



# UL 1017

## STANDARD FOR SAFETY

Vacuum Cleaners, Blower Cleaners,  
and Household Floor Finishing  
Machines

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UL Standard for Safety for Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines, UL 1017

Eleventh Edition, Dated March 26, 2025

### Summary of Topics

***This new Eleventh edition of ANSI/UL 1017 dated March 26, 2025 includes the following changes in requirements: Double insulation: Waiving overload test on motors moving air only; Addition of requirements for pin and sleeve terminals; Clarification of allowance for 18-inch cord length; Button-cell lithium batteries; Updates for motor polymeric motor insulation systems; Drop impact test for removable reservoirs; Suitability of motor protectors operating during abnormal conditions; Removal of polarization instructions from the Important Safeguards for products with 18 inch cord; Interlock endurance test; Attachment identification marking; General purpose transformer testing; Update safety critical function tables due to revision to UL 2595; Clarify location for blocked inlet condition of the severe conditions test (air inlet or end of hose); Clarification of defeated component test for polymeric fluid handling components for appliances with attachments containing liquids; Clarification of the thermal aging requirement of [5.21.10](#); Corrections and clarification of the PFHC requirements of [5.12.8](#) and the flowchart ([Figure F.1](#)) from Annex F Clarification of switches for steam cleaning attachments; Update attachment plug rating to align with appliance rating; Update supplier list of test carpet; Add UL 840 as alternative to meeting spacing requirements; 550 °C Glow Wire Test in place of HB; PTI test as alternative to CTI; Cord length of household extraction type floor cleaners; Ash vacuum cleaners; Replace "dielectric voltage-withstand" with "electric strength"; Revise requirement for grounding and bonding per CSA comment; Eliminate exceptions; Updated references to UL, CSA and IEC standards; Clarification of non-user-replaceable LED light sources in [4.13.5](#); Correction to [Table 5.3](#); Clarification of the Strength of handles test; Utility Vacuum Cleaner Definition/Instructions; Operation of protective devices during normal operation; Normal Operation Duty Cycle for products with a timer; Mechanical Hazard proposal; Mechanical Valve Operation for input test; Cord and conduction AWG units in [Table 4.2.1](#) and [Table 4.9](#); Motors without a horsepower rating; Battery-operated appliances – Disconnection before cleaning or servicing; Waiving the stalled rotor condition of [5.21.7](#) for electronically commutated motors; Clarifying the compliance criteria for flooding of live parts test of [5.12.5](#); Allow digital manuals; Testing on hard surfaces; Update the Scope to reflect the products covered; Use of mean flow in lieu of mean wattage for normal operation; Class H insulation temperature limits; Wire color coding; Updated reference to information technology equipment standards; Attachment plug rating for steam cleaners; Robotic floor care; Docking Station Supply Cord Type and Length; and Correction to conversion in [B3.2](#).***

The requirements are substantially in accordance with Proposal(s) on this subject dated May 3, 2024 and November 8, 2024.

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CSA C22.2 No. 243:25  
Seventh Edition



ULSE Inc.  
UL 1017  
Eleventh Edition

## Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines

March 26, 2025

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ANSI/UL 1017-2025



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## PREFACE

This is the harmonized CSA Group and ULSE standard for Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines. It is the seventh edition of CSA C22.2 No. 243, and the eleventh edition of UL 1017. This edition of CSA C22.2 No. 243 supersedes the previous edition(s) published in 2015 and 2017. This edition of UL 1017 supersedes the previous edition(s) published in 2017.

This harmonized standard was prepared by the CSA Group and ULSE. The efforts and support of the Vacuum Cleaner industry of both the USA and Canada are gratefully acknowledged.

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 Electrical Motor- and Battery-Operated Cleaning Appliances for Industrial and Commercial Use, under the jurisdiction of the CSA Technical Committee on Consumer and Commercial 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 developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

### Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be 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 identical standard for CSA Group and ULSE.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations. Presentation is word for word except for editorial changes.

### Reasons for Differences From IEC

There is no corresponding IEC standard.

### Interpretations

The interpretation by the standards development organization 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 standards development organization. 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 standards development organizations to more accurately reflect the intent.

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# Vacuum Cleaners, Blower Cleaners, And Household Floor Finishing Machines

## 1 Scope

1.1 This Standard applies to motor-operated vacuum cleaners and blower cleaners, and to household use floor sweepers and floor finishing machines to be employed in accordance with CSA C22.1, Canadian Electrical Code, Part I, and NFPA 70.

1.2 These requirements cover:

a) Vacuum cleaners, including central vacuum cleaners, ash vacuum cleaners and vacuum cleaners with steam cleaning attachments, for:

- 1) Household or commercial use;
- 2) Marine or RV installation;
- 3) Portable, stationary or fixed appliances;
- 4) Wet or dry pick-up;
- 5) Indoor or outdoor use;
- 6) Coin-operation; and
- 7) Battery-operation, including automatic rechargeable vacuum cleaners

b) Blower cleaners for:

- 1) Household or commercial use;
- 2) Indoor or outdoor use; and
- 3) Battery-operation

c) Floor sweepers for:

- 1) Household use; and
- 2) Battery-operation

d) Floor finishing machines including floor polishers, floor scrubbers, floor sanders, rug shampooers, extraction-type floor cleaning machines, rug and floor washers and similar machines, for:

- 1) Household use;
- 2) Indoor or outdoor use; and
- 3) Battery-operation

e) Current-carrying hoses and wall valves for:

- 1) Household use;
- 2) Wet or dry pick-up; and

3) Indoor use

f) Battery-operated cleaners as noted in (a) – (d), including:

1) automatic battery-powered cleaners for:

- i) Household or commercial use;
- ii) Units with a mass of 20 kg (44 lbs) or less, not including the docking station; and
- iii) Indoor use only

1.3 These requirements do not cover appliances rated more than 250 V. An appliance that utilizes some other source of energy, such as gas or steam, in addition to electric energy is to be investigated under these requirements and under such additional requirements as are applicable to the appliance under consideration.

1.4 These requirements do not cover appliances for use in locations such as those areas of hospitals, laboratories, institutions, and the like where dispersion of pathological, chemical, physical, radioactive or other agents could produce a risk to health. Appliances intended for use in such locations are investigated under these requirements and under such additional requirements as are applicable to the appliance, with appropriate consideration being given to the specific intended use.

1.5 These requirements apply only to a specific type or types of appliances, such as a vacuum cleaner or floor finishing machine, if the requirement is so identified by specific reference to the type or types involved. Absence of such specific reference or use of the term "appliance" indicates that the requirement applies to all appliances covered by this Standard.

1.6 This Standard does not apply to:

- a) Internal-combustion engine powered floor cleaning machines for industrial/commercial use with or without traction drive, such as floor buffers, scrubbers, sweepers, spray extraction machines, and polishers, (UL/ULC (ORD) 558, UL/CSA 60335-2-67, UL/CSA 60335-2-68, UL/CSA 60335-2-72);
- b) Battery-operated floor cleaning machines for industrial/commercial use with traction drive; (UL 583, UL/CSA 60335-2-72);
- c) Commercial robotic floor treatment machines (CSA/ANSI C22.2 No. 336);
- d) Commercial floor finishing machines (UL 561, CSA C22.2 No. 10, UL/CSA 60335-2-67, UL/CSA 60335-2-68, UL/CSA 60335-2-72); and
- e) Steam cleaners (CSA C22.2 No. 64, CSA E60335-2-54, UL 499). For steam cleaners with suction, the vacuum function is covered by this Standard.

1.7 These requirements do not cover machines that generate pressure in excess of 2.5 MPa (360 psi).

1.8 Specific constructions, tests, markings, guards, and the like are detailed for some common designs. Specific features and appliances not covered are to be given appropriate consideration. See Marking, Section [11](#).

## 2 General

### 2.1 Attachments

2.1.1 A functional attachment that is recommended, made available, or packaged with an appliance by the manufacturer for use with an appliance shall be included in the investigation of the appliance.

2.1.2 Unless otherwise specified within this Standard, a non-electrical attachment, such as a crevice tool, an upholstery brush, or the like, that has no driven parts need not be investigated. However if such an attachment is intended to facilitate a cleaning operation with the use of liquid and is intended for use with a dry pick up vacuum cleaner, it shall be investigated for use with the appliance.

2.1.3 An electrical attachment provided with line-voltage electrical contacts on the underside of the attachment and in close proximity to the surface to be cleaned shall comply with the following:

a) Based on the anticipated build-up of dust or dirt on the bottom of the attachment and the possibility of a conductive path being established between the electrical contacts, there shall not be an increase in the risk of fire due to the shorting of the electrical contacts. The attachment shall be tested as described in the abnormal operation – Shorted electrical contact test, [5.10.3](#).

b) During the anticipated cleaning of the attachment, there shall not be an increase in the risk of electric shock to the user. The attachment, while connected to the appliance, shall be tested as described in the Cleaning test, [5.12.9](#).

c) If the electrical attachment is intended to be inserted into mating electrical contacts (such as the contacts of a motorized brush), the mating of which can energize a load (such as the brush motor or relay coil), the mating electrical contacts on the attachment shall have suitable voltage and current ratings, and be suitably rated to make and break the particular load in accordance with CSA C22.2 No. 182.1 and UL 1977.

d) The applicable Severe conditions (see [5.21.5](#)) and Abnormal operation (see [5.21.7](#)) tests shall be conducted with and without the electrical attachment connected to the appliance as intended.

2.1.4 A vacuum cleaner provided with steam cleaning or a steam-cleaning attachment shall be evaluated and tested as a wet pick-up type vacuum.

2.1.5 A non-electrical container recommended by the manufacturer for use with a household wet/dry pick-up appliance, but not provided by the appliance manufacturer, shall be included in the investigation of the appliance. The appliance shall be designed so that it can be affixed or mounted to the container by the user without the use of tools. The appliance shall meet the applicable enclosure requirements of [4.2](#), [4.19.3](#), and [5.21](#) without the container attached. See also [11.1.8](#), [11.4.27](#), [12.2.7](#)(m), and [12.5.19](#).

### 2.2 Fluids – Proprietary

2.2.1 For a household extraction-type floor cleaning machine that is intended to be used with a proprietary fluid in accordance with [5.12.8.1.4](#), the manufacturer shall package the proprietary fluid with the appliance. If the appliance is intended for use with more than one proprietary fluid, the manufacturer shall package at least one of the proprietary fluids with the appliance.

2.2.2 If an attachment is recommended for use with an appliance, but is not packaged with the appliance, the proprietary fluid shall be included in the appliance packaging, or shall be included in the attachment packaging. See [2.1.1](#), [11.1.8](#), [12.5.7](#), and [12.7](#).

2.2.3 If an attachment and proprietary fluid is recommended for use with an extraction-type carpet cleaning machine, but the attachment and fluid are not packaged with the machine, and the attachment

and fluid are packaged separately from each other, the following shall apply. See [2.1.1](#), [11.1.8](#), [12.5.7](#), and [12.7.2](#).

- a) The household extraction-type floor cleaning machine shall be packaged with at least one cleaning fluid intended for the primary cleaning purpose of the machine. For example, a carpet cleaning machine shall be packaged with at least one carpet cleaning fluid.
- b) The instructions shall instruct the user how to obtain the hard surface attachment and proprietary fluid.

### 2.3 Instructions provided with the appliance

2.3.1 A copy of the operating, user-maintenance, and other instructions intended to accompany an appliance as produced shall be used as a guide in the examination and test of the appliance. For this purpose, a draft copy is sufficient and a final printed copy is not required.

2.3.2 The instructions provided with an appliance shall include such directions and information as deemed by the organization responsible for the appliance to be necessary to cover the operation, use and maintenance of the appliance, and shall comply with the requirements in Section [12](#), Instruction Manuals.

### 2.4 Secondary circuits

2.4.1 Annex [D](#) provides guidance for establishing various types of isolated secondary circuits and methods of evaluation applicable to each type of secondary circuit. This Annex does not supersede the requirements as specified in the body of this Standard.

### 2.5 Equipment for recreational vehicle or marine vessel installation

2.5.1 A fixed or stationary vacuum cleaner intended for installation in recreational vehicles (R/V) or marine vessels shall be evaluated to the additional requirements in [4.3.2](#), [4.4.5](#), [4.5.5.1.9](#), [5.19.6](#), [5.19.7](#), and [5.19.8](#), as applicable.

### 2.6 Units of measurement

2.6.1 The values given in SI (metric) units shall be normative. Any other values given shall be for information purposes only.

### 2.7 Referenced publications

2.7.1 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.

2.7.2 For products intended for use in Canada, general requirements are given in CSA C22.2 No. 0.

ANSI B94.11M

ASME B94.11M, *Twist Drills*

ASTM E230/E230M, *Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples*

ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*

ASTM F655, *Standard Specification for Test Carpets and Pads for Vacuum Cleaner Testing*

CFR 21, *Performance Standards for Light-Emitting Products, Part 1040, Chapter 1, Subchapter J, Radiological Health*

CSA C22.1, *Canadian Electrical Code, Part I*

CSA C22.2 No. 0, *General Requirements – Canadian Electrical Code, Part II*

CSA C22.2 No. 0.4, *Bonding of Electrical Equipment*

CSA C22.2 No. 0.15, *Adhesive Labels*

CSA C22.2 No. 0.17, *Evaluation of Properties of Polymeric Materials*

CSA C22.2 No. 0.2, *Insulation Coordination*

CSA C22.2 No. 0.23, *General Requirements for Battery-Powered Appliances*

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

CSA C22.2 No. 8, *Electromagnetic Interference (EMI) Filters*

CSA C22.2 No. 10, *Electric Floor Surfacing and Cleaning Machines*

CSA C22.2 No. 18.1, *Metallic Outlet Boxes*

CSA C22.2 No. 18.2, *Nonmetallic Outlet Boxes*

CSA C22.2 No. 18.3, *Conduit, Tubing, and Cable Fittings*

CSA C22.2 No. 18.5, *Positioning Devices*

CSA C22.2 No. 21, *Cord Sets and Power-Supply Cords*

CSA C22.2 No. 24, *Temperature-Indicating and Regulating Equipment*

CSA C22.2 No. 38, *Thermoset-Insulated Wires and Cables*

CSA C22.2 No. 42, *General Use Receptacles, Attachment Plugs, and Similar Wiring Devices*

CSA C22.2 No. 42.1, *Cover Plates for Flush-Mounted Wiring Devices*

CSA C22.2 No. 43, *Lampholders*

CSA C22.2 No. 49, *Flexible Cords and Cables*

CSA C22.2 No. 55, *Special Use Switches*

CSA C22.2 No. 64, *Household Cooking and Liquid-Heating Appliances*

CSA C22.2 No. 65, *Wire Connectors*

CSA C22.2 No. 66.1, *Low-Voltage Transformers – Part 1: General Requirements*

CSA C22.2 No. 66.2, *Low-Voltage Transformers – Part 2: General Purpose Transformers*

CSA C22.2 No. 66.3, *Low-Voltage Transformers – Part 3: Class 2 and Class 3 Transformers*

CSA C22.2 No. 72, *Heating Elements*

CSA C22.2 No. 75, *Thermoplastic-Insulated Wires and Cables*

CSA C22.2 No. 77, *Motors With Inherent Overheating Protection*

CSA C22.2 No. 100, *Motors and Generators*

CSA C22.2 No. 107.1, *General-Use Power Supplies*

CSA C22.2 No. 127, *Equipment and Lead Wires*

CSA C22.2 No. 144.1, *Ground-Fault Circuit-Interrupters*

CSA C22.2 No. 153, *Electrical Quick-Connect Terminals*

CSA C22.2 No. 158, *Terminal Blocks*

CSA C22.2 No. 182.1, *Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type*

CSA C22.2 No. 182.3, *Special Use Attachment Plugs, Receptacles, and Connectors*

CSA C22.2 No. 188, *Splicing Wire Connectors*

CSA C22.2 No. 190, *Capacitors and Power Factor Correction*

CSA C22.2 No. 197, *PVC Insulating Tape*

CSA C22.2 No. 198.1, *Extruded Insulating Tubing*

CSA C22.2 No. 198.3, *Coated Electrical Sleeving*

CSA C22.2 No. 210, *Appliance Wiring Material Products*

CSA C22.2 No. 223, *Power Supplies with Extra-Low-Voltage Class 2 Outputs*

CSA C22.2 No. 235, *Supplementary Protectors*

CSA C22.2 No. 248.1, *Low Voltage Fuses*

CSA C22.2 No. 248.14, *Low-Voltage Fuses – Part 14: Supplemental Fuses*

CSA C22.2 No. 248.5, *Low-Voltage Fuses – Part 5: Class G Fuses*

CSA C22.2 No. 250.13, *Light emitting diode (LED) equipment for lighting applications*

CSA C22.2 No. 270, *Arc fault protective devices*

CSA C22.2 No. 308, *Cord reels and multi-outlet assemblies*

CSA C22.2 No. 4248.1, *Fuseholders – Part 1: General Requirements*

CSA C22.2 No. 4248.9, *Fuseholders – Part 9: Class K*

CSA C22.2 No. 60320-1, *Appliance couplers for household and similar general purposes – Part 1: General requirements*

CSA 60335-2-67, *Household and Similar Electrical Appliances – Safety – Part 2-67: Particular Requirements for Floor Treatment Machines, for Commercial Use*

CSA 60335-2-68, *Household and Similar Electrical Appliances – Safety – Part 2-68: Particular Requirements for Spray Extraction Machines, for Commercial Use*

CSA 60335-2-72, *Household and Similar Electrical Appliances – Safety – Part 2-72: Particular Requirements for Floor Treatment Machines With or Without Traction Drive, for Commercial Use*

CSA C22.2 No. 60950-1, *Information Technology Equipment – Safety – Part 1: General Requirements*

CSA C22.2 No. 61058-1, *Switches for Appliances, Part 1: General Requirements*

CSA C22.2 No. 62841-1, *Electric motor-operated hand-held tools, transportable tools and lawn and garden machinery – Safety – Part 1: General requirements*

CSA E60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

CSA E60691, *Thermal-Links, Requirements and Application Guide*

CSA E60730-1, *Automatic Electrical Controls for Household and Similar Use – Part 1: General Requirements*

CSA E60730-2-9, *Automatic Electrical Controls for Household and Similar Use – Part 2: Particular Requirements for Temperature Sensing Controls*

CSA C22.2 No. 336, *Particular requirements for rechargeable battery-operated commercial robotic floor treatment machines with traction drives*

CRC C.1370, *Radiation Emitting Devices Regulations*

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60320, *Appliance Couplers for Household and Similar General Purposes*

IEC 60417, *Graphical Symbols for Use on Equipment*

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60695-2-13, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

IEC 62849, *Performance evaluation methods of mobile household robots*

IESNA RP-27.1, *Recommended Practice for Photobiological Safety for Lamps and Lamp Systems- General Requirements*

IESNA RP-27.3, *Recommended Practice for Photobiological Safety for Lamps – Risk Group Classification and Labeling*

ISO 216, *Writing paper and certain classes of printed matter – Trimmed sizes – A and B series, and indication of machine direction*

ISO 7000, *Graphical Symbols for Use on Equipment – Registered Symbols*

ISO 7000-1641

ISO 7010, *Graphical Symbols – Safety Colours and Safety Signs – Registered Safety Signs*

ISO 12100, *Safety of Machinery – General Principles for Design – Risk Assessment and Risk Reduction*

ISO 13849-1, *Safety of Machinery – Safety Related Parts of Control Systems – Part 1: General Principles for Design*

ISO 16000-9, *Indoor Air – Part 9: Determination of the Emission of Volatile Organic Compounds from Building Products and Furnishing – Emission Test Chamber Method*

ISO 28360, *Information Technology – Office Equipment – Determination of Chemical Emission Rates from Electronic Equipment*

NEMA WD 6, *Wiring Devices*

NFPA 70, *National Electrical Code*

TIL A-37, *Interim Certification Requirements for Switches Used in Tools*

UL 44, *Thermoset-Insulated Wires and Cables*

UL 62, *Flexible Cord and Cables*

UL 66, *Fixture Wire*

UL 83, *Thermoplastic-Insulated Wires and Cables*

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

UL 101, *Leakage Current for Appliances*

UL 157, *Gaskets and Seals*

UL 224, *Extruded Insulating Tubing*

UL 244A, *Solid-State Controls for Appliances*

UL 248-1, *Low Voltage Fuses*

UL 248-14, *Low-Voltage Fuses – Part 14: Supplemental Fuses*

UL 248-5, *Low-Voltage Fuses – Part 5: Class G Fuses*

UL 310, *Electrical Quick-Connect Terminals*

UL 353, *Limit Controls*

UL 355, *Cord Reels*

UL 486A-486B, *Wire Connectors*

UL 486C, *Splicing Wire Connectors*

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 496, *Lampholders*

UL 498, *Attachment Plugs and Receptacles*

UL 499, *Electric Heating Appliances*

UL 510, *Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape*

UL 514A, *Metallic Outlet Boxes*

UL 514B, *Conduit, Tubing, and Cable Fittings*

UL 514C, *Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers*

UL 514D, *Cover Plates for Flush-Mounted Wiring Devices*

UL 561, *Floor-Finishing Machines*

UL 583, *Electric-Battery-Powered Industrial Trucks*

UL 635, *Insulating Bushings*

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 758, *Appliance Wiring Material*

UL 796, *Printed Wiring Boards*

UL 810, *Capacitors*

UL 817, *Cord Sets and Power-Supply Cords*

UL 840, *Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment*

UL 943, *Ground-Fault Circuit-Interrupters*

UL 943B, *Appliance Leakage-Current Interrupters*

UL 969, *Marking and Labeling Systems*

UL 969A, *Marking and Labeling Systems – Flag Labels, Flag Tags, Wrap-Around Labels and Related Products*

UL 1004-1, *Rotating Electrical Machines – General Requirements*

UL 1004-2, *Impedance Protected Motors*

UL 1004-3, *Thermally Protected Motors*

UL 1004-7, *Electronically Protected Motors*

UL 1012, *Power Units Other Than Class 2*

UL 1030, *Sheathed Heating Elements*

UL 1053, *Ground-Fault Sensing and Relaying Equipment*

UL 1059, *Terminal Blocks*

UL 1077, *Supplementary Protectors for Use in Electrical Equipment*

UL 1283, *Electromagnetic Interference Filters*

UL 1310, *Class 2 Power Units*

UL 1439, *Tests for Sharpness of Edges on Equipment*

UL 1441, *Coated Electrical Sleeving*

UL 1446, *Systems of Insulating Materials – General*

UL 1449, *Surge Protective Devices*

UL 1565, *Positioning Devices*

UL 1577, *Optical Isolators*

UL 1676, *Conductive-Path and Discharge-Path Resistors for Use in Radio-, Video-, or Television-Type Appliances*

UL 1681, *Wiring Device Configurations*

UL 1699, *Arc-Fault Circuit-Interrupters*

UL 1977, *Component Connectors for Use in Data, Signal, Control and Power Applications*

UL 2595, 3<sup>rd</sup> edition, *General Requirements for Battery-Powered Appliances*

UL 2595, *General Requirements for Battery-Powered Appliances*

UL 4200A, *Products Incorporating Button Batteries or Coin Cell Batteries*

UL 4248-1, *Fuseholders – Part 1: General Requirements*

UL 4248-9, *Fuseholders – Part 9: Class K*

UL 5085-1, *Low-Voltage Transformers – Part 1: General Requirements*

UL 5085-2, *Low-Voltage Transformers – Part 2: General Purpose Transformers*

UL 5085-3, *Low-Voltage Transformers – Part 3: Class 2 and Class 3 Transformers*

UL 6059, *Particular Requirements for Switches for Tools*

UL 8750, *Light Emitting Diode (LED) Equipment for Use in Lighting Products*

UL 60320-1, *Appliance couplers for household and similar general purposes – Part 1: General requirements*

UL 60335-2-67, *Household and Similar Electrical Appliances – Safety – Part 2-67: Particular Requirements for Floor Treatment Machines, for Commercial Use*

UL 60335-2-68, *Household and Similar Electrical Appliances – Safety – Part 2-68: Particular Requirements for Spray Extraction Machines, for Commercial Use*

UL 60335-2-27, *Household and Similar Electrical Appliances – Safety – Part 2-72: Particular Requirements for Floor Treatment Machines With or Without Traction Drive, for Commercial Use*

UL 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

UL 60691, *Thermal-Links – Requirements and Application Guide*

UL 60730-1, *Automatic Electrical Controls for Household and Similar Use, Part 1: General Requirements*

UL 60730-2-7, *Automatic Electrical Controls for Household and Similar Use, Part 2: Particular Requirements for Timers and Time Switches*

UL 60730-2-9, *Automatic Electrical Controls for Household and Similar Use, Part 2: Particular Requirements for Temperature Sensing Controls*

UL 60950-1, *Information Technology Equipment – Safety – Part 1: General Requirements*

UL 61058-1, *Switches for Appliances, Part 1: General Requirements*

UL 61058-1-6, *Switches for Appliances – Part 2-6: Particular Requirements for Switches Used In Electric Motor-Operated Hand-Held Tools, Transportable Tools and Lawn and Garden Machinery*

UL 62368-1, *Audio/video, information and communication technology equipment – Part 1: Safety requirements*

UL 62841-1, *Electric Motor-Operated Hand-Held Tools, Transportable Tools And Lawn And Garden Machinery – Safety – Part 1: General Requirements*

### 3 Definitions

3.1 The following definitions apply in this Standard:

3.2 ACCESSIBLE PART OR SURFACE – A part or surface subject to contact by persons under any condition of operation or user function. In a determination of whether a live or noncurrent-carrying part or surface is accessible through an opening in the enclosure to such contact, the criteria specified in accessibility of live parts, [4.2.5](#), applies.

3.3 APPLIANCE COUPLER – A single-outlet, female contact device for attachment to a flexible cord as part of a cord set (detachable power-supply cord) to be connected to an appliance inlet (motor attachment plug).

3.4 APPLIANCE INLET (MOTOR ATTACHMENT PLUG) – A male contact device mounted on an end product appliance to provide an integral blade configuration for the connection of an appliance coupler or cord connector.

3.5 APPLIANCE (FLATIRON) PLUG – An appliance coupler type of device having a cord guard and a slot configuration specified for use with heating or cooking appliances.

3.6 ASH VACUUM CLEANER – A vacuum cleaner intended to vacuum cold ash from fireplaces, chimneys, ovens, ash-trays and similar places of ash accumulation.

3.7 AUTOMATICALLY CONTROLLED – 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.

3.8 AUTOMATIC BATTERY-POWERED FLOOR CLEANER (ROBOT FLOOR CLEANER) – Floor cleaner intended for unattended automatic operation and capable of autonomous motion. The automatic floor cleaner consists of a mobile part and may have a docking station or other accessories to assist its operation. These appliances may also be known as Robot Floor Cleaners.

3.9 AUTOMOTIVE VACUUM CLEANERS FOR PUBLIC USE – Vacuum cleaners provided for the use of the general public without restriction in locations such as filling stations and car washes that are either fixed or stationary installation.

3.10 BASIC INSULATION – The insulation in contact with live parts to provide basic protection against the risk of electric shock.

3.11 CONTROL, AUXILIARY – A device or assembly of devices that provides a functional utility, is not relied upon as an operating or protective control, and therefore is not relied upon for safety. For example, an efficiency control not relied upon to reduce the risk of electric shock, fire, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

3.12 CONTROL, MANUAL – A device that requires direct human interaction to activate or reset the control.

3.13 CONTROL, OPERATING – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation. For example, an electronic motor ON/OFF control, the failure of which another layer of protection (e.g., a warning marking on a motorized brush) would reduce the risk of electric shock, fire, or injury to persons, is considered an operating control.

3.14 CONTROL, PROTECTIVE – A device or assembly of devices, the operation of which is intended to reduce the risk of electric shock, fire, or injury to persons during normal and reasonably anticipated abnormal operation of the appliance. For example, an interlock control, a motor overload protector, a thermal cutout/limiter, or a thermostat intended to limit temperatures in the end product, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. During the evaluation of the protective control / circuit, the protective functions are verified under normal and single-fault conditions of the control.

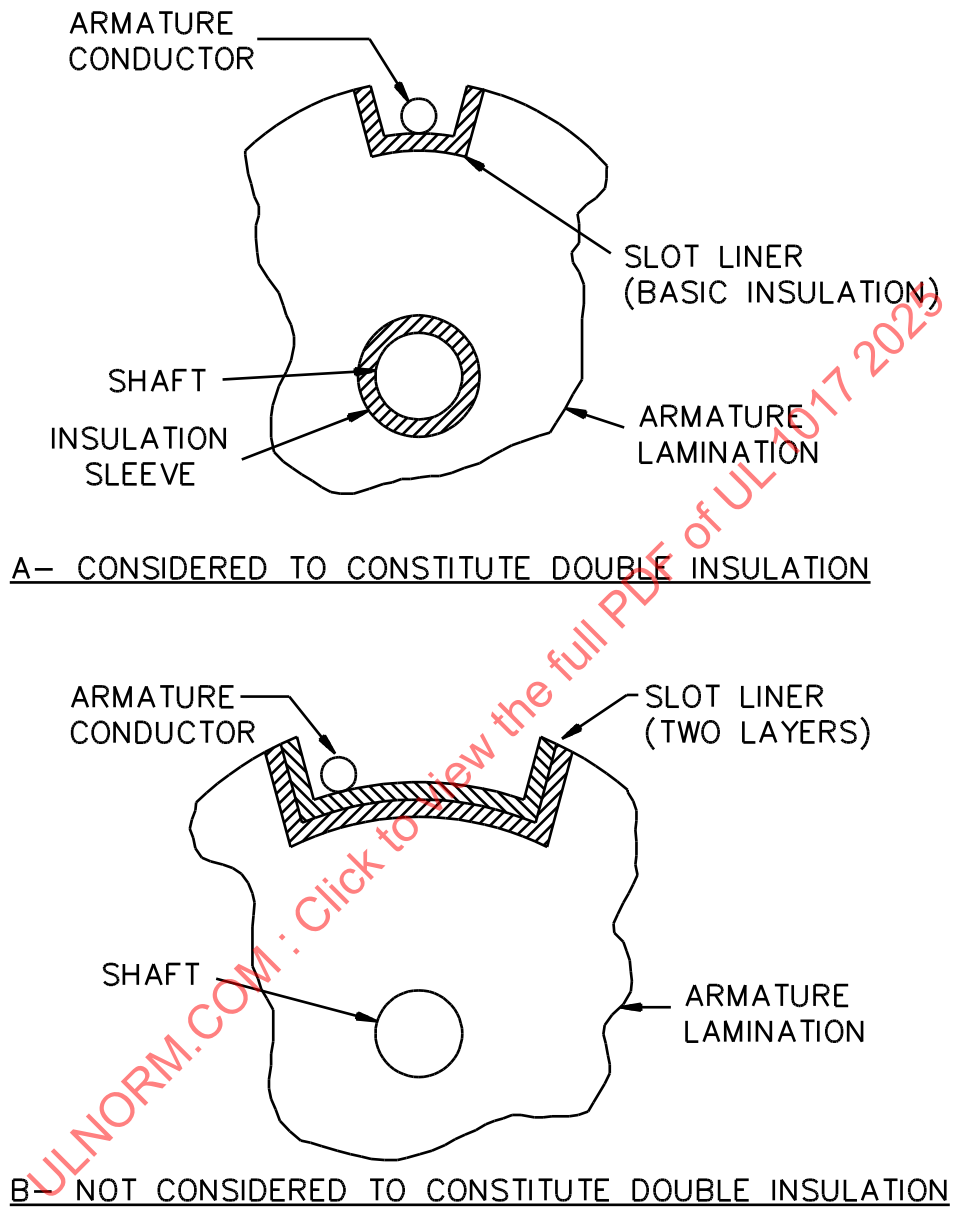
3.15 CORD CONNECTOR – A female contact device wired on flexible cord for use as an extension from an outlet to make a detachable electrical connection to an attachment plug or, as an appliance coupler, to an equipment inlet.

3.16 DOCKING STATION (BASE UNIT) – Unit that may provide manual or automatic battery charging facilities, dust removal from the mobile part (s), data processing facility or other support functions for use with automatic battery-powered floor cleaners.

3.17 DOUBLE INSULATION – An insulation system comprised of basic insulation and supplementary insulation, with the two insulations physically separated and so arranged that they are not simultaneously subjected to the same deteriorating influences (temperature, contaminants, and the like) to the same degree. See [Figure 3.1](#).

Figure 3.1

## Examples Illustrating Double Insulation



S0723A

3.18 DUST EXTRACTOR – A stationary or portable vacuum cleaner specifically designed to be connected to dust-generating machines

3.19 EXTRA-LOW VOLTAGE CIRCUIT – A circuit involving a peak open-circuit potential of not more than 42.4 V (30 Vrms) for dry applications and 21.2 V (15 Vrms) for wet applications, 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 an extra-low voltage circuit.

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

3.21 FLOOR SWEEPER – A portable, indoor-use, household or commercial, dry pick-up type appliance that is intended to sweep up dirt or debris from a bare floor surface or carpeted floor surface using a motor-driven rotating brush, without the use of suction. As the user moves the floor sweeper along the floor surface, the rotating brush sweeps up the dirt from the floor and gathers it into an on-board dirt container. This dirt container may be removable from the appliance so the user can empty it when full.

3.22 HARD SURFACE – Any surface that is not carpeted or upholstered.

3.23 HAZARDOUS MOVING PART – A moving part that is capable of causing injury to persons.

3.24 HOUSEHOLD EXTRACTION-TYPE FLOOR CLEANING MACHINE – Either a hard surface cleaning machine, a self-contained carpet cleaning machine, or a machine that can clean both hard surfaces and carpeted surfaces. These machines apply a cleaning solution to the surface to be cleaned and then extract the solution.

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

3.26 LIVE PART – A part that is conductively connected to a line-voltage circuit.

3.27 MEASUREMENT INDICATION UNIT (MIU) – The unit used in measuring leakage current as defined in UL 101.

3.28 MOTORIZED NOZZLE – An accessory containing a motor that is attached to the end of the hose or wand. It may be provided with power from a vacuum cleaner or, for a motorized nozzle intended for use with a central vacuum system, directly from the supply outlet or with a battery.

3.29 NONCURRENT-CARRYING METAL PART – A metal or other electrically conductive part, accessible or inaccessible, that is not conductively connected to a live part.

3.30 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.

3.31 POWER SWITCH – A switch that provides ON/OFF control for the following in (a) – (c) below. For an appliance provided with multiple switches that control the same loads, the power switch is considered to be the switch declared by the manufacturer to be the power switch and is accessible to the user during operation. If a motor is rated 1/3 hp or less, and the [11.4.15](#) marking is included, the motor control switch is not considered a power switch.

a) Portable appliances with a motor greater than 1/3 hp;

- b) Stationary appliances with a motor greater than 1/8 hp; or
- c) Motor controlling accessible hazardous moving part(s).

3.32 PROPRIETARY FLUID – An aqueous solution designated for use with a household extraction-type floor cleaning machine that is exclusively controlled by the same manufacturer as the appliance.

3.33 REINFORCED INSULATION – An improved basic insulation system with such mechanical and electrical qualities that it, in itself, provides the same degree of protection against a risk of electric shock as double insulation. It may consist of one or more layers of insulating materials.

3.34 SAFETY-CRITICAL FUNCTION – Function(s) required by this Standard, the loss of which would cause the appliance to function in such a manner as to expose the user to a risk that is in excess of the risk that is permitted by this end product standard under abnormal conditions.

3.35 STATIONARY APPLIANCE – Any 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.

3.36 STAND-ALONE PRODUCT – A product or accessory that is intended to be sold separately and used in conjunction with other equipment based on the marked ratings, such as current-carrying hoses and motorized nozzles for use with central vacuum cleaning systems.

3.37 SUPPLEMENTARY INSULATION – An independent insulation provided in addition to the basic insulation to protect against a risk of electric shock in case of mechanical rupture or electrical breakdown of the basic insulation. An enclosure of insulating material may form a part or all of the supplementary insulation.

3.38 UTILITY VACUUM CLEANER – A portable, floor-supported, cord-connected dry or wet/dry vacuum cleaner intended primarily for a work area, such as use in domestic garages, shops and construction sites.

## 4 Construction

### 4.1 Components

#### 4.1.1 General

4.1.1.1 Components shall comply with the safety requirements specified in the relevant CSA and UL standards as far as they reasonably apply, and to the extent that:

- a) The proper functioning of the component is required for the safety of the end-product; and
- b) The component itself does not increase the risk of fire or electric shock or personal injury when operated under either under normal use conditions or under the abnormal conditions described in this Standard.

4.1.1.2 Components that are generally required to meet the safety requirements of the component standards in their entirety are specified in [4.1.2](#). Other components may comply with this Standard or comply with the component standards referenced throughout this Standard.

4.1.1.3 A component that is required by this Standard to fulfill a particular referenced component standard shall:

- a) Be described within the scope of that standard;

- b) Be employed in the end product in a manner consistent with the intended use described in the component standard;
- c) Be used in accordance within its rating(s) established for the intended conditions of use or its established Conditions of Acceptability; and
- d) Additionally comply with the applicable requirements of this end product standard.

4.1.1.4 A component of a product covered by this Standard is not required to comply with a specific component requirement that:

- a) Involves a feature or characteristic not required in the application of the component in the product;
- b) Is superseded by a requirement in this Standard; or
- c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

#### 4.1.2 Specific component requirements

4.1.2.1 A marking and labeling system shall comply with CSA C22.2 No. 0.15 and UL 969 for the surface it is applied to, and to the environmental conditions consistent with the intended use of the product (e.g. indoor or outdoor).

4.1.2.2 A Class 2 power supply shall comply with:

- a) CSA C22.2 No. 223 and UL 1310;
- b) CSA C22.2 No. 60950-1 and UL 60950-1, with a "Class 2", or limited power source (LPS) output; or
- c) CSA C22.2 No. 62368-1 and UL 62368-1, with a Class 2 or limited power source (LPS) output.

4.1.2.3 A non-Class 2 power supply shall comply with:

- a) CSA C22.2 No. 107.1 and UL 1012; or
- b) CSA C22.2 No. 60950-1 and UL 60950-1; or
- c) CSA C22.2 No. 62368-1 and UL 62368-1.

4.1.2.4 Printed wiring boards, including the coatings, shall comply with CSA C22.2 No. 0.17 and UL 796, and have a minimum HB flame rating. Those printed wiring boards providing direct support of live parts shall additionally comply with the direct-support requirements for insulating materials in CSA C22.2 No. 0.17 and UL 746C.

4.1.2.5 A printed-wiring board in an extra-low voltage, non-safety circuit is not required to comply with the bonding requirements in CSA C22.2 No. 0.17 and UL 796 if the board is separated from parts of other circuits such that loosening of the bond between the foil conductor and the base material will not result in the foil conductors or components coming in contact with parts of other circuits of the control or of the end-use product.

4.1.2.6 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with UL 1577. If considered necessary, the dielectric voltage withstand tests required by UL 1577 shall be conducted applying the criteria of [5.11](#) of this end product standard.

4.1.2.7 An optical isolator that is relied upon to provide isolation between primary and secondary circuits or between other circuits as required by this end product standard shall comply with UL 1577. If considered necessary, the dielectric voltage withstand tests required by UL 1577 shall be conducted applying the criteria of [5.11](#) of this end product standard.

4.1.2.8 Component requirements are not specified for small electronic components on printed wiring boards, including diodes, transistors, resistors, inductors, integrated circuits, and capacitors not directly connected to the supply source.

4.1.2.9 Except as specified in [4.1.2.10](#), general-purpose transformers shall comply with CSA C22.2 No. 66.1 and UL 5085-1, and CSA C22.2 No. 66.2 and UL 5085-2.

4.1.2.10 A transformer that is completely enclosed within the end product enclosure and the secondary circuit is inaccessible, and that meets the applicable construction and performance requirements of this end product standard when tested in conjunction with the end product, meets the intent of [4.1.2.9](#). See [5.31](#).

4.1.2.11 Class 2 and Class 3 transformers, other than those located in an extra-low voltage circuit that does not involve a risk of fire or personal injury, shall comply with CSA C22.2 No. 66.1 and UL 5085-1, and CSA C22.2 No. 66.3 and UL 5085-3.

## 4.2 Enclosures

### 4.2.1 Mechanical strength and flammability

4.2.1.1 The frame and enclosure of an appliance shall have the necessary strength and rigidity to resist the abuses likely to be encountered during normal service. The degree of resistance inherent in the unit shall preclude total or partial collapse with the attendant reduction of spacings, loosening or displacement of parts, and other defects that alone or in combination constitute a risk of fire, electric shock, or injury to persons.

4.2.1.2 Except as specified in [4.2.1.3](#) and [4.2.1.4](#), for an unreinforced, flat surface:

- a) Cast metal shall not be less than 3.2-mm (1/8-in) thick;
- b) Malleable iron shall not be less than 2.4-mm (3/32-in) thick; and
- c) Die-cast metal shall not be less than 2.0-mm (5/64-in) thick.

4.2.1.3 Metal of a lesser thickness than in [4.2.1.2](#), but not less than 2.4, 1.6, and 1.2 mm (3/32, 1/16, and 3/64 in), respectively, may be acceptable provided the surface under consideration is:

- a) Curved, ribbed, or otherwise reinforced to provide mechanical strength equivalent to that required; or
- b) Of size or shape that provides mechanical strength equivalent to that required.

4.2.1.4 Metal of a lesser thickness than in [4.2.1.2](#), may be employed if it complies with the physical abuse tests in [5.19](#).

4.2.1.5 Except as specified in [4.2.1.6](#), an enclosure of sheet metal shall be judged with respect to size, shape, thickness of metal, and acceptability for the application considering the intended use of the appliance. Sheet steel shall have a minimum thickness of 0.66 mm (0.026 in); aluminum shall have a minimum thickness of 0.91 mm (0.036 in); and copper or brass shall have a minimum thickness of 0.84 mm (0.033 in).

4.2.1.6 An area that is relatively small or a surface that is curved or otherwise reinforced need not comply with [4.2.1.5](#) if it complies with the physical abuse tests in [5.19](#).

4.2.1.7 Factors that shall be taken into consideration when judging the acceptability of magnesium and nonmetallic material other than a polymeric material 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.

4.2.1.8 Polymeric parts employed to enclose uninsulated live parts or insulated live parts whose insulation is less than 0.7 mm (0.028 in), or equivalent, shall be subjected to the tests in [5.21](#) and shall have a flammability rating or comply with the testing as specified below:

- a) For a portable attended, household appliance:
  - 1) Minimum flammability rating of HB, or HBF for foamed materials, in accordance with CSA C22.2 No. 0.17 and UL 94;
  - 2) Needle flame test in accordance with CSA C22.2 No 0.17;
  - 3) 12 mm or 20 mm (3/4 inch) flame test in accordance with UL 746C;
  - 4) Glow-wire test at 550 °C in accordance with UL 746C;
  - 5) Minimum 550 Glow wire flammability index (GWFI) in accordance with IEC 60695-2-12; or
  - 6) Minimum 575 Glow wire ignitability temperature (GWIT) in accordance with IEC 60695-2-13.
- b) For other portable appliances:
  - 1) Minimum flammability rating of V-2
  - 2) Needle flame test in accordance with CSA C22.2 No. 0.17; or
  - 3) 12 mm or 20 mm (3/4 inch) flame test in accordance with UL 746C.
- c) For a stationary or fixed appliance;
  - 1) Minimum 5VA in accordance with CSA C22.2 No. 0.17 and UL 94; or
  - 2) 127 mm (5 inch) flame test in accordance with UL 746C.

4.2.1.9 Polymeric parts employed to enclose insulated live parts [insulation 0.7-mm (0.028-in) thick minimum or equivalent], internal wiring and moving parts shall be subjected to the mold stress-relief distortion test, [5.21.3](#), and the impact test, [5.21.4](#) and shall comply with [4.2.1.8\(a\)](#).

4.2.1.10 The requirements of [4.2.1.8](#), [4.2.1.9](#), and [4.2.2.1](#) are not applicable for coatings, such as paint, applied to the exterior surfaces of polymeric enclosure materials or to other external polymeric parts provided that the coating does not offer a continuous path for an internal flame to propagate externally.

4.2.1.11 With respect to the end-product flame tests referenced in [4.2.1.8](#), [4.2.1.9](#), and [4.2.2.1](#), if molded parts of the same polymeric material have different configurations, the end-product flame test shall be conducted on each configuration. The molded parts may have different internal bosses, projections, ribs, or other components mounted on the molded part that might have a potential negative or positive affect on the enclosure flame test results. If an engineering decision can be made that the two parts are very similar in construction, and one molded part can be considered to represent the other molded part, the end-product flame test may be waived. Different molding conditions of the molded parts is not the significant factor in determining if the end-product flame test has to be conducted in this type of situation.

## 4.2.2 Flammability of non-enclosure polymeric parts

4.2.2.1 Polymeric materials, including elastomeric materials, for use other than as described in [4.2.1.8](#) and [4.2.1.9](#), that are less than 12.7 mm (0.5 in) from an arcing part or less than 0.8 mm (0.03 in) from an uninsulated live part, shall comply with [4.2.1.8\(a\)](#)

4.2.2.2 The requirements of [4.2.2.1](#) are not applicable to small parts whose maximum volume does not exceed 2 cm<sup>3</sup> (0.12 in<sup>3</sup>).

## 4.2.3 Openings in enclosures

4.2.3.1 The enclosure of a remotely or automatically controlled appliance shall prevent molten metal, burning insulation, flaming particles, or the like from falling on combustible materials, including the surface upon which the appliance is supported. See [3.7](#) and [3.30](#).

4.2.3.2 The requirement in [4.2.3.1](#) will necessitate the use of a barrier of noncombustible material:

a) Under a motor unless:

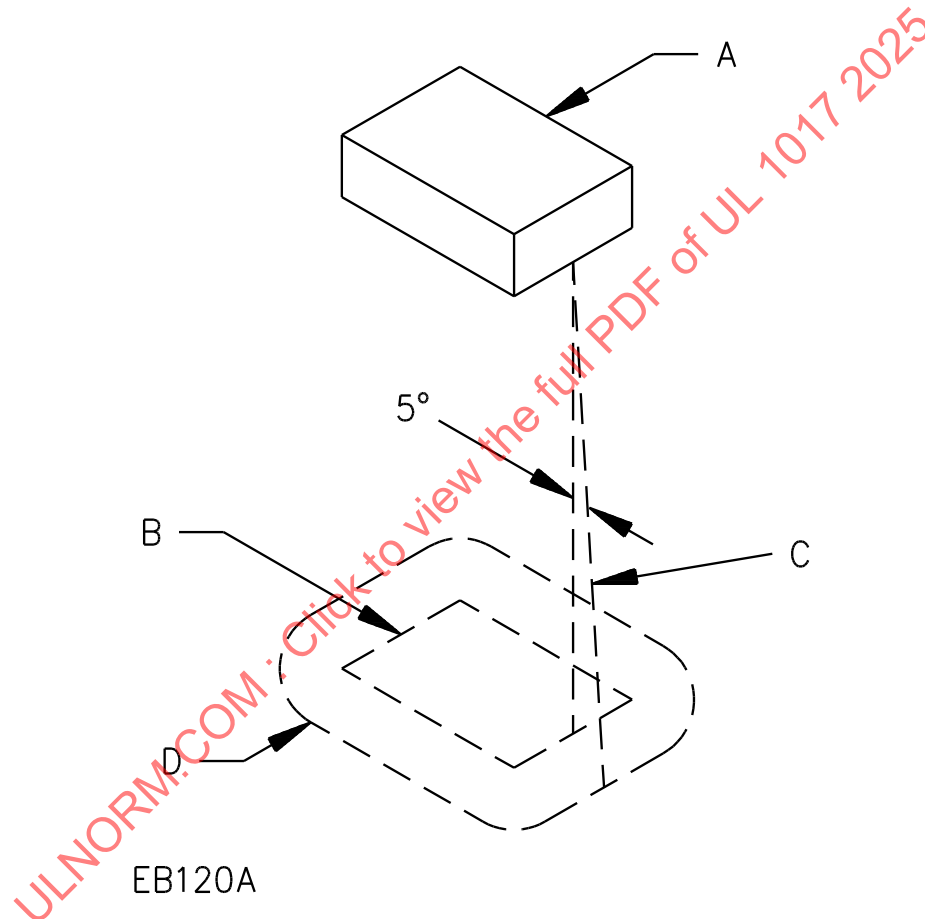
- 1) The structural parts of the motor or the appliance provide the equivalent of such a barrier;
- 2) The protection provided with the motor is such that no burning insulation or molten material falls to the surface that supports the appliance when the motor is energized under each of the following 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 shall be applied before the motor is energized, and the rotor shall 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 limit the temperature of the motor windings:
  - i) To 125 °C (257 °F) under the maximum load under which the motor will run without causing the protector to cycle; and
  - ii) To 150 °C (302 °F) with the rotor of the motor locked; and

b) Under wiring, unless there is no evidence of a risk of fire as a result of the tests in Section [5](#).

4.2.3.3 Except for the terminals, a switch, a relay, a solenoid, or the like in an appliance as specified in [4.2.3.1](#) shall be individually and completely enclosed unless malfunction of the component would not result in a risk of fire or there are no openings in the bottom of the appliance.

4.2.3.4 The barrier mentioned in [4.2.3.2](#) shall be located as illustrated in [Figure 4.1](#), and shall have an area in accordance with that illustration. Openings for drainage, ventilation, or the like may be employed in the barrier, if such openings would not permit molten metal, burning insulation, or the like to fall on flammable material.

**Figure 4.1**  
**Location and Extent of Barrier**



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. When moving, 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.

4.2.3.5 The construction of a vacuum cleaner intended to be exposed to rain shall comply with the water-spray test requirements specified in [5.12.1](#).

4.2.3.6 The construction of a wet pick-up vacuum cleaner shall comply with the wet pick-up test requirements specified in [5.12.2](#).

4.2.3.7 The door or cover of an enclosure shall be hinged or otherwise attached in an equivalent manner if it gives access to any overload protective device, the normal functioning of which requires renewal, or if it is necessary to open the cover in connection with the normal operation of the protective device.

4.2.3.8 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.

4.2.3.9 A portable cord-connected appliance that is provided with keyhole slots, notches, hanger holes, or the like for hanging on a wall shall be constructed so that the hanging means attached to the wall is not accessible when the appliance is placed on the hanging means as intended.

4.2.3.10 To determine whether an appliance complies with the requirement in [4.2.3.9](#), any part of the enclosure or barrier that can be removed without the use of tools to gain access to the hanging means shall be removed.

4.2.3.11 An opening in an appliance provided for hanging the appliance 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; or
- e) Any other part likely to create a risk of fire or electric shock.

#### **4.2.4 Adhesives used to secure parts**

4.2.4.1 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 [5.23](#).

4.2.4.2 The requirement in [4.2.4.1](#) also applies to an adhesive used to secure a part, including a nameplate, that can, if loosened or dislodged:

- a) Make a live part accessible;
- b) Reduce spacings below the minimum specified values; or
- c) Expose a normally enclosed moving part.

#### **4.2.5 Accessibility of live parts**

4.2.5.1 To reduce the likelihood of unintentional contact that can involve a risk of electric shock from an uninsulated live part or film-coated wire, an opening in an enclosure shall comply with one of the following:

- a) For an opening that has a minor dimension (see [4.2.5.5](#)) less than 25.4 mm (1 in), such a part or wire shall not be contacted by the probe illustrated in [Figure 4.2](#);
- b) For an opening that has a minor dimension of 25.4 mm (1 in) or more, such a part or wire shall be spaced from the opening as specified in [Table 4.1](#).
- c) A motor employed in an appliance intended for commercial use other than one used in either a hand-held appliance or a hand-supported portion of an appliance shall comply with (a) or (b) or [4.2.5.2](#).

**Table 4.1**  
**Minimum Acceptable Distance from an Opening to a Part that May Involve a Risk of Electric Shock**

Minimum dimension <sup>a</sup> of opening <sup>b</sup>		Minimum distance from opening to part <sup>b</sup>	
mm	(in)	mm	(in)
19.1 <sup>c</sup>	(3/4)	114.0	(4-1/2)
25.4	(1)	165.0	(6-1/2)
31.8	(1-1/4)	190.0	(7-1/2)
38.1	(1-1/2)	318.0	(12-1/2)
47.6	(1-7/8)	394.0	(15-1/2)
54.0	(2-1/8)	444.0	(17-1/2)
	d	762.0	(30)

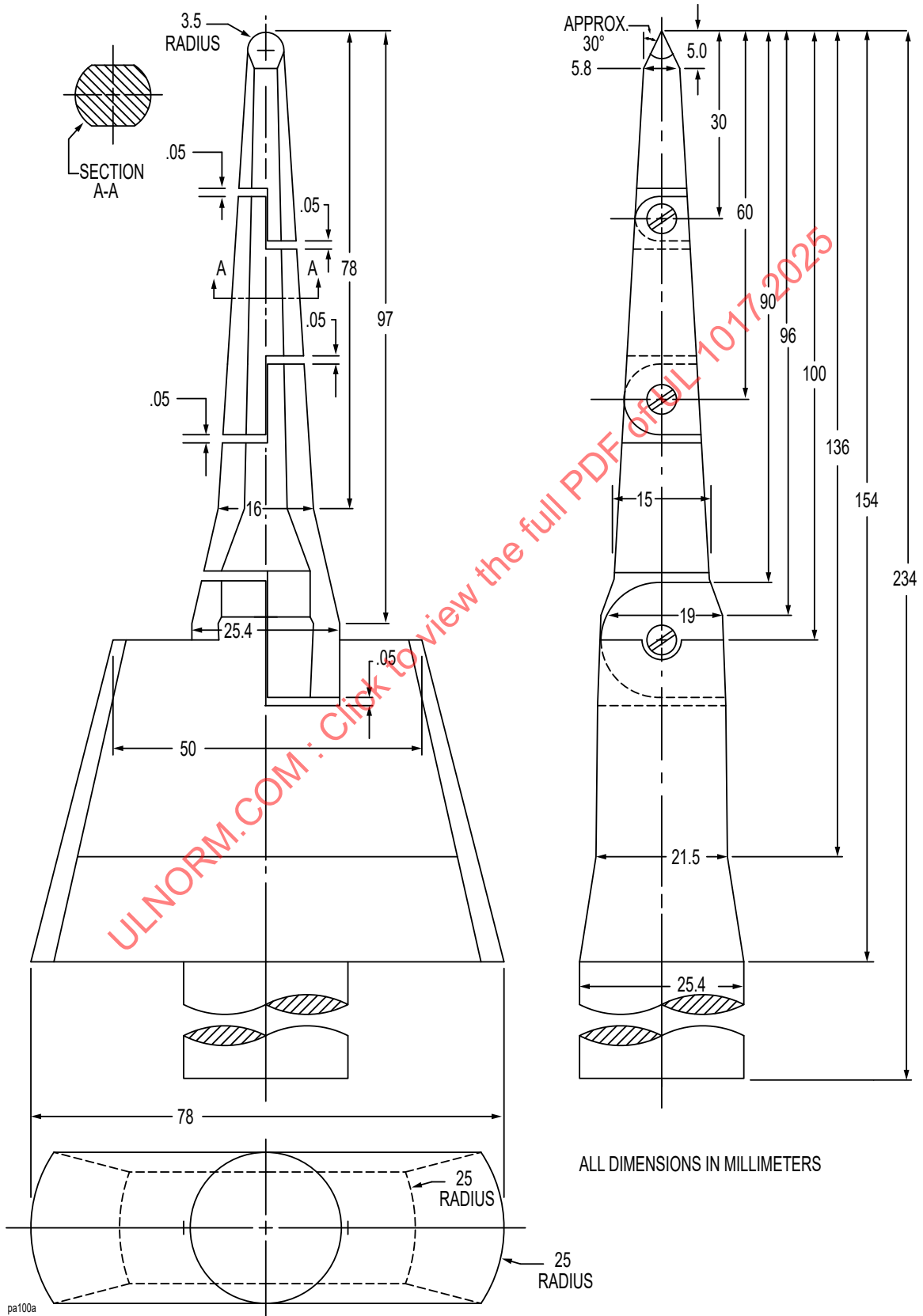
<sup>a</sup> See [4.2.5.5](#).

<sup>b</sup> Between 25.4 and 54.0 mm (1 and 2-1/8 in), interpolation shall be used to determine a value between values specified in this table.

<sup>c</sup> Any dimension less than 25.4 mm (1 in) applies to a motor only.

<sup>d</sup> More than 54.0 mm (2-1/8 in) but not more than 152 mm (6 in).

Figure 4.2  
Articulated Accessibility Probe



4.2.5.2 With respect to a part or wire as mentioned in [4.2.5.1](#) in an integral enclosure of a motor as mentioned in [4.2.5.1\(c\)](#):

- a) An opening that has a minor dimension (see [4.2.5.5](#)) less than 19.1 mm (3/4 in) is acceptable if:
  - 1) Film-coated wire cannot be contacted by the probe illustrated in [Figure 4.3](#);
  - 2) An uninsulated live part cannot be contacted by the probe illustrated in [Figure 4.4](#);
- b) An opening that has a minor dimension of 19.1 mm (3/4 in) or more is acceptable if a part or wire is spaced from the opening as specified in [Table 4.1](#).

**Figure 4.3**  
**Straight Probe**

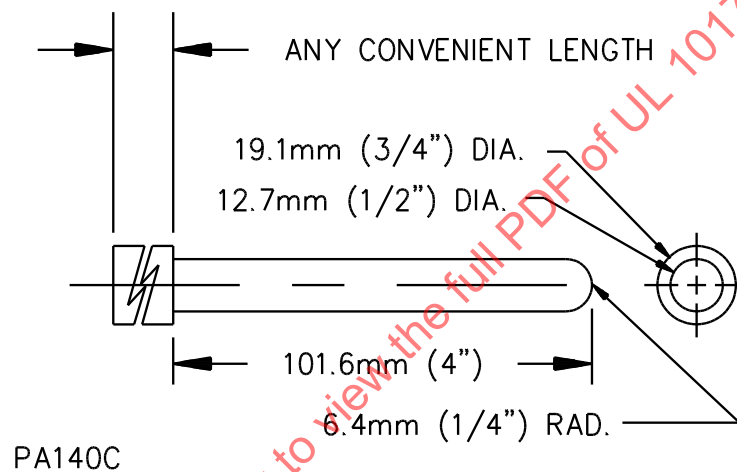
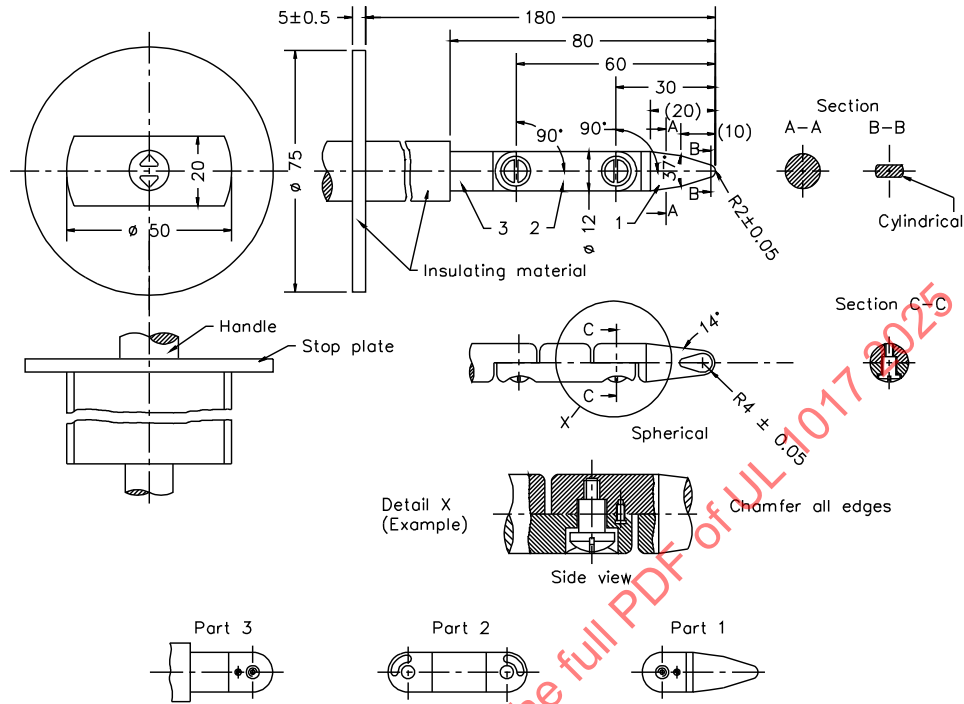


Figure 4.4

International Electrotechnical Commission, (IEC) Articulate Accessibility Probe with Stop Plate



SA1788A

4.2.5.3 The probes illustrated in [Figure 4.2](#) – [Figure 4.4](#) 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 probes illustrated in [Figure 4.2](#) – [Figure 4.4](#) shall be applied to any possible configuration and, if necessary, the configuration shall be changed after insertion through the opening.

4.2.5.4 The probes shall be used as measuring instruments to judge accessibility provided by an opening and not as instruments to judge the strength of a material.

4.2.5.5 With reference to the requirements in [4.2.5.1](#) and [4.2.5.2](#), 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.

4.2.5.6 During the investigation of an appliance to determine whether it complies with the requirements in [4.2.5.1](#) or [4.2.5.2](#), a part of the enclosure that can be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) shall be opened or removed.

4.2.5.7 The connection of an accessible part to live parts, including a supply conductor, to facilitate the discharge of static electricity shall comply with (a) – (d). To determine compliance with the remaining requirements in this Standard, the resistors and associated circuitry shall be investigated as live parts. The lead of the resistor connected to the accessible parts shall be investigated as a dead metal part:

- a) A minimum of two resistors connected in series shall be employed;
- b) The resistors shall comply with the applicable requirements in CSA C22.2 No. 62368-1, UL 1676 and UL 62368-1;
- c) For the tests described in [5.3](#), [5.4](#), [5.5](#) and [6.12](#), one resistor at a time shall be shorted; and
- d) For the test described in [5.11](#) and [6.13](#), as applicable, the lead of the resistor connected to the accessible part shall be disconnected.

#### 4.2.6 Button batteries or coin cell batteries

4.2.6.1 To reduce the risk of injury due to battery ingestion, the battery compartment of an appliance or any accessory, such as a wireless control, incorporating one, or more replaceable coin cell batteries shall comply with UL 4200A, if the appliance or any accessory:

- a) Is intended for use with one or more single cell batteries having a diameter of 32 mm (1.25 in) or less with a diameter greater than its height; and
- b) Is intended for household use.

### 4.3 Mechanical assembly

#### 4.3.1 General

4.3.1.1 An appliance shall be so assembled that the vibration of normal operation will not result in a risk of electric shock, fire, or injury to persons.

4.3.1.2 Components such as switches, lampholders, receptacles and plug connectors provided as parts of equipment shall be fastened securely and rigidly, and shall be restricted from turning by means other than friction between surfaces. Lock washers, properly applied, may be used as a means to restrict the turning of stem-mounted controls, except those that operate with a rotary motion.

4.3.1.3 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 can result in a reduction of spacings below the minimum specified values. Friction between surfaces to restrict shifting or turning of live parts shall not be used, but a lock washer, properly applied, may be used.

4.3.1.4 Fluid-handling tubing shall be mechanically secured at connections if there is a risk of fire or electric shock should the tubing become disconnected [see [5.12.8.1.1](#) (a) and (b)]. Tubing subject to a pressure greater than 0.7 kg/cm<sup>2</sup> (10 psi) shall also comply with the tubing pressure test described in [5.12.8.4](#).

4.3.1.5 Fluid-handling tubing subject to a pressure of 0.7 kg/cm<sup>2</sup> (10 psi) or less is not required to be mechanically secured if the tubing complies with the tubing pressure test of [5.12.8.4](#).

4.3.1.6 Except as specified in [4.3.1.7](#), an appliance shall be completely assembled before being shipped from the factory.

4.3.1.7 An appliance may be shipped from the factory partially disassembled to facilitate packaging if:

- a) All parts for assembly that are necessary for the operation of the appliance are provided in one package; a package may consist of several cartons provided as a unit;
- b) Proper assembly can be readily accomplished without introducing a risk of fire, electric shock, or injury to persons;
- c) Clear and detailed assembly instructions are provided;
- d) Internal electrical connections that must be made in the field are made by plug and receptacle connections only and do not require rearrangement of components or wiring. Internal connections that must be made in the field in an appliance intended for permanent connection to the power supply shall be made with means that comply with requirements in [4.5.5](#) or by plug and receptacle connection; and
- e) The appliance is marked in accordance with [11.4.25](#), if a required guard is shipped from the factory detached.

#### **4.3.2 Equipment intended for recreational vehicle or marine vessel installation**

4.3.2.1 For equipment intended for R/V or marine vessel installation, provisions such as mounting holes, clamps, lugs, or equivalent means shall be provided for securement of the equipment to the vehicle or vessel.

#### **4.3.3 Additional requirements for ash vacuum cleaners**

4.3.3.1 The ash vacuum cleaner dirt receptacle (e.g. metal tank or pail) shall be sheet steel, minimum 0.6 mm (0.024 in.) thick. Thinner wall sections may be used if the material meets the requirements of the Physical abuse test of [5.19.3](#). The dirt receptacle shall not sustain damage that allows ash to escape the receptacle.

4.3.3.2 All nozzles, connectors and deflectors made out of non-metallic material upstream of the primary filter shall have a minimum flame rating of V-1 or shall comply with the needle flame test in accordance with CSA C22.2 No. 0.17.

4.3.3.3 The primary filter media used with ash vacuum cleaners shall comply with one of the following:

- a) Glow-wire test at 650 °C in accordance with UL 746C;

- b) Minimum 650 Glow wire flammability index (GWFI) in accordance with IEC 60695-2-12; or
- c) Minimum 675 Glow wire ignitability temperature (GWIT) in accordance with IEC 60695-2-13.

4.3.3.4 Hoses used with ash vacuum cleaners shall be metal.

4.3.3.5 The fully extended length of the hose supplied with ash vacuum cleaners shall not exceed 2 m (78 in.).

4.3.3.6 The end of the hose handle shall have a smaller inside diameter than the body of the hose and handle to prevent hot ash from lodging in the hose or handle.

#### 4.4 Corrosion protection

4.4.1 Iron and steel parts, other than bearings, laminations or minor parts such as washers, screws or the like, shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means if the corrosion of such unprotected parts would be likely to result in a risk of fire, electric shock, or injury to persons.

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

4.4.3 In a vacuum cleaner with a steam-cleaning attachment, the metal sheath employed to enclose the heating element of an immersion-type water heater shall be protected against corrosion by enameling, galvanizing, plating, or other means, if the deterioration of such unprotected parts would be likely to result in risk of fire or electric shock; see [4.18](#).

4.4.4 A vacuum cleaner with a steam-cleaning attachment that is provided with a reservoir intended to hold a liquid shall have all live parts located or otherwise protected so that they will not be subject to wetting if the reservoir were to leak. Compliance shall be determined by the tests in [5.12.8](#).

4.4.5 For vacuum cleaners intended for marine vessel installation, all iron or steel parts of equipment, including bolts, nuts, screws, washers, and the like that are relied upon for compliance with the requirements in this Standard, shall be provided with a corrosion-resistant finish by:

- a) A coating of chromium, nickel, silver, or zinc applied by electroplating;
- b) Sheradizing;
- c) Hot-dip galvanizing;
- d) Enameling, if the surface has been treated by bonderizing or the equivalent and by the application of zinc chromate primer prior to enameling; or
- e) Other types of paint or coatings that provide equivalent resistance to corrosion as determined in the Salt-Spray Corrosion Test, [5.19.8](#).

4.4.6 With reference to [4.4.5](#), the following materials are known to be corrosion resistant and need not be subjected to the Salt-Spray Corrosion Test:

- a) Silver;
- b) Copper;
- c) Brass;

- d) Bronze;
- e) Copper-nickel;
- f) Aluminum alloys with a copper content of 0.4 % or less;
- g) Wood; and
- h) Polymeric material.

## 4.5 Supply connections

### 4.5.1 Cord-connected equipment

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

4.5.1.2 A cord set or power supply cord shall comply with CSA C22.2 No. 21 and UL 817. Flexible cords and cables shall comply with CSA C22.2 No. 49 and UL 62. Flexible cord and cables are considered to fulfill this requirement when preassembled in a cord set or power supply cord complying with CSA C22.2 No. 21 and UL 817.

4.5.1.3 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flatiron) plugs shall comply with CSA C22.2 No. 42 and UL 498. Attachment plugs and appliance couplers integral to cord sets or power supply cords are covered under the requirements of CSA C22.2 No. 21 and UL 817, and need not comply with CSA C22.2 No. 42 and UL 498.

4.5.1.4 Female devices (such as receptacles, appliance couplers, and connectors) that are intended, or that can be used, to interrupt current in the end product shall be suitably rated for current interruption of the specific type of load, when evaluated with its mating plug or connector. For example, an appliance coupler that can be used to interrupt the current of a motor load shall have a suitable horsepower rating when tested with its mating plug.

4.5.1.5 A stationary appliance may be provided with a length of flexible cord and an attachment plug for supply connection, if the use of the cord and attachment plug is intended to facilitate frequent service or maintenance. The investigation of such a feature shall include consideration of the utility of the appliance and the necessity of having it readily detachable from its source of supply by means of the plug. A stationary appliance provided with a cord and attachment plug, and intended for outdoor use, shall be provided with the marking and instruction specified in [11.4.29](#) and [12.3.1\(g\)](#), respectively.

4.5.1.6 Except as specified in [4.5.1.7](#), supply cords and cord sets shall:

- a) Have a voltage rating not less than the rated voltage of the appliance;
- b) Have an ampacity not less than the current rating of the appliance; and
- c) Employ flexible cords as specified in [Table 4.2](#) or a type at least as serviceable.

**Table 4.2  
Cord Types**

Appliance	Type of cord
Automotive and garage	S, ST <sup>a,b</sup>
Household, indoor use	SV, SVT <sup>e</sup>
Household, outdoor use	c
Commercial vacuum cleaners or blower cleaners	SJ, SJT <sup>d</sup>
Central vacuum cleaner	SJ, SJT
Household, indoor use, vacuum cleaner with steam-cleaning attachment, where temperatures are more than 121 °C (250 °F) on any surface that the cord is likely to touch when the appliance is used as intended	HPD, HPN, HSJ, HSJOO, or HSJO
Docking or charging stations of automatic battery-powered floor cleaners including those with a suction function	SPT-2

<sup>a</sup> An oil-resistant cord shall be used when the equipment is likely to be subjected to grease or oil.  
<sup>b</sup> Type SJ, or SJT cord is usable when the appliance is intended to be installed or used in a separate room provided for the purpose.  
<sup>c</sup> A household use vacuum cleaner and a household use, floor supported vacuum cleaner with an integral port provided for use as a blower, both intended primarily for indoor use and occasional outdoor use and marked according to item 3 or 5 of [Table 11.1](#) shall employ a Type SV or SVT cord. A household use vacuum cleaner intended primarily for outdoor use and a household blower cleaner intended for outdoor use shall employ a SJW or SJTW cord.  
<sup>d</sup> Cord marked with suffix "W" (such as, SJTW) shall be used when the appliance is intended for outdoor use.  
<sup>e</sup> Type SPT-1, -2, or -3; or SP-1, -2, or -3 cord may be used in locations that are protected or otherwise prevent the cord from being subjected to the same level of wear and abuse as the power cord, such as for an external connecting cord permanently attached to a wand.

4.5.1.7 For appliances provided with a general-use receptacle or receptacles, the requirements in [4.14](#) are applicable; see [4.14.5](#) and [4.14.6](#) for the supply cord and cord set requirements for portable, shop-type vacuum cleaners provided with general-use receptacles.

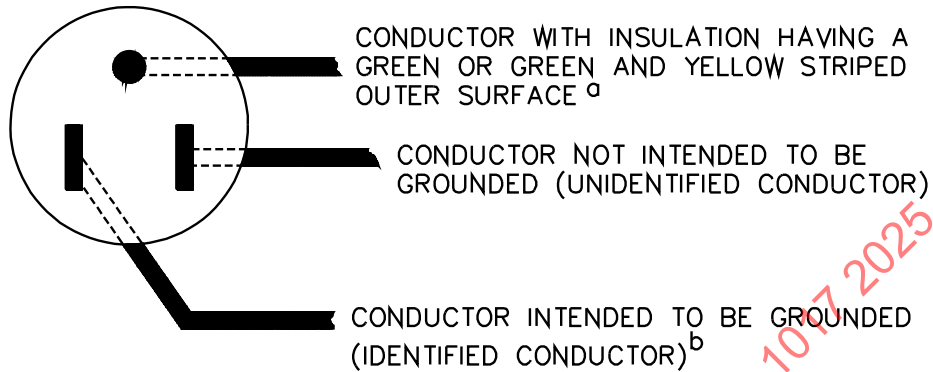
4.5.1.8 The voltage and current rating of the attachment plug shall correspond to the voltage and current rating of the product. When the product has provision to be field adapted for use with two or more different supply voltages, the attachment plug on the power supply cord provided with the product shall be rated for the supply voltage selected at the factory. See [11.3.2](#).

4.5.1.9 The attachment plug on 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 [4.10.1.5](#), [4.13.3](#), and [4.14.17](#) shall be a polarized type. The connections to the attachment plug shall be in accordance with [Figure 4.5](#) and [Table 4.3](#). See also polarization instructions, [12.4](#).

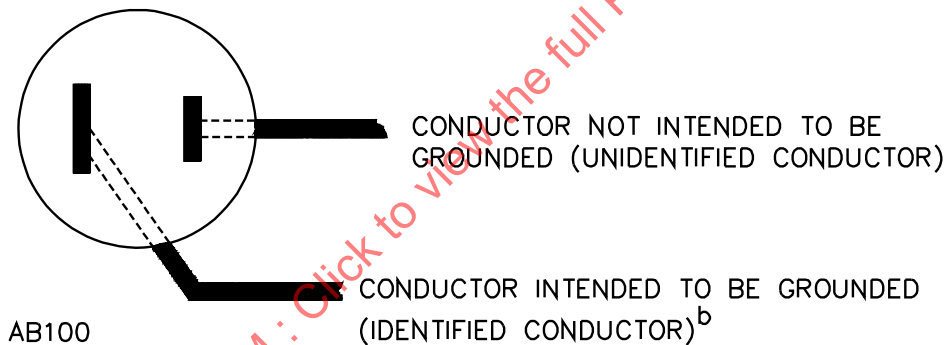
Figure 4.5

## Connections to Attachment Plug

CONNECTIONS OF CORD CONDUCTORS TO GROUNDING – TYPE ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



CONNECTIONS OF CORD CONDUCTORS TO POLARIZED ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



<sup>a</sup> The blade to which the green conductor is connected may have a U-shape instead of a circular cross section.

<sup>b</sup> Signifies a conductor identified in accordance with [Table 4.3](#).

**Table 4.3**  
**Polarity Identification of Flexible Cords**

Method of identification	Acceptable combinations	
	Conductor intended to be grounded <sup>a</sup>	All other conductors <sup>a</sup>
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 <sup>b</sup>	Solid color other than white or gray
	Solid light blue <sup>c</sup>	Solid color other than light blue, white, or gray
Color of separators	Solid white or gray <sup>d</sup>	Solid color other than white, or gray
<sup>a</sup> A conductor finished to show a green color with or without one or more yellow stripes or tracers shall be used only as an appliance-grounding conductor. See <a href="#">4.16.5</a> and <a href="#">Figure 4.5</a> . <sup>b</sup> Only for cords having no braid on any individual conductor. <sup>c</sup> For jacketed cords. <sup>d</sup> Only for cords having insulation on the individual conductors integral with the jacket.		

4.5.1.10 An appliance that is required to employ a polarized attachment plug as specified in [4.5.1.9](#), and that is provided with a detachable cord set shall also employ an appliance connector of the polarized type.

4.5.1.11 The power-supply cord of a portable appliance shall exit from the body of the attachment plug in a direction parallel to the major dimension of the blades and at a point opposite a point on the face of the plug geometrically centered between the blades. An angled attachment plug shall not be provided with a portable appliance, except a utility vacuum cleaner with an angled attachment plug with an integral ALCI or GFCI device.

4.5.1.12 The flexible cord may be attached permanently to an appliance or may be in the form of a separable cord set with means for connection to the appliance.

4.5.1.13 A household appliance intended for use with a detachable cord set shall not be provided with pin terminals that will accommodate a standard flatiron or an appliance plug.

4.5.1.14 For a commercial vacuum cleaner, a cord set (detachable power supply cord) with an IEC 60320 configuration appliance coupler exceeding 60 °C (140 °F) during the Temperature Test (see [5.8](#)) shall be of the special use type. See [11.4.23](#), [11.4.24](#), and [12.2.11](#). The appliance coupler temperature shall not exceed 70 °C (158 °F) and the rating of the coupler insulating material shall be at least 5 °C (9 °F) greater than the maximum measured temperature on the material.

4.5.1.15 Except as specified in [4.5.1.16](#), [4.5.1.18](#) and [4.5.1.19](#), for a vacuum cleaner or blower cleaner, the length of an attached flexible power supply cord or the length of a cord set (detachable power supply cord), shall not be less than 1.82 m (6 ft).

4.5.1.16 For a central vacuum cleaner and a docking or charging station including those with a suction function, the length of the flexible power supply cord or cord set shall not be less than 0.9 m (3 ft).

4.5.1.17 Except as specified in [4.5.1.19](#), a household-use floor finishing machine and a household extraction-type floor cleaning machine shall be provided with either a cord set (detachable power supply cord) or a power supply cord (nondetachable) not less than 4.57-m (15-ft) long. A hand-held household extraction-type floor cleaning machine shall be provided with either a cord set (detachable power supply cord) or a power supply cord (nondetachable) not less than 3.05-m (10-ft) long.

4.5.1.18 A portable commercial appliance, portable outdoor use appliance or portable hand-supported blower cleaner may be provided with an attached power supply cord not longer than 457 mm (18 in) or with a connector base (motor-attachment plug) if:

- a) The appliance is marked in accordance with [11.3.12](#) or provided with instructions in accordance with [12.5.3](#); or
- b) The manufacturer furnishes a detachable cord set, 1.82 m (6 ft) or more in length, with the appliance.

4.5.1.19 The length of the power-supply cord or cord set on a wet pick-up appliance that is supported by the body of a person but not solely handheld shall be not less than 6.1 m (20 ft).

4.5.1.20 The length of an attached flexible power supply cord is measured from the face of the attachment plug cap to the point at which the cord enters the appliance. The length of a cord set (detachable power supply cord) is measured including the fittings.

4.5.1.21 The means for connection (such as the attachment plug cap or connector base) of a wet pick-up appliance intended for use with a detachable cord set in accordance with [4.5.1.12](#) or [4.5.1.18](#) shall be of the locking type. The length of the attachment cord specified in [4.5.1.18](#) shall be such that the connection between the equipment attachment cord and the detachable cord set prevents the connection from being on the wet surface during intended use of the appliance.

4.5.1.22 An accessory, such as a detachable, electric power-driven brush, shall not be provided with a general-purpose attachment plug. However, an accessory intended for use with a central vacuum cleaning system or an accessory intended for commercial use with an extraction-type carpet cleaning system intended for commercial use may be provided with a general purpose attachment plug.

4.5.1.23 A motorized nozzle intended to be connected to an appliance that is intended for wet pick-up shall be provided with:

- a) An attached flexible power supply cord of such length as to plug directly into the appliance without the use of an intermediate connection such as a detachable cord set; or
- b) A cord-and-hose assembly that has been investigated and found to be acceptable for the application without creating a risk of fire, electric shock, or injury to persons when exposed to moisture.

4.5.1.24 An appliance incorporating a special-use connector and plug as a disconnecting means, such as a special use cord connector in the supply cord of a vacuum cleaner between the handle and the motor, shall have no exposed live parts under any normal condition as determined by the requirements in accessibility of live parts, [4.2.5](#).

4.5.1.25 A 3- to 2-wire grounding type adaptor shall not be provided with an appliance.

4.5.1.26 A component cord reel (or cord winder) shall comply with the applicable construction and performance requirements of this Standard. A cord reel that complies with CSA C22.2 No. 308 and UL 355 is considered to fulfill these requirements only if it additionally complies with the applicable cord reel tests described in [5.8.3](#), [5.12.3](#), and [5.16](#) of this Standard.

## 4.5.2 Pin terminals

4.5.2.1 An appliance provided with pin terminals shall have no live parts exposed to unintentional contact either during or after placement of a plug that is intended for the purpose on the pins in the normal manner.