

UL 1682

Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type



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UL Standard for Safety for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type, UL 1682

Third Edition, Dated August 6, 2007

SUMMARY OF TOPICS

This new edition provides the updated ANSI recognition of the Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type, UL 1682.

The new and/or revised requirements are substantially in accordance with UL's Proposal(s) on this subject dated October 13, 2006.

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.

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/ulforeword.html>

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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:

Page	Date
1-68	August 6, 2007
A1-A4	August 6, 2007
B1-B4	August 6, 2007

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Canadian Standards Association
CSA C22.2 No. 182.1-07
Third Edition



Underwriters Laboratories Inc.
UL 1682
Third Edition

Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type

August 6, 2007



ANSI/UL 1682-2007

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ISBN 978-1-55436-514-2

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The most recent designation of ANSI/UL 1682 as an American National Standard (ANSI) occurred on August 15, 2007.

This ANSI/UL Standard for Safety, which consists of the Third edition is under continuous maintenance, whereby each revision is ANSI approved upon publication.

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ANNEX B

Mandatory English and French Markings for Canada

Preface

This is the common UL and CSA Standard for plugs, receptacles, and cable connectors of the pin and sleeve type. It is the third edition of CSA C22.2 No. 182.1 and the third edition of UL 1682. This edition of CSA C22.2 No. 182.1 supersedes the previous editions, published in 2002 and 1988.

This common Standard was prepared by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL).

This Standard is considered suitable for use for conformity assessment within the stated scope of the Standard.

This Standard was reviewed by the CSA Subcommittee on C22.2 No. 182.1 under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee.

This Standard has been approved by the American National Standards Institute (ANSI) as an American National Standard.

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.

Where reference is made to a specific number of samples to be tested, the specified number is considered a minimum quantity.

Note: *Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.*

Level of harmonization

This Standard is published as an equivalent Standard. An equivalent Standard is a Standard that is substantially the same in technical content, except as follows. Technical deviations are allowed for Codes and Government Regulations and those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental, climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Interpretations

The interpretation by the SDO of an identical or equivalent Standard is based on the literal text to determine compliance with the Standard in accordance with the procedural rules of the SDO. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the SDOs to more accurately reflect the intent.

CSA Effective Date

The effective date for CSA International will be announced through *CSA Informs* or a CSA certification notice.

UL Effective Date

As of August 6, 2007, all products Listed, Recognized, or Classified by UL must comply with the requirements in this Standard.

1 Scope

1.1 This standard applies to pin and sleeve type plugs, receptacles, power inlets, and connectors, rated up to 800 amperes and up to 600 volts ac or dc, and which may include two or fewer pilot contacts. These devices are intended to provide power from branch circuits, or are for direct connection to the branch circuit in accordance with the Canadian Electrical Code Part I (CEC), C22.1, and the National Electrical Code (NEC), ANSI/NFPA 70, using copper conductors, for use in either indoor or outdoor nonhazardous locations. In Canada, the terminals of a device intended to accommodate aluminum conductors also comply with CSA C22.2 No. 65, Wire Connectors.

1.2 In the U.S. this standard does not apply to single conductor pin and sleeve devices.

1.3 This standard does not apply to:

- a) Devices molded integrally with flexible cord or cable that are covered by the Standard for Cord Sets and Power Supply Cords, UL 817 and Cord Sets and Power Supply Cords, CSA C22.2 No. 21;
- b) General and special use devices, such as attachment plugs, receptacles, cord connectors, inlets, current taps, flatiron and appliance plugs, that are covered by the Standard for Attachment Plugs and Receptacles, UL 498 and General Use Receptacles, Attachment Plugs, and Similar Wiring Devices, CSA C22.2 No. 42, Appliance Plugs for Heater Cord Sets, CSA C22.2 No. 57, and Industrial Locking Type, Special Use Attachment Plugs, Receptacles, and Connectors, CSA C22.2 No. 182.2;
- c) Single and multi-pole connectors, which may include 3 or more pilot contacts, intended for connection to copper conductors, for use in data, signal, control and power applications within and between electrical equipment, where exposed, that are covered by the Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977 and Special Use Attachment Plugs, Receptacles, and Connectors, CSA C22.2 No. 182.3;
- d) Devices intended for use in hazardous (Classified) locations that are covered by the Standard for Receptacle-Plug Combinations For Use in Hazardous (Classified) Locations, UL 1010 and Attachment Plugs, Receptacles, and Similar Wiring Devices for Use in Hazardous Locations: Class I, A, B, C, and D, Class II, Group G in Coal or Coke Dust, and in Gaseous Mines, CSA C22.2 No. 159;
- e) Products such as switched interlocks that are covered by the Standard for Industrial Control Equipment, UL 508 and Industrial Control Equipment, CSA C22.2 No. 14;

2 Definitions

2.1 For the purposes of this standard, the following definitions apply.

2.2 CONNECTOR (CABLE CONNECTOR) – A portable receptacle that is intended to provide power, with means for attachment of flexible cord or cable and not intended for permanent mounting.

2.3 CONTACT – A conductive element in a component that mates with a corresponding element to provide an electrical path.

2.4 CONTACT, PILOT – A conductive element intended to carry an indicating or controlling signal.

2.5 DELAYED ACTION – An arrangement that delays the separation of device housings which is intended to reduce the likelihood of exposure of arcing contacts during the breaking of the circuit when the plug is withdrawn.

2.6 ENCLOSURE – The case or housing into which the insulator and contacts are assembled. The enclosure system may be composed of elements such as outlet boxes, mounting panels, receptacles, plugs, and connectors.

2.7 GROUNDING (BONDING) PATH – A path between the grounding pin, or contact and the grounding terminal or, if the device has no grounding terminal, the point at which the path makes contact with a part of the metal raceway system, such as a box, box cover, or the raceway itself.

2.8 GROUNDING TYPE DEVICE – A device having a grounding (bonding) path.

2.9 INSULATION, ELECTRICAL – The insulation necessary for the proper functioning of the product and for basic protection against electrical shock.

2.10 INSULATOR – That portion of a device that provides for separation and support of contacts.

2.11 INTERLOCKED RECEPTACLE (OUTLET) – An outlet having a device, either electrical or mechanical, that is intended to reduce the likelihood of energizing the contacts before proper engagement with the plug, and that either is intended to reduce the risk of the plug being withdrawn while its contacts are energized or deenergizes the line contacts before separation.

2.12 LOCKING RETAINING MEANS – A mechanical arrangement that holds a plug or connector in position when it is in proper engagement and is intended to reduce the likelihood of its unintentional withdrawal. It may also facilitate environmental sealing.

2.13 MOTOR RATING – A rating expressed in horsepower (hp) and/or full load locked-rotor current and voltage assigned to a device that is intended to control a motor load.

2.14 PIN AND SLEEVE DEVICE – A plug, receptacle, power inlet or connector utilizing contacts that generally are cylindrical or circular and telescoping and are shrouded by an extension of the enclosure of the mating devices.

2.15 PLUG (ATTACHMENT PLUG) – A device intended to receive power when inserted in a receptacle or connector, which establishes connection between conductors of the attached flexible cord or cable and the conductors connected to the receptacle or cable connector.

2.16 POWER INLET – A permanently mounted plug intended to receive power from a cable connector.

2.17 RECEPTACLE (OUTLET) – A device that is intended to provide power to an inserted plug, and that is installed as a fixed outlet or on equipment.

2.18 SWITCHED RECEPTACLE – An outlet with an associated or integral switching device to disconnect the supply from the receptacle contacts.

2.19 TERMINAL – A conductive part provided on a contact for connecting a conductor.

2.20 TERMINAL, CRIMP TYPE – A terminal in which an electro-mechanical connection is made between the terminal lug and a conductor by compressing the lug onto the conductors.

2.21 TERMINAL, FIELD WIRING – A terminal to which power supply, load, control, or equipment grounding connections will be made in the field when the device is installed.

2.22 TERMINAL, PRESSURE-WIRE – A terminal in which the conductor is clamped under a pressure plate or saddle by one or more screws or nuts.

2.23 TERMINAL, SET SCREW – A terminal in which the clamping pressure is applied by the end of the screw bearing directly on the conductor.

2.24 TERMINAL, WIRE-BINDING SCREW – A terminal in which the conductor is bent around the screw and is clamped directly under the head of the screw when it is tightened.

3 General

3.1 Components

3.1.1 Except as indicated in Clause 3.1.2, a component of a product covered by this standard shall comply with the requirements for that component. See Annex A for a list of standards covering components generally used in the products covered by this standard. A component shall comply with the Canadian Standards Association or the Underwriters Laboratories Inc. standards as appropriate for the country where the product is to be used.

3.1.2 A component is not required to comply with a specific requirement that:

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

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

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

3.2 Reference publications

3.2.0 Products covered by this standard shall comply with the reference installation codes and standards as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used.

3.2.1 For undated references to standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this standard was approved. For dated references to standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the standard was approved.

CSA Standards

C22.1-06,
Canadian Electrical Code, Part I

CAN/CSA-C22.2 No. 0-M91 (R2006),
General Requirements – Canadian Electrical Code, Part II

C22.2 No. 0.2-93 (R2004),
Insulation Coordination

C22.2 No. 0.4-04,
Bonding of Electrical Equipment

C22.2 No. 0.15-01,
Adhesive Labels

CAN/CSA-C22.2 No. 0.17-00 (R2004),
Evaluation of Properties of Polymeric Materials

C22.2 No. 4-04,
Enclosed and Dead-Front Switches

CAN/CSA-C22.2 No. 5-02,
Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

C22.2 No. 14-05,
Industrial Control Equipment

C22.2 No. 21-95 (R2004),
Cord Sets and Power Supply Cords

C22.2 No. 39-M1987 (R2003),
Fuseholder Assemblies

C22.2 No. 42-99 (R2004),
General Use Receptacles, Attachment Plugs, and Similar Wiring Devices

C22.2 No. 57-M1985 (R2005),
Appliance Plugs for Heater Cord Sets

C22.2 No. 65-03,
Wire Connectors

CAN/CSA-C22.2 No. 94-M91 (R2006),
Special Purpose Enclosures

C22.2 No. 111-00 (R2005),
General-Use Snap Switches

C22.2 No. 159-M1987 (R2004),
Attachment Plugs, Receptacles, and Similar Wiring Devices for Use in Hazardous Locations, Class I, Groups A, B, C, and D; Class II, Group G, in Coal or Coke Dust, and in Gaseous Mines

C22.2 No. 182.2-M1987 (R2004),
Industrial Locking Type, Special Use Attachment Plugs, Receptacles and Connectors

C22.2 No. 182.3-M1987 (R2004),
Special Use Attachment Plugs, Receptacles and Connectors

UL Standards

UL 20
General-Use Snap Switches

UL 50
Enclosures for Electrical Equipment

UL 94
Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 98
Enclosed and Dead-Front Switches

UL 486E
Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

UL 489
Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

UL 498
Attachment Plugs and Receptacles

UL 508
Industrial Control Equipment

UL 512
Fuseholders

UL 746A
Polymeric Materials – Short Term Property Evaluations

UL 746B
Polymeric Materials – Long Term Property Evaluations

UL 746C

Polymeric Materials – Use in Electrical Equipment Evaluations

UL 817

Cord Sets and Power-Supply Cords

UL 840

Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 969

Marking and Labeling Systems

UL 1010

Receptacle-Plugs Combinations For Use In Hazardous (Classified) Locations

UL 1686

Pin and Sleeve Configurations

UL 1977

Component Connectors for Use in Data, Signal, Control and Power Applications

ANSI¹ Standards

ANSI/NFPA 70-2005²

National Electrical Code

ANSI/IEEE C37.09-1999 (2005)³

Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

ASTM⁴ Standards

ASTM D 570-98 (2005)

Standard Test Method for Water Absorption of Plastics

ASTM E 28-99 (2004)

Standard Test Methods for Softening Point of Resins Derived from Naval Stores by Ring-and-Ball Apparatus

IEC⁵ Standards

IEC 60664-1 (2002-06)

Insulation Coordination for Equipment within Low-Voltage Systems Part 1: Principles, Requirements and Tests

IEC 60695-2-10

Fire Hazard Testing – Part 2-10: Glowing/Hot-Wire Based Test Methods – Glow-Wire Apparatus and Common Test Procedure

¹ American National Standards Institute.

² National Fire Protection Association.

³ Institute of Electrical and Electronics Engineers, Inc.

⁴ American Society for Testing and Materials.

⁵ International Electrotechnical Commission.

3.3 Units of measurement

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

4 Construction

4.1 General

4.1.1 The ratings mentioned throughout this standard, including those mentioned in Clause 6.1.2, represent the maximum ampacity and voltage for a device. A device is considered to be for use with either alternating or direct current unless the rating includes a marking to restrict the use to alternating current. See Clause 7.1.6.1.

4.2 Configurations

4.2.1 Combinations of pin and sleeve attachment plugs and receptacles are covered by this standard. Standardized configurations of attachment plugs and receptacle combinations are located in UL 1686.

4.3 Insulating material

4.3.1 A base or body in or on which live parts are mounted shall be of ceramic or other insulating material meeting the requirements of this standard.

4.3.2 Vulcanized fiber or rubber may be used for insulating washers, separators, and barriers, but not as the sole support for live parts. The material shall be moisture resistant in accordance with Clause 5.7.

4.3.3 A polymeric material used for electrical insulation, an internal barrier necessary to maintain electrical clearances and creepage distances, or enclosure of live parts shall have a flame class rating of HB, V-2, V-1, V-0, VTM-2, VTM-1, VTM-0, 5VA or 5VB in accordance with the requirements of UL 94 or CAN/CSA-C22.2 No. 0.17. The flammability classification shall be judged at the actual minimum thickness employed within 0.8 mm (1/32 inch) of live parts within the device.

4.3.4 In Canada, insulating materials in contact with current-carrying parts of devices that are intended for permanent installation shall have a minimum flammability classification of V-2 in accordance with CAN/CSA-C22.2 No. 0.17, in a thickness of 1.6 mm or in the minimum thickness in contact with that current-carrying part, whichever thickness is greater.

4.3.5 In Canada, insulating materials in contact with current-carrying parts of devices not intended for permanent installation shall have a minimum flammability classification of HB in accordance with CAN/CSA-C22.2 No. 0.17.

4.3.6 In Canada, as an alternative to the requirements of Clause 4.3.4, a thermosetting material may be used as an insulating material in contact with current-carrying parts of devices intended for permanent installation, provided that such material has the characteristics specified in (a) and (b) below:

- a) A minimum flammability classification of HB in accordance with CAN/CSA-C22.2 No. 0.17; and
- b) The continuous use temperature index (mechanical without impact) is a minimum of 100°C, in accordance with CAN/CSA-C22.2 No. 0.17.

4.3.7 The internal insulating systems of components for which component requirements exist need not have a flame class rating.

4.3.8 A small part meeting all the following criteria need not have a flame class rating:

- a) Its volume does not exceed 2 cm³ (0.122 cubic inch);
- b) Its maximum dimension does not exceed 3 cm (1.18 inches); and
- c) Its location is such that it cannot propagate flame from one area to another or act as a bridge between a possible source of ignition and other ignitable parts.

4.3.9 Fiber and similar material that is equal to or less than 0.25 mm (0.010 inch) thick need not have a flame class rating.

4.3.10 A polymeric material used for electrical insulation, an internal barrier necessary to maintain electrical clearances and creepage distances, or enclosure of live parts shall comply with the requirements in Clauses 5.3 – 5.10.

4.3.11 A polymeric material having a maximum comparative tracking index (CTI) performance level class of 3 or a minimum CTI value of 175 need not comply with Clause 5.3.

4.3.12 A polymeric material having hot wire ignition (HWI) corresponding to the values shown in Table 1 for the applicable flammability classification need not comply with Clause 5.4.

4.3.13 A polymeric material having high-current arc resistance to ignition (HAI) corresponding to the values shown in Table 1 for the applicable flammability classification need not comply with Clause 5.5.

4.3.14 The internal insulating systems of components for which component requirements exist need not comply with the requirement in Clauses 5.3 – 5.5.

4.3.15 A small part meeting all the following criteria need not comply with the requirements in Clauses 5.3 – 5.5:

- a) Its volume does not exceed 2 cm³ (0.122 cubic inch);
- b) Its maximum dimension does not exceed 3 cm (1.18 inches); and
- c) Its location is such that it cannot propagate flame from one area to another or act as a bridge between a possible source of ignition and other ignitable parts.

4.3.16 Fiber and similar material that is equal to or less than 0.25 mm (0.010 inch) thick need not comply with the requirements in Clauses 5.3 – 5.5.

4.3.17 A polymeric material used for electrical insulation, an internal barrier necessary to maintain electrical clearances and creepage distances, or enclosure of live parts shall have the temperature index ratings shown in Table 2 for the specific application of the insulating material.

4.4 Resistance to corrosion

4.4.1 Parts of iron or steel other than stainless steel parts shall be protected against corrosion, in accordance with Clause 5.28.

4.5 Enclosures

4.5.1 General

4.5.1.1 An enclosure shall be constructed to reduce the risk of unintentional contact with uninsulated live parts, as indicated in Clause 4.8.1, and to provide internal parts with protection from specified external conditions. Additional items used to form an enclosure, such as adapters, hoods, covers, and the like, shall be permitted to be permanently secured to the device. In Canada, elements of metallic enclosure systems such as outlet boxes and mounting panels shall be provided with a grounding terminal.

4.5.2 Mechanical Strength

4.5.2.1 An enclosure shall have adequate strength and rigidity in accordance with Clauses 5.13 and 5.14.

4.5.3 Nonmetallic enclosures

4.5.3.1 A nonmetallic enclosure or a nonmetallic part of an enclosure shall comply with the applicable requirements in UL 746C or CAN/CSA-C22.2 No. 94 for Special Purpose Enclosures.

4.5.3.2 If a nonmetallic enclosure is identified as being intended to be exposed to specific chemicals, oils, acids, solvents, cleaning agents, and the like, the performance of the enclosure material shall not be adversely affected by such substances as determined by applicable tests as described in UL 746A or CAN/CSA-C22.2 No. 0.17.

4.5.3.3 Pliable, molded natural or synthetic rubber, or a combination thereof, or a pliable composition, the basic constituent of which is vinyl chloride or a copolymer of vinyl chloride and vinyl acetate, in the finished device that complies with Clause 5.2, may be employed as an insulating material for the enclosure of an attachment plug or a cord connector.

4.5.4 Metallic enclosures

4.5.4.1 An enclosure may be constructed of iron, steel, copper, brass, zinc, aluminum, or their alloys. Aluminum alloys containing less than 80% aluminum shall not be used. Magnesium and its alloys shall not be used.

4.5.4.2 Zinc or a zinc-based alloy shall not be used for an enclosure or parts of an enclosure which are in the primary grounding path.

4.5.5 Attachment plugs

4.5.5.1 An attachment plug shall not be provided with more than one multiconductor cord-outlet hole.

4.5.6 Specific enclosures

4.5.6.1 An enclosure marked with one or more environmental enclosure type designations shall comply with the applicable requirements in Clauses 5.29 and 7.1.14.

4.6 Current-carrying parts

4.6.1 A current-carrying part shall be of silver, copper, a copper alloy, or other material acceptable for the application. Plated iron or steel shall not be used for parts that are depended upon to carry current.

4.6.2 Stainless steel may be employed for a part not subject to arcing.

4.6.3 Pressure wire terminal screws and wire binding screws shall be permitted to be made of plated iron or steel.

4.6.4 Iron or steel, if protected against corrosion by zinc, tin, or equivalent plating, may be used for screws, plates, yokes, or other parts that are employed as a means of clamping the conductor, provided that such parts are not the primary current-carrying members.

4.6.5 Suitable means shall be provided for retaining live parts within such limits of alignment as to ensure that plugs will enter receptacles, connectors, and the like in the intended manner.

4.6.6 Uninsulated live parts shall be secured in place to ensure the clearances and creepage distances required in Clauses 4.7.1 and 4.7.3 are maintained.

4.6.7 A current-carrying part shall be prevented from turning relative to the surface on which it is mounted if such turning would result in a reduction of spacings below the minimum acceptable values.

4.7 Clearances and creepage distances

4.7.1 The clearances and creepage distances shall be not less than 6.4 mm (1/4 inch) between:

- a) Field wiring terminals of opposite polarity; and
- b) A field wiring terminal and any other uninsulated metal part of a different polarity.

4.7.2 For field wiring terminals intended for solder connections using solid or tin dipped stranded wire only, the minimum clearances and creepage distances between the terminals shall be as specified in UL 840 or CSA C22.2 No. 0.2. See Clause 7.1.12.2.

4.7.3 In all circuits other than at field wiring terminals, the acceptability of the clearances and creepage distances between an uninsulated live part and any other uninsulated metal part, not of the same polarity shall be as specified in UL 840, IEC 60664-1, or CSA C22.2 No. 0.2.

4.7.4 The dead metal mentioned in Clause 4.7.3 includes a metal surface on which the device is mounted in the intended manner. A dead-metal screw head, rivet, or the like is not considered to be exposed to contact by persons after the device is installed in the intended manner, if it cannot be contacted by the probe illustrated in Figure 1.

4.7.5 Clearances and creepage distances shall be measured in accordance with UL 840, IEC 60664-1, or CSA C22.2 No. 0.2. In determining the pollution degree and overvoltage category, the end-use application may be considered for a higher pollution degree and may modify those characteristics given in Clauses 4.7.8 and 4.7.9.

4.7.6 Clearances and creepage distances shall be measured in all conditions of use, both with and without mating devices of the intended configuration installed and any movable parts displaced to the position of a minimum spacing.

4.7.7 The clearances and creepage distances required in Clause 4.7.1 shall be measured through air and over insulating and conductive surfaces with the device wired as intended with the maximum anticipated conductor size. They shall be measured from any point on the terminal that may contact the clamped conductor as in the case of a wire-binding-screw terminal, or from any point on the perimeter of an opening to receive a conductor in the case of an enclosed terminal.

4.7.8 Indoor use equipment shall comply with the requirements for pollution degree 3. Outdoor use equipment shall comply with the requirements for pollution degree 4, unless protection is afforded by a suitable enclosure appropriate for the installation in which case a lower pollution degree can be achieved. The interior of equipment with enclosure Types 3, 3S, 4, 4X, 6 and 6P or Marine Type shall comply with the requirements for pollution degree 3. Hermetically sealed or encapsulated enclosures shall comply with the requirements for pollution degree 1.

4.7.9 Plugs, connectors, inlets, and other cord connected devices shall be rated overvoltage Category II and receptacles and other devices connected to fixed wiring shall be rated overvoltage Category III as defined in UL 840, IEC 60664-1, or CSA C22.2 No. 0.2.

4.8 Accessibility of live parts

4.8.1 To reduce the likelihood of unintentional contact that may involve a risk of electric shock from uninsulated live parts, a live part shall not be contacted by the probe illustrated in Figure 1. See Clause 4.8.6.

4.8.2 The contacts of an outlet device need not be evaluated for accessibility.

4.8.3 The probe illustrated in Figure 1 shall be applied to any depth that the recessing will permit, and shall be rotated, changed in configuration or angled before, during, and after application to any position that is necessary to examine the device.

4.8.4 The probe mentioned in Clause 4.8.1 shall be used as a measuring instrument to judge the accessibility provided by the recessing and not as an instrument to judge the strength of a material. The probe shall be applied with a force of 13 N (3 lbf) to determine accessibility.

4.8.5 During the examination of a product to determine whether it complies with the requirements in Clause 4.8.1, the device shall be wired and assembled in accordance with the manufacturer's instructions. Any other part that may be opened or removed by the user without using a tool shall be opened or removed.

4.8.6 Mating devices shall not have exposed live contacts when fully mated or during engagement or withdrawal.

4.8.7 Compliance with Clause 4.8.6 shall be determined with the use of the probe shown in Figure 1 in every possible position. See Clause 4.8.3.

4.8.8 The probe shall not be applied to holes in the shroud provided for locking if they do not exceed 10.2 mm (0.400 inch) diameter.

4.9 Grounding (bonding) and dead-metal parts

4.9.1 A grounding type device shall have a separate contact for interconnection of the equipment grounding conductor. In Canada, the means for providing grounding and bonding shall comply with CSA C22.2 No. 0.4.

4.9.2 The equipment grounding terminal or lead and its corresponding contact of a male inlet or equipment outlet intended for permanent installation shall be conductively connected to the mounting means, housing, hood, shell or other dead-metal parts of a device that may come into contact with the equipment enclosure.

4.9.3 In the United States, the conductive connection need not be provided if the mounting means, housing, hood, or shell is constructed of an insulating material and the lack of ground continuity to the equipment enclosure is readily apparent.

4.9.4 In the United States, the conductive connection need not be provided if the device is marked in accordance with Clause 7.1.3.1.

4.9.5 A device that has a metal shell used as the grounding contact member shall be as follows:

- a) The surface of the shell that is depended upon for grounding continuity shall not have a non-conductive coating or otherwise be subjected to conditions that may result in loss of grounding continuity;
- b) One or more separate spring type components shall be incorporated to provide grounding path continuity;
- c) The grounding components shall be protected against damage; and
- d) In the United States, the shell shall comply with the requirements of Clause 5.16.

4.9.6 The grounding contact shall be located and formed so the path of electrical continuity to the grounding contact of the mating plug is completed before continuity is established between any other contact and its respective contact on the plug.

4.9.7 The grounding contact need not make contact before any other contact if the device is of the interlocked type, which requires disconnection of the supply circuit before the plug can be inserted or removed.

4.9.8 The grounding contact path, except for the metal housing or mounting, shall be of copper or a copper alloy or equivalent material. If a metal housing is a part of the primary equipment grounding path, it shall not be of zinc or a zinc-based alloy.

4.9.9 A copper-base alloy rivet, which is used to hold parts together in the grounding-contact path or forms a part of the grounding path, shall not contain less than 80 percent copper.

4.9.10 A connection in the grounding-contact path shall be secured by riveting, bolting, clamping, or welding or by an equivalent mechanical means of securement, capable of complying with the requirements of Clause 5.16.

4.9.11 In mating devices provided with an equipment-grounding contact, the grounding contact shall not be capable of touching a line-side phase contact, independent of any polarization feature of the enclosure. The above requirement is applicable only to devices rated 100 A and less, with four or fewer power contacts, excluding grounding contacts. Such devices shall comply with the requirements of Clause 5.26.

4.9.12 All exposed non-current-carrying metal parts of a device that are likely to become energized shall be conductively connected to the equipment ground.

4.9.13 Grounding and other dead-metal parts shall be secured in place so that the spacing required in Clause 4.7 are maintained.