

UL 73

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Motor-Operated Appliances

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UL Standard for Safety for Motor-Operated Appliances, UL 73

Ninth Edition, Dated December 23, 2004

Revisions: This Standard contains revisions through and including April 25, 2006.

Summary of Topics

These editorial revisions to ANSI/UL 73 replace all references to UL 1020, the Standard for Thermal Cutoffs for Use in Electrical Appliances and Components, with reference to UL 60691, the Standard for Thermal-Links – Requirements and Application Guide. UL 1020 was withdrawn and superseded by UL 60691.

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 following table lists UL's future effective date with the corresponding references.

Future effective date	References
December 21, 2006	7.14, 7.15, 12.1.2.6, 12.1.2.9, 12.1.2.12, 12.1.3.3, 18.1.1, Section 44.1, 46.3, Section 52, 55.3, 56.1.16, 56.1.17, 56.3.3, 56.3.4, 56.3.5, 56.3.6, Section 56.8, Section 56.9, Section 57, Section 58, 59.1, 59.2, Figure 59.1, 59.3, 59.9, Section 60, and Section 61

The revisions dated April 25, 2006 include a reprinted title page (page1) for this Standard.

The revisions dated April 25, 2006 editorially replace all references to UL 1020 with the reference to UL 60691.

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.

As indicated on the title page (page1), this UL Standard for Safety has been adopted by the Department of Defense.

The UL Foreword is no longer located within the UL Standard. For information concerning the use and application of the requirements contained in this Standard, the current version of the UL Foreword is located on ULStandardsInfoNet at: <http://ulstandardsinfo.net.ul.com/ulforeword.html>

The master for this Standard at UL's Northbrook Office is the official document insofar as it relates to a UL service and the compliance of a product with respect to the requirements for that product and service, or if there are questions regarding the accuracy of this Standard.

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The requirements in this Standard are now in effect, except for those paragraphs, sections, tables, figures, and/or other elements of the Standard having future effective dates as indicated in the note following the affected item. The prior text for requirements that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

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:

Page	Date
1	April 25, 2006
2-80	December 23, 2004
A1-A2	April 25, 2006
CRG1-CRG8	December 23, 2004
SR1-SR2	December 23, 2004

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1

UL 73

Standard for Motor-Operated Appliances

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Ninth Edition

December 23, 2004

The most recent designation of ANSI/UL 73 as an American National Standard (ANSI) occurred on November 16, 2004. The ANSI approval for this standard does not include the Cover Page, Transmittal Pages, Title Page, or the CRG.

This ANSI/UL Standard for Safety, which consists of the Ninth Edition with revisions through April 25, 2006, 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. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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 73 on May 11, 1976. 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 set of revised requirements.

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CONTENTS

INTRODUCTION

1 Scope	6
2 Glossary	6
3 Components	7
4 Units of Measurement	8
5 References	8

CONSTRUCTION

6 General	8
7 Frame and Enclosure	8
8 Adhesives Used to Secure Parts	12
9 Mechanical Assembly	12
10 Protection Against Corrosion	13
11 Accessibility of Uninsulated Live Parts and Film-Coated Wire	13
12 Supply Connections	18
12.1 Cord-connected appliances	18
12.2 Permanently connected appliances	23
13 Current-Carrying Parts	25
14 Insulating Material	25
15 Internal Wiring	26
15.1 Mechanical protection	26
15.2 Splices and connections	27
16 Separation of Circuits	27
17 Capacitors	28
18 Grounding	28
18.1 General	28
18.2 Grounding identification	30
19 Heating Elements	30
20 Lampholders	31
21 Motors	31
21.1 Construction	31
21.2 Brush wear out	31
21.3 Overload protection	32
22 Overload- or Thermal-Protective Devices	34
23 Receptacles	35
24 Switches and Controls	35
25 Spacings	36

PROTECTION AGAINST INJURY TO PERSONS

26 General	38
27 Sharp Edges	38
28 Enclosures and Guards	38
29 Materials	40
30 Rotating or Moving Members	40
31 Parts Subject to Pressure	41
32 Pressure-Relief Devices	42
33 Switches, Controls, and Interlocks	43

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Documents

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34 Specific Appliances	44
35 Stability	44

PERFORMANCE

36 Leakage Current Test	45
37 Leakage Current Test Following Humidity Conditioning	47
38 Starting Current Test	48
39 Input Test	48
40 Temperature Tests	49
40.1 General	49
40.2 Maximum normal load	52
41 Surface Temperature Tests	52
41.1 Exterior surfaces	52
41.2 Contact surfaces	53
42 Dielectric Voltage-Withstand Test	53
43 Continuous Operation Test	54
44 Resistance-to-Moisture Test	55
44.1 Water spray test	55
44.2 Flooding of live parts	58
45 Tests on Switches and Controls	58
46 Strain-Relief Test	59
47 Abnormal Operation Test	59
48 Radiation Test	60
49 Ozone Test	60
50 Operational Test	60
51 Permanence of Marking Test	61
52 Permanence of Cord Tag Test	61
52.1 General	61

MANUFACTURING AND PRODUCTION TESTS

53 Dielectric Voltage-Withstand Test	62
54 Grounding Continuity Test	63

RATING

55 Details	64
------------------	----

MARKING

56 Details	64
56.1 General	64
56.2 Permanently connected appliances	67
56.3 Cord-connected appliances	68
56.4 Carbonators	69
56.5 Plumbing accessories	69
56.6 Insect-exterminating appliances	69
56.7 Components	69
56.8 Outdoor-use appliance	69
56.9 Double-insulated appliances	70

INSTRUCTION MANUAL

57 General	70
58 Instructions pertaining to risk of fire, electric shock, or injury to persons	71
59 Installation instructions	73
60 Operating instructions	77
61 User-Maintenance instructions	77

PROTECTION FROM CONTAMINATION

62 Scope	77
63 Construction	78
64 Performance	78
65 Marking	79

APPENDIX A

Standards for Components.....	A1
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CANADIAN REQUIREMENTS COMPARISON GUIDE CRG 73

UL AND CANADIAN STANDARDS FOR MOTOR-OPERATED APPLIANCES	CRG1
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INTRODUCTION

1 Scope

1.1 These requirements cover motor-operated appliances to be employed in accordance with the National Electrical Code, NFPA 70.

1.2 These requirements also cover small utilization appliances, such as vibrators in which motion of an operating part is produced by electrical means.

1.3 These requirements do not cover appliances rated more than 600 V; nor do they cover appliances involving universal motors rated more than 250 V.

1.4 These requirements do not cover equipment intended particularly for the control of electric motors; separator motors; nor electric clocks, fans, clothes dryers, washing machines, hair dryers, tools, waste disposers, dishwashers, office appliances and business equipment, refrigerators, air conditioners, vending and amusement machines, hair clippers and shavers, snow movers, automotive and garage equipment, or other motor-operated appliances that are covered by individual requirements.

1.5 An appliance that utilizes some other source of energy, such as gas or steam, in addition to electric energy will be investigated under these requirements and under such additional requirements as are applicable to the appliance under consideration.

2 Glossary

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

2.2 AUTOMATICALLY CONTROLLED APPLIANCE – An appliance is considered to be automatically controlled if:

- a) The repeated starting of the appliance, beyond one complete predetermined cycle of operation to the point where some form of limit switch opens the circuit, is independent of any manual control;
- b) During any single predetermined cycle of operation, the motor is caused to stop and restart one or more times;
- c) Upon energizing the appliance, the initial starting of the motor may be intentionally delayed beyond normal, conventional starting; or
- d) During any single predetermined cycle of operation, automatic changing of the mechanical load may reduce the motor speed sufficiently to reestablish starting-winding connections to the supply circuit.

2.3 FIXED APPLIANCE – Any equipment or appliance that is intended to be permanently connected electrically to the wiring system.

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

2.5 LOW-VOLTAGE CIRCUIT – A circuit involving a peak open-circuit potential of not more than 42.4 V supplied by a primary 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 considered to be a low voltage circuit.

2.6 PORTABLE APPLIANCE – An appliance that is easily carried or conveyed by hand, and is provided with a power-supply cord for connection to the supply circuit.

2.7 REMOTELY CONTROLLED APPLIANCE – An appliance that is out of sight of the operator who is at the starting device.

2.8 STATIONARY APPLIANCE – An appliance that is intended to be fastened in place or located in a dedicated space, and is provided with a power-supply cord for connection to the supply circuit.

3 Components

3.1 Except as indicated in 3.2, a component of an appliance 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 appliances 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 appliance 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.

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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.

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.

CONSTRUCTION

6 General

6.1 An appliance shall employ materials that are acceptable for the application.

7 Frame and Enclosure

7.1 An appliance shall be formed and assembled so that it will have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected, without increasing the risk of fire, electric shock or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other serious defects.

7.2 For unreinforced, flat surfaces in general, cast metal shall not be less than 1/8 in (3.2 mm) thick, except that malleable iron may be not less than 3/32 in (2.4 mm) and die cast metal may be not less than 5/64 in (2.0 mm) thick. Corresponding thicknesses of not less than 3/32, 1/16 (1.6 mm), and 3/64 in (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.

7.3 An enclosure of sheet metal shall be judged with respect to its size, shape, thickness of metal, and its application, considering the intended use of the complete appliance. The use of sheet steel having a thickness of less than 0.026 in (0.66 mm) if uncoated or 0.029 in (0.74 mm) if galvanized or of nonferrous sheet metal having a thickness of less than 0.036 in (0.91 mm) is not recommended, except for relatively small areas or for surfaces that are curved or otherwise reinforced.

7.4 Sheet metal to which a wiring system is to be connected in the field shall have a thickness not less than 0.032 in (0.81 mm) if uncoated steel, not less than 0.034 in (0.86 mm) if galvanized steel, and not less than 0.045 in (1.14 mm) if nonferrous.

7.5 Among the factors that shall be taken into consideration when judging a nonmetallic enclosure or an enclosure of magnesium are resistance to:

- a) Mechanical damage,
- b) Impact,
- c) Moisture-absorption,
- d) Combustion, and
- e) Distortion at temperatures to which the material may be subjected under conditions of normal or abnormal use.

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7.6 The enclosure of a remotely or automatically controlled appliance shall reduce the risk of molten metal, burning insulation, flaming particles, or the like from falling on combustible materials, including the surface upon which the appliance is supported.

7.7 The requirement in 7.6 will necessitate that a switch, a relay, 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. It will also necessitate the use of a barrier of noncombustible material:

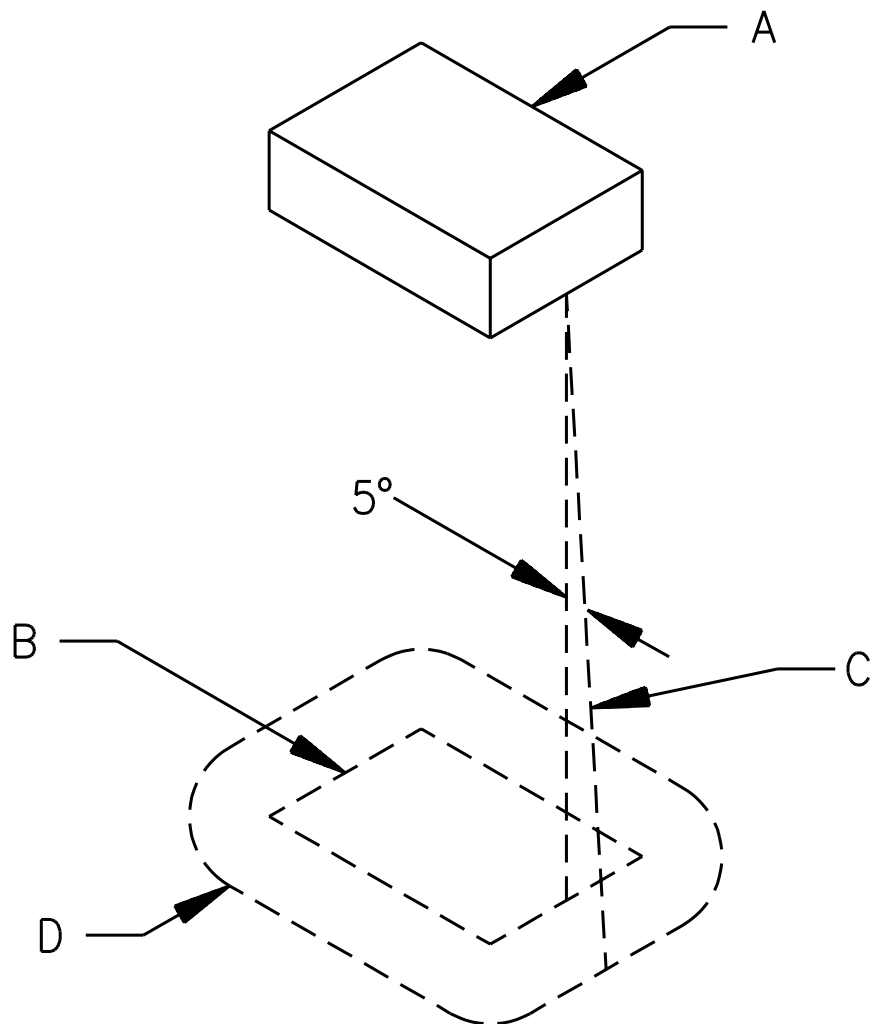
a) Under a motor unless:

- 1) The structural parts of the motor or of the appliance provide the equivalent of such a barrier;
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the appliance 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 rotor is to be locked;
- 3) The motor is provided with a thermal motor protector – a protective device that is sensitive to temperature and current – that will reduce the risk of 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 Overheating Protection for Motors, UL 2111, and the temperature of the motor winding will not exceed 150°C during the first 72 h of operation with the rotor of the motor locked.

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

7.8 The barrier mentioned in 7.7 shall be horizontal, shall be located as illustrated in Figure 7.1, 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.

Figure 7.1
Location and extent of barrier



SA0604-1

NOTES –

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 on horizontal plane.

C – Inclined line that traces out minimum area of barrier. The line is always (1) tangent to the component, (2) 5° from the vertical, and (3) oriented so 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.

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7.9 A door or a cover of an enclosure that provides access to any overload protective device that requires resetting or renewal shall be hinged or otherwise attached in an equivalent manner.

7.10 Means shall be provided for holding the door or cover over a fuseholder in a closed position, and the door or cover shall be tight-fitting.

7.11 A cord-connected appliance that is provided with keyhole slots, notches, hanger holes, or the like, for hanging on a wall shall be constructed in such a manner that the hanging means is not accessible without removing the appliance from the supporting means.

7.12 To determine whether a product complies with the requirement in 7.11, any part of the enclosure or barrier that can be removed without the use of tools to gain access to the hanging means is to be removed.

7.13 An opening in the appliance provided for hanging shall be located or guarded so that a nail, hook, or the like does not displace a part that would create a risk of fire or electric shock, and does not contact one of the following:

- a) An uninsulated live part.
- b) Magnet wire.
- c) Internal wiring.
- d) Moving parts.
- e) Any other part likely to create a risk of fire or electric shock.

7.14 An enclosure of polymeric material shall comply with the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C. The polymeric enclosure material of an appliance for outdoor-use shall be subjected to the Ultraviolet Light Exposure Test and the Cold Impact Test.

Exception: For an outdoor use appliance marked in accordance with 56.8.2, the Ultraviolet Light Exposure Test is not applicable and the conditioning for the Cold Impact Test is conducted at $0 \pm 2^\circ\text{C}$.

Added 7.14 effective December 21, 2006

7.15 An appliance intended for outdoor use shall comply with Water Spray Test, Section 44.1.

Exception: This requirement is not applicable if the appliance is marked in accordance with 56.8.2.

Added 7.15 effective December 21, 2006

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8 Adhesives Used to Secure Parts

8.1 An adhesive that is relied upon to reduce a risk of fire, electric shock, or injury to persons shall comply with the requirements for adhesives in the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

8.2 The requirement in 8.1 also applies to an adhesive used to secure a conductive part, including a nameplate, that may, if loosened or dislodged:

- a) Energize an accessible dead metal part,
- b) Make a live part accessible,
- c) Reduce spacings below the minimum acceptable values, or
- d) Short-circuit live parts.

8.3 Whether the conditions mentioned in 8.2(a) – (d) can occur is to be considered with respect to both:

- a) A part inside the device, and
- b) A part on the outside of the device that may affect equipment in which the device is to be installed.

9 Mechanical Assembly

9.1 An appliance shall be assembled so that it will not be adversely affected by the vibration of normal operation. Brush caps shall be tightly threaded or otherwise constructed to reduce the risk of loosening.

9.2 A switch other than a through-cord switch, a lampholder, an attachment-plug receptacle, a motor-attachment plug, or similar component shall be securely mounted and shall be prevented from turning. See 9.4.

Exception No. 1: A switch need not be prevented from turning provided:

- a) The switch is of a plunger or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during normal operation of the switch;*
- b) The means for mounting the switch makes it unlikely that operation of the switch will loosen it;*
- c) The spacings are not reduced below the minimum required values if the switch rotates; and*
- d) The normal operation of the switch is by mechanical means rather than by direct contact by persons.*

Exception No. 2: A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or indicator light in which the lamp is sealed in a nonremovable jewel, need not be prevented from turning if rotation cannot reduce spacings below the minimum required values.

9.3 Uninsulated live parts shall be secured to the base or mounting surface so that they will be prevented from turning or shifting in position, if such motion may result in a reduction of spacings below the minimum acceptable values.

9.4 The means for preventing the turning or shifting mentioned in 9.2 and 9.3 is to consist of more than friction between surfaces – for example, a properly applied lock washer is acceptable as the means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

10 Protection Against Corrosion

10.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means, if corrosion of such unprotected parts would be likely to result in a risk of fire, electric shock, or injury to persons.

Exception No. 1: Surfaces of sheet-steel and cast-iron parts within an enclosure may not be required to be protected against corrosion if the oxidation of the metal due to the exposure to air and moisture is not likely to be appreciable. The thickness of metal and temperature are also to be considered.

Exception No. 2: This requirement does not apply to bearings, laminations, or minor parts of iron or steel, such as washers, screws, and the like.

10.2 If deterioration of a liquid container provided as a part of an appliance would result in a risk of fire or electric shock, the container shall be of a material that is resistant to corrosion by the liquid intended to be used therein.

11 Accessibility of Uninsulated Live Parts and Film-Coated Wire

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

- a) For an opening that has a minor dimension (see 11.5) less than 1 in (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 11.1.
- b) For an opening that has a minor dimension of 1 in or more, such a part or wire shall be spaced from the opening as specified in Table 11.1.

Exception: A motor other than one used in either a hand-held appliance or a hand-supported portion of an appliance need not comply with these requirements if it complies with the requirements in 11.2.

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Table 11.1
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minimum dimension ^a of opening, in (mm) ^b		Minimum distance from opening to part, in (mm) ^b	
3/4 ^c	(19.1)	4-1/2	(114)
1 ^c	(25.4)	6-1/2	(165)
1-1/4	(31.8)	7-1/2	(190)
1-1/2	(38.1)	12-1/2	(318)
1-7/8	(47.6)	15-1/2	(394)
2-1/8	(54.0)	17-1/2	(444)
^d		30	(762)

^a See 11.5.
^b Between 3/4 and 2-1/8 in, interpolation is to be used to determine a value between values specified in the table.
^c Any dimension less than 1 in applies to a motor only.
^d More than 2-1/8 in, but not more than 6 in (152 mm).

11.2 With respect to a part or wire as mentioned in 11.1, in an integral enclosure of a motor as mentioned in the Exception to 11.1:

a) An opening that has a minor dimension (see 11.5) less than 3/4 in (19.1 mm) is acceptable if:

- 1) Film-coated wire cannot be contacted by the probe illustrated in Figure 11.3;
- 2) In a directly accessible motor (see 11.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 11.4; and
- 3) In an indirectly accessible motor (see 11.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 11.2.

b) An opening that has a minor dimension of 3/4 in or more is acceptable if a part or wire is spaced from the opening as specified in Table 11.1.

11.3 The probes mentioned in 11.1 and 11.2 and illustrated in Figures 11.1 – 11.4 shall be applied to any depth that the opening will permit, and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probe illustrated in Figures 11.1 and 11.4 shall be applied in any possible configuration; and, if necessary, the configuration shall be changed after insertion through the opening.

11.4 The probes mentioned in 11.3 and 11.5 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with the minimum force necessary to determine accessibility.

Figure 11.2
Straight probe

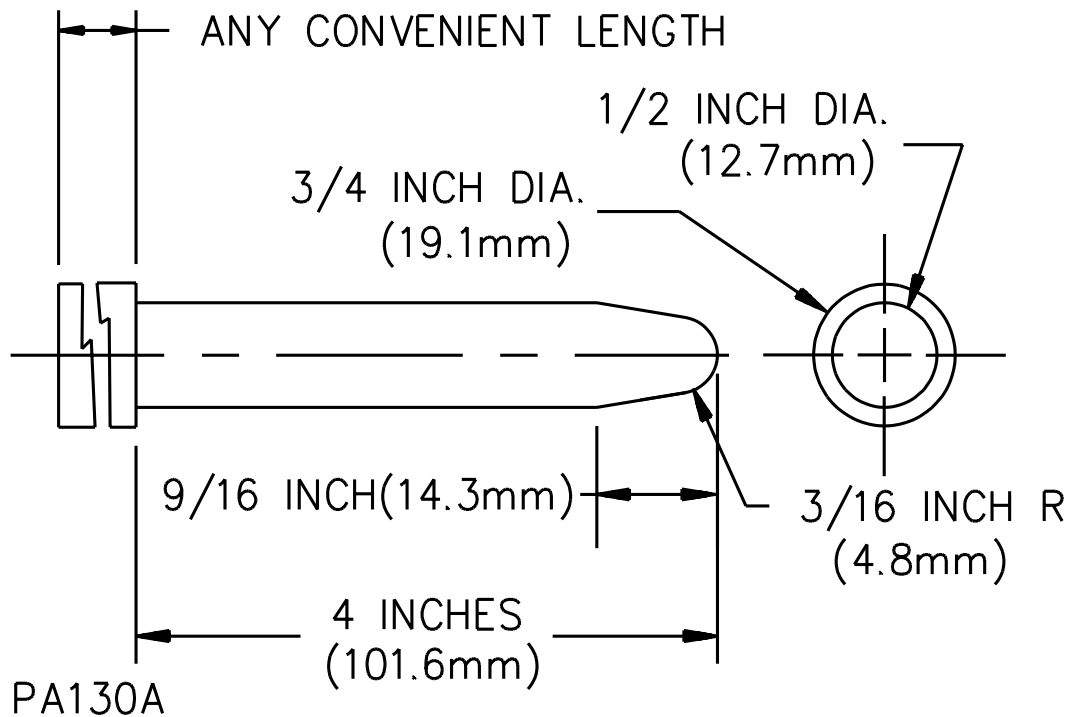
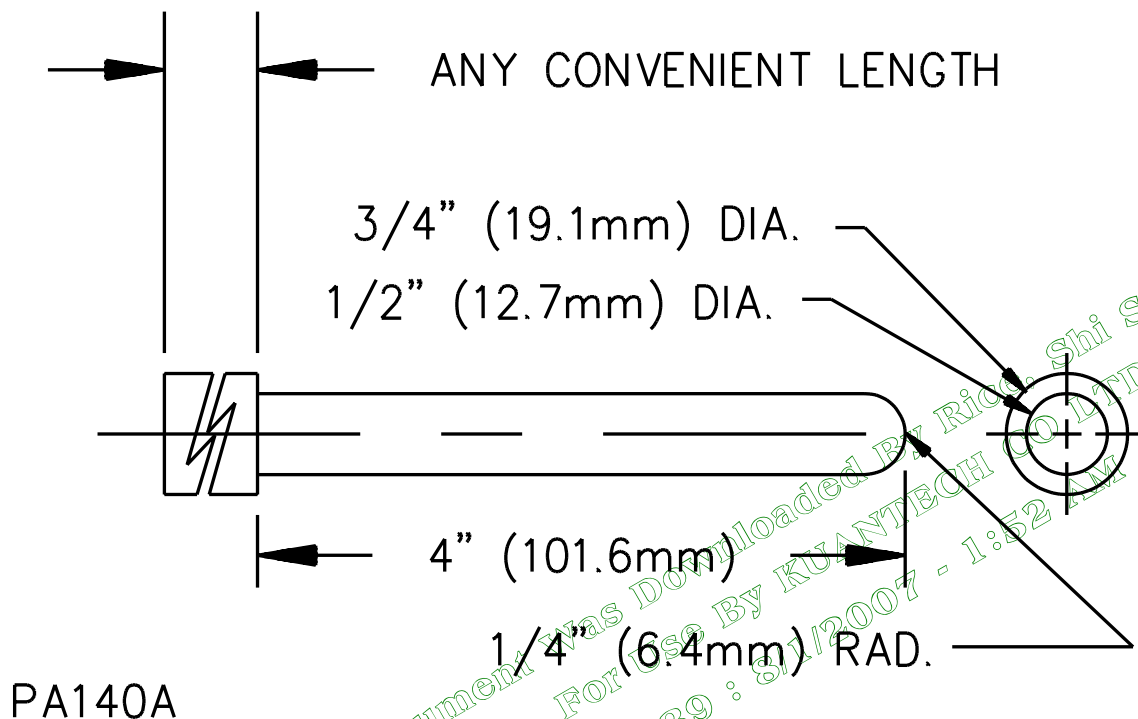


Figure 11.3
Straight probe



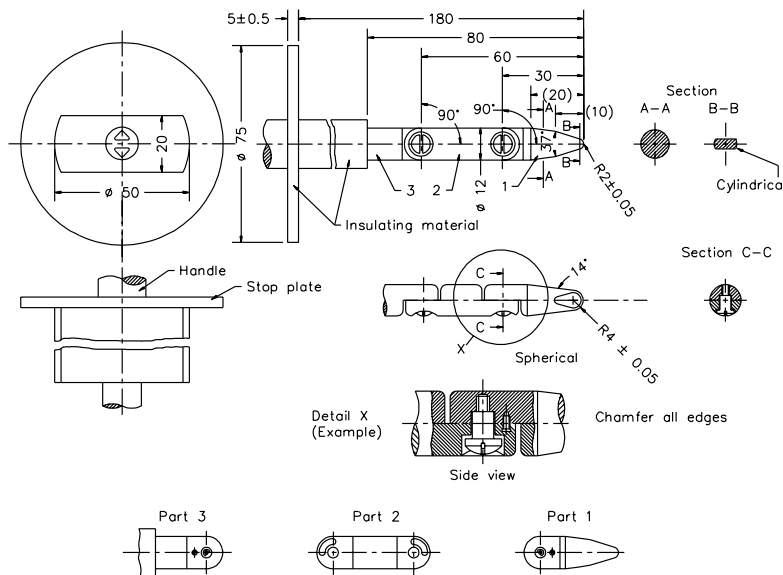
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Figure 11.4
International Electrotechnical Commission (IEC)
 Articulate accessibility probe with stop plate
 All dimensions in millimeters
 Courtesy of IEC



SA1788A

11.5 With reference to the requirements in 11.1 and 11.2, the minor dimension of an opening is the diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening.

11.6 With reference to the requirements in 11.2, an indirectly accessible motor is a motor that is accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, than can be opened or removed without using a tool, or that is located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted. A directly accessible motor is a motor that can be contacted without opening or removing any part or that is located so as to be accessible to contact.

11.7 During the examination of an appliance to determine whether it complies with the requirements in 11.1 or 11.2, a part of the enclosure that may be opened or removed by the user without a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

11.8 With reference to the requirements in 11.1 and 11.2, insulated brush caps are not required to be additionally enclosed.

12 Supply Connections

12.1 Cord-connected appliances

12.1.1 Carbonators

12.1.1.1 A carbonator that is connected to the electrical supply by a flexible cord shall comply with the following:

- a) All waterline connections shall be by means of flexible hose or equivalent;
- b) The flexible cord shall be of Type SJT or of a Type equally serviceable, shall not be longer than 10 ft (3.05 m), and shall have a grounding conductor and a grounding type attachment plug; and
- c) In addition to complying with the other applicable requirements in the standard, the wiring compartment shall be constructed and the cord attached so a permanent connection is able to be made to the power supply. The construction shall comply with the following conditions:
 - 1) The cord shall enter the wiring compartment through a 7/8-in (22.2-mm) diameter hole that, after the cord and any bushing or fitting provided have been removed, provides an opening for attachment of a wiring system that is intended for the appliance; and
 - 2) The power-supply cord is connected to the internal wiring by a device such as a terminal block, pressure cable connector, or a similar device, that accommodates permanent wiring having an ampacity rated for the appliance, and that complies with 12.2.2 – 12.2.4.

12.1.2 Cords and plugs

12.1.2.1 An appliance intended to be connected to the power-supply circuit by means of a flexible cord shall be provided with a flexible cord and an attachment plug for connection to the supply circuit.

12.1.2.2 The attachment plug of an appliance intended to be connected to a nominal 120 V circuit, and employing devices required to be connected to a specific supply conductor as specified in 20.2, 23.2, and 24.3 shall be a polarized type. The connections to the attachment plug shall be in accordance with Figure 12.1. The polarity identification of the supply cord shall be in accordance with Table 12.1. See 59.4.

12.1.2.3 An appliance that is required to employ a polarized attachment plug as specified in 12.1.2.2, and that is provided with a separate or detachable cord set as specified in Exception No. 1 of 12.1.2.6 and 12.1.2.8 shall also employ an appliance connector of the polarized type.

Table 12.1
Polarity identification of flexible cords

Method of identification	Acceptable combinations	
	Conductor intended to be grounded ^{a, b}	All other conductors ^a
Color of braids on individual conductors	Solid white or gray – without tracer	Solid color other than white or gray – without tracer
	Color other than white or gray – with tracer in braid	Solid color other than white or gray – without tracer
Color of insulation on individual conductors	Solid white or gray ^c	Solid color other than white or gray
	Solid light blue ^d	Solid color other than light blue, white or gray
Color of separators	Solid white or gray ^e	Solid color other than white, or gray
Other means	Tin or other white metallic coating on all strands of the conductor ^e	No tin or other white metallic coating on the strands of the conductor
	A stripe, ridge, or groove on the exterior surface of the cord ^e	

^a A conductor finished to show a green color with or without one or more yellow stripes or tracers is to be used only as an equipment-grounding conductor. See 18.2.1 and Figure 12.1.

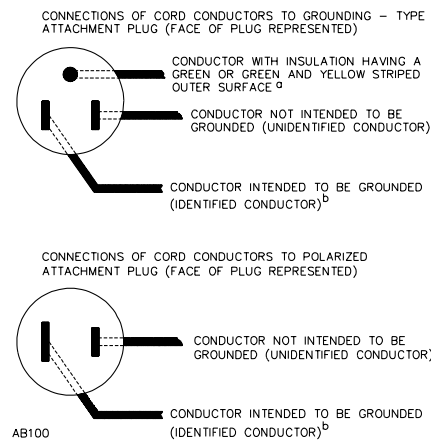
^b The grounded (identified) conductor is the neutral supply conductor.

^c Only for cords – other than Types SP-2, SPE-2, and SPT-2 – having no braid on any individual conductor.

^d For jacketed cords.

^e Only for cords having insulation on the individual conductors integral with the jacket, such as Types SP-2, SPE-2, and SPT-2 cords.

Figure 12.1
Connections to attachment plugs



NOTES –

^a In the above illustration, the blade to which the green conductor is connected may have a U-shape instead of a circular cross section.

^b Signifies a conductor identified in accordance with Table 12.1.

12.1.2.4 The flexible cord shall have a voltage rating not less than the rated voltage of the appliance, and shall have an ampacity that is not less than the current rating of the appliance.

12.1.2.5 Type SJ, SJE, SJO, SJOO, SJT, SJTO, or SJTOO cord is required when the appliance is intended for commercial or industrial use, and Type SP-2, SPE-2, or SPT-2 when the appliance is intended for household use.

12.1.2.6 The flexible cord shall not be less than 6 ft (1.83 m) long and shall be attached to the appliance.

Exception No. 1: An appliance that is not required to be provided with a grounding conductor may be provided with a separate cord set having means for connection to the appliance and a length of not less than 6 ft.

Exception No. 2: A cord-connected appliance that is required to be equipped with a grounding conductor may be provided with not more than 18 in (457 mm) of permanently attached flexible cord or with a connector base if:

a) For an outdoor use appliance, the appliance is marked in accordance with 56.3.5 and is provided with installation instructions in accordance with 59.9.

b) For other than an outdoor use appliance:

1) Usage of the appliance is such that it is necessary to connect the appliance by means of an extension cord during normal operation; the manufacturer makes extension cords available; and a statement indicating the availability of such extension cords is marked on the appliance or is included in an instruction book or the like that is regularly furnished with the appliance; or

2) The manufacturer furnishes a detachable cord set, 6 ft or more long, with the appliance.

Exception No. 3: This requirement does not apply to a cord as described in 12.1.1.1 (b).

Exception No. 4: A hand-supported engraver, intended for marking or etching materials, may be provided with not less than 5 ft (1.52 m) of attached flexible cord.

Revised 12.1.2.6 effective December 21, 2006

12.1.2.7 The length of an attached flexible cord includes the attachment plug. The length of a cord set includes the fittings.

12.1.2.8 A household appliance intended for use with a detachable cord set shall not be provided with terminal pins that will accommodate a standard flatiron or appliance plug.

12.1.2.9 The attachment plug shall have an ampere rating not less than 125% of the rated current of an appliance, or, when the appliance is not provided with a current rating, the measured input current under maximum normal load conditions, and a voltage rating equal to the rated voltage of the appliance. If an appliance can be adapted for use on two or more different values of voltage by field alteration of internal connections, the attachment plug provided with the appliance shall be acceptable for the voltage for which the appliance is connected when shipped from the factory. See 56.1.9.

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Exception: A stationary appliance, marked in accordance with 56.3.3, shall employ an attachment plug rated not less than the current rating of the appliance or, when the appliance is not provided with a current rating, the measured input current under maximum normal load conditions.

Revised 12.1.2.9 effective December 21, 2006

12.1.2.10 A three- to two-wire, grounding-type adapter shall not be provided with an appliance if:

- a) Usage of the appliance is such that it is necessary to connect it by means of an extension cord during normal operation,
- b) The manufacturer makes extension cords available, and
- c) A statement indicating the availability of such extension cords is marked on the appliance or is included in an instruction book or the like that is regularly furnished with the appliance.

12.1.2.11 If an appliance incorporates a disconnecting means, such as a cord connector in the supply cord between the handle and the motor, the arrangement shall be such that no live parts will be exposed under any normal conditions.

12.1.2.12 A flexible cord provided with an appliance intended to be used outdoors shall be rated for outdoor use. Such cords are identified by the letter "W" following the cord type designation marked on the jacket.

Added 12.1.2.12 effective December 21, 2006

12.1.3 Strain relief

12.1.3.1 Strain relief shall be provided so that mechanical stress on a flexible cord will not be transmitted to terminals, splices, or interior wiring.

12.1.3.2 A metal strain-relief clamp or band used with Type SP-2, SPE-2, or lighter general-use rubber-insulated cord shall be provided with auxiliary insulation over the cord for mechanical protection.

Exception: The auxiliary insulation may be omitted for Type SV, SVE, SVO, or SVOO cord.

12.1.3.3 A clamp of any material – metal or otherwise – is not acceptable for use on Type SPT-2, SVT, SVTO, or SVTOO cord.

Exception No. 1: A metal clamp is acceptable for strain relief on Types SPT-2, SVT, SVTO and SVTOO flexible cords protected by varnished-cloth tubing, phenolic, vulcanized fiber, or the equivalent between the clamp and the cord, if the combination clamp and cord protection installed as intended complies with 46.3. Thermoplastic tubing is not acceptable over thermoplastic cords.

Exception No. 2: A non-metallic clamp is acceptable on Types SPT-2, SVT, SVTO and SVTOO flexible cords without tubing, fiber, or equivalent cord protection between the clamp and the cord, if the clamp complies with 46.3.

Revised 12.1.3.3 effective December 21, 2006

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12.1.3.4 For types of thermoplastic-insulated cord, heavier than Type SPT-2, SVT, SVTO, or SVTOO, a clamp may be employed and the auxiliary insulation is not required unless it is judged that the clamp may damage the cord insulation.

12.1.3.5 Means shall be provided to reduce the risk of a flexible cord from being pushed into an appliance through a cord-entry hole if such displacement may subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is acceptable, or may reduce a spacing, such as to a metal strain-relief clamp, below the minimum acceptable value.

12.1.3.6 If a knot in a flexible cord serves as strain relief, a surface that the knot may contact shall be free from projections, sharp edges, burrs, fins, and the like that may cause abrasion of the insulation on the conductors.

12.1.4 Bushings

12.1.4.1 At a point where a flexible cord passes through an opening in a wall, barrier, or enclosing case, there shall be a bushing or the equivalent that shall be reliably secured in place, and shall have a smooth, rounded surface against which the cord may bear.

12.1.4.2 An insulating bushing shall be provided if:

- a) Type SP-2, SPE-2, SPT-2, or other cord lighter than Type SV or SVE is employed,
- b) The wall or barrier is of metal, or
- c) The construction is such that the cord may be subjected to strain or motion.

Exception: An insulated metal grommet having insulating material that is not less than 1/32 in (0.8 mm) thick and fills completely the space between the grommet and the metal in which it is mounted may be used instead of an insulating bushing.

12.1.4.3 A cord hole in wood, porcelain, phenolic composition, or other nonconducting material and having a smooth, rounded surface is considered to be equivalent to a bushing.

12.1.4.4 Ceramic materials and some molded compositions are generally acceptable for insulating bushings.

12.1.4.5 A separate bushing shall not be made of wood or of hot-molded shellac-and-tar compositions.

12.1.4.6 A vulcanized fiber bushing shall not be less than 3/64 in (1.2 mm) thick and formed and secured in place so that it will not be adversely affected by conditions of ordinary moisture.

12.1.4.7 A separate soft-rubber, neoprene, or polyvinyl chloride bushing shall not be employed in the appliance.

Exception No. 1: A separate soft-rubber, neoprene, or polyvinyl chloride bushing may be employed in the frame of a motor or in the enclosure of a capacitor attached to a motor provided that the bushing is:

- a) Not less than 3/64 in (1.2 mm) thick; and
- b) Located so that it will not be exposed to oil, grease, oily vapor, or other substances having a deleterious effect on the compound employed.

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Exception No. 2: A bushing of any of the materials mentioned above may be employed at any point in an appliance if used in conjunction with a type of cord for which an insulating bushing is not required. If a bushing of one or these materials is used anywhere in the appliance, the edges of the hole in which the bushing is mounted shall be smooth and free from burrs, fins, and the like.

12.1.4.8 At any point in an appliance, a bushing of the same material as, and molded integrally with, the supply cord is acceptable on a Type SP-2 or harder-service cord if the built-up section is not less than 1/16 in (1.6 mm) thick at the point where the cord passes through the enclosure.

12.2 Permanently connected appliances

12.2.1 General

12.2.1.1 Except as noted in 12.2.1.2, an appliance intended for permanent connection to the power supply shall have provision for connection of one of the wiring systems that would be acceptable for the appliance.

12.2.1.2 A stationary appliance may be provided with not more than 8 ft (2.44 m) of Type S, SE, SO, SOO, ST, STO, or STOO cord and an attachment plug for supply connection. The investigation of such a feature will include consideration of the utility of the appliance and the necessity of having it readily detachable from its source of supply by means of a plug.

12.2.2 Terminal compartment

12.2.2.1 A terminal box or compartment in which power-supply connections to a permanently connected appliance are to be made shall be located so that the connections may be readily inspected after the appliance is installed as intended.

12.2.2.2 A terminal compartment intended for connection of a supply raceway shall be attached to the appliance so as to be prevented from turning.

12.2.2.3 If it is intended that supply connections be made directly to a motor, the terminal compartment on the motor shall comply with the requirements for terminal compartments in the Standard for Electric Motors, UL 1004.

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12.2.3 Wiring terminals and leads

12.2.3.1 A permanently connected appliance shall be provided with wiring terminals for the connection of conductors having an ampacity acceptable for the appliance; or the appliance shall be provided with leads for such connection.

12.2.3.2 A field-wiring terminal is considered to be a terminal to which a wire may be connected in the field, unless the wire and, a means of making the connection – a pressure terminal connector, soldering lug, soldered loop, crimped eyelet, or the like, factory-assembled to the wire – are provided as a part of the appliance.

12.2.3.3 Wiring terminals for the supply conductors – excluding the grounding conductor – shall be provided with a pressure wire connector securely fastened in place – for example, firmly bolted or held by a screw.

Exception No. 1: A soldering lug may be used.

Exception No. 2: A 10 AWG (4.8 mm diameter) or larger wire-binding screw or stud-and-nut combination may be employed at a wiring terminal intended to accommodate a 10 AWG (5.3 mm²) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in place.

12.2.3.4 A wiring terminal shall be prevented from turning.

12.2.3.5 The free length of a lead inside an outlet box or wiring compartment shall be 6 in (150 mm) or more if the lead is intended for field connection to an external circuit.

Exception: The lead may be less than 6 in long if it is evident that the use of a longer lead might result in a risk of fire or electric shock.

12.2.3.6 A wire-binding screw or stud-and-nut combination at a wiring terminal shall not be smaller than 10 AWG (4.8 mm diameter).

Exception No. 1: A 8 AWG (4.2 mm diameter) screw or stud-and-nut combination may be used at a terminal intended only for the connection of a 14 AWG (2.1 mm²) conductor.

Exception No. 2: A 6 AWG (3.5 mm diameter) screw may be used for the connection of a 16 or 18 AWG (1.3 or 0.8 mm²) conductor in a low-voltage circuit.

12.2.3.7 According to the National Electrical Code, ANSI/NFPA 70, 14 AWG (2.1 mm²) is the smallest conductor that may be used for branch-circuit wiring, and therefore is the smallest conductor that may be anticipated at a terminal for connection of a power-supply wire.

12.2.3.8 A wire-binding screw shall thread into metal.

12.2.3.9 A terminal plate tapped for a wire-binding screw shall be of metal not less than 0.050 in (1.27 mm) thick and shall not have less than two full threads in the metal.

Exception: An alloy plate may be not less than 0.030 in (0.76 mm) thick if the tapped threads have the necessary mechanical strength.

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