UL 1090

STANDARD FOR SAFETY

Electric Snow Movers

UL Standard for Safety for Electric Snow Movers, UL 1090

Seventh Edition, Dated October 5, 2016

Summary of Topics

This revision of ANSI/UL 1090 dated March 14, 2022 includes revisions to cold testing to harmonize with ISO 8437 and ANSI B71.3; 25.3(b), 36.2, 44.2.2, 45.2.1, SA2.2(b).

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The new and revised requirements are substantially in accordance with Proposal(s) on this subject dated February 14, 2020.

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Standard for Electric Snow Movers

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The most recent designation of ANSI/UL 1090 as an American National Standard (ANSI) occurred on March 14, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 https://csds.ul.com.

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INTRODUCTION

1 Scope

1.1 These requirements cover cord-connected electrically operated snow movers rated 250 V or less to be employed in accordance with the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements also cover battery-operated snow movers as specified in Battery Powered Gardening Appliances, Supplement SA, in this Standard.

1.3 These requirements do not cover riding-type snow movers or snow movers intended for commercial or industrial use or for use in hazardous locations as defined in the National Electrical Code, ANSI/NFPA 70.

1.4 In addition to the requirements in this standard, a snow mover shall comply with 5.1, 5.2.2, 5.2.3, 5.2.5, 6, 7, 10.1 – 10.3, 11.1, and 12 of the Snow Throwers – Safety Specifications, ANSI B71.3.

Exception: Markings shall be considered durable and permanent if they comply with Permanency of Marking, Section 42, of this standard.

2 Units of Measurement

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

2.2 Unless otherwise indicated, all voltage and current values specified in this standard are root-mean-square.

3 Undated References

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

4 Glossary

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

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

4.3 APPLIANCE INLET (Motor Attachment Plug) – A male contact device mounted on an end product appliance to provide an integral blade configuration for the connection of an appliance coupler or cord connector.

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

4.5 AUTOMATICALLY CONTROLLED PRODUCT – A product is determined to be automatically controlled if it complies with one or more of the following conditions:

a) The repeated starting of the product is independent of any manual control after one complete cycle of operation, after which some form of limit device opens the circuit.

b) During any single preset cycle of operation, the motor is caused to stop and restart.

c) When the product is energized, the initial starting of the motor may be intentionally delayed beyond intended, conventional starting.

d) For a product employing a motor with a separate starting winding, during any single predetermined cycle of operation, automatic changing of the mechanical load reduces the motor speed sufficiently to reestablish starting-winding connections to the supply circuit.

4.6 COMPONENT – A device or fabricated part of the appliance covered by the scope of a safety standard dedicated to the purpose. When incorporated in an appliance, equipment otherwise typically field installed (e.g. luminaire) is considered to be a component. Unless otherwise specified, materials that compose a device or fabricated part, such as thermoplastic or copper, are not considered components.

4.7 CONTROL, AUTOMATIC ACTION – A control in which at least one aspect is non-manual.

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

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

4.10 CONTROL, OPERATING – A device or assembly of devices, the operation of which starts or regulates the end product during normal operation. For example, a thermostat, the failure of which a thermal cutout/limiter or another layer of protection would mitigate the risk of fire, electric shock, or injury to persons, is considered an operating control. Operating controls are also referred to as "regulating controls".

4.11 CONTROL, PROTECTIVE – A device or assembly of devices, the operation of which is intended to reduce the risk of fire, electric shock, or injury to persons during normal and reasonably anticipated abnormal operation of the appliance, whereby during the evaluation of the protective control/circuit, the protective functions are verified under normal and single-fault conditions of the control. For example, a thermal cutout/limiter, or any other control/circuit relied upon for normal and abnormal conditions, is considered a protective control. Protective controls are also referred to as "limiting controls" and "safety controls".

4.12 CONTROL, TYPE 1 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence has not been declared and tested under this standard.

4.13 CONTROL, TYPE 2 ACTION – The actuation of an automatic control for which the manufacturing deviation and the drift (tolerance before and after certain conditions) of its operating value, operating time, or operating sequence have been declared and tested under this standard.

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

4.4.15 DIRECTLY ACCESSIBLE MOTOR – A motor that can be contacted without opening or removing any part, or that is located so as to be accessible to contact.

4.16 ENCLOSURE – That portion of the snow mover that:

a) Renders inaccessible all parts that may otherwise present a risk of electric shock or injury to persons, or

b) Prevents propagation of flame initiated by electrical disturbances occurring within, or both.

4.17 GROUND-SUPPORTED SNOW MOVER – A snow mover that, during normal operation, is supported entirely or in part by the ground.

4.18 HAND-SUPPORTED SNOW MOVER – A snow mover that, at some time during normal operation, is intended to be completely supported by the user.

4.19 INDIRECTLY ACCESSIBLE MOTOR – A motor that is accessible only by opening or removing a part of the outer enclosure, such as a guard or panel, that can be opened or removed without using a tool, or that is located at such a height or is otherwise guarded or enclosed so that it is unlikely to be contacted.

4.20 LEAKAGE CURRENT – All current or currents, including capacitively-coupled current, that may be conveyed between exposed conductive surfaces of a snow mover and ground or other exposed conductive surfaces of the snow mover.

4.21 LIVE PART – A part energized with respect to earth or energized with respect to some other part.

CONSTRUCTION

5 Components

5.1 General

5.1.1 A component of a product covered by this standard shall:

a) Comply with the requirements for that component as indicated in 5.2 – 5.25;

b) Be used in accordance with its rating(s) established for the intended conditions of use;

c) Be used within its established use limitations or conditions of acceptability;

d) Additionally comply with the applicable requirements of this end product standard; and

e) Not contain mercury.

Exception No. 1: A component of a product covered by this standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product;

b) Is superseded by a requirement in this standard; or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

Exception No. 2: A component that complies with a UL component standard other than those specified in 5.2 – 5.25 is acceptable if:

a) The component also complies with the applicable component standard specified in 5.2 – 5.25; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements in the National Electrical Code, ANSI/NFPA 70, where applicable;

2) Considers long-term thermal properties of polymeric insulating materials in accordance with the Standard for Polymeric Materials – Long Term Property Evaluations, UL 746B; and

3) Any use limitations of the other component UL standards are identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.

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

5.1.3 A component that is also intended to perform other functions, such as over current protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable UL standard(s) that cover devices that provide those functions.

Exception: Where these other functions are not required for the application and not identified as part of markings, instructions, or packaging for the appliance, the additional component UL standard(s) need not be applied.

5.1.4 A component not anticipated by the requirements of this end product standard, not specifically covered by the component standards in 5.2 – 5.25, and that involves a risk of fire, electric shock, or injury to persons, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with 5.1.1 (b) – (d).

5.1.5 With regard to a component being additionally investigated, reference to construction and performance requirements in another UL end product standard is appropriate where that standard anticipates normal and abnormal use conditions consistent with the application of UL 1090.

5.2 Attachment plugs, receptacles, connectors, and terminals

5.2.1 Attachment plugs, receptacles, appliance couplers, appliance inlets (motor attachment plugs), and appliance (flatiron) plugs shall comply with the Standard for Attachment Plugs and Receptacles, UL 498. See 5.2.9.

Exception No. 1: Attachment plugs and appliance couplers integral to cord sets or power supply cords that are investigated in accordance with the requirements in the Standard for Cord Sets and Power-Supply Cords, UL 817, are not required to comply with UL 498.

Exception No. 2: A fabricated pin terminal assembly(ies) need not comply with UL 498 if it complies with Live Parts, Section 11, Electrical Insulation, Section 13, and Spacings, Section 18, of this end product standard.

5.2.2 Quick-connect terminals, both connectors and tabs, for use with one or two 22 – 10 AWG copper conductors, having nominal widths of 2.8, 3.2, 4.8, 5.2, and 6.3 mm (0.110, 0.125, 0.187, 0.205, and 0.250 in), intended for internal wiring connections in appliances, or for the field termination of conductors to appliance, shall comply with the Standard for Electrical Quick-Connect Terminals, UL 310.

Exception: Other sizes of quick-connect terminals shall be investigated with respect to crimp pull out, insertion-withdrawal, temperature rise, and all tests shall be conducted in accordance with UL 310.

5.2.3 Single and multipole connectors for use in data, signal, control and power applications within and between electrical equipment, and that are intended for factory assembly to copper or copper alloy conductors, or for factory assembly to printed wiring boards, shall comply with the Standard for Component Connectors for Use in Data, Signal, Control and Power Applications, UL 1977. See 5.2.9.

5.2.4 Wire connectors shall comply with the Standard for Wire Connectors, UL 486A-486B.

5.2.5 Splicing wire connectors shall comply with the Standard for Splicing Wire Connectors, UL 486C.

5.2.6 Multi-pole splicing wire connectors that are intended to facilitate the connection of hard-wired utilization equipment to the branch-circuit conductors of buildings shall comply with the Standard for Insulated Multi-Pole Splicing Wire Connectors, UL 2459. See 5.2.9.

5.2.7 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with the Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors, UL 486E.

5.2.8 Terminal blocks shall comply with the Standard for Terminal Blocks, UL 1059, and, if applicable, be suitably rated for field wiring.

Exception: A fabricated part performing the function of a terminal block need not comply with UL 1059 if the part complies with the requirements of Live Parts, Section 11, Electrical Insulation, Section 13, and Spacings, Section 18, of this end product standard. This exception does not apply to protective conductor terminal blocks.

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

5.4 Boxes and raceways

5.4.1 Electrical boxes and the associated bushings and fittings, and raceways, of the types specified in Chapter 3, Wiring Methods and Materials, of the National Electrical Code, NFPA 70 and that comply with the relevant UL standard (such as the Standard for Metallic Outlet Boxes, UL 514A, the Standard for Nonmetallic Outlet Boxes, Flush-Devices Boxes, and Covers, UL 514C, the Standard for Cover Plates for Flush-Mounted Wiring Devices, UL 514D) and Components – General, Section 5.1 are considered to comply with the requirements in this end product standard.

5.5 Capacitors and filters

5.5.1 A power capacitor employing a dielectric medium of wax or of liquid other than askarel shall comply with the requirements for protected oil-filled capacitors in the Standard for Capacitors, UL 810, and shall be used within its rated voltage.

5.5.2 An electromagnetic interference filter shall comply with the Standard for Electromagnetic Interference Filters, UL 1283.

5.6 Controls

5.6.1 General

5.6.1.1 Auxiliary controls shall be evaluated using the applicable requirements of this end product standard and the requirements in the Standard for Controls – End Product Test Parameters, Section 20.

5.6.1.2 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in 5.6.2 – 5.6.7 and if applicable, the requirements in Controls – End Product Test Parameters, Section 20, unless otherwise specified in this end product standard.

5.6.1.3 Operating controls that rely upon software for the normal operation of the end product where deviation or drift of the control may result in a risk of fire, electric shock, or injury to persons, such as a speed control unexpectedly changing its output, shall comply with one or both of the following standards:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, and the Standard for Software in Programmable Components, UL 1998; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

5.6.1.4 Protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in 5.6.2 – 5.6.7 and if applicable, the parameters in Controls – End Product Test Parameters, Section 20, unless otherwise specified in this end product standard.

5.6.1.5 Solid-state protective controls that do not rely upon software as a protective component shall comply with one or both of the following standards:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, except for the Controls Using Software requirements.

5.6.1.6 Protective controls that rely upon software as a protective component shall comply with one or both of the following standards:

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, and Standard for Software in Programmable Components, UL 1998; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

5.6.1.7 An electronic, non-protective control that is simple in design need only be subjected to the applicable requirements of this end-product standard. A control that does not include an integrated circuit or microprocessor, but does consist of a discrete switching device, capacitors, transistors, or resistors is considered simple in design.

5.6.2 Electromechanical and electronic controls

5.6.2.1 A control, other than as specified in 5.6.2 – 5.6.7, shall comply with one of the following:

a) The Standard for Solid-State Controls for Appliances, UL 244A;

b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873; or

c) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

5.6.3 Liquid level controls

5.6.3.1 A liquid level control shall comply with one of the following:

a) The Standard for Solid-State Controls for Appliances, UL 244A;

b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

c) The Standard for Industrial Control Equipment, UL 508; or

d) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, and;

1) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Water Level Controls of the Float Type for Household and Similar Applications, UL 60730-2-15; or

2) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Automatic Electrical Water Level Controls of the Float Type for Household and Similar Applications, UL 60730-2-15.

5.6.4 Motor and speed controls

5.6.4.1 A control used to start, stop, regulate or control the speed of a motor shall comply with one of the following:

a) The Standard for Solid-State Controls for Appliances,UL 244A;

b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

c) The Standard for Industrial Control Equipment, UL 508;

d) The Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal, and Energy, UL 61800-5-1; or

e) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

5.6.5 Pressure controls

5.6.5.1 A pressure control shall comply with one of the following:

a) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

b) The Standard for Industrial Control Equipment, UL 508; or

c) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements, UL 60730-2-6.

5.6.6 Temperature controls

5.6.6.1 A temperature control shall comply with one of the following:

a) The Standard for Solid-State Controls for Appliances, UL 244A;

b) The Standard for Temperature-Indicating and -Regulating Equipment, UL 873;

c) The Standard for Industrial Control Equipment, UL 508; or

d) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Temperature Sensing Controls, UL 60730-2-9.

5.6.6.2 A temperature positive temperature coefficient (PTC) or a negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control shall comply with the Standard for Thermistor-Type Devices, UL 1434.

5.6.6.3 A thermal cutoff shall comply with the Standard for Thermal-Links – Requirements and Application Guide, UL 60691.

5.6.7 Timer controls

5.6.7.1 A timer control shall comply with one of the following:

a) The Standard for Solid-State Controls for Appliances, UL 244A; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

5.7 Cords, cables, and internal wiring

5.7.1 A cord set or power supply cord shall comply with the Standard for Cord Sets and Power Supply Cords, UL 817.

5.7.2 Flexible cords and cables shall comply with the Standard for Flexible Cords and Cables, UL 62. Flexible cord and cables are considered to comply with this requirement when pre-assembled in a cord set or power supply cord complying with the Standard for Cord Sets and Power Supply Cords, UL 817.

5.7.3 Internal wiring composed of insulated conductors shall comply with the Standard for Appliance Wiring Material, UL 758.

Exception No. 1: Insulated conductors need not comply with UL 758 if they comply with one of the following:

a) The Standard for Thermoset-Insulated Wires and Cables, UL 44;

b) The Standard for Thermoplastic-Insulated Wires and Cables, UL 83;

c) The Standard for Fixture Wire, UL 66; or

d) The applicable UL standard(s) for other insulated conductor types specified in Chapter 3, Wiring Methods and Materials, of the National Electrical Code, ANSI/NFPA 70.

Exception No. 2: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire, electric shock or injury to persons need not comply with UL 758.

5.8 Cord reels

5.8.1 A cord reel shall comply with special use cord reel requirements of the Standard for Cord Reels, UL 355.

5.9 Film-coated wire (magnet wire)

5.9.1 The component requirements for film coated wire and Class 105 (A) insulation systems are not specified.

5.9.2 Film coated wire in intimate combination with one or more insulators, and incorporated in an insulation system rated Class 120 (E) or higher, shall comply with the magnet wire requirements in the Standard for Systems of Insulating Materials – General, UL 1446.

5.10 Gaskets, seals and tubing

5.10.1 Gaskets, o-rings, seals, and tubing the failure of which would increase the risk of fire, electric shock, injury to persons shall comply with the Standard for Gaskets and Seals, UL 157.

5.11 Ground-fault, arc-fault, and leakage current detectors/interrupters

5.11.1 Ground-fault circuit-interrupters (GFCI) for protection against electrical shock shall comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943. The following statement, or equivalent, shall be included as a marking near the GFCI, or as an instruction in the manual: "Press the TEST button (then RESET button) every month to assure proper operation."

5.11.2 Appliance-leakage-current interrupters (ALCI) for protection against electrical shock shall comply with the Standard for Appliance-Leakage-Current Interrupters, UL 943B.

5.11.3 With respect to 5.11.2, an ALCI is not considered an acceptable substitute for a GFCI when the National Electrical Code, ANSI/NFPA 70, requires a GFCI.

5.11.4 Equipment ground-fault protective devices shall comply with the Standard for Ground-Fault Sensing and Relaying Equipment, UL 1053, and the applicable requirements of the Standard for Ground-Fault Circuit-Interrupters, UL 943.

5.11.5 Arc-fault circuit-interrupters(AFCI) shall comply with the Standard for Arc-Fault Circuit-Interrupters, UL 1699.

5.11.6 Leakage-current detector-interrupters (LCDI) and any shielded cord between the LCDI and appliance shall comply with the Standard for Arc-Fault Circuit-Interrupters, UL 1699.

5.12 Insulation systems

5.12.1 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.

5.12.2 All insulation systems employing integral ground insulation shall comply with the requirements specified in the Standard for Systems of Insulating Materials – General, UL 1446.

5.13 Light sources and associated components

5.13.1 Lampholders and indicating lamps shall comply with the Standard for Lampholders, UL 496.

Exception: Lampholders forming part of a luminaire that complies with the applicable UL luminaire standard are considered to comply with this requirement.

5.13.2 Lighting ballasts shall comply with one of the following:

a) The Standard for Fluorescent-Lamp Ballasts, UL 935; or

b) The Standard for High-Intensity Discharge Lamp Ballasts, UL 1029.

Exception No. 1: Ballasts forming part of a luminaire that complies with an applicable UL luminaire standard are considered to comply with this requirement.

Exception No. 2: Ballasts for other light sources shall comply with the applicable UL standard(s).

5.13.3 Light emitting diode (LED) light sources shall comply with the Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products, UL 8750.

Exception No. 1: LED light sources forming part of a luminaire that complies with an applicable UL luminaire standard are considered to comply with this requirement.

Exception No. 2: Individual LED light sources mounted on printed wiring boards and intended for indicating purposes need not comply with UL 8750, but shall comply with the applicable requirements of this end product standard.

5.14 Marking and labeling systems

5.14.1 A marking and labeling system shall comply with the Standard for Marking and Labeling Systems, UL 969, under the specified environmental conditions. See Permanency of Marking, Section 42.

5.15 Motors and motor overload protection

5.15.1 General

5.15.1.1 General-purpose type motors having a NEMA frame size shall comply with the requirements specified in General Purpose-Type Motors, Section 5.15.2. This includes fractional HP motors rated up to 1 HP (typically NEMA frame sizes 42, 48, or 56), and integral HP motors rated 1 HP and greater (typically NEMA frame sizes 140 – 449T).

5.15.1.2 Motors not enclosed, or partially enclosed, by the end product enclosure shall comply with the requirements specified in 5.15.2.

5.15.1.3 Component type motors completely enclosed within the end product enclosure shall comply with the requirements specified in General-Purpose Type Motors, Section 5.15.2 or Component Type Motors, Section 5.15.3.

5.15.1.4 Motors located in a low voltage circuit are evaluated for the risk of fire, electric shock, or injury to persons in accordance with the applicable requirements of this end product standard.

5.15.1.5 Low voltage component fans that comply with the Standard for Electric Fans, UL 507, are considered to comply with the requirements for Motors, Section 14.

5.15.2 General-purpose type motors

5.15.2.1 A general-purpose type motor shall comply with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1.

5.15.3 Component type motors

5.15.3.1 Component type motors shall comply with either 5.15.3.2 or 5.15.3.3.

5.15.3.2 The motor shall comply with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, except as noted in Table 5.1.

Table 5.1
Superseded requirements

UL 1004-1 Exempted requirement	Superseded by UL 1090 requirements
Current and Horsepower Relation, Section 6	32.4
Cord-Connected Motors, Section 15	Section 10, Supply Connections
Factory Wiring Terminals and Leads, Section 17	Section 12, Internal Wiring
Electrical Insulation, Section 22	Section 14, Motors
Non-Metallic Functional Parts, Section 28	Section 6, Frame and Enclosure, Section 43, Polymeric Enclosures, Section 44, Polymeric Materials Classed Other Than HB, Section 45, Polymeric Materials Classed HB
Solid-State Controls, 7.2	5.2.6
Non-metallic enclosure thermal aging, 9.1.4	Section 5.18, Polymeric Materials
Motor enclosure, 9.2 – 9.4	Section 6, Frame and Enclosure
Grounding, Sections 10 and 11	Section 19, Grounding
Ventilation Openings, Section 12: only applicable where the openings are on surfaces considered to be the appliance enclosure.	Section 6, Frame and Enclosure
Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 13	Section 7, Accessibility of Uninsulated Live Parts and Film-Coated Wire
Protection Against Corrosion, Section 14	Section 9, Protection Against Corrosion
Available fault current ratings for motor start and running capacitors, Clause 26.6: not applicable for cord and plug connected appliances.	Section 17, Capacitors
Switch, Section 27 is not applicable to centrifugal starting switches	Section 39, Switches and Controls
With the exception of Sections 35 and 40 (Resilient Elastomer Mounting and Electrolytic Capacitor Tests, respectively), the performance tests in the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1 are not applicable	All applicable performance tests
Only the following marking requirements specified in 43.1 of UL 1004-1 are applicable: manufacturer's name or identification; rated voltage; rated frequency; number of phases if greater than 1; and multi-speed motors, other than a shaded-pole or a permanent-split-capacitor motor, shall be marked with the amperes and horsepower at each speed	Section 50, Identification and Rating

5.15.3.3 The motor shall comply with the applicable component requirements for Components, Section 5, the following construction requirements, and the applicable performance requirements (when tested in conjunction with the end product), of this end product standard:

a) Protection Against Corrosion, Section 9;

b) Internal Wiring, Section 12;

c) Electrical Insulation, Section 13;

d) Motors, Section 14;

e) Capacitors, Section 17;

f) Spacings, Section 18; and

g) Grounding, Section 19.

5.16 Motor overload protection

5.16.1 Thermal protection devices integral with the motor shall comply with one of the following:

a) The Standard for Overheating Protection for Motors, UL 2111;

b) The Standard for Thermally Protected Motors, UL 1004-3; or

c) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2 Particular Requirements for Thermal Motor Protectors, UL 60730-2-2; in conjunction with the Standard for Thermally Protected Motors, UL 1004-3 (to evaluate the motor-protector combination).

5.16.2 Impedance protection shall comply with one of the following:

a) The Standard for Overheating Protection for Motors, UL 2111; or

b) The Standard for Impedance Protected Motors, UL 1004-2.

5.16.3 Electronic protection integral to the motor shall comply with the Standard for Electronically Protected Motors, UL 1004-7.

5.16.4 Except as indicated in 5.16.3, electronically protected motor circuits shall comply with one of the following. See Motor and Speed Controls, 5.6.4, for basic control requirements.

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991. When the protective electronic circuit is relying upon software as a protective component, it shall comply with the requirements in the Standard for Tests for Software in Programmable Components, UL 1998. If software is relied upon to perform a safety function, it shall be considered software Class 1;

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; If software is relied upon to perform a safety function, it shall be considered software Class B; or

c) The Standard for Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal, and Energy, UL 61800-5-1.

Exception: Compliance with the above standards is not required for an electronically protected motor circuit if there is no risk of fire, electric shock, or injury to persons during abnormal testing with the motor electronic circuit rendered ineffective; compliance with the applicable requirements of this end product standard is then required.

5.17 Overcurrent protection

5.17.1 Fuses shall comply with the Standard for Low-Voltage Fuses – Part 1: General Requirements, UL 248-1; and the applicable UL 248 Part 2 (e.g. the Standard for Low-Voltage Fuses – Part 5: Class G Fuses, UL 248-5). Defined-use fuses that comply with UL 248-1 and another applicable UL standard for fuses are considered to comply with this requirement.

5.17.2 Fuseholders shall comply with The Standard for Fuseholders – Part 1: General Requirements, UL 4248-1, and the applicable Part 2 (e.g. the Standard for Fuse Holders – Part 9: Class K, UL 4248-9).

5.17.3 Circuit breakers shall comply with the Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures, UL 489.

Exception: Circuit breakers used in telecommunications circuitry that comply with the Standard for Circuit Breakers For Use in Communications Equipment, UL 489A, need not comply with UL 489.

5.17.4 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with the Standard for Ground-Fault Circuit-Interrupters, UL 943.

5.17.5 Supplementary protectors shall comply with the Standard for Supplementary Protectors for Use in Electrical Equipment, UL 1077.

5.17.6 Fusing resistors shall comply with the Standard for Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances, UL 1412.

5.18 Polymeric materials

5.18.1 Polymeric enclosure materials or a polymeric device which provides mechanical support or electrical insulation or separation whose deterioration would reduce spacings between uninsulated live parts or could result in a risk of fire, electric shock, or injury to persons shall comply with the following standards unless superseded by the requirements in this end product standard:

a) The Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A;

b) The Standard for Polymeric Materials – Long Term Property Evaluations,UL 746B; and

c) The Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

5.18.2 Polymeric materials molded or fabricated by a source other than the manufacturer, shall be identified according to the Standard for Polymeric Materials – Fabricated Parts, UL 746D.

5.19 Power supplies

5.19.1 A Class 2 power supply shall comply the Standard for Class 2 Power Units, UL 1310.

5.19.2 A non-Class 2 power supply shall comply with the Standard for Power Units Other Than Class 2, UL 1012.

5.20 Printed-wiring boards

5.20.1 Printed-wiring boards, including the coatings, shall comply with the Standard for Printed-Wiring Boards, UL 796.

Exception: A printed-wiring board in a Class 2 nonsafety circuit is not required to comply with the bonding requirements in UL 796 if the board is separated from parts of other circuits such that loosening of the bond between the foil conductor and the base material will not result in the foil conductors or components coming in contact with parts of other circuits of the control or of the end-use product.

5.20.2 A printed-wiring board containing circuitry in a line-connected circuit or a safety circuit shall comply with the direct-support of live parts requirements.

5.20.3 Unless otherwise specified, a printed-wiring board shall have a minimum flame classification of V-2.

Exception: A printed-wiring board located in a secondary circuit that complies with the requirements for Class 2 or limited voltage/current circuits have a minimum flame Class of HB.

5.21 Semiconductors and small electrical and electronic components

5.21.1 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with the Standard for Electrically Isolated Semiconductor Devices, UL 1557.

5.21.2 An optical isolator that is relied upon to provide isolation between primary and secondary circuits or between other circuits as required by this end product standard shall comply with the Standard for Optical Isolators, UL 1577.

5.21.3 Except as otherwise specified in this standard, component requirements are not specified for small electrical parts on printed-wiring boards, including diodes, transistors, resistors, inductors, integrated circuits, and capacitors not directly connected to the supply source.

5.21.4 Where an electronic component is determined to be a critical component during the Abnormal Operation Test, Section 35, in this standard, the circuit shall comply with one or both of the following standards. See Protective Controls (Limiting Controls), Section 20.4, for the test parameters to be used.

a) The Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, including its Follow-Up Program; and as applicable, the Standard for Software in Programmable Components, UL 1998 for controls that rely upon software as a protective component; and/or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1.

5.21.5 A critical component is a component that performs one or more safety-related functions whose failure results in a condition, such as the risk of fire, electric shock, or injury to persons, in the end product application.

5.21.6 A critical component may also be identified using a failure-mode and effect analysis (FMEA) in accordance with the Failure-Mode and Effect Analysis (FMEA) requirements in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991.

5.21.7 Portions of a circuit comprised of a microcontroller or other programmable device that performs a back-up, limiting, or other safety function intended to reduce the risk of fire, electric shock, or injury to persons shall comply with the Controls Using Software requirements in the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, Annex H.

5.22 Supplemental insulation, insulating bushings, and assembly aids

5.22.1 The requirements for supplemental insulation (e.g. tape, sleeving or tubing) are not specified unless the insulation or device is required to comply with a performance requirement of this standard. In such cases, the insulation or device shall comply with the following applicable standards:

a) Insulating tape shall comply with the Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape, UL 510;

b) Sleeving shall comply with the Standard for Coated Electrical Sleeving, UL 1441; or

c) Tubing shall comply with the Standard for Extruded Insulating Tubing, UL 224.

5.22.2 Wire positioning devices required to comply with the requirements of this end product standard shall comply with the Standard for Positioning Devices, UL 1565.

5.22.3 Insulating bushings shall comply with the Standard for Insulating Bushings, UL 635, and be suitable for the application with respect to the hole size and shape, maximum use temperature and wire size or type. To determine if the hole size and shape is suitable for the bushing, the applicable test(s) specified in this standard (e.g. Strain Relief Test, Section 37, Push-Back Relief Test, Section 38, Mold Stress Evaluation, 44.1) shall be conducted.

5.23 Switches

5.23.1 Switches shall comply with one of the following, as applicable:

a) The Standard for Switches for Appliances – Part 1: General Requirements, UL 61058-1;

b) The Standard for General-Use Snap Switches, UL 20; or

c) The Standard for Nonindustrial Photoelectric Switches for Lighting Control, UL 773A.

Exception: Switching devices that comply with the applicable UL standards for specialty applications (e.g. transfer switch equipment), industrial use (e.g. contactors, relays, auxiliary devices), or are integral to another component (e.g. switched lampholder) need not comply with this requirement.

5.23.2 Clock-operated switches, and time switches, including timers, shall comply with one of the following:

a) The Standard for Clock-Operated Switches, UL 917; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1, and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Timers and Time Switches, UL 60730-2-7.

5.23.3 A timer or time switch, incorporating electronic timing circuits or switching circuits, with or without separable contacts, that functions as a protective control, shall comply with the requirements for a protective control. See 5.6.1.4.

5.24 Transformers

5.24.1 General-purpose transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers – Part 2: General Purpose Transformers, UL 5085-2.

Exception: A transformer that complies with the Standard for Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances, UL 1411, and that is used in a circuit involving an audio or video component complies with the intent of this requirement.

5.24.2 Class 2 and Class 3 transformers shall comply with the Standard for Low Voltage Transformers – Part 1: General Requirements, UL 5085-1; and the Standard for Low Voltage Transformers – Part 3: Class 2 and Class 3 Transformers, UL 5085-3.

Exception: Transformers located in a low voltage circuit, and that do not involve a risk of fire, electric shock or injury to persons need not comply with this requirement.

5.25 Valves (electrically operated) and solenoids

5.25.1 Electrically operated valves shall comply with the:

a) The Standard for Electrically Operated Valves, UL 429; or

b) The Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1; and the Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Electrically Operated Water Valves, Including Mechanical Requirements, UL 60730-2-8.

Exception: Automatic valves intended for use with natural gas, manufactured gas, LP-gas or LP-gas-air mixtures shall comply with the Standard for Automatic Valves for Gas Appliances, ANSI Z21.21a/CSA 6.5a.

5.25.2 Solenoids shall comply with the applicable construction and performance requirements of this end-product standard.

6 Frame and Enclosure

6.1 General

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

6.1.2 Among the factors taken into consideration when a frame or enclosure is evaluated are:

a) Mechanical strength;

b) Resistance to impact;

c) Moisture-absorptive properties;

d) Combustibility and resistance to ignition from electrical sources;

e) Resistance to corrosion;

f) Resistance to distortion at temperatures to which the enclosure may be subjected under conditions of normal or abnormal use; and

g) Dielectric properties, insulation resistance, and resistance to arc tracking.

A frame or enclosure that will be exposed to oil, acids, solvents, reagents, cleaning agents or ozone as part of the use or application of the snow mover shall not be adversely affected by these materials as determined by appropriate tests.

6.1.3 The enclosure of a snow mover shall be such as to prevent water from causing a risk of electric shock when the snow mover is subjected to a rain test or other test to simulate conditions that might occur during use. See 34.3 and 34.5.

6.2 Metallic enclosures

6.2.1 Cast- and sheet-metal portions of an enclosure shall not be thinner than specified in Table 6.1 unless the enclosure is found to be acceptable when evaluated under the considerations mentioned in 6.1.2.

Table 6.1
Minimum acceptable thickness of metal enclosure

Metal	Minimum thickness			
	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, or the like		At relatively large unreinforced flat surfaces	
	Inch	(mm)	Inch	(mm)
Die-cast metal	3/64	(1.2)	6/64	(2.0)
Cast malleable iron	1/16	(1.6)	3/32	(2.4)
Other cast metal	3/32	(2.4)	1/8	(3.2)
Uncoated sheet steel	0.026	(0.66)	0.026	(0.66)
Galvanized sheet steel	0.029	(0.74)	0.029	(0.74)
Nonferrous sheet metal	0.036	(0.91)	0.036	(0.91)

6.3 Polymeric enclosures

6.3.1 A polymeric enclosure shall be of a material as defined by the tests in, Polymeric Materials Classed Other Than HB, Section 44, or of a material classed HB and as defined by the tests in Polymeric Materials Classed HB, Section 45.

6.3.2 The material used as the enclosure shall be acceptable for use at the maximum temperature to which it is exposed during intended use. Material exposed to temperatures in excess of 80°C (176°F) shall be investigated with respect to aging to determine if it is acceptable for the purpose.

6.4 Handles

6.4.1 A snow mover shall have a handle or handles that permit grasping the snow mover with two hands.

6.4.2 Other than as noted in 6.4.4, the handles or surfaces most likely to be grasped by the user during intended operation of a snow mover shall be of or covered with an insulating material that complies with the requirements in 6.4.5 and Handle Tests, Section 36.

6.4.3 With reference to 6.4.2, examples of surfaces that are likely to be grasped by the user during intended operation include a lever, a handle, or a button for a switch or other operator control. Surfaces of

a guard for a switch, or other operator control, are also included if located where likely to be grasped. Operator-handled controls that are remote from the handles of the snow mover are not included.

6.4.4 The outer surfaces of a handle or other area likely to be grasped during intended operation may be of electrically conductive material if:

a) Insulation complying with the requirement in 36.1(c) is interposed between the surfaces likely to be grasped and:

1) The snow moving member; and

2) Any metallic guard for the snow moving member; and

b) Surfaces likely to be grasped:

1) Are double-insulated from live parts; or

2) Do not enclose electrical components and are separated from all dead metal parts that enclose electrical components by insulation complying with the requirements in 36.1(c).

6.4.5 The insulating material mentioned in 6.4.2 shall be of a type and thickness that make it acceptable as the sole insulation between a live part and a dead metal part. If it overlies and is in intimate contact with dead metal, the nonconductive material shall not be less than 6/64 inches (2.0 mm) thick.

Exception: The thickness of the insulating material may be less than 6/64 inches if the material is found to be acceptable when judged under the considerations mentioned in 6.1.2.

6.4.6 An assembly screw in an area likely to be grasped that secures a covering of insulating material to a metal enclosure and threads into a metal enclosure containing electrical components or into a metal enclosure that contacts another metal enclosure containing live parts:

a) Shall not be accessible to the probe illustrated in Figure 7.3 when inserted to a depth of 1 in (26.4 mm); or

b) Shall be recessed not less than 1/8 inches (3.2 mm) behind the outer surface of the insulating material if the opening will not admit a 3/8-inch (9.6-mm) diameter rod.

7 Accessibility of Uninsulated Live Parts and Film-Coated Wire

7.1 Electrical parts of a snow mover shall be located or enclosed to reduce the risk of unintentional contact with uninsulated live parts. Insulated brush caps do not require an additional enclosure.

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

a) For an opening that has a minor dimension (see 7.6) less than 1 inch (25.4 mm), such a part or wire shall not be contacted by the probe illustrated in Figure 7.1.

b) For an opening that has a minor dimension of 1 inch or more, such a part or wire shall be spaced from the opening as specified in Table 7.1.

Exception: A motor other than one used in either a hand-held product or a hand-supported portion of a product need not comply with these requirements if it complies with the requirements in 7.3.

Figure 7.1

Articulate probe with web stop

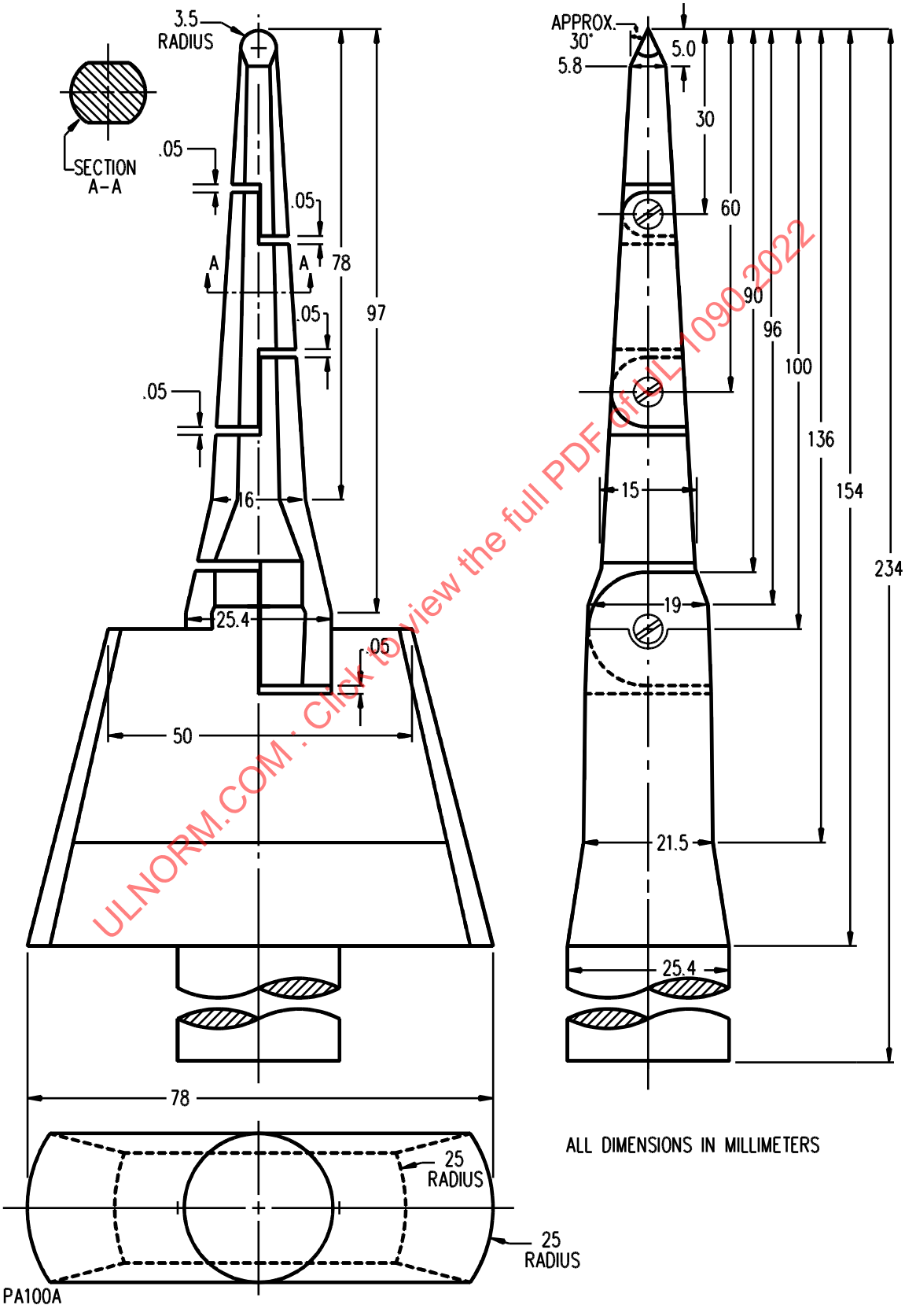


Table 7.1
Minimum acceptable distance from an opening to a part that may involve a risk of electric shock

Minor dimension[a] of opening		Minimum distance from opening to part	
Inch	(mm)[b]	Inch	(mm)[b]
3/4[c]	(19.1)	4-1/2	(114.0)
1[c]	(25.4)	7-1/2	(175.0)
1-1/4	(31.8)	7-1/2	(190.0)
1-1/2	(38.1)	12-1/2	(318.0)
1-7/8	(47.7)	15-1/2	(394.0)
2-1/8	(54.0)	17-1/2	(444.0)
d	d	30	(772.0)

[a] See 7.6.

[b] Between 3/4 inches (19.1 mm) and 2-1/8 inches (54.0 mm), interpolation is to be used to determine a value between values specified in the table.

[c] A dimension less than 1 inch (25.4 mm) applies to a motor only.

[d] More than 2-1/8 inches (54.0 mm), but not more than 7 inches (152.0 mm).

7.3 With reference to the Exception to 7.2, air openings in an integral enclosure of a motor shall comply with (a) or (b):

a) An opening that has a minor dimension (see 7.6) less than 3/4 inches (19.1 mm) is acceptable if:

1) Film-coated wire cannot be contacted by the probe illustrated in Figure 7.3;

2) In a directly accessible motor (see 7.6), an uninsulated live part cannot be contacted by the probe illustrated in Figure 7.4 ; and

3) In an indirectly accessible motor (see 4.19), an uninsulated live part cannot be contacted by the probe illustrated in Figure 7.2.

b) An opening that has a minor dimension of 3/4 inches (19.1 mm) or more is acceptable if a part or wire is spaced from the opening as specified in Table 7.1.

Figure 7.2

Probe for uninsulated live parts

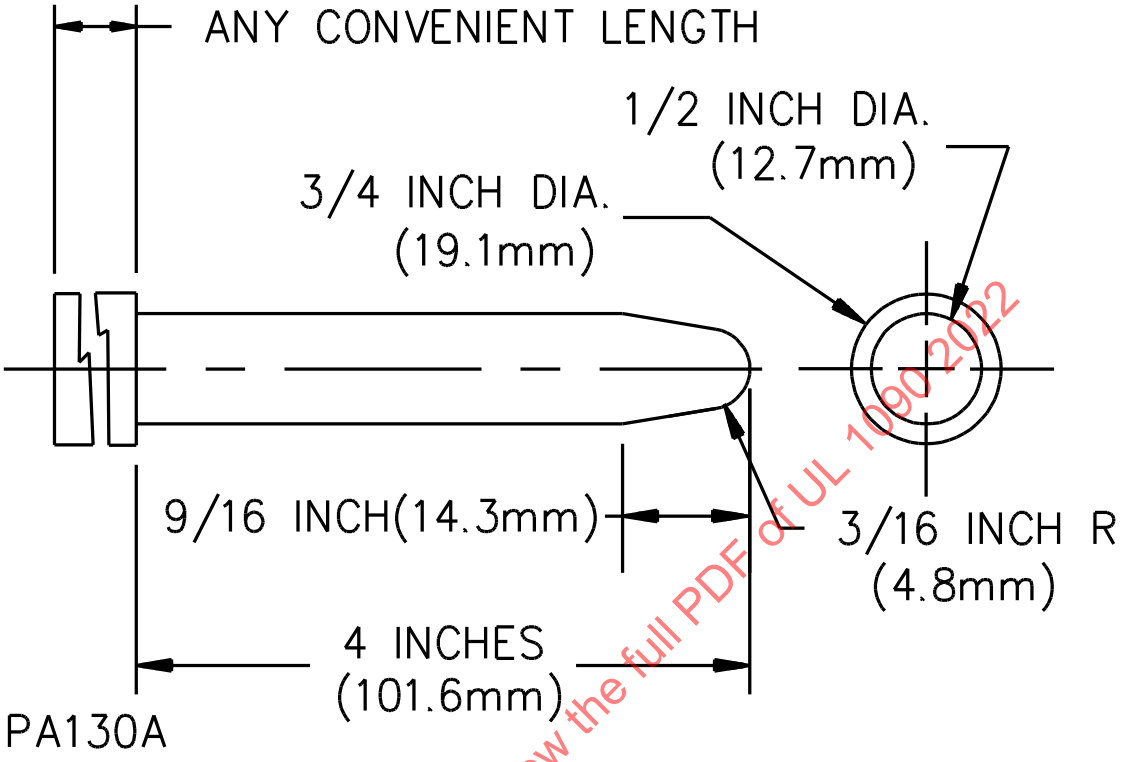


Figure 7.3

Probe for film-coated wire

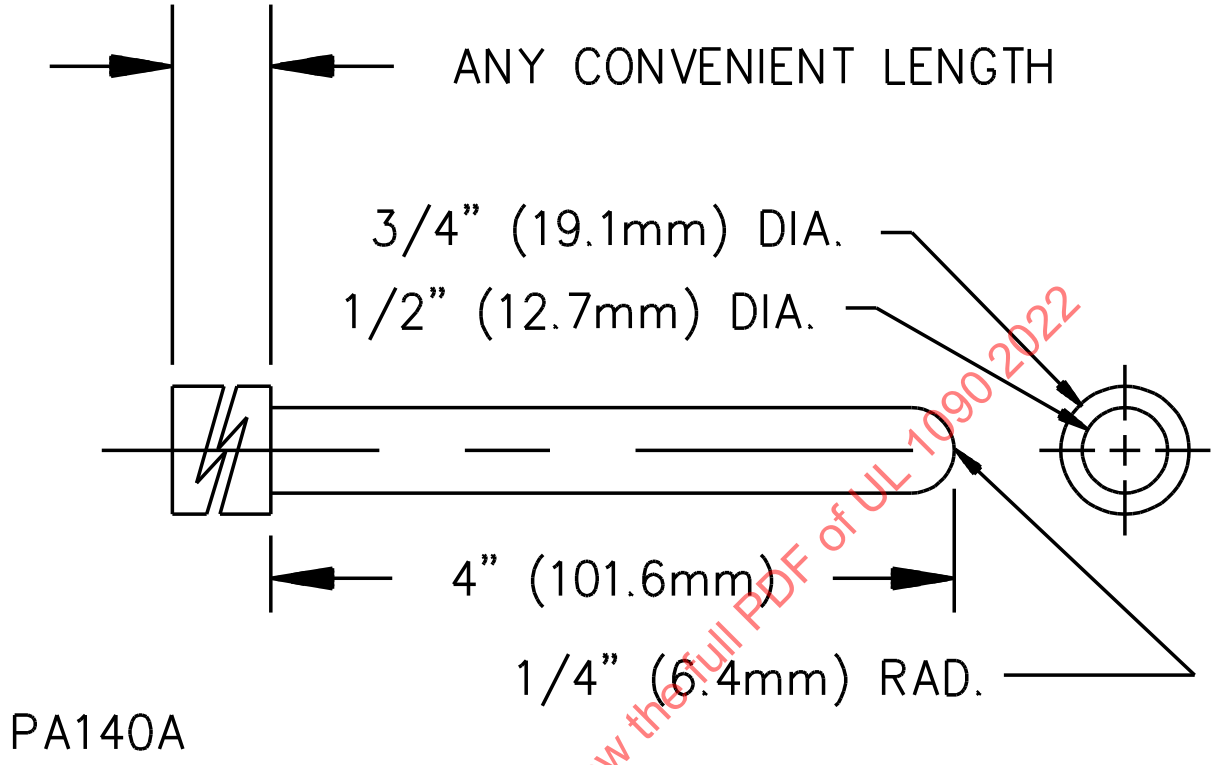
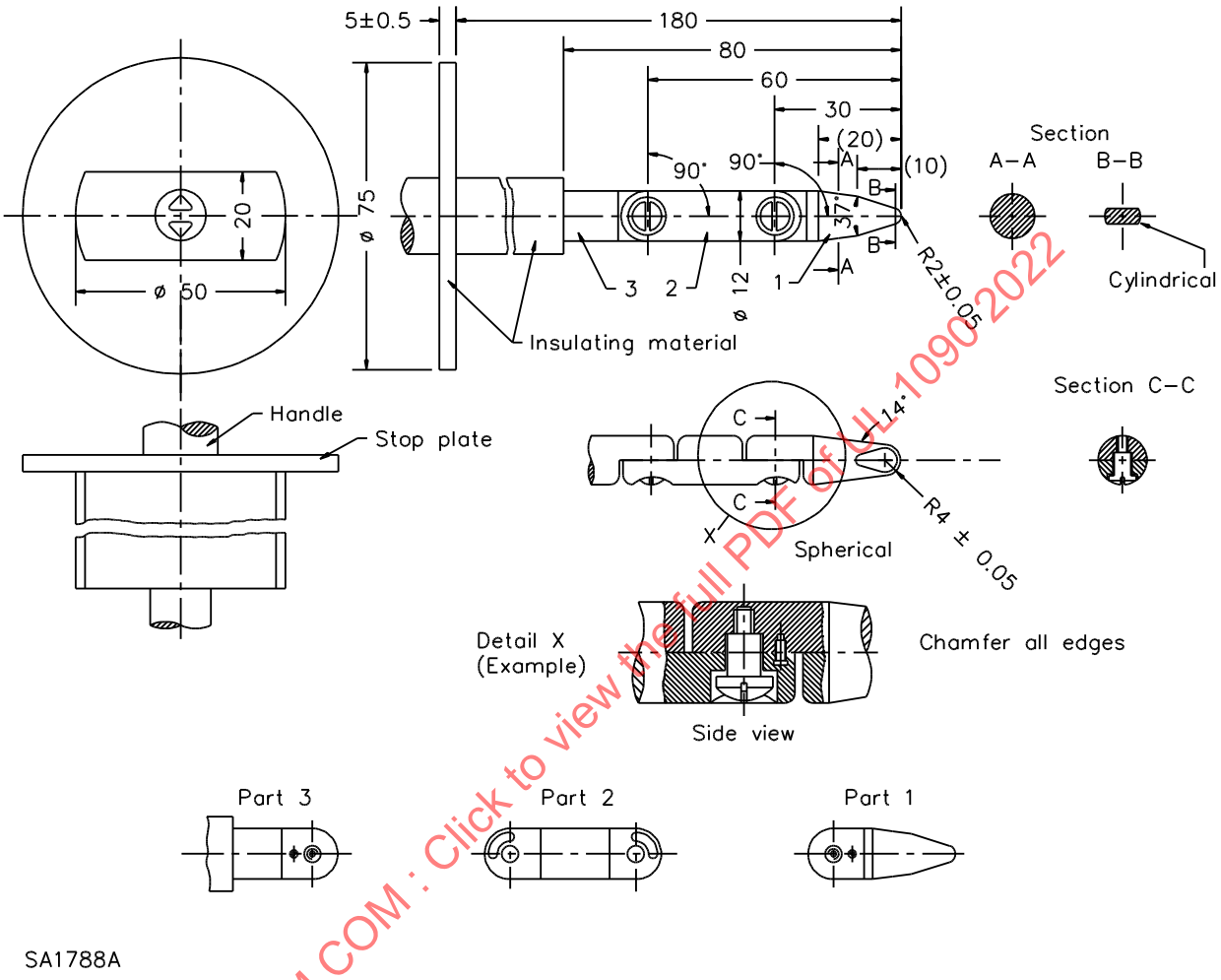


Figure 7.4

International Electrotechnical Commission (IEC) articulate accessibility probe with stop plate

(Courtesy of IEC)



7.4 The probes specified in 7.2 and 7.3 and illustrated in Figure 7.1 – Figure 7.4 shall be applied to any depth that the opening will permit, and shall be rotated or angled before, during, and after insertion through the opening to any position that is necessary to examine the enclosure. The probes illustrated in Figure 7.1 and Figure 7.4 shall be applied in any possible configuration; and if necessary, the configuration shall be changed after insertion through the opening.

7.5 The probes illustrated in Figure 7.1 – Figure 7.4 shall be used as measuring instruments to judge the accessibility provided by an opening, and not as instruments to judge the strength of a material; they shall be applied with the minimum force necessary to determine accessibility.

7.6 With reference to 7.2 and 7.3, 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.

7.7 During the examination of a product to determine compliance with 7.2 or 7.3, a part of the enclosure that may be opened or removed by the user without using a tool (to attach an accessory, to make an operating adjustment, or for other reasons) is to be opened or removed.

7.8 The opening illustrated in Figure 7.5 is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire:

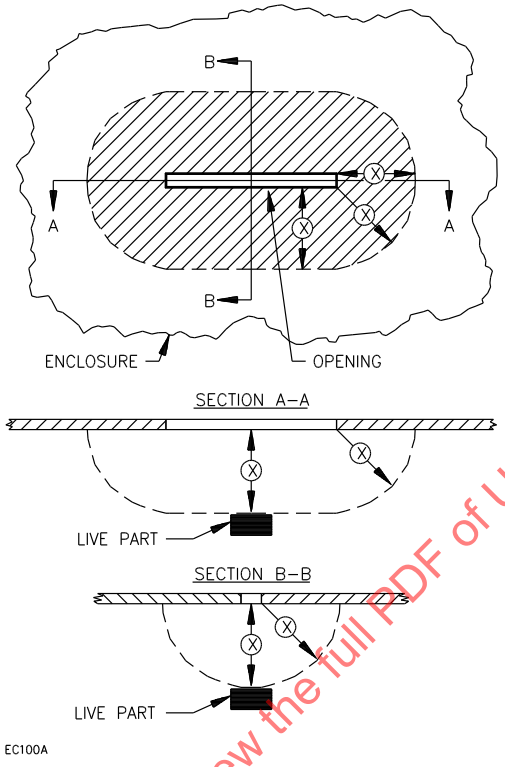
a) Less than X distance from the perimeter of the opening; and

b) Within the volume generated by projecting the perimeter distance X normal to its plane.

X equals five times the diameter of the largest round rod that can be inserted through the opening, but not less than 4 in (102 mm). In evaluating an opening, any barrier located within the volume usually is ignored unless it intersects the boundaries of the volume in a continuous, closed line.

Figure 7.5

Opening in enclosure



7.9 During the examination of a snow mover in connection with the requirements in 7.1, a part of the outer enclosure that may be removed without the use of tools by the user of the snow mover – to permit the attachment of accessories, to allow access to means for making operating adjustments, or for another reason – is to be disregarded; that is, it will not be assumed that the part in question affords protection against electric shock unless marked in accordance with 53.4.

7.10 A latch or a fastener that is intended to be opened by use of a coin or the like, is considered as being able to be opened without the use of a tool.

8 Mechanical Assembly

8.1 A snow mover shall be assembled so that the vibration that occurs during intended operation will not create a risk of fire, electric shock, or injury to persons.

8.2 A switch, a lampholder, an attachment-plug receptacle, a plug connector, or other component that is handled by the user shall be mounted securely and shall be prevented from turning by means other than friction between surfaces.

Exception No. 1: A switch need not be prevented from turning if all four of the following conditions are met:

a) The switch is of a plunger, slide, or other type that does not tend to rotate when operated. A toggle switch is considered to be subject to forces that tend to turn the switch during normal operation of the switch;

b) The means of mounting the switch makes it unlikely that operation of the switch will loosen the switch;

c) Spacings are not reduced below the minimum acceptable values if the switch rotates; and

d) Normal operation of the switch is by mechanical means rather than by direct contact by persons.

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

8.3 With reference to the requirements in 8.2, a lock washer, properly applied, is acceptable as the means for preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

8.4 Other than as noted in 8.5, a snow mover shall be completely assembled before being shipped from the factory.

8.5 A snow mover may be shipped from the factory partially disassembled to facilitate packaging if:

a) All parts that are necessary for operation of the product, such that the product complies with the requirements in this standard, are provided in one carton and are packaged so that no damage will occur in shipment that might result in a risk of fire, electric shock, or injury to persons;

b) Assembly can be readily accomplished without introducing a risk of fire, electric shock, or injury to persons;

c) Clear and detailed assembly instructions are provided;

d) Internal electrical connections that must be made in the field are made by plug and receptacle only and do not require rearrangement of components of wiring;

e) The product is marked as specified in 53.8; and

f) An acceptable grounding means is provided and clearly explained in the assembly instructions.

Exception: A product that is double insulated need not comply with (f).

8.6 With respect to the requirement in 8.5 (a) and (b), wiring and other components shall not be exposed to sharp edges, screw threads, sharp tools, or a risk of pinching, twisting, or other damage during shipment or assembly.

8.7 A snow mover shall be constructed so that user maintenance can be accomplished without pinching leads, reducing spacings, or mislocating or damaging:

a) The means of accomplishing strain relief;

b) A moving part; or

c) A guard or other device that is relied upon to reduce the risk of fire, electric shock, or injury to persons.

8.8 User maintenance as mentioned in 8.7 is considered to consist of inspection and replacement of motor brushes or fuses and other service that is recommended in the instruction manual to be performed by the user. It does not include maintenance that is recommended in the instruction manual to be done by authorized service personnel.

8.9 Compliance with the requirement in 8.7 may be accomplished by routing of wires, provision of wire channels or locating wells for components, use of barriers or restraints, securing of components, and other means.

8.10 Routing as mentioned in 8.9 is acceptable if the construction is such that after the wire has been put into position preparatory to the reassembling of the snow mover, the reassembly procedure will not result in the wire contacting a moving part or being pinched. This does not mean that the wire must be of such length or so clamped that it cannot reach the pinch point or the moving part.

9 Protection Against Corrosion

9.1 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 may not be required to be protected against corrosion.

Exception No. 2: Bearings, laminations, or minor parts of iron or steel, such as washers, screws, and the like.

10 Supply Connections

10.1 General

10.1.1 A snow mover shall be provided with a power-supply cord or a motor attachment plug for connecting an extension cord.

10.1.2 A snow mover intended for use with an extension cord shall not be provided with terminal pins that will accommodate a standard flatiron or appliance plug.

10.1.3 A power-supply cord shall be not less than 8 inches (203 mm) nor more than 18 inches (457 mm) long and located so that it cannot be damaged or impaired by any blades, belts, or moving parts.

10.2 Flexible cord

10.2.1 A flexible power-supply cord provided with a snow mover shall be Type SW, SOW, STW, STOW, SJW, SJOW, SJTW, SJTOW, SEW, SJEW, SEOW, or SJEOW. The color of the flexible cord shall not be white.

10.2.2 A flexible cord used in an extension cord provided with or made available for use with a snow mover shall be one of the types specified in 10.2.1.

10.2.3 A flexible cord shall have a voltage rating not less than the rated voltage of the snow mover, and shall have an ampacity not less than the current rating of the snow mover.

10.3 Attachment plug

10.3.1 An attachment plug shall have an ampacity not less than the rated current of the snow mover, and shall have a voltage rating not less than the rated voltage of the snow mover. If the snow mover can be adapted for use on two or more different values of voltage by field-alteration of internal connections, the

attachment plug provided with the snow mover shall be rated for the voltage for which the snow mover is connected when shipped from the factory. See 50.3.

10.3.2 A 3- to 2-wire grounding adapter shall not be provided with a snow mover.

10.3.3 An attachment plug may be of the locking type.

10.3.4 Means shall be provided to support the attachment plug so that the cord-connector body of an extension cord will not touch the ground when the handle is in an intended operating position.

10.3.5 Means shall be provided to reduce the risk of entry of snow between the face of the attachment plug and the face of the cord-connector body of an extension cord.

10.4 Strain relief

10.4.1 Strain relief shall be provided so that a stress on a flexible cord will not be transmitted to terminals, splices, or internal wiring in the snow mover or in a fitting, such as an attachment plug, an appliance plug, and the like.

10.4.2 A metal strain-relief clamp or band without auxiliary protection is acceptable with a power-supply cord, unless it is judged that the construction of the clamp may damage the cord insulation.

10.4.3 Means shall be provided to prevent the supply cord or lead from being pushed into the enclosure of an appliance through the cord-entry hole when such displacement results in:

a) Subjecting the supply cord or lead to mechanical damage;

b) Exposing the supply cord or lead to a temperature higher than that for which it is rated;

c) Reducing spacings (such as to a metal strain-relief clamp) below the minimum required values; or

d) Damaging internal connections or components.

To determine compliance, the supply cord or lead shall be tested in accordance with Push-Back Relief Test, Section 38.

10.5 Bushings

10.5.1 The edges of the entry hole for the power-supply cord, including the cord-entry hole in a bushing, shall be smooth and free from burrs, fins, and sharp edges. Unless an insulating bushing of a material that has been found acceptable for the application is provided, the hole in the metal in which the bushing is mounted shall be smooth and free from burrs, fins, and sharp edges.

11 Live Parts

11.1 A current-carrying part shall be made of aluminum, silver, copper, a copper alloy, or other material acceptable for the purpose.

11.2 Stainless steel or acceptably plated iron or steel may be used for a current-carrying part:

a) Within a motor or associated governor; or

b) If permitted in accordance with Components – General, Section 5.1.

Unplated or unpainted iron or steel is not acceptable. The foregoing restriction does not apply to stainless steel.

11.3 An uninsulated live part and its support shall be securely mounted to prevent turning or shifting in position if such motion may result in a reduction of spacings below the minimum acceptable values.

11.4 Friction between surfaces is not acceptable as the sole means to prevent turning of a live part but a lock washer or a factory-assembled press-fit, if properly applied, is acceptable for this purpose.

12 Internal Wiring

12.1 General

12.1.1 The wiring and connections between parts of a snow mover shall be acceptably protected or enclosed.

Exception: A length of flexible cord may be employed for external connections if flexibility is essential. See 12.1.2 and 12.1.4.

12.1.2 A flexible cord used for external interconnection as mentioned in the Exception to 12.1.1 shall be one of the types of cord specified in 10.2.1 and shall be provided with acceptable bushings and strain relief in accordance with 10.4.1 – 10.5.1 and Strain Relief Test, Section 37, unless the construction is such that the cord will be protected from stress and motion.

12.1.3 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of the snow mover.

12.1.4 With reference to exposure of internal wiring through openings in the enclosure of a snow mover, the protection of the wiring required by 12.1.1 is considered to exist if, when judged as if it were film-coated wire, the wiring would be acceptable in accordance with 7.2 and 7.3. No wiring is to be located where it is likely to be contacted by the user.

12.1.5 Internal wiring shall not be located near a hole in a snow mover where it can be damaged by a screw, a nail, or other device intended to support the snow mover.

12.1.6 Wiring inside a snow mover that might otherwise be subjected to mechanical damage shall be in armored cable, conduit, or electrical metallic tubing or shall be otherwise protected.

12.1.7 Wiring shall be protected from sharp edges including screw threads, burrs, fins, moving parts, and other agencies that might cause abrasion of the insulation on conductors.

12.2 Insulation

12.2.1 Insulated internal wiring shall be acceptable for the particular application, when considered with respect to:

a) The temperature and voltage to which the wiring is likely to be subjected;

b) Exposure to oil, grease, or other substances likely to have a deleterious effect on the insulation;

c) Exposure to moisture; and

d) Other conditions of service to which it is likely to be subjected.

12.2.2 Thermoplastic-insulated wire and neoprene-insulated wire employed for internal wiring shall be standard building wire or acceptable appliance wiring material, and shall comply with Table 12.1.

Table 12.1
Characteristics of internal wiring

Insulation	Nominal thickness of insulation, inch	Braid or jacket required	Nominal thickness of braid or jacket, inch
Thermoplastic or Neoprene	1/32	No	–
	1/64	Yes	1/64
Rubber	1/32[a]	Yes[a]	1/64[a]

[a] For heat-resistant rubber, other than a silicone type, the insulation thickness shall not be less than 3/64 in (1.2 mm) and no braid is required.

12.2.3 Insulating tubing employed in place of wire insulation shall be acceptable for the application and shall have at least a nominal wall thickness of 1/32 inches (0.8 mm) or more.

12.3 Splices and connections

12.3.1 All splices and connections shall be mechanically secure and shall provide reliable electrical continuity. A soldered connection shall be made mechanically secure before being soldered if breaking or loosening of the connection may result in a risk of fire or electric shock. Consideration shall be given to vibration and the like when judging the acceptability of electrical connections.

12.3.2 An open-end spade lug is not acceptable unless additional means, such as upturned lugs or the like, is provided to hold the lug in place should the wire-binding screw or nut become slightly loosened. In any case, an ordinary open-end lug with a lock washer is not acceptable.

12.3.3 A splice shall be acceptably insulated if permanence of spacings between the splice and other metal parts is not maintained.

12.3.4 The thickness of insulation on a splice shall not be less than 1/32 inches (0.8 mm). In determining if splice insulation consisting of coated-fabric, thermoplastic, or other tubing is acceptable, consideration is given to such factors as its dielectric properties, heat-resistance and moisture-resistance characteristics, and the like. Thermoplastic tape wrapped over a sharp edge is not acceptable.

12.3.5 The means of connecting stranded internal wiring shall be such that loose strands of wire will be prevented from contacting live parts of opposite polarity and dead metal parts.

12.3.6 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 connection point.

12.3.7 A wire-binding screw, a pressure wire connector, and the like used as the terminating device mentioned in 12.3.6 shall be acceptable for use with aluminum under the conditions involved – for example, temperature, heat cycling, and vibration.

13 Electrical Insulation

13.1 Insulating washers, bushings, and the like, and bases or supports for the mounting of live parts shall be made of moisture-resistant material such as glazed porcelain, phenolic or cold-molded composition, or other material acceptable for the particular application, that will not be adversely affected by the temperatures to which they will be subjected under conditions of use.

13.2 Vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts if shrinkage, current leakage, or warpage may introduce a risk of fire or electric shock. Thermoplastic material may be employed if investigated and found to have acceptable mechanical strength and rigidity, resistance to heat, resistance to flame propagation, dielectric strength, and other properties acceptable for the application. All of these properties are to be considered with respect to the effects of thermal aging.

13.3 A molded part shall have adequate mechanical strength and rigidity to withstand stresses of normal service. A brush cap shall be protected, by recessing or other means, from mechanical damage that might occur during normal use unless the part has the strength necessary to withstand the abuses to which it is likely to be subjected.

13.4 A brush cap of a hand-supported snow mover is considered to have adequate strength if it withstands the impact that results from dropping the snow mover through a distance of 3 ft (0.91 m) to strike a concrete surface without cracking or breaking. If the brush cap is located so that it cannot strike the surface when the test is being conducted, it is to be subjected to an impact of 1 ft-lb (1.36 N·m). If the snow mover is ground-supported, the brush cap is to withstand an impact of 1 ft-lb (1.36 N·m). The impact is to be applied through a hardened steel sphere having a diameter of 1/4 inches (6.4 mm), held in contact with the brush cap by any convenient means.

14 Motors

14.1 A motor shall be acceptable for the particular application, and shall be capable of handling the maximum normal load of the snow mover as described in 31.1 without introducing a risk of fire, electric shock, or injury to a person.

14.2 A motor winding shall resist the absorption of moisture and shall be formed and assembled in a workmanlike manner.

14.3 With reference to the requirement in 14.2, film-coated wire is not required to be additionally treated to prevent absorption of moisture, but fiber slot liners, cloth coil wrap, and similar moisture-absorptive materials should be provided with impregnation or otherwise treated to resist moisture absorption.

14.4 An overcurrent-protective device shall not open the circuit during normal operation of the snow mover.

14.5 A brush-holder assembly shall be constructed so that when a brush is worn out – no longer capable of performing its function – the brush, spring, and other parts of the assembly shall be retained to the degree necessary to prevent:

a) An accessible dead metal part from becoming energized; and

b) A live part from becoming accessible.

15 Switches and Controls

15.1 A switch or other control device shall be provided to control the motor. The switch or control device shall be acceptable for the application, and shall have a voltage and current rating not less than the corresponding values of the load that it controls.

15.2 A snow mover shall not employ a through-cord switch.

15.3 A single-pole switch in a snow mover employing a polarized attachment plug shall be connected in the conductor not intended to be grounded.

16 Lampholders

16.1 A lampholder shall be constructed or installed so that uninsulated live parts other than the lamp contacts will not be exposed to contact by persons removing or replacing a lamp during routine servicing.

16.2 The screw-shells of lampholders shall be connected:

a) To the conductor of the flexible cord intended to be grounded; or

b) To the same conductor of the flexible cord in the absence of a conductor that is intended to be grounded.

17 Capacitors

17.1 A capacitor provided as a part of a capacitor motor, and a capacitor connected across the line, such as a capacitor for radio-interference elimination, shall be housed within an acceptable enclosure or container that will protect the plates against mechanical damage and that will prevent the emission of flame or molten material resulting from breakdown or malfunction of the capacitor. Other than as noted in 17.2 and 17.3, the container shall be made of metal providing strength and protection not less than that of sheet steel 0.020 inches (0.51 mm) thick.

17.2 The container of a capacitor may be made of sheet steel thinner than that mentioned in 17.1 or of acceptable material other than metal if the capacitor is mounted in an enclosure that houses other parts of the snow mover and if such a box, case, or the like is acceptable for enclosing live parts.

17.3 The container of an electrolytic capacitor with means for venting shall be such as to provide protection against mechanical damage only, and the requirement for minimum container thickness does not apply. The container of an electrolytic capacitor not provided with means for venting and with an opening (gap) more than 1/16 inches (1.6 mm) wide need not comply with the requirement for container thickness given in 17.1 if it complies with the following: three samples of the capacitor, mounted in the usual manner and with cotton placed around openings in the container, are to be subjected to such overvoltage as to cause breakdown or malfunction. If the cotton ignites or if there is emission of molten metal upon breakdown or malfunction of the capacitor, the results are not acceptable.

17.4 The voltage rating of a capacitor other than a motor-starting capacitor shall not be less than the maximum steady-state voltage to which the capacitor is subjected during operation of the snow mover.

18 Spacings

18.1 The spacing between uninsulated live parts of opposite polarity and between uninsulated live parts and a dead metal part that is exposed to contact by persons or that may be grounded shall not be less than the value specified in Table 18.1 for alternating-current circuits. If an uninsulated live part is not rigidly fixed in position – by means other than friction between surfaces – or if a movable dead metal part is in proximity to an uninsulated live part, the construction shall be such that the minimum acceptable spacing will be maintained in all possible positions of the movable part.

Exception No. 1: Inherent spacings of a component of the snow mover, such as a switch, are to be judged on the basis of the requirements for the component in question.

Exception No. 2: For a repulsion motor, a repulsion-induction motor, or a repulsion-start induction motor, the spacing requirements do not apply to the commutator, the brush assembly, or the jumpers that short-circuit the brushes. Any uninsulated conductor of the rotor circuit is regarded as a dead metal part with respect to the stator circuit, and the appropriate spacing is required between uninsulated stator and rotor conductors.

Exception No. 3: Inherent spacings of a motor that complies with the Standard for Rotating Electrical Machines – General Requirements, UL 1004-1, need not comply with the spacing requirements for inside a motor specified in Table 18.1.

Table 18.1
Minimum acceptable spacings

Potential involved, volts	Parts involved	Motor diameter more than 7 in[a] (178 mm) minimum spacings[b]			
		Over surface		Through air	
		Inch	(mm)	Inch	(mm)
0 – 125	Between commutator bars or collector rings of a motor and the motor shaft and laminations	3/16	(4.8)	1/8	(3.2)
	Elsewhere in the appliance	1/4[c]	(6.4)	1/8[c]	(3.2)
126 – 250	Between commutator or collector rings of a motor	3/16	(4.8)	3/16	(4.8)
	Elsewhere in the appliance	1/4[c]	(6.4)	1/4[c]	(6.4)

[a] 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.

[b] Spacings of not less than 3/32 inches (2.4 mm) are acceptable throughout a universal motor and a motor with a diameter 7 inches or less.

[c] Film-coated wire is considered to be an uninsulated live part. However, a spacing not less than 3/32 inches over surface and through air between enameled wire, rigidly supported and held in place on a coil, and a dead metal part is acceptable in the snow mover.

18.2 In applying Table 18.1 to a snow mover incorporating two or more motors of different sizes, the spacings inside each motor are judged on the basis of the size of that motor, and the spacings elsewhere in the snow mover are judged on the basis of the size of the largest motor in the snow mover.

18.3 If an isolated dead metal part is interposed between or in close proximity to:

a) Live parts of opposite polarity;

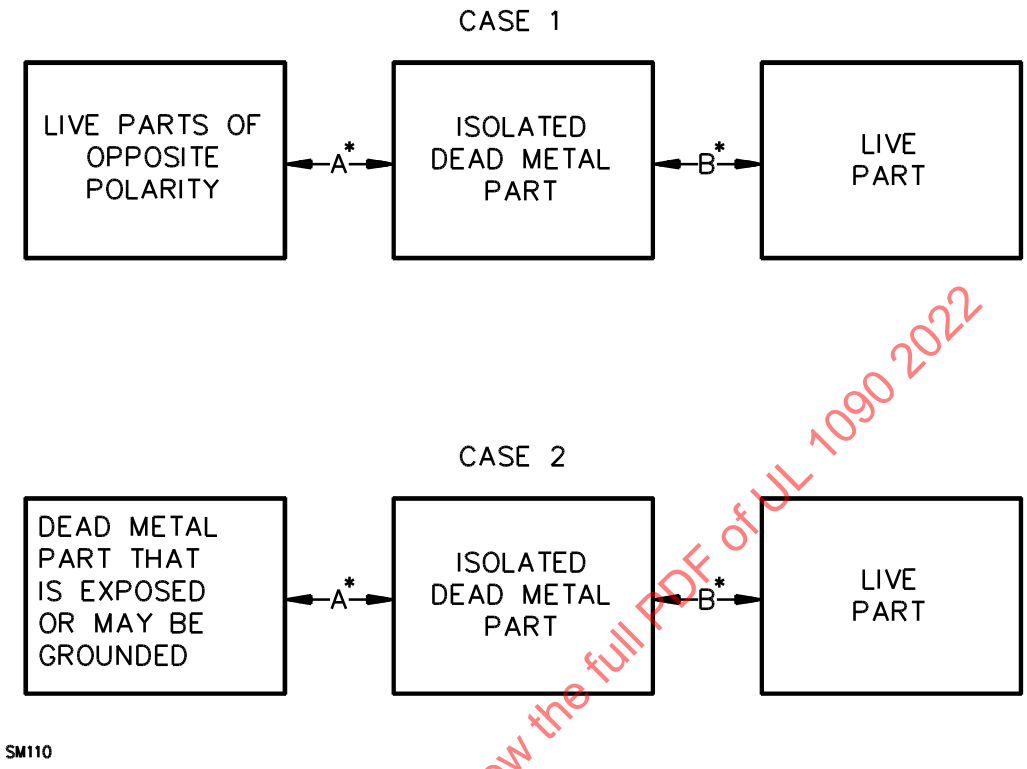
b) A live part and an exposed dead metal part; or

c) A live part and a dead metal part that may be grounded,

the spacing shall not be less than 3/64 inches (1.2 mm) between the isolated dead metal part and any one of the other parts previously mentioned, provided the sum of the spacing between the isolated dead metal part and each of the other two parts is not less than that specified in Table 18.1. See Figure 18.1.

Figure 18.1

Spacings for isolated dead metal parts



18.4 Primary-circuit spacings apply in all secondary circuits supplied by a transformer winding of 200 VA or higher capacity – maximum available power – at a potential more than 100 V. The spacings in all other secondary circuits are to be judged on the basis of the dielectric voltage-withstand test described in 32.2.

18.5 An insulating liner or barrier of vulcanized fiber or similar material employed where a spacing would otherwise be less than the minimum acceptable value shall not be less than 1/32 inches (0.8 mm) thick, and shall be so located or of such material that it will not be adversely affected by arcing.

Exception: Vulcanized fiber not less than 1/64 inches (0.4 mm) thick may be used in conjunction with an air spacing of not less than 50 percent of the minimum acceptable through-air spacing.

18.6 An insulating liner or barrier of a material other than that mentioned in 18.5 may be used if, upon investigation, the material is found to be acceptable for the particular application.

18.7 The spacings between an enclosure of polymeric material classed HB, as defined in 45.4.1, and:

a) A nonarcing bare live part, such as a bus bar, a connecting strap, or a terminal, shall not be less than 1/32 inches (0.8 mm).

b) An arcing part, such as a commutator or an unenclosed switch contact, shall not be less than 1/2 inches (12.7 mm) other than as indicated in 45.7.1.

18.8 The spacing specified in 18.7(b) is to be measured from the source of the arc.

19 Grounding

19.1 The requirements in 19.2 – 19.5 do not apply to double-insulated snow movers. See 55.2.

19.2 The flexible cord of a snow mover shall include an equipment-grounding conductor.

19.3 An equipment-grounding conductor of a flexible cord shall be:

a) Green with or without one or more yellow stripes;

b) Connected to the grounding member of an attachment plug of the grounding type; and

c) Conductively connected to:

1) All exposed dead metal parts of the snow mover; and

2) All dead metal parts within the enclosure that are exposed to contact during any user servicing and that are likely to become energized.

The grounding conductor shall be connected by means of a screw or other reliable means not likely to be removed during any servicing operation not involving the power-supply cord; solder alone shall not be used for securing this conductor. A sheet metal screw shall not be used for the connection of grounding conductors or connection devices to an enclosure.

19.4 The screw mentioned in 19.3(c) shall be of corrosion-resistant metal or shall be acceptably protected against corrosion. A lock washer or other acceptable means shall be employed to prevent the screw from being loosened by vibration. This screw shall have a slotted, hexagonal, green-colored head.

19.5 With reference to the requirement in 19.3(c), the following dead metal parts are not considered likely to become energized:

a) A small metal part, such as an adhesive-attached foil marking, a screw, a handle, and the like that is:

1) On the exterior of the enclosure and separated from all electrical components by grounded metal; or

2) Electrically isolated from all electrical components.

b) A panel or cover that is isolated from all electrical components by a barrier of vulcanized fiber, varnished cloth, phenolic composition, or other moisture-resistant insulating material not less than 1/32 inches (0.8 mm) thick and reliably secured in place.

c) A panel or cover that does not enclose uninsulated live parts and is electrically isolated from other electrical components.

d) Cores and assembly screws of relays, solenoids, and the like.

20 Controls – End Product Test Parameters

20.1 General

20.1.1 Spacings of controls shall comply with the electrical spacing, or clearances and clearance distance requirements of the applicable control standard as determined in Controls, 5.6.

20.1.2 Where reference is made to declared deviation and drift, this indicates the manufacturer's declaration of the control's tolerance before and after certain conditioning tests.

20.2 Auxiliary controls

20.2.1 Auxiliary controls shall not introduce a risk of risk of fire, electric shock, or injury to persons.

20.2.2 Auxiliary controls shall comply with the requirements of this end product standard.

Exception: An auxiliary control that complies with a component standard(s) specified in Controls, 5.6, is considered to comply with this requirement.

20.3 Operating controls (regulating controls)

20.3.1 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1:

a) Control action Types 1 or 2;

b) Unless otherwise specified in this standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;

c) Installation class 2 in accordance with the Standard for Electromagnetic Compatibility (EMC) – Part 4-5: Testing and Measurement Techniques – Surge Immunity Test, IEC 61000-4-5;

d) For the applicable Overvoltage Category, see Table 20.1;

e) For the applicable Material Group, see Table 20.2; and

f) For the applicable Pollution Degree, see Table 20.3.

20.3.2 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using other than the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1:

a) Control action Types 1 or 2;

b) Unless otherwise specified in this standard, manual and automatic controls shall be tested for 6,000 cycles with under maximum normal load conditions, and 50 cycles under overload conditions;

c) For the applicable Overvoltage Category, see Table 20.1;

d) For the applicable Material Group, see Table 20.2; and

e) For the applicable Pollution Degree, see Table 20.3.

Table 20.1
Overvoltage categories

Appliance	Overvoltage category
Control located in low-voltage circuit	I
Portable and stationary cord-connected	II
Intended for fixed wiring connection	III
NOTE – Applicable to low-voltage circuits if a short circuit between the parts involved may result in operation of the controlled equipment that would increase the risk of fire or electric shock.	

Table 20.2
Material group

CTI PLC value of insulating materials	Material group
CTI ≥ 600 (PLC = 0)	I
400 ≤ CTI < 600 (PLC = 1)	II
175 ≤ CTI < 400 (PLC = 2 or 3)	IIIa
100 ≤ CTI < 175 (PLC = 4)	IIIb
NOTE – PLC stands for Performance Level Category, and CTI stands for Comparative Tracking Index as specified in the Standard for Polymeric Materials – Short Term Property Evaluations, UL 746A.	

Table 20.3
Pollution degrees

Appliance control microenvironment	Pollution degree
No pollution or only dry, nonconductive pollution. The pollution has no influence. Typically hermetically sealed or encapsulated control without contaminating influences, or printed wiring boards with a protective coating can achieve this degree.	1
Normally, only nonconductive pollution. However, a temporary conductivity caused by condensation may be expected. Typically indoor appliances for use in household or commercial clean environments achieve this degree.	2
Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation that is expected. Typically controls located near and may be adversely affected by motors with graphite or graphite composite brushes, or outdoor use appliances achieve this degree.	3

20.4 Protective controls (limiting controls)

20.4.1 An electronic control that performs a protective function shall comply with the requirements in Controls, 5.6, while tested using the parameters in this section. Examples of protective controls include:

a) A control used to sense abnormal temperatures of components within the appliance;

b) An interlock function to de-energize a motor;

c) Temperature protection of the motor due to locked rotor; running overload, or loss of phase; or

d) Other function intended to reduce the risk of fire, electric shock, or injury to persons.

20.4.2 The following test parameters shall be among the items considered when judging the acceptability of an electronic protective control investigated using the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1:

a) Failure-Mode and Effect Analysis (FMEA) or equivalent risk analysis method;

b) Power supply voltage dips, variation and interruptions within a temperature range of 10°C (18°F) and the maximum ambient temperature determined by conducting the Temperature Test, Section 33;

c) Surge immunity test – installation class 3 shall be used;

d) Electrical fast transient/burst test, a test level 3 shall be used;

e) Electrostatic Discharge Test;

f) Radio-frequency electromagnetic field immunity:

1) Immunity to conducted disturbances, when applicable, test level 3 shall be used; and

2) Immunity to radiated electromagnetic fields, field strength of 3 V/m shall be used;

g) Thermal Cycling Test shall be conducted on protective devices intended for other than outdoor use at ambient temperatures of 0 ±2°C (32.0 ±3.6°F) and 40.0 ±2°C (104 ±3.6°F). For protective devices intended for outdoor use, the test shall be conducted at ambient temperatures of -35.0 ±2° C (-31.0 ±3.6°F) and 40.0 ±2°C (104 ±3.6°F). If the maximum ambient temperature of the control is determined to exceed the specified upper limit of the ambient temperature by conducting the Temperature Test, Section 33, this higher ambient temperature shall be used. The test shall be conducted for 14 days;

h) Overload shall be conducted based on the maximum declared ambient temperature (T_{max}) or as determined by conducting the Temperature Test, Section 33; and

i) If software is relied upon as part of the protective electronic control, it shall be evaluated as software class B.

20.4.3 The test parameters and conditions used in the investigation of the circuit covered by 5.6.1.5 shall be as specified in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991, using the following test parameters:

a) With regard to electrical supervision of critical components, for attended appliances, a motor operated system becoming permanently inoperative with respect to movement of an exposed portion of the appliance meets the criteria for trouble indication. For unattended appliances, electrical supervision of critical components may not rely on trouble indication.

b) A field strength of 3 V per meter is to be used for the Radiated EMI Test.

c) The Composite Operational and Cycling Test is to be conducted for 14 days at temperature extremes of 0°C (0°F) and 70°C (158°F).

d) The Exposure Class as defined under Humidity Classes for the products intended end use is to be used for the Humidity Test.

e) A vibration level of 5 g is to be used for the Vibration Test.

f) When the Demonstrated Method is conducted, the multiplier for the test acceleration factor is to be 576.30 for intermittent use appliances, or 5763.00 for continuous use appliances. The test acceleration factor equation is to be based on a 25°C (77°F) use ambient.

g) The Endurance Test is to be conducted concurrently with the Operational Test. The control shall perform its intended function while being conditioned for 14 days in an ambient air temperature of

60°C (140°F), or 10°C (18°F) greater than the operating temperature of the control, whichever is higher. During the test, the control is to be operated in a manner representing normal use.

h) For the Electrical Fast Transient Burst Test, test level 1 is to be used.

i) Conduct a failure-mode and effect analysis (FMEA).

j) If software is relied upon as part of the protective electronic control, it shall be evaluated as software class 1 in accordance with the Standard for Software in Programmable Components, UL 1998.

20.4.4 Unless otherwise specified in this standard, protective controls shall be evaluated for 100,000 cycles for Type 2 devices and 6,000 cycles for Type 1 devices with rated current.

20.5 Controls using a temperature sensing device

20.5.1 A temperature sensing positive temperature coefficient (PTC) or negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control, shall be tested using the following number of cycles when testing a sensing device in accordance with the Endurance Test as specified in the Standard for Tests for Safety-Related Controls Employing Solid-State Devices, UL 991 or the Standard for Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements, UL 60730-1:

a) For a device employed as a operating device – 6000 cycles;

b) For a device employed as a protective device – 100,000 cycles; and

c) For a device employed as a combination operating and protective device – 100,000 cycles.

PROTECTION AGAINST INJURY TO PERSONS

21 General

21.1 A snow mover, the intended operation of which may involve a risk of injury to persons, shall comply with the performance and constructional requirements specified in 1.3 and Sections 22 – 25.

21.2 If various functional attachments are available for use with a snow mover, each attachment will be considered individually.

22 Enclosures and Guards

22.1 An edge, a projection, and a corner of an enclosure, a frame, a guard, a handle, or the like shall be smooth and well-rounded, and not sharp to a degree that constitutes a risk of injury to persons during intended use and routine maintenance of a snow mover.

22.2 If breakage and deformation of an enclosure, a frame, a guard, or the like could result in a risk of injury to persons, the material of the part shall have the properties required to meet the expected loading conditions.

22.3 The enclosure or guard of a rotating part and a discharge guide or deflector shall be sufficiently complete and shall have such strength as to contain and deflect:

a) Parts that because of breakage or other reasons might become loose or separated from a rotating part; and

b) Foreign objects that might be struck and propelled by a rotating part.

23 Rotating Parts

23.1 A rotating part shall be designed and constructed of such material and in such manner as to preclude the likelihood of its release or loosening of a part that could injure a person.

23.2 A user-removable rotating part shall be assembled so that the direction of rotation tends to tighten the means used to hold the rotating part in place. Dynamic braking of the snow mover shall not loosen a retaining means during normal tests conducted on the snow mover.

23.3 A removable rotating part not intended to be removed by the user shall be secured by a keyed nut, a jam nut, a nut locked in place with a pin, or other positive means.

24 Switches and Controls

24.1 A device that automatically starts an appliance, such as a timer, an automatically reset overload-protective device, or the like shall not be employed unless it can be demonstrated that automatic starting will not result in a risk of injury to persons.

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

24.3 A switch shall be located or guarded so that the snow mover cannot be energized by:

a) Placing the snow mover in any at-rest position against a flat or contoured surface that may be encountered in actual use; or

b) Actuating the switch by irregular surfaces across which the snow mover may be moved.

24.4 A switch shall operate readily by finger pressure with the snow mover held in the intended manner.

24.5 A reversing switch shall not be provided on a snow mover that tends to be self-propelled.

24.6 A maintained-contact on-off switch or a momentary-contact switch that can be locked in the on position shall not be provided on a snow mover if the snow mover, when energized, has moving parts that are likely to cause injury to persons.

24.7 A hand-supported snow mover shall be provided with a lock out button and a separate trigger switch that requires 2 motions to energize the snow mover.

24.8 A snow mover shall be provided with an impeller control such that:

a) The impeller does not operate unless the operator actuates the control;

b) Continuous operator contact is required to maintain drive to the impeller; and

c) The impeller, when moving in the normal direction of travel, comes to a complete stop after the release of the control.

24.9 In addition to the impeller control required in 24.8, a snow mover shall be provided with a means that must be manually actuated before the impeller can be restarted. The additional means may be a control that is separate from the impeller control, or it may be incorporated into the impeller control as a double action device that requires two separate and distinct motions to restart the impeller.

25 Drop Test for Reliability of Parts

25.1 A component, as mentioned in 22.2, of a hand-supported snow mover shall withstand the Drop Test described in 25.2:

a) Without cracking that affects the functional strength of the part;

b) Without being affected to the extent that parts capable of causing injury would be exposed to unintentional contact; and

c) Without affecting the safe mechanical performance of the snow mover.

25.2 For the Drop Test, each of three samples of the complete snow mover is to be dropped three times from a height of 3 ft (0.91 m) onto a concrete surface in such a manner as to test the component most severely.

25.3 If the component is nonmetallic material, the Drop Test is to be performed on the sample or samples in the as-received condition. The test is then to be repeated on:

a) A different sample or samples that have been in an air oven for 7 hours at a uniform temperature not less than 10°C (18°F) higher than the maximum operating temperature of the material measured under normal operating conditions, but not less than 70°C (158°F), see 25.4; and

b) On samples that have been conditioned at a minimum temperature of minus 20°C (minus 4°F) or lower as recommended by the manufacturer for 7 hours.

The samples conditioned at the temperature in (a) are not to be tested until they have returned to room temperature.

25.4 Upon completion of the conditioning described in 25.3 and before being subjected to the Drop Test, no sample shall show checking, cracking, or other deleterious effects from the oven conditioning, nor shall any sample show distortion that would impede the proper use of the snow mover.

25.5 Deformation of a guard during the Drop Test is acceptable if:

a) Operation of the snow mover or performance of the guard is not affected; or

b) The guard can be readily restored to its original shape.

25.6 A functional component, including a portion of the drive system, need not comply with the requirement for the Drop Test if it is evident that the snow mover would not be capable of intended operation after the test.

PERFORMANCE

26 General

26.1 The performance of a snow mover is to be investigated by subjecting the required number of samples to the applicable tests described in 27.1 – 40.3. Insofar as is practicable, the tests are to be conducted in the order in which they are presented.

26.2 For a snow mover having a single voltage rating, such as 115 V, maximum rated voltage is considered to be 120 V. For a snow mover nominally rated 230 V, maximum rated voltage is considered to be 240 V. If the rating is given in terms of a range of voltages, the maximum rated voltage is considered to be the highest value of the range – 120 or 240 V minimum respectively.

27 Leakage Current Test

27.1 The leakage current of a snow mover rated for a nominal 120-V supply when tested in accordance with 27.2 – 27.6 shall not be more than 0.5 mA.

27.2 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure that has been investigated and found to be acceptable to reduce the risk of electric shock – see 7.1 – 7.10. Surfaces are considered to be simultaneously accessible if 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 voltages that are considered to be nonhazardous.

27.3 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 cm in contact with the surface. If the surface is less than 10 by 20 cm, the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the snow mover.

27.4 The measurement circuit for leakage current is to be as illustrated in Figure 27.1. The measurement instrument is defined in (a) – (d). The meter that is actually used for a measurement need only indicate the same numerical value for a particular measurement as would the defined instrument. The meter used need not have all the attributes of the defined instrument.

a) The meter is to have an input impedance of 1500 Ω resistive shunted by a capacitance of 0.15 mF.

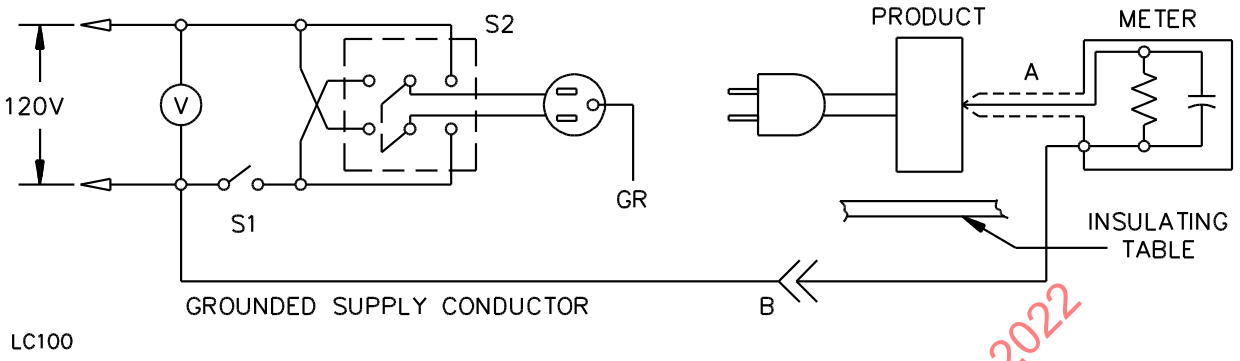
b) The meter is to indicate 1.11 times the average of the full-wave rectified composite wave form of voltage across the resistor or current through the resistor.

c) Over a frequency range of 0 – 100 KHz, the measurement circuitry is to have a frequency response – ratio of indicated to actual value of current – that is equal to the ratio of the impedance of a 1500 Ω resistor shunted by a 0.15 mF capacitor to 1500 Ω. At an indication of 0.5 mA, the measurement is to have an error of not more than 5 percent at 60 Hz.

d) Unless the meter is being used to measure leakage from one part of a snow mover to another, the meter is to be connected between the accessible parts and the grounded supply conductor.

Figure 27.1

Leakage current measurement circuit



NOTE:

A Probe with shield lead.

B Separated and used as clip when measuring currents from one part of device to another.

27.5 A sample of the snow mover is to be tested for leakage current starting with the as-received condition but with its grounding conductor, if any, open at the attachment plug. The as-received condition is without prior energization, except as may occur as part of the production line testing. The supply voltage is to be adjusted to 120 V. The test sequence with reference to the measuring circuit – Figure 27.1 – is to be as follows:

a) With switch S1 open, the snow mover is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2, and with the snow mover switching devices in all their normal operating positions.

b) Switch S1 is then to be closed energizing the snow mover, and within 5 seconds the leakage current is to be measured using both positions of switch S2 and with the snow mover switching devices in all their normal operating positions.

c) The leakage current is to be monitored until thermal stabilization. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is considered to be obtained by operation as in the normal temperature test.

27.6 Usually the complete leakage current test program described in 27.5 is to be conducted without interruption for other tests. With the concurrence of those concerned, a leakage current test may be interrupted for the purpose of conducting other nondestructive tests.

28 Starting Current Test

28.1 A snow mover shall start and operate as intended on a circuit protected by an ordinary – not time-delay – fuse having a current rating corresponding to the current rating of the attachment plug of the snow mover in accordance with Table 28.1.

Exception: This requirement does not apply to a snow mover that:

a) Will start and operate as intended on a circuit protected by a time-delay fuse; and

b) Is marked in accordance with 51.1.

Table 28.1
Rating of test fuse

Attachment plug rating, amperes	Fuse rating, amperes
15	15
20	20

28.2 In a test to determine whether a snow mover complies with the requirement in 28.1, the snow mover is to be connected to a supply of rated voltage and started three times, with the snow mover at room temperature at the beginning of the test. Each start of the motor is to be made under conditions representing the beginning of normal operation and the motor is to be allowed to come to rest between successive starts. The performance is considered to be unacceptable if the fuse opens, or if a thermal protector provided as part of the snow mover trips.

29 Continuity of Ground Connection

29.1 The requirements in 29.2 – 29.4 do not apply to double-insulated snow movers.

29.2 The grounding blade of the attachment plug and the dead metal parts of a snow mover mentioned in 19.3(c) shall be electrically connected.

29.3 The resistance between the point of connection of the equipment-grounding means at or within the snow mover and any other point in the grounding circuit of the snow mover shall not be more than 0.1 Ω.

29.4 Determination of whether a snow mover complies with the requirement in 29.3 may be determined by any acceptable instrument. If unacceptable results are observed, an alternating current of 20 A or more from a power supply of 12 V or less is to be passed from the point of connection of the equipment-grounding means to the metal part in the grounding circuit, and the resulting drop in potential is to be measured between the two points. The resistance in ohms is to be determined by dividing the drop in potential in volts by the current in amperes passing between the two points.

30 Impeller Stopping Test

30.1 A snow mover impeller shall stop within 3 seconds when tested in accordance with 30.2.

30.2 The snow mover is to be connected to a power-supply circuit of rated frequency and maximum rated voltage (see 33.3). The snow mover is then to be operated and the impeller is to be allowed to obtain maximum no load speed. The operator controlled switch or other control device is then to be released and the time for the impeller to come to a complete stop is to be measured.

31 Input Test

31.1 The current input to a snow mover shall not be more than 120 percent of the rated value when it is connected to a supply circuit of maximum rated voltage and rated frequency. A ground supported snow mover is operated clearing heavy snow that is approximately 6 – 7 inches (150 – 180 mm) deep or while the appliance is stationary and moving water that is 2 inches (50 mm) above the bottom of the impeller. For a hand-supported snow mover (e.g. a snow shovel), clearing heavy snow at 80% of maximum rated

depth, but not exceeding approximately 6 – 7 inches (150 – 180 mm) or moving water that is 1 inch (25 mm) above the bottom of the impeller.

32 Dielectric Voltage-Withstand Test

32.1 The requirements in 32.2 and 32.3 do not apply to double-insulated snow movers. See 55.2.

32.2 A snow mover shall withstand without breakdown for 1 minute the application of a 60-Hz essentially sinusoidal potential of 1000 V plus twice rated voltage, other than as specified in 32.3, between live parts and dead metal parts, with the snow mover at the temperature reached during the Temperature Test, Section 33.

32.3 For a snow mover employing an induction motor rated less than 1/2 hp (373 W output) and 250 V or less, the test potential for the motor – but not for the remainder of the snow mover – is to be 1000 V. See 32.4.

32.4 In applying 32.3 to a motor not rated in horsepower, use is to be made of the appropriate table of the National Electrical Code, ANSI/NFPA 70, 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 is to be used when the snow mover is marked for use on alternating current only; otherwise, the table applying to direct-current motors is to be used.

32.5 To determine whether a snow mover complies with the requirements in 32.2, the snow mover is to be tested by means of a 500-VA or larger capacity transformer the output voltage of which is essentially sinusoidal and can be varied. The applied potential is to be increased from zero until the required test level is reached, and is to be held at that level for 1 minute. The increase in the applied potential is to be at a substantially uniform rate and as rapid as is consistent with its value being correctly indicated by a voltmeter.

33 Temperature Test

33.1 A snow mover shall be tested with the load described in 31.1, and shall not:

a) Reach a temperature, at any point, high enough to cause a risk of fire or to damage any material used in the snow mover; or

b) Exceed the temperature rises specified in Table 33.1.

Table 33.1
Maximum acceptable temperature rises

Materials and components	°C	(°F)
1. Varnished-cloth insulation	85	(153)
2. Fuses	90	(162)
3. Fiber employed as electrical insulation	90	(162)
4. Wood and other combustible material	90	(162)
5. Phenolic composition employed as electrical insulation or as a part the deterioration of which would result in a hazardous condition	150[a]	(270)[a]
6. Rubber- or thermoplastic-insulated wires and cords	60[a,b]	(108)[a,b]
7. Capacitor		

Table 33.1 Continued on Next Page

Table 33.1 Continued

Materials and components	°C	(°F)
Electrolytic	65[c]	(117)[c]
Other types	90[d]	(162)[d]
8. Class 105 insulation systems on windings of a transformer		
Thermocouple method[e]	90	(162)
Resistance method[e]	100	(180)
9. Class 105 insulation systems on windings of a relay, a solenoid, and the like		
Thermocouple method [e]	90	(162)
Resistance method[e]	110	(198)
10. Class 130 insulation systems except as indicated in items 13 and 14[c]		
Thermocouple method	110	(198)
11. Class A insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 in (178 mm), of a d-c motor, and of a universal motor[e,f]		
A. In an open motor:		
Thermocouple method	90	(162)
Resistance method	110	(198)
B. In a totally enclosed motor:		
Thermocouple method	95	(171)
Resistance method	105	(189)
12. Class A insulation systems on coil windings of an a-c motor having a diameter of 7 in or less – not including a universal motor – and on a vibrator coil:[e,f]		
A. In an open motor and on a vibrator coil		
Thermocouple or resistance method	100	(180)
B. In a totally enclosed motor		
Thermocouple or resistance method	105	(189)
13. Class B insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 in of a d-c motor and of a universal motor:[e,f]		
A. In an open motor		
Thermocouple method	110	(198)
Resistance method	120	(216)
B. In a totally enclosed motor		
Thermocouple method	115	(207)
Resistance method	125	(225)
14. Class B insulation systems on coil windings of an a-c motor having a diameter of 7 in or less – not including universal motors – and on a vibrator coil:[e,f]		
A. In an open motor and on a vibrator coil		
Thermocouple or resistance method	120	(216)
B. In a totally enclosed motor		
Thermocouple or resistance method	125	(225)

[a] The limitations on phenolic composition and on rubber and thermoplastic insulation do not apply to compounds that have been investigated and found to have special heat-resistant properties.

[b] Rubber-insulated conductors within a motor having Class A insulation systems, rubber insulated motor leads, and a rubber-insulated flexible cord entering a motor may be subjected to a temperature rise of more than 60°C (108°F), if acceptable braid is employed on the conductor of other than a flexible cord. This does not apply to thermoplastic-insulated wires or cords.

Table 33.1 Continued on Next Page

Table 33.1 Continued

Materials and components	°C	(°F)
[c] For an electrolytic capacitor which is physically integral with or attached to a motor, the temperature rise on insulating material integral with the capacitor enclosure may be not more than 90°C (162°F).		
[d] A capacitor that operates at a temperature rise of more than a 90°C (162°F) may be judged on the basis of its marked temperature limit.		
[e] See 33.11.		
[f] See footnote a to Table 18.1.		

33.2 All values for temperature rises in Table 33.1 are based on an assumed ambient temperature of 0°C (32°F).

33.3 For the temperature test, the voltage of a direct-current power-supply circuit is to be 115 or 230 V, and that of an alternating-current circuit is to be 120 or 240 V, depending on whether a snow mover has a nominal voltage rating of 115 or 230 V. For a snow mover having a voltage rating other than those just indicated, the voltage of the power-supply circuit is to equal the maximum rated voltage of the snow mover. If the snow mover has a single frequency rating, the test is to be made at that frequency. A snow mover rated a-c – d-c, d-c – 60 Hz, or d-c – 25 Hz – 60 Hz is to be tested on direct current or 60-Hz alternating current, whichever results in higher temperatures. A snow mover rated 25 – 60 Hz or 50 – 60 Hz is to be tested on 60-Hz alternating current.

33.4 To determine whether a snow mover complies with the requirements in 33.1, it is to be connected to a supply of rated voltage as described in 33.3 and operated continuously until constant temperatures have been reached.

33.5 Thermal equilibrium or constant temperature is considered to exist when three successive readings, taken at intervals of 10 percent of the previously elapsed duration of the test, but not less than 5-minute intervals, indicate no change.

33.6 If a snow mover is obviously not intended for continuous operation, the test may be conducted so that it will take into consideration the probable intermittent or short-time operation of the snow mover.

33.7 A hand-supported snow mover, (e.g. a snow shovel) is operated intermittently for 30 cycles, or until temperatures stabilize, whichever is achieved first, each cycle comprising a period of continuous operation of 30 seconds, the snow mover loaded as described in 31.1, and a rest period of 10 seconds with the snow mover switched off. The temperature rises are measured during the end of the last "ON" period. At the manufacturer's option, the snow mover may be operated continuously until thermal stabilization.

33.8 Temperatures are to be measured by thermocouples except when the resistance method may be used as indicated in 33.11. The thermocouples are to consist of wires not larger than 24 AWG (0.21 mm^2) and not smaller than 30 AWG (0.05 mm^2). The thermocouples and related instruments shall be accurate and calibrated in accordance with good laboratory practice. The thermocouple wire is to conform to the requirements specified in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples, ASTM E230/E230M.

33.9 A thermocouple junction and adjacent thermocouple lead wire are to be securely held in good thermal contact with the surface of the material the temperature of which is being measured. In most cases, acceptable thermal contact will result from securely taping or cementing the thermocouple in place; but if a metal surface is involved, brazing or soldering the thermocouple to the metal may be necessary.

33.10 Whenever referee temperature measurements are necessary, thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a potentiometer-type indicating instrument are to be employed.

33.11 Ordinarily, the temperature of a coil or winding is to be measured by means of thermocouples mounted on the outside of the coil wrap. If the coil is inaccessible for mounting thermocouples, for example, a coil immersed in sealing compound, or if the coil wrap includes thermal insulation or more than 1/32 inches (0.8 mm) of cotton, paper, rayon or similar insulation, the resistance method is to be used. For the thermocouple-measured temperature of a coil of an alternating-current motor, other than a universal motor, having a frame diameter of 7 inches (178 mm) or less, see items 12 and 14 in Table 33.1, the thermocouple is to be mounted on the integrally applied insulation of the conductor.

33.12 In using the resistance method, the windings are to be at room temperature at the start of the test. The temperature rise of a winding is to 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 resistance of the coil at the end of the test in ohms;

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

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;

t_1 is room temperature at the beginning of the test in °C; and

t_2 is room temperature at the end of the test in °C.

34 Resistance to Moisture Test

34.1 A snow mover employing insulating material likely to be adversely affected by moisture under conditions of intended use shall be conditioned for 24 hours in moist air having a relative humidity of 85 ±5 percent at a temperature of 32 ±2°C (90 ±4°F). After the conditioning:

a) A snow mover rated for a nominal 120-V supply shall comply with the requirements in 27.1 in a repeated leakage-current test, except that the test is to be discontinued when leakage current stabilizes.

b) A snow mover other than mentioned in (a) shall have an insulation resistance of not less than 50,000 Ω between live parts and interconnected dead metal parts.

c) A snow mover shall be subjected to a dielectric voltage-withstand test as described in 32.2, with the snow mover still in the humidity chamber or room, at the specified humidity and temperature.

34.2 If it is necessary to remove the snow mover from the environmental chamber for the tests required by 34.1 (a) or (b), it is to be tested within 1 minute after removal.

34.3 After exposure to water spray as described in 34.4 and 34.5, a snow mover:

a) Rated for a nominal 120-V supply shall comply with the requirement in 27.1 in a repeated leakage-current test, except that the test shall be discontinued when leakage current stabilizes.

b) Of a type other than mentioned in (a) shall have an insulation resistance not less than 50,000 Ω between live parts and interconnected dead metal parts.

c) Shall withstand without breakdown for 1 minute the application of a 60-Hz essentially sinusoidal potential between live parts and exposed dead metal parts with the snow mover at the temperature reached during the temperature test. The dielectric-test potential shall be:

1) In accordance with 32.2 for grounded snow movers.

2) 2500 V for double-insulated snow movers rated a nominal 120 V.

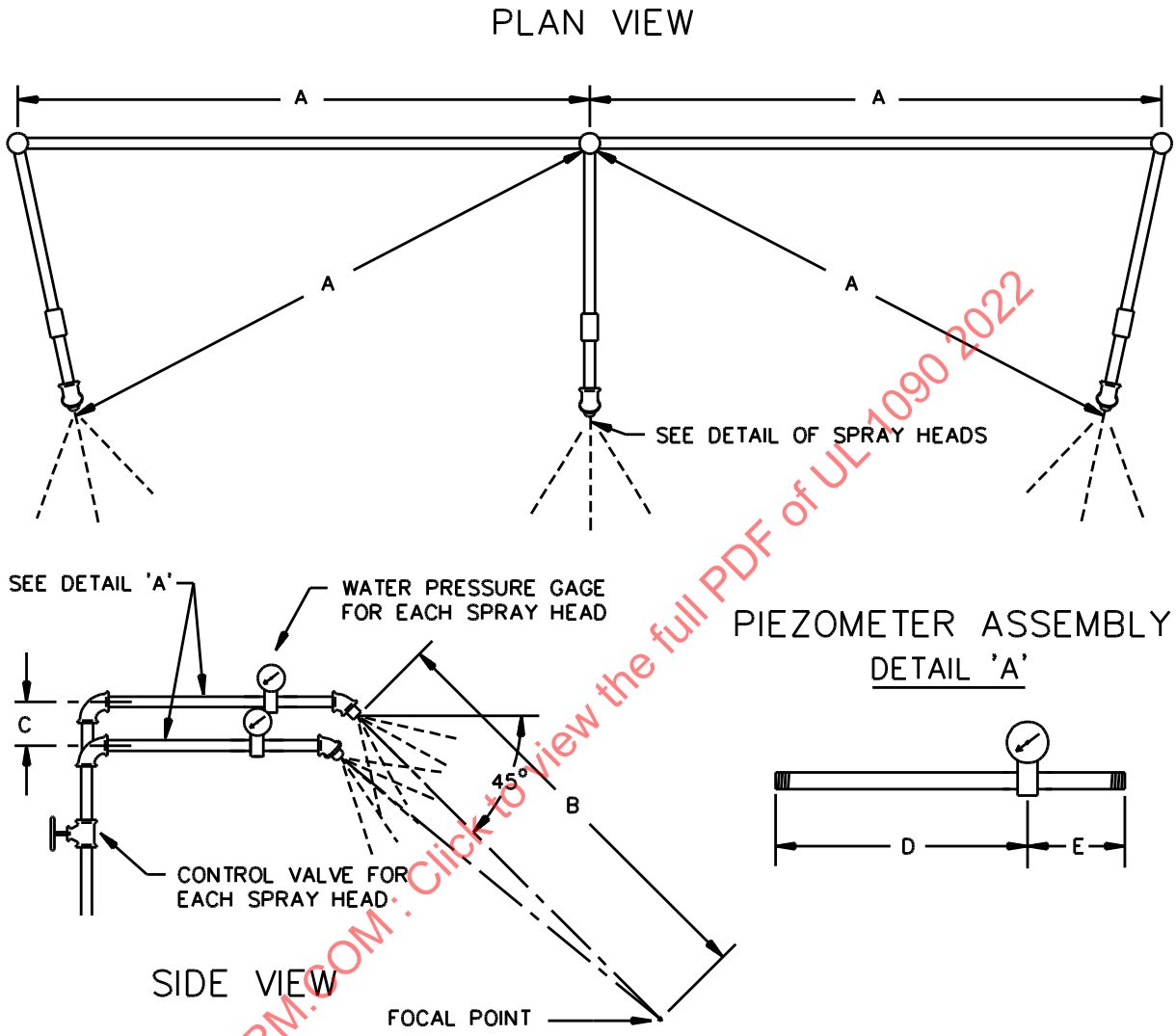
3) 3500 V plus twice the rated voltage of the snow mover for a double-insulated snow mover other than as mentioned in (2).

34.4 A snow mover, supported in the intended operating position, is to be subjected for 1 hour to a downward spray of water onto the top and sides, applied to the snow mover at an angle of 45 degrees to the vertical, and in the direction or directions most likely to cause water to enter. The snow mover is not to be operating while being subjected to the water spray, but immediately after the spray is stopped it is to be operated for 5 seconds and then tested as described in 34.3.

34.5 The water spray apparatus is to consist of three spray heads mounted in a water-supply pipe rack as illustrated in Figure 34.1. Spray heads are to be constructed in accordance with the details illustrated in Figure 34.2. The water pressure is to be maintained at 5 psi (36 kPa) at each spray head. The distance between the center nozzle and the snow mover is to be approximately 5 ft (1.5 m). The spray is to be directed at an angle of 45 degrees to the vertical toward louvers or other openings nearest to live parts.

Figure 34.1

Spray head pipe rack

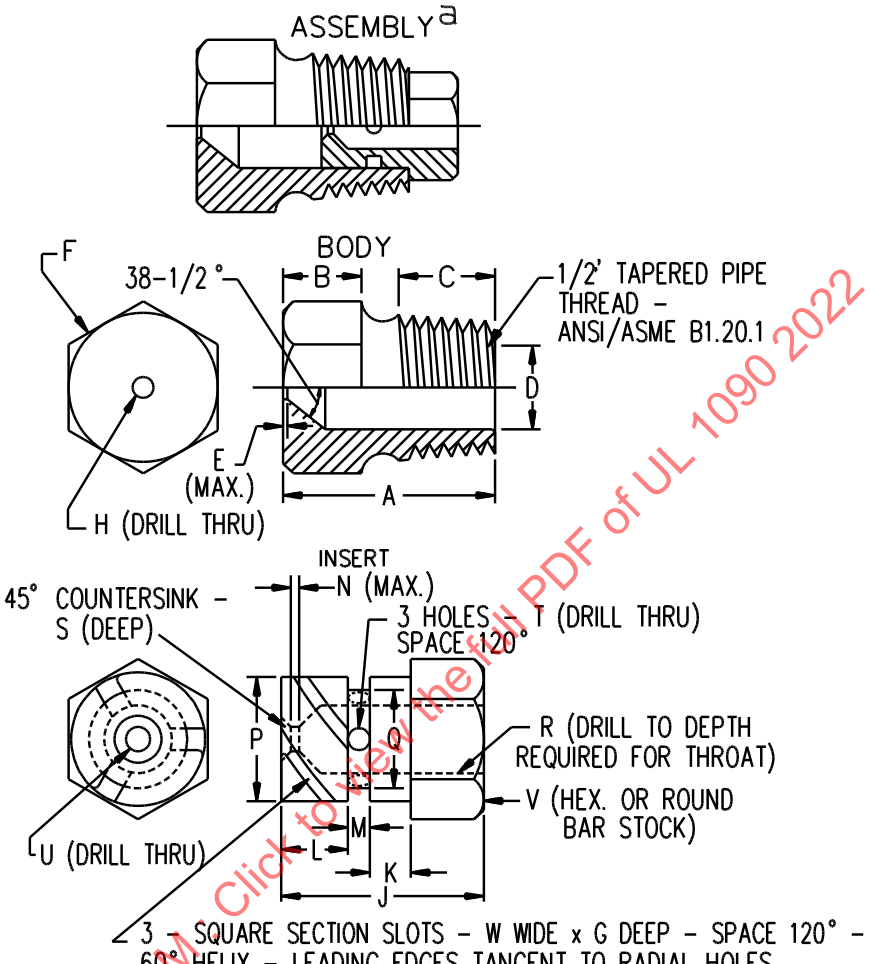


Item	inch	mm
A	28	710
B	55	1400
C	2–1/4	55
D	9	230
E	3	75

RT101E

Figure 34.2

Spray head assembly



Item	inch	mm	Item	inch	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

[b] ANSI B94.11M Drill Size

[c] Optional – To serve as a wrench grip.

RT100E

35 Abnormal Operation Test

35.1 If a snow mover employs a semiconductor or a semiconductor junction, a capacitor, or a combination of both, no risk of fire or electric shock shall result when either the semiconductor junction or the capacitor is short- or open-circuited.

35.2 To determine whether a snow mover complies with the requirements in 35.1, the snow mover is to be connected to a grounded supply of rated frequency and maximum rated voltage. The short- or open-circuited condition is to be introduced while operating at no load. Only one abnormal condition is to be simulated at a time.

35.3 If a snow mover is provided with a momentary-contact switch having no provision for being locked on and if there is indication of malfunction of the snow mover, such as emission of smoke, inability of the snow mover to operate in the normal manner, or other indication, the test is to be discontinued when the malfunction becomes evident. Otherwise, the test is to be continued until ultimate results occur. Exposed dead metal parts of the snow mover are to be connected to ground through a 3-A fuse. The results are unacceptable if the fuse opens during the test.

35.4 During the tests described in 35.2, the snow mover is to be connected in series with a nontime-delay fuse of the maximum current rating that can be accommodated by the fuseholder of the branch circuit to which the snow mover could be properly connected. Opening of the fuse before a risk of fire or electric shock results is an acceptable conclusion of a test.

36 Handle Tests

36.1 If the insulating material used for handles mentioned in 6.4.2 overlies dead metal:

a) The material shall not show holes, cracks, distortion, or other evidence of unacceptable deterioration after being conditioned as described in 36.2;

b) The material shall not break, crack, rupture, or show other adverse effects after the snow mover has been subjected to the impacts described in 36.3. The impact test is to be conducted on a sample that has been conditioned as described in 36.2; and

c) The material shall withstand without breakdown the application of a 60 Hz sinusoidal potential as described in 36.5.

36.2 The conditioning mentioned in 36.1 is to consist of placing the snow mover for 7 hours in an air-circulating oven at a temperature that is 10°C (18°F) more than the temperature attained by the handle under conditions of intended operation, but not less than 70°C (158°F), and for 7 hours in an air-circulating chamber at a minimum temperature of minus 20°C (minus 4°F) or lower as recommended by the manufacturer.

36.3 With reference to 36.1(b), a hand-supported snow mover is to be dropped twice on each handle through a distance of 3 ft (0.91 m) to strike a concrete surface. Each handle of a ground-supported snow mover is to be subjected to two impacts of 5 ft-lb (6.8 N·m). See 36.4. In the tests, two different samples may be used, one for each set of drops or impacts.

36.4 The impact specified in 36.3 is to be applied by dropping a steel sphere, 2 inches (50.8 mm) in diameter and weighing 1.18 lb (0.53 kg), through a vertical distance of 51 inches (1295 mm).

36.5 The dielectric voltage-withstand potential mentioned in 36.1(c) is to be 2000 V plus twice the rated voltage of the snow mover. The potential is to be applied between the accessible dead metal parts of the handles or surfaces most likely to be grasped by the user during intended operation of the snow mover,

including metal foil wrapped tightly around insulating material and inaccessible dead metal parts of the handle.

37 Strain Relief Test

37.1 When tested in accordance with 37.2, the strain-relief means provided on the power-supply cord shall withstand for 1 minute, without displacement, a pull of 35 lb (156 N) applied to the cord, with the connections within the snow mover disconnected.

37.2 A 35-lb (15.9-kg) weight is to be suspended on the power-supply cord and supported by the snow mover so that the strain-relief means will be stressed from any angle that the construction of the snow mover permits. 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.

37.3 A power-supply cord shall withstand for 1 minute 50 oz-in (0.35 N·m) of torque applied 1 inch (25.4 mm) from the strain relief without damage to the cord and without transmitting the torque to the terminations.

38 Push-Back Relief Test

38.1 To determine compliance with 10.4.3, a product shall be tested in accordance with 38.2 without occurrence of any of the conditions specified in 10.4.3 (a) – (d).

38.2 The supply cord or lead is to be held 1 inch (25.4 mm) from the point where the cord or lead emerges from the product and is then to be pushed back into the product. When a removable bushing which extends further than 1 inch is present, it is to be removed prior to the test. When the bushing is an integral part of the cord, then the test is to be carried out by holding the bushing. The cord or lead is to be pushed back into the product in 1-inch (25.4-mm) increments until the cord buckles or the force to push the cord into the product exceeds 6 lb-ft (26.7 N). The supply cord or lead within the product is to be manipulated to determine compliance with 10.4.3.

39 Switches and Controls

39.1 A switch or other device that controls the motor of a snow mover shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the snow mover. There shall be no electrical or mechanical breakdown of the device or undue pitting or burning of the contacts.

Exception: This requirement does not apply to:

a) A speed changing switch;

b) A reversing switch;

c) A switch that controls an induction motor and has an acceptable horsepower rating; or

d) A switch that is interlocked so that it will never have to break the locked-rotor current.

39.2 For the tests described in 39.3 – 39.7, the snow mover is to be connected to a grounded power-supply circuit of rated frequency and maximum rated voltage – see 33.3. During the tests, exposed dead metal parts of the snow mover are to be connected to ground through a 3-A plug fuse, so that any single-pole, current-interrupting device will be connected to the ungrounded conductor of the supply circuit. If the snow mover is intended for use on direct current, or on direct current as well as on alternating current, exposed dead metal parts of the snow mover are to be connected so as to be positive with respect to any

single-pole, current-interrupting control device. The results are not acceptable if the fuse in the grounding connection opens during any of the tests.

39.3 For the overload test described in 39.1, the rotor of the motor is to be locked and the device is to be operated at a rate of not more than 10 cycles per minute. The device is to be left in the on position as briefly as possible.

Exception: A faster rate of operation may be employed if agreeable to those concerned.

39.4 A switch or other device used for reversing the motor of a snow mover, unless acceptable for the application, shall perform acceptably when subjected to a test consisting of 25 cycles of operation as described in 39.5. There shall be no:

a) Electrical or mechanical breakdown of the device;

b) Undue pitting or burning of the contacts; and

c) Emission of molten metal or flame from the enclosure of the snow mover.

39.5 For the test mentioned in 39.4, each cycle of operation is to consist of:

a) Throwing the switch to the position in which the motor of the snow mover rotates in one direction, allowing the snow mover to attain full operating speed in that direction, then;

b) Without pause in any intermediate "off" position unless the switch will not function otherwise, throwing the switch to the position in which rotation is reversed, allowing the snow mover to attain normal speed in that direction; and then

c) Reversing the rotation again by throwing the switch to the initial "on" position.

39.6 A switch or other device for changing the speed of the motor of a snow mover, other than an on-off switch, unless acceptable for the application, shall perform acceptably when subjected to a test consisting of 50 cycles of operation as described in 39.7. There shall be no:

a) Electrical or mechanical breakdown of the device;

b) Undue pitting or burning of the contacts; and

c) Emission of molten metal or flame from the enclosure of the snow mover.

39.7 For the test mentioned in 39.6, each cycle of operation is to consist of operating the snow mover at one speed, throwing the switch to cause operation at the other speed, and then changing the setting back to the position that results in the first value of speed again.

39.8 Switch contacts in an isolated secondary circuit that is limited to 100 VA or less:

a) Need not have been investigated and found acceptable for the particular application; and

b) Need not be subjected to the tests in 39.1 – 39.7.

40 Attachment Plug Test

40.1 When tested as described in 40.2, the blades of the snow mover attachment plug shall not be conductively connected to the extension-cord connector when contacted by the test probe.

40.2 To determine whether an attachment plug complies with the requirement in 40.1, the plug is to be inserted in the extension-cord connector of the test assembly illustrated in Figure 40.1 or Figure 40.2 as applicable for grounded snow mover constructions. The test assembly illustrated in Figure 40.1 is to be used for double-insulated constructions that will accommodate a 3-wire grounded receptacle. The test assembly illustrated in Figure 40.2 is to be used for double-insulated constructions that will not accept a 3-wire grounded receptacle. The plug is to be inserted as far as possible into the extension-cord connector and then withdrawn not more than a distance that will permit the test probe to be inserted between the plug body and the extension-cord connector. The test probe is to be inserted with a force of 4.1 lb (17.5 N) or less. When the probe contacts a blade, the electrical continuity is to be determined using an instrument, such as an ohmmeter, between the contacts of the extension-cord connector and the test probe. The test is to be repeated for the other blade of the attachment plug.

Figure 40.1

Plug blade shielding gage

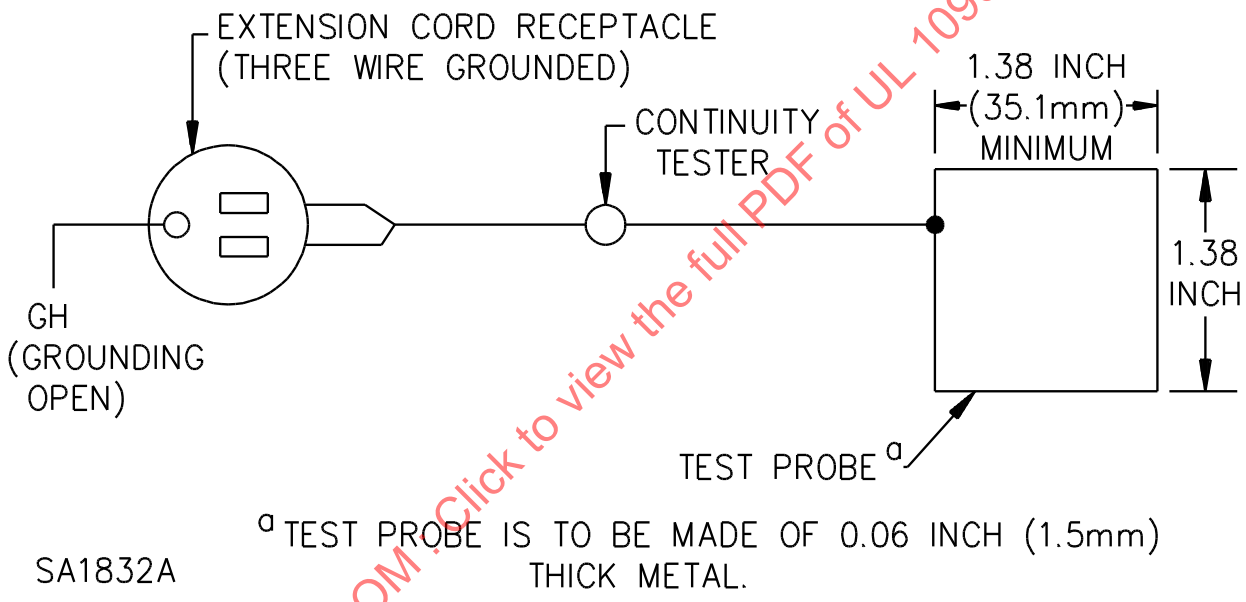
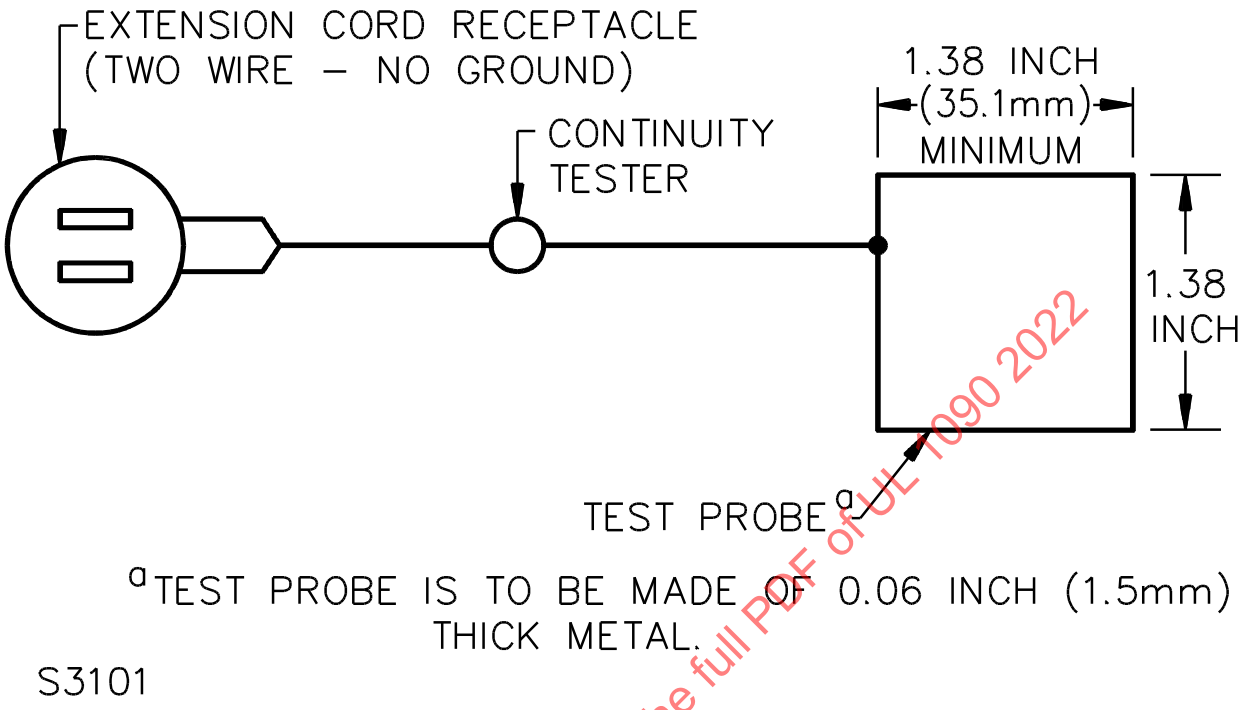


Figure 40.2

Plug blade shielding gage



40.3 The test probe, mentioned in 40.2, is to be made of 0.06-inch (1.5-mm) thick metal that is 1.38 inches (35 mm) wide and not less than 1.38 inches (35 mm) long.

41 Accelerated Aging Test

41.1 A rubber or neoprene compound forming a part that is depended upon for protection from rain shall have physical properties acceptable for the application before and after aging.

41.2 The test procedure for determining whether a part complies with the requirement in 41.1 depends upon the material of which it is composed, its size and shape, the mode of application in the snow mover, and other factors. The test procedure may include visual inspection for cracks, deformation, and the like, after artificial aging, as well as comparison of hardness, tensile strength, and elongation before and after artificial aging.

41.3 With reference to 41.1 and 41.2, a part of rubber or neoprene, tested to compare its tensile strength and elongation before and after artificial aging, is acceptable if these properties are found to be not less than the applicable minimum values specified in Table 41.1, when tested in the environment indicated as being applicable for a part that acquires the specified temperature increment during the temperature test.

Table 41.1
Artificial aging tests

Temperature of component during temperature test		Artificial-aging procedure[a]	Minimum acceptable percent of original (unaged) value	
°C	(°F)		Tensile strength	Elongation
60° or less	(140 or less)	Air oven aging for 70 h at 100 ±2°C (212 ±3.6°F)	60	60
61 – 75	(142 – 167)	Air oven aging for 168 h at 100 ±2°C (212 ±3.6°F)	50	50
76 – 90	(169 – 194)	Air oven aging for 168 h at 121.0 ±1.0°C (249.8 ±1.8°F)	50	50
91 – 105	(196 – 221)	Air oven aging for 168 h at 136.0 ±1.0°C (276.8 ±1.8°F)	50	50

[a] All samples regardless of temperature are to be subjected to this aging procedure.

42 Permanency of Marking

42.1 A required marking shall be molded, die-stamped, paint-stenciled, stamped or etched on metal, or indelibly stamped on pressure-sensitive labels secured by adhesive. Pressure-sensitive labels secured by adhesive shall comply with the Standard for Marking and Labeling Systems, UL 969. See 42.2. Ordinary usage, handling, storage, and the like of the snow mover will be considered in determining the permanence of a marking.

Exception: Pressure-sensitive labels need not be investigated with respect to exposure to ultraviolet light.

42.2 The outdoor low temperature test specified in the Standard for Marking and Labeling Systems, UL 969, is to be conducted at a temperature of minus 29°C (minus 20.2°F).

42A Electrostatic Discharge (ESD) Resistance Test

42A.1 *Deleted*

42A.2 *Deleted*

42A.3 *Deleted*

Figure 42A.1

Static electricity resistance test booth

Figure deleted

POLYMERIC ENCLOSURES

43 General

43.1 A polymeric enclosure that complies with the rate-of-burning requirement in 45.4.1 need not be subjected to the tests in 44.1.1 – 45.3.5 or 45.5.1 – 45.7.5 if:

a) All live parts within the enclosure are insulated or provided with acceptable internal enclosures independent of the outer polymeric enclosure;

b) All leads connecting components inside the enclosure are mechanically secured so that displacement of any component resulting from degradation of the polymeric material will not cause a stress on the junction between a lead and a terminal of the component; and

c) The power-supply-cord strain relief does not depend upon the enclosure.

43.2 With reference to 43.1(b), a component having integral leads is to be subjected to a strain-relief test unless such a test is a part of its regular test procedure.

43.3 A polymeric enclosure of material that complies with the rate-of-burning requirement in 45.4.1 need not be subjected to the test required by 44.4.1 if all live parts within the enclosure are acceptably insulated or provided with acceptable internal enclosures independent of the outer polymeric enclosure.

44 Polymeric Materials Classed Other Than HB

44.1 Mold stress evaluation

44.1.1 When tested as described in 44.1.2, the enclosure material shall comply with all the following conditions:

a) The material shall not soften as determined by handling immediately after the oven-conditioning period;

b) The material shall not crack;

c) No uninsulated live parts shall be exposed to the extent that the product would not comply with requirements of this standard that guard against unintentional contact with uninsulated live parts;

d) Spacings shall not be reduced below the minimum acceptable value; and

e) Warping, crazing, or distortion is acceptable if the snow mover complies with the strain relief requirements in Strain Relief Test, Section 37.

44.1.2 Three samples of the complete snow mover are to be placed for 7 hours in an oven maintained at a uniform temperature not less than 10°C (18°F) higher than the maximum operating temperature of the material measured under intended operating conditions, but not less than 70°C (158°F). Immediately following removal from the oven, the samples are to be examined with reference to the requirements of 44.1.1(a). After cooling to room temperature the samples are to be examined with reference to (b) – (d) and tested with reference to 44.1.1(e).

44.1.3 The oven conditioning described in 44.1.2 may cause the enclosure to distort to the extent that it is in a throw-away condition. This is acceptable provided the performance is evaluated several times during the oven conditioning to determine that intermediate stages of distortion do not result in performance that is unacceptable with respect to the risk of fire, electric shock, and injury to persons.