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Standard for Safety

UL 1570

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Fluorescent 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

July 25, 1995

Standard for

Fluorescent Lighting Fixtures

UL 1570, Fourth Edition

Accompanying this transmittal notice is a copy of the Fourth edition of UL 1570.

THIS EDITION OF THE STANDARD IS NOW IN EFFECT.

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 1570.

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

UL 1570

Standard for

Fluorescent 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.

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Fourth Edition

July 25, 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 1570 on January 18, 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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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 fluorescent electric lighting fixtures for commercial, industrial, or residential use in ordinary locations in accordance with the National Electrical Code, NFPA 70.

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 as defined in the National Electrical Code, NFPA 70;

d) Portable lamps;

e) Miscellaneous special purpose units, such as inspection lights, photographic lights, sewing-machine lights, garden lights, portable electric hand lamps, stage and studio lights, and medical and dental lights;

f) Fixtures involving a potential of over 1000 volts;

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

h) Fixtures provided with adapters or other forms of construction that 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;

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

k) Low voltage fixtures for use in recreational vehicles that are supplied solely by nominal automotive battery voltage.

1.3 A fixture provided with lampholders for both incandescent and fluorescent lamps (a combination incandescent-fluorescent lamp fixture) shall comply with the requirements of this standard and with requirements in 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 requirements in the Standard for High Intensity Discharge Lighting Fixtures, UL 1572, and with the requirements of this standard insofar as they apply to construction, test methods and marking requirements unique to fluorescent lamps.

1.5 A bathroom cabinet fixture is judged under the general requirements and under the applicable requirements for Metal Thickness in Section 9 and ventilation openings in 42.3.4 and 42.3.6.

1.6 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 General

2.1 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.

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

3 Glossary

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

3.2 BALLAST, HIGH POWER FACTOR – A reactor-type ballast marked to indicate it is of the high power factor type or marked for a power factor of 0.9 or higher.

3.3 BALLAST, OUTDOOR – A ballast marked:

a) "Type 1" or "T1" must be installed in a fixture enclosure complying with the requirements of 8.1.

b) "Type 2" or "T2" must be installed in the fixture enclosure to prevent the entry of water into the ballast.

c) "Weatherproof" or "WP" requires no additional enclosures mentioned by (a) and (b).

3.4 BALLAST, REACTOR, (SIMPLE REACTANCE) – A reactance type ballast in which the lamp ballasting impedance is provided by a single coil inductor – not a transformer or inductor with additional components.

3.5 CANOPY – A cover type device provided separately or with a fixture that is used to cover the outlet box by securing to the outlet box or ceiling.

3.6 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.

3.7 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.

3.8 FLAT GLASS – A glass panel, usually formed from sheet stock, the overall shape of which (not necessarily the surface) is essentially flat. The panel may have a slight curvature or bend(s).

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

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

3.11 OPENING – A hole in the wall of a required enclosure. The opening may be either an open hole or a knockout.

3.12 OPEN HOLE – An opening without a cover or similar closure material.

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

3.14 POLE – An outdoor support of metal, wood, or the like, over 12 feet (3.66 m) tall, on which at least one lighting fixture is intended to be mounted by means of arms or fittings. The height of the support is as measured from ground level.

3.15 POST – An outdoor support of metal, wood, or the like, no more than 12 feet (3.66 m) tall, on which a lighting fixture is intended to be mounted (usually on top). The height of the support is as measured from ground level.

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

3.17 PRESSURE TERMINAL CONNECTOR – A device that secures one or more wires to a terminal plate, stud, or similar device without the use of solder.

3.18 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:

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

Type Non-IC, – 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 at least 1/2 inch (12.7 mm) from combustible material.

Type Non-IC, Suitable for Installation in Poured Concrete or In Ground – A fixture that is identified as a Type Non-IC fixture, but that may also be identified as suitable for installation in poured concrete or in ground.

Type Non-IC, Suitable for Installation Only in Poured Concrete or In Ground – A fixture that is investigated and identified for installation only in poured concrete or in ground.

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.

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

3.20 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.

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

3.22 SURFACE MOUNT FIXTURE – A non-recessed fixture.

3.23 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.

3.24 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 circuit breakers.

3.25 WIRE-BINDING SCREW – A screw used as a post around which a wire is terminated.

4 Components

4.1 Except as indicated in 4.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

4.2 A component 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.

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

4.4 Specific components are recognized as being incomplete 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.

5 Assembly and Packaging

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

Exception No. 1: Wired fixture sections complying with Section 54 need not comply with this requirement.

Exception No. 2: Arm(s) of a fixture or stem(s) of a stem-pendant fixture may be disconnected from the body of the fixture if it is marked or provided with instructions as specified in 32.3.

Exception No. 3: A stem- or chain-pendant fixture, for which incomplete assembly for packaging or shipment is essential, may be shipped in a form that requires wiring after the fixture leaves the factory, but shall be unwired only to the extent required for shipping or packaging, if investigated and marked or provided with instructions in accordance with 34.1.5.

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

Exception: A lampholder, or a lampholder attached to a structural part, may be unmounted (but not unwired) to facilitate packaging for shipment.

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

Exception No. 1: Separate channels and reflectors that comply with Section 49 may be unassembled (but not unwired) for shipment.

Exception No. 2: Fixture fittings that comply with Section 47 need not be completely assembled when shipped from the factory.

Exception No. 3: Wired fixture sections may be unassembled for shipment only to an extent that complies with Section 54, Wired Fixture Sections.

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

Exception No. 5: Wireway channels, diffusers, and other parts that do not support electrical components may be shipped unassembled if packed on a pallet, or the equivalent, with the remaining parts of the fixture included.

5.4 A fixture that employs metal thinner than specified in Table 9.1 shall be assembled to the degree that it was assembled during the tests in Metal Thickness Equivalency Tests, Section 31.

5.5 A fixture is to be shipped from the factory in a carton or as an unpackaged complete assembly. Unassembled parts, such as stems, chains, and the like, if required elsewhere in the standard to accompany the fixture, shall be included.

Exception No. 1: A lens or diffuser that does not provide structural or enclosure functions as required by 8.1 need not be included.

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

5.6 A reflector kit is to be shipped from the factory in a single carton. All kit components and installation instructions shall be included.

Exception: Reflector kits may be bulk packed if every kit component or set of components is shipped in one or more cartons and each carton contains a set of installation instructions.

5.7 The carton referenced in 5.5 or 5.6 is a box of cardboard, pasteboard, shrink film, or the like (but not newspaper, wrapping paper, tissue paper, or similar materials). 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.

5.8 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.

5.9 A threaded joint, unassembled to the degree permitted in 5.3, shall comply with the requirements in 7.1 and 7.2, or such a joint shall be furnished with setscrews, lock washers, or locknuts.

CONSTRUCTION – MECHANICAL

6 General

6.1 Self-threading or sheet-metal screws shall not be used in aluminum, copper, or aluminum or copper alloys.

Exception No. 1: A self-threading or sheet-metal screw 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. The force is to be applied in a direction coincident with the axis of the screw without distress to the fastening means.

Exception No. 2: If the screw threads through such sheet metal into steel having a minimum thickness as specified in Table 9.1, the above requirement does not apply.

6.2 A sheet metal or self-threading screw shall not be used for mounting or support of a part (ballast, transformer, lampholder, starter holder, or the like) 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 equivalent to other acceptable fastening means.

7 Joints

7.1 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.

7.2 Friction alone between parts is not acceptable as a means to prevent turning. Turning shall be prevented by:

a) The use of a lock washer;

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

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

7.3 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:

a) For assembly;

b) To prevent turning of threaded tubing no larger than 1/8-inch (3.2-mm) pipe size; and

c) On bolts or studs that are no larger than 1/4 inch (6.4 mm) in diameter.

Exception: A sheet metal nut for bolts larger than 1/4 inch diameter may be used to prevent turning or loosening if it is not depended upon for mechanical strength.

7.4 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 result in damage to conductor insulation.

8 Enclosures

8.1 All splices, taps, transformers, all current-carrying parts or devices with exposed live parts, and all leads or terminals for field connection of supply wires shall be enclosed in materials specified in 8.2.

Exception No. 1: A fixture intended to be surface-mounted and outlet-box connected may have an opening as specified in 37.1.1.

Exception No. 2: A lampholder need not be enclosed.

Exception No. 3: A component device, such as a transformer, that has an integral outer enclosure in compliance with 8.2 need not be additionally enclosed.

Exception No. 4: A fixture with an integral pole or post, such as a bollard fixture, intended for mounting on an inorganic surface, need not have a bottom surface enclosure if the inorganic surface acts as the bottom surface enclosure.

Exception No. 5: A pole or post-mounted fixture may be provided with an opening for supply leads if the opening is intended to be closed off by a pole, post or a mounting arm.

8.2 An enclosure as specified in 8.1 shall be constructed of metal, glass, ceramic, porcelain, or a polymeric material that complies with the requirements of Polymeric Materials, Section 59. The minimum thickness for metal shall be as specified in Metal Thickness, Section 9, and for glass, as specified in Glass, Section 11.

8.3 Enclosure parts shall be secured by positive mechanical interference fit such as screws, snap fit, welding, and the like. Friction alone between parts is not an acceptable means of securing enclosure parts.

Exception: An enclosure part may be secured by friction alone if it complies with the following:

a) The enclosure part being secured by friction alone has no other electrical components secured to it such as a lampholder, switch, starter holder, and the like.

b) The enclosure part is not required to be removed during routine maintenance, such as for starter replacement, lamp replacement, and the like.

c) The friction between parts is sufficient to retain the enclosure part to the fixture when a 10 lb (4.54 kg) weight is applied to the enclosure part in accordance with the Weight Loading Test specified in SA4.6.2.

d) Where the enclosure part is required to be grounded in accordance with Grounding, Section 23, bonding continuity does not relay on friction alone between adjacent surfaces.

8.4 After assembly, there shall be no open holes in a fixture enclosure as described in 8.1.

Exception: Open holes specified in Openings, Section 10, are acceptable.

9 Metal Thickness

9.1 Sheet metal

9.1.1 The thickness of sheet metal in a fixture or canopy shall be no less than indicated in Table 9.1.

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, provide structural integrity, or support a wiring device.

Exception No. 2: A form of construction that employs metal that is thinner than specified in Table 9.1 may be used if investigated and found to comply with the applicable tests in Metal Thickness Equivalency Tests, Section 31.

9.1.2 The lengths noted in Table 9.1 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.

9.1.3 Footnote b of Table 9.1 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 no less than 0.032 inch (0.81 mm) thick, or flat steel bars no 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 no 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.

9.1.4 The values for minimum thickness indicated in Table 9.1 apply to measurements made on a formed part prior to the application of paint, varnish, or other coatings.

Table 9.1
Thickness of sheet metal

Specific construction[a]		Minimum thickness of sheet metal					
		Uncoated steel		Zinc-coated steel		Copper, brass, or aluminum	
		In.	(mm)	In.	(mm)	In.	(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	0.026	(0.66)	0.029	(0.74)	0.032	(0.81)
	Support	0.020[b]		0.023[b]		0.025[b]	
	No Component	0.020	(0.51)	0.023	(0.58)	0.025	(0.64)
	Support	0.016[b]		0.019[b]		0.020[b]	
Length Not More Than 26 Inches (660 mm)	Component	0.020	(0.51)	0.023	(0.58)	0.025	(0.64)
	Support	0.016[b]		0.019[b]		0.020[b]	
	No Component	0.016	(0.41)	0.019	(0.48)	0.020	(0.51)
	Support	0.013[b]		0.016[b]		0.016[b]	
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)
Transformer enclosure (Garden Light)		0.050	(1.27)	0.053	(1.35)	0.081	(2.05)

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

[b] Minimum acceptable thickness for forms of construction that have been found to provide the physical strength and protection contemplated by the requirement in 9.1.1.

[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.

9.2 Extrusions

9.2.1 An extruded metal part shall comply with the thickness requirements for sheet metal as described in 9.1.1.

9.3 Tubing

9.3.1 The minimum wall thickness of tubing:

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

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

9.4 Cast metal

9.4.1 The minimum thickness of cast metal shall be in accordance with Table 9.2.

Table 9.2
Minimum acceptable 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

10 Openings

10.1 The requirements of this section apply to acceptable openings in an enclosure as required in 8.1. All unused openings provided for purposes not specifically covered in 10.2, 10.3, or 43.2.1, or, for surface-mounted fixtures, not covered in 37.3.1 – 37.7.1, shall comply with the requirements for miscellaneous openings specified in 10.4 and 10.5.

10.2 An enclosure that contains one or more open coil type devices shall not have any open hole.

Exception No. 1: A surface-mounted fixture may have open holes as described in 37.3.3.

Exception No. 2: An enclosure may have an open hole no more than 1 inch (25.4 mm) in diameter for an automatic starter.

Exception No. 3: An open hole that is permitted elsewhere may be located 6 inches (152 mm) or more from the device, measured horizontally, when the fixture is mounted as intended. See 34.1.2 for marking requirements when the fixture can be mounted in more than one orientation.

10.3 An enclosure that contains a fuse mounted in an open-type fuseholder shall not have any open hole.

Exception: An open hole that is permitted elsewhere may be located 6 inches (152 mm) or more from the fuse, measured horizontally, when the fixture is mounted as intended. See 34.1.2 for marking requirements.

10.4 An open hole in the enclosure specified in 8.1 provided for miscellaneous purposes shall not exceed the dimensions specified in Table 10.1.

Table 10.1
Maximum size of miscellaneous open holes

Opening shape	Dimension		Maximum area	
	Inch	(mm)	Inch^2	(mm^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] A slot between two assembled parts that does not exceed 1/32 inch (0.8 mm) in width need not comply with the area limitation.

10.5 The total area of one or more open holes shall not be more than 15 percent of the area of the surface in which it is located. This includes the wiring compartment or integral outlet box compartment.

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

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 have an exposed area no greater than 1100 square inches (7097 cm^2).

Exception No. 1: Tempered glass may be used, if it is treated so 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.

Exception No. 2: Glass that does not comply with the minimum thickness requirements in Table 11.1 may be used, if it has been investigated and found to be mechanically equivalent.

Table 11.1
Minimum glass thickness

Exposed area of glass panel				Minimum thickness of glass					
More than		No more than		Flat		Curved		With concentric ribs	
Inches^2	(cm^2)	Inches^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

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 required in 8.1; or

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

11.4 An exposed edge of glass that may be contacted 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 secured in a frame by clips, or held by channels or 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 glass panel that is more than 300 square inches (1935 cm^2) or more than 26 inches (660 mm) long.

Exception No. 1: A frame need not 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 no more than 1100 square inches (7097 cm^2) 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 equivalent means, when the glass is in its intended operating position and during relamping. See 34.1.2 for marking requirements when the fixture can be mounted in more than one position.

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 that supports a glass panel greater than 300 square inches (1935 cm^2) 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.

Exception No. 1: A single piano-type hinge may be used if the length of the hinge is no 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 no more than 500 square inches (3226 cm^2) 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, 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 34.1.2 for marking requirements when the fixture can be mounted in more than one position.

Exception No. 4: A captive latch (a device that releases by at least two motions of the device, such as out and up) may be used in lieu of the combination of hinges 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, 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 of 1/8 inch (3.2 mm) or more.

Exception No. 2: A framed-glass panel that is no more than 50 inches (1.27 m) long and no 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 A clip 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 a clip shall be as indicated in Table 12.1.

Table 12.1
Clip dimensions

Exposed area of glass panel				Minimum clip size			
More than		No more than		Width		Overlap	
$Inches^2$	(cm^2)	$Inches^2$	(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

12.2.3 A clip 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. 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.

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 be no 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, 0.016 inch (0.41 mm) thick if of uncoated steel, and 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 Polymeric Materials, Section 59.

12.2.9 An adhesive material used to secure glassware to a frame shall comply with the applicable requirements in the Standard 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 34.1.6, 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 equivalent;

b) A stud with threaded end and nut;

c) Threads on glass part that engage a threaded fitter;

d) Spring clips that hold only by means of friction, if the assembly complies with 30.1;

e) Equivalent construction investigated and found to comply with 30.1;

f) Adhesive that complies with 12.2.9 and 12.2.10.

g) Its own weight in a frame that is not hinged or does not need to be removed for relamping.

CONSTRUCTION – ELECTRICAL

13 General

13.1 A fixture designed for use with a remotely mounted ballast shall be provided with leads for ballast secondary connections that extend from the lampholders to the point in the fixture where secondary connections will be made. The leads shall comply with the requirements of Wiring and Conductors, Section 18. The fixture shall comply with 20.4.

13.2 A wiring device (a switch, fuseholder, lampholder, or the like) shall be prevented from any turning, by a means specified in 7.2, that would apply tension to splices or other wiring connections, cause damage to the wiring, or otherwise adversely affect the assembly.

13.3 A fixture shall be constructed such that each lamp and automatic starter can be replaced without disturbing any supply wire and without subjecting any other wiring, component, or part to mechanical damage.

14 Device and Conductor Ratings

14.1 Voltage

14.1.1 Electrical devices and insulated conductors shall have a voltage rating at least equal to the voltage that will be applied to them during intended use.

14.1.2 A lampholder shall have a voltage rating no less than the output-voltage rating (if any) marked on the ballast with which it is used.

Exception: If the ballast is additionally marked with a secondary voltage to ground that is less than the marked output voltage, the rating of the lampholder may be no less than the marked secondary voltage to ground.

14.2 Current

14.2.1 Electrical devices shall have an ampere rating and insulated conductors shall have an ampacity rating for the total current, as specified in 14.2.2 and 14.2.3, to which they will be subjected during intended use.

14.2.2 The ampere rating of a device and the ampacity of a conductor shall be the combination of:

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

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

14.2.3 The ampacity rating of some commonly used insulated conductors are indicated in Table 14.1.

Table 14.1
Maximum ampacities of wires and cords with copper conductors

Types of wire and cord[a]	Ampacity				
	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, RHH, RHW, RUH, RUW, T, THHN, THW, THWN, TW, XHHW	–	–	20	25	40
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, ZF, ZFF, XF, XFF	6	8	17	23	28
Flexible Cords					
S, SO, SOO, SJ, SJO, SJOO, ST, STOO, SJT, SJTO, SJTOO, STO, SP-1, SP-2, SPT-1, SPT-2, SV, SVO, SVOO, SVT, SVTO, SVTOO, SE, SJE, SPE-1, SPE-2	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 with two conductors carrying current are shown in parentheses.

14.2.4 The ampere rating of a switch shall be multiplied by the derating factor as indicated in Table 14.2 before consideration of its current handling capability for the specified load.

Table 14.2
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	1/2	–

[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".

15 Switches

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

15.2 A special-use snap switch shall be rated in accordance with Table 14.2.

15.3 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, a cover plate, or the equivalent.

15.4 A manually operated switch used in a ceiling-mounted fixture and located within 2 feet (0.61 m) of the ceiling shall be of the pull type. The distance from the switch to the ceiling includes 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.

15.5 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 34.1.7, a single-pole photocontrol switch may be used.

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

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

15.8 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.

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

16 Convenience Receptacles and Fuses

16.1 A convenience receptacle may be provided only in a wall, under-cabinet, or floor-mounted fixture. See 34.1.2 for possible marking requirements.

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

16.3 A convenience receptacle shall be of the grounding type.

Exception: A 2-pole, 2-wire, parallel blade, polarized, nongrounding-type receptacle may be provided if the fixture is marked in accordance with 34.2.3 to indicate that the fixture is intended for replacement use.

16.4 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, which is within a rectangle 5/8 inch wide and 7/8 inch long that is located symmetrically about the receptacle contacts.

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

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

17 Lampholders

17.1 A ballast that is marked for use with circuit interrupting lampholders shall be connected to single pin circuit interrupting lampholders, bi-pin circuit interrupting lampholders, or recessed double contact lampholders. Recessed double contact lampholders for use with 800 and 1500 milliampere rapid start lamps are not of the circuit interrupting type.

17.2 A fixture requiring a circuit interrupting lampholder in accordance with 17.1 shall have it located in the low voltage end of the ballast circuit. The lampholder at the high voltage end shall be rated 600 volts or more.

Exception: A lampholder rated at 250 volts may be employed at the high voltage end if supplementary insulation consisting of 1/64-inch (0.4-mm) thick fiber or phenolic composition or a permanent air spacing of no less than 5/64 inch (2.0 mm) is provided between the back of the lampholder and the metal of the fixture.

17.3 A fixture shall not use lampholders designed for ferrule-type lamps.

17.4 A lamp-supported lampholder shall be provided with stranded wiring.

18 Wiring and Conductors

18.1 General

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

18.1.2 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.

18.1.3 A conductor shall be no smaller than No. 18 AWG (0.82 mm^2).

18.1.4 Some commonly used types of wire and flexible cord, and types of appliance wiring material that are acceptable if enclosed in accordance with 8.1, are shown in Tables 18.1 and 18.2.

18.1.5 A fixture shall use wiring rated for at least the temperature indicated in Table 18.3.

Exception: If the results of the Temperature Test in Section 28 show that wiring rated for a lower temperature is acceptable, wiring rated for that temperature may be used.

18.1.6 A means shall be provided to hold all wiring, including all through branch-circuit conductors, effectively in place within the wireway if the fixture enclosure must be opened to replace lamps or starters.

18.1.7 A reusable plastic wire-tie, a fiber strip, a smooth metal strip, or the like, is acceptable for holding wiring in place as required in 18.1.6, but an adhesive tape wrap or twist tie that consists of wires with or without a nonmetallic protective ribbon is not acceptable.

18.2 Flexing of wires

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

18.2.2 A wire or splice shall be located so that it need not be disturbed when a lamp or starter is being replaced.

Exception: Flexible wiring to a lampholder for circular lamps need not be so located.

18.3 Splices and connections

18.3.1 A splice shall be made mechanically and electrically secure and, unless an acceptable wire connector is used, shall be soldered.

18.3.2 A splice shall be inaccessible when a lamp or starter is being replaced.

18.3.3 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 with respect to the voltage and the temperature ratings as specified in Table 18.2, and to the thickness.

Table 18.1
Temperature and voltage ratings of wire and cord

Temperature rating		300 Volts	600 Volts	1000 Volts
60°C (140°F)	Wire	–	MTW, RUW, T[a], TF, TFF, TW	–
	Cord	C[a], PD[a], SJE, SJO, SJOO, SJT, SJTO, SJTOO, SP-1, SP-2, SPE-1, SPE-2, SPT-1, STP-2, SV, SVE, SVO, SVOO, SVT, SVTO, SVTOO	S, SE, SO, SOO, ST, STO, STOO	–
75°C (167°F)	Wire	FFH-1, RFH-1	FEPW[a], FFH-2, RFH-2, RH[a], RHW, RUH[a], THW, THWN, XHHW, ZW	RH-10
	Cord[b]	SJ[b], SJE[b], SJO[b], SJOO[b], SJT[b], SJTO[b], SVO, SVOO, SVT, SVTO, SPE-1, SPE-2, SPT-1, SPT-2	S[b], SE[b], SO[b], SOO, ST[b], STO, STOO, THWN	–
90°C (194°C)	Wire[c]	CF[a]	FEPW[a], RHH[a], TFFN, TFH, THHN[a], XHHW[a], Z, ZW[a]	THW
	Cord[c]	CFPD[a], HPN, SJO[b], SJOO[b], SJT[b], SJTO[b], SPE-1, SPE-2[b], SPT-1[b], SPT-2[b], SVO[b], SVOO[b], SVT[b], SVTO[b]	SO[b], SOO[b], ST[b], STOO[b]	–
105°C (221°F)	Wire	–	–	–
	Cord[b,c]	SJT[b], SPE-1[b], SPE-2[b], SPT-1[b], SPT-2[b], SVT[b]	ST[b]	–
125°C (257°F)	Wire[c]	AI[a]	AIA[a]	–
	Cord	–	–	–
150°C (302°F)	Wire	AF[a], SFF-1, XF, XFF	HF, HFF, PAFF, PFF, PGFF, PTFF, SFF-2, ZF, ZFF	–
	Cord	–	–	–
200°C (392°F)	Wire	A[a], AA[a], KF-1, KFF-1, SF-1	KF-2, KFF-2, PF, PGF, SF-2	–
250°C (482°F)	Wire	–	PAF, PFAH[a], PTF, TFE[a]	–
	Cord	–	–	–

[a] Not acceptable for use in fixtures intended to be used in damp or wet locations in accordance with Sections 62 – 70.

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

[c] See 18.1.5 for increased temperature ratings permitted by use of sleeving.

Table 18.2
Appliance wiring material insulation type, voltage, and temperature ratings[a]

Types of Insulation	Minimum thickness of insulation in inches (mm)							
	300 Volts				600 Volts			
	Without braid		With added impregnated braid cover		Without braid		With added impregnated braid or nylon cover [min 0.004 inch (0.1 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[b]	0.012	(0.30)	–	–	0.018	(0.46)	–	–

[a] 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 (480°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.

[b] Polytetrafluoroethylene or fluorinated ethylene propylene.

Table 18.3
Required temperature rating of wire

Position of wiring[a]	Temperature °C	Temperature °F
Permanently spaced no less than 3 inches (76.2 mm) from any ballast.	60	140
Less than 3 inches from, but not in contact with, any ballast except at the point of entry to the ballast	80[b]	176[b]
In contact with any ballast	90[b]	194[b]

[a] The permanently attached leads provided as a part of ballasts and fluorescent lampholders are rated for a temperature of at least 90°C (194°F). If provided with an outer braid, the braid must be retained, as the wires are rated for 75°C (167°F) without it.

[b] Wiring rated for a temperature of 75°C (167°F) or more may be used if it is provided with an outer braid.

18.3.4 General use insulating tape used in compliance with 18.3.3 is rated 80°C (170°F).

18.3.5 A wire connector, if supplied with the fixture for connection of field wires to the fixture, shall be rated for the size of wires to be connected.

18.3.6 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.

18.3.7 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 shall be accomplished by one of the following means:

a) The use of a pressure terminal connector, soldering lug, or crimped eyelet;

b) By soldering all strands of the wire together;

c) By tightly twisting all strands together;

d) By an equivalent means.

18.4 Prevention of wire damage

18.4.1 A fixture shall be constructed so that a wire can be pulled through, or the fixture otherwise wired, without damaging the covering or insulation on the conductors. A wire enclosure shall be free from burrs, fins, and other sharp edges that can contact wiring.

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

Exception: If the wiring is held or positioned away from such screw threads, the threads may be exposed.

18.4.3 If a conductor passes through an opening or crosses over the edge of sheet-metal it shall be held away from the edge of the metal or shall be protected by a bushing or a grommet or by rolling the edge of the metal no 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.

18.4.4 A bushing used to comply with 18.4.3 shall be held in place, and 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 the mechanical properties contemplated are provided.

18.5 Wiring to a lamp-supported lampholder

18.5.1 Wiring to a lamp-supported lampholder shall comply with the accessibility requirements in Accessibility of Current-Carrying Parts, Section 22, and the strain relief test requirements in 26.1 and 26.2.

Exception: A construction is considered to have acceptable strain relief provision and need not be subjected to the strain relief test if the lampholder leads are connected inside the ballast with no intervening splice between the lampholder and the ballast.

19 Polarity

19.1 If a fixture rated at a nominal 118 volts employs a single-pole switch, or if the fixture employs a ballast that has a grounded (neutral) line lead or that is marked to indicate that one of its line leads is to be connected to the grounded (neutral) conductor of the power-supply circuit, one of the leads or terminals for connection to the branch-circuit supply wires shall be white in color and shall be connected to the white (or otherwise marked) conductor of the ballast.

20 Ballasts

20.1 A fixture shall employ Class P ballast(s) (including dimming types).

Exception No. 1: A fixture provided with straight tubular lamps may employ simple reactance ballasts which are not rated Class P.

Exception No. 2: A fixture that is intended to be installed outdoors only, complies with Part 4, and is marked in accordance with 35.3 may employ simple reactance ballasts which are not rated Class P.

20.2 A fixture shall be provided with a ballast designed for the operation of lamps of the size intended for use with the fixture and shall be wired in accordance with the diagram or instructions on or with the ballast.

20.3 A fixture that employs a ballast of the dimming type, or a simple reactance type ballast with more than one lead in and one lead out, shall be investigated to determine its acceptability.

20.4 A fixture designed for a remotely mounted ballast:

a) Shall be marked in accordance with 35.1;

b) Shall be provided with means for connection of one of the supply wiring systems described in Power Supply Connection, Section 24; and

c) Shall employ other than single-pin type lampholders.

21 Electrical Spacings

21.1 An electrical spacing shall be no less than those indicated in Table 21.1, and for supply wiring terminals no less than indicated in 21.2.

Exception No. 1: Spacings may be less than specified in Table 21.1 or 21.2 within a snap switch, lampholder, ballast, and similar component device that complies with the requirements for the device.

Exception No. 2: Spacings may be less than specified in Table 21.1 or 21.2 between uninsulated live parts of such a device and dead metal that is part of the device (including mounting screws, rivets, yoke, clamp, and the like).

Exception No. 3: Spacings may be less than specified in Table 21.1 or 21.2 between live parts and that part of a dead metal surface on which the device is mounted in the intended manner.

Table 21.1
Spacings

Spacings involved			Minimum spacings									
			0 – 50 V (0 – 71 V)[a]		51 – 150 V (72 – 212)[a]		151 – 300 V (213 – 423)[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)
Between uninsulated live parts and	Uninsulated live parts of opposite polarity	Through air	1/16	(1.6)	1/8	(3.2)	1/4	(6.4)	3/8	(9.5)	3/8	(9.5)
		Over surface	1/16	(1.6)	1/4	(6.4)	3/8	(9.5)	1/2	(12.7)	1/2	(12.7)
	Uninsulated grounded dead metal parts	Through air	1/16	(1.6)	1/4	(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 figures in parentheses are peak voltages. When evaluating 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

21.2 The spacing between supply wiring terminals of opposite polarity and between the terminals and a grounded dead metal part shall be no less than 1/8 inch (3.2 mm) through air and 1/4 inch (6.4 mm) over surface, or as indicated in Table 21.1, whichever is higher.

21.3 The spacing between uninsulated live parts of different circuits involving different voltages shall be no less than that required for the circuit of the higher voltage.

21.4 Each spacing at a fuse or a fuseholder is to be measured with the fuse in place. The fuse is to have maximum standard dimensions.

21.5 Each spacing at a supply wiring terminal is to be measured with wire of the correct size for the rating connected to the terminal during intended service, but with wire no smaller than No. 14 AWG (2.1 mm^2).

21.6 When evaluating a spacing, any wire or cord not in compliance with the insulation thickness requirements in 18.1.2, 18.1.4, and 22.3.1 (including enamel-insulated wire) is considered to be a bare, current-carrying part.

21.7 If provision for the connection of conduit or armored cable is provided, the spacing shall be measured with the fitting in place, whether it is furnished with the fixture or not.

21.8 A spade or ring wire connector shall be prevented from turning by a shoulder, boss, or an equivalent means, if such turning could reduce the spacing to a value less than 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 spacing as noted in Table 21.1 or 21.2, a restraint is not required.

22 Accessibility of Current-Carrying Parts

22.1 Accessibility determination

22.1.1 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 22.1. The probe may be positioned as specified in 22.1.2.

Exception: The probe illustrated in Figure 22.2 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 34.3.4.

22.1.2 With respect to the requirement in 22.1.1, 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.

22.2 Uninsulated parts

22.2.1 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 22.4.1 – 22.4.3.

a) The uninsulated current-carrying contacts of a lampholder or automatic starter holder to which a lamp or automatic starter 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 22.1
Articulate probe with web stop

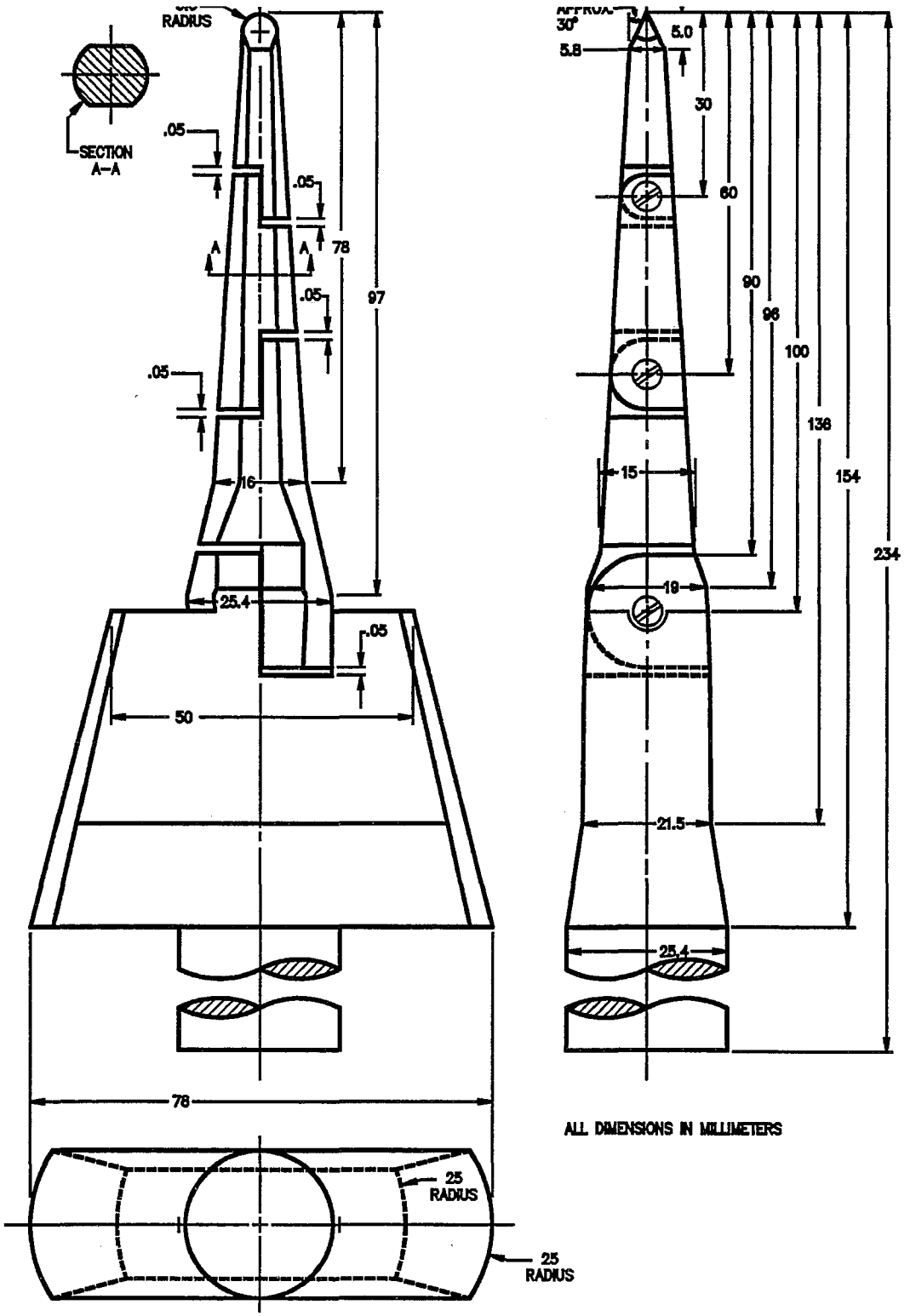
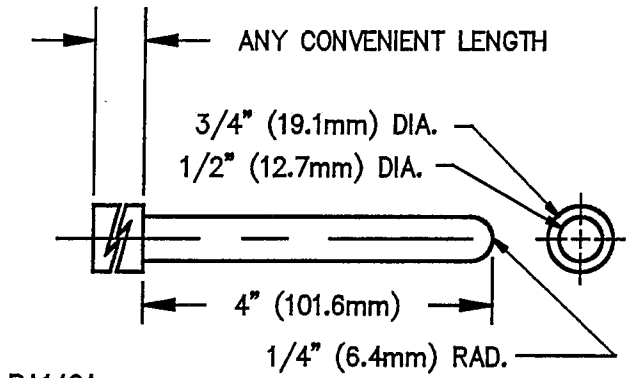


Figure 22.2
Straight probe



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22.3 Insulated parts

22.3.1 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 22.4.1 – 22.4.3.

a) Appliance wiring material that complies with the insulation requirements specified in Figure 22.3 and is routed through the chain of a chain-pendant fixture.

b) Any flexible cord specified in Table 18.1 if it is type SP2, SPT2, or heavier cord.

c) Any wire specified in Table 18.1 or any 600 volt rated appliance wiring material specified in Table 18.2 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;

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 a 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) Is accessible for no more than four inches and contains no splices; 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 18.1 or any 600 volt rated thermoplastic insulated appliance wiring material specified in Table 18.2 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 to within 1/2 inch (12.7 mm) of the lampholder from a point within the enclosure and;

4) Has no splices between the ballast and the lampholder.

e) The integral enclosure of a transformer or any other component device that complies with 22.4.1 – 22.4.3.

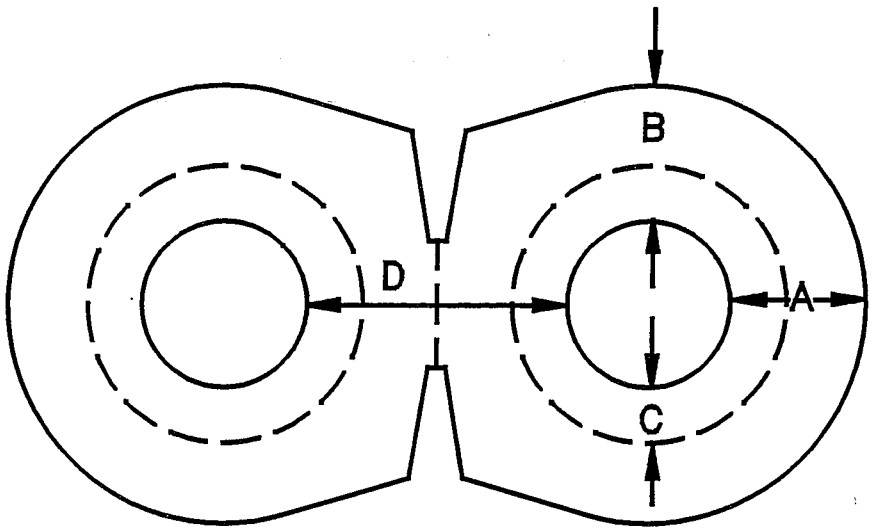
22.3.2 The following insulated current-carrying parts may be accessible to incidental contact only during user maintenance, including lamp and starter replacement:

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 22.4.1.

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.

Figure 22.3
Minimum insulation thickness for non-enclosed appliance wiring material in the chain of a chain-pendant fixture



A – Minimum acceptable average thickness away from tear area and outside point – 0.040 inch (1.02 mm).

B – Minimum acceptable thickness at any point (before separation*) – 0.035 inch (0.89 mm).

C – Minimum acceptable thickness at any point after separation* – 0.019 inch (0.49 mm).

D – Minimum acceptable distance between copper conductors* – 0.060 inch (1.52 mm).

*Not applicable for individual conductors.

22.4 Accessibility barriers

22.4.1 The accessibility barrier, as referenced in 22.2.1 and 22.3.1, 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 22.4.2.

Exception: An accessibility barrier may be of a thickness less than that specified if it complies with the requirement in 22.4.3.

22.4.2 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 59.8 of this standard.

22.4.3 The accessibility barrier as referenced in 22.2.1 and 22.3.1 need not be of the minimum thickness specified in 22.4.1 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 22.2.1 and 22.3.1 both during and after the application of the force.

23 Grounding

23.1 General

23.1.1 A fixture having a metal part not intended to be electrically live that is accessible using the probe illustrated in Figure 22.1 and that could be inadvertently energized, shall be provided with a means for connection to the branch circuit ground in accordance with 23.1.3 – 23.1.12. A means for grounding not described in 23.1.3 – 23.1.12 shall be investigated in accordance with the Standard for Electrical 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.

23.1.2 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 Fixture Fittings; Section 47 or a post arm) that are conductively connected to the fixture. See 34.2.4.

23.1.3 A means to connect the equipment grounding conductor of the branch circuit to the fixture as noted in 23.1.2 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.

23.1.4 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.

23.1.5 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.

23.1.6 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 Grounding Continuity Test, Section 29.

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

23.1.7 The cord of a cord-connected fixture shall contain an equipment grounding conductor complying with 23.1.4 and 23.1.5.

Exception: A pendant-type 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 23.1.5.

23.1.8 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.

23.1.9 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 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 23.1.5.

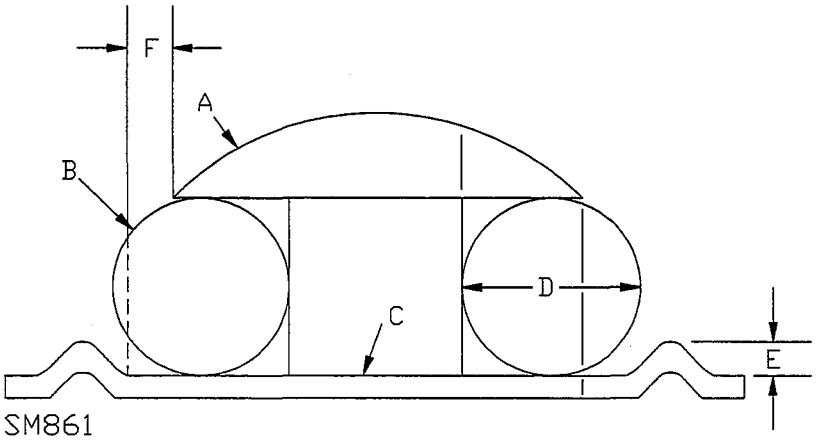
d) A sheet metal screw shall not be used.

23.1.10 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 23.1.

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

Figure 23.1
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

23.1.11 A pressure terminal intended for field connection of an equipment grounding conductor shall be plainly identified by being marked in accordance with 34.2.2.

23.1.12 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.

23.2 Bonding

23.2.1 All conductive parts of a fixture not intended to be electrically live that are accessible using the probe illustrated in Figure 22.1 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 Grounding Continuity Test, Section 29.

Exception: Chain links need not be conductively bonded.

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

23.2.3 A ballast, transformer, or similar device shall be mounted in contact with the metal of the fixture so as to provide grounding continuity.

23.2.4 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 23.2.6.

23.2.5 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.

23.2.6 A bonding wire shall be connected by:

a) A machine screw and nut;

b) A machine screw threaded into metal thick enough to permit at least two full threads;

c) A sheet metal or self-threading screw that withstands a torque of 30 inch-pounds without stripping;

d) A rivet; or

e) A means found equivalent by investigation.

23.2.7 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 29.2.

24 Power Supply Connection

24.1 Supply connection systems

24.1.1 A fixture shall be constructed so that it can be connected 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 General, Section 36. (For a suspended fixture, the provision is usually a canopy.)

b) Provision for connection of conduit as specified in 24.2.1 – 24.2.5.

c) A length of flexible cord as specified in Construction – Electrical, Section 38.

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 Construction – Mechanical, Section 37.

e) For a fixture intended for use in a suspended, T-bar grid ceiling only, or a 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 post as specified in General, Section 36.

g) For a fixture with an integral post or 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 mm) of the base.

24.1.2 A fixture shall have provision for connection to a single branch circuit of 20 amperes. This does not preclude connection to multiple inputs (usually switched) that derive from a single branch circuit.

Exception: A fixture with a dimming ballast may be connected to more than one 20 ampere branch circuit.

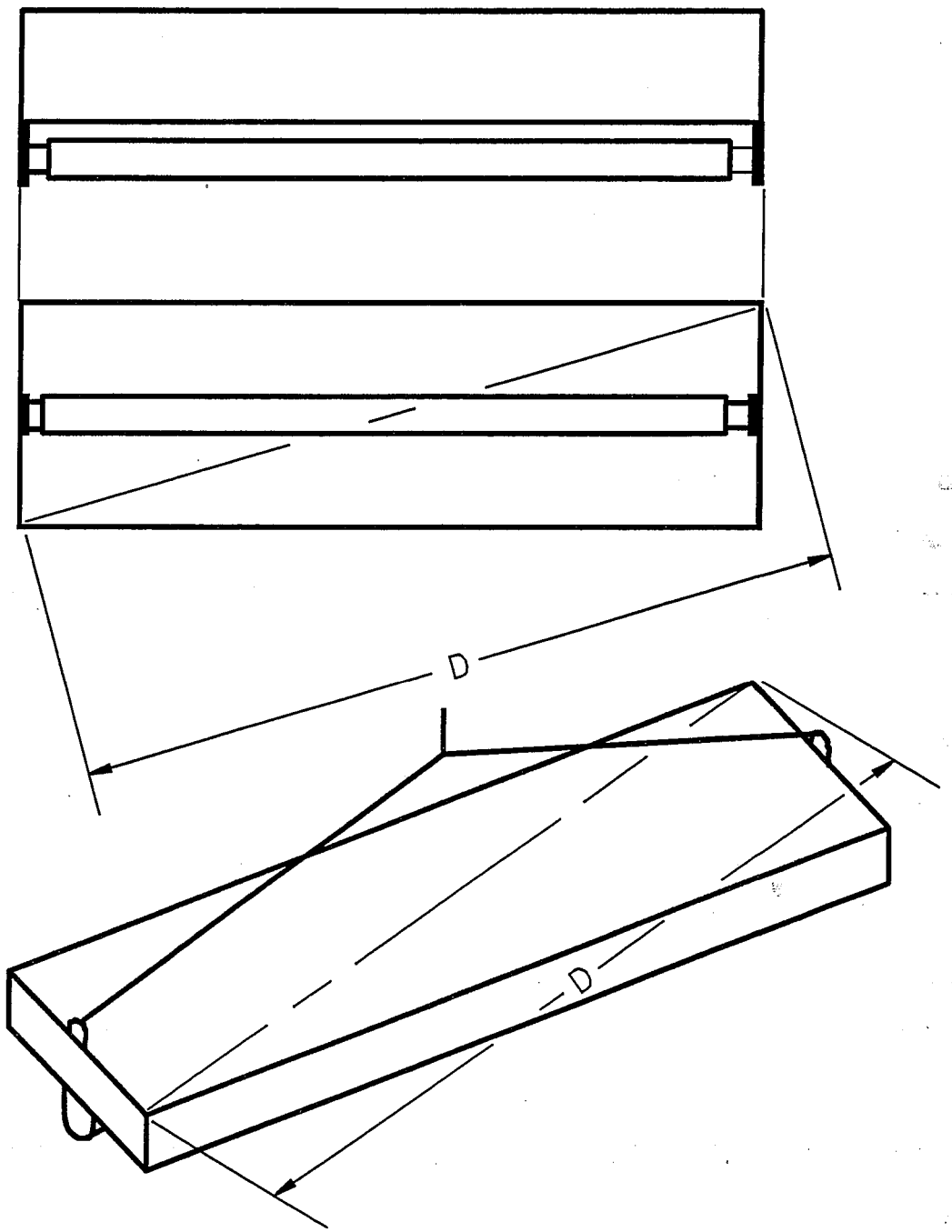
24.1.3 The provision for connection to the supply source shall permit the connections to be made at a common point without the addition of wiring in the field.

Exception: If an open hole is provided, wiring shall be provided to that hole.

24.1.4 A connection between the fixture conductor or terminal and the conductor 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.

24.1.5 The maximum length or diameter (D in Figure 24.1) used in making the weight-dimension value determination specified in 24.1.4 is to be measured in a horizontal plane with the fixture oriented in the intended position after installation, as illustrated in Figure 24.1. The maximum length is the maximum diameter or diagonal along the horizontal plane in any direction.

Figure 24.1
Maximum length of fixture



D – Maximum horizontal diameter or diagonal

24.1.6 With regard to 24.1.4, 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, such as glass parts, (crystals) attached to a chandelier, 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 24.1.4, the fixture shall be provided with a means of access to the supply wiring splices without removing the fixture or fixture part.

24.1.7 The free space volume within a wiring compartment or junction box for field connection of the fixture leads to branch circuit conductors shall be at least the number of conductors times the volume specified in Table 24.1 for the intended branch circuit rating. The number of conductors is to be determined by adding the number of branch circuit conductors that terminate inside the compartment or box to the fixture plus each branch circuit supply wire running through the compartment or box plus the grounding conductor in the compartment or box. One or more grounding conductors are treated collectively as one conductor. For example, a fixture with 4 through branch circuit wires would be: 2 (that terminate at the fixture supply leads) plus 2 (that run through the box) plus 1 for grounding times 2.25 (if intended for 20 ampere branch circuit connections) or 11.25 cubic inches (184.4 cm^3).

Table 24.1
Minimum volume required for each conductor

Intended branch circuit rating, amperes	Size of conductor		Minimum free space volume within box	
	AWG	(mm^2)	$Inches^3$	(cm^3)
15	14	2.1	2	32.8
20	12	3.3	2.25	36.8
30	10	5.3	2.5	40.9
40	8	8.4	3	49.1
50	6	13.3	5	81.9

24.1.8 Pigtail leads provided for connection to the supply branch circuit shall not extend more than 24 inches (610 mm) beyond the connection point(s) of the leads within the fixture unless general building wire is used. General building wires are identified in Table 14.1.

Exception No. 1: Recessed fixture tap conductors may extend farther than 24 inches beyond the farthest connection point if they comply with the requirements of 43.1.1 – 43.2.8.

Exception No. 2: A post-mounted fixture as described in Exception No. 2 of 37.6.1 may have pigtail leads that extend greater than 24 inches beyond the farthest connection point.

24.2 Conduit connection provision

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

24.2.2 An opening for conduit shall have dimensions as indicated in Table 24.2.

Table 24.2
Dimensions associated with openings for conduit

Nominal trade size of conduit	Unthreaded opening diameter[a]		Throat diameter				Minimum diameter of flat surface	
			Minimum		Maximum			
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 minimum tolerance of 0.015 inch (0.38 mm) applies to the knockout diameter. A knockout diameter is to be measured other than at a point where a tab may remain after removal of the knockout.

24.2.3 The minimum unobstructed diameter of the flat surface surrounding the back of an opening for unthreaded conduit shall be as indicated in Table 24.2.

24.2.4 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 nor more than five threads. The construction of the hole shall be such that a conduit bushing can be correctly attached and the minimum unobstructed diameter surrounding the back of the hole shall be as indicated in Table 24.2.

24.2.5 If threads for the connection of threaded conduit are not tapped 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 24.2.

24.2.6 A fixture designed for end-to-end mounting shall be provided with a coupling device, or shall be constructed so that there are smooth, unobstructed wireways between fixtures, unless the openings for the wires are of the trade size noted in Table 24.2.

24.2.7 A fixture intended for end-to-end mounting shall be constructed so that at least four 1/4-inch (6.4-mm) diameter wires can be run into, through, and out of the fixture after it is installed.

24.2.8 A snap-in or tab-mounted part (including an adapter plate) of other than a recessed fixture enclosure that has an opening for the field-connection of conduit shall be additionally secured by at least one screw, rivet, or the equivalent.

Exception: A snap-in or tab-mounted part that complies with the snap-in or tab-mounted parts pull test described in 27.1 – 27.4 need not be additionally secured.

24.3 Power supply connection means

24.3.1 The means for connection to a branch circuit shall consist of pigtail leads or a terminal block with pressure terminal connectors or wire binding screws.

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.

24.3.2 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 7.3.

25 Separation of Circuits

25.1 General

25.1.1 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.

25.1.2 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.

25.2 Segregation

25.2.1 The segregation required in 25.1.1 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.

25.2.2 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 25.2.1.

25.3 Separation by barriers

25.3.1 The separation required in 25.1.1 shall be provided by a barrier which can be made either of metal or of an 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.

25.3.2 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.

25.3.3 A barrier of insulating material shall have a minimum thickness of 0.028 inch (0.711 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

26 Strain Relief Test

26.1 A strain relief device for the wires of a lamp-supported lampholder is to be tested by the application of a 20 pound force (89 N) pull on the wires for 1 minute. The result is acceptable if the pull is not transmitted to terminals, splices, or internal wiring.

26.2 In testing in accordance with 26.1, 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.

27 Snap-In or Tab-Mounted Parts Pull Test

27.1 A snap-in or tab-mounted part of a fixture enclosure that:

a) Has an opening for the connection of conduit; and

b) Is not provided with an additional means of securement as required in 24.2.8;

shall be subjected to the test described in 27.2 – 27.4. If more than one opening is provided, the test is to be conducted on a different sample for each opening.

27.2 A length of rigid conduit is to be connected as intended to the conduit opening in the snap-in or tab-mounted part to be tested. The total length of the exposed conduit is to be 1 foot (305 mm). The part is then to be mounted to the fixture assembly as intended. The trade size of conduit used in the test is to be consistent with the size of the opening provided.

27.3 A force is to be applied to the free end of the conduit for 1 minute in each of the following directions:

a) A 30-pound (133-N) force is to be applied in a direction perpendicular to the plane of the part being tested.

b) A 10-pound (45-N) force is to be applied in a direction parallel to the plane of the part being tested in such a manner that a torque is applied to the part. The torque is to be applied in the direction most likely to damage the part.

27.4 Test results are acceptable if, after each application of force, the part remains attached to the fixture assembly.

28 Temperature Test

28.1 General

28.1.1 A fixture tested as described in 28.1.3 – 28.2.6 shall not attain a temperature at any point sufficiently high to present a risk of fire, to damage any materials used in the fixtures, or to exhibit rises in temperature at specified points greater than those indicated in Table 28.1.

28.1.2 Fixtures of the following types are to be subjected to a temperature test:

a) A fixture constructed as described in the Exception to 18.1.5, in 39.1.2, or both.

b) A fixture that is required, as specified in PART 3 – OTHER USES AND CONSTRUCTIONS, to comply with a temperature test.

28.1.3 The values for temperature rise in Table 28.1 are based on an assumed ambient temperature of 25°C (77°F), and the tests are to be conducted at an ambient temperature of 25°C ±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.

28.1.4 Temperature readings to determine compliance with Table 28.1 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.

28.1.5 A thermocouple is to consist of wires no larger than No. 24 AWG (0.21 mm^2) and no 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; and 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.

Table 28.1
Maximum acceptable temperature rise

Component or location		°C	°F
1.	Enclosure of automatic starter for fluorescent lamp	55	99
2.	Coil of open type device using Class 105 insulation system:		
	A. Thermocouple method	65	117
	B. Change of resistance method	75	135
	Class 130 insulation system:		
	A. Thermocouple method	85	153
	B. Change of resistance method	95	171
	Class 155 insulation system:		
	A. Thermocouple method	110	198
	B. Change of resistance method	115	207
	Class 180 insulation method:		
	A. Thermocouple method	125	225
	B. Change of resistance method	140	252
3.	Enclosure of metal enclosed and potted coil type device:		
	A. Class 105 insulation system	65	117
	B. Class 130 insulation system	85	153
	C. Class 155 insulation system	110	198
	D. Class 180 insulation system	125	225
4.	Capacitors[a,b]		
	A. Electrolytic	40	72
	B. Other types	65	117
5.	Resistor-type ballast	125	225
6.	Varnished-cloth insulation[b]	60	108
7.	Fuse	65	117
8.	Fiber used as electrical insulation	65	117
9.	Wood and other cellulosic material	65	117
10.	Insulated wires and cords	c	c
11.	Thermoplastic	d	d
12.	Point of connection of supply wires	e	e
13.	Points of fixture support	65	117

(Continued)

Table 28.1 (Cont'd)
Maximum acceptable temperature rise

Component or location	°C	°F
Recessed Fixtures		
14. Lampholder body of thermosetting material (phenolic, urea, or the like)[b]	125	225
15. Surface to which a marking label is attached	f	f
16. Metal of recessed housing (Type IC)	65	117
17. Insulation in contact with recessed housing and other parts of a fixture	65	117
18. Metal of recessed housing (Non-Type IC)	125	225
19. Wood of test box (Non-Type IC)	65	117
Wet Location Fixtures		
20. Gaskets	g	g

[a] For capacitors not integral with, and enclosed by, items 1, 2, and 5.

[b] These limitations do not apply to compounds or components that are rated for a higher temperature.

[c] 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 Wiring and Conductors, Section 18.

[d] The maximum temperature, when corrected to a 25°C (77°F) ambient temperature, is the temperature rating of the thermoplastic used as specified in Polymeric Materials, Section 59.

[e] Any temperature rise up to 65°C (117°F) is acceptable if consistent with the marking on the fixture as specified in 34.2.7.

[f] 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 or E marking as specified in 32.3.

[g] The maximum temperature of the material is acceptable is the material complies with the requirements in 69.8.1.

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

28.2 Normal test conditions

28.2.1 Conditions for the performance of normal temperature tests for fixtures are to be as indicated in 28.2.2 – 28.2.6 and 39.1.3 for surface-mounted fixtures, 44.1.1 for recessed fixtures, and as modified in Part 3 for other uses and constructions.

28.2.2 A fixture subjected to a temperature test is to be connected to a supply circuit of rated voltage and frequency and operated until constant temperatures are attained. Rated voltage is considered to be:

a) 120 volts if the marked rating is within the range of 110 – 125 volts; or

b) 240 volts if the marked rating is within the range of 220 – 250 volts.

If the voltage rating of the fixture does not fall within either of the indicated voltage ranges, the unit is to be tested at its rated voltage.

28.2.3 A fluorescent lamp used for a temperature test is to be of the type rated for the ballast involved.

28.2.4 For a fixture intended to accommodate, or be provided with, branch circuit wires that are wired through, the temperatures on the branch circuit wires are to 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 held in place by a single wrap of tape.

28.2.5 A fixture part designed to be adjustable by the user is to be positioned or adjusted to cause maximum heating of the fixture.

28.2.6 The temperature of the enclosure of a metal-enclosed and potted device is to be measured by soldering the thermocouple tip to the metal enclosure of the device.

29 Grounding Continuity Test

29.1 To determine compliance with 23.2.7, 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.

29.2 Any indicating instrument may be used to determine compliance with 23.2.7, but if unacceptable results are obtained, either an alternating or direct current of at least 25 amperes from a power supply of no 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.

30 Glass Support Test

30.1 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(s).

31 Metal Thickness Equivalency Tests

31.1 General

30.1.1 In accordance with Exception No. 2 to 9.1.1, any fixture that employs metal that is thinner than specified in Table 9.1 is to be subjected to the applicable tests described in 31.2.1 – 31.6.6.

31.2 Compression test

31.2.1 The fixture shall be subjected to the compression test described in 31.2.2 and shall comply with the results specified in 31.2.3.

31.2.2 The fixture is to be placed on a flat horizontal surface. A rod with a one-inch (25.4-mm) diameter flat face shall be used to apply a 25-pound (111-N) force to the center of the surface of any sheet metal part of a fixture that acts as an enclosure, provides structural integrity for the fixture, or supports a wiring device.

31.2.3 The results are acceptable if there is no deformation of the fixture such that there is reduction of spacings or exposure of uninsulated live parts as described in 22.2.1.

31.3 Flexing test

31.3.1 If the fixture is of the pendant type and is supported by two or more supports, it shall be subjected to the flexing test described in 31.3.2 and shall comply with the results specified in 31.3.3.

31.3.2 The pendant fixture is to be supported on wooden blocks, each located directly below the point of connection of the supports. Each wooden block is to be no more than 1 inch (25.4 mm) wide at the point where it contacts the fixture and may be as long as is needed to support the fixture. A 20-pound (89-N) force shall be applied to a 6 inch by 6 inch (152 mm by 152 mm) piece of 3/4-inch (19-mm) thick plywood centered on the top surface of the fixture midway between the two points of support closest to the ends of the fixture.

31.3.3 The results are acceptable if the deflection under load of the fixture is no more than 1/4 inch (6.4 mm) at any point.

31.4 Loading test

31.4.1 If the fixture is of the pendant type and is supported by two or more supports, it shall be subjected to the loading test described in 31.4.2 and shall comply with the results specified in 31.4.3.

31.4.2 The pendant fixture is to be suspended by the supports provided. A force equal to four times the weight of the fixture shall be applied to a 6 inch by 6 inch (152 mm by 152 mm) piece of 3/4-inch (19-mm) thick plywood centered on the top surface of the fixture.

31.4.3 The results are acceptable if there is no deformation of the fixture during loading such that:

a) There is reduction of spacings;

b) There is exposure of uninsulated live parts as described in 22.2.1; or

c) The fixture breaks free of the supports.

31.5 Impact test

31.5.1 The fixture shall be subjected to the impact described in 31.5.2 and shall comply with the results specified in 31.5.3.

31.5.2 Each of three samples of the fixture shall be subjected to a single impact of 5.0 foot-pounds (6.8 N•m) on any sheet metal surface that does not comply with Table 9.1 and that:

a) Acts as an enclosure;

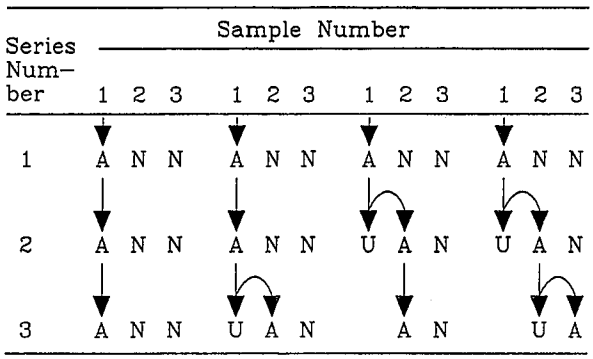
b) Provides structural integrity for the fixture; or

c) Supports a wiring device.

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 specified impact. For surfaces other than the top of an enclosure, the steel sphere is to be suspended by a cord and swung as a pendulum, dropping through the vertical distance necessary to cause it to strike the surface with the specified impact. Three samples shall be employed for the tests with the fixture held in place. However, if the manufacturer so elects, fewer samples may be used in accordance with Figure 31.1. The overall performance is acceptable upon completion of any one of the sequences represented in Figure 31.1.

Figure 31.1
Procedure for impact test

Each series consists of one ball impact as applicable



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31.5.3 The results are acceptable if there is no reduction of spacings or exposure of uninsulated live parts.

31.6 Torque test and cantilever test

31.6.1 If the fixture is of the pendant type and is supported by two or more supports, it shall be subjected to the torque test and cantilever test described in 31.6.3 and 31.6.5 and shall comply with the results specified in 31.6.4 and 31.6.6.

31.6.2 For these tests, the manufacturer is to provide both:

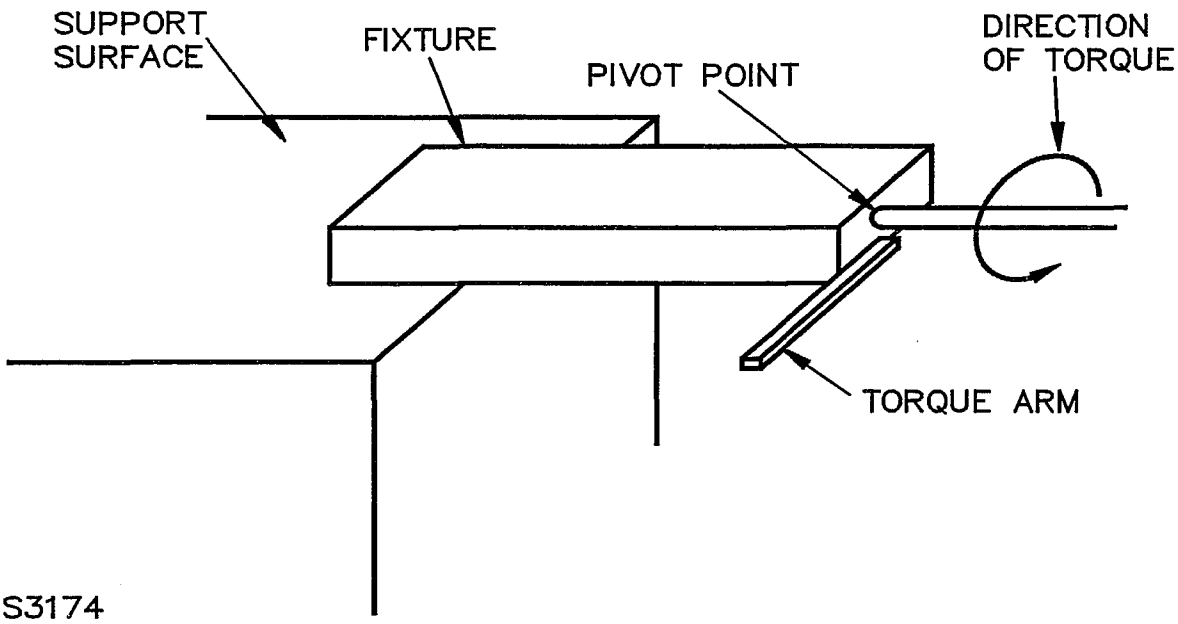
a) The fixture under investigation which complies with all the requirements in this standard except for the sheet metal thickness requirements in Table 9.1; and

b) A representative fixture which is similar in construction to the fixture under investigation and complies with the requirements in this standard, including the sheet metal thickness requirements in Table 9.1.

Both the representative fixture and the fixture under investigation shall be subjected to the torque and cantilever tests.

31.6.3 Both the representative fixture and the fixture under investigation are each to be securely mounted at one end to a solid horizontal surface as shown in Figure 31.2. The opposite end of each fixture is to be supported at the same height as the fixed end by means of a pivot arm attached to the pivot point on the fixture such that the fixture is free to twist around its major axis. A torque arm, 24 inches (610 mm) in length, is to be connected to the pivot end of each fixture at a right angle to its major axis. A 1-pound (4.4-N) force is to be applied to one end of the arm in a direction to cause each fixture to twist along its major axis.

Figure 31.2
Torque test



31.6.4 The results are acceptable if the angle of rotation of the fixture under investigation is less than or equal to the angle of rotation of the representative fixture.

31.6.5 Both the representative fixture and the fixture under investigation are each to be securely mounted at one end to a solid horizontal surface. The opposite end of each fixture is to be suspended by the support provided with the fixture. A 25-pound (111-N) force is to be applied to the suspended end of each fixture.

31.6.6 The results are acceptable if the deflection of the fixture under investigation at the location of the force is less than or equal to the deflection of the representative fixture.

MARKINGS

32 General

32.1 Marking on or with a fixture shall be legible, shall be one of the designated types, shall have a minimum height designated by form letter in Table 32.1, and shall be in one of the locations designated by form numbers in Table 32.2. The wording form letter, and form number shall be in accordance with specifications elsewhere in this standard for the particular case.

32.2 If the wording of a particular marking is given within quotation marks in this standard, the actual wording shall be used.

Exception: Words located between parentheses are optional.

32.3 The combination of a label material and printed ink used for Forms A and E in Table 32.1 shall be permanent, rated for the type of surface to which it will be affixed, and rated for a temperature of at least 60°C (140°F) in accordance with the Standard for Marking and Labeling Systems, UL 969, or 90°C (194°F) for a material located within 3 inches (76.2 mm) of a ballast.

32.4 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.

Table 32.1
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	(1) Lettering on pressure-sensitive label, (2) decalcomania transfer, (3) paper label, (4) paint-, ink-, or die-stamped lettering, (5) 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 a tie-on tab, stuffer sheet, or on the carton in which the fixture is packaged, or the equivalent.	Not specified	
D	In combination with the listing mark	Not specified	
E	Paint-stenciled, die-stamped, indelibly printed lettering[a], or indelibly printed label[b]	1/4	6.4
F	Indelibly printed, paint-stenciled, embossed[c], ink stamped lettering (including rubber ink stamps), indelibly printed 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 indelibly printed 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 32.4.

[b] An indelibly printed label shall comply with 32.3.

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

Table 32.2
Form designations
for location of markings

Form number of marking	Location
1	On exterior surface that will be visible after fixture is installed, except that, in the case of residential fixtures only, the marking may be at a point where it will be visible when making and inspecting the connections to the branch-circuit supply wires. In any case, 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. It is recommended that it can be on the exterior of a residential fixture when practicable.
2	Where visible during or after installation.
3	Visible to the installing electrician during installation.
4	Where 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	Adjacent to the ballast and visible before and during ballast replacement.
7	At a point where visible during relamping.
8	Near the classification mark and where visible after installation or during inspection of splices to the branch and circuit supply wires.
9	On smallest unit packaging.

33 Identification and Ratings

33.1 Identification

33.1.1 A fixture shall be marked in Form B-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 in this standard as the manufacturer). Form designations are specified in 32.1.

33.1.2 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.

33.1.3 A fixture intended for use with germicidal lamps shall be marked with the words "This fixture is designed for use with germicidal lamps and must be installed in compliance with competent technical directions so that the users' eye and bare skin will not be subjected to injurious rays". The marking shall be in Form A-1, unless it is preceded by the word "CAUTION" in letters no less than 1/8 inch (3.2 mm) in height, in which case it may be in Form B-1.

33.1.4 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."

33.1.5 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.

33.2 Ratings

33.2.1 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 marked with its electrical rating.

33.2.2 The marked voltage rating required in 33.2.1 is not to exceed the voltage rating of the ballast or ballasts employed, and if the input voltage rating of the ballast or ballasts used is less than 118 volts, the fixture is to be marked in Form B-4 "CAUTION – Do not use on a supply circuit of more than volts" with the indicated voltage value being the rated input voltage.

33.2.3 Instead of the current rating in amperes, a fixture employing a high-power-factor, reactor-type ballast or ballasts for bi-pin lamps (preheat or rapid start types) may be marked in Form B-4 "For line volt-amperes, multiply total lamp wattage by 1.25". Similarly, a fixture employing a low-power-factor, reactor-type ballast or ballasts for bi-pin lamps may be marked in Form B-4 "For line volt-amperes, multiply total lamp wattage by 2.5".

33.2.4 Instead of the current in amperes, a fixture employing single-pin lamps (instant start type) and a high-power-factor ballast or ballasts may be marked in Form B-4 "For line volt-amperes, multiply the total length of all lamps in inches by _____". The multiplying factor to be used in the preceding statement is to be as indicated in Table 33.1.

Table 33.1
Multiplying factors for ballasts

Maximum ballast output current in milliamperes	Minimum acceptable multiplying factor
120 or less	0.6
121 – 200	0.8
201 – 300	1.2
301 – 460	1.5

34 Fixture Orientation, Assembly, and Supply Connection

34.1 Orientation and assembly

34.1.1 An open-end fixture unit that is designed for continuous end-to-end installation shall be marked in Form B-3 "When installed, any open end shall be closed by an end plate", unless two end plates are supplied with each fixture. Form designations are specified in 32.1.

34.1.2 If a fixture can be mounted in more than one orientation, and if the correct orientation of the fixture is required in order to comply with a specific requirement elsewhere in this standard, the fixture shall be marked, in Form B-2, to indicate the correct orientation.

34.1.3 A fixture that is intended to be mounted on a wall shall be marked in Form B-2 "Wall mount Only".

34.1.4 A ceiling- and/or wall-mounted fixture tested on an uninsulated ceiling as described in the Exception to 39.3.4 shall be marked in Form F-3 "Mount on _____ only." The blank is to be filled with an identified noncombustible material (such as concrete or steel).

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

34.1.6 A fixture employing a frame assembly with glassware secured by adhesive shall be marked on the frame in Form B-7 "Replace only with complete assembly" or the equivalent if glassware needs replacement.

34.1.7 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-3 "WARNING – Risk of electric shock. Disconnect power before servicing".

34.1.8 A fixture that is not provided with a means for the physical support of conductors in a post or pole in accordance with 38.6.1 shall be marked in Form B-2 "Do not install on a post or pole that results in a vertical rise of 25 feet or higher".

34.2 Supply connection

34.2.1 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 part number of the proprietary system to which the fixture is to be connected.

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

34.2.2 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.

34.2.3 A fixture that employs a 2-wire, parallel blade, non-grounding type receptacle shall be marked in Form B-4 "For replacement use only. Do not use this fixture to replace grounded fixture".

34.2.4 A fixture not provided with a grounding means as described in the Exception to 23.1.2 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."

34.2.5 A fixture shall be marked in Form C "If supply wires are located within three inches (76.2 mm) of ballast, use wire rated for at least 90°C (194°F)".

Exception No. 1: No marking is required if testing indicates that surface temperatures on the ballast or on a barrier that may come in contact with the supply wire are less than or equal to 60°C (140°F).

Exception No. 2: If testing indicates that surface temperatures on the ballast or on a barrier that may come in contact with supply wire are greater than 60°C and less than or equal to 75°C (167°F), the fixture may be marked in Form C "If supply wires are located within 3 inches (76.2 mm) of ballast, use wire rated for 75°C (167°F)".

34.2.6 The wording of the markings described in 34.2.5 shall be at least 1/8 inch (3.2 mm) high. The marking shall also be provided on the carton or package in which the fixture is packed, in minimum 1/4-inch (6.4-mm) high letters.

34.2.7 A fixture subjected to a temperature test shall be marked in Forms F-4 and H-9 "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 34.1.

Exception No. 1: As noted in Table 34.1, if the attained temperature is 60°C (140°F) or less, the marking need not be provided.

Exception No. 2: If the fixture is provided with tap conductors, the fixture may be marked in Form F-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 (0.3 m) 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 34.1
Temperature markings

Temperature attained at point where power-supply wires are connected				Marked temperature	
Rise[a]		Scale[b]			
°C	(°F)	°C	(°F)	°C	(°F)
35 or less	63 or less	60 or less	140 or less	–	–
36 – 50	65 – 90	61 – 75	142 – 167	75	167
51 – 60	92 – 108	76 – 85	169 – 185	85	185
61 – 65	110 – 117	86 – 90	187 – 194	90	194

[a] From Table 28.1, item 12.

[b] Obtained by adding temperature rise and 25°C (77°F).

34.2.8 Only one temperature value is to be marked on a fixture construction as shipped from the manufacturer, even if it has been found acceptable at lower temperatures, as the result of tests with different lamps.

34.3 Installation instructions

34.3.1 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 equivalent: "RISK OF FIRE AND ELECTRIC SHOCK. THIS PRODUCT IS TO BE INSTALLED BY A QUALIFIED ELECTRICIAN ONLY," or equivalent wording, in letters at least 1/4 inch (6.4 mm) in height.

34.3.2 A fixture that employs a 3-wire receptacle shall be provided with the proper grounding instructions in accordance with 34.3.1 and shall be marked on the instructions with the following or equivalent wording: "This fixture employs a grounded type receptacle and is not intended for connection to a two-wire, ungrounded source of supply," or equivalent wording.

Exception: A fixture need not be provided with the marking if the fixture carton is marked with the word "WARNING" and the following or equivalent: "RISK OF FIRE AND ELECTRIC SHOCK. THIS PRODUCT IS TO BE INSTALLED BY A QUALIFIED ELECTRICIAN ONLY," or equivalent wording, in letters at least 1/4 inch (6.4 mm) in height.

34.3.3 A fixture that is provided with supply connections rated more than 60°C (140°F) but no more than 90°C (194°F) shall include the word "WARNING" and the following or equivalent wording: "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-9) and on the installation instructions described in 34.3.1.

Exception: A fixture need not be provided with this warning if the fixture carton is marked with the word "WARNING" and the following or equivalent: "RISK OF FIRE AND ELECTRIC SHOCK. THIS PRODUCT IS TO BE INSTALLED BY A QUALIFIED ELECTRICIAN ONLY," or equivalent wording, in letters at least 1/4 inch (6.4 mm) in height.

34.3.4 A fixture rated for less than 277V that complies with the accessibility requirements in the Exception to 22.1.1 shall be marked in Forms C-3 and H-9 "Not for Residential Use."

35 Ballasts

35.1 A fixture not provided with or designed for an integral ballast shall be marked in Form A-3 "This fixture to be connected to a Class P ballast suitable for ____ type lamps", where the blank is filled with the type of lamp for which the fixture is designed.

35.2 Fixtures that employ lamps with integral starters shall be marked in Form A-7 with the following: "WARNING -- Risk of fire. Use only type _____ lamps rated _____ watts."

Exception: The marking need not be provided if the fixture employs a Class P ballast.

35.3 A fixture that employs a non Class P ballast as specified in Exception No. 2 to 20.1 shall be marked in forms B-1 and B-9 (see 32.1) "Outdoor Use Only" in letters no less than 1/8 inch (3.2 mm) in height on the fixture and 1/4 inch (6.4 mm) in height on the carton. The carton shall not be provided with any information or illustrations that implies or depicts indoor use.

PART 2 – SURFACE-MOUNTED AND RECESSED FIXTURES

SURFACE-MOUNTED FIXTURES

36 General

36.1 In addition to the requirements in Sections 1 – 35, a surface-mounted fixture shall comply with the requirements under this heading.

37 Construction – Mechanical

37.1 Enclosures

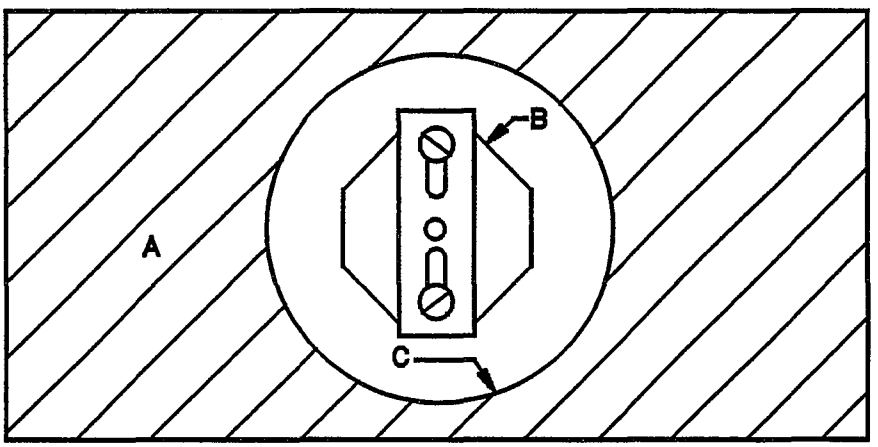
37.1.1 A surface-mounted, outlet-box connected fixture shall be provided with a back enclosure that may contain an opening with a maximum area of 180 square inches (1161 cm^2). The back enclosure shall comply with 8.1 and the dimensions of the opening shall be as specified in (a) or (b).

a) For a circular opening the diameter shall be no greater than 15 inches (381 mm), as shown in Figure 37.1.

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 37.2.

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).

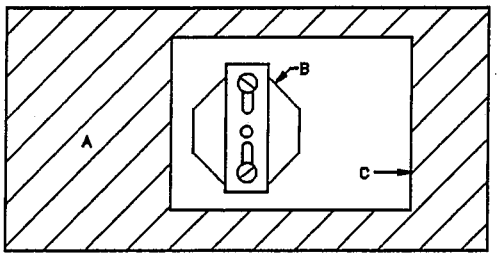
Figure 37.1
Dimensions of circular opening



S3320

A – Enclosure (canopy) back.
B – Outlet box.
C – Circular opening with maximum 15-inch (381-mm) diameter.

Figure 37.2
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).

37.2 Mounting means

37.2.1 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 pendant mounting by chain, cable, hook(s), or stem; or

f) Provision for support by threaded conduit.

37.2.2 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.

37.2.3 A fixture with provision for mounting to an outlet box shall not be provided with a table, shelf, or tray surface, or a basket, hook, eye, or other feature that would invite the addition of weight.

37.2.4 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.

37.2.5 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.

37.2.6 Unthreaded tubing shall be secured in place so that the force required to pull it out or bend it will be no 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.

37.2.7 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.

37.2.8 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 no 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 (4.2 mm diameter) size.

37.2.9 A swivel joint in a single-stem fixture shall be constructed so that turning will not cause damage to the insulation on the wires. The joint shall be constructed so that rotation of the fixture is limited to 360 degrees or less.

37.3 Open holes for fixture mounting

37.3.1 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 37.3.2 for open back fixtures and in 37.3.3 for other types.

37.3.2 An open back fixture that is to be supported by an outlet box shall be provided with only one of the following:

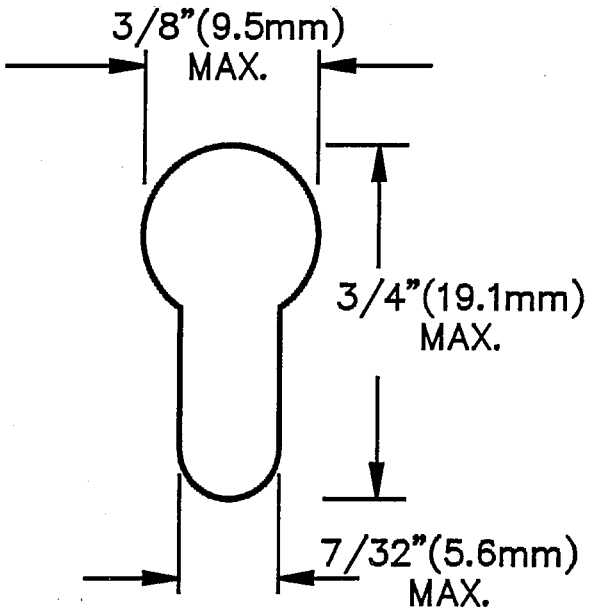
a) A crossbar with means for attachment to the fixture, where the open hole in the fixture will be fitted with a threaded tube to the crossbar.

b) Two open holes or two open keyhole slots for securing the fixture to an outlet box. Holes shall be maximum 7/32 inch (5.6 mm) diameter, and keyhole slots shall not exceed the dimensions shown in Figure 37.3.

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 8.2. The maximum hole size shall be 7/32 inch and keyhole slots shall not exceed dimensions shown in Figures 37.3 and 37.4.

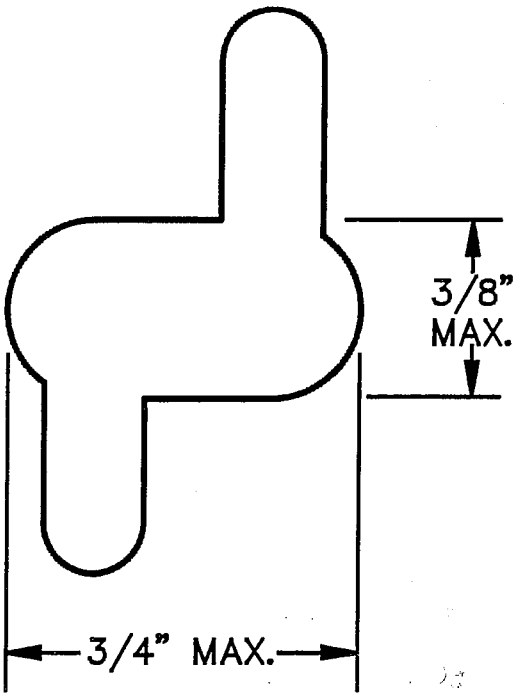
d) Any means for mounting that has been investigated and found to be the mechanical equivalent of (a) – (c). The area of open holes remaining, after mounting screws are in place, shall not exceed the unused area of four keyhole slots of maximum size as shown in Figures 37.3 and 37.4, or a total of 1-1/4 square inches (8.06 cm^2).

Figure 37.3
Keyhole slot



EC610

Figure 37.4
Joined keyhole slot



SI Equivalents

Inch	(mm)
7/32	5.6
3/8	9.5
3/4	19.1

37.3.3 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 no larger in size than 1/4 by 1/2 inch (6.4 by 12.7 mm), or 0.40 inch (10.2 mm) in diameter. A fixture of this type may have two such holes in addition for each additional 24 inches (610 mm) of length in excess of 50 inches (1.27 m).

37.4 Open holes for component mounting

37.4.1 Open holes may be provided in the back enclosure, facing the mounting surface, to permit factory mounting of alternative equipment, such as ballasts, 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 alternative 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 alternative equipment, is 0.05 square inch (0.32 cm^2).

d) The maximum total area of all unused open holes for alternative component mounting is 0.80 square inch (5.16 cm^2).

37.5 Open holes for pendant devices

37.5.1 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 suspension device. One or more knockouts may be provided in addition to, or in lieu of, the open hole or holes.

37.6 Access openings

37.6.1 A fixture intended to be mounted over an outlet box, or to a pole or post, shall be provided with an opening to permit access to the supply wiring splices without removing the fixture from the mounting surface, pole, or post.

Exception No. 1: A fixture need not be provided with a means of access to the supply wiring splices under the conditions described in 24.1.4 – 24.1.6.

Exception No. 2: A pole- or post-mounted fixture that:

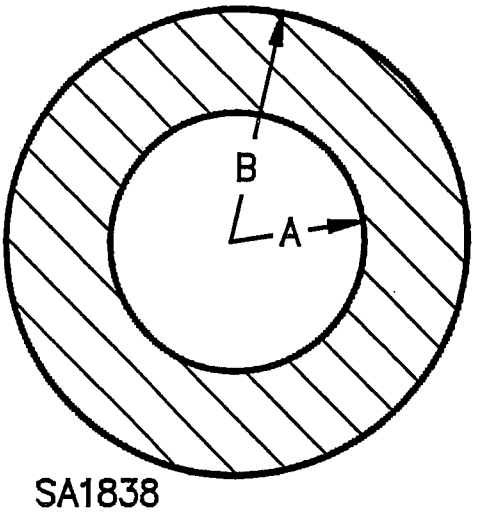
a) Is marked for use with, or shipped with, a pole or post as specified in 47.1.3 or a post arm that contains an access opening; and

b) Is provided with leads long enough to reach 6 inches (152 mm) beyond the access opening in the pole, post, or post arm;

need not be provided with the opening described above.

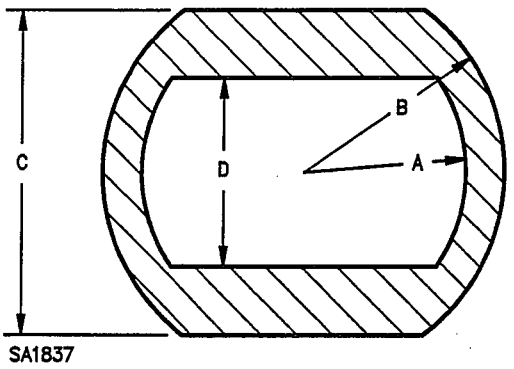
37.6.2 The access opening shall be of such size that the perimeter of the opening lies in the shaded area shown in Figure 37.5 or 37.6.

Figure 37.5
Access opening



A. 1 inch (25.4 mm) radius
B. 1-7/8 inch (47.6 mm) radius

Figure 37.6
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) maximum

37.6.3 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 8.1, or may consist of a glass fiber cylinder with a minimum wall thickness of 1 inch (25.4 mm), secured so as not to be disturbed during installation and field wiring of the fixture.

37.7 Miscellaneous open holes

37.7.1 An open hole provided in a wiring enclosure for purposes other than specified in 37.3.1 – 37.6.3 shall be located no closer than 1/2 inch (12.7 mm) to the building mounting surface or in a canopy or an open back fixture and shall comply with the area requirements specified in 10.4 and 10.5.

38 Construction – Electrical

38.1 Attachment plug equipped

38.1.1 A fixture designed for chain, hook, or similar pendant means 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 40.2.

38.1.2 A flexible cord shall be of Type SJ, SJE, S, SE, SO, SOO, SJO, SJOO, SJT, SJTO, SJTOO, ST, STO, or STOO.

38.1.3 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 38.1.

Table 38.1
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

38.1.4 A fixture with a power supply 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 40.1 and the strain relief device is provided.

38.1.5 On a fixture that will allow the cord to be pushed back into the fixture so that the spacing (between the cord and a ballast) mentioned in Table 18.3 is less than 3 inches (76.2 mm), the cord shall be rated for at least 90°C (194°F).

38.1.6 A strain relief device shall be provided. The device shall comply with the test requirements in 39.4.1 when subjected to a pull of 35 pounds force (156 N).

38.2 Cord-pendant

38.2.1 If a fixture or fixture part is designed to be supported by a flexible cord, the flexible cord shall be one of the following types:

a) Cord 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 in place over the insulation of each conductor of the cord where the jacket has been removed to make connections within the fixture; and

4) The jacket is removed for a distance of 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.

38.2.2 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 39.4.1 and 39.4.2 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 40.3, to show the method of strain relief that is to be applied in the field, such as a knot in the cord.

38.3 Cord-equipped adjustable fixture

38.3.1 A spot, flood, or other fixture that is adjustable after installation to change the angle of light may be provided with a flexible cord for connection to the power supply.

38.3.2 The cord mentioned in 38.3.1 shall comply with the requirements in 38.1.2 – 38.1.6 and shall be no more than 6 feet (1.83 m) and no less than 3 feet (0.91 m) in length. 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 standard conduit opening.

38.4 Chain-pendant

38.4.1 A chain- and canopy-pendant fixture shall be wired with stranded conductors arranged so that the weight of the fixture will not stress the conductors.

38.5 Outlet box mount provision

38.5.1 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).

Exception: A fixture to which supply connections are made to circuit-interrupting type lampholders at the low-voltage end of the fixture needs leads only long enough to reach the nearest opening.

38.6 Pole- or post-mounted fixtures

38.6.1 A fixture intended for pole- or post-mounting shall have a means of physical support for the wiring in the post. The support means may be either in the fixture itself or, if the fixture is shipped with, or marked for use with, a fixture fitting (such as a pole, post, or post arm), the means may be in the fitting. The acceptability of the support means shall be determined in accordance with 39.4.3.

Exception: A fixture need not be provided with strain relief if it is marked to prohibit its use on a post or pole that results in a vertical rise of 25 feet (7.62 m) or higher, as indicated in 34.1.8.

38.6.2 A pole- or post-mounted fixture shall comply with the dry location requirements specified in Part 1 or with the wet location requirements specified in Sections 66 – 70.

38.7 Stem-pendant fixtures

38.7.1 A pull-type switch or switch knockout provided in a stem-pendant fixture shall be located no more than 3-1/2 inches (89 mm) in any direction from the centerline of the stem if one single stem is employed. Such a switch or switch knockout provided in a fixture designed to be mounted on more than one stem shall be located in that part of the fixture that is between two stems or shall be spaced from the centerline of the nearest stem a distance of no more than one-half the distance between two stems, or spaced from the centerline of the nearest stem a distance no more than one-half the maximum distance between two adjacent stems.

38.7.2 If a fixture is designed to be mounted in a continuous row and supported by one stem located at the junction of each two fixtures and one stem at each end of the row, each fixture in the row is considered to be supported by two stems.

38.7.3 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 no 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 shall be no 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.

39 Performance

39.1 Temperature test – general

39.1.1 A fixture employing:

a) Class P ballast(s); or

b) Any ballast and straight tubular lamp(s);

need not be subjected to the temperature tests in 39.1.3 – 39.3.5. Also see 39.1.2.

39.1.2 A fixture shall be subjected to the normal temperature test if the fixture employs:

a) More than one ballast in which any ballast is spaced less than 1 inch (25.4 mm) end-to-end or 4 inches (102 mm) side-to-side from each other; or

b) Wire that is not spaced or rated as specified in 18.1.5 and Table 18.3.

39.1.3 A surface-mounted fixture shall be installed as described in 39.1.4 – 39.3.5 and subjected to the Temperature Test specified in Section 28 and 39.1.2.

39.1.4 A surface-mounted fixture shall be tested as a ceiling-mounted fixture.

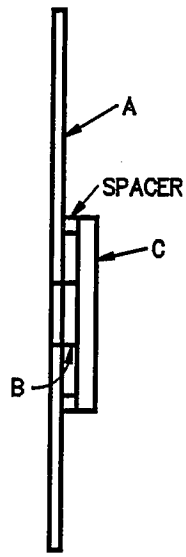
Exception: A fixture marked for "wall mount only" as specified in 34.1.3 need only be tested as a wall-mounted fixture.

39.2 Temperature test – wall-mounted fixtures

39.2.1 During the test, the fixture is to be mounted on the test wall described in 39.2.2 and 39.2.3. The fixture is to be located directly over the junction box.

39.2.2 The test wall is to be constructed as shown in Figure 39.1. The junction box is to be mounted through a hole in the wall such that the face of the box is flush with the face of the test wall. The box is to be secured to the wall by means of a support screwed to the back of the box and wall with the appropriate spacers.

Figure 39.1
Section of test wall



SM213

A – 1/2 inch thick plywood sheet. B – 4 inches by 1-1/2 inches deep octagonal trade size standard metal knockout box. C – 2 by 4 inch trade size pine lumber, one foot long. Spacer – 1 inch thick.

39.2.3 The test wall is to have dimensions such that it projects beyond the perimeter of the fixture after the fixture is installed.

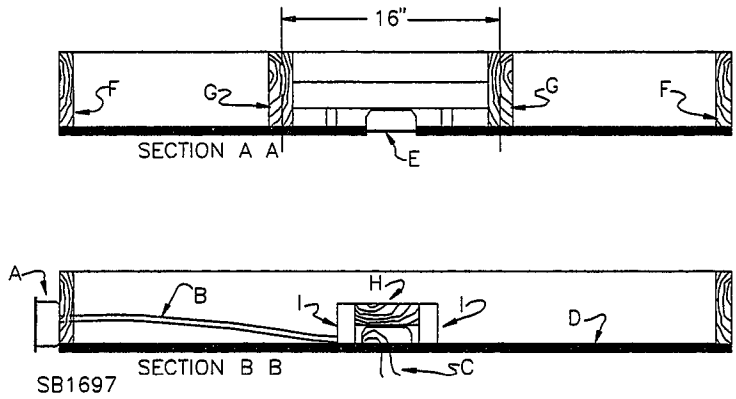
39.3 Temperature test – ceiling-mounted fixtures

39.3.1 During the test, the fixture is to be mounted on the test ceiling described in 39.3.3 and 39.3.4. The fixture is to be located directly under the junction box.

39.3.2 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.

39.3.3 The test ceiling is to be constructed as shown in Figures 39.2 and 39.3. The junction 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 39.2
Sections A – A and B – B of test ceiling



See Figure 39.3 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-fiberboard.

E – 4 inches by 1-1/2 inch deep octagonal trade size standard metal knockout box.

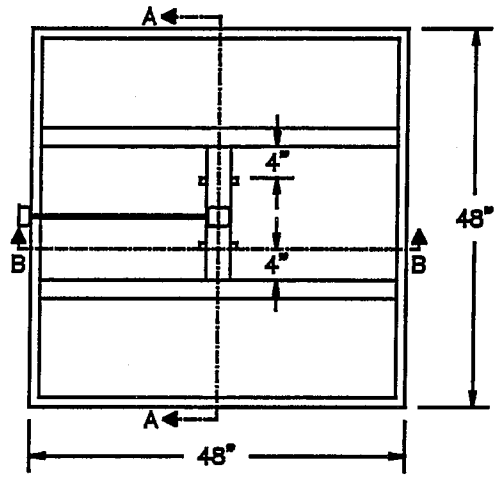
F – 1 by 6 inches.

G – 2 by 6 inches.

H – 2 by 4 inches.

I – 1 by 1 inch, all trade size pine lumber.

Figure 39.3
Plan of test ceiling



SB1700

39.3.4 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 34.1.4, the test ceiling is not required to be filled with insulation.

39.3.5 For surface mounted fixtures, supply wire temperatures are to be measured as described in 39.3.6.

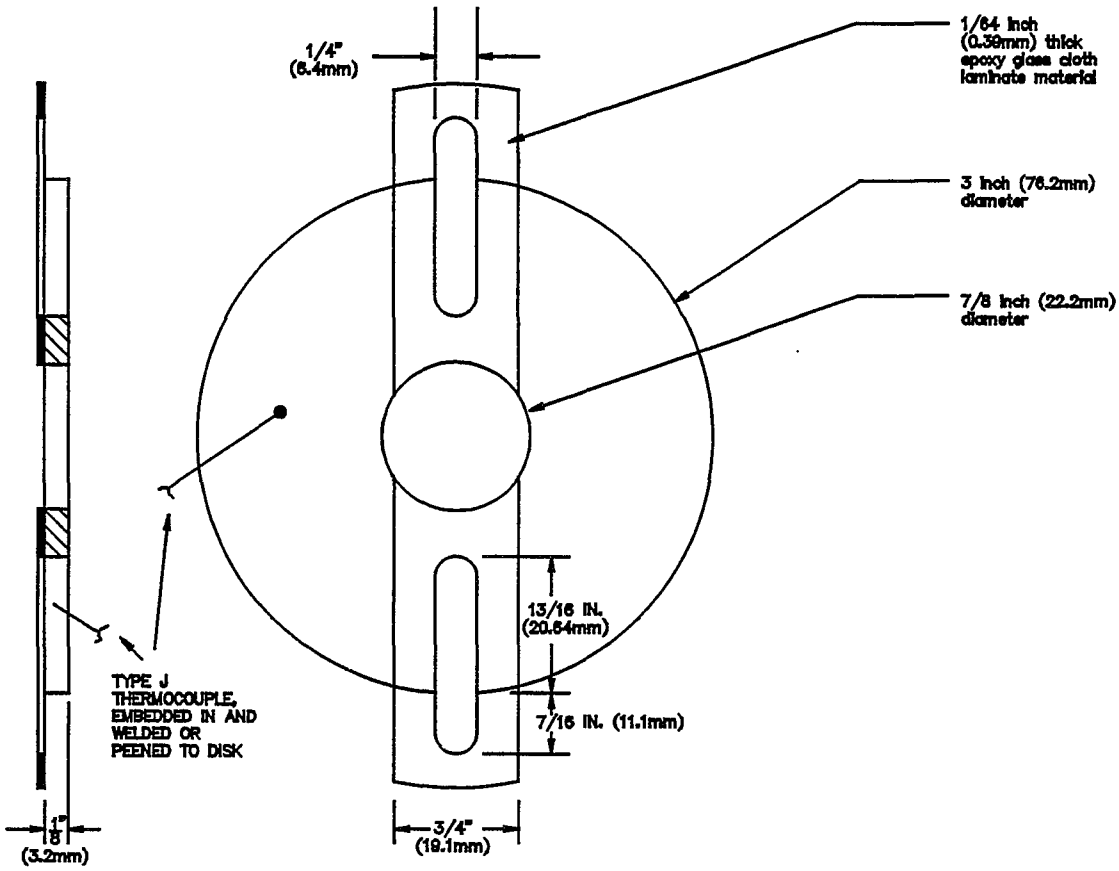
39.3.6 The copper temperature probe as illustrated in Figure 39.4 is to be positioned as follows:

a) For junction box mounted fixtures, the probe 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 on the fixture side of the crossbar with the thermocouple facing 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 be pushed as far into the fixture canopy as possible without mechanical tension or pressure.

Exception: The probe may be located in the junction box and flush with the test wall for wall-mounted fixtures provided with the marking described in 40.4.

b) For other than junction box mounted fixtures, a thermocouple is to be located inside the fixture as close as possible to heat producing components, but not more than 6 inches (152.4 mm) away from the point where the supply wiring enters the fixture.

Figure 39.4
Temperature probe for supply wire temperatures



SM211

(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

39.4 Strain relief

39.4.1 A strain relief device is to be tested by the application of a 35-pound (156-N) pulling force on the cord for 1 minute. The result is acceptable if the pull is not transmitted to terminals, splices, or internal wiring.

39.4.2 In testing in accordance with 39.4.1, 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.

39.4.3 To determine compliance with 38.6.1, the support means shall be capable of withstanding a force of 15 pounds (67 N) applied to three No. 14 AWG (2.1 mm^2), Type TW conductors in a downward direction for 1 minute. The results are acceptable if there is no indication that stress could be transmitted to the wiring terminals.

40 Markings

40.1 A fixture having a power supply cord that is electrically unconnected or unassembled to the fixture shall be marked in Form C with instructions for correct field assembly of the device. Form designations are specified in 32.1.

40.2 A fixture with a power supply cord that is not provided with hooks or a chain shall be marked in Form A-2 "For chain or hook suspension only".

40.3 A cord-suspended 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.

40.4 A wall-mounted fixture complying with the Exception to 39.3.6(a) shall be marked in Form B-3 with the word "CAUTION" and the following or equivalent wording: "RISK OF FIRE. PUSH SUPPLY LEADS SECURELY INTO JUNCTION BOX BEFORE PERMANENT MOUNTING."

RECESSED FIXTURES

41 General

41.1 In addition to the requirements under this heading, a recessed fixture shall comply with the requirements in Sections 1 – 35.

42 Construction – Mechanical

42.1 Mounting

42.1.1 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.

42.2 Mounting means

42.2.1 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;

b) Provision for suspension mounting by wire, chain, cable, hook(s), or stem; or

c) Integral clips that comply with the test in Security of Clips Provided With Ceiling-Suspended Fixtures, Section 45.

42.2.2 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.

42.3 Recessed housing

42.3.1 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. If the housing serves as part of an enclosure of conductors, current-carrying parts, lampholders, and lamps, those components shall be located on the room side of the housing. The recessed housing may be integral with components, such as ballasts, if the integral enclosure complies with Table 9.1 and if any lead wires are otherwise enclosed.

Exception: A recessed fixture intended for use in non fire-rated installations and marked in accordance with 46.9 need not completely close off a hole in a ceiling with its housing.

42.3.2 A wireway cover that does not constitute a part of the recessed housing shall be no less than 0.020 inch (0.51 mm) thick unless a greater thickness is required in Table 9.1.

42.3.3 Each ferrous sheet metal part of the recessed housing shall be plated, galvanized, enameled, painted, varnished, or lacquered.

Exception: The cut edges of prepainted stock, steel nuts, bolts, and screws, and enclosed steel pipe stems as well as plaster rings need not be so coated.

42.3.4 If the recessed housing also serves as part of the enclosure required in 8.1, there shall be no open hole:

a) In a top surface of the enclosure portion if the surface is horizontal or less than 30 degrees from the horizontal; or

b) In any outer wall of the recessed housing that contains any exposed, uninsulated live part.

Exception No. 1: A standard outlet box attached to the fixture need not comply with the above requirement if the box complies with the requirements for Metallic Outlet Boxes, UL 514A.

Exception No. 2: No more than two prying out slots, each having an area of no more than 0.040 square inch (1.02 mm^2), may be used in connection with knockouts located in the surfaces described in this paragraph.

Exception No. 3: Ballast mounting slots may have unused openings no greater than 0.040 square inch.

42.3.5 A recessed fixture marked in accordance with 46.5 to indicate it is for use in poured concrete shall have all knockouts, seams, and the like of the recessed housing mentioned in 42.3.1 sufficiently tight and closed to prevent the entrance of concrete into the wiring or lamp compartments. The fixture shall also be reinforced as may be necessary to provide the strength and rigidity required for the intended type of installation.

42.3.6 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) wide 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 hole in the mounting surface required to mount the fixture.

Exception No. 1: The recessed housing of a fixture marked for use in poured concrete or in ground as specified in 44.2.1 and 46.12 shall contain no open holes.

Exception No. 2: A fixture intended for use as an air handling register may employ open holes in the recessed housing exceeding the sizes and shapes specified if it is marked to limit its use as specified in 46.6.

42.3.7 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 42.3.6 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; and

b) Marked as specified in 46.7.

42.4 Polymeric subassemblies

42.4.1 A recessed fixture provided with polymeric subassemblies shall comply with the requirements of Polymeric Recessed Fixtures, Section 60.

43 Construction – Electrical

43.1 Tap conductors

43.1.1 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 43.1.

Table 43.1
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.

43.1.2 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 no more than 6-1/2 feet (1.98 m) beyond the recessed enclosure.

43.1.3 If a fixture with tap conductors is furnished with flexible metal conduit for those conductors, the conduit shall not extend less than 4 feet (1.22 m) nor more than 6 feet (1.83 m) from the recessed housing of the fixture. The tap conductors shall extend at least 6 inches (152 mm) beyond the unconnected end of the conduit, but shall be no more than 6-1/2 feet (1.98 m) beyond the recessed enclosure.

43.1.4 If a tap conductor is 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 43.1.

43.2 Adapter plates

43.2.1 A fixture with a knockout or open hole (usually rectangular in shape and located on top) to accommodate an adapter plate that, in turn, is intended to accommodate a length of flexible metal conduit for tap conductors, shall comply with the requirements in 43.2.2 – 43.2.8.

43.2.2 A fixture shall be shipped with the adapter plate attached.

Exception: If the fixture is marked in accordance with 46.2 to require an adapter plate, the fixture may employ a knockout or open hole intended to accommodate the plate.

43.2.3 The opening in the fixture shall have a maximum dimension (diagonal or equivalent) of 6 inches (152 mm).

43.2.4 The adapter plate shall be constructed of sheet metal with a minimum thickness of 0.026 inch (0.66 mm) if uncoated steel, 0.029 inch (0.74 mm) if zinc-coated steel, or 0.032 inch (0.81 mm) if copper, brass, or aluminum.

43.2.5 A knockout or open hole in the adapter plate shall comply with the requirements for openings for conduit as specified in 24.2.2 and 24.2.3.

43.2.6 The adapter plate shall be designed to be attached to the fixture by at least one screw, and shall cover the opening in the fixture such that no open hole exceeding 1/32 inch (0.8 mm) remains.

Exception: A screw need not be provided if the resistance between the plate and the fixture body does not exceed 0.1 ohm, as determined by passing a current of 30 amperes through the assembly and dividing the resultant voltage difference (between the plate and the fixture body) by 30.

43.2.7 Flexible metal conduit, if supplied with or attached to the adapter plate, shall be at least 4 feet (1.22 m) but no more than 6 feet (1.83 m) long and shall be at least 3/8 inch trade size. The conduit may terminate in a fitting intended to terminate at least 1/2 inch trade size conduit or in a fitting as specified in Table 43.1 for 3/8 inch trade size flexible conduit.

43.2.8 A tap conductor, if supplied with the flexible metal conduit, shall be at least I foot (0.31 m) longer than the conduit and shall be Type RUH, RUW, T, TF, TFF, TW, XHHW, TFN, THHN, THW, or THWN wire.

43.3 Accessibility

43.3.1 The accessibility of a supply connection required in 24.1.4 shall be such that the supply connection is accessible 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 46.1.

44 Performance

44.1 Normal temperature test – general

44.1.1 All Type IC recessed fixtures shall be subjected to the Temperature Test as described in Section 28, 44.1.3 – 44.4.4 and, if applicable, Fixtures Suitablel for Use With Through Branch Circuit Conductors, Section 53.

44.1.2 A Non-Type IC recessed fixture employing:

a) A single ballast or multiple ballasts spaced more than 1 inch (25.4 mm) end-to-end and 4 inches (102 mm) side-to-side from each other; and

b) Wire that is spaced or rated as specified in 18.1.5 and Table 18.3;

is temperature test exempt.

44.1.3 When a recessed fixture is tested for temperature, the results are acceptable if any thermal protective device that may be provided on the fixture does not cycle and if measured temperatures do not exceed the limits specified in Temperature Test, Section 28. The test lamp shall be as specified in 28.2.3. If trims are provided, such as with compact fluorescent lamped fixtures, the test is to be conducted as specified in Temperature Test, Section 28 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 in accordance with 44.2.1 – 44.2.4 if the fixture is intended for Non-Type IC installation or in accordance with 44.3.1 – 44.3.4 if the fixture is intended for Type IC installation.

44.2 Normal temperature test – non-type IC fixtures

44.2.1 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 46.4 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 46.13 shall be tested in at least 6 inches of 30 mesh dry builders sand, contained in the test box.

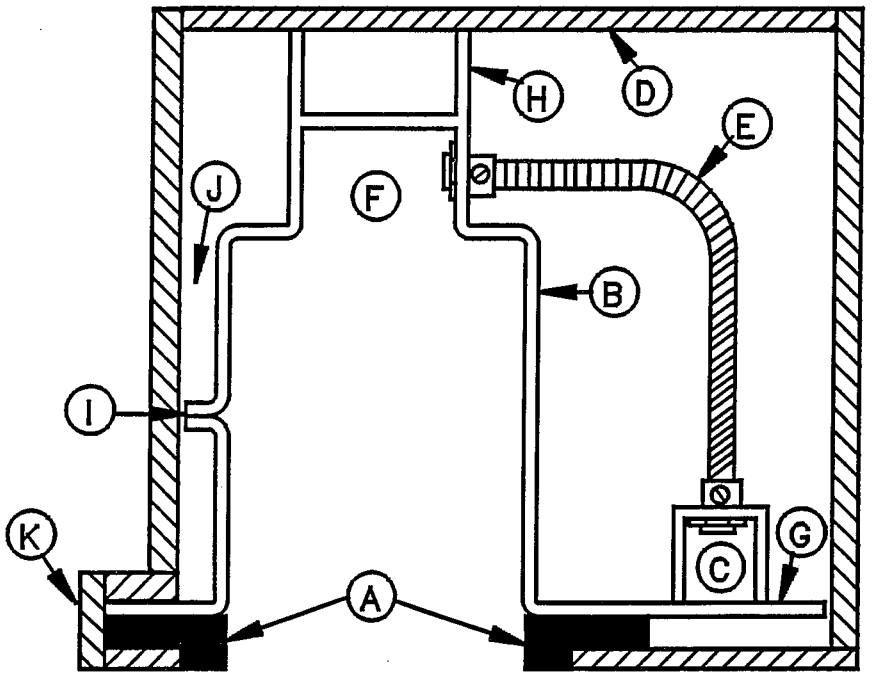
44.2.2 The dimensions of the test box shall be as follows:

a) Each wall is to be 1/2 inch (12.7 mm) from the nearest point on the recessed housing (lamp compartment) and junction box.

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 44.1(H) and Figure 44.2(G).

c) The overall test box dimensions are to be no more than 1-1/2 inches (38.1 mm) from the recessed housing and junction box 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 44.1(K) and Figure 44.2(H).

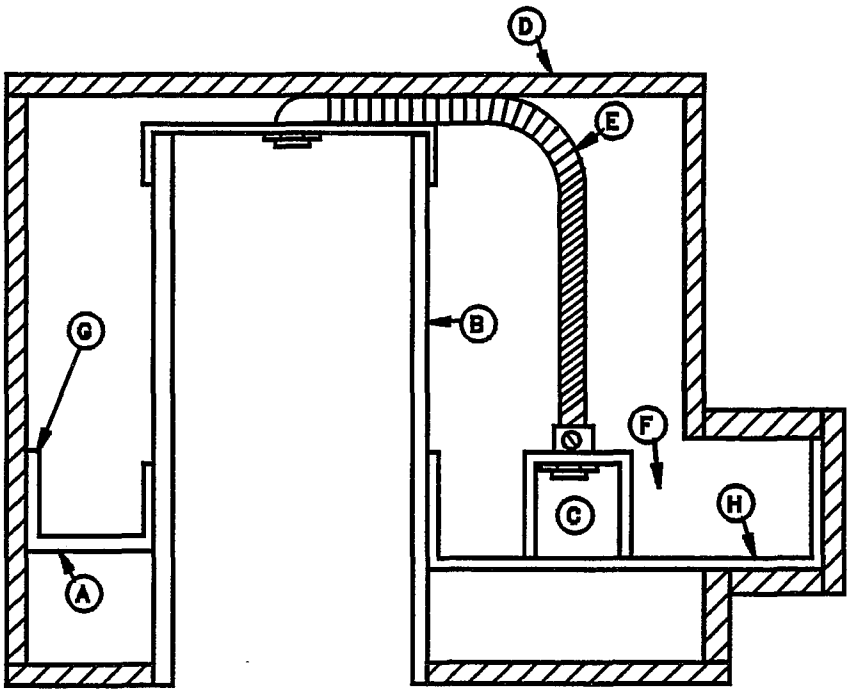
Figure 44.1
Example of test box configuration



S1883–5

A. Integral flange for plaster mounting.
B. Recessed housing.
C. Integral junction box.
D. Test box.
E. Flexible conduit.
F. Integral splice compartment.
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 44.2.4.
J. 1/2 inch spacing from test box to nearest portion of fixture enclosure.
K. Mounting projection 1-1/2 inches or longer. (Test box sheathes projection.)

Figure 44.2
Example of test box configuration



A. Mounting bracket.
B. Recessed housing.
C. Integral junction box.
D. Test box.
E. Flexible conduit.
F. 1-1/2 inch (38.1 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 flush with projection.)
H. Mounting projection 1-1/2 inches or longer. (Test box sheathes projection.)

44.2.3 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 flush with the test box.

44.2.4 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.

44.3 Normal temperature test – type IC fixtures

44.3.1 A fixture intended to be installed in a ceiling shall be mounted in the test box as described in 44.3.2. A fixture intended to be installed in a wall shall be mounted in the test box as described in 44.3.3.

44.3.2 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 incidental 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.

44.3.3 A wall-mounted fixture is to be mounted in a test box constructed of plywood as described in 44.3.2. The 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 incidental projection 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.

44.3.4 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. 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.

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, weldings, or a means that requires the use of tools to be removed.

44.3.5 During the test, 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 44.4.1 – 44.4.4.

44.4 Insulation

44.4.1 The 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).

44.4.2 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 44.4.1.

44.4.3 Insulation that has been conditioned through a blowing machine can 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.

44.4.4 The insulation is to be placed into 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.

45 Security of Clips Provided With Ceiling-Suspended Fixtures

45.1 A fixture provided with integral suspended ceiling clips shall remain in the ceiling grid for one minute when a force equal to the total weight of the fixture is applied in a direction normal to the mounting plane of the fixture.

45.2 The fixture is to be mounted as intended to a representative ceiling grid in accordance with the installation instructions and is to be attached to a plywood sheet to simulate a suspended ceiling. The inner plywood sheet area enclosed by the grid is to be removed to allow access to the room side of the fixture. The test assembly is then inverted.

46 Markings

46.1 A recessed fixture that complies with the Exception of 43.3.1 shall be marked in Form A-2 (see 32.1) "Access above ceiling required" or "Access behind wall required".

46.2 A fixture with an opening for an adapter plate complying with the Exception of 46.7 shall be marked in Form A-4, "Open hole to be closed with Adapter Plate Cat. No. _____".

46.3 An adapter plate not shipped with a fixture shall be marked with the manufacturer's name and catalog number.

46.4 A fixture that is tested in poured concrete, under the provision of the Exception of 44.2.1 shall be marked in Form F-3 "For installation only in poured concrete".

46.5 A recessed fixture that complies with the requirements in 42.3.5 may be marked in Form B-5 "Suitable for installation in poured concrete".

46.6 A fixture as specified in Exception No. 2 of 42.3.6 shall be marked in Form A-5 "To be used only in ceiling plenum of noncombustible construction – see 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 vent openings".

46.7 A fixture as specified in 42.3.7 shall be marked in Form A-5 "If vent openings are uncovered, fixture must be used only in ceiling plenum of noncombustible construction – see 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".

46.8 A recessed fixture intended for installation in a suspended ceiling as specified in 42.2.1 and 42.2.2 may be marked in Form B-2, "Suitable for use in suspended ceilings".

46.9 A recessed fixture intended for installation in a ceiling as specified in the Exception to 42.3.1 shall be marked in Form F-3, "For use in non-fire rated installations only."

46.10 A fixture intended for mounting near to, or in contact with, thermal or acoustic insulation, and tested in accordance with 44.1.3 for Type IC installation shall be marked in Form D-2 (see 31.1.1) "TYPE IC".

46.11 A recessed fixture provided with integral clips that comply with the test in Security of Clips Provided With Ceiling-Suspended Fixtures, Section 45, are to be marked in Form C-9 to indicate the intended grid type and installation instructions. The intended grids can be identified by NEMA designation, an illustration showing shape and cross sectional dimensions, or a specific manufacturer's name and model designation.

46.12 An in-ground recessed fixture that is tested as described in Exception No.2 to 44.2.1 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.

46.13 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."

PART 3 – OTHER USES AND CONSTRUCTIONS

47 Fixture Fittings

47.1 General

47.1.1 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 that are required by 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.

47.1.2 An assembly consisting of fixture fittings that form a complete fixture shall comply with the applicable requirements of this standard.

47.1.3 Each fixture fitting shall be marked in Form B-3 with the manufacturer's name or trademark and a catalog or model number. In addition, the fitting shall be marked with any other applicable markings that may be required elsewhere in this standard. Form designations are specified in 32.1.

47.1.4 Each fitting (or smallest unit carton of fittings) shall be provided with instructions that demonstrate the intended use.

47.2 Posts

47.2.1 A fixture fitting in the form of a support for a post-mounted fixture shall comply with 47.2.2 – 47.3.7.

47.2.2 A post shall be no longer than 12 feet (3.66 m) and shall serve as (or contain) a raceway that extends the entire length of the post. The raceway shall be constructed of:

a) Metal;

b) Metal-lined wood; or

c) Plastic conduit.

A metal raceway shall comply with 8.1, 47.3.1, and 47.3.2.

47.3 Raceways

47.3.1 A circular metal raceway, used for support of the fixture, shall have a minimum thickness of 0.040 inch (1.02 mm) if of steel and 0.064 inch (1.63 mm) if of other metal. A metal raceway, other than circular in shape, shall have a minimum thickness of 0.064 inch if of steel and 0.102 inch (2.59 mm) if of other metal. A metal lining 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. Plastic conduit without other mechanical support shall be extra-heavy wall (Schedule 80).

47.3.2 A post more than 3 feet (0.91 m) in length, having a raceway with an internal dimension smaller than that of 2-1/2 inch trade size conduit, shall be mechanically reinforced for the entire length and shall have a support base with an effective support area of at least 28 square inches (180.6 cm^2).

47.3.3 A ferrous metal raceway shall be made corrosion resistant as specified in 63.1 – 63.5. Aluminum intended for direct insertion into the ground or into concrete shall be provided with a protective (organic) coating.

47.3.4 A means for supply connection shall be provided on the post. The point for connection of conduit or cable shall be located at least 6 inches (152 mm) from the lower end of the metal raceway.

47.3.5 A post shall contain a splice compartment that is located above ground level. The compartment 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 grounding means that complies with Grounding, Section 23.

An access opening shall be a minimum of 2 inches (50.8 mm) by 4 inches (102 mm) and shall be provided with a rain-tight cover.

47.3.6 A post shall provide a means for bonding a fixture to the post.

47.3.7 A post shall comply with the requirements for wet locations as specified in Sections 66 – 70.

47.4 Fixture mounting connector

47.4.1 A two piece polymeric connector for mounting a fixture to an outlet box shall comply with the following:

a) Each half of the connector shall be provided with a means for electrically connecting the grounded, ungrounded, and grounding conductors in accordance with Grounding, Section 23.

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 22.1.1. 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 a 200 pound weight attached to it for 1 minute when secured to an outlet box mounted in an oven adjusted to operate at 100°C.

d) The polymeric material of the connector shall be rated minimum 94V1 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.

47.4.2 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°".

48 Rough-In and Finishing Sections for Suspended Ceiling and Recessed Fixtures

48.1 General

48.1.1 Requirements under this heading are supplementary to the other applicable requirements of this standard and apply to fixtures that, for necessary shipping and installation reasons, are in two sections, known as rough-in sections and finishing sections.

48.1.2 The sectional separation of the fixture generally is one of two constructions:

a) A construction 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 in which the finishing section includes the recessed portion of the enclosure (lamp housing or reflector) in addition to the finish frame and diffuser, if any; and

b) A construction 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 in which the finishing section includes all other parts necessary to complete the installation.

In addition, there may be some constructions in which glass diffusers serve to complete the required electrical enclosure of wiring or splices (or both) and that are normally required to have the diffuser shipped complete with the remainder of the fixture.

48.2 Assembly

48.2.1 The complete fixture, consisting of the assembled rough-in section and the finishing section, shall meet all other applicable requirements of this standard.

48.2.2 All electrical parts of the complete 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 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 or the equivalent provided as part of the finishing section into a receptacle or the equivalent on the rough-in section.

48.2.3 A rough-in section shall be marked in Form D-4 as described in 32.1 with the following information: "Rough-In Section ___ for (Suspended Ceiling) (Recessed) Fluorescent Fixture _____ For Use With Finishing Section ___". The first blank space is to be filled in with the type, catalog, part, or other appropriate designation for the rough-in section. The second blank space is to be filled in with the catalog number of the recessed (suspended ceiling) fixture. The third blank space is to be filled in with the type, catalog, part, or other appropriate designation for the finishing section.

Exception: The third blank space may be filled in with the phrase "Catalog Numbers Specified Below". The catalog number shall be listed immediately below the marking on the same label.

48.2.4 In addition to the markings required in 48.2.3, a rough-in section shall be marked with the following, as appropriate:

a) Identification (see 33.1.1 and 33.1.2);

b) Orientation and Assembly (see 34.1.1 – 34.1.8);

c) Supply Connections (see 34.2.1 – 34.2.6);

d) Recessed Fixture Markings (see 46.1 – 46.8); or

e) Damp or Wet Locations (see Part 4).

48.2.5 A finishing section shall be marked in Form D-4 with the following information: "Finishing Section For (Suspended Ceiling) (Recessed) Fluorescent Fixture ____ For Use With Rough-In Section _____". The first blank space is to be filled in with the type, catalog, part, or other appropriate designation for the finishing section. The second blank space is to be filled in with the type, catalog, part, or other appropriate designation for the rough-in section.

Exception: A finishing section may be marked "Finishing Section For Use With (Suspended Ceiling) (Recessed) Fluorescent Fixture Rough-In Section _____".

48.2.6 In addition to the markings required in 48.2.5, a finishing section shall be marked with the following, as appropriate:

a) Identification (see 33.1.1 and 33.1.2);

b) Lamp Replacement (see 35.2).

48.2.7 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 remainder of the finishing section.

48.2.8 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 the standard if the complete fixture were shipped in one carton.

49 Separate Channels and Reflectors

49.1 Requirements under this heading are supplementary to the other applicable requirements in this standard and apply to surface-mounted and recessed fixtures that consist of wired channels and unwired reflectors (required to complete part of the enclosure specified in 8.1 or to complete the recessed housing specified in 42.3.1) intended for shipment in separate packages either from the same or from separate factories.

49.2 The channel shall be completely wired with every splice and connection made.

Exception: A lampholder need not be mounted in its intended location and may be pushed back into the fixture body to prevent its breakage during shipment.

49.3 The reflector shall have no wiring or current-carrying part attached to it.

49.4 Each channel and each reflector shall be marked in Form B-4 with an identifying designation such as a style, catalog, or type number, and with information on the mating part or parts with which it is intended to be used. Form designations are specified in 32.1.

50 Reflector Kits

50.1 General

50.1.1 The requirements under this heading are supplementary to the other applicable requirements in this standard and apply to reflector kits that consist of one or more components that are intended to be installed in fluorescent lighting fixtures sometime after the initial installation of the fixture. The components of a reflector kit may be reflectors, ballasts, lampholders, wiring, brackets, wire connectors, or the like.

50.1.2 Table 50.1 defines the types of reflector kits covered by the requirements in this section based on the tasks involved in the installation of a reflector kit. The installation of a type I reflector kit may involve only those tasks that correspond to its reflector kit type in Table 50.1. A type II reflector kit may involve the tasks of kit types I and II.

Table 50.1
Reflector kit types

Reflector kit type	Tasks involved
I	– Reflector installation
	– Reflector replacement
II	– Lampholder relocation, removal, or replacement
	– Ballast relocation, removal, or replacement
	– Wire relocation, removal, replacement, or addition

50.2 Construction – mechanical

50.2.1 After installation of a reflector kit, all components of the reflector kit and all components of the fixture that were affected by the installation of the reflector kit shall be secured in place so that lamp replacement, inspection of splices to the branch-circuit supply wires, and routine maintenance will not loosen components or joints in the assembly.

50.2.2 Fluorescent lamps shall not be relied upon for support of any reflector kit component.

50.2.3 A polymeric material serving to complete the enclosure required in Enclosures, Section 8 or providing structural support of any electrical component or of any nonelectrical component weighing more than 3 ounces (85 g) shall comply with the requirements in Polymeric Materials, Section 59.

50.2.4 An adhesive or adhesive tape shall not be relied upon to secure any part to a panel, bracket, or component of a fluorescent fixture. An adhesive or adhesive tape may be relied upon to secure a part of a reflector kit to another part of a reflector kit if the adhesive or adhesive tape complies with the requirements for temperature, humidity, and indoor cyclic conditioning for adhesives in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. With regard to the temperature conditioning, a normal operating temperature of 90°C (194°F) shall be assumed unless temperature testing of the fixture/kit combination indicates that a lower normal operating temperature applies. This requirement applies to all adhesives including an adhesive used to secure a metal foil reflecting surface or a laminate reflecting surface to the reflector base material.

50.2.5 A reflector kit intended for installation in a fixture used as an air handling register shall not impede the intended air flow.

50.2.6 A nonmetallic material, adhesive, or adhesive tape used in a reflector kit intended for installation in a fixture used as an air handling register shall comply with 55.2.1 and 55.2.2.

50.2.7 After installation of a reflector kit, a fixture shall comply with the requirements in Enclosures, Section 8.

50.2.8 Metal parts of a reflector kit and those portions of a fixture affected by installation of the reflector kit shall comply with the requirements in Metal Thickness, Section 9.

50.2.9 A reflector kit and those portions of a fixture affected by installation of the reflector kit shall comply with the requirements in Openings, Section 10.

50.2.10 A reflector shall be structurally formed from metal, polymeric material, or cellulose fiber.

50.2.11 A cellulose fiber reflector shall not be relied upon for support of any other item.

Exception: A cellulose fiber reflector may be relied upon for support of a rib, bracket, frame, or the like that is positively secured to the reflector by a slot and tab, tabs, rivets, or the like and that is provided only:

a) To retain the shape of the reflector;

b) To maintain a spacing between the reflector and another part of the kit or fixture; or

c) To strengthen the reflector.

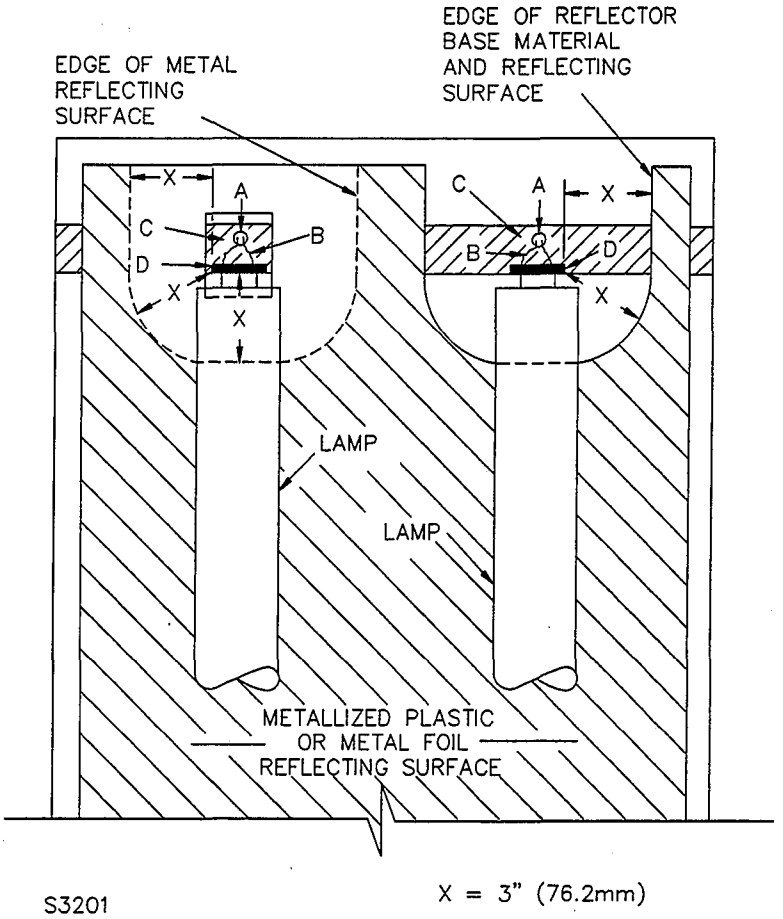
50.2.12 A reflector may be metallized with metal foil or covered by a laminate that includes a metallic film if:

a) Electrical spacings comply with the requirements in Section 21; and

b) The metal reflecting surface is grounded in accordance with the requirements in Grounding, Section 23.

Exception: A metal reflecting surface need not be grounded if the metal reflecting surface is spaced at least 3 inches (76.2 mm) horizontally from all lampholders, lamp contacts, lampholder leads, wiring, and other electrical components (excluding the fluorescent lamps) that are below the metal surface. See Figure 50.1.

Figure 50.1
Spacings for metal reflecting surface of reflector kit



A. Open hole in lampholder bracket through which the lampholder leads pass.

B. Exposed lampholder leads.

C. Bracket on which the lampholder is mounted.

D. Lampholder.

50.2.13 A reflector that is structurally formed from polymeric material and that is metallized shall comply with the applicable requirements for metallized plastic parts in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

Exception: A metallized polymeric reflector need not comply with UL 746C if the metallized surface is spaced at least 3 inches (76.2 mm) horizontally from all lampholders, lamp contacts, lampholder leads, wiring, and other electrical components (excluding the fluorescent lamps) that are below the metallized surface. See Figure 50.1.

50.2.14 A reflector shall be secured in place by brackets, horizontal overlapping flanges, screws, or equivalent mechanical means. Friction shall not be relied upon to secure the reflector in place. The securement means shall be such that it will withstand any unintentional contact that is likely to occur during lamp replacement.

50.3 Construction – electrical

50.3.1 General

50.3.1.1 After installation of a reflector kit, a fixture shall comply with 13.2 and 13.3 and Sections 14 – 16, 19, and 21 – 23.

50.3.1.2 After installation of a reflector kit, fixture splices shall be accessible for inspection.

50.3.1.3 Installation of a reflector kit shall not change:

a) The physical method by which the fixture is connected to the branch circuit; or

b) Any applicable portion of the fixture as described in 24.1.1 – 24.1.3.

50.3.1.4 After installation of a reflector kit, the assembly shall comply with 24.1.4 and 24.1.7.

50.3.1.5 Installation of a reflector kit shall not require alteration of the construction of lampholders, ballasts, or other electrical components.

50.3.2 Lampholders

50.3.2.1 Installation of a reflector kit may involve relocation or removal of lampholders and lampholder leads originally supplied with the fixture.

50.3.2.2 A reflector kit may be provided with replacement lampholders if the replacement lampholders are for use with the type of fluorescent lamps with which the ballast involved after reflector kit installation is intended to be used.

50.3.2.3 After installation of a reflector kit, lampholder connections shall comply with the requirements in Lampholders, Section 17.

50.3.2.4 After installation of a reflector kit, each pair of lampholders supporting a lamp shall be spaced to provide the intended support of the lamp.

50.3.3 Wiring and conductors

50.3.3.1 After installation of a reflector kit, all wiring and conductors shall comply with the requirements in Wiring and Conductors, Section 18.

50.3.3.2 If supplemental wiring or connectors or both are needed during the installation of the reflector kit, the reflector kit shall include the necessary wiring or connectors. The connectors shall be suitable for the number and size of conductors with which they are intended to be used. The supplemental wiring shall comply with the requirements in Wiring and Conductors, Section 18.

50.3.4 Ballasts

50.3.4.1 Installation of a reflector kit may involve the relocation, removal, or replacement of ballasts and leads originally supplied with the fixture. A replacement ballast shall be a Class P, thermally protected type and shall be suitable for use with the fluorescent lamps to be installed in the fixture after reflector kit installation.

50.3.4.2 Installation of a reflector kit shall not result in a circuit being altered and left in a configuration that results in a ballast operating with a type of lamp, a number of lamps, or a lamp circuit other than that which the ballast is intended to be used.

50.3.4.3 After installation of a reflector kit, the fixture assembly shall comply with the requirements in Ballasts, Section 20.

50.4 Markings

50.4.1 One of the components of a reflector kit such as a reflector or a bracket shall be marked in Form B-8 with the reflector kit manufacturer's name, trademark, or other descriptive marking.

50.4.2 A reflector kit that requires drilling or punching of holes into the structure of the fixture for kit installation shall be marked in Form B-3 with the word "WARNING" and the following or the equivalent: "Risk of fire or electric shock. Fixture wiring, ballasts, or other electrical parts may be damaged when drilling for installation of reflector kit hardware. Check for enclosed wiring and components".

50.5 Installation instructions

50.5.1 General

50.5.1.1 A reflector kit shall be provided with installation instructions that cover all aspects of fixture alteration required for the installation of the reflector kit. Each step shall be clearly explained and, if necessary, accompanied by an illustration showing execution of the step. All illustrations shall be of sufficient size and clarity for the user to distinguish all applicable features of the fixture and the reflector kit.

50.5.1.2 For a reflector kit that is bulk packed in accordance with the Exception of 5.6, one set of installation instructions shall be provided with each carton.

50.5.1.3 The installation instructions shall specify all components of the reflector kit before any installation steps are given so that the user may check the content of the reflector kit.

50.5.1.4 The installation instructions for a reflector kit of type I shall include an instruction with the word "WARNING" and the following or the equivalent: "Risk of fire or electric shock. Do not alter, relocate, or remove wiring, lampholders, ballasts, or any other electrical components". The installation instructions for a reflector kit of type II shall include an instruction with the word "WARNING" and the following or the equivalent: "Risk of fire or electric shock. Reflector kit installation requires knowledge of fluorescent lighting fixture electrical systems. If not qualified, do not attempt installation. Contact a qualified electrician".

50.5.1.5 The installation instructions shall include photographs or line drawings of the fixture or fixtures intended to be used with the reflector kit clearly showing:

a) The fixture without diffuser as it would be seen by the installer of a reflector kit;

b) Details of all panels, brackets, or components and their orientation prior to fixture alteration if these details are important to installation of the reflector kit as it is intended to be used;

c) All dimensions and spacings of all fixture walls, panels, brackets, openings, lampholders, and the like that are relied upon to comply with the requirements of this standard; and

d) All vents and the air path in a fixture used an as air handling register.

Exception: With respect to (c), only dimensions or spacings that show placement of the reflector and hardware are required to be shown for installation instructions provided with type I reflector kits.

50.5.1.6 The installation instructions shall include the word "WARNING" and the following or the equivalent: "Risk of fire or electric shock. Install this kit only in the fixture that has the construction features and dimensions shown in the _____". The blank is to be filled with the words photograph(s), drawing(s), photograph(s) or drawing(s), or photograph(s) and drawing(s), as applicable.

50.5.1.7 If the installation of a reflector kit will necessitate the making or altering of one or more open holes in an enclosure of live parts, the installation instructions shall identify the dimensions of all such open holes in a photograph or drawing. The installation instructions shall include the following statements: "Only those open holes indicated in the _____ may be made or altered as a result of kit installation. Do not leave any other open holes in an enclosure of wiring or electrical components". The blank is to be filled with the words photograph(s), drawing(s), photograph(s) or drawing(s), or photograph(s) and drawing(s), as applicable.

50.5.1.8 If the installation of a reflector kit will not necessitate the making of any open holes in an enclosure of live parts, the installation instructions shall include the following statement: "Do not make or alter any open holes in an enclosure of wiring or electrical components during kit installation".

50.5.1.9 The installation instructions for a reflector kit that requires drilling or punching of holes into the structure of the fixture for kit installation shall include an instruction with the word "WARNING" and the following or the equivalent: "Risk of fire or electric shock. Fixture wiring, ballasts, or other electrical parts may be damaged when drilling for installation of reflector kit hardware. Check for enclosed wiring and components".

50.5.1.10 If installation of a reflector kit will involve the alteration of reflector kit brackets or fixture brackets, the installation instructions shall include illustrations that show the appearance of the bracket or brackets before and after alteration. All dimensions of the brackets shall be clearly indicated and the instructions shall suggest a method of bracket alteration and the type of tool to be used.

50.5.1.11 The installation instructions for reflector kit type II shall include figures showing the supply, ballast, lampholder, and wiring configuration for the fixtures with which the reflector kit is intended to be used. Each figure shall:

a) Include wiring diagrams for only one configuration which will show the electrical position of all components before and after reflector kit installation;

b) Be on a separate page;

c) Be referenced in the text of the instructions; and

d) Identify all wiring splice points pertinent to kit installation.

All ballasts, lampholders, wiring, and other electrical components shall be consistently identified by a unique number or name in all wiring diagrams. Any conductor capping necessary for reflector kit installation shall also be identified in the figure.

50.5.2 Reflector kits involving reflector installation

50.5.2.1 The installation instructions shall indicate the intended method for reflector installation.

50.5.3 Reflector kits involving relocation, removal, or replacement of lampholders

50.5.3.1 The installation instructions for reflector kits requiring relocation, removal, or replacement of lampholders shall include illustrations that identify each lampholder and its physical position before and after reflector kit installation. Each lampholder shall be identified by a unique number or name that is the same as that used in the figures required in 50.5.1.11.

50.5.3.2 The installation instructions shall include a statement to warn the user that each lampholder shall be installed only in the intended manner and location.

50.5.3.3 If installation of a reflector kit results in the removal of lampholders, the installation instructions shall indicate that the lampholders and lampholder leads shall be removed.

50.5.4 Reflector kits involving alteration of ballasts

50.5.4.1 The installation instructions for reflector kits involving the relocation, removal, or replacement of ballasts shall include illustrations that identify each ballast and its physical position before and after reflector kit installation. Each ballast shall be identified by a unique number or name that is the same as that used in the figures required in 50.5.1.11.

50.5.4.2 The installation instructions for reflector kits involving the replacement of ballasts shall indicate:

a) All points where existing wiring is to be cut;

b) Which leads of the replacement ballast are to be spliced to which of the existing conductors; and

c) That all of the remaining conductor ends are to be capped.

50.5.4.3 If reflector kit installation results in the removal of a ballast, the installation instructions shall indicate:

a) Where the ballast supply conductors shall be cut;

b) That the ballast shall be removed; and

c) That the remaining conductor ends shall be capped.

50.5.5 Reflector kits involving alteration of wiring

50.5.5.1 The installation instructions for reflector kits involving the removal, relocation, or reconnection of wiring shall include the word "WARNING" and the following or the equivalent: "To prevent wiring damage or abrasion, do not expose wiring to edges of sheet metal or other sharp objects".

50.5.5.2 If installation of a reflector kit requires supplemental wiring, the figures described in 50.5.1.11 shall clearly indicate:

a) Conductors that are to be added; and

b) All related splices.

51 Raceways

51.1 General

51.1.1 The requirements under this heading apply to a surface-mounted or recessed fixture that is intended to serve as a raceway for conductors of a circuit other than those of the branch circuit supplying the fixture.

51.1.2 The raceway portion of a fixture shall comply with the requirements in Standard for Surface Metal Electrical Raceways and Fittings, UL 5, insofar as they apply. The requirements of UL 5 preclude constructions in which the ballast is located in the raceway.

51.1.3 The investigation mentioned in 51.1.2 shall include a temperature test:

a) With the fixture operating with the maximum number, type, and size of wires for which the fixture is designed and marked, installed in the raceway; and

b) With each wire carrying rated current, consideration being given to the applicable derating factor based on the number of conductors involved.

51.2 Markings

51.2.1 A fixture intended to be used as a raceway shall be marked in Form D-5 (see 32.1) "Suitable for use as a raceway".

51.2.2 A fixture complying with this section may be marked in Form D-4 "Maximum of ____ No. ____AWG branch circuit conductors suitable for at least ___C (___F) permitted in raceway (___ in ___ out)". The second parenthetical expression is optional and the number of in and out conductors shall be half of the maximum number of conductors permitted. The blank spaces shall be filled with information in accordance with acceptable test results. Form designations are specified in 32.1.

52 Recessed Fixture Junction Boxes for Use with Through Branch Wiring

52.1 General

52.1.1 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.

52.1.2 The minimum inside volume of the junction box shall be in accordance with 24.1.7 and Table 24.1.

52.2 Thickness

52.2.1 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 53.5.1, the box may be in accordance with the thickness requirements for openings for conduit connection specified in Table 9.1.

52.3 Holes

52.3.1 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 52.3.2 and 52.3.3.

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.

52.3.2 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).

52.3.3 A pry-out hole or slot in a knockout shall not be in a knockout of the 1-inch or larger trade size.

52.4 Knockouts

52.4.1 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).

52.5 Tests on knockouts

52.5.1 A force of 10 pounds 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.

52.6 Closures

52.6.1 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.

52.6.2 Other than as noted in 52.6.3, 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.

52.6.3 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.

52.6.4 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.

53 Fixtures Suitable for Use With Through Branch Circuit Conductors

53.1 General

53.1.1 Requirements under this heading are supplementary to the other applicable requirements of this standard and apply to fixtures of the recessed type. These requirements are intended to apply to field-installed branch-circuit wiring routed through the supply circuit junction box of a fixture, in addition to the branch-circuit wires supplying the fixture. These requirements do not apply to field-installed branch-circuit wiring routed in accordance with Section 410-31 of the National Electrical Code, ANSI/NFPA 1993.

53.1.2 The junction box for the through wire branch circuit conductors shall comply with the requirements in Recessed Fixture Junction Boxes for Use with Through Branch Wiring, Section 52, 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.

53.1.3 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.

53.1.4 The minimum inside volume of the junction box shall be in accordance with Table 24.1.

53.2 Normal temperature test

53.2.1 A fixture provided with a wiring compartment for through branch-circuit conductors shall be subjected to the temperature test appropriate for the fixture design involved and, in accordance with 53.2.2 – 53.2.5, a fixture marked for use with through branch-circuit wires shall comply with all of 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 parts or materials as given elsewhere in this standard.

Exception: A fixture need not be subjected to a temperature test if:

a) The wiring compartment in which the through-wires are to be installed is located at least 1/2 inch (12.7 mm) from the recessed housing on a bracket or on the plaster frame;

b) The volume of the wiring compartment complies with 24.1.7 and Table 24.1; and

c) There are no other heat producing components mounted on or in the outlet box.

53.2.2 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 53.5.1 shall be tested using nonmetallic sheathed (NM) cable fitted to the outlet box.

53.2.3 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 every 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. Type THHN wire shall be used.

53.2.4 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 direct contact with the copper conductor through a slit in the insulation and retained in place by a single wrap of tape.

53.2.5 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), Type THHN wire. Simultaneously, the fixture is to be operated from a separate source of supply with a lamp of the size and type for which the fixture is marked. The leads supplying the lamp leads shall be limited to short lengths so as not to contribute to the heat in the box.

53.3 Rigidity

53.3.1 A fixture intended for use with through branch conductors shall be subjected to the test described in 53.3.2 – 53.3.4. 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 53.5.1 need not be subjected to this test.

53.3.2 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: If the fixture is of other than the recessed type, the wood panel is to extend only 1 inch (25.4 mm) beyond the edges of the fixture.

53.3.3 For the purposes of this test, no consideration is to be made of the fixture mounting means with respect to a building structure.

53.3.4 A series of weights totaling 50 pounds (22.7 kg) are to be applied in 5-pound (2.27-kg) increments at the point on the outlet box most likely to be subject to deformation. The weights are to be removed after a period of 2 minutes and the deformation from the original, if any, is to be measured.

53.4 Angle of pull

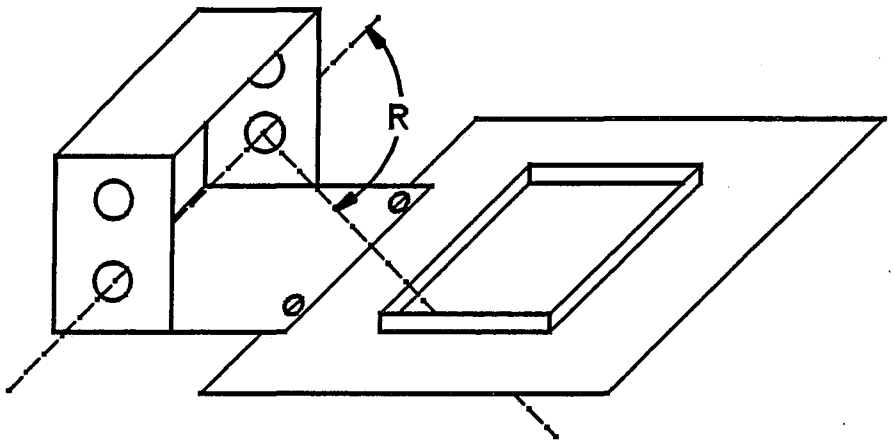
53.4.1 A fixture design requiring an angle of pull less than 120 degrees shall be subjected to the test described in 53.4.3 and 53.4.4.

Exception No. 1: A fixture marked for access behind the wall or ceiling as specified in 46.1 need not be tested.

Exception No. 2: A fixture marked for use with cable only in accordance with 53.5.1 need not be subjected to this test.

53.4.2 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 the conduit entry and extending through the fixture aperture with accessories such as baffles, trims, or reflectors removed as shown in Figure 53.1.

Figure 53.1
Angle of pull



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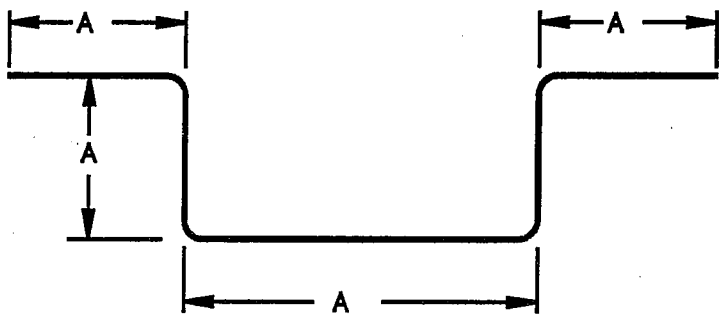
53.4.3 When tested under the conditions described in 53.4.4, the pulling of conductors shall be accomplished without damage to the conductors, fixture, or junction box. The plaster frame or other means of support shall be adequate.

53.4.4 The fixture is to be mounted in accordance with 53.3.2. 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 in the same plane, as shown in Figure 53.2, and one end shall be connected to the junction box opening with a conduit fitting. Pulling compounds shall not be used.

Figure 53.2
Configuration for pull test



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A is equal to approximately 2 feet (0.6 m)

53.5 Markings

53.5.1 A fixture complying with this section may be marked in Form D-3 (see 32.1) "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 52.2.1 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."

53.5.2 The supply wire marking specified in 34.2.7 and note f of Table 28.1 need not be provided if the fixture is marked as specified in 53.5.1. If, however, the fixture is marked for supply wire temperature, the value shall be the same as that used for the marking noted in 53.5.1.

53.5.3 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 acceptable test results obtained with the through branch circuit wires de-energized.

54 Wired Fixture Sections

54.1 General

54.1.1 The requirements under this heading 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.

54.1.2 Each wired fixture section may be unassembled to the extent otherwise permitted in this standard, but the field assembly shall be limited to interconnecting the leads between sections and to coupling sections together.

54.1.3 54.1.2 does not exclude the use of mounting hardware such as supporting stems, straps, chains, and the like that may be required in conjunction with the assembly and attachment of the fixture sections.

54.1.4 A set of wire leads intended for connection together in the field shall have matching identification by color of insulation and, if necessary, by marking of number, letter, or other means found to be acceptable. A set of leads for field connection at a junction between sections shall be distinguished by marking or other acceptable means from any other set of leads having a function not identical to it. Color identification of a current-carrying conductor shall be made by a color other than green with or without one or more yellow stripes.

54.1.5 A connection to be made in the field between conductors of adjoining sections shall be accessible for inspection without requiring the disconnection of any portion of the wiring.

54.2 Markings

54.2.1 Each carton or package shall include installation instructions describing the intended assembly, mounting, and connection of the sections.

54.2.2 Each wired fixture section shall be marked in Form B-1 (see 32.1) with the manufacturer's name, trademark, or similar means of identification.

54.2.3 Each wired fixture section that contains a ballast shall be additionally marked with its electrical ratings as described in 33.2.1.

54.2.4 Each surface-mounted wired fixture section shall be marked in Form D-1 "Wired Fluorescent Fixture Section _____, For Use With Wired Fluorescent Fixture Section _____". The blank spaces are to be filled with the manufacturer's catalog numbers, or equivalent, for guidance in correct assembly.

54.2.5 Each recessed wired fixture section shall be marked in Form D-1 "Wired Recessed Fluorescent Fixture Section ____, For Use With Wired Recessed Fluorescent Fixture Section ____". The blank spaces are to be filled in with the manufacturer's catalog numbers, or equivalent, properly related for guidance in correct assembly.

55 Fixtures for Use as Air Handling Registers

55.1 General

55.1.1 The requirements under this heading are supplementary to the other applicable requirements of 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.

55.1.2 These requirements also cover a plastic light diffuser or lens intended for use with an air-handling fixture.

55.2 Material in air path

55.2.1 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 no more than 25, and a smoke-developed rating of no more than 50 or designated "light" or "negligible" as described in 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 55.2.2.

55.2.2 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.

55.3 Markings

55.3.1 A fixture that complies with 55.1.1 – 55.2.2 may be marked, in Form B-5 (see 32.1) "Suitable for air handling use".

55.3.2 A fixture that is shipped without a light diffuser shall also be marked in Form B-5 "If a plastic light diffuser is used, use a labeled diffuser".

55.3.3 If a fixture is constructed to provide a frame for a light diffuser integral with the fixture body and the fixture is shipped without a light diffuser, the fixture shall be marked in Form B-5 with its catalog number, and "If a plastic light diffuser is used, use labeled diffuser marked for use with (catalog designation) fixture".

55.4 Plastic light diffusers and lenses

55.4.1 General

55.4.1.1 A plastic light diffuser or lens intended for use with an air-handling fixture shall comply with the requirements in 55.4.1.2 – 55.4.5.1.

55.4.1.2 The maximum area of the plastic material, the minimum distance over metal surfaces between exposed plastic material on adjacent fixtures, and other limiting features are not specified, but shall be determined during the investigation of the diffuser or lens material.

55.4.1.3 Unless a plastic light diffuser or lens has been found acceptable for use without a complete metal frame or door, or unless the frame is provided by an integral part of the fixture body, the diffuser shall be shipped with the door or frame in which it is to be mounted.

55.4.2 Construction

55.4.2.1 A diffuser or lens frame shall provide a complete metal U-shaped channel around the perimeter of the plastic material. The channel shall overlap the plastic material no more than 3/4 inch (19.1 mm) at either end and no more than 1/2 inch (12.7 mm) on either side. There shall be a visible clearance between the plastic material and each side of the channel.

Exception: A construction tested and found to be equivalent is acceptable.

55.4.2.2 The spacing between exposed surfaces of plastic diffuser or lens panels in adjacent fixtures – whether each diffuser or lens mounting is a separate frame or an integral part of the fixture body – shall be such that two connected fixtures will comply with the requirement in 55.4.3.2.

55.4.3 Large scale fallout test

55.4.3.1 An air-handling fixture is to be mounted as intended in a draft free test room with dimensions 12 feet by 8 feet with a 10 foot ceiling. A connection is to be made for return air or outlet air, whichever is appropriate for the fixture, at a rate of 240 cubic feet (6.8 m^3) per minute.

55.4.3.2 A steel pan with dimensions 21 inches by 21 inches by 4 inches by 0.25 inch thick (53.3 cm by 53.3 cm by 10.2 cm by 0.6 cm thick) is to be filled with 2 inches (5.1 cm) of alcohol. The pan is to be placed such that the center of the pan is below the center of the diffuser under test at a distance where the surface of the alcohol is 4 feet (121.9 cm) below the bottom surface of the diffuser. The alcohol is to be ignited and allowed to burn until ultimate results are obtained.

55.4.3.3 The results are considered acceptable if the diffuser does not ignite while in its intended position.

55.4.4 Impingement fire test

55.4.4.1 Two air-handling fixtures are to be mounted end-to-end with the ends touching in a draft free test room with dimensions 12 feet by 8 feet with a 10 foot high ceiling. A connection is to be made to one of the fixtures for return air or outlet air, whichever is appropriate for the fixture, at a rate of 240 cubic feet (6.8^3) per minute.

55.4.4.2 A 6 inch diameter (15.25 cm) by 4 inch (10.2 cm) deep steel container is to be filled with 4 inches (10.2) of alcohol. It is to be positioned such that the axial center of the container is below the center point of the edge of the diffuser farthest away from the fixture that is attached to the air connection. The distance from the surface of the alcohol to the bottom edge of the diffuser shall be 6 inches (15.25 cm). The alcohol is to be ignited and allowed to burn until ultimate results are obtained.

55.4.4.3 The results are considered acceptable if the flame is not propagated from the ignited diffuser to the adjacent diffuser.

55.4.5 Markings

55.4.5.1 A plastic light diffuser or lens that depends on the fixture for the provision of a frame and that is shipped separately from the fixture shall be marked in Form B-2 "Use with ____ (manufacturer's name) (catalog designation) ____ fixture only".

56 Low Density Ceiling Mounting

56.1 General

56.1.1 A fixture designed and marked for surface mounting on low density cellulose fiberboard shall comply with the requirements in 56.2.1 – 56.3.1.

56.2 Performance

56.2.1 A fixture shall not produce a temperature in excess of 75°C (167°F) in an ambient of 25°C (77°F) at any point on the test ceiling under the conditions described in Performance, Section 39.

Exception: The test need not be conducted if each ballast of a fixture is:

a) Rated at no more than 460 milliamperes lamp current; and

b) Spaced at least 3/8 inch (9.5 mm) below the ceiling by means of the fixture construction.

56.2.2 In judging the spacing mentioned in the Exception of 56.2.1, consideration shall be given to the likelihood of a reduction in this spacing as a result of:

a) Mounting the fixture on a cellulose fiberboard ceiling; and

b) Distortion of the mounting surface of the fixture as a result of the mounting.

56.3 Marking

56.3.1 A fixture that is found to comply with the requirements in 56.1.1 – 56.2.2 shall be marked in Form D-1 "Suitable for surface mounting on combustible low-density cellulose fiberboard".

56.3.2 A fixture of a type described in 46.1 shall be marked in Form A-2 "Access above ceiling required".

57 Dual Voltage Fixtures for Use in Recreational Vehicles

57.1 General

57.1.1 Requirements under this heading are supplementary to other applicable requirements of this standard, and apply to lighting fixtures for use in recreational vehicles on alternating current line and direct or alternating current low-voltage (below 30 volts rms or 42.4 volts peak to peak) circuits.

57.2 Separation of circuits

57.2.1 Unless provided with insulation rated for the highest voltage involved, insulated internal wiring conductors of different circuits shall be separated by a barrier or by restraint; and shall, in any case, be separated from any uninsulated live part connected to a different circuit.

57.2.2 A barrier shall be held in place. A metal barrier shall be at least 0.016 inch (0.41 mm) thick if of uncoated steel, 0.019 inch (0.48 mm) thick if of zinc-coated steel, and 0.020 inch (0.51 mm) thick if of copper, brass, or aluminum. A barrier of other material shall be of such thickness and be so supported that its deformation cannot be readily accomplished so as to defeat its purpose, but in any case, the thickness shall be no less than 0.028 inch (0.71 mm).

57.2.3 Separation of insulated conductors by restraint shall be accomplished by clamping, routing, or equivalent means to ensure permanent separation of no less than 1/2 inch (12.7 mm) from insulated or uninsulated live parts of a different circuit.

57.2.4 Supply wiring of the line-voltage circuit shall be separated, by the design of the fixture or by a barrier, from factory-installed conductors or uninsulated live parts of the low-voltage circuit. In the case of a fixture intended for mounting to an outlet box, the barrier shall be located outside the area that will be directly adjacent to the open side of a nominal 3-inch trade size outlet box when the fixture is mounted as intended.

57.3 Temperature

57.3.1 During a temperature test the fixture is to be operated simultaneously with the largest lamps with which it will be operated in normal service for both the line-voltage and the low-voltage circuits.

57.3.2 The low voltage lamp(s) shall be operated at rated voltage.

57.4 Markings

57.4.1 The fixture shall be marked, in Form D-6 (see 32.1), "For recreational vehicle use only".

58 Factory-Installed Branch Circuit Wires

58.1 Requirements under this heading are supplementary to the other applicable requirements in this standard, and apply to recessed and nonrecessed fixtures that have factory-installed branch circuit wires and are intended for end-to-end connection without the need for additional field wires. The branch circuit wires terminate at each end in an attachment plug or receptacle for such connection. These requirements do not apply to branch circuit segments that are merely placed into a fixture whether spliced to the fixture or not.

58.2 Factory-installed branch-circuit wires shall consist of lengths of No. 12 AWG (3.3 mm^2) Type RHH, THHN, or THW wire extending the length of the fixture.

58.3 Each factory-installed branch circuit wire shall be at least I foot (0.31 m) longer than the body of the fixture, and each shall be terminated in an attachment plug on one end and a receptacle on the other.

Exception: If two receptacles, one at each end of the fixture, are to be used in conjunction with a separate adapting connector, the receptacles shall be physically attached to the fixture and the wires need only be long enough to connect the receptacles.

58.4 A plug or receptacle shall be rated at least 20 amperes and at least the voltage input rating of the ballast. There may be a multipin single cap or receptacle at each end, or one for each wire.

58.5 The ballast, if connected to the branch circuit wires in the factory, shall be connected to either the plug or the receptacle, or by a tap to the branch circuit wire such that the branch circuit wire is not severed.

58.6 The color code of the branch circuit wires, in addition to one green or uninsulated wire and one white or natural gray wire, shall be: remaining single wire (in the case of a 2-wire circuit) black or blue; or remaining three wires (in the case of a 4-wire circuit), black, blue, and red. If a ballast is connected at the factory, one lead shall be connected to the white or natural gray wire.

Exception: If polarity of the branch circuit wires will be maintained by means of a single, factory-wired, polarized receptacle at one end of the fixture and a single, factory-wired, polarized attachment plug or receptacle at the other, and if the ballast is factory wired into the circuit, color identity of other than the green and the white or natural gray wires is not required.

58.7 An equipment grounding conductor, if provided, shall be bonded (see Grounding, Section 23) to the fixture at the factory.

58.8 The fixture shall be marked, in Form B-5 (see 32.1) "The ____ No. 12 Type ____ wires were factory installed", in which the quantity and the type designation respectively are entered in the blank spaces.

59 Polymeric Materials

59.1 A polymeric material, thermoplastic or thermosetting, that provides all or any part of the enclosure for electrical parts as specified in 8.1, or that provides structural support in a fixture, shall comply with the requirements of this section.

59.2 Reference need be made to the following standards:

a) Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A;

b) Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B;

c) Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C; and

d) Standard Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94.

59.3 A material shall comply with the requirements for fixed equipment as specified in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, as amended in this section.

59.4 With respect to consideration of thermal endurance of UL 746C, a normal temperature test need not be conducted, but polymeric material shall possess a mechanical temperature index, with impact, as a result of long term aging, of at least 105°C (221°F).

59.5 Any temperature of normal operating conditions specified in UL 746C is to be considered 105°C (221°F).

59.6 The distortion under load evaluation of UL 746C shall always be conducted.

59.7 The impact evaluation in UL 746C shall consist of the ball impact test.

59.8 The mold stress relief distortion evaluation in UL 746C shall be conducted only by the air oven method, not the test cell method.

59.9 The abnormal operation evaluation in UL 746C need not be done.

59.10 The severe conditions evaluation in UL 746C need not be done.

59.11 The exposure to ultraviolet light evaluation in UL 746C shall be done in all cases.

59.12 A fixture intended for use in damp or wet locations, in accordance with Sections 62 – 70, shall be evaluated for water exposure and immersion in accordance with UL 746C.

59.13 Polymeric material shall not be the only support of a non-polymeric part that weighs more than 2 pounds (0.91 kg). Such a part shall be attached to the mounting means of the fixture by a metal chain, cable, or equivalent.

Exception: A polymeric materials 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.

59.14 Any metal part in a polymeric enclosure that is required to be grounded in accordance with the requirements in Grounding, Section 23, shall be bonded.

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 8.1 or that provides structural support in a fixture.)

60.1.2 Polymeric subassemblies shall comply with the applicable requirements of 59.1 – 59.12.

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-9 (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 46.9 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 Fixtures for Use in Nonresidential Occupancies in Exhaust Ducts or Hoods Above Cooking Equipment

61.1 General

61.1.1 The requirements under this heading are supplementary to the other applicable requirements of this standard and apply to both recessed and surface-mounted types of lighting fixtures for use in nonresidential occupancies in exhaust ducts or hoods above cooking equipment in accordance with the National Electrical Code, ANSI/NFPA 70-1993, and the Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations (National Fire Codes, Vol. 4, 1989), ANSI/NFPA 96-1994.

61.1.2 The enclosure shall be of steel no thinner than 0.043 inch (1.09 mm) or stainless steel no thinner than 0.037 inch (0.94 mm).

61.1.3 The enclosure, including the diffuser and frame, shall be constructed so cooking vapors and grease are excluded from the lamp and wiring compartments by welding, brazing, gasketing, or equivalent means.

61.1.4 There shall be no openings in the enclosure.

Exception: An opening for the connection of a metallic wiring system, and an opening for the purpose of servicing the lamp compartment are acceptable, provided that both openings will be closed in intended use.

61.1.5 An enclosure or part that serves to complete the enclosure shall be of steel coated with zinc or cadmium in accordance with 67.1.1 – 67.1.4.

61.1.6 Every mounting hole of the fixture shall be in an external mounting foot, lug, or flange.

61.1.7 Every piece of mounting hardware (excluding screws, nuts, washers and the like) shall be mounted on the fixture at the factory.

61.1.8 Means for the connection of threaded conduit shall be provided and shall comply with Power Supply Connection, Section 24.

61.1.9 A light diffuser shall be of glass that is resistant to thermal and mechanical shock in accordance with 61.2.2.1, 61.2.2.2, 61.2.5.1, and 61.2.5.2.

61.1.10 Gasket and sealing material shall be resistant to deterioration from the temperature, cooking grease, and vapors to which it is likely to be subjected, as determined by an investigation that will include consideration of:

a) Irregularity of contact surfaces;

b) Aging; and

c) Methods of intended installation of the light diffuser.

61.1.11 A recessed fixture shall be provided with gasketing on the mounting surface between the fixture and the cooking hood.

61.2 Performance

61.2.1 Temperature test

61.2.1.1 A fixture of the type described in 61.1.1 shall be tested as specified in Temperature Test, Section 28, when mounted in a closed test compartment having a volume at least five times the approximate volume of the fixture enclosure, and with no restriction of the free flow of air inside.

61.2.1.2 A surface-mounted fixture is to be suspended in the test compartment.

61.2.1.3 A recessed fixture is to be enclosed in a test box constructed of 1/2 inch (12.7 mm) thick fir plywood, A – D grade, that is reasonably tight but not sealed. The box dimensions are to be in accordance with the marking specified in 61.2.7.2. The test box with the fixture inside is to be mounted to an opening in an additional close-fitting wall inside the test compartment to simulate recessed mounting in the hood.

61.2.1.4 Air in the test compartment is to be maintained at a constant temperature of 75 ±2°C (167 ±4°F).

Exception: At the manufacturer's option, the temperature of the air in the test compartment may be as low as 25°C (77°F).

61.2.1.5 When temperatures on the fixture have stabilized, they are to be recorded and corrected to a nominal 75°C (167°F) test compartment temperature by use of the formula:

$$T = Tm + (75 - Tc)$$

in which:

T is the corrected temperature in degrees C on the fixture,

Tc is the test compartment air temperature in degrees C, and

Tm is the meter reading of the temperature in degrees C being measured on the fixture.

61.2.1.6 The results are acceptable if the adjusted temperatures are within the limits specified for various materials in Temperature Test, Section 28.

61.2.2 Thermal shock test

61.2.2.1 While the fixture and diffuser are at operating temperature, the diffuser is to be subjected to a spray of water at a temperature of 25 ±5°C (77 ±9°F). The water spray is to be created by use of a rubber ear syringe and is to be directed and applied normal to the surface of the diffuser at the hottest location.

61.2.2.2 The results are acceptable if there is no breaking or cracking of the diffuser that would affect the integrity of the overall enclosure.

61.2.3 Submersible cycling test

61.2.3.1 A surface-mounted fixture or the exposed surface of a recessed fixture shall be maintained for 6 hours under a 2 inch (50.8 mm) head of water. During the test the fixture is to be energized in cycles of 1/2 hour on and 1/2 hour off. Before conducting the test the lamp compartment is to be opened one time and then closed, representing relamping in the field.

61.2.3.2 Gasketing putty or a sealing compound shall be used to seal the conduit used for supply leads to maintain a constant pressure.

61.2.3.3 The results are acceptable if there is no entrance of water at any seam, joint or gasket seal, or through the diffuser into the fixture during this test.

61.2.4 Lard or fat and oil immersion test

61.2.4.1 The gasket material is to be inspected for signs of cracking, hardening, permanent deformation, or other indication of deterioration. Two groups of specimens are to be tested for hardness, tensile strength, and elongation both before and after immersion for 96 hours in lard or other animal fat (in the case of one group of specimens), and in corn oil (in the case of the second group of specimens). In all cases the lard or other animal fat and the corn oil are to be maintained at a temperature of 100°C (212°F).

61.2.4.2 The results are acceptable if there is no cracking, hardening, permanent deformation, or change in hardness, tensile strength, or elongation as a result of this exposure. The comparison evaluation will depend on the material involved and its size, shape, and application in the fixture.

61.2.5 Mechanical abuse test

61.2.5.1 One as-received sample of the diffuser assembly is to be subjected to an impact of 3 foot-pounds force (4.07 J) delivered by the use of a 1.18 pound (0.54 kg) spherical steel ball, approximately 2 inches (50.8 mm) in diameter.

61.2.5.2 The results are acceptable if there is no breakage or cracking of the material, or if there is no water leakage into the fixture as determined by a repetition of the test described in 61.2.3.1 – 61.2.3.3.

61.2.6 Accelerated aging test

61.2.6.1 One as-received sample of the complete fixture is to be exposed in a circulating air oven for 7 hours to a temperature of 10°C (18°F) above normal operating temperature, but no less than 100°C (212°F) as established by tests outlined in 61.2.1.1 – 61.2.1.6. Upon completion of this test, the mechanical abuse and submersible cycling tests described in 61.2.5.1, 61.2.5.2, and 61.2.3.1 – 61.2.3.3 are to be repeated.

61.2.6.2 The results are acceptable if distortion is limited to the extent that the fixture continues to operate satisfactorily and there is no water leakage into the fixture.

61.2.7 Markings

61.2.7.1 The fixture shall be marked in Form B-2 (see 32.1) with the minimum temperature rating of the supply wiring, and with the wording "For use within commercial cooking hoods", or the equivalent, and "Mount a minimum of 4 feet above cooking surface".

61.2.7.2 A recessed fixture shall be marked in Form B-2 with the minimum acceptable spacings:

a) Between centers of adjacent units;

b) To side walls; and

c) Above the fixture.

PART 4 – FIXTURES FOR USE IN DAMP OR WET LOCATIONS

DAMP LOCATIONS

62 General

62.1 The requirements for damp-location fixtures are supplementary to the other applicable requirements in this standard, and apply to surface-mounted fixtures, post- or 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.

63 Construction – Mechanical

63.1 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.

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

63.3 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as described in 63.1.

Exception: Hinge pins need not be provided with the corrosion protection required in 63.1.

63.4 Sheet steel or other metal that is painted to comply with 63.1 and 63.3 shall be properly cleaned of grease and the like prior to painting.

63.5 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.

63.6 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.

64 Construction – Electrical

64.1 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 vulcanized fiber, phenolic, urea, porcelain, and the like are examples of acceptable materials.

64.2 Single-pin or recessed double-contact lampholders shall be of the weatherproof type or of a type acceptable for use in outdoor enclosed signs.

64.3 A ballast shall be of the outdoor or weatherproof type.

65 Markings

65.1 A fixture that complies with the requirements in Sections 62 – 64 and that is intended for use in damp locations shall be marked in Form D-1 (see 32.1) "Suitable for damp locations".

65.2 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

66 General

66.1 The requirements for wet-location fixtures are supplementary to the other applicable requirements in this standard, and apply to surface-mounted fixtures, post- or 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.

66.2 These requirements do not cover fixtures for use underwater (such as in a decorative fountain or a swimming pool) nor in areas that contain flammable or corrosive liquids or gases.

67 Construction – Mechanical

67.1 Corrosion protection

67.1.1 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 67.1.

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 (a) Type G90 of Table 67.1, 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 67.1.2 – 67.1.5 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 63.1 – 63.6.

Table 67.1
Sheet steel coatings

Type of Coating	Type or thickness[a] Inch	(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 B555-1986, Standard Guide for Measurement of Electrodeposited Metallic Coating Thicknesses by the Dropping Test (R1991).

[b] Conforming with the coating designation G90, G60, or A60 in Table 1 of ASTM A653-A653M-94, Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) 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.

67.1.2 Hinges, bolts, and fasteners made of ferrous materials shall be protected against corrosion as described in 62.1 for damp locations.

Exception: Hinge pins need not be provided with the corrosion protection required in 62.1.

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

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

67.1.5 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.

67.2 Enclosures

67.2.1 An enclosure or enclosures shall be constructed so 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, waterproof ballasts, and the like.

Exception: For the purposes of this requirement, the outer surface of the glass envelope of a lamp may be wetted.

67.2.2 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 70.6 and 70.7 shall be provided with the fixture.

Exception: If a drain hole as described in 67.4.2 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 67.2.1.

67.2.3 To determine compliance with 67.2.1 and 67.2.2, a complete assembly is to be subjected to the rain, sprinkler, or immersion test as specified in Performance, Section 69.

67.3 Gaskets and bushings

67.3.1 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 67.8.1.

Exception: Gaskets or bushings tested while installed in the fixture as described in 69.8.2 need not be subjected to the test described in 69.8.1.

67.3.2 A gasket shall be secured so 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.

67.3.3 If an adhesive is used to secure a gasket as described in 67.3.2, the gasket assembly shall comply with the gasket adhesion test described in 69.9.1.

67.4 Openings

67.4.1 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 Performance, Section 69, show no entrance of water into the fixture with the opening(s) open, the opening(s) 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(s) need not be threaded.

67.4.2 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 67.2.

Exception No. 1: A fixture that has been subjected to the rain or sprinkler test as required in 69.1.1 – 69.2.1 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 67.2.2.

Table 67.2
Size of drain holes

Opening shape	Minimum dimension		Minimum area		Maximum dimension		Maximum area	
	Inch	(mm)	Inch^2	(mm^2)	Inch	(mm)	Inches^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

67.5 Thermoplastic water shields

67.5.1 A polymeric 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; and

b) Comply with the exposure to ultraviolet light test in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

67.5.2 A polymeric water shield, including wood, whether provided as a lens, a diffuser, or an opaque part, shall be subjected to the ball impact test described in 69.10.1.

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

68 Construction – Electrical

68.1 The fixture shall comply with the requirements in 64.1 – 64.3.

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

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

68.4 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.

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

69 Performance

69.1 General – tests required

69.1.1 A fixture shall be subjected to the appropriate rain, sprinkler, and immersion test(s) as required in 69.1.2 – 69.2.1 and specified in 69.1.3 – 69.3.1. A summary of the tests required is provided in Table 69.1.

69.1.2 A wall-mounted surface fixture, a wall-mounted recessed fixture, and a pole- or post-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 70.2; or

b) A post-mounted fixture (such as a bollard) with the lamp or other electrical component mounted less than 3 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.

69.1.3 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 70.6.

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.

Table 69.1
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- or Post-Mounted and Ground-Mounted	Yes	No[c]	No
Ground-Mounted Recessed	No	No	Yes

[a] Test not required if the fixture is marked for covered installation only as specified in 69.1.3.

[b] Test not required if rain test conducted as described in 69.1.3.

[c] Test required if the fixture is marked for use 3 feet (914 mm) or less from ground or on a post mounted fixture (including bollards) with lamp or other electrical components less than 3 feet above ground as specified in 69.1.2.

69.1.4 A recessed fixture which can be mounted in the ground or below grade level shall be subjected to the immersion test described in 69.6.2.

Exception: A recessed fixture marked as specified in 70.4 need not be subjected to the test.

69.2 General – test conditions

69.2.1 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 70.7 are to be provided with fittings intended for use with wet locations that comply with 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 open hole provided for the connection of the power supply as described in Power Supply Connection, Section 24, is to be sealed with plastic, tape, or the like to simulate a watertight seal between the fixture and a building structure. All wired fixture sections, fittings, and the like are to be assembled as intended.

69.2.2 A fixture that is marked in accordance with 70.3 to indicate a limited angle of mounting shall be mounted during a test in the most severe position permitted by the marking.

69.2.3 A fixture that from its appearance could be mounted on either a wall or a ceiling shall be treated as both a wall-mounted and a ceiling-mounted fixture.

Exception: A fixture marked as specified in 70.4 may be treated as only a wall- or ceiling-mounted fixture.

69.2.4 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

69.3 General – test results

69.3.1 Test result are acceptable if, after completion of the ball impact test (if applicable) and the rain, sprinkler, or immersion test, no water has entered the fixture.

Exception: Water may enter pole- or post-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 67.4.2.

69.4 Sprinkler test

69.4.1 A fixture required to be subjected to a sprinkler test shall comply with the requirements in 69.4.2 and 69.4.3.

69.4.2 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 69.2.4, with adjustable parts arranged for maximum vulnerability to the water spray. Ceiling-mounted and wall-mounted or recessed fixtures intended for mounting within 3 feet (914 mm) of the ground, shall be similarly tested in the most vulnerable normal mounting position.

69.4.3 The fixture is to be positioned as shown in Figure 69.1 in front of a standard water spray head of the type shown in Figure 69.2, to which the water pressure is maintained at a gage pressure of 20 pounds per square inch (138 kPa).

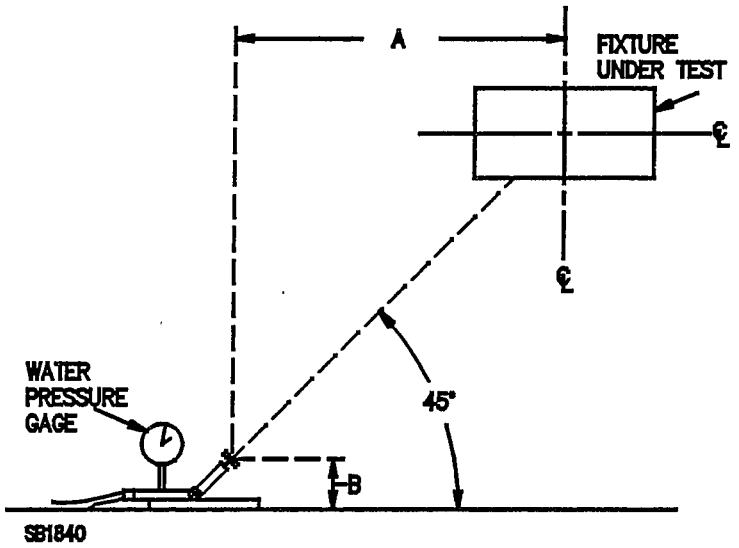
69.5 Rain test

69.5.1 A fixture required to be subjected to a rain test shall comply with the requirements in 69.5.2 and 69.5.3.

69.5.2 The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as shown in Figure 69.3. Spray heads are to be constructed in accordance with the details shown in Figure 69.2. The fixture is to be set up as in a normal installation with conduit connections – 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 at 5 pounds per square inch (34.5 kPa) at each spray head.

69.5.3 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 reinstallation of rings, frames, lamps, or other replaceable parts serving to compress the gasket.

Figure 69.1
Representative sprinkler test setup



A – 36 inches (914.4 mm)
B – 3 – 6 inches (76.2 – 152.4 mm)

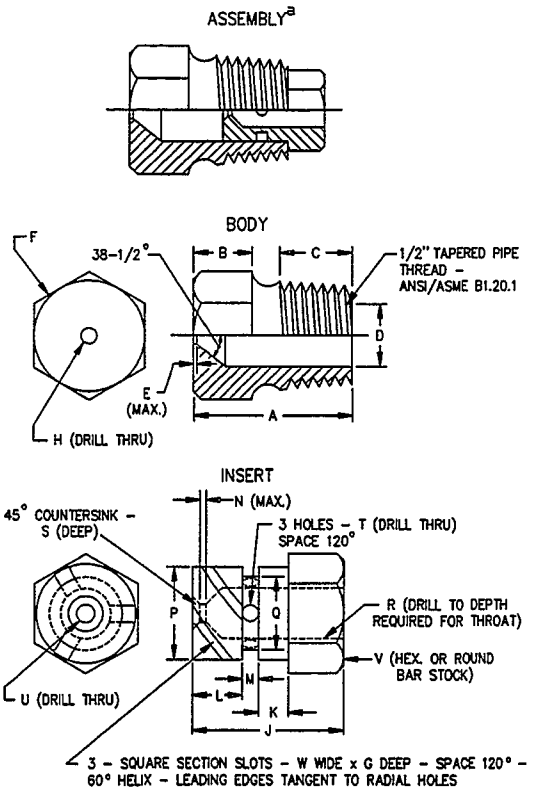
Note: The fixture is to be mounted as intended with the dimensional center of the fixture on a line projected from the centerline of the nozzle head.

69.6 Immersion test

69.6.1 A recessed fixture required to be subjected to an immersion test shall comply with the requirements in 69.6.2.

69.6.2 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 submerging shall be 5°C (41°F) or lower. The unit shall remain underwater for at least 4 hours. At the end of 4 hours, the fixture is to be removed from the water. At the end 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.

Figure 69.2
Spray head



RT100C

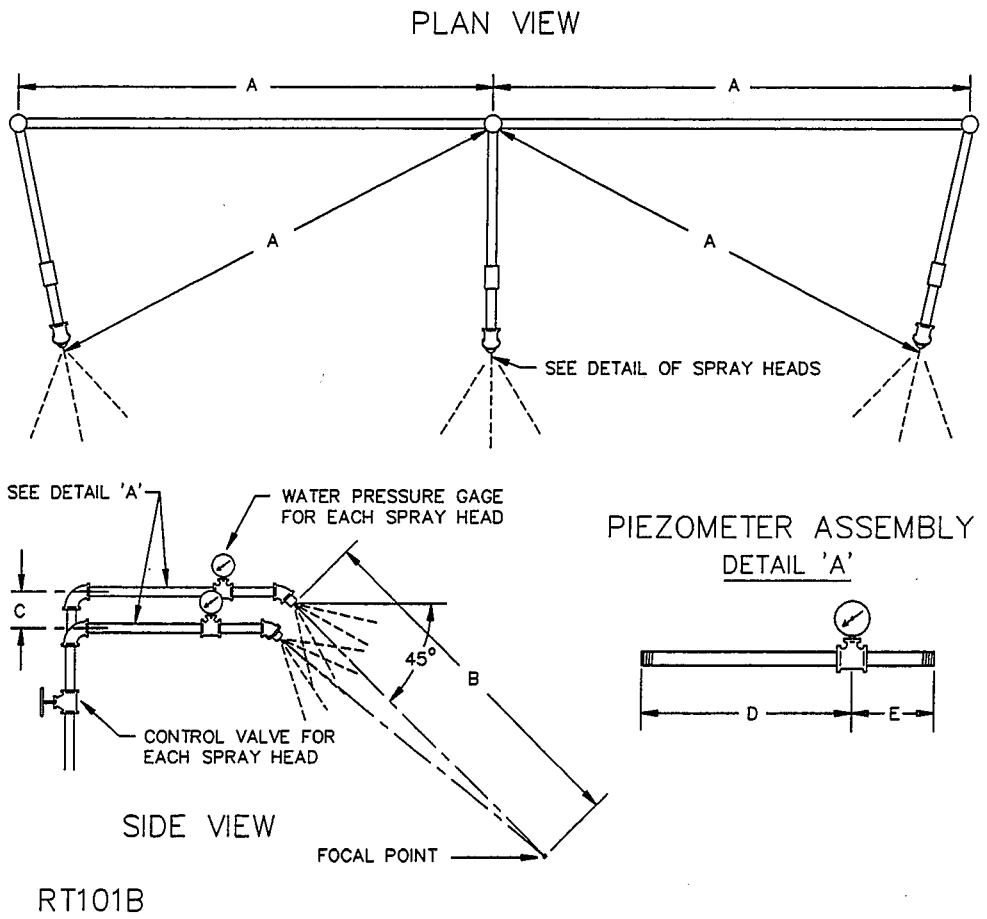
Item	Inch	mm	Item	Inch	mm
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35)[b]	2.80
H	(No. 9)[b]	5.0	U	(No. 40)[b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Molded Nylon Rain-Test Spray Heads are available from Underwriters Laboratories Inc.

[b] Standard for Twist Drills, ANSI/ASME B94.11M-1993, Drill size

[c] Optional – To serve as wrench grip.

Figure 69.3
Spray head piping



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

69.7 Thermal shock test

69.7.1 A fixture that employs a water shield is to be subjected to a simulated, sudden exposure to rain after operation under normal conditions for 1 hour. 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.

69.8 Thermal conditioning

69.8.1 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 28, have a tensile strength of no less than 60 percent and an elongation of no less than 75 percent of the values determined before conditioning. The maximum operating temperature of the gasket is to be determined by operating the fixture under the conditions specified in the temperature test and measuring the gasket temperature by thermocouples of the type specified in 28.1.5.

Exception No. 1: This test need not be conducted if a gasket or bushing is tested while installed in the fixture as described in 69.8.2.

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 thermal conditioning test.

Exception No. 3: The conditioning temperature shall be 100°C (212°F) for fixtures not subjected to the temperature test.

Exception No. 4: A silicone rubber gasket used on a fixture not subjected to the temperature test need not be subjected to the thermal conditioning test.

69.8.2 As an alternative to the test described in 69.8.1, 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 28. 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.

69.8.3 In regard to 69.8.2, 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 69.8.2 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.

69.9 Gasket adhesion test

69.9.1 In accordance with 67.3.3, 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 69.8.1 or 69.8.2, 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.

69.10 Water shield impact test

69.10.1 Each of three samples of the polymeric water shields, including wood, described in 67.5.1 and 67.5.2, mounted in its intended manner on the fixture, shall be 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 (0.535 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.

69.10.2 Following the impact test described in 69.10.1, 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 Performance, Section 69. Test results are acceptable, even with cracking or breaking of the water shield, if the fixture complies with the requirements in 69.3.1.

70 Markings

70.1 A fixture that complies with the requirements in Sections 66 – 69 and that is intended for use in wet locations shall be marked in Form D-1 (see 32.1) "Suitable for wet locations".

70.2 A wall-mounted fixture intended for use within 3 feet (914 mm) of the ground that complies with the sprinkler test shall be marked, in Form D-1, "Suitable (for mounting) within 3 feet of the ground".

70.3 A fixture with adjustable or 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.

70.4 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.

70.5 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 70.7.

70.6 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.

70.7 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.

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 Fluorescent Lighting Fixtures, UL 1570. Any reference to the term "Standard" also applies to UL 1570.

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 authorized 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 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.

SA4 Manufacturer's Test Program

SA4.1 Glass support test

SA4.1.1 A sample of each fixture style that employs a glass diffuser supported by friction shall be tested not less than once a quarter to determine compliance with 30.1.

SA4.1.2 The test may be performed as follows:

a) Weigh the diffuser.

b) Pour an amount of granular material, such as sand, equal to four times the weight of the diffuser into the diffuser, distributing it evenly.

c) Mount the diffuser as intended.

d) If the diffuser stays in place, the test results are acceptable.

e) If the diffuser does not stay in place, select three additional samples and repeat the test on each new sample. If the diffuser does not stay in place on all three samples, the lot is to be rejected.

SA4.2 Grounding continuity test

SA4.2.1 Tests are to be conducted by the manufacturer for grounding continuity as described in 29.1 and 29.2 to determine compliance with 23.2.7. The test is to be performed as a periodic 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.

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 29.1. If it is necessary to perform the alternate test method described in 29.2, it shall be authorized in the Procedure.

b) For products that comply with Assembly and Packaging, Section 5, 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.

c) The Grounding Continuity Test shall also be conducted after the Test of Fixtures with Snap-In or Tab-Mounted Parts described in SA4.5.1.

SA4.3 Strain relief test

SA4.3.1 As required in 26.1, 38.1.6, and 39.4.1, the strain relief tests are to be conducted as described in 26.2 and 39.4.2. The tests are to be conducted on a representative sample of each type of fixture required to comply with the test during each factory visit. The field representative shall witness the test during each inspection.

SA4.4 Fixtures not assembled

SA4.4.1 For those fixtures which are shipped without being assembled in accordance with Assembly and Packaging, Section 5, the manufacturer shall, not less than once per inspection quarter, assemble the fixture using the assembly instructions and then conduct the grounding 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.

SA4.5 Fixtures with snap-in or tab-mounted parts

SA4.5.1 The manufacturer shall periodically conduct the testing described in Snap-In or Tab-Mounted Parts Pull Test, Section 27, for those fixtures with snap-in or tab-mounted parts not provided with the additional securement described in 24.2.8. The field representative shall witness the test as part of the product inspection.

a) For fixtures shipped with snap-in or tab-mounted parts assembled onto the fixture and that are not described in the Procedure, "periodically" shall mean not less than once per 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.

b) For fixtures with tab-mounted parts described in the Procedure, the testing need not be conducted.

SA4.6 Enclosure part securement

SA4.6.1 Each enclosure part that is secured to a fixture by friction alone shall be subjected to the Weight Loading and Impact Tests specified in SA4.6.2 and SA4.6.3.

SA4.6.2 A fixture with an enclosure part secured by friction alone shall be mounted in an orientation that would cause the part to be dislodged from the fixture with the least amount of weight applied to the part. A 10 lb (4.54 kg) weight shall be evenly distributed on the enclosure part for one minute. After one minute, the enclosure part shall remain in place and the grounding continuity between the enclosure part and the fixture shall comply with the Grounding Continuity Test requirements in SA4.2.1.

SA4.6.3 A fixture with enclosure parts secured by friction alone shall be subjected to a single impact of 5 ft-lbs. produced by a steel sphere, 2 inches (50.8 mm) in diameter, and weighing 1.18 lbs (0.535 kg). The impact is to be applied either by dropping the steel sphere directly on the product or by pendulum striking the enclosure part from the side while the fixture is secured in place in its intended mounting position. The method used shall most likely cause the part secured by friction to be dislodged from the fixture during impact. As a result of the impact, the enclosure part shall remain in place and grounding continuity shall be maintained as determined by performing the Grounding Continuity Test in SA4.2.1.

SA4.7 Test records

SA4.7.1 Records of all required tests 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 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 The descriptions in the Procedure may address construction features not specified in the referenced Standard. Usually a fixture is described because of a test performed at the certification organization, and 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 Other than as noted in SA6.2, the field representative shall determine that the product complies with the appropriate construction requirements in the Standard.

SA6.2 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.

SA6.3 In reference to 24.1.1(e) and Exception No. 2 to 24.3.1, 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.

Table SA6.1
Requirements needing engineering investigation

Paragraph number	Comment
1.3	
1.4	
1.6	
4.1	See SA7.1.
4.2	See SA7.1. For Recognized Components only.
4.3	See SA7.1. For Recognized Components only.
4.4	See SA7.1.
5.1 Exception No. 3	
5.3 Exception No. 2	
5.4	
6.2 Exception	
8.2	For polymeric material only
9.1.1 Exception No. 2	
11.1 Exception No. 2	
12.1.1	For adhesives only
12.2.8 Exception	
12.2.9	If adhesive is used for mounting
12.2.10	
12.3.1 (e) and (f)	
18.1.5 Exception	
22.4.2	
22.4.3	
23.1.10 Exception No. 2	
23.2.2	
23.2.6	Equivalent means, and sheet metal or self threading screw
24.1.3 Exception	
24.3.1 Exception No. 2	See SA6.3
Section 28	
29.2	Alternate method
Section 31	
34.2.5 Exceptions No. 1 and 2	
37.2.6	
37.2.7 Exception No. 2	
37.3.2(d)	
Section 39	39.1.2 may be evaluated by field representative.

(Continued)

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

Paragraph number	Comment
42.3.4 Exception No. 1	Unless Listed outlet box is used
42.3.5	Fixture to be reinforced as necessary
43.2.6 Exception	
Section 44	44.1.2 may be evaluated by field representative.
Sections 47, 48, 49	
50.2.3 – 50.2.6, 50.2.13	Exception to 50.2.13 may be evaluated by filed representative.
Section 51	
52.1.1, 52.5.1, 52.6.3	
Section 53	
55.2.1 – 55.3.1, 55.4.1.1 – 55.4.4.1	Only Exception to 55.4.2.1 applies. 55.3.1 applies only if nonmetallic material is in air path or plenum.
Section 56	Exception to 56.2.1 may be evaluated by field representative
Sections 57, 58, 59, 61, 66	59.4 may be evaluated by field representative if the mechanical temperature index can be verified.
Section 67	Except for corrosion protection.
Sections 68, 69, 70	

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 a Forms A and E Marking of Table 32.1 and 32.3, 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 60°C (or 90°C if located within 3 inches of a ballast).

b) Appliance Wiring Material – Any Recognized Component AWM may be used if it complies with 18.1.4.

c) Corrosion Protection – Any Recognized Component Metallic Protective Coating rated G90 may be used to comply with Table 67.1, 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) Special-Use Switches – Recognized Component special-use switches that have been investigated for compliance with the Standard for Special-Use Switches, UL 1054, may be used within the recognized rating in accordance with 15.2.

SA8 Special Constructions

SA8.1 Bushings

SA8.1.1 Any Listed bushing is acceptable for the prevention of wire damage in accordance with 18.4.3.

SA8.2 Enclosure securement

SA8.2.1 Enclosure securement for enclosure part that is secured by friction alone as specified in the Exception to 8.4, a representative sample of the most recent production shall be subjected to the tests specified in SA4.6.1 – SA4.6.3 once a quarter. The field representative may accept an enclosure part secured by friction alone if it requires 10 lbs (4.54 kg) or more for the enclosure part to be removed from the fixture, the part does not fall off as a result of the Impact Test and grounding continuity of the enclosure part to the fixture is maintained after each test has been completed.

SA8.3 Grounding

SA8.3.1 To verify that a grounding or bonding screw threads into metal a minimum of two full threads in accordance with 23.2.6, multiply the metal thickness in inches by the screw pitch. For example:

Metal (thickness) x pitch = threads

i.e., 0.065 in. X 32 threads/in. = 2.08 threads

0.056 in. X 36 threads/in. = 2.02 threads

SA8.3.2 The screw referenced in 23.1.9 that is intended for connection of the grounding conductor may also have a green colored, slotted, round head.

SA8.4 Threaded joints

SA8.4.1 Compounds used to prevent turning of threaded joints are acceptable provided that the compounds do not interfere with the ground continuity of the fixture.

SA8.5 Lamps

SA8.5.1 "Energy-Saving" lamps may not be shipped with Listed lighting fixtures unless the ballast is marked to indicate its suitability for use with such lamps.

SA8.6 Reflector kits

SA8.6.1 An evaluation of reflector kits intended for use with field installed Listed fixtures in accordance with Reflector Kits, Section 50, shall be performed on each design of fixture identified in the reflector kit instruction sheet. The reflector kit manufacturer shall provide for the field representative a complete sample of each design of fixture with which the reflector kit is intended to be installed. The evaluation is to consist of:

a) The field representative assembling the reflector kit to each fixture using the installation instructions provided with the reflector kit (and the necessary tools as provided by the manufacturer) to determine the adequacy of the instructions;

b) An inspection of the assembled fixture/kit combination to determine compliance with the requirements in the Standard;

c) Verification that the fixture construction complies with the construction drawing in the instructions; and

d) The original sample of the fixture need not be retained by the reflector kit manufacturer after the field representative determines initial compliance if:

1) The manufacturer maintains a drawing of the fixture construction design and identifies the reflector kit to be utilized in the design;

2) The drawing is signed off by the field representative after evaluating the acceptability of the reflector kit with the fixture; and

3) The drawing is retained at the factory so as to be readily available for the field representative's use during subsequent evaluations of the reflector kit design.

SA8.6.2 A Type 2 reflector kit shall not employ a ballast of the dimming type, or a simple reactance ballast with more than one lead in and one lead out, unless it has been tested by the certification organization and described in the Procedure.

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 32.1, and shall be in one of the locations designated by the form numbers in Table 32.2. The wording, form letter, and form number shall also be in accordance with the specifications given elsewhere in the Standard for the particular case.

SA9.2 Paragraph references for the markings associated with fixtures requiring a Procedure description or markings which require specific values developed as the result of an investigation are provided in Table SA9.1. Reference shall be made to the Procedure for authorization to use these markings. The form, size, and wording of a marking shall be as specified in the Standard. The blank spaces are to be filled in with information provided in the Procedure.

Table SA9.1
Markings needing engineering investigation

Paragraph Number	Paragraph Number
15.5	49.4
33.1.2	51.2.1
34.1.3	51.2.2
34.1.4	53.5.1 – 53.5.3
34.1.6	54.2.5
34.1.7	55.4.5.1
46.4	57.4.1
48.2.3	58.8
48.2.4	61.2.7.1
48.2.5	61.2.7.2
48.2.6	70.1 – 70.7

SA9.3 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, wired fixture channel, fixture reflector, or wired fixture section. One Listing Mark shall be applied to each section of a two-section lighting unit of which neither section is a complete fixture because one or more lamps in one section are controlled by one or more ballasts in the other section. Such two-section units may bear one Listing Mark only when both sections are packed (completely wired) and shipped in a single carton. Such two-section units may alternately bear a wired fixture section Listing Mark on each section, provided each section complies with the requirements of 54.1.1 – 54.2.5, and when so labeled, each section may be shipped in a separate carton.

SA10.1.2 The Listing Mark shall be so located on the exterior of the fixture, wired channel, or reflector 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 Fluorescent Lighting Fixtures shall consist of the following declaration:

CERTIFICATION ORGANIZATION
LOGO OR NAME

LISTED

(PRODUCT CATEGORY)

together with the product name (such as "Fluorescent Fixture," "Wired Fixture Section," 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
Capacitors – UL 810
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, Starters, and Starter Holders for Fluorescent Lamps – UL 542
Marking and Labeling Systems – UL 969
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