



Underwriters Laboratories Inc.
Standard for Safety



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

Eighth Edition, Dated September 10, 2010

Summary of Topics

The new edition dated September 10, 2010 was issued to incorporate the following new and revised requirements and to reflect the September 10, 2010 ANSI recognition of the standard:

- Addition of requirements for portable rechargeable battery-powered appliances.
- Clarification for polymeric fluid-handling component requirements.
- Clarification of the meter circuit in Figure 6 – Leakage Current Measurement Circuits.
- Addition of installation instruction for a permanently connected appliance.
- Addition of requirements for detachable power supply cords.
- Addition of requirement for coatings applied to the exterior surfaces of polymeric materials and other external polymeric parts.
- Addition of an exception to Clause 4.13.5 for spacings within a motor.
- Revisions to address accessibility of moving parts through openings 1.375 inches or greater.
- Addition of blower cleaner impeller requirements.
- Leakage current testing in lieu of volume resistivity requirements.
- Revision of proprietary fluid requirements for self contained carpet cleaning machines.
- Revision of central vacuum outlet assembly grounding requirements.
- Requirements for a flexible switch actuator.
- Requirements for an electrical attachment with contacts on the underside of the attachment.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated January 9, 2009, July 10, 2009, September 11, 2009, and July 16, 2010.

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that have been revised and that have a future effective date are located after the Standard, and are preceded by a "SUPERSEDED REQUIREMENTS" notice.

The following table lists the future effective dates with the corresponding reference.

Future Effective Date	References
August 1, 2013	Clauses 1.2, 2.3, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.16, 3.5.1, 4.14.1, 4.16.3.1, 4.16.3.3, 4.16.8, 5.12.8.1.1, 5.12.8.3, 5.27, 7, 8.2.6, 11.2.7, Table 9, Figures 25 and 26, and Annex C



Canadian Standards Association
CSA C22.2 No. 243-10
Fourth Edition



Underwriters Laboratories Inc.
UL 1017
Eighth Edition

Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines

September 10, 2010



ANSI/UL 1017-2010

Commitment for Amendments

These procedures are issued jointly by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the procedures may be submitted to CSA or UL at any time. Revisions to these procedures will be made only after review and approval by CSA and UL. Revisions of these procedures will be made by issuing revised or additional pages bearing their date of issue.

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This ANSI/UL Standard for Safety consists of the Eighth Edition. The most recent designation of ANSI/UL 1017 as an American National Standard (ANSI) occurred on September 10, 2010. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface. Any other portions of this ANSI/UL standard that were not processed in accordance with ANSI/UL requirements are noted at the beginning of the impacted sections.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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ANNEX B

French Language Markings

This ANNEX is provided for information only

ANNEX C

Probe Tolerances

Preface

This is the harmonized CSA and UL standard for Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines. It is the fourth edition of CSA-C22.2 No. 243, and the eighth edition of UL 1017. This edition of CSA-C22.2 No. 243 supersedes the previous edition(s) published in 2001. This edition of UL 1017 supersedes the previous edition(s) published in 2001.

This harmonized standard was prepared by the Canadian Standards Association (CSA) and Underwriters Laboratories Inc. (UL). 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 Integrated Committee on Electrical Motor-Operated Cleaning Appliances for Industrial 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 approved by the American National Standards Institute (ANSI) as an American National Standard.

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 identical standard for CSA and UL.

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.

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.

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 September 10, 2010 all products Listed by UL must comply with the requirements in this standard except for clauses, figures, tables, and annexes in the following list, which are effective August 1, 2013.

Clauses 1.2, 2.3, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.16, 3.5.1, 4.14.1, 4.16.3.1, 4.16.3.3, 4.16.8, 5.12.8.1.1, 5.12.8.3, 5.27, 7, 8.2.6, 11.2.7, Table 9, Figures 25 and 26, and Annex C

Between September 10, 2010 and August 1, 2013, new product submittals to UL may be evaluated under all requirements in this standard or, if requested in writing, evaluated under presently effective requirements only. The presently effective requirements are contained in the eighth edition of UL 1017.

A UL effective date is one established by Underwriters Laboratories Inc. and is not part of the ANSI approved standard.

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 finishing machines to be employed in accordance with the Canadian Electrical Code Part I (CEC), C22.1, and the National Electrical Code (NEC), ANSI/NFPA 70.

1.2 These requirements cover:

- a) household, commercial, and coin-operated vacuum cleaning machines and blower cleaners, intended for indoor or outdoor use or both;
- b) household, commercial, and coin-operated wet pick-up, dry pick-up, permanently mounted, portable, and central vacuum cleaners and blower cleaner systems;
- c) household electrically powered floor finishing machines, including floor polishers, floor scrubbers, floor sanders, rug shampooers, rug and floor washers, and similar machines;
- d) appliances covered by this Standard that are marked as being provided with double insulation and that employ double insulation in place of grounding in accordance with the Exception to Clause 4.14.1;
- e) portable rechargeable battery-powered appliances for indoor or outdoor use with rechargeable non-user and user replaceable batteries; see Clause 7;
- f) current-carrying hoses for use with vacuum cleaner/motorized nozzle combination appliances intended for household, dry pick-up, indoor use; see Clause 8;
- g) current-carrying hoses for use with motorized nozzles intended for use with central vacuum cleaning systems intended for household, dry pick-up, indoor use; see Clause 8;
- h) wet pick-up current-carrying hoses for use with household, indoor use carpet cleaning equipment; see Clause 8; and
- i) electrified wall valves for connection of current-carrying hose/motorized nozzle combinations for central vacuum cleaning systems intended for household use; see Clause 8.

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.

2 Definitions

2.1 The following definitions apply in this Standard:

2.2 **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, Clause 4.1.4, applies.

2.3 **Appliance unit** – The functional part of the rechargeable battery-powered appliance that employs the motor assembly and battery assembly. The Class 2 power unit is not part of the appliance unit.

2.4 **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.

2.5 **Basic insulation** – The insulation in contact with live (current-carrying) parts to provide basic protection against the risk of electric shock.

2.6 **Battery assembly** – A single cell, or group of cells that are connected, that forms a part to provide power to the appliance unit.

2.7 **Battery assembly, Fully charged** – A battery assembly that is charged for a minimum of 16 h or in accordance with the manufacturer's instructions, whichever is greater.

2.8 **Battery assembly, Fully discharged** – A fully charged battery assembly that is discharged for one additional hour after the appliance unit has ceased operation.

2.9 **Battery, Integral** – A battery assembly that is contained within the appliance unit, and that is not removed from the appliance unit for charging purposes, but only removed for disposal or recycling purposes.

2.10 **Battery pack** – A battery assembly that is contained within its individual enclosure.

2.11 **Battery response** – An adverse reaction that may increase the risk of personal injury, such as a battery pack exploding, under certain conditions.

- 2.12 **Cell** – A single (basic) functional electrochemical unit consisting of electrodes (positive and negative), electrolyte, container, terminals, and typically separators, that is a source of electrical energy by direct conversion of chemical energy.
- 2.13 **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 13.
- 2.14 **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.
- 2.15 **Hard surface** – Any surface that is not carpeted or upholstered.
- 2.16 **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.
- 2.17 **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.
- 2.18 **Live (current-carrying) part** – A part that is conductively connected to a line-voltage circuit. See Clause 2.17.
- 2.19 **Measurement indication unit (MIU)** – The unit used in measuring leakage current as defined in the Standard for Leakage Current for Appliances, UL 101.
- 2.20 **Noncurrent-carrying metal part** – A metal or other electrically conductive part, accessible or inaccessible, that is not conductively connected to a live part.
- 2.21 **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.
- 2.22 **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.
- 2.23 **Remotely controlled appliance** – An appliance that is out of sight of the operator who is at the starting device.
- 2.24 **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 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 CSA and UL standards.

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

- a) involves a feature or characteristic not needed in the application of the component in the product covered by this standard; or
- b) is superseded by a requirement in this standard.

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

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

3.2 Attachments

3.2.1 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.

Exception: A nonelectrical attachment, such as a crevice tool, an upholstery brush, or the like, that has no driven parts and is intended to facilitate a cleaning operation without the use of a liquid need not be investigated.

3.2.2 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, Clause 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, Clause 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 the Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977 and the Standard for Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type, CSA C22.2 No. 182.1.

d) The applicable severe conditions (see Clause 5.21.5) and abnormal operation (see Clause 5.21.7) tests shall be conducted with and without the electrical attachment connected to the appliance as intended.

3.3 Fluids – proprietary

3.3.1 For a household extraction-type floor cleaning machine that is intended to be used with a proprietary fluid in accordance with Exception No. 2 to Clause 5.12.8.1.1, 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.

3.4 Instructions provided with the appliance

3.4.1 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.

3.4.2 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 for instruction manuals specified in Clause 11.

3.5 Reference publications

3.5.1 Products covered by this standard shall comply with the referenced installation codes and standards noted in Annex A. Where reference is made to any Standards, such reference shall be considered to refer to the latest editions and revisions thereto available at the time of printing, unless otherwise specified.

CSA Standards

C22.1

Canadian Electrical Code, Part I

C22.2 No. 0.17

Evaluation of Properties of Polymeric Materials

C22.2 No. 1

Audio, Video, and Similar Electronic Equipment

C22.2 No. 18.1

Metallic Outlet Boxes

C22.2 No. 18.2

Nonmetallic Outlet Boxes

C22.2 No. 24

Temperature-Indicating and Regulating Equipment

C22.2 No. 77

Motors With Inherent Overheating Protection

C22.2 No. 100
Motors and Generators

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

C22.2 No. 223
Power Supplies with Extra-Low-Voltage Class 2 Output

UL Standards

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 514A
Metallic Outlet Boxes

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

UL 746A
Polymeric Materials – Short Term Property Evaluations

UL 873
Temperature-Indicating and -Regulating Equipment

UL 1310
Class 2 Power Units

UL 1446
Systems of Insulating Materials – General

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

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

UL 2111
Overheating Protection for Motors

American National Standards Institute (ANSI)

ANSI/ISA MC96.1
Temperature Measurement Thermocouples

ANSI/NFPA 70
National Electrical Code

4 Construction

4.1 Enclosures

4.1.1 Mechanical strength

4.1.1.1 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.

4.1.1.2 For an unreinforced, flat surface:

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

Exception No. 1: Metal of a lesser thickness but not less than 3/32, 1/16, and 3/64 in (2.4, 1.6, and 1.2 mm), 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.*

Exception No. 2: Metal of a lesser thickness may be employed if it complies with the physical abuse tests in Clause 5.19.

4.1.1.3 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 0.026 in (0.66 mm); aluminum shall have a minimum thickness of 0.036 in (0.91 mm); and copper or brass shall have a minimum thickness of 0.033 in (0.84 mm).

Exception: An area that is relatively small or a surface that is curved or otherwise reinforced need not comply with this requirement if it complies with the physical abuse tests in Clause 5.19.

4.1.1.4 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.

4.1.1.5 Polymeric parts employed to enclose uninsulated live parts or insulated live parts whose insulation is less than 0.028 in (0.7 mm), or equivalent, shall be subjected to the tests in Clause 5.21 and shall have a flammability rating as noted below in accordance with the Standard for Evaluation of Properties of Polymeric Materials, CSA C22.2 No. 0.17 and the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94:

a) 5 VA and 0.175 VA Test A for a stationary appliance or an appliance that is permanently installed;

b) HB and 0.17 HB minimum for a portable attended, intermittent duty, household appliance; and

c) V2 and 0.17 V2 minimum for an appliance other than as mentioned in (a) and (b).

4.1.1.6 Polymeric parts employed to enclose insulated live parts [insulation 0.028-in (0.7-mm) thick minimum or equivalent], internal wiring and moving parts shall have a minimum flammability rating of HB and 0.17 HB, and shall be subjected to the mold stress-relief distortion test, Clause 5.21.3, and the impact test, Clause 5.21.4.

4.1.1.7 Polymeric materials for use other than as described in Clauses 4.1.1.5 and 4.1.1.6 shall have a minimum flammability rating of HB and 0.17 HB.

Exception No. 1: A small part whose maximum volume does not exceed 0.12 in³ (2 cm³) is not required to comply with Clause 4.1.1.7.

Exception No. 2: An external polymeric part that is detachable without the use of tools is not required to comply with Clause 4.1.1.7.

4.1.1.8 The requirements of Clauses 4.1.1.5, 4.1.1.6, and 4.1.1.7 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.

4.1.2 Openings in enclosures

4.1.2.1 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 Clause 2.1.

4.1.2.2 The requirement in Clause 4.1.2.1 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 Clause 5.

4.1.2.3 A switch, a relay, a solenoid, or the like in an appliance as specified in Clause 4.1.2.1 shall be individually and completely enclosed.

Exception No. 1: The terminals of a switch, a relay, a solenoid, or the like need not be individually and completely enclosed.

Exception No. 2: If malfunction of the component would not result in a risk of fire then the component need not be individually and completely enclosed.

Exception No. 3: If there are no openings in the bottom of the appliance enclosure then a switch, a relay, a solenoid or the like need not be individually and completely enclosed.

4.1.2.4 The barrier mentioned in Clause 4.1.2.1 shall be located as illustrated in Figure 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.

4.1.2.5 The construction of a vacuum cleaner intended to be exposed to rain shall comply with the water-spray test requirements specified in Clause 5.12.1.

4.1.2.6 The construction of a wet pick-up vacuum cleaner shall comply with the wet pick-up test requirements specified in Clause 5.12.2.

4.1.2.7 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.

4.1.2.8 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.

4.1.2.9 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.

4.1.2.10 To determine whether an appliance complies with the requirement in Clause 4.1.2.9, 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.

4.1.2.11 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.

4.1.3 Adhesives used to secure parts

4.1.3.1 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 Clause 5.23.

4.1.3.2 The requirement in Clause 4.1.3.1 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.

4.1.4 Accessibility of live parts

4.1.4.1 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 either (a) or (b):

- a) for an opening that has a minor dimension (see Clause 4.1.4.5) less than 1 in (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 2;
- b) for an opening that has a minor dimension of 1 in (25.4 mm) or more, such a part or wire shall be spaced from the opening as specified in Table 1.

Exception: 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 need not comply with these requirements if it complies with the requirements in Clause 4.1.4.2.

4.1.4.2 With respect to a part or wire as mentioned in Clause 4.1.4.1 in an integral enclosure of a motor as mentioned in the exception to Clause 4.1.4.1:

- a) an opening that has a minor dimension (see Clause 4.1.4.5) less than 3/4 in (19.1 mm) is acceptable if:
 - 1) film-coated wire cannot be contacted by the probe illustrated in Figure 3;
 - 2) an uninsulated live part cannot be contacted by the probe illustrated in Figure 4;
- b) an opening that has a minor dimension of 3/4 in (19.1 mm) or more is acceptable if a part or wire is spaced from the opening as specified in Table 1.

4.1.4.3 The probes illustrated in Figures 2 – 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 Figures 2 – 4 shall be applied to any possible configuration and, if necessary, the configuration shall be changed after insertion through the opening.

4.1.4.4 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.

4.1.4.5 With reference to the requirements in Clauses 4.1.4.1 and 4.1.4.2, 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.

4.1.4.6 During the investigation of an appliance to determine whether it complies with the requirements in Clause 4.1.4.1 or 4.1.4.2, 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.

4.1.4.7 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 the Standard for Conductive-Path and Discharge-Path Resistors for Use in Radio-, Video-, or Television-Type Appliances, UL 1676, and the Standard for Audio, Video, and Similar Electronic Equipment, CSA C22.2 No.1;
- c) for the tests described in Clauses 5.3, 5.4, 5.5, and 6.12, one resistor at a time shall be shorted; and
- d) for the test described in Clauses 5.11 and 6.13, as applicable, the lead of the resistor connected to the accessible part shall be disconnected.

4.2 Mechanical assembly

4.2.1 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.

4.2.2 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.

4.2.3 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.

4.2.4 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 Clause 5.12.8.1.1 (a) and (b)). Tubing subject to a pressure greater than 10 psi (0.7 kg/cm²) shall also comply with the tubing pressure test described in Clause 5.12.8.4.

Exception: Fluid-handling tubing subject to a pressure of 10 psi or less is not required to be mechanically secured if the tubing complies with the tubing pressure test (see Clause 5.12.8.4).

4.3 Corrosion protection

4.3.1 Iron and steel parts 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.

Exception No. 1: In certain instances in which the oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable – thickness of metal and temperature also being factors – surfaces of sheet steel and cast-iron parts within an enclosure will in some cases not be required to be protected against corrosion.

Exception No. 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, or the like need not be protected against corrosion.

4.3.2 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 Supply connections

4.4.1 Cord-connected equipment

4.4.1.1 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.

4.4.1.2 A stationary appliance may be provided with not more than 8 ft (2.44 m) of cord and an attachment plug for supply connection. 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.

4.4.1.3 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 2 or a type at least as serviceable.

4.4.1.4 The voltage rating of the attachment plug shall correspond to the voltage rating of the product and the ampere rating of the attachment plug shall not be less than 125% of the ampere 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 Clause 10.3.2.

Exception No. 1: A stationary product marked in accordance with Clause 10.3.6 shall employ an attachment plug cap rated no less than the current rating of the appliance or the input current under normal load conditions as specified in Clause 5.2, whichever is greater.

Exception No. 2: A commercial vacuum cleaner marked in accordance with Clause 10.3.7, rated 120 V, 60 Hz, 12 – 15 A, and employing a motor driven cleaning brush 22-in (55.9-cm) wide, or wider, shall employ an attachment plug cap rated not less than the current rating of the appliance.

4.4.1.5 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 Clauses 4.9.7, 4.11.3, and 4.12.8 shall be a polarized type. The connections to the attachment plug shall be in accordance with Figure 5 and Table 3. See also polarization instructions, Clause 11.4.

4.4.1.6 An appliance that is required to employ a polarized attachment plug as specified in Clause 4.4.1.5, and that is provided with a detachable cord set shall also employ an appliance connector of the polarized type.

4.4.1.7 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.

4.4.1.8 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.

4.4.1.9 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.

4.4.1.10 For a commercial vacuum cleaner, a detachable power supply cord with an IEC 60320 configuration appliance coupler exceeding 60°C (140°F) during the Temperature Test (see Clause 5.8) shall be of the special use type. See Clauses 3.1, 4.4.1.11, 10.4.19, 10.4.20, and 11.2.10, including Annex A.

4.4.1.11 With reference to Clause 4.4.1.10, 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.

4.4.1.12 Other than as noted in Clauses 4.4.1.15 and 4.4.1.16, the length of an attached flexible power supply cord for a vacuum cleaner or blower cleaner shall not be less than 6 ft (1.82 m) from the face of the attachment plug cap to the point at which the cord enters the appliance.

Exception: For a central vacuum cleaner, the length of the flexible power supply cord shall not be less than 3 ft (0.9 m). For required installation instructions see Clause 11.5.9.

4.4.1.13 A household-use floor finishing machine shall be provided with either a detachable or a nondetachable power supply cord not less than 15-ft (4.57-m) long, including fittings.

4.4.1.14 The length of a cord set, including fittings, shall not be less than 6 ft (1.82 m) except as specified in Clause 4.4.1.16.

4.4.1.15 A portable commercial appliance, portable outdoor use appliance or portable hand-supported blower cleaner shall be provided with not more than 18 in (457 mm) of permanently attached flexible power-supply cord or with a connector base (motor-attachment plug) if:

- a) the appliance is marked in accordance with Clause 10.3.15 or provided with instructions in accordance with Clause 11.5.3; or
- b) the manufacturer furnishes a detachable cord set, 6 ft (1.82 m) or more in length, with the appliance.

4.4.1.16 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 20 ft (6.1 m).

4.4.1.17 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 Clause 4.4.1.8 or 4.4.1.15 shall be of the locking type.

4.4.1.18 An accessory, such as a detachable, electric power-driven brush, shall not be provided with a general purpose attachment plug.

Exception No. 1: An accessory intended for use with a central vacuum cleaning system may be provided with a general purpose attachment plug provided the accessory is marked in accordance with Clause 10.3.14.

Exception No. 2: An accessory intended for use with an extraction-type carpet cleaning system intended for commercial use may be provided with a general purpose attachment plug.

4.4.1.19 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.

4.4.1.20 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, Clause 4.1.4.

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

4.4.2 Pin terminals

4.4.2.1 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.

4.4.2.2 A pin guard shall be provided that will restrict contact with any current-carrying pin by:

- a) a straight edge placed in any position across and in contact with edges of the plug opening without the plug in place to reduce the likelihood of mechanical damage to the pins; and
- b) the probe illustrated in Figure 2 while the probe is inserted through any opening with the appliance in any position, with the plug aligned with the pins and the face of the plug in the plane perpendicular to the axis and tangent to the end of the farthest projecting current-carrying pin.

4.4.3 Strain relief

4.4.3.1 Supply cords shall be provided with strain relief that reduces the likelihood of mechanical stress on the external portion of the cord from being transmitted to internal wiring, splices and terminals. The strain relief means shall comply with the test requirements specified in Clause 5.14.

4.4.3.2 Unless known to be acceptable for the purpose, a clamp of any material – metal or otherwise – shall not be used on a Type SVT cord or on cords of similar or lighter construction. For harder usage types of thermoplastic-insulated cord, clamps may be employed. In such cases, auxiliary insulation is not required unless it is determined that the cord grip may damage the insulation of the cord.

Exception: A clamp may be used on Type SVT (or similar) cord protected by varnished cloth tubing, phenolic, vulcanized fiber, or the equivalent under the cord grip, subject to the investigation described in Clause 5.14.3. Thermoplastic tubing is not acceptable over thermoplastic cords.

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

4.4.3.4 It shall not be possible for flexible cords to be pushed into the appliance through the cord-entry holes, if such displacement

a) can subject the cords to mechanical injury or to exposure to a temperature higher than that for which the cord is intended; or

b) is liable to reduce spacings (such as from uninsulated live parts to a metal strain relief clamp) below the specified minimum values.

4.4.3.5 The flexible cord shall be restrained from any rotation that could cause movement of the internal wiring at splices and terminals.

4.4.4 Bushings

4.4.4.1 Holes in sheet-metal walls through which insulated conductors pass shall be provided with smoothly rounded bushings or shall have smooth, well-rounded surfaces upon which such conductors may bear.

4.4.5 Permanently connected equipment

4.4.5.1 General

4.4.5.1.1 An appliance intended to be fastened or secured in position shall be provided with field-wiring terminals or leads for the connection of power-supply conductors, and shall have means for connection of a permanent wiring system.

4.4.5.1.2 Where openings for conduit are provided in sheet metal enclosures, the metal thickness shall be not less than 0.032-in (0.81-mm) thick if of sheet steel or 0.043-in (1.09-mm) thick if of nonferrous metal.

4.4.5.1.3 Terminal boxes or wiring compartments in which supply connections are made shall be located so that the connections will be accessible for inspection when the vacuum cleaner is installed as intended.

4.4.5.1.4 The compartment mentioned in Clause 4.4.5.1.3 shall be located so that, during conduit connections, internal wiring and electrical components will not be exposed to mechanical damage or strain.

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

4.4.5.2 Wiring terminals and leads

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

4.4.5.2.2 An appliance required to be grounded and equipped with terminals or leads for field connections of power-supply conductors shall be provided with a terminal or lead for connection of an equipment-grounding conductor.

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

4.4.5.2.4 A terminal solely for connection of an equipment-grounding conductor shall be capable of securing a conductor of the size necessary for the particular application. Solder alone shall not be used for connecting an equipment-grounding conductor.

4.4.5.2.5 A wiring terminal shall be provided with a soldering lug or with a pressure wire connector securely fastened in place – for example, firmly bolted or held by a screw.

Exception: A wire-binding screw may be employed at a wiring terminal intended to accommodate a 10 AWG (5.3 mm²) or smaller conductor if upturned lugs or the equivalent are provided to hold the wire in place.

4.4.5.2.6 A wiring terminal shall be prevented from turning.

4.4.5.2.7 The free length of a lead inside an outlet box or wiring compartment shall not be less than 6 in (152 mm) if the lead is intended for field connection to an external circuit.

Exception: The lead may be less than 6-in (152-mm) long if it is evident that the use of a longer lead might result in a risk of fire or electric shock.

4.4.5.2.8 A lead to be connected to a power-supply conductor in the field shall not be smaller than 18 AWG (0.82 mm²) and the insulation shall be thermoplastic with a wall thickness of at least 1/32 in (0.8 mm) or the equivalent.

4.4.5.3 Wire-binding screws

4.4.5.3.1 The size of a screw shall be not less than:

- a) No. 10 if for use with conductors larger than 14 AWG (2.1 mm²);
- b) No. 8 if for use with 14 AWG (2.1 mm²) conductors; or
- c) No. 6 if for use with conductors smaller than 14 AWG (2.1 mm²).

4.4.5.3.2 Upturned lugs or a cupped washer shall be capable of retaining a supply conductor of the size indicated in Clause 4.4.5.3.1 under the head of the screw or washer.

4.4.5.3.3 Wire-binding screws shall thread into metal.

4.4.5.4 Terminal plates and threading

4.4.5.4.1 Terminal plates through which wire binding screws are threaded shall have a thickness at least equal to twice the pitch of the thread of the screw but not less than 0.030 in (0.78 mm), and shall have at least two complete clean-cut full threads.

4.4.5.4.2 Screws engaging threaded holes in plates shall have not fewer than two full threads engaging under any reasonably foreseeable condition of service.

4.4.5.5 Identification of terminals and leads

4.4.5.5.1 A permanently connected appliance rated 125 or 125/250 V – 3-wire – or less and employing a lampholder of the Edison-screw-shell type, or a single-pole switch or overcurrent-protective device other than an automatic control, shall have one terminal or lead identified for the connection of the grounded conductor of the supply circuit. The identified terminal or lead shall be the one that is electrically connected to a screw shell of a lampholder and to which no switch or overcurrent protective device of the single-pole type other than an automatic control without a marked OFF position is connected.

4.4.5.5.2 A terminal intended for the connection of a grounded power supply conductor shall be of, or plated with, metal that is substantially white in color and shall be readily distinguishable from the other terminals, or identification of that terminal shall be clearly shown in some other manner, such as on an attached wiring diagram. A lead intended for connection to a grounded power-supply conductor shall be finished to show a white or gray color and shall be readily distinguishable from the other leads.

4.4.5.5.3 The surface of an insulated lead intended solely for the connection of an equipment-grounding conductor shall be green with or without one or more yellow stripes, and no other lead shall be so identified.

4.4.5.5.4 A wire-binding screw intended for the connection of an equipment-grounding conductor shall have a green-colored head that is hexagonal, slotted, or both. A pressure wire connector intended for connection of such a conductor shall be plainly identified, such as by being marked "G", "GR", "Ground", or the like, or by a marking on a wiring diagram provided on the appliance. The wire-binding screw or pressure wire connector shall be located so that it is unlikely to be removed during normal servicing of the appliance.

4.5 Current-carrying parts

4.5.1 A current-carrying part shall be of silver, copper, a copper alloy, stainless steel or other similar metal acceptable for the application.

4.5.2 Ordinary iron or steel shall not be used as a current-carrying part.

Exception: Ordinary iron or steel provided with a corrosion-resistant coating may be used for a current-carrying part if acceptable in accordance with Clause 3.1.

4.6 Internal wiring and interconnecting cords

4.6.1 Mechanical protection

4.6.1.1 The wiring and connections between parts of an appliance shall be protected or enclosed. See Clause 4.6.1.3.

Exception: A length of flexible cord may be employed for external interconnections if flexibility is essential. See Clause 4.6.1.2.

4.6.1.2 Any exposed cord shall be of a type at least as serviceable as the power supply cord on the appliance unless located or protected so as to reduce the likelihood of mechanical damage.

4.6.1.3 For the purpose of these requirements, internal wiring of an appliance shall be considered to be all the interconnecting wiring beyond the point where the power-supply cord of a cord-connected appliance enters the enclosure, or beyond the wiring terminals or leads for power supply connection of a fixed appliance, even though some of the wiring may be flexible cord.

4.6.1.4 With reference to exposure of insulated wiring through an opening in the enclosure of an appliance, the protection of such wiring required by Clause 4.6.1.1 shall be considered to exist if, when determined as though it were film-coated wire, the wiring would comply with accessibility of live parts, Clause 4.1.4. Internal wiring not so protected shall be secured within the enclosure so that it is unlikely to be subjected to stress or mechanical damage.

4.6.1.5 If the wiring of an appliance is located so that it may be subjected to mechanical damage, it shall be in armored cable, rigid metal conduit, electrical metallic tubing, metal raceway, or otherwise protected.

4.6.1.6 Wires within an enclosure, compartment, raceway, or the like shall be disposed or protected so that no damage to insulation of a conductor can result from contact with any rough, sharp, or moving parts.

4.6.1.7 A flexible cord used for external interconnection as mentioned in the Exception to Clause 4.6.1.1, shall be provided with strain relief in accordance with Clause 4.4.3 unless the construction is such that the cord will be protected from stress or motion.

Exception: An external interconnecting cord located in a part of the enclosure that is capable of being opened or removed by the user without using a tool, such as a dust bag compartment, shall employ a strain-relief means that complies with the strain relief test, Clause 5.14, when subjected to a force of 20 lbs (89 N).

4.6.1.8 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of the appliance.

4.6.1.9 Internal wiring shall consist of conductors with a type of insulation rated for the particular application, when considered with respect to:

- a) temperature and voltage to which the wiring will be subjected;
- b) exposure to oil or grease; and
- c) other conditions of service to which it is liable to be subjected.

4.6.1.10 Wiring routed between the handle and the base of an upright-type vacuum cleaner that can be subjected to flexing or movement during normal operation of the appliance shall comply with Clause 5.18, wire flexing.

4.6.2 Polarization of connectors

4.6.2.1 If a device required to be connected to a specific supply conductor (see Clauses 4.9.7, 4.11.3, and 4.12.8) is employed in an externally interconnected part, such as a motorized nozzle, the connections shall employ terminal fittings that can only mate such that the required connection to the proper supply conductor is maintained.

4.6.3 Splices and connections

4.6.3.1 Splices and connections shall be mechanically secure and shall provide adequate and reliable electrical contact. Soldered connections shall be made mechanically secure before being soldered, if breaking or loosening of the connections can result in a risk of fire, electric shock, or injury to persons. Splices shall be provided with insulation equivalent to that of the wires involved if permanency of spacing between splices and other metal parts will in some cases not be maintained.

4.6.3.2 In an appliance in which excessive vibration is likely to occur, the requirement in Clause 4.6.3.1 will necessitate the use of lock-washers or other means to prevent wire-binding screws and nuts from becoming loosened.

4.6.3.3 Insulation consisting of two layers of friction tape, two layers of thermoplastic tape, or one layer of friction tape on top of one layer of rubber tape, is acceptable on a splice if the voltage involved is less than 250 V. In determining if splice insulation consisting of coated-fabric, thermoplastic or other type of tubing is acceptable, consideration shall be given to such factors as its dielectric properties, resistance to heat, resistance to moisture, and the like. Thermoplastic tape wrapped over a sharp edge shall not be used.

4.6.3.4 Where stranded internal wiring is connected to a wire-binding screw, loose strands of wire shall be positively prevented from contacting other uninsulated live parts that are not always of the same polarity as the wire and from contacting non-current carrying metal parts. This may be accomplished by use of pressure terminal connectors, soldering lugs, crimped eyelets, soldering all strands of the wire together, or other reliable means.

4.6.3.5 Aluminum conductors, insulated or uninsulated, used as internal wiring, such as for interconnection between current-carrying parts or as motor windings, shall be terminated at each end by a method acceptable for the combination of metals involved at the point of connection.

4.6.3.6 With reference to Clause 4.6.3.5, if a wire-binding screw construction or a pressure wire connector is used as a terminating device, it shall be rated for use with aluminum under the conditions involved, for example, temperature, heat-cycling, and vibration.

4.6.4 Separation of circuits

4.6.4.1 Conductors of circuits operating at different potentials shall be reliably separated from each other unless they are each provided with insulation rated for the highest potential involved.

4.6.4.2 An insulated conductor shall be reliably retained so that it cannot contact an uninsulated live part of a circuit operating at a different potential.

4.6.4.3 In a compartment that is intended for the field installation of conductors, and that contains provision for connection of extra-low voltage circuit conductors, and Class 1, power, or lighting circuit conductors, a barrier shall be provided to separate the conductors of the different circuits, or the arrangement of the compartment shall be such that a minimum spacing of 1/4 in (6.4 mm) can be maintained between the conductors of the different circuits including the conductors to be field installed.

4.7 Electrical insulation

4.7.1 Current-carrying parts shall be supported on heat-resistant and moisture absorption-resistant insulating materials such as porcelain or phenolic composition.

4.7.2 Polymeric material employed to support a live part, in direct contact with a live part, or within 1/32 in (0.8 mm) from a live part shall be rated for use at the operating temperature involved and shall have the following material properties, all determined in accordance with the standard for polymeric material properties, see Annex A:

- a) volume resistivity of at least $50 \times 10^6 \Omega\text{-cm}$;
- b) comparative tracking index (CTI) of at least 100 V (PLC 4 – see note (a) of Table 4); and
- c) a high current arc ignition (HAI) and hot-wire ignition (HWI) as specified in Table 4.

Exception No. 1: In lieu of volume resistivity, compliance with the end-product leakage-current requirements (Clause 5.3) is acceptable. Leakage current measurement shall be taken from accessible surfaces of the polymeric material in question. If the polymeric part in question is not accessible, the leakage current shall be measured in accordance with Clauses 5.3.3 and 5.3.4.

Exception No. 2: A material with a HAI property less than that required in Table 4 may be used when the spacing over the surface of the material is at least 1/2 in (12.7 mm) between:

- a) live parts of opposite polarity;*
- b) live parts and grounded noncurrent-carrying metal; and*
- c) live parts and exposed noncurrent-carrying metal.*

Exception No. 3: A material that does not comply with the requirements specified in Table 4 for HAI shall be evaluated using the power (current, voltage, and power factor) of the circuit in the end product by conducting a short-circuit test in accordance with end-product arc resistance, Clause 5.25.

Exception No. 4: Materials that do not comply with the minimum HWI requirements specified in Table 4 shall comply with the abnormal overload test, Clause 5.26.

Exception No. 5: Foamed thermoplastic material employed for sound reduction that is in direct contact with an uninsulated live part or is within 1/32 in (0.8 mm) of an uninsulated live part shall be rated HF-1 and is not required to be evaluated for CTI, HWI, and HAI.

4.7.3 Thermoplastic parts employed to support live parts shall be subjected to the mold stress-relief distortion test, Clause 5.21.3. As a result of the test, required spacings shall be maintained and the live parts shall remain reliably secured in place.

4.7.4 Fiber shall not be used as the sole support for uninsulated current-carrying parts if shrinkage, moisture absorption, or warping can introduce current leakage or a risk of electric shock, fire, or injury to persons. Untreated fiber shall not be used in contact with live parts where moisture absorption can result in a leakage current greater than that specified in Clauses 5.3 and 5.4.

4.7.5 Small molded parts such as brush caps shall be constructed so as to have adequate mechanical strength and rigidity to withstand the most severe stresses that they are liable to be subjected to in service. As an alternative, such parts may have additional mechanical protection. (See Clause 5.19.4.)

4.8 Motors

4.8.1 General

4.8.1.1 Motors shall be of a type suitable for the particular application. They shall be capable of carrying the normal load (see Clause 5.2) without exceeding the permissible temperatures when the appliance is tested in accordance with the temperature test, Clause 5.8.

4.8.1.2 A motor winding shall resist the absorption of moisture.

4.8.1.3 With reference to the requirement in Clause 4.8.1.2, film-coated wire is not required to be additionally treated to reduce the likelihood of absorption of moisture, but fiber slot liners, cloth coil wrap, and similar moisture-absorptive materials shall be provided with impregnation or otherwise treated to reduce the likelihood of moisture absorption.

4.8.1.4 A polymeric material employed in a Class 105 (A) insulation system that isolates the windings from dead metal parts shall be unfilled or glass-reinforced nylon, polycarbonate, polybutylene terephthalate, polyethylene terephthalate, phenolic or acetal, and shall have a relative or generic thermal index for electrical properties of 105°C (221°F) minimum. Leads shall be rated 90°C (194°F) minimum. Materials used in an insulation system that operates above Class 105 (A) temperatures shall comply with the Standard for Systems of Insulating Materials – General, UL 1446. Motors employing thermoplastic materials shall be subjected to the tests in thermoplastic motor insulation systems, Clause 5.24.

Exception No. 1: Other polymeric materials used in a Class 105 (A) insulation system shall comply with the requirements for thermal aging in Clause 5.24.4.

Exception No. 2: Slot liners of polyethylene terephthalate that are 0.007-in (0.18-mm) thick minimum are not required to be subjected to the tests in Clause 5.24.

4.8.2 Brushes and brush holders in commutator motors

4.8.2.1 A brush cap shall be recessed, enclosed, or otherwise protected from mechanical damage that might occur during normal use of the appliance unless the part performs acceptably in the impact test described in Clause 5.19.4.

4.8.2.2 A brush cap that is accessible to the user without the removal of a guard or enclosure shall be provided with a positive means that will prevent its disengagement from the brush holder assembly. Screw threads only on the brush cap are not considered a positive means.

4.8.2.3 A brush holder assembly shall be so constructed that when a brush is no longer capable of performing its function, the brush, spring, and other parts of the assembly will be retained to the degree necessary to prevent accessible noncurrent-carrying metal parts from becoming energized and to prevent live parts from becoming accessible.

4.8.3 Overload protection

4.8.3.1 A motor shall be provided with overload protection when it is:

- a) automatically or remotely controlled;
- b) permanently connected and manually started;
- c) in an unattended appliance;
- d) in a cord-connected, portable, shop-type vacuum cleaner provided with a receptacle as specified in the Exception to Clause 4.12.1; or
- e) in a coin-operated appliance.

4.8.3.2 A product as mentioned in Clause 4.8.3.1 shall have motor-overload protection as specified in (a) or (b):

- a) thermal protection complying with the applicable requirements in the standard for thermal protectors, see Annex A; or

Exception No. 1: The locked-rotor temperature test on a manually reset device shall be continued for four operations (that is three resets, four trips) of the protective device.

Exception No. 2: A motor intended to move air only, by means of an air-moving fan that is integrally attached, keyed, or otherwise fixed to the motor, is not required to have running-overload protection.

Exception No. 3: A shaded-pole motor with a 2:1 or smaller ratio between locked-rotor and no-load currents and a 1 A or smaller difference between no-load and locked-rotor current shall be considered to have acceptable overload protection if it is protected against locked-rotor conditions only.

- b) impedance protection complying with the applicable requirements in the standard for impedance-protected motors, see Annex A, when the motor is tested as used in the product under stalled-rotor conditions.

4.8.3.3 For a multispeed motor of any of the types mentioned in Clause 4.8.3.1 that employs a separate overload protective device to provide running-overload protection, the requirements in Clause 4.8.3.2 apply at all speeds at which the motor is intended to operate.

4.8.3.4 The motor of an appliance with load characteristics likely to result in an overload or stalled condition that will not be evident to the user shall incorporate thermal or overload protection in accordance with the requirements in Clause 4.8.3.2.

4.8.3.5 A thermal or overload protective device shall not open the circuit during the temperature test, Clause 5.8.

4.8.3.6 The functioning of a motor-protective device provided as part of an appliance, whether such device is required or not, shall not result in a risk of fire, electric shock, or injury to persons.

4.8.3.7 Fuses employed for motor-running overload protection shall be located in each ungrounded conductor.

4.8.3.8 Devices other than those that are inherent in a motor employed for motor-running overload protection shall be located in each ungrounded conductor.

4.9 Switches, relays, and similar controls

4.9.1 Switches, relays, and similar controls shall be suitable for their particular application, and shall have current and voltage ratings not less than those of the circuits controlled.

4.9.2 With reference to the requirement in Clause 4.9.1, the ampacity of a switch that controls an inductive load other than a motor, such as a transformer or an electric discharge-lamp ballast, shall not be less than twice the rated full-load current of the inductive load unless the switch has been investigated and found to be acceptable for the application.

4.9.3 A switch or other control shall be guarded or located so that it is not likely to be damaged during use of the appliance. A through-cord switch shall not be employed unless:

- a) it cannot contact the floor during use of the appliance; or
- b) it has been investigated for such abuse as may occur during use.

4.9.4 A switch that controls a medium-base lampholder of other than a pilot or indicating light shall have been investigated and found acceptable for use with tungsten-filament lamps, or shall have a direct-current rating at least ten times the maximum tungsten load that it controls or an alternating-current rating at least six times the maximum tungsten load that it controls.

4.9.5 A motor control switch shall be provided in a cord-connected appliance that employs a motor rated more than 1/3 hp (249 W output). The switch shall be in a readily accessible location.

4.9.6 A switch, relay, or similar control that controls a motor shall be subjected to the test in Clause 5.15.

4.9.7 A switch or an overcurrent-protective device of the single pole type shall be electrically connected to the ungrounded conductor of the supply circuit.

Exception No. 1: An automatic control without a marked OFF position need not be connected to the ungrounded conductor.

Exception No. 2: For an appliance with a main ON-OFF switch any subsequent switch that does not control the entire appliance need not be connected to the ungrounded conductor.

4.9.8 Flexible switch actuators

4.9.8.1 A switch or control that is actuated by a flexible thermoplastic material (such as used in a membrane-type switch) and that functions as a main ON-OFF switch, shall comply with Clause 5.15.3, in addition to complying with the other applicable switch requirements in Clause 4.9.

4.9.8.2 With respect to Clause 4.9.8.1, a membrane-type switch is considered to be a momentary switching device in which at least one contact is on, or made of, a flexible substrate.

4.10 Capacitors

4.10.1 A capacitor provided as part of a capacitor/motor combination, and a capacitor connected across-the-line, such as a capacitor for radio-interference elimination or power-factor correction, shall be housed within an enclosure or container so that mechanical damage to the plates is unlikely to occur and so that there will be no emission of flame or molten material resulting from breakdown or malfunction of the capacitor. The container shall be of metal providing strength not less than that of uncoated steel having a thickness of 0.020 in (0.51 mm).

Exception: The container of a capacitor may be made of sheet metal having a lesser thickness or may be of material other than metal, if the capacitor is mounted in an enclosure that houses other parts of the appliance, and if such box, case, or the like is acceptable for the enclosure of current-carrying parts as specified in Clause 4.1.1.

4.10.2 In an appliance that is intended to be automatically or remotely controlled, if a capacitor that is not a part of a capacitor/motor combination or a capacitor-start motor is connected so that capacitor breakdown or malfunction would result in a risk of fire, electric shock, or injury to persons, thermal or overcurrent protection shall be provided in the appliance.

4.10.3 If an appliance employs a combination consisting of a rectifier and an electrolytic capacitor, no risk of fire, electric shock, or injury to persons shall result if either the rectifier or the capacitor is short-circuited.

4.10.4 If an appliance is intended to be controlled by or operated in conjunction with a capacitor or a capacitor/transformer unit, such a capacitor or unit shall be supplied with the appliance. See Clause 10.3.4.

4.10.5 Under both normal and abnormal conditions of use, a capacitor employing a dielectric medium more combustible than askarel shall not result in risk of fire or electric shock, and shall be constructed to reduce the likelihood of expelling the dielectric medium.

4.10.6 A capacitor complying with the applicable requirements for protected oil-filled capacitors specified in the standard for capacitors (see Annex A) shall be considered to be constructed to reduce the likelihood of expelling the dielectric medium.

4.10.7 For a capacitor employing a liquid dielectric medium more combustible than askarel and provided with an expansion mechanism to reduce the likelihood of expelling the dielectric medium, the spacing from a terminal of the capacitor, including an assembled wire connector, to:

- a) an electrically isolated part or a part constructed of a nonconductive material shall be at least 1/2 in (12.7 mm); or
- b) an uninsulated live part of opposite polarity or an uninsulated noncurrent-carrying metal part that is either accessible or grounded shall not be less than the sum of the appropriate value from Table 5 and 1/2 in (12.7 mm).

4.11 Lampholders

4.11.1 Lampholders for extra-low-voltage lamps (that is, lamps rated at 30 V or less) shall not be tapped across parts of motor windings if the motor rating is more than 150 V.

4.11.2 Lampholders and lamps shall be adequately secured and protected from mechanical injury.

4.11.3 An Edison-base lampholder shall be wired so that the screw-shell will be electrically connected to the grounded conductor of the power-supply circuit.

4.12 Receptacles

4.12.1 A cord-connected, portable appliance shall not be provided with a general-use receptacle.

Exception: A cord-connected, portable, shop-type vacuum cleaner may be provided with a general-use receptacle that is specifically intended for connection of a portable tool that has provision for connection to a vacuum cleaner hose, if it complies with Clauses 4.12.2 – 4.12.8, and with the following:

- a) the vacuum cleaner shall have a provision for grounding in accordance with Clause 4.14;*
- b) the vacuum cleaner shall be provided with a minimum 3-position switch that controls the power to the receptacle, such that a tool plugged into the receptacle can only be energized with the switch in the auto position. The switch shall have marked on, off and auto positions. With the switch in the auto position, the vacuum cleaner shall not operate when the on/off switch of the tool is in the off position;*
- c) a polymeric material that encloses uninsulated live parts that are energized when the main switch is in the auto position and the tool is not operating shall comply with Clause 4.1.1.5 (c);*
- d) the vacuum cleaner shall be rated as specified in Clause 10.1.3, and the attachment plug cap shall be rated in accordance with Clause 4.4.1.4 for the load of the appliance including the maximum marked ampere rating of the receptacle;*
- e) the vacuum cleaner motor shall employ overload protection that complies with Clauses 4.8.3.2 – 4.8.3.8;*
- f) the vacuum cleaner shall be marked with the cautionary markings specified in Clause 10.4.18; and*

g) the normal load for tests as described in Clause 5.2 shall also include a representative tool plugged into the receptacle and energized.

4.12.2 A general-use receptacle shall be of the grounding type.

4.12.3 If an appliance includes one or more attachment-plug receptacles intended for general use, and if the overcurrent protection of the branch circuit to which the appliance will properly be connected exceeds that acceptable for the receptacle or receptacles, each receptacle circuit shall have suitable overcurrent protection provided as a part of the appliance.

4.12.4 A fuseholder provided in accordance with Clause 4.12.3 shall be of Type S construction or shall be of the Edison-base type with a factory-installed nonremovable Type S adaptor.

4.12.5 The face of a general-use receptacle shall:

- a) be flush with or project beyond a nonconductive surrounding surface; or
- b) project at least 0.015 in (0.38 mm) beyond a conductive surrounding surface.

4.12.6 Ground-fault circuit protection (Class A) shall be provided for general-use receptacles that are part of an appliance intended to be used outdoors.

4.12.7 An attachment-plug receptacle of an appliance intended for wet pick-up shall be located so that it is unlikely to be wetted.

4.12.8 A general-use receptacle for use on a nominal 120 V circuit shall have the grounded supply conductor connected to the terminal that is substantially white in color or otherwise marked to indicate that it is intended for connection to the grounded supply conductor.

4.13 Spacings

4.13.1 Except as permitted in Clauses 4.13.5 and 4.13.6, spacings shall not be less than those specified in Table 5 or Table 6. If uninsulated live parts are not rigidly supported by means other than friction or if movable noncurrent-carrying metal parts are in proximity to uninsulated live parts, the construction shall be such that the minimum spacings specified will be maintained under all conditions.

4.13.2 Spacings at wiring terminals to which supply connections are made in the field shall comply with Table 5:

- a) between uninsulated live parts of opposite polarity;
- b) between uninsulated live parts and noncurrent-carrying metal parts; and
- c) between line voltage parts and extra low voltage parts.

4.13.3 At a terminal screw and stud to which connection may be made in the field by means of a wire connector, an eyelet, or the like, it is required that the spacings be not less than those specified in Table 5 when such connector, eyelet, or the like is in such position that minimum spacings – between opposite polarity and to noncurrent-carrying metal – exist.

4.13.4 Spacings shall comply with Table 6 at points other than as specified in Clause 4.13.2 or 4.13.3 that are:

- a) between uninsulated live parts of opposite polarity;
- b) between uninsulated live parts and noncurrent-carrying metal parts including the enclosure; and
- c) between line voltage parts and extra low voltage parts.

4.13.5 The spacings within motors, snap switches, lampholders, or other devices supplied as part of the equipment shall comply with the requirements of the standard for that component. See Clause 3.1.

Exception: The spacings within a motor complying with Table 6 need not comply with the component spacings requirements in the Standard for Motors and Generators, CSA C22.2 No. 100.

4.13.6 An insulating barrier or liner may be used to obtain the required spacings if it is:

- a) of adequate dielectric strength and resistance to moisture;
- b) not adversely affected by arcing and suitable for the temperatures encountered;
- c) of adequate mechanical strength and permanently retained in place by means other than adhesives, unless evaluated per Clause 4.1.3.1; and
- d) not less than 1/32-in (0.8-mm) thick if vulcanized fiber, except that it may be not less than 1/64-in (0.4-mm) thick if used in conjunction with a through-air spacing not less than one-half of that required.

4.13.7 Spacings are not specified for the following types of circuits:

- a) an extra low voltage circuit – see Clause 2;
- b) between traces on a printed wiring board in circuits that:
 - 1) are located on a part of a printed wiring board provided with conformal coating that complies with the requirements for such coatings (see Annex A); or
 - 2) are connected to the load side of a resistor such that a short circuit from that point to the other side of the supply does not result in the wattage rating of the resistor being exceeded.

4.13.8 All uninsulated live parts connected to different line- or extra low-voltage circuits shall be spaced from one another as though they were parts of opposite polarity, in accordance with the requirements in Clause 4.13.2 and shall be judged on the basis of the highest voltage involved.

4.13.9 In applying Table 6 to an appliance incorporating two or more motors of different sizes, the spacings in the appliance are judged on the basis of the size of the largest motor in the appliance.

4.13.10 In applying Table 6 to a motor not rated in horsepower, use shall be made of the appropriate table of the Electrical Code (see Clause 1) that gives the relationships between horsepower and full-load currents for motors. For a universal motor, the table applying to a single-phase, alternating-current motor shall be used if the appliance is marked for use on alternating current only; otherwise, the table applying to direct-current motors shall be used.

4.13.11 Spacings to polymeric enclosures

4.13.11.1 The spacings between the polymeric enclosure and:

a) a nonarcing uninsulated live part (a bus bar, a connecting strap, a terminal, or the like) shall be no less than 1/32 in (0.8 mm). If less than a 1/32 in (0.8 mm) spacing is provided, the enclosure material shall comply with the requirements for support of live parts described in Clause 4.7.2, unless an acceptable insulating barrier is employed; or

b) an arcing part (at a commutator, unenclosed switch contacts, and the like) shall not be less than 1/2 in (12.7 mm) except as indicated in Clause 4.13.11.3.

4.13.11.2 The spacing mentioned in Clause 4.13.11.1(b) shall be measured from the source of the arc – that is, from the interface of the brush and the commutator or from the interface of the switch contacts, and the like.

4.13.11.3 The spacing mentioned in Clause 4.13.11.1(b) may be less than 1/2 in (12.7 mm) but not less than 1/32 in (0.8 mm) if the material has a minimum high-current arc ignition (HAI) as noted in Table 4. If the spacing is less than 1/32 in (0.8 mm), the material shall comply with all of the requirements for support of live parts described in Clause 4.7.2.

4.14 Grounding and bonding

4.14.1 An appliance of one or more of the following types shall have provision for grounding:

a) an appliance intended to be used on a circuit operating at more than 150 V to ground – see Clause 4.14.2;

b) a central vacuum cleaner;

c) a commercial vacuum cleaner or blower cleaner;

d) a household shop-type vacuum cleaner or blower cleaner;

e) a wet pick-up vacuum cleaner;

f) a household use floor finishing machine; or

g) a cord-connected, portable, shop-type vacuum cleaner provided with a general-use receptacle for use with a portable tool as specified in the Exception to Clause 4.12.1.

h) an electrified wall valve assembly (see Clause 8.2.6).

Exception: A cord-connected appliance, other than as described in (g), provided with a system of double insulation as specified in double insulation, Clause 6, is not required to have provision for grounding.

4.14.2 With reference to Clause 4.14.1, a 2-wire appliance intended to operate at a nominal potential of 240 V and any other potential greater than 150 V, shall be provided with means for grounding in accordance with Clauses 4.14.4 and 4.14.5 unless the marked rating on the appliance is 120/240 V or the appliance is otherwise marked to indicate that it is to be connected to a circuit operating at 150 V or less to ground.

4.14.3 If a grounding means is provided, whether required or not, it shall be in accordance with Clause 4.14.4 and if the appliance is cord connected it shall comply with the requirements in Clause 4.14.5. All exposed noncurrent-carrying metal parts and all noncurrent-carrying metal parts within the enclosure that are exposed to contact during any user servicing operation and are likely to become energized shall be reliably connected to the means for grounding. Hinged or pivoting joints are not considered acceptable for bonding unless they are provided with an additional conductive connection, such as a bonding jumper.

4.14.4 The following are considered acceptable means for grounding:

- a) in an appliance intended to be permanently connected by a metal-enclosed wiring system – a knockout or equivalent opening in the metal enclosure of the appliance. See Clause 4.4.5.1.1;
- b) in an appliance intended to be permanently connected by a nonmetal-enclosed wiring system, for example, nonmetallic sheathed cable – an equipment-grounding terminal or lead, see Clauses 4.4.5.2.2 and 4.4.5.2.4; and
- c) in a cord-connected appliance – an equipment-grounding conductor in the cord.

4.14.5 The grounding conductor of a flexible cord shall be green with or without one or more yellow stripes. The grounding conductor shall be secured to the frame or enclosure of the appliance by means of a screw that is not likely to be removed during any servicing operation not involving the power-supply cord, or by other equivalent means. A quick-connect terminal with a detent as a means for latching mating parts and a current-carrying capacity at least equivalent to that of the current-carrying conductors of the flexible cord is considered to be equivalent means. Solder alone shall not be used for securing the grounding conductor. The grounding conductor shall be connected to the fixed member of a grounding-type attachment plug, except that the grounding member of the plug on a portable hand-guided or supported appliance may be of the movable, self-restoring type. Servicing as mentioned in this Clause includes repair of the appliance by a qualified service person.

4.14.6 A separable connecting device provided with a grounding connection shall be such that the equipment-grounding connection is made before connection to and broken after disconnection from the supply circuit.

Exception: Interlocked plugs, receptacles, and connectors that are not energized when the equipment-grounding connection is made.

4.14.7 If an appliance is intended to be grounded and is provided with means for separate connection to more than one power supply, each such connection shall be provided with a means for grounding.

4.14.8 An appliance marked as being provided with double insulation shall not be provided with a means for grounding.

4.14.9 A double-insulated motorized nozzle may be employed with a vacuum cleaner having a means for grounding provided the nozzle is marked in accordance with item 8 of Table 17.

4.15 Protective devices

4.15.1 The screw shell of a plug type fuseholder and the cap end of an extractor post type fuseholder shall be connected toward the load.

4.15.2 A protective device, such as a fuse, the normal function of which requires renewal or replacement, shall be in a readily accessible location, other than as noted in Clause 4.15.4.

4.15.3 A protective device shall be wholly inaccessible from outside the appliance without opening a door or cover.

Exception: The operating handle of a circuit breaker, the operating button of a manually operable motor protector, and similar parts may project outside the appliance enclosure.

4.15.4 The protective device mentioned in Clause 4.15.2 need not be in a readily accessible location if:

- a) the appliance, with the protective device shunted out of the circuit, would comply with all applicable requirements in this standard; and
- b) the presence of the protective device would ordinarily be unknown to the user of the appliance because of its location and the omission of reference to the device in the operating instructions, circuit diagram, and the like for the appliance.

4.16 Protection against injury to persons

4.16.1 General

4.16.1.1 If the operation and maintenance of an appliance by the user involves a risk of injury to persons, protection shall be provided to reduce the risk.

4.16.1.2 When judging an appliance with respect to the requirement in Clause 4.16.1.1, consideration shall be given to reasonably foreseeable misuse of the appliance.

4.16.1.3 The adequacy of a guard, a release, an interlock, and the like, and whether such a device is required, shall be determined from an investigation of the complete appliance, its operating characteristics, and the likelihood of a risk of injury to persons resulting from a cause other than gross negligence. The investigation shall include consideration of the results of breakdown or malfunction of any one component, but not more than one component at a time, unless one event contributes to another. If the investigation shows that breakdown or malfunction of a particular component can result in a risk of injury to persons, that component shall be investigated for reliability.

4.16.1.4 Specific constructions, tests, markings, guards, and the like are detailed for some common designs. Specific features and appliances not covered shall be given appropriate consideration. See marking, Clause 10.

4.16.2 Sharp edges

4.16.2.1 An enclosure, a frame, a guard, a handle, or the like shall not be sufficiently sharp to constitute a risk of injury to persons during normal maintenance and use.

4.16.3 Enclosures and guards

4.16.3.1 The rotor of a motor, a pulley, a belt, a gear, a fan, or other moving part that could cause injury to persons shall be enclosed or provided with other means to reduce the likelihood of unintentional contact. An opening in an enclosure or guard shall comply with either (a) or (b).

- a) For an opening that has a minor dimension less than 1.375 in (34.9 mm), such a moving part shall not be contacted by the probe illustrated in Figure 2. See Clause 4.1.4.5 and Annex C.
- b) For an opening that has a minor dimension of 1.375 in (34.9 mm) or more, such a moving part shall not be contacted by the probe illustrated in Figures 25 and 26. See Clause 4.1.4.5 and Annex C.

Exception No. 1: A moving part or portion of a moving part that is necessarily exposed to perform the work function need not be enclosed but, when necessary, guarding shall be provided.

Exception No. 2: An opening in the integral enclosure of a motor employed in an appliance intended for commercial use, that is not used in either a hand-held appliance or a hand-supported portion of an appliance, is acceptable if a moving part cannot be contacted by the probe illustrated in Figure 4.

4.16.3.2 During the examination of an appliance to determine whether it complies with the requirements in Clause 4.16.3.1, a part of the enclosure that can be removed without the use of a tool (to attach an accessory, to make an operating adjustment, or for other reasons) shall be opened or removed.

Exception: A part need not be opened or removed if it is marked in accordance with Clause 10.4.13.

4.16.3.3 During the examination of a central vacuum cleaner or a dust extraction system to determine whether the appliance complies with the requirements in Clause 4.16.3.1, all the attachments and fittings recommended in the installation manual shall be installed as intended. For a central vacuum marked in accordance with Clause 10.3.12, the exhaust piping shall also be in place during this examination.

4.16.3.4 With respect to both intended operation of the appliance and reasonably foreseeable misuse, a moving part that may involve a risk of injury to persons shall be considered with respect to:

- a) the degree of exposure necessary to perform the intended function;
- b) the sharpness of the moving part;
- c) the likelihood of unintentional contact;
- d) the speed of the moving part; and

e) the likelihood that a part of the body would be endangered or clothing would become entangled by the moving part.

4.16.3.5 An enclosure or guard over a moving part shall retain:

a) a part that, because of breakage or other reasons, can become loose or can separate from the moving part; and

b) a foreign object that can be struck and propelled by the part.

4.16.4 Surface temperatures

4.16.4.1 During the temperature test, Clause 5.8, the temperature of a surface that can be contacted by the user shall not be more than the value specified in Table 7. If the test is conducted at a room temperature of other than 25°C (77°F), the results shall be corrected to that temperature.

4.16.5 Stability

4.16.5.1 A portable appliance of the water-containing type or the wet pick-up type shall be tested as described in stability, Clause 5.13, and shall not overturn.

Exception: An upright-type appliance that is hand guided while in use is not required to be tested. An upright-type appliance provided with facilities for non-hand guided operation, such as a hose, shall be tested with the appliance arranged for such non-hand guided operation.

4.16.6 Strength of handles

4.16.6.1 A handle used to carry an appliance shall withstand a force of four times the empty weight of the appliance without damage to the handle, its securing means or that portion of the enclosure to which the handle is attached. See strength of handles, Clause 5.20.

4.16.7 Interlocks, switches, and controls

4.16.7.1 An appliance shall be constructed so as to reduce the likelihood of unexpected operation of any parts capable of causing injury to persons.

4.16.7.2 Each function of a multiple-function appliance shall be taken into consideration in determining whether the appliance complies with the requirement in Clause 4.16.7.1.

4.16.7.3 If unintentional operation of a switch can result in a risk of injury to persons, the actuator of the switch shall be located or guarded so that such operation is unlikely.

4.16.7.4 With reference to Clause 4.16.7.3, a switch shall be considered to be located or guarded so that unintentional operation is unlikely if it is:

a) mounted in an upright vacuum cleaner or motorized nozzle (including the hose or wand) and the switch is not actuated when the appliance is placed on both flat carpeted and noncarpeted surfaces in any position in which the rotating brush is accessible for maintenance. During this examination, the appliance may be moved around on, but is not to be lifted from, the surface. The carpeting shall be as described in Clause 5.2.1.2; or

b) located on a canister vacuum cleaner that controls the motorized nozzle.

4.16.7.5 The actuator of a switch may be guarded by recessing, ribs, barriers, or the like.

4.16.7.6 Automatic-reset types of protective devices shall not be used in appliances if the automatic restarting of the appliance could result in any risk of fire, electric shock, or injury to persons.

4.16.7.7 The requirement in Clause 4.16.7.6 necessitates the use of an interlock in an appliance if moving parts or the like are likely to present a risk of injury to persons upon automatic starting of the appliance.

4.16.7.8 The actuator of an interlock shall be located so that unintentional operation is unlikely.

4.16.7.9 Operation of an interlock during use shall not inconvenience the operator so as to encourage deliberate defeat of the interlock.

4.16.7.10 An interlock shall not be likely to be defeated by materials that could accumulate during use of the appliance.

4.16.7.11 An interlock shall be such that it can only be defeated by:

- a) damaging the appliance;
- b) making wiring connections or alterations; or
- c) using materials that are not readily available.

4.16.7.12 If an interlock is actuated by movement of a guard, the arrangement shall be such that the guard is in place when the interlock is in the position that permits operation of the parts being guarded. With the guard removed, the interlock shall comply with the requirement in Clause 4.16.7.8.

4.16.8 Blower Cleaner Impellers

4.16.8.1 The impeller of a blower cleaner shall have the necessary strength and rigidity to resist the abuses likely to be encountered during normal service.

4.16.8.2 The blower cleaner shall be tested as described in blower cleaner impeller tests, Clause 5.27, without parts of the impeller being ejected from the blower, without cracks or other damage to the impeller that are visible to the naked eye upon inspection, and without the occurrence of any other condition that would increase the risk of injury to persons resulting from operation of the blower.

4.16.8.3 The visual inspection described in Clause 4.16.8.2 indicates a visual inspection conducted without using a device to magnify the area in question, by a person with normal vision (1x vision) or corrected to normal vision.

5 Tests

5.1 General

5.1.1 The appliance shall be subjected to the applicable tests for the type of appliance and its application.

5.1.2 Unless otherwise specified, the test voltage shall be as specified in Table 8 and maintained at that voltage throughout the test.

5.1.3 An appliance rated ac/dc or dc-60 Hz shall be tested on direct current or 60 Hz alternating current, whichever results in the most unfavorable operating conditions for the particular test.

5.2 Normal loads

5.2.1 General

5.2.1.1 Normal load shall be considered to be that load which approximates as closely as possible the most severe conditions of normal use but is not a deliberate overload. A multifunction appliance shall be tested individually for each applicable normal load.

5.2.1.2 The carpet employed for tests shall be level-looped, woven-through-the-back type, having a 216 pitch, eight wires per 1 in (25.4 mm), 1/4-in (6.4-mm) high three-ply wool yarn fiber pile. The carpet shall have a finished weight of 74.7 oz/yd² (253 g/m²), consisting of a face weighing 43.9 oz/yd² (149 g/m²), and backed by a synthetic and jute material weighing 15.4 oz/yd² (52 g/m²). A carpet that provides equivalent performance characteristics for the test being conducted may be used in place of this test carpet. The carpet shall be installed over 60–68 oz/yd² (2.0 – 2.3 kg/m²) sponge rubber padding.

5.2.1.3 For the tests, the appliance shall be operated continuously with a clean dust bag or filter, if provided, in place. For each condition, the appliance shall be operated until constant temperatures are attained.

5.2.2 Portable vacuum cleaners

5.2.2.1 The vacuum cleaner shall be operated with the air intake closed off sufficiently to maintain a mean wattage input to the appliance. For upright type vacuum cleaners provided with an integral port for connection of above floor cleaning tools, this attachment port shall be used for this test condition. See Clause 5.2.2.2.

5.2.2.2 Mean wattage input is the mathematical average of the wattage input noted with the air intake wide open and with the air intake completely blocked. All inputs shall be noted on a thoroughly heated appliance with any detachable hose removed. The wattage input for the intake sealed condition shall be noted 15 – 20 s after the intake has been completely closed off. The method of closing shall not impose a mechanical load on the movement of a brush, if provided. If an appliance employs a mechanical valve that operates under the blocked inlet condition, the valve shall be prevented from functioning.

5.2.2.3 A vacuum cleaner intended for use with a motorized nozzle shall be additionally operated while connected to a motorized nozzle that is operated as described in Clause 5.2.4.1.

5.2.2.4 A vacuum cleaner employing a motor driven brush (or similar device) shall be additionally operated on the test carpet described in Clause 5.2.1.2. During operation, the product shall be moved forward and backward on the carpet simulating normal use. If a carpet height adjustment is provided, it shall be adjusted in accordance with the instructions provided with the product to the lowest position for the test carpet.

5.2.2.5 A vacuum cleaner that has provision to be operated as a blower shall be additionally operated as specified in Clause 5.2.5.

5.2.2.6 A dust collector shall be operated with the air intake completely opened. When the product employs a flow-thru type motor, where ventilating air is dependent on the working air flow, the product shall be additionally tested in accordance with Clause 5.2.2.1.

5.2.3 Central vacuum cleaners

5.2.3.1 A central vacuum cleaner shall be mounted in the intended manner in a 3/8-in (9.5-mm) thick, black-painted plywood corner alcove consisting of a floor, a 90° wall angle formed by two vertical plywood sheets, and an 8-ft (2.44-m) high ceiling with all surfaces of the alcove extending not less than 2 ft (0.61 m) beyond the physical limits of the appliance. The appliance shall be located as close to the walls and to the floor or ceiling as its construction will allow unless marked in accordance with Clauses 10.3.10, 10.3.11 or 10.3.12, as applicable. Other than as noted in Clause 5.2.3.2, the exhaust opening shall be pointed in the direction that results in maximum temperatures on the appliance. The inlet of the central vacuum cleaner shall be piped 9 ± 3 in (22.9 ± 7.6 cm) beyond the alcove. The appliance shall be operated with the air intake blocked off sufficiently to maintain a mean wattage input to the appliance. See Clause 5.2.2.2.

5.2.3.2 If a central vacuum cleaner is provided with a means for connecting an outdoor exhaust and is marked in accordance with Clause 10.3.12, the exhaust piping shall be in place during the test described in Clause 5.2.3.1.

5.2.4 Motorized nozzles

5.2.4.1 A motorized nozzle, with a vacuum cleaner attached, shall be operated continuously until constant temperatures are reached. While operating, the nozzle shall be moved forward and backward, simulating normal use over a carpet as described in Clause 5.2.1.2. If the motorized nozzle has a carpet-height adjustment, it shall be adjusted in accordance with the manufacturer's instructions to the lowest position for the test carpet.

5.2.5 Blower cleaners

5.2.5.1 A blower cleaner and a vacuum cleaner that has provision to also operate as a blower shall be operated with the air intake and exhaust completely open and without a hose, fitting, or blower tube connected, unless such hose, fitting, or tube is required to activate the blower operation. For an appliance, where the cooling air is dependent on the working air flow, the appliance shall be additionally operated with the tube or accessory attached to result in the maximum air restriction. Operation shall continue until constant temperatures are attained for each condition.

5.2.5.2 A blower cleaner provided with a connector base (motor-attachment plug cap) or a power-supply cord 18-in (457-mm) long or less shall be connected to the source of supply using a 25-ft (7.62-m) long cord set. The cord set shall be the minimum gauge size for use with the product's rating.

5.2.6 Household floor finishing machines

5.2.6.1 Each household floor finishing machine shall be tested on a previously polished composition-tile surface in the operation for which it is intended that produces maximum intended load for 1 h of continuous operation, or until constant temperatures are attained, whichever is less.

5.3 Leakage current

5.3.1 The leakage current of a single-phase cord-connected appliance when tested in accordance with Clauses 5.3.3 – 5.3.6 shall not be more than:

- a) 0.5 MIU for an ungrounded, 2-wire, portable appliance;
- b) 0.5 MIU for a grounded, 3-wire, portable appliance;
- c) 0.75 MIU for a grounded, 3-wire, stationary appliance employing a standard attachment plug rated 20 A or less; or
- d) that specified in Clause 6.12 for an appliance marked to indicate that it employs double insulation. See Clause 10.3.8.

5.3.2 Leakage current refers to all currents, including capacitively coupled currents, that can be conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of an appliance.

5.3.3 All exposed conductive surfaces shall be tested for leakage currents. The leakage currents from these surfaces shall be measured to the grounded supply conductor individually as well as collectively where simultaneously accessible and from one surface to another where simultaneously accessible. Parts shall be considered to be exposed surfaces unless guarded by an enclosure considered acceptable to reduce a risk of electric shock. Surfaces shall be considered to be simultaneously accessible when they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at extra low voltages that are not considered to involve a risk of electric shock.

5.3.4 If a surface other than metal is used for the enclosure or part of the enclosure, the leakage current shall be measured using a metal foil with an area of 3.9 by 7.8 in (10 by 20 cm) in contact with the surface. Where the surface is less than 3.9 by 7.8 in (10 by 20 cm), the metal foil shall be the same size as the surface. The metal foil shall not remain in place long enough to affect the temperature of the appliance.

5.3.5 The measurement instrument shall be as described in the Standard for Leakage Current for Appliances, UL 101, and if applicable, shall be set to reaction mode. The measurement circuit shall be as illustrated in Figure 6.

5.3.6 The sample shall be at room temperature at the start of the test. It shall be energized and operated under conditions of normal load described in Clause 5.2 until thermal stabilization is obtained. Before, during and after this operation, the leakage current shall be monitored. Appliances with controls for speed, temperature, and the like shall be tested with such controls in all of their various operating positions. For the test, the leakage current shall be noted using both positions of switch S2 and with switch S1 both open and closed.

5.3.7 The grounding conductor of cord-connected equipment shall not be connected to ground except through the test meter.

5.3.8 For an appliance employing discharge-path resistors as described in Clause 4.1.4.7, the resistors shall be shorted one at a time during the test.

5.4 Leakage current following humidity conditioning

5.4.1 A cord connected appliance shall comply with the requirements for leakage current, Clause 5.3, following conditioning for 48 h in moist air having a relative humidity of $88 \pm 2\%$ at a room temperature of $32.0 \pm 2.0^\circ\text{C}$ ($89.6 \pm 3.6^\circ\text{F}$):

- a) the appliance shall be at a temperature just above the test chamber temperature when it is placed in the humidity chamber;
- b) the appliance shall remain in the humidity chamber for 48 h;
- c) following this exposure, while still in the test chamber, the sample shall be tested unenergized (that is, switch S1, open);
- d) the sample shall then be tested energized, except that the test may be discontinued when the leakage current has stabilized or decreased.

5.4.2 This test may be conducted in the humidity chamber or immediately after the sample has been removed from the humidity chamber.

5.4.3 For an appliance employing discharge-path resistors as described in Clause 4.1.4.7, the resistors shall be shorted one at a time during the test.

5.5 Leakage current – abnormal operating conditions

5.5.1 During and after operation as described in Clauses 5.5.2 – 5.5.4, the leakage current of a portable, cord connected, vacuum cleaner or motorized nozzle shall not exceed 5.0 MIU.

5.5.2 For each applicable operating condition in Clauses 5.5.3 and 5.5.4, each sample of the appliance shall be tested for leakage current starting with the as-received condition. Following this, each sample shall be subjected to each applicable operating condition as described in Clauses 5.5.3 and 5.5.4 while being monitored continuously for leakage current. The power to the appliance shall be controlled by a remote switching device. The leakage current shall be evaluated using the method described in Clauses 5.3.3 – 5.3.7.

5.5.3 Three samples of an appliance shall be subjected to the applicable operating condition in (a) or (b):

- a) for an appliance having a rotating agitator, operation for 30 s with the agitator locked in place; or
- b) for an appliance having a dirty-air-fan system, operation for 30 s with the dirty-air-fan locked in place.

5.5.4 One sample of an appliance shall be operated for 1 min with the intake port on the body of the appliance completely sealed off – the port shall be sealed so as not to impede the movement of a brush or otherwise impose a mechanical friction load on the appliance.

5.5.5 For an appliance employing discharge-path resistors as described in Clause 4.1.4.7, the resistors shall be shorted one at a time during the test.

5.6 Starting current

5.6.1 An appliance shall start and operate normally on a circuit protected by an ordinary – not time-delay – fuse having a current rating corresponding to that of the branch circuit to which the appliance should be connected. During the test in Clause 5.6.2, the fuse shall not open or an overload protector provided as part of the appliance shall not trip.

Exception: A time-delay fuse may be used, as provided in Clause 5.6.3.

5.6.2 To determine whether an appliance complies with the requirement in Clause 5.6.1, the appliance shall be started three times, with the appliance at room temperature at the beginning of the test. Each start of the motor shall be made under conditions representing the beginning of normal operation – the beginning of the normal operating cycle, in the case of an automatic appliance – and the motor shall be allowed to come to rest between successive starts.

5.6.3 For the test in Clause 5.6.2, a time-delay fuse may be employed if all of the following are met:

- a) the construction of the appliance or the nature of its usage is such that it is likely to be used continually on the same branch circuit after installation;
- b) the appliance will start and operate normally on a circuit protected by a time-delay fuse; and
- c) the appliance is marked in accordance with Clause 10.3.5.

5.7 Rating

5.7.1 The input current in amperes (and watts, if so marked) to the appliance shall not vary from the marked current (and wattage) rating by more than plus 10% and minus 15% when the equipment is operated under normal load conditions, as described in Clause 5.2.

Exception: See Clause 5.7.3.

5.7.2 For a multifunction appliance, such as a vacuum-cleaner/motorized-nozzle combination, vacuum cleaner-blower, or the like, the input shall be based on the highest load when tested under all applicable conditions of normal load as described in Clause 5.2. See Clause 10.1.3.

5.7.3 Single-phase equipment having a rating not exceeding 3 A (and 250 W, if so marked) shall not exceed the marked amperes (and watts) input by more than 20%.

5.8 Temperature

5.8.1 An appliance shall be tested under the applicable conditions of normal load as described in Clause 5.2, and shall not attain a temperature at any point sufficiently high to constitute a risk of fire, to damage any materials employed in the appliance, or to exceed the temperature rises specified in Table 9.

5.8.2 All values for temperature rises in Table 9 are based on an assumed ambient temperature of 25°C (77°F). Tests may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

5.8.3 If an appliance incorporates a reel for the power-supply cord, one-third of the length of the cord shall be unreeled for the temperature test.

5.8.4 If an appliance is obviously not intended for continuous operation, the temperature test may be conducted so that it will take into consideration the probable intermittent or short-time operation of the appliance.

5.8.5 Thermal equilibrium or constant temperature shall be considered to exist when three successive readings, taken at intervals of 10% of the previously elapsed duration of the test, but not less than 5-min intervals, indicate no increase.

5.8.6 Coil or winding temperatures shall be measured by thermocouples or by using the change-of-resistance method. For a thermocouple-measured temperature of a coil of an alternate-current motor having a diameter of 7 in (178 mm) or less and a universal motor, the thermocouple shall be mounted on the integrally applied insulation on the conductor. For any other motor, the thermocouple may be applied on the outer surface as a wrap that is not more than 1/32-in (0.8-mm) thick and consists of cotton, paper, rayon, or the like – but not of asbestos or similar thermal insulation.

5.8.7 Thermocouples shall consist of wires not larger than 24 AWG (0.21 mm²) and not smaller than 30 AWG (0.05 mm²). When thermocouples are used in determining temperatures in electrical equipment, it is common practice to employ thermocouples consisting of 30 AWG (0.05 mm²) iron and constantan wire and a potentiometer-type instrument; and such equipment shall be used whenever referee temperature measurements by thermocouples are necessary. The thermocouple wire shall conform with the requirements specified in the Initial Calibration Tolerances for Thermocouples table in Temperature Measurement Thermocouples, ANSI/ISA MC96.1.

5.8.8 In using the resistance method, the windings shall be at room temperature at the start of the test. The temperature rise of a winding shall be calculated from the formula:

$$\Delta t = \frac{R}{r} (k + t_1) - (k + t_2)$$

in which:

Δt is the temperature rise in °C;

R is the resistance of the coil at the end of the test in ohms;

r is the resistance of the coil at the beginning of the test in ohms;

t₁ is the temperature in °C of the coil at the time resistance "r" is being measured;

t₂ is the room temperature at the end of the test in °C; and

k is 234.5 for copper, 225.0 for electrical conductor grade (EC) aluminum. Values of the constant k for other grades must be determined.

5.9 Severe operating conditions

5.9.1 Extreme operating voltage

5.9.1.1 The appliance shall be operated under conditions of normal load, as described in Clause 5.2, while connected to the extreme operating voltages (high and low) specified in Table 10. During the test, temperatures shall be monitored on the motor. As a result of this operation, temperatures on motor insulation shall not exceed those specified in Table 9 plus an additional 20°C (36°F) rise.

5.9.2 Central vacuum cleaners – blocked and open inlet

5.9.2.1 A central vacuum cleaner shall be operated as described in Clause 5.9.2.2. The temperature of the windings of a Class A (105°C) insulated motor shall not exceed 140°C (284°F) and of a Class B (130°C) insulated motor shall not exceed 165°C (329°F).

5.9.2.2 To determine whether a central vacuum cleaner complies with the requirement in Clause 5.9.2.1, it shall be installed and operated as described in Clause 5.2.3.1, except that the air intake shall be firstly, completely closed off and, secondly, completely open.

5.10 Abnormal operation

5.10.1 General

5.10.1.1 Equipment shall not cause a risk of fire or electric shock when operating under the abnormal conditions specified in Clauses 5.10.2 and 5.10.3.

5.10.1.2 Operation under the abnormal conditions specified in Clauses 5.10.2.1 and 5.10.3.1 shall not result in a risk of fire or electric shock. A risk of fire or electric shock shall be considered to exist if the test results in any of the following:

- a) ignition of the cheesecloth or the tissue paper;
- b) the 3 A fuse connected to earth ground opens;
- c) any opening is developed in the overall enclosure that is larger than those permitted by accessibility requirements as covered by accessibility to live parts, Clause 4.1.4; or
- d) the appliance does not comply with the dielectric voltage-withstand test, Clause 5.11.

5.10.1.3 Following the abnormal condition specified in Clauses 5.10.2 and 5.10.3, the sample shall be subjected to the applicable dielectric voltage-withstand test, Clause 5.11.

5.10.1.4 For the abnormal operation tests specified in Clauses 5.10.2 and 5.10.3, the appliance shall be connected to a supply circuit protected by a 30-A time-delay fuse marked Type D. It shall be placed on a white tissue paper covered softwood surface. A single layer of cheesecloth shall be draped loosely over the entire product. Exposed noncurrent-carrying metal parts shall be connected to earth ground through a 3-A nontime delay type fuse. The supply circuit connection shall be such that the maximum potential exists between the protective device of the product, if any, and the chassis.

5.10.2 Electronic components

5.10.2.1 A single malfunction (short or open) of any circuit component, such as a resistor, capacitor, solid state device, and the like, shall not result in a risk of fire or electric shock or increased risk of personal injury. For a discrete, multiple (more than two) terminal device, such as a transistor, SCR, triac, or an integrated circuit device, any combination of terminals taken two at a time shall be open- or short-circuited.

Exception: Abnormal operation testing of multiple terminal circuit devices may be reduced if it can be determined by circuit analysis that an open- or short-circuit of the terminal(s) is not likely to result in a risk of fire, electric shock, or injury to persons.

5.10.2.2 The dielectric voltage-withstand test described in Clause 5.11 need be conducted only after the last abnormal operation test unless it is necessary to replace components after conducting the other tests.

5.10.3 Shorted electrical contact test

5.10.3.1 To determine compliance with Clause 5.10.1, the electrical contacts located on the underside of an electrical attachment shall be short-circuited, and then connected to the appliance as intended, before the appliance is energized. After the short-circuit is made, the appliance shall be energized.

5.11 Dielectric voltage-withstand test

5.11.1 An appliance shall withstand for 1 min without breakdown the application of a 60-Hz essentially sinusoidal potential between live parts and dead metal parts – or between live parts of opposite polarity for a test on a capacitor as mentioned in (c) – with the appliance at the maximum operating temperature reached during intended use. Other than as noted in Clause 5.11.3, the test potential shall be:

- a) one thousand volts for an appliance employing a motor rated 1/2 hp (373 W output) or less;
- b) one thousand volts plus twice the rated voltage for an appliance employing a motor rated more than 1/2 hp, or except as noted in (d), an appliance applied directly to persons or supported by the body of a person;
- c) one thousand volts, or 1000 V plus twice rated voltage – depending upon the value of the test potential applied to the appliance as a whole – between the terminals of a capacitor used for radio-interference elimination or arc suppression;
- d) twenty-five hundred volts for a wet pick-up appliance that is supported by the body of a person but not solely hand held; and
- e) as specified in dielectric voltage-withstand test, Clause 6.13, for an appliance marked to indicate that it employs double insulation. See Clause 10.3.9.

5.11.2 For applying Clause 5.11.1 to motors not rated in horsepower, reference shall be made to Clause 4.13.10.

5.11.3 If a transformer or an autotransformer is employed in the appliance, the test potential for the secondary circuit shall be:

- a) one thousand volts if the secondary operates at 51 – 250 V; or
- b) five hundred volts if the secondary operates at 50 V or less, except that this does not apply if the secondary circuit is supplied from a Class 2 transformer.

5.11.4 To determine whether an appliance complies with the requirements in Clauses 5.11.1 and 5.11.3, the appliance shall be tested by means of a 500 VA or larger transformer, the output voltage of which is essentially sinusoidal and can be varied. Starting at zero, the applied potential shall be increased until the required test value is reached, and shall be held at that value for 1 min. The increase in the applied potential shall be at a substantially uniform rate and as rapid as consistent with its values being correctly indicated by a voltmeter.

5.11.5 With reference to the requirement in Clause 5.11.4, a 500 VA or larger capacity transformer need not be used if the transformer is provided with a voltmeter to measure directly the applied output potential.

5.11.6 For an appliance employing discharge-path resistors as described in Clause 4.1.4.7, the connection shall be open-circuited at the point of attachment to the accessible part.

5.12 Resistance to moisture

5.12.1 Water spray

5.12.1.1 An outdoor use appliance that is not marked as specified in item 3, 5, or 11 of Table 17 shall be tested as described in Clauses 5.12.1.2 and 5.12.1.3:

a) during and after the test:

- 1) there shall be no wetting of any electrical component; and
- 2) no water shall enter a compartment housing field-installed wiring; and

b) after the test:

- 1) a cord-connected appliance shall comply with the requirements in Clause 5.3.1, leakage current test, except that the test shall be discontinued when the leakage current stabilizes; and
- 2) an appliance shall comply with the requirement in Clause 5.11.1, dielectric voltage-withstand test.

5.12.1.2 To determine whether a vacuum cleaner complies with the requirements in Clauses 4.1.2.5 and 5.12.1.1, the appliance shall be mounted under the apparatus described in Clause 5.12.1.3 and subjected to a water spray for 1 h while operating and 1 h while not operating.

5.12.1.3 The water spray apparatus shall consist of three spray heads constructed in accordance with the details illustrated in Figure 7 and mounted in a water supply pipe rack as illustrated in Figure 8. The water pressure shall be maintained at each spray head at approximately 5 lbf/in² (34 kPa). The distance between the center nozzle and the appliance shall be approximately 5 ft (1.5 m). The appliance shall be brought into the focal area of the three spray heads in such a position and under such conditions that water will be most likely to enter, except that consideration shall be given to the normal mounting position.

5.12.2 Wet pick-up

5.12.2.1 A wet pick-up appliance shall be conditioned as described in Clauses 5.12.2.4 and 5.12.2.5. After the conditioning:

- a) there shall be no obvious wetting of any uninsulated live part (see Clause 5.12.2.3);
- b) no water shall enter a compartment housing field-installed wiring;
- c) the appliance:
 - 1) if grounded:
 - i) after the conditioning, shall comply with the dielectric voltage-withstand requirement in Clause 5.11;
 - ii) if cord connected, during and after the conditioning, shall not have a leakage current of more than 5.0 MIU when tested as described in Clauses 5.3.3 – 5.3.7;
 - 2) if double insulated, shall comply with the leakage current and dielectric voltage withstand requirements specified in Clauses 6.12.1 and 6.19.

5.12.2.2 During the conditioning described in Clause 5.12.2.4(c), the temperature of the motor winding shall not exceed 140°C (284°F).

5.12.2.3 Obvious wetting as mentioned in Clauses 5.12.2.1(a) and 5.12.8.1.1 signifies wetting by a stream, spray, or dripping of water or fluid on the component that obviously will be repeated during each test, but does not signify wetting by random drops of water or fluid that may wet the component by chance.

5.12.2.4 A wet pick-up appliance shall be operated while picking-up water as noted in (a), (b) or (c). The hose end shall be immersed in the water. A float, if provided, shall be defeated:

- a) an appliance that discharges water into a compartment that contains electrical components, including the motor windings, shall be operated for 5 min after it begins to discharge water;
- b) an appliance other than as noted in (a) and that is provided with a float shall be operated until it has picked up as much water as its capacity permits as evidenced by water discharge from the exhaust (or other) opening; or
- c) an appliance other than as noted in (a) and that is not provided with a float shall be operated for 5 min after it begins to discharge water.

5.12.2.5 A wet pick-up appliance employing double insulation shall be subjected to the two additional wet pick-up test conditions described in (a) and (b).

- a) The appliance shall be operated as described in Clause 5.12.2.4, except that a float shall not be defeated and the water shall include a low-sudsing detergent in the amount of 5 g/L. This solution shall be picked up in a manner to promote sudsing. The test shall also be terminated if the float operates to seal the vacuum air inlet such that water cannot discharge from the exhaust opening.

b) A float shall be defeated. The appliance shall be operated picking up water from a level above the top of the appliance until it has picked up its maximum capacity. The appliance shall then be de-energized (not disconnected) and the water allowed to continue to siphon for a period of 5 s following first evidence of water discharge through the exhaust (or other) opening. The appliance shall then be reenergized while simultaneously lifting the pick-up hose up out of the water. Operation shall be continued until water ceases to discharge through the exhaust opening.

5.12.2.6 When a motorized nozzle intended for wet pick-up use with an extraction-type carpet cleaning system or an upright-type wet pick-up appliance with a driven brush is operated under each of the conditions described in Clause 5.12.2.7 or 5.12.2.8, respectively:

- a) there shall not be obvious wetting of any uninsulated live part or film-coated wiring; and
- b) the appliance:
 - 1) shall not have a leakage current of more than 0.5 MIU when tested as described in Clauses 5.3.3 – 5.3.7 during and immediately after operation; and
 - 2) shall comply with the dielectric voltage-withstand requirements in Clause 5.11 after operation.

5.12.2.7 A motorized nozzle of the type specified in Clause 5.12.2.6 shall be operated in a flat-bottomed vessel filled with water so that a depth of 1/8 in (3.2 mm) of water is maintained. The vessel shall be a size such that the nozzle moves about freely; and the motorized nozzle shall be operated:

- a) without a vacuum cleaner attached for 15 min; and
- b) with a vacuum cleaner attached until the appliance has picked up as much water as its capacity holds or for 5 min, whichever occurs sooner.

5.12.2.8 An appliance of the type specified in Clause 5.12.2.6 shall be operated in a flat-bottomed vessel filled with water so that a depth of 1/8 in (3.2 mm) of water is maintained. The vessel shall be of a size such that the appliance moves about freely, and:

- a) for an appliance with the provision for the operation of a driven brush without operation of the vacuum motor:
 - 1) the driven brush shall be operated for 15 min; and
 - 2) the complete appliance shall be operated until it has picked up as much water as its capacity holds or for 5 min, whichever occurs sooner; and
- b) for an appliance other than as noted in (a), the complete appliance shall be operated for 20 min. The water level shall be maintained at the 1/8-in (3.2-mm) level. When the liquid container is filled to capacity, operation shall be halted and the container emptied. The time needed for emptying shall not be included in the 20 min of appliance operation.

5.12.3 Cord reel wetting

5.12.3.1 An appliance, such as a wet pick-up vacuum cleaner, that employs a cord reel shall be conditioned as described in Clause 5.12.3.2. The appliance shall comply with Clause 5.12.2.1 (a) and (c).

5.12.3.2 A solution consisting of low-sudsing detergent and room temperature water in the amount of 5 g/L shall be placed in a shallow container to a depth of 1/2 in (12.7 mm) minimum. The power supply cord of the appliance shall be fully extended, and the entire length of cord that can contact the floor shall be placed in the container. The cord shall be oriented such that it does not interfere with the normal retraction process. The cord shall then be retracted back into the cord reel housing as intended. This procedure shall be repeated four times for a total of five complete tests. The attachment plug cap (including the blades) shall be dried with a soft cloth to remove any surface moisture before conducting the leakage current and dielectric voltage-withstand tests.

5.12.4 Overflow

5.12.4.1 An appliance that employs a liquid reservoir intended to be filled by the user shall be conditioned as described in Clause 5.12.4.2. During and after conditioning, the appliance shall comply with Clause 5.12.2.1. The test shall be conducted with the control switch in the on position and switch S1 from Figure 6 open.

Exception: A product having a reservoir that must be removed to be filled need not comply with this requirement.

5.12.4.2 The product and reservoir shall be in their intended position for filling of the reservoir. Distilled water with 0.6 g/L of sodium chloride and 5.4 g/L of a low sudsing detergent shall be poured into the liquid reservoir through an orifice 3 per 8-in (9.5-mm) in diameter until the reservoir is filled to maximum capacity. Additional solution equal to 15% of the capacity, but not more than 1 pint (0.47 L), shall then be poured into the reservoir.

5.12.5 Flooding of live parts

5.12.5.1 The malfunction of a timer switch, a float, or a pressure-operated switch, or the deterioration or damage of a part of rubber or similar material, such as a boot, diaphragm, seal, or gasket, shall not cause flooding of the electrical components of an appliance that employs water or other electrically conductive liquid in its operation.

5.12.5.2 To determine whether an appliance complies with the requirement in Clause 5.12.5.1 with respect to the deterioration or damage of a part, such as a boot, diaphragm, seal, or gasket, such a part shall be removed completely and the machine operated as in normal operation.

Exception: A part, such as a boot, diaphragm, seal, or gasket, not subject to flexing and also for use with water or a proprietary fluid as described in Clause 3.3.1, is not required to be removed if the part complies with Clause 5.12.5.4.

5.12.5.3 With reference to Clauses 5.12.5.1 and 5.12.5.2, infrequent motion of small amplitude, such as that experienced during normal operation by a diaphragm covering a pressure-sensitive switch, shall not be considered to constitute flexing.

5.12.5.4 To determine compliance with the Exception to Clause 5.12.5.2, three samples of a part, such as a boot, diaphragm, seal, or gasket, shall be subjected to each applicable condition as described in Table 19. After the conditioning, the material used shall retain 50% of its original tensile strength and elongation. The tensile strength and elongation test shall be conducted in accordance with the Standard for Gaskets and Seals, UL 157.

Exception No. 1: If the part is subjected to water only in its operation, the part need not comply with the immersion conditioning.

Exception No. 2: If a part (such as a boot, diaphragm, seal, or gasket) is too small to determine the percent elongation and tensile strength, the part shall be subjected to a visual examination. The part shall not harden, deform, melt, or otherwise deteriorate to a degree that will adversely affect the sealing properties.

5.12.6 Tipover

5.12.6.1 A wet pick-up vacuum cleaner employing double insulation shall be subjected to the tests described in Clauses 5.12.6.4, 5.12.6.5, and 5.12.6.6. As a result of the tests:

- a) there shall not be obvious wetting of any uninsulated live parts (see Clause 5.12.2.3);
- b) the leakage current shall not exceed 5.0 MIU during and after the conditioning when the appliance is tested as specified in leakage current, Clause 5.3; and
- c) the appliance shall comply with the dielectric voltage-withstand, as described in Clause 6.19.1(b).

5.12.6.2 A wet pick-up appliance that is provided with grounding and that is supported by the body of a person and not solely hand held shall be subjected to the tests in Clauses 5.12.6.4, 5.12.6.5, and 5.12.6.6. As a result of the tests:

- a) there shall not be obvious wetting of any uninsulated live parts (See Clause 5.12.2.3);
- b) the leakage current shall not exceed 5.0 MIU during and after the conditioning when the appliance is tested as specified in leakage current, Clause 5.3; and
- c) the appliance shall comply with the dielectric voltage-withstand test, Clause 5.11, between live parts and accessible noncurrent-carrying metal.

5.12.6.3 A wet pick-up appliance that is provided with grounding and that is completely supported in the hand shall be subjected to the tests described in Clause 5.12.6.5. As a result of the tests:

- a) there shall not be obvious wetting of any uninsulated live parts (See Clause 5.12.2.3);
- b) the leakage-current shall not exceed 5.0 MIU during and after the conditioning when the appliance is tested as specified in leakage current, Clause 5.3; and
- c) the appliance shall comply with the dielectric voltage-withstand test, Clause 5.11, between live parts and accessible noncurrent-carrying metal.

5.12.6.4 A float shall be defeated. The appliance shall be operated continuously picking up water until the container is filled to maximum capacity. The appliance shall then be de-energized (not disconnected) and tipped over for 30 s. The tipover shall consist of placing the appliance to rest on its side (approximately 90°). It shall then be returned to its upright position and energized for 30 s drawing in air only. This procedure of filling to capacity, tipping over, and uprighting shall be repeated for a total of four times, tipping in a different direction each time.

5.12.6.5 The test described in Clause 5.12.6.4 shall be repeated (four tips) but with the following changes:

- a) the appliance shall be allowed to continue to operate (remain energized) when tipped over, with the hose removed from the water supply; and
- b) the cleaner shall be tipped for a period of 5 s.

5.12.6.6 A backpack-type body supported appliance shall be subjected to two additional tipover conditions. The tests described in Clauses 5.12.6.4 and 5.12.6.5 (not operating and operating) shall be repeated with the sample being tipped 180°.

5.12.6.7 A new appliance may be used for each of the tipovers described in Clauses 5.12.6.4, 5.12.6.5, and 5.12.6.6. If the same appliance is used for all conditions, disassembly for the examination for wetting of live parts, as mentioned in Clause 5.12.2.1(a) need only be made following the final tipover.

5.12.7 Wet scrubbing

5.12.7.1 After the test specified in Clause 5.12.7.2, a household floor finishing machine shall comply with (a) – (c):

- a) there shall be no obvious wetting of any uninsulated live part (see Clause 5.12.2.3);
- b) no water shall enter a compartment housing field-installed wiring;
- c) the machine:
 - 1) if grounded:
 - i) after the conditioning, shall comply with the dielectric voltage-withstand test, Clause 5.11;
 - ii) during and after the conditioning, shall not have a leakage current of more than 0.5 MIU when tested as described in Clauses 5.3.3 to 5.3.7; and
 - 2) if double insulated, shall comply with the leakage current test, Clause 6.12, and dielectric voltage-withstand test, Clause 6.19 (b).

5.12.7.2 A household use floor finishing machine intended for floor scrubbing shall be operated for 15 min in a flat-bottomed container filled with water to a depth of 1/8 in (3.2 mm). The container shall be sufficiently large so that the product can move freely.

5.12.8 Polymeric fluid-handling components

5.12.8.1 All components

5.12.8.1.1 An appliance that employs a polymeric fluid-handling component, such as a reservoir, tank, or tubing, shall be subjected to the test described in Clause 5.12.8.1.2 with the appliance unenergized, and then energized, and operated under normal load conditions. Separate samples may be used for the unenergized and energized normal load conditions. As a result of the test:

- a) there shall be no obvious wetting of live parts, film-coated wire, or insulation adversely affected by the fluids used with the appliance (see Clause 5.12.2.3); and
- b) the appliance shall comply with the requirements specified in Clause 5.12.2.1(b) and (c).

Exception No. 1: A household extraction-type floor cleaning machine that is not intended to be used with a proprietary fluid shall comply with Clause 5.12.8.2.

Exception No. 2: A household extraction-type floor cleaning machine that is intended to be used with a proprietary fluid shall comply with Clause 5.12.8.3. See also Clauses 3.3, 11.2.7 (i), and Table 17, Item 16.

5.12.8.1.2 To determine if a polymeric fluid-handling component complies with Clause 5.12.8.1.1, a 1/4-in (6.4-mm) diameter hole shall be drilled in the reservoir and attached tubing in any location that can result in the solution reaching a live part, film-coated wire, or insulation. The hole shall then be plugged, and the reservoir shall be filled to 50% of its capacity with the solution described in Clause 5.12.4.2. The plug shall then be removed, so that all of the solution flows out. The component shall be in its intended position, and the appliance shall be in the position that, during intended use, allows maximum exposure to the solution. For a component, such as tubing, attached to the output of a pump and the pump itself, the pump shall be operated until the reservoir is empty.

Exception: If the inside diameter of the tubing is less than 1/4 in (6.4 mm), the size of the hole drilled in the tubing shall be equal to the inside diameter of the tubing.

5.12.8.2 Household extraction-type floor cleaning machines; components for use with non-proprietary fluids

5.12.8.2.1 With reference to Exception No. 1 to Clause 5.12.8.1.1, if deterioration, breakage, or the like, of a polymeric fluid-handling component can result in the risk of fire or electric shock, samples of the polymeric fluid-handling component shall be subjected to the mold stress-relief distortion test described in Clause 5.21.3 and to one of the impact tests indicated below. As a result of the tests, there shall be no leakage such that the appliance does not comply with Clause 5.12.8.1.1 (see Clause 5.12.8.2.2).

- a) For a floor-supported appliance, the impact test shall be as described in Clause 5.19.3 if the component location can be exposed to a blow in normal use. Reservoirs or tanks shall be subjected to the ball impact test while empty and in normal use position.
- b) For other than floor-supported appliances, the impact test shall be as described in Clause 5.19.2 with the component in its intended position and with any reservoir or tank filled.

5.12.8.2.2 In determining compliance with the requirements specified in Clause 5.12.8.1.1, the polymeric fluid-handling component shall be placed in its intended position and the appliance shall be in the position that, during intended use, allows maximum exposure to the fluid. The reservoir or tank shall be filled to its capacity with the solution described in Clause 5.12.4.2, and a pump, if provided, shall be operated until the reservoir or tank is empty.

5.12.8.3 Household extraction-type floor cleaning machines; components for use with proprietary fluids

5.12.8.3.1 Reservoir, tank, tubing, and similar

5.12.8.3.1.1 With reference to Exception No. 2 to Clause 5.12.8.1.1, if deterioration, breakage, or the like of a polymeric fluid-handling component can result in the risk of fire or electric shock, samples of the polymeric fluid-handling component shall be conditioned and tested as described in Clauses 5.12.8.3.1.2 and 5.12.8.3.1.3. As a result of the tests, there shall be no leakage such that the appliance does not comply with Clause 5.12.8.1.1. In determining compliance with the requirements specified in Clause 5.12.8.1.1, after the conditioning and testing, the polymeric fluid-handling component shall be placed in its intended position and the appliance shall be in the position that, during intended use, allows maximum exposure to the fluid. The reservoir or tank shall be filled to its capacity with the solution described in Clause 5.12.4.2, and a pump, if provided, shall be operated until the reservoir or tank is empty.

5.12.8.3.1.2 The polymeric fluid-handling component shall be subjected to one of the following conditions and comply with Clause 5.12.8.3.1.1:

a) three samples shall be immersed in a boiling solution consisting of three times the recommended concentration of the proprietary fluid for seven days. If more than one fluid is recommended, the fluids with the highest pH, lowest pH, highest d-limonene, and highest organic solvent (including d-limonene) available for a given machine shall be employed; or

b) three samples shall be immersed in a solution consisting of three times the recommended concentration of the proprietary fluid for 1000 h at a temperature of 10°C (50°F) above the temperature to which the component is subjected, but not less than 70°C (158°F). If more than one fluid is recommended, the fluids with the highest pH, lowest pH, highest d-limonene, and highest organic solvent (including d-limonene) available for a given machine shall be employed.

Exception No. 1: 100% concentration of the proprietary fluid or fluids shall be used for the solution for an appliance that has a polymeric fluid-handling component, such as a reservoir assembly, that contains only the proprietary fluid.

Exception No. 2: A part such as a boot, diaphragm, seal, or gasket need not comply, but shall comply with Clause 5.12.5.2.

Exception No. 3: If more than one fluid is recommended, a single pH solution may be employed if the fluids with the highest and lowest pH are between 6 and 8.5 (representing the normal pH in ground water). For example, testing only the highest d-limonene content solution meets the intent of this requirement if all the recommended fluids exhibit pH's between 6 and 8.5 and do not contain higher organic solvent content. Similarly, testing only the highest organic solvent content (including d-limonene) solution meets the intent of this requirement if all of the recommended fluids exhibit pH's between 6 and 8.5.

5.12.8.3.1.3 The polymeric fluid-handling component shall be subjected to the following tests and comply with Clause 5.12.8.3.1.1:

- a) one sample shall be subjected to the mold stress-relief distortion test as described in Clause 5.21.3; and
- b) one sample shall be subjected to an impact test as described in Clause 5.19.2 or 5.19.3, as applicable (see also Clause 5.12.8.2.1).

5.12.8.3.2 Pumps

5.12.8.3.2.1 A pump of a household extraction-type floor cleaning machine that is intended to be used with a proprietary fluid and that employs polymeric fluid-handling parts shall be conditioned as described in Clause 5.12.8.3.2.2. If more than one fluid is recommended, the fluids with the highest pH, lowest pH, highest d-limonene, and highest organic solvent (including d-limonene) available for a given machine shall be employed for the pump conditioning described in Clause 5.12.8.3.2.2. After the conditioning, there shall be no leakage such that the appliance does not comply with the requirements in Clause 5.12.8.1.1 (see Clause 5.12.8.3.2.4).

5.12.8.3.2.2 The pump shall be continuously cycled ON for 8 min and OFF for 2 min for 30 days while pumping a solution consisting of three times the recommended concentration of the proprietary fluid. The fluid shall be maintained at a temperature of 68.3 – 71.1°C (155 – 160°F).

Exception No. 1: A solution of 100% concentration of the proprietary fluid or fluids shall be used for an appliance that has a polymeric fluid-handling component, such as a reservoir assembly, that contains only the proprietary fluid.

Exception No. 2: If more than one fluid is recommended, a single pH solution may be employed if the fluids with the highest and lowest pH are between 6 and 8.5 (representing the normal pH in ground water). For example, testing only the highest d-limonene content solution meets the intent of this requirement if all the recommended fluids exhibit pH's between 6 and 8.5 and do not contain higher organic solvent content. Similarly, testing only the highest organic solvent content (including d-limonene) solution meets the intent of this requirement if all of the recommended fluids exhibit pH's between 6 and 8.5.

5.12.8.3.2.3 With reference to the conditioning described in Clause 5.12.8.3.2.2, for a pump employing a motor with brushes, if the pump ceases to operate in 25 h or less due to brushes wearing out, the brushes shall be replaced. If the pump ceases to operate after 25 h, but before the completion of the 30 days, the conditioning shall be considered complete.

5.12.8.3.2.4 In determining compliance with the requirements specified in Clause 5.12.8.1.1, after the conditioning and testing, the polymeric fluid-handling component shall be placed in its intended position and the appliance shall be in the position that, during intended use, allows maximum exposure to the fluid. The reservoir or tank shall be filled to its capacity with the solution described in Clause 5.12.4.2, and the pump shall be operated until the reservoir or tank is empty.

5.12.8.4 Tubing pressure test

5.12.8.4.1 Tubing described in Clause 4.2.4 shall be subjected to a hydrostatic pressure of two times the maximum pressure for a period of one minute after the conditioning described in Clause 5.12.8.4.2. As a result of the test there shall be no leaking.

5.12.8.4.2 Prior to pressure testing (see Clause 5.12.8.4.1), samples shall be conditioned as follows:

- a) two samples as received;
- b) two samples after mold stress-relief distortion, see Clause 5.21.3; and
- c) for tubing for use only with a proprietary fluid or water, two samples after immersion as specified in Clause 5.12.8.3.1.2(a) or (b).

5.12.9 Cleaning test

5.12.9.1 The cleaning of an electrical attachment provided with contacts located on the underside of the attachment shall not result in a risk of electric shock, when tested in accordance with Clauses 5.12.9.2 through 5.12.9.5.

5.12.9.2 A sample of the electrical attachment shall be subjected to three simulated cleanings in accordance with the manufacturer's instructions. If instructions are not provided, then the sample shall be subjected to three simulated cleanings of the underside of the attachment in the area of the electrical contacts using a damp cloth (a cloth that is completely wet but not dripping). Each cleaning shall consist of 10 back-and-forth movements in 10 s.

5.12.9.3 The sample shall be orientated in the position considered worse case (e.g. with the underside of the attachment facing upwards), while attached to the appliance as intended. During each of the three simulated cleanings, the leakage current shall be measured in accordance with the applicable leakage current test (see Clause 5.3 or 6.12) with the appliance connected to the power supply but not energized. The leakage current shall be measured between metal foil with an area of 3.9×7.9 in (10×20 cm) in contact with the thermoplastic surfaces nearest the electrical contacts of the sample and the grounded side of the supply source.

5.12.9.4 Immediately after the three simulated cleanings, the sample shall be orientated as in normal use, and the leakage current shall again be measured in accordance with the applicable leakage current test (see Clause 5.3 or 6.12) between metal foil with an area of 3.9×7.9 in (10×20 cm) in contact with the thermoplastic surfaces nearest the electrical contacts of the sample and the grounded side of the supply source, and then subjected to the applicable dielectric withstand test (see Clause 5.11 or 6.19).

5.12.9.5 The sample shall then be disassembled and examined for the presence of water on electrical components. There shall be no obvious wetting of any uninsulated live part (see Clause 5.12.2.3).

5.13 Stability

5.13.1 An appliance as mentioned in Clause 4.16.5.1 shall be subjected to the stability test. The appliance shall not be energized during the stability test, and shall be filled with water to maximum normal capacity. The test shall be conducted under conditions most likely to cause the appliance to overturn. The following conditions shall be such as to result in the least stability:

- a) the position of all casters and other movable or adjustable parts, including that of the supply cord resting on the surface supporting the appliance;
- b) the connection of or omission of any attachment made available or recommended by the manufacturer; and
- c) the direction in which the appliance is tipped or the supporting surface is inclined.

5.13.2 The appliance shall be separately tested under both of the following conditions:

- a) the appliance shall be positioned at an angle of 10° from the horizontal by:
 - 1) placement on an inclined plane; or
 - 2) tipping from an at-rest position on a horizontal plane; and
- b) the appliance shall be subjected to a 5-lb (22-N) pulling force applied at the hose connection point and parallel to the supporting surface, with the appliance on a horizontal surface and the wheels blocked.

5.14 Strain relief

5.14.1 When tested as described in Clause 5.14.2, the strain-relief means provided on the power-supply cord shall withstand for 1 min, without displacement, a force of 35 lbs (156 N) applied to the cord, with the connections within the appliance disconnected. The strain relief is not acceptable if, at the point of disconnection of the conductors, there is such movement of the cord as to indicate that stress would have resulted on the connections.

5.14.2 A 35-lb (15.9-kg) weight shall be suspended from the cord and supported by the appliance so that the strain-relief means will be stressed from any angle that the construction of the appliance permits.

5.14.3 For the investigation mentioned in the Exception to Clause 4.4.3.2, four samples of the clamp that have been applied to the cord in the intended manner shall be used. One sample shall be subjected to the dielectric voltage-withstand and strain-relief tests in the as-received condition. The other three samples shall be placed in an air oven for 168 h. The oven temperature shall be 10°C (18°F) higher than the maximum temperature measured on the cord at the strain-relief device under normal operating conditions, but not less than 70°C (158°F) in any case. The samples, after being conditioned in the oven, shall be subjected to the dielectric voltage-withstand and strain-relief tests. The value of the applied potential shall be as indicated in Clause 5.11. The potential shall be applied between the conductors and, if the clamp is metal, the potential shall be applied between the conductors and the clamp. After cooling to room temperature, the conditioned samples shall comply with the strain-relief test requirements in Clause 5.14.1 and the dielectric voltage-withstand requirements in Clause 5.11.

5.15 Switches, relays, and similar controls

5.15.1 A switch or other device that controls a motor of an appliance, unless it has been found to be acceptable for the application or is interlocked so that it will never break the locked-rotor motor current, shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the appliance. There shall be no electrical or mechanical breakdown of the device or undue pitting or burning of the contacts, and the fuse in the grounding connection shall not open.

5.15.2 To determine whether a switch or other control device complies with the requirement in Clause 5.15.1, the appliance shall be connected to a grounded supply circuit. The rotor of the motor shall be locked in position. During the test, exposed noncurrent-carrying metal parts shall be connected to ground through a 3-A plug fuse, and the connection shall be such that any single-pole, current-rupturing device will be located in the ungrounded conductor of the supply circuit. If the appliance is intended for use on direct current, or on direct current as well as alternating current, the exposed noncurrent-carrying metal parts of the appliance shall be connected so as to be positive with respect to a single-pole, current-rupturing control device. The device shall be operated at a rate not more than 10 cycles per minute, except that a faster rate of operation may be employed, if agreeable to those concerned.

5.15.3 The flexible thermoplastic switch actuator of a membrane-type switch shall withstand a 6000 cycle mechanical endurance test as specified in Clause 5.15.4. At the completion of the test there shall be no electrical or mechanical failure of the flexible switch actuator.

5.15.4 A sample of the switch actuator shall be subjected to 6000 cycles of mechanical actuation, without voltage applied to the appliance, at a minimum cycle rate of 6 cycles per minute.

5.16 Cord reel flexing

5.16.1 The supply cord on a cord reel shall withstand a 6000 cycle mechanical endurance test as specified in Clauses 5.16.2 and 5.16.3 (without voltage applied) as follows:

- a) at the completion of the test there shall be no undue abrasion of or other damage to the cord jacket, breakage of the conductors, or evidence of undue wear of the movable and stationary contacts; and
- b) after completion of the test the appliance shall still function and shall withstand the specified dielectric voltage-withstand test.

5.16.2 The supply cord shall be unreeled for a length of not less than 30 in (762 mm), and recoiled on the reel by the automatic re-reeling action at a rate not exceeding 10 cycles per min, unless the manufacturer agrees to a faster rate.

5.16.3 The supply cord shall be unreeled in such a direction that the greatest abrasion to the jacket occurs, and to result in as close to a 90° bend in the cord as practical at the exit from the appliance enclosure.

5.17 Power-supply cord flexing

5.17.1 The power-supply cord of a portable appliance shall be subjected to the test specified in Clauses 5.17.3 – 5.17.7. As a result of the test, there shall not be:

- a) short circuit between the conductors (see Clause 5.17.2);
- b) breakage of more than 10% of the strands of any conductor;
- c) movement of the cord in its strain relief that indicates that stress has resulted on the cord connections;
- d) loosening of any cord guard;
- e) damage to the cord or cord guard which impairs compliance with this Standard; or
- f) broken strands piercing the insulation and becoming accessible.

Exception: This test does not apply to appliances with cord reels. Such appliances are tested in accordance with Clause 5.16.

5.17.2 With reference to Clause 5.17.1, conductors include grounding conductors. A short circuit between conductors of the cord is determined when, any time during the test, the current exceeds a value equal to twice the rated current of the appliance.

5.17.3 The part of the appliance comprising the cord entry, the cord guard, when supplied, and the supply cord shall be fixed to an apparatus having an oscillating member as shown in Figure 24, so that, when the oscillating member is at the middle of its travel, the axis of the cord where it enters the cord guard or cord entry is vertical and passes through the axis of oscillation. The distance A, as shown in Figure 24, between the axis of oscillation and the point where the cord or cord guard enters the appliance shall be adjusted so that when the oscillating member moves over its full range, the cord and load make the minimum lateral movement. For this test, the cord entry is the last point at which the cord is permanently attached to the appliance by the manufacturer.

5.17.4 The load shown in Figure 24 shall be 2.25 lbf (10 N).

5.17.5 The oscillating member shall be moved through an angle of 90° (45° on either side of the vertical), at a rate of 60 flexings per minute. A flexing is one movement of 90°. The number of flexings shall be:

- a) for household use – 10 000 flexings if the cord can be replaced without damaging the appliance; otherwise 20 000 flexings;
- b) for commercial use – 20 000 flexings.

5.17.6 The cord and its associated parts shall be turned through an angle of 90° after half the number of flexings.

5.17.7 During the test, the conductors shall be loaded to the rated current of the appliance. The rated voltage shall be applied between the conductors. Current shall not be passed through the grounding conductor which shall be connected to ground.

5.18 Wire flexing

5.18.1 With reference to Clause 4.6.1.10, after being subjected to the test specified in Clause 5.18.2, an upright-type vacuum cleaner shall:

- a) operate as intended;
- b) not have damaged wire insulation that exposes bare conductor;
- c) comply with Clause 5.11, dielectric voltage-withstand, with the wiring under test wrapped in metal foil; and
- d) not exceed the temperature limit specified in Table 9 for the wiring under test when subjected to a repeat temperature test in accordance with temperature, Clause 5.8.

5.18.2 A cycle of flexing shall start with the handle in the vertical (stored) position. The handle shall be rotated until the center of the handle grip area is in the position described in (a) or (b), and then returned to the vertical position. The appliance shall remain energized during the test. The number of cycles shall be as specified in Clause 5.18.3:

- a) the handle shall be rotated to 31 in (78.7 cm) from the floor; or
- b) the handle shall be rotated to its maximum extent.

5.18.3 Household appliances shall be subjected to 9000 cycles of flexing to the position specified in Clause 5.18.2(a) followed by 1000 cycles of flexing to the position specified in Clause 5.18.2(b). Commercial appliances shall be subjected to 45,000 cycles of flexing to the position specified in Clause 5.18.2(a), followed by 5000 cycles of flexing to the position specified in Clause 5.18.2(b). The rate of flexing shall be 6 – 10 cycles per minute, except that a faster rate of flexing may be employed, if agreeable to those concerned.

5.19 Physical abuse

5.19.1 General

5.19.1.1 An appliance employing enclosures in accordance with Exception No. 2 of Clause 4.1.1.2, the Exception to Clause 4.1.1.3, or Clause 5.21, shall withstand the impacts described in Clause 5.19.2 or 5.19.3, as applicable, without occurrence of any of the following:

- a) a reduction of spacings below the minimum specified values;
- b) exposure of insulated or uninsulated live parts as determined by accessibility of live parts, Clause 4.1.4;
- c) any other condition that would increase the risk of electric shock; and
- d) any condition that would increase the risk of injury to persons resulting from operation of the appliance.

5.19.1.2 Following the applicable impact, metal enclosure parts of the sample shall comply with the dielectric voltage-withstand test, Clause 5.11.

5.19.2 Drop impact

5.19.2.1 Appliances completely supported in the hand or by the body during use shall withstand being dropped three times on a hardwood floor from a height of 3 ft (0.91 m). The sample shall be positioned so that the sample strikes the surface in a position different from those in the other two drops. The hardwood surface shall consist of a layer of nominal 1-in (25-mm) tongue-and-groove oak flooring mounted on two layers of nominal 3/4-in (19-mm) fir plywood. The oak flooring shall be 3/4-in (19-mm) by 2-1/4-in (57-mm) thick. The assembly shall rest on a concrete floor, or an equivalent nonresilient floor, during the test.

5.19.2.2 A wet pick-up appliance that is completely supported in the hand or by the body during use shall be additionally subjected to the test described in Clause 5.19.2.1 when filled to maximum capacity with water prior to each drop. For an appliance with separate tanks for clean solution and recovery, only one tank shall be filled. In determining compliance with Clause 5.19.1(c), the water shall not be investigated as a condition that would increase the risk of electric shock.

5.19.3 Ball impact

5.19.3.1 Stationary, fixed, or floor-supported equipment shall withstand an impact of 5 ft-lb (6.8 J) from a solid, smooth, steel sphere 2 in (51 mm) in diameter and weighing approximately 1.18 lbs (0.5 kg) while the equipment is supported against or on a rigid surface that prevents the equipment from moving as a result of the impact. The impact shall be applied to any location considered exposed to a blow in normal use but not to brush caps or the actuating mechanism of switches.

5.19.4 Brush caps and switch actuators

5.19.4.1 Accessible motor brush caps and the actuating mechanism of switches and controls shall withstand a single impact applied by the impactor shown in Figure 9 dropped from a height of 2 ft (610 mm) onto the cap or actuator. As a result of the test:

- a) spacings shall not be reduced below the minimum values specified in spacings, Clause 4.1.3;
- b) insulated or uninsulated live parts shall not be exposed as determined by accessibility of live parts, Clause 4.1.4;
- c) a switch shall remain mounted (see Clause 4.2); and
- d) for an appliance provided with double-insulation, the double-insulation system shall remain intact.

5.19.5 Deflection

5.19.5.1 An appliance employing a metal enclosure in accordance with Exception No. 2 of Clause 4.1.1.2, or the Exception to Clause 4.1.1.3 shall be subjected to the deflection test specified in Clause 5.19.5.2, and shall comply with Clause 5.19.1.1 (a) – (d).

5.19.5.2 A force of 25 lbs(111 N) shall be applied for 1 min to any area of the enclosure accessible after installation by means of a 1/2-in (12.7-mm) diameter hemisphere.

5.20 Strength of handles

5.20.1 To determine whether an appliance complies with the requirements in Clause 4.16.6.1, the weight of the appliance plus a force of three times its weight shall be used. The load shall be uniformly applied over a 3-in (76.2-mm) width at the center of the handle without clamping. The load shall be started at zero and gradually increased so that the test value is reached in 5 to 10 s and shall be maintained for 1 min. When more than one handle is furnished on an appliance, and the appliance is unable to be carried by one handle, the force shall be distributed between the handles. The distribution of force shall be determined by measuring the percentage of the appliance weight sustained by each handle with the appliance in the normal carrying position. When an appliance is furnished with more than one handle and can be carried by only one handle, each handle shall sustain the total force. A wet pick-up type appliance that is completely supported in the hand or by the body during use shall be filled to maximum normal capacity with water when determining the weight of the appliance and during the test. For an appliance with separate tanks for clean solution and recovery, only the largest tank shall be filled to maximum normal capacity with water during the test.

5.21 Polymeric enclosure parts

5.21.1 Volume resistivity

5.21.1.1 The volume resistivity of the polymeric material shall be:

- a) not less than 50 M Ω -cm after conditioning for 40 h at 23 \pm 2°C (73 \pm 4°F) and 50 \pm 5% relative humidity; and
- b) not less than 10 M Ω -cm after exposure for 96 h to moist air having a relative humidity of 90 \pm 5% at a temperature of 35 \pm 2°C (95 \pm 4°F).

Exception No. 1: A polymeric material having a volume resistivity lower than that required may be used if, with the enclosure considered to be a noncurrent-carrying metal part, the product complies with the requirements for spacings in Clause 4.13.

Exception No. 2: In lieu of volume resistivity, compliance with the end-product leakage-current requirements (Clause 5.3) is acceptable. Leakage current measurement shall be taken from accessible surfaces of the polymeric material in question.

5.21.1.2 The volume resistivity shall be determined in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

5.21.2 Resistance to hot-wire ignition

5.21.2.1 For a portable appliance, a polymeric material shall resist being ignited for 7 s or longer (PLC 4 – see note a of Table 4) when subjected to the hot wire ignition test described in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

Exception: The test need not be conducted if the electrically live parts, including all internal wiring, are spaced 1/2 in (12.7 mm) or more from the material.

5.21.2.2 For a stationary or fixed appliance, a polymeric material shall resist being ignited for 15 s or longer (PLC 3 – see note a of Table 4) when subjected to the hot-wire ignition test.

Exception: The test need not be conducted if the electrically live parts, including all internal wiring, are spaced 1/2 in (12.7 mm) or more from the material.

5.21.3 Mold stress-relief distortion

5.21.3.1 Conditioning of the appliance as described in Clause 5.21.3.2 shall not cause softening of the material as determined by handling immediately after the conditioning, nor shall there be shrinkage, warpage, or other distortion of the enclosure, as judged after cooling to room temperature, that results in any of the following:

- a) reduction of spacings between uninsulated live parts of opposite polarity, uninsulated live parts and accessible noncurrent-carrying or grounded metal, uninsulated live parts and the enclosure to less than the minimum specified values specified in spacings, Clause 4.13;
- b) making uninsulated live parts or internal wiring accessible to contact as determined by accessibility to live parts, Clause 4.1.4;
- c) causing a condition that results in the appliance not complying with the power-supply-cord strain-relief requirements in Clause 5.21.6.1, if applicable; or
- d) defeating the integrity of the enclosure so that mechanical protection in accordance with Clause 4.1.1 is not afforded to internal parts of the appliance.

Exception: The conditioning described in Clause 5.21.3.2 is not required for rigid thermosetting materials or for low-pressure foamed molded parts.

5.21.3.2 One sample of the complete appliance shall be placed in a full-draft circulating air oven maintained at a uniform temperature at least 10°C (18°F) higher than the maximum temperature of the material measured under normal operating conditions but not less than 70°C (158°F). The sample shall remain in the oven for 7 h. After its careful removal from the oven and return to room temperature, the sample shall be investigated for compliance with Clause 5.21.3.1.

5.21.4 Impact

5.21.4.1 The appliance shall be subjected to the applicable impact described in Clause 5.19.

5.21.4.2 Each of three samples of an appliance intended for outdoor use shall be cooled to a temperature of minus 35.0 ±2.0°C (minus 31.0 ±3.6°F) and maintained at this temperature for 3 h. While the unit is still cold, the samples shall be subjected to the applicable impact described in Clause 5.19.

Exception: For an appliance marked in accordance with Item 3, 5, or 11 of Table 17, the conditioning temperature shall be 0 ±2°C (32 ±3.6°F).

5.21.5 Severe conditions

5.21.5.1 An appliance shall be conditioned as described in Clause 5.21.5.3 and:

- a) during conditioning, there shall be no:
 - 1) flaming of the material upon which the appliance is placed or with which it is draped, or
 - 2) ignition of the enclosure material; and
- b) after conditioning, the appliance shall comply with the mold stress-relief distortion requirements in Clause 5.21.3.1 (a), (b), and (d).

5.21.5.2 For an appliance conditioned as described in Clauses 5.9.1.1 and 5.21.5.3 (b) and (c), the no-load current input to the appliance shall not be greater than 150% of the no-load current input of the appliance measured on an unconditioned sample.

5.21.5.3 An appliance shall be subjected to the applicable conditions in (a), (b), or (c):

- a) an appliance that employs a motor, the only function of which is to move air, shall be conditioned as noted in Clause 5.21.5.4;
- b) an appliance that employs a motor to perform a function other than to move air shall be tested as specified in Clause 5.9.1.1; or
- c) an appliance that employs a dual-purpose motor, one function of which is to move air, shall be tested as noted in Clauses 5.9.1.1 and 5.21.5.4.

5.21.5.4 An appliance as described in Clause 5.21.5.3 (a) and (c) shall be placed on a single layer of white tissue paper on a softwood surface and shall be draped with a single layer of cheesecloth. The sample shall be operated for a period of 7 h with the air intake completely open and for a period of 7 h with the air inlet completely blocked. During the open inlet condition, a hole shall be cut in the cheesecloth to accommodate the vacuum air inlet. A separate sample may be used for each condition.

Exception: For a product that employs a flow-through type vacuum motor, the open inlet condition need not be conducted.

5.21.5.5 During the conditioning mentioned in Clauses 5.21.5.2 – 5.21.5.4:

- a) a motor-protective device may be retained in the circuit if it complies with the requirements for temperature and endurance under locked-rotor conditions in the Standard for Motors with Inherent Overheating Protection, CSA C22.2 No. 77, and the Standard for Overheating Protection for Motors, UL 2111; and
- b) a temperature-sensitive device, such as a thermostat, may be retained in the circuit provided it:
 - 1) complies with the requirements for appliance temperature limiting controls in the Standard for Temperature-Indicating and Regulating Equipment, CSA C22.2 No. 24, and the Standard for Temperature-Indicating and -Regulating Equipment, UL 873, with a minimum appliance control endurance level of 6000 cycles;

- 2) has an acceptable electrical rating for the load controlled; and
- 3) complies with the requirement in Clause 4.8.3.5.

5.21.6 Strain-relief after mold stress-relief distortion

5.21.6.1 After the test samples have cooled to room temperature following the oven conditioning described in Clause 5.21.3, the sample shall be subjected to the strain-relief test, Clause 5.14, and shall comply with the requirements.

5.21.7 Abnormal operation

5.21.7.1 When tested as described in Clause 5.21.7.2, there shall be no ignition of the enclosure material or exposure of live parts. There shall be no ignition of the combustible material that the appliance is placed on or draped with as a result of emission of flame through other than existing openings.

5.21.7.2 The appliance shall be operated under the conditions of abnormal operation that are appropriate for the product, such as stalled-rotor operation. During the test, the appliance shall rest on white tissue paper on a softwood surface. A single layer of cheesecloth shall be draped over the entire appliance and the appliance shall be operated continuously until the ultimate results have been determined. In most cases, continuous operation for 7 h may be necessary to obtain the ultimate results. The simulated abnormal conditions shall be imposed one at a time. A new sample may be used to evaluate any or all conditions of abnormal use.

5.21.8 Exposure to ultraviolet light

5.21.8.1 A polymeric material used for the enclosure of an electrical appliance that is intended to be used outdoors and is not marked per Item 3, 5, or 11 of Table 17 shall be acceptably resistant to degradation when exposed to ultraviolet light.

5.21.9 Crushing resistance

5.21.9.1 Stationary and fixed appliances shall withstand a 1-min application of the crushing force described in Clause 5.21.9.2 without resulting in any of the following:

- a) reduction of spacings below the minimum values specified in Clause 4.13;
- b) accessibility to contact of uninsulated live parts of internal wiring;
- c) such breakage, cracking, rupture, and the like as to adversely affect the insulation; or
- d) production of any other condition that would increase the risk of electric shock or fire during the intended use of the appliance.

5.21.9.2 Three samples of an appliance shall be backed on the mounting side by a fixed rigid supporting surface. The crushing force shall be applied to the side opposite the mounting surface, and by flat surfaces each 4 by 10 in (102 by 254 mm). Each force applicator shall exert 100 lbs (45.4 kg) on the sample. As many applicators shall be applied as the sample can accommodate on the surface opposite the mounting surface, based on an arrangement of applicators as indicated in Figure 10.

5.21.10 Thermal aging

5.21.10.1 A material used for the enclosure shall be resistant to thermal degradation at the maximum temperature to which it is exposed during normal use of the appliance. The thermal-aging characteristics of the material shall comply with one of the following:

a) the material shall have a relative temperature index, based on historical data or a long-term thermal aging program, described in the standard for polymeric materials – long term property evaluations, see Annex A, which indicates acceptability for use at the temperature involved; or

b) the polymeric material may be considered appropriate from a thermal-aging standpoint if the maximum temperature to which it is exposed during normal use of the appliance does not exceed:

- 1) 80°C (176°F) for an attended, intermittent-duty household use appliance;
- 2) 65°C (149°F) for any other portable appliance; and
- 3) 50°C (122°F) for all other appliances.

5.22 Polymeric materials used as structural support

5.22.1 An appliance that employs a polymeric material for the structural support of a motor-driven cleaning brush, a motor bearing, or the like, including part or all of an enclosure, where deterioration or breakage could result in excessive overload of the motor, shall be subjected to the impact tests specified in Clause 5.19.2 or 5.19.3 and the mold stress-relief distortion test, Clause 5.21.3. As a result of each test, the appliance shall have an input current not greater than 150% of the current measured during the applicable input test conducted on the unconditioned sample with the air-intake open.

Exception: This requirement does not apply to polymeric material used for the support of bearings of a belt-driven part if stalling of the part will not result in stalling of the motor.

5.23 Adhesives

5.23.1 General

5.23.1.1 An adhesive as mentioned in Clause 4.1.3 shall be subjected to the tests specified in Clauses 5.23.2 – 5.23.6. Unless otherwise specified, all testing shall be conducted in a standard laboratory atmosphere at 23.0 ±2.0°C (73.4 ±3.6°F) and 50 ±5% relative humidity.

5.23.1.2 Specimens shall be prepared that represent the use of the adhesive in the application, including fabrication, surface preparation, and the temperature and pressure application during bonding.

5.23.2 As-received test

5.23.2.1 Twenty specimens shall be conditioned for 40 h at $23.0 \pm 2.0^{\circ}\text{C}$ ($73.0 \pm 3.6^{\circ}\text{F}$) and a relative humidity of $50 \pm 5\%$ prior to testing.

5.23.2.2 The specimens shall be subjected to applicable tests to determine the value of the bond-strength in the as-received condition. Specimens that break at an obvious flaw remote from the adhesive line shall be discarded and a retest conducted. The average value of the bond-strength shall be computed. This value shall be used for comparison with values for bond-strength after the environmental conditioning described in Clauses 5.23.3 – 5.23.6.

5.23.3 Effect of temperature

5.23.3.1 Ten specimens shall be conditioned for 1000 h at the oven temperature taken from the respective thermal-endurance-profile line in Figure 11, where the temperature index T is the measured normal operating temperature (see Clause 5.8) of the adhesive, but not less than 60°C (140°F).

Exception: On the same thermal-endurance-profile line in Figure 11, a shorter or longer time at a higher or lower temperature respectively may be employed if agreeable to all concerned, but a period no less than 300 h shall be used.

5.23.3.2 After the conditioning, the specimens shall be brought to and tested at room temperature to determine the bond-strength values. The average conditioned value shall be at least 50% of the unconditioned value.

5.23.4 Effect of humidity

5.23.4.1 Ten specimens shall be conditioned for 7 days at 95 – 100% relative humidity at $60 \pm 1^{\circ}\text{C}$ ($140 \pm 1.8^{\circ}\text{F}$).

5.23.4.2 After the conditioning, the specimens shall be brought to and tested at room temperature to determine the bond-strength values. The average conditioned value shall be at least 50% of the unconditioned value.

5.23.5 Effect of cyclic conditions

5.23.5.1 Ten specimens shall be subjected to three complete cycles of the conditioning indicated in Table 11.

5.23.5.2 After the conditioning, the specimens shall be brought to and tested at room temperature to determine the bond-strength values. The average conditioned value shall not be less than 50% of the unconditioned average value.

5.23.6 Effect of cold

5.23.6.1 There shall be no visual signs of cracking or chipping of the bond between the two adhered parts of the specimens after conditioning for 24 h at minus $35 \pm 1^\circ\text{C}$ (minus $31 \pm 1.8^\circ\text{F}$) for outdoor-use applications and at $0 \pm 1^\circ\text{C}$ ($32 \pm 1.8^\circ\text{F}$) for indoor-use applications. At least six specimens shall be subjected to the cold conditioning.

5.24 Thermoplastic motor insulation systems

5.24.1 General

5.24.1.1 Motors that employ thermoplastic materials to electrically isolate the windings and similar live parts from other live parts or noncurrent-carrying metal parts shall be subjected to the tests in Clauses 5.24.2 and 5.24.3.

Exception: A motor that serves to move air only with a direct mounted fan need not be subjected to the test in Clause 5.24.3.

5.24.2 Abnormal conditioning

5.24.2.1 The motor shall be subjected to the abnormal conditioning described in Clause 5.24.2.2 and shall comply with all of the following conditions:

- a) the 3 A fuse shall remain intact; and
- b) the material under test shall withstand, without breakdown, the dielectric voltage-withstand potential specified in Clause 5.11 immediately following the conditioning specified in Clause 5.24.2.2 and with the 3 A fuse removed from the circuit.

5.24.2.2 The motor shall be operated with the armature locked until ultimate results have been determined or for 7 h, whichever occurs first. Noncurrent-carrying metal parts of the motor that are insulated by the material under test shall be connected to ground through a 3-A, quick-acting, plug type fuse.

5.24.3 Running overload

5.24.3.1 Thermoplastic insulating material employed in motors with a stalled-rotor current greater than twice the normal operating current shall comply with all of the following after the overload-burnout conditioning described in Clauses 5.24.3.2 and 5.24.3.3:

- a) the 3 A fuse shall not rupture as a result of deterioration of the thermoplastic motor insulation system under test; and
- b) the thermoplastic material under test shall comply with the dielectric voltage-withstand test described in Clause 5.11 immediately following the overload-burnout conditioning.

Exception: A double-insulated appliance shall be tested in accordance with overload test on motors, Clause 6.17.

5.24.3.2 For vacuum cleaners and blower cleaners, each of three samples of the motor shall be subjected to operation at normal load for 1 h. Immediately following operating at normal load, the load shall be increased in steps of 10% of the rated current for each of four successive 1-h periods, followed by two 1/2-h periods, followed by eight 1/4-h periods, followed by such additional periods of 5 min until the motor burns out. During the test, noncurrent-carrying metal parts of the motor that are insulated by the material under test shall be connected to ground through a 3-A, quick-acting fuse.

5.24.3.3 For household use floor finishing machines, each of three samples of the complete product shall be subjected to operation at no load for 1/2 h, immediately followed by operation at normal load for 1/2 h. Immediately following this, the load shall be increased in steps of 10% of the rated current for each of four successive 1-h periods, followed by two 1/2-h periods, followed by eight 1/4-h periods, followed by such additional periods of 5 min until the motor burns out. During the test, noncurrent-carrying metal parts of the motor that are insulated by the material under test shall be connected to ground through a 3-A, quick-acting fuse.

5.24.4 Thermal aging

5.24.4.1 A polymeric material employed in a Class 105 (A) motor insulation system in accordance with Exception No. 1 to Clause 4.8.1.4 shall be aged for the amount of time corresponding to an aging temperature that appears on the Class 105 (A) system response shown in Figure 12. The motor insulation system shall cool to room temperature and the applicable dielectric voltage-withstand requirements specified in Clause 5.11 shall be applied between live parts and noncurrent-carrying metal parts that are isolated from each other by the material under consideration.

5.25 End-product arc resistance

5.25.1 A polymeric material employed in accordance with Exception No. 2 to Clause 4.7.2 shall be tested as specified in Clause 5.25.2. There shall be no ignition:

- a) within 15 arcs for materials classed V-0 and 0.17 V-0;
- b) within 30 arcs for materials classed V-1 and 0.17 V-1, and V-2 and 0.17 V-2; or
- c) within 60 arcs for materials classed HB and 0.17 HB.

5.25.2 The flammability ratings are in accordance with the Standard for Evaluation of Properties of Polymeric Materials, CSA C22.2 No. 0.17, and the Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances, UL 94. In addition, there shall not be a permanent conductive carbon path judged by application of a dielectric voltage-withstand potential between the live part and the adjacent part of different potential, as required in dielectric voltage-withstand, Clause 5.11.

5.25.3 The current for the arcing test shall be based upon the normal load-current rating and minimum power factor. The voltage used for the test shall be equal to the available voltage at the live part. The arc shall be established between the live part and any adjacent part where breakdown is likely to occur. The arc shall be used to attempt to ignite materials forming parts of the enclosure or to ignite materials located between the parts of different potential. The arc shall be established by means of a copper or stainless steel conductive probe. The conductive probe shall be used to create arc tracking or a carbon build-up across the surface of the insulating material at the rate of 40 arc separations per minute. (A rate of 30 arc separations per minute may be used if 40 arc separations per minute is not practical.)

5.26 Abnormal overload

5.26.1 A polymeric material employed in accordance with Exception No. 3 to Clause 4.7.2 shall be capable of withstanding the temperatures that are generated during or as a result of passing the abnormal currents through the live parts that are in contact with or within 1/32 in (0.79 mm) of the insulating material without ignition, undue distortion, or melting of the material being evaluated. The value of the abnormal current and the time shall be as specified in Table 12. See Clauses 5.26.2 and 5.26.3.

5.26.2 If there is no overcurrent protective device provided as part of the equipment or it cannot be relied upon, evaluation shall be based upon the available energy to the end-product using percentages of the intended branch-circuit overcurrent device, but not less than a 30 A normal-acting protective device.

5.26.3 If an overcurrent protective device is provided as part of the equipment, it shall be relied upon only if the device is not user-serviceable unless substitution of a device with a higher-rated value is unlikely due to keying or other constructional features.

5.27 Blower cleaner impeller tests

5.27.1 General

5.27.1.1 A blower cleaner shall withstand the test described in Clause 5.27.2, without occurrence of any of the following:

- a) parts of the impeller being ejected from the blower;
- b) cracks or other damage to the impeller that are visible to the naked eye upon inspection;
- c) any other condition that would increase the risk of injury to persons resulting from operation of the appliance.

5.27.2 Overspeed

5.27.2.1 A blower cleaner provided with a series motor shall be operated while set to its highest speed at a voltage equal to 1.3 times the rated voltage for 1 min.

Exception: This test is not applicable for battery operated blower cleaners.

5.27.2.2 A blower cleaner provided with a series motor and thermoplastic fan shall also be subjected to the test in Clause 5.27.2.1 after the following oven conditioning. One sample of the complete appliance shall be placed in a full-draft circulating air oven maintained at a uniform temperature at least 10°C (18°F) higher than the maximum temperature of the material measured under normal operating conditions but not less than 70°C (158°F). The sample shall remain in the oven for 7 h. After its careful removal from the oven and return to room temperature, the sample shall be tested in accordance with Clause 5.27.2.1 and then investigated for compliance with Clause 5.27.1.1.

Exception: This test is not applicable for battery operated blower cleaners.

6 Double insulation

6.1 Scope

6.1.1 These requirements apply to appliances marked as being provided with double insulation and to appliances that employ double insulation in place of grounding in accordance with the Exception to Clause 4.14.1. These requirements supplement those contained elsewhere in this Standard.

6.2 Definitions

6.2.1 See Clause 2.

6.3 Construction – general

6.3.1 The appliance shall be so constructed that double insulation is interposed between all live parts and each of the following:

- a) all accessible surfaces of the appliance; and
- b) parts that are conductively connected to accessible noncurrent-carrying metal parts or surfaces.

Exception: A construction using reinforced insulation complying with Clause 6.4 may be used in place of double insulation.

6.3.2 The thickness and the resistance to deterioration with aging of a material employed as supplementary insulation shall not be less than that required for the same material employed as basic insulation.

6.3.3 The insulation qualities and resistance to deterioration with aging of a material employed as reinforced insulation shall not be less than the combination of basic and supplementary insulation.

6.3.4 The appliance shall be so constructed that the added protection against a risk of electric shock provided by the supplementary or reinforced insulation is not reduced by the abuses likely to be encountered during normal service (see Clauses 6.15, resistance to impact test, and 6.16, abnormal operation test).

6.3.5 The appliance shall be so constructed that the following parts are not accessible:

- a) a live part;
- b) a noncurrent-carrying metal part that is insulated from live parts by basic insulation only, unless it is reinforced insulation as described in Clause 6.4; and
- c) basic insulation itself, unless it is reinforced insulation as described in Clause 6.4.

6.3.6 The appliance shall be constructed so that all parts – straps, screws, nuts, washers, springs, and the like – are secured so that they are not likely to become loosened or displaced if such loosening or displacement reduces the spacings to values below those specified in Table 13.

Exception: If loosening or displacement of the part causes malfunctioning of the appliance and does not result in an accessible live part, the appliance need not be so constructed.

6.3.7 Parts secured by two independent fastenings or by means of screws or nuts provided with lockwashers are considered not likely to become loose, if these fastening means are not required to be removed during routine servicing.

6.3.8 Leakage, rupture or overfilling of a reservoir, pipe, tube, or the like for storing or conducting water or other fluid associated with the appliance shall not render either basic, reinforced, or supplementary insulation ineffective or result in deterioration of the insulation.

6.4 Reinforced insulation

6.4.1 General

6.4.1.1 Reinforced insulation may be used in place of double insulation anywhere in the appliance if the reinforced insulation consists of one or more layers with a total thickness of not less than 3/16 in (4.8 mm), and in locations as specified in Clauses 6.4.2 – 6.4.8. In a multilayer assembly, contact between adjacent layers is acceptable.

6.4.2 Brush caps and brush holders

6.4.2.1 Reinforced insulation is considered to exist in an accessible brush cap or brush holder if the construction complies with each of the following:

- a) the brush cap or brush holder shall be so recessed that, if it is mounted normally, its top is inside the plane of the opening in the surrounding portion of the enclosure of the appliance;
- b) the brush cap or brush holder shall be entirely composed of insulating material; and
- c) the construction complies with Clause 6.4.3 or 6.4.4, as applicable.

6.4.3 Brush holders in enclosures of insulating material

6.4.3.1 A brush holder assembly that is supported in the insulating material housing of the appliance shall have a total insulation thickness not less than 3/16 in (4.8 mm) and any path between parts of the enclosure shall be broken by barriers or the like so that there is no direct path from the outside to live parts of the brush holder assembly.

6.4.4 Brush holders in enclosures of conductive material

6.4.4.1 A brush holder mounted in an enclosure of conductive material shall have its own enclosure of insulating material and the construction shall comply with the following:

- a) all live parts of the brush holder assembly shall be enclosed in the enclosure of insulating material; and

Exception: The wiring terminals of the brush itself need not be enclosed.

- b) the enclosure of the brush holder assembly shall be separated from accessible noncurrent-carrying metal parts by any one or more of the following constructions:

- 1) mica not thinner than 0.005 in (0.13 mm);
- 2) other inorganic insulation having electrical properties at least equivalent to those of mica; or
- 3) acceptable organic insulating material not less than 1/16-in (1.6-mm) thick.

6.4.5 Commutator and end turns of the armature winding

6.4.5.1 Reinforced insulation is considered to exist between the commutator segments and the shaft, or the end turns and the shaft, and in both locations, if the insulation consists of one or more of the following:

- a) sheet mica that is not less than 0.005-in (0.13-mm) thick;
- b) other inorganic insulation having electrical properties at least equivalent to those of mica. If such insulation is used under the commutator segments, the thickness of the insulation shall not be less than 0.080 in (2.0 mm). If such insulation is used under the end turns, the thickness of the insulation shall not be less than 0.039 in (1 mm) or the length of the air gap, whichever is larger; or
- c) acceptable organic insulating material if the armature complies with the investigation of armature employing reinforced insulation, Clause 6.18.

6.4.5.2 If any of the constructions described in Clause 6.4.5.1(b) are used, the armature laminations shall be insulated from the shaft by either of the following:

- a) sheet mica that is not less than 0.005-in (0.13-mm) thick; or
- b) other inorganic insulation having electrical properties at least equivalent to those of mica. The thickness of the insulation shall not be less than 0.039 in (1 mm) or the length of the air gap, whichever is larger.

6.4.6 Switches

6.4.6.1 Reinforced insulation is considered to exist at a switch if the switch has its own enclosure of insulating material and if the following conditions are met:

- a) a noncurrent-carrying metal part that extends outside of the switch enclosure shall not enter the arc chamber;
- b) the plunger, toggle or the like that contacts live parts inside the switch shall be entirely composed of insulating material;
- c) a live part inside the switch shall not be contacted by a metal actuating arm, cam, or the like;
- d) all live parts other than the terminals shall be completely enclosed in the switch enclosure; and
- e) in an appliance employing a conductive enclosure, that portion of the switch or switch enclosure that contains arcing parts shall be separated from exposed noncurrent-carrying metal by means of not less than 0.005-in (0.13-mm) thick mica or by other insulation having at least the equivalent electrical properties, and any metal in contact with the switch enclosure shall be insulated from accessible noncurrent-carrying metal by supplementary insulation; or
- f) in an appliance employing an enclosure of insulating material, metal mounting screws or rivets used to secure the switch to accessible noncurrent-carrying metal shall not pass through the body of the switch enclosure. The mounting means may pass through tabs, ears, and the like projecting from the switch body.

6.4.7 Flexible cord

6.4.7.1 Reinforced insulation is considered to exist inside an appliance where the jacket of a jacketed-type flexible cord contacts supplementary insulation.

6.4.7.2 Inside the appliance where the jacket has been removed, the insulated individual conductors of a jacketed-type flexible cord may be insulated from an accessible noncurrent-carrying metal part by supplementary insulation in any one of the following forms:

- a) an insulating liner;
- b) a coating of insulating material; or
- c) a sleeve around the cord, if the sleeve is loose fitting and is secured to the enclosure.

6.4.7.3 If one or more of the insulated individual conductors of the flexible cord contacts supplementary insulation inside the appliance, the conductor insulation and the supplementary insulation shall be such that they are not affected to the same degree by deteriorating influences such as heat, contaminants and the like. The flexible cord jacket itself may serve as the supplementary insulation for the insulated individual conductors if the jacket is of thermoplastic or thermoset material; and the conditions of use of the appliance are not likely to stress or degrade the physical properties of the jacket.

6.4.8 Internal wiring

6.4.8.1 Reinforced insulation is considered to exist at points inside of the appliance where the insulated wiring – including insulated splices – contacts supplementary insulation. See Clause 6.4.8.3.

6.4.8.2 Internal wiring that has basic insulation – including an insulated splice – shall be spaced at least 1/32 in (0.8 mm) from an accessible noncurrent-carrying metal part.

6.4.8.3 If internal wiring that has basic insulation – including an insulated splice – contacts an enclosure of insulating material, the insulation on the wire and the enclosure of the insulating material shall be such that they are not affected to the same degree by deteriorating influences such as heat and contaminants.

6.4.8.4 Insulating tubing may be accepted as supplementary insulation between internal wiring that has basic insulation – including an insulated splice – and accessible noncurrent-carrying metal, if all of the following conditions are met:

- a) the tubing shall be loose fitting on the conductors;
- b) the tubing shall be so fixed in position as to restrict relative movement between the tubing and the metal;
- c) the length of the leads shall reduce the likelihood of any tension during assembly or repair;
- d) the tubing shall not contact sharp bends, projections, corners or the like, nor shall it be subject to tension or compression;
- e) the wiring shall not be subject to flexing;
- f) the materials of the tubing and the insulation on the wire shall be such that they are not affected to the same degree by deteriorating influences such as heat and contaminants; and
- g) the tubing shall be of a thickness that is acceptable for the application.

6.5 Power supply cord

6.5.1 A power supply cord shall not include a grounding conductor.

6.5.2 Inside the appliance, the insulated individual conductors of a power supply cord shall not contact an accessible noncurrent-carrying metal part.

6.6 Strain relief

6.6.1 If an accessible metal strain-relief clamp is employed, it shall be provided with supplementary insulation located between the clamp and the flexible cord.

6.7 Bushings

6.7.1 A bushing of insulating material shall be provided at each point at which a flexible cord passes through a noncurrent-carrying metal part. A bushing of rubber, neoprene, polyvinyl chloride, or similar material shall not be used for this application.

6.8 Capacitors

6.8.1 The dielectric in a capacitor shall not be depended upon as supplementary insulation.

6.9 Extra-low voltage circuits

6.9.1 If an extra-low voltage circuit, see Clause 2.1, is conductively connected to an accessible noncurrent-carrying metal part, or terminal or outlet for connection of circuits external to the appliance, the circuit shall be considered to be accessible noncurrent-carrying metal.

6.10 Spacings

6.10.1 Spacings shall be in accordance with Table 13.

6.11 Internal wiring

6.11.1 Internal wiring shall be located or restrained so that breakage or loosening of the wire at a termination and subsequent displacement cannot reduce the spacings to values below those specified in Table 13.

Exception: If breakage or loosening of the wire at a termination and subsequent displacement causes malfunctioning of the appliance and does not result in a live part being made accessible, internal wiring need not be restrained or so located.

6.11.2 Compliance with Clause 6.11.1 can be accomplished by one or more of the following means:

- a) the use of barriers;
- b) relative placement of parts;
- c) physical restraint of the conductor in addition to that resulting from its intended electrical connections; or
- d) other equivalent means.

6.11.3 The requirement specified in Clause 6.11.1 necessitates that a brush holder be constructed so that, upon removal of the brush cap, the spring cannot contact accessible noncurrent-carrying metal.

6.11.4 A supplementary part, such as an insulating barrier liner, that is necessary to maintain the level of insulation shall be so secured to the appliance that it remains in place when the power supply cord or a component, such as a switch, is being replaced.

Exception: A supplementary part need not be fixed to the appliance if its design precludes its being left out after servicing of the appliance.

6.12 Leakage-current test

6.12.1 The leakage current of a double insulated appliance when tested in accordance with Clause 5.3, leakage current, Clause 5.4, leakage-current following humidity conditioning, and Clause 8.5, leakage-current test, shall not be more than:

- a) 0.25 MIU for accessible noncurrent-carrying metal parts;
- b) 0.5 MIU for inaccessible noncurrent-carrying metal parts; and
- c) 0.5 MIU between accessible and inaccessible noncurrent-carrying metal parts.

6.12.2 Prior to the test described in Clause 6.12.1, an appliance having parts that are likely to produce conductive dust, such as the commutator and brush assembly of a universal motor, shall be operated for 100 h, or until the brushes wear out, whichever interval is shorter, but in no case less than 25 h. Brushes shall be replaced during this test if necessary to achieve 25 h of operation. Air inlets shall be unrestricted and motorized agitators (if provided) shall be unloaded.

6.12.3 The humidity chamber conditioned sample specified in leakage-current following humidity conditioning, Clause 5.4, may be used for several tests. The sequence of testing following humidity conditioning shall be:

- a) leakage current;
- b) insulation resistance (see Clause 6.14); and
- c) dielectric withstand.

6.12.4 For an appliance employing discharge-path resistors as described in Clause 4.1.4.7, the resistors shall be shorted one at a time prior to the test.

6.13 Dielectric voltage-withstand test

6.13.1 For the tests specified in dielectric voltage-withstand, Clause 5.11, and dielectric voltage-withstand test, Clause 8.4, the points of application and the potentials employed shall be in accordance with Table 14.

6.13.2 For an appliance employing discharge-path resistors as described in Clause 4.1.4.7, the connection shall be open-circuited at the point of attachment to the accessible part.

6.14 Insulation resistance

6.14.1 The appliance shall be conditioned as described in leakage-current following humidity conditioning, Clause 5.4. After conditioning, the appliance shall have an insulation resistance not less than the following:

- a) between live parts and accessible noncurrent-carrying metal parts – 7 M Ω ;
- b) between live parts and inaccessible noncurrent-carrying metal parts – 2 M Ω ; and
- c) between inaccessible noncurrent-carrying metal parts and accessible noncurrent-carrying metal parts – 5 M Ω .

6.14.2 For an appliance having an outer enclosure consisting wholly or partly of insulating material, the term "accessible noncurrent-carrying metal parts" used in Clause 6.14.1 signifies metal foil tightly wrapped around the exterior of the enclosure.

6.14.3 If the appliance has parts that might produce conductive dust, the insulation resistance test shall be made on the sample conditioned in accordance with Clause 6.12.2. See also Clause 6.12.3.

6.14.4 The measurements of insulation resistance and the dielectric voltage-withstand test mentioned in Clause 6.14.6 shall be made with the appliance still in the humidity conditioning chamber.

6.14.5 In the determination of insulation resistance, a direct potential of 500 V shall be employed, and the value of insulation resistance shall be determined 1 min after application of the test potential. The sample shall not be energized during this test.

6.14.6 Following the insulation resistance test, and while still humidity conditioned, the sample shall be subjected to the dielectric voltage-withstand test in Clause 6.13.

6.15 Resistance to impact test

6.15.1 The appliance shall withstand the applicable impact tests specified in Clause 5.19 without making accessible to contact noncurrent-carrying metal parts that are insulated from live parts by basic insulation only, and basic insulation. The appliance shall comply with the dielectric voltage-withstand test in Clause 6.13 after being subjected to the impact test.

6.16 Abnormal operation test

6.16.1 Abnormal operation as specified in Clause 5.21.7 shall not affect the insulation to the extent that it does not comply with Clause 6.16.2 or that it exposes live parts. The tests specified in abnormal operation, Clause 5.21.7, shall be conducted on all double insulated appliances regardless of whether they employ thermoplastic or metal enclosures.

6.16.2 Following abnormal operation specified in Clause 6.16.1, the appliance shall be given time to cool to room temperature and shall withstand for 1 min without breakdown the application, between live parts and accessible noncurrent-carrying metal parts, or the foil described in note b of Table 13 and Figure 14, of the potential specified in Table 14.

6.17 Overload test on motors

6.17.1 Operation of a motor under conditions of extreme overload shall not affect the appliance insulation to the extent that the insulation does not comply with Clause 6.17.5.3 or that live parts are exposed.

6.17.2 To determine whether a motor complies with Clause 6.17.1, three previously untested samples of the appliance shall be operated as described in Clause 6.17.3.1 for vacuum cleaners and blower cleaners or Clause 6.17.4.1 for household use floor finishing machines.

6.17.3 Vacuum cleaners and blower cleaners

6.17.3.1 Each of three samples of the motor shall be subjected to operation at rated load for 1 h. Immediately following this, the load shall be increased in steps of 10% of the rated current for each of four successive 1-h periods, followed by two 1/2-h periods, followed by eight 1/4-h periods, followed by such additional periods of 5 min each as prove necessary to achieve breakdown of the basic insulation.

6.17.4 Household use floor finishing machines

6.17.4.1 Each of three samples of the complete product shall be subjected to operation at no load for 1/2 h, immediately followed by operation at full load for 1/2 h. Immediately following this, the load shall be increased in steps of 10% of the rated current for each of four successive 1-h periods, followed by two 1/2-h periods, followed by eight 1/4-h periods, followed by such additional periods of 5 min each as prove necessary to produce malfunction or breakdown of the basic insulation.

6.17.5 Test conditions

6.17.5.1 With reference to Clauses 6.17.3.1 and 6.17.4.1, breakdown of the basic insulation shall be considered to have occurred when flame appears or the winding burns open. If flame appears, the overload operation shall be terminated, and the flames extinguished.

6.17.5.2 During the running-overload operation described in Clause 6.17.3.1 or 6.17.4.1, any protective device provided with the motor shall be short-circuited, and the branch-circuit protection shall be of high enough capacity to withstand the test currents without opening the circuit. The objective of the test shall determine the integrity of the motor insulation and not the effectiveness of a protective device.

6.17.5.3 Following the operation described in Clause 6.17.3.1 or 6.17.4.1, the motor shall be given time to cool to room temperature and shall withstand for 1 min, without breakdown, the application of a 60-Hz potential of 1000 V plus twice the rated voltage between:

- a) live parts and accessible noncurrent-carrying metal parts or the foil as mentioned in note b to Table 13 and Figure 14; and
- b) all inaccessible noncurrent-carrying metal parts and accessible noncurrent-carrying metal parts or the foil as mentioned in note b to Table 13 and Figure 14.

6.18 Investigation of armature employing reinforced insulation

6.18.1 If a motor construction includes reinforced armature insulation as mentioned in Clause 6.4.5.1(c), each of three samples of the armature, after each of three conditioning procedures described in Clauses 6.18.2 – 6.18.4, shall withstand for 1 min, without breakdown, the application of a 60 Hz sinusoidal potential of 1000 V plus twice the rated voltage between the armature winding and the noncurrent-carrying metal that is separated from live parts by reinforced insulation.

6.18.2 The three samples mentioned in Clause 6.18.1 shall first be conditioned in an oven for 500 h at a temperature of 120°C (248°F) for a Class A system, 140°C (284°F) for a Class B system or 20°C (68°F) higher than the temperature rating of the insulation, if other than Class A or Class B.

6.18.3 One armature sample shall then be caused to carry the locked rotor current of the motor, another shall be caused to carry half of such locked rotor current, and the third shall be caused to carry one fourth of that locked rotor current. The specified current shall flow in each sample for 4 h unless breakdown of the basic insulation, as defined in Clause 6.17.5.1, occurs before the end of that interval. If breakdown of the basic insulation of a given sample does not occur before the end of the 4-h period, the test shall be continued as long as is necessary to accomplish that result, with the current during each additional hour being increased by 50% of the initial value.

6.18.4 Each sample shall then be rotated at its normal no-load speed for 1 min by any convenient external means.

6.19 Resistance to moisture test

6.19.1 As a result of the applicable tests mentioned in resistance to moisture, Clause 5.12, the appliance shall:

- a) comply with the leakage-current test, Clause 6.12; and
- b) withstand for 1 min, without breakdown, the application of a 60 Hz essentially sinusoidal potential of 2000 V plus twice the rated voltage of the appliance between live parts and accessible noncurrent-carrying metal parts, or the foil mentioned in note b to Table 13 and Figure 14.

6.20 Manufacturing and production tests

6.20.1 Production line dielectric voltage-withstand test

6.20.1.1 Each appliance marked as double insulated shall withstand for one second without electrical breakdown, as a routine production-line test, the application of the potentials indicated in Table 15 in accordance with the test method described in dielectric voltage-withstand, Clause 9.1.

7 Rechargeable Battery-Powered Appliances

7.1 Scope

7.1.1 These requirements apply to portable rechargeable battery-powered appliances for indoor or outdoor use with rechargeable non-user and user replaceable batteries. The rechargeable (secondary) batteries have a nominal operating voltage of 30 V dc, a peak open-circuit potential of not more than 42.4 V, and a maximum capacity of 6 A-h. The batteries are contained within the appliance unit or are part of the appliance unit as a pack. The batteries are intended to be charged by a separate Class 2 power unit, either direct plug-in or cord-connected.

7.1.2 These requirements do not include:

- a) portable rechargeable battery-powered appliances:
 - 1) that are charged by a power unit other than Class 2;
 - 2) with an integral Class 2 or other than Class 2 power unit;
 - 3) using general purpose (non-chargeable) batteries installed by the user;
 - 4) that are supported by the body, not solely hand-held;
 - 5) with a stand alone battery pack that is contained in a separate enclosure and is connected by a cord; or
 - 6) that are automatically or remotely controlled;
- b) portable appliances directly supplied from a battery-powered electrical system of a vehicle such as a connector intended for insertion into a cigarette lighter receptacle; and

- c) stationary or fixed rechargeable battery-powered appliances.

7.1.3 Unless otherwise indicated, these requirements supplement those in Clauses 4, 5, 6, 9, 10, and 11 of this Standard.

7.1.4 The term "Class 2 power unit," as used in these requirements, refers to a direct plug-in or cord-connected Class 2 power unit – Class 2 battery charger, Class 2 power supply, or Class 2 power unit.

7.2 Definitions

7.2.1 See Clause 2.

7.3 General

7.3.1 Components

7.3.1.1 With reference to Clause 3.1, a Class 2 power unit shall comply with the Standard for Power Supplies with Extra-Low-Voltage Class 2 Output, CSA C22.2 No. 223 and the Standard for Class 2 Power Units, UL 1310.

7.3.1.2 A nickel cadmium (Ni-Cad) battery assembly or battery pack shall comply with the applicable requirements of this end-product standard.

7.3.1.3 A nickel metal hydride (Ni-MH) battery assembly or battery pack shall comply with the applicable requirements of this end-product standard.

7.3.1.4 A lithium ion (Li-On) battery shall comply with the requirements for secondary lithium cells in the Standard for Lithium Batteries, UL 1642.

7.3.1.4.1 Factors that shall be taken into consideration when determining the acceptability of the lithium ion battery are:

- a) the ratings and acceptability criteria for the lithium ion battery;
- b) evaluation of multiple batteries or cells when used as a battery pack or integral battery; and
- c) the compatibility of the end-product, battery (cell or pack), and charger.

7.4 Construction

7.4.1 For the requirements specified in Clause 4, the following risks shall be considered for an appliance unit and a battery pack:

- a) fire; and
- b) injury to persons, including battery response.

7.4.2 Enclosures

7.4.2.1 Openings in enclosures

7.4.2.1.1 The requirement in Clause 4.1.2.9 does not apply to a permanently attached wall hung charger base connected to a direct plug-in Class 2 power unit that can be removed from the supply without the use of a tool.

7.4.3 Mechanical assembly

7.4.3.1 A battery assembly shall not be specified for user replacement and shall not be accessible to the user. A battery assembly is considered to be accessible to the user if:

- a) the user can access the battery assembly without the use of a tool, or
- b) access to the battery assembly with a tool the user is instructed to use for any purpose is not prohibited by a cautionary marking in accordance with Clause 7.8.3.2.

Exception: Users may be instructed to remove the battery assembly for proper disposal or recycling at the end of product life.

7.4.4 Terminals

7.4.4.1 Terminals of an appliance unit intended for charging the batteries and terminals of a battery pack shall be guarded or recessed from the face of a connector to reduce the likelihood of short-circuiting. The terminal guard shall restrict contact across the terminals by a straight edge placed in any position across and in contact with edges of the external parts of the appliance unit or the battery pack.

7.4.5 Electrical insulation

7.4.5.1 The requirements in Clause 4.7.2 covering electrical insulation do not apply to an appliance unit and a battery pack.

7.4.6 Motors

7.4.6.1 The requirements in Clause 4.8 covering motors do not apply (see Clause 7.5.11.5).

7.4.7 Switches, relays, and similar controls

7.4.7.1 For the requirements in Clause 4.9.1, a switch or similar control employed in an appliance unit that controls a motor shall have a dc rating not less than that of the circuit it controls.

Exception No. 1: A switch or similar control that controls a motor for a moving part that could cause injury to persons need not comply with this requirement if it complies with the 50 cycle overload test specified in Clause 5.15 (see Clause 7.5.9.1) and the 6000 cycle endurance test specified in Clause 7.5.9.2.

Exception No. 2: A switch or a similar control other than as described in Exception No. 1 need not comply with this requirement if it complies with the 50 cycle overload test specified in Clause 5.15 (see Clause 7.5.9.1).

7.4.8 Spacings

7.4.8.1 With reference to Clause 4.13.1, for an appliance unit or a battery pack, the electrical spacings between uninsulated live parts of opposite polarity and between uninsulated live parts and dead metal parts shall not be less than 1/64 in (0.4 mm).

7.4.9 Protection against injury to persons

7.4.9.1 Surface temperatures

7.4.9.1.1 With reference to Clause 4.16.4.1, the temperature of a surface that can be contacted by the user shall include any accessible surface of an appliance unit, if applicable, including any host area for a battery pack, and a battery pack that becomes accessible when the battery pack is detached.

7.5 Tests

7.5.1 General

7.5.1.1 Testing covering the risk of electric shock, such as the leakage current test, does not apply to an appliance unit and a battery pack (see Clause 7.4.1).

7.5.1.2 For an appliance unit which can be operated for its intended function while electrically connected to the Class 2 power unit, testing shall be conducted under the most onerous condition of supply configuration. In cases where the most onerous condition is not apparent, testing shall be conducted in each applicable mode of operation.

7.5.2 Normal loads

7.5.2.1 General

7.5.2.1.1 With reference to Clause 5.2, testing under normal load shall commence with a fully charged battery assembly for each applicable condition.

7.5.2.2 Portable rechargeable battery-powered vacuum cleaners

7.5.2.2.1 With reference to Clause 5.2.2.1, a portable rechargeable battery-powered vacuum cleaner shall be operated:

- a) as specified in Clause 5.2.2.1; or
- b) with the air intake wide open (unrestricted).

7.5.2.2.2 With reference to the mean wattage input described in Clause 5.2.2.2, the input measurements with the air intake wide open and with the air intake completely blocked shall be made independently and following fully charging the battery assembly.

7.5.3 Starting current

7.5.3.1 The testing specified in Clause 5.6 for starting current does not apply.

7.5.4 Rating

7.5.4.1 General

7.5.4.1.1 The rating requirements specified in Clause 5.7 do not apply.

7.5.4.2 Charging output rating

7.5.4.2.1 The marked output rating in amperes, volt-amperes or watts of a Class 2 power unit shall not be exceeded during the charging operation as specified in Clause 7.5.4.2.2.

Exception: A Class 2 power unit with a measured output that exceeds its marked rating need not comply with the requirement as long as it complies with the temperature test specified in Clause 7.5.5.2.

7.5.4.2.2 To determine whether a Class 2 power unit and an appliance unit, or a battery pack, combination complies with the requirement in Clause 7.5.4.2.1, the combination shall be operated as intended in the charging mode. Testing shall commence with a fully-discharged battery assembly. The charging output shall be measured for a minimum of 90 min.

7.5.5 Temperature

7.5.5.1 With reference to Clause 5.8, a Class 2 power unit and an appliance unit, or a battery pack, combination shall be operated in the charging mode, starting with a fully-discharged battery assembly, until the battery assembly is fully charged. Then, the appliance unit shall be operated under normal load, as specified in Clause 5.2, until it ceases to operate. For an appliance unit with more than one mode of operation, the battery assembly shall be fully recharged between the modes of operation.

7.5.5.2 With reference to the Exception in Clause 7.5.4.2.1, temperature rises on the electrical insulation of a Class 2 power unit shall also be measured during the testing specified in Clause 7.5.5.1.

7.5.5.3 With reference to Clause 7.5.1.2, for an appliance unit which can be operated for its intended function while connected to the Class 2 power unit, testing shall be repeated as specified in Clause 7.5.5.1, except:

- a) the operation in the charging mode shall be continued as necessary until constant temperatures are attained; and
- b) the operation of the appliance unit under normal load shall be conducted with both a fully charged battery assembly and a fully-discharged battery assembly until constant temperatures are attained.

7.5.6 Severe operating conditions

7.5.6.1 The testing specified in Clause 5.9 for severe operating conditions does not apply.

7.5.7 Dielectric voltage-withstand

7.5.7.1 The testing specified in Clause 5.11 for dielectric voltage-withstand does not apply.

7.5.8 Resistance to moisture

7.5.8.1 The testing specified in Clause 5.12 for resistance to moisture does not apply.

7.5.9 Switches, relays, and similar controls

7.5.9.1 With reference to Clause 5.15 and to Exception Nos. 1 and 2 in Clause 7.4.7.1, a switch or similar control shall be tested with the locked-rotor current of the appliance unit having a fully charged battery assembly. The specified 3-A plug fuse connected to ground does not apply.

7.5.9.2 With reference to Exception No. 1 in Clause 7.4.7.1, a switch or similar control shall comply with 6000 cycles of endurance testing in accordance with the standards for switches; see Annex A. Testing shall be conducted making and breaking the current encountered in the fully charged appliance unit operated at no-load. For testing, the connection of dead metal parts through a 15 A or less fuse does not apply. There shall be no electrical or mechanical malfunction of the switch or similar control. At the conclusion of the test, the switch or similar control shall be capable of performing its normal function and there shall be no loosening of parts or any other defect that will diminish appreciably the usefulness and reliability of the switch or similar control.

7.5.10 Physical abuse

7.5.10.1 With reference to Clause 5.19.1.1, an appliance unit employing an integral battery or a battery pack shall withstand the impacts without any occurrence as specified in (a) for reduction of spacings that would increase the risk of fire, (b), or (d) of Clause 5.19.1.1. There shall also be no occurrence such as cracking or breaking that would allow exposure or loss of containment of electrolyte.

7.5.10.2 With reference to Clause 7.5.10.1, an appliance unit with a battery pack shall withstand the impacts with and without the battery pack attached as intended to the appliance unit and the battery pack shall be subjected to the impacts alone.

Exception: A battery pack that complies with the Standard for Household and Commercial Batteries, UL 2054, including the external enclosure requirements, need not be subjected to the impacts alone.

7.5.11 Polymeric enclosure parts

7.5.11.1 Resistance to hot-wire ignition

7.5.11.1.1 With reference to Clause 5.21.2.1, the minimum requirement does not apply to a polymeric material enclosing live parts of:

- a) an appliance unit and a battery pack that complies with the abnormal overload test, Clause 5.26 (see Clause 7.5.14); or
- b) a battery pack that complies with the Standard for Household and Commercial Batteries, UL 2054, including the external enclosure requirements.

7.5.11.2 Mold stress-relief distortion

7.5.11.2.1 With reference to Clause 5.21.3, an appliance unit employing an integral battery or battery pack shall withstand the conditioning without any occurrence specified in (a) for reduction of spacings that would increase the risk of fire, (b), or (d) of Clause 5.21.3.1. There shall also be no occurrence such as cracking, shrinkage, warpage, or other distortion of the enclosure that would increase the risk of exposure or loss of containment of electrolyte.

Exception: A battery pack that complies with the Standard for Household and Commercial Batteries, UL 2054, including the external enclosure requirements, need not be subjected to the mold stress-relief distortion test.

7.5.11.3 Impact – outdoor use

7.5.11.3.1 When testing in accordance with Clause 5.21.4, each of three samples of an appliance unit employing an integral battery or battery pack that is intended for outdoor use shall withstand the impacts as described in Clause 7.5.10 without occurrence as specified in Clause 7.5.10.1 (see Clause 7.5.10.2).

Exception: For an appliance marked in accordance with Clause 7.8.3.2, the conditioning temperature shall be $0 \pm 2^{\circ}\text{C}$ ($32 \pm 3.6^{\circ}\text{F}$).

7.5.11.4 Severe conditions

7.5.11.4.1 With reference to Clause 5.21.5, Clause 5.21.5.3(b) does not apply.

7.5.11.5 Abnormal operation

7.5.11.5.1 The appliance unit shall be subjected to the testing in Clause 5.21.7 under the conditions specified in Clause 7.5.11.5.2. Testing for each condition shall commence with a fully charged battery assembly. As a result of the testing there shall be no:

- a) ignition of the combustible material that the appliance is placed on or draped with as a result of emission of flames;
- b) exposure of internal wiring and other insulated or uninsulated live parts, as determined by accessibility of live parts, Clause 4.1.4;
- c) condition that would allow exposure or loss of containment of electrolyte; and
- d) rupturing or expulsion of a cell casing or battery pack enclosure.

7.5.11.5.2 The appliance unit shall be subjected to the testing described in Clause 7.5.11.5.1 with the:

- a) rotor/armature of the motor mechanically stalled; and
- b) motor terminals short-circuited.

7.5.11.6 Exposure to ultraviolet light – outdoor use

7.5.11.6.1 A polymeric material used for the enclosure of an appliance unit and a battery pack that is intended to be used outdoors shall be acceptably resistant to degradation when exposed to ultraviolet light.

Exception No. 1: An appliance unit and a battery pack that is marked in accordance with Clause 7.8.3.3 need not comply with the requirement.

Exception No. 2: A battery pack that complies with the Standard for Household and Commercial Batteries, UL 2054, including the external enclosure requirements, need not comply with the requirement.

7.5.12 Polymeric materials used as structural support

7.5.12.1 The testing specified in Clause 5.22 for polymeric materials used as structural support does not apply to the appliance unit.

7.5.13 Thermoplastic motor insulation systems

7.5.13.1 The testing specified in Clause 5.24 for thermoplastic motor insulation systems does not apply to an appliance unit.

7.5.14 Abnormal overload

7.5.14.1 When testing in accordance with Clause 5.26, the testing shall commence with a fully charged battery pack.

7.5.15 Battery venting – NiCad and Ni-MH

7.5.15.1 A battery assembly, which may be provided as a battery pack, employing NiCad batteries shall be subjected to the test specified in Clause 7.5.15.2. As a result of the test, there shall be:

- a) venting of the battery assembly as exhibited by emission of gas bubbles in the oil medium;
- b) no rupturing, expulsion or distortion of a cell casing or battery pack enclosure; and
- c) no leaking or expulsion of the battery electrolyte.

7.5.15.2 A fully charged battery assembly, which may be provided as a battery pack, shall be immersed in a container of non-conductive oil and then be discharged by short-circuiting the battery terminals. Any protective device provided for the battery assembly shall be defeated during testing. Operation shall be continued until ultimate results.

7.6 Double insulation

7.6.1 The requirements specified in Clause 6 covering double insulation do not apply for an appliance unit and a battery pack.

7.7 Manufacturing and production tests

7.7.1 The requirements specified in Clause 9 covering manufacturing and production tests do not apply.

7.8 Markings

7.8.1 General

7.8.1.1 With reference to Clause 10, for an appliance unit and a battery pack, the markings shall pertain to the risk of fire and injury to persons, including battery response.

7.8.1.2 With reference to Clause 10.1.1, the appliance unit shall be permanently and plainly marked with (a), (b) and (c).

7.8.2 Details

7.8.2.1 With reference to Clause 10.3.13, the appliance unit shall be marked with "For Household Use Only," "Household Type," or the equivalent.

7.8.2.2 An appliance unit and a battery pack shall be permanently and plainly marked: "For Use Only With + Charger", or the equivalent.

+Replace with the Class 2 power unit manufacturer's name and model/catalog number.

7.8.2.3 An appliance unit provided with a user replaceable battery pack shall be permanently and plainly marked: "For use only with + battery", or the equivalent. The battery pack shall be marked with the manufacturer's name and battery model/catalog number.

+Replace with the manufacturer's name and model/catalog number.

7.8.3 Cautionary

7.8.3.1 A Class 2 power unit shall be permanently and plainly marked with the word "CAUTION" and the following statement or the equivalent, unless suitable for outdoor use:

a) "For Indoor Use Only" or

b) "Risk of Electric Shock – Dry Location Use Only" or "Risk of Electric Shock – Do Not Expose to Liquid, Vapor, or Rain" in accordance with the standards for Class 2 power units, see Annex A.

7.8.3.2 With reference to Clause 7.4.3.1(b), a battery assembly that is considered to be accessible to the user with a tool they are instructed to use for any purpose shall be marked with the word "CAUTION" and the following statement: "Risk of Fire or Injury To Persons – No User-Serviceable Parts Inside" or "– No User-Replaceable Parts Inside", or the equivalent. The marking shall be located on or adjacent to the cover of the compartment.

7.8.3.3 With reference to the Exception in Clause 7.5.11.3 and the Exception No. 1 in Clause 7.5.11.6.1, an appliance unit and a battery pack that is intended to be used outdoors shall be permanently marked with the word "CAUTION" and the following statement: "Store Indoors", or the equivalent. The marking shall be readily visible while the appliance unit and battery pack is in use or being readied for use.

7.9 Instruction manual

7.9.1 General

7.9.1.1 With reference to Clause 11, for an appliance unit and a battery pack, the instructions shall pertain to the risk of fire and injury to persons, including battery response, and for the complete rechargeable battery-powered appliance, which includes the Class 2 power unit, the instructions shall also include risk of electric shock.

7.9.2 Instructions pertaining to a risk of fire, electric shock, or injury to persons

7.9.2.1 With reference to Clause 11.2.6, the instructions for a rechargeable battery-powered appliance shall include, as applicable: (also see Clause 11.2.7).

- a) all of the items in the list, with the omission of items 1 and 11;
- b) with reference to item 2 in the list, the applicable item from Table 17 shall include “Do not use outdoors or on wet surfaces”;
- c) with reference to item 8 in the list, the following text may be used in lieu of it: “Do not handle charger, including charger plug, and charger terminals with wet hands”; and
- d) the following additional items:
 - 1) Do not charge the unit outdoors.
 - 2) Use only the charger supplied by the manufacturer to recharge.
 - 3) Do not incinerate the appliance even if it is severely damaged. The batteries can explode in a fire.

8 Current-carrying hoses and accessory electrified wall valves

8.1 Scope

8.1.1 These requirements cover:

- a) current-carrying hoses for use with vacuum cleaner/motorized nozzle combination appliances intended for household, dry pick-up, indoor use;
- b) current-carrying hoses for use with motorized nozzles intended for use with central vacuum cleaning systems intended for household, dry pick-up, indoor use;
- c) wet pick-up current-carrying hoses for use with household, indoor use carpet cleaning equipment; and
- d) electrified wall valves for connection of current-carrying hose/motorized nozzle combinations for central vacuum cleaning systems intended for household use.

8.1.2 These requirements supplement those in Clauses 1 – 6 and Clause 10 of this Standard.

8.2 Construction – general

8.2.1 A current-carrying hose, as covered by these requirements, consists of individually insulated copper, copper-clad steel, or steel-reinforced copper conductors that are additionally insulated by the hose structure. The conductors may be used for structural support of the hose.

8.2.2 An electrified wall valve for a central vacuum cleaning system intended for the connection of a current-carrying hose/motorized nozzle combination shall be configured as shown in Figure 21. See Clause 8.2.5. In addition, the wall-valve assembly shall comply with the applicable requirements in the Standard for Metallic Outlet Boxes, CSA C22.2 No. 18.1, and the Standard for Metallic Outlet Boxes, UL 514A; or the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, C22.2 No. 18.2, and the Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers, UL 514C.

8.2.3 The configuration of the field wiring leads to the connector of a wall-valve assembly shall be as shown in Figure 22.

8.2.4 The end fitting of a current-carrying hose intended for connection to a central vacuum cleaner wall valve, employing direct supply connections for electrical accessories, shall be configured as shown in Figure 23. See Clause 8.2.5.

8.2.5 A current-carrying hose/electrified wall-valve combination employing a configuration other than that specified in Clauses 8.2.2 and 8.2.4 shall have the hose and wall valve marked in accordance with Clauses 8.16.6, 11.5.13, and the Exception to Clause 11.5.15.

8.2.6 All accessible noncurrent-carrying metal parts of a central vacuum cleaner's electrified wall valve assembly (outlet assembly) that are likely to be energized shall be connected to the equipment grounding conductor or equipment grounding terminal of the valve assembly. Parts that are not considered likely to be energized are metal screws or rivets in polymeric enclosures or faceplates, external metal springs used on a self-closing polymeric cover, and the like. Electrified wall valves connected to an extra-low voltage circuit are excluded from this requirement.

8.3 Tests – general

8.3.1 Unless otherwise specified, each sample that is subjected to the tests described in Clauses 8.4 – 8.15 shall be of the length intended for normal use.

8.4 Dielectric voltage-withstand test

8.4.1 A current-carrying hose shall withstand without breakdown for 1 min the application of a 60 Hz essentially sinusoidal potential as described in the dielectric voltage-withstand test, Clause 5.11 when tested in accordance with Clauses 8.4.2 or 8.4.3, and 8.4.4.

8.4.2 A sample of a dry pick-up hose, including the complete end fittings, shall be tested in the as-received condition. The sample shall be suspended in a vertical position with 2 ft (0.61 m) of the hose and the complete end fitting placed into a container. The container and the inside of the hose section that is within the container shall be filled with No. 7-1/2 conductive shot, except that, if agreeable to those concerned, smaller shot may be used. For the purpose of this test, an uninsulated live part, such as a pin terminal, used to facilitate a user separable connection shall be insulated. Additionally, any opening in a hose end fitting that complies with accessibility to live parts, Clause 4.1.4, may be sealed.

8.4.3 A sample of a wet pick-up current-carrying hose shall be tested while immersed in a solution consisting of 0.5 g of sodium chloride per liter of distilled water. All the air shall be displaced by the solution from the interior of the hose during the immersion.

Exception: The external portion of the vacuum cleaner connector end may be tested using the lead shot specified in Clause 8.4.2.

8.4.4 After preparation as described in Clause 8.4.2 or 8.4.3, the potential shall be applied between current-carrying conductors of opposite polarity, and between current-carrying conductors and the conductive shot or solution. The test shall be conducted on each end of the sample if different end fittings are employed.

8.5 Leakage-current test

8.5.1 The leakage current of a current-carrying hose, when tested as described in Clause 8.5.2, shall not be more than 0.5 MIU.

8.5.2 A sample of the current-carrying hose assembly shall be tested in the as-received condition. The sample shall be prepared as described in Clause 8.4.2 or 8.4.3, as applicable. The leakage current shall be measured from the conductive shot for a dry pick-up hose, and from the solution for a wet pick-up hose. The test method shall be as specified for leakage-current, Clause 5.3, and leakage-current after humidity conditioning, Clause 5.4.

8.6 Oven conditioning test

8.6.1 After being conditioned as described in Clause 8.6.2, the insulation of a current-carrying hose shall not show excessive deterioration – for example, cracking, flaking, or softening – and shall comply with the dielectric voltage-withstand test specified in Clause 8.4.1.

8.6.2 Three samples of the complete current-carrying hose assembly shall be conditioned for 7 h in an air-circulating oven at 70°C (158°F). After being removed from the oven, the samples shall be examined for deterioration. For the purpose of this test, discoloration of the hose material shall not be considered deterioration.

8.6.3 Additional samples to be conditioned as described in Clause 8.6.2 prior to further testing shall remain at normal room temperature for a minimum of 24 h after removal from the oven before such tests are conducted.

8.7 Voltage drop test

8.7.1 The voltage drop across a current-carrying hose shall not exceed 6% of the rated voltage when the hose is tested as described in Clause 8.7.2.

Exception: The voltage drop may exceed 6 percent if it is determined in the end-use application that such a drop does not have an adverse effect on the motorized nozzle connected to the hose.

8.7.2 The hose shall be connected to a 60 Hz supply circuit that causes it to carry rated current. This condition shall continue until temperatures stabilize, at which time the maximum voltage drop across both conductors shall be measured.

8.8 Temperature test

8.8.1 A current-carrying hose shall be tested as described in Clause 8.8.2. During the test:

- a) the temperature rise of the insulation material (see Clause 8.2) shall not exceed 35°C (63°F) at any point; and
- b) no other material or component part shall exceed the temperature rises specified in Table 9.

8.8.2 The hose shall be placed on a softwood surface and shall be connected to a 60 Hz supply circuit that causes the hose to carry rated current. The test shall be continued until constant temperatures are reached. Temperatures shall be measured using thermocouples.

8.9 Overload test

8.9.1 Two samples of the hose, one in the as-received condition and one subjected to the oven conditioning specified in Clause 8.6, shall be tested as described in Clause 8.9.2. During the test, there shall be no evidence of a risk of fire and, upon completion of the test, the hose shall comply with the dielectric voltage-withstand test, Clause 8.4. If, after the procedure described in Clause 8.9.2, sections of the hose exhibit more deterioration than the sections being subjected to dielectric testing, then a 2-ft (0.61-m) long sample of the more deteriorated section or sections of the hose shall also be subjected to the dielectric voltage-withstand test, Clause 8.4.

8.9.2 The hose shall be placed on a softwood surface that is covered by a single layer of white tissue paper. It shall be connected to a circuit that causes the hose to carry rated locked-rotor current continuously for 7 h.

8.10 Limited overcurrent test

8.10.1 A current-carrying hose shall be tested as described in Clauses 8.10.2 – 8.10.5. During the test, there shall be no evidence of a risk of fire, and, upon completion of the test, there shall be no exposure of current-carrying parts.

8.10.2 Three samples of a current-carrying hose in the as-received condition shall be tested. Each sample shall be placed on a softwood surface that is covered by a single layer of white tissue paper and draped with a single layer of cheesecloth. For a hose that is less than 15-ft (4.6-m) long, the hose shall be tested in a straight configuration. For a hose that is 15 ft (4.6 m) or longer:

- a) two-thirds of the hose at the end intended for connection to the test circuit shall be in a coiled configuration having a 0.5-m inner diameter of the coil; and
- b) one-third of the hose at the end intended for connection to the power nozzle shall be in a straight configuration.

8.10.3 The conductors at the end of the hose intended for connection to the power nozzle shall be externally connected together. The other end of the hose shall be connected in series with 18 AWG (0.82 mm²) Type SVT cord to a 120 V, 60 Hz test circuit with a power factor of 0.9 to 1.0. Without the hose in the circuit, the circuit shall have a short-circuit capacity of 200 A. The length of the cord shall be 18 ft (5.5 m) for a hose intended for use with a portable appliance, or 6 ft (1.8 m) for a hose intended to be connected directly to the source of electrical supply. The hose may be connected in parallel with a load representing a vacuum cleaner of the minimum rating intended to be used with the hose assembly.

8.10.4 A 3-in (76-mm) long, 99.9% silver, 0.02-in (0.53-mm) diameter wire employed as described in Clause 8.10.5, or the fuse provided in the appliance, shall be connected in series with the hose under test. If there is no evidence of a risk of fire, the test shall continue until the series silver wire opens at least one inch from either terminal to which it is connected, the appliance fuse opens, or for a period of 7 h, whichever occurs first.

8.10.5 The silver wire mentioned in Clause 8.10.2 shall be placed horizontally along the center line of a box with approximate inside dimensions of 3-1/2-in (89-mm) long, 1-3/4-in (45-mm) wide, and 3-in (76-mm) high. Two wiring terminals shall be spaced 3 in apart inside the box, and one end of the silver wire shall be connected to each terminal so that the wire measures 3 in from terminal to terminal. The silver wire shall be connected to the hose under test with 12 AWG (3.3 mm²) copper wire connected through wireways (small openings or holes) in the sides of the box.

8.11 Crushing test

8.11.1 A current-carrying hose shall be subjected to a crushing force of 500 lbs (2224 N) as described in Clause 8.11.2. While the force is maintained at 500 lbs, the hose shall withstand for 1 min without breakdown the application of a 60 Hz essentially sinusoidal potential as specified in the dielectric voltage-withstand test, Clause 5.11. Following the test, there shall be no exposure of any uninsulated live parts.

8.11.2 A current-carrying hose in the as-received condition and one that has been conditioned as described in oven conditioning test, Clause 8.6, shall be tested. Each sample shall not be less than 8-in (203-mm) long. The hose shall be:

- a) placed between two 4- by 4-in (102- by 102-mm), 1/2-in (12.7-mm) thick steel plates with a 1/16-in (1.6-mm) radius at the edges; and
- b) positioned so that its major axis is perpendicular to two opposite edges of the steel plates.

8.11.3 The sample and the plates shall then be placed in a testing machine that will decrease the distance between the plates at a rate of not more than 1/2 in/min (12.7 mm/min). The crushing force shall be applied until a force of 500 lbs (2224 N) is reached. The dielectric potential shall then be applied between:

- a) each current-carrying conductor;
- b) the current-carrying conductors and the steel plates; and
- c) the current-carrying conductors and any noncurrent-carrying metal provided.

8.12 Thermal shock test

8.12.1 After being conditioned as described in Clause 8.12.3, a current-carrying hose shall comply with the dielectric voltage-withstand requirement in Clause 8.4.1.

8.12.2 A current-carrying hose in the as-received condition and one that has been conditioned as described in oven conditioning test, Clause 8.6, shall be tested. Each sample shall be 24-in (61.0-cm) long and shall be subjected to a total of 10 cycles of conditioning described in Clause 8.12.3.

8.12.3 Each sample shall be bent to form the shape shown in Figure 15, and shall be secured at a distance of 1 in (25 mm) from each end. The hose shall be conditioned for 3 h in an air-circulating oven at a temperature of 65°C (149°F). Immediately after being removed from the oven, the sample shall be conditioned for 3 h at a temperature of minus 20°C (minus 4°F). Between 15 – 20 s after removal from the freezer, the hose shall be flexed three times, as illustrated in Figure 16, at a rate of one flex per second. To complete a cycle of conditioning, the sample shall be returned to room temperature.

8.13 Flexing test

8.13.1 Vertical

8.13.1.1 A current-carrying hose in the as-received condition and one that has been conditioned as described in oven conditioning test, Clause 8.6, shall be tested as described in Clauses 8.13.1.3 and 8.13.1.4. Each sample shall be 4 ft (1.2 m) long, exclusive of the attached end fitting or cuff. Following the test:

- a) the conductors in each sample shall be unbroken and undamaged as demonstrated by energizing the hose so that rated current flows for 1 min;
- b) each sample shall comply with the dielectric voltage-withstand test, Clause 8.4;
- c) the end fitting shall not separate from the hose; and
- d) no sample shall have an increase of more than 10% in electrical resistance of the hose assembly.

8.13.1.2 The test described in Clauses 8.13.1.3 and 8.13.1.4 shall be repeated on additional samples employing the opposite end fitting if it is of a different construction from the one tested.

8.13.1.3 The end fitting or cuff shall be mounted to the test apparatus illustrated in Figure 17. A weight of 11 lbs (4.98 kg) shall be attached to the free end. To avoid swaying of the weight, an adjustable deflection plate shall be employed. Initially, the height of the test fixture shall be adjusted so that at the bottom of the stroke, the weight just comes to rest on the supporting plate. No further adjustment to the height shall be made unless the weight is not lifted from the supporting plate at any time during a cycle. At that time, the height shall be readjusted as described for initial adjustment. The hose end fitting shall be mounted on the pivot arm so that the point where the hose enters the end fitting is 12 in (305 mm) from the arm pivot point.

8.13.1.4 Each cycle of operation shall consist of rotating the fixture arm upward 40° and returning it to the horizontal. The test apparatus shall be operated for 2500 cycles at a rate of 10 cycles per minute. The fixed end shall then be rotated 90° and operated for an additional 2500 cycles. This procedure shall be repeated two additional times, rotating the fitting an additional 90° each time, for a total of 10,000 cycles.

8.13.2 Horizontal

8.13.2.1 A current-carrying hose in the as-received condition and one that has been conditioned as described in oven conditioning test, Clause 8.6, shall be tested as described in Clause 8.13.2.2. Each sample shall be 4-ft (1.2-m) long, exclusive of the attached end fitting or cuff. Following the test:

- a) the conductors in each sample shall be unbroken and undamaged as demonstrated by energizing the hose so that rated current flows for 1 min;
- b) each sample shall comply with dielectric voltage-withstand test, Clause 8.4; and
- c) no sample shall have an increase of more than 10% in electrical resistance of the hose assembly.

8.13.2.2 The hose shall be secured at one end to a test apparatus that will provide a horizontal reciprocating motion having a total travel of $12 \pm 1/4$ in (305 ± 6.4 mm). The reciprocating motion shall be generated through a 24-in (610-mm) long connecting rod that is moved in a sinusoidal motion by a 6-in (152-mm) long driving arm rotating at 36 ± 1 revolutions per minute. See Figure 18. The hose shall be placed over a pulley, illustrated in Figure 19. The pulley side walls may be increased to any convenient diameter necessary to hold the hose to the center line. The free end shall be attached to a 10 lb ± 1 oz (4.54 ± 0.03 kg) weight. With the weight guided to prevent swinging, the test shall be conducted for 20,000 cycles – one cycle consisting of one forward and one reverse movement of the reciprocating apparatus.

8.14 Abrasion test

8.14.1 General

8.14.1.1 A current-carrying hose shall be tested as described in Clauses 8.14.2 and 8.14.3 without exposing a current-carrying part, as determined by visual examination and by compliance, after testing, with the dielectric voltage-withstand test, Clause 8.4.

8.14.2 External

8.14.2.1 A 2-ft (0.61-m) long sample that includes the section passed over the emery cloth surface as specified in Clause 8.14.2.2 shall be used for the dielectric voltage-withstand test.

8.14.2.2 One sample, 4-ft (1.2-m) long, of a current-carrying hose in the as-received condition and one sample of the same length that has been conditioned as described in oven conditioning test, Clause 8.6, shall be tested. The samples shall be passed over a 2 – 3-in (51 – 76-mm) wide piece of emery cloth as described in Clause 8.14.2.3. The emery cloth shall be supported by the 90° arc of a cylinder having a 7-1/2-in (191-mm) radius. With one end of the hose secured to the reciprocating apparatus described in Clause 8.13.2.2, and with the free end of the hose attached to a 2-1/2 lb (1.13 kg) weight, the hose shall be positioned so that the midpoint of the hose is at the center of the emery cloth at the middle of the cycle. With the weight guided to prevent swinging, the hose shall pass over the emery cloth surface for 350 cycles – one cycle consisting of one forward and one reverse movement of the reciprocating apparatus.

8.14.2.3 The emery cloth mentioned in Clause 8.14.2.2 shall be No. 120 grit and shall be an aluminum oxide abrasive. The emery cloth shall have a cloth backing and an enclosed type of coating.

8.14.3 Internal

8.14.3.1 The entire length of the hose shall be subjected to the dielectric voltage-withstand test by testing a series of 2-ft (0.61-m) long segments.

8.14.3.2 One 4-ft (1.2-m) long sample of a current-carrying hose in the as-received condition and one sample of the same length that has been conditioned as described in oven conditioning test, Clause 8.6 shall be tested. Each sample shall be provided with fittings for connection to the power nozzle and vacuum cleaner so that normal suction is provided. The hose shall lie in a horizontal plane and the midpoint of the hose shall be formed around a 90° arc of a cylinder having a 10-in (254-mm) radius. The air flow through the hose shall be maintained at 50 ft³ (1.4 m³) per minute. The vacuum cleaner shall be energized and the hose is to pick up 100 lbs (45.4 kg) of previously unused 50 – 70 core silica sand at a rate of 5 lbs (2.3 kg) per minute. Each sample shall pick up the sand five times so that a total of 500 lbs (227 kg) of sand is picked up.

8.15 Wet pick-up

8.15.1 General

8.15.1.1 A current-carrying hose that is to be used as a component in a designated model of a household carpet cleaning appliance intended by the manufacturer for wet pick-up shall comply with the requirements for double-insulation specified in Clause 6.

8.15.1.2 For the purposes of these requirements, the interior surface of a wet pick-up current-carrying hose shall be considered accessible.

8.15.2 Immersion test

8.15.2.1 Two samples of a complete wet pick-up current-carrying hose, including end-fittings, shall be subjected to the immersion conditioning and tests specified in Clause 8.15.2.2. One sample shall be in the as-received condition; and one sample shall be conditioned in an air-circulating oven for 7 h at 70°C (158°F).

8.15.2.2 The samples described in Clause 8.15.2.1 shall be immersed for 7 days at 70°C (158°F) in the test solution supplied or recommended by the manufacturer, and mixed according to the manufacturer's recommendations. All the air shall be displaced by the solution from the interior of the hose during the immersion. After conditioning, each hose sample shall be subjected to the dielectric voltage-withstand test specified in Clause 8.4.3, and the thermal-shock test, Clause 8.12.

8.16 Marking

8.16.1 A current-carrying hose shall be permanently marked with the statement: "This Hose Contains Electrical Wires," or the equivalent. This marking shall be in letters not less than 3/32-in (2.4-mm) high, and visible either during assembly to the appliance or while in use.

8.16.2 A current-carrying hose as described in Clause 8.2.4 shall be permanently marked on the end-fitting intended for connection to the wall valve with the following: "Connect Only to a Type A Wall Valve."

8.16.3 A wall valve as described in Clause 8.2.2 shall be permanently marked where visible after installation with the following: "Central Vacuum Cleaning System Wall Valve – Type A."

8.16.4 A wall valve shall be marked and rated with an electrical rating of 120 V, 60 Hz, 7 A.

8.16.5 A wall valve shall be marked "For Household Use Only" or the equivalent.

8.16.6 A current-carrying hose/electrified wall-valve combination as described in Clause 8.2.5 shall be marked with the word "WARNING " and the following or the equivalent:

a) on the wall valve: "To reduce the risk of electric shock connect only (hose manufacturer's name) electric hose, Cat. No. ___ to this wall valve."; and

b) on the hose: " To reduce the risk of electric shock, connect only to (valve manufacturer's name) electrified wall valve, Cat. No. ___."

9 Manufacturing and production tests

9.1 Dielectric voltage-withstand

9.1.1 Each appliance shall withstand without electrical breakdown, as a routine production-line test, the application of a potential at a frequency within the range of 40 – 70 Hz between the primary wiring and:

a) accessible noncurrent-carrying metal parts that are likely to become energized; and

b) accessible extra-low voltage (42.4 V peak or less) metal parts, including terminals.

9.1.2 The production-line test shall be in accordance with either Condition A or Condition B of Table 16.

9.1.3 The appliance may be in a heated or unheated condition for the test.

9.1.4 The test shall be conducted when the appliance is fully assembled. It is not intended that the appliance be unwired, modified, or disassembled for the test.

Exception No. 1: A part such as a snap cover or a friction-fit knob that would interfere with performance of the test need not be in place.

Exception No. 2: The test may be conducted before final assembly if the test represents that for the complete appliance.

9.1.5 If the appliance employs a solid-state component that is not relied upon to reduce a risk of electric shock and that can be damaged by the dielectric voltage-withstand potential, the test mentioned in Clause 9.1.1 may be conducted before the component is electrically connected provided a random sampling of each day's production is tested at the potential specified in Table 16. The circuitry may be rearranged for the purpose of this test to reduce the likelihood of solid-state component damage while retaining representative dielectric stress of the circuit.

9.1.6 The test equipment shall include a transformer having an essentially sinusoidal output, a means of indicating the test potential, an audible or visual indicator of electrical breakdown, and either a manually reset device to restore the equipment after electrical breakdown or an automatic feature that rejects any unacceptable unit.

9.1.7 If the output rating of the test equipment transformer is less than 500 VA, the equipment shall include a voltmeter in the output circuit to directly indicate the test potential.

9.1.8 If the output rating of the test equipment transformer is 500 VA or more, the test potential may be indicated:

- a) by a voltmeter in the primary circuit or in a tertiary winding circuit;
- b) by a selector switch marked to indicate the test potential; or
- c) by a marking in a readily visible location to indicate the test potential of equipment having a single test potential output. When a marking is used without an indicating voltmeter, the equipment shall include a positive means, such as a power-on lamp to indicate that the manually reset switch has been reset following a dielectric breakdown.

9.1.9 Test equipment, other than that described in Clauses 9.1.6 – 9.1.8, may be used if found to accomplish the intended factory control.

9.1.10 During the test, the primary switch shall be in the on position, both sides of the primary circuit of the appliance shall be connected together and to one terminal of the test equipment, and the second test-equipment terminal shall be connected to the accessible noncurrent-carrying metal.

Exception No. 1: An appliance – resistive, high-impedance winding, or the like – having circuitry not subject to excessive secondary-voltage build-up in case of electrical breakdown during the test may be tested with a single-pole primary switch, if used, in the OFF position, or with only one side of the primary circuit connected to the test equipment when the primary switch is in the ON position, or when a primary switch is not used.

Exception No. 2: The primary switch is not required to be in the ON position if the testing means applied full test potential between primary wiring and noncurrent-carrying metal parts with the switch not in the ON position.

9.2 Grounding-continuity

9.2.1 Each appliance that has a power-supply cord having a grounding conductor shall be tested, as a routine production-line test, to determine that grounding continuity exists between the grounding blade of the attachment plug and the accessible noncurrent-carrying metal parts of the appliance that are likely to become energized.

9.2.2 Only a single test need be conducted if the accessible noncurrent-carrying metal part selected is conductively connected by design to all other accessible noncurrent-carrying metal parts.

9.2.3 Any suitable indicating device – an ohmmeter, a battery-and-buzzer combination, or the like – may be used to determine compliance with the grounding continuity requirement in Clause 9.2.1.

10 Marking

Advisory Note: In Canada, there are two official languages, English and French. Annex B lists some examples of French translations of the markings specified in this Standard.

10.1 General

10.1.1 An appliance shall be plainly and permanently marked where it will be readily visible – after installation, in the case of a permanently connected appliance – with;

- a) the manufacturer's name, trade name, trademark, or other descriptive marking by which the organization responsible for the product may be identified;
- b) a distinctive catalog number or the equivalent;
- c) the date or other dating period of manufacture not exceeding any three month period;
- d) the electrical rating; and
- e) for an appliance intended for connection to a 120/240 V, 3-wire, single-phase power source – "3-wire."

Exception No. 1: The manufacturer's identification may be in a traceable code if the appliance is identified by the brand or trademark owned by a private labeller.

Exception No. 2: The date of manufacture may be abbreviated or in a nationally accepted conventional code or in a code affirmed by the manufacturer, provided that the code:

- a) does not repeat in less than 10 years for a household appliance, and less than 20 years for a commercial appliance; and*
- b) does not require reference to the manufacturer's records to determine when the appliance was manufactured.*

10.1.2 The electrical rating specified in Clause 10.1.1(d) shall include volts, frequency – expressed in hertz, Hz or DC, or both – and amperes. Watts may also be included. The number of phases shall be included in the rating of an appliance intended for use on a polyphase circuit. No other ratings, such as horsepower, shall be included.

10.1.3 An appliance having provision for an electrical attachment, such as a motorized nozzle, that is not provided with the appliance shall be marked in accordance with Clause 10.1.2 to separately identify the input with and without the attachment. See Clause 10.1.4.

10.1.4 An appliance having provision for an electrical attachment, such as a motorized nozzle, that is not provided with the appliance shall be marked on the surface adjacent to the power receptacle to specify the attachment intended to be used.

10.1.5 An attachment that is packaged and marketed separately from the basic appliance shall be marked with a distinctive catalog number or the equivalent.

Exception: A nonelectrical attachment, such as a crevice tool, an upholstery brush, or the like that has no driven parts and is intended to facilitate a cleaning operation without the use of a liquid need not be investigated.

10.2 Permanence

10.2.1 Markings required by this Standard shall be permanent and shall be molded, die-stamped, paint-stencilled, stamped or etched metal that is permanently secured, or indelibly stamped lettering on a pressure-sensitive label secured by adhesive that, upon investigation, is found to be acceptable for the application. Ordinary usage, handling, storage and the like of an appliance shall be considered in the determination of the permanence of a marking.

10.2.2 Unless it has been investigated and found to be acceptable for the application, a pressure-sensitive label or a label that is secured by cement or adhesive and that is required to be permanent shall comply with the standard for marking and labeling systems, see Annex A.

10.3 Details

10.3.1 If the appliance is equipped with a single motor as the only electrical energy consuming component and the electrical rating appears on the motor nameplate, the rating need not appear elsewhere on the equipment, provided that the motor nameplate is readily visible with the motor installed as intended. See Clause 5.7.1.

10.3.2 A cord-connected appliance equipped with a dual-voltage motor with the motor nameplate used to show the electrical rating, as indicated in Clause 10.3.1, shall be provided with an additional permanent marking to indicate the particular voltage for which the equipment is intended to be connected when shipped from the factory.

10.3.3 If a manufacturer produces or assembles appliances at more than one factory, each finished appliance shall have a distinctive marking by which it may be identified as the product of a particular factory. This marking need not be readily visible.

10.3.4 If the capacitor or capacitor/transformer unit mentioned in Clause 4.10.4 is not physically a part of the appliance, it shall be marked with an identification symbol. This symbol shall also appear on the nameplate of the motor.

10.3.5 If an appliance will not start and reach normal running speed when connected to a circuit protected by an ordinary – not a time-delay – fuse as described in Clause 5.6.1, the appliance shall be plainly marked with the following or the equivalent, "If connected to a circuit protected by fuses, use time-delay fuses, marked Type D, with this appliance."

10.3.6 A stationary appliance employing an attachment plug in accordance with Exception 1 to Clause 4.4.1.4 shall be marked "Connect To Individual Branch Circuit." This marking shall be included with the electrical rating marking of Clause 10.1.1.

10.3.7 A commercial vacuum cleaner employing an attachment plug in accordance with Exception No. 2 to Clause 4.4.1.4 shall be marked "Connect Only To A Dedicated Individual Branch Circuit." This marking shall be included with the electrical rating marking specified in Clause 10.1.1(d).

10.3.8 An appliance shall not be marked with a double insulation symbol (a square within a square), the words "double insulation," or the equivalent unless it complies with the requirements for double insulated appliances specified in Clause 6.

10.3.9 A double insulated appliance shall be permanently marked with the statement "DOUBLE INSULATION – When servicing, use only identical replacement parts." The words "DOUBLE INSULATED" or the double insulation symbol – a square within a square – may be used instead of "DOUBLE INSULATION" in the marking.

10.3.10 If a specific spacing is necessary between a central vacuum cleaner and the surfaces of the test alcove described in Clause 5.2.3.1 to reduce the likelihood of attaining temperatures within the appliance or on adjacent surfaces in excess of those specified in Table 9, the appliance shall be permanently marked in a location that will be readily visible after installation with the following or the equivalent: "Mount at least...inches from side walls (and floor or ceiling)."

10.3.11 If an outdoor exhaust is necessary on a central vacuum cleaner to reduce the likelihood of attaining temperatures within the appliance or on adjacent surfaces in excess of those specified in Table 9, the appliance shall be permanently marked in a location readily visible after installation as intended to make the user aware of the necessity for outdoor exhausting. See Clause 11.5.5.

10.3.12 An appliance for which it is necessary that exhaust air be vented for proper operation, or an appliance provided with instructions or markings that specify that exhaust air be vented, shall be marked, in a location that will be visible when the exhaust system is being installed, with explicit instructions specifying:

- a) how the appliance shall be vented; and
- b) that the exhaust air shall not be vented into a wall, a ceiling, or a concealed space of a building.

Exception: See Clause 11.5.6.

10.3.13 Unless it has been investigated and found to be acceptable for commercial use, an appliance shall be marked "For Household Use Only," "Household Type," or the equivalent.

10.3.14 An electrical accessory that is provided with a general purpose attachment plug and is intended for use with a central vacuum cleaning system shall be permanently marked, "For Use Only With Central Vacuum Cleaners," or the equivalent.

10.3.15 If an appliance is provided with a power-supply cord 18-in (457-mm) long or less or with a connector base (motor-attachment plug) in accordance with Clause 4.4.1.15, a statement shall be marked on the appliance or shall be in the instructions packaged with the appliance advising of:

- a) the availability of an extension cord;
- b) the cord description by means of gage and, in accordance with Clause 4.4.1.3, construction type; and
- c) the importance of using such a cord.

10.3.16 A product identified for pick-up of potentially hazardous substances (such as asbestos) shall be marked: "The Use Of This Machine In Conjunction With The Pick-Up of \pm Has Not Been Investigated By \pm ."

+Replaced with substances for which the product has been investigated to pick-up.

++Replaced with name of organization certifying compliance with this Standard.

10.3.17 An appliance provided with a Class 2 power source with output terminals for connection of external wiring to the output of the power source shall be marked adjacent to the terminals with the following or equivalent:

- a) for an output of 15 V or less: "Class 2, _____ V." (the blank shall be replaced with the nominal open-circuit voltage present at the terminals); and
- b) for an output greater than 15 V: "Class 2 Not Wet, _____ V." (the blank shall be replaced with the nominal open-circuit voltage present at the terminals.)



10.4 Cautionary

10.4.1 A marking shall be provided on an appliance to inform the user of a risk of injury that is not obvious.

10.4.2 A marking intended to reduce the risk of injury to persons shall be permanent and shall be located on a part that cannot be:

- a) removed without impairing the operation of the appliance; or
- b) left off of the appliance without its being readily apparent.

10.4.3 A cautionary marking shall be prefixed by a signal word "DANGER," "WARNING," or "CAUTION." The marking shall be in letters not less than 3/32-in (2.4-mm) high. The signal word shall be more prominent than any other required marking on the appliance.

10.4.4 If, when energized, an appliance has a moving part that may cause injury to persons, a motor control switch on the appliance, other than a momentary-contact switch or a push-on/push-off switch, shall have a plainly marked off position. International symbols  and  may be used if the significance of these symbols is explained in the instructions packaged with the product.

10.4.5 An appliance having provision for two or more separate connections to a branch circuit or other power-supply source shall be permanently marked with the word "CAUTION" and the following or the equivalent, "This appliance has more than one connection to the source of supply. To reduce the risk of electric shock, disconnect all such connections before servicing." The marking shall be located at each point of connection and shall be readily visible after installation of the appliance.

10.4.6 An appliance or an accessory of a type mentioned in Table 17 shall be provided with a permanent marking containing the applicable warning. The wording of the marking shall be as stated in Table 17 or shall be in equally definitive terminology containing all three required parts of the marking specified. These three required parts are the signal word, the risk statement, and the risk reduction statement. The marking shall be readily visible while the appliance or accessory is in use or being readied for use. See Clauses 10.4.9 – 10.4.11.

10.4.7 With reference to the requirement in Clause 10.4.6, a marking that combines two or more applicable warnings need not include the signal word "WARNING" more than once.

10.4.8 The warning marking required by Clause 10.4.6 and Table 17 may be supplemented with a statement indicating the intended use of the product provided:

- a) the product has been investigated for this use; and
- b) the supplement is no longer than the warning specified in Table 17 and is in smaller print.

10.4.9 If the appliance cannot be used without a hose, the marking required in Clause 10.4.6 may be located on the hose, instead of on the appliance, in the area of the handle and in such a manner and location that it will be readily visible to the user during normal operation.

10.4.10 If the appliance, such as an upright vacuum cleaner, can be used with or without a hose and if the marking on the appliance is not visible when the hose is being used, the marking required by Clause 10.4.6 shall also be marked on the hose in accordance with Clause 10.4.9.

10.4.11 A central vacuum cleaner not intended for wet pick-up shall be marked in accordance with Item 6 of Table 17. If the hose is provided by the manufacturer, it shall also be marked in the area of the handle and in such a manner and location that it will be visible to the user during normal operation.

10.4.12 A permanently-connected vacuum cleaner intended for outdoor use and any vacuum cleaner intended for use where gasoline or other volatile flammable liquids are transferred to fuel tanks of vehicles shall be permanently marked in a location where it will be readily visible after installation with the word "DANGER" and the following statement or the equivalent: "This equipment incorporates parts such as switches, motors, or the like that tend to produce arcs or sparks that can cause an explosion. When located in gasoline-dispensing and service stations install and use at least 20 ft (6 m) horizontally from the exterior enclosure of any dispensing pump and at least 18 in (450 mm) above a driveway or ground level." See Clause 11.5.8.

10.4.13 A part of an enclosure as described in the Exception to Clause 4.16.3.2 shall be marked to indicate that such servicing is to be done with the appliance disconnected from the supply circuit as follows or the equivalent:

"CAUTION – To Reduce The Risk Of Injury From Moving Parts – Unplug Before Servicing."

10.4.14 If the construction of an appliance is such that cleaning or similar servicing to be done by the user (such as replacement of pilot lamps, fuses, drive belts, and the like) involves the exposure of any normally enclosed or protected uninsulated live parts to unintentional contact, the appliance shall be clearly and permanently marked with the following, or equivalent wording:

"WARNING – TO REDUCE THE RISK OF ELECTRIC SHOCK– UNPLUG BEFORE CLEANING OR SERVICING."

10.4.15 If any point within a terminal box or wiring compartment of a permanently connected appliance in which the power-supply conductors are intended to be connected, including such conductors themselves, attains a temperature rise of more than 35°C (63°F) during the normal-temperature test, the appliance shall be marked: "CAUTION – For supply connection, use wires rated for at least ___ °C (___°F)," or with an equivalent statement. The temperature value shall be in accordance with Table 18. This statement shall be located at or near the point where the supply connections are to be made, and shall be clearly visible both during and after installation of the appliance.

10.4.16 A wet pick-up current-carrying hose shall be marked with the following or equivalent wording:

"WARNING – This hose contains electric wires. To reduce risk of electric shock do not use or repair a damaged hose."

10.4.17 An appliance provided with a removable float for wet pick-up operation shall be marked with the following or the equivalent:

"WARNING – To reduce the risk of electric shock, always install float before any wet pick-up operation."

10.4.18 A cord-connected, portable, shop-type vacuum cleaner provided with a general-use receptacle in accordance with the Exception to Clause 4.12.1 shall be marked with the word "WARNING" and the following or the equivalent:

a) near the receptacle:

1) "To reduce the risk of fire, only connect a tool rated ___ amperes maximum to this receptacle;" or

2) "To reduce the risk of fire, connect only (tool manufacturer's name), model (model number);" and

b) near the switch that controls the power to the receptacle: "Risk of Injury to Persons – tool should be turned off before placing switch in the auto position."

10.4.19 With reference to Clause 4.4.1.10, the special-use detachable power supply cord shall be provided with the following marking or equivalent "Only For Use With ± Model ++ Vacuum Cleaner. ± Part No. +++ Supply Cord Rated ++++ V, ++++ A, With ++++ °C Connector."

+Replace with the vacuum cleaner manufacturer's name.

++Replace with the vacuum cleaner manufacturer's vacuum cleaner model number.

+++Replace with the vacuum cleaner manufacturer's supply cord part number.

++++Replace with the voltage, amperage, and temperature rating, respectively, of connector.

10.4.20 With reference to Clause 4.4.1.10, the appliance shall be provided with the following correlation cautionary marking or equivalent "WARNING: For Use Only With ± Part No. ++ Supply Cord."

+Replace with the vacuum cleaner manufacturer's name.

++Replace with vacuum cleaner manufacturer's supply cord part number.

11 Instruction Manual

Advisory Note: In Canada, there are two official languages, English and French. Annex B lists some examples of French translations of the instructions specified in this Standard.

11.1 General

11.1.1 An appliance shall be provided with legible instructions pertaining to:

- a) the risk of fire, electric shock, or injury to persons that may be associated with its use;
- b) operation and installation;
- c) user-maintenance and storage;
- d) as applicable, grounding or double insulation; and
- e) as applicable, polarization.

11.1.2 The instructions shall indicate whether the appliance is intended for household or commercial use or both.

11.1.3 The text of all required instructions shall be in the words specified or words that are equivalent, clear, and understandable.

Exception: If an appliance is such that the specified wording is unnecessary or conflicting, the wording may be omitted or modified, as appropriate.

11.1.4 With reference to the requirements in Clause 11.1.3, there shall be no substitute for the signal word "WARNING", except that, in some cases, the signal word "DANGER" may be substituted for "WARNING."

11.1.5 Wording in parentheses in Clauses 11.2 – 11.5 is explanatory, indicating options, alternatives, or cross-references. Wherever the word "appliance" is used, the name of the specific appliance may be substituted in the final text.

11.2 Instructions pertaining to a risk of fire, electric shock, or injury to persons

11.2.1 Instructions pertaining to a risk of fire, electric shock, or injury to persons shall warn the user of reasonably foreseeable risks and state the precautions that should be taken to reduce such risks.

11.2.2 The instructions pertaining to a risk of fire, electric shock, or injury to persons shall be:

- a) in the first part of the manual;
- b) before the operating instructions;
- c) separate in format from other instructions related to assembly, operation, maintenance, and storage; and
- d) a permanent part of the manual.

11.2.3 The instructions specified in Clause 11.2.6 shall include all applicable markings specified in Table 17; however, the signal word "WARNING" and the statement of risk need not be added. Any marking required by Clause 10.4.1 shall also be included.

11.2.4 The height of lettering in the text and illustrations of the instructions specified in Clauses 11.2.6 and 11.2.7 shall be as follows:

- a) upper case letters – not less than 5/64 in (1.9 mm);
- b) lower case letters – not less than 1/16 in (1.6 mm); and
- c) the statements: "IMPORTANT SAFETY INSTRUCTIONS" and "SAVE THESE INSTRUCTIONS," required by Clause 11.2.5, and the cautionary signal word, "WARNING," required by Clauses 11.2.6 and 11.3.1 – not less than 3/16 in (4.8 mm).

11.2.5 The statement "IMPORTANT SAFETY INSTRUCTIONS" or the equivalent shall precede the list of instructions required by Clauses 11.2.6 and 11.2.7, and the statement "SAVE THESE INSTRUCTIONS" or the equivalent shall either precede or follow the list.

11.2.6 The instructions required by Clause 11.2.1 shall include the items in the following list, as applicable, and any other instructions that the manufacturer deems necessary for the appliance. The list shall not include the items mentioned in Clause 11.1.2 or in Clauses 11.4 and 11.5. The statement "Read all instructions before using" shall precede the list of items as shown below. The items need not be numbered nor be in the order presented.

IMPORTANT SAFETY INSTRUCTIONS

When using an electrical appliance, basic precautions should always be followed, including the following:

READ ALL INSTRUCTIONS

BEFORE USING (THIS APPLIANCE)

WARNING – To reduce the risk of fire, electric shock, or injury:

1. Do not leave appliance when plugged in. Unplug from outlet when not in use and before servicing.
2. (Applicable item from Table 17, such as "Do not use outdoors or on wet surfaces"; see Clause 11.2.3.)
3. Do not allow to be used as a toy. Close attention is necessary when used by or near children.
4. Use only as described in this manual. Use only manufacturer's recommended attachments.
5. Do not use with damaged cord or plug. If appliance is not working as it should, has been dropped, damaged, left outdoors, or dropped into water, return it to a service center.
6. Do not pull or carry by cord, use cord as a handle, close a door on cord, or pull cord around sharp edges or corners. Do not run appliance over cord. Keep cord away from heated surfaces.
7. Do not unplug by pulling on cord. To unplug, grasp the plug, not the cord.
8. Do not handle plug or appliance with wet hands.
9. Do not put any object into openings. Do not use with any opening blocked; keep free of dust, lint, hair, and anything that may reduce air flow.
10. Keep hair, loose clothing, fingers, and all parts of body away from openings and moving parts.
11. Turn off all controls before unplugging.
12. Use extra care when cleaning on stairs.

13. Do not use to pick up flammable or combustible liquids, such as gasoline, or use in areas where they may be present.

SAVE THESE INSTRUCTIONS

11.2.7 The following instructions shall be included in the list of items in addition to the items in Clause 11.2.6 for the appliances indicated. When more than one item applies to the appliance, all applicable items for the appliance type shall be included:

- a) for an appliance intended for use with a motorized nozzle and without a current-carrying hose: "Always turn off this appliance before connecting or disconnecting motorized nozzle."
- b) for an appliance intended for use with both a motorized nozzle and a current-carrying hose:
 - 1) "The hose contains electrical wires. Do not use when damaged, cut, or punctured. Avoid picking up sharp objects;"
 - 2) "Always turn off this appliance before connecting or disconnecting either hose or motorized nozzle;" and
 - 3) where the hose is intended for connection to a wall valve constructed as described in Clause 8.2.2: "Connect hose only to a Type A wall valve," or for a hose intended for connection to a wall valve constructed as described in Clause 8.2.5, "Connect hose only to (valve manufacturer's name) wall valve, Cat. No. ___."
- c) for an appliance supplied with a cord reel: "Hold plug when rewinding onto cord reel. Do not allow plug to whip when rewinding."
- d) for a grounded appliance: "Connect to a properly grounded outlet only. See Grounding Instructions."
- e) for a double-insulated appliance: "This appliance is provided with double insulation. Use only identical replacement parts. See instructions for Servicing of Double-Insulated Appliances."
- f) for an appliance having a mechanical accessory other than a motorized nozzle: "Unplug before connecting (Name of mechanical accessory)."
- g) for a vacuum cleaner:
 - 1) "Do not pick up anything that is burning or smoking, such as cigarettes, matches, or hot ashes."
 - 2) "Do not use without dust bag and/or filters in place."
- h) for an electrified wall valve:
 - 1) "Connect only a Type A current-carrying hose to this wall valve."
 - 2) "Do not install a wall valve outdoors."
 - 3) "Do not use with a damaged hose. Return hose to a service center."

- 4) "To unplug, grasp, and pull on the hose connection. Do not unplug by pulling on the hose."
 - 5) "Do not handle the hose or hose connector with wet hands."
- i) for a household extraction-type floor cleaning machine:
- 1) for a machine that is intended to be used with a proprietary fluid: "To Reduce the Risk of Fire and Electric Shock due to internal component damage, use only + cleaning fluid intended for use with this appliance. See the Cleaning Fluid section of this manual." The word "fluid" may be replaced with the word "product(s)."
 - + Replace with the appliance manufacturer's name.
 - 2) For all other machines that are not intended to be used with a proprietary fluid: "To Reduce the Risk of Fire, do not use a flammable or combustible liquid to clean a floor."

Exception No. 1: Instructions specified in (b)(2) are not required when an investigation reveals that there is a reliable electrical connection between the appliance and accessory.

Exception No. 2: For a wall valve as described in Clause 8.2.5, instructions specified in (h)(1) shall be "Connect only (hose manufacturer's name) current-carrying hose, Cat. No. __ to this wall valve."

Exception No. 3: For a household extraction-type floor cleaning machine for use with a proprietary fluid, instead of the instruction in (i)(1), the following instruction may be added to Item 2 of Clause 11.2.6: "See the Cleaning Fluid section of this manual." The word "fluid" may be replaced with the word "product(s)."

11.2.8 If complete guarding of a moving part that could cause a risk of injury to persons would defeat the utility of an appliance, a statement shall be provided in the instruction manual to warn the user of the potential risk.

11.2.9 The instruction manual for a floor-sanding machine shall contain the word "WARNING" and the following or the equivalent: "Risk of explosion. Floor sanding can result in an explosive mixture of fine dust and air. Use floor-sanding machine only in a well-ventilated area free from any flame or match."

11.2.10 With reference to Clauses 4.4.1.10, the instruction manual shall be provided with the following text or equivalent "WARNING: To Reduce The Risk of Fire or Electric Shock Use Appliance Only With ± Part No. ++ Supply Cord. If Cord is Damaged or Lost, Replace With Part No. ++."

+Replace with the vacuum cleaner manufacturer's name.

++Replace with the vacuum cleaner manufacturer's supply cord part number.

11.3 Grounding/double insulation instructions

11.3.1 For a grounded or double-insulated appliance, the instructions shall include (a) – (f), as applicable.

a) For all grounded, cord-connected appliances:

GROUNDING INSTRUCTIONS

This appliance must be grounded. If it should malfunction or breakdown, grounding provides a path of least resistance for electric current to reduce the risk of electric shock. This appliance is equipped with a cord having an equipment-grounding conductor and grounding plug. The plug must be inserted into an appropriate outlet that is properly installed and grounded in accordance with all local codes and ordinances.

WARNING – Improper connection of the equipment-grounding conductor can result in a risk of electric shock. Check with a qualified electrician or service person if you are in doubt as to whether the outlet is properly grounded. Do not modify the plug provided with the appliance – if it will not fit the outlet, have a proper outlet installed by a qualified electrician.

b) For a grounded, cord-connected appliance rated less than 15 A and intended for use on a nominal 120-V supply circuit, the instructions in either item 1 or 2:

1) This appliance is for use on a nominal 120-V circuit, and has a grounded plug that looks like the plug illustrated in sketch A in Figure 20. A temporary adaptor that looks like the adaptor illustrated in sketches B and C may be used to connect this plug to a 2-pole receptacle as shown in sketch B if a properly grounded outlet is not available. The temporary adaptor should be used only until a properly grounded outlet (sketch A) can be installed by a qualified electrician. The green colored rigid ear, lug, or the like extending from the adaptor must be connected to a permanent ground such as a properly grounded outlet box cover. Whenever the adaptor is used, it must be held in place by a metal screw.

Exception: In Canada, the use of a temporary adaptor is not permitted by the Canadian Electrical Code, C22.1.

2) This appliance is for use on a nominal 120-V circuit and has a grounding attachment plug that looks like the plug illustrated in sketch A in Figure 20. Make sure that the appliance is connected to an outlet having the same configuration as the plug. No adaptor should be used with this appliance.

c) For all other grounded, cord-connected appliances:

This appliance is for use on a circuit having a nominal rating more than 120 V (or This appliance is rated more than 15 A and is for use on a circuit having a nominal rating of 120 V) and is factory-equipped with a specific electric cord and plug to permit connection to a proper electric circuit. Make sure that the appliance is connected to an outlet having the same configuration as the plug. No adaptor should be used with this appliance. If the appliance must be reconnected for use on a different type of electric circuit, the reconnection should be made by qualified service personnel.

- d) For a permanently connected appliance:

GROUNDING INSTRUCTIONS

This appliance must be connected to a grounded metal, permanent wiring system; or an equipment-grounding conductor must be run with the circuit conductors and connected to the equipment-grounding terminal or lead on the appliance:

- e) For a double-insulated, cord-connected appliance:

SERVICING OF DOUBLE-INSULATED APPLIANCES

A double-insulated appliance is marked with one or more of the following: The words "DOUBLE INSULATION" or "DOUBLE INSULATED" or the double insulation symbol (square within a square).



In a double-insulated appliance, two systems of insulation are provided instead of grounding. No grounding means is provided on a double-insulated appliance, nor should a means for grounding be added to the appliance. Servicing a double-insulated appliance requires extreme care and knowledge of the system, and should be done only by qualified service personnel. Replacement parts for a double-insulated appliance must be identical to the parts they replace.

- f) For a carpet cleaning appliance employing a wet pick-up current-carrying hose:

SERVICING OF WET PICK-UP ELECTRIC HOSE

WARNING – This hose contains electric wires. In order to reduce the risk of electric shock, do not use or attempt to repair a damaged hose or substitute any other type of hose. Servicing of the wet pick-up electric hose requires extreme care and knowledge of the construction. Servicing of a wet pick-up electric hose should be done only by qualified service personnel.

11.4 Polarization instructions

11.4.1 An appliance provided with a 2-blade, polarized attachment plug shall be provided with the following instructions or the equivalent: "To reduce the risk of electric shock, this appliance has a polarized plug (one blade is wider than the other). This plug will fit in a polarized outlet only one way. If the plug does not fit fully in the outlet, reverse the plug. If it still does not fit, contact a qualified electrician to install the proper outlet. Do not change the plug in any way."

11.5 Installation and operating instructions

11.5.1 The installation and operating instructions shall include all information needed to assemble, install, and operate the appliance.

11.5.2 The installation instructions of a permanently connected appliance, such as a central vacuum cleaner, shall not recommend that an installer, such as a qualified electrician, cut (or bend over) and insulate the grounding conductor from a field wiring supply cable.

11.5.3 With reference to the requirement in Clause 4.4.1.14, a statement advising of the availability of an acceptable extension cord, its description, and the importance of using such a cord may be included in the operating instructions.

11.5.4 If an appliance with a dual-voltage motor employs an attachment plug, instructions shall be provided to indicate the type of plug that should be used if the appliance is reconnected for the alternate voltage.

11.5.5 For a central vacuum cleaner, if an outdoor exhaust is specified by the manufacturer or required and the appliance is marked in accordance with Clause 10.3.11, instructions describing the method of exhausting shall be included in the installation and operating instructions provided with the appliance.

11.5.6 The marking specified in Clause 10.3.12, as an alternative, may be included in the installation instructions.

11.5.7 The operating instructions shall identify by catalog number or the equivalent which separately packaged and marketed attachments have been investigated for use with the basic appliance. See Clause 3.2.

Exception: This requirement does not preclude the investigation of any attachment made available in the future. The information packaged with such an attachment shall include the model number of the basic appliance with which it is to be used.

11.5.8 Instructions for a permanently connected vacuum cleaner intended for outdoor use and any vacuum cleaner intended for use in areas where gasoline or other volatile flammable liquids are transferred to fuel tanks of vehicles shall also include the information provided by the marking specified in Clause 10.4.12.

11.5.9 The installation instructions provided with a central vacuum cleaner employing a power supply cord less than 6 ft (1.82 m) in length shall indicate the length of the power supply cord provided on the product, and shall advise the user that the product should be mounted such that the product's power supply cord can be directly plugged into an electrical outlet. It shall also indicate that an extension cord should not be used.

11.5.10 The instructions provided with a carpet cleaning appliance provided with a wet pick-up current carrying hose shall include the following:

- a) "This hose is to be examined periodically for visible deterioration, such as abrasion, cracks, splits and the like."
- b) "This hose is to be used only for indoor household carpet cleaning applications using only manufacturer's recommended cleaning solution."

11.5.11 The instructions shall include specific instructions for an appliance intended for wet pick-up operation, and provided with a removable float, to inform the user to install the float in the recommended manner before any wet pick-up operation.

11.5.12 The instructions for a current-carrying hose as described in Clause 8.2.4 and a wall valve as described in Clause 8.2.2 shall include the word "WARNING" and the following:

- a) for the wall valve: "To reduce the risk of electric shock, connect only a motorized nozzle/current-carrying hose combination intended for connection to a Type A central vacuum cleaning system wall valve."; and
- b) for the motorized nozzle/current-carrying hose combination: "To reduce the risk of electric shock, connect only to a Type A central vacuum cleaning system wall valve."

11.5.13 The instructions for a current-carrying hose/electrified wall-valve combination as described in Clause 8.2.5 shall include the word "WARNING" and the following or the equivalent:

- a) for the wall valve: "To reduce the risk of electric shock, connect only (hose manufacturer's name) electric hose, Cat. No. ___ to this wall valve."; and
- b) for the motorized nozzle/current-carrying hose combination: "To reduce the risk of electric shock, connect only to (valve manufacturer's name) electrified wall valve, Cat. No. ___."

11.5.14 The instructions for an electrified wall valve shall contain the following statements or the equivalent:

- a) "For Household Use Only.";
- b) "Install only on a nominal 120 V supply protected by a maximum 20 A overcurrent protective device."; and
- c) "The pin connector on this wall valve is intended for use on a nominal 120 V supply only. It is required to be wired by a qualified electrician and is required to conform to local electrical codes."

11.5.15 The packaging for an electrified wall valve as described in Clause 8.2.2 shall be marked: "For use only with central vacuum cleaning system motorized nozzles that employ a Type A current-carrying hose."

Exception: The packaging for a current-carrying hose and for an electrified wall valve as described in Clause 8.2.5 shall be marked with the word "WARNING" and the following:

- a) for the wall valve: "To reduce the risk of electric shock, use only with (hose manufacturer's name) electric hose, Cat. No. ___."; and

- b) for the motorized nozzle/current-carrying hose combination: "To reduce the risk of electric shock, only connect this product to (valve manufacturer's name) electrified wall valve, Cat. No. ___."

11.6 User-maintenance instructions

11.6.1 User-maintenance instructions shall include:

- a) instructions for cleaning and user-maintenance operations recommended by the manufacturer, such as lubrication or nonlubrication, and a statement to the user that any other servicing should be performed by an authorized service representative or that the appliance has no user serviceable parts;
- b) instructions for an appliance employing an automatically reset thermal limiter that shuts off the entire appliance or any operating part of the appliance shall inform the user of what is expected if the thermal limiter operates; and
- c) specific instructions for the proper method of storage of the cord, the total appliance, and the like, when the appliance is not in use, and for care of the cord while in use.

11.7 Proprietary fluid instructions

11.7.1 For a household extraction-type floor cleaning machine that is to be used with a proprietary fluid in accordance with Exception No. 2 of Clause 5.12.8.1.1, the instruction manual shall contain a Cleaning Fluid (or Cleaning Product) section. The following instruction shall be included in the first part of the section: "WARNING: To Reduce the Risk of Fire and Electric Shock due to internal component damage, use only ± cleaning fluid intended for use with the appliance." The "±" is replaced with the appliance manufacturer's name. The word "fluid" may be replaced by the word "product(s)." The section shall also include the recommended cleaning fluid, or a list of recommended cleaning fluids, identified by the appliance manufacturer's name and cleaning fluid identification. Only a proprietary fluid in compliance with the tests specified in Clause 5.12.8.3 shall be mentioned.

**Table 1 – Minimum acceptable distance from an opening to a part that may involve a risk of electric shock
(See Clauses 4.1.4.1 and 4.1.4.2)**

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

^a See Clause 4.1.4.5.
^b Between 1 and 2-1/8 in (25.4 and 54.0 mm), interpolation is to be used to determine a value between values specified in this table.
^c Any dimension less than 1 in (25.4 mm) applies to a motor only.
^d More than 2-1/8 in (54.0 mm) but not more than 6 in (152 mm).

**Table 2 – Cord types
(See Clause 4.4.1.3)**

Appliance	Type of cord
Automotive and garage	S, ST ^{a,b}
Household, indoor use	SV, SVT
Household, outdoor use	c
Commercial vacuum cleaners or blower cleaners	SJ, SJT ^d
Central vacuum cleaner	SJ, SJT

^a An oil-resistant cord is required when the equipment is likely to be subjected to grease or oil.
^b 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.
^c 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 17 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.
^d Cord marked with suffix "W" (such as, SJTW) is required when the appliance is intended for outdoor use.

**Table 3 – Polarity identification of flexible cords
(See Clause 4.4.1.5)**

Method of identification	Acceptable combinations	
	Conductor intended to be grounded ^a	All other conductors ^a
Color of braids on individual conductors	Solid white or gray – without tracer	Solid color other than white or gray – without tracer
	Color other than white or gray – with tracer in braid	Solid color other than white or gray – without tracer
Color of insulation on individual conductors	Solid white or gray ^b	Solid color other than white or gray
	Solid light blue ^c	Solid color other than light blue, white, or gray
Color of separators	Solid white or gray ^d	Solid color other than white, or gray

^a A conductor finished to show a green color with or without one or more yellow stripes or tracers shall be used only as an equipment-grounding conductor. See Clause 4.14.5 and Figure 5.
^b Only for cords having no braid on any individual conductor.
^c For jacketed cords.
^d Only for cords having insulation on the individual conductors integral with the jacket.

**Table 4 – Material property
(See Clauses 4.7.2, 4.13.11.3, 5.21.2.1 and 5.21.2.2)**

Material property (units)	Flame rating of material			
	V-0, 0.17V-0	V-1, 0.17V-1	V-2, 0.17V-2	HB, 0.17HB
HAI (arcs)	≥ 15	≥ 30	≥ 30	≥ 60
(PLC) ^a	(3)	(2)	(2)	(1)
HWI (seconds)	≥ 7	≥ 15	≥ 30	≥ 30
(PLC) ^a	(4)	(3)	(2)	(2)

^aPLC is the performance level category in accordance with the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.

**Table 5 – Minimum spacings for uninsulated live parts at supply wiring terminals
(See Clauses 4.10.7, 4.13.1, 4.13.2 and 4.13.3)**

Potential involved, V	Over surface, in (mm)	Through air, in (mm)
250 or less	1/4 (6.4)	1/4 (6.4)

NOTE –
1. For extra-low voltage circuits, see Clause 4.6.4.3.
2. These spacings do not apply to connecting straps or buses extending away from wiring terminals; such spacings are judged under the requirements of Table 6.

**Table 6 – Minimum spacings at other than supply wiring terminals
(See Clauses 4.13.1, 4.13.4, 4.13.5, 4.13.9 and 4.13.10 and Table 5)**

Potential involved, V	Rating of motor employed ^a	Motor Diameter 7 in (178 mm) or less ^b	
		Over surface, in (mm)	Through air, in (mm)
0 – 125	1/3 hp (250 W output) or less	1/16 (1.6)	1/16 (1.6)
	More than 1/3 hp	3/32 (2.4)	3/32 (2.4)
126 – 250	All motors	3/32 (2.4)	3/32 (2.4)

NOTE– For extra low voltage circuits, see Clause 4.13.4.

^a See Clause 4.13.10 for motors that are not rated in horsepower. For universal motors in appliances rated for use on ac circuits, the table below shall be used.

115 ac, single phase	7.2 A
230 ac, single phase	3.6 A

^b This is the diameter, measured in the plane of the laminations of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and the like used solely for motor mounting, cooling, assembly, or connection.

**Table 7 – Maximum surface temperatures
(See Clause 4.16.4.1)**

Location	Composition of surfaces ^a	
	Metallic	Nonmetallic
A handle or knob that is grasped for lifting, carrying or holding	50°C (122°F)	60°C (140°F)
A handle or knob that is contacted but does not involve lifting, carrying, or holding and other surfaces subjected to contact in operation and user maintenance	60°C (140°F)	85°C (185°F)
A surface subject to casual contact	70°C (158°F)	95°C (203°F)

^a A handle, knob or the like made of a material other than metal that is plated or clad with metal, having a thickness of 0.005 in (0.13 mm) or less, is judged as a nonmetallic part.

**Table 8 – Test voltages
(See Clause 5.1.2)**

Appliance marked rating, V	Test voltage, V
110 – 120	120
200 – 208	208
220 – 240	240

**Table 9 – Maximum acceptable temperature rises
(See Clauses 5.8.1, 5.8.2, 5.9.1.1, 5.18.1, 8.8.1, 10.3.10 and 10.3.11)**

Materials and component parts	°C	°F
1. Varnished-cloth insulation	60	108
2. Fuses	65	117
3. Fiber employed as electrical insulation	65	117
4. Wood and other flammable material	65	117
5. At any point within a terminal box or wiring compartment of a permanently connected appliance in which power-supply conductors are to be connected, including such conductors themselves, unless the appliance is marked in accordance with Clause 10.4.15	35	63
6. A surface upon which a stationary appliance can be mounted in service, and surfaces that can be adjacent to the appliance when so mounted	65	117
7. Class A (105°C) insulation systems on coil windings of an ac motor having a frame diameter of more than 7 in (178 mm) and of a dc motor ^{a,b} :		
(a) In an open motor and on a vibrator coil		
Thermocouple method	65	117
Resistance method	75	135
(b) In a totally enclosed motor		
Thermocouple method	70	126
Resistance method	80	144
8. Class A (105°C) insulation system on coil windings of an ac motor having a frame diameter of 7 in (178 mm) or less, of a universal motor, and on a vibrator coil ^{a,b} :		
(a) In an open motor and on a vibrator coil		
Thermocouple or resistance method	75	135
(b) In a totally enclosed motor		
Thermocouple or resistance method	80	144
9. Class B (130°C) insulation, except as indicated in items 15 and 16 ^a		
Thermocouple method	85	153
10. Phenolic composition employed as electrical insulation or as a part the deterioration of which would result in a risk of fire or electric shock ^c	125	225
11. Rubber insulated wire and cord ^c	35	63
12. Thermoplastic-insulated wire and cord ^c	35	63
13. Capacitor		
Electrolytic ^d	40	72
Other Types ^e	65	117
14. Class A (105°C) insulation on windings of relay, a solenoid, and the like ^a		
Thermocouple method	65	117
Resistance method	85	153
15. Class B (130°C) insulation systems on coil windings of an ac motor having a frame diameter of more than 7 in (178 mm) and of a dc motor ^{a,b}		
(a) In an open motor		
Thermocouple method	85	153
Resistance method	95	171
(b) In a totally enclosed motor		
Thermocouple method	90	162
Resistance method	100	180
16. Class B (130°C) insulation systems on coil windings of an ac motor having a frame diameter of 7 in (178 mm) or less and of a universal motor ^{a,b} :		
(a) In an open motor method		
Thermocouple or resistance method	95	171
(b) In a totally enclosed motor		
Thermocouple or resistance method	100	180

Table 9 – Maximum acceptable temperature rises Continued on Next Page

Table 9 – Maximum acceptable temperature rises Continued

Materials and component parts	°C	°F										
17. Class A (105°C) insulation systems on windings of a transformer ^f												
Thermocouple method	65	117										
Resistance method	75	135										
<p>^a At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple may be higher by the following amount than the maximum specified.</p> <table border="1"> <thead> <tr> <th><u>Item</u></th> <th><u>Additional Temperature Rise</u></th> </tr> </thead> <tbody> <tr> <td>Part A of Item 7 and Item 14</td> <td>15°C 27°F</td> </tr> <tr> <td>Part A of Item 8</td> <td>5 °C 9°F</td> </tr> <tr> <td>Part A of Item 15</td> <td>20°C 36°F</td> </tr> <tr> <td>Part A of Item 16</td> <td>10°C 18°F</td> </tr> </tbody> </table> <p>Provided that the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table. See Clause 5.8.6.</p> <p>^b This is the diameter, measured in the plane of the laminations, of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and the like used solely for motor mounting, cooling assembly, or connection.</p> <p>^c The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found to be acceptable for a higher temperature.</p> <p>^d For an electrolytic capacitor that is integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure shall not be more than 65°C (117°F).</p> <p>^e A capacitor that operates at a temperature rise of more than 65°C (117°F) may be judged on the basis of its marked temperature limit.</p> <p>^f Limit is specified for a transformer employed in a Class 2 power unit in accordance with Clause 7.5.5.2.</p>			<u>Item</u>	<u>Additional Temperature Rise</u>	Part A of Item 7 and Item 14	15°C 27°F	Part A of Item 8	5 °C 9°F	Part A of Item 15	20°C 36°F	Part A of Item 16	10°C 18°F
<u>Item</u>	<u>Additional Temperature Rise</u>											
Part A of Item 7 and Item 14	15°C 27°F											
Part A of Item 8	5 °C 9°F											
Part A of Item 15	20°C 36°F											
Part A of Item 16	10°C 18°F											

**Table 10 – Extreme operating voltages
(See Clause 5.9.1.1)**

Appliance rating, V	Test voltages, V	
	Low	High
110 – 120	104	127
200 – 208	187	220
220 – 240	208	254

**Table 11 – Cycling conditions
(See Clause 5.23.5.1)**

For indoor end-use applications	For outdoor end-use applications
24 h at T ^a followed immediately by at least 96 h at 35.0 ±2.0°C (95.0 ±3.6°F), 90% relative humidity, followed by 8 h at 0.0 ±2.0°C (32.0 ±3.6°F)	A minimum of 24 h immersed in 25.0 ±2.0°C (77.0 ±3.6°F) water, followed immediately by at least 96 h at 35.0 ±2.0°C (95.0 ±3.6°F), 90% relative humidity; followed by 8 h at minus 35.0 ±2.0°C (minus 31.0 ±3.6°F).
^a T is the measured normal operating temperature, but not less than 60°C (140°F).	

**Table 12 – Abnormal overload test
(See Clause 5.26.1)**

Overcurrent protective device rating, A	Minimum test time ^a , min		
	110% current ^b	135% current	200% current
0 – 30	7 h	60	2
31 – 60	7	60	4

^a If circuit conditions are such as to open a current carrying conductor without resulting in a risk of electric shock, fire, or injury to persons, the test circuit current shall be reduced to a point where the circuit remains intact for at least the time indicated but where maximum heating is generated.

^b The test may be terminated when the temperatures have stabilized, indicating that ultimate results have already been achieved.

**Table 13 – Minimum spacings
(See Clauses 6.3.6, 6.10.1, 6.11.1, 6.16.2, 6.17.5.3 and 6.19.1 and Table 14)**

Parts between which spacings are measured	Minimum acceptable spacings
1. Uninsulated live parts and noncurrent-carrying metal parts that are separated by basic insulation only. ^a	Not less than the through air and over surface spacings specified in Clause 4.13
2. Accessible noncurrent-carrying metal parts ^b and noncurrent-carrying metal parts separated from uninsulated live parts by basic insulation only (this ordinarily is a spacing resulting from supplementary insulation).	Not less than the through air and over surface spacings specified in Clause 4.13
3. Uninsulated live parts and noncurrent-carrying metal parts ^b separated by double insulation or by reinforced insulation, where acceptable, except as indicated in item 4.	Not less than twice the through air and over surface spacings specified in Clause 4.13
4. Uninsulated live parts and accessible noncurrent-carrying metal parts ^b at a commutator or other location on which foreign materials can build up.	5/16 in (8.0 mm) over surface
5. Uninsulated live parts, including film coated wire wound in the form of a coil and reliably held in place, and the interior surface of insulating material that serves as supplementary insulation.	1/32 in (0.8 mm)
6. Outer surface of a wrapped coil and the interior surface of insulating material that serves as supplementary insulation.	1/32 in (0.8 mm)

^a Reference Clause 4.13.5.

^b If the outer surface of the enclosure consists wholly or partially of insulating material, the spacings applied to accessible noncurrent-carrying metal also apply to metal foil wrapped tightly around and in intimate contact with the enclosure. The foil shall be drawn tightly across any opening in the enclosure to form a flat plane across such opening. See Figure 14.

**Table 14 – Points of application and voltages for dielectric voltage-withstand test
(See Clauses 6.13.1 and 6.16.2)**

Points between which potential shall be applied	Test potential in V
1. Live parts and inaccessible noncurrent-carrying metal parts	Voltage prescribed for dielectric voltage-withstand test in Clause 5.11
2. Inaccessible noncurrent-carrying metal parts and accessible noncurrent-carrying metal parts or for equipment with an outer enclosure of insulating material, metal foil wrapped tightly around the enclosure – see Figure 14	2000 V plus twice the rated voltage of the equipment
3. Accessible noncurrent-carrying metal parts, or the foil mentioned in item 2, and metal foil in contact with the inner surfaces of insulating barriers provided to accomplish compliance with Table 13	2000 V plus twice the rated voltage of the equipment
4. Accessible noncurrent-carrying metal parts and: a) metal foil wrapped around the power-supply cord inside the inlet bushings, cord guards, strain-relief clamps, and the like; or b) a metal rod of the same cross-sectional dimensions as the cord and inserted in its place	2000 V plus twice the rated voltage of the equipment
5. Live parts and accessible noncurrent-carrying metal parts, or the foil mentioned in item 2	3500 V plus twice the rated voltage of the equipment

**Table 15 – Production-line dielectric voltage-withstand test potentials
(See Clause 6.20.1.1)**

Points between which potential shall be applied ^{a, b}	Test potential in V	
	RMS	Peak
1. Live parts and noncurrent-carrying metal parts insulated from one another by basic insulation	1000	1414
2. Inaccessible noncurrent-carrying metal parts and accessible noncurrent-carrying metal parts insulated from one another by supplementary (protecting) insulation	1500	2122
3. Live parts and accessible noncurrent-carrying metal parts for: a) body supported wet pick-up appliance b) all other appliances	3000 2500	4242 3536

^a If necessary because of the inaccessibility of parts, tests in accordance with items 1 and 2 may be conducted on subassemblies of the equipment, and, in this case, the test indicated in item 3 shall be conducted. If the tests in accordance with items 1 and 2 are conducted on the completely assembled equipment, the tests indicated in item 3 may be omitted if there is no reinforced insulation.

^b Those parts of the tests described in items 2 and 3 that include application of metal foil to outer enclosures of insulating material may be waived if the manufacturer has an acceptable quality-control program. This program shall determine that the insulating material in question is free from cracks and metal inclusions, and that it has the physical and electrical strength required for the application. To determine that the material is free of cracks or metal inclusions, a 100% visual inspection is required. Periodic physical-property tests on molded parts shall also be conducted.

**Table 16 – Production line test conditions
(See Clauses 9.1.2 and 9.1.5)**

Appliance rating and form	Condition A		Condition B	
	Potential, V	Time, s	Potential, V	Time, s
250 V or less with or without a motor rated 1/2 hp (373 W) or less	1000	60	1200	1
More than 250 V, or employing a motor rated more than 1/2 hp (373 W), or applied directly to persons or supported by the body of a person	1000+2V ^a	60	1200+2.4V ^a	1
A wet pick-up appliance that is supported by the body of a person but not solely hand held	2500	60	3000	1

^a V is rated voltage of the appliance.

**Table 17 – Warning markings
(See Clauses 4.14.9, 5.12.1.1, 5.12.8.1.1, 5.21.4.2, 5.21.8.1, 7.9.2.1, 10.4.6, 10.4.8, 10.4.11, 11.2.3 and 11.2.6)**

Type of appliance or accessory	Marking required
1. Not grounded, not double insulated.	WARNING – To Reduce The Risk Of Electric Shock – Do not use outdoors or on wet surfaces.
2. Grounded or double-insulated, intended for indoor use only, not intended for wet pick-up.	WARNING – To Reduce The Risk Of Electric Shock – Do not use outdoors or on wet surfaces.
3. Grounded or double-insulated, intended for indoor or outdoor use – not intended for wet pick-up.	WARNING – To Reduce The Risk Of Electric Shock – Do not use on wet surfaces. Do not expose to rain. Store indoors.
4. Intended for indoor use only and for wet pick-up.	WARNING – To Reduce The Risk Of Electric Shock – Use indoors only.
5. Intended for indoor or outdoor use and for wet pick-up, but not intended to be exposed to rain.	WARNING – To Reduce The Risk Of Electric Shock – Do not expose to rain. Store indoors.
6. Central vacuum cleaners.	WARNING – To Reduce The Risk Of Electric Shock – Do not use on wet surfaces.
7. Motorized nozzle intended for dry-pickup only, may be connected to a vacuum cleaner intended for wet pick-up.	WARNING – To Reduce The Risk Of Electric Shock – Do not use motorized nozzle on wet surfaces.
8. Double-insulated motorized nozzle, may be connected to a grounded vacuum cleaner.	WARNING – Only motorized nozzle is double-insulated. To reduce risk of electric shock – Connect vacuum cleaner to a properly grounded outlet.
9. Motorized nozzle intended for use with an extraction-type carpet cleaning system.	WARNING – Do not immerse. To reduce risk of electric shock – Use only on carpet moistened by cleaning process.
10. Blowers and floor finishing machines not intended for outdoor use.	WARNING – To Reduce The Risk Of Electric Shock – Use Indoors Only.
11. Blower intended for outdoor use but not intended to be exposed to rain.	WARNING – To Reduce The Risk Of Electric Shock – Do Not Expose To Rain – Store Indoors.
12. Wet pick-up current-carrying hoses.	WARNING – This hose contains electric wires. To reduce the risk of electric shock, do not use or repair a damaged hose.
13. Wet pick-up vacuum cleaners employing a removable float for wet pick-up operation.	WARNING – To reduce the risk of electric shock, always install float before any wet pick-up operation.
14. A floor scrubber, polisher, buffer, waxer, or sander, or a machine intended for multiple purposes.	WARNING – To reduce the risk of fire, use only commercially available floor cleaners and waxes intended for machine application.
15. A floor sander or multi-purpose appliance with floor sanding being one of its purposes.	WARNING – Risk of explosion. Floor sanding can result in an explosive mixture of fine dust and air. Use floor sanding machine only in well ventilated area.
16. Household extraction-type floor cleaning machines:	

Table 17 – Warning markings Continued

Type of appliance or accessory	Marking required
a) for use with a proprietary fluid. b) All others.	WARNING – To Reduce the Risk of Fire and Electric Shock – Use only ± cleaning products intended for use with this machine.” + Replace with appliance manufacturer’s name. WARNING – To Reduce the Risk of Fire – Do not use a flammable or combustible liquid to clean a floor.

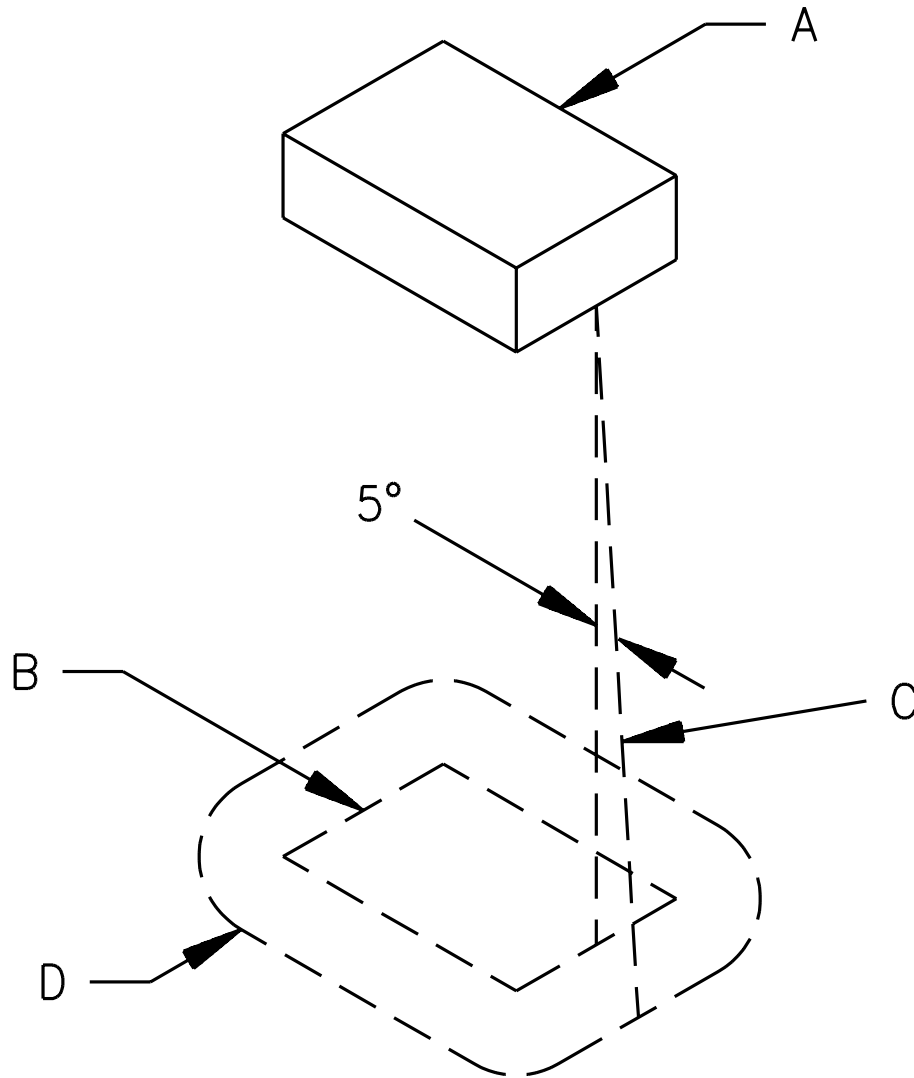
**Table 18 – Outlet-box marking
(See Clause 10.4.15)**

Temperature rise attained in terminal box or compartment during test		Temperature marking	
36 – 50°C	(64 – 90°F)	75°C	(167°F)
51 – 65°C	(91 – 117°F)	90°C	(194°F)

**Table 19 – Artificial-aging tests
(See Clause 5.12.5.4)**

Temperature on component during normal temperature test	Artificial-aging procedure
60°C (140°F) or less	Immersion for 168 h at 70 ±1°C (158 ±1.8°F) in a solution consisting of three times the recommended concentration of the proprietary fluid to which the component is exposed
More than 60°C (140°F)	Immersion for 168 h in a boiling solution consisting of three times the recommended concentration of the proprietary fluid to which the component is exposed
60°C (140°F) or less	Air oven aging for 70 h at 100 ±2°C (212 ±3.6°F)
61 – 90°C (142 – 194°F)	Air oven aging for 168 h at 121 ±1°C (250 ±1.8°F)
91 – 105°C (196 – 221°F)	Air oven aging for 168 h at 136 ±1°C (277 ±1.8°F)

Figure 1 – Location and extent of barrier
(See Clause 4.1.2.4)



EB120A

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.

Figure 2 – Articulated accessibility probe
(See Clauses 4.1.4.1, 4.1.4.3, 4.4.2.2 and 4.16.3.1)

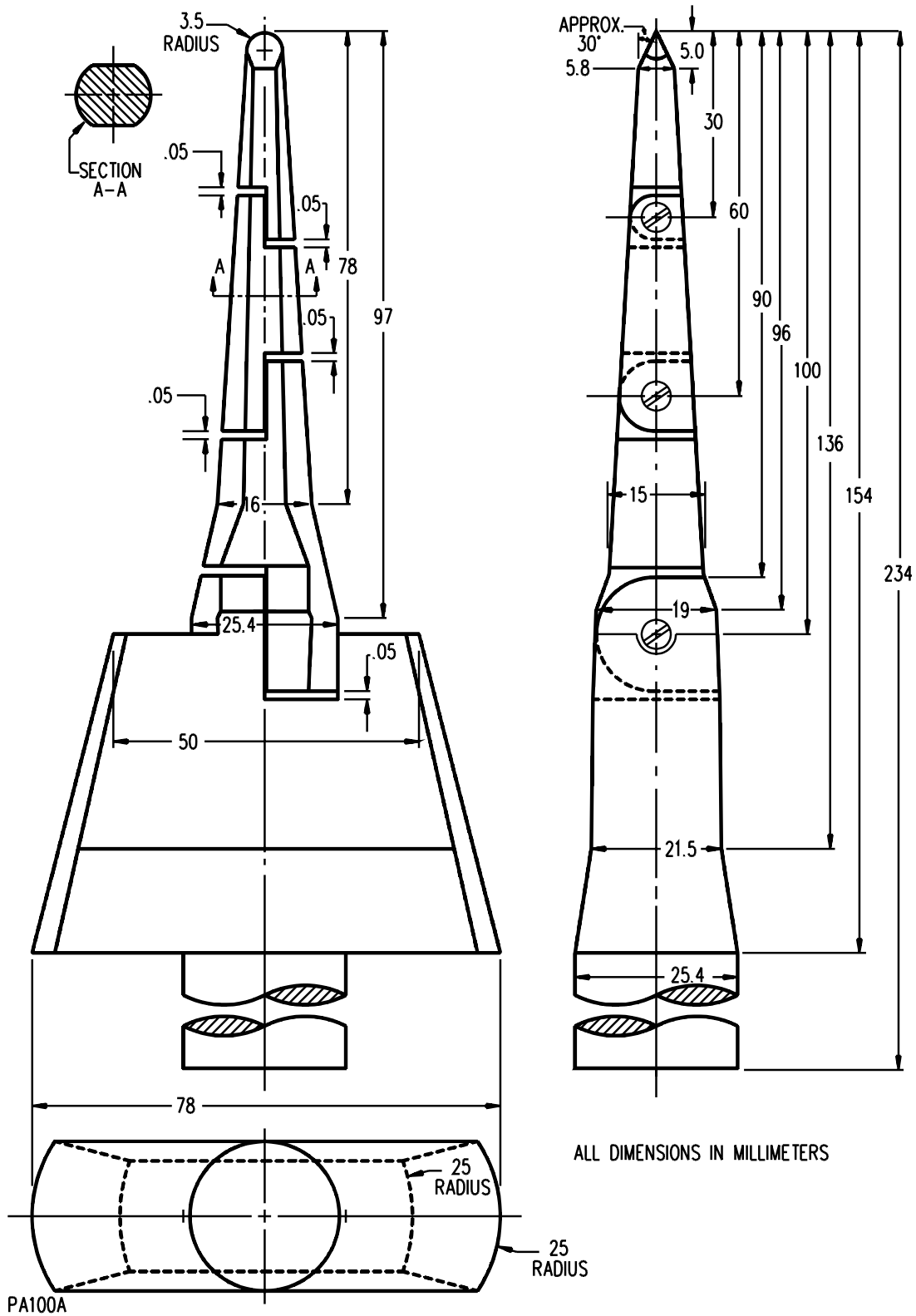


Figure 3 – Straight probe
(See Clauses 4.1.4.2 and 4.1.4.3)

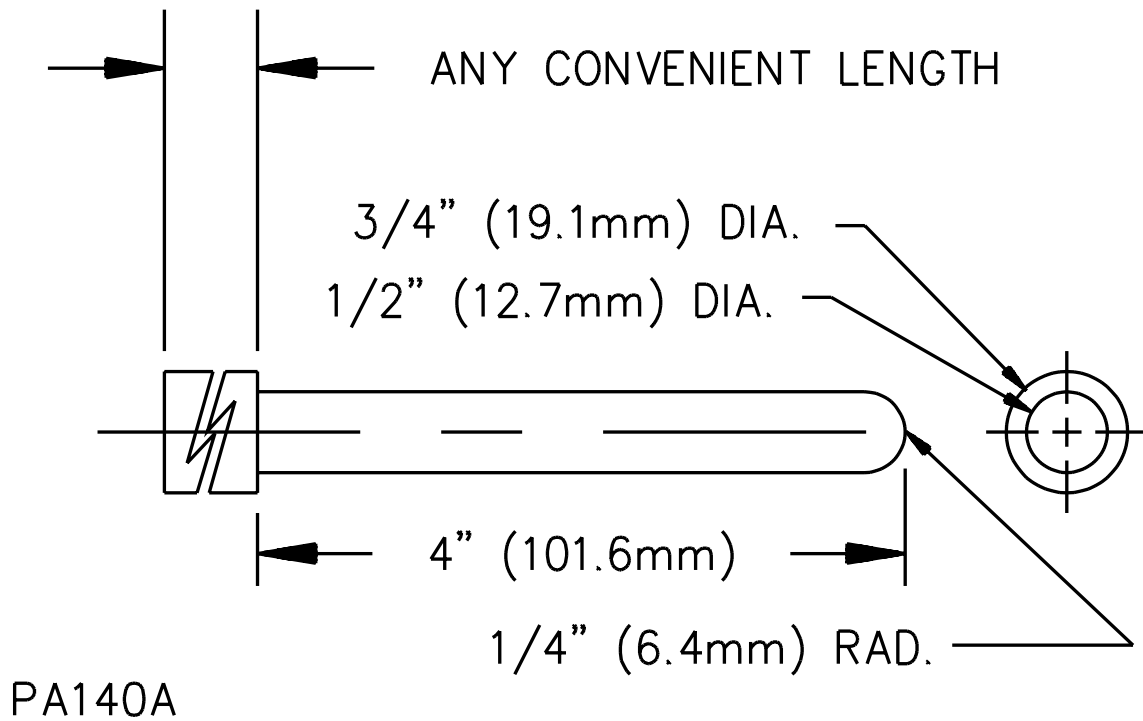
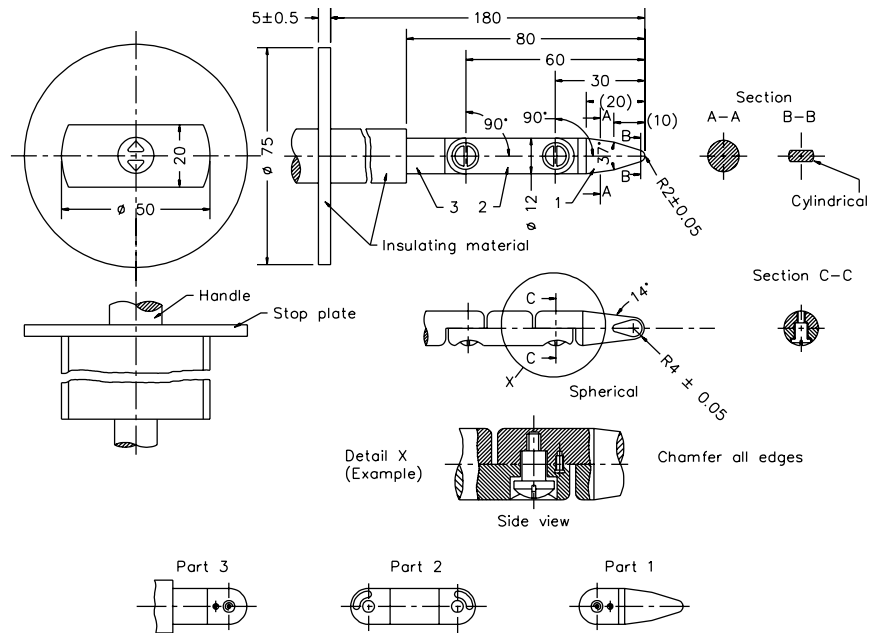
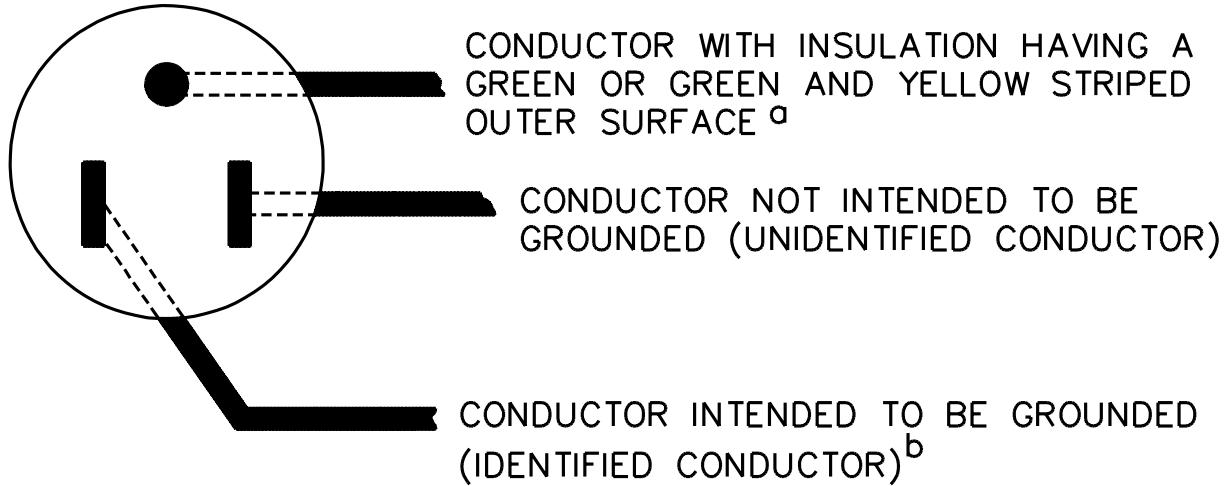


Figure 4 – International Electrotechnical Commission, (IEC) articulate accessibility probe with stop plate
(See Clauses 4.1.4.2, 4.1.4.3 and 4.16.3.1)

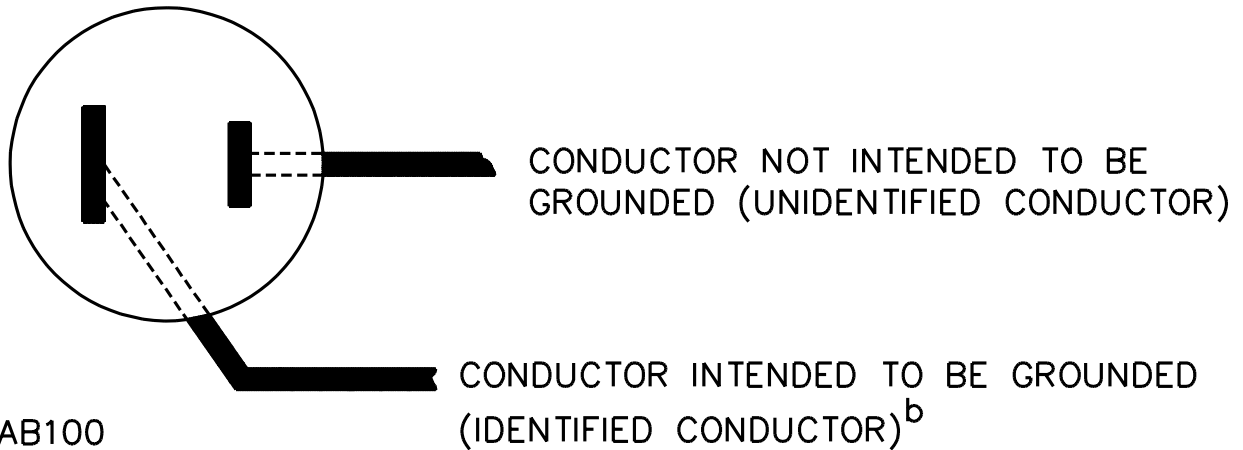


**Figure 5 – Connections to attachment plug
(See Clause 4.4.1.5 and Table 3)**

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



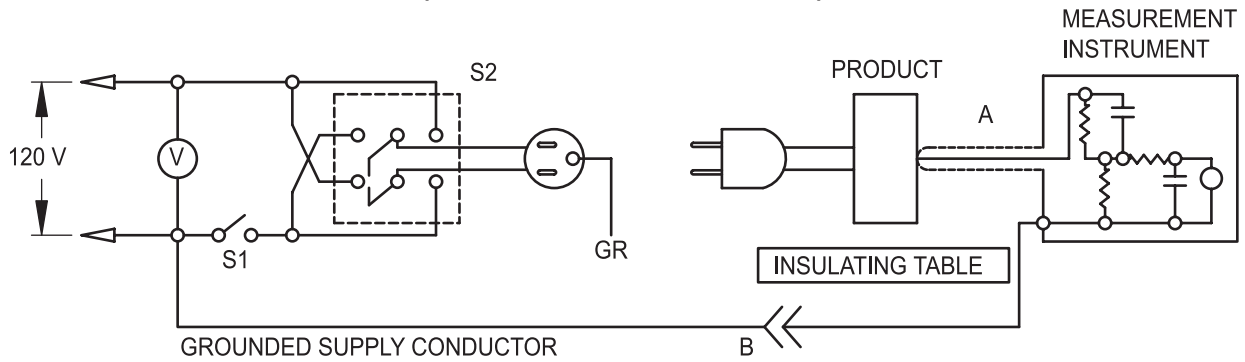
CONNECTIONS OF CORD CONDUCTORS TO POLARIZED ATTACHMENT PLUG (FACE OF PLUG REPRESENTED)



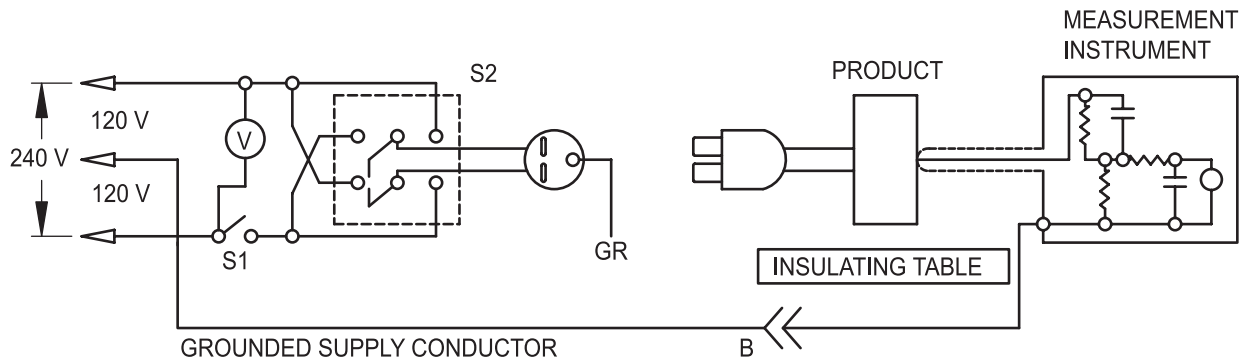
^a The blade to which the green conductor is connected may have a U-shape instead of a circular cross section.

^b Signifies a conductor identified in accordance with Table 3.

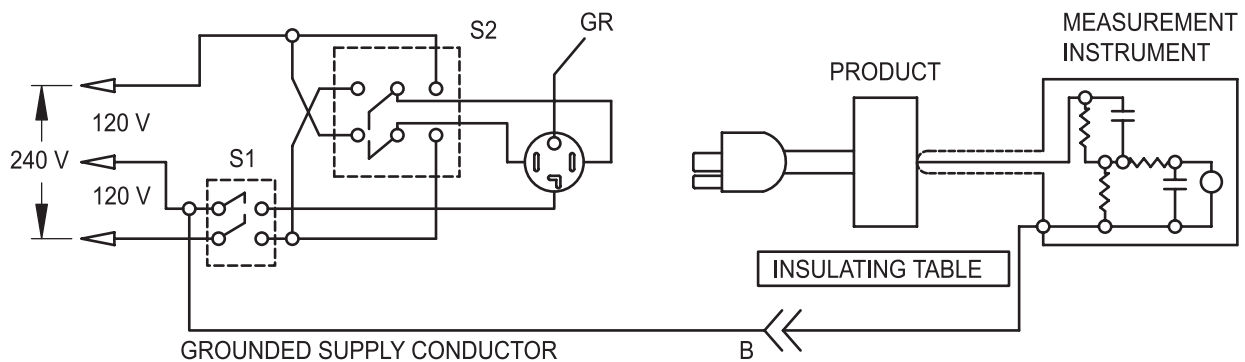
**Figure 6 – Leakage current measurement circuits
(See Clauses 5.3.5 and 5.12.4.1)**



Product intended for connection to a 120-volt power supply, as illustrated above.



Product intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.



Product intended for connection to a 3-wire, grounded neutral power supply, as illustrated above.

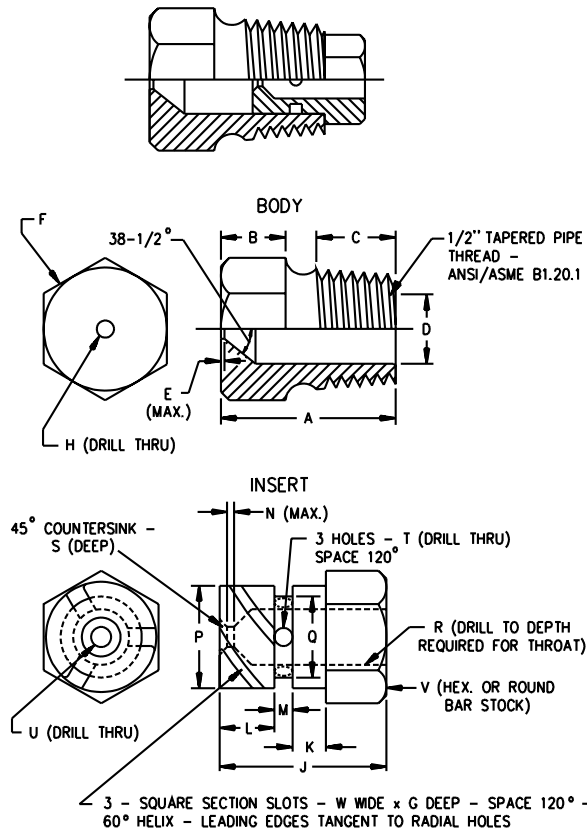
su0013

A – Probe with shielded lead.

B – Separated and used as clip when measuring currents from one part of product to another.

Figure 7 – Spray head
(See Clause 5.12.1.3)

ASSEMBLY^a



RT100C

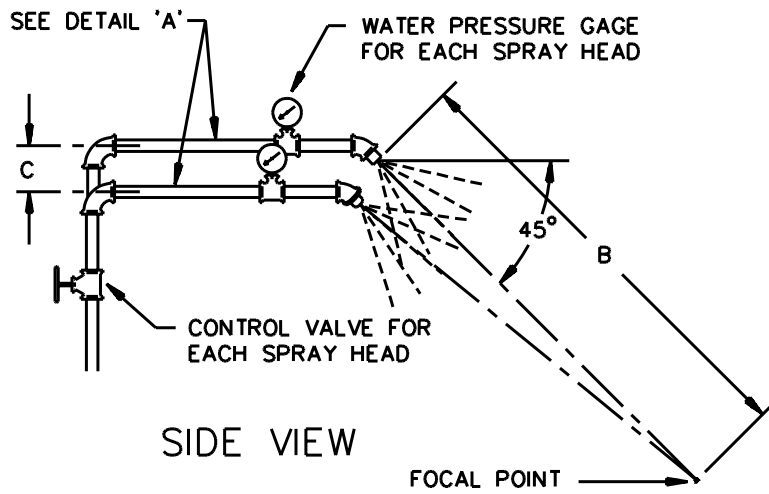
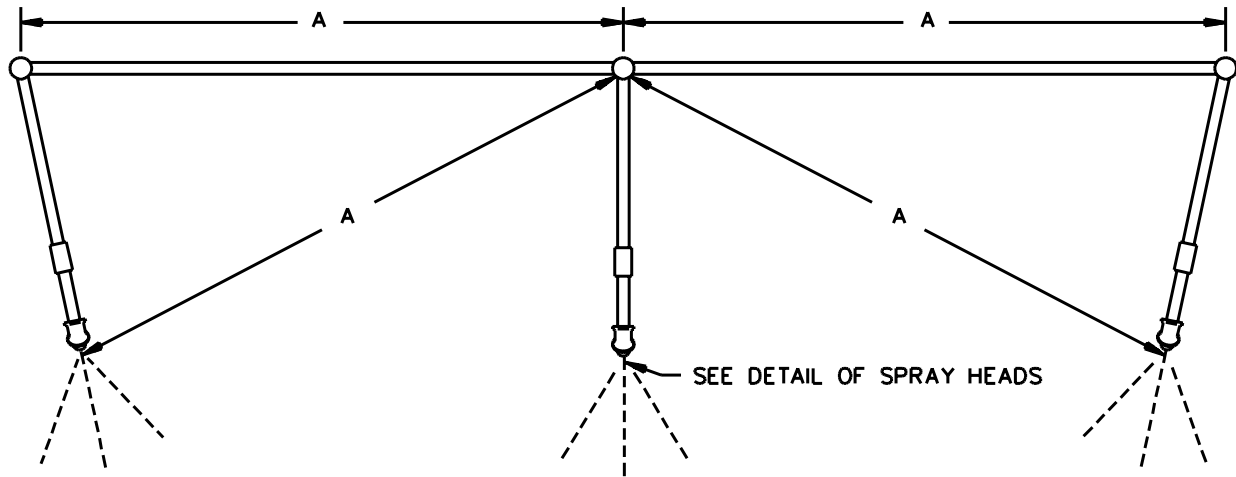
Item	in	(mm)	Item	in	(mm)
A	1-7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35) ^b	2.80
H	(No. 9) ^b	5.0	U	(No. 40) ^b	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

^a Nylon Rain-Test Spray heads are available from Underwriters Laboratories Inc.

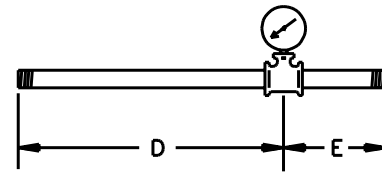
^b ANSI B94.11M Drill size

^c Optional – To serve as wrench grip.

Figure 8 – Spray head pipe rack
(See Clause 5.12.1.3)
PLAN VIEW



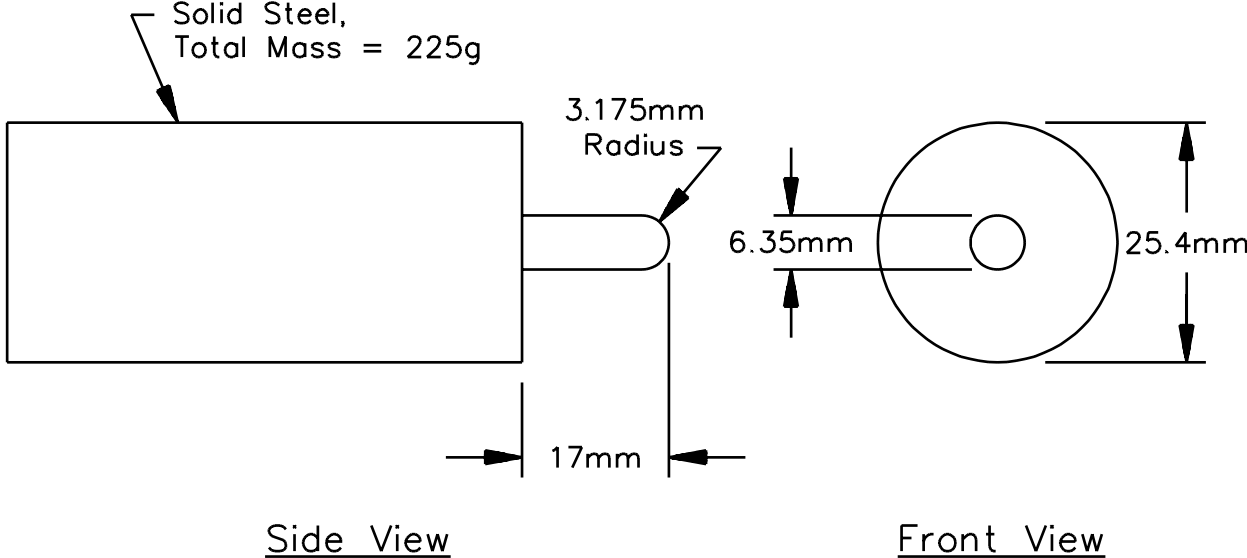
PIEZOMETER ASSEMBLY
DETAIL 'A'



RT101B

Item	in	(mm)
A	28	710
B	55	1400
C	2-1/4	55
D	9	230
E	3	75

Figure 9 – Impactor
(See Clause 5.19.4.1)



S3630

**Figure 10 – Location of applicators for crush-resistance test
(See Clause 5.21.9.2)**

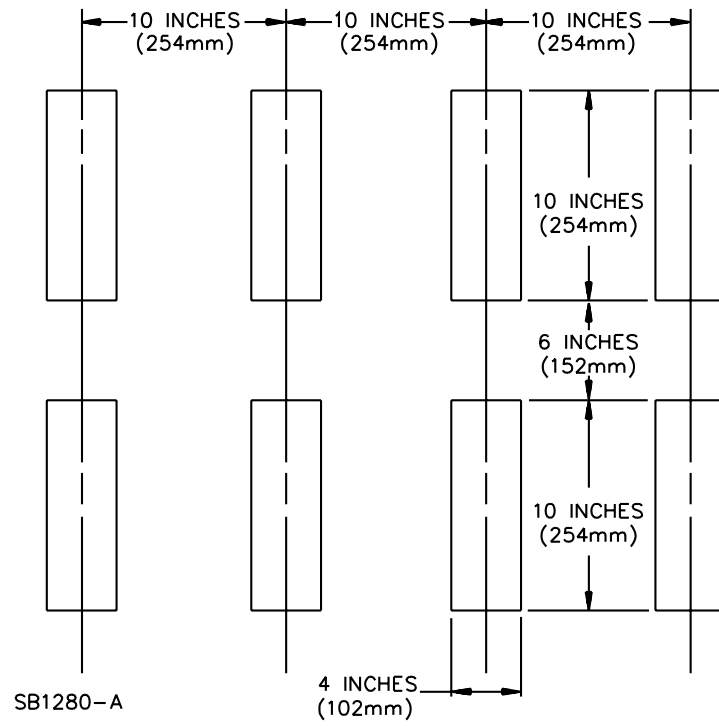
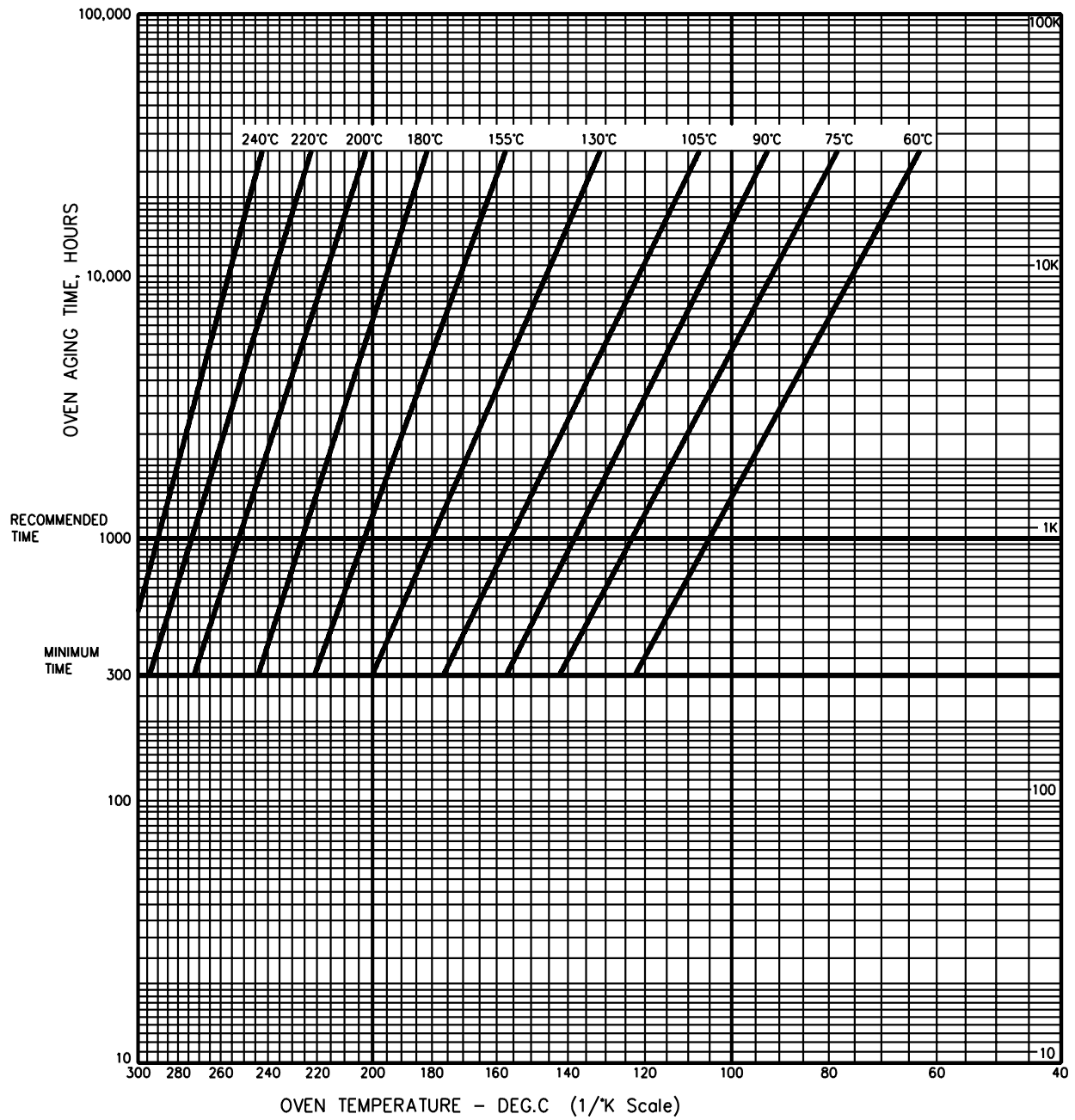


Figure 11 – Conditioning time versus oven temperature for temperature index of adhesives
(See Clause 5.23.3.1)



SB1631A

Figure 12 – Class 105 (A) system response
(See Clauses 5.24.4.1 and 5.26.1)

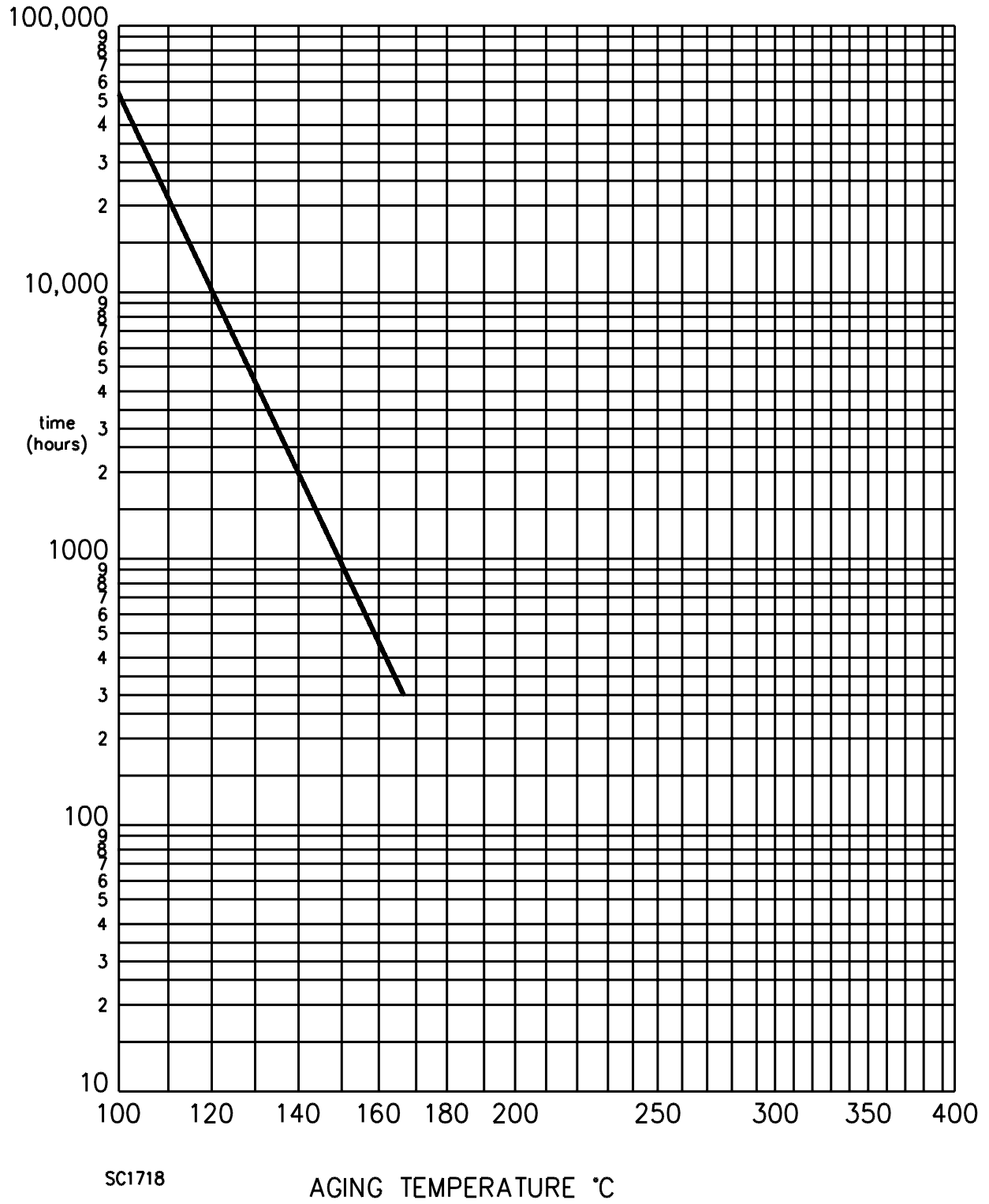
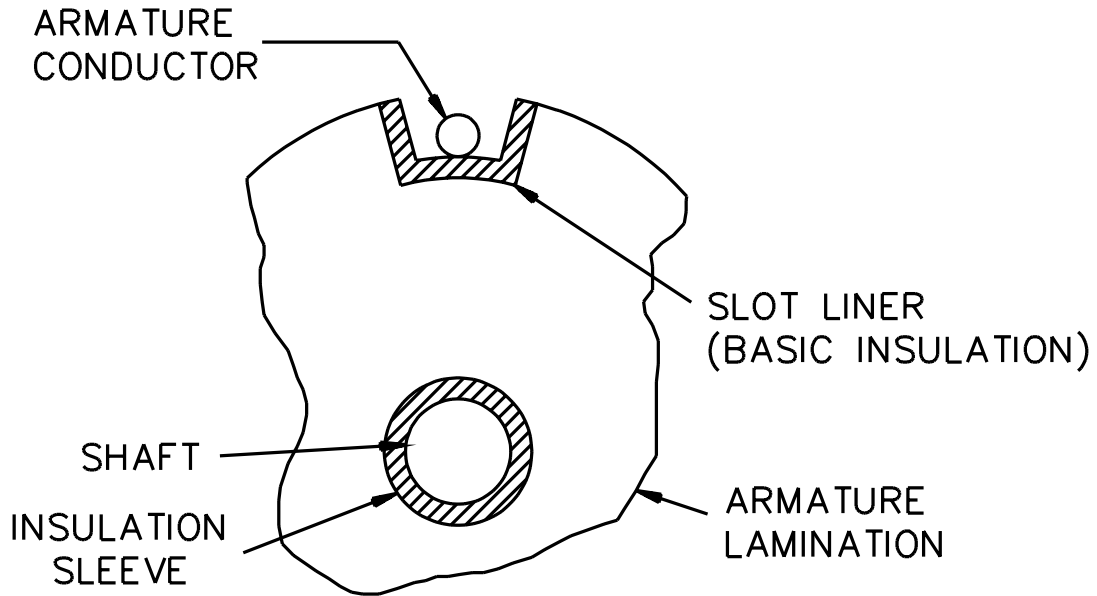
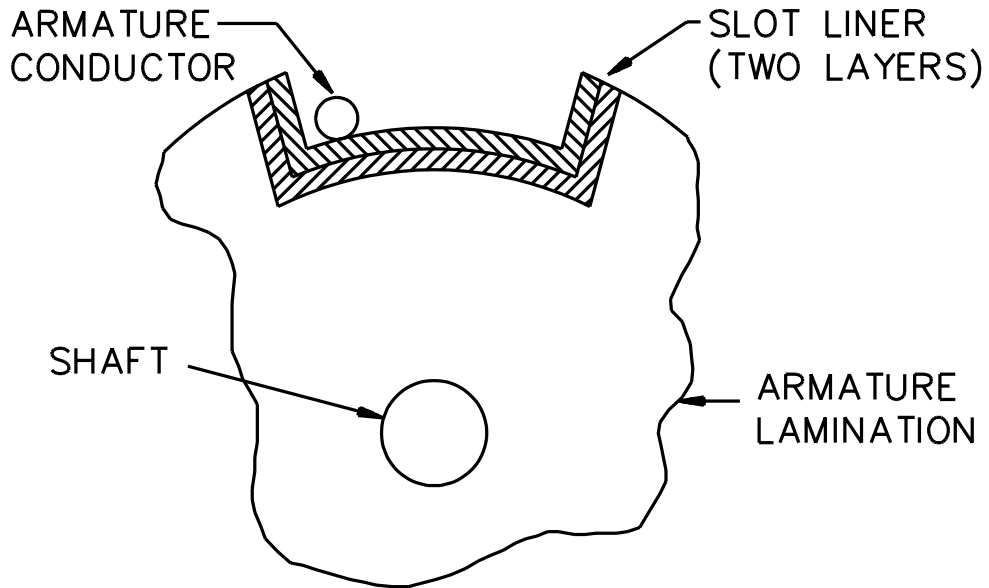


Figure 13 – Examples illustrating double insulation
(See Clause 2.13)



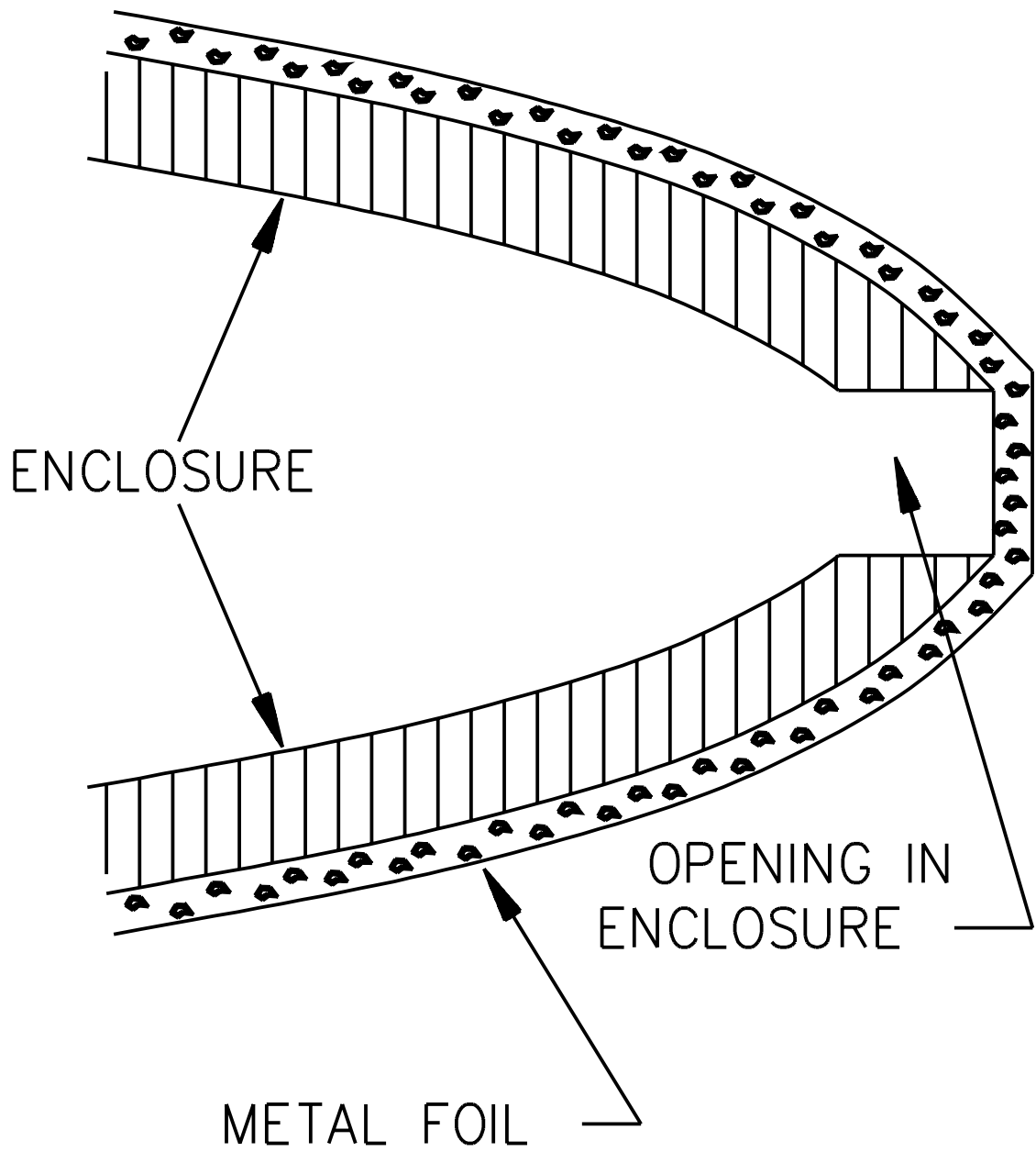
A– CONSIDERED TO CONSTITUTE DOUBLE INSULATION



B– NOT CONSIDERED TO CONSTITUTE DOUBLE INSULATION

S0723A

Figure 14 – Method of covering enclosure with foil for measurement and tests
(See Clauses 6.16.2, 6.17.5.3, 6.19.1, Table 13 and Table 14)



SB0722

Figure 15 – Hose position during conditioning
(See Clause 8.12.3)

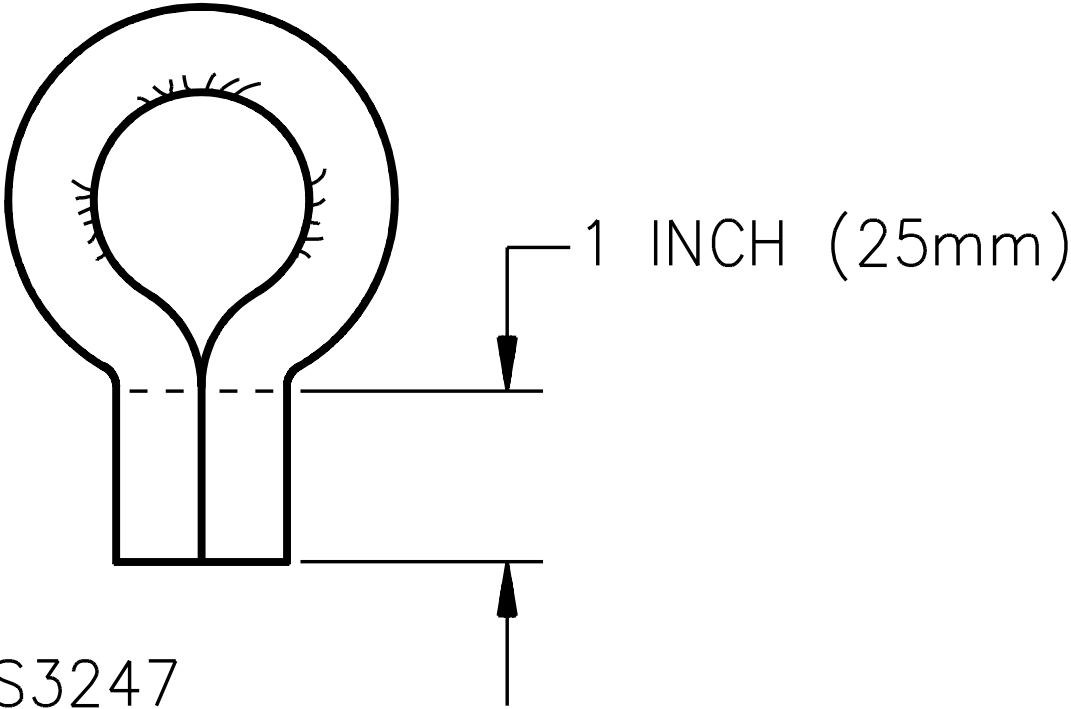


Figure 16 – Flex cycle
(See Clause 8.12.3)

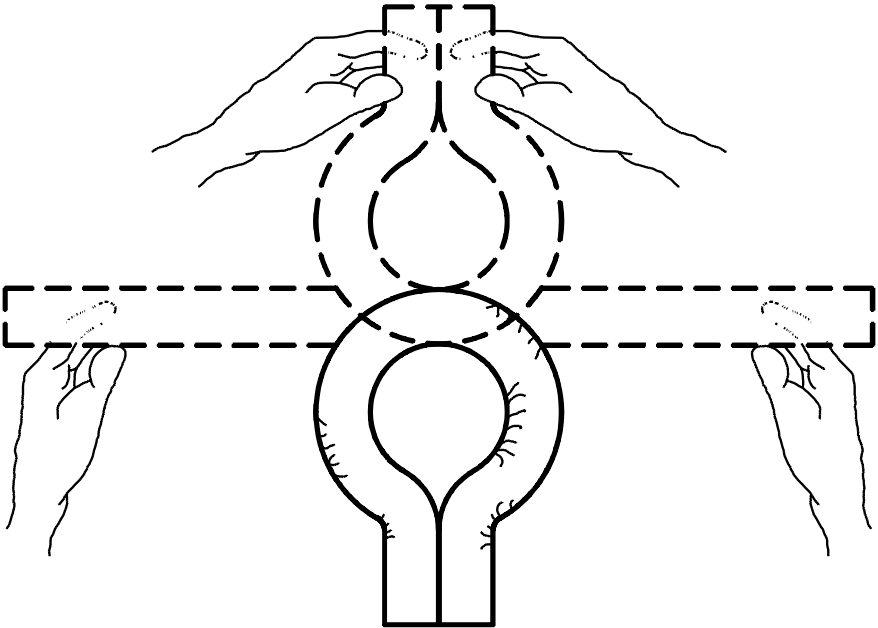
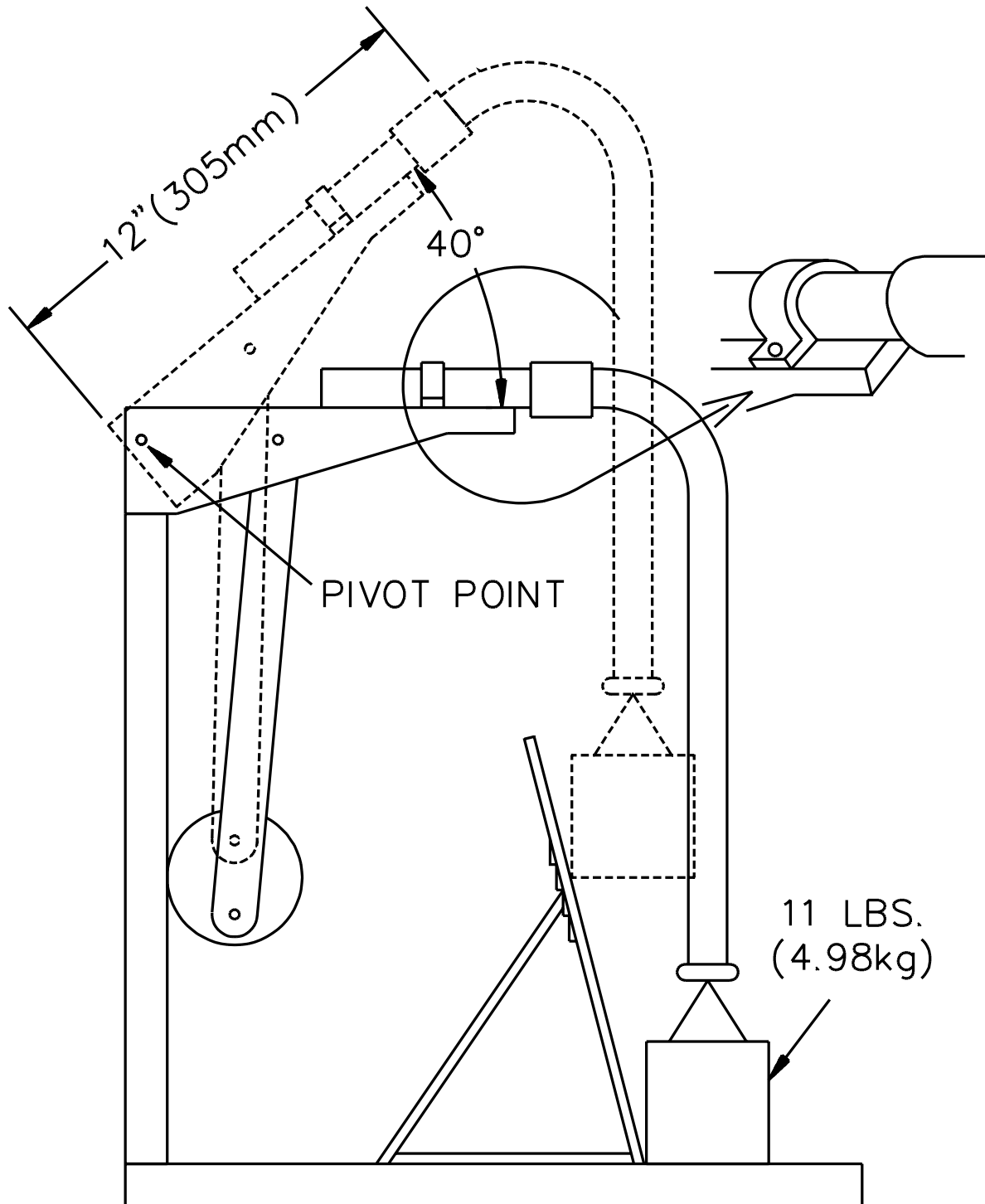
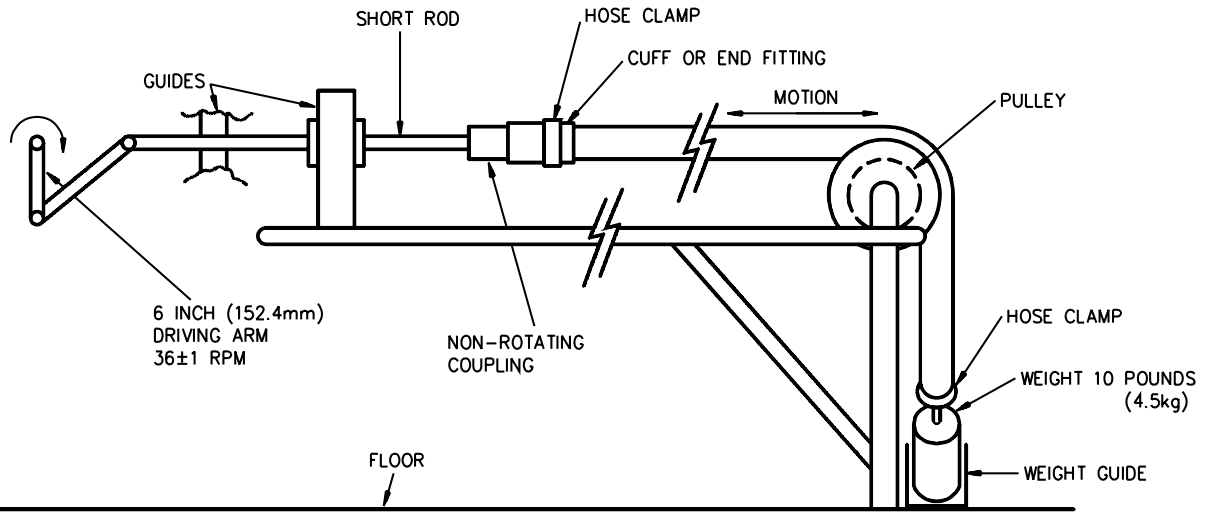


Figure 17 – Vertical reciprocating test apparatus
(See Clause 8.13.1.3)

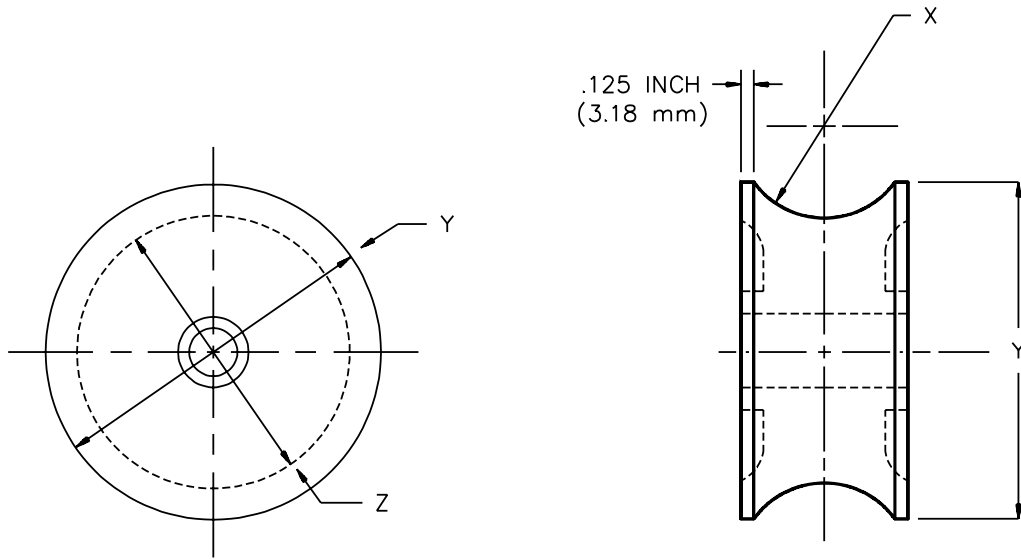


**Figure 18 – Horizontal reciprocating test apparatus
(See Clause 8.13.2.2)**



S3244

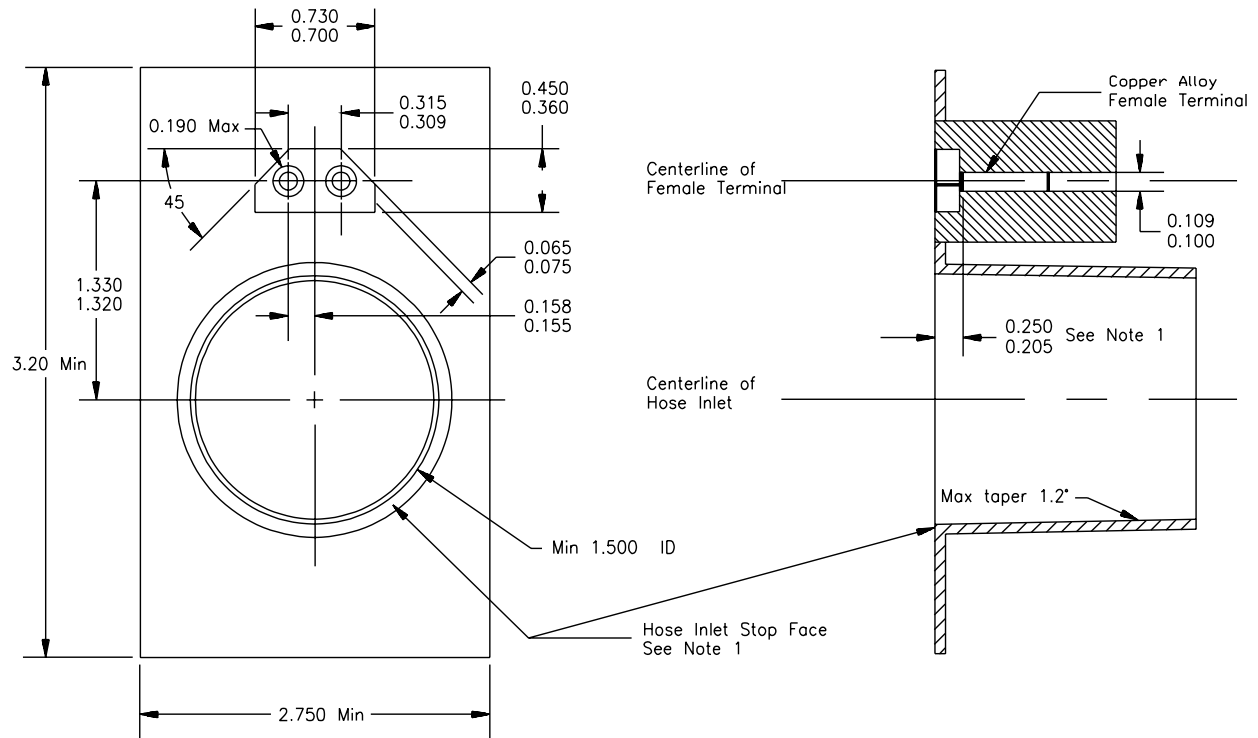
Figure 19 – Pulley dimensions
(See Clause 8.13.2.2)



- X = THE MAXIMUM DIAMETER OF THE HOSE + 1/4 INCH (6.4 mm)
 Y = TWO TIMES THE MINIMUM DIAMETER OF THE HOSE PLUS
 3.75 INCHES (95.3 mm)
 Z = ROOT DIAMETER OF 3.75 INCHES

S3246A

**Figure 21 – Type A wall-valve configuration
(See Clause 8.2.2)**



SM1278

NOTES

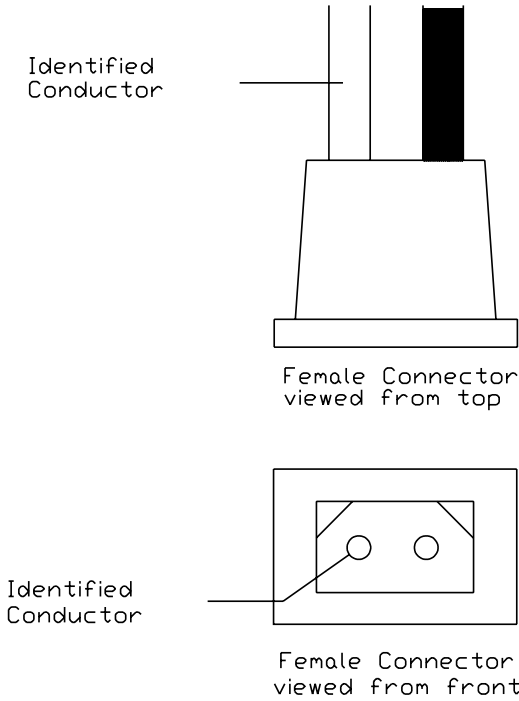
1 The hose inlet stop face is not required to be flush with the inner valve surface. When the inlet stop face is raised, the dimension is referenced from the surface of the raised area of the inlet stop face to the terminal.

2 All dimensions in this figure are in inches and the SI units for the dimensions are:

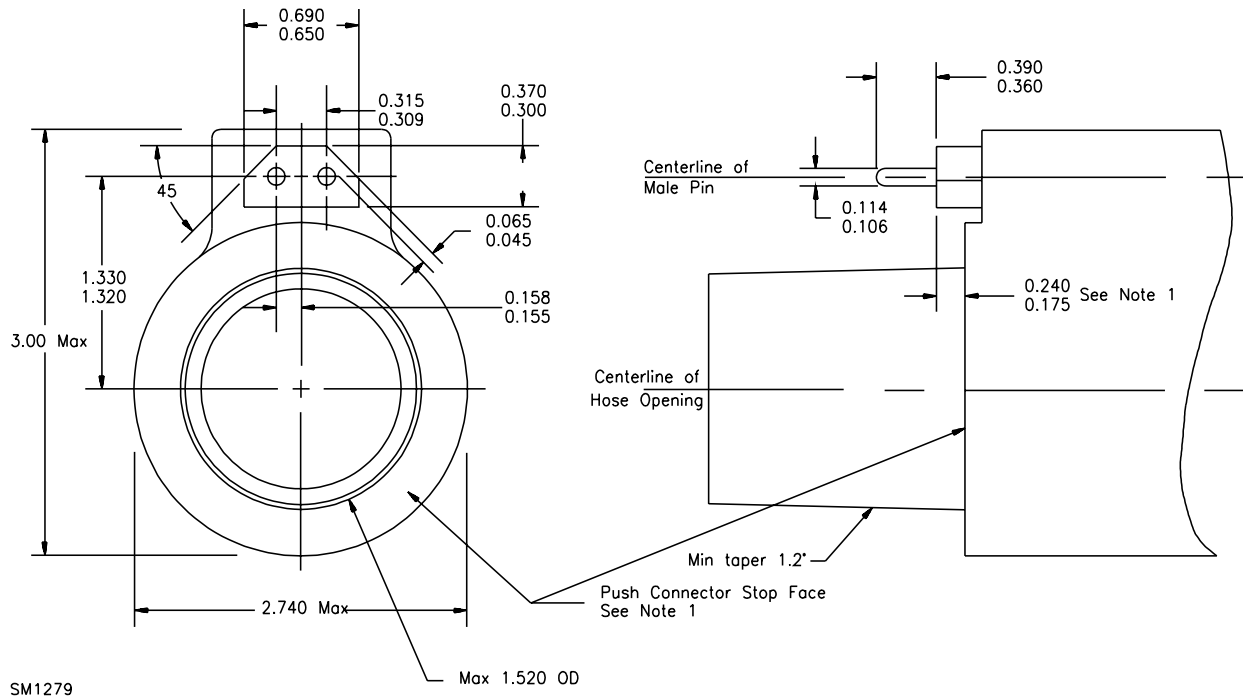
1 in = 25.4 mm

10 in = 254 mm

**Figure 22 – Female power connector configuration for Type A wall valve
(See Clause 8.2.3)**



**Figure 23 – Hose end fitting configuration for connection to a Type A wall valve
(See Clause 8.2.4)**



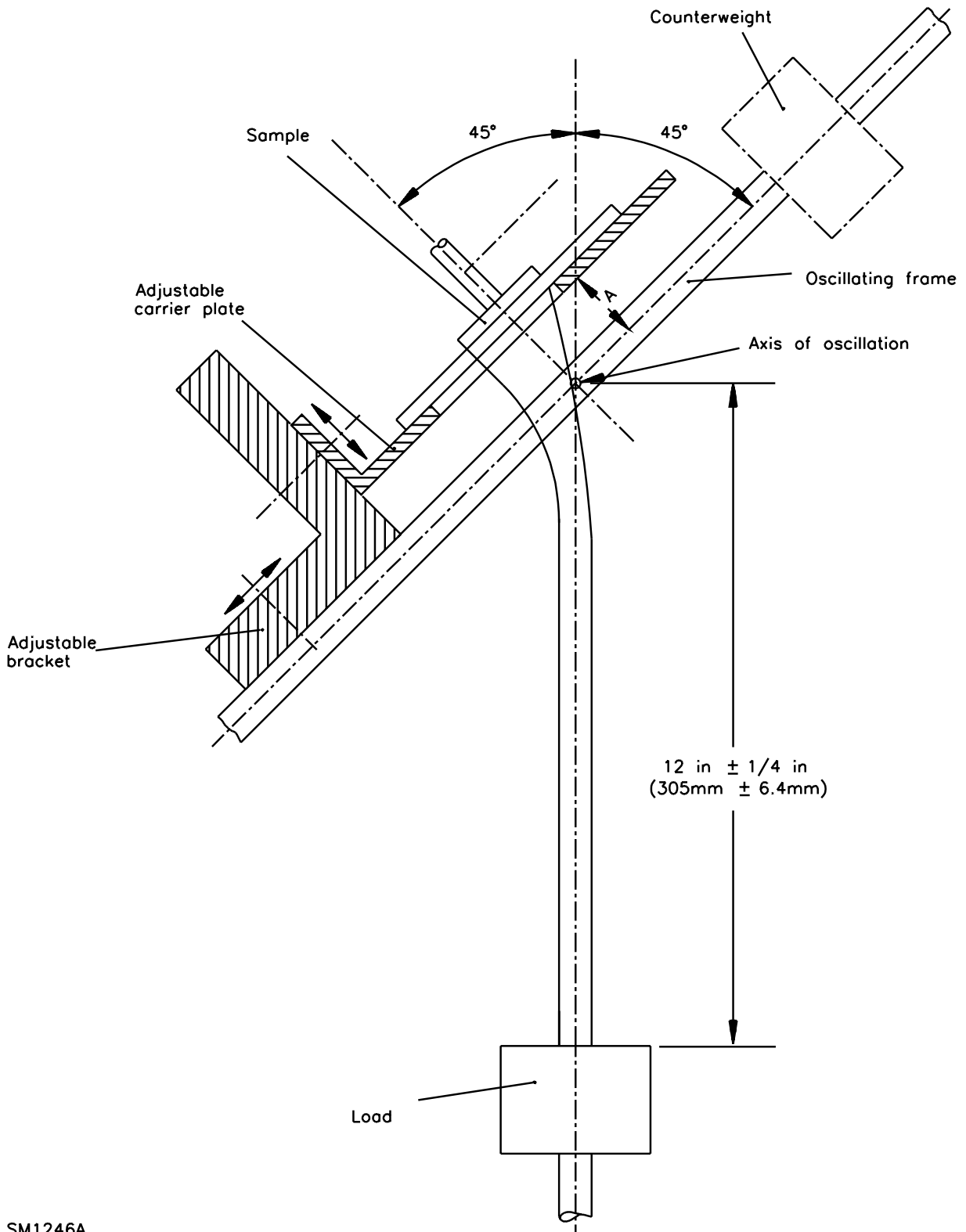
NOTES:

1. When provided with a beveled surface, the dimension is referenced from the surface of the stop face at the connector tube.
2. All dimensions in this figure are in inches and the SI units for the dimensions are:

1 in = 25.4 mm

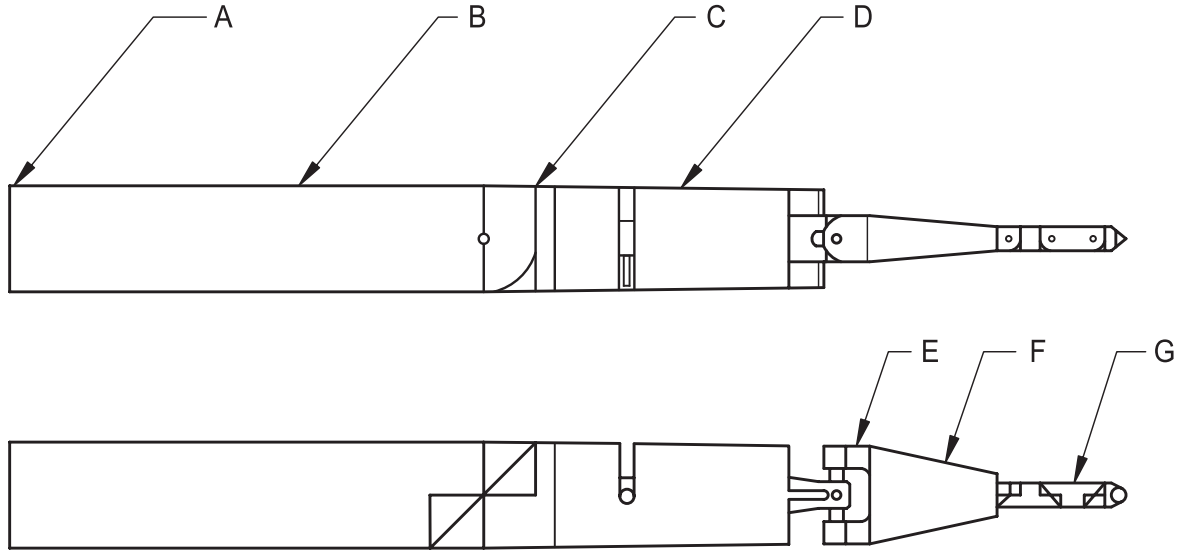
10 in = 254 mm

Figure 24 Apparatus for cord flexing test
(See Clauses 5.17.3 and 5.17.4)



SM1246A

**Figure 25 – Accessibility probe for openings 1.375 in (34.9 mm) or more
(See Clause 4.16.3.1, Annex C Tables C.1 and C.2 and Figure 26)**

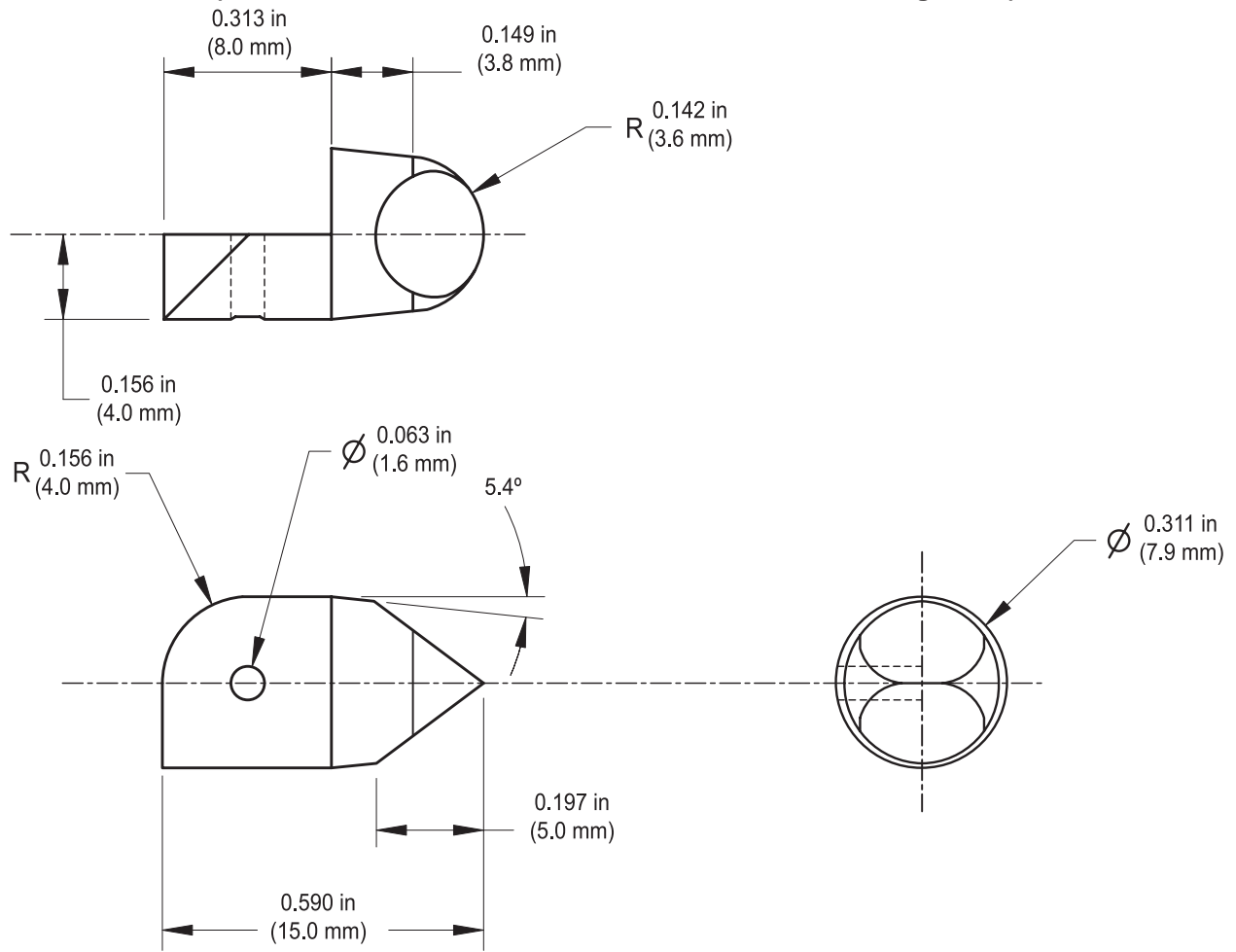


su0252

- A – Upper arm circumference – female – 5th percentile = 4.685 in (11.9 cm)
 - B – Shoulder to elbow length – male – 95th percentile = 6.61 in (16.8 cm)
 - C – Forearm circumference – female – 5th percentile = 4.76 in (12.1 cm)
 - D – Lower arm length – male – 95th percentile = 8.76 in (22.7 cm) (elbow to fingertip)
 - E – Minimum hand clearance diameter – female – 5th percentile = 1.374 in (3.49 cm)
 - F – Hand length – male – 95th percentile = 4.016 in (10.2 cm)
 - G1 – Middle finger length – male – 95th percentile = 1.772 in (4.5 cm)
 - G2 – Middle finger diameter – female – 5th percentile = 0.311 in (0.79 cm)
- All dimensions apply to the 13 – 18 month age bracket (male and female).

See <http://ovrt.nist.gov/projects/anthrokids/child.html> for more details.

Figure 26 – Finger tip detail
(See Clause 4.16.3.1, Annex C Tables C.1 and C.2 and Figure 25)



su0253

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ANNEX A

Standards for components

A.1 Component standards

A1.1 The CSA and UL standards listed below are used for evaluation of components and features of products covered by this standard. Components shall comply with all the applicable CSA and UL component standards. These standards shall be considered to refer to the latest edition and all revisions published to that edition.

CSA Standards

C22.1

Canadian Electrical Code, Part I

C22.2 No. 0

General Requirements— Canadian Electrical Code, Part II

C22.2 No. 0.1

General Requirements for Double-Insulated Equipment

C22.2 No. 0.4

Bonding of Electrical Equipment

C22.2 No. 0.15

Adhesive Labels

C22.2 No. 0.17

Evaluation of Properties of Polymeric Materials

C22.2 No. 1

Audio, Video, and Similar Electronic Equipment

C22.2 No. 8

Electromagnetic Interference (EMI) Filers

C22.2 No. 10

Electric Floor Surfacing and Cleaning Machines

C22.2 No. 21

Cord Sets and Power Supply Cords

C22.2 No. 24

Temperature-Indicating and -Regulating Equipment

C22.2 No. 38

Thermoset Insulated Wires and Cables

C22.2 No. 39

Fuseholder Assemblies

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

C22.2 No. 43
Lampholders

C22.2 No. 49
Flexible Cords and Cables

C22.2 No. 55
Special Use Switches

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

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

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

C22.2 No. 74
Equipment for Use with Electric Discharge Lamps

C22.2 No. 75
Thermoplastic-Insulated Wires and Cables

C22.2 No. 77
Motors With Inherent Overheating Protection

C22.2 No. 100
Motors and Generators

C22.2 No. 111
General Use Switches

C22.2 No. 156
Solid-State Speed Controls

C22.2 No. 177
Clock-Operated Switches

C22.2 No. 209
Thermal Cut-Offs

C22.2 No. 223
Power Supplies with Extra-Low-Voltage Class 2 Output

C22.2 No. 4248
Series Fuseholders

C22.2 No. 61058-1
Switches for Appliances – Part 1: General Requirements

UL Standards

UL 20

Switches, General Use, Snap

UL 44

Thermoset-Insulated Wires and Cables

UL 62

Flexible Cords and Cables

UL 83

Thermoplastic-Insulated Wires and Cables

UL 94

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

UL 157

Gaskets and Seals

UL 248-1

Fuses, Low-Voltage – Part 1: General Requirements

UL 248-11

Fuses, Low-Voltage – Part 11: Plug Fuses

UL 310

Terminals, Electrical Quick-Connect

UL 355

Cord Reels

UL 496

Lampholders

UL 498

Attachment Plugs and Receptacles

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 746D

Polymeric Materials – Fabricated Parts

UL 796

Printed-Wiring Boards

UL 810

Capacitors

UL 817

Cord Sets and Power-Supply Cords

UL 917

Switches, Clock-Operated

UL 969

Marking and Labelling Systems

UL 1004

Motors, Electric

UL 1054

Switches, Special-Use

UL 1310

Class 2 Power Units

UL 1439

Sharpness of Edges on Equipment, Tests for

UL 1446

Insulation Materials – General, Systems of

UL 1676

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

UL 2111

Overheating Protection for Motors

UL 4248-1

Fuseholders – Part 1: General Requirements

UL 61058-1

Switches for Appliances – Part 1: General Requirements

ANNEX B

French Language Markings

This ANNEX is provided for information only

The information contained in this annex is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this annex may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary to fulfill the objectives of the standard.

Clause	English	French
7.8.2.1	"For Household Use Only," "Household Type,"	«Pour usage domestique seulement.» «Type ménager.»
7.8.2.2	"For Use Only With ± Charger." ± Replace with the Class 2 power unit manufacturer's name and model/catalog number.	«Utiliser seulement le chargeur de pile ±.» Remplacer ± par le nom du fabricant de l'appareil de classe 2 et le numéro de modèle ou la référence catalogue.
7.8.2.3	"For use only with ± battery." ± Replace with the manufacturer's name and model/catalog number.	«Doit être utilisé seulement avec une pile ±.» ± Remplacer par le nom du fabricant et le numéro de modèle ou la référence catalogue.
7.8.3.1	"CAUTION" "For Indoor Use Only" or "Risk of Electric Shock – Dry Location Use Only" or "Risk of Electric Shock – Do Not Expose to Liquid, Vapor, or Rain"	«ATTENTION. Pour emploi à l'intérieur seulement» ou «Risque de choc électrique. À utiliser dans un endroit sec seulement.» ou «Risque de choc électrique. Ne pas exposer aux liquides, à la vapeur ou à la pluie.»
7.8.3.2	"CAUTION", "Risk of Fire or Injury To Persons – No User-Serviceable Parts Inside" or "– No User-Replaceable Parts Inside"	«ATTENTION. Risque d'incendie ou de blessure. Ne contient aucune pièce réparable par l'utilisateur.» ou «Ne contient aucune pièce remplaçable par l'utilisateur.»
7.8.3.3	"CAUTION", "Store Indoors"	«ATTENTION. Ranger à l'intérieur.»
7.9.2.1	"Do not use outdoors or on wet surfaces," "Do not handle charger, including charger plug, and charger terminals with wet hands," "Do not charge the unit outdoors," "Use only the charger supplied by the manufacturer to recharge," "Do not incinerate the appliance even if it is severely damaged. The batteries can explode in a fire."	«Ne pas utiliser à l'extérieur et ne pas aspirer de déchets humides.» «Ne pas manipuler le chargeur ni la fiche ou les bornes du chargeur avec les mains humides.» «Ne pas charger l'appareil à l'extérieur.» «Utiliser seulement le chargeur fourni par le fabricant pour recharger la pile.» «Ne pas incinérer l'appareil même s'il est très endommagé car les piles peuvent exploser dans les flammes.»
8.16.1	"This Hose Contains Electrical Wires"	«Ce flexible contient des fils électriques.»
8.16.2	"Connect Only to a Type A Wall Valve."	«Doit être connectée à une prise murale d'aspirateur de type A seulement.»
8.16.3	"Central Vacuum Cleaning System Wall Valve – Type A."	«Prise murale d'aspirateur central – Type A.»
8.16.5	"For Household Use Only"	«Pour usage domestique seulement.»
8.16.6	"WARNING," "To reduce the risk of electric shock connect only (hose manufacturer's name) electric hose, Cat. No. ___ to this wall valve." "To reduce the risk of electric shock, connect only to (valve manufacturer's name) electrified wall valve, Cat. No. ___."	«AVERTISSEMENT. Pour réduire le risque de choc électrique, seul un flexible porteur de courant (nom du fabricant du flexible), référence catalogue ___ doit être connecté à cette prise murale d'aspirateur.» «Pour réduire le risque de choc électrique, ce flexible ne doit être connecté qu'à une prise murale électrifiée (nom du fabricant de la prise d'aspirateur central), référence catalogue ___.»

Table Continued on Next Page

Table Continued

Clause	English	French
10.3.5	"If connected to a circuit protected by fuses, use time-delay fuses, marked Type D, with this appliance."	«Si cet appareil est branché à une dérivation protégée par des fusibles, ces fusibles doivent être temporisés et marqués type D.»
10.3.6	"Connect To Individual Branch Circuit."	«Connecter à une dérivation distincte.»
10.3.7	"Connect Only To A Dedicated Individual Branch Circuit."	«Doit être connecté à une dérivation distincte exclusivement réservée à l'appareil.»
10.3.8	"double insulation,"	«isolation double»
10.3.9	"DOUBLE INSULATION – When servicing, use only identical replacement parts." "DOUBLE INSULATED"	«ISOLATION DOUBLE. Pour le dépannage, utiliser uniquement des pièces de remplacement identiques aux pièces d'origine.» «ISOLATION DOUBLE»
10.3.10	"Mount ___ at least...inches from side walls (and floor or ceiling)"	«Assurer un dégagement d'au moins ___ pouces entre l'appareil et les parois latérales (ou le plancher, ou le plafond, selon le cas).»
10.3.13	"For Household Use Only," "Household Type"	«Pour usage domestique seulement», «Type ménager»
10.3.14	"For Use Only With Central Vacuum Cleaners,"	«Utiliser seulement avec un aspirateur central.»
10.3.16	"The Use of This Machine In Conjunction With The Pick-Up of ± Has Not Been Investigated By ±±."	«L'utilisation de cet appareil pour aspirer ± n'a pas fait l'objet d'une étude de la part de ±±.»
	± Replaced with substances for which the product has been investigated to pick-up.	± Remplacer par le nom de la substance.
	±± Replaced with name of organization certifying compliance with this Standard.	±± Remplacer par le nom de l'organisme attestant la conformité à cette norme.
10.3.17	"Class 2, ____ V." (the blank shall be replaced with the nominal open-circuit voltage present at the terminals), "Class 2 Not Wet, ____ V." (the blank shall be replaced with the nominal open-circuit voltage present at the terminals.)	«Classe 2, ____ V.» (Remplacer l'espace par la tension nominale en circuit ouvert présente aux bornes.) «Classe 2, non humide, ____ V.» (Remplacer l'espace par la tension nominale en circuit ouvert présente aux bornes.)
10.4.3	"DANGER," "WARNING," or "CAUTION."	«DANGER», «AVERTISSEMENT» ou «ATTENTION».
10.4.5	"CAUTION", "This appliance has more than one connection to the source of supply. To reduce the risk of electric shock, disconnect all such connections before servicing."	«ATTENTION. Cet appareil est relié à plus d'une source d'alimentation. Pour réduire le risque de choc électrique, couper toutes les alimentations avant le dépannage.»
10.4.12	"DANGER", "This equipment incorporates parts such as switches, motors, or the like that tend to produce arcs or sparks that can cause an explosion. When located in gasoline-dispensing and service stations install and use at least 20 ft (6 m) horizontally from the exterior enclosure of any dispensing pump and at least 18 in (450 mm) above a driveway or ground level."	«DANGER. Cet appareil comporte des pièces telles qu'un commutateur et un moteur susceptibles de produire des arcs électriques et des étincelles pouvant causer des explosions. Si l'aspirateur est installé dans un poste de distribution d'essence ou une station-service, assurer un dégagement horizontal minimal de 20 pi (6 m) entre l'aspirateur et l'enveloppe de la pompe à essence la plus proche, et un dégagement vertical minimal de 18 po (450 mm) entre l'aspirateur et le sol.»
10.4.13	"CAUTION – To Reduce The Risk Of Injury From Moving Parts - Unplug Before Servicing."	«ATTENTION. Pour éviter d'être blessé par des pièces en mouvement, débrancher l'appareil avant le dépannage.»
10.4.14	"WARNING – TO REDUCE THE RISK OF ELECTRIC SHOCK– UNPLUG BEFORE CLEANING OR SERVICING."	«AVERTISSEMENT. POUR RÉDUIRE LE RISQUE DE CHOC ÉLECTRIQUE, DÉBRANCHER L'APPAREIL AVANT LE NETTOYAGE OU LE DÉPANNAGE.»

Table Continued on Next Page

Table Continued

Clause	English	French
10.4.15	"CAUTION – For supply connection, use wires rated for at least ___ °C (___°F)."	«ATTENTION. Pour les connexions d'alimentation, utiliser des fils à une température nominale d'au moins ___ °C (___ °F).»
10.4.16	"WARNING – This hose contains electric wires. To reduce risk of electric shock do not use or repair a damaged hose."	«AVERTISSEMENT. Ce flexible contient des fils électriques. Pour réduire le risque de choc électrique, ne pas utiliser ni réparer un flexible endommagé.»
10.4.17	"WARNING – To reduce the risk of electric shock, always install float before any wet pick-up operation."	«AVERTISSEMENT. Pour réduire le risque de choc électrique, toujours installer le flotteur avant d'aspirer des déchets humides.»
10.4.18	"WARNING", "To reduce the risk of fire, only connect a tool rated ___ amperes maximum to this receptacle;","To reduce the risk of fire, connect only (tool manufacturer's name), model (model number);","Risk of Injury to Persons – tool should be turned off before placing switch in the auto position."	«AVERTISSEMENT. Pour réduire le risque d'incendie, ne raccorder qu'un outil de ___ A max. à cette prise.» «Pour réduire le risque d'incendie, ne raccorder qu'un outil (nom du fabricant de l'outil), modèle (numéro de modèle).» «Risque de blessure. Mettre l'outil hors tension avant de mettre l'interrupteur à la position AUTO.»
10.4.19	"Only For Use With \pm Model $\pm\pm$ Vacuum Cleaner. \pm Part No. $\pm\pm\pm$ Supply Cord Rated $\pm\pm\pm\pm$ V, $\pm\pm\pm\pm$ A, With $\pm\pm\pm\pm$ °C Connector." \pm Replace with the vacuum cleaner manufacturer's name. $\pm\pm$ Replace with the vacuum cleaner manufacturer's vacuum cleaner model number. $\pm\pm\pm$ Replace with the vacuum cleaner manufacturer's supply cord part number. $\pm\pm\pm\pm$ Replace with the voltage, amperage, and temperature rating, respectively, of connector.	«Doit être utilisé seulement avec un aspirateur \pm modèle $\pm\pm$. Cordon d'alimentation \pm , n[ordm] de pièce $\pm\pm\pm$, avec connecteur $\pm\pm\pm\pm$ V, $\pm\pm\pm\pm$ A, $\pm\pm\pm\pm$ °C (valeurs nominales).» \pm Remplacer par le nom du fabricant de l'aspirateur. $\pm\pm$ Remplacer par le numéro de modèle d'aspirateur de ce fabricant. $\pm\pm\pm$ Remplacer par le numéro de pièce du cordon d'aspirateur de ce fabricant. $\pm\pm\pm\pm$ Remplacer, respectivement, par la tension, l'intensité et la température nominales du connecteur.
10.4.20	"WARNING: For Use Only With \pm Part No. $\pm\pm$ Supply Cord." \pm Replace with the vacuum cleaner manufacturer's name. $\pm\pm$ Replace with vacuum cleaner manufacturer's supply cord part number.	«AVERTISSEMENT. Doit être utilisé seulement avec un cordon d'alimentation \pm , n[ordm] de pièce. $\pm\pm$.» \pm Remplacer par le nom du fabricant de l'aspirateur. $\pm\pm$ Remplacer par le numéro de pièce du cordon d'aspirateur de ce fabricant

See Clause 11.2.6, the main text starting with "IMPORTANT SAFETY INSTRUCTIONS" for the equivalent English.

IMPORTANTES MESURES DE SÉCURITÉ

L'utilisation d'un appareil électrique demande certaines précautions, dont les suivantes:

LIRE TOUTES LES INSTRUCTIONS AVANT D'UTILISER (CET APPAREIL)

AVERTISSEMENT: pour réduire le risque d'incendie, de choc électrique ou de blessure:

1. Ne pas laisser l'appareil sans surveillance lorsqu'il est branché. Le débrancher lorsqu'il n'est pas utilisé et avant le dépannage.
2. (Marquage pertinent du tableau 17, tel que «Ne pas utiliser à l'extérieur ou ne pas aspirer de déchets humides.» Voir l'article 11.2.3.)
3. Ne pas laisser les enfants jouer avec l'appareil ou s'en servir sans surveillance. Redoubler d'attention s'il y a des enfants à proximité lorsqu'on utilise l'appareil.
4. Utiliser l'appareil en respectant les consignes de cette notice d'emploi et n'utiliser que les accessoires recommandés par le fabricant.
5. Ne pas utiliser l'appareil si le cordon ou la fiche est endommagé. Retourner l'appareil à un atelier de réparation s'il ne fonctionne pas normalement, s'il a été échappé, s'il est endommagé, s'il a été oublié à l'extérieur ou immergé.
6. Le cordon ne doit pas être utilisé comme une poignée ou pour tirer, traîner ou soulever l'appareil. Ne pas faire passer l'appareil sur le cordon ; ne pas coincer le cordon dans l'embrasure en refermant les portes ni tirer dessus à l'angle d'un mur ou d'une autre arête vive et le tenir à distance des surfaces chaudes.
7. Ne pas tirer sur le cordon pour débrancher l'appareil; tirer plutôt sur la fiche.
8. Ne pas toucher la fiche du cordon ou l'appareil avec les mains humides.
9. Ne pas insérer d'objet dans une ouverture quelconque de l'appareil. Ne pas utiliser l'appareil lorsqu'une ouverture est bloquée et enlever la poussière, la peluche, les cheveux, etc., qui peuvent gêner le débit d'air.
10. Veiller à bien se garder – doigts, cheveux, vêtements amples – à distance des ouvertures et des pièces mobiles.
11. Mettre toutes les commandes en position d'arrêt avant de débrancher l'appareil.
12. Redoubler d'attention en nettoyant les escaliers.
13. Ne pas se servir de l'appareil pour aspirer des liquides combustibles ou inflammables comme de l'essence ou dans un endroit où il peut y avoir de tels liquides.

CONSERVER CES INSTRUCTIONS

See Clause 11.3.1, the main text under the appropriate item headings for the equivalent English.

Les marquages pertinents, parmi ceux de la liste a) à f) ci-dessous, doivent figurer dans la notice d'instructions des appareils mis à la terre ou à double isolation.

- a) Tous les appareils mis à la terre et munis d'un cordon:

INSTRUCTIONS DE MISE À LA TERRE

Cet appareil doit être mis à la terre. En cas de défaillance ou de panne, le circuit de mise à la terre offre au courant un chemin de moindre résistance qui réduit le risque de choc électrique.

L'appareil est pourvu d'un cordon muni d'un conducteur qui en assure la mise à la terre et d'une fiche avec broche de terre. Cette fiche doit être branchée sur une prise convenable, correctement installée et reliée à la terre conformément aux codes et aux règlements du lieu.

AVERTISSEMENT. Un conducteur de terre mal raccordé présente des risques de choc électrique. Consulter un électricien ou un technicien d'entretien compétent en cas de doute à propos de la mise à la terre d'une prise quelconque. Ne pas modifier la fiche vendue avec l'appareil; si elle ne s'insère pas dans la prise, faire installer une nouvelle prise par un électricien compétent.

b) Appareils mis à la terre et munis d'un cordon, d'une intensité nominale inférieure à 15 A et destinés à être branchés sur un circuit d'alimentation de 120 V: la notice d'emploi de ces appareils doit comporter l'alinéa 1) ou 2) ci-dessous:

1) Cet appareil destiné à un circuit nominal de 120 V est muni d'une fiche de terre semblable à celle illustrée dans le croquis A de la figure 20. Un adaptateur temporaire comme celui illustré dans les croquis B et C peut être utilisé pour brancher l'appareil sur une prise à deux broches (croquis B) en l'absence d'une prise correctement reliée à la terre. Mais cet adaptateur temporaire ne devrait être utilisé qu'en attendant l'installation, par un électricien compétent, d'une prise correctement mise à la terre (croquis A). L'oreillette rigide, le crochet ou autre dispositif de couleur verte intégré à l'adaptateur doit être connecté à un élément correctement relié à la terre, par exemple le couvercle d'une boîte de sortie mise à la terre, et il doit être fixé à la prise au moyen d'une vis métallique.

Exception: Au Canada, l'emploi d'un adaptateur temporaire est interdit par le Code canadien de l'électricité, C22.1.

2) Cet appareil destiné à un circuit nominal de 120 V est muni d'une fiche de terre semblable à celle illustrée dans le croquis A de la figure 20. L'appareil doit être branché sur une prise ayant la même configuration que la fiche. Aucun adaptateur ne devrait être utilisé avec cet appareil.

c) Autres appareils mis à la terre et munis d'un cordon:

Cet appareil, destiné à un circuit nominal de plus 120 V, (ou Cet appareil, d'une intensité nominale supérieure à 15 A et destiné à un circuit nominal de 120 V,) est équipé en usine d'un cordon et d'une fiche spéciale qui permettent de le brancher sur un circuit électrique approprié. L'appareil doit être branché sur une prise ayant la même configuration que la fiche. Aucun adaptateur ne devrait être utilisé avec cet appareil. Si les connexions doivent être modifiées pour utiliser l'appareil sur un autre type de circuit, elles devraient l'être par un technicien d'entretien compétent.

d) Appareils branchés à demeure:

INSTRUCTIONS DE MISE À LA TERRE

Cet appareil doit être relié à un élément métallique mis à la terre du circuit électrique permanent, ou un conducteur de terre installé avec les conducteurs de phase doit être raccordé à la borne ou au fil de mise à la masse de l'appareil.

e) Appareils à double isolation munis d'un cordon:

ENTRETIEN DES APPAREILS À ISOLATION DOUBLE

Les appareils à isolation double portent le marquage «ISOLATION DOUBLE» et (ou) un symbole d'isolation double (un carré dans un carré):



Dans un appareil à isolation double, deux isolations distinctes remplacent la mise à la terre. L'appareil ne comporte pas de dispositif de mise à la terre et on ne doit pas tenter d'ajouter un tel dispositif à ce type d'appareil. L'entretien de ces appareils exige un grand soin et une bonne connaissance du système et ne devrait être confié qu'à un technicien d'entretien compétent. Les pièces de rechange utilisées dans un appareil à isolation double doivent être identiques aux pièces originales.

f) Shampoineuses à flexibles porteurs de courant pour déchets humides:

ENTRETIEN DES FLEXIBLES PORTEURS DE COURANT POUR DÉCHETS HUMIDES

AVERTISSEMENT. Ce flexible contient des fils électriques. Pour réduire le risque de choc électrique, on ne doit pas utiliser ou tenter de réparer un flexible endommagé ni le remplacer par un flexible d'un autre type. La réparation de ces flexibles pour déchets humides exige un grand soin ainsi qu'une bonne connaissance de leur construction et ne devrait être confiée qu'à un technicien d'entretien compétent.

Clause	English	French
11.2.7	<p>"Always turn off this appliance before connecting or disconnecting motorized nozzle."</p> <p>"The hose contains electrical wires. Do not use when damaged, cut, or punctured. Avoid picking up sharp objects."</p> <p>"Always turn off this appliance before connecting or disconnecting either hose or motorized nozzle."</p> <p>"Connect hose only to a Type A wall valve."</p> <p>"Connect hose only to (valve manufacturer's name) wall valve, Cat. No. ___."</p> <p>"Hold plug when rewinding onto cord reel. Do not allow plug to whip when rewinding."</p> <p>"Connect to a properly grounded outlet only. See Grounding Instructions."</p> <p>"This appliance is provided with double insulation. Use only identical replacement parts. See instructions for Servicing of Double-Insulated Appliances."</p>	<p>«Toujours mettre l'interrupteur de l'appareil à la position ARRÊT avant de connecter ou d'enlever la brosse à moteur.»</p> <p>«Le flexible contient des fils électriques. Ne pas l'utiliser s'il est endommagé, coupé ou perforé. Éviter d'aspirer des objets pointus.»</p> <p>«Toujours mettre l'interrupteur de l'appareil à la position ARRÊT avant de brancher ou de débrancher le flexible ou la brosse à moteur.»</p> <p>«Le flexible doit être connecté à une prise murale de type A seulement.»</p> <p>«Le flexible doit être connecté à une prise murale (nom du fabricant de la prise d'aspirateur), référence catalogue ___.»</p> <p>«Tenir la fiche en enroulant le cordon, pour l'empêcher de battre par terre.»</p> <p>«Doit être branché sur une prise de courant avec mise à la terre. Voir les instructions de mise à la terre.»</p> <p>«Cet appareil est muni d'une isolation double. N'utiliser que des pièces de rechange identiques aux pièces d'origine. Voir les instructions d'entretien des appareils à isolation double.»</p>

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Clause	English	French
	"Unplug before connecting (Name of mechanical accessory)."	«Débrancher l'appareil avant de connecter (nom de l'accessoire).»
	"Do not pick up anything that is burning or smoking, such as cigarettes, matches, or hot ashes."	«Ne pas aspirer de matières en combustion ou qui dégagent de la fumée, comme des cigarettes, des allumettes ou des cendres chaudes.»
	"Do not use without dust bag and/or filters in place."	«Ne pas utiliser l'appareil sans filtre ou sans sac à poussière.»
	"Connect only a Type A current-carrying hose to this wall valve."	«Seul un flexible porteur de courant de type A doit être connecté à cette prise murale d'aspirateur.»
	"Do not install a wall valve outdoors."	«Ne pas installer de prise d'aspirateur à l'extérieur.»
	"Do not use with a damaged hose. Return hose to a service center."	«Ne pas utiliser l'appareil avec un flexible endommagé. Envoyer le flexible à un centre de service pour le faire réparer.»
	"To unplug, grasp, and pull on the hose connection. Do not unplug by pulling on the hose."	«Pour débrancher le flexible, l'empoigner par son connecteur. Ne pas tirer directement sur le flexible pour l'enlever.»
	"Do not handle the hose or hose connector with wet hands."	«Ne pas manipuler le flexible ou son connecteur avec les mains humides.»
	"To Reduce the Risk of Fire and Electric Shock due to internal component damage, use only ± cleaning fluid intended for use with this appliance. See the Cleaning Fluid section of this manual." The word "fluid" may be replaced with the word "product(s)."	«Pour réduire le risque d'incendie ou de choc électrique dû au dommage de composants internes, utiliser seulement le liquide de nettoyage ± prévu pour cet appareil (voir détails sur les produits de nettoyage ailleurs dans cette notice).» Le mot «liquide» peut être remplacé par le mot «produit».
	± Replace with the appliance manufacturer's name.	± Remplacer par le nom du fabricant de l'appareil.
	"To Reduce the Risk of Fire, do not use a flammable or combustible liquid to clean a floor."	«Pour réduire le risque d'incendie, ne pas se servir d'un liquide combustible ou inflammable pour nettoyer les planchers.»
	"Connect only (hose manufacturer's name) current-carrying hose, Cat. No. ___ to this wall valve."	«Seul un flexible porteur de courant (nom du fabricant du flexible), référence catalogue ___ doit être connecté à cette prise murale d'aspirateur.»
	"See the Cleaning Fluid section of this manual." The word "fluid" may be replaced with the word "product(s)."	«Voir les détails sur les produits de nettoyage ailleurs dans cette notice.» Le mot «liquide» peut être remplacé par le mot «produits».
11.2.9	"WARNING", "Risk of explosion. Floor sanding can result in an explosive mixture of fine dust and air. Use floor-sanding machine only in a well-ventilated area free from any flame or match."	«AVERTISSEMENT. Risque d'explosion. Le ponçage de parquets peut entraîner la formation d'un mélange explosif de poussière et d'air. Utiliser la ponceuse uniquement dans un endroit bien ventilé, où il n'y a ni flammes ni allumettes.»
11.2.10	"WARNING: To Reduce The Risk of Fire or Electric Shock Use Appliance Only With ± Part No. ±± Supply Cord. If Cord is Damaged or Lost, Replace With Part No. ±±."	«AVERTISSEMENT. Pour réduire le risque d'incendie ou de choc électrique, l'appareil doit être utilisé uniquement avec un cordon d'alimentation ±, n[ordm] de pièce ±±. Si le cordon est perdu ou endommagé, il doit être remplacé par un cordon n[ordm] ±±.»
	± Replace with the vacuum cleaner manufacturer's name.	± Remplacer par le nom du fabricant de l'aspirateur.

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Clause	English	French
11.4.1	<p>±± Replace with the vacuum cleaner manufacturer's supply cord part number.</p> <p>"To reduce the risk of electric shock, this appliance has a polarized plug (one blade is wider than the other). This plug will fit in a polarized outlet only one way. If the plug does not fit fully in the outlet, reverse the plug. If it still does not fit, contact a qualified electrician to install the proper outlet. Do not change the plug in any way."</p>	<p>±± Remplacer par le numéro de pièce du cordon d'aspirateur de ce fabricant.</p> <p>«Pour réduire le risque de choc électrique, cet appareil est muni d'une fiche polarisée (une des lames est plus large que l'autre). Cette fiche ne peut être insérée dans une prise polarisée que si elle est orientée dans le bon sens. Si elle ne peut pas être insérée dans un sens, inverser la fiche dans l'autre sens. Si elle ne peut toujours pas être insérée dans la prise, faire installer la prise appropriée par un électricien compétent. Ne pas modifier la prise en aucune façon.»</p>
11.5.10	<p>"This hose is to be examined periodically for visible deterioration, such as abrasion, cracks, splits and the like." "This hose is to be used only for indoor household carpet cleaning applications using only manufacturer's recommended cleaning solution."</p>	<p>«Ce flexible doit être examiné périodiquement pour s'assurer qu'il n'est pas endommagé par abrasion, fissuration, fendillement ou autre.»</p> <p>«Ce flexible ne doit être utilisé que pour le nettoyage de tapis à usage domestique, à l'intérieur, et en utilisant la solution nettoyante recommandée par le fabricant.»</p>
11.5.12	<p>"WARNING", "To reduce the risk of electric shock, connect only a motorized nozzle/ current-carrying hose combination intended for connection to a Type A central vacuum cleaning system wall valve." "To reduce the risk of electric shock, connect only to a Type A central vacuum cleaning system wall valve."</p>	<p>«AVERTISSEMENT. Pour réduire le risque de choc électrique, utiliser seulement une brosse motorisée à flexible porteur de courant et destiné à être connecté à une prise murale d'aspirateur central de type A.» «Pour réduire le risque de choc électrique, l'appareil doit seulement être connecté à une prise murale d'aspirateur central de type A.»</p>
11.5.13	<p>"WARNING", "To reduce the risk of electric shock, connect only (hose manufacturer's name) electric hose, Cat. No. ___ to this wall valve." "To reduce the risk of electric shock, connect only to (valve manufacturer's name) electrified wall valve, Cat. No. ___"</p>	<p>«AVERTISSEMENT. Pour réduire le risque de choc électrique, seul un flexible porteur de courant (nom du fabricant du flexible), référence catalogue ___ doit être connecté à cette prise murale d'aspirateur.» «Pour réduire le risque de choc électrique, ce flexible ne doit être connecté qu'à une prise murale électrifiée (nom du fabricant de la prise d'aspirateur central), référence catalogue ___.»</p>
11.5.14	<p>"For Household Use Only." "Install only on a nominal 120 V supply protected by a maximum 20 A overcurrent protective device." "The pin connector on this wall valve is intended for use on a nominal 120 V supply only. It is required to be wired by a qualified electrician and is required to conform to local electrical codes."</p>	<p>«Pour usage domestique seulement.» «Installer uniquement sur une dérivation 120 V protégée par un dispositif de surintensité de 20 A au maximum.» «Le plot de connexion de cette prise murale d'aspirateur convient seulement à une alimentation 120 V. Cette connexion doit être câblée par un électricien compétent et doit être conforme aux exigences du code de l'électricité du lieu.»</p>
11.5.15	<p>"For use only with central vacuum cleaning system motorized nozzles that employ a Type A current-carrying hose." "WARNING", "To reduce the risk of electric shock, use only with (hose manufacturer's name) electric hose, Cat. No. ___." "To reduce the risk of electric shock, only connect this product to (valve manufacturer's name) electrified wall valve, Cat. No. ___."</p>	<p>«Pour emploi seulement avec les brosses motorisées d'aspirateur central qui utilisent un flexible porteur de courant de type A.»</p> <p>«AVERTISSEMENT. Pour réduire le risque de choc électrique, utiliser seulement avec un flexible porteur de courant (nom du fabricant du flexible), référence catalogue ___.» «Pour réduire le risque de choc électrique, ce produit doit seulement être connecté à une prise murale électrifiée (nom du fabricant de la prise d'aspirateur central), référence catalogue ___.»</p>

Table Continued

Clause	English	French
11.7.1	<p>"WARNING: To Reduce the Risk of Fire and Electric Shock due to internal component damage, use only ± cleaning fluid intended for use with the appliance."</p> <p>"±" is replaced with the appliance manufacturer's name</p>	<p>«AVERTISSEMENT. Pour réduire le risque d'incendie ou de choc électrique dû au dommage de composants internes, utiliser seulement le liquide de nettoyage + prévu pour cet appareil.»</p> <p>± Remplacer par le nom du fabricant de l'appareil</p>

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ANNEX C**Probe Tolerances**

**Table C.1 – Linear probe tolerances
(See Clause 4.16.3.1 and Figures 25 and 26)**

Linear dimensions	Range	Tolerance
All	Up to 0.039 in (1 mm)	± 0.002 in (0.05 mm)
	0.039 to 0.984 in (1 to 25 mm)	± 0.004 in (0.1 mm)
	0.984 in (25 mm) and above	$\pm 0.5\%$

**Table C.2 – Angular probe tolerances
(See Clause 4.16.3.1 and Figures 25 and 26)**

Angles	Range	Tolerance
All	All	$\pm 1^\circ$

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**Superseded requirements for
the Standard for
Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines
UL 1017, Eighth Edition**

The requirements shown are the current requirements that have been superseded by requirements in this edition. The numbers in parentheses refer to the new requirements with future effective dates that have superseded these requirements. To retain the current requirements, do not discard the following requirements until the future effective dates are reached.

1.2 These requirements cover:

- a) household, commercial, and coin-operated vacuum cleaning machines and blower cleaners, intended for indoor or outdoor use or both;
- b) household, commercial, and coin-operated wet pick-up, dry pick-up, permanently mounted, portable, and central vacuum cleaners and blower cleaner systems;
- c) household current-carrying hoses for dry pick-up, indoor use;
- d) household accessory electrified wall valves for central vacuum cleaning systems for connection of current-carrying hose/motorized nozzle combinations; and
- e) household electrically powered floor finishing machines, including floor polishers, floor scrubbers, floor sanders, rug shampooers, rug and floor washers, and similar machines.

3.4.1 (3.5.1) Where reference is made to CSA or UL Standards, such reference shall be considered to refer to the latest edition and all amendments published to that edition up to the time when this Standard was approved.

UL Standards

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

UL 101,
Leakage Current for Appliances

UL 746A,
Polymeric Materials – Short Term Property Evaluations

UL 873,
Temperature-Indicating and -Regulating Equipment

UL 1446,
Systems of Insulating Materials – General

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

UL 2111,
Overheating Protection for Motors

CSA Standards

C22.1-98,
Canadian Electrical code, Part 1

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

C22.2 No. 24-93 (R1999),
Temperature-Indicating and Regulating Equipment

C22.2 No. 77-95 (R1999),
Motors With Inherent Overheating Protection

3.4.2 (3.5.1) This Standard refers to the following publications and where such reference is made it shall be to the edition listed below.

American National Standards Institute (ANSI)

ANSI MC96.1,
Temperature Measurement Thermocouples

4.14.1 An appliance of one or more of the following types shall have provision for grounding:

- a) an appliance intended to be used on a circuit operating at more than 150 volts to ground – see Clause 4.14.2;
- b) a central vacuum cleaner;
- c) a commercial vacuum cleaner or blower cleaner;
- d) a household shop-type vacuum cleaner or blower cleaner;
- e) a wet pick-up vacuum cleaner;
- f) a household use floor finishing machine; or
- g) a cord-connected, portable, shop-type vacuum cleaner provided with a general-use receptacle for use with a portable tool as specified in the Exception to Clause 4.12.1.

Exception: A cord-connected appliance, other than as described in (g), provided with a system of double insulation as specified in double insulation, Clause 6, is not required to have provision for grounding.

4.16.3.1 The rotor of a motor, a pulley, a belt, a gear, a fan, or other moving part that could cause injury to persons shall be enclosed or provided with other means to reduce the likelihood of unintentional contact, and such a part shall not be contacted by the probe illustrated in Figure 2.

Exception No. 1: A moving part or portion of a moving part that is necessarily exposed to perform the work function need not be enclosed but, when necessary, guarding shall be provided.

Exception No. 2: An opening in the integral enclosure of a motor employed in an appliance intended for commercial use, that is not used in either a hand-held appliance or a hand-supported portion of an appliance, is acceptable if a moving part cannot be contacted by the probe illustrated in Figure 4.

5.12.8.1.1 An appliance that employs polymeric fluid-handling components shall be subjected to the test described in Clause 5.12.8.1.2. As a result of the test:

- a) there shall be no obvious wetting of live parts, film-coated wire, or insulation adversely affected by the fluids used with the appliance (see Clause 5.12.2.3); and
- b) the appliance shall comply with the requirements specified in Clause 5.12.2.1(b) and (c).

Exception No. 1: A household use self-contained carpet cleaning machine that has no accessories or instructions for cleaning hard surfaces shall comply with Clause 5.12.8.1.3.

Exception No. 2: A household use appliance that may be used on a hard surface and used only with a proprietary fluid shall comply with Clause 5.12.8.2. See also Clauses 3.2A and 10.2.7 (j).

5.12.8.2 (5.12.8.3) Components for use with proprietary fluids

5.12.8.2.1 (5.12.8.3.1) Reservoir, tubing, and similar

5.12.8.2.1.1 (5.12.8.3.1.1) A polymeric fluid-handling component, such as a reservoir or tubing, of an appliance that may be used on a hard surface and used only with a proprietary fluid, shall be conditioned and tested as described in Clauses 5.12.8.2.1.2 and 5.12.8.2.1.3. As a result of the conditioning and impact test, there shall be no cracking or breakage to allow liquid to leak from the polymeric fluid-handling component such that the appliance does not comply with the requirements specified in Clause 5.12.8.1.1 (see Clause 5.12.8.1.4). As a result of the conditioning and mold stress-relief distortion test, there shall be no shrinkage, warpage, or any other distortion of the polymeric fluid-handling component, as determined after cooling to room temperature, that results in one or both of the following conditions:

- a) interference with the operation or user servicing of the appliance; or
- b) openings that allow liquid to leak from the polymeric fluid-handling component such that the appliance does not comply with the requirements specified in Clause 5.12.8.1.1 (see Clause 5.12.8.1.4).

5.12.8.2.1.2 (5.12.8.3.1.2) The polymeric fluid-handling component, such as a reservoir or tubing, as mentioned in Clause 5.12.8.2.1.1, shall be subjected to one of the following conditions:

- a) three samples shall be immersed in a boiling solution consisting of three times the recommended concentration of the proprietary fluid for seven days. If more than one fluid is recommended, the fluid resulting in the most severe conditions shall be employed; or
- b) three samples shall be immersed in a solution consisting of three times the recommended concentration of the proprietary fluid for 1000 hours at a temperature of 10°C (50°F) above the temperature to which the component is subjected, but not less than 70°C (158°F). If more than one fluid is recommended, the fluid resulting in the most severe conditions shall be employed.

Exception No. 1: 100% concentration of the proprietary fluid shall be used for the solution for an appliance that has a polymeric fluid-handling component, such as a reservoir assembly, that contains only the proprietary fluid.

Exception No. 2: A part such as a boot, diaphragm, seal, or gasket need not comply, but shall comply with Clause 5.12.5.2.

5.12.8.2.1.3 (5.12.8.3.1.3) To determine if a polymeric fluid-handling component, such as a reservoir or tubing, complies with Clause 5.12.8.2.1.1, following the conditioning in (a) or (b) of Clause 5.12.8.2.1.2, the polymeric fluid-handling component shall be subjected to the following tests:

- a) one sample shall be subjected to an impact test as described in Clause 5.18.2 or 5.18.3 as applicable; and
- b) one sample shall be subjected to a mold stress-relief distortion test as described in Clause 5.20.3.

5.12.8.2.2 (5.12.8.3.2) Pumps

5.12.8.2.2.1 (5.12.8.3.2.1) A pump of an appliance that may be used on a hard surface and used only with a proprietary fluid and that employs polymeric fluid-handling parts, shall be conditioned as described in Clause 5.12.8.2.2.2. As a result of the conditioning, there shall be no leakage such that the appliance does not comply with the requirements in Clause 5.12.8.1.1 (see Clause 5.12.8.1.4).

5.12.8.2.2.2 (5.12.8.3.2.2) The pump shall be continuously cycled ON for eight minutes and OFF for two minutes for 30 days while pumping a solution consisting of three times the recommended concentration of the proprietary fluid. The fluid shall be maintained at a temperature of 68.3 – 71.1°C (155 – 160°F).

Exception: A solution of 100% concentration of the proprietary fluid shall be used for an appliance that has a polymeric fluid-handling component, such as a reservoir assembly, that contains only the proprietary fluid.

5.12.8.2.2.3 (5.12.8.3.2.3) With reference to the conditioning described in Clause 5.12.8.2.2.2, for a pump employing a motor with brushes, if the pump ceases to operate in 25 hours or less due to brushes wearing out, the brushes shall be replaced. If the pump ceases to operate after 25 hours, but before the completion of the 30 days, the conditioning shall be considered complete.

10.2.7 (11.2.7) The following instructions shall be included in the list of items in addition to the items in Clause 10.2.6 for the appliances indicated. When more than one item applies to the appliance, all applicable items for the appliance type shall be included:

- a) for an appliance intended for use with a motorized nozzle and without a current-carrying hose: "Always turn off this appliance before connecting or disconnecting motorized nozzle."
- b) for an appliance intended for use with both a motorized nozzle and a current-carrying hose:
 - 1) "The hose contains electrical wires. Do not use when damaged, cut, or punctured. Avoid picking up sharp objects;"
 - 2) "Always turn off this appliance before connecting or disconnecting either hose or motorized nozzle;" and
 - 3) where the hose is intended for connection to a wall valve constructed as described in Clause 7.2.2: "Connect hose only to a Type A wall valve," or for a hose intended for connection to a wall valve constructed as described in Clause 7.2.5, "Connect hose only to (valve manufacturer's name) wall valve, Cat. No. ___."
- c) for a rechargeable appliance: "Use only the charger supplied by the manufacturer to recharge."

- d) for an appliance supplied with a cord reel: "Hold plug when rewinding onto cord reel. Do not allow plug to whip when rewinding."
- e) for a grounded appliance: "Connect to a properly grounded outlet only. See Grounding Instructions."
- f) for a double-insulated appliance: "This appliance is provided with double insulation. Use only identical replacement parts. See instructions for Servicing of Double-Insulated Appliances."
- g) for an appliance having a mechanical accessory other than a motorized nozzle: "Unplug before connecting (Name of mechanical accessory)."
- h) for a vacuum cleaner:
- 1) "Do not pick up anything that is burning or smoking, such as cigarettes, matches, or hot ashes."
 - 2) "Do not use without dust bag and/or filters in place."
- i) for an electrified wall valve:
- 1) "Connect only a Type A current-carrying hose to this wall valve."
 - 2) "Do not install a wall valve outdoors."
 - 3) "Do not use with a damaged hose. Return hose to a service center."
 - 4) "To unplug, grasp, and pull on the hose connection. Do not unplug by pulling on the hose."
 - 5) "Do not handle the hose or hose connector with wet hands."
- j) for an appliance, such as a floor or carpet cleaning machine, for use with a fluid:
- 1) for an appliance that may be used on a hard surface and used only with a proprietary fluid: "To Reduce the Risk of Fire and Electric Shock due to internal component damage, use only + cleaning fluid intended for use with this appliance. See the Cleaning Fluid section of this manual." The word "fluid" may be replaced with the word "product(s)."

+ Replace with the appliance manufacturer's name.
 - 2) For all others: "To Reduce the Risk of Fire, do not use a flammable or combustible liquid to clean a floor."

Exception No. 1: Instructions specified in (b)(2) are not required when an investigation reveals that there is a reliable electrical connection between the appliance and accessory.

Exception No. 2: For a wall valve as described in Clause 7.2.5, instructions specified in (i)(1) shall be "Connect only (hose manufacturer's name) current-carrying hose, Cat. No. ___ to this wall valve."

Table 9 – Maximum acceptable temperature rises
(See Clauses 5.8.1, 5.8.2, 5.9.1.1, 5.18.1, 8.8.1, 10.3.10, and 10.3.11)

Materials and component parts	°C	°F
1. Varnished-cloth insulation	60	108
2. Fuses	65	117
3. Fiber employed as electrical insulation	65	117
4. Wood and other flammable material	65	117
5. At any point within a terminal box or wiring compartment of a permanently connected appliance in which power-supply conductors are to be connected, including such conductors themselves, unless the appliance is marked in accordance with Clause 10.4.15	35	63
6. A surface upon which a stationary appliance may be mounted in service, and surfaces that may be adjacent to the appliance when so mounted	65	117
7. Class A (105°C) insulation systems on coil windings of an ac motor having a frame diameter of more than 7 inches (178 mm) and of a dc motor ^{a,b} :		
(a) In an open motor and on a vibrator coil		
Thermocouple method	65	117
Resistance method	75	135
(b) In a totally enclosed motor		
Thermocouple method	70	126
Resistance method	80	144
8. Class A (105°C) insulation system on coil windings of an ac motor having a frame diameter of 7 inches or less, of a universal motor, and on a vibrator coil ^{a,b} :		
(a) In an open motor and on a vibrator coil		
Thermocouple or resistance method	75	135
(b) In a totally enclosed motor		
Thermocouple or resistance method	80	144
9. Class B (130°C) insulation, except as indicated in items 15 and 16 ^a		
Thermocouple method	85	153
10. Phenolic composition employed as electrical insulation or as a part the deterioration of which would result in a risk of fire or electric shock ^c	125	225
11. Rubber insulated wire and cord ^c	35	63
12. Thermoplastic-insulated wire and cord ^c	35	63
13. Capacitor		
Electrolytic ^d	40	72
Other Types ^e	65	117
14. Class A (105°C) insulation on windings of relay, a solenoid, and the like ^a		
Thermocouple method	65	117
Resistance method	85	153
15. Class B (130°C) insulation systems on coil windings of an ac motor having a frame diameter of more than 7 inches and of a dc motor ^{a,b}		
(a) In an open motor		
Thermocouple method	85	153
Resistance method	95	171
(b) In a totally enclosed motor		
Thermocouple method	90	162
Resistance method	100	180
16. Class B (130°C) insulation systems on coil windings of an ac motor having a frame diameter of 7 inches or less and of a universal motor ^{a,b} :		
(a) In an open motor method		
Thermocouple or resistance method	95	171
(b) In a totally enclosed motor		
Thermocouple or resistance method	100	180

Table 9 – Maximum acceptable temperature rises Continued on Next Page

Table 9 – Maximum acceptable temperature rises Continued

Materials and component parts	°C	°F
<p>^a At a point on the surface of a coil where the temperature is affected by an external source of heat, the temperature rise measured by a thermocouple may be higher by the following amount than the maximum specified.</p>		
<u>Item</u>	<u>Additional Temperature Rise</u>	
Part A of Item 7 and Item 14	15°C 27°F	
Part A of Item 8	5 °C 9°F	
Part A of Item 15	20°C 36°F	
Part A of Item 16	10°C 18°F	
<p>Provided that the temperature rise of the coil, as measured by the resistance method, is not more than that specified in the table. See Clause 5.8.6.</p>		
<p>^b This is the diameter, measured in the plane of the laminations, of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and the like used solely for motor mounting, cooling assembly, or connection.</p>		
<p>^c The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found to be acceptable for a higher temperature.</p>		
<p>^d For an electrolytic capacitor that is integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may not be more than 65°C (117°F).</p>		
<p>^e A capacitor that operates at a temperature rise of more than 65°C (117°F) may be judged on the basis of its marked temperature limit.</p>		

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