rule.

2. CANCELLATION. AC 25.812-1, Floor Proximity Emergency Escape Path Marking, dated September 30, 1985, is canceled.

3. RELATED FAR SECTIONS.

a. Section 25.812, Amendment 25-58, of Part 25 of the FAR - Emergency Lighting.

b. Section 121.310, Amendment 121-183, of Part 121 of the FAR - Additional Emergency Equipment.

4. BACKGROUND.

a. As part of the Federal Aviation Administration's (FAA) continuing efforts to upgrade aircraft cabin safety and improve occupant survivability in aircraft accidents, the agency has examined numerous factors which may affect the ability of passengers to quickly and safely evacuate airplanes in emergency situations. One factor which has been shown to be significant is that smoke in a post crash fire can obscure overhead emergency lighting, making cabin evacuation difficult. The FAA has conducted research, testing, and design studies, and undertaken rulemaking relating to the concept of placing additional sources of emergency lighting at a lower level, in the relatively clear air near the cabin floor.

b. Following public rulemaking, Amendments 25-58 and 121-183 (49 FR 43182; October 26, 1984) were issued, establishing requirements for floor proximity emergency escape path marking which will provide visual guidance for emergency cabin evacuation when all sources of cabin lighting more than four feet above the aisle floor are totally obscured by smoke. These amendments make the standards applicable to future type certification of transport category airplanes and require that airplanes type

certificated after January 1, 1958, and operating under Part 121 (air carrier) of the FAR be equipped with a system meeting these standards by November 26, 1986.

5. OBJECTIVE OF THE RULE.

a. Research and studies conducted by the Federal Aviation Administration prior to the issuance of the rule included analyses of a number of systems utilizing point lighting, flood lighting, strip lighting, markers, signs, reflective materials, and other marking methods. Since no system was shown to be so clearly superior to the others that it warranted establishment through regulation as the single standard, an objective performance standard was developed, rather than a standard which would require a particular type of system.

b. Floor proximity marking is intended to allow passengers who have become familiar with the cabin layout during the period of general overhead illumination prior to an accident to find their way to exits unassisted, should the general overhead illumination become obscured by smoke. This objective is stated in the rule as two separate requirements. The first is that the emergency escape path marking will enable each passenger to visually identify the emergency escape path along the cabin aisle floor after leaving the cabin seat, and the second is that the marking will enable each passenger to readily identify each exit from the emergency escape path by reference only to markings and visual features not more than four feet above the cabin floor. In both cases it is assumed that all sources of illumination more than four feet above the cabin aisle floor are totally obscured and that it is dark.[1]

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[1]The applicable portions of Section 25.812 of the FAR read as follows:

> § 25.812 Emergency lighting.
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> * * * * *
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> (e) Floor proximity emergency escape path marking must provide emergency evacuation guidance for passengers when all sources of illumination more than four feet above the cabin aisle floor are totally obscured. In the dark of the night, the floor proximity emergency escape path marking must enable each passenger to --
>
> (1) After leaving the passenger seat, visually identify the emergency escape path along the cabin aisle floor to the first exits or pair of exits forward and aft of the seat; and
>
> (2) Readily identify each exit from the emergency escape path by reference only to markings and visual features not more than four feet above the cabin floor.
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> * * * * *

6. DEMONSTRATING COMPLIANCE WITH THE RULE. While the rule does not preclude a single system or installation meeting both requirements (§§ 25.812(e)(1) & (2)), the requirements should be evaluated separately in finding compliance with the rule and are discussed separately below.

a. Section 25.812(e)(1).

(1) Section 25.812(e)(1) requires that the marking enable each passenger to visually identify the emergency escape path along the cabin aisle floor; it does not require visual guidance to enable a passenger to move from the seat to the aisle. While the standard does not preclude compliance by the use of conspicuous lighting or marking near the ends of the aisle or at other critical points along the aisle, it does specifically require that the passenger be able to visually identify the emergency escape path itself along the cabin aisle floor. Different approaches to meeting this requirement could be used including, for example, systems which illuminate the floor and seat areas along the escape path, or systems which visually identify the escape path through point sources of light. No specific number, spacing, or location of light sources is required; and acceptable designs may vary depending on factors such as aisle length or interior configuration, as long as the required visual identification of the emergency escape path along the cabin aisle floor is provided. This requirement would not be met by a system which merely provides a distant light at the exit or outlines the escape path, where the escape path remains essentially dark. The fact that a light located in the vicinity of an exit may be partially visible from the point where a passenger enters the aisle after leaving the seat would not constitute compliance with the requirement that the passenger be able to "visually identify the emergency escape path along the cabin aisle floor." Outlining the escape path, but not providing for visual recognition of the cabin aisle floor along the escape path, is also not in compliance with the requirement; i.e., the use of mini or micro bulbs which can be seen when illuminated, but which do not illuminate the surrounding areas, is not acceptable.

(2) While the rule does not require that the escape path marking indicate a particular direction, forward versus aft, in which the passenger should move in an emergency, the system should not tend to lead a passenger toward an end of the cabin where there are no exits. This will be a concern in a limited number of cabin configurations. In most configurations, there are emergency exits (including some classified as "excess" exits) both forward and aft of most passenger seats, and the direction which the passenger chooses to move in an actual emergency will depend on conditions in the cabin, such as crowding, existence of fire or smoke, or usability of different exits.

(3) The escape path markings, coupled with the exit markings discussed below, should be designed so that they will not tend to lead passengers past available exits. This is especially critical in the case of non-floor level overwing exits where continuous seat spacing in most cases obscures the recognition of exit features and markings. Test subject demonstrations have shown that some recognizable aisle cue,

identifiable as the exit location is approached, is necessary to assure passengers do not continue past this type of exit. Also, on multi-aisle airplanes, the required emergency escape path along the cross-aisle floor requires the same level of visual identification as the emergency escape path along the main cabin aisle floor. Test subject demonstrations confirm that required cross-aisle escape paths which cannot be visually identified by passengers act as negative cues. Even passengers who recognize that their next available exit would be across the airplane do not elect to go to that exit because of the inability to visually identify the cross-aisle escape path.

b. Section 25.812(e)(2) requires that the floor proximity emergency marking enable each passenger to readily identify each exit from the emergency escape path by reference only to markings and visual features not more than 4 feet above the cabin floor. The requirement to "readily identify" would be met by a system which enables a passenger to make positive visual identification of the exit itself, without hesitation or delay. It is not sufficient for a passenger to recognize that he or she is in the vicinity of an exit, as by increased general illumination, nor is it sufficient for a passenger to be able to identify only the fore and aft location of the exit along the cabin floor. The exit itself must be sufficiently identifiable to enable a passenger to proceed immediately to it, whether it is in the open or closed position.

c. Critical Ambient Conditions. Sections 25.812(i) and 121.310(d)(3) of the FAR require that the energy supply to each emergency lighting unit provide the required level of illumination for at least 10 minutes at the critical ambient conditions after emergency landing. For compliance with these sections, the appropriate test conditions of Radio Technical Commission for Aeronautics Document No. DO-160B, Section 4, may be used to determine the output level for any emergency power supplies which are used as part of the floor proximity emergency escape path marking. An alternate method of compliance would be to use any combination of analysis, lab tests, or actual airplane tests to show that the energy supply to each emergency lighting unit provides the required level of illumination for at least 10 minutes. The following conditions have been found to be an acceptable alternative:

(1) Cruise Cold Soak.

(i) Airplane flight at the maximum altitude for maximum cruise time.

(ii) Emergency descent and immediate landing at a -40°F ambient temperature.

(iii) Floor proximity emergency escape path marking systems and subsystems activated.

(2) Overnight Cold Soak.

(i) Unconditioned airplane sitting for 8 hours in a ramp environment of -40°F.

(ii) Airplane interior warmed for 2 hours, using normal airplane or ground facilities.

(iii) Immediate aborted takeoff at a -40°F ambient temperature.

(iv) Floor proximity emergency escape path marking systems and subsystems activated.

(3) Hot Day.

(i) Unconditioned airplane sitting for 8 hours in a ramp environment of +120°F.

(ii) Airplane interior cooled for 2 hours, using normal airplane or ground facilities.

(iii) Immediate aborted takeoff at +90°F ambient temperature.

(iv) Floor proximity emergency escape path marking systems and subsystems activated.

d. Transverse Vertical Separation.

(1) Section 25.812(l)(1) of the FAR requires that a single, transverse vertical separation of the fuselage during crash landing must not render inoperative more than 25 percent of all electrically illuminated emergency lights required by § 25.812. The acceptable loss is in addition to the lights that are directly damaged by the separation. The floor proximity emergency escape path marking system, as a part of the airplane emergency lighting system, must comply with this requirement when installed in airplanes whose certification basis includes Amendment 25-15 or later. Compliance with this requirement can be demonstrated by including the floor proximity escape path marking system as part of the total airplane electrically illuminated emergency lights, or by showing that the floor proximity emergency escape path marking system standing alone will comply.

(2) Floor proximity emergency escape path marking system designs have been presented for approval which meet the vertical separation requirement due to the fact that the system, as installed, is divided into segments, each with its own power supply. In such systems, physical separation and redundancy are utilized to assure that no more than 25 percent of the required lights are rendered inoperative.

(3) Other systems are being designed such that light sources are powered in parallel by two power supplies (located fore and aft) so that either power supply will provide the required level of lighting. For such systems, the question of protection against direct shorts (conductor to fuselage or conductor to conductor) becomes relevant in determining the number of inoperative emergency lights resulting from a vertical separation of the fuselage.

(4) Conductor to fuselage direct shorts are considered likely during any fuselage vertical separation and should be accounted for in the system design for compliance with § 25.812(l)(1) during such an event. Conductor to conductor direct shorts, however, need to be evaluated on a system-by-system basis to determine if the intent of the rule is met in that loss of more than 25 percent of the required emergency lights is unlikely. Examples of means which can be utilized to meet the intent of the requirement are design features which result in conductors which act as fuses at the location of short circuits in preventing total loss of system power, or utilization of blocking diodes to assure retention of power supplies. Assumptions involving severing of conductors cleanly and in an open state are not alone satisfactory. The system design must be demonstrated to possess characteristics (i.e., architecture, circuit protection, redundancy, independence, physical separation, design failure modes) which will show that loss of more than 25 percent of the required emergency lights is not likely should a vertical separation occur, resulting in a conducting material severing the fuselage and remaining in proximity to the severed conductors.

e. Dispatch With Inoperative Lights. If eventual approval is desired for dispatch of the airplane with inoperative light units under Minimum Equipment List (MEL) provisions, evaluation of the floor proximity emergency escape path marking system for compliance with the required lighting levels, with the proposed light units inoperative, should be accomplished during the initial system approval to expedite approval under the MEL.

f. Anticipated Wear and Abuse. The design of the system should take into account wear of and abuse to the system typical of the location of the system. Items such as spilled fluids, airline cleaning fluids, and damage from high heels and service carts should be considered.

7. CONDUCT OF EVALUATIONS.

a. Evaluations should be conducted under conditions of darkness. If they are conducted during daylight hours, each window, door, emergency exit (open and closed), and other openings should have provisions to prevent light from entering the passenger cabin. Each internal door and curtain should be in the takeoff configuration. During the evaluation, only the floor proximity escape path marking system being evaluated should provide light. The output of the floor proximity emergency escape path marking system power supplies should be that which would exist after 10 minutes of continuous operation under the "critical ambient conditions" determined under

paragraph 6c. Also, if approval is requested with inoperative light units as noted in paragraph 6e, the system should be configured with the desired light units inoperative.

b. These evaluations are intended to verify the efficacy of floor proximity markings when all lighting more than 4 feet above the cabin aisle floor is totally obscured by dense smoke. In an actual fire, illumination from the floor proximity system would be confined to the area beneath the overlaying smoke and would not illuminate or reflect throughout the cabin in general. In a demonstration in which there is no overlaying smoke, illumination from the floor proximity system might reflect into the upper cabin and produce unrealistic illumination for the cabin and escape path. Unrealistic reflections and illumination should be accounted for in demonstrations, either through a rational determination that they do not change the validity of the demonstration results, or through the use of shielding or shrouding, if necessary, to minimize or eliminate their effects.

c. While in an actual fire the obscuring layer of smoke might vary along the length of the cabin above and below 4 feet, this figure is used as a nominal design height for purposes of the rule, and the air below this is deemed clear for purposes of floor proximity marking design.

d. The evaluation should account for passengers who are either alone or in nearly vacated sections of the cabin, who must find their way to the exit without benefit of crewmembers, queues of passengers, human voices, or other cues to aid them.

e. Since the evaluation is to determine the effectiveness of a system which is to provide visual reference and orientation, and is not a test of egress performance and evacuation rate, the distribution of articles to create minor obstructions in the aisle, as is done for full-scale evacuation demonstrations, is not essential. However, if the design of the floor proximity marking system is such that its performance may be compromised by the presence of a limited amount of carry-on baggage, blankets, pillows, and other similar articles in the aisles or in the vicinity of the emergency exits, then the evaluation should account for this situation. The same holds true for carry-on baggage stowed under seats. The evaluation should be done with baggage under the seats representative of what would be there in a fully occupied airplane. While this may not be necessary for all systems, it would be particularly critical in a system where illumination is provided from light sources which project under the seats.

f. Evaluations should also account for conditions which can be reasonably anticipated to occur in emergency evacuations which might compromise the effectiveness of the floor proximity escape path marking system. For example, passengers bunching at the exits or flight attendants assisting in the evacuation may tend to block light sources near the exits. This may be critical for systems relying on a minimum number of light sources, particularly when those sources are located where they are likely to be blocked during an emergency evacuation.

g. While the rule does not require a demonstration of the system using test subjects representative of airline passengers, this may prove useful in some cases for identifying strengths or weaknesses of particular systems, which may not be apparent to engineering personnel familiar with the system and the aircraft layout. The following guidance should be used in demonstrations with test subjects and should also be considered during engineering evaluations done without test subjects. The test subject acting alone and without assistance should be able to:

(1) Leave the passenger seat or seat row and enter the walkway area immediately adjacent (visual reference to the escape path marking need not be used to assist the test subject in locating the walkway area immediately adjacent to the seat or seat row);

(2) Standing or stooping in the adjacent walkway area, identify from visual reference to the floor proximity marking system the direction(s) of the first exit or pair of exits forward and aft and indicate to the observer the means by which identification is made;

(3) Traverse to those exits without significant hesitation, delay, or evidence of confusion; and

(4) Make positive identification of the exits by visual reference to features not more than 4 feet above the cabin floor and indicate to the observer the means by which identification is made. The exits may be open or closed for the demonstration. Identification should be made for at least one exit of each type and marking system in the cabin, in both the open and closed positions.

h. The test subjects used in the demonstrations noted in paragraph 7g should not be crewmembers, mechanics, or training personnel who maintain or operate the airplane in the normal course of their duties. They should be representative of the average airline passenger with regard to male/female population and age categories. A minimum of three test subjects should be used to evaluate each exit identifier/aisle marking configuration provided. Subjects should be admitted to the cabin one at a time, and given the preflight briefing under normal cabin lighting conditions. After the preflight briefing on exit locations, and while the individual providing the briefing is explaining the role of the test subject, all exit markings above 48 inches affecting the exits to be evaluated should be covered. On twin-aisle airplanes, once a companion exit has been identified, the test subject can be told that exit is unuseable and asked to

locate the next available exit to evaluate the cross-aisle escape path marking. The test subjects that have completed the test should be kept segregated from the other test subjects.

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APPENDIX 1. ACCEPTABLE MARKING SYSTEMS

The following types of systems have been found acceptable for different areas of the floor proximity emergency escape path marking.

1. Escape Path Marking Along the Cabin Aisle Floor.

   a. Electro-luminescent lighting strips along the floor.

   b. Incandescent light tracks or assemblies along the floor.

   c. Seat mounted incandescent light assemblies.

   d. Seat mounted electro-luminescent lighting strips.

   e. Multiple incandescent, remotely activated flood lights.

2. Escape Path Marking Along the Escape Path Cross-Aisle Floor.

   a. Incandescent light tracks or assemblies along the floor or on forward or aft face of cross-aisle structural bulkheads.

   b. Electro-luminescent lighting strips along floor or on forward or aft face of cross-aisle structural bulkheads.

   c. Remotely activated incandescent floodlights.

   d. Incandescent floodlight located at door jamb.

3. Aisle Cues for Non-Floor Level Overwing Exits.

   a. Multiple red lenses closely spaced in a segment of light track along the floor.

   b. Red lens light assemblies on the floor.

   c. Subdued strobe light at exit sidewall.

   d. Orange overlayed electro-luminescent light strip.

   e. Exit identifier mounted on adjacent seat end bay.

4. Exit Markers.

a. Light-emiting diode (LED) exit identifier with "EXIT" legend, adjacent to exit.

b. Incandescent or electro-luminescent exit identifier with "EXIT" legend adjacent to exit.

c. Incandescent light assembly with "EXIT" legend located on exit access floor adjacent to exit.

d. Incandescent or electro-luminescent light assemblies adjacent to exits with recognizable exit features.

5. Directional Markers for Cabin Zones with Exits at Only One End.

a. Directional arrow overlays on incandescent light tracks/assemblies or electro-luminescent light strips.

b. Illuminated directional placards on aisle seat end bays and vertical bulkheads.