

BM
R2
R2

Northbrook, Illinois • (708) 272-8800
 Melville, New York • (516) 271-6200
 Santa Clara, California • (408) 985-2400
 Research Triangle Park,
 North Carolina • (919) 549-1400



Subjects 1994 (924)

1285 Walt Whitman Road
 Melville, NY 11747
 July 25, 1995

TO: Casualty Council of Underwriters Laboratories Inc.,
 Electrical Council of Underwriters Laboratories Inc.,
 Fire Council of Underwriters Laboratories Inc.,
 Subscribers to UL's Standards Services for
 Low Level Path Marking and Lighting Systems,
 Emergency Lighting and Power Equipment

SUBJECT: Status of Proposed Requirements in UL's Subject 1994 (924) Bulletin Dated
 December 22, 1994.

Underwriters Laboratories Inc. (UL) is continuing to consider the comments received in response to the subject document.

As a result of UL's consideration of these comments, the proposed requirements will be published essentially as originally proposed. UL anticipates printing and publication of revised pages for UL 1994 during the fourth quarter of 1995.

Replies will be sent to all comments by October, 1995.

UNDERWRITERS LABORATORIES INC.

REVIEWED BY:

Patricia A. Tymus (cit)

PATRICIA A. TYMUS (Ext. 22735)
 Associate Project Engineer
 Standards Department

Steven J. Altamura (cit)

STEVEN J. ALTAMURA (Ext. 22336)
 Staff Engineer
 Engineering Services 215I

SR:CAA

1994BUL.T01;PAT;cit

A not-for-profit organization
 dedicated to public safety and
 committed to quality service

AVA Documents
 Document Sharing Hub

**Underwriters Laboratories Inc.®**A not-for-profit organization dedicated to public safety
and committed to quality service**February 9, 1994****Revision pages for****Standard for****Low Level Path Marking and Lighting Systems****UL 1994, First Edition**

Attached to this transmittal notice is a revision of the first edition of UL 1994.

A CHANGE ON A PAGE DATED FEBRUARY 9, 1994 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT.

The new and revised requirements are substantially in accordance with UL's bulletin on this subject dated October 30, 1992. The bulletin is now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	May 23, 1991 (Reprinted February 9, 1994)
2	May 23, 1991
3	February 9, 1994
4	May 23, 1991
5 — 9	February 9, 1994
10 — 27	May 23, 1991
28	October 14, 1992
29 — 36	May 23, 1991
37, 38	February 9, 1994
39 — 46	May 23, 1991
47 — 49	February 9, 1994
50	May 23, 1991
51, 52, 52A, 53	February 9, 1994
54, 55, A1	May 23, 1991

(21)

MAY 23, 1991

(Title Page Reprinted: February 9, 1994)

1

UL 1994

Standard For

**Low Level Path Marking
And Lighting Systems**

First Edition

May 23, 1991

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

ISBN 1-55989-201-3

COPYRIGHT © 1991, 1994 UNDERWRITERS LABORATORIES INC.

UL's Standards for Safety are copyrighted to protect UL's publication rights, not to restrict their use in product design or evaluation. See paragraph E of the Foreword.

(1 — 05/23/91 — 02/09/94)

TABLE OF CONTENTS

FOREWORD

INTRODUCTION

1. Scope	5
2. General	5
3. Glossary	6
4. Installation and Operating Instructions	6

CONSTRUCTION

5. General	8
6. Accessories	13
7. Enclosures	14
8. Polymeric Materials	23
9. Protection Against Corrosion	25

FIELD WIRING CONNECTIONS

10. General	25
11. Cord-Connected Products	27
12. Permanently-Connected Products	28
13. Grounding	30

INTERNAL WIRING

14. Cord-Connected Products	31
15. Permanently-Connected Products	32
16. Wiring Methods	34
17. Separation of Circuits	35
18. Bonding for Grounding	35

COMPONENTS, ELECTRICAL

19. General	38
20. Capacitors	40
21. Coil Windings	41
22. Electric-Discharge Lighting Systems	41
23. Fuseholders	42
24. Lampholders and Lamps	42
25. Overcurrent Protection	43
26. Switches and Controllers	43
27. Transformers	43

SPACINGS

28. General	44
29. High-Voltage Circuits	44
30. Low-Voltage, Power-Limited Circuits	46
31. Barriers	46

PERFORMANCE

32. General	47
33. Visibility Test	48
34. Smoke-Laden Visibility Test	49
35. Strain Relief Test	51
36. Snap-On Cover Test	51
37. Glass Breakage Test	51
37A. Impact Resistance of Self-Luminous Marking Systems	52

MANUFACTURING AND PRODUCTION TESTS

38. General	52
39. Production-Line Dielectric Voltage-Withstand Test	52

MARKINGS

40. Details	52A
41. Permanently-Connected Products	53
42. Cautionary Markings	54

APPENDIX A

Standards for Components	A1
------------------------------------	----

FOREWORD

A. This Standard contains basic requirements for products covered by Underwriters Laboratories Inc. (UL) under its Follow-Up Service for this category within the limitations given below and in the Scope section of this Standard. These requirements are based upon sound engineering principles, research, records of tests and field experience, and an appreciation of the problems of manufacture, installation, and use derived from consultation with and information obtained from manufacturers, users, inspection authorities, and others having specialized experience. They are subject to revision as further experience and investigation may show is necessary or desirable.

B. The observance of the requirements of this Standard by a manufacturer is one of the conditions of the continued coverage of the manufacturer's product.

C. A product which complies with the text of this Standard will not necessarily be judged to comply with the Standard if, when examined and tested, it is found to have other features which impair the level of safety contemplated by these requirements.

D. A product employing materials or having forms of construction differing from those detailed in the requirements of this Standard may be examined and tested according to the intent of the requirements and, if found to be substantially equivalent, may be judged to comply with the Standard.

E. UL, in performing its functions in accordance with its objectives, does not assume or undertake to discharge any responsibility of the manufacturer or any other party. The opinions and findings of UL represent its professional judgment given with due consideration to the necessary limitations of practical operation and state of the art at the time the Standard is processed. UL shall not be responsible to anyone for the use of or reliance upon this Standard by anyone. UL shall not incur any obligation or liability for damages, including consequential damages, arising out of or in connection with the use, interpretation of or reliance upon this Standard.

F. Many tests required by the Standards of UL are inherently hazardous and adequate safeguards for personnel and property shall be employed in conducting such tests.

INTRODUCTION

1. Scope

1.1 These requirements cover low level path marking and lighting systems, including photo-luminescent, self-luminous, and externally powered systems, for indoor installation in low level locations on floors, or on walls at or near the floor, to identify a path for egress during emergency situations. These systems are intended for installation and use as required by building and fire safety codes such as the Life Safety Code, NFPA 101; the National Building Code sponsored by the Building Officials and Code Administrators (BOCA); the Standard Building Code sponsored by the Southern Building Code Congress International (SBCCI); and the Uniform Building Code sponsored by the International Congress of Building Officials (ICBO).

Paragraph 1.1 revised October 30, 1992

1.2 Photo-luminescent marking systems include such materials as sheeting, adhesive-backed laminates, and paints and inks, and require no external power supply to activate their luminescent properties other than exposure to ambient light.

Paragraph 1.2 revised October 30, 1992

1.2A Self-luminous systems include constructions as defined in paragraph 3.9.

Paragraph 1.2A added October 30, 1992

1.3 Externally powered lighting systems include varying designs of electric lamps that may be intended for connection to any combination of normal power supply, emergency power supply, and battery backup.

1.4 These requirements do not cover exit fixtures, exit lights, and self-luminous exit signs (including those intended for floor-proximity installation) intended for use in accordance with the Life Safety Code, NFPA 101, or emergency lighting fixtures. Such equipment is investigated under the requirements in the Standard for Emergency Lighting and Power Equipment, UL 924.

Paragraph 1.4 revised October 30, 1992

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those in use when the standard was developed, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as

determined necessary to maintain the level of safety for the user of the product as originally anticipated by the intent of this standard.

2. General

General

2.1 Externally powered systems incorporating power supplies installed in the emergency power circuit of a building shall also comply with the applicable power supply requirements in the requirements for power units other than Class 2, UL 1012.

Paragraph 2.1 revised February 9, 1994

2.2 Externally powered systems with power supplies incorporating Class 1 transformers shall also comply with the applicable requirements in the Standard for Specialty Transformers, UL 506.

2.3 Externally powered systems with power supplies incorporating Class 2 or Class 3 transformers shall also comply with the applicable requirements in the Standard for Class 2 and Class 3 Transformers, UL 1585.

Paragraph 2.3 revised February 9, 1994

2.4 Externally powered systems incorporating a battery-backup power supply shall also comply with the applicable requirements in the Standard for Emergency Lighting and Power Equipment, UL 924.

Components

2.5 Except as indicated in paragraph 2.6, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.6 A component need not comply with a specific requirement that:

A. Involves a feature or characteristic not needed in the application of the component in the product covered by this standard, or

B. Is superseded by a requirement in this standard.

2.7 A component shall be used in accordance with its recognized rating established for the intended conditions of use.

2.8 Specific components are recognized as being incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits and shall be used only under those specific conditions for which they have been recognized.

Units of Measurement

2.9 If a value for measurement is followed by a value in other units in parentheses, the second value may be only approximate. The first stated value is the requirement.

Terminology

2.10 The term "product" as used in these requirements refers to low level path marking and lighting systems or any part thereof covered by these requirements unless specifically noted otherwise.

Undated References

2.11 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

3. Glossary

3.1 For purposes of this standard the following definitions apply.

3.2 **DIRECTIONAL MARKER** — A photo-luminescent, self-luminous, or externally powered marker that is mounted at a low level and that is provided with a means of identifying the direction of emergency egress. A directional marker is intended only for use with and as part of a low level path marking and lighting system. See paragraph 1.4 for other limitations.

Paragraph 3.2 revised October 30, 1992

3.3 *Paragraph 3.3 deleted October 30, 1992*

3.4 *Paragraph 3.4 revised and relocated as paragraph 3.7A October 30, 1992*

3.5 **HIGH-VOLTAGE CIRCUIT** — A circuit involving a potential of more than 30 volts ac, 42.4 volts peak or dc, but not more than 600 volts.

3.6 **LOW LEVEL** — Identifies the location of path markers on floors or on walls at or near the floor as specified in the system installation instructions.

Paragraph 3.6 revised October 30, 1992

3.7 **LOW-VOLTAGE CIRCUIT** — A circuit involving a potential of not more than 30 volts ac, 42.4 volts peak or dc, and supplied by (1) an energy limiting battery circuit, (2) a standard Class 2 transformer, or (3) a combination of a transformer and fixed impedance which, as a unit, complies with all performance requirements for a Class 2 transformer. (See also Section 30.)

3.7A **PATH MARKER** — A photo-luminescent, self-luminous, or externally powered marker mounted at a low level that includes the words "EXIT," "TO EXIT," "STAIR," "TO STAIR," "STAIRS," "TO STAIRS," "FIRE ESCAPE," "TO FIRE ESCAPE," or the like, and may also include a directional indicator. A path marker is intended only for use with and as part of a low level path marking and lighting system. See paragraph 1.4 for other limitations.

Paragraph 3.4 revised and relocated as paragraph 3.7A October 30, 1992

3.8 **PHOTO-LUMINESCENT** — The property of emitting light as the result of absorption of visible or invisible light, which continues for a length of time after excitation.

Paragraph 3.8 revised October 30, 1992

3.9 **SELF-LUMINOUS** — A system powered continuously by a self-contained power source other than a battery or batteries, such as radioactive tritium gas. Such a system is independent of external power supplies or other energy for its operation.

Paragraph 3.9 added October 30, 1992

4. Installation and Operating Instructions

General

4.1 Installation and operating instructions shall be furnished with each system and accessory.

4.2 Instructions are to accompany each unit and accessory, either individually or with each shipment to the installer. If the instructions for the unit do not cover a field installed accessory, instructions are to be furnished with the accessory.

4.3 A copy of the installation and operating instructions intended to accompany each product or component as produced, is to be used as a guide in the examination and test of the product or component.

4.4 The instructions shall include such directions and information as deemed by the organization responsible for the product to be necessary to cover the intended installation, maintenance, operation, and use of the product or component.

4.5 Installation and operating instructions provided with each photo-luminescent marking system shall include, but not be limited to, the following:

A. Specific details on the proper surface preparation and application methods.

B. Mounting instructions for laminates, if any.

C. Information on the appropriate surface to which the materials may be applied.

D. Guidelines for designing and installing the path marking system.

E. Information on maintenance inspection procedures.

F. Complete details of the installation and application conditions including, but not limited to, the following: (1) the minimum amount of ambient illumination necessary for the photo-luminescent system to function as intended, (2) an instruction that the control of the ambient illumination be restricted to authorized personnel, and (3) a warning against the use of the system where the ambient illumination level is less than the minimum specified value.

G. Reference to applicable local and national installation codes as appropriate, such as the Life Safety Code, NFPA 101; the California State Building Code; and the like.

H. For a path marker, the words: "This path marker is intended only for use with and as part of a low level path marking and lighting system and is not intended to be used as an exit sign in accordance with NFPA 101, Section 5 — 10, or other codes that specify listing in accordance with UL 924."

Revised paragraph 4.5 effective May 1, 1993

4.6 Installation and operating instructions provided with each externally powered system shall include, but not be limited to, the following:

A. Reference to applicable local and national installation codes as appropriate, such as the National Electrical Code, NFPA 70; the Life Safety Code, NFPA 101; the California State Building Code; and the like.

B. An instruction that the system shall be connected to an emergency power circuit, or be provided with an emergency power supply.

C. Mounting instructions for system components.

D. Guidelines for installing the path marking system.

E. For a path marker, the words: "This path marker is intended only for use with and as part of a low level path marking and lighting system and is not intended to be used as an exit sign in accordance with NFPA 101, Section 5 — 10, or codes that specify listing in accordance with UL 924."

Revised paragraph 4.6 effective May 1, 1993

4.6A Installation and operating instructions provided with each self-luminous marking system shall include, but not be limited to, the following:

A. Instructions for installing the path marking system.

B. Information on maintenance and inspection procedures.

C. Reference to the applicable local and national installation codes as appropriate, such as the Life Safety Code, NFPA 101; the California State Building Code; and the like.

D. For a path marker, the words: "This path marker is intended only for use with and as part of a low level path marking and lighting system and is not intended to be used as an exit sign in accordance with NFPA 101, Section 5 — 10, or other codes that specify listing in accordance with UL 924."

Added paragraph 4.6A effective May 1, 1993

Safety Instructions

4.7 The safety instructions shall be a permanent part of the manual but separated in format and preceding all other instructions (such as installation, operation, and maintenance instructions).

4.8 The safety instructions shall include instructions or illustrations to identify important safety features, in addition to the important safeguards given in paragraph 4.12.

4.9 The height of lettering in the text and illustrations of the safety instructions shall be as follows:

A. The phrases "IMPORTANT SAFEGUARDS," "READ AND FOLLOW ALL SAFETY INSTRUCTIONS," and "SAVE THESE INSTRUCTIONS" shall be in letters at least 3/16 inch (4.8 mm) in height.

B. Other upper case letters shall be at least 0.083 inch (2.1 mm) in height.

C. Lower case letters shall be at least 1/16 inch (1.6 mm) in height.

4.10 The items may be numbered. The phrases "READ AND FOLLOW ALL SAFETY INSTRUCTIONS" and "SAVE THESE INSTRUCTIONS" shall be first and last, respectively, in a list of items. Other important safeguard items considered appropriate by the manufacturer may be inserted.

4.11 For all equipment, the safety instructions shall include the following safeguards or the equivalent.

Exception: If a specific safeguard does not apply to a particular type of equipment, the safeguard may be modified or deleted as appropriate.

"IMPORTANT SAFEGUARDS"

When using electrical equipment, basic safety precautions should always be followed including the following:

1. READ AND FOLLOW ALL SAFETY INSTRUCTIONS.
2. Do not use outdoors (this item may be omitted if the product is suitable for outdoor use.)

3. Do not let power supply cords touch hot surfaces.

4. Do not mount near gas or electric heaters.

5. Use caution when servicing batteries. Battery acid can cause burns to skin and eyes. If acid is spilled on skin or in eyes, flush acid with fresh water and contact a physician immediately.

6. The use of accessory equipment not recommended by the manufacturer may cause an unsafe condition.

7. Do not use this equipment for other than intended use.

SAVE THESE INSTRUCTIONS

Other Instructions

4.12 The instruction manual shall include instructions for installation, operation, and maintenance recommended by the manufacturer. The instructions shall warn the user that all servicing should be performed by qualified service personnel.

CONSTRUCTION

5. General

Assembly

5.1 Electrical components of externally powered systems, including wiring, raceways, and enclosures, shall be constructed for installation in accordance with the applicable requirements as appropriate for Class 1, 2, and 3 circuits as defined in the National Electrical Code, NFPA 70-1990. Temporary removal or relocation of factory wiring shall not be required to accomplish field wiring.

5.2 Physical components of photo-luminescent systems shall be constructed for proper installation in accordance with the manufacturer's installation instructions. Components may include bulk quantities of photo-luminescent materials and may also be provided with imprinted directional or path markers.

Paragraph 5.2 revised October 30, 1992

5.2A Self-luminous marking systems utilizing a radioactive material as the energy source are subject to the requirements of the United States Nuclear Regulatory Commission as applied to a generally licensed device.

Paragraph 5.2A added October 30, 1992

Product Assembly

5.3 Electrically powered equipment shall be a complete assembly and shall include all the essential components necessary for its intended function when used or installed as intended. The product may be shipped from the factory as two or more major subassemblies. See paragraph 5.4.

5.4 A product that is not assembled by the manufacturer as a complete unit shall be arranged in major subassemblies. Each subassembly shall be capable of being incorporated into a final assembly when installed in accordance with the installation instructions.

Mechanical Protection

5.5 Louvers and other openings in the ultimate enclosure shall be constructed and located to reduce the risk of unintentional contact with hot surfaces or with moving parts that may cause a risk of injury to persons. Also, see paragraph 5.10. In determining compliance with this requirement, parts such as covers, panels, or grilles used as part of the enclosure are to be removed unless tools are required for their removal.

5.6 The degree of protection required by paragraph 5.5 depends upon the general design and the intended use of the product. The location where the product ordinarily will be used is considered when judging the acceptable degree of exposure of moving parts. Other factors taken into consideration in judging the acceptability of exposed moving parts are (1) the degree of exposure, (2) the sharpness of the moving parts, (3) the likelihood of unintentional contact with the moving parts, and (4) the speed of movement of those parts.

5.7 Moving parts that may cause injury to persons, such as fan blades or blower wheels, shall be guarded or enclosed so that the minor dimension of any opening does not exceed the values in paragraphs 5.8 and 5.11. Parts required for guarding shall be secured by means dependent

upon tools for their removal unless the guard is required to be in place in order for the product to function.

5.8 The distance from an opening to the moving part shall be in accordance with Table 5.1, but the minor dimension of the opening shall not, in any case, exceed 1 inch (25.4 mm). For an opening having a minor dimension intermediate between two of the values included in the table, the distance from the opening to the moving part shall be not less than that found by appropriate interpolation between the corresponding values in the table. The minor dimension of the opening is determined by the largest hemispherically tipped cylindrical probe that can be inserted through the opening with a force of 5 pounds (22.3 N). See paragraph 5.11 for round holes and slots.

TABLE 5.1
DIMENSIONS OF OPENINGS

Minor Dimensions of Opening ^a		Minimum Distance from Opening to Moving Part ^c	
Inches	mm	Inches	mm
1/4	6.4	1/2	12.7
3/8	9.5	1-1/2	38.1
1/2	12.7	2-1/2	63.5
3/4	19.1	4-1/2	114.0
1	25.4	6-1/2	165.0
1-1/2	38.1	10-1/2	267.0
2	50.8	14-1/2	368.0
2-1/4 ^b	57.2	16-1/2	419.0
2-1/2 ^b	63.5	18-1/2	470.0
2-3/4 ^b	69.9	20-1/2	521.0
3 ^b	76.2	22-1/2	572.0
Over 2	Over 50.8	30	762.0

^a Openings less than 1/4 inch (6.4 mm) are not to be considered.

^b These values apply only to openings at the base of the product where the upper edge of the opening is less than 8 inches (203 mm) above the floor. The product is to be in its intended operating position.

^c Also applies to hot parts.

5.9 A moving part is not to be considered when judging compliance with paragraph 5.6 if (1) the part is unlikely to be contacted through the opening because of the location of fixed components, including baffles, (2) the part is made inoperative, when exposed, through the use of interlocking devices, or (3) the chassis of the product is of a slide-out type construction that must be withdrawn from its enclosure to expose the moving part that may cause injury to persons.

5.10 Surfaces that exceed temperature rise limits during the temperature tests shall be guarded in accordance with paragraphs 5.7 — 5.9 or 5.11. See paragraphs 32.6 and 32.7.

5.11 If an opening consists of a round hole or slot having a major straight line dimension of less than 2 inches (50.8 mm), the distance to a moving part that may cause injury to persons shall be in accordance with Table 5.2. If an opening consists of a round hole or slot having a major straight line dimension more than 2 inches (50.8 mm), the distance to a moving part that may cause injury to persons shall be in accordance with Table 5.1. For an opening having a minor dimension intermediate between two of the values included in the table, the distance from the opening to the moving part shall be not less than that found by interpolation between the corresponding values shown in the appropriate column.

Electrical Protection

5.12 Louvers and other openings in the enclosure shall be constructed and located to reduce the risk of unintentional contact with uninsulated live parts. In determining compliance with this requirement, parts such as covers, panels, and grills used as part of the enclosure are to be removed unless tools are required for their removal or an interlock is provided.

5.13 Uninsulated high-voltage live parts shall be located, guarded, or enclosed as indicated in paragraphs 5.14 — 5.19.

5.14 If an opening in the enclosure will not permit the entrance of a 3/4 inch (19.1 mm) diameter rod, the probe illustrated in Figure 5.1 shall not touch any uninsulated live parts and the probe illustrated in Figure 5.2 shall not touch any film-coated wire when inserted through the opening. The probe shall not pass through grilles, screens, louvers, or the like when a force of 5 pounds (22.3 N) is applied.

TABLE 5.2
DIMENSION OF OPENINGS FOR ROUND HOLES OR SLOTS HAVING
A MAJOR DIMENSION LESS THAN 2 INCHES (50.8 mm)^a

Minor Dimension of Opening		Minimum Distance From Opening to Moving Part ^b			
		Round Holes		Slots	
		Inches	mm	Inches	mm
1/4	6.4	1/8	3.2	1/2	12.7
3/8	9.5	1	25.4	1-1/2	38.1
1/2	12.7	2	50.8	2-1/2	63.5
3/4	19.1	3-1/4	82.6	3-1/4	82.6
1	25.1	4	102.0	4	102.0

^a Table 5.1 applies if major dimension of slot is 2 inches (50.8 mm) or greater.

^b Also applies to hot parts.

18.8 An internal connection for bonding internal parts to the enclosure for grounding, but not for a field installed grounding conductor or for the grounding wire in a supply cord, may use a quick-connect terminal of the specified dimensions if the connector is not likely to be displaced and the component is limited to use on a circuit having a branch-circuit protective device, rated as specified in Table 18.1.

TABLE 18.1
MINIMUM INTERNAL TERMINAL
CONNECTIONS FOR BONDING

Terminal Dimensions, Inch (mm)	Rating of Protective Device, Amperes
0.20 by 0.187 by 0.250 (0.51 by 4.75 by 6.35)	20 or less
0.032 by 0.187 by 0.250 (.081 by 4.75 by 6.35)	20 or less
0.032 by 0.205 by 0.250 (0.81 by 5.2 by 6.35)	20 or less
0.032 by 0.250 by 0.312 (0.81 by 6.35 by 7.92)	60 or less

Table 18.1 revised October 30, 1992

18.9 A connection that depends upon the clamping action exerted by rubber or other nonmetallic material may be acceptable if it complies with the requirements specified in paragraph 18.13 under any normal degree of compression permitted by a variable clamping device and if the results are still acceptable after exposure to the effects of oil, grease, moisture, and thermal degradation that may occur in service. Also, the effect of assembling and disassembling for maintenance purposes, such a clamping device is to be considered, with particular emphasis on the likelihood of the clamping device being reassembled in its intended fashion.

18.10 Except as mentioned in paragraphs 18.13 and 18.14, on a cord-connected product, a bonding conductor or strap shall have a cross-sectional area not less than that of the grounding conductor of the supply cord.

18.11 On a permanently-connected product, the size of a conductor used to bond an electrical enclosure shall be based on the rating of the branch-circuit overcurrent device to which the equipment will be connected. The size of the conductor or strap shall not be less than as specified in Table 18.2.

Exception: A smaller conductor may be used if it complies with the requirements in paragraph 18.13.

Paragraph 18.11 revised October 30, 1992

TABLE 18.2
MINIMUM BONDING WIRE
CONDUCTOR SIZE

Rating of Overcurrent Device, Amperes	Size of Bonding Conductor ^a			
	Copper Wire AWG	(mm ²)	Aluminum Wire AWG	(mm ²)
15	14	(2.1)	12	(3.3)
20	12	(3.3)	10	(5.3)
30	10	(5.3)	8	(8.4)
40	10	(5.3)	8	(8.4)
60	10	(5.3)	8	(8.4)
100	8	(8.4)	6	(13.3)
200	6	(13.3)	4	(21.2)

^a Or equivalent cross-sectional area.

Table 18.2 revised October 30, 1992

18.12 A conductor, such as a clamp or strap, used in place of a separate wire conductor as specified in paragraph 18.11, is considered acceptable if the minimum cross-sectional conducting area is equivalent to the wire sizes specified in Table 18.2.

Paragraph 18.12 revised October 30, 1992

18.13 A smaller conductor may be used if the bonding conductor and connection comply with the bonding conductor test described in the Standard for Emergency Lighting and Power Equipment, UL 924, or the requirements for power units other than Class 2, UL 1012. See paragraphs 32.6 and 32.7.

Paragraph 18.13 revised October 30, 1992

18.14 A bonding conductor to a motor or other electrical component need not be larger than the size of the motor-circuit conductors supplying the component. See paragraph 18.7.

18.15 Splices shall not be used in wire conductors used to bond electrical enclosures or other electrical components.

18.16 If more than one size branch-circuit overcurrent protection device is involved, the size of the bonding conductor is to be based on the rating of the overcurrent device intended to provide ground-fault protection for the component bonded by the conductor.

COMPONENTS, ELECTRICAL

19. General

Mounting of Components

19.1 A switch, lampholder, attachment-plug, connector base, or similar electrical component shall be secured in position, and, except as specified in paragraphs 19.2 — 19.10, shall be prevented from turning.

19.2 In the mounting or supporting of small, fragile, insulating parts, screws or other fastenings shall not be tight enough to cause cracking or breaking of these parts with expansion and contraction. Generally, such parts should be slightly loose.

19.3 The requirement that a switch be prevented from turning may be waived if all four of the following conditions are met:

A. The switch is a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to rotate the switch during intended operation of the switch.

B. The means for mounting the switch makes it unlikely that the operation of the switch will loosen it.

C. Spacings are not reduced below the minimum required values if the switch rotates.

D. The operation of the switch is by mechanical linkage rather than by direct contact by persons.

19.4 A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, need not be prevented from turning if rotation will not reduce spacings below the minimum required values.

19.5 Uninsulated live parts shall be so secured to the base or mounting surface that they will be prevented from turning or shifting in position, if such motion may result in a reduction of spacings below the acceptable values. (The securing of contact assemblies shall provide for the continued alignment of contacts.)

19.6 The means for preventing turning shall consist of more than friction between surfaces.

19.7 A toothed lock washer that provides both spring take-up and an interference lock is acceptable as the means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

19.8 A flush plate for outlet-box mounting shall be of 0.030 inch (0.76 mm) or thicker ferrous metal, of 0.040 inch (1.02 mm) or thicker nonferrous metal, or of 0.100 inch (2.54 mm) or thicker nonconductive material.

PERFORMANCE

32. General

General

32.1 Samples of low level path marking and lighting systems shall be determined to be visible according to (1) the Visibility Test, Section 33, and (2) the Smoke-Laden Visibility Test, Section 34. Observers' eyes are to be preconditioned according to paragraph 33.2. Observations are to be made using both as-received and conditioned samples. Testing is to be conducted at a temperature of $25 \pm 5^{\circ}\text{C}$ ($77 \pm 9^{\circ}\text{F}$).

Paragraph 32.1 revised October 30, 1992

32.1A With regard to paragraphs 32.1, 33.1, 33.2, and 34.1, a low level path marking and lighting system is considered visible if observers are able to identify the location, orientation, and configuration of the sample and if any words, symbols, or directional indicators are legible; that is, the observers are able to correctly read the words, describe the symbols, and identify the direction of directional indicators.

Paragraph 32.1A added October 30, 1992

32.2 For the purposes of the tests described in Sections 32 — 34, photo-luminescent marking systems such as paints and inks are to be applied to representative surfaces in accordance with the manufacturer's instructions. Test surfaces are to be previously untreated and uncoated and are to include wood, steel, concrete, interior wall board (thickness may vary), and other surfaces as specified by the manufacturer unless the manufacturer's instructions specifically exclude applications to one or more of these test surfaces. Where photo-luminescent sheeting and adhesive-backed laminates are to be evaluated, test samples are to be prepared by applying the materials in accordance with the manufacturers instructions to the same test surfaces. If self supporting types of panels or sheet goods are intended to be physically secured to a wall surface, they may be tested without being applied to a support surface. Testing is to be conducted using nominal 4 by 12 inch (102 by 305 mm) samples or the smallest size of the product if greater than 4 by 12 inches.

Paragraph 32.2 revised October 30, 1992

32.3 Samples of externally powered systems are to represent actual intended installations, as closely as practicable, in accordance with the manufacturer's instructions.

32.3A Samples of a self-luminous marking system are to have a luminance no higher than that which will be present on the date marked on the product in accordance with paragraph 40.5A for replacing the system.

Paragraph 32.3A added October 30, 1992

32.4 Accelerated aging and conditioning tests are conducted as described in paragraphs 32.8 — 32.12. Following these tests the samples are to be examined for the extent of degradation that has occurred. There shall be no shrinking, cracking, separation from the substrate, or other evidence of deterioration that could affect continued performance of the product. Additionally, the conditioned samples are to be evaluated for compliance with the visibility tests described in Sections 33 and 34.

32.5 Electrical system evaluation shall include consideration of various exposures to environmental conditions and abuse that may affect continued performance of the system. Specific system testing shall depend on the manufacturer's recommended application and installation for the system.

32.6 An externally powered system incorporating a power supply shall be subjected to the following performance requirements described in the requirements for power units other than Class 2, UL 1012:

General

Leakage Current Test

Power Input Test

Temperature Test

Dielectric Voltage-Withstand Test

Mechanical Strength Tests for Metal Enclosures

Strain Relief and Bushing Tests

Overload of Switches and Controls Test

Isolated Limited Energy Circuit Capacity

Abnormal Tests

Capacitors Test

Bonding Conductor Test

Paragraph 32.6 revised February 9, 1994

32.7 If the power supply of an externally powered system is of the emergency type, it shall be subjected to the following performance requirements described in the Standard for Emergency Lighting and Power Equipment, UL 924:

General

Leakage Current Test
Normal Operation Test
Battery Discharge Test
Sealed Battery/Cell Pressure Release Test
Battery Vent Cap Test
Battery Compartment Ventilation Test
Current Input Test
Temperature Test
Abnormal Temperature Test
Overvoltage and Undervoltage Test
Composite Solid State Switch Inverter Test
Voltage Surge Test
Dielectric Voltage-Withstand Test
Conformal Coating Test Program I
Conformal Coating Test Program II
Strain Relief Test

Oven Aging Test

32.8 Conditioning is to include air-oven aging of samples of the illuminated portion of either an externally powered, self-luminous, or photo-luminescent system, at one of the following temperatures for the corresponding period of time, as selected by the manufacturer:

- A. 100°C (212°F) for 336 hours,
- B. 90°C (194°F) for 672 hours,
- C. 80°C (176°F) for 1344 hours, or
- D. 70°C (158°F) for 3500 hours.

Paragraph 32.8 revised October 30, 1992

32.9 Air-oven aging shall be conducted such that the samples are maintained in a totally dark environment.

Light Exposure Test

32.10 Conditioning of photo-luminescent systems is to include placing samples or test panels in an enclosure and subjecting them to a 12 hour on and 12 hour off cycling of light exposure. The ambient light level at the surface of the samples is to be adjusted to 5 to 10 foot-candles (54 to 108 lux) and the cycling is to be conducted through a period of 28 days.

Paragraph 32.10 revised October 30, 1992

32.11 A second set of photo-luminescent system samples or test panels is to be conditioned at an incandescent illuminance, at the surface of the samples, of 1 foot-candle (10.8 lux) for a period of 60 minutes.

Exception: A higher incandescent illuminance not exceeding 10 foot-candles (108 lux) for a period not exceeding 30 minutes may be used if the product and instructions are marked as specified in item F of paragraph 4.5 and item D of paragraph 40.4.

Paragraph 32.11 revised October 30, 1992

32.12 Immediately following the conditioning described in paragraphs 32.10 and 32.11 and without exposure to any external light source the samples are to be subjected to observations described in paragraph 33.1.

Abuse of Floor Systems

32.13 If the manufacturer's instructions indicate the intended installation of the system includes usage on a floor surface, conditioning of a system shall include subjecting samples to various forms of abuse or abrasion to represent that produced by scrubbing or washing, repeated traverses of an industrial vehicle, or repeated walking.

Continuous Operation and Cycling

32.14 Conditioning of externally powered systems is to include subjecting a sample to 11-1/2 days of continuous operation at maximum rated voltage, and is also to include subjecting a sample to 100,000 cycles of operation at a cycle rate of 5 seconds on and 5 seconds off. Following the conditioning, the sample shall comply with the requirements in paragraph 33.1.

33. Visibility Test

General

33.1 To determine if as-received and conditioned samples of systems and materials are visible at a distance of 25 feet (7.62 m) under conditions of total darkness, the procedures outlined in paragraphs 33.3 — 33.6 are to be conducted. All samples shall be readily visible as specified in paragraph 32.1A for a period of up to 90 minutes.

Paragraph 33.1 revised October 30, 1992

33.2 For initial visibility observations, observers' eyes are to be preconditioned at 50 foot-candles (538 lux) for 5 minutes immediately prior to terminating such lighting and commencing the observations. For observations at the end of 90 minutes of system operation, the observers' eyes are to be preconditioned for 30 minutes at the same ambient illumination as for the test sample, from 60 minutes into the test until the observation is made at the end of 90 minutes. A shorter conditioning time may be used if agreeable to those concerned. With the samples placed a distance of 25 feet (7.62 m) from the observers, the observers are to record the time required to determine visibility as specified in paragraph 32.1A. The time required for the observers to report their observations is to be recorded for reference.

Paragraph 33.2 revised October 30, 1992

Externally Powered Systems

33.3 Observations of externally powered systems shall be conducted with representative samples connected as intended in service to a supply source of rated voltage. If the illumination of an externally powered system will vary with a change in supply voltage, observations shall also be conducted with samples connected to supply sources of 85 and 110 percent of rated voltage.

33.4 Externally powered systems that are provided with an emergency battery-backup power supply are also to be observed in accordance with paragraph 32.1 after 1-1/2 hours of full load applied to the power-supply output.

Photo-Luminescent Systems

33.5 Samples of photo-luminescent materials, except for the samples conditioned in accordance with paragraph 32.11, are to be preconditioned with 10 minutes of exposure to 50 foot-candles (538 lux) of incandescent illumination.

Paragraph 33.5 revised October 30, 1992

33.6 Observations in accordance with paragraph 33.1 are to be conducted immediately after the samples have been preconditioned with the 10 minutes exposure and again after 1-1/2 hours of total darkness. The conditioned samples from paragraph 32.11 are not to be subjected to these additional exposures before being subjected to visibility tests following the 1-1/2 hours of total darkness.

34. Smoke-Laden Visibility Test

34.1 To determine if as-received and conditioned samples of systems and materials are visible under smoke-laden conditions, the procedures outlined in paragraphs 34.2 — 34.6 are to be conducted. All samples shall be visible as specified in paragraph 32.1A (1) at the start of the test and (2) after 90 minutes of continuous operation for externally powered systems, if the source of power is a battery, and for photo-luminescent systems through and observation distance of 12 feet (3.66 m) with a smoke density so that 50 percent blockage of transmitted light is measured in accordance with paragraph 34.5. Observers' eyes are to be preconditioned in accordance with paragraph 33.2. Photo-luminescent samples are to remain in total darkness during the 90 minutes.

Paragraph 34.1 revised October 30, 1992

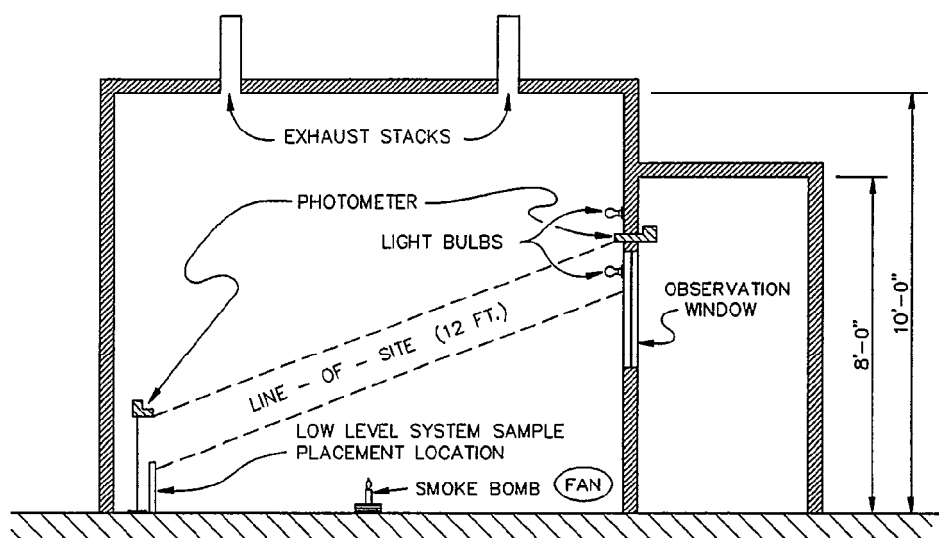
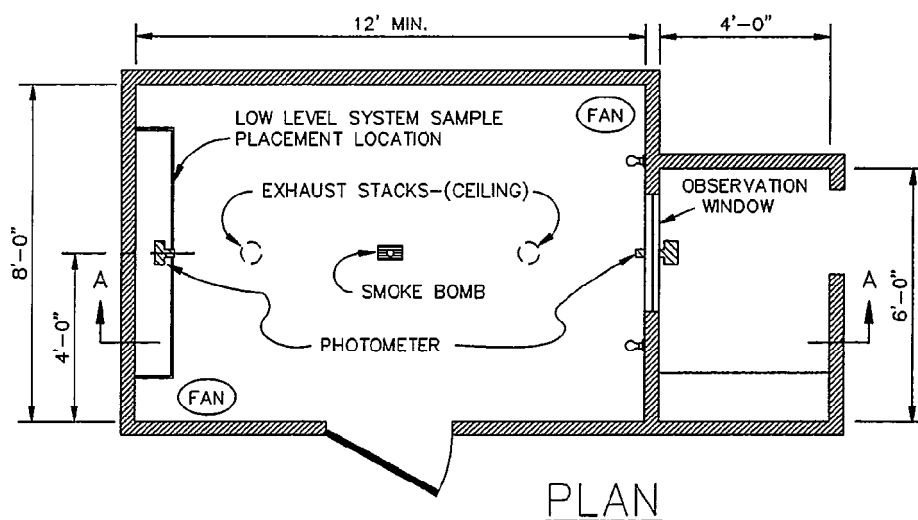
34.2 The samples described in paragraph 32.2, 32.3, or 32.3A are to be subjected to this test.

Paragraph 34.2 revised October 30, 1992

34.3 The samples are to be placed at or near the floor, in accordance with the manufacturer's instructions, in a room, as shown in Figure 34.1, having (1) dimensions of at least 8 by 12 by 10 feet (2.4 by 3.7 by 3.0 m); (2) walls, ceiling and floor painted flat black; (3) an air circulation system consisting of two 15 inch (381 mm) diameter electric fans located at opposite corners directing air streams upward toward the diagonal opposite corner of the room in order to provide uniform dispersion of the smoke; and (4) an exhaust system consisting of a blower through two 6 inch (152 mm) openings in the roof. Observation of a photo-luminescent system is to begin as soon as practical upon removal of the conditioning light. The smoke in the room is to be at the required density and uniformity at the time the samples are to be observed. There is to be no illumination in the test room other than that provided by the test samples during the observations.

Paragraph 34.3 revised October 30, 1992

FIGURE 34.1
SMOKE ROOM DETAILS



S3664

34.4 A 6.7 ounce (190 g) smoke bomb capable of producing white smoke with a particle size range of 10^{-4} to 10^{-6} cm in diameter^a for approximately 2 — 3 minutes is to be used to introduce smoke into the room during the smoke-laden observation tests. Measurement of the smoke density is to be made at the time visibility was lost and again as the samples become visible during the gradual clearing of the smoke in the room by an exhaust system.

Paragraph 34.4 revised October 30, 1992

34.5 A photometer and photo cell is to be provided in the room in order to measure the optical density of the smoke and is to be located at approximately the line-of-sight between a standing observer and the test samples.

34.6 Observations of the samples is to be made along the line-of-sight, as shown in Figure 34.1, in accordance with paragraph 33.2. The observation distance is to be 12 feet (3.66 m).

35. Strain Relief Test

35.1 When the strain relief means is tested as described in paragraphs 35.2 — 35.3 there shall be no insulation damage or movement of the conductors of the cord, indicating that a stress would have been transmitted to the connections.

35.2 A strain relief means is to be tested by removing or severing the electrical connections of the cord or each lead wire within the unit and then applying the force specified in paragraph 35.3.

35.3 A force of 35 pounds (156 N) for a power-supply cord and 20 pounds (89 N) for a lead wire is to be applied such that the strain relief means will be stressed from any angle that the construction of the product permits. The force is to be maintained for 1 minute.

^a A smoke bomb with these features is available from Superior Signal Company, Inc., Spotswood, New Jersey; Model 3C.

36. Snap-On Cover Test

36.1 A snap-on cover that gives access to uninsulated bare live parts and that does not require a tool for removal shall withstand the following tests:

A. A cover that can be removed with one hand shall not be released when a squeezing force of 14 pounds (62.3 N) is applied at any two points, the distance between which shall not exceed 5 inches (127 mm), as measured by a tape stretched tightly over that portion of the surface of the cover that would be encompassed by the palm of the hand. The test shall be performed before and after ten removal and replacement operations;

B. A cover shall not become disengaged from the case when a direct pull of 14 pounds (62.3 N) is applied. For this test, the cover is to be gripped at any two convenient points. The test shall be performed before and after ten removal and replacement operations; and

C. A cover shall withstand an impact force of 1 foot-pound (1.36 N·m) applied to the accessible faces of the cover (one blow per face) without being displaced. The radius of the ball used for this test shall be not less than 1 inch (25.4 mm).

37. Glass Breakage Test

37.1 Glass that covers a larger area than that specified in paragraph 7.56 shall not be less than 1/8 inch (3.2 mm) thick and shall conform to one of the following:

A. The glass shall be of a nonshattering or tempered type that, when broken, shall conform to the performance specifications in the American National Standard Safety Performance Specifications and Methods of Test for Safety Glazing Material Used in Buildings, ANSI Z97.1-1984; or

B. Shall withstand a 2-1/2 foot-pound (2.41 J) impact from a 2-inch (50.8-mm) diameter, 1.18 pound (535 g) steel sphere without cracking or breaking to the extent that a piece is released or dropped from its normal position.

37A. Impact Resistance of Self-Luminous Marking Systems

37A.1 Three "as received" samples and three samples after conditioning in accordance with paragraph 32.8 are to be tested. Each sample is to be subjected to a single impact of 5 foot-pounds (6.8 N) at any point exposed to impact. The points selected are to be such that the impacts produce the most adverse results. The samples are to be mounted or otherwise restrained on a supporting surface of a material and in a manner representative of the most unfavorable condition of intended installation. The impact is to be produced by a solid, smooth sphere, 2 inches (50.8 mm) in diameter and weighing 1.18 pounds (0.54 kg). The steel sphere is to be dropped freely, or suspended by a cord and swung as a pendulum, dropping through the vertical distance necessary to cause it to strike the surface with the necessary impact. If the manufacturer so elects, fewer than three samples may be used in accordance with Figure 37A.1. The results of the impact tests are acceptable if there is no cracking, breakage, or detachment of any component or parts, such as a lens or diffuser, the light source, the enclosure, or the means of support or mounting.

Paragraph 37A.1 added October 30, 1992

FIGURE 37A.1
PROCEDURE FOR IMPACT TEST

Series Number	Sample Number											
	1	2	3	1	2	3	1	2	3	1	2	3
1	A	N	N	A	N	N	A	N	N	A	N	N
2	A	N	N	A	N	N	U	A	N	U	A	N
3	A	N	N	U	A	N	A	N		U	A	N

Arrows indicate sequence of test procedure
 A — Acceptable results from drop
 U — Unacceptable results from drop
 N — No test necessary

SA1182

Figure 37A.1 added October 30, 1992

MANUFACTURING AND PRODUCTION TESTS

38. General

38.1 In order to verify compliance with these requirements in production, the manufacturer shall provide regular production control, inspection, and tests. The program shall include at least the following for each product.

38.2 Other test arrangements may be considered and accepted if found to achieve the results contemplated.

39. Production-Line Dielectric Voltage-Withstand Test

39.1 The manufacturer shall conduct a dielectric voltage-withstand test on each electrical product. A 60 hertz potential as indicated below shall be applied between high-voltage parts and dead metal parts for a period of 1 minute.

- A. 1000 volts for units rated 250 volts or less.
- B. 1000 volts plus twice rated voltage for units rated over 250 volts.

Exception: The time of application of the potential may be reduced to 1 second if the value of the test potential is 120 percent of the value indicated.

39.2 If a product employs low-voltage circuits, the test is to be conducted with the low-voltage circuit connected to the cabinet, chassis, or other dead metal part so that the potential that is applied between the high-voltage live parts and dead metal parts will simultaneously be applied between high-voltage live parts and low-voltage circuits.

39.3 If the product employs components such as a solid state control that can be damaged by the dielectric potential, the test may be conducted before the component or components are electrically connected. However, a random sampling of each day's production is to be tested with the components electrically connected to assure compliance with paragraph 39.1.

39.4 A 500 volt-ampere or larger transformer, the output voltage of which is essentially sinusoidal and can be varied, is to be used to determine compliance with paragraph 39.1. The requirement of a 500 volt-ampere or larger transformer can be waived if the high potential testing equipment used is such that it maintains the specified high potential voltage at the equipment for the duration of the test.

39.5 The test equipment used for the test in paragraph 39.1 is to include a visible indication of application of the test potential and an audible or visible indication of breakdown. In the event of breakdown, manual reset of an external switch is to be required, or an automatic reject of the unit under test is to result. Other arrangements may be acceptable if found to achieve the results contemplated.

MARKINGS

40. Details

General

40.1 Unless specifically indicated otherwise, every marking required in the following paragraphs and elsewhere in this standard shall be permanent.

40.2 A marking that is required to be permanent shall be molded, die-stamped, paint-stenciled, stamped, or etched metal that is permanently secured, or indelibly stamped on pressure-sensitive labels secured by adhesive.

40.3 To determine if a pressure-sensitive label, or label secured by cement or adhesive, is of a permanent nature, representative samples are to be subjected to exposure conditions for indoor use as defined in the Standard for Marking and Labeling Systems, UL 969.

40.4 Each product shall be marked on each major system component and material container as specified in items A — E. The marking is to be applied so as to be visible after installation to the materials and components that can be marked such as tapes, plastic sheeting, laminates, and the like. For materials that cannot be marked, such as inks, paints, and adhesives, the marking is to be applied to the smallest unit container.

A. The manufacturer's or private labeler's name or identifying symbol.

B. A distinctive type, model, or material designation.

C. The electrical rating (for externally powered systems).

D. The minimum amount of ambient illumination necessary for the photo-luminescent system to function, if greater than 1 foot-candle (10.8 lux).

E. For a path marker, the words "This path marker is intended only for use with and as part of a low level path marking and lighting system and is not intended to be used as an exit sign in accordance with NFPA 101, Section 5 — 10 or other codes that specify listing in accordance with UL 924."

Revised paragraph 40.4 effective May 1, 1993

40.4A As a component of a self-illuminating marking system, a marking in the form of a plaque that complies with paragraph 40.2 shall be included so as to permanently display pertinent information about operation and application of the system installed in a building. The minimum dimensions of the plaque shall be 8 by 10 inches (203 by 254 mm) and the text shall be in blocked, upper-case letters minimum 1/8 inch (3.2 mm) high. The information shall include, but not be limited to, the following:

A. A description of the system and its purpose.

B. The manufacturer's name.

C. The system designation.

D. The minimum ambient illumination necessary if more than 1 foot-candle (10.8 lux) consistent with the value used in accordance with the exception of paragraph 32.11.

E. A warning against allowing the illumination on the surface of the system to decline below the minimum required value.

F. Reference to applicable installation codes as appropriate, such as the Life Safety Code, NFPA 101; the California State Building Code; and the like.

G. An instruction that the plaque is to be posted in a conspicuous location in an area of the building accessible and visible to maintenance and inspection personnel.

H. An indication that the control of the ambient illumination is to be restricted to authorized personnel.

I. A statement that a copy of the information on the plaque is to be maintained with other applicable building permits and documents.

Added paragraph 40.4A effective July 1, 1992

40.4B Product markings, instructions, or other literature for a path marker as defined in paragraph 3.7A shall not use terms containing the words "sign" or "exit" to refer to the product.

Added paragraph 40.4A effective May 1, 1993

40.5 If a manufacturer produces path markings or systems at more than one factory, each product shall have a distinctive marking to identify it as that of a particular factory.

40.5A A self-luminous system shall be marked with the date, expressed in month and year, on or before which the system is to be replaced.

Paragraph 40.5A added October 30, 1992

Externally Powered Systems

40.6 The information specified in paragraph 40.4 shall be on a nameplate(s) so located that after installation of the product, it will be readily visible and legible without requiring the use of tools for removal of panels, and the like. The nameplate shall be constructed and fastened so as to form a permanent part of the product assembly.

40.7 The nameplate(s) shall be located on a fixed frame member or on a panel that will not be removed for installation or service; however, it may be located on a panel if (1) the panel requires the use of tools for removal, and (2) the panel must be in place for operation of the equipment.

40.8 An electrical accessory intended for field installation in or on a product shall be marked with the name or identifying symbol of the manufacturer or private labeler, with a catalog number or equivalent designation, and with the type of equipment with which it is intended to be used. The associated product shall be marked to indicate the catalog number or equivalent designation of such an accessory and the name of the manufacturer or private labeler of that accessory.

40.9 With regard to paragraph 40.8, instructions for installing the accessory shall be provided on or with the accessory. A statement shall be included in the instructions warning the user that the product must be disconnected from the source of electrical supply before attempting the installation and that the accessory is intended for use only with the product that is marked to indicate such use.

40.10 If the accessory is designed to be installed by means of receptacles and plug-in connectors that have been investigated to make and break circuits under loads, and if such connection or disconnection does not result in exposure of uninsulated live parts, the statement that the product must be disconnected from the source of electrical supply need not be employed.

40.11 Each separate assembly of the product shall include, on the assembly, the manufacturer's identification and an identifying type, model, or catalog designation. For example, separate indoor (and outdoor) sections, and a separate control assembly, shall each be marked as indicated.

41. Permanently-Connected Products

41.1 A permanently-connected product shall have the individual loads marked in amperes. The marking shall indicate clearly which loads operate concurrently, unless it is obvious that the total load is the sum of the individual loads.

41.2 Unless correct field-wiring connections are obvious, a wiring diagram shall be attached to each permanently-connected product to show the intended method of making field-wiring connections. A paper sticker glued or shellacked to an accessible cover is considered as conforming with this requirement.

41.3 A product intended for permanent connection to a wiring system other than metal-clad cable or conduit shall be marked to indicate the system or systems for which it is designed. The marking shall be located so that it will be visible when power supply connections to the product are made.

41.4 If a low-voltage device or part of a device is intended to be wired in the field to become only part of (1) a Class 1 circuit or (2) a Class 2 circuit wired as a Class 1 circuit, the terminals of the device or part of the device shall be marked accordingly. A low-voltage switching or power-consuming device or part of a device that is intended to be wired in the field to become part of a Class 2 circuit only shall be marked accordingly; but a low-voltage power-supply device that includes a transformer is not required to be marked to indicate that it is suitable for use in a Class 2 circuit only. A low-voltage device or part of a device that is designed for connection to either a Class 1 or Class 2 circuit is not required to be so marked.

41.5 A product provided with field-wiring terminals shall be marked:

A. "Use Copper Conductors Only" or "Use Copper or Copper-Clad Aluminum Conductors Only" if the product is not intended for field connection with aluminum wire.

B. "Use Copper or Aluminum Conductors" or "Use Copper, Copper-Clad, or Aluminum Conductors" if the product is intended for field connection with either copper or aluminum wire.

In either case, an equivalent appropriate statement may be used in the marking. The marking shall be independent of any marking on the terminal connectors, and shall be visible during and after installation of the product.

41.6 A product not provided with an equipment-grounding terminal or lead shall be marked "If This Unit is Supplied by a Wiring System That, In Accordance With the National Electrical Code, Requires the Installation of an Equipment-Grounding Conductor or Conductors, A Terminal or Terminals for Connection Thereof Must be Installed," or with an equivalent statement. This marking shall be located in the wiring compartment where the power-supply conductors will be connected, and shall give pertinent information, such as where the terminal or terminals should be mounted, how they should be mounted, and the like.

42. Cautionary Markings

42.1 A required cautionary marking shall be prefixed by the word "CAUTION," "WARNING," or "DANGER," and shall be in letters no less than 1/8 inch (3.2 mm) high.

42.2 If the construction of the product necessitates removal of a panel or opening of a cover by a tool for the purpose of servicing by the user and if such disassembly involves the exposure of persons to unintentional contact with any enclosed or protected live part, the product shall be marked "CAUTION" and the following or equivalent statement: "Risk of Electric Shock — Disconnect Power Before Servicing Unit." This may be incorporated with the marking specified in paragraph 7.34.

**Underwriters Laboratories Inc.®**

An independent, not-for-profit organization testing for public safety

October 14, 1992**Revision pages for****STANDARD FOR****LOW LEVEL PATH MARKING AND LIGHTING SYSTEMS****UL 1994, FIRST EDITION**

Attached to this transmittal notice is a revision of the first edition of UL 1994.

A CHANGE ON A PAGE DATED OCTOBER 14, 1992 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT.

The new and revised requirements are in accordance with UL's bulletin on this subject dated June 4, 1992. The bulletin is now obsolete and may be discarded.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	May 23, 1991 (Reprinted: October 14, 1992)
2 — 6	May 23, 1991
7	October 14, 1992
8 — 27	May 23, 1991
28	October 14, 1992
29 — 47	May 23, 1991
48	October 14, 1992
49 — 51	May 23, 1991
52, 52A	October 14, 1992
53 — 55, A1, A2	May 23, 1991

(9)

May 23, 1991
(Title Page Reprinted: October 14, 1992)

1

UL 1994

STANDARD FOR
LOW LEVEL PATH MARKING
AND LIGHTING SYSTEMS

FIRST EDITION

MAY 23, 1991

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

ISBN 1-55989-201-3

COPYRIGHT © 1991, 1992 UNDERWRITERS LABORATORIES INC.

UL's Standards for Safety are copyrighted to protect UL's publication rights, not to restrict their use in product design or evaluation. See paragraph E of the Foreword.

(1 — 05/23/91 — 10/14/92)

TABLE OF CONTENTS

FOREWORD

INTRODUCTION

1. Scope	5
2. General	5
3. Glossary	6
4. Installation and Operating Instructions	6

CONSTRUCTION

5. General	8
6. Accessories	13
7. Enclosures	14
8. Polymeric Materials	23
9. Protection Against Corrosion	25

FIELD WIRING CONNECTIONS

10. General	25
11. Cord-Connected Products	27
12. Permanently-Connected Products	28
13. Grounding	30

INTERNAL WIRING

14. Cord-Connected Products	31
15. Permanently-Connected Products	32
16. Wiring Methods	34
17. Separation of Circuits	35
18. Bonding for Grounding	35

COMPONENTS, ELECTRICAL

19. General	38
20. Capacitors	40
21. Coil Windings	41
22. Electric-Discharge Lighting Systems	41
23. Fuseholders	42
24. Lampholders and Lamps	42
25. Overcurrent Protection	43
26. Switches and Controllers	43
27. Transformers	43

SPACINGS

28. General	44
29. High-Voltage Circuits	44
30. Low-Voltage, Power-Limited Circuits	46
31. Barriers	46

4.4 The instructions shall include such directions and information as deemed by the organization responsible for the product to be necessary to cover the intended installation, maintenance, operation, and use of the product or component.

4.5 Installation and operating instructions provided with each self-illuminating marking system shall include, but not be limited to, the following:

A. Specific details on the proper surface preparation and application methods.

B. Mounting instructions for laminates, if any.

C. Information on the appropriate surface to which the materials may be applied.

D. Guidelines for designing and installing the path marking system.

E. Information on maintenance inspection procedures.

F. Complete details of the installation and application conditions including, but not limited to, the following: (1) the minimum amount of ambient illumination necessary for the self-illuminating system to function as intended, (2) an instruction that the control of the ambient illumination be restricted to authorized personnel, and (3) a warning against the use of the system where the ambient illumination level is less than the minimum specified value.

G. Reference to applicable local and national installation codes as appropriate, such as the Life Safety Code, NFPA 101; the California State Building Code; and the like.

Paragraph 4.5 revised June 4, 1992

4.6 Installation and operating instructions provided with each externally powered system shall include, but not be limited to, the following:

A. Reference to applicable local and national installation codes as appropriate, such as NFPA 70, NFPA 101, California State Building Code, and the like.

B. Indication that the system circuitry shall be installed in an emergency power circuit, or be provided with an emergency supply of power.

C. Mounting instructions for system components.

D. Guidelines for installing the path marking system.

Safety Instructions

4.7 The safety instructions shall be a permanent part of the manual but separated in format and preceding all other instructions (such as installation, operation, and maintenance instructions).

4.8 The safety instructions shall include instructions or illustrations to identify important safety features, in addition to the important safeguards given in paragraph 4.12.

4.9 The height of lettering in the text and illustrations of the safety instructions shall be as follows:

A. The phrases "IMPORTANT SAFEGUARDS," "READ AND FOLLOW ALL SAFETY INSTRUCTIONS," and "SAVE THESE INSTRUCTIONS" shall be in letters at least 3/16 inch (4.8 mm) in height.

B. Other upper case letters shall be at least 0.083 inch (2.1 mm) in height.

C. Lower case letters shall be at least 1/16 inch (1.6 mm) in height.

4.10 The items may be numbered. The phrases "READ AND FOLLOW ALL SAFETY INSTRUCTIONS" and "SAVE THESE INSTRUCTIONS" shall be first and last, respectively, in a list of items. Other important safeguard items considered appropriate by the manufacturer may be inserted.

4.11 For all equipment, the safety instructions shall include the following safeguards or the equivalent.

Exception: If a specific safeguard does not apply to a particular type of equipment, the safeguard may be modified or deleted as appropriate.

“IMPORTANT SAFEGUARDS

When using electrical equipment, basic safety precautions should always be followed including the following:

1. READ AND FOLLOW ALL SAFETY INSTRUCTIONS.
2. Do not use outdoors (this item may be omitted if the product is suitable for outdoor use.)
3. Do not let power supply cords touch hot surfaces.
4. Do not mount near gas or electric heaters.
5. Use caution when servicing batteries. Battery acid can cause burns to skin and eyes. If acid is spilled on skin or in eyes, flush acid with fresh water and contact a physician immediately.
6. The use of accessory equipment not recommended by the manufacturer may cause an unsafe condition.
7. Do not use this equipment for other than intended use.

SAVE THESE INSTRUCTIONS”

Other Instructions

4.12 The instruction manual shall include instructions for installation, operation, and maintenance recommended by the manufacturer. The instructions shall warn the user that all servicing should be performed by qualified service personnel.

CONSTRUCTION

5. General

Assembly

5.1 Electrical components of externally powered systems, including wiring, raceways, and enclosures, shall be constructed for installation in accordance with the applicable requirements as appropriate for Class 1, 2, and 3 circuits as defined in the National Electrical Code, NFPA 70-1990. Temporary removal or relocation of factory wiring shall not be required to accomplish field wiring.

5.2 Physical components of self-illuminated systems shall be constructed for proper installation in accordance with the manufacturer's installation instructions. Components may include bulk quantities of self-illuminating materials and may also be provided with imprinted directional or exit markers.

Product Assembly

5.3 Electrically powered equipment shall be a complete assembly and shall include all the essential components necessary for its intended function when used or installed as intended. The product may be shipped from the factory as two or more major subassemblies. See paragraph 5.4.

5.4 A product that is not assembled by the manufacturer as a complete unit shall be arranged in major subassemblies. Each subassembly shall be capable of being incorporated into a final assembly when installed in accordance with the installation instructions.

Mechanical Protection

5.5 Louvers and other openings in the ultimate enclosure shall be constructed and located to reduce the risk of unintentional contact with hot surfaces or with moving parts that may cause a risk of injury to persons. Also, see paragraph 5.10. In determining compliance with this requirement, parts such as covers, panels, or grilles used as part of the enclosure are to be removed unless tools are required for their removal.

10.7 For wire-bending space measurement, the lug or connector is to be at the smallest angle it can assume to the perpendicular of the wall the box is mounted to without defeating any means provided to prevent its turning (such as a boss, shoulder, walls of a recess, multiple bolts securing the connector, and the like). However, it is assumed that the connector is not so oriented that the wire will be directed into a corner of the box to such an extent that the wall situated across from the box wall would necessitate additional bending of the wire. If a terminal is provided with one or more lugs or connectors for the connection of conductors in multiple, the distance is to be measured from the wire opening closest to the wall of the enclosure. If the connectors for a circuit are fixed in position (for example, by the walls of a recess) so that they are turned toward each other, the distance is to be measured at the wire opening nearest to the wall in a direction perpendicular to the wall. A barrier, shoulder, or the like is to be disregarded when the measurement is being made if it does not reduce the radius to which the wire must be bent otherwise.

10.8 A wiring space in which knockouts are provided shall be of such a width to accommodate (with respect to bending) conductors of the maximum size likely to be used at that knockout.

Exception: The wiring space may be of lesser width if:

A. Knockouts of required size are provided elsewhere in the equipment,

B. The wiring space at such other point or points is sufficiently wide to accommodate the conductors in question, and

C. The knockout or knockouts at such other points can be conveniently used in the intended wiring of the device. The values of the minimum acceptable width of a wiring space, with respect to conductors entering the knockout, are the same as the values of minimum bending space given in Table 10.1.

11. Cord-Connected Products

11.1 A product intended for cord connection to the power supply shall be provided with a flexible cord and attachment plug of the type, voltage rating, and ampacity consistent with the rating and intended application of the product.

11.2 The marked rating of the attachment plug of a cord-connected product shall not be less than 125 percent of the rating of the product.

11.3 A cord-connected product shall employ grounding-type attachment plugs that conform to the American National Standards designated in the following Table 11.1.

TABLE 11.1
ATTACHMENT PLUGS

Nameplate Rating			Attachment Plug	
Volts	Phase	Amperes ^a	Rating	ANSI Designation ^b
110–120	1	12.0	15 amperes, 125 volts	5-15P
110–120	1	16.0	20 amperes, 125 volts	5-20P
200–240	1	12.0	15 amperes, 250 volts	6-15P
200–240	1	16.0	20 amperes, 250 volts	6-20P
110–120/200–240	1	12.0	15 amperes, 125/250 volts	14-15P
110–120/200–240	1	16.0	20 amperes, 125/250 volts	14-20P

^aAmpere rating is maximum permitted to be marked on the product nameplate for attachment plug indicated.

^bStandard for Wiring Devices — Dimensional Requirements, ANSI/NEMA WD6-1988.