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Electric Plumbing Accessories



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Revisions: This Standard contains revisions through and including October 22, 2003.

SUMMARY OF TOPICS

The revisions dated October 22, 2003 were issued to update the Title Page to indicate the latest approval of ANSI/UL 1951 as an American National Standard.

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Text that has been changed in any manner is marked with a vertical line in the margin. Changes in requirements are marked with a vertical line in the margin and are followed by an effective date note indicating the date of publication or the date on which the changed requirement becomes effective.

The revisions dated October 22, 2003 include a reprinted title page (page1) for this Standard.

As indicated on the title page (page 1), this UL Standard for Safety is an American National Standard. Attention is directed to the note on the title page of this Standard outlining the procedures to be followed to retain the approved text of this ANSI/UL Standard.

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

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

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Standard for Electric Plumbing Accessories

First Edition

April 25, 1994

The most recent designation of ANSI/UL 1951 as an American National Standard (ANSI) occurred on September 24, 2003. The ANSI approval for this standard does not include the Cover Page, Transmittal Pages, Title Page, Foreword, or Appendix A.

This ANSI/UL Standard for Safety, which consists of the First Edition with revisions through October 22, 2003, is under continuous maintenance, whereby each revision is ANSI approved upon publication. Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Written comments are to be sent to the UL Northbrook Standards Department, 333 Pfingsten Road, Northbrook, IL 60062.

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

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

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APPENDIX A

Standards for Components..... A1

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 which conflict with specific requirements of the Standard cannot be judged to comply with the Standard. A product employing materials or having forms of construction not addressed by this Standard may be examined and tested according to the intent of the requirements and, if found to meet the intent of this Standard, 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.

INTRODUCTION

1 Scope

1.1 These requirements cover equipment connected to or used with plumbing in commercial or household locations. Examples of equipment covered by these requirements are irrigation equipment, sprinkler controls, water controls located in kitchens and bathrooms, electric faucets, and toilet flushing systems. All equipment is intended for installation and use in accordance with the National Electrical Code, NFPA 70, and is rated 600 volts or less.

1.2 These requirements do not cover pumps, dishwashers, washing machines, or other equipment connected to plumbing that is covered by individual requirements.

1.3 These requirements do not cover refrigeration systems or controls that regulate water temperature, or equipment for use in hazardous locations as defined in the National Electrical Code, NFPA 70.

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

1.4 revised January 14, 2000

2 Glossary

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

2.2 **FIELD-WIRING TERMINAL** – A terminal to which power supply (including equipment grounding) or control connection will be made in the field when the product is installed as intended. If the wire, to be connected to the terminal, is provided as part of the unit and a pressure terminal, connector, soldering lug, soldered loop, crimped eyelet, or other means for making the connection is factory-assembled to the wire, it is not a field wiring terminal.

2.3 **LINE-VOLTAGE CIRCUIT** – A circuit involving a potential of not more than 600 volts and having circuit characteristics in excess of those of a low-voltage circuit.

2.4 **LOW-VOLTAGE CIRCUIT** – A circuit involving a peak open-circuit potential of not more than 42.4 volts supplied by a battery, by a Class 2 transformer, or by a combination of a transformer and a fixed impedance that as a unit, complies with all performance requirements for a Class 2 transformer. A circuit derived from a line-voltage circuit by connecting a resistance in series with the supply circuit as a means of limiting the voltage and current is not a low-voltage circuit.

2.4 revised January 14, 2000

2.5 **OPPOSITE POLARITY** – A difference of potential between two points, where shorting of these two points would result in a condition involving overload, rupturing of printed wiring-board tracks, components or fuses, and the like.

2.6 **PRIMARY CIRCUITS** – The wiring and components that are conductively connected to the supply circuit.

2.7 SAFETY CIRCUIT – A primary or secondary circuit that contains a control relied upon to reduce a risk of fire, electric shock, or injury to persons.

2.8 SECONDARY CIRCUIT – A circuit supplied from a secondary winding of an isolation transformer.

2.9 USER SERVICING – Any form of servicing that can be performed by personnel other than those who are trained to maintain the particular equipment is considered user servicing. Some examples of user servicing are:

- a) Attaching accessories by means of attachment plugs and receptacles or by means of other separable connectors.
- b) Replacing lamps and fuses and resetting circuit breakers located in an operator-access area unless the lamps, fuses, or circuit breakers are marked to indicate replacement or resetting only by qualified service personnel.
- c) Making routine operating adjustments necessary to adapt the unit for its different intended functions.
- d) Any operation described or implied in the operator's manual, whether or not tools are required.

3 Components

3.1 Except as indicated in 3.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

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

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

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

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

4 Units of Measurement

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

4.2 Unless indicated otherwise, all voltage and current values are rms and wattage values are average power.

5 References

5.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

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CONSTRUCTION

6 Frame and Enclosure

6.1 General

6.1.1 Equipment shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it may be subjected, without increasing the risk of fire, electric shock, or injury to persons due to total or partial collapse resulting in a reduction of spacings, loosening or displacement of parts, or other defects.

6.1.2 Equipment that complies with the requirements in 6.1.3 – 6.7.1 is considered to comply with 6.1.1.

6.1.3 The enclosure shall prevent molten metal, burning insulation, flaming particles, or the like from falling on combustible materials, including the surface upon which the equipment is supported.

6.2 Barriers

6.2.1 The requirement in 6.1.3 will necessitate that a switch, a relay, a transformer, a solenoid, or the like be individually and completely enclosed, except for terminals, unless it can be shown that malfunction of the component would not result in a risk of fire, or there are no openings in the bottom of the appliance enclosure.

6.2.2 A barrier of noncombustible material shall be provided:

a) Under a motor unless:

- 1) The structural parts of the motor or of the equipment provide the equivalent of such a barrier; or
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the equipment when the motor is energized under each of the following fault conditions:
 - i) Open main winding;
 - ii) Open starting winding;
 - iii) Starting switch short-circuited; and
 - iv) Capacitor of permanent-split capacitor motor short-circuited – the short circuit is to be applied before the motor is energized, and the motor is to be locked; or
- 3) The motor is provided with a thermal motor protector – a protective device that is sensitive to temperature and current – that will prevent the temperature of the motor windings from exceeding 125°C (257°F) under the maximum load under which the motor will run without causing the protector to cycle and from exceeding 150°C (302°F) with the rotor of the motor locked; or

4) The motor complies with the requirements in the Standard for Impedance-Protected Motors, UL 519, and the temperature of the motor winding will not exceed 150°C during the first 72 hours of operation with the rotor of the motor locked.

b) Under wiring, unless it is neoprene, cross-linked polyethylene, or thermoplastic insulated.

6.2.3 The barrier mentioned in 6.2.2 shall be horizontal, shall be located as illustrated in Figure 6.1, and shall not have an area less than that described in that illustration. Openings for drainage, ventilation, and the like may be employed in the barrier, provided such openings would not permit molten metal, burning insulation, or the like to fall on combustible material.

6.3 Doors and covers

6.3.1 An enclosure and a part of an enclosure such as a door or cover shall be provided with means for firmly securing it in place.

6.3.2 An enclosure cover shall be hinged if:

- a) It gives access to a fuse or other overcurrent device, the functioning of which requires renewal, or
- b) It is necessary to open the cover in order to reset a device in connection with normal operation of the product.

6.3.3 If a cover is required by 6.3.2 to be hinged, then the cover shall not depend solely upon screws or other similar means requiring the use of a tool to hold it closed, but shall be provided with a spring latch or catch, or a hand-operable captive fastener.

6.4 Cast metal

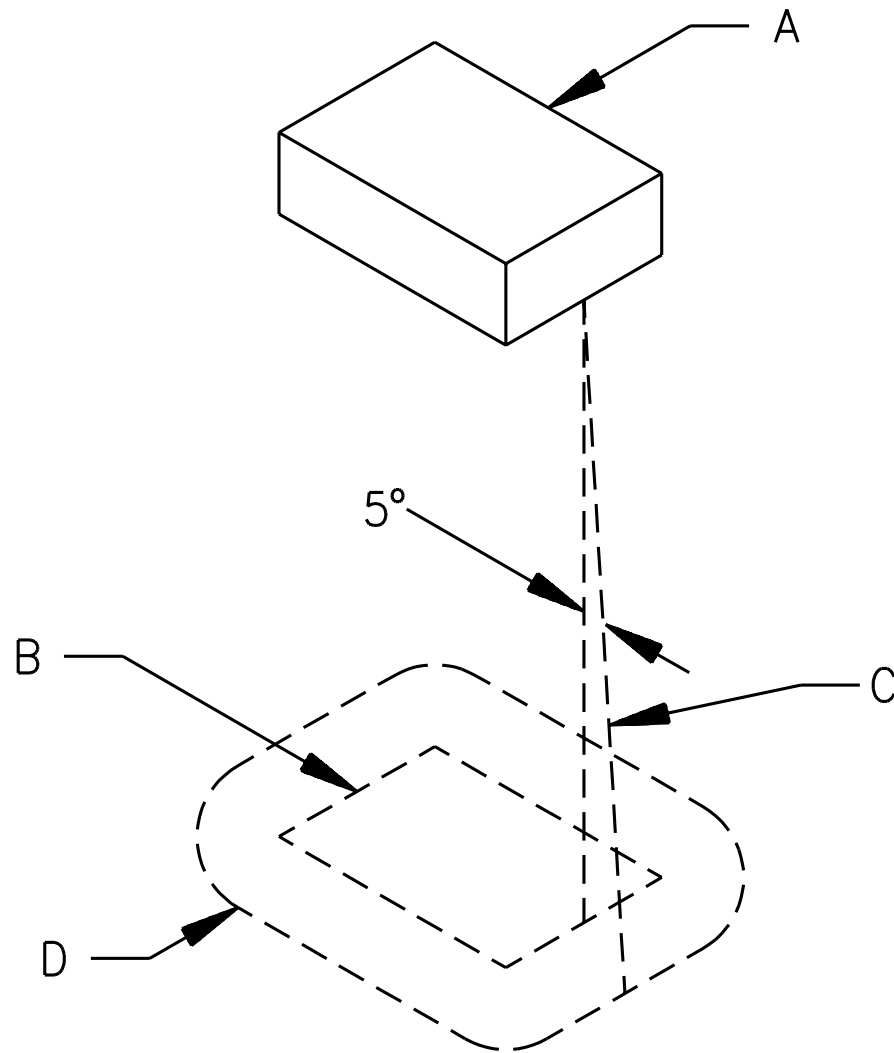
6.4.1 For unreinforced flat surfaces, in general, cast metal shall not be less than 1/8 inch (3.2 mm) thick, except that malleable iron may be not less than 3/32 inch (2.4 mm) and die-cast metal may be not less than 5/64 inch (2.0 mm) thick. Corresponding thicknesses of not less than 3/32 inch (2.4 mm), 1/16 inch (1.6 mm), and 3/64 inch (1.2 mm), respectively, may be acceptable if the surface under consideration is curved, ribbed, or otherwise reinforced, or if the shape or size, or both, of the surface is such that the necessary mechanical strength is provided.

6.5 Sheet metal

6.5.1 Other than at points where a wiring system is to be connected, the thickness of a sheet-metal enclosure shall not be less than that specified in Tables 6.1 and 6.2.

Figure 6.1
Location and extent of barrier

Figure 6.1 revised July 24, 1998



SA0604-1

A – Region to be shielded by barrier. This will consist of the entire component if it is not otherwise shielded, and will consist of the unshielded portion of a component that is partially shielded by the component enclosure or equivalent.

B – Projection of outline of component of horizontal plane.

C – Inclined line that traces out minimum area of barrier. When moving, the line is always tangent to the component, 5 degrees from the vertical, and so oriented that the area traced out on a horizontal plane is maximum.

D – Location (horizontal) and minimum area for barrier. The area is that included inside the line of intersection traced out by the inclined line C and the horizontal plane of the barrier.

Table 6.1
Minimum thickness of sheet metal for enclosures – carbon steel or stainless steel

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness, Inch (mm)	
Maximum width ^b , Inches (cm)	Maximum length ^c , Inches (cm)	Maximum width ^b , Inches (cm)	Maximum length, Inches (cm)	Uncoated metal	Coated metal
4.0 (10.2)	Not limited	6.25 (15.9)	Not limited	0.020 ^d (0.51)	0.023 ^d (0.58)
4.75 (12.1)	5.75 (14.6)	6.75 (17.1)	8.25 (21.0)		
6.0 (15.2)	Not limited	9.5 (24.1)	Not limited	0.026 ^d (0.66)	0.029 ^d (0.74)
7.0 (17.8)	8.75 (22.2)	10.0 (25.4)	12.5 (31.8)		
8.0 (20.3)	Not limited	12.0 (30.5)	Not limited	0.032 (0.81)	0.034 (0.86)
9.0 (22.9)	11.5 (29.2)	13.0 (33.0)	16.0 (40.6)		
12.5 (31.8)	Not limited	19.5 (49.5)	Not limited	0.042 (1.07)	0.045 (1.14)
14.0 (35.6)	18.0 (45.7)	21.0 (53.3)	25.0 (63.5)		
18.0 (45.7)	Not limited	27.0 (68.6)	Not limited	0.053 (1.35)	0.056 (1.42)
20.0 (50.8)	25.0 (63.5)	29.0 (73.7)	36.0 (91.4)		
22.0 (55.9)	Not limited	33.0 (83.8)	Not limited	0.060 (1.52)	0.063 (1.60)
25.0 (63.5)	31.0 (78.7)	35.0 (88.9)	43.0 (109.2)		
25.0 (63.5)	Not limited	39.0 (99.1)	Not limited	0.067 (1.70)	0.070 (1.78)
29.0 (73.7)	36.0 (91.4)	41.0 (104.1)	51.0 (129.5)		
33.0 (83.8)	Not limited	51.0 (129.5)	Not limited	0.080 (2.03)	0.084 (2.13)
38.0 (96.5)	47.0 (119.4)	54.0 (137.2)	66.0 (167.6)		
42.0 (106.7)	Not limited	64.0 (162.6)	Not limited	0.093 (2.36)	0.097 (2.46)
47.0 (119.4)	59.0 (149.9)	68.0 (172.7)	84.0 (213.4)		
52.0 (132.1)	Not limited	80.0 (203.2)	Not limited	0.108 (2.74)	0.111 (2.82)
60.0 (152.4)	74.0 (188.0)	84.0 (213.4)	103.0 (261.6)		
63.0 (160.0)	Not limited	97.0 (246.4)	Not limited	0.123 (3.12)	0.126 (3.20)
73.0 (185.4)	90.0 (228.6)	103.0 (261.6)	127.0 (322.6)		

^a See 6.5.4.

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

^c "Not limited" applies only if the edge of the surface is flanged at least 1/2 inch (12.7 mm) or fastened to adjacent surfaces not normally removed in use.

^d Sheet steel for an enclosure intended for outdoor use shall not be less than 0.034 inch (0.86 mm) thick if zinc coated and not less than 0.032 inch (0.81 mm) thick if uncoated.

Table 6.2
Minimum acceptable thickness of sheet metal for enclosures – aluminum, copper, or brass

Without supporting frame ^a		With supporting frame or equivalent reinforcing ^a		Minimum thickness Inch (mm)
Maximum width ^b , Inches (cm)	Maximum length ^c , Inches (cm)	Maximum width ^b , Inches (cm)	Maximum length, Inches (cm)	
3.0 (7.6)	Not limited	7.0 (17.8)	Not limited	0.023 ^d (0.58)
3.5 (8.9)	4.0 (10.2)	8.5 (21.6)	9.5 (24.1)	
4.0 (10.2)	Not limited	10.0 (25.4)	Not limited	0.029 (0.74)
5.0 (12.7)	6.0 (15.2)	10.5 (26.7)	13.5 (34.3)	
6.0 (15.2)	Not limited	14.0 (35.6)	Not limited	0.036 (0.91)
6.5 (16.5)	8.0 (20.3)	15.0 (38.1)	18.0 (45.7)	
8.0 (20.3)	Not limited	19.0 (48.3)	Not limited	0.045 (1.14)
9.5 (24.1)	11.5 (29.2)	21.0 (53.3)	25.0 (63.5)	
12.0 (30.5)	Not limited	28.0 (71.1)	Not limited	0.058 (1.47)
14.0 (35.6)	16.0 (40.6)	30.0 (76.2)	37.0 (94.0)	
18.0 (45.7)	Not limited	42.0 (106.7)	Not limited	0.075 (1.91)
20.0 (50.8)	25.0 (63.5)	45.0 (114.3)	55.0 (139.7)	
25.0 (63.5)	Not limited	60.0 (152.4)	Not limited	0.095 (2.41)
29.0 (73.7)	36.0 (91.4)	64.0 (162.6)	78.0 (198.1)	
37.0 (94.0)	Not limited	87.0 (221.0)	Not limited	0.122 (3.10)
42.0 (106.7)	53.0 (134.6)	93.0 (236.2)	114.0 (289.6)	
52.0 (132.1)	Not limited	123.0 (312.4)	Not limited	0.153 (3.89)
60.0 (152.4)	74.0 (188.0)	130.0 (330.2)	160.0 (406.4)	

^a See 6.5.4.
^b The width is the smaller dimension of a rectangular piece of sheet metal that is part of an enclosure. Adjacent surfaces of an enclosure may have common supports and be made of a single sheet.
^c "Not limited" applies only if the edge of the surface is flanged at least 1/2 inch (12.7 mm) or fastened to adjacent surfaces not normally removed in use.
^d Sheet copper, brass, or aluminum for an enclosure intended for outdoor use shall not be less than 0.029 inch (0.75 mm) thick.

6.5.2 At points at which a wiring system is to be connected, uncoated steel shall be at least 0.032 inch (0.81 mm) thick, zinc-coated steel shall be at least 0.034 inch (0.86 mm) thick, and nonferrous metal shall be at least 0.045 inch (1.14 mm) thick.

6.5.3 Tables 6.1 and 6.2 are based on a uniform deflection of the enclosure surface for any given load concentrated at the center of the surface regardless of metal thickness.

6.5.4 With reference to Tables 6.1 and 6.2, a supporting frame is a structure of angle or channel or a folded rigid section of sheet metal that is rigidly attached and has essentially the same outside dimensions as the enclosure surface and that has sufficient torsional rigidity to resist the bending moments that may be applied by the enclosure surface when it is deflected. A structure that is as rigid as one built with a frame of angles or channels is considered to have equivalent reinforcing. Constructions considered to be without supporting frame include:

- a) Single sheet with single formed flanges – formed edges,
- b) A single sheet that is corrugated or ribbed,
- c) An enclosure surface loosely attached to a frame, for example, with spring clips and
- d) An enclosure surface having an unsupported edge.

6.6 Nonmetallic enclosures

6.6.1 General

6.6.1.1 Tests on nonmetallic enclosures shall be conducted in accordance with requirements for fixed or stationary equipment, as applicable in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C, and also with the additional requirement specified in this standard.

6.7 Outdoor-use enclosures

6.7.1 Equipment intended for outdoor use that is not intended to be submersible shall employ a construction that provides drainage.

7 Mounting

7.1 Permanently connected units

7.1.1 Provision shall be made for securely mounting permanently connected equipment in position. Bolts, screws, or other parts used for assembling the equipment shall be independent of those used for securing component parts to the frame, base, or panel.

7.2 Cord-connected units

7.2.1 Cord-connected equipment shall not include means for permanent mounting. One or two keyhole slots for wall hanging may be provided if the hanging screws, nails, and the like, are not accessible for tightening, and if long nails, hooks, or screws for hanging will not be likely to touch internal wiring, components, or live parts, and will not result in spacing less than those required in Table 25.1.

8 Protection Against Corrosion

8.1 An iron or steel part shall be protected against corrosion by enameling, painting, galvanizing, plating, or an equivalent means, if corrosion of such a part would result in a risk of fire, electric shock, or injury to persons.

Exception No. 1: This requirement does not apply in certain instances where oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable, thickness of metal and temperature also being factors.

Exception No. 2: This requirement does not apply to bearings, laminations, or other minor parts of iron or steel, such as a washer, a screw, and the like, or to spot welds in coated materials used indoors.

Exception No. 3: Stainless steel may be employed without additional corrosion resistance.

8.2 Cabinets and cutout boxes shall comply with the Standard for Enclosures for Electrical Equipment, UL 50.

9 Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts

9.1 To reduce the likelihood of unintentional contact that may involve a risk of electric shock from an uninsulated live part or film-coated wire or injury to persons from a moving part, an opening in an enclosure shall comply with either (a) or (b).

a) For an opening that has a minor dimension as described in 9.5 of less than 1 inch (25.4 mm), an uninsulated live part, a moving part, or film-coated wire shall not be contacted by the probe illustrated in Figure 9.1, or

b) For an opening that has a minor dimension as described in 9.5 of 1 inch or more, an uninsulated part, a moving part, or film-coated wire shall be spaced from the opening as specified in Table 9.1.

Exception: An opening in a motor need not comply with these requirements if it complies with the requirements in 9.2.