



UL 773

STANDARD FOR SAFETY

Plug-In Locking Type Photocontrols for
Use with Area Lighting

ULNORM.COM : Click to view the full PDF of UL 773 2020

ULNORM.COM : Click to view the full PDF of UL 773 2020

UL Standard for Safety for Plug-In Locking Type Photocontrols for Use with Area Lighting, UL 773

Fifth Edition, Dated March 18, 2016

Summary of Topics

This revision of UL 773 dated July 29, 2020 includes adding the reference of UL 60730-1 to cover electronic requirements and UL 746C to cover polymeric materials; [7.4](#), Section [7A](#), [10.1.1](#), [10.2](#), Section [18A](#), and [33.1.1](#).

Text that has been changed in any manner or impacted by UL'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 April 10, 2020.

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 UL.

UL 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 UL 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 UL or an authorized UL representative has been advised of the possibility of such damage. In no event shall UL'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 UL 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.

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 773 2020

MARCH 18, 2016

(Title Page Reprinted: July 29, 2020)

1

UL 773

Standard for Plug-In Locking Type Photocontrols for Use with Area Lighting

The First edition was titled Plug-In Locking Type Photocontrols for Use With Area and Roadway Lighting.

First Edition – November, 1974
Second Edition – September, 1982
Third Edition – June, 1987
Fourth Edition – January, 1995

Fifth Edition

March 18, 2016

This UL Standard for Safety consists of the Fifth Edition including revisions through July 29, 2020.

The Department of Defense (DoD) has adopted UL 773 on May 7, 1984. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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

COPYRIGHT © 2020 UNDERWRITERS LABORATORIES INC.

No Text on This Page

ULNORM.COM : Click to view the full PDF of UL 773 2020

CONTENTS

INTRODUCTION

1	Scope	5
2	Components	5
3	Units of Measurement	5
4	Undated References	5
5	Glossary	5

CONSTRUCTION

ALL EQUIPMENT

6	General	6
7	Insulating Material	6
7A	Polymeric Enclosures	6
8	Corrosion Protection	7
9	Current-Carrying Parts	9
10	Spacing	10

CONTROL UNIT

11	General	10
12	Enclosure	12
13	Internal Wiring	12
14	Coil Windings	12

SHORTING AND OPEN-CIRCUIT PLUGS

15	General	12
----	---------------	----

CONTROL RECEPTACLE

16	General	13
17	Enclosure	15
18	Field Wiring	16
18A	Electronic Circuits	17

PERFORMANCE

19	General	17
20	Interchangeability Test	19
21	Raintightness Test	21
22	Exposure to Ultraviolet and Water Test	24
23	Exposure to Humid Atmosphere Test	24
24	Exposure to Low Temperature Test	25
25	Mold Stress Relief Test	25
26	Resistance to Impact Test	25
27	Horizontal Burning Test	26
28	Normal Temperature Test	26
29	Operation Test	27
30	Overload Test	28
31	Endurance Test	29

31.1	General.....	29
31.2	Electronic ballast, CFLs and LED driver rated controls.....	30
32	Dielectric Voltage-Withstand Test	34
33	Abnormal Switching Test.....	34
34	Spark Gap Test	35

MANUFACTURING AND PRODUCTION TESTS

35	Production-Line Dielectric Voltage-Withstand	35
----	--	----

RATING

36	Details	36
----	---------------	----

MARKING

37	Details	36
----	---------------	----

ULNORM.COM : Click to view the full PDF of UL 773 2020

INTRODUCTION

1 Scope

1.1 These requirements cover light-sensitive control units of the plug-in, locking type, rated 480 V ac or less, for controlling outdoor electric lighting fixtures used for area lighting.

1.2 These requirements also cover receptacle devices equipped electrically and mechanically to receive the light-sensitive control units described in [1.1](#).

1.3 Shorting and open-circuit devices, used as substitutes, where necessary, for the light-sensitive control units described in [1.1](#), are also covered by the requirements in this standard, where applicable.

1.4 These requirements do not cover photoelectric switches, intended for residential, industrial or commercial use, of the non-plug-in, nonlocking type.

2 Components

2.1 Except as indicated in [2.2](#), a component of a product covered by this standard shall comply with the requirements for that component.

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.

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

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.

3 Units of Measurement

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

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.

5 Glossary

5.1 ACCESSIBLE PART – A part so located that it can be contacted by a person, either directly or by means of a probe or tool.

5.2 CONTROL RECEPTACLE – An outlet device equipped electrically and mechanically to receive a control unit having a standard 3-blade plug configuration.

5.3 CONTROL UNIT – A plug-in, locking type, light-sensitive control device, with a standard 3-blade plug configuration, used with a mating control receptacle for the control of outdoor electric lighting fixtures for area lighting.

5.4 LIVE PARTS – Denotes metal or other conductive parts that have a potential difference with respect to ground or any other conductive part.

5.5 OPEN-CIRCUIT PLUG – A device similar in construction to a shorting plug, but intended to maintain a lighting fixture in the off mode of operation until removed.

5.6 SHORTING PLUG – A plug-in, locking type device, having the same standard 3-blade plug configuration as a control unit and which provides an electrical connection through the control receptacle of an outdoor electric lighting fixture, without performing a control function. A shorting plug is used as a substitute, where necessary, for a control unit and maintains a lighting fixture in the on mode of operation until removed.

CONSTRUCTION

ALL EQUIPMENT

6 General

6.1 The requirements detailed in Sections [7](#) – [10](#) are applicable to all equipment covered by this standard. Requirements applicable to specific equipment only are detailed separately.

7 Insulating Material

7.1 A base for mounting of uninsulated live parts shall be strong, not easily ignited, moisture-resistant and insulating. The base shall be so constructed that, considering the material used, it will withstand the most severe conditions likely to be encountered in service.

7.2 Insulating material, including barriers between parts of opposite polarity and material that may be subject to the influence of the arc formed by the opening of contacts, shall be acceptable for the particular application.

7.3 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts.

7.4 Polymeric materials used to meet the requirements of [7.1](#) and [7.2](#) shall comply with the requirements of UL 746C, Standard for Polymeric Materials – Use in Electrical Equipment Evaluations. Polymeric materials that may be exposed to the outdoor elements and/or subjected to sunlight shall be evaluated or rated for resistance to water absorption and exposure to UV in accordance with the requirements of Section [22](#).

7A Polymeric Enclosures

7A.1 Polymeric material used in the construction of the enclosure shall comply with the requirements under path II (all other portable equipment) of Table 4.1 in UL 746C, Standard for Polymeric Materials – Use in Electrical Equipment Evaluations for the intended purpose and application.

Exception: Polymeric materials used in the Fresnel lens of a control shall have a minimum flame rating of HB where the PWB serves as the barrier to the spread of fire.

8 Corrosion Protection

8.1 Iron and steel parts, except for thermal elements, magnet-pole faces, hardened and polished parts such as latching surfaces, and the like where such protection is impractical, shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means.

8.2 Phosphate treatment with an oil or wax coating is acceptable as corrosion protection for magnets and armatures; oil treatment is acceptable as corrosion protection for steel springs; and stainless steel is acceptable without additional protection, if properly polished or treated.

8.3 All surfaces of a metal enclosure, and all attached metal parts of an enclosure, shall be protected against corrosion by one of the coatings described in [8.4](#) – [8.6](#), unless the metal is inherently resistant to corrosion. Metals shall not be used in combinations as to cause galvanic action that will adversely affect any part of the device.

8.4 A sheet steel enclosure shall be protected against corrosion by one of the coatings as specified in (a) – (f).

a) Hot-dipped mill galvanized sheet steel conforming with the coating Designation G90 in Table I of ASTM Designation A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in this ASTM Designation. The weight of the zinc coating may be determined by an acceptable method; however, in case of question the weight of coating shall be established in accordance with the test method of ASTM Designation A90.

b) A zinc coating, other than that provided on hot-dipped mill galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00061 inch (0.015 mm) on each surface with a minimum thickness of 0.00054 inch (0.014 mm). The thickness of the coating shall be established by the chromic acid dropping test as described in [8.5](#). An annealed coating shall comply with [8.6](#).

c) A zinc coating conforming with item 1 or 2 and with one coat of an organic finish of the epoxy or alkyd-resin type or other outdoor paint on both surfaces after forming. The acceptability of the paint may be determined by consideration of its composition or by corrosion tests if these are considered necessary.

1) Hot-dipped mill galvanized sheet steel conforming with the coating Designation G60 or A60 in Table I of ASTM Designation A653/A653M, with not less than 40 percent of the zinc on any side, based on the minimum single spot test requirement in this ASTM Designation. The weight of zinc coating may be determined by any acceptable method; however, in case of question the weight of coating shall be established in accordance with the test method of ASTM Designation A90. An A60 (alloyed) coating shall also comply with [8.6](#).

2) A zinc coating, other than that provided on hot-dipped mill galvanized sheet steel, uniformly applied to an average thickness of not less than 0.00041 inch (0.010 mm) on each surface with a minimum thickness of 0.00034 inch (0.009 mm). The thickness of the coating shall be established by the chromic acid dropping test as described in [8.5](#). An annealed coating shall also comply with [8.6](#).

d) A cadmium coating not less than 0.0010 inch (0.025 mm) thick on both surfaces. The thickness of coating shall be established by the chromic acid dropping test as described in [8.5](#).

e) A cadmium coating not less than 0.00075 inch (0.019 mm) thick on both surfaces with one coat of outdoor paint on both surfaces, or not less than 0.00051 inch (0.013 mm) thick on both surfaces with two coats of outdoor paint on both surfaces. The thickness of the cadmium coating shall be established by the chromic acid dropping test as described in [8.5](#) and the paint shall be as specified in (c).

f) Other finishes, including paints, special metal finishes, or combinations of the two may be accepted when comparative tests with galvanized sheet steel (without annealing, wiping or other surface treatment) as specified in (a), indicate they provide equivalent protection. Among the factors which are taken into consideration when evaluating the acceptability of such coating systems are exposure to salt spray, moist carbon dioxide-sulphur dioxide-air mixtures, moist hydrogen sulphide-air mixtures, ultraviolet light, and water.

8.5 The method of determining the thickness of coating by the chromic acid dropping test as specified in (a) – (h).

a) The solution to be used for the chromic acid dropping test is to be made from distilled water and is to contain 200 g/L of chemically pure chromic acid (CrO_3) and 50 g/L of chemically pure concentrated sulphuric acid (H_2SO_4). (The latter is equivalent to 27 mm/L of chemically pure concentrated sulphuric acid, specific gravity 1.84, containing 96 percent of H_2SO_4 .)

b) The test solution is to be contained in a glass vessel, such as a separatory funnel, with the outlet equipped with a stopcock and a capillary tube of approximately 0.025 inch (0.64 mm) inside bore and 5.5 inches (140 mm) long. The lower end of the capillary tube shall be tapered to form a tip, the drops from which are to be about 0.05 mm each. To preserve an effectively constant level, a small glass tube is to be inserted in the top of the funnel through a rubber stopper and its position adjusted so that, when the stopcock is open, the rate of dropping is 100 ± 5 drops per minute. If desired, an additional stopcock may be used in place of the glass tube to control the rate of dropping.

c) The sample and the test solution should be kept in the test room long enough to acquire the temperature of the room, which should be noted and recorded. The test is to be conducted at a room temperature of $70.0 - 90.0^\circ\text{F}$ ($21.1 - 32.0^\circ\text{C}$).

d) Each sample is to be thoroughly cleaned before testing. All grease, lacquer, paint, and other nonmetallic coatings are to be removed completely using an appropriate solvent. Samples are then to be thoroughly rinsed in water and dried with clean cheesecloth. Care should be exercised to avoid contact of the cleaned surface with the hands or any foreign material.

e) The sample to be tested is to be supported from 0.7 to 1 inch (18 to 25 mm) below the orifice, so that the drops of solution strike the point to be tested and run off quickly. The surface to be tested should be inclined about 45 degrees from horizontal.

f) After cleaning, the sample to be tested is to be put in place under the orifice. The stopcock is to be opened and the time in seconds is to be measured with a stop watch until the dropping solution dissolves off the protective metal coating, exposing the base metal. The end point is the first appearance of the base metal recognizable by the change in color at that point.

g) Each sample of a test lot is to be subjected to the test at three or more points, excluding cut, stenciled, and threaded surfaces, on the inside surface and at an equal number of points on the outside surface, at places where the metal coating may be expected to be the thinnest. On enclosures made from precoated sheets, the external corners that are subjected to the greatest deformation may have thin coatings.

h) To calculate the thickness of the coating being tested, select from [Table 8.1](#) the thickness factor appropriate for the temperature at which the test was conducted and multiply by the time in seconds required to expose base metal as specified in (f).

Table 8.1
Coating-thickness factors

Temperature, degrees F (C)	Thickness factors, 0.00001 inch (0.00025 mm) per second	
	Cadmium platings	Zinc platings
70 (21.1)	1.331	0.980
71 (21.7)	1.340	0.990
72 (22.2)	1.352	1.000
73 (22.8)	1.362	1.010
74 (23.3)	1.372	1.015
75 (23.9)	1.383	1.025
76 (24.4)	1.395	1.033
77 (25.0)	1.405	1.042
78 (25.6)	1.416	1.050
79 (26.1)	1.427	1.060
80 (26.7)	1.438	0.070
81 (27.2)	1.450	1.080
82 (27.8)	1.460	1.085
83 (28.3)	1.470	1.095
84 (28.9)	1.480	1.100
85 (29.4)	1.490	1.110
86 (30.0)	1.501	1.120
87 (30.6)	1.513	1.130
88 (31.1)	1.524	1.141
89 (31.7)	1.534	1.150
90 (32.2)	1.546	1.160

8.6 A hot-dipped mill galvanized A60 (alloyed) coating or an annealed coating on sheet steel which is bent or similarly formed or extruded or rolled at edge of holes after annealing shall be additionally painted in the effected area if the process damages the zinc coating. If flaking or cracking of the zinc coating at the outside radius of the bend for formed section is visible at 25 power magnification, the zinc coating is considered to be damaged. Simple sheared or cut edges and punched holes are not required to be additionally protected.

9 Current-Carrying Parts

9.1 Current-carrying parts shall have the mechanical strength and ampacity (current-carrying capacity) needed for the service and shall be of metal that is acceptable for the particular application.

9.2 Except as noted in [9.3](#), uninsulated live parts shall be prevented from turning or shifting in position by methods other than friction between surfaces if such motion may result in reduction of spacings to less than as indicated in [Table 10.1](#).

9.3 A lock washer, properly applied, is generally considered acceptable with respect to the requirement of [9.2](#).

9.4 The security of contact assemblies shall be such as to provide for the continued alignment of contacts.

10 Spacing

10.1 Control units, shorting and open circuit plugs, and control receptacles shall have spacings between any uninsulated live part and an uninsulated live part of opposite polarity or an accessible dead-metal part not less than as indicated in [Table 10.1](#), except as specified in [10.3](#).

Table 10.1
Minimum spacings

Components	Potential involved volts	Through air		Over surface	
		inch	(mm)	inch	(mm)
Control unit	0 – 250	1/16	(1.6)	3/32	(2.4)
	251 – 480	3/32	(2.4)	1/8	(3.2)
Shorting plug, open-circuit plug, and control receptacle	480	1/8	(3.2)	1/8	(3.2)

10.1.1 As an alternate to [10.1](#), the electronics used in control units shall comply with the creepage and clearance requirements of UL 840, Standard for Insulation Coordination including Clearances and Creepage Distances for Electrical Equipment or UL 60730-1, Standard for Automatic Electrical Controls – Part 1: General Requirements.

10.2 Insulating material used in place of the air space specified in [Table 10.1](#) shall be of a type that is acceptable for the sole support of live parts and shall comply with the requirements of Section [7](#).

10.3 If the construction of a control unit is such that reduced spacings are provided, between live parts, for protection against surge voltages (provision of the spark gap), then such reduced spacings shall be specified by the manufacturer. The voltage, at which such a spark gap is intended to arc, or break down, shall also be specified.

10.4 Surge voltage protection, as described in [10.3](#), shall be subjected to the spark gap test detailed in [34.1](#) – [34.3](#).

CONTROL UNIT

11 General

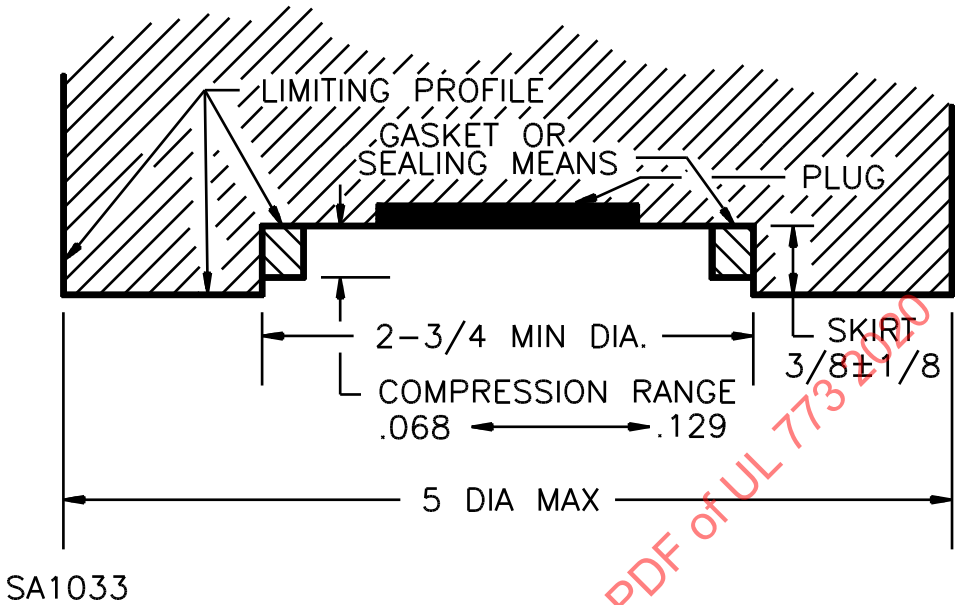
11.1 A control unit shall be of the plug-in, locking type, 3-pole, 3-wire, with the plug blade configuration and limiting dimensions as specified in the Standard for Physical and Electrical Interchangeability and Testing for Locking-Type Photocontrol Devices and Mating Receptacles for Roadway and Area Lighting Equipment, ANSI C136.10.

11.2 For dimming applications, a control unit shall be of the plug-in, locking type, 3-pole, 3-wire with the addition of two (optionally four) conductors, with the plug blade configuration and limiting dimensions as specified in the Standard for Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver, ANSI C136.41.

11.3 A control unit shall comply with the profile restriction of [Figure 11.1](#).

Exception: The diameter of the skirt may be greater than 5 inches provided that the product complies with the marking requirements of [37.7](#).

Figure 11.1
Configuration and limiting dimensions for control unit, shorting plug



Gasket and Sealing Means – A sealing means shall be provided on the control device which will form an effective seal at the required seat in [Figure 16.1](#) with the unit control device installed in its locked position, the sealing means shall not encroach on the area within the limiting profile of the mounting shown in [Figure 16.1](#). Gasket or sealing means must be compressible to provide an effective seal over the range of 0.129 – 0.068 inch (3.28 – 1.73 mm).

Limiting Profile – The profile of the control device, with the exception of the sealing means and the electrical contacts of the plug, shall not project into the area below the limiting profile.

Dimensions – All dimension in inches.

Inch	0.068	1/8	0.129	3/8	2-3/4	5
(mm)	(1.73)	(3.2)	(3.28)	(9.5)	(69.8)	(127)

12 Enclosure

12.1 The enclosure of a control unit shall be so constructed that it will withstand the ordinary abuses and environmental conditions to which it may be subjected in its intended use. This is to be without increasing the risk of fire, shock or personal injury due to total or partial collapse. A resulting reduction of spacings to less than as specified in [Table 10.1](#), loosening or displacement of parts, or other serious defects shall not occur.

12.2 Compliance with [12.1](#) is to be determined by subjecting representative control units to the test procedures listed in [Table 19.1](#).

13 Internal Wiring

13.1 Internal wiring shall consist of general use wire, or appliance wiring material, acceptable for the particular application, when considered with respect to the temperature, voltage and conditions of service to which the wiring is likely to be subjected.

13.2 Internal wiring shall be so supported or routed that contact with moving parts or parts having sharp edges or burrs, that may cause abrasion of conductor insulation, will not be likely.

13.3 A bare conductor, including pigtails and coil leads, shall be so supported that the spacings specified in [Table 10.1](#) will be maintained.

13.4 All joints and connections shall be mechanically secure and shall provide adequate and reliable contact without strain on connections and terminals.

13.5 A splice shall be provided with insulation equivalent to that of the wires involved.

13.6 Aluminum conductors, insulated or uninsulated, used for internal-wiring interconnections between current-carrying parts shall be terminated at each end by a method appropriate for the combination of metals involved at the connection point.

13.7 If a wire-binding screw construction or a pressure-wire connector is used as a terminating device, it shall be acceptable for use with aluminum under the conditions involved (for example, temperature, heat cycling, vibration).

14 Coil Windings

14.1 Coil windings of relays shall resist the absorption of moisture. This may be accomplished by impregnating, dipping or brushing with varnish, or by equivalent means.

14.2 In general, enamel insulated wire, nylon and phenolic bobbins, treated fibers, treated electrical tapes and most Class 105 insulations having a varnish or similar treatment are considered inherently resistant to the absorption of moisture and need not be further treated.

SHORTING AND OPEN-CIRCUIT PLUGS

15 General

15.1 Shorting and open-circuit plugs shall be of the plug-in, locking type, 3-pole, 3-wire, with the plug blade configuration and limiting dimensions as specified in the Standard for Physical and Electrical Interchangeability and Testing for Locking-Type Photocontrol Devices and Mating Receptacles for Roadway and Area Lighting Equipment, ANSI C136.10.

15.2 For dimming applications, shorting and open-circuit plugs shall be of the plug-in, locking type, 3-pole, 3-wire with the addition of two (optionally four) conductors, with the plug blade configuration and limiting dimensions as specified in the Standard for Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver, ANSI C136.41.

15.3 Shorting and open-circuit plugs when mounted in the intended manner of use, shall comply with the profile restrictions in [Figure 11.1](#).

15.4 A shorting or open-circuit plug shall be so constructed that it will withstand the abuses and environmental conditions to which it may be subjected in its intended use. This is to be without increasing its risk of fire, shock or injury to persons due to total or partial collapse. A resulting reduction of spacings to less than as specified in [Table 10.1](#), loosening or displacement of parts, or other serious defects shall not occur.

15.5 Compliance with [15.4](#) shall be determined by subjecting representative samples of the shorting or open-circuit plug to the test procedures listed in [Table 19.1](#).

CONTROL RECEPTACLE

16 General

16.1 A control receptacle shall be of the plug-in locking type, 3-pole, 3-wire, with the contact configurations and limiting dimensions as specified in the Standard for Physical and Electrical Interchangeability and Testing for Locking-Type Photocontrol Devices and Mating Receptacles for Roadway and Area Lighting Equipment, ANSI C136.10.

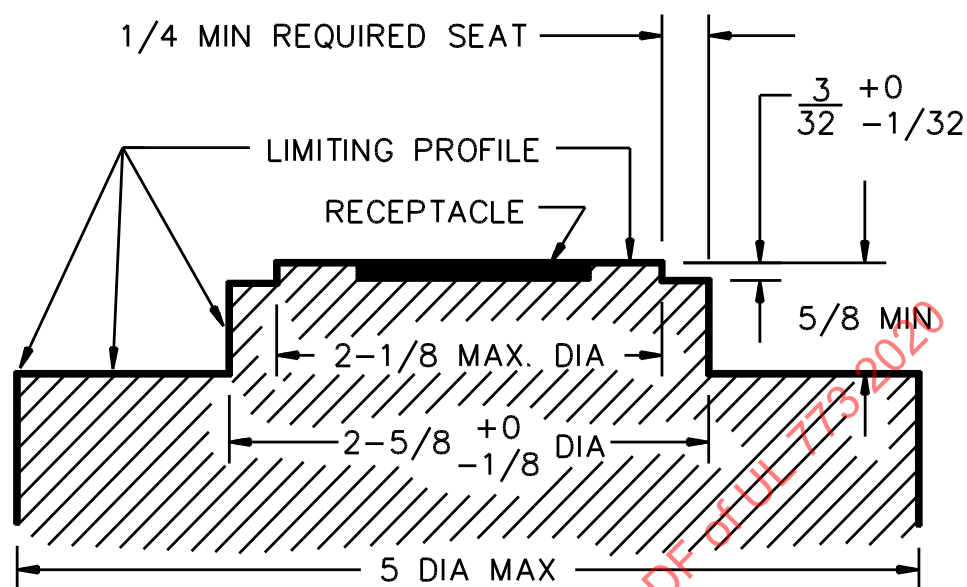
16.2 For dimming applications, a control receptacle shall be of the plug-in locking type, 3-pole, 3-wire with the addition of two (optionally four) conductors, with the plug blade configuration and limiting dimensions as specified in the Standard for Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver, ANSI C136.41.

16.3 A control receptacle, when mounted in the intended manner of use, shall comply with the profile restrictions in [Figure 16.1](#).

16.4 A control receptacle shall be constructed and mounted in such a manner that it can be rotated through a minimum of 250 degrees. A stop shall be provided to prevent rotation of more than 360 degrees. See also [37.4](#).

Figure 16.1

Configuration and limiting dimensions for control receptacle



SA1030

Required Seat – Shall be a smooth flat horizontal surface.

Limiting Profile – The profile of the receptacle and head assembly shall not project into area above the limiting profile with the control device installed.

Dimension – All dimensions in inches

Inch	1/32	3/32	1/8	1/4	5/8	2-1/8	2-5/8	5
(mm)	(0.8)	(2.4)	(3.2)	(6.4)	(15.9)	(54.0)	(66.7)	(127)

17 Enclosure

17.1 The enclosure of a control receptacle shall be so constructed that it will withstand the ordinary abuses and environmental conditions to which it may be subjected in its intended use. This is to be without increasing its risk of fire, shock or injury to persons due to total or partial collapse. A resulting reduction of spacings to less than specified in [Table 10.1](#), loosening or displacement of parts, or other serious defects shall not occur.

17.2 Compliance with [17.1](#) is to be determined by subjecting representative samples of the control receptacle to the test procedures listed in [Table 19.1](#).

17.3 An enclosure of sheet metal having the construction indicated in [Table 17.1](#) or [Table 17.2](#) will generally be considered to have an acceptable level of the factors indicated in [17.2](#).

17.4 The enclosure of a control receptacle shall have provision for the connection of one of the wiring systems in accordance with the National Electrical Code, ANSI/NFPA 70 acceptable for the particular application.

17.5 The enclosure of a control receptacle shall be acceptable for outdoor use (raintight), as determined by the test described in Raintightness Test, Section [21](#).

Table 17.1
Minimum thickness of sheet metal for enclosures – carbon steel or stainless steel^a

Without supporting frame ^b		Without supporting frame or equivalent reinforcing ^b		Minimum thickness in inches (mm)	
Maximum width ^c inches (cm)	Maximum length ^d inches (cm)	Maximum width ^c inches (cm)	Maximum length inches (cm)	Uncoated	Zinc-coated
8.0 (20.3)	Not limited	12.0 (30.5)	Not limited	0.032 (0.81)	0.034 (0.86)
9.0 (22.9)	11.5 (29.2)	13.0 (33.0)	16.0 (40.6)		
12.5 (31.8)	Not limited	19.5 (49.5)	Not limited	0.042 (1.07)	0.045 (1.14)
14.0 (35.6)	18.0 (45.7)	21.0 (53.3)	25.0 (63.5)		
18.0 (45.7)	Not limited	27.0 (68.6)	Not limited	0.053 (1.35)	0.056 (1.42)
20.0 (50.8)	25.0 (63.5)	29.0 (73.7)	36.0 (91.4)		
22.0 (55.9)	Not limited	33.0 (83.8)	Not limited	0.060 (1.52)	0.063 (1.60)
25.0 (63.5)	31.0 (78.7)	35.0 (88.9)	43.0 (109.2)		

^a [Table 17.1](#) and [Table 17.2](#) are based upon the initial deflection of an enclosure surface with a concentrated load at the center of the surface.

^b A supporting frame is a structure of angle or channel or a folded rigid section of sheet metal which is rigidly attached to and has essentially the same outside dimensions as the enclosure surface and which has sufficient torsional rigidity to resist the bending moments which may be applied via the enclosure surface when it is deflected. Construction that is considered to have equivalent reinforcing may be accomplished by designs that will produce a structure which is as rigid as one built with a frame of angles or channels. Construction considered to be without a supporting frame includes:

- a) Single sheet with single- formed flanges (formed edges),
- b) A single sheet which is corrugated or ribbed, and
- c) An enclosure surface loosely attached to a frame (for example, with spring clips).

^c The width is the smaller dimension of a rectangular sheet-metal piece which is part of an enclosure. Adjacent surfaces of an enclosure may have supports in common and be made of a single sheet.

^d For panels which are not supported along one side (for example, side panels of boxes) the length of the unsupported side shall be limited to the dimensions specified.

Table 17.2
Minimum thickness of sheet metal for enclosures – aluminum, copper, or brass^a

Without supporting frame ^b		With supporting frame or equivalent reinforcing ^b		Minimum thickness inches (mm)
Maximum width ^c inches (cm)	Maximum length ^d inches (cm)	Maximum width ^c inches (cm)	Maximum length inches (cm)	
4.0 (10.2)	Not limited	10.0 (25.4)	Not limited	0.029 ^e
5.0 (12.7)	6.05 (15.2)	10.5 (26.7)	13.5 (34.3)	(0.74)
6.0 (15.2)	Not limited	14.0 (35.6)	Not limited	0.036 ^e
6.5 (16.5)	8.0 (20.3)	15.0 (38.1)	18.0 (45.7)	(0.91)
8.0 (20.3)	Not limited	19.0 (48.3)	Not limited	0.045
9.5 (24.1)	11.5 (29.2)	21.0 (53.3)	25.0 (63.5)	(1.14)
12.0 (30.5)	Not limited	28.0 (71.1)	Not limited	0.058
14.0 (35.6)	16.0 (40.6)	30.0 (76.2)	37.0 (94.0)	(1.47)
18.0 (45.7)	Not limited	42.0 (106.7)	Not limited	0.075
20.0 (50.8)	25.0 (63.5)	45.0 (114.3)	55.0 (139.7)	(1.91)

^{a-d} See notes a – d to [Table 17.1](#).
^e Nonferrous metal is not to be less than 0.045 inch (1.14 mm) thick at points to which a wiring system is to be attached.

18 Field Wiring

18.1 A control receptacle shall be provided with field-wiring terminals for the connection of conductors having an ampacity (current-carrying capacity in amperes) in accordance with the National Electrical Code, ANSI/NFPA 70 acceptable for the particular application, or field-connection leads.

18.2 Lead-type terminals shall not differ by more than two wire sizes from the size referred to in [18.1](#). Wire smaller than 14 AWG (2.1 mm²) shall not be used.

18.3 The insulation of lead-type terminals shall be acceptable for the purpose, such as 0.030 inch (0.76 mm) thick minimum rubber or thermoplastic material.

18.4 A lead-type terminal shall be so constructed as to withstand the stress of normal handling without damage to the control receptacle.

18.5 In order to determine compliance with the provisions of [18.4](#), each terminal lead is to withstand a tensile force increased gradually to 20 lbf (89 N), and maintained at that value for 1 minute.

18.6 Green coloring, with or without one or more yellow stripes, and white or grey coloring shall not be used for the covering of a terminal lead, unless intended for connection to grounding and grounded conductors, respectively. See also [37.3](#).

18.7 The free length of a terminal lead shall be at least 6 inches (152 mm).

18.8 A terminal connector shall be prevented from moving so as to strain factory connections or reduce spacings to unacceptable values. Friction alone is not to be depended upon to prevent such movement.

18.9 Terminal parts by which connections are made shall provide acceptable through connections even under hard usage. For 8 AWG (8.4 mm²) and larger wires, soldering lugs or solderless (pressure) wire connectors shall be used. For 10 AWG (5.3 mm²) and smaller wires, the parts to which wiring connections

are made may consist of clamps or binding screws with terminal plates having upturned lugs, or the equivalent, to hold the wires in position.

18.10 A wiring terminal shall be prevented from turning.

18.11 A wire-binding screw to which field-wiring connections are made shall not be smaller than No. 8 except that a No. 6 (13.3 mm²) screw may be used for a terminal to which 14 AWG (1.63 mm) wire would normally be connected.

18.12 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 inch (1.27 mm) in thickness and shall have not less than two full threads in the metal; except that a special alloy plate less than 0.050 inch (1.27 mm) but not less than 0.030 inch (0.76 mm) in thickness may be accepted if the tapped threads have adequate mechanical strength.

18.13 A terminal plate formed from stock having the minimum required thickness, as given in [18.12](#), may have the metal extruded at the tapped hole for the binding screw so as to provide two full threads.

18.14 A wire-binding screw shall thread into metal.

18A Electronic Circuits

18A.1 Electronic circuits shall comply with the applicable requirements of UL 60730-1, the Standard for Automatic Electrical Controls – Part 1: General Requirements.

PERFORMANCE

19 General

19.1 The performance of control units, shorting and open-circuit plugs and control receptacles shall be investigated by subjecting a representative sample (or samples), in commercial form, to the tests indicated in [Table 19.1](#). Mating plugs or control receptacles used in conjunction with the testing of these devices shall be in accordance with the dimensions specified in the Standard for Physical and Electrical Interchangeability and Testing for Locking-Type Photocontrol Devices and Mating Receptacles for Roadway and Area Lighting Equipment, ANSI C136.10 and/or the Standard for Dimming Control between an External Locking Type Photocontrol and Ballast or Driver, ANSI C136.41, as appropriate.

19.2 The order of tests shall be as indicated in [Table 19.1](#), as far as applicable. The various tests shall be conducted at rated frequency and at the test potential indicated in [Table 19.2](#).

19.3 Shorting and open-circuit plugs and control receptacles are to be tested at a potential as indicated in the 440 – 480 column of [Table 19.2](#). See also [36.4](#) and [36.5](#).

19.4 Tests on a control unit, or a shorting or open-circuit plug, are to be conducted with the unit plugged into a mating control receptacle, having the contact and profile configurations detailed in [Figure 16.1](#), where such a mating receptacle is necessary for the proper operation of the device being tested.

Table 19.3
Voltage for tests on range rated devices other than specified in [Table 19.2](#)

Test	Method of determining test potential
Resistance to Impact	Highest voltage in range
Normal Temperature	Lowest nominal voltage (simulating dusk or dawn conditions) and highest voltage (simulating daylight conditions)
Overvoltage	110 percent of highest nominal ^a voltage
Undervoltage	85 percent of lowest nominal voltage
Overload/Endurance	Lowest nominal voltage and highest voltage
^a Nominal voltages are considered to be 120, 208, 240, 277, 347, and 480	

19.5 Tests on a control receptacle are to be conducted in conjunction with a mating control unit or shorting plug, having the plug blade and profile configurations detailed in [Figure 11.1](#), where such a plug-in device is necessary for the proper operation of the control receptacle.

19.6 The operating characteristics of any control unit shall be determined from analysis of design and normal operation, prior to subjecting it to the test program.

19.7 Consideration will be given to such inherent characteristics of each unit, as effects of varying light levels (dusk and dawn twilight effects) and speed of the on-off switch function (snap-action or slow-make, slow-break characteristics) of the control unit.

19.8 From this determination of normal operating characteristics, an operating rate for cycling tests (operation, overload, and endurance) are to be established.

19.9 Any device with a specified range rating other than as indicated by examples in [Table 19.2](#), shall be tested in accordance with the requirements of [Table 19.3](#).

19.10 The value of rated current, noted in any test, may be derived by calculation from the relationship

$$A = \frac{W}{V} \quad \text{or} \quad A = \frac{VA}{V}$$

in which:

W is the rated power,

V is the nominal voltage, and

VA is the volt-ampere rating of the device.

20 Interchangeability Test

20.1 A control unit shall not constitute a risk of fire or electric shock when connected to a 480 V control receptacle circuit, in both the simulated dusk or dawn (dark) condition and daylight condition. It is acceptable to carry out both tests on one control unit provided cumulative stress as a result of sequencing testing is avoided.

20.2 The requirement specified in [20.1](#) shall be determined by adjusting a resistive load, connected to a 480 V supply, to the maximum amp rating. The maximum amperage rating is to be calculated using the rated voltage of the control unit. For devices rated in amps, the maximum amp rating is determined at

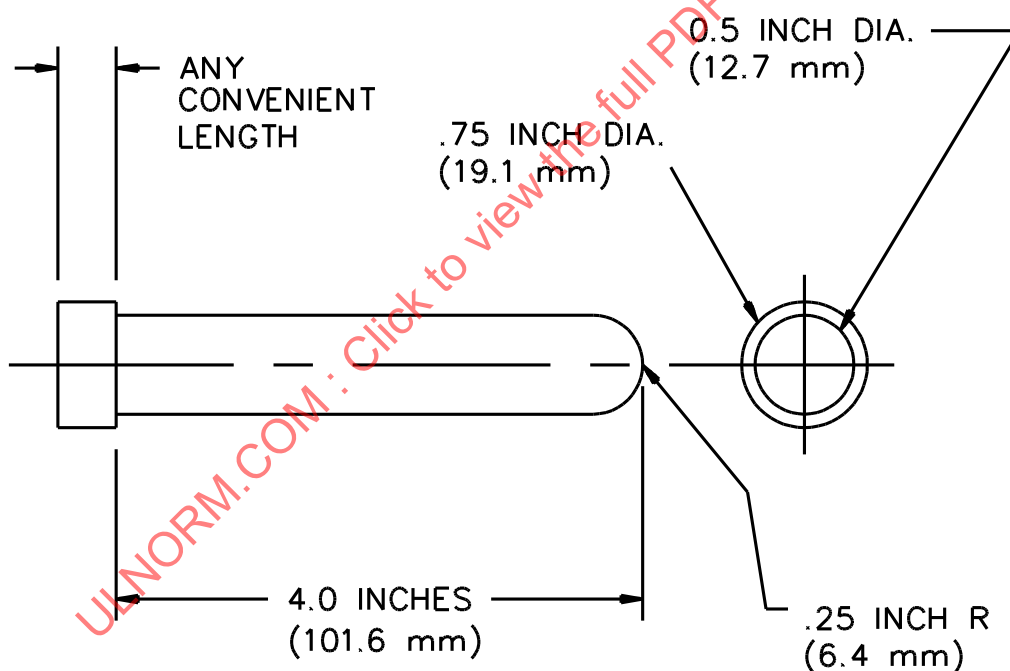
rated voltage. For devices rated in watts, the maximum amperage rating is to be calculated using rated maximum watts at rated voltage of the control unit. Three thicknesses of cloth as described in [20.4](#) are to be arranged below the control receptacle, while another three thicknesses of cloth are draped over the control unit. With the supply power off, the control unit is to be plugged into the mating receptacle, and then the supply power is to be applied. After a minimum of 1 hour, the supply is to be disconnected for conditions (a) or (b), or after a maximum of 7 hours:

- a) The control unit has reached a steady state temperature, demonstrated by three successive readings taken at minimum of 5 minutes apart showing no change greater than $\pm 2^{\circ}\text{C}$ ($\pm 3.6^{\circ}\text{F}$); or
- b) No load or monitoring/control current is measured.

20.3 Inability of the control unit to operate normally, after being subjected to the conditions specified in [20.2](#) shall not constitute unacceptable results; however, scorching of the cloth indicators or accessibility of uninsulated live parts to the test probe (see [Figure 20.1](#)) through any opening in the enclosure is considered to be unacceptable.

Figure 20.1

Test probe



PA145

20.4 The cloth to be used is to be bleached cheesecloth, 36 inches (914 mm) wide, running 14 to 15 yd/lb (28 – 30 m/kg), and having what is known to the trade as a count of 32 by 28. In placing the cloth in position for this test, the material is to be folded in such a manner that cut or torn edges will not be exposed directly to an arc or flash.

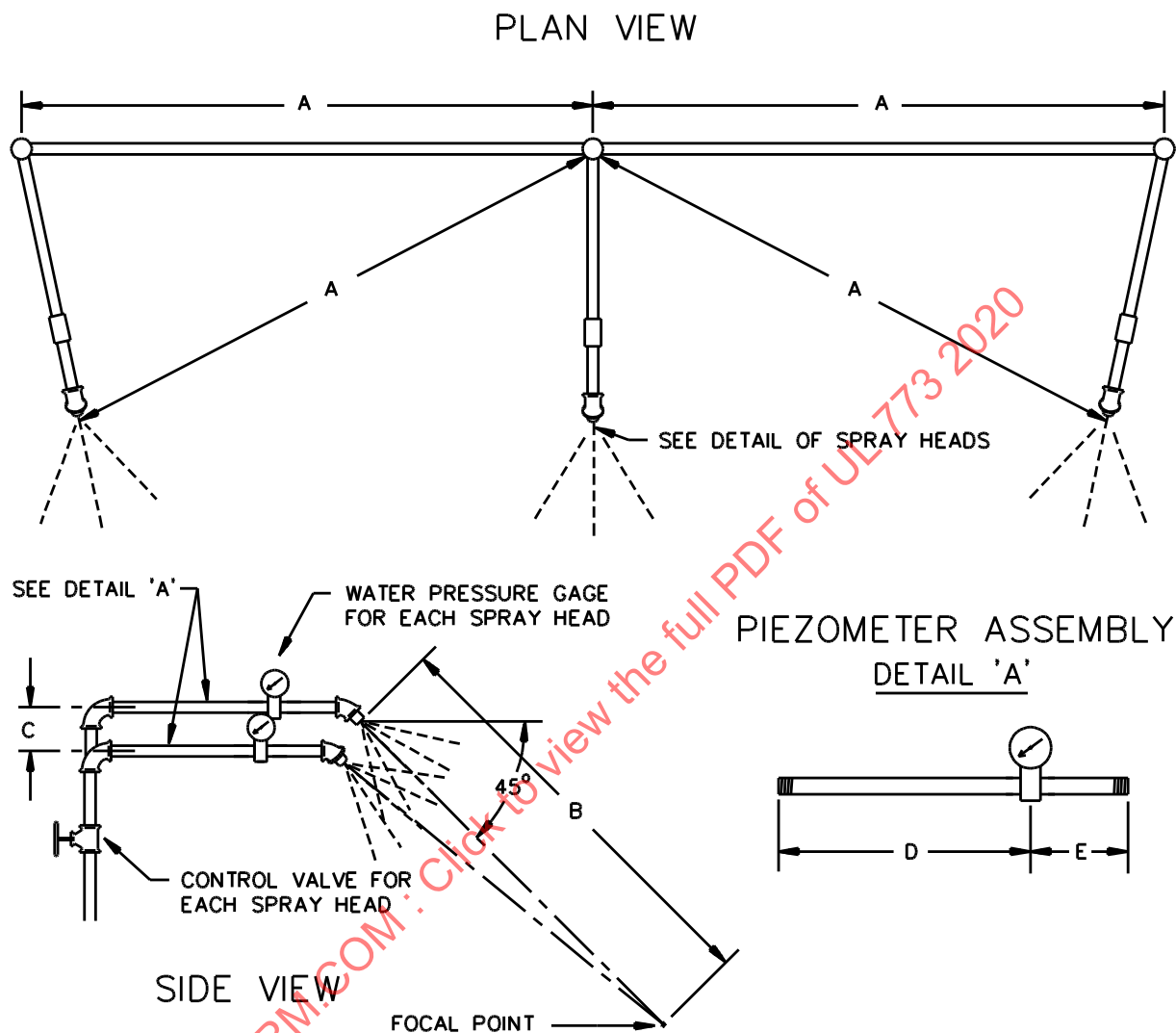
21 Raintightness Test

21.1 A control unit shall be constructed in such a manner that it will exclude the entrance of any water to the interior space of its enclosure, or to the interior of the control receptacle with which it is tested, when subjected to the water spray described in [21.2](#).

21.2 A control unit shall be firmly secured to a control receptacle and the water spray applied to the top front of the unit at an angle of 45 degrees to the vertical. The control unit is to be positioned in the focal area of the three spray heads. The water pressure is to be maintained at 5 psi (34.5 kPa) at each spray head for 1 hour. [Figure 21.1](#) and [Figure 21.2](#) depict the spray head piping and nozzle construction.

ULNORM.COM : Click to view the full PDF of UL 773 2020

Figure 21.1
Rain-test spray-head piping



Item	mm	inch
A	710	28
B	1400	55
C	55	2-1/4
D	230	9
E	75	3

RT101F

21.3 Within 5 minutes after completion of the spray test, the control unit shall be tested in accordance with Dielectric Voltage-Withstand Test, Section [32](#).

21.4 A shorting plug, an open-circuit plug, and a control receptacle shall comply with the requirements in [21.1](#) and [21.2](#).

21.5 A sealing gasket provided with a control unit, or a shorting or open-circuit plug, as a weather seal for the junction made with a control receptacle shall be evaluated by the requirements in [21.6](#) – [21.9](#).

21.6 A gasket of an elastomeric or thermoplastic material or a composition gasket utilizing an elastomeric material, used as a weather seal for the junction between a control unit or a shorting or open-circuit plug and a control receptacle, shall be resistant to aging as determined by the accelerated-aging tests described in [21.7](#) or [21.8](#).

21.7 A gasket of rubber or neoprene, or a composition thereof, is to be placed for 70 hours in a full-draft circulating-air oven at a temperature of $100 \pm 2^{\circ}\text{C}$ ($212 \pm 3.6^{\circ}\text{F}$). The gasket is considered resistant to aging if there is no visible evidence of deterioration such as softening, hardening, or cracking after flexing.

21.8 A gasket of thermoplastic material, or a composition thereof, may be accepted after consideration of the effects of heat aging, distortion under conditions of use, and the means of securing the gasket to the cover or enclosure.

21.9 The adhesive cement used to secure the gasket shall be adequately resistant to aging as determined by exposing a sample of the enclosure with the gasket cemented in place, to a temperature of 100°C (212°F) for 72 hours. The adhesive cement is considered to be adequately resistant to aging if there is no visible evidence of the gasket to peel off, or to be dislodged from the original position of the gasket during and after this test.

22 Exposure to Ultraviolet and Water Test

22.1 A polymeric enclosure of a control unit shall be capable of withstanding 360 hours of exposure to ultraviolet radiation, without adversely affecting its impact resistance, by subjecting three samples of the enclosure to the test procedure described in [22.2](#) and [22.3](#), followed by the impact test described in [24.2](#) and [24.3](#).

22.2 The enclosure samples are to be exposed to ultraviolet light from a radiation means, such as two carbon arcs formed between vertical electrodes, 1/2 inch (12.7 mm) in diameter, located at the center of a movable, vertical metal cylinder, 31 inches (787 mm) in diameter and 17-3/4 inches (451 mm) high. Each arc is to be enclosed by a clear globe of No. PX Pyrex glass, or equivalent.

22.3 The samples are to be mounted on the inside of the cylinder, in such a manner that only the external surface of the enclosure is exposed to ultraviolet radiation. The cylinder is to be rotated about the arcs at one revolution per minute. A system of nozzles is to be provided so that each sample can be sprayed, in turn, with water as the cylinder revolves. The operating cycle is to consist of 102 minutes of light only and 18 minutes of light and water. The temperature within the cylinder, while the apparatus is in operation, is to be $63.0 \pm 5.0^{\circ}\text{C}$ ($145.4 \pm 9.0^{\circ}\text{F}$), and the test is to be continued for 360 hours.

22.4 A shorting or open-circuit plug shall comply with the requirements of [22.1](#)– [22.3](#).

23 Exposure to Humid Atmosphere Test

23.1 A control unit shall resist the absorption of moisture when subjected to a humid atmosphere for not less than 168 hours by exposing a control unit, firmly secured to a control receptacle, to air at a relative humidity of 96 ± 2 percent, at a temperature of $50 \pm 2^{\circ}\text{C}$ ($122 \pm 4^{\circ}\text{F}$). The sample is then to be removed from

the humidity chamber and, within 1 minute of removal, subjected to the Dielectric Voltage-Withstand Test described in Dielectric Voltage-Withstand Test, Section [32](#).

24 Exposure to Low Temperature Test

24.1 A polymeric enclosure of a control unit shall be capable of withstanding exposure to low temperature for 72 hours by exposing a complete control unit to an ambient temperature of minus 29.0°C (minus 20.2°F). At the end of the 72 hours, the complete assembly is to be removed from the cold chamber and the control unit enclosure is to be visually inspected for cracks. Following the visual inspection, and within 1 minute of removal from the cold chamber, the control unit is to be subjected to an impact of 1 ft-lbf (1.36 N·m) by means of a solid, smooth, steel sphere, 2 inches (50.8 mm) in diameter, applied to external surfaces.

24.2 The sphere mentioned in [24.1](#) is to be allowed to fall freely, from rest, through the distance required to cause the specified impact upon the surface under test. For surfaces other than horizontal, the sphere may be suspended by a cord and allowed to fall as a pendulum through the required distance. The control unit is to be inserted into a mating control receptacle, which is rigidly held in place during the impact test.

24.3 Openings in the enclosure shall be evaluated in accordance with [20.3](#).

24.4 A shorting or open-circuit plug shall comply with the requirements of [24.1](#)–[24.3](#).

24.5 A control receptacle shall comply with the visual inspection requirements of [24.1](#) only.

25 Mold Stress Relief Test

25.1 Three samples of a device employing polymeric materials shall be conditioned by placing them in a circulating-air oven maintained at a uniform temperature at least 10°C (18°F) higher than the maximum temperature of the material, measured under normal operating conditions, but not less than 70°C (158°F) in any case. The samples are to remain in the oven for 7 hours. After careful removal from the oven and return to room temperature, they shall be checked for compliance with [25.2](#).

25.2 Conditioning of a control unit, or shorting or open-circuit plug, as described in [25.1](#) shall not:

- a) Reduce spacings below the minimum acceptable values,
- b) Make any bare live parts or internal wiring accessible to contact by test probe [Figure 20.1](#),
- c) Have an undue adverse effect on the insulation, or
- d) Produce any other condition that might increase the risk of electric shock or fire of the device.

26 Resistance to Impact Test

26.1 A control unit, shorting plug, or open-circuit plug shall not introduce a risk of fire, electric shock, or injury to persons when subjected to the impact test described in this section.

26.2 A control unit, shorting plug, or open-circuit plug shall be dropped from a height of 3 feet (0.9 m) onto a concrete surface, not less than 2 inches (51 mm) thick. The control unit is then to be inserted into a control receptacle connected to a rated supply source and a load circuit equivalent to the load rating of the control unit.

26.3 Three thicknesses of cloth (see [20.4](#)) are to be arranged below the control unit, while another three thicknesses are to be draped over the control unit during insertion into the control unit receptacle.

26.4 Inability of the control unit to operate normally after being subjected to the conditions in [26.2](#) shall not constitute unacceptable results; however, scorching of the cloth indicators or accessibility of uninsulated live parts to the test probe (see [Figure 20.1](#)) through any opening in the enclosure is considered unacceptable.

26.5 The control receptacle enclosure is to be subjected to an externally applied impact of 5 ft-lbf (6.8 N·m) applied by way of a solid, smooth, steel sphere 2 inches (50.8 mm) in diameter.

26.6 The sphere is to be allowed to fall freely from rest through the distance required to cause the specified impact upon the surface being tested. For surfaces other than horizontal, the sphere may be suspended by a cord and allowed to fall as a pendulum through the required distance. The enclosure is to be placed against a vertical wall with the surface to be tested in the same vertical plane as the point of support of the pendulum.

26.7 The surfaces mentioned in [26.6](#) are those exposed during normal service. A sample that has been struck is not required to withstand another blow. However, if more than one blow is applied to a single sample, unacceptable results after the first blow are to be disregarded provided that the same surface withstands a blow on another sample. A device that produces unacceptable results during a first blow is not acceptable.

27 Horizontal Burning Test

27.1 The enclosure material of a control unit or shorting or open-circuit plug shall have a burning rate not in excess of the requirements for Horizontal Burning Test for Classifying Materials HB as required in the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

28 Normal Temperature Test

28.1 A control unit or a shorting plug shall not attain a temperature, at any point, sufficiently high to constitute a risk of fire or to damage any materials used in the device, nor show temperature rises at specific points greater than those indicated in [Table 28.1](#).

28.2 An appropriate control receptacle is to be connected to a supply source and load, as required by the rating of the control unit or shorting plug. The control unit or shorting plug is then to be plugged into the control receptacle and secured as in its intended use. In the case of a control unit, the normal temperature test is to be conducted:

- a) With the photocell circuit carrying maximum current simulating daylight conditions and the load circuit open and
- b) With the photocell circuit simulating dusk or dawn conditions and the load circuit carrying maximum current. See [19.10](#).

28.3 The control unit or shorting plug is to be allowed to operate, under full load conditions, until constant temperatures are attained.

28.4 Except at coils, temperature readings are to be obtained by means of thermocouples consisting of wires not larger than 24 AWG (0.21 mm²). A temperature is considered to be constant when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change. The primary (preferred) method of measuring temperature on coils is the thermocouple method; but temperature measurements by either the thermocouple or resistance method are acceptable, except that the thermocouple method is not to be used for a temperature measurement at any point where supplementary heat insulation is used. When thermocouples are used in the determination of temperature in connection with the heating of electrical

devices, it is standard practice to employ thermocouples consisting of 30 AWG (0.05 mm²) iron and constantan wires and a potentiometer-type indicating instrument; and such equipment is to be used whenever referee temperature measurements by thermocouples are necessary.

Table 28.1
Maximum temperature rises

Materials and Component Parts	°C	(°F)
1. Class 90 insulation systems ^a		
Thermocouple method	50	(90)
Resistance method	60	(108)
2. Class 105 insulation systems ^a		
Thermocouple method	65	(117)
Resistance method	85	(153)
3. Class 130 insulation systems ^a		
Thermocouple method	85	(153)
Resistance method	95	(171)
4. Varnished-cloth insulation	60	(108)
5. Solid and built-up contacts, buses and connecting straps	65	(117)
6. Any combustible material	65	(117)
7. Phenolic composition used as electrical insulation or as a part whose malfunction or breakdown would result in a risk of fire or electric shock ^b	125	(225)
8. All rubber or thermoplastic insulated wires except those mentioned in item 9 ^b	35	(63)
9. Types RFH, FFH, and RH wires ^b	50	(90)
10. Sealing compounds	c	c
11. Capacitors	25°C	(45°F)
	less than the marked limit	

^a See [28.4](#).

^b The limitation on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds which have been investigated and determined to have special heat-resistant properties.

^c Unless a thermosetting material, the maximum sealing compound temperature, when corrected to a 25°C (77°F) ambient temperature is 15°C (27°F) less than the softening point of the compound as determined by the Standard Test Methods for Softening Point of Resins Derived from Pine Chemicals and Hydrocarbons, by Ring-and-Ball Apparatus, ASTM E28.

29 Operation Test

29.1 A control unit shall be capable of withstanding 110 percent of its rated voltage continuously, without damage, and shall operate successfully at 85 percent of its rated voltage, under full load conditions.

29.2 The requirements specified in [29.1](#) shall be determined by increasing the supply voltage to the control unit to 110 percent of its rated voltage (see [Table 19.2](#)). The control unit is to be operated in a daylight condition at the increased voltage until constant temperatures are attained. The control unit shall be capable of normal operation, at the increased voltage, after temperatures have stabilized.

29.3 Following operation at increased voltage, the supply voltage to the control unit is to be decreased to 100 percent of rated voltage and the unit allowed to operate in daylight condition until temperatures stabilize. The supply voltage is then to be reduced to 85 percent of rated voltage (see [Table 19.2](#)). The control unit shall be capable of normal operation at the reduced voltage.

29.4 With regard to the operation of the control unit described in [29.2](#) and [29.3](#), consideration is to be given to varying light levels and the speed of the on-off switching function (see [19.6](#) and [19.8](#)) and the operation test is to be conducted in the manner most simulating actual service conditions.

30 Overload Test

30.1 A control unit or a control receptacle shall be capable of withstanding an overload condition without electrical or mechanical malfunction, for 50 cycles of operation. The fuse described in [30.9](#), connected to indicate arc-over to grounded metal, shall not open.

30.2 The requirements specified in [30.1](#) shall be determined by subjecting a control unit to the overload conditions described in [30.5](#) – [30.12](#), and a control receptacle to the overload conditions described in [30.13](#) – [30.15](#).

30.3 Separate samples may be used for tungsten-filament lamp and electric-discharge lamp tests.

30.4 The overload test(s) shall cover the conditions of maximum voltage, power and current interrupted. Any device rated in a range which covers more than one nominal voltage is to be tested at both the lower and higher values (see [Table 19.2](#)) to effectively cover the conditions of maximum current and power.

30.5 A control unit is to be plugged into a control receptacle, connected to a supply source of rated voltage and a load adjusted in accordance with [Table 30.1](#). The control unit is then to be operated in such a manner that the specified load current is interrupted and then restored, for a total of 50 cycles of operation, at the rate of 6 cycles of load interruption and restoration per minute. Each test cycle is to be 1 second on and 9 seconds off.

Table 30.1
Test currents for control units

Control used for	Test current	Power factor
Tungsten-filament lamp control	1.5 x rated current ^a	0.75 – 0.80
Electric-discharge lamp control	3.0 x rated current ^a	0.40 – 0.50
^a See 19.10		

30.6 If the construction of the control unit is such as to preclude operation at the rate of 6 cycles of load interruption and restoration per minute (1 second on and 9 seconds off), another rate of operation, which is agreeable to those concerned, may be used for the overload test.

30.7 If analysis of the construction and normal operation (see [19.6](#) – [19.8](#)) indicates that a cycling rate based on slowly changing light levels is more applicable to normal operation of the control unit being tested than is the 6 cycles of load interruption and restoration per minute rate, then the control unit is to be cycled at the rate determined, from such analysis, to be most appropriate.

30.8 For the overload test, the open-circuit voltage of the supply circuit is to be not less than 100 percent, nor more than 105 percent, of the test voltage specified in [Table 19.2](#), except that a higher voltage may be used, if agreeable to those concerned. The closed circuit voltage of the supply circuit is to be not less than 97-1/2 percent of the test voltage specified in [Table 19.2](#).

30.9 A control unit intended for use on a grounded-neutral system shall be tested with a fuse connected between grounded metal parts (such as a metal mounting plate) and the grounded conductor of the supply circuit. A control circuit intended for use on any other system shall be tested with a fuse connected between grounded metal parts and the unswitched line of the supply circuit. The fuse is to be a 3 A, non-

renewable, non-time-delay, Class H fuse, having a voltage rating not less than the voltage rating of the control unit being tested.

30.10 Reactive components of the test load may be parallel, if of the air core type, but no reactances shall be connected in parallel with resistances, except that an air core reactor may be shunted by resistance, the loss in which is approximately 1 percent of the total power consumption in that phase, calculated in accordance with the formula:

$$R_{SH} = 100 \left(\frac{1}{PF} - PF \right) \frac{E}{I}$$

in which:

PF is the power factor,

E is the closed circuit phase voltage, and

I is the phase current.

30.11 Circuit characteristics are normally determined using laboratory type meters. It is not necessary that the device to be tested be in the circuit when making the circuit determination. The test current required is to be the rms symmetrical current value.

30.12 In addition to the overload test, a control unit shall be made to interrupt and restore the same test load, by withdrawal and insertion into its associated control receptacle for 10 cycles. A separate sample may be used for this test.

30.13 A control receptacle is to be mounted in a manner considered representative of service conditions and connected to a supply source of rated voltage and a load adjusted to 300 percent of rated current, at a power factor of 0.40 – 0.50.

30.14 Test voltage and ground fuse requirements shall be in accordance with [30.8](#) and [30.9](#).

30.15 The overload test of [30.13](#) is to be conducted by manually inserting and withdrawing an appropriate shorting plug, making and breaking the specified load, for a total of 50 cycles of operation, at a rate of 6 cycles of operation per minute. Each test cycle is to be 1 second on and 9 seconds off.

31 Endurance Test

31.1 General

31.1.1 Following the overload test, the control unit shall be capable of successfully completing, without electrical or mechanical breakdown, 3,650 cycles of operation and the fuse described in [30.9](#), connected to indicate arc-over to grounded metal, shall not open.

31.1.2 The requirements specified in [31.1.1](#) shall be determined by subjecting a control unit to an endurance test, where the unit is mounted, connected and operated as described in [30.5](#) – [30.11](#), except that the test load is to be adjusted in accordance with [Table 31.1](#).