CERTIFICATE

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THE UNITED STATES OF AMERICA
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By the Authority Vested By Part 5 of the United States Code § 552(a) and Part 1 of the Code of Regulations § 51 the attached document has been duly INCORPORATED BY REFERENCE and shall be considered legally binding upon all citizens and residents of the United States of America. *HEED THIS NOTICE*: Criminal penalties may apply for noncompliance.

Document Name: UL 1572: High Intensity Discharge Lighting Fixtures

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Standard for Safety

UL 1572

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High Intensity Discharge Lighting Fixtures

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Underwriters Laboratories Inc.®

Standard

Underwriters Laboratories Inc.®

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

May 1, 1996

Revision pages for

Standard for

High Intensity Discharge Lighting Fixtures

UL 1572, Fourth Edition

Attached to this transmittal notice is a revision of the Fourth edition of UL 1572.

A CHANGE ON A PAGE DATED MAY 1, 1996 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THESE NEW AND REVISED REQUIREMENTS ARE NOW IN EFFECT EXCEPT FOR THOSE PARAGRAPHS, SECTIONS, TABLES, AND FIGURES HAVING FUTURE EFFECTIVE DATES AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM. TO RETAIN THE REQUIREMENTS IN EFFECT UNTIL THESE FUTURE EFFECTIVE DATES, DO NOT DISCARD THE PAGES REPLACED BY THOSE HAVING FUTURE EFFECTIVE DATES UNTIL THOSE DATES.

The following revisions were also issued to include Type W cords as an alternative to W-A Cords for outside use; publish the requirements that must be applied in order to obtain a c-UL Mark (Canadian Requirements Comparison Guide - CRG (1572)); and correct miscellaneous errors.

As of May 3, 1999, marine lighting fixtures Listed by UL must comply with the requirements in this Standard. Between May 1, 1996 and May 3, 1999, new submittals to UL for marine lighting fixtures may be evaluated under all requirements in this Standard or, if requested in writing, evaluated under presently effective requirements only. The presently effective requirements are contained in the Seventh edition of UL 595.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect this option, it should be noted that compliance with all the requirements in this standard will be required as a condition of continued Listing and Follow-Up Services after the effective date and understanding of this should be signified in writing.

The new and revised requirements are substantially in accordance with UL's bulletins on this subject dated May 26, 1995 and April 19, 1996. These bulletins are now obsolete and may be discarded.

Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the Department of Defense approved text of UL 1572.

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

(Continued)

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

Page	Date
1	July 27, 1995(Reprinted May 1, 1996)
2	–
3, 4	July 27, 1995
4A, 5	May 1, 1996
6 – 21	July 27, 1995
22	May 1, 1996
23 – 59	July 27, 1995
60	October 9, 1995
61 – 121	July 27, 1995
122	May 1, 1996
123	July 27, 1996
124	May 1, 1996
125 – 134, SA1 – SA6	July 27, 1995
SA7	May 1, 1996
SA8 – SA11	July 27, 1995
SB1 – SB7	May 1, 1996
A1, B1	July 27, 1995
CRG1 – CRG7	May 1, 1996

JULY 27, 1995
(Title Page Reprited: May 1, 1996)

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UL 1572

Standard for

High Intensity Discharge Lighting Fixtures

Prior to the first edition, the requirements for the products covered by this standard were included in the Standard for Electric Lighting Fixtures, UL 57.

First Edition – March, 1980
Second Edition – December, 1984
Third Edition – October, 1991

Fourth Edition

July 27, 1995

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

The Department of Defense (DoD) has adopted UL 1572 on February 25, 1985. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

ISBN 1-55989-873-9

FOREWORD

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

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

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

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

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

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

12.1.5 A frame or glass panel that is 300 square inches (1935 cm^2) or less in area, and that must be opened for relamping, shall be provided with at least one hinge and a positive latch as defined in 12.1.4.

Exception No. 1: A spring catch that does not provide a positive latch may be used if it engages for a distance 1/8 inch (3.2 mm) or more.

Exception No. 2: A framed glass panel that is not greater than 50 inches (1.27 m) long, and not less than 3 inches (76.2 mm) wide may be removable from the fixture for relamping.

Exception No. 3: A glass panel with no dimension greater than 26 inches (660 mm) may be secured by one stud and nut or the equivalent.

Exception No. 4: A frame may be secured by two or more captive latches for glassware of 150 square inches (968 cm^2) or less, or by four or more captive latches for glassware of 300 square inches or less.

12.2 Clips

12.2.1 Clips required to support flat glass shall comply with the requirements in 12.2.2 – 12.2.8.

12.2.2 The width and overlap of clips shall be as indicated in Table 12.1.

12.2.3 Clips may be mounted with either the width or the edge of the clip bearing against the glass.

12.2.4 There shall be one or more clips for each 8 inches (203 mm) of edge or fraction thereof, as determined by dividing the perimeter of the glassware (in inches) by 8 inches. A double clip is counted as two clips.

12.2.5 The double clip mentioned in 12.2.4 is a clip having at least double the width required in Table 12.1 or is one having a pair of fingers, each of which has the width required in Table 12.1, in which case the single supporting member that is common to the two fingers shall have a width at least double that required in Table 12.1.

Table 12.1
Clip dimensions

Exposed area of glass panel				Minimum clip size			
More than		Not more than		Width		Overlap	
$Inch^2$	(cm^2)	$Inch^2$	(cm^2)	Inch	(mm)	Inch	(mm)
0	0	300	1935	3/32	2.4	3/16	4.8
300	1935	500	3226	1/4	6.4	1/4	6.4
500	3226	1100	7097	1/2	12.7	1/2	12.7

12.2.6 There shall be at least one clip on each straight edge that is more than 12 inches (305 mm) long.

12.2.7 The distance between the adjacent edges of any two clips, as measured along the edge of the glassware, shall not be more than 16 inches (406 mm).

12.2.8 A channel, trough, frame, or clip for holding a glass panel or lens shall be constructed of metal not less than 0.017 inch (0.43 mm) thick if of galvanized steel, not less than 0.016 inch (0.41 mm) thick if of uncoated steel, and not less than 0.020 inch (0.51 mm) thick if of aluminum or copper.

Exception: A clip that is used to restrain but not support glass may be of a polymeric material that complies with Section 59, Polymeric Materials.

12.2.9 An adhesive material used to secure glassware to a frame shall comply with the applicable requirements for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, with respect to the type of materials to be joined.

12.2.10 A glass and frame assembly that complies with 12.2.9 shall be replaceable as a unit and shall be marked, as specified in 36.2.2, to indicate that the complete assembly should be replaced when glass is broken.

12.3 Shaped glass supports

12.3.1 A glass globe, molded or blown glass, a decorative glass part, or the like, shall be mounted by means of:

a) A circular fitter with at least three setscrews, thumbscrews, or the like;

b) A stud with threaded end and nut;

c) Threads on the glass part that engages a threaded fitter;

d) Spring clips that hold only by means of friction, if the assembly complies with 12.3.2;

e) Equivalent construction investigated and found to comply with 12.3.2; or

f) Adhesive that complies with 12.2.9 and 12.2.10.

12.3.1 revised May 1, 1996

12.3.2 A glass diffuser supported by friction shall remain in place when a force equal to five times the total weight of the complete diffuser is applied to the diffuser in the direction of gravity, with the fixture mounted in its intended mounting position.

13 Lamp Compartments

13.1 A fixture intended and marked for use with metal halide lamps shall be provided with a lamp containment barrier. The lamp containment barrier shall not have any open holes greater than 1/8 inch (3.2 mm) diagonally or in diameter. That part of the lamp containment barrier where particles from a ruptured lamp are likely to drop to and rest, shall be of a material as specified in 13.2.

Exception No. 1: A lamp containment barrier need not be provided if:

a) The manufacturer of the lamp intended to be used in the fixture does not identify the lamp as needing to be enclosed for the orientation of the lamp in the fixture;

b) The major axis of the lamp is oriented ±15 degrees from vertical when the fixture is installed as intended; and

c) The fixture is marked as specified in 39.3.

Table 69.1
Sheet steel coatings

Type of coating	Type or thickness[a] Inches	(mm)	Description
(A) Hot-dipped mill galvanized steel	G90[b]		–
	G60[b]		with 1 coat of outdoor paint[c]
	A60[b]		with 1 coat of outdoor paint[c]
(B) Zinc coating other than Type (A)	0.00061	0.0155[d]	–
	0.00041	0.0104[d]	with 1 coat of outdoor paint[c]
(C) Cadmium coating	0.0010	0.0254	–
	0.00075	0.01905	with 1 coat of outdoor paint[c]
	0.0005	0.0127	with 2 coats of outdoor paint[c]
(D) Vitreous enamel[e]	–		–

[a] As determined by ASTM B 555-1986(R1991), Standard Guidelines for Measurement of Electrodeposited Metallic Coating Thicknesses by the Dropping Test.

[b] Conforming with the coating designation G90, G60, or A60 in Table 1 of ASTM A 525-1993, Standard Specification for General Requirements for Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process with no less than 40 percent of the zinc on any side based on the minimum single spot test requirement in this ASTM standard.

[c] Identified as outdoor paint by paint manufacturer.

[d] Average thickness with a spot minus tolerance of 0.00007 inch (0.00178 mm).

[e] Acceptable on sheet steel at least 0.026 inch (0.66 mm) thick.

69.1.2 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as described in 65.1 for damp locations.

Exception: Hinge pins need not be provided with the corrosion protection required in 65.1.

69.1.3 The acceptability of a coating on hinges, bolts, and fasteners may be determined by visual inspection.

69.1.4 Punched holes and cut edges in ferrous material need not be corrosion protected.

69.1.5 Welds in iron or steel (other than stainless steel) shall be painted with one coat of any outdoor paint.

Exception: One coat of any indoor paint is acceptable over a spot weld on galvanized steel.

69.2 Enclosures

69.2.1 An enclosure or enclosures shall be so constructed as to prevent the wetting of live parts or electrical components or wiring not identified for use in contact with water, and to reduce the risk of electric shock due to weather exposure. Parts identified for use in contact with water include flexible cords marked "W-A", liquid tight flexible metal conduit, outlet boxes marked for use in wet locations, and rigid conduit.

Exception No. 1: Wetting of the outer surface of the glass envelope of a lamp is not prohibited.

Exception No. 2: The marking "W" is an alternative designation for "W-A."

69.2.1 revised May 1, 1996

69.2.2 A wall-mounted recessed fixture shall be constructed so it prevents the entrance of any water into the enclosure. The enclosure shall be intended for permanent connection to watertight supply connection fittings. Installation instructions as specified in 72.6 shall be provided with the fixture.

Exception: If a drain hole as described in 69.4.2 is provided to drain water from the front of the fixture, water may enter the fixture if there is no wetting of live parts as described in 69.2.1.

69.2.3 To determine compliance with 69.2.1 and 69.2.2 a complete assembly is to be subjected to the rain, sprinkler, or immersion test as specified in Section 71, Performance.

69.3 Gaskets and bushings

69.3.1 A gasket or bushing employed to comply with the requirements for wet locations shall comply with the requirements of the thermal conditioning test described in 71.9.2.

Exception: Gaskets or bushings tested while installed in the fixture as described in 71.9.3 need not be subjected to the test described in 71.9.2.

69.3.2 A gasket shall be so secured that removal of a lamp from the fixture or opening of glassware or a frame for relamping will not cause the gasket to loosen. Clips or a clamping ring are acceptable means of securement. An adhesive or other means shall be investigated.

69.3.3 If an adhesive is used to secure a gasket as described in 69.3.2, the gasket assembly shall comply with the gasket adhesion test described in 71.10.1.

69.4 Openings

69.4.1 An opening for the connection of conduit or for an auxiliary part shall be threaded.

Exception No. 1: If the rain and sprinkler tests as described in Section 71, Performance, show no entrance of water into the fixture with any opening open, the opening need not be threaded.

Exception No. 2: If a conduit fitting intended for use in wet locations is provided that complies with the requirements in the Standard for Fittings for Conduit and Outlet Boxes, UL 514B, the opening need not be threaded.

69.4.2 An open drain hole shall be provided on all fixtures to prevent the accumulation of water above a level that would result in the wetting of an electrical part or opening for the connection of conduit or for an auxiliary part. The hole shall be as specified in Table 69.2.

Exception No. 1: A fixture that has been subjected to the rain or sprinkler test as required in 71.1.1 — 71.1.4 need not be provided with a drain hole if no water enters the fixture.

Exception No. 2: A ground-mounted recessed fixture shall not be provided with a drain hole.

Exception No. 3: A drain hole is not required on a wall-mounted recessed fixture as described in 69.2.2.

Table 69.2
Size of drain holes

Opening shape	Minimum dimension		Minimum area		Maximum dimension		Maximum area	
	Inch	(mm)	Inch^2	(mm^2)	Inch	(mm)	Inch^2	(cm^2)
Slot	1/8 (width)	3.2	0.012	7.74	3/8 (width)	9.6	1-1/2	9.68
Square	1/8 (side)	3.2	–	–	1/2 (side)	12.7	–	–
Round	1/8 (diameter)	3.2	–	–	1/2 (diameter)	12.7	–	–
Irregular	–	–	0.012	7.74	–	–	1-1/2	9.68

69.5 Water shields

69.5.1 A material, not including wood, used as a water shield, whether provided as a lens, diffuser, or opaque part, shall:

a) Be classified at least 94HB in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, if of polymeric material;

b) Comply with the exposure to ultraviolet light test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, if of polymeric material; and

c) Be subjected to impact conditioning as specified in 71.2.1 – 71.2.4 before the fixture is subjected to the rain, sprinkler, or immersion tests as required by 71.4.1.

69.5.2 A wood water shield shall be subjected to the impact conditioning described in 71.2.1 – 71.2.4 before the fixture is subjected to the rain, sprinkler, or immersion tests as required in 71.4.1.

Exception: Wood that is at least 1/2 inch (12.7 mm) thick need not be subjected to the impact conditioning.

70 Construction – Electrical

70.1 The fixture shall comply with the requirements in 66.1 and 66.2.

70.2 Any cord exposed outside of a surface mount fixture shall be marked "W-A" after the type designation.

Exception: The marking "W" is an alternative designation for "W-A."

70.2 revised May 1, 1996

70.3 A switch, other than the photoelectric type, shall be enclosed inside the fixture.

70.4 A fixture provided with a receptacle shall be constructed to prevent the entrance of water into the receptacle with or without any provided cover in place and with or without an attachment plug in place.

Exception: If water is not excluded during the rain or sprinkler tests with the receptacle cover open, the cover shall close automatically when not in use.

70.5 In a ground-mounted fixture, a receptacle shall be located at least 6 inches (152.4 mm) above ground level.

71 Performance

71.1 General – tests required

71.1.1 A fixture shall be subjected to the appropriate rain, sprinkler, and immersion test as required in 71.1.2 – 71.1.4 and specified in 71.3.1 – 71.4.1. A summary of the tests required is provided in Table 71.1.

Table 71.1
Required tests for wet location fixtures

Type of Fixture	Rain	Sprinkler	Immersion
Non-Pendant Surface-Mounted Ceiling	Yes[a]	Yes[b]	No
Cord- or Chain-Pendant Surface-Mounted Ceiling	Yes	No	No
Recessed Ceiling	Yes[a]	Yes	No
Surface-Mounted Wall	Yes	No[c]	No
Recessed Wall	Yes	No[c]	No
Pole-Mounted and Ground-Mounted	Yes	No	No
Ground-Mounted Recessed	No	No	Yes

[a] Test not required if the fixture is marked for covered ceiling installation only as specified in 71.1.3.

[b] Test not required if rain test conducted as described in 71.1.3.

[c] Test required if the fixture is marked for used 4 feet (1.22 m) or less from ground or on a pole-mounted fixture (including bollards) with lamp or other electrical components less than 4 feet above ground as specified in 71.1.2.

Table SA6.1 (Cont'd)
Requirements needing engineering investigation

Paragraph number	Comment
23.4.2	
24.1 Exception Nos. 1 and 2	
24.3	For other means only
25.1.10 Exception No. 2	
25.2.2	
Section 29	
Section 30	
Section 31	
32.2	Alternate Method
33.4	
34.3	See SA7.1 for
41.1.8	Exception
41.1.9 Exception No. 2	
41.2.2(d)	
Section 43	
Section 45	
Section 46	
Section 47	
Section 48	
Section 51	
Section 52	
Section 53	
Section 54	
Section 55	
Section 56	
Section 57	
Section 58	
Section 59	
Section 60	
Section 61	
Section 62	
Section 63	
65.1	For equivalent only
69.1.1 Exception Nos. 1 and 5	See (c) of SA7.1 for exception
Table 69.1	
69.2.1 – 69.5.2	
Section 70	
Section 71	
Section 73	

Table SA6.1 revised May 1, 1996

SA6.2 In reference to 26.1.1(e) and Exception No. 2 to 26.3.1, the field representative may accept without Procedure description a manufactured wiring system (prefabricated lighting and power distribution assembly) if:

a) It is a Listed manufactured wiring system; and

b) The correlation and installation instruction markings for the wiring system are applied to the fixture and are visible after installation.

SA7 Components

SA7.1 All component parts are to be Listed unless specifically described in the Procedure or noted as follows:

a) Marking Labels – A printed label, used to conform to Form A Marking of Table 34.1 and 34.3, is acceptable if it:

1) Is a Recognized Component Marking and Labeling System that complies with the Standard for Marking and Labeling Systems, UL 969; and

2) Is rated for the type of surface to which it is affixed and for a temperature of at least 150°C unless otherwise described.

b) Appliance Wiring Material – Any Recognized Component AWM may be used if it complies with 19.1.4.

c) Corrosion Protection – Any Recognized Component Metallic Protective Coating rated G90 may be used to comply with Table 69.1, Type (A) coatings, without Procedure description.

d) Wiring in Fixtures Marked "Suitable for Wet Locations" –

1) Appliance wiring material [as noted in (b)] that does not have any outer braid or filler of absorptive material may be used in fixtures marked "Suitable For Wet Locations."

2) Fixture wires Type RFH-1, RFH-2, FFH-2, and AF may not be used for fixtures marked "Suitable For Wet Locations."

e) Supplementary Insulation – In addition to the supplementary insulation materials mentioned in 19.1.5, the wires indicated may also be considered satisfactory for a 150°C rating if each individual conductor is provided with snugly fitting supplementary insulation in the form of electrical insulating tubing or processed tubing having a voltage rating equal to or higher than the wire insulation. The temperature rating of the tubing shall be 150°C or higher and shall be marked on the surface of the tubing. Insulating tubing or processed tubing must be acceptably evaluated by the certification organization for use as a supplementary insulation.

SA8 Special Constructions

SA8.1 All fixtures and fittings covered by Part 3 and other products evaluated for special use are required to be submitted to the certification organization for test and evaluation. They are not eligible to bear the Listing Mark unless authorized specifically in the Procedure.

SUPPLEMENT SB - MARINE USE ELECTRIC LIGHTING FIXTURES

INTRODUCTION

SB1 Scope

SB1.1 In addition to complying with the construction, performance and marking requirements in this standard, an electric lighting fixture intended for use on a marine vessel shall comply with the requirements in Sections SB2 – SB17.

Added SB1.1 effective May 3, 1999

SB1.2 These requirements cover electric lighting fixtures for installation on marine vessels utilizing grounded systems in accordance with United States Coast Guard Electrical Engineering Regulations 46 CFR, Parts 110 – 113, Subchapter J and, insofar as it applies; the National Electrical Code, ANSI/NFPA 70-1996; and the Recommended Practice for Electrical Installations on Shipboard, IEEE 45.

Added SB1.2 effective May 3, 1999

SB1.3 These requirements do not cover marine lighting fixtures for use in hazardous locations, as defined in the National Electrical Code, emergency lighting marine fixtures, or low voltage marine fixtures (less than 50 volts) supplied solely by a battery, transformer, converter or similar power supply source.

Added SB1.3 effective May 3, 1999

SB2 Glossary

SB2.1 For the purpose of this supplement the following definitions apply.

Added SB2.1 effective May 3, 1999

SB2.2 INSIDE DRIPPROOF-TYPE FIXTURE – A fixture intended for use on a marine vessel in an inside damp or wet location and subject to oil or water drippage.

Added SB2.2 effective May 3, 1999

SB2.3 INSIDE-TYPE FIXTURE – A fixture intended for use on a marine vessel in an inside dry or damp location.

Added SB2.3 effective May 3, 1999

SB2.4 OUTSIDE-TYPE FIXTURES – A fixture intended for use outside or in other severely wet locations on a marine vessel.

Added SB2.4 effective May 3, 1999

CONSTRUCTION

SB3 General

SB3.1 All electrical components shall comply with the requirements specified in Section 66, Damp Location Construction – Electrical, and Section 70, Wet Location Construction – Electrical, of this Standard as follows:

a) Inside-Type fixtures shall comply with the damp location requirements of Section 66, Construction – Electrical.

b) Inside Dripproof-Type and Outside-Type fixtures shall comply with the wet location requirements of Section 70, Construction – Electrical.

Added SB3.1 effective May 3, 1999

SB3.2 Thermal protection specified in 47.9 of the Standard is not required for recessed fixtures.

Added SB3.2 effective May 3, 1999

SB4 Convenience Receptacles, Switches, And Fuses

SB4.1 A pull-chain switch or lampholder shall not be provided.

Added SB4.1 effective May 3, 1999

SB4.2 A receptacle shall not be provided, except for Inside-Type wall mounted fixtures.

Added SB4.2 effective May 3, 1999

SB4.3 A fuse shall not be provided in a fixture, except as protection internal to a ballast.

Added SB4.3 effective May 3, 1999

SB5 Lampholders

SB5.1 A porcelain part of a lampholder shall not be rigidly mounted unless a silicone rubber gasket, or equivalent, at least 0.05 inch (1.27 mm) thick is provided between the porcelain and mounting means. The gasket material shall have a relative thermal index (RTI) at least equal to the maximum lampholder temperature obtained during the Temperature Test, Section 30.

Exception: A gasket is not required when the lampholder assembly does not show any signs of damage which impairs normal operation when subjected to the Shock Test of Section SB16.

Added SB5.1 effective May 3, 1999

SB5.2 A fixture shall not rely upon the screw shell of a lampholder as a means of support for the fixture.

Added SB5.2 effective May 3, 1999

SB6 Wiring And Conductors

SB6.1 All fixture wiring and conductors shall be stranded.

Added SB6.1 effective May 3, 1999

SB6.2 A power supply cord shall comply with the electrical construction requirements for surface-mounted fixtures specified in 42.1 – 42.7 of the Standard.

Added SB6.2 effective May 3, 1999

SB7 Power Supply Connections

SB7.1 A fixture shall be provided with an outlet box or shall have an opening for the connection of marine-type cable.

Exception No. 1: A fixture which is intended for cable connections and shipyard drilling and installation is not required to be provided with an outlet box or an opening for connection of marine-type cable.

Exception No. 2: Cord-equipped adjustable fixtures (such as desk lamps and floor lamps) are not required to be provided with an outlet box or an opening for connection of marine-type cable.

Exception No. 3: Cord-equipped adjustable fixtures (such as desk lamps and floor lamps) provided with an attachment plug are not required to be provided with an outlet box or an opening for connection of marine-type cable.

Added SB7.1 effective May 3, 1999

SB7.2 The opening for marine-type cable shall comply with 26.2.1 – 26.2.6 of this Standard for conduit connections. Unless the fixture is Indoor-Type, the openings shall be threaded.

Added SB7.2 effective May 3, 1999

SB7.3 Cord connected fixtures shall be 3-conductor type.

Added SB7.3 effective May 3, 1999

SB7.4 A fixture shall not be used as a connection box for a circuit other than the branch circuit supplying the fixture.

Added SB7.4 effective May 3, 1999

SB8 Corrosion Protection

SB8.1 All inside and outside surfaces of cast ferrous metal, sheet steel or ferrous tubing shall comply with the following requirements:

a) Inside-Type – The corrosion protection means shall comply with the damp location requirements of Section 65, Construction – Mechanical, of the Standard.

b) Inside Dripproof-Type – The corrosion protection means shall comply with the wet location requirements of Section 69, Construction – Mechanical, of the Standard.

c) Outside-Type – The corrosion protection means shall comply with the Standard Test Method of Salt Spray (Fog) Testing, ASTM B117-94 for 200 hours. The material shall not show pitting, cracking, or other deterioration more severe than that resulting from a similar test on passivated AISI type 304 stainless steel.

Exception: An Outside-Type fixture marked for fresh water use only in accordance with SB17.4 that has a corrosion protection means which complies with the wet location requirements of Section 69, Construction — Mechanical, of the Standard meets the intent of this requirement.

Added SB8.1 effective May 3, 1999

SB8.2 All inside and outside surfaces of cast aluminum, sheet aluminum or aluminum tubing shall comply with the following requirements:

a) Inside-Type or Inside Dripproof-Type – shall comply with the following as applicable:

1) Unplated Sheet Aluminum – material shall be an alloy of the 5000 series as given in the Standard Specification for Aluminum-Alloy Sheet and Plate, ANSI/ASTM B209-1977.

2) Unplated Cast Aluminum – material shall be one of the alloys included in Table SB8.1.

3) Painted or Plated Aluminum – use of other aluminum alloys requires an additional corrosion protection means which complies with the wet location requirements of Section 69, Construction – Mechanical, of the Standard.

4) Other unplated aluminum alloys equivalent in corrosion resistance to (1) or (2).

b) Outside-Type – the unplated, plated, or painted aluminum alloy shall have a copper content of 0.4 percent or less.

Exception: When the material complies with SB8.1(c), the copper content limit of 0.4 percent is not applicable.

Added SB8.2 effective May 3, 1999

Table SB8.1
Aluminum alloys

Sand-Cast	Permanent-Mold Cast	Die-Cast	Machined Bar and Rod Stock
353.0	356.0	360.0	5052
356.0	A356.0	A360.0	5056
A356.0	A357.0	A413.0	5456
A443.0	A443.0	C443.0	6061
B443.0	B443.0	518.0	
512.0	512.0		
514.0	535.0		
520.0			
710			
NOTE – These designations conform with those given in the specifications of the ANSI H35.1.			

Added Table SB8.1 effective May 3, 1999

SB8.3 The use of other corrosion resistant materials such as silver, corrosion-resistant stainless steel, copper, brass, bronze, and copper-nickel alloys do not require any additional corrosion protection.

Added SB8.3 effective May 3, 1999

SB9 Openings

SB9.1 There shall be no openings in a fixture except as indicated in SB9.2 and SB9.3.

Added SB9.1 effective May 3, 1999

SB9.2 An Inside-Type surface mounted fixture shall have no openings in the wireway exposed to the mounting surface.

Added SB9.2 effective May 3, 1999

SB9.3 An Inside-Type surface mounted fixture, 26 inches (660 mm) or less in length, shall have not more than two open mounting holes exposed to the mounting surface. Each hole shall be not larger that 1/4 by 1/2 inch (6.4 by 12.7 mm) or 0.40 inch (10.2 mm) in diameter. Each additional 24 inches (610 mm) of length or fraction thereof qualifies the fixture for two additional mounting holes.

Added SB9.3 effective May 3, 1999

SB9.4 An Inside-Type recessed fixture shall have no openings in the wireway that contains uninsulated live parts. A slot or louver located in the recessed portion of the enclosure shall not exceed 3/8 inch (9.5 mm) in width and not more than 1-1/2 square inches (9.7 cm^2) in area, and any other ventilating hole provided in the recessed portion of the enclosure shall not be more than 1 inch (25.4 mm) in diameter. The total area of ventilating openings shall not be more than 15 percent of the area of the surface in which they are located.

Added SB9.4 effective May 3, 1999

SB10 Joints And Gaskets

SB10.1 A seam or joint in a fixture enclosure, for other than the Inside-Type, shall be provided with a gasket or shall be otherwise constructed to exclude oil or water drippage.

Added SB10.1 effective May 3, 1999

SB10.2 Gaskets relied upon to exclude oil or water drippage shall comply with the thermal conditioning test described in 71.9.1 – 71.9.4 of the Standard.

Added SB10.2 effective May 3, 1999

SB11 Means For Mounting

SB11.1 A fixture shall be provided with a permanent mounting means.

Exception: A fixture intended for mounting by means of mounting holes which are drilled at the shipyard complies with this requirement.

Added SB11.1 effective May 3, 1999

SB11.2 A fixture that is intended for outlet box mounting shall be provided with the outlet box.

Added SB11.2 effective May 3, 1999

SB11.3 A pendant fixture shall be of the rigid metal conduit stem-suspended type only.

Added SB11.3 effective May 3, 1999

SB12 Glass And Lamp Support

SB12.1 Glassware shall be securely mounted in a frame or held by a clamp-type fitter.

Added SB12.1 effective May 3, 1999

PERFORMANCE

SB13 Temperature Test

SB13.1 A surface mounted fixture shall comply with the temperature test requirements for surface-mounted fixtures specified in Section 43, Surface Mounted Fixtures – Performance, of the Standard, with the exception that the test ceiling for ceiling mounted fixtures is not required to be filled with insulation.

Added SB13.1 effective May 3, 1999

SB13.2 A recessed mounted fixture shall comply with the Type Non-IC normal temperature test requirements for recessed fixtures specified in Section 48. Abnormal operation tests with insulation are not required.

Added SB13.2 effective May 3, 1999

SB13.3 Marked supply wire ratings shall not exceed 110°C (230°F).

Added SB13.3 effective May 3, 1999

SB14 Drippage Test

SB14.1 An Inside Dripproof-Type fixture shall be subjected to the test described in SB14.2. No water shall contact wiring devices or lamps after exposure to the drippage for 1 hour.

Exception: An alternative to this test is the rain test described in 71.6.1 — 71.6.3.

Added SB14.1 effective May 3, 1999

SB14.2 To determine whether a fixture complies with the requirement in SB14.1, it is to be tested as follows. A glass globe or a plastic panel not provided with a gasket is to be removed for the test. With the top of wire entrances sealed, the fixture is to be mounted directly beneath a shower head (as described in SB14.3), vertically oriented. The water pressure is to be such that the area of water drippage covers the entire cross section of the fixture or, in the case of a fluorescent-lamp fixture, the entire width of the fixture. When the fixture is provided with means for adjustment of position, it is to be adjusted as far from the vertical position as possible. With the adjustment complete, the fixture, including the portion that is normally vertical, is to be tilted to make the normally vertical part 15 degrees from the vertical. The direction of tilt and adjustment is to provide the maximum exposure of lamps and wiring devices. The test is also to be conducted with the fixture in any more-upright position when required.

Added SB14.2 effective May 3, 1999

SB14.3 The showerhead of SB14.2 shall be as shown in Figure 71.3.

Added SB14.3 effective May 3, 1999

SB15 Moisture Resistance Test

SB15.1 An Outside-Type fixture shall be subjected to a moisture resistance test. Water shall not enter the compartment that houses wiring, wiring devices, or lamps under any condition of exposure other than submersion.

Added SB15.1 effective May 3, 1999

SB15.2 To determine whether an enclosure complies with the requirement in SB15.1, a complete fixture is to be mounted as in actual service with any factory-threaded conduit holes plugged, and a solid stream of water from a nozzle not less than 1 inch (25.4 mm) in diameter and under a pressure of 15 pounds per square inch (103 kPa) at the nozzle is to be directed at the enclosure from a distance of 10 feet (3.05 m) for 5 minutes.

Added SB15.2 effective May 3, 1999

SB15.3 At the end of the test, any water on the exterior of the enclosure is to be removed with a cloth and the enclosure then opened and examined for any evidence of leakage.

Added SB15.3 effective May 3, 1999

SB16 Shock Test

SB16.1 A sample of a porcelain lampholder assembly not provided with a gasket shall not show any signs of physical damage which impairs normal operation; damages mountings, displaces components, or reduces electrical spacings when subjected to the test outlined in SB16.2.

Added SB16.1 effective May 3, 1999

SB16.2 One sample of the lampholder assembly is to be mounted as intended to a rigid test fixture and fitted with a lamp of the maximum rated wattage. The test fixture is then to be subjected to 5000 shock impacts, each having a 25 g peak acceleration and a 20 – 25 ms duration, as measured at the base of the half-sine shock envelope. The test assembly is then to inspected for signs of damage.

Added SB16.2 effective May 3, 1999

MARKINGS

SB17 General

SB17.1 All fixtures shall be marked in accordance with the Standard except as described in this section.

Added SB17.1 effective May 3, 1999

SB17.2 A fixture that complies with the Inside-Type requirements of this supplement shall be marked in Form D-1 "Inside Type."

Added SB17.2 effective May 3, 1999

SB17.3 A fixture that complies with the Inside Dripproof-Type requirements of this supplement shall be marked in Form D-1 "Inside Dripproof Type."

Added SB17.3 effective May 3, 1999

SB17.4 A fixture that complies with the Outside-Type requirements of this supplement shall be marked in Form D-1 "Outside Type" or "Outside Type (Salt Water)."

Exception: Outside-Type fixtures which have been evaluated only for fresh water are marked "Outside Type (Fresh Water)."

Added SB17.4 effective May 3, 1999

CANADIAN REQUIREMENTS COMPARISON GUIDE CRG (1572)

UL AND CANADIAN

STANDARDS FOR

HIGH INTENSITY DISCHARGE LIGHTING FIXTURES

c UL Underwriters Laboratories Inc.®

Product Category: High Intensity Discharge Lighting Fixtures
UL Category Control Numbers: IEXT, IEXZ

UL Standard:	Standard for High Intensity Discharge Lighting Fixtures UL 1572 Fourth Edition
Canadian Standard:	Luminaires CAN/CSA–22.2 No. 9–M1989 Seventh Edition

This Canadian Requirement Comparison Guide is only intended to identify Canadian requirements that must be applied in addition to the requirements in the UL Standard to obtain a C–UL Mark. The guide is not intended to replace a thorough review and comparison of the requirements applicable to the product category as contained in the applicable UL and Canadian Standards. Where requirements are not specifically addressed, compliance with the requirements in the UL Standard satisfy the requirements in the Canadian Standard.

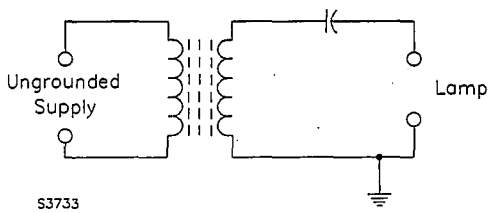
The actual requirements applied for a C–UL product investigation may differ from those identified in this guide based on the specific features, characteristics, components, materials, or systems used in the product.

CRG: 1572
Issue No.: 1
Issue Date: May 1, 1996

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

The following outlines the requirements contained in CSA 22.2 No. 9–M1989 that are in addition to the requirements in UL 1572 that must be met in order for a product to bear the appropriate UL Marking. UL provides a certification program for products that meet the Canadian requirements. The C-UL Mark is the manufacturers assurance that products as evaluated by UL, continue to comply with the appropriate Canadian requirements.

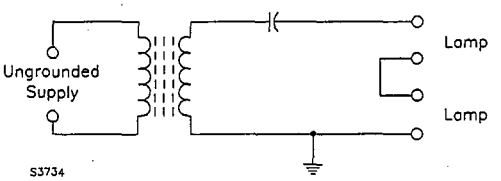
Requirements Topics	CSA Clause	Comparison
General Requirements	3.1	See CSA C22.2 No. 0
Components	3.2	Look for CSA Certified or c–UL Components. Otherwise, refer to the appropriate Standard.
Weight and Support	4.3.3	A fixture which weighs in excess of 4.6 kg (10 lbs) is required to have a separate support so that the weight of the fixture is not transmitted to the splice connections when examining field splices. See Clause 6.14 for loading test. A fixture which weighs in excess of 11.34 Kg (25 lbs) shall be provided with a means of support independent of the outlet box.
Swivel Joints	4.6.4	A swivel joint shall withstand a torsion test and pull test; see Clause 6.9
Nonmetallic Swivel Joints	4.6.5	Nonmetallic swivel joints shall be minimum 1.3 mm thick.
Tap Conductors	4.12.13	The tap conductors for recessed fixtures are capable of being 18 AWG minimum when provided with a factory installed raceway, 14 AWG when the raceway is provided but not installed. In either case the raceway shall be provided. Tap conductors shall extend 150 mm beyond the raceway, and be provided with a raceway that extends at least 450 mm but not more that 2000 mm.
Lampholder Screwshell	4.17.5	A fixture provided with an auto transformer shall not be used on an ungrounded supply circuit.
	4.17.6	The lampholder screwshell of H.I.D. fixtures, when used with two winding, isolated type ballasts, shall be separately bonded.



ISOLATING (2 WINDING) BALLAST

FIGURE 1

ACCEPTABLE INSTALLATION METHOD OF HID BALLAST THAT IS CONNECTED TO A LAMPHOLDER



ISOLATING (2 WINDING) BALLAST

FIGURE 2

ACCEPTABLE INSTALLATION METHOD OF HID BALLAST SUPPLYING TWO LAMPS IN SERIES

Requirements Topics	CSA Clause	Comparison
Receptacles	4.18.4.1	A receptacle shall be of the grounding type unless connected to an isolating type transformer.
Integral Fuse and Fuseholder	4.18.6.5	Bare live parts of the fuse or fuseholder shall not be contacted by the probe while completely inserted, or during insertion or removal of the fuse. Panel mounted, in–line fuseholder shall be wired such that the live end is connected to the terminal that is least accessible from outside the enclosure.
"Planter" Type Fixtures	4.6.6	A planter type fixture requires engineering investigation.
Air Handling Fixtures	4.22	An air handling fixture requires engineering investigation.
Junction Box Covers	6.13	A junction box cover that is not secured with a screw shall be evaluated to determine when after 10 cycles of opening and closing the box, it will support for 5 minutes a pull from an object having a mass of (50 lb.) 22.7 kg.
Spacings	4.19.1	Spacings shall be verified as follows: 0 – 50 V – 1/8 inch oversurface or through air 251 – 300 V – 3/8 inch through air.
Mounting Holes	4.2.2.7	Mounting holes shall be less than or equal to 1.3 cm^2 with total area less than or equal to .35% of the area of the enclosure mounting surface. Two holes shall be provided for mounting when the fixture mounting surface area is less than or equal to 260 cm^2. One additional hole is required for each additional 1300 cm^2, unless the fixture is outlet box mounted.
End–To–End Mounted Fixtures	4.5.3	End–to–end mounted fixtures shall be provided with means to retain wire when raceway is opened.
Wiring Temperature Rating	4.12.11	Fiberglass tubing is not to be substituted for properly temperature rated wiring.
Bonding Terminal	4.21.5	A bonding terminal shall not be located on a cover plate.
Ink Stamped Markings	5.1.4	Ink stamping shall be durable. See Clause 6.15.
Accessibility Probe	Figure 1	Where accessibility is being evaluated by the articulated probe, the UL probe is to be used. The CSA probe has no web stop; therefore, the web stop on the UL probe shall not be allowed to prevent its access.
Markings	5.1, 5.3	When a fixture is intended to be marked with a c–UL Label, the fixture shall be provided with the following, in addition to the UL markings. These general markings are to be provided with all fixtures. a) Listee's name, trademark, or other recognized symbol of identification.

Requirements Topics	CSA Clause	Comparison
Markings (Cont'd)		b) The fixture catalog number or model number or type (ceiling–surface, wall–surface, display, electronic, hospital, machine–shop, recessed, totally enclosed gasketed, or transformer operated.) *Exception: The fixture series designation (such as MP Series) is an alternative marking to the specific catalog number or model number (such as MP—22222) when the full designation appears on the fixture carton.* c) The month and year of manufacture, at least, shall be marked on each product or its carton. d) The primary electrical rating in volts, hertz, and total amps or watts, except on fixtures incorporating incandescent lamps and on those intended for remotely installed ballasts or transformers. e) The secondary electrical rating in volts and amperes or volt–amperes, where different from the primary rating. f) Mounting information as required. g) Surface mounted fixtures intended to be mounted over an outlet box, which by the UL Standard requires greater than 75°C supply wiring, are not to bear the UL Mark for Canada. h) Fixtures provided with integral outlet boxes (fixtures to which conduit is directly connected) and having supply connections rated greater that 75°C shall be marked as follows: "Min . . . . C SUPPLY LEADS" The temperature rating shall be 90°C, 105°C or 125°C, as specified. i) Recessed fixtures marked for installation only on non–combustible surfaces are also marked: INSTALL IN BUILDING OF FIRE RESISTIVE CONSTRUCTION. MOUNT ON NON–COMBUSTIBLE MATERIAL.

Requirements Topics	CSA Clause	Comparison
Markings (Cont'd)		j) Recessed fixtures which are required to be marked for access above ceiling as indicated in the individual Reports shall be additionally marked: "FOR ACCESSIBLE CEILINGS ONLY"
		k) Recessed fixtures marked Type IC shall also be marked as follows: "UTILIZABLE WITH THERMAL INSULATION" where accessible from below the ceiling; and "VAPOUR BARRIER MUST BE SUITABLE FOR 90°C"
		l) Fixtures intended for indoor/outdoor or outdoor (wet) locations shall be marked as follows: "INDOOR/OUTDOOR USE"
		m) Fixtures intended for outdoor use only shall be marked: "OUTDOOR USE ONLY"
		n) Fixtures marked for through branch circuits may also be marked: "MAXIMUM OF _____ NO. _____ AWG THROUGH BRANCH CIRCUIT CONDUCTORS SUITABLE FOR AT LEAST _____ °C (°F) PERMITTED IN BOX" where the expressions in parentheses are alternative wording.
		o) Fixtures intended for continuous row mounting are also marked: "CONTINUOUS–ROW MOUNTING"
		p) Fixtures that are unassembled, where parts are shipped in more than one package shall include the warning or equivalent graphics: "ASSEMBLE PART(S)...ONLY WITH PART(S)..."

Requirements Topics	CSA Clause	Comparison
Markings (Cont'd)		q) Instructions regarding the proper use of mounting hooks shall be provided with fixtures having long runs of chain, cord or similar types shall contain wording such as: "USE HOOK TO SUPPORT CHAIN, NOT ELECTRICAL CORD" r) Mounting instructions for fixtures marked: "WALL MOUNT ONLY" s) If a replaceable fuse is provided, the fuse ampere rating and identification shall be located where plainly visible during fuse replacement.

Underwriters Laboratories Inc.®
A not-for-profit organization dedicated to public safety
and committed to quality service

July 27, 1995

Standard for

High Intensity Discharge Lighting Fixture

UL 1572, Fourth Edition

Accompanying this transmittal notice is a copy of the Fourth edition of UL 1572.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT EXCEPT FOR PARAGRAPH 50.3.2 WHICH BECOMES EFFECTIVE NOVEMBER 2, 1996 AS INDICATED IN THE SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEMS.

New product submittals made prior to a specified future effective date will be judged under all of the requirements in this standard unless the applicant specifically requests that the product be judged under the current requirements. However, should the applicant elect this option, it should be noted that compliance with all the requirements in this standard will be required as a condition of continued Listing and Follow-Up Services after the effective date and understanding of this should be signified in writing.

Attention is directed to the note on the title page of this standard identifying that the Department of Defense has adopted the text of UL 1572.

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

UL 1572

Standard for

High Intensity Discharge Lighting Fixtures

Prior to the first edition, the requirements for the products covered by this standard were included in the Standard for Electric Lighting Fixtures, UL 57.

First Edition – March, 1980
Second Edition – December, 1984
Third Edition – October, 1991

Fourth Edition

July 27, 1995

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

The Department of Defense (DoD) has adopted UL 1572 on February 25, 1985. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

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

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DAMP LOCATIONS

FOREWORD

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

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

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

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

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

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

PART 1 – ALL FIXTURES

INTRODUCTION

1 Scope

1.1 These requirements cover general use high intensity discharge (HID) electric lighting fixtures for commercial, industrial, or residential use in ordinary locations in accordance with the National Electrical Code, ANSI/NFPA 70. Included are mercury vapor, metal halide, high pressure sodium, and low pressure sodium lamp types, all intended to be operated by a ballast.

1.2 These requirements do not cover:

a) Fixtures for installation aboard a ship or boat;

b) Fixtures for underwater installation;

c) Fixtures for use in hazardous locations;

d) Portable lamps;

e) Portable electric hand lamps, stage and studio lights, medical and dental lights, and the like;

f) Fixtures intended for use with self-ballasted HID lamps;

g) Emergency lighting fixtures, or fixtures with integral batteries;

h) Fixtures provided with adapters or other forms of construction to enable them to be mounted on or supported by any other fixture, lampholder, or receptacle;

i) Fixtures intended for field mounting to furniture as part of a cord-connected task lighting assembly; and

j) Lighting units having flashing characteristics, words or symbols designed to convey information or attract attention (exclusive of exit lighting).

1.3 A fixture provided with lampholders for both incandescent and high intensity discharge lamps (a combination incandescent/high intensity discharge lamp fixture) shall comply with the requirements in this standard and with the Standard for Incandescent Lighting Fixtures, UL 1571, insofar as they apply to construction, test methods, and marking requirements unique to incandescent lamps.

1.4 A fixture provided with lampholders for both fluorescent and high intensity discharge lamps (a combination fluorescent/high intensity discharge lamp fixture) shall comply with the requirements in this standard and with the Standard for Fluorescent Lighting Fixtures, UL 1570, insofar as they apply to construction, test methods, and marking requirements unique to high intensity discharge fixtures.

1.5 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this Standard, and that involve a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this Standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this Standard cannot be judged to comply with this Standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this Standard.

2 Glossary

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

2.2 ACCESSIBILITY BARRIER – A material provided to limit access to:

a) Uninsulated live parts; and

b) Live parts insulated with materials not intended to be subject to user contact.

All or part of the barrier may also serve as an enclosure as defined in 2.7.

2.3 CANOPY, DROP – A canopy that can be lowered for access to the supply connections without lowering the fixture. The canopy does not support the fixture.

2.4 CELLULOSIC – A paper- or wood-type product that is treated or processed, such as insulation, paper, and fiber.

2.5 CENTER – An imaginary point that is the dimensional center of the fixture in a plane on the fixture that is adjacent and parallel to the intended mounting surface (wall or ceiling).

2.6 DIAGRAM, CIRCUIT – A line drawing, graphic design, and/or written instructions that explain the process of identifying conductors and making supply connections between the fixture and the branch circuit.

2.7 ENCLOSURE – A material provided to enclose electrical parts and components that may be considered to involve a risk of fire. All or part of the enclosure may also serve as an accessibility barrier as defined in 2.2 or as a recessed housing as defined in 2.21.

2.8 FIELD-CONNECTED BALLAST – A ballast that may or may not be provided with the fixture and that is intended to be electrically connected to the fixture during installation. The ballast may be mounted on the fixture or mounted remotely.

2.9 FLAT GLASS – A glass panel usually formed from sheet stock whose overall shape (not necessarily the surface) is essentially flat or may have a slight curvature or bend.

2.10 GASKET – A preformed, resilient material used between two rigid surfaces.

2.11 KNOCKOUT – A partially cut-out opening that is closed until the precut material is removed.

2.12 LAMP – The device, commonly called a light bulb or bulb, intended to be inserted into a lampholder (socket) to produce light.

2.13 LAMP CONTAINMENT BARRIER – A barrier that consists of the top, sides, and bottom that enclose the lamp compartment. The barrier may consist of a metal housing (recessed or otherwise), a polymeric enclosure, a glass diffuser or lens, a metal canopy, a metal screen, or the like.

2.14 OPEN HOLE – An aperture in a recessed housing or enclosure that is not covered or filled by another part. Typically, open holes relate:

a) To ventilation;

b) To apertures provided for several different constructions that are left unused; and

c) To an uncovered aperture provided for making supply connections.

2.15 OPENING – An aperture in an enclosure that is covered or filled by a plug or knockout and that has the potential of becoming an open hole. Typically, openings relate to supply connections and accessibility for inspection of splices.

2.16 PENDANT FIXTURE – A fixture that is supported by and suspended from an outlet box by a chain, cord, stem, or cable.

2.17 POLE – A fixture support of metal, wood, or other material on which at least one lighting fixture is intended to be mounted.

2.18 POWER SUPPLY CORD – A length of flexible cord provided with an attachment plug at one end.

2.19 PRESSURE WIRE TERMINAL – A device that accepts one or more wires for securement and for electrical connection to other conductors. This is accomplished by means of a tightening device that presses and captures a straight segment of the conductor(s) between conductive surfaces.

2.20 RECESSED FIXTURE – A fixture intended to be installed in a hole in a wall, ceiling, or in-ground surface such that all or part of the fixture is behind the mounting surface. The types of recessed fixtures are as follows:

a) Type IC – A fixture that is investigated and identified for installation in a cavity where thermal insulation will be in direct contact with the enclosure.

b) Type Non-IC, Thermally Protected – A fixture that is investigated and identified for installation in a cavity that may or may not be insulated. All insulation is intended to be spaced at least 3 inches (76.2 mm) from the sides of the fixture. Insulation is not intended to be provided over the top of the fixture. The recessed portions of the enclosure, other than at points of support, are intended to be spaced a minimum distance from other combustible material as follows:

1) Fixtures that are not provided with any specific markings specifying spacings to ceiling and side wall surfaces are intended to be spaced at least 1/2 inch (12.7 mm) from combustible material.

2) Fixtures provided with marked spacings to ceiling and side wall surfaces are intended to be spaced from combustible material at least as marked on the fixture.

c) Type Non-IC, Concrete or In-ground Only – A fixture that is not provided with thermal protection because it is investigated and identified for installation only in poured concrete or in-ground.

d) Canopy Fixture – A fixture intended for installation through an opening in an outdoor canopy or marquee such as those used over gas station pumping islands and similar locations. This product is not intended for indoor use or outdoor installation in which thermal insulation would be employed.

2.21 RECESSED HOUSING – The metal of a recessed fixture that serves to close off the hole provided in a ceiling or wall surface to mount the fixture. It does not necessarily enclose wires or the like.

2.22 REMOTE BALLAST – A ballast that is not mounted on a fixture or one that is mounted on the fixture 18 inches (457 mm) or more from the recessed housing as measured from the nearest point on the ballast to the nearest point (other than an incidental projection) on the recessed housing. The ballast may or may not be provided with the fixture.

2.23 SPLICE – Any point where one wire is connected to another wire. A wire terminating at a pressure wiring terminal or wire binding screw is not considered to be a splice.

2.24 STRAIN RELIEF DEVICE – A knot, bushing, or equivalent to prevent strain from being transmitted to a wire or cord at a termination point inside the fixture.

2.25 SURFACE-MOUNTED FIXTURE – A nonrecessed fixture.

2.26 SUSPENDED CEILING – A part of a building structure that is located on the room side of the structural ceiling (for example, wood joisted or structural steel) and that generally provides a plenum area above it for wiring that may or may not be accessible by service personnel.

2.27 SWITCH – A device intended to open, close, or change connections in a circuit. It includes manual switches and electrically operated switches (relays) but does not include fuses or the like.

2.28 UNINTENTIONAL MISWIRING – A field installation condition in which:

a) An unconnected lead intended to be field connected may be unintentionally connected to another unconnected lead or to an unused terminal which may result in a component, such as a thermal protector, being shunted out of the intended circuit location; or

b) A lead that is intended to be field connected may not be connected which may result in a component, such as a thermal sensor with a heater lead left unconnected, unable to function properly.

Disconnecting a lead from another lead or a terminal is considered intentional.

2.29 WATER SHIELD – A structural part of a wet location fixture relied upon to reduce or prevent the entrance of water into a fixture or onto current-carrying parts and investigated for such use during a rain, sprinkler, or immersion test.

2.30 WIRE BINDING SCREW – A screw used as a post around which a wire is to be wrapped.

3 Components

3.1 Except as indicated in 3.2, 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.

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

a) Involves a feature or characteristic not needed in the application of the component in the product covered by this standard; or

b) Is superseded by a requirement in this standard.

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

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

4 Units of Measurement

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

4.2 Unless indicated otherwise all voltage and current values mentioned in this standard are root mean square (rms).

5 Assembly and Packaging

5.1 A fixture shall be completely wired with all splices and connections completed.

Exception No. 1: Splices and connections in wired fixture sections complying with Section 58 may be completed as part of the field installation.

Exception No. 2: An arm of a fixture or a stem of a stem-suspended fixture may be disconnected from the body of the fixture if it is marked or provided with instructions as specified in 36.2.1.

Exception No. 3: A stem- or chain-suspended fixture, for which incomplete assembly for packaging or shipment is essential, may be shipped in a form that requires some wiring after the fixture leaves the factory if investigated and marked or provided with instructions as specified in 36.2.1, but shall be unwired only to the extent required by the shipping assembly.

5.2 A fixture shall be constructed with all electrical components mounted in place.

Exception No. 1: A lampholder or other device mounted by a snap fit construction may be unmounted if:

a) Instructions for correct assembly are provided as specified in 36.2.1 and no electrical assembly or connections need be made; or

b) The assembly is made the subject of an investigation.

Exception No. 2: A field-connected ballast of a recessed fixture need not be mounted in place if:

a) The weight of the ballast is such that the combination is likely to be damaged during shipping; and

b) The fixture is provided with instructions in accordance with 36.2.1.

Exception No. 3: A remote ballast of a recessed fixture need not be mounted in place but may be shipped with the fixture.

5.3 A fixture shall be completely assembled when shipped from the factory.

Exception No. 1: Recessed fixture sections that comply with Section 53, Rough-In and Finishing Sections for Recessed Fixtures, need not be assembled together.

Exception No. 2: Trims need not be secured to the fixture.

Exception No. 3: Fixture fittings that comply with Section 51 need not be completely assembled.

Exception No. 4: A stem- or chain-pendant fixture, or a fixture of similar construction, for which incomplete assembly is essential for packaging or shipment, may be unassembled only to the extent necessary to facilitate packaging for shipment or to make connection to the source of power supply.

Exception No. 5: Wireway channels, diffusers, and other parts that do not support electrical components need not be attached to the fixture when shipped if the parts are shipped in the same package as the remaining parts of the fixture or in a separate package that is securely attached to the fixture package.

5.4 A fixture shall be shipped from the factory in a carton or as an unpackaged complete assembly. Unassembled parts, such as stems and chains, shall be included if required elsewhere in the standard to accompany the fixture. Glassware need not be actually mounted in a frame or holder but may be separately wrapped to protect it from breakage during shipment.

Exception No. 1: A lens or diffuser that does not provide structural or enclosure functions as required in 7.1 need not be included.

Exception No. 2: Fixtures may be bulk packed if all unassembled parts are included.

5.5 If the acceptability of a fixture is dependent on the size or shape of a diffuser, the diffuser (glass, plastic, metal, or the like) shall be packed and shipped together with the remainder of the fixture in one carton that contains only one complete fixture, or in a bulk carton that contains fixtures that are compatible with all diffusers in the carton.

5.6 As specified in 5.4, a carton is a box of cardboard, pasteboard, shrink film, or the like (but not newspaper, wrapping paper, tissue paper, or the like). It need not be rectangular in form, since the so-called "Pinch Pack" of cardboard wrap with ends pinched together and stapled is considered a carton. Parts banded or otherwise secured to a carton need not be located inside the carton.

5.7 A part that must be removed to assemble stems or connect a fixture in the intended manner to the supply circuit need not be fastened, but the construction shall be such, and the hardware shall be provided, to permit a satisfactory field assembly.

5.8 A threaded joint, unassembled to the degree permitted in 5.3, shall comply with the requirements in 6.2.1 and 6.2.2, or such joint shall be furnished with setscrews, lock washers, or locknuts.

CONSTRUCTION – MECHANICAL

6 General

6.1 Screws

6.1.1 Self-threading or sheet metal screws shall not be used to secure electrical or enclosure component parts in place or together when the screw threads only into aluminum, copper, or aluminum or copper alloys.

Exception: Self-threading or sheet metal screws may be used if threads are not stripped when the screw is tightened with a torque of 30 pound force inches (3.39 N•m) and the part, supported by the screw, is then subjected to a force equal to four times the weight of the part applied in a direction coincident with the axis of the screw.

6.1.2 Sheet-metal or self-threading screws shall not be used for mounting or supporting a part that weighs more than 7-1/2 pounds (3.4 kg).

Exception: Sheet-metal or self-threading screws may be used if the construction is investigated and found to be the equivalent of other acceptable fastening means.

6.2 Joints

6.2.1 The method of making a joint between metal parts and of fastening arms and supports shall provide strength and rigidity and prevent turning that would result in movement of wires or wiring devices after the assembly is completed.

6.2.2 Frictional contact alone between parts is not acceptable as means to prevent turning. Turning shall be prevented by:

a) The use of a lock washer, properly applied;

b) A locknut seated against another nut or metal surface; or

c) By some other equivalent positive mechanical method where two parts mate by interference fit.

6.2.3 Sheet-metal nuts may be used if supplied as part of an armored-cable or flexible-conduit and, if fabricated of heat-treated steel, may be used for assembly or to prevent turning of threaded tubing not larger than 1/8-inch pipe size and on bolts or studs that are not larger than 1/4 inch (6.4 mm) in diameter.

Exception: Sheet-metal nuts for bolts larger than 1/4 inch diameter may be used to prevent turning or loosening if they are not depended upon for mechanical strength.

6.2.4 The fastening means for securing telescoping parts in an adjustable telescoping arm may depend on friction alone if rotation between parts is limited to 360 degrees or less and rotation will not cause damage to conductor insulation.

7 Enclosures

7.1 All splices, transformers, ballasts, capacitors, current-carrying parts or devices with live parts, that are not enclosed and leads or terminals for field connection of supply wires shall be enclosed in material specified in 7.2.

Exception No. 1: A flexible cord or power supply cord for connection to the supply as specified in Section 42, Construction – Electrical, need not be enclosed.

Exception No. 2: The back of the enclosure of a fixture intended only to be surface-mounted and outlet-box connected may have an open area as specified in 41.1.1.

Exception No. 3: A lampholder need not be enclosed.

Exception No. 4: An integral outer metal enclosure provided on a component device, such as the end bells of a transformer or ballast, need not be enclosed in a material as specified in 7.2.

Exception No. 5: A fixture with an integral pole, such as a bollard fixture, intended for mounting on a surface, need not have a mounting surface enclosure.

Exception No. 6: A pole-mounted fixture may be provided with an opening for supply leads if the opening is intended to be closed off by a pole, or mounting arm.

7.2 An enclosure specified in 7.1 shall be constructed of metal, glass, ceramic, porcelain, or a polymeric material that complies with the requirements in Section 59, Polymeric Materials. The minimum thickness for metal shall be as specified in Section 8, Metal Thickness, and for glass, as specified in Section 11, Glass.

8 Metal Thickness

8.1 Sheet metal

8.1.1 The thickness of sheet metal in a fixture or a canopy shall be no less than indicated in Table 8.1.

Exception No. 1: The thickness of metal is not specified for:

a) A purely ornamental part;

b) A reflector part that does not form part of the enclosure; or

c) Any part not required to serve as the enclosure, to provide structural integrity, or to act as support of a wiring device.

Exception No. 2: A form of construction that employs metal having a thickness less than that specified may be used if investigated and found to provide equivalent strength and protection.

Table 8.1
Thickness of sheet metal

Specific construction[a]		Minimum thickness of sheet metal					
		Uncoated steel		Zinc-coated steel		Copper, brass or aluminum	
		Inch	(mm)	Inch	(mm)	Inch	(mm)
At opening for conduit connection		0.026	0.66	0.029	0.74	0.032	0.81
Length more than 26 inches (660 mm)	Component Support	0.026	0.66	0.029	0.74	0.032	0.81
		0.020[b]	0.51	0.023[b]	0.58	0.025[b]	0.64
	No component support	0.020	0.51	0.023	0.58	0.025	0.64
		0.016[b]	0.41	0.019[b]	0.48	0.020[b]	0.51
Length not more than 26 inches (660 mm)	Component Support	0.020	0.51	0.023	0.58	0.025	0.64
		0.016[b]	0.41	0.019[b]	0.48	0.020[b]	0.51
	No component support	0.016	0.41	0.019	0.48	0.020	0.51
		0.013[b]	0.33	0.016[b]	0.41	0.016[b]	0.41
Recessed Housings		0.026	0.66	0.029	0.74	0.032	0.81
Canopy Supporting:							
8 pounds (3.6 kg) or less[c]		0.016	0.41	0.019	0.48	0.020	0.51
More than 8 pounds[c,d]		0.020	0.51	0.023	0.58	0.020	0.51
Any convenience receptacle		0.020	0.51	0.023	0.58	0.020	0.51
Surface-mounted fixture, length not more than 15 inches (381 mm)		0.016	0.41	0.019	0.48	0.020	0.51

[a] A component refers to an electrical device, such a lampholder or switch.

[b] Minimum thicknesses for forms of construction that have been found to provide the physical strength and protection required in 8.1.

[c] The weight of lamps is not included.

[d] The thickness may be the same as that required for 8 pounds or less if the rim is reinforced by turning the metal at least 180 degrees, or by turning a 1/8 inch (3.2 mm) or wider right-angle flange at the rim.

8.1.2 The lengths noted in Table 8.1 are considered to be:

a) The diameter of a circular fixture;

b) The longest diameter of an elliptical fixture;

c) The longest side of a triangular fixture;

d) The diagonal of a rectangular fixture; and

e) The longest diagonal of a multisided fixture.

8.1.3 Footnote b of Table 8.1 applies to any single surface or single flat sheet. Rigid members consisting of 1/2 by 1/2 inch (12.7 by 12.7 mm) 90-degree angle strips formed of sheet steel not less than 0.032 inch (0.81 mm) thick, or flat steel bars not less than 3/8 inch (9.6 mm) wide and 1/8 inch (3.2 mm) thick, may be used to reinforce and divide a large area into sections for which lighter metal may be used. Such reinforcement, unless along the longer dimension of the surface, is to be additionally secured to the adjacent sides of the enclosure. A single piece of sheet metal that is corner-bent to form an angle of not more than 120 degrees is considered to be reinforced along the bend, and its thickness may be based on the length of the largest flat surface involved.

8.1.4 The values for minimum thickness indicated in Table 8.1 apply to measurements made on a formed part prior to the application of paint, varnish, and the like.

8.2 Extrusions

8.2.1 An extruded metal part shall comply with the thickness requirements for sheet metal as described in 8.1.

8.3 Tubing

8.3.1 The minimum wall thickness of tubing:

a) With or without pressed (rolled) threads shall be 0.025 inch (0.64 mm); or

b) Having die-cut threads shall be 0.040 inch (1.02 mm).

8.4 Cast metal

8.4.1 The minimum thickness of cast metal shall be in accordance with Table 8.2.

Table 8.2
Minimum thickness of cast metal

Metal	At unreinforced areas exceeding 35 square inches (226 cm^2)		At all other areas	
	Inch	(mm)	Inch	(mm)
Die-cast metal	5/64	2.0	3/64	1.2
Cast malleable iron or permanent mold cast aluminum	3/32	2.4	1/16	1.6
Other cast metal	1/8	3.2	3/32	2.4

9 Open Holes

9.1 The requirements in this section apply to permissible open holes in the enclosures as covered in 7.1. All open holes provided for special purposes, not specifically covered in 9.2 or 9.3, or, for surface-mounted fixtures, not covered in 41.2.1 – 41.6.1, shall comply with the requirements for miscellaneous open holes specified in 9.4 and 9.5.

9.2 An enclosure of other than a pole- or wall-mounted fixture marked as suitable for wet locations only shall not have any open holes if it contains an open coil type device.

Exception No. 1: Open holes are permitted as described in 41.2.3 and 41.3.1 for surface-mounted fixtures.

Exception No. 2: Open holes that are permitted elsewhere may be located 6 inches (152 mm) or more from the device, measured horizontally, when the fixture is mounted as intended. See 36.1.2 for possible marking requirements.

Exception No. 3: A fixture that incorporates an open coil type ballast or power supply may have open holes in the enclosure as specified in 9.4, 41.2.3, and 41.3.1 if the transformer has been determined to comply with the burnout test requirements specified in the Standard for High-Intensity-Discharge Lamp Ballasts, UL 1029, or, if a power supply has been investigated to determine compliance with the abnormal and burnout tests specified in the Standard for Power Supplies, UL 1012.

Exception No. 4: An enclosure of an open coil ballast or transformer may have open holes in its surface if a metal baffle is provided that complies with Figure 9.1 and the following:

a) The distance between the baffle and the other enclosure, X, shall not exceed 1/4 inch (6.4 mm).

b) The dimensions of the baffle, Y, shall be at least the cross-sectional dimensions of the live part.

c) The distance where the enclosure overlaps the baffle, Z, shall be at least two times the distance between the baffle and the outer enclosure.

Exception No. 5: A ceiling-mounted surface or recessed fixture marked as suitable for outdoor wet locations only may have open holes in that part of the enclosure facing away from the surface to which the fixture is intended to be secured.

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

Exception: Open holes that are permitted elsewhere may be located 6 inches (152 mm) or more from the fuse, measured horizontally, when the fixture is mounted as intended. See 36.1.2 for possible marking requirements.

9.4 An open hole in the enclosure specified in 7.1 provided for miscellaneous purposes shall not exceed the dimensions specified in Table 9.1.

Figure 9.1
Relationship of baffle and electrical part to prevent emission

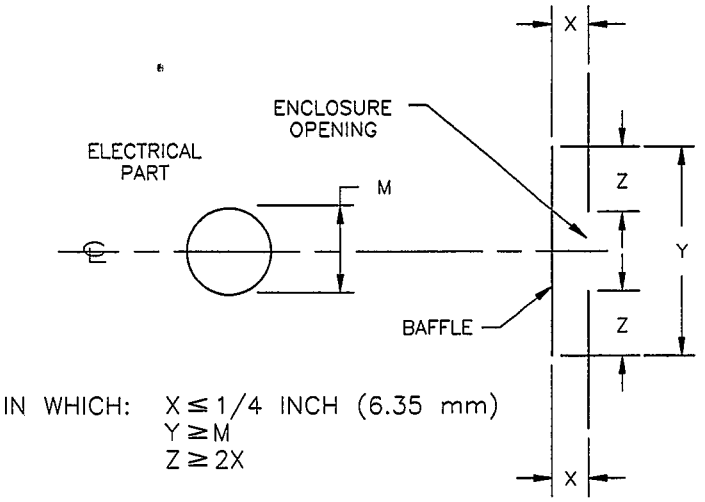


Table 9.1
Maximum six of miscellaneous open holes

Opening shape	Dimension		Maximum Area	
	Inch	(mm)	In^2	(cm^2)
Slot[a]	3/8 (width)	9.6	1-1/2	9.68
Square	1/2 (side)	12.7	–	–
Round	1/2 (diameter)	12.7	–	–
Irregular	–	–	1-1/2	9.68

[a] An open hole between two assembled parts that does not exceed 1/32 inch (0.8 mm) need not comply with the area limitation.

9.5 The total area of one or more miscellaneous open holes shall be no more than 15 percent of the area of the surface in which the hole or holes are located, including a wiring compartment or an integral outlet box compartment.

10 Openings

10.1 A knockout shall be secured in place so that it can be removed readily without distortion of the enclosure, but will remain in place during handling.

11 Glass

11.1 A flat panel of glass, smooth or otherwise, shall have a minimum thickness as indicated in Table 11.1 and shall not have an exposed area greater than 1100 square inches (7097 cm^2).

Exception No. 1: Tempered glass so treated that, when broken, it will completely dice into fragments such that the weight of the ten largest crack-free fragments does not exceed the weight of 10 square inches (64.5 cm^2) of the original test panel need not comply with the minimum thickness and exposed area requirements.

Exception No. 2: Other glass may be used if it has been investigated and found to be mechanically equivalent to glass complying with the thickness and exposed area requirements.

Table 11.1
Minimum glass thickness

Exposed area of glass panel				Minimum thickness of glass					
More than		Not more than		Flat[a]		Curved[b]		Fluted, ribbed, or patterned[c]	
$Inch^2$	(cm^2)	$Inch^2$	(cm^2)	Inch	(mm)	Inch	(mm)	Inch	(mm)
0	0	150	968	0.083	2.11	0.083	2.11	0.083	2.11
150	968	500	3226	0.10	2.54	0.083	2.11	0.083	2.11
500	3226	1100	7097	0.14	3.56	0.10	2.54	0.10	2.54

[a] See 11.1 for conditions and additional requirements.

[b] See 11.3 for conditions and additional requirements.

[c] Instructions on proper measurement of glass thickness are contained in 11.2.

11.2 The minimum thickness of fluted, ribbed, or patterned glass is to be measured from a valley to the other side, or between valleys on opposite sides.

Exception: If the dimension of the piece is longer in a direction along the rib than in a direction perpendicular to the rib, the measurement is to be made between the peak of a rib and the other side, or between the peak and an opposite valley.

11.3 The thickness of a glass lens, glass that is curved or bent, and glass having other shapes shall be as specified in Table 11.1:

a) If the glass is used as an enclosure as required in 7.1; or

b) If the glass area is greater than 275 square inches (1774 cm^2).

11.4 Exposed edges of glass that may be touched during relamping, cleaning, or servicing shall be seamed, swiped, fire-polished, or similarly treated to eliminate sharpness.

12 Glass Support

12.1 Flat glass mounting means

12.1.1 Flat glass shall be mounted by clips in a frame or securely held by channels or by adhesive. The mounting means shall comply with the requirements in 12.1.2 – 12.2.10.

Exception: Clips are not required if the glass is held in place by its own weight in a frame that is not hinged and that does not need to be moved for relamping, cleaning, or servicing.

12.1.2 A frame shall be provided on at least three sides of a panel of glass that is more than 300 square inches (1935 cm^2) in area or more than 26 inches (660 mm) long.

Exception No. 1: A frame need be provided on only two sides if the glass has a metal stiffener along one edge or if metal bands, spaced no more than 26 inches apart, support the glass.

Exception No. 2: A glass panel that is more than 300 square inches but not more than 1100 square inches (7097 cm^2) in area may be held in place by clips around two sides and top if the panel will be in a vertical position upon installation of the fixture, and provided that the weight of the glass is supported by the bottom frame of the fixture, or some other substantial means, when the glass is in its intended position and during relamping. See 36.1.2 for a possible marking requirement.

12.1.3 Clips or channels shall be provided to secure glassware in a frame that is hinged or that is removable without the use of tools.

12.1.4 A frame with a glass panel greater than 300 square inches (1935 cm^2) in area and that must be opened for relamping shall be provided with two or more hinges and a positive latch. A positive latch requires a definite lifting, twisting, or equivalent motion to open and close.

Exception No. 1: A single piano-type hinge may be used if the length of the hinge is not less than 65 percent of the length of the side of the frame to which it is attached.

Exception No. 2: A framed glass panel that is not more than 500 square inches (3226 cm^2) in area need not be hinged if it can be kept within and supported by the fixture during relamping.

Exception No. 3: An arrangement that permits the removal of a glassware frame without the use of tools may be used if the frame will not fall out under conditions of intended use, including servicing (such as lamp replacement and lens cleaning), unless it is given a definite lifting-twisting or equivalent motion. The acceptability of the arrangement is to be determined with the fixture in its installed position. See 36.1.2 for possible marking requirements.

Exception No. 4: Captive latches (devices that release by at least two motions of the device, such as out and up) may be used in lieu of the combination of hinge and positive latch if spaced no more than 15 inches (381 mm) apart on the perimeter of the frame.

12.1.5 A frame or glass panel that is 300 square inches (1935 cm^2) or less in area, and that must be opened for relamping, shall be provided with at least one hinge and a positive latch as defined in 12.1.4.

Exception No. 1: A spring catch that does not provide a positive latch may be used if it engages for a distance 1/8 inch (3.2 mm) or more.

Exception No. 2: A framed glass panel that is not greater than 50 inches (1.27 m) long, and not less than 3 inches (76.2 mm) wide may be removable from the fixture for relamping.

Exception No. 3: A glass panel with no dimension greater than 26 inches (660 mm) may be secured by one stud and nut or the equivalent.

Exception No. 4: A frame may be secured by two or more captive latches for glassware of 150 square inches (968 cm^2) or less, or by four or more captive latches for glassware of 300 square inches or less.

12.2 Clips

12.2.1 Clips required to support flat glass shall comply with the requirements in 12.2.2 – 12.2.8.

12.2.2 The width and overlap of clips shall be as indicated in Table 12.1.

12.2.3 Clips may be mounted with either the width or the edge of the clip bearing against the glass.

12.2.4 There shall be one or more clips for each 8 inches (203 mm) of edge or fraction thereof, as determined by dividing the perimeter of the glassware (in inches) by 8 inches. A double clip is counted as two clips.

12.2.5 The double clip mentioned in 12.2.4 is a clip having at least double the width required in Table 12.1 or is one having a pair of fingers, each of which has the width required in Table 12.1, in which case the single supporting member that is common to the two fingers shall have a width at least double that required in Table 12.1.

Table 12.1
Clip dimensions

Exposed area of glass panel				Minimum clip size			
More than		Not more than		Width		Overlap	
$Inch^2$	(cm^2)	$Inch^2$	(cm^2)	Inch	(mm)	Inch	(mm)
0	0	300	1935	3/32	2.4	3/16	4.8
300	1935	500	3226	1/4	6.4	1/4	6.4
500	3226	1100	7097	1/2	12.7	1/2	12.7

12.2.6 There shall be at least one clip on each straight edge that is more than 12 inches (305 mm) long.

12.2.7 The distance between the adjacent edges of any two clips, as measured along the edge of the glassware, shall not be more than 16 inches (406 mm).

12.2.8 A channel, trough, frame, or clip for holding a glass panel or lens shall be constructed of metal not less than 0.017 inch (0.43 mm) thick if of galvanized steel, not less than 0.016 inch (0.41 mm) thick if of uncoated steel, and not less than 0.020 inch (0.51 mm) thick if of aluminum or copper.

Exception: A clip that is used to restrain but not support glass may be of a polymeric material that complies with Section 59, Polymeric Materials.

12.2.9 An adhesive material used to secure glassware to a frame shall comply with the applicable requirements for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, with respect to the type of materials to be joined.

12.2.10 A glass and frame assembly that complies with 12.2.9 shall be replaceable as a unit and shall be marked, as specified in 36.2.2, to indicate that the complete assembly should be replaced when glass is broken.

12.3 Shaped glass supports

12.3.1 A glass glove, molded or blown glass, a decorative glass part, or the like, shall be mounted by means of:

a) A circular fitter with at least three setscrews, thumbscrews, or the like;

b) A stud with threaded end and nut;

c) Threads on the glass part that engages a threaded fitter;

d) Spring clips that hold only by means of friction, if the assembly complies with 12.3.2;

e) Equivalent construction investigated and found to comply with 12.3.2; or

f) Adhesive that complies with 12.2.9 and 12.2.10.

12.3.2 A glass diffuser supported by friction shall remain in place when a force equal to five times the total weight of the complete diffuser is applied to the diffuser in the direction of gravity, with the fixture mounted in its intended mounting position.

13 Lamp Compartments

13.1 A fixture intended and marked for use with metal halide lamps shall be provided with a lamp containment barrier. The lamp containment barrier shall not have any open holes greater than 1/8 inch (3.2 mm) diagonally or in diameter. That part of the lamp containment barrier where particles from a ruptured lamp are likely to drop to and rest, shall be of a material as specified in 13.2.

Exception No. 1: A lamp containment barrier need not be provided if:

a) The manufacturer of the lamp intended to be used in the fixture does not identify the lamp as needing to be enclosed for the orientation of the lamp in the fixture;

b) The major axis of the lamp is oriented ±15 degrees from vertical when the fixture is installed as intended; and

c) The fixture is marked as specified in 39.3.

Exception No. 2: A lamp containment barrier, at points other than where particles from a ruptured lamp are likely to drop to and rest, may be provided with open holes greater than 1/8 inch diagonally or in diameter if additional barriers are located such that there is no line-of-sight opening between the arc tube of the lamp and any point external to the fixture.

13.2 With reference to 13.1, the surface of the lamp containment barrier, where particles from a ruptured lamp are likely to drop to and rest, shall be metal, minimum 1/8 inch (3.2 mm) thick tempered or borosilicate glass, or metal screen with open holes of maximum 1/8 inch (3.2 mm) diagonally or in diameter.

Exception No. 1: A lamp containment barrier of a polymeric material may be used if it complies with the Polymeric Lamp Containment Barrier requirements in Section 61.

Exception No. 2: A glass material other than tempered or borosilicate glass may be used if it complies with the Glass Thermal Shock/Containment Test described in Section 28.

CONSTRUCTION – ELECTRICAL

14 General

14.1 A wiring device (a switch, fuseholder, lampholder, or the like) shall be prevented from any turning, by means specified in 6.2.2, that would apply tension to splices or other wiring, or otherwise adversely affect the assembly.

15 Device and Conductor Ratings

15.1 Voltage

15.1.1 Electrical devices and insulated conductors shall have a voltage rating at least equal to the voltage that would be applied to them during intended use. The output circuit of a ballast is considered to be 300 volts for mercury vapor lamps of 400 watts or less, and 600 volts for all other wattages and types of lamps.

15.2 Current

15.2.1 An electrical device shall have an ampere rating, and insulated conductors shall have an ampacity rating for the total current, as specified in 15.2.2 and 15.2.3, to which they would be subjected during intended use.

15.2.2 The ampere rating of a device and the ampacity of conductors shall be the combination of:

a) The sum of the ampere ratings of all load devices (transformer, relay, ballast, and the like) that use the conductor for their supply;

b) A value of 15 amperes for one or two single receptacles or for one duplex receptacle; and

c) A value of 8 amperes for lampholders for 1000 watt type H36 mercury vapor lamps, and 6 amperes for all other HID lamps.

15.2.3 The ampacity ratings of some commonly used insulated conductors are indicated in Table 15.1.

15.2.4 The ampere rating of a switch shall be multiplied by the derating factor as indicated in Table 15.2 before consideration of its current handling capability for the specified load.

Table 15.1
Maximum ampacity ratings of wires and cords with copper conductors

Types of wire and cord[a]	Ampacity, No.				
	18 AWG	16 AWG	14 AWG	12 AWG	10 AWG
SI equivalent, mm^2 sectional area	(0.82)	(1.3)	(2.1)	(3.3)	(5.3)
General Building Wires					
RH, RHW, RUH, RUW, T, THHN, THW, THWN, TW, XHHW	–	–	20	25	35
AIA, AI, Z	–	–	40	50	70
A, AA	–	–	45	55	75
PFAH, TFE	–	–	60	80	110
Fixture Wires					
RFH-1, RFH-2, FFH-1, FFH-2, TF, TFF, TFN, TFFN, AF, CF, HF, HFF, KF-1, KFF-1, KF-2, KFF-2, PAF, PAFF, PF, PFF, PGF, PGFF, PTF, PTFF, SF-1, SF-2, SFF-1, SFF-2, XF, XFF, ZF, ZFF	6	8	17	23	28
Flexible Cords					
S, SE, SO, SOO, SJ, SJE, SJO, SJOO, ST, SJT, SJTO, SJTOO, STO, STOO, SP-1, SP-2, SPE-1, SPE-2, SPE-3, SPT-1, SPT-2, SV, SVE, SVO, SVOO, SVT, SVTO, SVTOO	7(10)[b]	10(13)[b]	15(18)[b]	20(25)[b]	25(30)[b]
AFC, AFPD, CFPD	6	8	17	23	28
Appliance Wiring Material	6	8	17	23	28

[a] Some of the types of wire and cord are not made in each of the sizes shown. For each such type and size the ampacity shown is inapplicable.

[b] These ampacities are applicable to 3-conductor cords and 4-conductor cords with three conductors carrying current. The corresponding ampacities for these sizes of 2-conductor cords and 3-conductor cords carrying current are shown in parentheses.

Table 15.2
Switch derating factors

Switching load	Switch type			
	AC general use[a]	AC "L"[b]	AC	DC
Transformer	none	none	1/2	–
Receptacle	none	none	1/6	1/10
Ballast	none	none	1/6	–

[a] This column applies not only to general-use AC switches (for mounting in flush-device outlet boxes) but also to switches of the fixture, pendant, and through-cord types rated AC only.

[b] A switch (other than a type mentioned in note a) that has been investigated for the control of inductive loads, is marked with the letter "L" in conjunction with the current rating at which the inductive rating applies; for example: "1 ampere, 125 volt, L".

16 Switches

16.1 A fixture designed to operate on a branch circuit of more than 300 volts to ground shall not incorporate a manually operated switch.

16.2 A special use snap switch shall be rated in accordance with Table 15.2.

16.3 A manually operated switch used in a fixture designed to operate on a circuit of more than 150 volts to ground shall be located so that it is not readily accessible, such as behind a lens or diffuser, or behind a cover plate or the like.

16.4 A manually operated switch that is used in a ceiling-mounted fixture and that is intended to be located within 2 feet (0.61 m) of the ceiling shall be of the pull type. The distance from switch to ceiling shall include the maximum length of flexible cord, stem, or chain provided with the fixture.

Exception: A switch that:

a) Does not energize or de-energize the fixture during intended use (such as a switch that regulates light level); or

b) Is located so that it is not readily accessible;

need not be of the pull type.

16.5 A switch used in a 2-wire input circuit derived from a branch circuit of between 125 and 250 volts shall be of the double-pole type.

Exception: If the fixture is marked as specified in 36.2.3, a single-pole photocontrol switch may be used.

16.6 A switch used in a multiwire circuit shall be of the multipole type and shall be connected such that all ungrounded wires are switched.

16.7 A switch shall comply with the requirements for Polarity as specified in Section 20.

16.8 A fixture intended for use with a plug-in type photocontrol shall employ a receptacle that complies with the Standard for Plug-In, Locking Type Photocontrols for Use With Area Lighting, UL 773.

16.9 A fixture provided with a receptacle for a photocontrol shall be shipped with the control or with a shorting or open circuit plug.

Exception: A fixture not provided with a photocontrol need not be shipped with a shorting or open circuit plug if it is marked for use with a specific plug as indicated in 36.2.4.

16.10 A switch shall not be connected in the secondary of a ballast unless it is rated for switching a HID lamp load.

17 Convenience Receptacles and Fuses

17.1 A convenience receptacle may be provided only in a wall-, under cabinet-, or floor-mounted fixture. See 34.1 for marking requirements.

17.2 No more than one duplex or two single convenience receptacles may be provided with each fixture.

17.3 A convenience receptacle shall be of the grounding type.

17.4 The face of a convenience receptacle that is less than 5/8 inch (15.9 mm) wide or 7/8 inch (22.2 mm) long shall project a minimum of 0.015 inch (0.38 mm) and a maximum of 3/16 inch (4.8 mm) from any part of the receptacle-mounting surface, including screwheads and the like, that is within a rectangle 5/8 inch wide and 7/8 inch long, the rectangle being symmetrically located about the receptacle contacts.

Exception: The minimum projection shall be 3/32 inch (2.4 mm) if the mounting surface for the receptacle is electrically conductive.

17.5 A fuse, if provided, shall be mounted in a fuseholder of the corresponding type and rating.

18 Lampholders

18.1 A porcelain lampholder mounted by means of a screw-ring shall be used only with the gasket usually supplied with this type of lampholder.

Exception: If a lampholder is mounted on and supported by porcelain, a gasket is not required.

18.2 The depth of a lamp cavity of a screw-base lampholder, as measured vertically from the plane of the depressed center contact to the plane of the rim of the insulating lining or lampholder body (if of insulating material) shall be as indicated in Table 18.1.

Table 18.1
Depth of lamp cavity

Trade size of lampholder	Depth of lamp cavity			
	Minimum		Maximum	
	Inches	(mm)	Inches	(mm)
Mogul	1-5/8	41.3	1-11/16	42.9
Admedium	1-1/8	28.6	1-3/16	30.2
Medium	15/16	23.8	1	25.4

18.3 The maximum-depth requirement in Table 18.1 does not apply to a construction in which the outer shell (insulating material) is flared and extends beyond the specified limit to provide further protection against contact with current-carrying parts.

18.4 If the method of mounting a lampholder affects the depth of the lamp cavity, the determination of its depth is to be made with the device mounted as intended.

18.5 A lampholder with exposed terminals shall have the terminals located behind a permanent barrier or similar construction to comply with the accessibility requirements in Section 23, Accessibility of Current-Carrying Parts.

18.6 A lampholder for a high pressure sodium lamp shall have a pulse voltage rating of at least the pulse voltage output of the lamp igniter.

19 Wiring and Conductors

19.1 General

19.1.1 A conductor shall be made of copper or copper alloy.

19.1.2 A conductor shall have insulation rated for the voltage, temperature, and condition of service to which it will be subjected under conditions of intended use.

19.1.3 A conductor shall not be smaller than No. 18 AWG (0.82 mm^2).

19.1.4 Some commonly used types of fixture wire, flexible cord, and appliance wiring material enclosed in accordance with 7.1 are enumerated in Tables 19.1 and 19.2.

Table 19.1
Temperature and voltage ratings of wire and cord

Temperature rating		300 Volts	600 Volts
60°C (140°F)	Wire	–	TF, TFF, T[a], TW, RUW
	Cord	C[a], PD[a], SV, SVE, SVO, SVOO, SVT, SVTO, SVTOO, SP-1, SPT-1, SP-2, SPE-2, SPT-2, SJO, SJOO, SJT, SJTO, SJTOO	S, SE, SO, SOO, ST, STO, STOO
75°C (167°F)	Wire	FFH-1, RFH-1	FFH-2, RFH-2, RH[a], RHW, XHHW, RUH[a], TWH, THWN, FEPW[a], ZW
	Cord[b]	SVO, SCOO, SVT, SPE-1, SPE-2, SPT-1, SPT-2, SJ, SJE, SJO, SJOO, SJT	S, SE, SO, SOO, ST
90°C (194°F)	Wire[c]	CF	RHH[a], THHN[a], TFH, TFFN, XHHW[a], FEPW[a], Z, ZW[a]
	Cord[c]	SVO[b], SVT[b], SPT-1[b], SPT-2[b], HPN, SJT[b], CFPD[a]	SO[b], SOO[b], ST[b]
105°C (221°F)	Cord[b,c]	SVT, SPT-1, SPT-2, SJT	ST[b]
125°C (257°F)	Wire[c]	AI[a]	AIA[a]
150°C (302°F)	Wire	SFF-1, AF[a], XF, XFF	SFF-2, PFF, PGFF, PTFF, PAFF, SF, SFF, HF, HFF
200°C (392°F)	Wire	SF-1, A[a], AA[a], KF-1, KFF-1	SF-2, PF, PGF, KF-2, KFF-2
250°C (482°F)	Wire	–	PTF, PAF, PFAH[a], TFE[a]

[a] Not acceptable for use in fixtures intended to be used in damp or wet locations in accordance with Sections 64 – 72.

[b] Only if surface marked "75°C", "90°C", or "105°C" whichever is applicable.

[c] See 19.1.5 for increased temperature ratings by use of sleeving.

Table 19.2
Appliance wiring material insulation – type, voltage, and temperature ratings

	Minimum thickness of insulation							
	300 volts				600 volts			
	Without braid		With added impregnated braid cover		Without braid		With added impregnated braid or nylon[b] cover	
Types of Insulation	Inch	(mm)	Inch	(mm)	Inch	(mm)	Inch	(mm)
Thermoplastic	0.013	0.33	0.013	0.33	0.027	0.69	0.015	0.38
Thermoset	0.013	0.33	0.013	0.33	0.027	0.69	0.027	0.69
Rubber	0.027	0.69	0.013	0.33	0.040	1.02	0.027	0.69
Neoprene	0.027	0.69	0.013	0.33	0.042	1.07	0.027	0.69
Silicone Rubber	0.027	0.69	0.013	0.33	0.040	1.02	0.027	0.69
Fluoroplastic[a]	0.012	0.30	–	–	0.018	0.46	–	–

NOTE – The temperature marking of appliance-wiring material or miscellaneous wire consists of:

1) Colored threads;

2) Durable, continuous (unbroken), straight, longitudinal stripes printed in indelible ink on the surface of the insulation; or

3) Durable and legible indelible ink printing (or legible indent printing)

in words in degrees Celsius on (or in) the surface of the insulation. The number and color of the threads or stripes are: one green for 75°C (167°F); one red for 90°C (194°F); one yellow for 105°C (221°F); one blue for 125°C (257°F); one brown for 150°C (302°F); one black for 200°C (392°F); two black for 250°C (482°F). If a stripe or thread is used to identify the temperature marking of an 80°C (176°F) thermoplastic-insulated wire (the identification is not required), the stripe or thread is green.

[a] Polytetrafluoroethylene or fluorinated ethylene propylene.

[b] Minimum acceptable thickness for the nylon cover is 0.004 inch (0.1 mm).

19.1.5 A wire, appliance wiring material, or each insulated conductor of a cord that is rated for 90°C (194°F), 105°C (221°F), or 125°C (257°F) is considered as rated for 150°C (302°F) if each wire is individually provided with supplementary insulation that consists of snugly fitting woven glass sleeving at least 0.010 inch (0.25 mm) thick, or woven-glass tape of sufficient number of layers (but not less than two in any case) to provide a total thickness of not less than 0.010 inch (0.25 mm).

Exception: The supplementary insulation for each insulated conductor for Type SPT-1, SV, SVE, SVT, SVO, SVOO, SVTO, and SVTOO cords shall be 1-1/2 times as thick as the insulation thickness specified above.

19.1.6 Means shall be provided to hold all wiring, including all through branch-circuit conductors, in place within the wireway if the fixture enclosure must be opened to replace lamps.

19.1.7 Reusable plastic wire-ties, fiber strips, smooth metal strips, and the like are acceptable for holding wiring in place as required in 19.1.6, but adhesive tape wraps or twist ties that consist of wires with or without a nonmetallic protective ribbon are not acceptable.

19.2 Flexing of wires

19.2.1 A wire or cord that can be flexed because of an adjustable, movable, or flexible part of a fixture shall be of the stranded type and shall be so secured that it will not be cut or abraded under conditions of intended use, including relamping, servicing, and inspection of the supply connections.

19.3 Splices and connections

19.3.1 A splice shall be so located that it need not be disturbed when a lamp is being replaced.

19.3.2 A splice shall be:

a) Made with solder or a wire connector; and

b) Electrically and mechanically secure.

19.3.3 A soldered splice and a splice made with an uninsulated wire connector shall be covered with insulation equivalent to that required on the conductors. The equivalence is to be determined with respect to voltage and temperature ratings as specified in Table 19.2 and with respect to thickness.

19.3.4 General use insulating tape used in compliance with 19.3.3 is rated 80°C (170°F).

19.3.5 Wire connectors, if supplied with the fixture for connection of field wires to the fixture, shall be rated for the size of wires to be connected.

19.3.6 An insulated wire connector shall be rated for the temperature and voltage involved.

Exception: A connector rated 300 volts may be used to join wires having a potential of more than 300 volts if the splice (including the connector) is additionally covered with insulation acceptable for the voltage difference between the higher voltage and 300 volts.

19.3.7 If stranded internal wiring is connected to a wire binding screw or stud terminal, the construction shall be such that no loose strands result. This is to be accomplished by one of the following means:

a) Using pressure terminal connectors, soldering lugs, or crimped eyelets;

b) Soldering all strands of the wire together;

c) Tightly twisting all strands together; or

d) Using a means equivalent to (a), (b), or (c).

19.4 Wireways

19.4.1 A fixture shall be so designed that wires can be pulled through, or the fixture otherwise wired, without damaging the coverings of insulation on the conductors. A wire enclosure shall be free from burrs, fins, and other sharp edges that can come in contact with wires.

19.4.2 Threads of sheet metal and self-tapping screws shall not be exposed in a wiring enclosure for a distance of more than 3/16 inch (4.8 mm).

Exception: Screw threads may be exposed for a distance of greater than 3/16 inch if wires are held or positioned so they will not contact the threads.

19.4.3 If a conductor passes through an opening or crosses over the edge of sheet metal, the conductor shall be held away from the edges of the metal or shall be protected by a bushing, a grommet, or by rolling the edge of the metal not less than 120 degrees. Sleeving is not an acceptable means of preventing cutting and abrasion of wires.

Exception: The edges of sheet metal thicker than 0.042 inch (1.07 mm) need only be treated by reaming or the equivalent to remove burrs, fins, and sharp edges.

19.4.4 A bushing used in accordance with 19.4.3 shall be securely held in place. A bushing constructed of insulating material shall be at least 3/64 inch (1.2 mm) thick. A rubber bushing is not acceptable.

Exception: A bushing less than 3/64 inch thick is acceptable if an investigation shows that its mechanical properties are equivalent to those provided by a bushing at least 3/64 inch thick.

19.5 Wiring to a lamp-supported lampholder

19.5.1 Wiring to a lamp-supported lampholder shall be enclosed in accordance with the enclosure requirements in Section 7, Enclosures, and shall comply with the accessibility requirements in Section 23, Accessibility of Current-Carrying Parts, and the strain relief test requirements in 29.1 and 29.2.

20 Polarity

20.1 An Edison-base lampholder in a fixture intended to be electrically connected to a branch circuit supply with a grounded circuit conductor shall be wired such that the screw shell is electrically connected to the grounded conductor.

Exception: A screw shell lampholder that is connected to a circuit electrically isolated from the supply (such as in the secondary of an isolated secondary transformer or ballast) or that operates at a potential to ground, and between conductors, of 30 volts rms (42.4 volts peak) or less.

20.2 A fixture containing a general use receptacle shall be wired such that the grounded circuit terminal of the receptacle is electrically connected to the grounded circuit conductor of the branch circuit supply.

20.3 A fixture intended for connection to a branch circuit supply with a grounded circuit conductor shall have the means for connecting the fixture to the supply wiring identified in accordance with Table 20.1 or 20.2, or 20.4 or 20.5.

Table 20.1
Polarity identification of wires

Identification obtained by	Acceptable combinations[a]		
		Grounded (neutral) wire	All other wires
Color of Braid[b]	A	Solid white or natural gray without tracer	White or natural gray with tracer in braid or Solid color other than white, natural gray, or green, without tracer
	B[c]	Color other than white, natural gray, or green, with tracer in braid	Solid color other than white, natural gray, or green, without tracer
Color of Insulation[b]	C	Solid white or natural gray; strip, white or natural gray, on contrasting color other than green	Solid color other than white, natural gray or green
Color of Separator[b]	D	Solid white or natural gray	Solid color other than white, natural gray, or green
Conductor Tinning[d]	E	Tin or other suitable metal on all strands of the conductor	No tin or other white metal on the strands the conductor

[a] A green wire, with or without one or more yellow stripes, is to be used only as an equipment grounding conductor.

[b] If color of braid, insulation, or separator is used for identification, all conductors are to be either tinned or not tinned.

[c] Only if conductors are exposed as described in this standard, such as in chain-pendant fixtures.

[d] If conductor tinning is used for identification, all braids or insulation are to have the same color and shape.

Table 20.2
Polarity identification of flexible cords

Identification obtained by	Acceptable combinations[a]		
	Grounded (neutral) wire		All other wires
Color of Braids on Individual Conductors	A	Solid white or natural gray, without tracer	Solid color other than white, natural gray, or green, without tracer
	B[b]	Solid white or natural gray, without tracer	White or natural gray with tracer in braid
	C	Color other than white, natural gray, or green, with tracer in braid	Solid color other than white, natural gray, or green, without tracer
Color of Insulation on Individual Conductors	D[c]	Solid white or natural gray	Solid color other than white, natural gray, or green

[a] A green wire, with or without a yellow tracer or one or more yellow stripes, is to be used only as equipment grounding conductor.

[b] Only for Types C and PD cords.

[c] Only for cords having no braid on any individual conductor.

20.4 A conductor may be identified, as near as possible to the point where the wire leaves a fixture other than the chain, stem or cord pendant type, by means of a permanent tag or tape, a band of paint, ink, or wax crayon marking of a color that will identify the conductor covering.

20.5 A field-wiring terminal to which the screw shells of lampholders are connected and which is required in 20.1 to be identified shall be of metal substantially white in color or shall be identified by means of a metal-plated coating substantially white in color.

20.6 A single-pole switch shall not be connected in the grounded (neutral) circuit conductor.

20.7 The requirements in 20.1 preclude the acceptance of screw type lampholders that are connected in series unless connected to wires electrically isolated from the supply, such as in the secondary of an isolated secondary transformer.

20.8 A fuse or similar device shall not be connected in the grounded (neutral) circuit conductor.

20.9 If a fixture employs a ballast that is intended to be connected to a branch circuit with a grounded circuit conductor (neutral), then the lead or terminal for connection to the neutral shall be white in color or otherwise marked to indicate the proper connection.

21 Ballasts and Capacitors

21.1 General

21.1.1 A fixture shall be provided with a ballast rated for the operation of lamps of the size for which the fixture is designed and shall be electrically connected in accordance with the diagram or instructions on or with the ballast.

Exception: A fixture designed for use only with a remote ballast need not be provided with a ballast.

21.1.2 A recessed indoor fixture provided with other than a remote ballast shall be provided with thermal protection and shall comply with the test requirements in Section 48, Performance.

21.1.3 A recessed indoor fixture with a remote ballast shall comply with the requirements in Section 54, Fixtures with Remote Ballasts, and shall be provided with thermal protection such that the fixture complies with the insulation abnormal operation test requirement in 48.3.1.1 or the Type IC fixture normal temperature test requirement in 48.4.1.7 without relying on a thermal protector in the ballast.

21.1.4 A remote ballast that is provided with a recessed indoor fixture shall be thermally protected and shall be so identified.

21.1.5 A fixture having a capacitor as a component separate from the ballast shall incorporate means, such as a bleeder resistor, for the automatic discharge of the capacitor within 1 minute after removal of the lamp from the circuit or after opening of the primary circuit, or both. The voltage (V) at the end of 1 minute across the terminals shall be reduced to a value of 50 volts or less, and the energy stored (J) shall be less than 20 joules as determined by the equation:

$$J = 5 \times 10^{-7} CV^2$$

where C is the capacitor rating in microfarads.

21.1.6 To comply with 21.1.5, the maximum resistance value of a bleeder resistor shall be determined by the equation:

$$R = \frac{K}{C}$$

where:

R is the resistance value in megohms,
K is the resistor factor determined from Table 21.1, and
C is the capacitor rating in microfarads.

Table 21.1
Bleeder resistor factor (K)

Voltage		
Peak	rms[a]	Factor (K)
0 – 100	0 – 70	85
101 – 110	71 – 78	76
111 – 120	79 – 85	70
121 – 130	86 – 92	63
131 – 140	93 – 99	55
141 – 150	100 – 106	54
151 – 170	107 – 120	50
171 – 200	121 – 141	44
201 – 240	142 – 169	39
241 – 280	170 – 197	35
281 – 325	198 – 230	32
326 – 375	231 – 265	30
376 – 450	266 – 318	27
451 – 500	319 – 353	26
501 – 700	354 – 495	23
701 – 1000	496 – 707	19

[a] For a transformer type ballast, the voltage value to be applied from this table is the rms voltage rating of the capacitor as specified by the ballast.

21.1.7 The requirement in 21.1.5 may be met without the use of a bleeder resistor if the capacitor is located in a closed loop of the circuit and if the loop is not opened by removal of the lamp or by the opening of a switch, fuse, or similar device.

21.2 Nonintegral oil-filled capacitors

21.2.1 If an oil-filled capacitor in an electric discharge fixture is not integral with the ballast, its characteristics and installation shall comply with 21.2.2 – 21.2.5.

21.2.2 The capacitor shall comply with the requirements in the Standard for Capacitors, UL 810, and shall be rated for the voltage to which it is to be connected. Such capacitors relieve an internal fault condition by movement of the terminal end of the capacitor enclosure to break the circuit internally. Movement is initiated by internal pressure during a fault condition, causing expansion of the capacitor body.

21.2.3 The capacitor shall be rated not less than the maximum fault current to which it may be subjected, as follows:

a) A value of 10,000 amperes when connected across the ballast primary; that is, when the capacitor is in parallel with the ballast input circuit;

b) A value of 200 amperes when connected in series with a ballast coil; or

c) The maximum current available to the capacitor under capacitor short-circuit condition, as determined by an investigation.

21.2.4 The placement and mounting of a capacitor in a fixture shall be such that a free air space is provided in front of the capacitor end-terminals to enable the capacitor to expand, without obstruction, under a fault condition. This expansion clearance space shall be sufficient to allow the front enclosure and terminals of the capacitor, with associated wire connectors and supply leads attached, to travel 1/2 inch (12.7 mm) in a direction perpendicular to the mounting surface of the terminals.

Exception: The expansion clearance space may be less than 1/2 inch if an investigation determines that the space needed for a particular capacitor is provided.

21.2.5 In addition to the expansion clearance space specified in 21.2.4, an electrical air spacing between any exposed live part of the capacitor, such as exposed terminals and wire connectors, and:

a) Any uninsulated live part of opposite polarity; or

b) Uninsulated, grounded dead metal parts shall (after expansion) be:

1) At least 1/16 inch (1.6 mm) if the voltage involved does not exceed 300 volts; or

2) At least 1/8 inch (3.2 mm), if the voltage involved exceeds 300 volts.

22 Electrical Spacings

22.1 Electrical spacings between:

a) Insulated live parts of opposite polarity; and

b) Uninsulated live parts and dead-metal parts;

shall be no less than those indicated in Table 22.1 and between supply wiring terminals shall be no less than indicated in 22.2.

Exception: Snap switches, lampholders, and similar component devices that comply with the requirements for Components as specified in Section 3, Components, need not comply with the spacings specified in Table 22.1 with respect to:

a) Spacings between internal features of the device;

b) Spacings between uninsulated live parts and dead-metal that is part of the device; and

c) Spacings between live parts of the device and dead-metal parts of the fixture on which the device is mounted in the intended manner.

Table 22.1
Electrical spacings

	Minimum spacing									
	0 – 50 V (0 – 71 V)[a]		51 – 150 V (72 – 212 V)[a]		151 – 300 V (213 – 423 V)[a]		301 – 600 V (424 – 846 V)[a]		Over 600 V (over 846 V)[a]	
	Inch	(mm)	Inch	(mm)	Inch	(mm)	Inch	(mm)	Inch	(mm)
Through Air	1/16	1.6	1/8	3.2	1/4	6.4	3/8	9.5	1/2	12.7
Over Surface	1/16	1.6	1/4	6.4	3/8	9.5	1/2	12.7	5/8	15.9

[a] The values in parentheses are peak voltages. When investigating the voltage of a circuit that produces other than an essentially sinusoidal waveform, both rms and peak values are considered, and the requirement for the larger spacing is to be applied.

22.2 The spacings between supply wiring terminals of opposite polarity and between the terminals and a grounded dead metal part shall not be less than 1/8 inch (3.2 mm) through air and 1/4 inch (6.4 mm) over surface, or as indicated in Table 22.1, whichever is greater.

22.3 The spacing between uninsulated live parts of different circuits involving different voltages shall not be less than that required for the circuit of the higher voltage.

22.4 The spacings at fuses and fuseholders are to be measured with the fuses in place. The fuses are to be those with maximum standard dimensions.

22.5 The spacing at a supply wiring terminal is to be measured with wire of the required size for the rating connected to the terminal as in actual service, but in any case with wire no smaller than No. 14 AWG (2.1 mm^2).

22.6 When investigating spacings, any wire or cord not in compliance with the insulation thickness requirements in 19.1.2 and 19.1.5 (including film-coated wire) is considered to be a bare, current-carrying part.

22.7 If provision is made for the connection of conduit or armored cable, spacings shall be measured with fittings in place, whether they are furnished with the fixture or not.

22.8 A spade or ring wire connector shall be prevented from turning by means of a reliable restraint, such as a shoulder or boss, if such turning would reduce spacings to values less than those required. A lock washer alone is not acceptable for this purpose.

Exception: If a wiring lug or connector can be turned ±30 degrees from normal without reducing spacings as required in Table 22.1 or 22.2, a restraint need not be provided.

23 Accessibility of Current-Carrying Parts

23.1 Accessibility determination

23.1.1 Current-carrying parts, insulated and uninsulated, that are determined to be accessible including during normal maintenance shall comply with the requirements in this section. Current-carrying parts are considered accessible if they can be contacted by the articulate probe that is illustrated in Figure 23.1. The probe may be positioned as specified in 23.1.2.

Exception: The probe illustrated in Figure 23.2 may be used if:

a) All or part of an enclosure must be removed to perform normal maintenance, including relamping; and

b) The fixture is rated for 277V or higher or is marked "Not for Residential Use" in accordance with 36.3.1.

23.1.2 With respect to the requirement in 23.1.1, the probe may be articulated into any configuration, and may be rotated or angled to any position, before, during, or after inserting into the opening, and the penetration may be to any depth allowed by the opening size, including a minimum depth combined with the maximum articulation.

23.2 Uninsulated parts

23.2.1 The following uninsulated current-carrying parts may be accessible. Contact with all other uninsulated current-carrying parts shall be prevented by an accessibility barrier as specified in 23.4.1 – 23.4.3.

a) The uninsulated current-carrying contacts of a lampholder into which a lamp connects.

b) An uninsulated current-carrying part that involves a voltage of less than 30 volts RMS (42.4 volts peak) and is electrically isolated from the primary circuit.

Figure 23.1
Articulate probe with web stop

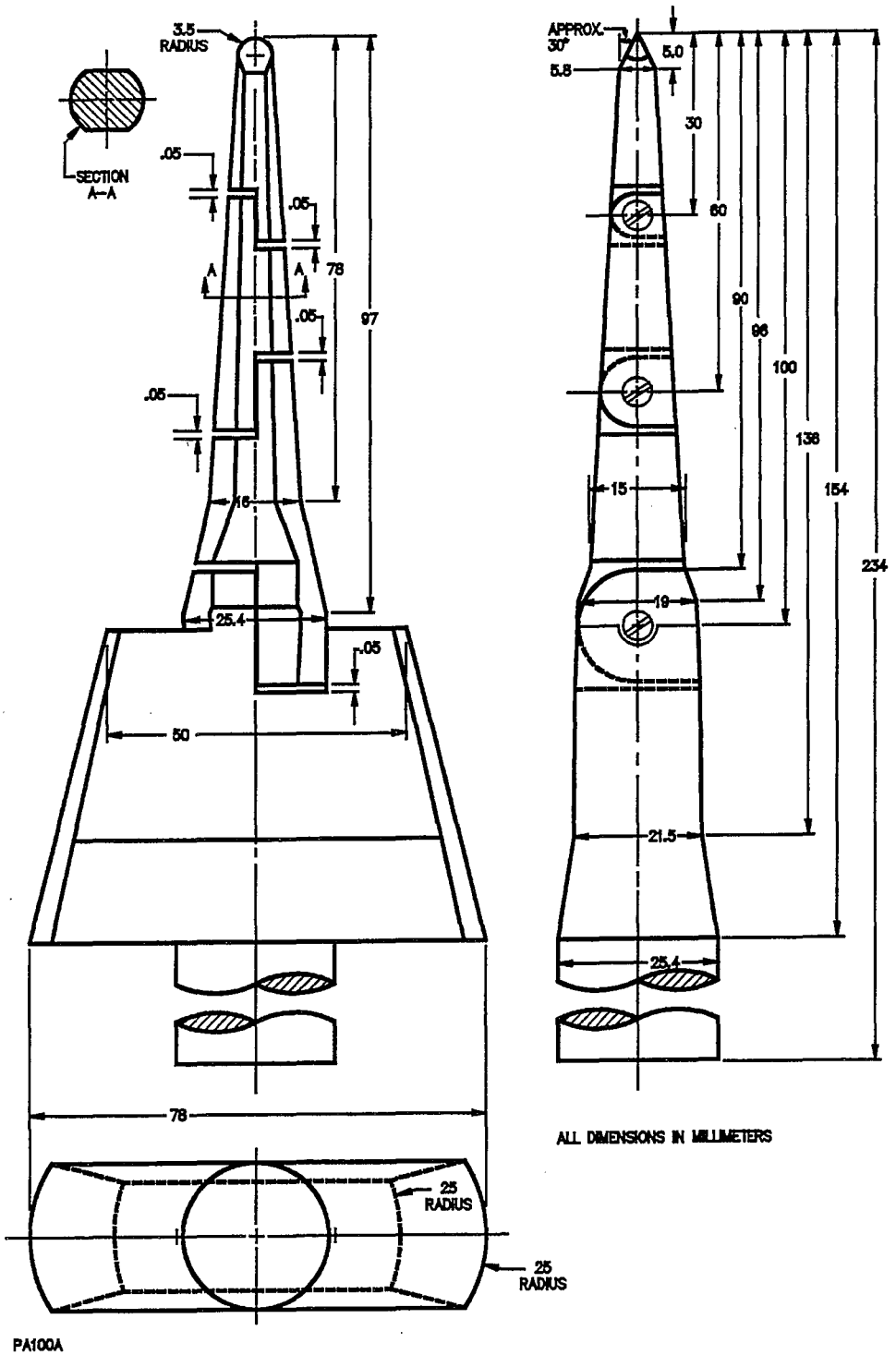
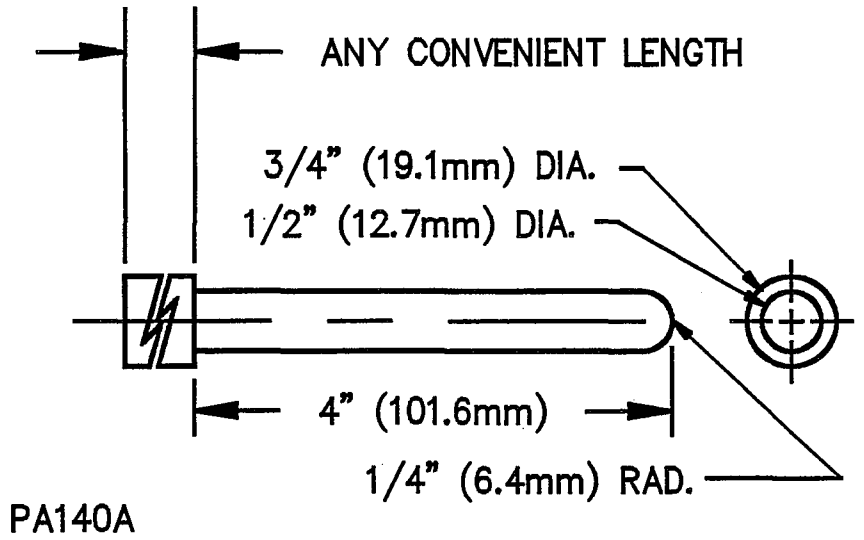


Figure 23.2
straight probe



23.3 Insulated parts

23.3.1 The following insulated current-carrying parts may be accessible. Contact with all other insulated current-carrying parts shall be prevented by an accessibility barrier as specified 23.4.1 – 23.4.3.

a) Appliance wiring material that complies with the insulation requirements specified in Figure 23.3 and is routed through the chain of a chain-pendant fixture.

b) Any flexible cord specified in Table 19.1 if it is type SP-2, SPT-2, or heavier cord.

c) Any wire specified in Table 19.1 or any 600 volt rated appliance wiring material specified in Table 19.2 that:

1) Does not terminate in a lamp-supported lampholder and;

2) Is:

i) Visible for the entire length that is accessible;

ii) Routed in close proximity to a structural part of the fixture; and

Exception: Wiring to an adjustable spotlight or similar construction need not be routed in close proximity to a structural part of the fixture.

iii) Secured at least every 3 inches (76.2 mm) if stranded wire or every 4 inches (101.6 mm) if solid wire to the structural part of the fixture or threaded through chain links, and;

Exception: Wiring to an adjustable spotlight or similar construction need not be secured where flexing of the wire is required for adjusting of the light.

3) Either:

i) Accessible for no more than four inches, contains no splices as defined in 2.23, and the accessible end of the wire does not terminate at the starter or lampholder required to be pulse rated; or

ii) The wire is enclosed in a minimum 0.01 inch (0.25 mm) thick glass fiber or thermoplastic sleeving and factory-made splices using insulated crimp type connectors are enclosed in a minimum 0.01 inch (0.25 mm) thick glass fiber or thermoplastic sleeving.

d) Any wire specified in Table 19.1 or any 600 volt rated thermoplastic insulated appliance wiring material specified in Table 19.2 that:

1) Terminates in a lamp-supported lampholder and;

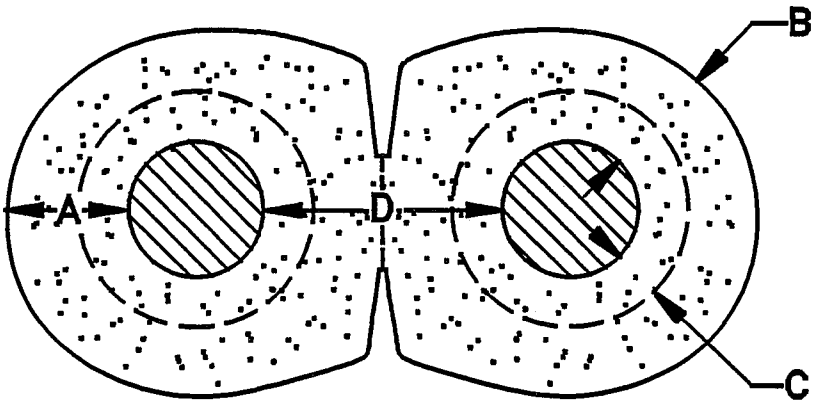
2) Has a minimum 0.027 inch (0.69 mm) thick insulation and;

3) Is covered – collectively if more than one wire – with nominal 0.020 inch (0.51 mm) thick glass fiber or thermoplastic sleeving that extends from within 1/2 inch (12.7 mm) of the lampholder to within an enclosure and;

4) Has no splices as defined in 2.23 between the ballast and the lampholder.

e) The integral metal enclosure of a transformer or ballast or any other component device that complies with 23.4.1 – 23.4.3.

Figure 23.3
Minimum insulation thicknesses for non-enclosed appliance wiring material in the chain of a chain-pendant fixture



S3527

A – Minimum average thickness away from tear area and outside point – 0.040 inch (1.02 mm).
B – Minimum thickness at any point before separation* – 0.035 inch (0.89 mm).
C – Minimum thickness at any point after separation* – 0.019 inch (0.49 mm).
D – Minimum distance between copper conductors* – 0.060 inch (1.52 mm).

*Not applicable for individual conductors

23.3.2 The following insulated current-carrying parts may be accessible to incidental contact only during user maintenance, including relamping:

a) The terminals of a ballast, capacitor, or terminal block and the ballast coil if insulated with materials that are mechanically secured in place and comply with 23.4.1.

b) Factory made splices employing insulated crimp-on wire connectors or wire connectors (other than the twist-on type) that comply with the Standard for Splicing Wire Connectors, UL 486C, as long as they do not have to be moved to accomplish the maintenance operation.

c) Any wiring, as long as it does not have to be moved to accomplish the maintenance operation.

23.4 Accessibility barriers

23.4.1 The accessibility barrier, as referenced in 23.2.1 and 23.3.1, shall be constructed of:

a) Metal (ferrous, aluminum, brass, zinc, or copper) minimum 0.016 inch (0.41 mm) thick;

b) Glass, porcelain, or ceramic minimum 1/8 inch (3.2 mm) thick;

c) Impregnated glass fiber sleeving at least 0.01 inch (0.25 mm) thick that is rated for the temperature involved;

d) Vulcanized fiber minimum 0.028 inch (0.71 mm) thick; or

e) A polymeric material that complies with 23.4.2.

Exception: An accessibility barrier may be of a thickness less than that specified if it complies with the requirement in 23.4.3.

23.4.2 A polymeric material used to form an accessibility barrier shall:

a) Be rated for at least the maximum operating temperature of the barrier in the fixture;

b) Be classified at least 94HB in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94; and

c) Comply with minimum property and test requirements in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

The minimum properties are 30 seconds ignition time (maximum assigned performance level category 3) for hot wire ignition (HWI) and 60 arcs (maximum assigned performance level category 1) for high-ampere arc ignition (HAI). The test requirement is the mold stress relief test referenced in 59.7 of this standard.

23.4.3 The accessibility barrier as referenced in 23.2.1 and 23.3.1 need not be of the minimum thickness specified in 23.4.2 if the application of a force of 10 pounds (44.5 N) over an area of 1 square inch (6.45 cm^2) on the barrier does not result in:

a) Permanent distortion of a metal barrier;

b) Temporary displacement of a metal barrier that results in a reduction in spacings; or

c) Breaking or cracking of a glass, porcelain, ceramic, or polymeric barrier.

Permanent or temporary distortion of a polymeric barrier is acceptable if parts required to be inaccessible continue to be inaccessible as specified in 23.2.1 and 23.3.1 both during and after the application of the force.

24 Thermal Insulation

24.1 Thermal insulation that is provided as part of a fixture shall be glass fiber that complies with the requirements in 24.2 – 24.4 and Section 31, Thermal Insulation Rigidity Test.

Exception No. 1: Other inorganic insulation material may be used.

Exception No. 2: A polymeric material that complies with the requirements in Section 59, Polymeric Materials, may be used.

24.2 Thermal insulation shall be permanently and reliably secured in place. Holes through the insulation for the passage of wires, mounting screws, stems, fixture studs, and the like, shall be not larger than necessary, and all such holes shall be provided at the factory.

24.3 Thermal insulation is considered to be secured in place if it is attached to the fixture in the intended position by:

a) Two staples or bolts;

b) An adhesive applied to at least one-third of the surface of the insulation; or

c) Members of the fixture that do not have to be removed for installation.

A lead wire projecting through the insulation is not acceptable for securing the insulation in place. Other means may be used if investigated and found to be mechanically equivalent.

24.4 Thermal insulation shall not be used within 1/4 inch (6.4 mm) of any opening for the connection of conduit unless the insulation is attached to a cover or other part that will be removed when conduit is being attached to the fixture.

25 Grounding

25.1 General

25.1.1 A fixture having a metal part not intended to be electrically live that is accessible using the probe illustrated in Figure 23.1 and that could be inadvertently energized, shall be provided with a means for connection to the branch circuit ground in accordance with 25.1.3 – 25.1.12. A means for grounding not described in 25.1.3 – 25.1.12 shall be investigated in accordance with the Standard for Grounding and Bonding Equipment, UL 467.

Exception: If the only metal parts of the fixture are the chain links, a grounding means need not be provided.

25.1.2 An equipment grounding means shall be provided on the cross-bar (mounting strap), if the cross-bar and the fixture are conductively connected after installation. Otherwise, the equipment grounding means shall be provided on the fixture.

Exception: A grounding means need not be provided on a post-mounted fixture if it is shipped with, or marked for use with, fixture fittings (a post as specified in Section 52, Poles, or a post arm) that are conductively connected to the fixture. See 38.6.

25.1.3 A means to connect the equipment grounding conductor of the branch circuit to the fixture as noted in 25.1.2 shall be provided. This shall consist of a pigtail lead, a pressure terminal connector, a wire binding screw, the grounding contact of a receptacle or the grounding pin of an attachment plug or the equivalent. The grounding means shall be at the same location as the power supply connection means.

Exception: A fixture intended for installation only in environmental air handling spaces other than ducts or plenums need not be provided with a grounding conductor or terminal if the fixture is marked in accordance with 49.28 and provided with a fitting as specified in 47.1.4.

25.1.4 A fixture equipment grounding conductor shall not be smaller than the gauge of wire used for the fixture's supply connections nor smaller than No. 18 AWG (0.82 mm^2). If insulated, this conductor, where visible to the installer, shall have a braid of continuous green color with or without a yellow tracer or, if no braid is employed, the insulation on the conductor shall be green with or without one or more yellow stripes. A conductor having green insulation and a braid of other than green may be employed if the green insulation is readily visible where connection to the branch-circuit supply wires will be made.

25.1.5 A fastener (screw, rivet or other device) used to terminate the fixture equipment grounding conductor shall not also be used to fasten another component part, including a bonding conductor.

Exception No. 1: The equipment grounding conductor of a chain pendant fixture may be secured to a ring terminal that is, in turn, secured to a threaded nipple and a screw collar loop.

Exception No. 2: A grounding conductor may be secured to the same screw as the bonding conductor if the grounding conductor is separately secured such that it need not be loosened or removed during replacement or disconnection of any bonding conductor.

Exception No. 3: An equipment grounding conductor may be secured to a medium-base lampholder. If the equipment grounding conductor is secured to a snap-fit lampholder it shall comply with 25.2.3 or 25.2.4.

25.1.6 The reliability of the grounding system shall be maintained as follows:

a) Positive means of maintaining contact between conductive surfaces are required, e.g. screws, rivets, welding, etc.

b) If the reliability of a grounding connection is questioned it shall be subjected to the test in Section 32, Grounding Continuity Test.

c) Thermoplastic materials used in a grounding system shall comply with Section 59, Polymeric Materials.

25.1.7 The cord of a cord-connected fixture shall contain an equipment grounding conductor complying with 25.1.4 and 25.1.5.

Exception: A pendant-type suspended fixture construction in which a 2-wire cord and separate equipment grounding conductor are intended to be interwoven though the chain need not comply with 25.1.5.

25.1.8 A pressure-type grounding terminal for field connection shall comply with the requirements in the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

25.1.9 A wire binding screw intended for field connection of the branch circuit equipment grounding conductor shall comply with the following:

a) The screw shall be No. 8 (4.2 mm major diameter) or larger.

b) The screw head shall be colored green and shall have a hexagonal shape, slotted, or both.

c) The screw shall not be used to secure more than one wire except as permitted by Exception No. 2 to 25.1.5.

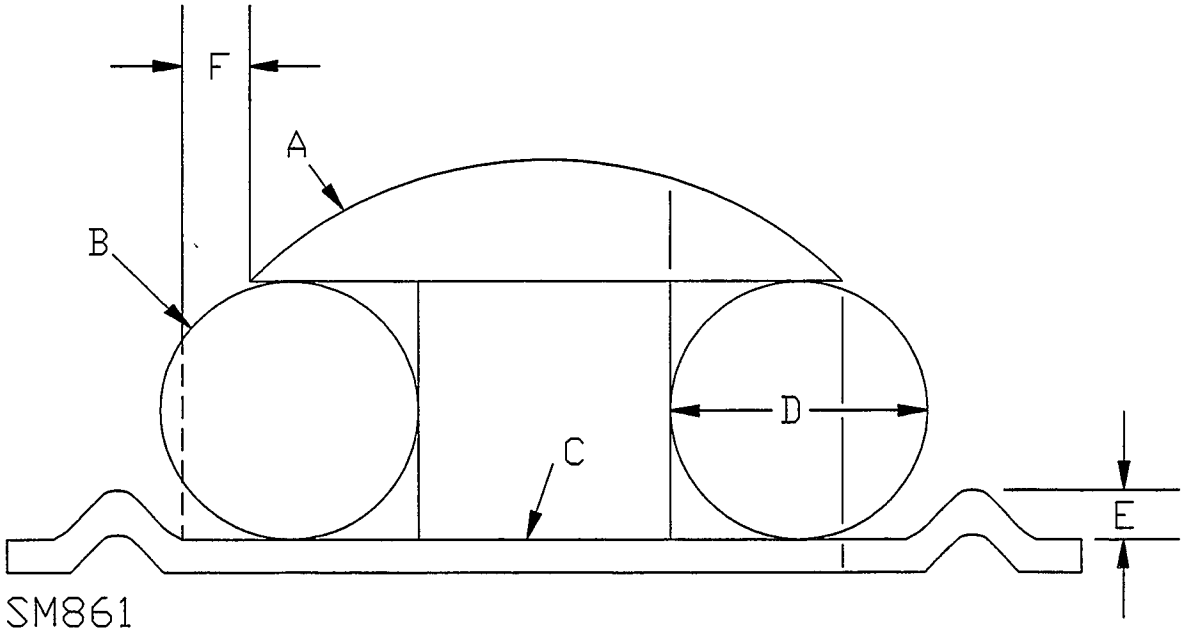
d) A sheet metal screw shall not be used.

25.1.10 A cupped washer shall be provided to hold the wire under the head of the screw.

Exception No. 1: A cupped washer need not be provided if there are two raised areas around the tapped hole that are minimum 1/4 inch (6.4 mm) apart (on center) and comply with Figure 25.1.

Exception No. 2: Other means may be used to hold the wire if investigated and found to be equivalent.

Figure 25.1
Terminal-conductor relationship



A – Wire binding Screw
B – Conductor
C – Terminal Plate
D – Maximum conductor diameter, but not less than 0.08 inch (2 mm)
E – Minimum height of raised areas = 0.04 inch (1.0 mm)
F – The horizontal dimension from the edge of the screwhead to the inside edge of the raised area = 0 to 1/4 D

25.1.11 A pressure terminal intended for field connection of an equipment grounding conductor shall be plainly identified by being marked in accordance with 38.4.

25.1.12 A terminal plate having a tapped hole for a wire binding screw shall be of metal and shall have no fewer than two full threads in the metal. A detail, such as an extruded hole, may be used to provide two full threads.

25.2 Bonding

25.2.1 All conductive parts of a fixture not intended to be electrically live that are accessible using the probe illustrated in Figure 23.1 and that could inadvertently become energized shall be conductively bonded to the fixture grounding means. Any part with a non-conductive coating may require treatment of the part, such as masking, removal of the coating at points of connection, or the use of fastening means that penetrate the surface coating. If special treatment is necessary or if grounding continuity is not obvious, the resistance shall be measured by the method described in Section 32, Grounding Continuity.

Exception: Chain links need not be conductively bonded.

25.2.2 If the integrity of the bonding system relies on the thickness and insulation characteristics of a polymeric material, the material shall comply with Section 59, Polymeric Materials.

25.2.3 A factory assembled snap-fit lampholder that is relied upon for the continuity of the bonding system shall comply with Section 32, Grounding Continuity Test.

25.2.4 A field assembled snap-fit lampholder that is relied upon for the continuity of the bonding system shall comply with:

a) Exception No. 1 to 5.2; and

b) Section 32, Grounding Continuity Test.

25.2.5 A grounding-type convenience receptacle mounted in a metal fixture enclosure shall have the receptacle grounding terminal bonded to the fixture grounding system by one of the following methods:

a) Riveting, bolting, or welding the metal mounting yoke or strap (if provided) of the receptacle to the metal fixture enclosure.

b) A copper bonding wire equal to or greater than the supply leads to the receptacle and connected to the fixture enclosure in a manner that complies with the 25.2.8.

25.2.6 A part that:

a) Is required to be grounded;

b) Is likely to be removed during normal use, including relamping; and

c) Supports a current carrying component;

shall be bonded to the fixture. A wire used to bond the part shall be stranded copper the same wire gauge as the current carrying conductors to that part, or larger.

Exception: A part provided with a disconnect that includes a bonding wire and, simultaneously makes and breaks all conductors or interrupts the bonding lead last and connects it first, is not required to have a separate wire to bond the part.

25.2.7 A bonding wire shall be connected by:

a) A machine screw and nut;

b) A machine screw that threads into metal where the metal provides at least two full threads;

c) A rivet; or

d) Equivalent means as determined by an investigation.

A sheet metal screw or self-threading screw is not acceptable for this use unless it can withstand a torque of 30 pound-inches without stripping.

25.2.8 All parts required to be grounded shall be conductively bonded to the ground termination point such that the resistance between any two points is 0.1 ohm or less as determined in 32.1.

26 Power Supply Connection

26.1 Supply connection systems

26.1.1 A fixture shall be so constructed that it can be connected readily to a branch circuit wiring system by at least one of the following:

a) Provision on the fixture for mounting over an outlet box as described in 42.4.1. (For a suspended fixture, the provision is usually a canopy.)

b) Provision for connection of conduit as specified in 26.2.1 – 25.2.6.

c) A length of flexible cord as specified in Section 42, Construction – Electrical.

d) A length of flexible conduit with emerging leads, or leads only, but with provision for attachment of conduit where leads emerge as specified in Section 47, Construction – Electrical.

e) For a fixture intended for use in a suspended, T-bar grid ceiling only, or recessed fixture, provision for a proprietary wiring system, such as a prefabricated power and lighting distribution system in which fixtures are connected to the branch circuit by cable sets, or the like.

f) Provision for mounting to a pole as specified in Section 41, Construction – Mechanical.

g) For a fixture with an integral pole, such as a bollard fixture, provision for mounting to a noncombustible base over a conduit stub and having internal supply conductors reaching within 6 inches (152.4 mm) of the base.

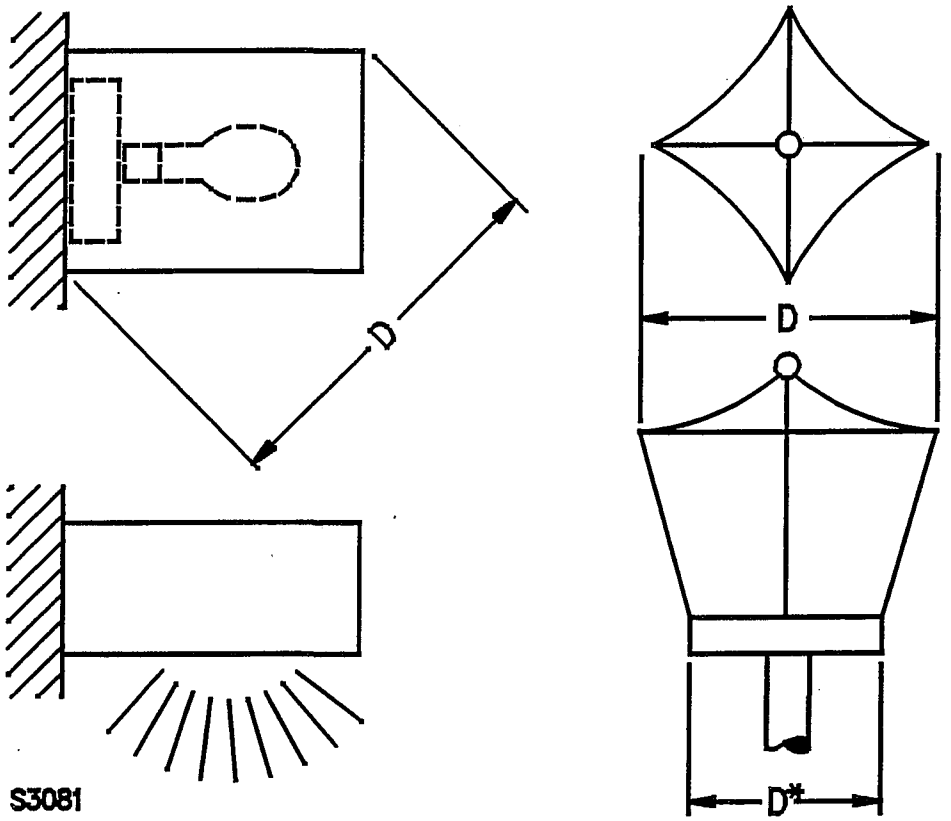
26.1.2 A fixture shall have provision for connection to a single branch circuit. This does not, however, preclude connection to multiple inputs (usually switched) that derive from a single branch circuit.

26.1.3 The provision for connection to the supply source shall permit all supply connections to be made at a common point without the addition of wire in the field.

26.1.4 Connections between the fixture conductors or terminals and the conductors of the power supply branch circuit shall be readily accessible for inspection. The connections are considered readily accessible if the weight of the fixture does not exceed 25 pounds (11.35 kg), and the weight-dimension value, defined as the value obtained by multiplying the weight in pounds (kg) by the maximum length or diameter in inches (mm), does not exceed 500 (5761). A fixture with a weight greater than 25 pounds or a weight-dimension value greater than 500 shall be provided with a means of access to the supply wiring splices without removing the fixture.

26.1.5 The maximum length or diameter (D in Figure 26.1) used in making the weight-dimension value determination specified in 26.1.4 is to be measured in a horizontal plane with the fixture oriented in the intended position after installation, as illustrated in Figure 26.1. The maximum length is the maximum diameter or diagonal along the horizontal plane in any direction.

Figure 26.1
Maximum length of fixture



D – Maximum horizontal diameter or diagonal

D* – Same as D except with readily removable part (diffuser) that is less than 25 pounds (11.35 kg), and the weight-dimension value is less than 500 (5761) removed.

26.1.6 With regard to 26.1.4, a part(s) that is readily removable without disturbing the wiring, such as a diffuser, may be removed from the fixture before determining the weight and weight-dimension value of the fixture. The part that is removed from the fixture for this determination shall also be subject to the same weight and weight-dimension limits as the fixture. A large number of removable parts are not considered readily removable due to the time involved in removing each part. If the fixture part that was removed exceeds the limits specified in 26.1.4, the fixture shall be provided with a means of access to the supply wiring splices without removing the fixture or fixture part.

26.1.7 Free space within a wiring compartment for field connection of the fixture leads to branch circuit conductors shall be at least 2.25 cubic inches (36.9 cm^3) for each supply wire that terminates inside the compartment. One or more grounding conductors are treated collectively as one conductor.

26.1.8 Pigtail leads provided for the connection to the supply branch circuit shall not extend greater than 24 inches (610 mm) beyond the connection point of the fixture unless general building wire is used. General building wire is identified in Table 15.1.

Exception No. 1: Recessed fixture tap conductors that comply with the requirements in 47.1.1 – 47.1.4 may extend greater than 24 inches beyond the farthest connection point.

Exception No. 2: Pigtail leads in a pole-mounted fixture as described in Exception No. 2 of 41.5.1 may extend greater than 24 inches beyond the farthest connection point.

26.2 Conduit connection provision

26.2.1 Only one opening for the entrance of branch circuit power supply wires by conduit may be an open hole, and it shall be so located that those wires can be connected readily to the fixture supply means.

26.2.2 An opening for conduit shall have dimensions as indicated in Table 26.1.

Table 26.1
Dimensions associated with openings for conduit

Nominal trade size of conduit	Unthreaded opening diameter[a]		Throat minimum		Diameter maximum		Minimum diameter of flat surface	
Inches	Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
1/2	0.875	22.2	0.56	14.2	0.62	15.7	1.15	29.2
3/4	1.109	28.2	0.74	18.8	0.82	20.8	1.45	36.8
1	1.375	34.9	0.94	23.9	1.05	26.7	1.80	45.7
1-1/4	1.734	44.0	1.24	31.5	1.38	35.1	2.31	58.7

[a] A plus tolerance of 0.031 inch (0.79 mm) and a minus tolerance of 0.015 inch (0.38 mm) applies to the knockout diameter. Knockout diameters will be measured other than at points where a tab may remain after removal of knockout.

26.2.3 An opening for conduit connection shall not be located in a snap-fit structural part unless that part is investigated for acceptability.

26.2.4 The minimum unobstructed diameter of the flat surface surrounding the back of an opening for unthreaded conduit shall be as indicated in Table 26.1.

26.2.5 If threads for the connection of threaded conduit are tapped all the way through a hole, there shall be no fewer than 3-1/2 but no more than five threads. The construction of the hole shall be such that a conduit bushing can be securely attached, and the minimum unobstructed diameter surrounding the back of the hole shall be as indicated in Table 26.1.

26.2.6 If threads for the connection of threaded conduit are not taped all the way through a hole, there shall be no fewer than five full threads. The unthreaded parts of the hole and the back edge shall be smooth and well rounded for protection of the conductors. The unthreaded throat diameter of the hole shall have an internal diameter as noted in Table 26.1.

26.3 Power supply connection means

26.3.1 The means for connection to a branch circuit shall consist of pigtail leads or a terminal block with a pressure terminal connector or wire binding screw.

Exception No. 1: For a pendant fixture, the means may consist of a cord and attachment plug.

Exception No. 2: For a proprietary wiring system, the means may consist of a receptacle or attachment plug.

26.3.2 A field-wiring terminal shall be prevented from turning or shifting in position by means other than friction between surfaces. This may be accomplished by two screws or rivets; by square shoulders or mortises; by a dowel pin, lug or offset; by a connecting strap or clip fitted into an adjacent part; or by a means described in 6.2.4.

27 Separation of Circuits

27.1 General

27.1.1 Fixtures requiring the field installation of power limited circuits designated Class 2 or Class 3, shall be provided with a means of segregating or separating the field installed wiring from all lighting or power circuit wiring within the fixture.

27.1.2 Class 2 or Class 3 wiring may be in random contact with lighting or power circuit wiring provided:

a) All of the involved wiring is factory installed; and

b) All of the wiring is rated for the maximum voltage that exists on any of the circuits.

27.2 Segregation

27.2.1 The segregation required in 27.1.1 can be accomplished by the location of knockouts in the wiring compartment such that a permanent separation of 1/4 inch (6.4 mm) minimum is provided.

27.2.2 If additional knockouts are provided in the wiring compartment it should be assumed that field wiring can enter the wiring compartment at any of these additional knockouts; therefore, the locations of the additional knockouts shall also provide the segregation described in 27.2.1.

27.3 Separation by barriers

27.3.1 The separation required in 27.1.1 shall be provided by a barrier which can be made either of metal or of a insulating material. The barrier shall completely enclose a compartment such that there are no openings greater than 1/16 inch (1.6 mm). The 1/16 inch dimension is measured between the barrier and enclosure walls, components, or the like that would serve as part of the compartment.

27.3.2 A metal barrier used to provide separation shall have a minimum thickness of 0.016 inch (0.41 mm) and be bonded to other grounded parts of the fixture.

27.3.3 A barrier of insulating material shall have a minimum thickness of 0.028 inch (0.71 mm) and be either:

a) Any vulcanized fiber; or

b) A molded polymeric material having a relative temperature index (RTI) without impact suitable for the temperature involved.

PERFORMANCE

28 Glass Thermal Shock/Containment Test

28.1 In accordance with Exception No. 2 to 13.2, a glass material shall be subjected to the glass thermal shock/containment test described in 28.2 – 28.4 to determine its suitability for use as a lamp containment barrier.

28.2 Each of three samples of the lamp containment barrier material to be tested is to be supported by its outer edges and oriented as it would be during normal operation. The lamp containment barrier material is to be maintained at a temperature of 25 ±5°C (77 ±9°F).

28.3 Three arc tube segments, as specified in Table 28.1, are to be preheated to 1100°C (2012°F) for a minimum of 15 minutes.

Table 28.1
Quartz arc tube test segments

Lamp wattage	Outside diameter		Wall thickness		Length	
	Inch	(mm)	Inch	(mm)	Inch	(mm)
150 or less	0.55	14.0	0.040	1.0	1/4	6.4
151 to 400	0.85	21.6	0.049	1.24	1/4	6.4
greater than 400	1.0	25.8	0.07	1.9	1/2	12.7

28.4 Each arc tube segment is then to be removed from the oven and, within 2 seconds, placed on the thinnest part of each lamp containment barrier. Each arc tube segment is to be placed on the barrier such that the longitudinal axis of the cylinder is perpendicular to the plane of the barrier.

28.5 The results are acceptable if none of the samples of the glass lamp containment barrier material shatter or crack.

29 Strain Relief Test

29.1 A strain relief device for the wires of a lamp-supported lampholder is to be tested by the application of a 20 pound (8.9 N) pulling force on the wires for 1 minute. The result is acceptable if the pull is not transmitted to terminals, splices, or internal wiring.

29.2 In testing in accordance with 29.1, the conductors are to be severed immediately adjacent to the terminals or splices. The pull is to be applied to the wire in a direction perpendicular to the plane of the entrance to the fixture. Movement of any wire more than 1/16 inch (1.6 mm) at the point where it is severed is not acceptable.

30 Temperature Test

30.1 General

30.1.1 A fixture shall be tested as described in 30.1.2 – 30.2.7 and shall not attain a temperature at any point sufficiently high to present the risk of fire, to damage any materials employed in the fixtures, or to exhibit greater rises in temperature at specific points than indicated in Table 30.1.

Table 30.1
Maximum acceptable temperature rise

Component Location	°C	(°F)
All Fixtures		
1. Points of connection of supply wires	a	a
2. Lampholder body of thermosetting material (phenolic, urea, and the like)[b]	125	125
3. Coil of open coil type device employing Class 105 insulation system:		
Thermocouple method	65	117
4. Enclosure of a potted, metal-enclosure coil type device. Class 105 insulation system	65	117
5. Coil of device employing		
Class 130 insulation systems:		
Thermocouple method	85	153
Resistance method	95	171
Class 155 insulation systems:		
Thermocouple method	110	198
Resistance method	115	207
Class 180 insulation systems:		
Thermocouple method	125	225
Resistance method	140	252
Class 200 insulation systems:		
Thermocouple method	145	261
Resistance method	160	288
Class 220 insulation systems:		
Thermocouple method	160	288
Resistance method	175	315
Class 250 insulation systems:		
Thermocouple method	190	342
Resistance method	205	369
6. Fuse	5	117
7. Fiber employed as electrical insulation[b]	65	117
8. Wood	65	117

(Continued)

Table 30.1 (Cont'd)
Maximum acceptable temperature rise

Component Location	°C	(°F)
9. Copper conductor:		
A. Tinned or bare strands having:		
1. A diameter less than 0.015 inch (0.38 mm)	125	225
2. A diameter of 0.015 inch or more	175	315
B. Plated with nickel, gold, silver, or a combination of these	225	405
10. Termination of copper conductor and pressure terminal connectors without a nickel coating or equivalent protection	125	225
11. Lampholder screw shell, center contact, or other connecting device of aluminum or unplated copper	175	315
12. Polymeric material used for enclosure or structural parts	c	c
13. Surface to which a marking label is attached	d	d
14. Wire or cord	e	e
15. Points of fixture support[f]	65	117
16. Varnished cloth insulation[b]	60	108
17. Enclosure of electronic starter for HPS lamp[b]	65	117
18. Capacitors[b,g]		
Electrolytic	40	72
Other types	65	117
Recessed Fixtures		
19. Metal of recessed housing (Non Type IC Fixture)	125	225
20. Test box for recessed fixture (Non Type IC Fixture)	65	117
21. Screen, shield, or recessed housing in contact with insulation (Type IC Fixture)	65	117
Wet Location Fixtures		
22. On gaskets of silicone rubber[h]	175	315
23. On non-thermal setting sealing compound[h]	i	i
24. On thermoplastic watershields[h,j]	40	72
25. On rubber gaskets[h]	35	63
26. On neoprene gaskets[h]	65	117
27. On gaskets of cork or other fibrous material[h]	100	180

(Continued)

Table 30.1 (Cont'd)

[a] Any temperature rise up to 175°C (315°F) is acceptable consistent with the marking on the fixture as specified in 38.2.

[b] These limitations do not apply to compounds or components that have been investigated and found acceptable for a higher temperature.

[c] The investigation of a polymeric material shall comply with the requirements in Section 59, Polymeric Materials.

[d] The maximum temperature, when corrected to a 25°C (77°F) ambient temperature, is the temperature rating of a label that is used as a Form A marking as specified in 34.3.

[e] The maximum temperature, when corrected to a 25°C (77°F) ambient temperature, is the temperature rating of the wire or cord used as specified in Section 19, Wiring and Conductors.

[f] The maximum temperature rise is 125°C (225°F) if a ceiling-mounted or recessed fixture is marked in accordance with 49.8 to restrict its use to ceilings of noncombustible constructions or if marked in accordance with 49.3 to restrict it to use in poured concrete, or if a surface-mounted fixture is marked for concrete mounting only as specified in 44.5.

[g] For capacitors not integral with, and enclosed by, (4).

[h] Applicable only for materials used in wet locations in compliance with Sections 68 – 72.

[i] 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 Method for Softening Point by the Ring and Ball Apparatus, ASTM E 28-1992.

[j] Not applicable if the material is rated for a higher temperature as specified in 71.9.1.

30.1.2 The values for temperature rise in Table 30.1 are based on an assumed ambient temperature of 25°C (77°F), and tests are to be conducted at an ambient temperature of 25 ±5°C (77 ±9°F). The ambient temperature is to be measured by means of a thermocouple immersed in a bath of 15 milliliters of mineral oil in a glass container. The oil bath is to be placed:

a) At the same level as the horizontal plane formed by a line that passes through the fixture halfway down its vertical length; and

b) At least three fixture diameters from the fixture horizontally.

Variations below or above 25°C are respectively to be added to or subtracted from the obtained temperature of the point in question.

30.1.3 Temperature readings to determine compliance with Table 30.1 are to be obtained by thermocouples. A temperature is considered to be constant when three successive readings, taken at 30 minute intervals, indicate no change. The first reading is to be taken no sooner than 3-1/2 hours after the test has begun.

30.1.4 Thermocouples are to consist of wires not larger than No. 24 AWG (0.21 mm^2) and not smaller than No. 30 AWG (0.05 mm^2). It is standard practice to employ thermocouples consisting of No. 30 AWG iron and constantan wires and a potentiometer-type instrument; such equipment is to be used whenever referee temperature measurements by thermocouples are necessary. The thermocouple wire is to conform with the requirements for special thermocouples as listed in the table of limits of error of thermocouples, Temperature-Measurement Thermocouples, ANSI/ISA MC96.1-1982.

30.1.5 A thermocouple junction and the adjacent thermocouple lead wire are to be held securely in thermal contact with the surface of the material of which the temperature is being measured and should be placed at locations of the hottest accessible parts. Tape is not to be used to secure the thermocouple within 3 inches (76.2 mm) of the thermocouple junction.

30.1.6 The temperature of a coil or winding of a ballast employing a Class 130 or higher insulation system is to be measured by means of the change-of-resistance method. For a potted device, it will usually be necessary to have a unit made up with test leads brought out before it is potted, as well as having a thermocouple placed on the capacitor (if provided).

30.1.7 At a point on the surface of a coil of a ballast where the temperature is affected by an external source of heat radiation (for example, a lamp), the temperature rise measured by means of thermocouples mounted on the outside of the coil wrap may be greater than the indicated maximum if the temperature rise of the coil, as measured by the resistance method, is not greater than specified in Table 30.1. The maximum allowable temperature differential for the thermocouple method is 20°C (36°F).

30.1.8 The test of one ballast to represent others is acceptable with the following exceptions:

a) A metal halide or mercury vapor type may not represent a high pressure sodium (HPS) type.

b) An HPS type may not represent a metal halide or mercury vapor type.

c) A lower wattage type may not represent a higher wattage type.

d) A ballast with one class insulation system may not represent a ballast with a different class insulation system.

e) For a ballast of other than the enclosed and potted type with a Class 105 insulation system, a ballast with a bench-test temperature may not represent a ballast with a higher bench-test temperature.

f) An unprotected ballast may not represent a protected ballast if the protector:

1) Is buried within the ballast and has a temperature rating of less than the rating of the ballast insulation system; or

2) Is located directly on the ballast core or under the wrap of an open coil and has a temperature rating of less than 90°C (194°F) for a Class 105 system, 110°C (230°F) for a Class 130 system, or 150°C (302°F) for a Class 180 system.

30.2 Normal test conditions

30.2.1 Conditions for the performance of normal temperature tests for fixtures are to be as indicated in 30.2.2 – 30.2.7 and 43.1.1.1 for surface-mounted fixtures, 48.2.1, 48.4.1.1, and 48.4.1.2 for recessed fixtures, and as modified in Part 3 for special uses and constructions.

30.2.2 When subjected to a temperature test, a fixture shall be provided with a nominal system consisting of a ballast, capacitor, and lamp combination that complies with 30.2.3 and 30.2.4. A fixture is to be operated at rated frequency and at:

a) A supply voltage rated for the ballast; or

b) The supply voltage necessary to be considered a nominal system in accordance with 30.2.4.

Exception: A nominal system need not be provided if the fixture is provided with a self-ballasted lamp.

30.2.3 A nominal system shall be a combination of components such that, when connected to the supply voltage rated for the ballast and measured as specified in 30.2.4, the lamp operates at its marked wattage rating ±5 percent. The capacitance of the capacitor is to be within ±5 percent of the capacitance rated for the ballast.

Exception: A lamp need not operate within ±5 percent of its marked rating when operated by a ballast intended to operate the lamp at other than the lamp's marked rating. Such a construction is to be documented by the ballast manufacturer.

30.2.4 To determine whether a ballast, capacitor, and lamp combination is considered to be a nominal system, the components are to be installed in a fixture and the fixture is to be operated in a 25 ±5°C (77 ±9°F) ambient temperature while connected to a rated supply voltage source. A nominal system is considered to exist when the measured lamp wattage after the wattage stabilizes (generally within 15 minutes) is within ±5 percent of the marked rating of the lamp. Otherwise, to be considered a nominal system, the ballast supply voltage may be adjusted to cause the lamp to operate at the marked lamp wattage.

30.2.5 For a fixture intended to accommodate, or be provided with, branch circuit wires that are wired through, the temperatures on the branch circuit wires shall be determined by thermocouples located on the branch circuit conductors, placed in direct contact with the copper conductor through a slit in the insulation and retained in place by a single wrap of tape.

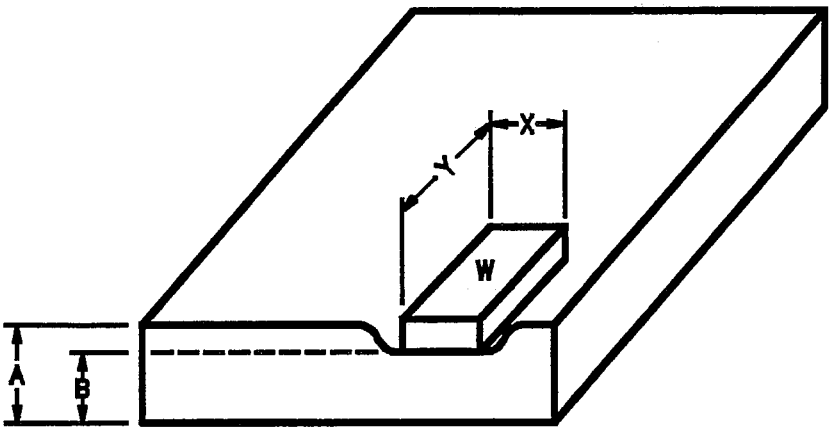
30.2.6 A fixture part designed to be adjustable by the user shall be positioned or adjusted to cause maximum heating of the fixture, mounting surface, or both unless the part is marked to show a specific mounting position in accordance with 36.1.2. If the part is so marked, then the fixture part shall be positioned as marked for the temperature test.

30.2.7 If a fixture utilizes a polymeric part required in this standard (such as a thermoplastic enclosure, watershield, lens, or diffuser), temperatures are to be measured by placing one or more thermocouples in contact with the part in such a manner that the thermocouple is wedged between the part and any metallic material or other source of conducted heat. For a source of radiated or convected heat, thermocouples are to be inserted from the outside surface through holes in the polymeric material, such that the thermocouple tips are located in the plane of the inside surface and are sealed in place with fuller's earth and sodium silicate (waterglass).

31 Thermal Insulation Rigidity Test

31.1 The rigidity of a glass fiber pad used as thermal insulation shall be determined by the placement of a flat-sided object on the pad as illustrated in Figure 31.1. The flat-sided object is to have an area of at least 1 square inch (6.45 cm^2) in contact with the pad and weigh at least 1 ounce (28.4 g) to exert a pressure of 1 ounce per square inch (4.4 g/cm^2). Test results are acceptable if the depth of the compressed pad is one-half or less of the depth of the uncompressed pad.

Figure 31.1
Rigidity of thermal insulation



S2071

$$\frac{W}{X \cdot Y} = 1 \text{ ounce per square inch } (4.4 \text{ g/cm}^2)$$

$$\frac{B}{A} \geq 0.5$$

Where:

W = Weight of flat-sided object in ounces (g)
X = Width in inches (cm)
Y = Length in inches (cm)
A = Depth of uncompressed pad
B = Depth of compressed pad

32 Grounding Continuity Test

32.1 To determine compliance with 25.2.8, each fixture design provided with a grounding means is to be tested for grounding continuity between the grounding means and the accessible dead metal of the fixture that is required to be grounded.

32.2 Any indicating instrument may be used to determine compliance with 25.2.8 but if unacceptable results are obtained, either an alternating or a direct current of at least 25 amperes from a power supply of not more than 12 volts is to be passed from the point of connection of the equipment grounding means to a point in the grounding circuit, and the resulting drop in voltage is to be measured between the two points. The resistance (in ohms) may then be calculated by dividing the drop in potential (in volts) by the current (in amperes). The results are acceptable if the resistance does not exceed 0.1 ohm.

MANUFACTURING AND PRODUCTION TESTS

33 Dielectric Voltage-Withstand Test

33.1 Each fixture that contains wiring through a stem, arm, tubing, or the like, more than 1-1/2 inches (38.1 mm) long or that cannot be inspected after the fixture is manufactured shall, as a routine production line test, be subjected to the application of a 40 – 70 hertz potential of 1200 volts between:

a) Primary wiring, including connected components, and accessible dead metal parts of the fixture lamp that are likely to become energized, including those parts that are accessible only during relamping; and

b) Primary wiring and accessible low-voltage (42.4 volts peak or less) metal parts, including terminals.

The results are acceptable if there is no dielectric breakdown.

33.2 The test potential indicated in 33.1 is to be applied for 1 second.

Exception: The test potential may be reduced to 1000 volts if the time is increased to 1 minute.

33.3 The test is to be conducted when the fixture is complete – fully assembled. It is not intended that it be unwired, modified, or disassembled for the test.

Exception No. 1: Parts such as shades or diffusers that would interfere with performance of the test need not be in place during the test.

Exception No. 2: The test may be performed before final assembly if the test represents that for the completed fixture.

33.4 If the fixture employs a solid-state component that is not relied upon to reduce the risk of electric shock and that may be damaged by the dielectric potential, the test may be conducted before the component is electrically connected provided that a random sampling of each day's production is tested at the potential specified in 33.1. The circuitry may be rearranged for the purpose of the test to reduce the likelihood of solid-state-component damage while retaining the representative dielectric stress of the circuit.

33.5 The test equipment shall include a transformer having an essentially sinusoidal output, a means of indicating the test potential, and an audible or visible indication of breakdown. In the event of breakdown, manual reset of an external switch or an automatic reject of the unacceptable unit under test is required.

33.6 If the output of the test equipment transformer is less than 500 volt-amperes, the equipment shall include a voltmeter in the output circuit to indicate directly the test potential.

33.7 If the output of the test equipment transformer is 500 volt-amperes or larger, the test potential may be indicated by a voltmeter in the primary circuit or in a tertiary winding circuit, by a selector switch marked to indicate the test potential or by a marking in a readily visible location to indicate the test potential of equipment having a single test potential output. When a marking is used without an indicating voltmeter, the equipment shall include a positive means, such as a power-on lamp, to indicate that the manually reset switch has been reset following a tripout.

33.8 Test equipment other than that described in 33.5 – 33.7 may be used if found to accomplish the intended factory control.

33.9 During the test, any switch is to be in the on position, both sides of the primary circuit of the fixture are to be connected together and to one terminal of the test equipment, and the second test-equipment terminal is to be connected to the accessible dead metal.

MARKINGS

34 General

34.1 A marking on or with a fixture shall be legible, shall be one of the types in and shall have a minimum height designated by form letter in Table 34.1, and shall be in one of the locations designated by form numbers in Table 34.2. The wording, form letter, and form number shall be in accordance with applicable specifications elsewhere in this standard.

Table 34.1
Form designations for type and height of marking

Form letter of marking	Type	Minimum height	
		Inch	(mm)
A	Paint-stenciled, die-stamped, indelibly printed lettering[a], or indelibly printed label[b]	1/8	3.2
B	On fixture in form of pressure-sensitive label, decalcomania transfer, paper label, paint-ink or die-stamped lettering, as manufacturer's portion of combination listing mark, or equivalent. A tie-on tab, stuffer sheet, or equivalent is not acceptable.	Not specified unless otherwise indicated	
C	In the form of instructions on or with the fixture. A tie-on tab, stuffer sheet, marking on carton, or equivalent is acceptable.	Not specified	
D	In combination with the listing mark	Not specified	
E	Paint-stenciled, die-stamped, indelibly printed lettering[a]; indelibly printed label[b]	1/4	6.4
F	Indelibly printed, paint-stenciled, embossed[c], ink stamped lettering (including rubber ink stamps), indelibly printed label[b], lettering on a pressure-sensitive label, or the equivalent	1/8	3.2
G	Letters on red or orange background, or red letters	3/8	9.6
H	Indelibly printed, paint stenciled, ink stamped lettering, (including rubber ink stamps), or lettering on a pressure-sensitive label, or the equivalent	1/4	6.4

[a] Indelibly printed lettering shall be applied by a stamping device as described in 34.4.

[b] An indelibly printed label shall comply with 34.3.

[c] Embossed lettering must project toward the viewer at least 0.01 inch (0.25 mm) from the background surface.

Table 34.2
Form designations for location of marking

Form number of marking	Location
1	On exterior surface that will usually be visible after fixture is installed. Marking is considered to be visible after the fixture is installed when only the removal of the lamp, glassware, or a drop canopy is required to make the marking visible.
2	Where visible during or after installation.
3	Readily visible to the installing electrician during installation.
4	Where readily visible: to installing electrician, to persons inspecting splices to the branch-circuit supply wires, and at or near the point where supply connections are to be made.
5	Where visible after the fixture is installed.
6	At a point where visible during relamping.
7	On smallest unit packaging carton.

34.2 If the wording of a particular marking is given within quotations marks in this standard, the actual wording must be used.

Exception: Unless as noted otherwise in a specific requirement, words located between parentheses are optional.

34.3 The combination of a label material and printed ink used for Form A in Table 34.1 shall be permanent and rated for the type of surface and temperature of surface to which it will be affixed in accordance with the Standard for Marking and Labeling Systems, UL 969.

34.4 Indelibly printed lettering shall be applied by a stamping device (other than a rubber ink stamp) that results in consistent and even pressure applied to the printing process regardless of operator.

35 Identification

35.1 A fixture shall be marked in Form B-1 (see 34.1) with the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified (hereafter referred to as the manufacturer).

35.2 If a manufacturer produces or assembles fixtures at more than one factory, each fixture shall have a distinctive marking in Form B-1 (which may be in code) by which it may be identified as the product of a particular factory. The code of one factory may be the absence of a factory identification marking.

35.3 A fixture that does not comply with the requirements for damp or wet locations shall be marked in Form D-2, "Suitable for dry locations only."

35.4 A dry location fixture shall not be provided with any information such as markings, instructions, or illustrations either on the carton or with the fixture that implies or depicts a damp or wet location use.

36 Fixture Orientation and Assembly

36.1 Orientation

36.1.1 A fixture that from its appearance could be mounted on either a wall or ceiling, and which contains a general use receptacle, shall be marked in Form A-3 (see 34.1), "For wall (or under cabinet) mounting only."

36.1.2 If a fixture that from its appearance could be mounted in more than one orientation (such as either on a wall or ceiling), and if the correct orientation of the fixture is required to comply with a specific requirement elsewhere in this standard, it shall be marked in Form A-2, to indicate the correct orientation.

36.1.3 A fixture that is not provided with a means for the physical support of conductors in a pole in accordance with 42.5.1 shall be marked in Form B-2 "Do not install on a pole that is not provided with integral supply wire supports and that results in a vertical rise of 100 feet or higher."

36.2 Assembly

36.2.1 A fixture that requires electrical or mechanical assembly after shipment shall have instructions for correct assembly in Form C.

36.2.2 A fixture employing a frame assembly with glassware secured by adhesive shall be marked on the frame in Form B-5 "Replace with complete assembly" or the equivalent to indicate that the assembly is to be replaced if glassware needs replacement.

36.2.3 A fixture provided with a photocontrolled switch that is connected in a circuit of between 125 and 250 volts shall be marked in Form A-4 "WARNING – To reduce the risk of electric shock disconnect power before servicing."

36.2.4 In accordance with the Exception to 16.9, a fixture provided with a receptacle for a photocontrol but not shipped with the photocontrol or with a shorting or open-circuit plug shall be marked in Form A-2 with the word "CAUTION" and the following or the equivalent: "Risk of electric shock. Use (manufacturer's name and catalog number) shorting or open circuit plug."

36.3 Installation instructions

36.3.1 A fixture rated for less than 277 V that complies with the accessibility requirements in the Exception to 23.1.1 shall be marked in Forms C-3 and H-7 "Not for Residential Use."

37 Ratings

37.1 A fixture shall be marked in Form B-4 with its electrical ratings. The electrical ratings shall include the voltage, current, and frequency, and may include the power factor.

Exception: A fixture intended for use with a remote ballast need not be so marked.

37.2 The marked voltage rating required in 37.1 shall not exceed the voltage rating of the ballast or ballasts employed. If the input voltage rating of the ballast or ballasts used is less than 118 volts, the fixture is to be marked in Form D-4 "CAUTION – Do not use on a supply circuit of more than ____ volts", in which the blank space is filled with the rated input voltage.

38 Supply Connections

38.1 A fixture designed to be connected to a proprietary wiring system shall be marked in Form B-4 with the following information:

a) The name and means of identification of the proprietary system to which the fixture is to be connected; and

b) All cautionary or other markings required for the system.

38.2 A fixture shall be marked in Form E-4 or D-4 "For supply connections use wire rated for at least ___°C (___°F)", in which the "(___°F)" is optional and the blank space is filled with the marked temperature noted in Table 38.1.

Exception No. 1: If the marked temperature noted in Table 38.1 for a fixture is 90°C (194°F) or less, the marking may be in Form A-4.

Exception No. 2: If the marked temperature noted in Table 38.1 for a fixture is 60°C (140°F) or less, the marking need not be provided.

Exception No. 3: If the fixture is provided with tap conductors, the fixture may be marked in Form A-4 or D-4 "For supply connections, use wire rated at least ___°C (if supply connections are made inside the fixture) or 60°C (if supply connections are made at the ends of the tap conductors and are located at least 1 foot from the fixture)". The blank is to be filled in with the temperature measured at the supply connection point inside the fixture during the temperature test.

Table 38.1
Temperature markings

Temperature attained at point where power supply wires are connected				Marked temperature	
Rise[a]		Scale			
C	(F)	C[b]	(F)	C	(F)
35 or less	63 or less	60 or less	140 or less	60	140
36 – 50	65 – 90	61 – 75	142 – 167	75[c]	167[c]
51 – 60	92 – 108	76 – 85	169 – 185	85[c]	185[c]
61 – 65	110 – 117	86 – 90	187 – 194	90[c]	194[c]
66 – 85	119 – 153	91 – 110	196 – 230	110[c]	230[c]
86 – 100	155 – 180	111 – 125	232 – 257	125[c]	257[c]
101 – 125	182 – 225	126 – 150	259 – 302	150[c]	302[c]
126 – 175	227 – 315	151 – 200	304 – 392	200[c]	392[c]

[a] From Table 30.1(1).

[b] Obtained by adding temperature rise and 25 C.

[c] See 38.3.

38.3 The marking required in 38.2 shall also be marked on the exterior of the carton or package in which the fixture is packed in Form H-7.

38.4 A fixture having a pressure wire terminal for the connection of an equipment grounding conductor shall be marked, in Form B-3, adjacent to the terminal or screw "GROUND," "GRND," OR "GND." The electrical symbol for grounding alone is not acceptable.

38.5 A fixture marked in accordance with the requirements in 38.2 for supply connections rated greater than 90°C (194°F) shall be marked in Form B-4 or D-4, "Not for use in dwellings". If the marking is concealed by a carton or similar construction, the carton shall also be marked in Form H-7.

38.6 A fixture not provided with a grounding means as described in the Exception to 25.1.2 shall be marked in Form B-3 with the following or equivalent: "Mount this fixture only to metallic posts which are provided with a grounding means, such as a ground screw or ground wire."

38.7 A fixture shall be provided with installation instructions. The instructions shall be secured, attached, or captured to the fixture so as to be visible before or during installation of the fixture. These instructions shall include a circuit diagram that describes the proper method of making connections to a power supply, including the proper method of connecting the grounding means and maintaining polarity.

Exception No. 1: The instructions need not be attached to the fixture if a tag or other similar means is secured to the fixture that directs the installer to the installation instruction sheet for making the wiring connections.

Exception No. 2: A fixture need not be provided with the instructions as specified if the fixture carton is marked with the word "WARNING" and the following or the equivalent: "Risk of Fire and Electric Shock. This Product is to be Installed by a Qualified Electrician Only" in letters at least 1/4 inch (6.4 mm) in height.

38.8 A fixture that employs a 3-wire receptacle shall be provided with the proper grounding instructions in accordance with 38.7 and shall be marked on the instructions with the following or the equivalent: "This fixture employs a grounded type receptacle and is not intended for connection to a two-wire, ungrounded source of supply."

Exception: A fixture need not be provided with the marking if the fixture carton is marked "WARNING" and the following or equivalent: "Risk of Fire and Electric Shock. This Product is to be Installed by a Qualified Electrician Only" in letters at least 1/4 inch (6.4 mm) in height.

38.9 A fixture that is:

a) Intended to be connected to or over an outlet box; and

b) Marked in accordance with the requirements in 38.2 for supply connections rated 75°C (167°F) or 90°C (194°F);

shall include the word "WARNING" and the following or the equivalent: "Risk of Fire. Most Dwellings Built Before 1985 Have Supply Wire Rated 60°C. Consult a Qualified Electrician Before Installing." This warning shall be located on the fixture carton (in Form H-7) and on the installation instructions described in 38.7.

Exception No. 1: The marking need not be provided if the fixture is marked in Form B-4 or D-4, "Not for use in dwellings."

Exception No.2: A fixture need not be provided with this warning if the fixture carton is marked with the word "WARNING" and the following or the equivalent: "Risk of Fire and Electric Shock. This Product is to be Installed by a Qualified Electrician Only" in letters at least 1/4 inch (6.4 mm) in height.

39 Lamp Replacement

39.1 A fixture (including a fixture intended to be connected to a remote ballast that is not provided with the fixture) shall be marked with the replacement lamp wattage and ANSI designation for which the ballast is rated, as specified in Table 39.1 with the wording and in the form specified in 39.4.

Exception No. 1: A fixture for use with low pressure sodium lamps need not be marked with a lamp replacement marking.

Exception No. 2: A fixture intended for use with a lamp that has no ANSI lamp designation may be marked with the lamp wattage, type (H, M, or S), and voltage.

Exception No. 3: A fixture need not be marked with the ANSI lamp designation or lamp type if the fixture:

a) Is of an open lamp construction and marked in accordance with 39.3 and 39.5; or

b) Is of an enclosed lamp construction that complies with the lamp rupture requirements in Section 13, Lamp Compartments, and is marked in accordance with 39.5.

39.2 A fixture intended to be connected to a remote ballast that is not provided with the fixture shall be marked in Form B-4 "For use with max(imum) ____ watts for Type H, ____ watts for Type M, and ____ watts for Type S lamps only". The letters in parentheses are optional. Where the lamp wattage is the same for more than one lamp type and where one or more lamp types are not intended for use with a fixture, the marking may be adjusted accordingly. For example, "For use with max ____ watts for Type H and M lamps only".

39.3 A fixture that complies with Exception No. 1 to 13.1 shall be marked in Form A-5 "CAUTION – To reduce risk of fire, do not use lamp identified for use in enclosed fixtures only."

39.4 In accordance with 39.1 and Exception No. 1 to 49.20, a fixture may be marked "CAUTION" or "WARNING" and "RISK OF FIRE. USE ONLY 1 WATTS, 2 TYPE, 3 LAMP (MAX)". The blanks are to be filled in as designated below:

[1] Tested lamp wattage.

[2] Tested lamp type and size (examples: R, PAR).

[3] Tested lamp shape symbol (examples:  , ).

The marking shall be in Form A-6 and words in parentheses are optional.

Exception No. 1: A fixture that complies with the Temperature Test requirements in Section 30 and Section 43 or 48 with other than an R or PAR type lamp need not be marked with the lamp type and lamp shape symbol.

Exception No. 2: The marking provided on a surface-mounted fixture need not include the words "CAUTION" or "WARNING" and "RISK OF FIRE." It need only read "USE ONLY ___ WATTS, ___ TYPE, ____ LAMP (MAX)" or the equivalent.

Table 39.1
ANSI lamp designations

Wattage	Mercury vapor	Low pressure sodium	Metal halide	High pressure sodium
18	–	L69	–	–
35	–	L70	–	S76
40	H45	–	–	–
50	H45	–	–	S68
55	–	L71	–	–
70	–	–	M85	S62
75	H43	–	–	–
90	–	L72	–	–
100	H38	–	M90	S54
125	H42	–	–	–
135	–	L73	–	–
150	–	–	M81	S55[a]
150	–	–	–	S56[b]
175	H39	–	M57	–
180	–	L74	–	–
200	–	–	–	S66
250	H37	–	M58	S50
310	–	–	–	S67
400	H33	–	M59	S51
700	H35	–	–	–
750	–	–	M83	–
1000	H36[c]	–	M47	S52
1000	H34[d]	–	–	–
1500	–	–	M48	–

[a] 55 volt lamp.

[b] 100 volt lamp.

[c] Low current lamp.

[d] High current lamp.

39.5 A fixture that complies with Exception No. 3 to 39.1 may be marked in Form B-6: "For use with max(imum) ____ watts for Type H, ____ watts for Type M, and ____ watts for Type S lamps only". The letters in parentheses are optional. Where the lamp wattage is the same for more than one lamp type and where one or more lamp types are not intended for use with a fixture, the marking may be adjusted accordingly. For example, "For use with max ____ watts for Type H and M lamps only".

PART 2 – SURFACE-MOUNTED AND RECESSED FIXTURES

SURFACE-MOUNTED FIXTURES

40 General

40.1 In addition to the requirements in Sections 1 – 39, a surface-mounted fixture shall comply with the requirements in Sections 41 – 44.

41 Construction – Mechanical

41.1 Enclosures

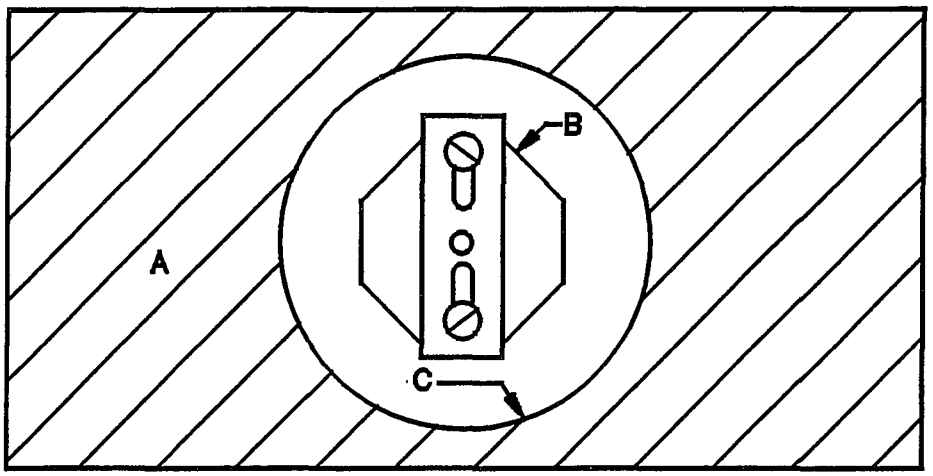
41.1.1 A surface-mounted, outlet-box connected fixture shall be provided with a back enclosure that may contain an opening with a maximum area of 180 square inches (1161 cm^2). The back enclosure shall comply with 7.1 and the dimensions of the opening shall be as specified in (a) or (b).

a) For a circular opening the diameter shall be no greater than 15 inches (381 mm), as shown in Figure 41.1.

b) For a non-circular opening, the maximum linear dimension (including a diagonal dimension) shall be no greater than 26 inches (660 mm), as shown in Figure 41.2.

Exception: The fixture need not be provided with a back enclosure if the back of the canopy is less than 180 square inches in area and has overall dimensions less than those specified in (a) or (b).

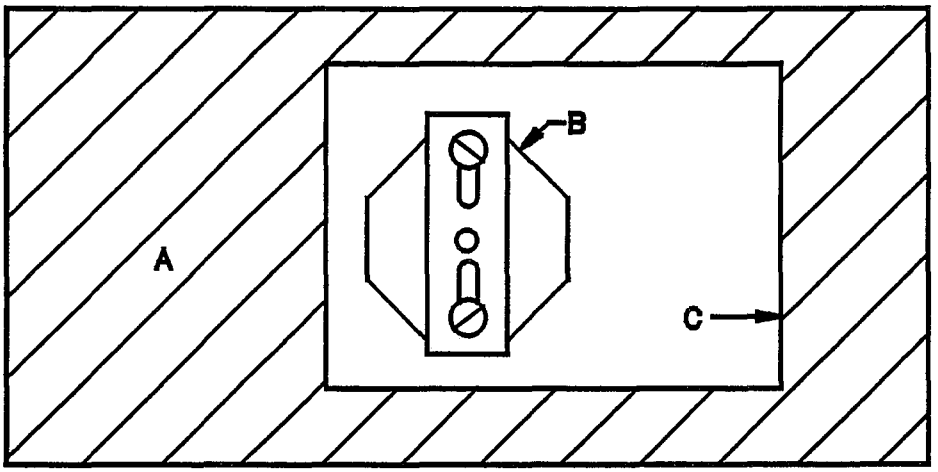
Figure 41.1
Dimensions of circular opening



S3320

A – Enclosure (canopy) back.
B – Outlet box.
C – Circular opening with maximum 15-inch (381-mm) diameter.

Figure 41.2
Dimensions of non-circular opening



S3321

A – Enclosure (canopy) back.
B – Outlet box.
C – Non-circular opening with a maximum linear dimension (usually diagonal) of 26 inches (660 mm).

41.1.2 A fixture shall be provided with means for mounting such as:

a) Keyhole slots or holes for mounting to an outlet box or mounting surface;

b) A trim flange for mounting in a suspended ceiling T-bar grid;

c) A tenon or fitter for mounting to a pole;

d) Holes for mounting to threaded studs;

e) Provision for suspension mounting by chain, cable, hook or stem; or

f) Provision for support by threaded conduit.

41.1.3 A fixture weighing more than 50 pounds (22.7 kg) (including lamps) shall be provided with means for support that will be independent of the outlet box.

41.1.4 A fixture with provision for mounting to an outlet box shall not be provided with a table, shelf, tray surface, basket, hook, eye, or other feature that would encourage the addition of weight.

41.1.5 The requirement in 41.1.4 does not preclude a construction that provides an additional mounting feature that would allow the fixture to be supported independently of the outlet box.

41.1.6 Double setscrews, double canopy rings, or a screw ring shall be employed if a drop canopy supports a pull-type switch or pendant receptacle or contains a knockout.

41.1.7 Single canopy rings on two separate stems, both of which hold the canopy, are considered to be the equivalent of double canopy rings on a single stem.

41.1.8 Unthreaded tubing shall be so secured in place that the force required to pull it out or bend it will not be less than the force required to pull out or bend tubing that is mounted by means of threads and secured by a setscrew, locknut, solder, or cement.

41.1.9 A supporting crossbar shall be metal and shall have a thickness not less than 0.053 inch (1.35 mm) if of steel, or 0.075 inch (1.91 mm) if other than steel.

Exception No. 1: If reinforced by turning of flanges along the edges, the crossbar may have a thickness not less than 0.042 (1.07 mm) if of steel, or 0.058 inch (1.47 mm) if other than steel.

Exception No. 2: A crossbar may be of lesser thickness if investigated and found able to support four times the weight of the fixture without any visible distortion.

41.1.10 If a fixture is designed for direct attachment to an outlet box and if the surface containing the mounting screw holes is more than 1/8 inch (3.2 mm) from the mounting surface, two metal screws shall be furnished with the fixture. Each of these screws shall have a length not less than 1/2 inch (12.7 mm) plus the distance from the mounting surface to the fixture that contains the screw holes and shall be 8-32 size.

41.1.11 A swivel joint in a single-stem fixture shall be so constructed that turning will not cause damage to the insulation on the wires. The joint shall be so constructed that rotation of the fixture is limited to 360 degrees or less.

41.2 Open holes for fixture mounting

41.2.1 The back enclosure of a fixture or a canopy may contain only those open mounting holes facing the mounting surface to which the fixture would be attached as specified in 41.2.2 for open back fixtures and 42.7.1 for other types of fixtures.

41.2.2 A fixture that is to be supported by an outlet box shall be provided with only one of the following:

a) A crossbar with means for attachment to the fixture, where the open hole in the fixture will be fitted with a threaded tube to the crossbar.

b) Two open holes or two open keyhole slots for securing the fixture to an outlet box. Holes shall be a maximum 7/32 inch (5.6 mm) diameter, and keyhole slots shall not exceed the dimensions shown in Figure 41.3.

c) Two pairs of open holes or two pairs of open keyhole slots if the holes are located over a part of the fixture body or diffuser constructed of material specified in 7.2. The maximum hole size shall be 7/32 inch and keyhole slots shall not exceed dimensions shown in Figures 41.3 and 41.4.

d) Any means for mounting that has been investigated and found to be the mechanical equivalent of (a) – (c). The area of open holes remaining, after mounting screws are in place shall not exceed the unused area of four keyhole slots of maximum size as shown in Figures 41.3 and 41.4 [1-1/4 square inches (8.06 cm^2)].

Figure 41.3
Keyhole slot

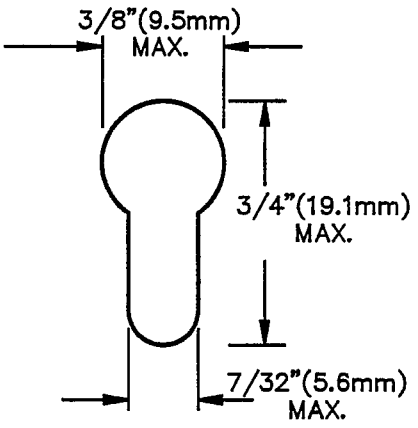
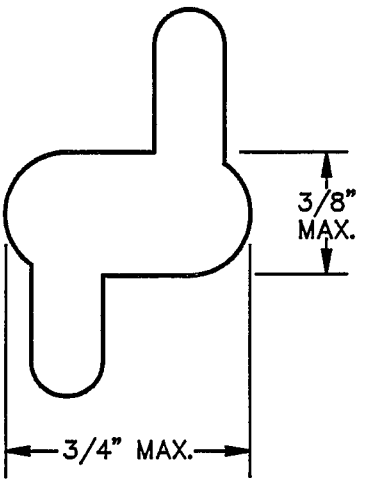


Figure 41.4
Joined keyhole slot



EC610

41.2.3 A fixture designed for surface mounting on a wall or ceiling may have a maximum of four open mounting holes in the back enclosure, facing the mounting surface, each not larger in size than 1/4 by 1/2 inch (6.4 by 12.7 mm) or 0.44 inch (11.2 mm) in diameter. A fixture of this type may have two such holes for each additional 24 inches (610 mm) of length in excess of 50 inches (1.27 m).

41.3 Open holes for component mounting

41.3.1 Open holes may be provided in the back enclosure, facing the mounting surface, to permit the factory mounting of alternate equipment, such as transformers, in accordance with the following:

a) The maximum diameter of any open hole is 5/16 inch (7.9 mm).

b) The minimum diameter of any open hole is 0.120 inch (3.05 mm) unless it can be shown that alternate equipment requires a smaller hole.

c) The maximum area of each unclosed portion of a slot used to accommodate equipment mounted in place, or of an unused slot intended for accommodation of alternate equipment, is 0.05 square inch (0.32 cm^2).

d) The maximum total area of all unused open holes for alternate component mounting is 0.80 square inch (5.16 cm^2).

41.4 Open holes for pendant devices

41.4.1 If stems and canopies, or chains with chain loops at both ends, are packaged with the fixture as shipped, one open hole (or pair of holes intended for an S-shaped hook) may be provided for each stem or chain if each hole will be closed by a pendant device. One or more knockouts may be provided in addition to, or in lieu of, the open hole or holes.

41.5 Access openings

41.5.1 A fixture intended to be mounted over an outlet box, or to a pole, shall be provided with an opening to permit access to the supply wiring splices without removing the fixture from the mounting surface or pole.

Exception No. 1: A fixture need not be provided with a means of access to the supply wiring splices under the conditions described in 26.1.4, 26.1.5, and 26.1.6.

Exception No. 2: A pole-mounted fixture need not be provided with an access opening if it:

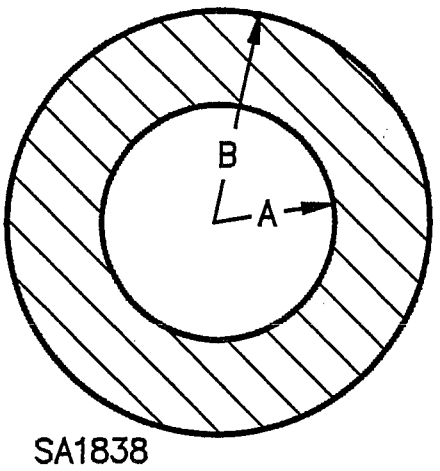
a) Is marked for use with, or shipped with, a pole as specified in Section 52, Poles, or a pole arm that contains an access opening; and

b) Is provided with leads long enough to reach 6 inches (152 mm) beyond the access opening in the pole, or pole arm;

need not comply with this requirement.

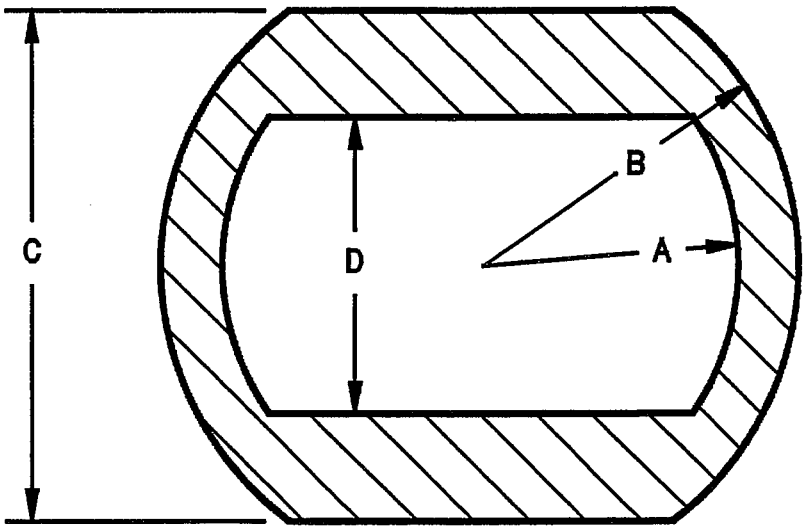
41.5.2 The access opening shall be of such size that the perimeter of the opening lies in the shaded areas shown in Figures 41.5 and 41.6.

Figure 41.5
Access opening



A 1 inch (25.4 mm) radius
B 1-7/8 inch (47.6 mm)

Figure 41.6
Elongated access opening



A 1-5/8 inch (41.3 mm) radius.
B 1-7/8 inch (47.6 mm) radius.
C 3 inch (76.2 mm) maximum.
D 1-3/4 inch (44.5 mm) minimum.

41.5.3 The plane of the access opening shall lie in the plane of the mounting surface, or the fixture shall be provided with a collar or similar device to complete the wireway enclosure between the back of the fixture and the mounting surface. The collar shall comply with the enclosure requirements in 7.1, or may consist of a glass fiber cylinder with a minimum wall thickness of 1 inch (25.4 mm), so secured as not to be disturbed during installation and field wiring of the fixture.

41.6 Miscellaneous open holes

41.6.1 An open hole provided in a wiring enclosure for purposes other than specified in 41.2.1 – 41.5.3 shall not be located closer than 1/2 inch (12.7 mm) to the building mounting surface or in a canopy of an open back fixture and shall comply with the area requirements specified in 9.4 and 9.5.

42 Construction – Electrical

42.1 Cord-equipped adjustable fixture

42.1.1 A spotlight, floodlight, or other fixture that is adjustable after installation (that is, the angle of light can be changed) may be provided with either a cord bushing and a length of flexible cord for connection to the power supply or a junction box cord grip bushing without a length of flexible cord.

42.1.2 The cord mentioned in 42.1.1 shall comply with the requirements in 42.1.3 – 42.1.6.

42.1.3 A flexible cord shall be of Type SJ, SJE, SJO, SJOO, SJT, SJTO, SJTOO, S, SE, SO, SOO, ST, STO, or STOO.

42.1.4 A fixture with a flexible cord shall be shipped with the cord mounted in place and connected.

Exception: The cord may be unconnected if the fixture is marked with a wiring diagram in accordance with 44.3 and the strain relief device is provided.

42.1.5 A strain relief device shall be provided on a flexible cord. The device shall comply with the test requirements in 43.2.1 when subjected to a pull of 35 pounds force (156 N).

42.1.6 A bushing that has an integral strain relief means shall be provided on or with the free end of the cord and shall be of the type intended for use in a typical conduit opening.

42.2 Cord-pendant fixtures

42.2.1 If a fixture part is designed to be supported by a flexible cord, the flexible cord shall be one of the following types:

a) Type SJ, SJE, SJO, SJOO, SJT, SJTO, SJTOO, or heavier cord if the fixture or fixture part weighs no more than 10 pounds (4.54 kg).

b) Cord Type SV, SVE, or SVT if:

1) The cord is not likely to be subjected to kinks or sharp bends;

2) The fixture or fixture part weighs no more than 3 pounds (1.36 kg);

3) Supplementary insulating tubing is secured over the insulation of each conductor of the cord where the jacket has been removed to make connections with the fixture; and

4) The jacket is removed for at least 6 inches (152 mm) and insulating tubing is secured over the insulation of each conductor at the power-supply end of the cord.

42.2.2 A flexible cord that is used for the support of any fixture, or fixture part, shall be provided with a strain relief device at both ends of the cord. The device shall comply with the test requirements in 43.2.1 and 43.2.2 when subjected to a pull of 35 pounds force (156 N).

Exception: A strain relief device need not be provided at the canopy end if instructions are furnished with the fixture, as specified in 44.1, to show the method of strain relief that is to be applied on the field, such as a knot in the cord.

42.3 Chain-pendant fixtures

42.3.1 A chain and canopy suspended fixture shall be wired with stranded conductors so arranged that the weight of the fixture will not stress the conductors.

42.4 Outlet box mount provision

42.4.1 A fixture designed to be mounted over an outlet box shall be provided with supply leads that are long enough to reach to the center of the outlet box at the ceiling line, plus 6 inches (152 mm).

42.5 Pole-mounted fixtures

42.5.1 A fixture intended for pole mounting shall have a means of physical support for the wiring in the pole. The support means may be either in the fixture itself or, if the fixture is shipped with or marked for use with a pole, the means may be in the pole. The acceptability of the support means shall be determined as described in 43.2.3.

Exception: A fixture need not be provided with this support means if it is marked to prohibit its use on a pole that is not provided with integral supply wire support and results in a vertical rise of 100 feet (30.5 m) or higher, as indicated in 36.1.3.

42.5.2 A pole-mounted fixture shall comply with the dry location requirements specified in Part 1 or with the wet location requirements specified in Sections 68 – 72.

42.6 Stem-pendant fixtures

42.6.1 A pull type switch or switch knockout in a sheet metal drop canopy that is secured by setscrews, whether mounted in the rim or elsewhere, shall be located not more than 3-1/2 inches (89 mm) from the center of the drop canopy.

Exception: If a drop canopy secured by setscrews is more than 7 inches (177 mm) in length or diameter and is reinforced by a metal bar at least 1/8 inch (3.2 mm), the switch or knockout may be located more than 3-1/2 inches from the center, but not be farther away than 3-1/2 inches from the means of attaching the reinforcing bar to the canopy. The attachment of the bar to the canopy shall consist of bolts, rivets, or welds.

42.7 Attachment plug-equipped fixtures

42.7.1 A fixture designed for chain, hook, or similar means for suspension may be provided with a power supply cord. If a chain or hook is not shipped with the fixture, the fixture shall be marked in accordance with 44.4.

42.7.2 If a flexible cord is terminated with an attachment plug for connection to the branch circuit supply, the rating of the attachment plug shall comply with Table 42.1.

Table 42.1
Attachment plug ratings
for cord-connected fixtures

Maximum fixture rating (amperes)	Minimum attachment plug rating (amperes)
12	15
16	20
24	30
32	40
40	50

42.7.3 The fixture shall comply with 42.1.3 – 42.1.5.

43 Performance

43.1 Temperature test

43.1.1 General

43.1.1.1 A fixture shall be subjected to a temperature test as described in Section 30, Temperature Test, and 43.1.2.1 – 43.1.5.7.

43.1.2 Pendant fixtures

43.1.2.1 A cord-, chain-, or stem-pendant fixture shall be mounted from overhead, as in actual use, such that there are no room obstructions, including a floor or walls, closer than 2 feet (0.61 m) to the fixture. If any lamp would be located less than 2 feet from the ceiling during intended use, the fixture shall comply with the test requirements in 43.1.5.3.

43.1.2.2 A fixture that can either be cord-, stem-, or chain-pendant or can be directly mounted to a ceiling without the use of the cord, stem or chain, shall be tested as a ceiling-mounted fixture in accordance with the requirements in 43.1.5.3 without the stem or chain.

43.1.3 Floor- (pole-) mounted fixtures

43.1.3.1 A floor-mounted fixture provided with a means for mounting to a floor shall be mounted as intended, such that there are no room obstructions, ceilings or walls closer than 3 feet (0.91 m) to the fixture.

43.1.3.2 A pole-mounted fixture not factory-provided with a pole shall be mounted to a representative length of pole under conditions as noted in 43.1.3.1.

43.1.4 Wall-mounted fixtures

43.1.4.1 A fixture that is tested as a wall-mounted fixture shall be mounted to a vertical plywood sheet of such dimensions that a projection of the fixture falls completely on the sheet.

43.1.5 Ceiling-mounted fixtures

43.1.5.1 A ceiling-mounted fixture shall be tested as specified in 43.1.5.3 – 43.1.5.7.

Exception: If the fixture is intended and marked for use only on a concrete or steel surface, or on a surface of another identified noncombustible material, the test ceiling is not to be filled with insulation.

43.1.5.2 A fixture that from its appearance could be used either on a ceiling or on a wall shall be tested as a ceiling-mounted fixture.

Exception: A fixture marked for wall mounting as specified in 44.2 need only be tested as a wall-mounted fixture.

43.1.5.3 During the test, the fixture is to be mounted on the test ceiling described in 43.1.5.5 and 43.1.5.6. The fixture is to be located directly under the outlet box. A single thermocouple is to be located at the point:

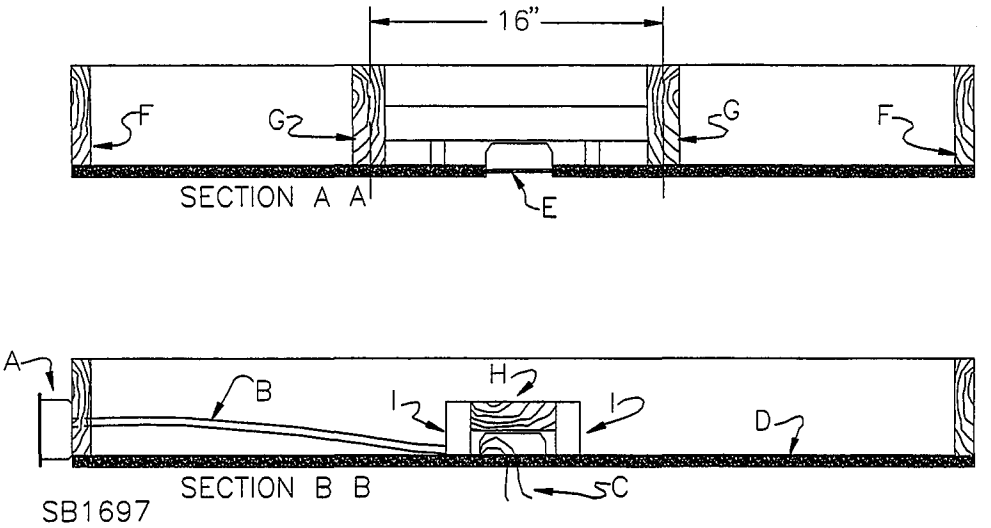
a) Where the fixture contacts the ceiling; and

b) That is closest to the arc tube of a lamp.

43.1.5.4 During the test, the test ceiling is to be mounted in a draft-free room. The test ceiling should be located not less than 6 feet (1.8 m) above the floor, not less than 1 foot (0.3 m) below the room ceiling, and not less than 2 feet (0.6 m) from any wall or other obstruction.

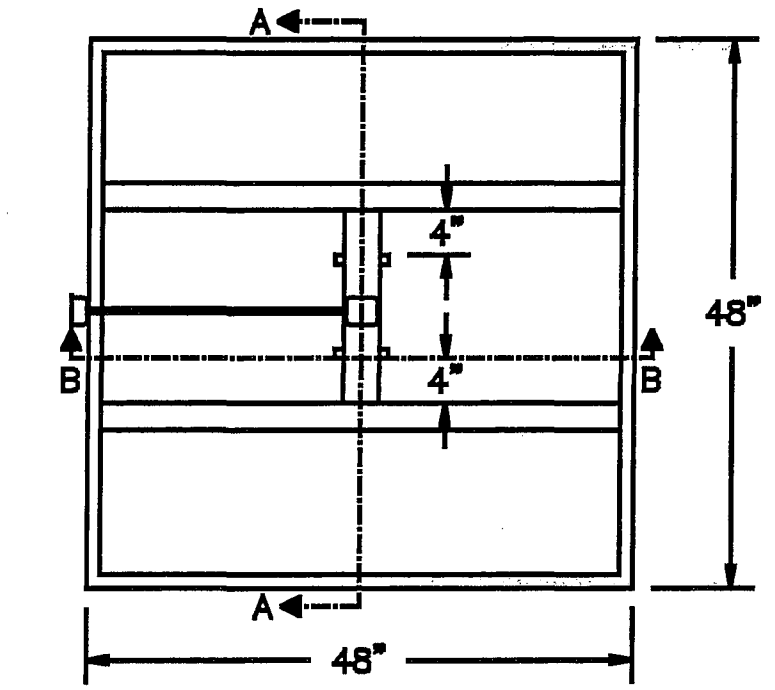
43.1.5.5 The test ceiling is to be constructed as shown in Figures 43.1 and 43.2. The outlet box is to be mounted in the exact center of the ceiling panel and is to project through, and be flush with, the bottom of the ceiling. The four 1- by 1-inch trade size supports are to prevent inward bending of the fiber board.

Figure 43.1
Sections A – A and B – B of test ceiling



See Figure 43.2 for plan. A – Standard utility box with blank cover. B – 3/8 inch trade size flexible metal conduit with straight connectors. C – No. 14 AWG (2.1 mm^2) Type TW wire. D – 1/2 inch (12.7 mm) thick low-density cellulose-fiber board. E – 4 inch octagonal by 1-1/2 inch deep trade size standard metal knockout box. F – 1 by 6 inches, G – 2 by 6 inches. H – 2 by 4 inches, I – 1 by 1 inch, all trade size pine lumber.

Figure 43.2
Plan of test figure



SB1700

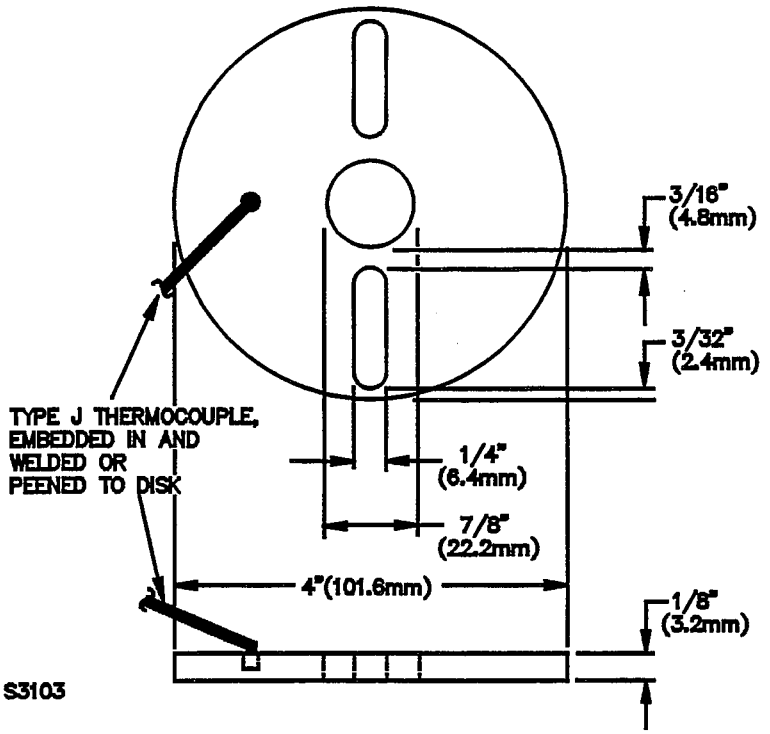
43.1.5.6 The white-faced sound deadening board is to be evenly covered with an expanding polyurethane foam installed in accordance with the manufacturer's instructions to a uniform depth of 3-1/2 inches (89 mm).

Exception: If the fixture is for use only on a concrete or steel surface, or on a surface made of another identified noncombustible material, and is marked as described in 44.5, the test ceiling is not to be filled with insulation.

43.1.5.7 With regard to the supply wire temperature limits specified in Table 30.1(1), a copper temperature probe as illustrated in Figure 43.3 is to be placed between the fixture and the junction box, with the two screws used for mounting the fixture passing through the elongated openings on the probe (or, if a nipple is used to support the fixture, the nipple is to pass through the center opening in the probe). The probe is to be placed below the crossbar with the thermocouple facing into the junction box. The fixture supply leads are to be routed through the center opening in the probe (or, if a nipple is used, through the elongated openings), and the probe is to rest on the insulation (if provided) or on the uppermost interior surface of the canopy without mechanical tension or pressure.

Figure 43.3
Temperature probe for supply wire temperatures

(All dimensions are in inches)



Metric Equivalents

Inches	(mm)
3/32	2.4
1/8	3.2
3/16	4.8
1/4	6.4
7/8	22.2
4	101.6

43.2 Strain relief test

43.2.1 A strain relief device is to be tested by a 35-pound pull force (156 N) on the cord for 1 minute. The result is acceptable if the pull is not transmitted to terminals, splices, or internal wiring.

43.2.2 In testing in accordance with 43.2.1, the conductors are to be severed immediately adjacent to the terminals or splices. The pull is to be applied to the cord or wire in a direction perpendicular to the plane of the entrance to the fixture. Movement of the cord of more than 1/16 inch (1.6 mm) at the point where it is severed is not acceptable.

43.2.3 To determine compliance with 42.5.1, the support means shall be capable of withstanding a downward force of 15 pounds (67 N) applied to three No. 14 AWG (2.1 mm^2) Type TW conductors for 1 minute. No evidence of stress on the wiring terminals constitutes acceptable completion of the test.

44 Markings

44.1 A cord-pendant fixture that is shipped without the strain relief device attached to the cord at the canopy shall be marked in Form C to show the method of strain relief.

44.2 A fixture that is to comply with the Exception to 43.1.5.2 shall be marked in Form A-3 "Wall mount only".

44.3 A fixture having a power supply cord that is electrically unconnected or unassembled to the fixture shall be marked in Form C (see 34.1) with instructions for correct field assembly of the device.

44.4 A fixture having a cord and attachment plug and that is not provided with a hook, loop, or chain, shall be marked in Form A-2 "For chain or hook suspension only".

44.5 A ceiling-mounted fixture tested on an uninsulated ceiling as described in the Exception to 43.5.1.1 shall be marked in Form A-3 "Mount on _____ only." The blank is to be filled with an identified noncombustible material (for example, concrete or steel).

44.6 A fixture shall be provided with a lamp replacement marking in accordance with 39.1.

RECESSED FIXTURES

45 General

45.1 In addition to the requirements in Sections 1 – 39, a recessed fixture shall comply with the requirements in Sections 45 – 50.

45.2 A recessed fixture shall comply with the requirements under this heading according to the intended installation as defined in 2.20.

45.3 A recessed fixture shall be intended for installation with 1/2-inch (12.7-mm) minimum spacings from the fixture to cavity surfaces (side wall and overhead building member) and 1-inch (25.4-mm) spacings to adjacent fixture(s).

Exception No. 1: A recessed fixture intended for:

a) Other than residential use;

b) Use in an area with no less than 6-inch (152-mm) horizontal and no less than 1/2-inch (12.7-mm) vertical spacings to cavity surfaces; and

c) Use with center spacings between fixtures of no less than 2 feet (610 mm);

may be marked in accordance with 49.10 with spacings greater than 1/2 inch if it complies with the marked spacing requirements in Section 48, Performance.

Exception No. 2: An in-ground recessed fixture marked in accordance with 49.4 need not comply with this requirement.

46 Construction – Mechanical

46.1 Mounting

46.1.1 A recessed fixture shall be provided with means for mounting that may include hanger bars for mounting between wood joists, a plaster frame, or brackets (or the equivalent) with slots for direct attachment of the sides of the fixture to the building.

46.2 Mounting means

46.2.1 A recessed fixture intended for installation in a suspended ceiling shall be provided with means for mounting such as:

a) A trim flange for mounting in a suspended ceiling grid; or

b) Provision for suspension mounting by wire, chain, cable, hook, or stem.

46.2.2 A recessed fixture weighing more than 50 pounds (22.7 kg) (including lamps) intended for installation in a suspended ceiling shall be provided with means for support that will be independent of the suspended ceiling grid.

46.2.3 A flexible cord on a cord-pendant, recessed fixture intended for installation in a suspended ceiling shall be located below the plane of the suspended ceiling.

Exception: Flexible cord may be provided above the plane of the suspended ceiling if it is enclosed for its entire length in accordance with the enclosure requirements in 7.1.

46.3 Recessed housing

46.3.1 A fixture provided with a metal recessed housing shall be constructed such that a hole in a ceiling or wall structure is closed off by the metal recessed housing. All current-carrying parts shall be located on the room side of the housing unless they are enclosed as specified in 46.6.1.

Exception: A recessed fixture intended for use in non fire-rated installations and marked in accordance with 60.4.2 need not completely close off a hole in a ceiling with its housing.

46.3.2 A wireway cover that does not constitute a part of the recessed housing shall be at least 0.020 inch (0.51 mm) thick unless a greater thickness is required in Table 8.1.

46.3.3 All ferrous sheet metal parts of the recessed housing shall be plated, galvanized, enameled, painted, varnished, or lacquered.

Exception: The cut edges of prepainted stock, and steel nuts, bolts, and screws, and enclosed steel pipe stems as well as plaster rings need not be so coated.

46.4 Polymeric subassemblies

46.4.1 A recessed fixture provided with polymeric subassemblies shall comply with the requirements of Section 60, Polymeric Recessed Fixtures.

46.5 Open holes, recessed housing

46.5.1 Part or all of the recessed housing that also serves as an enclosure as required by 7.1, shall comply with the enclosure requirements specified in 46.6.2.

46.5.2 A recessed fixture marked in accordance with 49.3 and 49.5 to indicate it is for use in poured concrete shall have all knockouts, seams, and the like of the recessed housing closed to exclude concrete from the wiring and lamp compartments.

46.5.3 The provisions for open holes in a recessed housing shall be as follows:

a) An open hole in the shape of a slot or louver provided in the recessed housing shall be no more than 3/8 inch (9.5 mm) in width nor more than 1-1/2 square inches (9.7 cm^2) in area, and any other open hole shall be no more than 1 inch (25.4 mm) in diameter. The total area of all open holes shall be no more than 15 percent 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.

b) The recessed housing of a fixture marked for use in poured concrete or in ground as specified in 49.3, 49.4, and 49.5 shall contain no open holes.

c) A fixture intended for use as an air handling register may employ open holes in the recessed housing exceeding the sizes and shapes specified in (a) if it is marked to limit its use as specified in 49.6.

d) The recessed housing of a fixture marked "TYPE IC" shall contain no open hole as a slot or louver larger than 3/16 inch (4.8 mm) in width or more than 1-1/2 square inches (968 mm^2) in area. Any other shape of open hole shall be such that it does not permit the entrance of a 1/4-inch (6.4-mm) diameter rod.

46.5.4 A fixture intended for optional use as an air handling register that employs air passages in the recessed housing exceeding the size or area defined for open holes in 46.5.3 shall be:

a) Constructed so that the portion of the air passage that exceeds the size or area is provided as a knockout or is covered with a removable cover (or equivalent); and

b) Marked as specified in 49.7.

46.6 Open holes, enclosures

46.6.1 All current-carrying parts intended to be located on the concealed space (area behind a wall or ceiling) side of the recessed housing shall be enclosed in a material as specified in 7.2 that has no open holes.

Exception: A junction box attached to the fixture may have open holes as specified for recessed fixture junction boxes in Section 56, Recessed Fixture Junction Boxes for Use With Through Branch Wiring.

46.6.2 All current-carrying parts located on the room side of the recessed housing that are required to be enclosed in accordance with 7.1 shall be enclosed in a material as specified in 7.2 with no open holes.

Exception: The enclosure material that faces the room side of the fixture may be provided with Open Holes as specified in Section 9.

46.7 Wiring

46.7.1 A recessed fixture that is intended to be connected to a remote ballast shall be constructed and intended for installation in accordance with either of the wiring configurations shown in Figure 49.1.

Exception: The wiring configuration may be modified to accommodate different supply voltages such as 240 volts or 480/277 volts.

46.8 Screens

46.8.1 If a fixture is provided with a screen or shield so that insulation cannot contact the recessed housing of the fixture, the screen or shield is to be rigidly attached and of sufficient strength to support the field-installed insulation and to withstand normal handling without reduction of intended spacings.

47 Construction – Electrical

47.1 Tap conductors

47.1.1 If tap conductors are furnished with a recessed fixture for connection to power supply conductors at a point beyond the recessed housing, such leads shall be building wire or fixture wire with insulation thickness as specified in Table 47.1. Appliance wiring material insulation on conductors shall not be provided as leads for tap conductors.

Table 47.1
Wire insulation thickness and maximum number of conductors in 3/8 inch flexible metal conduit

Size		Max. 0.03 inch (0.8 mm) insulation with outer jacket[a]		0.02 – 0.03 inch (0.5 – 0.8 mm) insulation with outer jacket[b]		0.015 inch (0.4 mm) insulation with outer jacket[c]		0.0055 – 0.015 inch (0.14 – 0.4 mm) insulation without outer jacket[d]	
AWG	(mm^2)	Inside[e]	Outside[f]	Inside[e]	Outside[f]	Inside[e]	Outside[f]	Inside[e]	Outside[f]
18	0.82	–	3	3	7	4	8	5	8
16	1.3	–	2	2	4	3	7	4	8
14	2.1	–	–	–	4	3	7	3	7
12	3.3	–	–	–	3	–	4	–	–
10	5.3	–	–	–	–	–	2	–	–

NOTE – In addition, one uninsulated grounding conductor of the same AWG size may be installed.

[a] Examples: RH, RHH, FFH-2, RFH-2, SF-2, SFF-2.

[b] Examples: T, TW,XHHW, ZW, RUH, RUW, PFA, PFAH, TFE, TF, TFF, CF, AF, PF, PGF, PFF, PGFF.

[c] Examples: THHN, THWN, Z, RFH-1, FFH-1, TFN, TFFN, SF-1.

[d] Examples: KF-1, KF-2, KFF-1, KFF-2, SFF-1, HF, HFF, ZF, ZFF.

[e] Fitting may be inside conduit.

[f] Fitting must be outside conduit.

47.1.2 If a fixture is not furnished with flexible metal conduit, the tap conductors shall extend at least 4-1/2 feet (1.37 m), but not greater than 6-1/2 feet (1.98 m) beyond the recessed enclosure.

47.1.3 If a fixture with tap conductors is furnished with flexible metal conduit for those conductors, the conduit shall extend no less than 4 feet (1.22 m) and no greater than 6 feet (1.83 m) from the recessed housing of the fixture, and the tap conductors shall extend at least 6 inches (152 mm) beyond the unconnected end of the conduit, but not greater than 6-1/2 feet (1.98 m) beyond the recessed enclosure.

47.1.4 If tap conductors are furnished with a fixture, but flexible metal conduit is not, the fixture shall be furnished with a connection fitting for at least 1/2 inch trade size conduit.

Exception: A fitting for 3/8 inch trade size may be furnished provided the maximum number of conductors and the type of fitting (that is, inside type or outside type) are in accordance with the wire size and type as shown in Table 47.1.

47.2 Accessibility

47.2.1 The accessibility of the supply connections required in 26.1.4 shall be such that the supply connections are available from the room side of the fixture.

Exception: The connections may be accessible only from behind the fixture if it is marked to restrict its use to locations with access behind the mounting surface, in accordance with 49.1.

47.2.2 Supply connections are considered accessible from the room side of the fixture if there is an opening available from the front of the fixture that:

a) Provides visual access to the front center of the outlet box cover from the room side of the opening; and

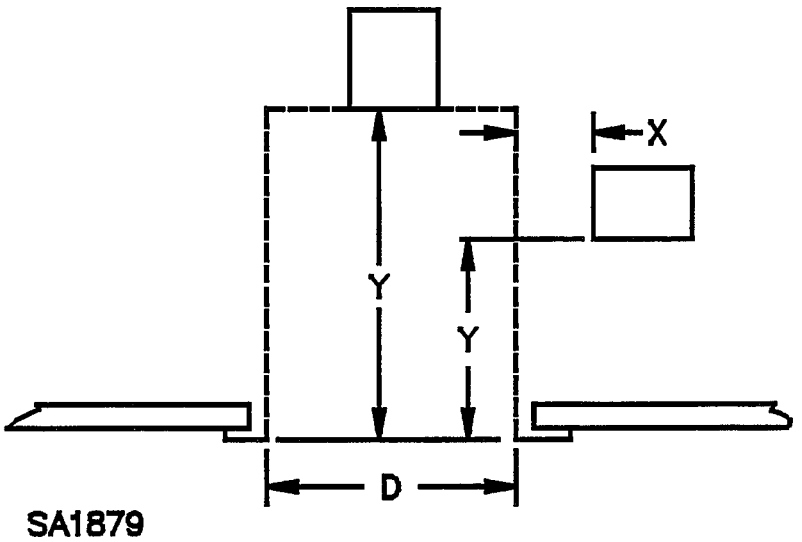
b) Has a diameter (D) that is at least 3 inches (76.2 mm) but no greater than 6 inches (152 mm) as defined by the following equation:

$$D \geq 3 + X + Y$$

where:

X and Y are as illustrated in Figure 47.1.

Figure 47.1
Access to supply connections



X = Distance from edge of access opening to plane of cover on side wiring compartment.
Y = Distance from plane of access opening to plane of nearest surface of wiring compartment that is parallel to the plane of the access opening.
D = Smallest diameter of access opening.

47.2.3 Any hardware (such as a reflector or cover) that must be removed to provide access to the supply connections shall be readily and easily removable.

47.2.4 A fixture marked for use in poured concrete or in ground as specified in 49.3, 49.4, and 49.5 shall provide accessibility only from the relamping side of the fixture.

47.3 Thermal protection

47.3.1 A recessed fixture intended for installation indoors shall be provided with a form of thermal protection that complies with the requirements for thermal protective devices for lighting fixtures, as specified in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873.

Exception No. 1: A fixture marked to indicate that it is for use only in poured concrete as specified in 49.3 need not be provided with thermal protection.

Exception No. 2: Thermal protection need not be provided on a Type IC fixture.

Exception No.3: A canopy fixture is not required to be thermally protected.

47.3.2 A thermal protector shall be suitable for the voltage and current involved and shall be rated for inductive or motor loads.

47.3.3 A thermal protector or thermal sensor shall be connected to an ungrounded primary lead or terminal of a ballast to eliminate unintentional miswiring as defined in 2.28. Examples of acceptable wiring configurations when a multitap or multiple input winding ballast is provided are shown in Figures 47.2 and 47.3. The fixture shall be provided with installation instructions as specified in 49.18.

Exception No. 1: A thermal protector or thermal sensor need not be wired into the ballast primary circuit before being shipped if the thermal protector leads or the heater leads of a thermal sensor are already connected to a plug or receptacle. The wiring configuration is to be such that when the fixture is connected (by a plug connected to the ballast leads) to each source of supply rated for the ballast, the protector circuit:

a) Is connected in series with the ungrounded conductor; and

b) Cannot be bypassed without intentionally doing so (cutting off or otherwise removing a plug or receptacle).

See Figure 47.4 for examples.

Exception No. 2: The marking specified in 49.19 may be provided instead of wiring one lead of a thermal protector to a ballast primary winding if the thermal protector does not de-energize the lamp when it opens. Such a condition is considered to exist if, when the fixture is connected to a supply source of more than 120 volts having a wiring configuration such as is shown in Figure 47.5, the lamp continues to operate after the opening of the thermal protector is simulated by the disconnection of the lead of a thermal protector or the lead of a thermal sensor. The wiring configuration shown in Figure 47.5 is not considered acceptable and is representative of a test configuration to determine if the lamp will continue to be energized when the thermal protector opens.

Exception No. 3: The wiring configuration of a thermal protector or thermal sensor need not be as shown by the examples in Figures 47.2 and 47.3 if the protector is wired in series with the ungrounded secondary lead of the ballast and the lamp.

Figure 47.2
Wiring diagram for fixture provided with multitap ballast and thermal protector

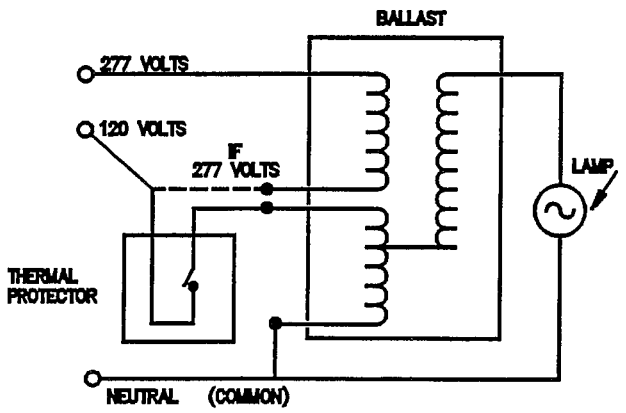


Figure 47.3
Wiring diagram for fixture provided with multitap ballast and thermal sensor

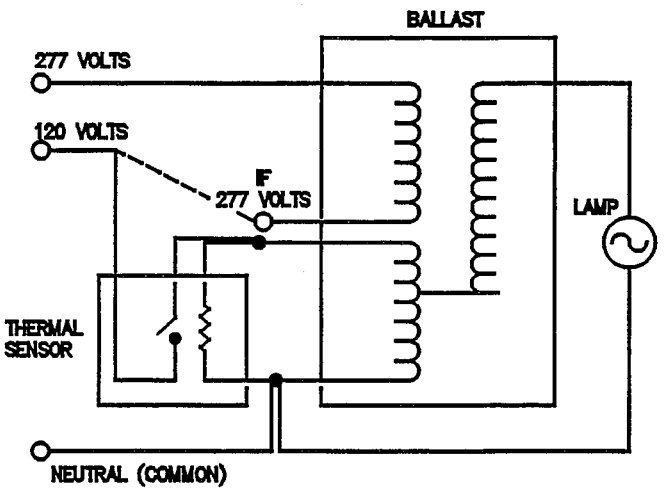
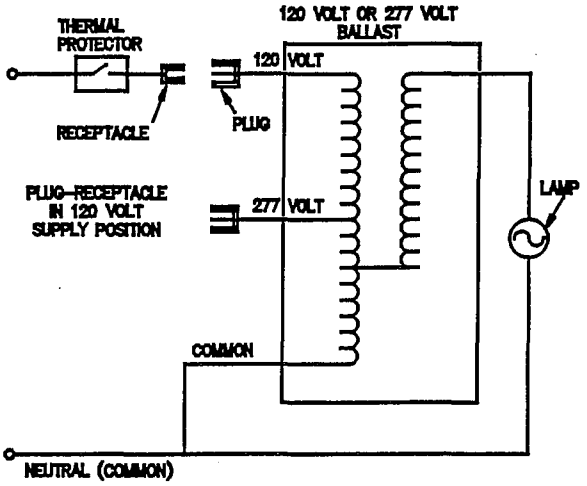
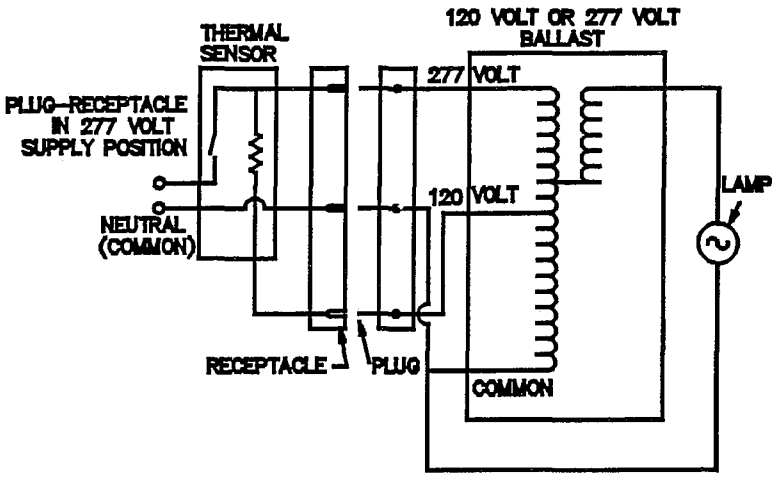


Figure 47.4
Wiring diagrams for ballast provided with thermal protector or thermal sensor

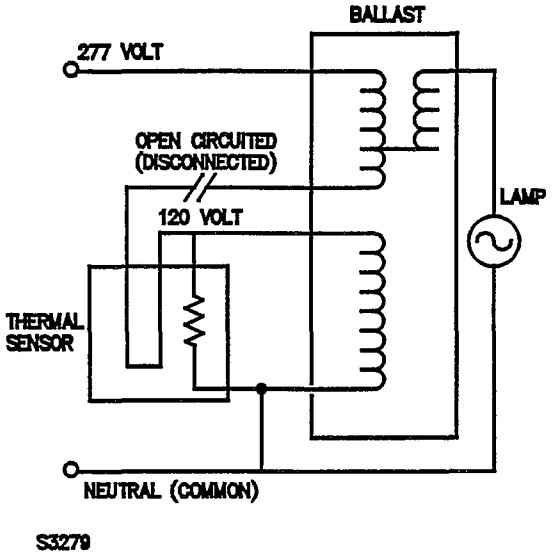


S3277



S3278

Figure 47.5
Wiring diagram of unacceptable configuration for fixture provided with multitap ballast with secondary circuit rated more than 120 volts



47.3.4 The thermal protector provided in a fixture marked in accordance with 49.29 shall be acceptable for the maximum branch circuit amperage marked on the fixture.

47.3.5 A self-heating thermal protector (SHTP) may be substituted for another SHTP that has previously been investigated and determined to be acceptable without additional test, if the SHTP:

a) Is identified as being equivalent to the original device employed in the fixture; and

b) Complies with the requirements for equivalent SHTPs in the Standard for Temperature-Indicating and -Regulating Equipment, UL 873.

48 Performance

48.1 Type Non-IC fixtures

48.1.1 A Type non-IC recessed fixture that is not marked "Type IC" in accordance with 49.11 shall be subjected to the temperature test specified in 48.2.1 – 48.2.6.

48.1.2 A Type non-IC recessed fixture that is not marked "Type IC" in accordance with 49.11 shall be subjected to the abnormal operation tests specified in 48.3.1.1 – 48.3.2.6.

Exception No.1: A fixture marked in accordance with 49.3 and 49.4 to indicate that it is for installation only in poured concrete need not be subjected to the abnormal operation test.

Exception No.2: A canopy fixture need not be subjected to the abnormal operation test.

48.2 Temperature test

48.2.1 When a Type non-IC recessed fixture is subjected to the temperature test, the results are acceptable if:

a) The temperatures attained do not exceed the values indicated in Section 30, Temperature Test; and

b) The thermal protective device required by 47.3.1 does not function.

The test lamp shall be as specified in 30.2.3. The test is to be conducted as specified in Section 30, Temperature Test, for each trim intended for use with the fixture housing and, if a height-adjustable lampholder is provided, in the highest and lowest positions possible for each fixture-trim combination. See 48.5.1 and 48.5.2 to determine the highest position. The fixture is to be installed in a test box as described in 48.2.2 – 48.2.6.

48.2.2 During the test the fixture is to be mounted in a test box built of 1/2-inch (12.7-mm) thick fir plywood, A – D grade, that is reasonably airtight, but not sealed. For marked spacings, the fixture is to be installed in the test box with the fixture center in the center of the wall of the box that represents the wall surface or ceiling surface, as appropriate.

Exception No.1: A fixture marked in accordance with 49.3 to indicate that it is for installation only in poured concrete shall be tested installed as intended in poured concrete, where the concrete is at least 6 inches (152 mm) thick outside the recessed housing. If agreeable to the manufacturer, 30 mesh dry builders sand, contained in the test box, may be used instead of concrete.

Exception No.2: An in-ground recessed fixture marked in accordance with 49.9 shall be tested in at least 6 inches of 30 mesh dry builders sand, contained in the test box.

48.2.3 The overall dimensions of the plywood test box shall comply with either (a) or (b) as follows:

a) Standard Spacings – There is to be no spacing between the walls of the test box and the recessed housing (lamp compartment), junction box, and ballast compartment.

Exception: The test box dimensions are to be adjusted as described in 48.2.4.

b) Marked Spacings – For a fixture with marked spacings as specified in the Exception to 45.3, the box is to be square with the length of each wall equal to twice the center spacing marked on the fixture (see 49.12(c)). The height of the test box is to be the measured height of the fixture plus the spacing to an overhead building member as marked on the fixture (see 49.12(b)).

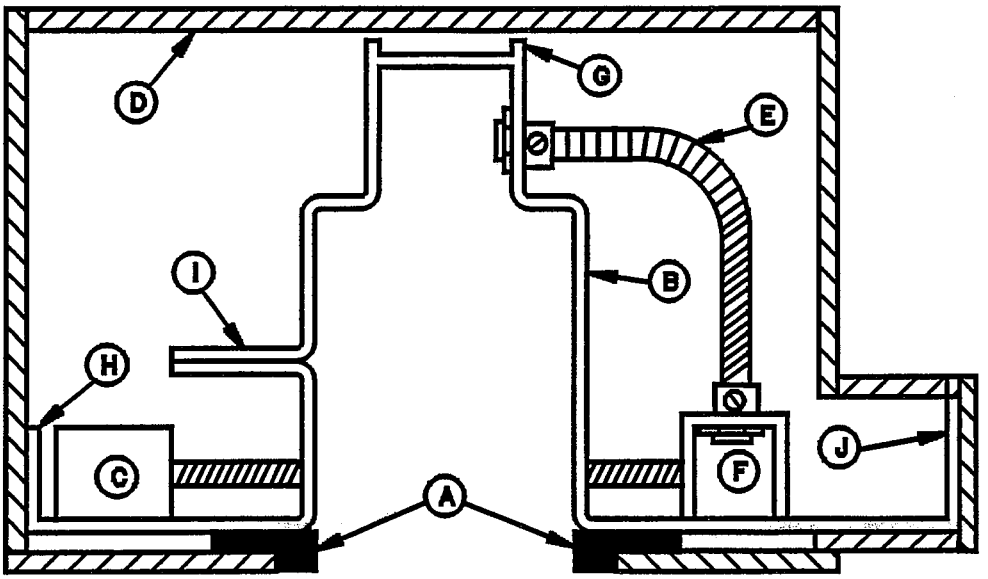
48.2.4 The dimensions of the test box specified in 48.2.3(a) are to be adjusted as follows:

a) Each wall is to be 1/2 inch (12.7 mm) from the nearest point on the recessed housing (lamp compartment), junction box, and ballast compartment.

b) The test box dimensions are to be adjusted to provide no spacing between the test box and each mounting projection that is 1/2 inch to 1-1/2 inches (38.1 mm) long. See Figure 48.1(H) and Figure 48.2(G).

c) The overall test box dimensions are to be no more than 1-1/2 inches (38.1 mm) from the recessed housing, junction box, and ballast enclosure to accommodate a mounting projection longer than 1-1/2 inches. The projection is to be sheathed by the test box (no spacing between test box and any side of projection) as shown in Figure 48.1(J) and Figure 48.2(H).

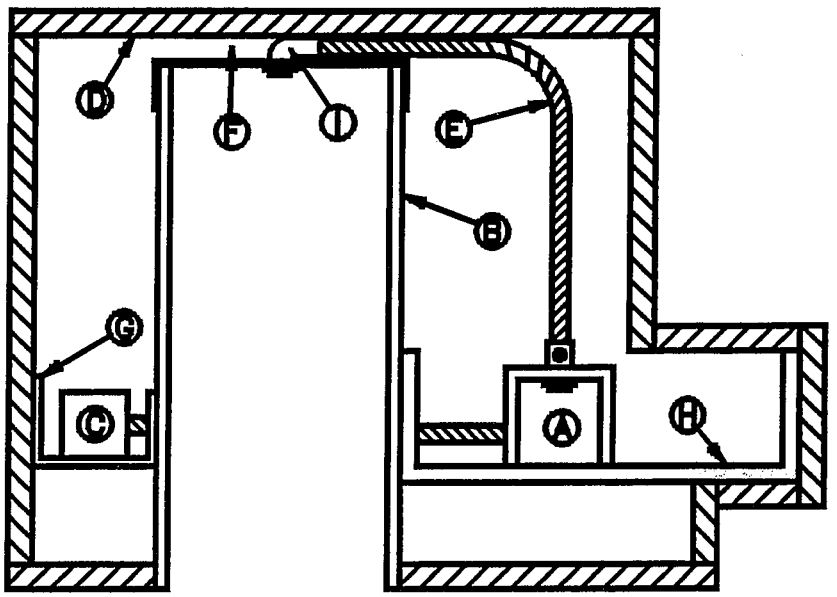
Figure 48.1
Example of test box configuration



S1883–4

A. Integral flange for plaster mounting.
B. Recessed housing.
C. Integral junction box.
D. Test box.
E. Flexible conduit.
F. Ballast enclosure.
G. Mounting projection up to 1/2 inch (12.7 mm) in length.
H. Mounting projection more than 1/2 inch, but less than 1-1/2 inches (38.1 mm). (Test box in contact with projection.)
I. Incidental projection. See 48.2.6.
J. Mounting projection 1-1/2 inches or longer. (Test box sheathes projection.)

Figure 48.2
Example of test box configuration



S1884—3A

A. Ballast enclosure.
B. Recessed housing.
C. Integral junction box.
D. Test box.
E. Flexible conduit.
F. 1/2 inch (12.7 mm) spacing from test box to nearest portion of fixture enclosure.
G. Mounting projection more than 1/2 inch, but less than 1-1/2 inches (38.1 mm). (Test box in contact with projection.)
H. Mounting projection 1-1/2 inches or longer (Test box sheathes projection.)
I. Right angle type conduit connector provided for test.

48.2.5 Any flexible conduit provided with the fixture is to be bent as tightly as possible without damage. There is to be no spacing between the conduit and the plywood test box; that is, the conduit is to be in contact with the test box.

48.2.6 Incidental projections (those projections that serve no purpose) shall not affect the dimensions of the test box. If the presence of an incidental projection interferes with the test box dimensions, the projection is to be removed.

48.3 Abnormal operation tests

48.3.1 Insulation

48.3.1.1 A fixture intended to be mounted in a ceiling shall be mounted in the test box as described in 48.4.1.6 and tested as described in 48.3.1.4. A fixture intended to be mounted in a wall shall be mounted in the test box as described in 48.4.1.7 and tested as described in 48.3.1.4.

48.3.1.2 The interior space between the plywood box and the exterior surface of the recessed housing of the fixture is to be filled with loose-fill cellulosic insulation. The insulation is to be rated, conditioned, and placed as specified in 48.4.2.1 – 48.4.2.4.

48.3.1.3 The vertical depth of the insulation shall be 4 inches (102 mm) measured from the inside bottom surface of the test box, or 2 inches (50.8 mm) from the lowest glass portion of the intended lamp(s), whichever is higher.

Exception No. 1: The depth of insulation shall not exceed the height of the top of the lamp compartment.

Exception No. 2: A wall-mounted fixture shall be covered such that the topmost portion of the fixture is under 8-1/2 inches (216 mm) of insulation.

48.3.1.4 The fixture is to be operated as specified in Section 30, Temperature Test. The test box is initially to be filled with the thermal insulation specified in 48.3.1.2 to a vertical depth as specified in 48.3.1.3. The test is to be conducted with the fixture, test box, and insulation starting at room ambient. The fixture is to be operated until the thermal protector trips at least once or the fixture has operated for 7-1/2 hours, whichever occurs first.

48.3.1.5 If the thermal protector trips within 3 hours of the start of the test, the results are acceptable if the maximum temperature during the 3 hours does not exceed 160°C (320°F) on any part of the fixture in contact with the test box or thermal insulation.

48.3.1.6 If the thermal protector trips after 3 hours but before 7-1/2 hours, or does not trip within 7-1/2 hours:

a) The maximum temperatures during fixture operation shall not exceed the temperatures specified in Table 30.1; and

b) The thermal insulation vertical depth is to be increased 2 inches (50.8 mm) and the test described in 48.3.1.4 is to be repeated with the fixture and the insulation starting at room ambient.

48.3.1.7 Retesting with increased depths of insulation is to continue until:

a) The thermal protector trips within 3 hours of the start of the test to determine compliance with 48.3.1.5;

b) The temperatures in Table 30.1 are exceeded; or

c) The protector fails to operate within 3 hours with the thermal insulation at a depth of 8-1/2 inches (216 mm) above the highest projection of the fixture.

The depth of insulation is to be increased in 2 inch increments except the last increase may be less than 2 inches as required to increase the depth of the insulation to 8-1/2 inches above the highest projection of the fixture. If it is necessary to increase the depth of insulation to 8-1/2 inches, the thermal protector shall trip within 3 hours of the start of the test, or the temperature limits of Table 30.1 shall not be exceeded within 7-1/2 hours of the start of the test.

Exception: For purposes of this requirement, the maximum acceptable temperature rise on any part of the recessed housing in contact with thermal insulation is to be 65°C (117°F), or a temperature limit of 90°C (194°F), rather than the 125°C (225°F) rise indicated in Table 30.1(19).

48.3.2 Marked spacings

48.3.2.1 A fixture marked with larger than 1/2-inch (12.7-mm) spacings to cavity surfaces as specified in the Exception to 45.3 shall be mounted in a test box constructed as described in 48.3.2.2 and shall be subjected to the temperature test described in 48.2.1 – 48.2.6. The lamp wattage, type, and size are to be as rated and marked in accordance with 49.14.

48.3.2.2 The dimensions of the test box are to be such that, when the fixture is mounted inside the box, the fixture to overhead member spacings and the fixture to side wall spacings are one-half those provided by the normal temperature test box described in 48.2.3(b), but in no case less than 1/2 inch (12.7 mm).

48.3.2.3 The fixture is to be operated for 7-1/2 hours or until the thermal protector trips, whichever occurs first.

48.3.2.4 If the thermal protector trips within 3 hours, test results are acceptable if one or more lamps in the fixture are de-energized and temperatures attained on parts of the fixture in contact with combustible materials (for example, the test box and fixture support surfaces) do not exceed 160°C (320°F).

48.3.2.5 If the thermal protector does not trip within 3 hours and the temperatures do not exceed those specified in 48.3.2.6, the test is to be reconducted with the fixture mounted in a test box with dimensions that provide:

a) One-half the vertical dimension from the top of the fixture to the top of the previous test box; and

b) One-half the smallest horizontal dimension from the fixture to the side of the previous test box.

In no case is a test box to fixture spacing to be less than 1/2 inch (12.7 mm). The test is to be repeated in this manner until:

a) The protector trips within 3 hours; or

b) The protector does not trip within 3 hours and the temperatures exceed the limits specified in 48.3.2.6.

48.3.2.6 If the thermal protector does not trip within 3 hours, test results are acceptable if temperatures attained on parts of the fixture in contact with combustible materials (for example, the test box and fixture support surfaces) do not exceed 90°C (194°F).

48.4 Type IC fixtures

48.4.1 Normal temperature test

48.4.1.1 A recessed fixture marked "TYPE IC" as specified in 49.11 shall be tested as specified in 48.4.1.2 – 48.4.1.8.

48.4.1.2 When a Type IC recessed fixture is subjected to the temperature test, the results are acceptable if the temperatures attained do not exceed the values indicated in Section 30, Temperature Test. The test lamp shall be as specified in 30.2.3. The test is to be conducted as specified in Section 30, Temperature Test, for each trim intended to be used with the fixture housing and, if a height-adjustable lampholder is provided, in the highest and lowest positions possible for each fixture-trim combination. The fixture is to be installed in a test box as described in 48.4.1.4 – 48.4.1.8.

48.4.1.3 During the test, any thermal protective device that may be provided on the fixture or in the ballast shall not cycle (nuisance-trip).

48.4.1.4 The interior space, between the plywood box and the exterior surface of the recessed housing of the fixture, is to be filled with loose fill cellulosic insulation. The insulation is to be rated, conditioned, and placed as specified in 48.4.2.1 – 48.4.2.4.

48.4.1.5 A fixture intended to be mounted in a ceiling shall be mounted in the test box described in 48.4.1.6 and tested as described in 48.4.1.4. A fixture intended to be mounted in a wall shall be mounted in the test box described in 48.4.1.7 and tested as described in 48.4.1.4.

48.4.1.6 A ceiling-mounted fixture is to be mounted in a rectangular box built of 1/2-inch (12.7-mm) thick fir plywood, A – D grade. The plywood test box is to have dimensions such that each wall is 8-1/2 inches (216 mm) from the nearest point of the recessed housing, junction box, or mounting projection of the fixture and the top edge of each wall is 8-1/2 inches above the height of the installed fixture. The top of the box is to be open. The thickness of the wall of the box representing a ceiling is to be increased as necessary for a fixture that is intended for thicker ceilings than 1/2 inch or a fixture that is adjustable to accommodate different ceiling thicknesses.

48.4.1.7 A wall-mounted fixture is to be mounted in a test box constructed of 1/2-inch (12.7-mm) thick fir plywood, A – D grade. The plywood test box is to have dimensions such that the horizontal top and bottom, and the two vertical sides, are each 8-1/2 inches (216 mm) from the nearest points of the recessed housing, junction box, or mounting projections of the fixture. The back of the test box is to be in contact with the back of the fixture, or 6 inches (152 mm) from the front wall of the test box, whichever results in the largest spacing to the front wall of the test box.

48.4.1.8 If a fixture is provided with a screen or shield so that insulation cannot contact the recessed housing of the fixture, the plywood test box is to be spaced 8-1/2 inches (216 mm) from the screen or shield.

Exception: The screen or shield is to be removed from the fixture if it is not attached to the fixture in a permanent manner such as with rivets, welds, or an attachment means that requires the use of tools.

48.4.2 Insulation

48.4.2.1 Cellulosic insulation is to be rated for a thermal resistance of 3.75 – 3.85 R/inch with a conditioned density of 2.0 – 2.5 pounds per cubic foot (32 – 40 kg/m^3)

48.4.2.2 The insulation is to be conditioned through a blowing or vacuum machine before being placed around the test fixture. The blowing or vacuum machine shall be capable of conditioning the insulation to the density specified in 48.4.2.1.

48.4.2.3 Insulation that has been conditioned through a blowing machine may be blown to allow it to fall into the test box around the fixture or into a storage container. The insulation conditioned by a blowing machine into a storage container or by the vacuum machine into a storage container is to be placed in the test box around the fixture by hand or scoop in a manner to minimize packing or settling.

48.4.2.4 The insulation is to be placed in the space between the test box and fixture in a uniform manner such that all areas surrounding the mounting brackets, incidental projections on the fixture, and the like, are free of large air pockets or cavities. Small cavities such as 1/2 inch (12.7 mm) high spaces between the brackets and the test box are not required to be filled other than through natural filling as a result of placing the insulation around the area.

48.5 Lampholder mounting bracket stops

48.5.1 A fixture provided with a means to vary the depth of a lampholder within a lamp compartment or recessed housing shall be tested without the lampholder mounting bracket stop(s) in place if the stop(s) can be defeated as specified in 48.5.2.

48.5.2 To determine if a fixture should be tested without the lampholder mounting bracket stop(s) in place, the adjustable lampholder bracket is to be adjusted until it is in contact with the stop(s). A weight totalling 10 pounds (4.5 kg) is to be applied in 5-pound (2.3-kilogram) increments to the lampholder mounting bracket. The weights are to be removed after 2 minutes and the displacement of the stop(s) from its original position is to be measured. The results are acceptable if all of the stops are not displaced more than 1/8 inch (3.2 mm) beyond their original position and the lampholder mounting bracket is not displaced past any of the stops.

49 Markings

49.1 A recessed fixture that complies with the Exception to 47.2.1 shall be marked in Form A-2 (see 34.1) "Access above ceiling required" or "Access behind wall required."

49.2 With respect to the supply wire temperature marking (as specified in note a of Table 30.1 and in 38.2) on a fixture furnished with tap conductors or with the provision for tap conductors, the temperature shall be that recorded at the point of connection of the tap conductors to the fixture.

49.3 A fixture that is tested in poured concrete, under the provision of the Exception to 48.2.2, shall be marked in Form A-6 "For installation only in poured concrete."

49.4 An in-ground recessed fixture that is tested as described in Exception No.2 to 48.2.2 shall be marked in Form F-6: "Ground Installation Only."

Exception: An in-ground recessed fixture that is marked for installation only in concrete need not be provided with this marking.

49.5 A fixture that is constructed as specified in 46.5.2, but not tested in poured concrete, may be marked in Form B-5 "Suitable for installation in poured concrete."

49.6 A fixture as specified in 46.11(c) shall be marked in Form A-5 "To be used only in ceiling plenum of noncombustible construction – see the Standard for the Installation of Air Conditioning and Ventilating Systems (National Fire Codes, Vol. 4, 1989), NFPA 90A-1993 – or with air handling part that covers openings."

49.7 A fixture as specified in 45.5.4 shall be marked in Form A-5 "If vent openings are uncovered, fixture must be used only in ceiling plenum of noncombustible construction – See the Standard for the Installation of Air Conditioning and Ventilating Systems (National Fire Codes, Vol. 4, 1989), NFPA 90A-1993 – or with air handling part that covers openings."

49.8 A fixture that produces a temperature rise greater than 65°C (117°F) equivalent to a scale temperature of 90°C (194°F), on a mounting surface or recessed housing as specified in note f of Table 30.1 shall be marked in Form A-6 "CAUTION – High surface temperatures, install this fixture only in buildings of fire-resistant construction where the fixture is not mounted on or adjacent to combustible materials."

49.9 An in-ground recessed fixture that produces a temperature rise greater than 65°C (117°F), equivalent to a scale temperature of 90°C (194°F), on a mounting surface or recessed housing shall be marked in Form F-6 "CAUTION – High surface temperatures, install this fixture only where the fixture is not mounted in or adjacent to combustible materials."

49.10 A fixture that is tested as specified in 48.1.1 shall be marked in Forms B-2 and H-7 with the word "WARNING" and the following or the equivalent: "RISK OF FIRE. Do not install insulation within 3 inches of fixture sides or wiring compartment nor above fixture in such a manner to entrap heat". For Form B-2, the upper case letters shall be no less than 1/8 inch (3.2 mm) in height and the lower case letters shall be no less than 1/16 inch (1.6 mm) in height.

49.11 A fixture intended for mounting near or in contact with thermal or acoustic insulation and tested in accordance with 48.4.1.1 shall be marked in Form D-2 "TYPE IC."

49.12 A fixture shall be marked in Form D-2 "Not for residential use. Install with minimum spacings between:

a) Centers of adjacent fixtures: ___ feet;

b) Top of fixture and an overhead building member: ___ inches; and

c) Fixture center to side wall: ___ feet."

The blank in (a) is to be filled in with the appropriate spacing in feet (2, 3, 4, 5, and so on, measured in 1-foot increments). The minimum center to center dimensions shall be as specified in 49.13. The blank in (b) is to be filled in with the appropriate spacing in inches (1/2, 3, 6, 8, 10, 12, 15, 18, 24, and so on, measured in 6-inch increments from 24 inches on). The blank in (c) is to be filled in with the appropriate spacing in feet, equal to one-half the value specified in (a) (1, 1-1/2, 2, 2-1/2, 3, and so on, measured in 1/2-foot increments).

Exception: The marking need not be provided for a fixture that complies with the temperature test requirements in Section 48, Performance, when tested in a test box as described in 48.5(a).

49.13 The minimum marked center to center spacing between adjacent fixtures is to be determined by measuring the length and width of the recessed fixture, adding 1 foot (305 mm) to the greater of the two measurements, and rounding the resulting figure up to the next whole number (in feet); however, in no case shall the marked spacing be less than 2 feet (610 mm).

49.14 A fixture shall be marked with the lamp replacement markings specified in Section 39, Lamp Replacement.

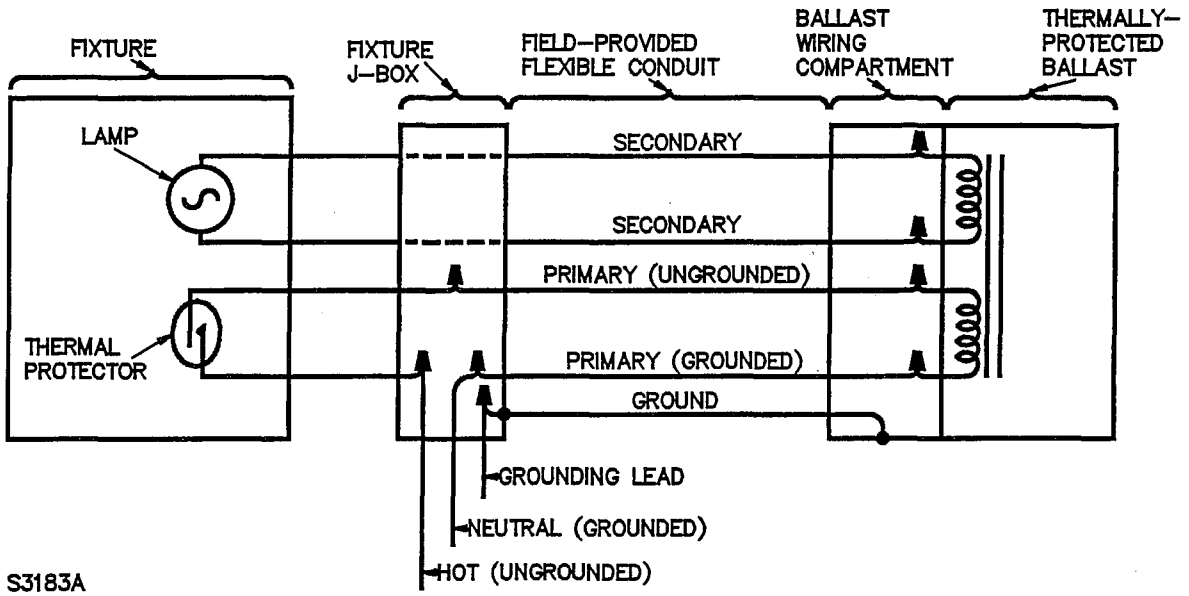
49.15 A fixture provided with a thermal protective device shall be marked "NOTICE – Thermally protected fixture. Blinking light may indicate insulation too close to fixture (or other condition causing overheating)." Conditions that could result in the light blinking may be stated in place of the phrase provided in parentheses. The marking shall be in Form A-6.

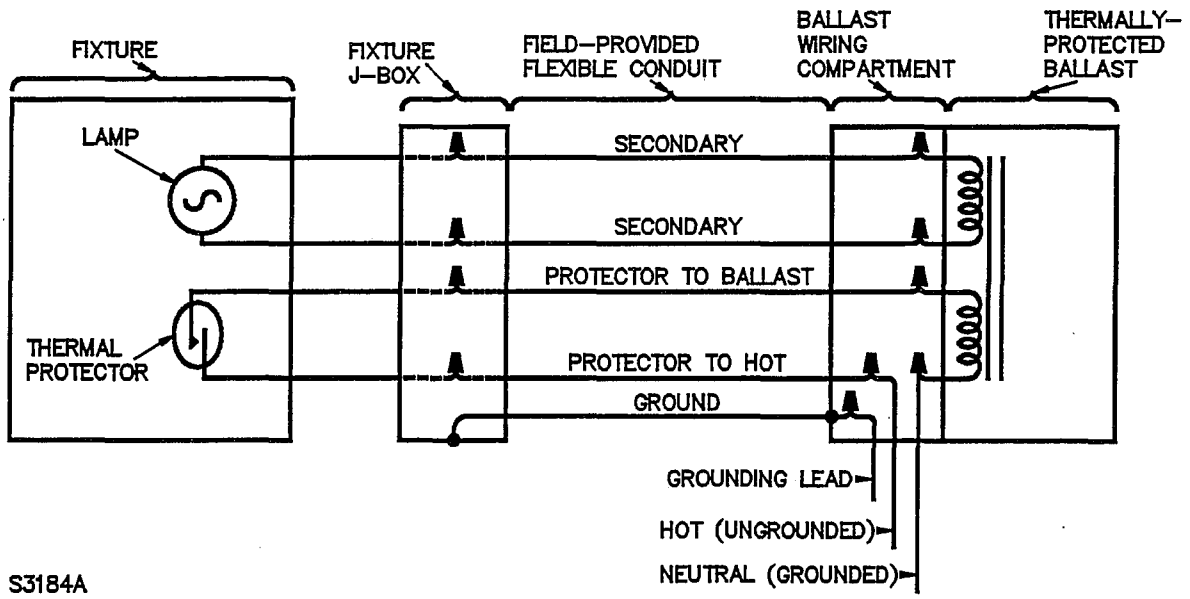
Exception: The words "thermally protected fixture" need not be included in the marking if they are provided on the fixture in Form A-2.

49.16 A recessed fixture intended for installation in a suspended ceiling as specified in 46.2.1 – 46.2.3 may be marked in Form B-2, "Suitable for use in suspended ceilings."

49.17 A recessed fixture intended to be connected to a remote ballast as specified in 46.7.1 shall be provided with wiring and installation instructions in Form C that identify the intended wiring connections including where the supply connections are to be made. One or both of the two methods of wiring instructions shown in Figure 49.1 are to be used.

Figure 49.1
Wiring diagrams for connections between a remote ballast and a recessed fixture





49.18 A recessed fixture provided with a multitap ballast and thermal protector or thermal sensor as specified in 47.3.3 shall be provided with wiring and installation instructions in Form C. The installation instructions shall not instruct the installer to disconnect a wire or lead from one point of connection and connect it to another lead or terminal. A wiring diagram similar to Figure 47.2 or 47.3, as appropriate, shall be included in the instructions.

49.19 A recessed fixture that complies with Exception No. 2 to 47.3.3 shall be provided with installation instructions that specify the method to be used to connect the thermal protector or thermal sensor in the circuit and shall be marked in Form A-3 with the word "WARNING" and the following or the equivalent: "To reduce the risk of fire, the thermal protection system provided with this fixture must be wired as specified in the installation instructions".

49.20 In accordance with 39.1, a fixture shall be marked with a lamp replacement marking system. The marking system shall consist of two separate markings on different parts of the fixture as specified in 49.21 and 49.22. The markings shall be visible during relamping and located as specified in 49.25.

Exception No. 1: For a fixture that requires a different type of lamp (R, PAR, or A) with two or more available trims, the lamp replacement marking may be as specified in 49.23.

Exception No. 2: The marking system may consist of the marking specified in 49.24 if the entire text of the marking is visible during relamping as specified in 49.24 for all trims and finishing sections provided for use with the fixture.

49.21 In accordance with 49.20, a fixture or a rough-in section shall be marked in Form A with the word "CAUTION" or "WARNING" and with the following: "RISK OF FIRE. USE ONLY THE LAMP SPECIFIED ON THE TRIM". A trim or finishing section shall be marked in accordance with 49.22. The marking shall be located as specified in 49.25.

49.22 In accordance with 49.21, a fixture trim or finishing section shall be marked in Form E "Use __1__, __2__ Type, __3__". The blank is to be filled in as designated below:

[1] Either the tested lamp ANSI designation or the tested lamp wattage, lamp type (HPS, MH, or H), and voltage in accordance with Exception No. 2 to 39.1.

[2] Tested lamp type (examples: R, PAR).

[3] Tested lamp shape symbol (examples: ,).

The marking shall be located as specified in 49.25.

Exception: A trim or finishing section intended for use with other than an R or PAR type lamp need not be marked with the lamp type and lamp shape symbol if the fixture and trim, rough-in and finishing section fixture, or rough-in and finishing section fixture and trim comply with Section 48, Performance.

49.23 In accordance with Exception No. 1 to 49.20, for a fixture that requires a different type lamp in two or more of the available trims, the lamp replacement marking on the fixture housing shall be as shown in Figure 49.2. The trim shall be marked with an identifying number that corresponds to a trim number on the fixture housing marking. The lamp type, size, and wattage markings shall be in Form E-6 and located as specified in 49.25. The rest of the marking shall be in Form A-6.

Figure 49.2
Trim number lamp replacement marking example

WARNING – RISK OF FIRE. USE WITH ___ WATTS (MAX)[a] (MFR. NAME) TRIMS ONLY FOR EACH LAMP TYPE INDICATED. SEE TRIM FOR NO.	
TRIM NO.[b]	LAMP SIZE AND TYPE[b]
A100	A
A201	A
R50	R

[a] The word MAX in parentheses is optional.

[b] The trim catalog numbers and lamp sizes and types in this figure are examples of the information to be provided.

49.24 In accordance with Exception No. 2 to 49.20, a fixture may be marked "CAUTION" or "WARNING" and "RISK OF FIRE. USE ONLY MAX 1 WATTS, 2 TYPE, 3 ". The blanks are to be filled in as designated below:

[1] Either the tested lamp ANSI designation or the tested lamp wattage, lamp type (HPS, MH, or H), and voltage in accordance with Exception No. 2 to 39.1.

[2] Tested lamp type (examples: R, PAR).

[3] Tested lamp shape symbol (examples:  , ).

The marking shall be located as specified in 49.25. The words "CAUTION" or "WARNING" and "RISK OF FIRE. USE ONLY" shall be in Form A and the remainder of the marking shall be in Form E.

Exception: A fixture intended for use with other than an R or PAR type lamp need not be marked with the lamp type and lamp shape symbol if the fixture and trim, rough-in and finishing section fixture, or rough-in and finishing section fixture and trim comply with Section 48, Performance.

49.25 A lamp replacement marking shall be located such that when a fixture consisting of:

a) A fixture and a trim;

b) A rough-in section and a finishing section; or

c) A rough-in section, a finishing section, and a trim;

is assembled as intended, the lamp replacement marking system is visible during relamping. For a fixture or a rough-in and finishing section fixture provided with several trims, the marking shall be of the same type and similar location for all trims. For trims with lamps in which the lamp can be replaced without lowering or removing the trim, the lamp replacement marking shall be located so that it is visible without lowering or removing the trim.

Exception No. 1: A fixture provided with a trim having a socket type reflector such that the inside back surface of the recessed housing is not visible during relamping need not be provided with the part of the marking specified in 49.21 visible during relamping.

Exception No. 2: A lamp replacement marking may be located behind the trim if it complies with 49.26.

49.26 A lamp replacement marking may be located behind the trim if the fixture is marked "WARNING – RISK OF FIRE" and the following or equivalent statement: See other side of trim for relamping instructions. The marking shall appear in Form E-6.

49.27 A fixture shall be marked on the fixture housing or finishing section "CAUTION – Risk of fire. Use with (manufacturer's name) (catalog number) trims only" in Form B-5.

49.28 A fixture intended for installation only in environmental air handling spaces other than ducts or plenums and that complies with the Exception to 25.1.3 shall be marked in Form D-4 in accordance with 34.1, "Suitable only for installation in environmental air handling spaces other than ducts or plenums where a complete metal enclosed wiring system is provided."

49.29 A fixture intended to be connected to a branch circuit supply in excess of 20 amperes and that is provided with a thermal protective device shall be marked in Form B-4 "Suitable for connection to a branch circuit supply rated _____ amps maximum" if the thermal protective device has been determined to be acceptable for the rated maximum amperes to be marked. The possible branch circuit ratings are 30, 40, and 50 amperes.

Exception: A fixture employing a mogul lampholder and provided with a thermal protective device with a 20 ampere branch circuit rating shall be marked in Form B-4 "Suitable for connection to branch circuit supply rated 20 amps maximum."

50 Recessed Trims

50.1 General

50.1.1 Requirements in this section are supplementary to other applicable requirements of this standard and apply to trims that are:

a) Provided with a housing of a recessed fixture; or

b) Intended to be installed sometime after the initial installation of the fixture, including trims manufactured by other than the recessed fixture manufacturer.

50.2 Construction

50.2.1 A trim that is part of the electrical enclosure shall comply with the enclosure and metal thickness requirements of Sections 7 and 8.

50.2.2 A ferrous sheet metal trim shall comply with the resistance to corrosion requirements of 46.3.3.

50.2.3 A trim that is intended for use with damp or wet location fixtures shall comply with the appropriate requirements of Part 4 of this standard.

50.3 Performance

50.3.1 A fixture/trim combination shall comply with all the requirements of Section 48, Performance.

50.3.2 A trim manufactured by other than the recessed housing manufacturer shall be tested with all the same lamp type(s) and wattage(s) identified for the trim it is intended to replace.

50.3.2 effective November 2, 1996

50.4 Markings

50.4.1 A trim shall be marked in Form B-1 with the manufacturer's name and model number.

50.4.2 A trim shall be marked in Form D-2 with the housing catalog number(s) for which the trim is intended to be used.

Exception: This marking is not required if the trim is only for use with housings from the same manufacturer, and the trim is not provided with a Listing Mark.

50.4.3 A trim shall comply with the marking requirements of 49.15 if the marking on the housing would be concealed by the trim.

50.4.4 A trim shall be provided with the appropriate lamp replacement marking described in 49.24 – 49.26.

Exception: This marking is not required if the trim is only for use with housings from the same manufacturer, and the lamp replacement marking is on the housing and visible during relamping with the trim installed or removed, should the trim construction require its removal for intended relamping.

PART 3 – SPECIAL USES OR CONSTRUCTIONS

51 Fixture Fittings

51.1 A fixture fitting is a subassembly of a fixture intended to be field assembled to one or more separate fixture fittings or to a complete fixture. Such fittings may include reflectors, ballast assemblies, enclosure end plates, mounting hanger assemblies, adapter plates, or other parts required in this standard that are shipped separately from the fixture (or other fittings) and are subsequently field installed. Fixture fittings may also include optional parts that can be added to an otherwise complete fixture in the field.

51.2 An assembly consisting of fixture fittings that form a complete fixture shall comply with the applicable requirements in this standard.

51.3 Each fixture fitting shall be marked in Form B-3 (see 34.1) with the manufacturer's name or trademark and a catalog or model number. In addition, the fitting shall be marked with other applicable markings required in this standard.

51.4 Each fitting (or smallest unit carton of fittings) shall be provided with instructions that demonstrate the intended use.

52 Poles

52.1 A support for a pole-mounted fixture shall comply with 52.2 – 52.9.

52.2 A pole shall serve as or contain a raceway that extends the entire length of the pole. The pole shall be constructed of:

a) Metal;

b) Metal-lined wood;

c) Concrete; or

d) Polymeric material.

A metal pole shall comply with 7.1 and 52.3. A pole made of polymeric material shall comply with 7.1 and 7.2.

52.3 A circular metal pole used for support of a fixture shall have a minimum thickness of 0.040 inch (1.01 mm) if of steel and 0.050 inch (1.27 mm) if of aluminum alloy. A metal pole that is other than circular in shape shall have a minimum thickness of 0.064 inch (1.63 mm) if of steel and 0.074 inch (1.88 mm) if of aluminum alloy. A metal lining in a wooden pole shall be at least 0.026 inch (0.66 mm) thick if of steel and 0.032 inch (0.81 mm) thick if of other metal.

Exception: A pole intended to support a single fixture weighing 10 pounds (4.5 kg) or less mounted on top of the pole within 6 inches (152 mm) of the center axis of the pole may be one-half of the minimum thickness specified.

52.4 A ferrous metal pole and raceway shall be provided with protection against corrosion as specified in 69.1.1 – 69.1.5. Aluminum intended for direct insertion into the ground or into concrete shall be provided with a protective (organic) coating.

52.5 A pole having its own means for supply connection shall be constructed such that the point of connection of conduit or cable shall be located at least 6 inches (152 mm) from the lower end of the metal raceway.

52.6 A pole shall be provided with an area located above ground level within the pole or pole base that is dedicated to making and inspecting splices. This area shall provide:

a) A complete enclosure for splices;

b) Access to splices without removing the fixture or placing any strain on the splices; and

c) A rectangular handhole not less than 2 inches (50.8 mm) by 4 inches (102 mm).

The corners of the handhole may be radiused up to one-half of the width. A handhole shall be permitted to be other shapes and sizes, provided a projected view of the finished opening will encompass the described area.

Exception: A pole that is 8 feet (2.44 m) or less in height (measured from ground level) need not be provided with the splice compartment if:

a) The incoming wiring supply can be brought up through the pole without the need for additional splices or pull points; and

b) The interior of the pole and any splices are accessible by removal of the fixture.

52.7 A pole shall be provided with:

a) A grounding means that complies with Section 25, Grounding; and

b) A means for bonding a fixture to the pole.

Exception: A pole that is 8 feet (2.44 m) or less in height (measured from ground level) need not be provided with a grounding means if the pole is provided with a means for bonding the pole to a fixture.

52.8 A pole shall comply with the requirements for wet locations as specified in Sections 68 – 72.

52.9 A pole which has a vertical rise for wiring 100 feet (30.48 m) or higher shall have a means of physical support for the wiring. The acceptability of the support means shall be as described in 43.2.3.

Exception: A pole marked in Form B-2 with the following or equivalent wording: "For Use Only With Fixtures Provided With Integral Supply Wire Support" need not be provided with physical support for the wiring.

52.10 A two piece polymeric connector for mounting a fixture to an outlet box shall comply with the following:

a) A means for electrically connecting the grounded, ungrounded, and grounding conductors in accordance with Section 25, Grounding.

b) If the means provided for the electrical connections is by terminal contacts in each connector half, the contacts on the half secured to the outlet box shall be inaccessible to contact by the inadvertent contact as determined by the probe specified in 23.1.1. In addition, the polymeric material in contact with the terminals shall have maximum performance level category rating of 4 for HWI, 3 for HAI, and 5 for CTI. The minimum dielectric voltage of the material shall be 5000.

c) The connector shall be capable of supporting without distortion on a 200 pound weight attached to it for 1 minute when secured in an outlet box mounted in an oven adjusted to operate at 100°C.

d) The polymeric material of the connector shall be rated minimum 94-V1 in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, and minimum 90°C in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B.

52.11 A polymeric connector shall be provided with installation instructions. The instructions shall specify proper installation, including the proper method for connecting the grounding means to the fixture and a grounding lead in an outlet box. The installation instructions shall also be marked "WARNING – Risk of shock or injury to persons. Do not connect this product to a fixture marked for supply wires greater than 90°".

53 Rough-In and Finishing Sections for Recessed Fixtures

53.1 General

53.1.1 Requirements in this section are supplementary to other applicable requirements in this standard and apply to recessed fixtures that, for shipping and installation reasons, are in two sections known as rough-in sections and finishing sections.

53.1.2 The sectional separation of the fixture generally is one of two designs:

a) A design in which the rough-in section includes all electrical parts and the wiring or splice compartment to which the branch circuit wiring is to be connected, and the finishing section includes the recessed portion of the enclosure (lamp housing or reflector) in addition to the finish frame and diffuser; and

b) A design known as a pre-wired unit in which the rough-in section consists only of a plaster frame and wiring or splice compartment to which the branch circuit is to be connected, and the finishing section includes all other parts necessary to complete the installation.

In addition, there may be some constructions in which a glass diffuser serves to complete the required electrical enclosure of wiring and splices, and some constructions that are required to have the diffuser shipped complete with the remainder of the fixture.

53.2 Assembly

53.2.1 The complete recessed fixture, consisting of the assembled rough-in section and the finishing section shall meet all other applicable requirements in this standard.

53.2.2 All electrical parts of the complete recessed fixture shall be provided in one section, and all wiring on this section shall be completed at the factory. It is intended that the only wiring to be completed in the field is the connection to the branch circuit conductors.

Exception: All electrical parts of the complete recessed fixture need not be provided on one section if electrical connection between parts on the rough-in and finishing sections is completed by plugging an attachment plug provided as part of the finishing section into a receptacle or the equivalent on the rough-in section.

53.2.3 A rough-in section shall be marked in Form D-4 (see 34.1) with the following information (1) the legend: "Rough-In Section for Recessed High Intensity Discharge Fixture _____ For Use With Finishing Section _____". The first blank is to be filled in with the type, catalog, or part number or other appropriate designation for the rough-in section. The second blank is to be filled in with the type, catalog, or part number or other appropriate designation for the finishing section.

53.2.4 In addition to the markings required in 53.2.3, a rough-in section shall be marked with the following, as appropriate:

a) Identification markings, as described in 35.1 and 35.2;

b) Orientation and assembly markings, as described in 36.1.1 – 36.2.4;

c) Rating markings, as described in 37.1 and 37.2;

d) Supply connection markings, as described in 38.1 – 38.4;

e) Recessed fixture markings, as described in 49.1 – 49.11; and

f) Markings for fixtures for use in damp or wet locations, as described in Part 4.

53.2.5 A finishing section shall be marked in Form D-4 with the legend "Finishing Section for Recessed High Intensity Discharge Fixture _____ For Use With Rough-In Section _____." The first blank is to be filled in with the type, catalog, or part number or other appropriate designation for the finishing section. The second blank is to be filled in with the type, catalog, or part number or other appropriate designation for the rough-in section.

53.2.6 In addition to the markings required in 53.2.5, a finishing section shall be marked with the following, as appropriate:

a) Identification markings, as described in 35.1 and 35.2; and

b) Lamp replacement markings, as described in 39.1 – 39.3.

53.2.7 If a light diffuser is not provided, a marking in Form A-1 on the finishing section shall indicate that the fixture must not be used with a light diffuser.

53.2.8 Each rough-in and each finishing section shall be packaged in a separate container. The finishing section shall include any light diffuser intended for use with the fixture.

Exception: Glassware may be in a separate carton, and shipped with the carton containing the rest of the finishing section.

53.2.9 The parts in each carton need not be completely assembled (for example, the glassware need not be mounted in the frame) if the degree of disassembly would comply with appropriate requirements in the standard when the complete fixture was shipped in one carton.

54 Fixtures with Remote Ballasts

54.1 The requirements in this section apply only to surface mounted or recessed fixtures that are designed for operation from a ballast mounted away from the fixture itself. The ballast and interconnecting means are usually field supplied.

54.2 A fixture shall be provided with leads for supply connections that extend from the lampholders to the point inside the fixture where supply connections will be made. The leads shall comply with the requirements in Section 26, Power Supply Connection.

54.3 A fixture shall be provided with a means for the connection of one of the supply wiring systems in accordance with Section 26, Power Supply Connection, to permit the field interconnection of the fixture to the remote ballast.

55 Fixtures Suitable for Use with Through Branch Circuit Conductors

55.1 General

55.1.1 Requirements in this section are supplementary to other applicable requirements in this standard and apply to fixtures of the recessed type. They are intended to accommodate field-installed branch-circuit wiring through the fixture supply circuit outlet box, in addition to the branch circuit wires supplying the fixture.

55.1.2 The junction box for the through wire branch circuit conductors shall comply with the requirements in Section 56, Recessed Fixture Junction Boxes for Use With Through Branch Wiring, if constructed of metal and shall be judged under the construction requirements in the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C, if constructed of other than metal.

55.2 Temperature test

55.2.1 When subjected to the temperature test appropriate for the fixture design involved, and in accordance with 55.2.2 – 55.2.7, a fixture marked for use with through branch-circuit wires shall comply with all the following:

a) The temperatures of the through branch-circuit conductors shall not exceed the branch-circuit wire temperature rating for which the fixture is marked.

b) The temperature of any fixture surface that the branch-circuit wire may contact shall not exceed the branch-circuit wire temperature rating for which the fixture is marked.

c) The temperatures of other parts or materials of the fixture shall not exceed the limit for such part or material as specified in Table 30.1.

55.2.2 Two lengths of electrical metallic tubing, of a size rated for the number and size of the conductors installed, are to be fitted to the outlet box through which the branch circuits are to be routed. The lengths of electrical metallic tubing are to extend approximately 1 foot (0.3 m) outside of the test enclosure and the outer ends are to be plugged with cotton to prevent air circulation.

Exception: A fixture marked for use with cable only in accordance with 55.5.1 may be tested using nonmetallic sheathed (NM) cable fitted to the outlet box.

55.2.3 The length and size of the wiring to be placed in the outlet box shall correspond to the number and size of the branch circuit conductors for which the fixture is marked. For each two conductors permitted in the outlet box, wiring shall be placed inside the box equal to the length of the box or 12 inches (305 mm), whichever is longer. A wire type (such as Type TW or Type THHN) provided with minimum 0.027 inch (0.69 mm) thick polyvinyl chloride insulation with or without minimum 0.004 inch (0.10 mm) thick nylon jacket insulation shall be used.

55.2.4 Temperatures on the wiring and box surfaces shall be determined by thermocouples located at critical points of the assembly. The thermocouples located on the branch-circuit conductors shall be placed in contact with the copper conductor through a slit in the insulation and retained in place by a single wrap of tape.

55.2.5 During the temperature test, the branch-circuit conductors are to be connected in series and to a supply source of any convenient voltage. This assembly shall be adjusted to operate at 80 percent of the ampacity of the branch-circuit conductors [that is, 16 amperes for No. 12 AWG (3.3 mm^2) wire with minimum 0.027 inch (0.69 mm) thick polyvinyl chloride insulation with or without minimum 0.004 inch (0.10 mm) thick nylon jacket insulation (such as Type TW or Type THHN wire)]. Simultaneously, the fixture is to be operated with a lamp of the size and type for which the fixture is marked from a separate source of supply. The leads supplying the lamp leads shall be limited to short lengths so as not to contribute to the heat in the box.

55.3 Rigidity

55.3.1 A fixture intended for use with through-branch conductors shall be subjected to the test described in 55.3.2 – 55.3.4. When tested in accordance with these paragraphs, the permanent deformation of the fixture, or of the hardware or outlet box of the fixture, shall not exceed 1/8 inch (3.2 mm).

Exception No. 1: A fixture provided with hanger bars that attach either:

a) Directly to the junction box; or

b) Within 2 inches (50.8 mm) of the junction box on the bracket that secures the junction box to the fixture;

need not be subjected to this test.

Exception No. 2: A fixture marked for use with cable only in accordance with 55.5.1 need not be subjected to this test.

55.3.2 The fixture is to be mounted to a 1/2-inch (12.7-mm) -thick wood panel in such a way that the plaster frame or other means provided with the fixture for attachment to the ceiling is rigidly affixed to the panel. The wood panel shall extend beyond the outlet box to simulate the ceiling. No other means provided for securing the assembly shall be used during this test.

Exception: The wood panel should extend only 1 inch (25.4 mm) beyond the edges of the fixture if the fixture is of other than the recessed type.

55.3.3 With respect to 55.3.2, failure of the mounting to the building (that is, breaking of the screw or pull-out of the nails) is not considered a test failure.

55.3.4 A series of weights totaling 50 pounds (22.7 kg) are to be applied in 5-pound (2.3-kg) increments at the point on the outlet box most likely to cause deformation. The weights are to be removed after 2 minutes, and the deformation from the original is to be measured.

55.4 Angle of pull

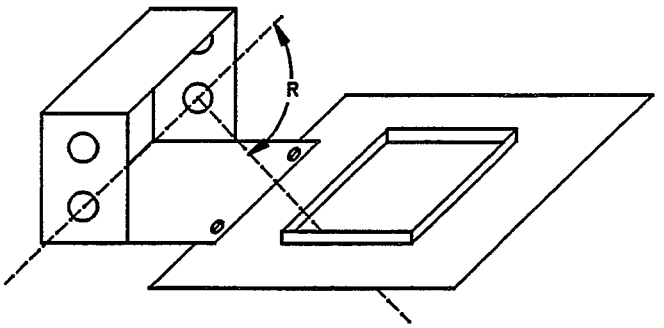
55.4.1 A fixture design requiring an angle of pull less than 120 degrees shall be subjected to the test described in 55.4.3 and 55.4.4.

Exception No. 1: A fixture marked for access behind the wall or ceiling as specified in 49.1 need not be tested.

Exception No. 2: A fixture marked for use with cable only in accordance with 55.5.1 need not be subjected to this test.

55.4.2 The angle of pull is the largest possible angle between the center line of any conduit entry and a second straight line originating on the plane and at the center point of that conduit entry and extending through the fixture aperture with accessories such as baffles, trims, or reflectors removed as shown in Figure 55.1.

Figure 55.1
Angle of pull



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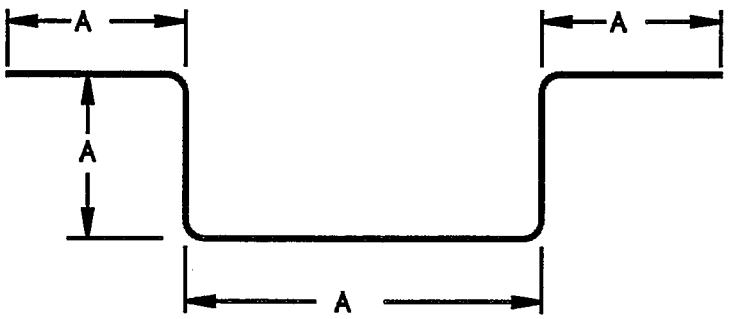
55.4.3 When tested under the conditions described in 55.4.4, the pulling of conductors shall be accomplished without damage to the conductors, fixture, or outlet box. The plaster frame or other means of support shall rigidly hold the fixture during the test.

55.4.4 The fixture is to be mounted in accordance with 55.3.2. Working through the opening provided, 10-foot (3.05-m) lengths of the number and size of conductors for which the fixture is marked shall be pulled through the appropriate trade size electrical metallic tubing. The tubing shall be formed into four 90-degree bends, as shown in Figure 55.2, in the same plane and one end shall be connected to the outlet box opening with a conduit fitting. Pulling compounds shall not be used.

Figure 55.2
Configuration for pull test



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NOTE: A is equal to approximately 2 feet (0.6 m)

55.5 Markings

55.5.1 A fixture complying with this section may be marked in Form D-3 (see 34.1) "Maximum of ___ No. ___ AWG through branch circuit conductors suitable for at least ___ °C (__°F) permitted in a box." The parenthetical expression is optional. The blank spaces shall be filled with information in accordance with acceptable test results. A fixture that complies with Exception No. 5 to 56.2.1 shall be additionally marked in Forms D-2 and H-7 with the following or equivalent wording: "Only Suitable For Use With Cables. Not For Pulling Wires."

55.5.2 The supply wire marking specified in 38.2 and Table 30.1, note a, need not be provided if the fixture is marked as specified in 55.5.1.

55.5.3 A fixture may be additionally marked "For end of run, use wire suitable for at least _____°C (_____°F) in which "(____°F)" is optional and the blank spaces are filled with information in accordance with test results with the through branch circuit wires de-energized.

56 Recessed Fixture Junction Boxes for Use With Through Branch Wiring

56.1 General

56.1.1 The junction box shall be located and constructed to permit the connection of raceway or cable, pulling of wires, splicing of conductors, and inspection of splices.

56.1.2 The minimum inside volume of the junction box shall be in accordance with Table 56.1.

Table 56.1
Minimum volume required for each "permitted" conductor

Size of conductor		Minimum free space volume within box	
AWG	(mm^2)	$Inches^3$	(cm^3)
14	2.1	2	32.8
12	3.3	2.25	36.8
10	5.3	2.5	40.9
8	8.4	3	49.1
6	13.3	5	81.9

56.2 Thickness

56.2.1 The thickness of a junction box and junction box cover shall be no less than 0.091 inch (2.31 mm) if of sheet aluminum alloy, 0.0625 inch (1.59 mm) if of sheet metal other than sheet aluminum, and 1/8 inch (3.2 mm) if of cast metal.

Exception No. 1: The minimum thickness at or within 1/4 inch (6.4 mm) of any right-angle bend in a drawn sheet-steel box may be 0.041 inch (1.04 mm).

Exception No. 2: The average thickness of the sides and ends of a drawn steel box may be 0.058 inch (1.47 mm) based on three measurements made on the side and end of the box but no less than 3/8 inch (9.5 mm) from a right-angle bend. The three measurements are to be made in a line perpendicular to the front of the box at a point 1/4 inch from the front, at a point 1/4 inch from the right angle bend at the neck, and at a point equidistant between the two.

Exception No. 3: The wall of a malleable-iron box or a die-cast or permanently-mold-cast aluminum, brass or bronze box may be no less than 3/32 inch (2.4 mm) thick.

Exception No. 4: A wall thickness of no less than 3/32 inch is acceptable for clearance of a cover screw in the area directly beneath the cover mounting lug if that area is no larger than 0.050 inch^2 (32.36 mm^2) and has no straight-line dimension more than 1/2 inch (12.7 mm).

Exception No. 5: If a fixture is marked for use with cable only as specified in 55.5.1, the box may be in accordance with the thickness requirements for openings for conduit connection specified in Table 8.1.

56.3 Holes

56.3.1 An open hole in a box, such as a mounting-screw hole, shall have no dimension larger than 17/64 inch (6.7 mm).

Exception No. 1: A pry-out hole or slot may be provided in a knockout as specified in 56.3.2 and 56.3.3.

Exception No. 2: A slot with one dimension no larger than 5/8 inch (15.9 mm) and the other dimension no larger than 1/8 inch (3.2 mm) is acceptable in a box that is intended for use within a complete metal enclosure only.

56.3.2 The area of a pry-out hole or slot in a knockout shall be no more than 0.040 square inch (25.81 mm^2).

56.3.3 A pry-out hole or slot in a knockout shall not be in a knockout of the 1-inch or larger trade size.

56.4 Knockouts

56.4.1 A knockout shall completely cover the opening in which it is located, and the clearance between the knockout and the opening shall be no more than 0.010 inch (0.25 mm).

56.5 Tests on knockouts

56.5.1 A force of 10 pounds (4.5 kg) shall be applied to a knockout for 1 minute by means of a 1/4 inch (6.4 mm) diameter mandrel with a flat end. The force is to be applied in a direction perpendicular to the plane of the knockout and at the point most likely to cause movement. The knockout shall remain in place and the clearance between the knockout and the opening shall be no more than 0.010 inch (0.25 mm) when measured 1 hour after the force has been removed.

56.6 Closures

56.6.1 Unless threaded or provided with a threadless connector, an opening in a junction box intended for the entrance of a wiring system shall be effectively closed.

56.6.2 Other than as noted in 56.6.3, a sheet-metal plug or plate used to close an unused opening in a metal box shall be no less than 0.054 inch (1.38 mm) thick if of steel, and no less than 0.081 inch (2.06 mm) thick if of aluminum.

56.6.3 A sheet-steel plug or plate no less than 0.010 inch (0.25 mm) thick and constructed so that it cannot be removed by a force of 20 pounds (89 N) applied in the direction most likely to remove it is acceptable for closing an unused opening that is:

a) In a junction box that is:

1) Intended for installation only in concrete; and

2) Marked or shipped in a carton marked to indicate that the box is intended for installation only in concrete;

b) Threaded; and

c) No larger than 1-1/2 inch trade size.

56.6.4 A cast-metal plug for closing an opening in a junction box shall be no thinner than 1/16 inch (1.6 mm) if of die-cast zinc, die-cast aluminum, or malleable iron, and shall be no thinner than 1/8 inch (3.2 mm) if of sand-cast aluminum or cast iron. A die-cast zinc plug shall be no larger than the 1-inch trade size.

57 Fixtures for Use as Air Handling Registers

57.1 General

57.1.1 Requirements in this section are supplementary to other applicable requirements in this standard and apply to both recessed and surface-mounted fixtures for use with heating, ventilating, and air-conditioning systems in accordance with the National Electrical Code, ANSI/NFPA 70-1993, and the Standard for the Installation of Air-Conditioning and Ventilating Systems (National Fire Codes, Vol. 4, 1989), NFPA 90A-1993.

57.2 Material in air path

57.2.1 A nonmetallic material, adhesive, or coating used for a part other than a lamp, lampholder, or light diffuser that is located in the air path or plenum shall comply with one of the following:

a) The material shall be one that has a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50 or designated "light" or "negligible" as described in the requirements for Tests for Surface Burning Characteristics of Building Materials, UL 723.

b) The material shall not ignite or flame during or after the test described in 57.2.2.

57.2.2 A sample of the material is to be held over the vertical test flame for 5 minutes at an angle of 30 degrees from the horizontal by means of a jig. The test flame is to be supplied by a Bunsen burner with a nominal 7/16-inch (11.1-mm) diameter barrel, adjusted to give a 1-1/2-inch (38.1-mm) high yellow cone (air shut off). The flame is to be applied in such a manner that 3/4 inch (19.1 mm) of the flame is in contact with the sample.

57.3 Markings

57.3.1 A fixture that complies with 57.1.1 – 57.2.2 may be marked in Form B-5 (see 34.1) "Suitable for air handling use."

58 Wired Fixture Sections

58.1 General

58.1.1 The requirements in this section are supplementary to other applicable requirements in this standard and apply only to surface-mounted or recessed fixtures of such size that shipment in one carton or fully assembled is not practical. The equipment may be in separate parts known as wired fixture sections, each section containing factory-installed electrical components or wiring.

58.1.2 Each wired fixture section may be shipped as an incomplete assembly to the extent otherwise permitted in this standard, but field assembly shall be limited to interconnecting the leads between sections and to coupling sections together.

58.1.3 58.1.2 does not exclude the use of mounting hardware such as supporting stems, straps, and chains that may be required to be used in conjunction with the assembly and attachment of the fixture sections.

58.1.4 Wire leads intended for connection together in the field shall have matching identification by color of insulation and, if necessary, by the marking of number, letter, or the like. A set of leads for field connection at a junction between sections shall be distinguished by appropriate marking or the like acceptable means from any other set of leads having a function not identical to it. Color identification of current-carrying conductors shall be made by colors other than green with or without one or more yellow stripes.

58.1.5 Connections that are to be made in the field between conductors of adjoining sections shall be easily accessible for inspection without requiring the disconnection of any portion of the wiring.

58.2 Markings

58.2.1 Each carton or package shall include installation instructions describing or illustrating the correct assembly, mounting, and connection of the sections.

58.2.2 Each wired fixture section shall be plainly marked in Form B-1 (see 34.1) with the manufacturer's name, trademark, or similar means of identification.

58.2.3 Each wired fixture section that contains a ballast shall be marked with its electrical ratings as described in 37.1 and 37.2.

58.2.4 Each wired fixture section shall be marked in Form D-1 "Wired High Intensity Discharge Fixture Section _____, for Use with Wired High Intensity Discharge Fixture Section _____". The blank spaces are to be filled with the manufacturer's catalog numbers, or equivalent, identified for guidance in assembly.

58.2.5 Each recessed wired fixture section shall be marked in Form D-1 "Wired Recessed High Intensity Discharge Fixture Section _____, for Use with Wired Recessed High Intensity Discharge Fixture Section _____." The blank spaces are to be filled with the manufacturer's type, catalog, or part numbers or other appropriate designations, identified for guidance in assembly.

59 Polymeric Materials

59.1 A polymeric material, thermoplastic or thermosetting, used in the manufacture of all or any part of the enclosure for electrical parts as specified in 7.1, or that provides structural support in a fixture, shall comply with the requirements in this section.

59.2 When investigating polymeric materials intended for use as described in 59.1, reference need be made in the following standards.

a) UL 746A – Standard for Polymeric Materials – Short Term Property Evaluations;

b) UL 746B – Standard for Polymeric Materials – Long Term Property Evaluations;

c) UL 746C – Standard for Polymeric Materials – Use in Electrical Equipment Evaluations; and

d) UL 94 – Standard Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

59.3 A material shall comply with the requirements for fixed equipment as specified in UL 746C, as amended in this section.

59.4 With respect to consideration of thermal endurance in UL 746C, a normal temperature test shall be conducted, and the material shall possess a mechanical temperature index, with impact, as a result of long term aging, of at least the measured temperature.

59.5 The distortion under load investigation in UL 746C shall be conducted in all cases.

59.6 The impact investigation in UL 746C shall include only the ball impact test.

59.7 The mold stress relief distortion investigation in UL 746C shall be conducted only by the air oven method, not the test cell method.

59.8 The severe conditions investigation in UL 746C need not be conducted.

59.9 Any nonpolymeric part that weighs more than 2 pounds (0.91 kg) shall not be solely supported by a polymeric material. A metal chain or cable or the equivalent shall be used to connect such a part to the mounting means of the fixture.

Exception: A polymeric material may support more than 2 pounds (0.91 kg) if it complies with the following:

a) The polymeric material shall be rated at least minimum 94HB if the polymeric part is considered to be a decorative part, 94-5V if the part also serves as an enclosure, or 94-V1 if the part is internal and supports electrical components. The ratings are determined in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

b) The polymeric material shall be rated in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B for at least the maximum operating temperature of the part during normal operation.

c) The polymeric part shall be capable of supporting, without distortion, four times the weight of the part being supported for 1 minute, when secured in place as intended during normal use in an oven maintained at 10°C higher than the maximum operating temperature of the polymeric part.

59.10 All metal parts in a polymeric enclosure that are required to be grounded in accordance with the requirements in Section 25, Grounding, shall be bonded.

59.11 Fixtures for damp or wet locations, in accordance with Sections 64 – 72, shall be investigated for water exposure and immersion in accordance with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluation, UL 746C.

60 Polymeric Recessed Fixtures

60.1 General

60.1.1 The requirements under this heading are supplementary to the other applicable requirements of this standard and apply to recessed fixtures provided with polymeric subassemblies (any part of the recessed fixture that is made of polymeric material and that provides all or any part of the enclosure for electrical parts as specified in 7.1 or that provides structural support in a fixture).

60.1.2 Polymeric subassemblies shall comply with the applicable requirements of 59.1 – 59.11.

60.2 Flammability and UV ratings

60.2.1 A fixture provided with a polymeric subassembly shall meet the following flammability requirements:

a) The subassembly shall be molded from materials that are classed as 94-5VA by the five inch burning test described in the Standard Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94; or

b) The subassembly shall comply with the 5 Inch Flame Test described in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

c) A junction box constructed of polymeric material shall comply with 60.3.3.1.

60.2.2 In addition to complying with the flammability requirements of 60.2.1, the material of a polymeric subassembly of a fixture with a lamp located in a position likely to degrade the subassembly shall comply with the Ultraviolet Light Exposure Test specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

60.3 Performance

60.3.1 Resistance to impact tests

60.3.1.1 A fixture provided with a polymeric subassembly shall comply with the ball impact evaluation of the Resistance to Impact Tests described in UL 746C, the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations.

60.3.1.2 The test is to be conducted at ambient temperature 25°C (77°F) and 0°C (32°F).

60.3.1.3 The test specified in 60.3.1.1 shall also be conducted at -35°C (-25°F) in the following cases:

a) For fixtures marked for use in wet locations; and

b) For assemblies, such as outer housings, exposed to the room side or ceiling side of the installation.

60.3.2 Metallized plastic parts

60.3.2.1 Metallized plastic parts that employ an electrically conductive material shall comply with the applicable requirements for such parts in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, if detachment of the conductive material from the plastic parts may result in the risk of electric shock or fire. For example, metallized plastic parts that are located within the fixture that could peel, allowing conductive material to contact uninsulated parts (such as lampholder terminals) that may increase the risk of electric shock or fire. In addition, an increased risk of fire may exist with metallized plastic parts that employ electrically conductive material that peels, resulting in the fixture operating at a significantly higher temperature than with the material in tact.

60.3.2.2 The metallized parts referred to in 60.3.2.1 shall also comply with the applicable bonding requirements of this standard.

60.3.3 Polymeric electrical connection box

60.3.3.1 A polymeric box provided for supply connections shall comply with the appropriate requirements in the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

60.3.4 Durability test

60.3.4.1 A polymeric housing containing a screw-shell type lampholder shall be subjected to the torque test described in 60.3.4.2. As a result of the torque, there shall be no reduction of spacings nor deformation of the polymeric housing.

60.3.4.2 A torque of 20 lbf-in (2.26 N•m) shall be applied gradually to a screw-shell type lampholder so that there is no sudden jerk on the lampholder. The torque shall be applied for one minute.

60.3.4.3 For all polymeric housings containing a lampholder, the lampholder shall be subjected to the pull test described in 60.3.4.4. As a result of the pull, there shall be no reduction of spacings nor deformation of the polymeric housing.

60.3.4.4 Using a different sample from the one used in 60.3.4.1 and 60.3.4.2, a straight pull (downward force) of 20 lbf (89 N) shall be exerted on the lampholder for one minute.

60.4 Marking

60.4.1 A fixture provided with a polymeric box described in 60.3.3.1 shall be marked in Form C-7 (instructions) with the type of wiring method to be employed.

60.4.2 A fixture that is provided with a polymeric recessed housing or otherwise complies with the Exception to 46.3.1 shall be marked in Form F-3 with the following or the equivalent: "For use in one- and two-family dwellings only." and "Not for use in fire rated installations."

61 Polymeric Lamp Containment Barrier

61.1 General

61.1.1 These requirements apply only to that part of a lamp containment barrier (as defined in 3.13) that is of a polymeric material and is intended to be provided in a fixture in a location where particles from a ruptured metal halide lamp are likely to drop to and rest.

61.1.2 In accordance with Exception No. 1 to 13.2, a polymeric material shall be subjected to the plastic flammability/containment test described in 61.2.1 – 61.2.4 to determine its suitability for use as a lamp containment barrier.

61.2 Test method

61.2.1 Three sections, each a minimum of 6 inches (152 mm) square and obtained from different samples of the lamp containment barrier to be tested, are to be supported by their outer edges and oriented as they would be during normal operation. A surface located 12 inches (305 m) below the test samples is to be covered by a layer of dry absorbent cotton that is nominal 1/4 inch (6.4 mm) thick.

61.2.2 During the test, each sample of the lamp containment barrier material is to be heated to and maintained at the maximum operating temperature for each thickness of material recorded when tested in accordance with the Temperature Test described in Section 30.

61.2.3 Three arc tube segments, as specified in Table 28.1, are to be preheated to 1100°C (2012°F) for a minimum of 15 minutes.

61.2.4 Each arc tube segment is then to be placed on the barrier such that the longitudinal axis of the cylinder is perpendicular to the plane of the barrier. The transfer of each arc tube segment from the oven to the surface of the containment barrier shall not exceed 2 seconds.

61.2.5 The results are considered acceptable if, during the testing of the samples, the dry absorbent cotton located below the test sample is not ignited by flaming drips of plastic material or any arc tube segment that penetrates the lamp containment barrier material and falls on the cotton.

62 Fixtures Suitable for Use in Elevated Ambients

62.1 General

62.1.1 Requirements in this section are supplementary to other applicable requirements in this standard and apply to surface-mounted types of lighting fixtures (other than one suitable for use in a suspended ceiling) for use in locations that experience a continuous elevated ambient, such as may occur in a boiler room, foundry, or the like.

62.2 Temperature test

62.2.1 During the temperature test, a source of heated air is to be provided, producing an elevated ambient temperature equal to that marked on the fixture. The air flow past the fixture is not to exceed 30 feet (9.1 m) per minute. Maximum variations of 5°C (9°F) of the intended ambient are to be added to or subtracted from the observed temperature readings.

Exception: The test may, at the manufacturer's option, be conducted at an ambient temperature of 25 ±5°C (77 ±9°F), and the full difference between the actual test ambient and the marked temperature is to be added to the observed temperature readings.

62.3 Marking

62.3.1 A fixture that complies with 62.2.1 may be marked in Form B-2 (see 34.1) "Suitable for operation in ambients not exceeding _____°C (____°F)", where the blank is filled in with 40, 55, 65, 75 or 90°C (104, 131, 149, 167 or 194°F). The parenthetical [(____°F)] values are optional.

62.3.2 A fixture may be marked in tabular form for elevated ambient temperatures corresponding with the supply wire temperature rating needed at each ambient. One example is:

Suitable for operation in:			
Ambient not exceeding		For supply connections, use wire suitable for at least	
65°C	(149°F)	75°C	(167°F)
75°C	(167°F)	90°C	(194°F)
90°C	(194°F)	110°C	(230°F)

63 Metal Halide Lamps Without Integral Outer Glass Envelopes

63.1 General

63.1.1 Requirements in this section are supplementary to other applicable requirements in this standard and apply to fixtures marked for use with metal halide lamps that have quartz arc tubes and may be provided with quartz outer envelopes but that are not provided with integral glass outer envelopes.

63.1.2 If a fixture is intended to be used with a metal halide lamp that is not provided with an integral outer glass envelope, the fixture shall be provided with a metal and glass lamp containment barrier. The metal of a lamp containment barrier shall comply with minimum thickness requirements specified in Section 8 or 46. The glass of a lamp containment barrier shall comply with 63.1.3 and with the glass impact tests specified in 63.2.1, 63.2.2, and 63.2.3.

63.1.3 The glass material of the lamp containment barrier specified in 63.1.2 shall be:

a) Minimum 5/32-inch (4.0-mm) thick sodalime glass; or

b) Minimum 1/8-inch (3.2-mm) thick glass with a transmission characteristic in accordance with Table 63.1.

Table 63.1
Ultraviolet transmission characteristics

Wavelength, nanometers	Maximum transmission, percent
350	85
320	40
300	8
290	0.5
less than 280	0.1

63.1.4 Any open holes provided in the lamp containment barrier shall be provided with a barrier to prevent the emission of direct light or light that has reflected off of only one surface after being emitted from the lamp. All open holes shall be less than 1/8 inch (3.2 mm) diagonally or in diameter.

63.1.5 The fixture shall be marked in accordance with 63.3.1 and provided with an interlock that will de-energize the lamp when the fixture is opened for lamp replacement.

63.2 Glass impact test

63.2.1 In accordance with 63.1.2, a sample of the glass lamp containment barrier installed in a fixture other than as noted in 63.2.2 shall withstand, without fracturing, a 2 foot-pound (2.7 N•m) impact. The impact is to be applied by a 2-inch (50.8-mm) diameter steel ball weighing 1.18 pounds (0.54 kg) to the center of the glass lamp containment barrier.

63.2.2 An impact force of 5 foot-pounds (6.8 N•m) shall be applied to:

a) Ground-mounted recessed fixtures; and

b) Fixtures intended to be installed within 4 feet (1.22 m) of the ground and marked in accordance with 72.2.

63.2.3 The glass lamp containment barrier is to be subjected to the impact by releasing the steel ball from the height necessary to produce the desired impact force. The figure containing the glass containment barrier to be tested is to be supported by a rigid surface [3/4 inch (19.1 mm) thick tongue and groove oak flooring or 3/4 inch thick plywood over a concrete pad].

63.3 Markings

63.3.1 A fixture that is interlocked in accordance with 63.1.5 shall be marked in Form A-5 with the word "CAUTION" and the following or the equivalent: "Risk of exposure to excessive ultraviolet (UV) radiation – Do not operate without complete lamp enclosure in place or if glass lens is damaged".

PART 4 – FIXTURES FOR USE IN DAMP OR WET LOCATIONS

DAMP LOCATIONS

64 General

64.1 Requirements for damp-location fixtures are supplementary to other applicable requirements in this standard and apply to surface-mounted fixtures, pole-mounted fixtures, and recessed fixtures marked "Suitable for damp locations." Such fixtures are suitable for installation in interior locations protected from weather but subject to moderate degrees of moisture, such as some basements, some barns, some cold storage warehouses and the like, the partially protected locations under canopies, marquees, roofed open porches, and the like.

65 Construction – Mechanical

65.1 All inside and outside surfaces of sheet steel or other mechanical parts of iron or steel shall be zinc-coated, cadmium-plated, enameled, painted, or provided with equivalent protection against corrosion on all surfaces.

65.2 Punched holes and cut edges in ferrous material need not be corrosion protected.

65.3 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as described in 65.1.

Exception: Hinge pins need not be provided with the corrosion protection required in 65.1.

65.4 Sheet steel or other metal that is painted to comply with 65.1 and 65.2 shall be properly cleaned of grease and the like prior to painting.

65.5 Welds in iron or steel (other than stainless steel) shall be painted or provided with equivalent protection against corrosion. Copper, aluminum, alloys of copper and aluminum, stainless steel, and similar materials having inherent resistance to atmospheric corrosion need not be provided with additional corrosion protection.

65.6 Vitreous enamel may be used as the only protective coating for sheet steel having a thickness of 0.026 inch (0.66 mm) or more.

66 Construction – Electrical

66.1 Nonabsorptive electrical insulation shall be used in the construction of electrical components where it is relied upon to provide electrical spacings or sole support of live electrical parts or as electrical insulation. Untreated fiber is an example of a material that shall not be used while treated cellulose fiber, phenolic, urea, porcelain, and the like, are examples of acceptable materials.

66.2 The screw shell in a screw shell-type lampholder shall not be made of unplated aluminum.

67 Markings

67.1 A fixture that complies with the requirements in Sections 64 – 66 and that is intended for use in damp locations shall be marked in Form D-1 (see 33.1) "Suitable for damp locations."

67.2 A damp location fixture shall not be provided with any information such as markings, instructions, or illustrations either on the carton or with the fixture that implies or depicts a wet location use.

WET LOCATIONS

68 General

68.1 The requirements for wet-location fixtures are supplementary in the other applicable requirements in this standard, and apply to surface-mounted fixtures, pole-mounted fixtures, and recessed fixtures marked "Suitable for wet locations." Such fixtures are suitable for installation in underground areas, in concrete slabs or masonry, locations subject to rain, vehicle washing areas, locations subject to spray of a noncorrosive and nonflammable liquid, and the like.

68.2 These requirements do not cover fixtures for use under water (such as in a decorative fountain or a swimming pool) nor in areas that contain flammable or corrosive liquids or gases.

69 Construction – Mechanical

69.1 General

69.1.1 The inside and outside surfaces of cast ferrous metal, sheet steel, or ferrous tubing shall be protected against corrosion by one of the coatings described in Table 69.1.

Exception No. 1: Other finishes, including paints, special metallic finishes and combinations of the two that have, by comparative tests with galvanized-sheet steel conforming with Table 69.1(A), Type G90, indicated they provide equivalent protection, may be used.

Exception No. 2: A metal part, such as a decorative part, that is not required for conformance with this standard need not be protected against corrosion.

Exception No. 3: Stainless steel need not be additionally protected against corrosion.

Exception No. 4: Edges, fasteners, and welds complying with 69.1.2 – 69.1.5 need not be additionally protected against corrosion.

Exception No. 5: If the inside surfaces of the fixture are protected from the elements such that no water enters the fixture during the rain, sprinkler, or immersion tests, the inside surfaces may be provided with corrosion protection equivalent to that specified in 65.1 – 65.6.

Table 69.1
Sheet steel coatings

Type of coating	Type or thickness[a] Inches	(mm)	Description
(A) Hot-dipped mill galvanized steel	G90[b]		–
	G60[b]		with 1 coat of outdoor paint[c]
	A60[b]		with 1 coat of outdoor paint[c]
(B) Zinc coating other than Type (A)	0.00061	0.0155[d]	–
	0.00041	0.0104[d]	with 1 coat of outdoor paint[c]
(C) Cadmium coating	0.0010	0.0254	–
	0.00075	0.01905	with 1 coat of outdoor paint[c]
	0.0005	0.0127	with 2 coats of outdoor paint[c]
(D) Vitreous enamel[e]	–		–

[a] As determined by ASTM B 555-1986(R1991), Standard Guidelines for Measurement of Electrodeposited Metallic Coating Thicknesses by the Dropping Test.

[b] Conforming with the coating designation G90, G60, or A60 in Table 1 of ASTM A 525-1993, Standard Specification for General Requirements for Sheet Steel, Zinc-Coated (Galvanized) by the Hot Dip Process with no less than 40 percent of the zinc on any side based on the minimum single spot test requirement in this ASTM standard.

[c] Identified as outdoor paint by paint manufacturer.

[d] Average thickness with a spot minus tolerance of 0.00007 inch (0.00178 mm).

[e] Acceptable on sheet steel at least 0.026 inch (0.66 mm) thick.

69.1.2 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as described in 65.1 for damp locations.

Exception: Hinge pins need not be provided with the corrosion protection required in 65.1.

69.1.3 The acceptability of a coating on hinges, bolts, and fasteners may be determined by visual inspection.

69.1.4 Punched holes and cut edges in ferrous material need not be corrosion protected.

69.1.5 Welds in iron or steel (other than stainless steel) shall be painted with one coat of any outdoor paint.

Exception: One coat of any indoor paint is acceptable over a spot weld on galvanized steel.

69.2 Enclosures

69.2.1 An enclosure or enclosures shall be so constructed as to prevent the wetting of live parts or electrical components or wiring not identified for use in contact with water and to reduce the risk of electric shock due to weather exposure. Parts identified for use in contact with water include flexible cords marked "W-A", liquid tight flexible metal conduit, outlet boxes marked for use in wet locations, rigid conduit, and the like.

Exception: For the purposes of this requirement, the outer surface of the glass envelope of a lamp may be wetted.

69.2.2 A wall-mounted recessed fixture shall be constructed so it prevents the entrance of any water into the enclosure. The enclosure shall be intended for permanent connection to watertight supply connection fittings. Installation instructions as specified in 72.6 shall be provided with the fixture.

Exception: If a drain hole as described in 69.4.2 is provided to drain water from the front of the fixture, water may enter the fixture if there is no wetting of live parts as described in 69.2.1.

69.2.3 To determine compliance with 69.2.1 and 69.2.2 a complete assembly is to be subjected to the rain, sprinkler, or immersion test as specified in Section 71, Performance.

69.3 Gaskets and bushings

69.3.1 A gasket or bushing employed to comply with the requirements for wet locations shall comply with the requirements of the thermal conditioning test described in 71.9.2.

Exception: Gaskets or bushings tested while installed in the fixture as described in 71.9.3 need not be subjected to the test described in 71.9.2.

69.3.2 A gasket shall be so secured that removal of a lamp from the fixture or opening of glassware or a frame for relamping will not cause the gasket to loosen. Clips or a clamping ring are acceptable means of securement. An adhesive or other means shall be investigated.

69.3.3 If an adhesive is used to secure a gasket as described in 69.3.2, the gasket assembly shall comply with the gasket adhesion test described in 71.10.1.

69.4 Openings

69.4.1 An opening for the connection of conduit or for an auxiliary part shall be threaded.

Exception No. 1: If the rain and sprinkler tests as described in Section 71, Performance, show no entrance of water into the fixture with any opening open, the opening need not be threaded.

Exception No. 2: If a conduit fitting intended for use in wet locations is provided that complies with the requirements in the Standard for Fittings for Conduit and Outlet Boxes, UL 514B, the opening need not be threaded.

69.4.2 An open drain hole shall be provided on all fixtures to prevent the accumulation of water above a level that would result in the wetting of an electrical part or opening for the connection of conduit or for an auxiliary part. The hole shall be as specified in Table 69.2.

Exception No. 1: A fixture that has been subjected to the rain or sprinkler test as required in 71.1.1 – 71.1.4 need not be provided with a drain hole if no water enters the fixture.

Exception No. 2: A ground-mounted recessed fixture shall not be provided with a drain hole.

Exception No. 3: A drain hole is not required on a wall-mounted recessed fixture as described in 69.2.2.

Table 69.2
Size of drain holes

Opening shape	Minimum dimension		Minimum area		Maximum dimension		Maximum area	
	Inch	(mm)	Inch^2	(mm^2)	Inch	(mm)	Inch^2	(cm^2)
Slot	1/8 (width)	3.2	0.012	7.74	3/8 (width)	9.6	1-1/2	9.68
Square	1/8 (side)	3.2	–	–	1/2 (side)	12.7	–	–
Round	1/8 (diameter)	3.2	–	–	1/2 (diameter)	12.7	–	–
Irregular	–	–	0.012	7.74	–	–	1-1/2	9.68

69.5 Water shields

69.5.1 A material, not including wood, used as a water shield, whether provided as a lens, diffuser, or opaque part, shall:

a) Be classified at least 94HB in accordance with the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94, if of polymeric material;

b) Comply with the exposure to ultraviolet light test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, if of polymeric material; and

c) Be subjected to impact conditioning as specified in 71.2.1 – 71.2.4 before the fixture is subjected to the rain, sprinkler, or immersion tests as required by 71.4.1.

69.5.2 A wood water shield shall be subjected to the impact conditioning described in 71.2.1 – 71.2.4 before the fixture is subjected to the rain, sprinkler, or immersion tests as required in 71.4.1.

Exception: Wood that is at least 1/2 inch (12.7 mm) thick need not be subjected to the impact conditioning.

70 Construction – Electrical

70.1 The fixture shall comply with the requirements in 66.1 and 66.2.

70.2 Any cord exposed outside of a surface-mounted fixture shall be marked "W-A" following the type designation.

70.3 A switch, other than the photoelectric type, shall be enclosed inside the fixture.

70.4 A fixture provided with a receptacle shall be constructed to prevent the entrance of water into the receptacle with or without any provided cover in place and with or without an attachment plug in place.

Exception: If water is not excluded during the rain or sprinkler tests with the receptacle cover open, the cover shall close automatically when not in use.

70.5 In a ground-mounted fixture, a receptacle shall be located at least 6 inches (152.4 mm) above ground level.

71 Performance

71.1 General – tests required

71.1.1 A fixture shall be subjected to the appropriate rain, sprinkler, and immersion test as required in 71.1.2 – 71.1.4 and specified in 71.3.1 – 71.4.1. A summary of the tests required is provided in Table 71.1.

Table 71.1
Required tests for wet location fixtures

Type of Fixture	Rain	Sprinkler	Immersion
Non-Pendant Surface-Mounted Ceiling	Yes[a]	Yes[b]	No
Cord- or Chain-Pendant Surface-Mounted Ceiling	Yes	No	No
Recessed Ceiling	Yes[a]	Yes	No
Surface-Mounted Wall	Yes	No[c]	No
Recessed Wall	Yes	No[c]	No
Pole-Mounted and Ground-Mounted	Yes	No	No
Ground-Mounted Recessed	No	No	Yes

[a] Test not required if the fixture is marked for covered ceiling installation only as specified in 71.1.3.

[b] Test not required if rain test conducted as described in 71.1.3.

[c] Test required if the fixture is marked for used 4 feet (1.22 m) or less from ground or on a pole-mounted fixture (including bollards) with lamp or other electrical components less than 4 feet above ground as specified in 71.1.2.

71.1.2 A wall-mounted surface fixture, a wall-mounted recessed fixture, and a pole-mounted fixture shall be subjected to the rain test. If the fixture is:

a) Intended for mounting within 4 feet (1.22 m) of the ground and marked as specified in 72.2; or

b) A pole-mounted fixture (such as a bollard) with the lamp or other electrical component mounted less than 4 feet from the ground;

the bottom surface of the fixture shall be subjected to the sprinkler tests.

Exception: The rain and sprinkler tests are not required if the construction features of the fixture are such that it is readily apparent water will not enter it when it is used in the intended manner. For example, a pole-mounted fixture intended for installation with a diffuser facing down and provided with a top and side enclosure having all seams continuously welded would not need to be subjected to the rain test.

71.1.3 A ceiling-mounted fixture shall be subjected to the rain and sprinkler tests.

Exception No. 1: A recessed ceiling-mounted fixture and a non-pendant surface-mounted ceiling fixture need not be subjected to the rain test if it is marked "For covered ceiling installation only" in accordance with 72.4.

Exception No. 2: The rain and sprinkler tests are not required if the construction features of the fixture are such that it is readily apparent water will not enter the fixture when it is used in the intended manner.

Exception No. 3: A cord- or chain-pendant surface-mounted ceiling fixture need not be subjected to the sprinkler test.

Exception No. 4: A fixture subjected to the rain test with no ceiling above the fixture during the rain test need not be subjected to the sprinkler test.

71.1.4 A recessed fixture which can be mounted in the ground or below grade level shall be subjected to the immersion test described in 71.7.2.

Exception: A recessed fixture marked as specified in 72.4 need not be subjected to the test.

71.2 Water shield impact conditioning

71.2.1 For a ground-mounted recessed fixture having a nonmetallic water shield as described in 69.5.1 and 69.5.2, the water shield shall be mounted in its intended manner on the fixture and subjected to a single 3-foot-pound (4.1 N•m)-impact on any surface that can be exposed to a blow during intended use. This impact is to be produced by dropping a steel sphere, 2 inches (50.8 mm) in diameter and weighing 1.18 pounds (0.54 kg), from the height necessary to produce the desired impact force. For surfaces other than the top of a water shield, the steel sphere is to be suspended by a cord and swung as a pendulum, dropping through the vertical distance necessary to produce the desired impact force.

71.2.2 A nonmetallic water shield that is mounted:

a) 4 feet (1.22 m) or less from the bottom of a ground-mounted fixture; or

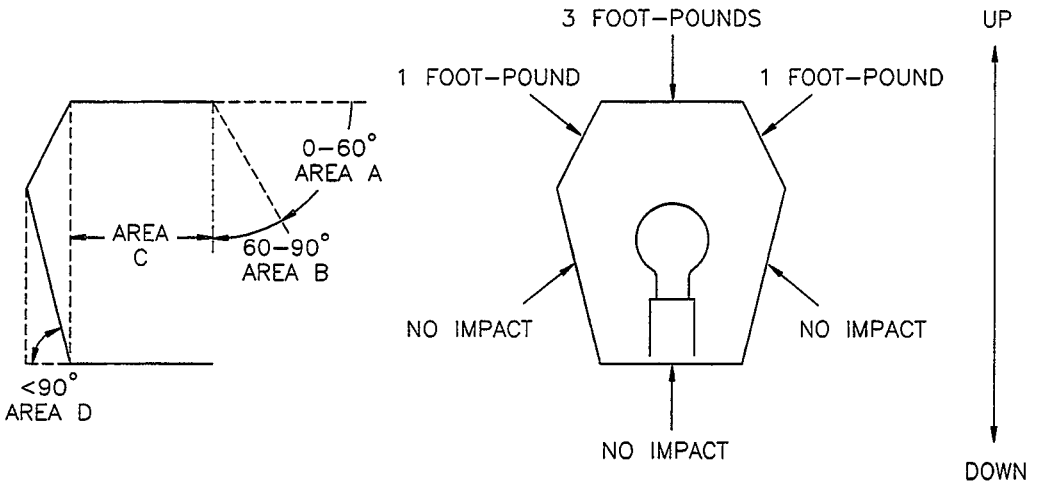
b) On a wall- or pole-mounted fixture intended and marked for mounting less than 4 feet from the ground as specified in 72.2

shall be impact conditioned as specified in 71.2.4. The impact force shall be 3 foot-pounds (4.1 N•m) on all surfaces.

71.2.3 A nonmetallic water shield intended for installation at least 4 feet (1.22 m) above ground level shall be impact conditioned as specified in 71.2.4. The impact force shall be 3 foot-pounds (4.1 N•m) if in Area A, 1 foot-pound (1.4 N•m) if in Area B, and no impact if in Area C or D of Figure 71.1.

Exception: The water shield of a fixture marked as suitable for covered ceiling installation only, need not be subjected to the impact conditioning.

Figure 71.1
Impact force on water shields



Example: Post-mounted fixture located more than 4 feet above ground level.

Fixture positioned as intended after installation. Rainshield installed in fixture and fixture mounted as intended.

71.2.4 The impact specified in 71.2.2 and 71.2.3 is to be produced by dropping 1 pound (0.45 kg) of lead shot, wrapped by 2 layers of cheesecloth into a 2-inch (50.8-mm) diameter sphere, from the height necessary to produce the desired impact. The height is to be 36 inches (914 mm) for a 3 foot-pound (4.1 N•m) impact and 12 inches (305 mm) for a 1 foot-pound (1.4 N•m) impact.

71.3 General – test conditions

71.3.1 Before a rain, sprinkler, or immersion test is conducted, an enclosure containing an opening for supply connections is to be fitted with the intended supply connection means. For example, a wall-mounted recessed fixture and a fixture intended for ground installation marked for use with wet location supply fittings in accordance with 72.7 are to be provided with fittings intended for use with wet locations that comply with the requirements in the Standard for Fittings for Conduit and Outlet Boxes, UL 514B. However, a surface-mounted, outlet box-connected fixture is to be mounted to the wall or ceiling as intended, and the like are to be assembled as intended.

71.3.2 A fixture that is marked in accordance with 72.3 to indicate a limited angle of mounting shall be mounted during a test in the most severe position permitted by the marking.

71.3.3 A fixture that from its appearance could be mounted on either a wall or a ceiling shall be treated as both a wall-mounted fixture and a ceiling-mounted fixture.

Exception: A fixture marked as specified in 72.4 may be treated as only a wall- or ceiling-mounted fixture.

71.3.4 The rain or sprinkler test is to be conducted in the following operating sequence:

Duration in hours	Lamp	Water
1	On	Off
1/2	Off	On
2	On	On
1/2	Off	On

71.4 General – test results

71.4.1 Test results are acceptable if, after the impact conditioning (if applicable) and the rain, sprinkler, or immersion tests, no water has entered the fixture.

Exception: Water may enter pole-mounted, recessed ceiling-, recessed wall-, and surface-mounted fixtures if the water does not cause wetting of any lampholder, wiring, or other electrical parts that are not inherently waterproof and if the fixture is provided with a drain hole as required in 69.4.2.

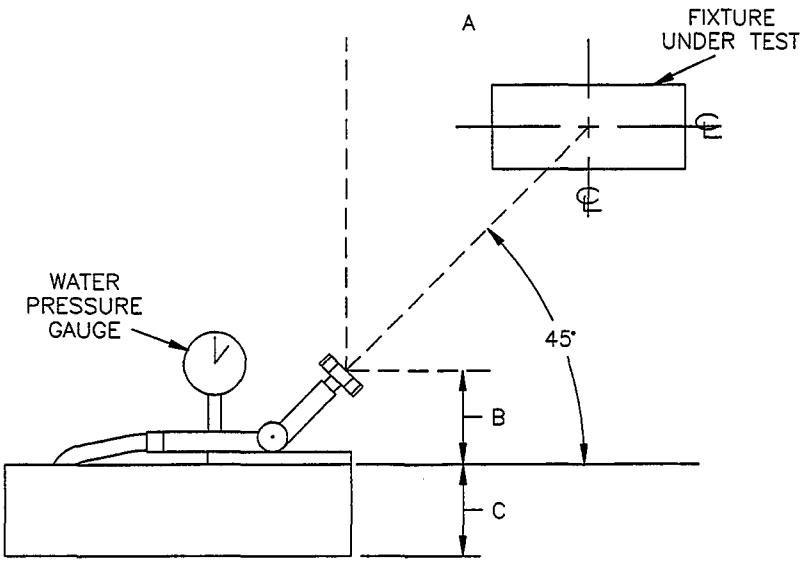
71.5 Sprinkler test

71.5.1 A fixture required to be subjected to a sprinkler test shall comply with the requirements in 71.5.2 and 71.5.3.

71.5.2 A ground-mounted fixture is to be turned about its vertical axis to each of four positions 90 degrees from each other, each for 30 minutes during the 2-hour portion of the test described in 71.3.4, with adjustable parts arranged for maximum vulnerability to the water spray. Post-, wall-mounted and recessed fixtures, intended for mounting within 4 feet (1.22 m) of the ground and ceiling-mounted fixtures shall be similarly tested in the most vulnerable normal mounting position.

71.5.3 The fixture is to be positioned, as shown in Figure 71.2, in front of a standard water spray head of the type shown in Figure 71.3, to which the water pressure is maintained at a gage pressure of 20 pounds per square inch (138 kPa).

Figure 71.2
Representative sprinkler test setup

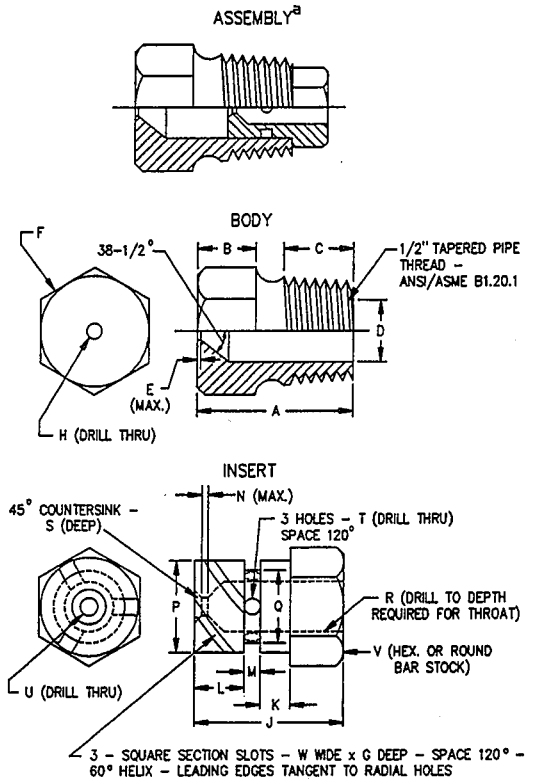


A – 36 inches (914 mm).

B – 3 – 6 inches (76.2 – 152 mm).

C – Height necessary for the fixture to be mounted as intended with the dimensional center of the fixture on a line projected from the center line of the nozzle head.

Figure 71.3
Spray head



Item	Inch	mm	Item	Inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No. 9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories Inc.

[b] Twist drills, ANSI/ASME B94.11M-1993, Drill size

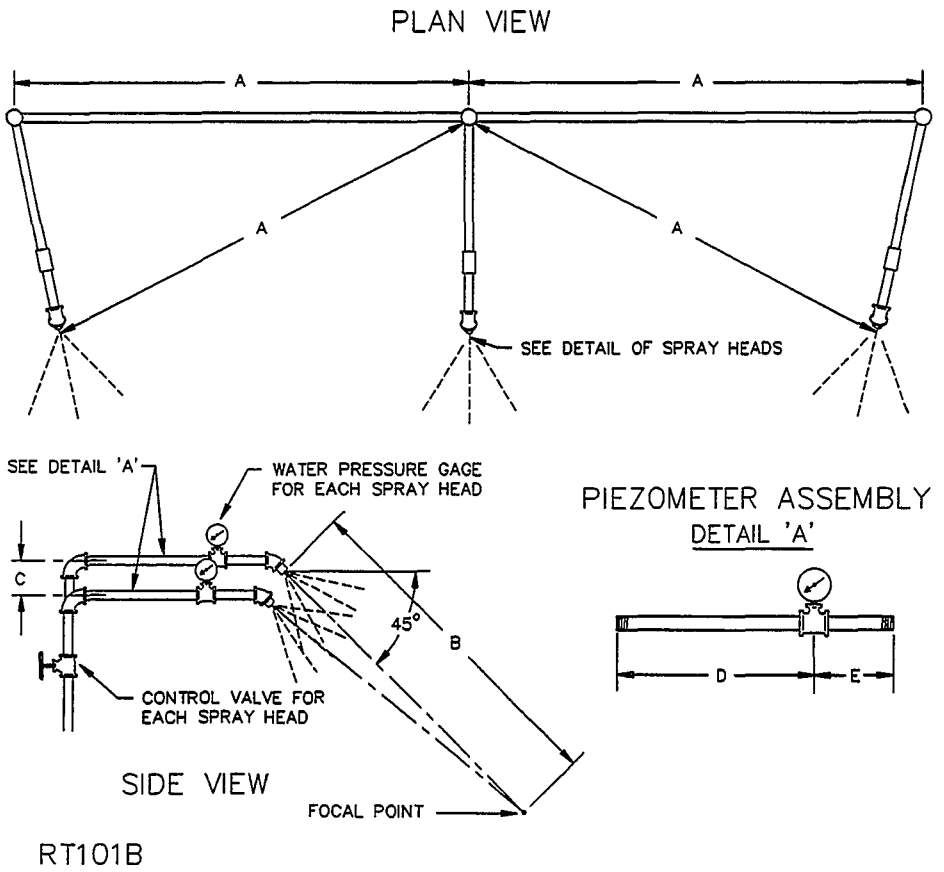
[c] Optional – To serve as wrench grip.

71.6 Rain test

71.6.1 A fixture required to be subjected to a rain test shall comply with the requirements in 71.6.2 and 71.6.3.

71.6.2 The rain test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 71.4. Spray heads are to be constructed in accordance with the details shown in Figure 71.3. The fixture is to be set up as in an intended installation with conduit – without pipe compound – if so intended. The enclosure is to be positioned in the focal area of the spray heads so that the greatest quantity of water is likely to enter the enclosure. The water pressure is to be maintained as 5 pounds per square inch (34.5 kPa) at each spray head.

Figure 71.4
Rain test apparatus



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

71.6.3 A gasketed fixture shall be tested after the temperature test (if required elsewhere in this standard) or after operation for 1/2 hour, followed by removal and replacement of rings, frames, lamps or other replaceable part serving to compress the gasket.

71.7 Immersion test

71.7.1 A recessed fixture required to be subjected to an immersion test shall comply with the requirements in 71.7.2.

71.7.2 The fixture shall be subjected to a cycling test by operating the unit at room temperature (dry) for 3-1/2 hours. At the end of the "on" part of the cycle, the fixture shall be de-energized and immediately submerged under at least 1 foot (304.8 mm) of water. The temperature of the water before submersion shall be 5°C (41°F) or lower. The unit shall remain under water for at least four hours. At the end of four hours, the fixture is to be removed from the water. At the expiration of the "off" part of the cycle, the fixture is to be subjected to two additional "on/off" cycles. Before the second cycle and before the third cycle, the fixture shall be placed in a dry location at room temperature for approximately 16-1/2 hours. The fixture shall be inspected immediately after the third immersion. The fixture is to be tested with or without an auxiliary well form and mounted face-up, with the screws that support the face torqued to the manufacturer's recommended values.

71.8 Thermal shock test

71.8.1 A fixture that employs a glass water shield is to be subjected to a simulated, sudden exposure to rain after operation under intended conditions until temperatures stabilize. This test may be part of the rain, sprinkler, or immersion test, or may be conducted using a sprinkling can with:

a) A capacity of at least 1 gallon (3.79 L);

b) A spout with a minimum disk diameter of 3 inches (76.2 mm); and

c) At least 50 holes, each with a minimum diameter of 0.079 inch (2.0 mm), in the disk;

as appropriate. For the purposes of this test, the temperature of the water is to be 5 ±1°C (41 ±1.8°F). Results of this test are acceptable if the water shield remains intact and does not crack or break.

71.9 Thermal conditioning

71.9.1 A polymeric material, not including wood, used as a water shield that is subjected to an operating temperature in excess of 65°C (149°F) as determined by the temperature test shall retain its original dimensions and shape after exposure for 1000 hours to a temperature in accordance with Table 71.2. Exposure time may be reduced by one-half for each increase in oven temperature of 10°C (18°F). If the sample is too large for the test oven, the sample may be cut to fit.

Exception No. 1: A polymeric water shield that also serves as an enclosure, as required in 7.1, and that complies with the requirements in Section 59, Polymeric Materials, need not be tested.

Exception No. 2: A material that possesses a mechanical temperature index, with impact, as a result of long term aging, of at least the temperature to which it is subjected need not be tested.

Table 71.2
1000-Hour exposure temperature

Normal temperature on polymeric diffuser or lens material				Oven test temperature	
Higher than		Not higher than			
C	(°F)	C	(°F)	C	(°F)
65	149	75	167	85	185
75	167	85	185	95	203
85	185	95	203	105	221

71.9.2 A gasket or bushing employed to comply with the requirements for wet locations shall, after conditioning for 168 hours in a circulating air oven at a temperature 20°C (36°F) above the temperature measured on the gasket or bushing during the Temperature Test described in Section 30, have a tensile strength of not less than 60 percent and an elongation of not less than 75 percent of the values determined before conditioning.

Exception No. 1: This test need not be conducted if a gasket or bushing is tested while installed in the fixture as described in 71.9.3.

Exception No. 2: Neoprene rubber is acceptable for 60°C (140°F) and silicone rubber is acceptable for 105°C (221°F) without being subjected to the test.

71.9.3 As an alternative to the test described in 71.9.2, a gasket or bushing employed to comply with the requirements for wet locations may be tested as follows. With the gasket(s) or bushing(s) in place, the fixture is to be conditioned in a circulating air oven for 240 hours at 20°C (36°F) above the temperature measured in the Temperature Test described in Section 30. After the conditioning, any panels which depend on the gasket or bushing for sealing are to be opened. The results are acceptable if a visual inspection shows no damage to the gasket, and the gasket has remained in place. The fixture panels are then to be closed and the fixture subjected to the rain, sprinkler and immersion tests, as appropriate.

71.9.4 In regard to 71.9.3, if the fixture is provided with more than one gasket and if the temperature rise measured on the gasket material during the temperature test is not the same for all gaskets, then the test described in 71.9.3 may be conducted at the accelerated aging condition corresponding to the highest temperature rise for the gaskets. Otherwise, a separate fixture will need to be tested at each measured temperature rise on the gaskets.

71.10 Gasket adhesion test

71.10.1 In accordance with 69.3.3, a gasket secured by an adhesive shall be tested as follows. The force required to remove the gasket from its mounting surface is to be measured while pulling on the edge of the gasket in a plane perpendicular to the surface on which the gasket is mounted. Six samples of the gasket assembly are then to be subjected to the gasket conditioning described in 71.9.2 or 71.9.3 as appropriate. The force required to remove the gaskets from the mounting surface is to be measured within 1/2 hour after completion of the conditioning for three of the samples, and 24 hours after the conditioning for the remaining three samples. The results are acceptable if the force necessary to remove the gasket from its mounting surface is at least 60 percent of the value measured prior to the conditioning.

71.10.2 Following the impact test described in 71.2.1, the fixture with the water shield that sustained the most damage is to be subjected to any rain, sprinkler, or immersion tests that may be required in Section 71, Performance. Test results are acceptable, even with cracking or breaking of the water shield, if the fixture complies with the requirements in 71.5.1.

72 Markings

72.1 A fixture that complies with requirements in Sections 68 – 71 and that is intended for use in wet locations shall be marked in Form D-1 (see 33.1) "Suitable for wet locations."

72.2 A wall- or pole-mounted fixture intended for use within 4 feet (1.22 m) of the ground and that complies with the sprinkler test shall be marked in Form D-1 "Suitable (for mounting) within 4 feet of the ground".

Exception: A fixture with an integral pole (bollard type fixture) less than 4 feet in height need not be so marked.

72.3 A fixture with adjustable mounting or possible alternative mounting positions, and a fixture provided with an open reflector, shall be marked in Form B-2 to indicate the limits of adjustment or mounting position necessary to comply with test requirements.

72.4 A fixture that is not intended for ground installation shall be marked in Form B-2:

a) "For side wall installation only;"

b) "For ceiling installation only;" or

c) "For covered ceiling installation only," if not intended for exposure to rain on the back surface.

The marking may combine (a) and (b) or (a) and (c) if the fixture is intended for such use.

72.5 A fixture intended for installation in the ground or below grade level and that complies with the requirements of the immersion test shall be marked in Form B-2 with the following or equivalent wording: "Suitable for Ground Installation" or "In Ground Installation Only." The fixture shall be provided with installation instructions as specified in 72.7.

72.6 A surface-mounted, outlet-box connected fixture and a recessed wall-mounted fixture shall be marked in Form C with instructions for proper installation. The instructions shall:

a) Require the use of caulking compound to provide a watertight seal; and

b) Identify the generic type of caulking compound to be used.

Exception: Installation instructions need not require the use of caulking compound if:

a) The fixture is intended to be mounted on a weatherproof outlet box and is provided with a gasket; and

b) The instructions specify that the fixture is intended for use only on outlet boxes marked for use in wet locations.

72.7 Wall-mounted recessed fixtures and fixtures marked for ground installation shall be marked in Form C with instructions for installation, including the use of fittings identified for use in wet locations required for supply connections.

INDUSTRIAL AND AGRICULTURAL FIXTURES WITH OPEN WIRING SYSTEMS

73 General

73.1 These requirements are supplementary to other applicable requirements in this standard and apply to those fixtures intended to be supplied by a branch circuit of the open wiring type in accordance with Article 320 of the National Electrical Code, ANSI/NFPA 70-1993.

73.2 In addition to compliance with this section, a fixture for connection to an open wiring system shall comply with Parts 1 and 2 and with 68.1, 68.2, 69.1.1 – 69.5.1, 71.1.1, 71.3.1 – 71.4.1, 71.6.1 – 71.6.3, 72.1, 72.4, and 72.6 in this standard.

73.3 A fixture shall be provided with leads of Type RHW, RUW, TW, THW, THWN, or XHHW wire that extend at least 18 inches (458 mm) from the point of entry into the fixture. For a metal enclosure, each lead shall enter the fixture through an individual insulating bushing or through individual holes provided in a single bushing. For an enclosure of insulating material, each lead shall be routed individually through a hole in the enclosure.

Exception: Leads need not be provided if the fixture employs an enclosure to house field wiring terminals such that the fixture complies with the rain test described in 71.6.1 – 71.6.3 without connection to branch circuit wiring.

73.4 The insulating bushing mentioned in 73.3 may be of porcelain, phenolic, or urea composition, or of other insulating material that has been investigated and found to have equivalent insulating properties. A bushing of soft rubber or of hot-molded shellac and tar composition is not acceptable.

73.5 A fixture that complies with the requirements in 73.1 – 73.4 shall be marked in Forms D-1 and H-7 (in accordance with 34.1) "Do not install in residential locations" and in Form C-2 "This fixture is intended to be installed in accordance with Article 320 of the National Electrical Code, ANSI/NFPA 70-1993".

SUPPLEMENT SA – FOLLOW-UP INSPECTION INSTRUCTIONS

GENERAL

SA1 Scope

SA1.1 This Supplement describes the manufacturer's production program necessary to verify that the product continues to be in compliance with the requirements in this Standard.

SA1.2 This Supplement also describes the duties and responsibilities of the field representative of the certification organization.

SA1.3 Recognizing that manufacturers are required to have quality assurance systems in place for the control of their production processes and products, this Supplement only covers the sampling inspections, tests, and other measures taken by the manufacturer and considered to be the minimum requirements of the certification organization. Such inspections, tests, and measures are supplemented by the certification organization as an audit of the means that the manufacturer exercises to determine conformance of products with the certification organization's requirements.

SA1.4 The certification organization shall have additional authority specified in legally binding agreements, signed by both the certification organization and manufacturer, to control the use and application of the certification organization's registered mark(s) for product, packaging, advertising, and associated literature. The legal agreements shall cover the control methods to be used by the certification organization and the manufacturer's options for appeal. Any additional inspections, tests, or other measures deemed necessary by the certification organization but to be taken by the manufacturer are to be applied in order to control the use and application of the certification organization's registered Mark(s).

SA1.5 Any paragraph, Section, Table, or Figure number referenced in this Supplement that is not prefixed by SA refers to the requirements in the Standard for High Intensity Discharge Lighting Fixtures, UL 1572. Any reference to the term "Standard" also applies to UL 1572.

SA2 Glossary

SA2.1 For the purposes of this Supplement, the following definitions apply.

SA2.2 CERTIFICATION ORGANIZATION – A third party organization independent of the manufacturer who, under a legally binding contract with the manufacturer, evaluates a product for compliance with requirements specified in the Standard, and who maintains periodic inspection of production of these products to verify compliance with the specifications in the Procedure and this Supplement.

SA2.3 FIELD REPRESENTATIVE – An authorized representative of the certification organization who makes periodic unannounced visits to the manufacturer's facilities for purposes of conducting inspections and monitoring the manufacturer's production program.

SA2.4 INSPECTION REPORT – The report generated by the field representative summarizing the results of the inspection visit.

SA2.5 LISTED PRODUCT – A product that has been determined to comply with the appropriate standards by a certification organization concerned with product evaluation and that maintains periodic inspection of production of Listed products.

SA2.6 LISTING MARK – A distinctive registered mark of the certification organization (that includes, in addition to the mark, the product name, a control number, and the word "Listed") that the manufacturer is authorized to apply to Listed products as the manufacturer's declaration that the products under the program described in this Supplement conform to the requirements in the Standard.

SA2.7 MANUFACTURER – The authorized party who maintains and operates the facilities where a Listed product is fabricated, processed, finished, or stored and where the product is inspected and/or tested as described in this Supplement.

SA2.8 MANUFACTURER'S TEST PROGRAM – The tests described in this Supplement that are conducted by the manufacturer on a periodic or 100 percent basis and for which the manufacturer may be required to keep records.

SA2.9 PROCEDURE – The document issued by the certification organization, upon determination that a product is eligible for Listing, for use by the manufacturer and the field representative. The document contains requirements and other provisions and conditions regarding the Listed product and provides the authorization for the manufacturer to use the Listing Mark on products fulfilling these requirements.

SA2.10 RECOGNIZED COMPONENT – A part or subassembly intended for use in other equipment and that has been investigated for certain construction or performance, or both, characteristics. A Recognized Component is incomplete in construction features or is restricted in performance capabilities so as not to warrant its acceptability as a field-installed component. It is intended solely as a factory-installed component of other equipment where its acceptability is determined by the certification organization.

SA2.11 VARIATION NOTICE (VN) – A document used to record observed differences between a product or manufacturing process and the description of the product or process in the Procedure and/or Standard.

RESPONSIBILITY OF THE MANUFACTURER

SA3 General

SA3.1 It is the manufacturer's responsibility to restrict the use of the Listing Mark to those products specifically authorized by the certification organization that are found by the manufacturer's own quality assurance program to comply with the Procedure description.

SA3.2 The manufacturer shall confine all Listing Marks to the location or locations authorized in the Procedure.

SA3.3 During hours in which the manufacturer's facilities are in operation, the manufacturer shall permit the field representative free access to any portion of the premises where the product or components thereof are being fabricated, processed, finished, or stored, and to the test area assigned for the field representative's use. The field representative shall be permitted to inspect and to verify the results of the prescribed tests on, prior to shipment, any product bearing or intended to bear the Listing Mark.

SA3.4 The manufacturer shall provide, at a convenient location, all required test equipment and accommodations and any required personnel for conducting all tests that are to be performed at the manufacturer's facilities. These shall be available when needed so that the inspection work can proceed without undue delay.

SA3.5 The manufacturer shall determine that the test equipment is functioning properly and shall have the equipment calibrated at regular intervals, not less than once annually, or whenever it has been subject to abuse (such as being dropped or struck with an object) or its accuracy is questionable. Calibration may be by the manufacturer or by an outside laboratory. In either case, the equipment shall be calibrated by comparison with a standard that is traceable to the applicable U.S. or foreign National standard. Calibration records shall be maintained by the manufacturer until the next succeeding calibration of the equipment, and shall be readily available for review by the field representative.

SA3.6 A product that is found to no longer be in compliance with the requirements of the certification organization shall be corrected by the manufacturer if the Listing Mark is to be used on the product. If the noncompliance was the result of a manufacturing or testing process, the manufacturer shall check subsequent production until it is certain that the process or test method has been corrected and the noncompliance will not reoccur.

SA4 Manufacturer's Test Program

SA4.1 Grounding continuity test

SA4.1.1 Tests are to be conducted by the manufacturer for grounding continuity as described in 32.1 and 32.2 to determine compliance with 25.2.8. The test is to be performed as a production line test, at least one test per production run per shift for each design, by the manufacturer.

In addition, the field representative is to witness the manufacturer's performance of this test during each inspection. For snap-fit lampholder construction, see SA4.5.1.

a) Any indicating instrument (such as an ohmmeter, low voltage battery and buzzer combination, or the like) may be employed for the test described in 32.1. If it is necessary to perform the alternate test method described in 32.2, it shall be authorized in the Procedure.

b) For products that comply with Section 5, Assembly and Packaging, and are shipped unassembled, the manufacturer shall assemble at least one unit prior to performing the Grounding Continuity Test for assembled products. Products are to be assembled in accordance with the manufacturer's assembly instructions.

SA4.2 Dielectric voltage-withstand test

SA4.2.1 The manufacturer shall conduct a dielectric voltage-withstand test on 100 percent of production of the types of fixtures described in 33.1. The test shall be conducted in accordance with Section 33, Dielectric Voltage-Withstand Test, and shall be witnessed by the field representative during each inspection.

Exception: If the wiring is routed through Listed conduit, the test need not be conducted.

SA4.3 Polarity

SA4.3.1 If the polarity required in Section 20, Polarity, cannot be verified visually, the manufacturer shall conduct a polarity test not less than once per inspection quarter, or more frequently if deemed necessary by the field representative based on volume of production, type of fixture, number of variation notices, and similar considerations on each fixture construction that requires polarity of wiring. The test shall be conducted in accordance with SA4.3.2. The field representative shall witness the test during each inspection. *Note that polarity is not applicable to lampholders connected to the secondary of an isolated transformer or ballast, or fixtures intended for use on branch circuits not having an identified circuit conductor.*

SA4.3.2 The test shall be conducted to verify continuity between the identified (neutral) input means and lampholder screwshell by means of an indicating device such as an ohmmeter, battery and buzzer combination, or similar devices. The test is to be conducted without the lamp in place.

SA4.4 Fixtures not assembled

SA4.4.1 For those fixtures which are shipped without being assembled in accordance with Section 5, Assembly and Packaging, the manufacturer shall, not less than once per inspection quarter, assemble the fixture using the assembly instructions and then conduct the ground continuity test. The test frequency may be increased if deemed necessary by the field representative based on volume of production, type of fixture, number of variation notices, and similar considerations. The field representative shall witness the tests to determine that the assembled fixtures are in compliance with the Standard and also that any assembly instructions packed with the fixtures are clear and complete. For snap-fit lampholder constructions, see SA4.5.1.

SA4.5 Grounding continuity test for snap-fit lampholder construction

SA4.5.1 Tests are to be conducted by the manufacturer for grounding continuity as described in 32.1 and 32.2 to determine compliance with 25.2.8. The test is to be performed as a production line test on fixtures employing snap-fit lampholder constructions with the fixture grounding means integral with the lampholder at the following frequencies:

a) A fixture which is factory assembled and described in the Procedure document is to be subjected to the grounding continuity test once per inspection quarter.

b) A fixture which is unassembled and described in the Procedure document is to be subjected to the grounding continuity test once per inspection quarter.

c) A fixture which is factory assembled and not described in the Procedure document is to be subjected to a 100 percent grounding continuity test.

d) A fixture which is unassembled and not described in the Procedure document is not an acceptable combination.

The field representative is to witness the manufacturer's performance of this test during each inspection.

SA4.6 Test records

SA4.6.1 Records of all required tests, other than the dielectric voltage-withstand test, shall be retained for at least six months. The test records shall include the dates tests were performed, the quantity (individual pieces or lots) and models tested, and the disposition of any noncomplying results or products.

RESPONSIBILITY OF THE FIELD REPRESENTATIVE

SA5 General

SA5.1 At each visit to the manufacturer's facility, the field representative shall see a representative sampling of each type of fixture which bears or is intended to bear the Listing Mark, and shall then inspect samples to be representative of the manufacturer's output. These samples are to be reviewed in accordance with this Supplement, the Procedure description, and the applicable requirements of the Standard. An inspection report shall be completed after each visit.

SA5.2 Any observed differences between the fixture or manufacturing process and the description of the fixture or process in the Procedure and/or Standard shall immediately be called to the attention of the manufacturer. Any observed differences shall be confirmed in a Variation Notice.

SA5.3 A product that is found to no longer be in compliance with the requirements of the certification organization shall be brought into compliance by the manufacturer if the Listing Mark is to be used on the product. If the noncompliance was the result of a manufacturing or testing process, the manufacturer shall check subsequent production until it is certain that the process or test method has been corrected and the noncompliance will not reoccur. The field representative shall verify that the product continues to be in compliance with the requirements of the certification organization.

SA5.4 A product that does not comply with the provisions of these Follow-Up Inspection Instructions shall have the Listing Mark removed or obliterated. The manufacturer shall satisfy the field representative that all Listing Marks are removed or obliterated from rejected material. Those Marks not destroyed during the removal from the product shall be turned over to the field representative for destruction. If rejection of the product is questioned by the manufacturer, the manufacturer may hold the material at the point of inspection, typically at the factory, pending an appeal.

SA5.5 All high intensity discharge fixtures require testing by the certification organization. Only those features that would affect the test results are described. Other construction features not described in the Procedure or this Supplement shall be evaluated by the field representative according to the requirements in the Standard.

SA5.6 Other than for the requirements tabulated in Table SA6.1, wherever the word "equivalent" is used in the Standard, it is intended that the field representative shall determine the equivalence. The equivalence shall be determined by applying the construction and/or performance criteria of the requirement specified in the Standard. If there is any doubt on the part of the field representative, the certification organization is to be contacted.

SA6 Construction

SA6.1 The requirements tabulated in Table SA6.1 require application of engineering judgment or test procedures from the Standard to determine compliance and shall not be applied by the field representative. Compliance with these requirements shall be determined exclusively by the certification organization. If during inspection the field representative discovers features that are subject to these requirements, the product is not to bear the Listing Mark until it has been submitted to the certification organization for determination of compliance and the material or construction in question has been described in the Procedure. See SA9.2.

Table SA6.1
requirements needing engineering investigation

Paragraph number	Comment
1.3	
1.4	
1.5	
Section 3	
5.1 Exception No. 3	
5.2(b) of Exception No. 1	
5.2 Exception Nos. 2 and 3	
5.3 Exception Nos. 1 and 3	
5.5	
6.1.2 Exception	
7.2	
8.1.1 Exception No. 2	
Table 8.1 Footnote "c"	
9.2 Exception Nos. 3 and 5	
11.1 Exception Nos. 1 and 2	
12.1.1	
12.2.8 Exception	
12.2.9	
12.3.1 (e) and (f)	
13.1 Exception No. 2	
13.2 Exception Nos. 1 and 2	
16.8	
16.9 Exception	
16.10	
18.6	
19.4.4 Exception	
20.1 Exception	
21.1.1	Ballast Investigation Only
21.1.2	
22.1.3	Second Sentences
Table 22.1 Footnote "a"	
23.2.1(b)	
23.4.1 (c), (d) and (e) and the Exception	

(Continued)

Table SA6.1 (Cont'd)
Requirements needing engineering investigation

Paragraph number	Comment
23.4.2	
24.1 Exception Nos. 1 and 2	
24.3	For other means only
25.1.10 Exception No. 2	
25.2.2	
Section 29	
Section 30	
Section 31	
32.2	Alternate Method
33.4	
34.3	See SA7.1 for
41.1.8	Exception
41.1.9 Exception No. 2	
41.2.2(d)	
Section 43	
Section 45	
Section 46	
Section 47	
Section 48	
Section 51	
Section 52	
Section 53	
Section 54	
Section 55	
Section 56	
Section 57	
Section 58	
Section 59	
Section 61	
Section 62	
Section 63	
65.1	For equivalent only
69.1.1 Exception Nos. 1 and 5	See (c) of SA7.1 for exception
Table 69.1	
69.2.1 – 69.5.2	
Section 70	
Section 71	
Section 73	

SA6.2 In reference to 26.1.1(e) and Exception No. 2 to 26.3.1, the field representative may accept without Procedure description a manufactured wiring system (prefabricated lighting and power distribution assembly) if:

a) It is a Listed manufactured wiring system; and

b) The correlation and installation instruction markings for the wiring system are applied to the fixture and are visible after installation.

SA7 Components

SA7.1 All component parts are to be Listed unless specifically described in the Procedure or noted as follows:

a) Marking Labels – A printed label, used to conform to Form A Marking of Table 34.1 and 34.3, is acceptable if it:

1) Is a Recognized Component Marking and Labeling System that complies with the Standard for Marking and Labeling Systems, UL 969; and

2) Is rated for the type of surface to which it is affixed and for a temperature of at least 150°C unless otherwise described.

b) Appliance Wiring Material – Any Recognized Component AWM may be used if it complies with 19.1.4.

c) Corrosion Protection – Any Recognized Component Metallic Protective Coating rated G90 may be used to comply with Table 69.1, Type (A) coatings, without Procedure description.

d) Wiring in Fixtures Marked "Suitable for Wet Locations" –

1) Appliance wiring material [as noted in (b)] that does not have any outer braid or filler of absorptive material may be used in fixtures marked "Suitable For Wet Locations."

2) Fixture wires Type RFH-1, RFH-2, FFH-2, and AF may not be used for fixtures marked "Suitable For Wet Locations."

e) Supplementary Insulation – In addition to the supplementary insulation materials mentioned in 19.1.5, the wires indicated may also be considered satisfactory for a 150°C rating if each individual conductor is provided with snugly fitting supplementary insulation in the form of electrical insulating tubing or processed tubing having a voltage rating equal to or higher than the wire insulation. The temperature rating of the tubing shall be 150°C or higher and shall be marked on the surface of the tubing. Insulating tubing or processed tubing must be acceptably evaluated by the certification organization for use as a supplementary insulation.

SA8 Special Constructions

SA8.1 All fixtures and fittings covered by Part 3 and other products evaluated for special use are required to be submitted to the certification organization for test and evaluation. They are not eligible to bear the Listing Mark unless authorized specifically in the Procedure.

SA8.2 Any Listed bushing is acceptable for the prevention of wire damage in accordance with 19.4.4.

SA8.3 Compounds used to prevent the turning of threaded joints are acceptable provided that the compounds do not interfere with the ground continuity of the fixture.

SA8.4 Glass fiber sleeving referenced in 19.1.5 need not be a Recognized Component type sleeving.

SA8.5 To verify that a grounding or bonding screw threads into metal a minimum of two full threads in accordance with 25.2.8, multiply the metal thickness in inches by the screw pitch. For example:

Metal (thickness) X pitch = threads
i.e., 0.065 *inch X* 32 *threads/inch* = 2.08 *threads*
0.056 *inch X* 36 *threads/inch* = 2.02 *threads*

SA8.6 The screw referenced in 25.1.9 that is intended for connection of the grounding conductor may also have a green colored, slotted, round head.

SA8.7 A canopy, mounting strap (cross-bar), chain, stems, and associated mounting hardware may be unassembled. If the grounding means is provided by a wire binding screw to the mounting strap (cross-bar), the screw need not be installed in the mounting strap (cross-bar) if instructions for proper assembly and wiring are provided.

MARKING

SA9 Required Markings

SA9.1 Markings on or with a fixture shall be of a type and minimum height designated by one of the form letters in Table 34.1, and shall be in one of the locations designated by the form numbers on Table 34.2.

SA9.2 The field representative is authorized to verify the text and the form of the required markings, including those specified in Table SA9.1.

Table SA9.1
Markings needing engineering investigation

Paragraph number	
36.1.2	With regard to testing orientation only
36.2.2	
36.2.4	
37.2	
38.1	
38.2	
39.1 – 39.5	
44.2 – 44.6	
49.1	
49.3	
49.5 – 49.10	
49.11, 49.12	
49.15	
49.16 – 49.19	
49.20 – 49.29	
52.9 Exception	
53.2.3 – 53.2.7	
55.5.1 – 55.5.3	
57.3.1	
58.2.4, 58.2.5	
62.3.1	
63.3.1	
72.1 – 72.7	
73.5	

SA9.3 The paragraphs specified in Table SA9.1 are associated with markings which require specific values developed as the result of an investigation.

SA9.4 Specific values required for some markings in Table SA9.1 will be provided in the Procedure description. The context of these markings shall be verified by the field representative.

SA9.5 If a marking specified in Table SA9.1 is not Procedure described, the eligibility to apply the marking to the product shall be verified by the certification organization.

SA9.6 The field representative shall review the shipping carton and the installation instructions to determine that there is no information or representation that conflicts with any required markings. For example, a fixture marked for use in dry locations shall not show a picture of an outdoor installation on the carton or a wall-mounted fixture shall not show a picture of a ceiling installation on the carton.

SA10 Listing Mark

SA10.1 General

SA10.1.1 One appropriate Listing Mark shall be applied to each complete fixture. One Listing Mark shall be applied to each rough-in and finishing section (as appropriate) of a two-section lighting unit which is not shipped as a complete fixture. Such two-section units may bear one Listing Mark only when both sections are packed (completely wired) and shipped in a single carton.

SA10.1.2 The Listing Mark shall be so located on the exterior of the fixture that it will normally be visible when the fixture is installed. In the case of residential fixtures only, the Listing Mark may be located at the point where it will be visible when making and inspecting the connections to the branch-circuit supply wires. In any case, the location of the Listing Mark is considered to be acceptable when only the removal of the lamp, glassware, or a drop canopy is required for the Listing Mark to be visible. It is recommended that the Listing Mark be located on the exterior of residential fixtures when practicable.

SA10.1.3 The field representative shall not permit the attachment of Listing Marks to products not covered by the Procedure, unless special authorization for such action is received from the certification organization.

SA10.2 Standard listing mark

SA10.2.1 The Listing Mark for High Intensity Discharge Lighting Fixtures shall consist of the following declaration:

CERTIFICATION ORGANIZATION LOGO
OR NAME

LISTED

(PRODUCT CATEGORY)

together with the product name (such as "High Intensity Discharge Fixture" or the like), the statement "Suitable for dry locations only," "Suitable for damp locations," or "Suitable for wet locations" consistent with the Listing, and a control number, by means of which the certification organization maintains a record of the manufacturer to whom the Listing Marks are released, the date of release, and the approximate date of use. It is recommended that, insofar as possible, manufacturers use the Listing Marks consecutively with respect to these numbers.

SA10.3 Combination listing marks

SA10.3.1 Combination Listing Marks are available for all fixture designations. Combination Listing Marks are the same as the Standard Listing Mark except that they include the Listee's identification, and may include other information.

APPENDIX A

Standards for Components

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

Title of Standard – UL Standard Designation

Attachment Plugs and Receptacles – UL 498
Ballasts, High-Intensity-Discharge Lamp – UL 1029
Cables, Nonmetallic-Sheathed – UL 719
Connectors, Splicing Wire – UL 486C
Cord Sets and Power-Supply Cords – UL 817
Flammability of Plastic Materials for Parts in Devices and Appliances, Tests for – UL 94
Insulating Tape, Polyvinyl Chloride, Polyethylene, and Rubber – UL 510
Lampholders, Edison-Base – UL 496
Marking and Labeling Systems – UL 969
Outlet Boxes, Fittings for Conduit and – UL 514B
Outlet Boxes, Flush-Device Boxes and Covers, Nonmetallic – UL 514C
Outlet Boxes, Metallic – UL 514A
Polymeric Materials – Fabricated Parts – UL 746D
Polymeric Materials – Long Term Property Evaluations – UL 746B
Polymeric Materials – Short Term Property Evaluations – UL 746A
Polymeric Materials – Use in Electrical Equipment Evaluations – UL 746C
Raceways and Fittings, Surface Metal – UL 5
Switches, General-Use Snap – UL 20
Switches, Special-Use – UL 1054
Terminal Blocks – UL 1059
Tubing, Electrical Metallic – UL 797
Tubing, Extruded Insulating – UL 224
Tubing for Electric Wiring, Flexible Nonmetallic – UL 3
Wire Connectors and Soldering Lugs for Use With Copper Conductors – UL 486A
Wire, Flexible Cord and Fixture – UL 62
Wires, Cables, and Flexible Cords, Electrical, – UL 1581
Wires and Cables, Rubber-Insulated – UL 44
Wires and Cables, Thermoplastic-Insulated – UL 83

APPENDIX B

ENCLOSURE AND ACCESSIBILITY OF INSULATED AND UNINSULATED CURRENT-CARRYING PARTS DESCRIBED IN SECTIONS 7 AND 23 AND RECESSED HOUSING REQUIREMENTS DESCRIBED IN SECTION 46

B1 Purpose

B1.1 This appendix provides an explanation of the application of requirements in this standard to determine compliance of a current-carrying part with regard to being:

a) Enclosed from the room side of a fixture (enclosure requirements);

b) Enclosed from the concealed space or building structure side of a fixture (recessed housing requirements); and

c) Accessible from the room side of a fixture (accessibility requirements).

This appendix also provides an explanation of the application of requirements to determine compliance of a recessed housing with regard to the propagation of a fire through a recessed fixture.

B1.2 This appendix is not part of this Standard, but is included for information purposes only.

B2 Definition of Intent

B2.1 The enclosure requirements and the accessibility requirements are intended to address two different safety concerns associated with insulated and uninsulated current-carrying parts.

B2.2 The enclosure requirements are intended to address the containment of a possible fire generated by an electrical fault in a current-carrying part during normal operation but not during relamping.

B2.3 The accessibility requirements are intended to reduce the risk of electric shock during normal operation and during relamping.

B2.4 The recessed housing requirements are intended to reduce the propagation of a fire on the room side of a fixture through the fixture to the concealed space side of a fixture.

B2.5 The requirements for open holes in enclosures (specified in Section 9, Open Holes), in accessibility barriers (specified in Section 23, Accessibility of Current-Carrying Parts), and in recessed housings (specified in Section 46, Construction – Mechanical) are also separate and different even though they may be applied to the same material and are to be considered when applying requirements for each function as described in B1.1.

B3 Application of Requirements

B3.1 When applying the enclosure, accessibility, and recessed housing requirements to a fixture, the requirements are to be applied separately even though a material may serve more than one function. The requirements for each function are to be applied to a material or part in accordance with the definition of intent for each function.