

UL 2388

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Flexible Lighting Products



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Future Effective Date	References
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The revised effective date is in accordance with UL’s Bulletin(s) on this subject dated August 19, 2002. The bulletin(s) is now obsolete and may be discarded.

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This Standard consists of pages dated as shown in the following checklist:

Page	Date
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5-6 .....	July 3, 2002
7-34 .....	September 27, 2002
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**JULY 3, 2002**

**1**

**UL 2388**

**Standard for Flexible Lighting Products**

**First Edition**

**July 3, 2002**

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 set of revised requirements.

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## 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 that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire or of electric shock or injury to persons shall be evaluated using appropriate additional component and end-product requirements to maintain the level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard does not comply with this standard. Revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this 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 This standard covers portable flexible lighting products with a maximum input voltage rating of 120 volts to be used in accordance with the National Electrical Code, ANSI/NFPA 70. These products are provided with a power supply cord and are intended for outline and decorative lighting use.

Effective date for 1.1 changed from July 3, 2003 to November 1, 2003

1.2 These requirements cover lighting products incorporating non-replaceable series and series/parallel connected lamps enclosed within a flexible polymeric tube or extrusion.

Effective date for 1.2 changed from July 3, 2003 to November 1, 2003

1.3 These requirements also cover flexible lighting products used in light sculptures.

Effective date for 1.3 changed from July 3, 2003 to November 1, 2003

1.4 These requirements do not cover lighting products with replaceable lamps.

Effective date for 1.4 changed from July 3, 2003 to November 1, 2003

1.5 These requirements do not cover lighting products covered by UL 588, Seasonal and Holiday Decorative Products.

Effective date for 1.5 changed from July 3, 2003 to November 1, 2003

### 2 Components

2.1 Except as indicated in 2.2, a component of a products covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components used in the products covered by this standard.

Effective date for 2.1 changed from July 3, 2003 to November 1, 2003

2.2 A component is not required to comply with a specific requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or
- b) Is superseded by a requirement in this standard.

Effective date for 2.2 changed from July 3, 2003 to November 1, 2003

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

Effective date for 2.3 changed from July 3, 2003 to November 1, 2003

2.4 Specific components are 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.

Effective date for 2.4 changed from July 3, 2003 to November 1, 2003

### 3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

Effective date for 3.1 changed from July 3, 2003 to November 1, 2003

### 4 Undated References

4.1 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.

Effective date for 4.1 changed from July 3, 2003 to November 1, 2003

### 5 Glossary

5.1 For the purpose of this standard, the following definitions apply.

Effective date for 5.1 changed from July 3, 2003 to November 1, 2003

5.2 EXTENSION SEGMENT – A flexible lighting product intended to be connected to a connector of another flexible lighting product and not provided with a means to independently connect to a 120 V supply circuit.

Effective date for 5.2 changed from July 3, 2003 to November 1, 2003

5.3 INTERNAL LAMP SHUNT – A device that provides a current path when the filament of a lamp opens so that the remaining lamps in a series-connected string remain illuminated.

Effective date for 5.3 changed from July 3, 2003 to November 1, 2003

5.4 LIGHT SCULPTURE – A polymeric or metallic rigid frame to which a flexible light is attached. The flexible light provides outline illumination of the figure or object created by the frame.

Effective date for 5.4 changed from July 3, 2003 to November 1, 2003

5.5 NON-EXTENDABLE FLEXIBLE LIGHT – A flexible light product that is not provided with any means to add an extension segment.

Effective date for 5.5 changed from July 3, 2003 to November 1, 2003

## CONSTRUCTION

### 6 Assembly and Packaging

6.1 A flexible lighting product shall be completely wired with each electrical component mounted in place and with each splice and connection completed.

Effective date for 6.1 changed from July 3, 2003 to November 1, 2003

6.2 Detachable power-supply cords and extension segments that comply with Section 17, Interconnecting Means, need not be connected.

Effective date for 6.2 changed from July 3, 2003 to November 1, 2003

6.3 The package for a flexible lighting product designed to be connected to its source of supply by means of a detachable power-supply cord shall include the detachable power-supply cord.

Effective date for 6.3 changed from July 3, 2003 to November 1, 2003

## 7 Enclosures

7.1 The enclosure shall withstand the abuses that it is subjected to without total or partial collapse of the enclosure, reduction of spacing, loosening or displacement of parts, or other defects that increase the risk of fire, electric shock, or injury to persons.

Effective date for 7.1 changed from July 3, 2003 to November 1, 2003

7.2 A polymeric material used to enclose or provide structural support for electrical current carrying parts shall:

- a) Have a minimum flammability rating of V-1; and
- b) Have a minimum HWI (hot-wire resistance to ignition) Performance Level Category (PLC) of 3, a minimum HAI (high-current arc resistance to ignition) PLC of 2, and a minimum CTI PLC of 4, if marked for indoor use, or a minimum PLC of 3, if marked for outdoor use.

Effective date for 7.2 changed from July 3, 2003 to November 1, 2003

7.3 The polymeric tube or extrusion section of the flexible light enclosure that is used to enclose the lamps shall comply with the:

- a) Crush Test, Section 27;
- b) Ball Impact Test, Section 28;
- c) Flexing Test, Section 29; and
- d) Oven Conditioning Test, Section 30.

Effective date for 7.3 changed from July 3, 2003 to November 1, 2003

7.4 There shall be a minimum of 3/64 inch (1.2 mm) of insulating material between uninsulated current carrying parts of the series or series/parallel light string and the outer surface of the enclosure.

Effective date for 7.4 changed from July 3, 2003 to November 1, 2003

7.5 A polymeric enclosure for a controller or other accessory used with a flexible light shall comply with the:

- a) Crush Test, Section 27;
- b) Ball Impact Test, Section 28; and
- c) Oven Conditioning Test, Section 30.

Effective date for 7.5 changed from July 3, 2003 to November 1, 2003

7.6 The flammability rating specified in 7.2(a) is to be determined by the applicable tests in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

Effective date for 7.6 changed from July 3, 2003 to November 1, 2003

7.7 As an alternative to 7.2(a), the polymeric material is able to comply with the 3/4 inch or 12 mm flame test of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. At the conclusion of the test there shall not be openings large enough to enable a 1/4 inch (6.4 mm) diameter rod to penetrate the enclosure and there shall not be ignition of the cotton indicator. The indicator is to be absorbent, 100 percent cotton thinned to approximately 2 by 2 inches (50 by 50 mm) and a maximum thickness of 0.24 inches (6 mm). The cotton is to be placed horizontally 11.8 ±0.39 inches (300 ±10 mm) below the component material.

Effective date for 7.7 changed from July 3, 2003 to November 1, 2003

7.8 With regard to consideration of thermal endurance in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, the material shall possess a mechanical temperature index, with impact, as a result of long term aging or a generic temperature index of at least the measured temperature in the Normal Temperature Test, Section 23.

Effective date for 7.8 changed from July 3, 2003 to November 1, 2003

7.9 The temperature index specified in 7.8 shall include temperatures measured on polymeric materials closest to or in direct contact with any lamp.

Effective date for 7.9 changed from July 3, 2003 to November 1, 2003

7.10 An enclosure formed of polymeric material and marked for outdoor use in accordance with Section 41, Outdoor Use Markings, shall comply with:

- a) The UV resistance and water exposure requirements from the Standard for Polymeric Materials – Use in Electrical Equipment, UL 746C;
- b) The Rain Test, Section 35; and
- c) For an enclosure of a flexible light, the Cold Bend Test, Section 31.

Effective date for 7.10 changed from July 3, 2003 to November 1, 2003

7.11 As an alternative to 7.10(a), polymeric material employed as an enclosure of a flexible lighting product marked for outdoor use is able to be subjected to the Ultraviolet (UV) Light Exposure and Water Immersion Tests of the Standard for Seasonal and Holiday Decorative Products, UL 588, except that after conditioning, the samples are to be subjected to the flammability rating evaluation of 7.6 or 7.7 as applicable, the Crush Test, Section 27 and the Ball Impact Test, Section 28. The end-product test force and impact values shall be reduced by 30 percent after the UV light exposure test, and reduced by 50 percent after the water immersion test. At the conclusion of the conditioning and end-product tests, the flammability rating shall not be reduced and the samples shall comply with the requirements of 27.2 and 28.5. The ball impact test is only applicable to a controller or other accessory used with a flexible light.

Effective date for 7.11 changed from July 3, 2003 to November 1, 2003

7.12 If a flexible light enclosure consists of multiple layers of polymeric materials, all layers shall comply with 7.2 and only the outermost layer needs to comply with the UV resistance and water exposure requirements of 7.10(a), providing that the outermost layer complies with the minimum thickness of 7.4.

Effective date for 7.12 changed from July 3, 2003 to November 1, 2003

## 8 Polymeric Decorative Parts

8.1 A polymeric material used as a purely decorative part that is near any component that generates heat shall:

- a) Be installed on the unit when it is temperature tested;
- b) Have a minimum flammability rating of HB; and
- c) Not melt or deform in any way that interferes with the normal operation of the flexible lighting product or causes a risk of fire or electric shock during the Normal Temperature Test, Section 23.

Effective date for 8.1 changed from July 3, 2003 to November 1, 2003

## 9 Light Sculptures

9.1 The frame of a light sculpture shall be:

- a) Metal that is free of sharp edges or burrs that are able to cut or abrade conductors or the insulation; or
- b) A polymeric material that complies with the Oven Conditioning Test, Section 30, such that stress is not placed on electrical connections or wire as a result of the test.

*Exception: A light sculpture supplied by a Class 2 circuit is not required to comply with 9.1.*

Effective date for 9.1 changed from July 3, 2003 to November 1, 2003

9.2 If the light sculpture folds, such as for storage, it shall have sufficient free length of wire to avoid pinching, cutting, or abrading of the conductors or insulation.

Effective date for 9.2 changed from July 3, 2003 to November 1, 2003

## 10 Accessibility of Current Carrying Parts

10.1 An uninsulated current carrying part involving a risk of shock shall be enclosed so that it is not accessible to unintentional contact by persons during normal use.

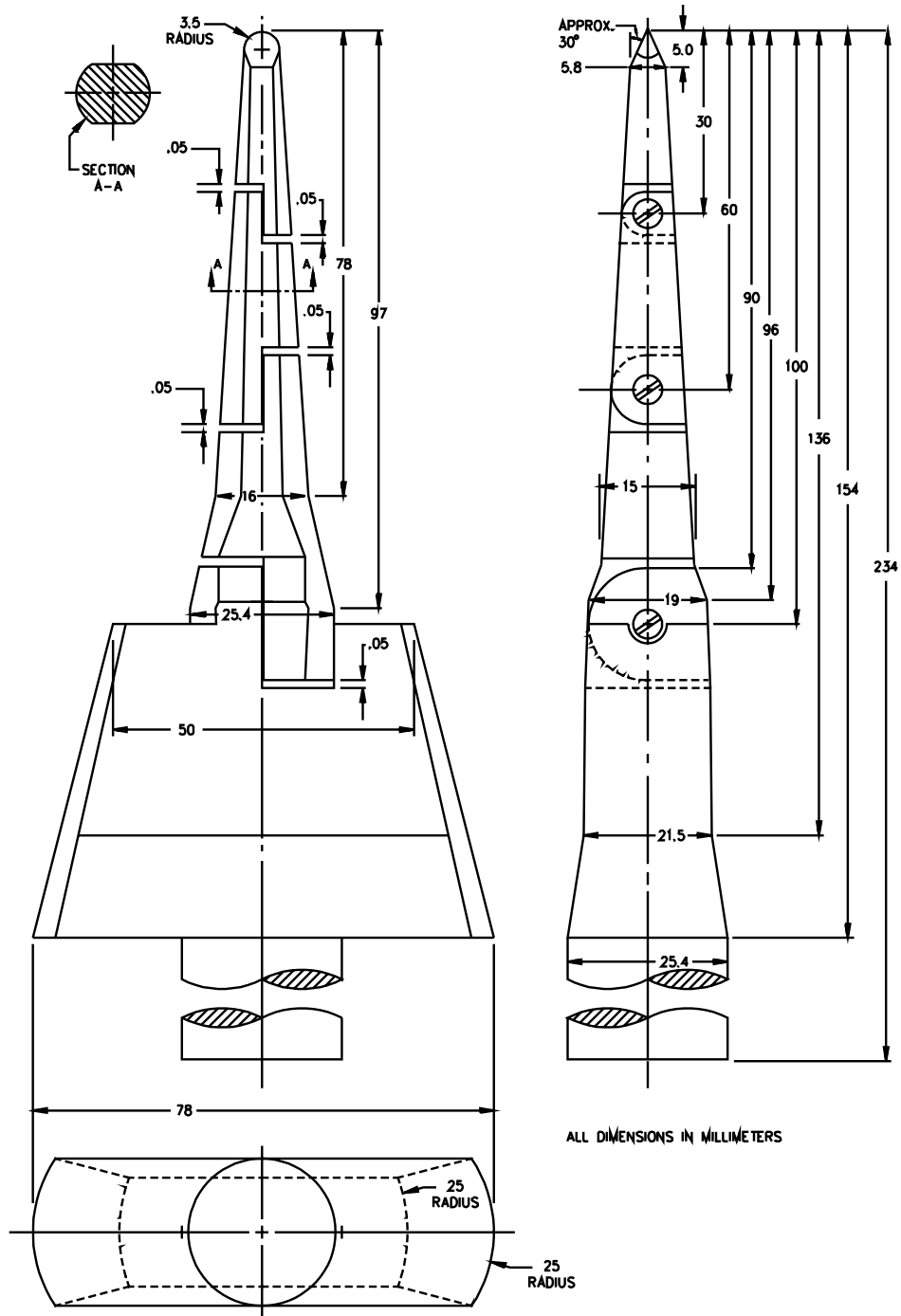
Effective date for 10.1 changed from July 3, 2003 to November 1, 2003

10.2 A current carrying part is considered inaccessible when the UL articulated accessibility probe, shown in Figure 10.1, is unable to be manipulated to touch it. The probe shall be applied to any depth that the opening will permit; and shall be rotated or angled, before, during, and after insertion through the opening, to any position that is necessary to try and contact the current carrying part.

Effective date for 10.2 changed from July 3, 2003 to November 1, 2003

**Figure 10.1**  
**Articulate probe with web stop**

Effective date for Figure 10.1 changed from July 3, 2003 to November 1, 2003



PA100A



10.3 An end cap provided to prevent contact with uninsulated current carrying parts shall be secured in place and comply with the End Cap Pull Test, Section 34.

Effective date for 10.3 changed from July 3, 2003 to November 1, 2003

## 11 Insulating Materials

11.1 A polymeric material used as an electrical insulator, or as direct or indirect support of a current carrying part, shall comply with the requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Effective date for 11.1 changed from July 3, 2003 to November 1, 2003

## 12 Electrical Spacing

12.1 Except as noted in 12.2, the electrical spacing between uninsulated current carrying parts of opposite polarity, and between uninsulated current carrying parts and accessible metal that is capable of being grounded shall be minimum 1/16 inch (1.6 mm) through air or over surface.

Effective date for 12.1 changed from July 3, 2003 to November 1, 2003

12.2 The electrical spacing between uninsulated current carrying parts of opposite polarity in the series lamp circuit shall be minimum 1/32 inch (0.8 mm) through air or over surface.

Effective date for 12.2 changed from July 3, 2003 to November 1, 2003

12.3 Film-coated wire is considered to be a current carrying part in determining compliance of a product with the spacing requirements.

Effective date for 12.3 changed from July 3, 2003 to November 1, 2003

## 13 Lamps

13.1 Lamps used in flexible lighting products shall not be user replaceable or provided with an internal shunt device.

Effective date for 13.1 changed from July 3, 2003 to November 1, 2003

## 14 Conductors

14.1 All conductors shall be copper or copper alloy.

Effective date for 14.1 changed from July 3, 2003 to November 1, 2003

14.2 All conductors, other than integral lamp leads and series connection type, shall be 18 AWG minimum, and stranded.

Effective date for 14.2 changed from July 3, 2003 to November 1, 2003

14.3 The maximum normal current for internal conductors, flexible cord, and interconnecting cord shall not exceed the value specified in Table 14.1.

Effective date for 14.3 changed from July 3, 2003 to November 1, 2003

**Table 14.1**  
**Maximum normal current for internal conductors, flexible cord, and interconnecting cord**

Effective date for Table 14.1 changed from July 3, 2003 to November 1, 2003

Wire gauge, AWG (mm <sup>2</sup> )	Maximum normal current, Amp
18 (0.82)	8
16 (1.3)	10
14 (2.1)	12
12 (3.3)	16

## 15 Splices and Connections

15.1 A splice shall be mechanically and electrically secure.

Effective date for 15.1 changed from July 3, 2003 to November 1, 2003

15.2 Field connections shall be limited to detachable power supply cords and interconnection of extension segments.

Effective date for 15.2 changed from July 3, 2003 to November 1, 2003

15.3 The field connections in 15.2 shall not permit accessibility to uninsulated current carrying parts during installation. For example, the supply side end shall have a female configuration and the mating load side shall have a male configuration.

Effective date for 15.3 changed from July 3, 2003 to November 1, 2003

## 16 Attachment Plugs

16.1 An attachment plug shall be:

- a) Standard NEMA type 1-15 (15 A, 120 V) or 1-20 (20 A, 120 V) configuration;
- b) Fused; and
- c) Polarized.

Effective date for 16.1 changed from July 3, 2003 to November 1, 2003

16.2 Attachment plugs shall comply with the applicable requirements of the Standard for Attachment Plugs and Receptacles, UL 498 or the Standard for Cord Sets and Power Supply Cords, UL 817.

Effective date for 16.2 changed from July 3, 2003 to November 1, 2003

16.3 A flexible lighting product that is non-extendable is not required to comply with 16.1 (b) and (c).

Effective date for 16.3 changed from July 3, 2003 to November 1, 2003

## 17 Interconnecting Means

17.1 Connectors shall comply with the applicable requirements of the Standard for Attachment Plugs and Receptacles, UL 498 or the Standard for Cord Sets and Power Supply Cords, UL 817 or the Standard for Seasonal and Holiday Decorative Products, UL 588, and shall be suitable for making and breaking under load.

Effective date for 17.1 changed from July 3, 2003 to November 1, 2003

17.2 Crimp connections made between internal wiring and a connector shall comply with the Crimp Connection Secureness Test, Section 33.

Effective date for 17.2 changed from July 3, 2003 to November 1, 2003

17.3 The interconnecting means shall consist of connector parts where the means of maintaining polarity, strain relief, and maintaining electrical connections are inherent in the construction of the interconnecting parts.

Effective date for 17.3 changed from July 3, 2003 to November 1, 2003

17.4 An interconnecting means shall not require any assembly by the user other than the connection of mating male and female connectors.

Effective date for 17.4 changed from July 3, 2003 to November 1, 2003

## 18 Switches, Fuses, and Controllers

18.1 A switch or controller shall have a voltage and current rating suitable for the maximum load it controls.

Effective date for 18.1 changed from July 3, 2003 to November 1, 2003

18.2 A controller shall comply with the Standard for Industrial Control Equipment, UL 508, or the Standard for Seasonal and Holiday Decorative Products, UL 588.

Effective date for 18.2 changed from July 3, 2003 to November 1, 2003

18.3 A flexible lighting product is not required to be provided with a switch or controller.

Effective date for 18.3 changed from July 3, 2003 to November 1, 2003

18.4 A switch, fuse or other protective device shall be connected to the ungrounded supply conductor.

Effective date for 18.4 changed from July 3, 2003 to November 1, 2003

18.5 The current rating of the fuse employed shall not exceed the lesser of the following values:

a) The normal current rating as shown in Table 14.1 for the internal conductors, power supply cords, or interconnecting cords; or

b) 120 percent of the current rating of any connector switch, plug, or a controller that relies on the fuse for overcurrent protection.

Effective date for 18.5 changed from July 3, 2003 to November 1, 2003

18.6 Fuses required for compliance with 18.5 shall be replaceable. The assembly or packaging shall include minimum of one spare fuse for each rating.

Effective date for 18.6 changed from July 3, 2003 to November 1, 2003

18.7 A flexible lighting product that is non-extendable is not required to be provided with a fuse.

Effective date for 18.7 changed from July 3, 2003 to November 1, 2003

## 19 Power Supply Cord and Interconnecting Cords

19.1 A power-supply cord and any interconnecting cord shall be:

- a) Not smaller than 18 AWG (0.82 mm<sup>2</sup>);
- b) At least equal to SPT-2;
- c) Rated VW-1; and
- d) The maximum normal current shall not exceed the value specified in Table 14.1.

Effective date for 19.1 changed from July 3, 2003 to November 1, 2003

19.2 Products marked for outdoor use shall have a jacketed power supply cord at least equal to SJT (junior hard service cord type) with a "W" suffix.

Effective date for 19.2 changed from July 3, 2003 to November 1, 2003

## 20 Strain Relief

20.1 Strain relief shall be provided for all power-supply cord and interconnecting cord terminations. The strain relief shall comply with the Strain Relief Test, Section 32.

Effective date for 20.1 changed from July 3, 2003 to November 1, 2003

## 21 Mounting Means

21.1 A flexible lighting product shall be provided with a means for mounting.

Effective date for 21.1 changed from July 3, 2003 to November 1, 2003

21.2 The mounting means shall not pinch or otherwise damage the insulation of the flexible light.

Effective date for 21.2 changed from July 3, 2003 to November 1, 2003

21.3 The mounting means shall be designed to prohibit permanently securing the flexible lighting to a building, permanent fixtures, or other similar structures. This does not preclude the provision of clips or separable mounting brackets, that are designed to be permanently attached to a building structure.

Effective date for 21.3 changed from July 3, 2003 to November 1, 2003

21.4 A flexible lighting product shall not require tools to remove it from the mounting clips or brackets.

Effective date for 21.4 changed from July 3, 2003 to November 1, 2003

**PERFORMANCE**

**22 Input Test**

22.1 The input current to the flexible light shall not exceed the marked rating by more than 10 percent when connected to a 120 V, 60 Hz source of supply.

Effective date for 22.1 changed from July 3, 2003 to November 1, 2003

22.2 The maximum number of extension segments or flexible light lengths permitted by the installation instructions shall be connected to the flexible light during this test.

Effective date for 22.2 changed from July 3, 2003 to November 1, 2003

**23 Normal Temperature Test**

23.1 The temperature rises measured on the flexible light, when mounted as described in 23.3 and connected to a 120 V, 60 Hz source of supply, shall not exceed the values specified in Table 23.1. There shall be no melting, deformation, or discoloration of any polymeric materials involving a risk of fire or shock.

Effective date for 23.1 changed from July 3, 2003 to November 1, 2003

**Table 23.1**  
**Maximum acceptable temperature rises**

Effective date for Table 23.1 changed from July 3, 2003 to November 1, 2003

Materials and component parts of the unit	Temperature rises	
	°C	°F
1. Polymeric enclosure	a	a
2. External surfaces that can be contacted by persons or may come in contact with combustible material during normal use	65	117
3. Supporting surfaces	65	117
4. Insulating materials		
a) Polymeric	a	a
b) Fiber	65	117
c) Wood and similar material	65	117
d) Phenolic composition <sup>b</sup>	125	225
5. Gasketing materials for outdoor use		
a) Polymeric	a	a
b) Neoprene rubber	65	117
c) Ordinary rubber	45	81
d) Silicone rubber	205	401
e) Fiber	65	117
6. Softening point of any sealing compound	c	c
7. Fuses	65 <sup>b</sup>	117 <sup>b</sup>
8. Insulated conductors	35 <sup>b</sup>	63 <sup>b</sup>
9. Flexible cords	35 <sup>b</sup>	63 <sup>b</sup>
<sup>a</sup> The maximum temperature of a polymeric material, when corrected to 77°F (25°C) ambient temperature, shall not exceed the temperature index. <sup>b</sup> Does not apply if investigated and accepted for a higher temperature. <sup>c</sup> The maximum sealing compound temperature, when corrected to 77°F (25°C) ambient temperature, is 27°F (15°C) less than the softening point of the compound as determined by the Standard Test Method For Softening Point By Ring-And-Ball Apparatus, ASTM E 28.		

23.2 Tests are to be conducted at an ambient temperature of  $77 \pm 9^{\circ}\text{F}$  ( $25 \pm 5^{\circ}\text{C}$ ).

Effective date for 23.2 changed from July 3, 2003 to November 1, 2003

23.3 A representative section of the flexible light shall be mounted and tested for each of the following installations:

Method A – Ceiling Mount – The flexible light shall be mounted on an insulated test ceiling in accordance with Standard for Luminaires, UL 1598, and arranged so that there are 10 parallel lengths, with a 0.2 inch (5 mm) spacing between lengths.

Method B – Alcove Mounting – The flexible light shall be mounted horizontally along the top of a U-shaped plywood alcove that is open at the bottom, with side walls 1/2 inch (12.7 mm) from the edge of the flexible light.

Method C – Mounting On Pole – The flexible light shall be tightly coiled around a  $6 \pm 0.25$  inch ( $152 \pm 6.35$  mm) diameter wooden pole to form a single layer of adjacent turns.

Effective date for 23.3 changed from July 3, 2003 to November 1, 2003

23.4 An extendible flexible lighting unit shall be provided with a suitable load to represent the total maximum length specified by the manufacturer.

Effective date for 23.4 changed from July 3, 2003 to November 1, 2003

23.5 Temperature measurements are to be made with 30 AWG iron Constantan thermocouple wires and an appropriate measurement instrument. The unit is to be operated until constant temperatures are obtained, where constant temperatures are indicated by the test running for at least 3 hours and where three successive readings at thirty minute intervals are within  $1.8^{\circ}\text{F}$  ( $1^{\circ}\text{C}$ ) of one another and not still rising.

Effective date for 23.5 changed from July 3, 2003 to November 1, 2003

23.6 Temperature measurements of the flexible light housing shall be made by thermocouples in contact with the inner surface of the tube as close as possible to a light (heat) source. This may be accomplished by slitting or drilling through the enclosure to an appropriate depth, taking care not to otherwise damage the sample or create additional openings that would permit heat dissipation not representative of an otherwise intact specimen.

Effective date for 23.6 changed from July 3, 2003 to November 1, 2003

## 24 Abnormal Operation Test

24.1 The flexible light of maximum rated length shall be tightly coiled around a 6 inch (152.4 mm) diameter mandrel, with the cross sectional dimensions of the resulting stack of turns approximately equal in height and width. Four pieces of string, distributed equidistantly around the coil at 90 degree increments, are to be used to secure the coil in this configuration. The mandrel shall then be removed, and the sample placed on a tissue paper covered soft wood board and then in turn covered with a single layer of tissue paper.

Effective date for 24.1 changed from July 3, 2003 to November 1, 2003

24.2 The sample shall be connected to a 120 volt, 60 Hz source of supply, protected by a 20A slow blow fuse, and operated until constant temperatures are obtained, but not less than 7.5 hours.

Effective date for 24.2 changed from July 3, 2003 to November 1, 2003

24.3 The results are acceptable if there is no glowing, flaming or charring of the tissue paper nor any melting, charring, cracking or deformation of the polymeric materials that allows accessibility to current carrying parts as determined by applying the accessibility probe as described in 10.2. Opening of the line fuse or the attachment plug fuse is an acceptable result.

Effective date for 24.3 changed from July 3, 2003 to November 1, 2003

## 25 Insulation Resistance Test

25.1 The insulation resistance of a flexible light shall not be less than 100 megohms when measured between:

- a) Current carrying parts and dead metal parts that are exposed to contact by persons or that may be grounded in service; and
- b) Current carrying parts and any external surface of the light enclosure and cords.

Effective date for 25.1 changed from July 3, 2003 to November 1, 2003

25.2 The insulation resistance is to be measured by a magneto megohmmeter that has an open-circuit output of 500 volts, or by equivalent equipment.

Effective date for 25.2 changed from July 3, 2003 to November 1, 2003

25.3 When measuring insulation resistance between current carrying parts and the surface of a flexible light enclosure, an 18 inch (45.7 cm) minimum section of the flexible light is to be completely immersed in stainless steel ball bearings with an approximate diameter of 0.10 inch (2.5 mm). The shot is to be connected to one terminal of the insulation resistance measurement equipment, and the current carrying parts of the flexible light are to be connected to the other terminal of the equipment.

Effective date for 25.3 changed from July 3, 2003 to November 1, 2003

25.4 A flexible light intended for outdoor use shall additionally be tested by immersing the flexible light for a period of 24 hours in a salt solution consisting of 8 grams of NaCl per liter of distilled water prior to conducting the insulation resistance test. A metal tub shall be used as a container for the salt solution, and serve as the external electrode for the insulation resistance measurement equipment test terminal. The flexible light shall be positioned in the solution so that no part of a separable connector is immersed in the solution.

Effective date for 25.4 changed from July 3, 2003 to November 1, 2003

## 26 Dielectric Voltage Withstand Test

26.1 The flexible light shall be capable of withstanding without breakdown for a period of 1 minute, the application of a 60 Hz potential of 1250 volts between:

- a) Current carrying parts of opposite polarity of detachable power-supply cords and interconnecting cords; and
- b) Current carrying parts and any surface of insulating material that is exposed to contact by persons or that may be in contact with ground in service.

Effective date for 26.1 changed from July 3, 2003 to November 1, 2003

26.2 For the test in 26.1(b), the potential is to be applied between the input leads connected together and a sample of the flexible light sample and foil wrapped tightly around the light enclosure, all connectors and the outer surface of all cords. The length of the foil should be sufficient to wrap a complete section of the series light string, at least one connector for an extension segment, and the connector and outer surface of the power-supply cord.

Effective date for 26.2 changed from July 3, 2003 to November 1, 2003

26.3 A flexible light marked for outdoor use shall additionally be tested following immersing the unit for a period of 24 hours in a salt solution, as described in 25.4.

Effective date for 26.3 changed from July 3, 2003 to November 1, 2003

26.4 The test potential is to be supplied from a 500 VA or larger capacity testing transformer whose output potential is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test voltage is reached, and held at that voltage for 1 minute. The increase in the applied potential is to be at a substantially uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

Effective date for 26.4 changed from July 3, 2003 to November 1, 2003

## 27 Crush Test

27.1 One sample of the flexible light, including connectors, is to be plugged into a 120 volt supply and stretched out flat on a hardwood surface to form a straight line and operated for a minimum of 1 hour. A piece of 1/2 inch (50.8 mm) thick plywood measuring 3 by 3 inch (76.2 by 76.2 mm) is placed on top of a representative section of the flexible light enclosure along its longitudinal and a load of 200 pound (90.9 kg) is to be gradually applied to the top of the plywood and allowed to remain in this condition for a period of one minute. The test may be repeated along the length of the flexible light to ensure that all representative sections, including connectors and end caps, are tested.

Effective date for 27.1 changed from July 3, 2003 to November 1, 2003

27.2 There shall be no:

- a) Accessibility of uninsulated current carrying parts as determined by applying the accessibility probe specified in 10.2;
- b) Reduction of spacing to values below minimum acceptable values specified in 12.1;
- c) Reduction in the effectiveness of strain relief as determined by conducting the Strain Relief Test, Section 32;



d) Dielectric breakdown as determined by conducting the Dielectric Voltage Withstand Test, Section 26; or

e) Cracking or other damage to an outdoor flexible light enclosure that allows water to contact current carrying parts not inherently corrosion resistant, as determined by conducting the Rain Test, Section 35.

Effective date for 27.2 changed from July 3, 2003 to November 1, 2003

## 28 Ball Impact Test

28.1 Three samples of the polymeric enclosures for a controller or other accessory used with flexible lights are to be tested. Each is to be subjected to a single impact. Each of the impacts is to be made in a different location on the sample.

Effective date for 28.1 changed from July 3, 2003 to November 1, 2003

28.2 For products that are marked for use in outdoor locations, the samples are to be cooled to a temperature of  $-31 \pm 2^{\circ}\text{F}$  ( $-35 \pm 1.1^{\circ}\text{C}$ ) and maintained at that temperature for 3 hours, prior to conducting the ball impact tests. The impact is to be applied to the samples within 1 minute upon removal from the cooling chamber.

Effective date for 28.2 changed from July 3, 2003 to November 1, 2003

28.3 A product that is marked for indoor use only is to be tested at room temperature,  $77 \pm 9^{\circ}\text{F}$  ( $25 \pm 5^{\circ}\text{C}$ ).

Effective date for 28.3 changed from July 3, 2003 to November 1, 2003

28.4 Each sample is to be placed on a concrete surface in the positions most likely to produce adverse results. The impact force is obtained using a solid smooth steel sphere 2 inches (50.8 mm) in diameter and weighing 1.18 pounds (0.53 kg). The sphere is to be allowed to fall freely from rest through the distance required to strike the test sample with an energy of 5 foot-pounds (6.78 N-m).

Effective date for 28.4 changed from July 3, 2003 to November 1, 2003

28.5 There shall be no:

a) Accessibility of uninsulated current carrying parts as determined by applying the accessibility probe specified in 10.2;

b) Reduction of spacing to values below minimum acceptable values specified in 12.1;

c) Reduction in the effectiveness of strain relief as determined by conducting the Strain Relief Test, Section 32;

d) Dielectric breakdown as determined by conducting the Dielectric Voltage Withstand Test, Section 26; or

e) Cracking or other damage to an outdoor enclosure that allows water to contact current carrying parts not inherently corrosion resistant, as determined by conducting the Rain Test, Section 35.

Effective date for 28.5 changed from July 3, 2003 to November 1, 2003

## 29 Flexing Test

29.1 Flexible lights with detachable power-supply cords and connectors for extension segments are to be subjected to this test.

Effective date for 29.1 changed from July 3, 2003 to November 1, 2003

29.2 Six samples of the flexible light attached to its supply connector shall be subjected to 750 cycles of 180 degree flexing. If the flexible light is also provided with a load connector for interconnecting extension segments, three additional samples shall be tested with the supply connector and three additional samples shall be tested with the load connector.

Effective date for 29.2 changed from July 3, 2003 to November 1, 2003

29.3 Each sample shall consist of a connector secured as intended to a section of the flexible light body. The length of the flexible lamp used for this test shall be not less than 20 inches (508 mm) long and contain at least one complete series lamp string.

Effective date for 29.3 changed from July 3, 2003 to November 1, 2003

29.4 Each sample is to be secured to the flexing apparatus described in the Flexing Test-Services Employing Parallel Cords of Integral or Nonintegral Construction, in the Standard for Cord Sets and Power-Supply Cords, UL 817, so that the flexible light assumes the natural bend permitted by the construction.

Effective date for 29.4 changed from July 3, 2003 to November 1, 2003

29.5 Each connector is to be secured in the jaws of the flexing machine so that the point of flexible light body exit is at the center of rotation. The rotating jaws are to be adjusted to rotate to an angle of 90 degrees to each side of the centered position. At the centered position, the flexible light body is to hang vertically and a test weight of 10 ounces (284 g) shall be attached to the flexible light body approximately 12 inches (305 mm) from the point of rotation.

Effective date for 29.5 changed from July 3, 2003 to November 1, 2003

29.6 Each sample is to be subjected to the flexing of 29.5 until 750 cycles are completed or a conductor opens as determined by a suitable current detection device. A flexing cycle consists of rotation of the jaws from the vertical (centered) position until 90 degrees to one side, back past the vertical position until 90 degrees to the other side, and back to the vertical (centered) position. The rate of testing shall be 10 cycles per minute.

Effective date for 29.6 changed from July 3, 2003 to November 1, 2003

29.7 There shall be no:

- a) Conductor opening within 750 flexible cycles;
- b) Accessibility of uninsulated current carrying parts as determined by applying the accessibility probe specified in 10.2;
- c) Reduction of spacing to values below minimum acceptable values specified in 12.1;
- d) Reduction in the effectiveness of strain relief as determined by conducting the Strain Relief Test, Section 32;
- e) Dielectric breakdown as determined by conducting the Dielectric Voltage Withstand Test, Section 26; or

- f) Cracking or other damage to an outdoor flexible light enclosure that allows water to contact current carrying parts not inherently corrosion resistant, as determined by conducting the Rain Test, Section 35.

Effective date for 29.7 changed from July 3, 2003 to November 1, 2003

### 30 Oven Conditioning Test

30.1 The flexible light is to be placed in a full-draft circulating-air oven for seven hours. The oven is to be maintained at a uniform temperature of 18°F (10°C) higher than that measured on the polymeric material during the temperature test, but no less than 158°F (70°C). After removal from the oven, the sample is to be permitted to cool to room temperature and then inspected.

Effective date for 30.1 changed from July 3, 2003 to November 1, 2003

30.2 The results are acceptable if there is no softening, cracking or warping, or other signs of deterioration in the light jacket or connectors that would tend to expose uninsulated current carrying parts or reduce electrical spacing.

Effective date for 30.2 changed from July 3, 2003 to November 1, 2003

### 31 Cold Bend Test

31.1 A sample of the flexible light intended for outdoor use and a 3 inch (76.2 mm) diameter metal mandrel are to be placed in a cold chamber maintained at minus 4 ±3.6°F (minus 20 ±2°C) for a period of 4 hours. Immediately upon removal from the chamber, the flexible light is to be tightly wound around the mandrel for six complete turns. This winding operation is to be completed within 30 seconds of the time that the cold chamber is opened.

Effective date for 31.1 changed from July 3, 2003 to November 1, 2003

31.2 There shall be no cracking or other damage that exposes uninsulated current carrying parts or reduces electrical spacings.

Effective date for 31.2 changed from July 3, 2003 to November 1, 2003

### 32 Strain Relief Test

32.1 A sample of the flexible light shall withstand a 35 pound (16 kg) force without damage to the insulation or parts and without strain being transmitted to internal conductors or terminals of a conductor.

Effective date for 32.1 changed from July 3, 2003 to November 1, 2003

32.2 The force is to be gradually applied to the cord in parallel with the direction the cord normally enters the flexible light or connector. The force is to be maintained for one minute.

Effective date for 32.2 changed from July 3, 2003 to November 1, 2003

32.3 If the flexible light employs a molded thermoplastic strain relief, a sample is to be conditioned in a hot air circulating oven for a period of seven hours. The oven temperature is to be maintained at 18°F (10°C) higher than that measured on the plastic during the temperature test but no less than 158°F (70°C). The Strain Relief Test is to be conducted after the sample has cooled to room temperature.

Effective date for 32.3 changed from July 3, 2003 to November 1, 2003

### 33 Crimp Connection Secureness Test

33.1 Six samples of the individual crimp connections used to make electrical connection to the flexible light conductors or connectors are to be subjected to this test. Samples are to be tested with the outer plastic enclosure jacketing removed. Each terminal is to be held rigidly and a 20 pound (9.1 kg) weight attached to the conductor. The weight is then to be gradually released to hang freely suspended for a duration of one minute.

Effective date for 33.1 changed from July 3, 2003 to November 1, 2003

33.2 The conductors shall remain securely attached to the crimp connectors at the completion of this test.

Effective date for 33.2 changed from July 3, 2003 to November 1, 2003

### 34 End Cap Pull Test

34.1 Three samples of the flexible light are to be held rigidly secured, and the force required to completely remove the end cap from each sample in a direction parallel to the longitudinal centerline of the flexible light is to be measured. The force shall be applied in a straight line without torque.

Effective date for 34.1 changed from July 3, 2003 to November 1, 2003

34.2 This test is to be repeated with three additional samples that have been conditioned in a hot air circulating oven for a period of seven hours. The oven temperature is to be maintained at 18°F (10°C) higher than that measured in the area of the end cap during the temperature test but not less than 158°F (70°C).

Effective date for 34.2 changed from July 3, 2003 to November 1, 2003

34.3 The minimum average force required to remove the end cap from each of the sets of three samples of flexible lights for each condition shall not be less than 20 pounds (9.1 kg), and the force to remove any one end cap shall be not less than 15 pounds (6.8 kg).

Effective date for 34.3 changed from July 3, 2003 to November 1, 2003

### 35 Rain Test

35.1 A sample of the flexible light intended for outdoor use shall be positioned on a flat surface and energized as indicated in the following table. The test is to be conducted using the rain apparatus as described in the Standard for Luminaires, UL 1598. The unit shall be positioned in the focal area of the spray in order to cause maximum wetting of gaskets, joints and openings. If the flexible light is extendible, the test is to be conducted with an additional unit is to be plugged into the extension connector. The water flow gauges are to be adjusted to yield a 5 psi (34.5 kPa) water spray to simulate a beating rain for sequence in Table 35.1.

Effective date for 35.1 changed from July 3, 2003 to November 1, 2003

**Table 35.1**  
**Test parameters**

Effective date for Table 35.1 changed from July 3, 2003 to November 1, 2003

Duration (hrs)	Lamp	Water
1	On	Off
1/2	Off	On
2	On	On
1/2	Off	On

35.2 Following the last application of the water spray, the sample shall be subjected to the Dielectric Withstand Test, Section 26.

Effective date for 35.2 changed from July 3, 2003 to November 1, 2003

35.3 For the Dielectric Withstand Test, Section 26, the dielectric trip current is to be set for 300 mA maximum.

Effective date for 35.3 changed from July 3, 2003 to November 1, 2003

35.4 No water shall contact uninsulated current carrying parts and there shall be no dielectric breakdown.

Effective date for 35.4 changed from July 3, 2003 to November 1, 2003

35.5 Water is allowed to enter the interior of a fused attachment plug when the device complies with the applicable requirements of UL 588 , Standard for Seasonal and Holiday Decorative Products, and is rated for outdoor use.

Effective date for 35.5 changed from July 3, 2003 to November 1, 2003

**36 Test for Permanence of Cord Tag**

36.1 Samples of marking tags shall be subjected to the tests described in Tests for Permanence of Cord Tags of Standard for Cord Sets and Power-Supply Cords, UL 817.

Effective date for 36.1 changed from July 3, 2003 to November 1, 2003

**MANUFACTURING AND PRODUCTION TESTS**

**37 Production-Line Spark Test**

37.1 A spark tester shall include a voltage source, electrode, voltmeter, fault-signal device or system, and the appropriate electrical connections. The ability of the equipment to comply with the requirements in 37.1 – 37.17 shall be certified a minimum of once a year by an accredited independent calibration service or its equivalent, such as checking the test potential with a voltmeter whose calibration is traceable. Calibration shall be traceable to a National Institute of Standards and Technology (USA) standard or to other national physical measures recognized as equivalent by NIST.

Effective date for 37.1 changed from July 3, 2003 to November 1, 2003

37.2 The voltage source of a spark tester shall maintain a minimum test potential of 6000 volts RMS under all normal conditions of leakage current. The core of a transformer and one end of its secondary winding shall be solidly connected to earth ground. A voltage source shall not be connected to more than one electrode.

Effective date for 37.2 changed from July 3, 2003 to November 1, 2003

37.3 The electrode shall be of the link- or bead-chain type and shall make intimate contact throughout its entire length with the surface of the flexible light enclosure being tested.

Effective date for 37.3 changed from July 3, 2003 to November 1, 2003

37.4 The bottom of the metal electrode enclosure shall be U- or V-shaped, the chains shall have a length appreciably greater than the depth of the enclosure, and the width of the trough shall be (typically 1-1/2 inches or 40 mm) greater than the diameter of the flexible light enclosure that is tested.

Effective date for 37.4 changed from July 3, 2003 to November 1, 2003

37.5 For a bead-chain electrode, the longitudinal and transverse spacings of the chains and the diameter of each bead shall comply with Table 37.1. The vertical spacing between beads in each chain shall not exceed the diameter of a bead.

Effective date for 37.5 changed from July 3, 2003 to November 1, 2003

**Table 37.1**  
**Maximum center-to-center spacings of bead chains**

Effective date for Table 37.1 changed from July 3, 2003 to November 1, 2003

Diameter of a bead <sup>a</sup>		Longitudinal spacing within each row <sup>a</sup>		Transverse spacing between rows <sup>a</sup>			
				Chains staggered		Chains not staggered	
Inch	(mm)	Inch	(mm)	Inch	(mm)	Inch	(mm)
3/16	(5.0)	1/2	(13)	1/2	(13)	3/8	(10)
3/32	(2.5)	b	b	b	b	b	b

<sup>a</sup> A diameter and spacings other than indicated comply where investigation shows that the chains contact an equal or greater area of the outer surface of the wire.

<sup>b</sup> The chains shall be staggered and shall touch one another in the longitudinal and transverse directions.

37.6 The electrode shall have an earth-grounded metal screen or an equivalent guard that protects operating personnel against electric shock from the electrode and associated current carrying parts.

Effective date for 37.6 changed from July 3, 2003 to November 1, 2003

37.7 The voltmeter shall be connected in the circuit to indicate the actual test potential at all times.

Effective date for 37.7 changed from July 3, 2003 to November 1, 2003

37.8 The equipment shall include a light, counter, or other device or system that gives a signal in the event of a fault. When a fault is detected, the signal shall be maintained until the indicator is reset manually.

Effective date for 37.8 changed from July 3, 2003 to November 1, 2003

37.9 The spark test shall be conducted as the flexible light enclosure is being cut just prior to storage in or shipping from the factory in which the flexible light enclosure is made. The insulation at points of repair shall be re-sparked.

Effective date for 37.9 changed from July 3, 2003 to November 1, 2003

37.10 A flexible light enclosure that has been spark-tested in compliance with 37.9 need not be re-sparked if it is subsequently re-cut into lengths shorter than 200 feet (60 m).

Effective date for 37.10 changed from July 3, 2003 to November 1, 2003

37.11 The length of the electrode is not specified. However, the rate of speed at which the wire travels through the electrode shall keep any point on the wire in contact with the electrode for not less than a total of 18 positive and negative crests of the supply voltage (the equivalent of 9 full cycles of the supply voltage). The maximum speed of the flexible light enclosure is to be determined by means of whichever of the following formulas is applicable.

$$\text{Feet per minute} = (5/9) \times \text{Frequency (hertz)} \times \text{Electrode length (inches)}$$

or

$$\text{Meters per minute} = (1/150) \times \text{Frequency (hertz)} \times \text{Electrode length (mm)}$$

For convenience, Table 37.2 shows the formulas for several frequencies.

Effective date for 37.11 changed from July 3, 2003 to November 1, 2003

**Table 37.2**  
**Formula for maximum speed of the flexible light enclosure in terms of electrode length L**

Effective date for Table 37.2 changed from July 3, 2003 to November 1, 2003

Nominal supply (Frequency in hertz)	Feet per minute (L in inches)	Meters per minute (L in millimeters)
50	27.8L <sub>in</sub>	0.333L <sub>mm</sub>
60	33.3L <sub>in</sub>	0.400L <sub>mm</sub>
100	55.6L <sub>in</sub>	0.667L <sub>mm</sub>
400	222L <sub>in</sub>	2.67L <sub>mm</sub>
1000	556L <sub>in</sub>	6.67L <sub>mm</sub>
3000	1667L <sub>in</sub>	20.0L <sub>mm</sub>
4000	2222L <sub>in</sub>	26.7L <sub>mm</sub>

37.12 The conductor of the flexible light enclosure shall be earth-grounded during the spark test. Where the conductor coming from the pay-off reel is bare, the conductor shall be earth-grounded at the pay-off reel or at another point at which continuous contact with the bare conductor, prior to the insulating process, is maintained. Where the conductor coming from the pay-off reel is insulated, an earth-ground connection shall be made at both the pay-off and the take-up reels. In any case, each earth-ground connection shall be bonded directly to the earth ground in the spark tester.

Effective date for 37.12 changed from July 3, 2003 to November 1, 2003

37.13 To determine whether or not a flexible light enclosure is continuous, the conductor is to be connected in series with a lamp, buzzer, bell, or other indicator and a power supply. The conductor is continuous from end-to-end of the finished wire where the lamp lights, the bell or buzzer sounds, or another indicator signal is given.

Effective date for 37.13 changed from July 3, 2003 to November 1, 2003

37.14 For the factory production continuity testing of a flexible light enclosure, it is the manufacturer's choice whether to substitute either of the following for the test in 37.13 a:

- a) Continuous eddy-current procedure complying with 37.15 and 37.16; or
- b) Continuous differential capacitive-current procedure complying with 37.17.

Effective date for 37.14 changed from July 3, 2003 to November 1, 2003

37.15 The eddy-current test arrangement shall include equipment that complies with each of the following:

- a) The equipment is to apply current at one or several frequencies in the range of 1 – 125 kHz to a test coil for the purpose of inducing eddy currents in the conductor moving through the coil at production speed;
- b) The equipment is to detect the variation in impedance of the test coil caused by each break in the conductor;
- c) The equipment is to provide a visual indication to the operator.

Effective date for 37.15 changed from July 3, 2003 to November 1, 2003

37.16 The longitudinal axis of the conductor is to be coincident with the electrical center of the test coil. The flexible light enclosure is to have little or no vibration as it passes through the test coil and is to clear the coil by a distance that is not greater than 1/2 inch (13 mm). Variations in the speed of the flexible light enclosure through the test coil are to be limited to plus 50 percent and minus whatever percentage (50 percent maximum) keeps the signal amplitude from falling below the level at which a break can be detected. Calibration without any wire in the test coil is to be made at least daily to check whether the equipment is functioning. The temperature along the length of the flexible light enclosure being tested is not to vary from the temperature at which the equipment was calibrated, balanced, and so forth unless the variations are gradual and are without hot or cold spots that cause false signals.

Effective date for 37.16 changed from July 3, 2003 to November 1, 2003

37.17 The differential capacitive-current procedure shall include equipment that complies with each of the following:

- a) The equipment is to be used in conjunction with a 1 – 3 kHz or higher-frequency spark tester;
- b) Two pickup electrodes are to be located in tandem either along the portion of the conductor being tested that is moving from the grounded pay-off reel toward the spark electrode, or along the portion of the conductor being tested that is moving toward the grounded take-up reel from the spark electrode;
- c) As each break in the conductor is passing from the first pickup electrode toward the second, the equipment is to detect the difference between the voltage capacitively coupled from the conductor under test to the pickup electrode nearest the spark electrode and the lower voltage coupled to the pickup electrode nearest the grounded reel; and
- d) The equipment is to show a visual indication to the operator.

Effective date for 37.17 changed from July 3, 2003 to November 1, 2003



### 38 Operational Test

38.1 Each flexible light shall be tested by the manufacturer. Inability of any lamp to light is to be considered unacceptable. The manufacturer may use a means other than lamping that produces results equal to actual lamping.

Effective date for 38.1 changed from July 3, 2003 to November 1, 2003

### 39 Polarization Continuity Test

39.1 As a routine production-line verification, each flexible light provided with a 2-wire polarized attachment plug shall be tested for electrical continuity between the grounded (neutral) circuit supply conductor of the attachment plug (wider blade) and the load fitting, if employed. Electrical continuity shall also be verified between the ungrounded (hot) circuit supply conductor of the attachment plug (narrow blade) and the overcurrent-protective device.

Effective date for 39.1 changed from July 3, 2003 to November 1, 2003

39.2 Any indicating device such as an ohmmeter, a battery-and-buzzer combination, or similar continuity testing device, shall be used to determine compliance with the continuity requirements in 39.1.

Effective date for 39.2 changed from July 3, 2003 to November 1, 2003

## MARKING

### 40 General

40.1 The markings specified in Sections 40 and 41 shall be located on a tag attached to the product or within 6 inches (152.4 mm) of the face of the attachment plug or supply connector. The tag shall comply with Section 36, Test for Permanence of Cord Tag, and shall have the marking in black on a white background.

Effective date for 40.1 changed from July 3, 2003 to November 1, 2003

40.2 All required markings for a flexible lighting product shall be permanent, rated for the type of surface and surface temperature. The letters shall be a minimum of 1/8 inch (3.2 mm) high.

Effective date for 40.2 changed from July 3, 2003 to November 1, 2003

40.3 The following markings shall be provided and visible during installation:

- a) Catalog number and Listee's name or other identifier;
- b) Electrical rating, including voltage and current; and
- c) "WARNING – Do not mount or support flexible light in a manner that can damage the outer jacket or cord insulation.";
- d) "WARNING – Risk of Fire and Electric Shock. Uncoil flexible light prior to plugging in."; and
- e) "Do not install near flammable liquids."

Effective date for 40.3 changed from July 3, 2003 to November 1, 2003

40.4 Units intended only for indoor use shall be marked:

- a) "CAUTION – Use indoors only."; and
- b) "CAUTION – Risk of Electric Shock. Do not use flexible lighting product or any extension cord near water or where water may accumulate."

Effective date for 40.4 changed from July 3, 2003 to November 1, 2003

40.5 Units with provision for connection extension segments shall be marked:

- a) With the maximum total length in feet that can be connected together; and
- b) "CAUTION – Risk of Fire or Electric Shock. Use only flexible light extension segments specified in the manufacturer's instructions."

Effective date for 40.5 changed from July 3, 2003 to November 1, 2003

40.6 The marked rating for 40.5(a) in feet shall correspond to a total current in accordance with the maximum fuse rating of 18.5.

Effective date for 40.6 changed from July 3, 2003 to November 1, 2003

40.7 A flexible lighting unit shall not be marked or provided with instructions that indicate suitability for field cutting or splicing.

Effective date for 40.7 changed from July 3, 2003 to November 1, 2003

## 41 Outdoor Use Markings

41.1 Products intended for outdoor use shall be marked:

- a) "Suitable for outdoor use." or "Suitable for indoor and outdoor use.";
- b) "CAUTION – Risk of Electric Shock. Do not use with extension cord near water or where water may accumulate. For use only on GFCI protected circuits."; and
- c) "Material may become brittle when cold. Do not install where it may be stepped on or subject to physical damage."

Effective date for 41.1 changed from July 3, 2003 to November 1, 2003

## INSTRUCTIONS

### 42 Installation and Use Instructions

42.1 A flexible lighting product shall be provided with installation instructions, which include the following:

- a) Electrical ratings;
- b) Mounting instructions and instructions to indicate proper use; and
- c) Fuse replacement rating.

Effective date for 42.1 changed from July 3, 2003 to November 1, 2003

42.2 The following safety instructions shall be provided with a flexible lighting product:

- a) **"READ AND FOLLOW ALL SAFETY INSTRUCTIONS**
- b) "Do not cover this product as the covering may cause the flexible light to overheat and melt or ignite."
- c) "Do not operate with the flexible light tightly coiled."
- d) "Do not puncture, cut, shorten, or splice the flexible lighting."
- e) "Do not route the cord or flexible lighting through walls, doors, windows or any like part of the building structure."
- f) "Do not use if there is any damage to the light or cord insulation. Inspect periodically."
- g) "Do not submerge flexible light in liquids, or use the product in the vicinity of standing water or other liquids."
- h) "Secure this flexible light using only the hangers or clips provided. Do not secure this product or its cord with staples, nails, or like means that may damage the insulation."
- i) "Do not subject flexible lighting to continuous flexing."
- j) (For extendible units) "Do Not Exceed The Length in Feet Permitted By The Marking."

#### **SAVE THESE INSTRUCTIONS"**

Effective date for 42.2 changed from July 3, 2003 to November 1, 2003

42.3 The height of the lettering in the safety instructions specified in 42.2 shall be as follows:

- a) Upper case letters shall not be less than 1/12 inch (2.1 mm) in height;
- b) Lower case letters shall not be less than 1/16 inch (1/6 mm) in height; and

c) The phrases "IMPORTANT SAFETY INSTRUCTIONS", "READ AND FOLLOW ALL SAFETY INSTRUCTIONS" and "SAVE THESE INSTRUCTIONS" shall be in letters not less than 3/16 inch (4.8mm) in height.

Effective date for 42.3 changed from July 3, 2003 to November 1, 2003

42.4 Units with provision for the connection of extension segments shall be provided with detailed installation instructions on how to extend the flexible light. Items that need to be included are:

- a) A statement to disconnect power before adding segments;
- b) Identification (manufacturer and catalog number) of suitable extension segments.
- c) Maximum length that is able to be added;
- d) For outdoor use units, a statement advising the user to make sure that all connections and the end cap on the last segment are tightly secured to preclude the entry of water.

Effective date for 42.4 changed from July 3, 2003 to November 1, 2003

### 43 Outdoor Use Instructions

43.1 The following additional safety instructions for outdoor use units shall be included with the instructions specified in 42.2.

**"WARNING: When using outdoor use portable lighting products, basic safety precautions should always be followed to reduce the risk of fire, electric shock, and personal injury, including the following:**

Read All Instructions

- a) Ground Fault Circuit Interrupter (GFCI) protection should be provided on the circuits or outlet to be used for the outdoor use flexible lighting product. Receptacles are available having built-in GFCI protection for this measure of safety.
- b) Use only outdoor extension cords, such as type SW, SOW, STW, STOW, SJW, SJOW, SJTW, or SJTOW. This designation is marked on the wire of the extension cord."

Effective date for 43.1 changed from July 3, 2003 to November 1, 2003

#### 44 Packaging Instructions and Markings

44.1 The packaging material attached to or provided with a flexible lighting product should not display any of the following:

- a) Pictures or sketches showing flexible lighting used near swimming pools, spas, tubs, fountains, or any other bodies of liquids;
- b) Information indicating that the product is suitable for use in a child's room, nursery, or other child's play area; or
- c) Statements relating to the suitability of indoor use units for damp or wet locations.

Effective date for 44.1 changed from July 3, 2003 to November 1, 2003

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## APPENDIX A

### Standards for Components

Standards under which components of the products covered by this standard are evaluated include the following:

Title of Standard – UL Standard Designation

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Attachment Plugs and Receptacles – UL 498

Cord Sets and Power-Supply Cords – UL 817

Flexible Cord and Fixture Wire – UL 62

Fuseholders – UL 512

Fuses – Part 1: General Requirements, Low-Voltage – UL 248-1

Fuses – Part 14: Supplemental Fuses, Low-Voltage – UL 248-14

Gaskets and Seals – UL 157

Industrial Control Equipment – UL 508

Luminaires – UL 1598

Marking and Labeling Systems – UL 969

Plastic Materials for Parts in Devices and Appliances, Tests for Flammability – UL 94

Polymeric Materials – Short Term Property Evaluations – UL 746A

Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C

Power Units, Class 2 – UL 1310

Printed-Wiring Boards – UL 796

Seasonal and Holiday Decorative Products – UL 588

Small Polymeric Component Materials, Tests for Flammability of – UL 1694

Snap Switches, General Use – UL 20

Switches, Special-Use – UL 1054

Transformers, Class 2 and Class 3 – UL 1585

Transformers, Specialty – UL 506

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