



UL 2108

STANDARD FOR SAFETY

Low Voltage Lighting Systems

UL Standard for Safety for Low Voltage Lighting Systems, UL 2108

Second Edition, Dated December 7, 2015

Summary of Topics

These revisions to ANSI/UL 2108 dated April 18, 2023 include the following changes in requirements:

- **Scope simplification; [1.1](#)**
- **Scope exclusions; [1.5](#)**
- **Definition Removals; [3.13](#), [3.14](#), [3.14.1](#), [3.21](#) and [3.23](#)**
- **Permitted openings in recessed housings; [11.9](#)**
- **Protective devices and the Maximum Output Test; [19.1](#) and [33.2.2](#)**
- **Power unit temperature test; [34.2.3](#), [48.2.8](#) and [48.2.8A](#)**
- **Overload Test; [36.2](#) and [Figure 36.1](#)**
- **Removal of surge protection devices for dielectric withstand test; [37.1](#) and [Appendix A](#)**
- **Reduced the marking minimum letter height; [48.1.3](#), [48.2.7](#), [48.4.3](#), [48.5.2](#), [67.1.3](#), [67.1.5](#), [67.1.6](#) and [83.1](#)**
- **Marking type options; [Table 48.1](#), [48.1.10](#) and [48.1.11](#)**
- **Class 2 luminaires with signal inputs; [51.1](#)**
- **Clarification of class 2 wet location compliance; [51.3](#) and [73.7](#)**
- **Class 2 device housings; [3.6A](#), [Section 53](#), [62.1](#), [62.4](#) and [66.1](#)**
- **Separable mounting means for class 2 luminaires; [54.1](#) and [68.5](#)**
- **Grounding permitted but not required for class 2 luminaires; [59.4](#)**
- **Editorial Corrections; [Section 6](#), [9.1](#), [45.4](#), [Table 51.1](#) and [B2.1.8](#)**

Text that has been changed in any manner or impacted by ULSE's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated March 3, 2023.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form by any means, electronic, mechanical photocopying, recording, or otherwise without prior permission of ULSE Inc. (ULSE).

ULSE provides this Standard "as is" without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability or fitness for any purpose.

In no event will ULSE be liable for any special, incidental, consequential, indirect or similar damages, including loss of profits, lost savings, loss of data, or any other damages arising out of the use of or the inability to use this Standard, even if ULSE or an authorized ULSE representative has been advised of the possibility of such damage. In no event shall ULSE's liability for any damage ever exceed the price paid for this Standard, regardless of the form of the claim.

Users of the electronic versions of UL's Standards for Safety agree to defend, indemnify, and hold ULSE harmless from and against any loss, expense, liability, damage, claim, or judgment (including reasonable attorney's fees) resulting from any error or deviation introduced while purchaser is storing an electronic Standard on the purchaser's computer system.

DECEMBER 7, 2015
(Title Page Reprinted: April 18, 2023)



ANSI/UL 2108-2023

1

UL 2108

Standard for Low Voltage Lighting Systems

First Edition – February, 2004

Second Edition

December 7, 2015

This ANSI/UL Standard for Safety consists of the Second Edition including revisions through April 18, 2023.

The most recent designation of ANSI/UL 2108 as an American National Standard (ANSI) occurred on April 18, 2023. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

Comments or proposals for revisions on any part of the Standard may be submitted to ULSE at any time. Proposals should be submitted via a Proposal Request in ULSE's Collaborative Standards Development System (CSDS) at <https://csds.ul.com>.

Our Standards for Safety are copyrighted by ULSE Inc. Neither a printed nor electronic copy of a Standard should be altered in any way. All of our Standards and all copyrights, ownerships, and rights regarding those Standards shall remain the sole and exclusive property of ULSE Inc.

COPYRIGHT © 2023 ULSE INC.

No Text on This Page

CONTENTS

INTRODUCTION

1	Scope	7
2	Units of Measurement	7
3	Glossary	7
4	Components	10
5	Undated References	10
6	Organization and Application	12

PART I – POWER UNITS

GENERAL

7	General	12
---	---------------	----

CONSTRUCTION – MECHANICAL

8	General Construction	12
9	Enclosure	13
10	Openings	15
11	Recessed Housings	15
11A	Equipment for Use in Environmental Air-Handling Spaces (Plenums)	16
12	Corrosion Protection	16
13	Damp and Wet Locations	16

CONSTRUCTION – ELECTRICAL

14	Current-Carrying Parts	16
15	Conductors and Cords	17
16	Splices and Connections	17
17	Transformer	18
18	Electronic Power Supply	19
19	Protective Devices	19
20	Electronic Circuits	20
21	Switches	20
22	Accessibility to Live Parts	21
23	Electrical Spacings	23
24	Electrical Barriers	23
25	Electrical Insulation	23
26	Separation of Circuits	24
27	Grounding and Bonding	25
28	Supply Connections	26
29	Secondary Connections	28
30	Exposed Bare and Insulated Conductors	29
31	Mounting Means	29

PERFORMANCE

32	General	30
33	Input and Output Tests	31
33.1	Input test	31



	33.2 Maximum output test.....	31
34	Normal Temperature Test.....	31
	34.1 General.....	31
	34.2 Power units	34
	34.3 Additional test conditions.....	34
	34.4 Open devices	35
35	Abnormal Recessed Temperature Test.....	35
36	Overload Test.....	36
37	Dielectric Voltage Withstand Test.....	38
38	Exposed Bare Conductor Abnormal Operation Test	38
38A	Class 2-Supplied Exposed Bare Conductor Abnormal Operation Test	40
39	Component Fault Test.....	40
40	Grounding Continuity Test.....	41
41	Strain Relief for Flexible Cord Test.....	41
42	Mounting Means Test.....	41
	42.1 Tension loading	41
	42.2 Gravity loading	41
	42.3 Test Results	42
43	Insulated Conductor Dielectric Withstand Test	42
44	Loose Luminaire/Connection Test.....	42
45	Insulation-Piercing Terminal Temperature Test.....	42

MANUFACTURING AND PRODUCTION TESTS

46	Dielectric Voltage Withstand Test.....	44
47	Continuity of Grounding Connection Test.....	44

MARKING

48	Details.....	44
	48.1 General.....	44
	48.2 Power units	46
	48.3 Wall and ceiling surface mount.....	48
	48.4 Under-cabinet and cabinet mount	48
	48.5 Recessed mounting	48
	48.6 Pictograph type markings	49

INSTALLATION INSTRUCTIONS

49	Power Units	49
50	Exposed Bare Conductors	50
50A	Open Devices	50

PART II – EXPOSED BARE CONDUCTOR LUMINAIRES, CLASS 2 LUMINAIRES, AND CLASS 2 COMPONENTS

GENERAL

51	General	50
----	---------------	----

CONSTRUCTION – MECHANICAL

52	General Construction.....	51
53	Housing.....	52
54	Mounting Means	52



Documents

Document Sharing Hub

55	Glassware	53
56	Tungsten-Halogen Lamp Containment Barrier and UV Filter	53

CONSTRUCTION – ELECTRICAL

57	Leads and Conductors	54
58	Splices	55
59	Supply Connections	55

PERFORMANCE

60	Normal Temperature Test	55
61	Abnormal Recessed Temperature Test	56
62	Luminaire Drop Impact Test	56
63	Secureness of Conductors Test	57
64	Mounting Means Test	57
65	Mounting Means Failure Test	58
66	Luminaire Component Fault Test	58

MARKINGS

67	Details	58
67.1	General	58
67.2	Exposed bare conductor luminaires	60
67.3	Class 2 luminaires	60

INSTRUCTIONS

68	General	61
----	---------------	----

PART III – OTHER LUMINAIRES

GENERAL

69	General	62
----	---------------	----

CONSTRUCTION

70	Mechanical Construction	62
71	Electrical Construction	63

PERFORMANCE

72	General	63
----	---------------	----

MARKING AND INSTRUCTIONS

73	General	64
----	---------------	----

SUPPLEMENTARY REQUIREMENTS

74	Incandescent Luminaires	64
75	Fluorescent Luminaires	65
76	Surface Mounted Luminaires	65

77	Recessed Mounted Luminaires	66
----	-----------------------------------	----

PART IV – LUMINAIRES WITH BATTERIES GENERAL

GENERAL

78	General	66
----	---------------	----

CONSTRUCTION

79	General	66
----	---------------	----

PERFORMANCE

80	Battery Charge Rate Measurement.....	67
81	Battery Charging Circuit Abnormal Tests	67
82	Temperature Test	68

MARKINGS AND INSTRUCTIONS

83	General	68
----	---------------	----

APPENDIX A

Standards for Components	69
--------------------------------	----

APPENDIX B (Informative) MANUFACTURING AND PRODUCTION TESTS

B1	General.....	70
B2	Insulation Integrity Tests	70
	B2.1 Dielectric Voltage Withstand Test.....	70
	B2.2 DC Insulation Resistance Measurement Test.....	71
B3	Continuity of Grounding Connection Test	71

INTRODUCTION

1 Scope

1.1 These requirements apply to low voltage lighting systems and components intended for installation in accordance with the National Electrical Code, NFPA 70, Article 411.

1.2 These requirements cover:

a) Power units in which output is limited to 25 A and below the risk of electric shock voltage levels as defined in [3.19](#); and

b) Class 2, exposed bare conductor, POE, and other low-voltage luminaires and lighting systems.

1.3 These requirements do not cover lighting equipment covered by other standards such as, but not limited to, the Standard for Portable Electric Luminaires, UL 153, the Standard for Track Lighting Systems, UL 1574, or the Standard for Luminaires, UL 1598:

a) Luminaires provided with a cord and attachment plug intended for branch circuit connection. See the Standard for Portable Electric Luminaires, UL 153.

b) Luminaires intended to be mounted to and relocatable along a track, including when the track is supplied at low voltage. See the Standard for Track Lighting Systems, UL 1574.

c) Luminaires intended to be carried by hand or exclusively used not connected to a branch circuit. See the Standard for Flashlights and Lanterns, UL 1576.

d) Luminaires integrated with a power unit in a singular product. See the Standard for Luminaires, UL 1598.

1.4 Light emitting diode (LED) components, controls, and subassemblies integral to a low voltage lighting system shall comply with the applicable requirements of the Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products, UL 8750.

1.5 These requirements do not address certain specialized applications, including but not limited to hazardous/classified locations, emergency lighting, marine (ship-board) lighting, horticultural systems, germicidal luminaires, air-handling luminaires, or luminaires installed over cooking equipment. Low voltage lighting system equipment intended for such applications are to be investigated in accordance with standards written for the purpose.

2 Units of Measurement

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

3 Glossary

3.1 For the purpose of this standard the following definitions apply.

3.2 ACCESSIBILITY BARRIER – A material provided to limit access to uninsulated current-carrying parts that involve a risk of shock and insulated current-carrying parts not intended to be subject to user contact.

3.2.1 BATTERY – General term for (1) any single cell, or (2) a group of cells connected together either in a series and/or parallel configuration. May be ready for use or may be an installed component.

3.2.2 BATTERY CELL – The basic manufactured unit of a battery. Provides electrical energy by direct conversion of chemical energy and designed to be charged electrically. Consists of electrodes, separators, electrolyte, container and terminals.

3.2.3 BATTERY, SECONDARY – A battery intended to be charged and discharged multiple times under prescribed rates of charging and discharging in accordance with the battery manufacturer's recommendations.

3.3 CABINET MOUNTED UNIT – A luminaire or power unit intended for final installation into cabinets and similar location, such that all or part of the unit is located within the interior space of the cabinet.

3.4 CONDUCTORS, INSULATED – A conductor encased within material recognized as electrical insulation.

3.5 ENCLOSURE – A material provided to enclose electrical parts and components that involve a risk of fire, and to protect internal parts from the environment and from mechanical damage. All or part of the enclosure is not prohibited from also serving as an accessibility barrier or recessed housing.

3.6 EXPOSED CONDUCTORS – Low voltage supply conductors with no additional housing, which provide physical support and electrical supply connections for one or more luminaire assemblies, including assemblies capable of being repositioned along the length of the conductors. Does not include lighting track bus bars (see UL 1574 clause 3.4) which may be accessible within their housing.

3.6A HOUSING – A protective casing for a device that is not required to meet the construction or performance criteria of an enclosure.

3.7 LAMP CONTAINMENT BARRIER – Any part of the luminaire that surrounds the lamp to contain hot particles of the lamp in the event that it ruptures.

3.8 LOCATION, DAMP – An exterior or interior location that is normally or periodically subject to condensation of moisture in, on, or adjacent to electrical equipment, and includes partially protected locations.

3.9 LOCATION, DRY – A location not normally subject to dampness, but may include a location subject to temporary dampness, as in the case of a building under construction, provided ventilation is adequate to prevent an accumulation of moisture.

3.10 LOCATION, WET – A location in which water or other liquid may drip, splash, or flow on or against electrical equipment.

3.11 LOW VOLTAGE LUMINAIRE – A lighting unit intended for connection to a power source for which output voltage does not represent a risk of electric shock.

3.12 NOMINAL OUTPUT WATTAGE/LOAD – Specified by power unit or system manufacturer as total lamp wattage. Assumes that lamps are operating at rated lamp voltage.

3.13 Deleted

3.13.1 OPEN DEVICE – A component or subassembly with instructions that limit installation to within enclosures of metal or nonmetallic materials suitable for fire containment and that limits user access to parts representing a risk of electric shock.

3.14 Deleted

3.14.1 Deleted

3.15 POWER UNIT – The equipment that powers and controls the luminaires in a low voltage lighting system. A power unit has the following characteristics:

- a) An isolating type transformer or electronic power supply of output voltage not exceeding the risk of electric shock;
- b) Is intended for field installation; and
- c) Each secondary circuit is limited to 25 A.

3.16 POWER OVER ETHERNET (PoE) – A DC power system conforming to IEEE 802.3 that uses category 5 (CAT5) or similar cables and 8P8C (RJ45) modular connectors to concurrently carry power and data between the power source and powered device. The voltage and power of all PoE systems are within the class 2 limits of NFPA 70, and therefore are given comparable treatment within this standard.

3.17 RECESSED HOUSING – A part of a recessed luminaire or power unit that projects into the ceiling or wall cavity and serves to close off the opening from the room side, and does not necessarily enclose conductors or similar components.

3.18 RECESSED EQUIPMENT – Equipment intended to be installed through (penetrating) or located above the mounting surface, and identified as one of the following:

Inherently Protected - Suitable for installation where in direct contact with thermal insulation or combustible materials, without reliance on a thermal protector to limit operating temperatures.

Type IC, Thermally Protected – Suitable for installation where in direct contact with thermal insulation or combustible materials.

Type Non-IC, Thermally Protected – Suitable for installation with minimum dimensions and spacings to thermal insulation or combustible materials in accordance with the installation code.

Type Non-IC, Concrete Only – Suitable for installation only in poured concrete.

3.19 RISK OF ELECTRIC SHOCK – A risk of shock exists between any two uninsulated conductive parts or between an uninsulated conductive part and earth ground, if the continuous current flow through a 1500 Ω resistor in parallel with a 0.015 μF capacitor connected between the two points exceeds a 5 mA and if the open circuit voltage exceeds the following limits in [Table 3.1](#).

Table 3.1
Risk of electric shock voltage limits

Waveform type ^a	Maximum Voltage	
	Dry and damp locations	Wet locations
Sinusoidal ac	30 V rms	15 V rms
Non-sinusoidal ac	42.4 V peak	21.2 V peak
Continuous dc ^b	60 V	30 V
10 – 200 Hz interrupted dc ^c	24.8 V	12.4 V
^a For a combined ac + dc waveform, the dry and damp location voltage limit shall be the non-sinusoidal ac limit where the dc voltage is no more than 20.9 V, and shall be $(33 + 0.45V_{dc})$ where the dc voltage is greater than 20.9 V. The wet location voltage limit shall be half this amount.		

Table 3.1 Continued on Next Page

Table 3.1 Continued

Waveform type ^a	Maximum Voltage	
	Dry and damp locations	Wet locations
^b If the peak-to-peak ripple voltage on a dc waveform exceeds 10% of the dc voltage, the waveform shall be considered a combined waveform per footnote a above. ^c Contact with interrupted dc at a lower or higher frequency shall be permitted only after a special investigation based on the specific waveform parameters.		

3.19.1 RISK OF FIRE – a risk of fire exists in an electrical circuit or device if the maximum voltage (V), current (I), or power ($V \times I$) exceeds the applicable class 2 limit defined in Table 11(A) (for AC circuits) or 11(B) (for DC circuits) of NFPA 70.

3.20 SURFACE MOUNT UNIT – A luminaire or power unit that is designed to be mounted on the room side of a wall, ceiling, or other surface.

3.21 Deleted

3.22 UNDER-CABINET OR SHELF-MOUNTED UNIT – A luminaire and/or power unit intended for surface or blind hole mounting under a cabinet or shelf, where the unit does not extend through the mounting surface or into the cabinet interior.

3.23 Deleted

4 Components

4.1 Except as indicated in 4.2, 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.

4.2 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.

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

4.4 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.

5 Undated References

5.1 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.

5.2 The following publications are referenced in this Standard:

ASTM E230/E230M, Standard Specification and Temperature-Electromotive Force Tables for Standardized Thermocouples



Documents

Document Sharing Hub

IEEE 802.3, Standard for Ethernet

NFPA 70, National Electrical Code

NFPA 90A, Installation of Air-Conditioning and Ventilating Systems

UL 13, Power-Limited Circuit Cables

UL 62, Flexible Cords and Cables

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

UL 153, Portable Electric Luminaires

UL 444, Communications Cables

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

UL 758, Appliance Wiring Material

UL 796, Printed-Wiring Boards

UL 873, Temperature-Indicating and -Regulating Equipment

UL 879, Electric Sign Components

UL 924, Emergency Lighting Equipment

UL 969, Marking and Labeling Systems

UL 1012, Power Units Other Than Class 2

UL 1097, Double Insulation Systems for Use in Electrical Equipment

UL 1310, Class 2 Power Units

UL 1411, Transformer and Motor Transformers for Use in Audio-, Radio- and Television-Type Appliances

UL 1574, Track Lighting Systems

UL 1577, Optical Isolators

UL 1598, Luminaires

UL 1642, Lithium Batteries

UL 1838, Low Voltage Landscape Lighting Systems

UL 2043, Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces

UL 2054, Household and Commercial Batteries

UL 2097, Reference Standard for Double Insulation Systems for Use in Electronic Equipment

UL 4200A, Products Incorporating Button or Coin Cell Batteries of Lithium Technologies

UL 5085-1, Low Voltage Transformers – Part 1: General Requirements

UL 5085-2, Low Voltage Transformers – Part 2: General Purpose Transformers

UL 5085-3, Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers

UL 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Products

UL 60730-1, Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements

UL 60950-1, Information Technology Equipment – Safety – Part 1: General Requirements

UL 62133-1, Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications – Part 1: Nickel Systems

UL 62133-2, Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes – Safety Requirements for Portable Sealed Secondary Cells, and for Batteries Made from Them, for Use in Portable Applications – Part 2: Lithium Systems

UL 62368-1, Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements

6 Organization and Application

6.1 Deleted

PART I – POWER UNITS

GENERAL

7 General

7.1 These requirements apply to the power units in a low voltage lighting systems.

7.2 The maximum rating of a power unit shall not exceed the risk of electric shock voltage, or 25 A per circuit, under any conditions of load.

7.3 The low voltage secondary circuit shall be isolated from the primary circuit. If the secondary circuit output exceeds NEC Article 725 class 2 limits, it shall not be grounded.

CONSTRUCTION – MECHANICAL

8 General Construction

8.1 Insulated conductors that pass over edges or through openings in metal shall be secured from contacting the edges or be protected from cutting and abrasion. For sheet metal less than 0.042 in (1.1 mm) thick, protection shall be provided by one of the following methods:

- a) Rolling the edges of the metal not less than 120 degrees;
- b) A bushing or grommet of a material other than rubber at least 0.047 in (1.2 mm) thick;
- c) Glass sleeving at least 0.010 in (0.25 mm) thick; or
- d) Other means that provide equivalent protection.

8.2 A component such as a lampholder, switch, or other part of an assembly shall be restricted from loosening or turning when such motion adversely affects the intended performance of a component, a reduction of electrical spacings, or results in a risk of fire. Friction alone does not meet the intent of restriction of movement. The use of a lock washer, a star washer, dimples, upturned lugs, ears, and similar means meets the intent of the requirement for this purpose.

9 Enclosure

9.1 All current-carrying parts that present a risk of fire or of electric shock shall be enclosed in material specified in [9.2](#) – [9.4](#), and assembled per [9.6](#).

Exception: Open devices and Exposed Bare and Insulated Conductors compliant with Section [30](#).

9.2 The thickness of sheet and extruded metal in a power unit enclosure shall be in accordance with [Table 9.1](#).

Table 9.1
Minimum thickness of sheet metal and extruded aluminum for enclosures

Specific construction		Steel				Copper, brass, aluminum sheet, and extruded aluminum			
		Unreinforced		Reinforced		Unreinforced		Reinforced	
		in	(mm)	in	(mm)	in	(mm)	in	(mm)
At opening for conduit connection		0.026	(0.66)	0.026	(0.66)	0.032	(0.81)	0.032	(0.81)
Length more than 26 in (660 mm)	No electrical component support	0.020	(0.51)	0.016	(0.41)	0.022	(0.56)	0.017	(0.43)
	Electrical component support	0.026	(0.66)	0.020	(0.51)	0.028	(0.71)	0.022	(0.56)
Length not more than 26 in (660 mm)	No electrical component support	0.016	(0.41)	0.013	(0.33)	0.020	(0.51)	0.016	(0.41)
	Electrical component support	0.020	(0.51)	0.016	(0.41)	0.025	(0.64)	0.020	(0.51)
Length not more than 15 in (380 mm)	No electrical component support	0.016	(0.41)	0.013	(0.33)	0.020	(0.51)	0.016	(0.41)
	Electrical component support	0.016	(0.41)	0.016	(0.41)	0.020	(0.51)	0.020	(0.51)
Notes:									
(1) Reinforced – a form of construction that provides equivalent mechanical strength.									

Table 9.1 Continued on Next Page

Table 9.1 Continued

Specific construction	Steel		Copper, brass, aluminum sheet, and extruded aluminum	
	Unreinforced	Reinforced	Unreinforced	Reinforced
	in (mm)	in (mm)	in (mm)	in (mm)
(2) No electrical component support – the minimum thickness required for mounting of non-electrical parts.				
(3) Examples of acceptable methods of reinforcement are:				
a) a single piece of sheet metal that is formed to result in a maximum internal angle of 120 degrees;				
b) 0.5 by 0.5 in (13 by 13 mm) 90 degrees formed from sheet steel, 0.266 in (8.1 mm) minimum thickness, used to divide a surface into small sections and, unless along the greater dimension, are additionally secured to the adjacent sides of the enclosure;				
c) flat steel bars, 0.375 in (9.5 mm) wide minimum, 0.125 in (3.2 mm) thick minimum, used and secured as in (b); and				
d) curved, ribbed, or flanged surfaces. A surface is considered to be flanged if the two opposite sides are bent 0.50 in (13 mm) or wider at right angles to the surface.				
(4) For coated or finished metals, the minimum thickness is considered to be obtained if the overall thickness exceeds that required in this table by at least 0.0005 in (0.013 mm) for each side coated or finished.				
(5) Length – the longest straight line that can be drawn on any unreinforced flat section.				

9.3 The thickness of an enclosure material constructed of cast metal shall be in accordance with [Table 9.2](#).

Table 9.2
Minimum thickness of cast metal for enclosures

Material	Unreinforced		Reinforced	
	in	(mm)	in	(mm)
Cast metal	0.126	(3.2)	0.094	(2.4)
Cast malleable iron	0.094	(2.4)	0.063	(1.6)
Permanent mold – cast aluminum	0.094	(2.4)	0.063	(1.6)
Die cast metal	0.079	(2.0)	0.047	(1.2)
Note: Reinforced dimensions are usable at the root of threads, a surface that is curved or otherwise reinforced; and for a surface of such shape, or size, or both, that the strength contemplated is provided. Areas for breakouts, or similar reasons, are able to have thinner sections, when the strength of structure is not affected, and in no case thinner than required for sheet metal.				

9.4 An enclosure formed of a polymeric material, shall comply with the Impact, Flammability, Mold Stress, and Relative Temperature Index (RTI) of UL 746C.

Exception: When the temperature measured during the normal temperature test is less than 65°C (149°F), the enclosure is not required to comply with the RTI requirement.

9.5 A polymeric material relied upon to provide all or a portion of the strain relief shall comply with the requirements of the Strain Relief for Flexible Cord Test, Section 41, after the Mold Stress Relief Distortion Test in UL 746C.

9.6 An enclosure shall be assembled to provide the mechanical strength required to resist the expected conditions of use without resulting in a risk of fire, electric shock, or injury to persons due to total or partial failures that cause reduction of spacings (electrical or thermal), loosening or displacement of parts, or

other serious defects. Where an enclosure relies on adhesive, the adhesive shall be suitable for the associated temperature, environmental exposure, surface materials, and mechanical forces.

10 Openings

10.1 All splices, open coil devices, capacitors, leads or terminals for field connection of supply wires, other arcing live parts, or current-carrying parts involving a risk of fire or shock shall be provided with an enclosure of a material specified in Enclosure, Section [9](#) without any open holes.

Exception: Open holes are able to be used when all uninsulated current-carrying parts or splices involving a risk of shock as defined in [3.19](#) are not accessible by the accessibility probe shown in [Figure 22.1](#) and the open holes do not exceed the dimensions specified in [10.2](#).

10.2 An open hole in the enclosure shall not exceed 1-1/2 in² (968 mm²) in area, and the total area of one or more open holes shall not be more than 15% of the area of the surface in which the hole or holes are located.

Exception: A higher percentage of surface area may be open where the materials and configuration of the surface retain sufficient mechanical integrity for the application.

10.3 An enclosure containing a fuse mounted in an open type fuseholder shall have no open holes.

Exception: Openings in an enclosure containing an open type fuseholder are able to be located 6 in (152 mm) or more from the fuse, measured horizontally, when the power unit is mounted as intended.

10.4 *Deleted*

11 Recessed Housings

11.1 A recessed product shall be constructed such that a hole in a ceiling or wall structure is closed off by the recessed housing.

11.2 A sheet metal recessed housing shall have a minimum thickness of 0.026 in (0.66 mm) when of steel, and 0.028 in (0.71 mm) when of aluminum or copper alloy.

11.3 A polymeric recessed housing shall have a generic or relative temperature index equal to or greater than the highest temperature measured on the part during the normal temperature test.

11.4 *Deleted*

11.5 A recessed housing shall comply with Section [10](#), Openings.

11.6 The recessed housing of a product marked for use in poured concrete or in ground shall contain no open holes.

11.7 The recessed housing of a product marked "TYPE IC RECESSED" shall contain no open hole as a slot or louver larger than 3/16 in (4.8 mm) in width. Any other shape of an open hole shall be such that it does not permit the entrance of a 1/4 in (6.4 mm) diameter rod.

11.8 The recessed housing of a product marked "TYPE NON-IC RECESSED" shall contain no open hole as a slot or louver larger than 3/8 in (9.5 mm) in width. Any other shape of an open hole shall be such that it does not permit the entrance of a 1 in (25.4 mm) diameter rod.

11.9 The total area of all open holes in a recessed luminaire housing shall be no more than 15 % of the area of the inside diameter of the recessed housing or plaster frame where the housing or frame passes through the hole in the mounting surface.

Exception: A higher percentage of surface area may be open where the materials and configuration of the surface retain sufficient mechanical integrity for the application.

11.10 A polymeric recessed housing shall be marked as specified in [48.5.7](#).

11A Equipment for Use in Environmental Air-Handling Spaces (Plenums)

11A.1 Equipment with polymeric enclosure parts intended to be installed in air-handling spaces^a shall comply with the requirements in UL 2043.

^a Equipment evaluated in accordance with these requirements is considered to comply with the fire retardant and low smoke producing requirements of Section 300.22(C) of the National Electrical Code, NFPA 70; Chapter 4 of Standard for the Installation of Air-Conditioning and Ventilating Systems, NFPA 90A; Section 602 of the International Mechanical Code; and Section 602 of the Uniform Mechanical Code.

11A.2 Equipment that complies with [11A.1](#), and equipment with a metal enclosure (even if that enclosure is ventilated), is permitted to be marked in accordance with [48.1.9](#).

12 Corrosion Protection

12.1 Ferrous metal parts of the enclosure not inherently corrosion resistant shall be protected against corrosion by enameling, galvanizing, zinc or cadmium plating, or other equivalent means.

12.2 Edges, punched holes, and spot welds in prefinished steel, enclosed steel pipe, and hanger locations for painting or plating in ferrous metals do not require any corrosion protection.

13 Damp and Wet Locations

13.1 Products marked suitable for wet locations in accordance with [48.2.12](#) shall comply with the wet location construction and performance requirements of UL 1598.

13.2 Products marked suitable for damp locations in accordance with [48.2.13](#) shall comply with the following:

- a) Ferrous metal parts shall be protected against corrosion by enameling, galvanizing, zinc or cadmium plating, or other equivalent means; and
- b) The product shall not be provided with any information such as markings, instructions, or illustrations either on the carton or with the product that implies or depicts a wet location use.

13.3 Power units intended for exposed bare conductor lighting systems shall not be marked suitable for wet or damp locations.

CONSTRUCTION – ELECTRICAL

14 Current-Carrying Parts

14.1 All current-carrying parts shall be made of copper or copper alloy.

Exception: Aluminum and aluminum alloys are permitted to conduct current in the output circuit of exposed bare conductor lighting systems.

15 Conductors and Cords

15.1 Wiring not protected in accordance with Exposed Bare and Insulated Conductors, Section 30 shall consist of general use wire or appliance wiring material with insulation rated for the maximum temperature and voltage of the unit.

15.2 Conductors shall be 18 AWG (0.82 mm²) minimum.

Exception No. 1: Conductors of a size smaller than 18 AWG, but not smaller than 24 AWG (0.20 mm²), may be used under the following conditions:

- a) Where they are completely enclosed;*
- b) Where they are not subject to movement under normal use; and*
- c) In the secondary of a transformer, or in a circuit using solid-state devices.*

Exception No. 2: Conductors of any size are permitted when the conductors are in Class 2 or equivalent isolated low voltage, limited energy circuits only and are physically separated from all other non-Class 2 or non-isolated low voltage, limited energy circuits, such as by a barrier or reliably fixed spacing of minimum 0.25 in (6.4 mm).

15.3 The maximum ampacity of 18 AWG (0.82 mm²) or larger wire and cord with copper conductors shall be in accordance with [Table 15.1](#).

Exception: A conductor is not required to be sized in accordance with [Table 15.1](#) when it complies with the Direct-Current Bus-Bar or Conductor Resistance Test described in UL 1574.

Table 15.1
Maximum ampacities of wire and cords

Types of wire and cord ^a	Ampacity ^b				
	18 AWG (0.82 mm ²)	16 AWG (1.3 mm ²)	14 AWG (2.1 mm ²)	12 AWG (3.3 mm ²)	10 AWG (5.3 mm ²)
General building wire (Conductors for general wiring)	—	—	20	25	30
Fixture wire	6	8	17	23	28
Flexible cord ^c	10	13	18	25	30
Appliance wiring material	6	8	17	23	28
^a Except for appliance wiring material, see NFPA 70, for required wire and cord types covered by these designations.					
^b The SI equivalent for each conductor size is shown in parentheses in terms of cross-sectional area.					
^c These ampacities are applicable to 2-conductor cords carrying current.					

16 Splices and Connections

16.1 A splice made with solder or a wire connector shall be electrically and mechanically secure.

16.2 An insulated splice or connector shall be provided with insulation that has temperature and voltage ratings equal to or greater than required for the conductor insulation.

16.3 Soldered connections to printed wiring boards shall be secured by one of the following methods:

- a) A conductor passed through a hole and soldered on the opposite side.
- b) A solder connection covered with epoxy, silicone rubber, or potting.
- c) A surface mount connection with solder reflow.
- d) A conductor held rigidly in place (without the use of solder) so as to preclude any movement at the point of electrical connection.
- e) Surface Mount Device (SMD) components and components without integral leads soldered to the printed wiring board. Surface mounted connector receptacles and associated connectors with leads are acceptable without additional mechanical securement where the lead wires are not subject to movement after assembly.
- f) Where supplied by a Class 2 or LVLE source, solder alone is sufficient if detachment will not reduce spacings of electrical parts to non-Class 2 or non-LVLE circuits below the applicable required spacings.
- g) A wave-solder connection to a metal-clad printed-circuit board without any further mechanical security.
- h) Any other method that offers mechanical securement of the connection before soldering.

17 Transformer

17.1 The primary and secondary windings of a transformer shall be isolated and comply with one of the following:

- a) UL 5085-1, and UL 5085-2;
- b) UL 5085-1, and UL 5085-3;
- c) UL 1411;
- d) UL 1838;
- e) UL 1012; or
- f) UL 1310.

17.2 A Class 2 power unit employing a transformer shall comply with the Class 2 requirements of UL 5085-1, and UL 5085-3, or UL 1310.

17.3 The construction of a transformer in a power unit marked suitable for wet locations shall comply with at least one of the following:

- a) Primary and secondary windings mounted on separate sections of the core;
- b) Primary and secondary windings separated by a shield of copper minimum 0.002 in (0.051 mm) thick, or brass, minimum 0.005 in (0.127 mm) thick;
- c) A flanged bobbin-wound construction that complies with UL 1012;
- d) A split bobbin construction and comply with the requirements for double insulation in UL 1097, or UL 2097;

- e) UL 1411, construction, performance, and 3500 V rms dielectric voltage withstand test requirements;
- f) The Class 2 requirements in UL 5085-1, and UL 5085-3; or
- g) UL 1310 and be marked as double insulated.

17.4 The shield in [17.3\(b\)](#) shall be bonded to the transformer core and to the power unit grounding means. The bonding shall comply with the Grounding Continuity Test, Section [40](#).

Exception: Bonding the shield to the core is not required for a toroidal type transformer when the transformer is isolated from ground.

17.5 A connection shall be made between the shield and ground by means of a bonding lead sized at least as large as the conductor used to supply the primary winding magnet wire, and shall be no smaller than 18 AWG (0.82 mm²).

18 Electronic Power Supply

18.1 An electronic power supply of a power unit shall comply with the electrical construction and performance requirements of one of the following standards:

- a) UL 1012;
- b) UL 1310;
- c) UL 60950-1; or UL 62368-1;
- d) UL 879; or
- e) UL 8750.

18.2 A power unit that complies with the applicable output performance requirements of UL 1310, is permitted to be marked in accordance with [48.2.10](#). A power unit whose output complies with (a), (b), or (c) below is permitted to be marked in accordance with [48.2.11](#):

- a) The LPS (limited power source) parameters of UL 60950-1;
- b) The LVLE (low voltage limited energy) parameters of UL 8750 where the marked wattage or VA is 100 or less; or
- c) The Limited Power Source Test of UL 2054.

18.3 A power unit with an electronic power supply shall isolate the primary from the secondary by such means as optical isolators that comply with the UL 1577, or transformers that comply with Transformer, Section [17](#).

19 Protective Devices

19.1 Each output of the power unit shall be limited to a maximum of 25 A, either by design or by operation of a protective device. Compliance shall be determined by the Maximum Output Test, [33.2.2](#).

19.2 An overcurrent protective device shall comply with the appropriate Standard.

19.3 A nonresettable thermal protective device shall be inaccessible and shall be located within the enclosure.