UL 1447

STANDARD FOR SAFETY

Electric Lawn Mowers

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UL Standard for Safety for Electric Lawn Mowers, UL 1447

Sixth Edition, Dated October 13, 2017

Summary of Topics

The reaffirmation of ANSI/UL 1447 dated April 9, 2025 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.

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

The requirements are substantially in accordance with Proposal(s) on this subject dated February 21, 2025.

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UL 1447

Standard for Electric Lawn Mowers

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Third Edition – June, 1994
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Fifth Edition – August, 2011

Sixth Edition

October 13, 2017

This ANSI/UL Standard for Safety consists of the Sixth Edition including revisions through April 9, 2025.

The most recent designation of ANSI/UL 1447 as a Reaffirmed American National Standard (ANS) occurred on April 9, 2025. 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 ULSE at any time. Proposals should be submitted via a Proposal Request in the Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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PART 1 – ALL LAWN MOWERS

INTRODUCTION

1 Scope

1.1 These requirements cover cord-connected electrically operated lawn mowers rated 250 volts or less to be employed in accordance with ANSI/NFPA 70.

1.2 These requirements also cover battery-powered lawn mowers as specified in Battery-Powered Lawn Mowers, Supplement SA in this Standard.

1.3 These requirements do not cover equipment for use in hazardous locations as defined in the , ANSI/NFPA 70.

1.4 These requirements do not cover sulky-type lawn mowers, garden tractors or their attachments, flail mowers, sickle-bar mowers, robotic lawn mowers, or lawn mowers intended for commercial use.

1.5 In addition to the requirements in this standard, a lawn mower shall comply with ANSI B71.1, and with the Safety Standard for Walk-Behind Power Lawn Mowers, 16 CFR 1205.

1.6 In the text, a requirement that applies only to a rotary or other type of lawn mower is identified by a specific reference in that requirement to the specific lawn mower involved. Absence of the specific reference, or use of the term lawn mower, indicates that the requirement applies to all of the lawn mowers covered in this standard.

2 Units of Measurement

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

3 References

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

ANSI Standards

ANSI/NFPA 70
National Electrical Code

ANSI B71.1
Safety Specification for Consumer Turf-Care Equipment – Walk-Behind Mowers and Ride-On Machines with Mowers

ANSI B71.1
Safety Specification for Consumer Turf-Care Equipment – Walk-Behind Mowers and Ride-On Machines with Mowers

ANSI Z21.21a/CSA 6.5a
Automatic Valves for Gas Appliances

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ASTM E230/E230M
Tolerances on Initial Values of EMF versus Temperature tables in the Standard Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

IEC Standards

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Electromagnetic Compatibility (Emc) – Part 4-5: Testing And Measurement Techniques – Surge Immunity Test

IEC 61672-1
Electroacoustics – Sound Level Meters – Part 1: Specifications

IEC 61672-2
Electroacoustics – Sound Level Meters – Part 2: Pattern Evaluation Tests

NFPA Standards

ANSI/NFPA 70
National Electrical Code

UL Standards

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General-Use Snap Switches

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UL 486C
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UL 489
Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 498
Attachment Plugs and Receptacles

489A
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Electric Fans

UL 508
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UL 510
Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

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Metallic Outlet Boxes

UL 514C
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Appliance Wiring Material

UL 773A
Nonindustrial Photoelectric Switches for Lighting Control

UL 796
Printed-Wiring Boards

UL 810
Capacitors

UL 817
Cord Sets and Power-Supply Cords

UL 873
Temperature-Indicating and – Regulating Equipment

UL 917
Clock-Operated Switches

UL 935
Fluorescent-Lamp Ballasts

UL 943
Ground-Fault Circuit-Interrupters

UL 943B
Appliance Leakage-Current Interrupters

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Marking and Labeling Systems

UL 991
Tests for Safety-Related Controls Employing Solid-State Devices

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Rotating Electrical Machines – General Requirements

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UL 60730-2-6
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UL 60730-2-7
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IEC 61000-4-5
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4 Glossary

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

4.2 ACCESSIBLE PART – A part located so that it can be contacted by a person, either directly or by means of a probe or tool, or so that it is not recessed the required distance behind an opening. See Section 7, Accessibility of Live Parts.

4.3 APPLIANCE – 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).

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

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

4.6 BASIC INSULATION – The insulation applied to live parts to provide basic protection against electric shock.

4.7 BLADE – Any rigid or semi-rigid device or means that is intended to cut grass during mowing operations and includes all blades of a multi-blade mower.

4.8 BLADE-TIP CIRCLE – The path described by the outermost point of the blade as it moves about its axis.

4.9 CATCHER ASSEMBLY – A part or combination of parts on a lawn mower that provides a means of collecting grass clippings and debris.

4.10 COMPONENT – A device or fabricated part of the appliance covered by the scope of a 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.

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

4.12 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 electric shock, fire, or injury to persons during normal or abnormal operation of the end product is considered an auxiliary control.

4.13 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.

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

4.15 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 electric shock, fire, or injury to persons, is considered an operating control. Operating controls are also referred to as "regulating controls".

4.16 CONTROL, PROTECTIVE – A device or assembly of devices, the operation of which is intended to reduce the risk of electric shock, fire or injury to persons during normal and reasonably anticipated abnormal operation of the appliance. For example, 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". During the evaluation of the protective control/circuit, the protective functions are verified under normal and single-fault conditions of the control.

4.17 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 have not been declared and tested under this Standard.

4.18 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.

4.19 CUTTING HEIGHT – The vertical distance between the blade-tip circle and the supporting surface of a lawn mower.

4.20 CUTTING WIDTH – For a single-blade mower, the diameter of the blade-tip circle. For a multi-blade mower, the width of a composite of all blade-tip circles measured perpendicular to the forward direction of the mower.

4.21 DEAD-MAN CONTROL – An operator control designed so that it will automatically interrupt power when the actuating force supplied by the operator is removed.

4.22 DEFORM – Any visible alteration of shape or dimension of a body caused by stresses induced by external forces.

4.23 DOUBLE INSULATION – An insulation system comprised of both basic insulation and supplementary insulation, with the two insulation systems physically separated and arranged so that they are not simultaneously subjected to the same deteriorating influences – temperature, contaminants, and the like – to the same degree. See Figure 4.1.

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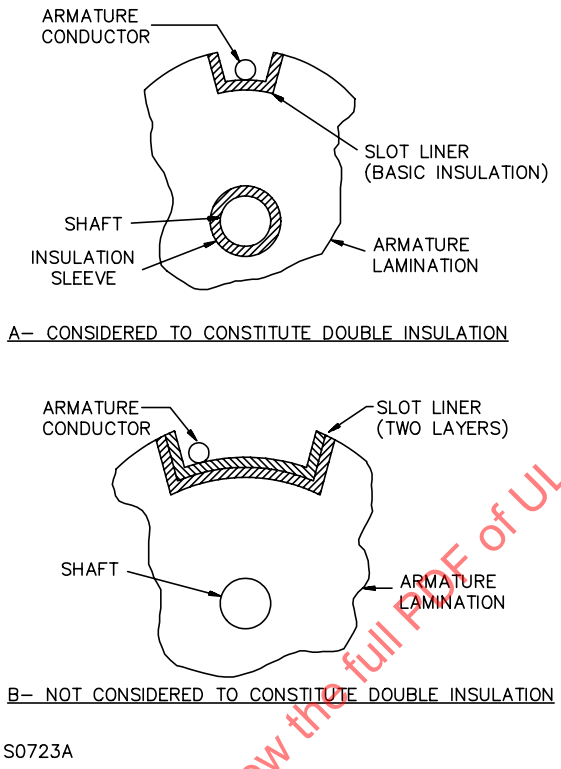
Figure 4.1

Examples illustrating 4.23



4.24 ENCLOSURE – That portion of the lawn mower that:

a) Renders inaccessible all or any part that may otherwise present a risk of electric shock or injury to persons; or

b) Reduces the propagation of flame that may be initiated by electrical disturbances occurring within.

4.25 GUARD – A part or an assembly provided for shielding an area that would otherwise introduce a risk of electric shock or injury to persons.

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

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

4.28 MAXIMUM OPERATING SPEED – The maximum revolutions per minute (rpm) obtainable by the motor under the conditions of the particular test where the term is used. For a cord-connected mower, it is the speed attained when the mower is energized from a 120V, (or 240V if applicable), 60Hz supply source with any blade speed controls set at maximum. For a battery-powered mower it is the speed attained after the battery has been fully charged in accordance with the mower manufacturer's instructions.

4.29 MINOR DIMENSION OF AN OPENING – The diameter of the largest cylindrical probe having a hemispherical tip that can be inserted through the opening with a force of 5 pounds (22.2 N).

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4.30 MOTOR – A power-producing machine that converts electrical energy into mechanical energy.

4.31 NORMAL STARTING MEANS – The primary mechanism intended to be actuated by the operator to start a mower's motor.

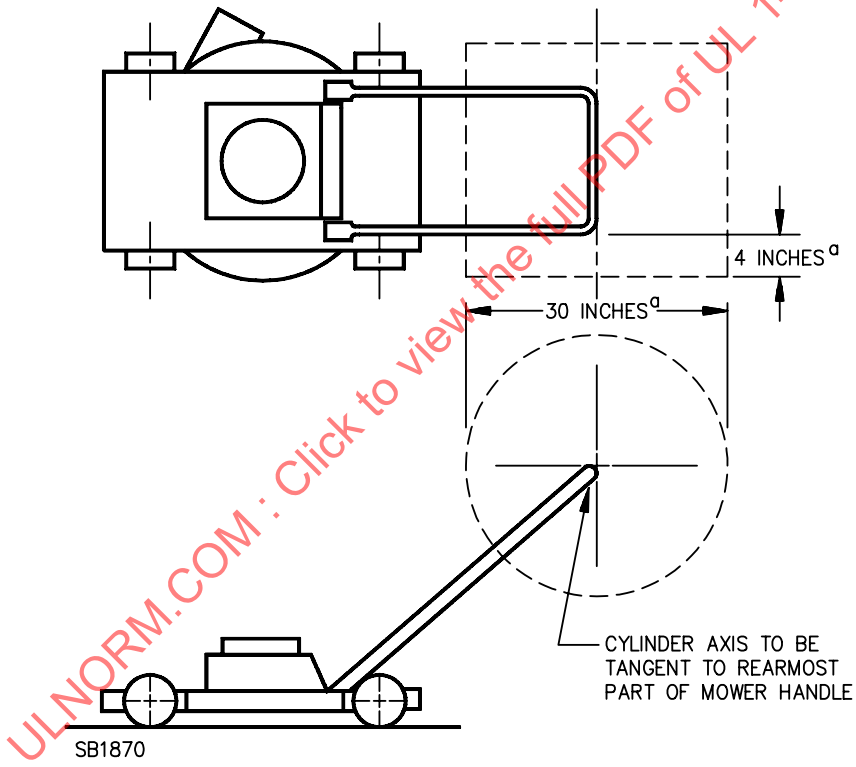
4.32 OPERATING CONTROL ZONE – The space enclosed by a cylinder with a radius of 15 inches (380 mm) having a horizontal axis that is:

a) Perpendicular to the fore-aft centerline of the mower; and

b) Tangent to the rearmost part of the mower handle, extending 4 inches (102 mm) beyond the outermost portion of each side of the handle. See Figure 4.2.

Figure 4.2

Operating control zone



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4.33 OPERATOR CONTROL – Any device necessary for operating a lawn mower including a drive-engaging control, a movable-guide control, a drive-speed changing control, and a deflector control.

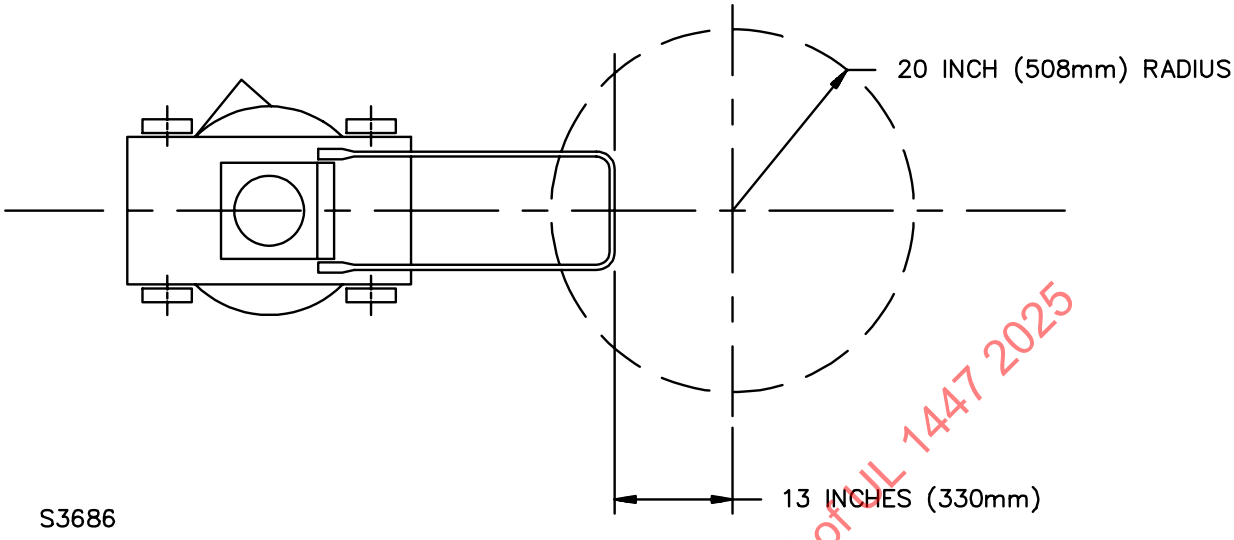
4.34 OPERATOR ZONE – The space enclosed by a cylinder, from ground to 6 feet (1.63 m) above ground, with a radius of 20 inches (508 mm), having a vertical axis that is:

a) Located 13 inches (330 mm) behind the handle assembly when adjusted to the most unfavorable position; and

b) Centered on the fore-aft centerline of the cutting width. See Figure 4.3.

Figure 4.3

Operator zone



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4.35 REEL-TYPE MOWER – A lawn mower that cuts grass by rotating one or more helically formed blades about a horizontal axis to provide a shearing action with a stationary cutter bar or bed knife.

4.36 REINFORCED INSULATION – An improved basic insulation with such mechanical and electrical qualities that it, in itself, provides the same degree of protection against electric shock as double insulation. It may consist of one or more layers of insulating material. It is acceptable in place of double insulation only in accordance with the Exception to 70.1.

4.37 ROBOTIC LAWN MOWER – An unattended lawn mower that operates automatically.

4.38 ROTARY MOWER – A lawn mower in which one or more cutting blades rotate in essentially a horizontal plane about at least one vertical axis.

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

4.40 SWING-OVER HANDLE – A handle that pivots from one end of a lawn mower to the other about a horizontal axis to allow reversing the direction of travel of the lawn mower without turning the lawn mower around.

4.41 WALK-BEHIND LAWN MOWER – A grass-cutting machine that:

a) Is either pushed or self-propelled;

b) Has a minimum cutting width of 12 inches (305 mm);

c) Employs a motor as the power source; and

d) Is controlled by an operator walking behind the mower.

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 – 5.23;

b) Be used in accordance with it's rating 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 – 5.23, is acceptable if:

a) The component also complies with the applicable component standard specified in 5.2 – 5.23; or

b) The component standard:

1) Is compatible with the ampacity and overcurrent protection requirements in ANSI/NFPA 70, where appropriate;

2) Considers long-term thermal properties of polymeric insulating materials in accordance with UL 746B; and

3) Any use limitations of the other component UL standard is 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 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 that cover devices that provide those functions.

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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 need not be applied.

5.1.3 A component not anticipated by the requirements of this Standard, not specifically covered by the component standards in 5.2 – 5.23, and that involves a risk of electric shock, fire, or personal injury, shall be additionally investigated in accordance with the applicable UL standard, and shall comply with Components – General, Section 5.1 (b) – (d).

5.1.4 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 1447.

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 UL 498. See 5.2.8.

Exception No. 1: Attachment plugs and appliance couplers integral to cord sets or power supply cords are investigated in accordance with UL 817, and need not comply with UL 498.

Exception No. 2: A fabricated pin terminal assembly need not comply with UL 498, if it complies with Section 13, Live Parts; Section 15, Electrical Insulation; and Section 22, Spacings, of this 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 0.110, 0.125, 0.187, 0.205, and 0.250 inch (2.8, 3.2, 4.8, 5.2, and 6.3 mm), intended for internal wiring connections in appliances, or for the field termination of conductors to the appliance, shall comply with 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 multi-pole 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 UL 1977. See 5.2.8.

5.2.4 Wire connectors shall comply with UL 486A-486B.

5.2.5 Splicing wire connectors shall comply with 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 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 UL 486E.

5.2.8 Terminal blocks shall comply with 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 Flexible Cord, Section 12.3; Section 13, Live Parts; Section 15, Electrical Insulation; and Section 22, Spacings, of this end product Standard. This exception does not apply to protective conductor terminal blocks.

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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.

5.3 Batteries

5.3.1 Rechargeable lithium ion (Li-ion) cells shall comply with the requirements for secondary lithium cells specified in UL 1642.

5.4 Boxes and raceways

5.4.1 Electrical boxes and the associated bushings and fittings, and raceways, of the types specified in Wiring Methods and Materials of ANSI/NFPA 70 and that comply with the relevant UL standard (such as UL 514A, UL 514C, and UL 514D) and Components – General, Section 5.1, are considered to comply with the requirements of this Standard.

5.5 Capacitors and filters

5.5.1 The component requirements for a capacitor are not specified. A capacitor complying with UL 810 is considered to fulfill the requirements of 20.1.

5.5.2 Electromagnetic interference filters with integral enclosures that comply with UL 1283 are considered to fulfill the requirements of 20.1.

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 Section 18, Controls – End Product Test Parameters.

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 Section 18, Controls – End Product Test Parameters, 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 hazard, such as a speed control unexpectedly changing its output, shall comply with UL 991, UL 1998; and/or 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 Section 18, Controls – End Product Test Parameters, 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 UL 991, and/or UL 60730-1, except the Controls Using Software.

5.6.1.6 Protective controls that rely upon software as a protective component shall comply with UL 991, UL 1998 and/or 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

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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 UL 244A, UL 873 or UL 60730-1.

5.6.3 Liquid level controls

5.6.3.1 A liquid level control shall comply with UL 244A, UL 873, UL 508, UL 60730-1, and 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 UL 244A, UL 873, UL 508, UL 61800-5-1, or UL 60730-1.

5.6.5 Pressure controls

5.6.5.1 A pressure control shall comply with UL 873, UL 508 or UL 60730-2-6.

5.6.6 Temperature controls

5.6.6.1 A temperature control shall comply with UL 244A, UL 873, or UL 60730-1 and 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 UL 1434.

5.6.6.3 A thermal cutoff shall comply with UL 60691.

5.6.7 Timer controls

5.6.7.1 A timer control shall comply with UL 244A or UL 60730-1, and UL 60730-2-7.

5.7 Cords, cables, and internal wiring

5.7.1 A cord set or power supply cord shall comply with UL 817.

5.7.2 Flexible cords and cables shall comply with UL 62. Flexible cord and cables are considered to fulfill this requirement when preassembled in a cord set or power supply cord complying with UL 817.

5.7.3 Internal wiring composed of insulated conductors shall comply with UL 758.

Exception No. 1: Insulated conductors need not comply with UL 758, if they comply with UL 44, UL 83, UL 66 or the applicable UL standard for other insulated conductor types specified in Wiring Methods and Materials of 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 or personal injury need not comply with UL 758.

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5.8 Cord reels

5.8.1 A cord reel shall comply with special use cord reel requirements of 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 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, or other hazards shall comply with 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 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 UL 943B. An ALCI is not considered an acceptable substitute for a GFCI when NFPA 70 requires a GFCI.

5.11.3 Equipment ground-fault protective devices shall comply with UL 1053, and the applicable requirements of UL 943.

5.11.4 Arc-fault circuit-interrupters (AFCI) shall comply with UL 1699.

5.11.5 Leakage-current detector-interrupters (LCDI) and any shielded cord between the LCDI and appliance shall comply with 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 UL 1446.

5.12.2 All insulation systems employing integral ground insulation shall comply with the requirements specified in UL 1446.

5.13 Light sources and associated components

5.13.1 Lampholders and indicating lamps shall comply with UL 496.

5.13.2 Lighting ballasts shall comply with UL 935 and UL 1029.

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

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Exception No. 2: Ballasts for other light sources shall comply with the appropriate UL standard.

5.13.3 Light emitting diode (LED) light sources shall comply with UL 8750.

Exception No. 1: LED light sources forming part of a luminaire that complies with an appropriate UL luminaire standard are considered to fulfill 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 UL 969, under the specified environmental conditions.

Exception: A marking or labeling system that complies with Section 44, Permanency of Marking Tests, of this Standard is considered to fulfill the requirement.

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 General-Purpose Type Motors, Section 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 and personal injury in accordance with the applicable requirements of this end product Standard.

5.15.1.5 Low voltage component fans that comply with UL 507, are considered to comply with the requirements of Section 4.16, Motors, of this Standard.

5.15.2 General-purpose type motors

5.15.2.1 A general-purpose type motor shall comply with 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 UL 1004-1 except as noted in Table 5.1.

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Table 5.1
Superseded requirements

UL 1004-1 Exempted Requirement	Superseded by UL 1447 Requirements
Section 6, Current and Horsepower Relation	31.3
Section 15, Cord-Connected Motors	Section 12, Supply Connections
Section 17, Factory Wiring Terminals and Leads	Section 14, Internal Wiring
Section 22, Electrical Insulation	Section 15, Electrical Insulation
Section 28, Non-Metallic Functional Parts	Section 6, Frame and Enclosure Section 15, Electrical Insulation Section 4.16, Motors
7.2, Solid-State Controls	Controls, Section 5.6
9.1.4, Non-metallic enclosure thermal aging	Polymeric Enclosures, Section 6.3
9.2 – 9.4, Motor enclosure	Section 4.16, Motors
Sections 10 and 11, Grounding	Section 23, Grounding
Section 12, Ventilation Openings: only applicable where the openings are on surfaces considered to be the appliance enclosure.	Section 4.16, Motors Section 7, Accessibility of Live Parts
Section 13, Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts	Section 4.16, Motors Section 7, Accessibility of Live Parts
Section 14, Protection Against Corrosion	Protection Against Corrosion, Section 6.5
Available fault current ratings for motor start and running capacitors, 26.6: not applicable for cord and plug connected appliances.	Section 20, Capacitors
Section 27, Switch, is not applicable to centrifugal starting switches	Section 17, Switches and Controls
With the exception of Sections 35 and 40 (Resilient Elastomer Mounting and Electrolytic Capacitor Tests, respectively), the performance tests in 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, Markings – General

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5.15.3.3 The motor shall comply with the applicable component requirements in Components – General, Section 5.1, 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, 6.5;

b) Internal Wiring, Section 14;

c) Electrical Insulating, Section 15;

d) Motors, Section 4.16;

e) Capacitors, Section 20;

f) Spacings, Section 22; and

g) Grounding, Section 23.

5.15.4 Motor overload protection

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

a) UL 2111;

b) UL 1004-3; or

c) UL 60730-1; and UL 60730-2-2; in conjunction with UL 1004-3, (to evaluate the motor-protector combination).

5.15.4.2 Impedance protection shall comply with UL 2111 or UL 1004-2

5.15.4.3 Electronic protection integral to the motor shall comply with UL 1004-7.

5.15.4.4 Except as indicated in 5.15.4.3, electronically protected motor circuits shall comply with one of the following (see Motor and Speed Controls, Section 5.6.4, for basic control requirements):

a) UL 991. When the protective electronic circuit is relying upon software as a protective component, it shall comply with the requirements in UL 1998. If software is relied upon to perform a safety function, it shall be considered software Class 1;

b) UL 60730-1; If software is relied upon to perform a safety function, it shall be considered software Class B; or

c) 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 casualty hazard during abnormal testing with the motor electronic circuit rendered ineffective; compliance with the applicable requirements of this end product Standard is then required.

5.16 Overcurrent protection

5.16.1 Fuses shall comply with UL 248-1; and the applicable UL 248 Part (e.g. UL 248-5). Defined use fuses that comply with UL 248-1 and another applicable UL standard for fuses are considered to fulfill this requirement.

5.16.2 Fuseholders shall comply with UL 4248-1, and the applicable Part (e.g. UL 4248-9).

5.16.3 Circuit breakers shall comply with UL 489.

Exception: Circuit breakers used in telecommunications circuitry that comply with UL 489A, need not comply with UL 489.

5.16.4 Circuit breakers having integral ground fault circuit interrupter capability for protection against electrical shock shall additionally comply with UL 943.

5.16.5 Supplementary protectors shall comply with UL 1077.

5.16.6 Fusing resistors shall comply with UL 1412.

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5.17 Polymeric materials and enclosures

5.17.1 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 risk of injury shall comply with UL 746A, UL 746B, and UL 746C unless superseded by the requirements in this Standard.

5.17.2 Polymeric materials molded or fabricated by a source other than the manufacturer, shall be identified according to UL 746D.

5.17.3 Metallized or painted polymeric parts or enclosures shall comply with the applicable requirements of UL 746C. This requirement is not applicable to exterior surfaces of polymeric enclosure materials or parts provided that the metallized coating or paint does not offer a continuous path for an internal flame to propagate externally.

5.18 Printed-wiring boards

5.18.1 Printed-wiring boards, including the coatings, shall comply with UL 796.

Exception: A printed-wiring board in a Class 2 non-safety 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.

5.18.2 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.

5.18.3 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.

5.19 Semiconductors and small electrical and electronic components

5.19.1 A power switching semiconductor device that is relied upon to provide isolation to ground shall comply with UL 1557.

5.19.2 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 UL 1577.

5.19.3 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.

5.19.4 Where an electronic component is determined to be a critical component during the Section 34, Abnormal Operation Test, in this Standard, the circuit shall comply with one or both of the following standards (see Protective Controls (Limitation Controls), Section 18.4, for the test parameters to be used):

a) UL 991, including its Follow-Up Program; and as applicable, the UL 1998 for controls that rely upon software as a protective component; and/or

b) UL 60730-1.

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5.19.5 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.

5.19.6 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 of UL 991.

5.19.7 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 Controls Using Software requirements in UL 60730-1.

5.20 Supplemental insulation, insulating bushings, and assembly aids

5.20.1 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 UL 510;

b) Sleeving shall comply with UL 1441; or

c) Tubing shall comply with UL 224.

5.20.2 Wire positioning devices required to comply with the requirements of this Standard shall comply with UL 1565.

5.20.3 Insulating bushings shall comply with 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 specified in this Standard (e.g. Strain Relief Test, Push-Back Relief Test, and Mold Stress Evaluation Test) should be conducted.

5.21 Switches

5.21.1 Switches shall comply with UL 1054, UL 61058-1, UL 20, and UL 773A as applicable:

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.

5.21.2 A clock-operated switch, in which the switching contacts are actuated by a clock-work, by a gear-train, by electrically-wound spring motors, by electric clock-type motors, or by equivalent arrangements, shall comply with UL 917 or UL 60730-1 and UL 60730-2-7.

5.21.3 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.

5.22 Transformers

5.22.1 General-purpose transformers shall comply with UL 5085-1 and UL 5085-2.

Exception: A transformer that complies with UL 1411 and that is used in a circuit involving an audio or video component, complies with the intent of this requirement.

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5.22.2 Class 2 and Class 3 transformers shall comply with UL 5085-1 and UL 5085-3.

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

5.23 Valves (electrically operated) and solenoids

5.23.1 Electrically operated valves shall comply with UL 429 or UL 60730-1 and 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 ANSI Z21.21a/CSA 6.5a.

5.23.2 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 lawn mower shall be formed and assembled so that it has the strength and rigidity necessary to resist the abuses to which is subjected, without introducing a risk of fire, electric shock, or injury to persons due to total or partial collapse with resulting reduction of spacings, loosening or displacement of parts, or other defects.

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

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.

6.1.3 Materials that are exposed to oil, acids, solvents, reagents, cleaning agents, or ozone as part of the use or application of the lawn mower shall not be adversely affected by these environments as determined by appropriate tests.

6.1.4 An edge, a projection, a corner, or the like of an enclosure, a frame, a guard, a handle, or the like shall be smooth and well-rounded, and not sufficiently sharp to constitute a risk of injury to persons in normal use and maintenance of a lawn mower.

6.1.5 If breakage or deformation of an enclosure, a frame, a guard, or the like, results in a risk of injury to persons, the material of the part shall have the properties required to meet the expected loading conditions without breakage or deformation.

6.1.6 With regard to the requirement in 6.1.5, a component of a lawn mower that is exposed to impact shall withstand the ball-impact test described in Section 29, Impact Test:

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

b) Without being affected to the extent that parts presenting a risk of electric shock or injury to persons would be exposed to unintentional contact; and

c) Without affecting the intended mechanical performance of the lawn mower.

6.1.7 A catcher assembly constructed of a woven fabric shall comply with the requirements of 65.1 and 65.2.

6.2 Metallic enclosures

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

Table 6.1
Minimum acceptable thickness of metal enclosure

Metal	Minimum thickness, inch (mm)			
	At small, flat, unreinforced surfaces and at surfaces that are reinforced by curving, ribbing, or the like		At relatively large unreinforced flat surfaces	
Die-cast metal	3/64	(1.2)	5/64	(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)

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6.3 Polymeric enclosures

6.3.1 A polymeric enclosure shall be of a material complying with the tests specified in Section 45, Polymeric Materials Other Than HB, or of a material classified HB complying with the tests specified in Section 46, Polymeric Materials Classified HB.

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

6.4 Handles

6.4.1 Other than as noted in 6.4.3, the handles or surfaces most likely to be grasped by the user during the normal operation of a lawn mower shall be made of or covered with an insulating material that complies with the requirements in 6.4.4, 6.4.5, Handle Durability Test, Section 35, Dielectric Voltage-Withstand Test, Section 79 and the second entry in Table 79.1.

6.4.2 With reference to 6.4.1, examples of surfaces that are likely to be grasped by the user during normal operation include a lever, handle, or 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, such as wheel adjustments, collector bag releases, and the like, that are remote from the handles of the lawn mower are not included.

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

a) Insulation complying with the requirements in 79.1, and the second entry in Table 79.1, is interposed between the surfaces likely to be grasped and:

1) The cutting member; and

2) Any metallic guard for the cutting 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 79.1, and the second entry in Table 79.1.

6.4.4 The insulating material specified in 6.4.1, 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 insulating material shall be at least 5/64 inch (2.0 mm) thick.

Exception: The thickness of the insulating material may be less than 5/64 inch (2.0 mm) if the material is found to be acceptable when judged under the considerations specified in 6.1.2.

6.4.5 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 inch (25.4 mm); or

b) Shall not be recessed less than 1/8 inch (3.2 mm) behind the outer surface of the insulating material if the opening will not admit a 3/8-inch (9.5-mm) diameter rod.

6.5 Protection against corrosion

6.5.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means if the corrosion of such unprotected parts introduces 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 need not be protected against corrosion.

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7 Accessibility of Live Parts

7.1 Electrical parts of a lawn mower shall be located or enclosed to reduce the likelihood of unintentional contact with uninsulated live parts. Insulated brush caps do not require additional enclosure.

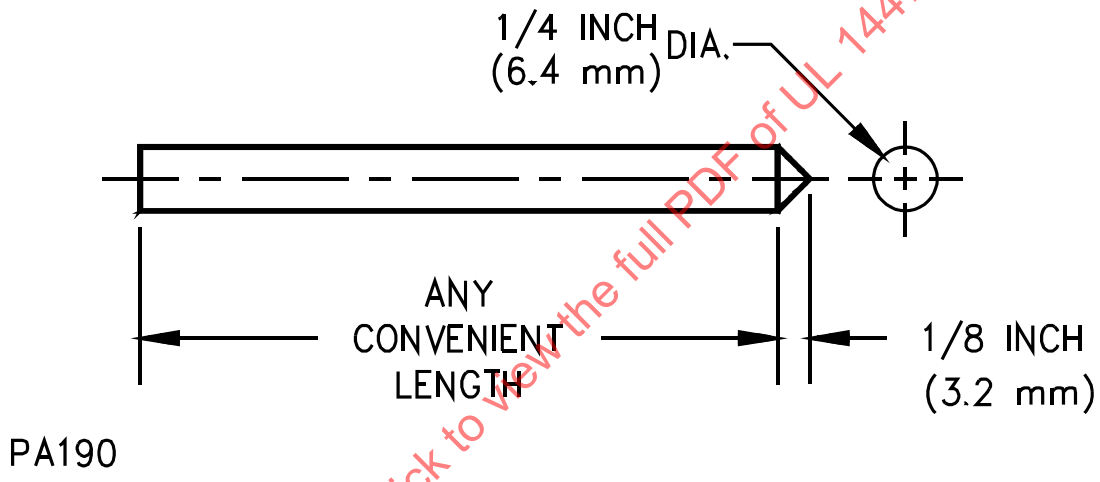
7.2 An opening in the handle portion – the area likely to be handled during normal operation in guiding – of a lawn mower is acceptable if the probe of Figure 7.1, when inserted as far as possible into the opening:

a) Does not enter the opening for a distance of more than 1/8 inch (3.2 mm); and

b) Does not touch any uninsulated live part or film-coated wire.

Figure 7.1

Probe for hand-supported enclosure



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7.3 With reference to the requirement in 7.1, and except as indicated in 7.2, an opening is capable of being used when:

a) A probe as illustrated in Figure 7.2, cannot be made to touch any uninsulated live part or any film-coated wire when inserted through the opening in any possible direction using no appreciable force; and

b) A probe as illustrated in Figure 7.3, cannot be made to touch any uninsulated live part when inserted through the opening in any possible direction using no appreciable force.

7.4 The opening illustrated in Figure 7.4, 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 diameter rod that can be inserted through the opening, but not less than 4 inches (101 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 7.2

IEC articulate probe

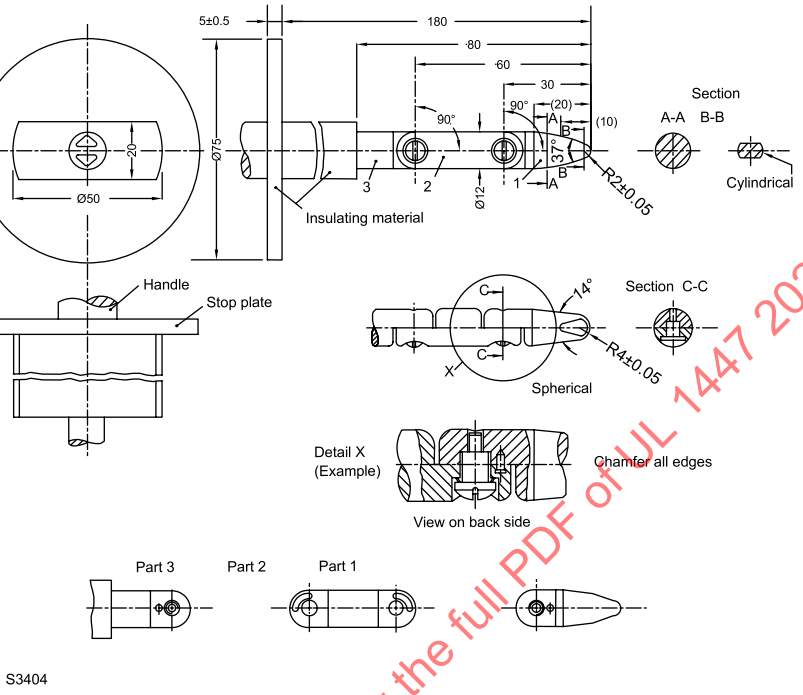

Figure 7.3

IEC test pin

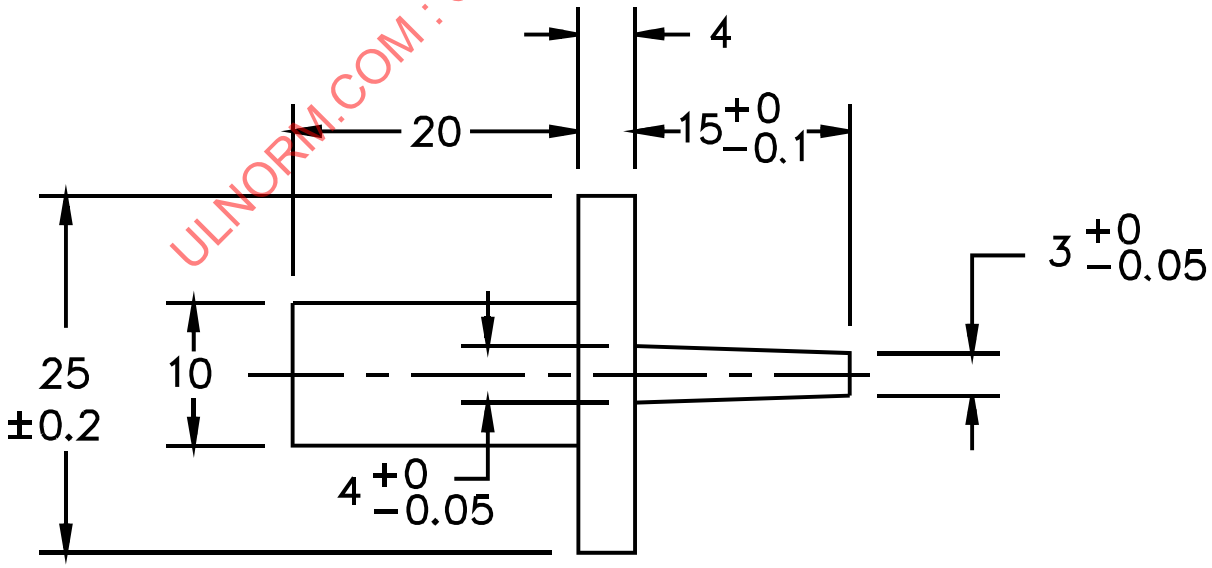

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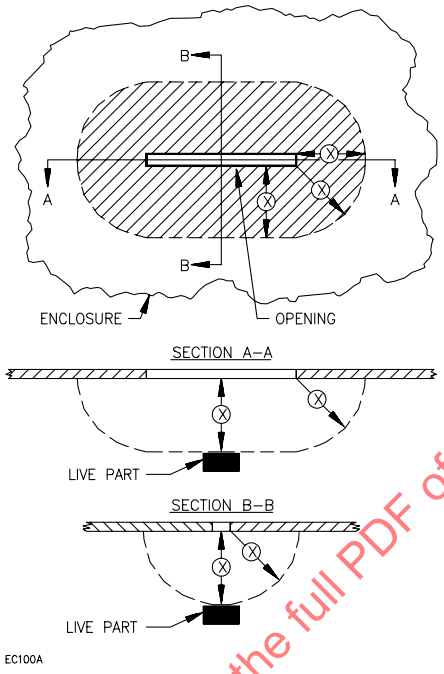
Figure 7.4

Opening in enclosure



Proportions exaggerated for clarity

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7.5 During the examination of a lawn mower 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 lawn mower, 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 shock unless marked in accordance with 54.4.

7.6 A latch or 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.

7.7 An opening in a guard or enclosure around a moving part capable of causing injury, such as a cutting tool, a fan, a pulley, a gear, a chain, or the like, shall have a minor dimension less than 1 inch (25.4 mm).

Exception: This requirement does not apply to an opening for the cutting edges or discharge chute of a lawn mower.

7.8 The unobstructed distance from the opening to the moving part specified in 7.7, shall not be less than 8D minus 1.5 inches (38 mm), in which D is the minor dimension of the opening in inches (or millimeters). However, a fan is considered to be acceptably guarded if the blade cannot be contacted with the probe illustrated in Figure 7.2.

8 Accessibility of Moving Parts

8.1 Moving parts shall be guarded or enclosed to reduce the risk of injury to persons.

8.2 Among the factors to be considered when judging the acceptability of an exposed moving part are:

a) Degree of exposure;

b) Sharpness of the moving part;

c) The likelihood of unintentional contact therewith;

d) The speed of the moving part; and

e) The likelihood that fingers, arms, or feet would be exposed to a risk of injury to persons by the moving part or that clothing would be caught by the part.

9 Mechanical Assembly

9.1 General

9.1.1 A lawn mower shall be assembled so that it is unlikely to create a risk of fire, electric shock, or injury to persons due to vibration during normal operation.

9.1.2 If various functional attachments are available for use with a lawn mower, each attachment shall be considered individually.

9.1.3 Some guards provided over moving parts are required to be self-restoring. Other features of guards that shall be considered include:

a) Removability without the use of tools;

b) Removability for servicing and likelihood of replacement;

c) Strength and rigidity;

d) Completeness; and

e) Introduction of an additional risk of injury such as a pinch point and the necessity for additional handling because of a need for servicing, such as cleaning, unjamming, and the like.

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

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

b) Foreign objects that are struck and propelled by a rotating member.

9.1.5 If a guard must be moved in order to install a catcher assembly, it shall be hinged or otherwise affixed to a lawn mower so that it automatically assumes its intended position when the catcher assembly is removed.

Exception: The hinged guard is not required to be used when a safety interlock is incorporated and when the interlock is suitable for 10,000 cycles at normal load.

9.1.6 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.

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Exception No. 1: The requirement that a switch be prevented from turning may be waived 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.

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.

9.1.7 With reference to the requirements in 9.1.6, 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.

9.1.8 An adhesive that is used to secure a part which if dislodged would result in a risk of electric shock, fire, or injury to persons shall comply with the requirements for adhesives in UL 746C.

9.1.9 The requirement in 9.1.8, also applies to an adhesive used to secure a conductive part that when loosened or dislodged:

a) Energizes an accessible dead metal part;

b) Makes a live part accessible;

c) Reduces spacings below the minimum acceptable values; or

d) Short-circuits live parts.

9.1.10 A lawn mower shall be so constructed that user-maintenance can be accomplished without the likelihood of:

a) Pinching leads;

b) Reducing spacings to values less than those indicated in Table 22.1;

c) Mislocating or damaging the means for accomplishing strain relief; and

d) Mislocating or damaging a guard or other similar device.

9.1.11 User-maintenance is considered to consist of inspection of or 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 the instruction manual recommends be done by authorized service personnel.

9.1.12 Compliance with the requirements in 9.1.10, is to be accomplished by routing of wires, provision of wire channels, provision of locating wells for components, use of barriers, use of restraints, securing of components, and other means.

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9.1.13 Routing as mentioned in 9.1.10, is acceptable if the construction is such that after the wire has been put into the intended position prior to reassembling the lawn mower so that 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.

9.1.14 A lawn mower employing a soft rubber, neoprene, or polyvinyl chloride pressure pad to hold down or maintain permanent position of an electrical part, such as a motor, to provide for intended functioning of the lawn mower shall be tested in accordance with 40.2. If the pressure pad is exposed to grease, it shall also be tested in accordance with 40.3.

Exception: The test is not required if a risk of fire or electric shock does not result from deterioration of the pad as determined by the test in 40.1.

9.2 Lawn mowers shipped partially disassembled

9.2.1 A lawn mower shall be completely assembled before shipped from the factory.

Exception: A lawn mower may be shipped from the factory partially disassembled to facilitate packaging if:

a) All parts for assembly that are necessary for the operation of the lawn mower are provided in one carton;

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

c) Clear and detailed assembly instructions are provided;

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

e) The lawn mower is marked in accordance with 54.8, if a required guard is shipped from the factory detached.

10 Handles

10.1 A lawn mower shall have a handle or handles that permit grasping the lawn mower with both hands.

10.2 The handle of a lawn mower shall be attached to the product so that the handle will not become unintentionally uncoupled during operation.

10.3 A positive stop or latch shall be provided for the handle in its intended operating position or positions. The stop or latch shall not be subject to unintentional disengagement during intended operation of the lawn mower and shall not allow the center of the handle grips to come closer than 17 inches (432 mm) horizontally behind the closest path of the mower blade or blades unless the blades are manually disengaged.

10.4 A swing-over handle shall comply with the requirements in 10.3, with the handle in either operating position.

11 Rotating Parts

11.1 A rotating part shall be formed and assembled so that it has the strength and rigidity necessary to reduce the risk of its release or loosening in a manner that may cause injury to persons.

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11.2 Except as noted in 11.3, a user-removable rotating part, such as a blade, 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 lawn mower shall not loosen a retaining means during tests conducted on the dynamic braking device.

11.3 A lawn mower employing a removable rotating part not intended to be removed by the user shall be secured as specified in 11.2, by a keyed nut, a jam nut, a nut locked in place with a pin, or other positive means.

11.4 The means of fastening the cutting members to the body of a multi-piece blade or disc shall be such that the fastening means will not become worn to a condition that introduces a risk of injury to persons before the cutting members are worn beyond any usefulness.

12 Supply Connections

12.1 Power-supply cord

12.1.1 A lawn mower shall be provided with a power-supply cord that cannot be damaged or impaired by any cutting edges, blades, belts, or rotating parts on the lawn mower.

Exception: A lawn mower may employ a motor attachment plug for connecting an extension cord.

12.1.2 A power-supply cord shall be 8 – 18 inches (200 – 460 mm) long.

12.2 Cord set

12.2.1 A lawn mower intended for use with a cord set shall not be provided with terminal pins that accommodate a standard appliance plug.

12.3 Flexible cord

12.3.1 A flexible power supply cord provided with a lawn mower shall be Type SW, SOW, STW, STOW, SJOW, SJTW, or SJTOW.

12.3.2 The flexible cord used in a cord set provided with, or made available for use with, a lawn mower shall be one of the types specified in 12.3.1.

12.3.3 A flexible cord shall be acceptable for use at a voltage not less than the rated voltage of the lawn mower, and shall have an ampacity not less than the current rating of the lawn mower.

12.4 Attachment plug

12.4.1 An attachment plug shall be rated for use at a current not less than the rated current, and at the rated voltage of the lawn mower. If the lawn mower is adaptable for use on two or more different values of voltage by field-alteration of internal connections, the attachment plug provided with the lawn mower shall be rated for the voltage for which the lawn mower is connected when shipped from the factory. See 51.3.

12.4.2 The attachment plug shall be of the polarized- or 3-prong grounding-type.

12.4.3 A 3- to 2-wire grounding adapter shall not be provided with a lawn mower.

12.4.4 An attachment plug may be of the locking type.

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12.4.5 Means shall be provided to support the attachment plug of a lawn mower so that the cord connector of the extension cord will not touch the ground when the handle is in a normal operating position.

12.4.6 An attachment plug on a lawn mower supply cord shall be constructed so that, when inserted in an extension cord connector – cord connector body – the blades will not be energized until they are inaccessible to contact by persons. See Section 36, Attachment Plug Test.

12.5 Strain relief

12.5.1 Strain relief shall be provided so that a stress on a flexible cord is not transmitted to terminals, splices, or internal wiring in the lawn mower or in a fitting, such as an attachment plug, or an appliance plug.

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

12.5.3 Means shall be provided to prevent the supply cord from being pushed into the enclosure of a lawn mower through the cord-entry hole when such displacement results in:

a) Subjecting the supply cord to mechanical damage;

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

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

d) Damaging internal connections or components.

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

12.6 Bushings

12.6.1 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.

13 Live Parts

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

13.2 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 2.1.

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

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13.3 An uninsulated live part and its support shall be secured to the base or mounting surface so that it is prevented from turning or shifting in position if such motion results in a reduction of spacings below the minimum acceptable values.

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

14 Internal Wiring

14.1 General

14.1.1 The wiring and connections between parts of a lawn mower shall be adequately protected or enclosed.

Exception: A suitable length of flexible cord may be employed for external connections if flexibility is essential. See 14.1.2 and 14.1.4.

14.1.2 A flexible cord used for external interconnection as specified in the Exception to 14.1.1, shall be one of the types of cord specified in 12.3.1, or the equivalent, and shall be provided with suitable bushings and strain relief in accordance with the requirements in 12.4.6 – 12.5.3, and Section 37, Strain Relief Test, unless the construction is such that the cord will be protected from stress and motion.

14.1.3 Insulated wires may be bunched and passed through a single opening in a metal wall within the enclosure of the lawn mower.

14.1.4 With reference to exposure of internal wiring through openings in the enclosure of a lawn mower, the protection of the wiring required in 14.1.1, 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 can be contacted by the user.

14.1.5 Internal wiring shall not be located near a hole in the appliance where it can be damaged by a screw, nail, or other device intended to support the lawn mower.

14.1.6 Wiring inside a lawn mower that might otherwise be subjected to mechanical damage shall be in armored cable, conduit, or electrical metallic tubing or shall be otherwise protected.

14.1.7 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.

14.1.8 Insulated internal wiring shall be suitable 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 services to which it is subjected.

14.1.9 Thermoplastic-insulated wire and neoprene-insulated wire employed for internal wiring shall be standard building wire or suitable appliance wiring material, and shall comply with Table 14.1.

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Table 14.1
Characteristics of internal wiring

Insulation	Nominal thickness of insulation, inch (mm)	Nominal thickness of braid or jacket, inch
Thermoplastic or	1/32 or 0.030 (0.76)	Not required
neoprene rubber	1/64 or 0.015 (0.38)	1/64 or 0.015
	1/32 or 0.030 (0.76)	1/64 or 0.015[a]
[a]For heat-resistant rubber, other than a silicone type, the insulation thickness shall not be less than 3/64 inch (0.018 mm) and no braid is required.		

14.1.10 Insulating tubing employed in place of wire insulation shall be suitable for the application as specified in 14.1.8, and shall have a nominal wall thickness of at least 1/32 inch (0.8 mm).

14.2 Splices and connections

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

14.2.2 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 loosened. An ordinary open-end spade lug with a lock washer is not acceptable.

14.2.3 A splice shall be adequately insulated if permanence of spacings between the splice and other metal parts is not ensured.

14.2.4 The thickness of insulation on a splice shall be 1/32 inch (0.8 mm) or more. 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-resistant and moisture-resistant characteristics, and the like. Thermoplastic tape wrapped over a sharp edge is not acceptable.

14.2.5 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.

14.2.6 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 suitable for the combination of metals involved at the connection point.

14.2.7 A wire-binding screw, a pressure wire connector, or the like, used as the terminating device specified in 14.2.6, shall be suitable for use with aluminum under the conditions involved including such factors as temperature, heat cycling, and vibration.

15 Electrical Insulation

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

15.2 Ordinary vulcanized fiber that is used for insulating bushings, washers, separators, and barriers, shall not be used as the sole support for uninsulated live parts if shrinkage, current leakage, or warpage

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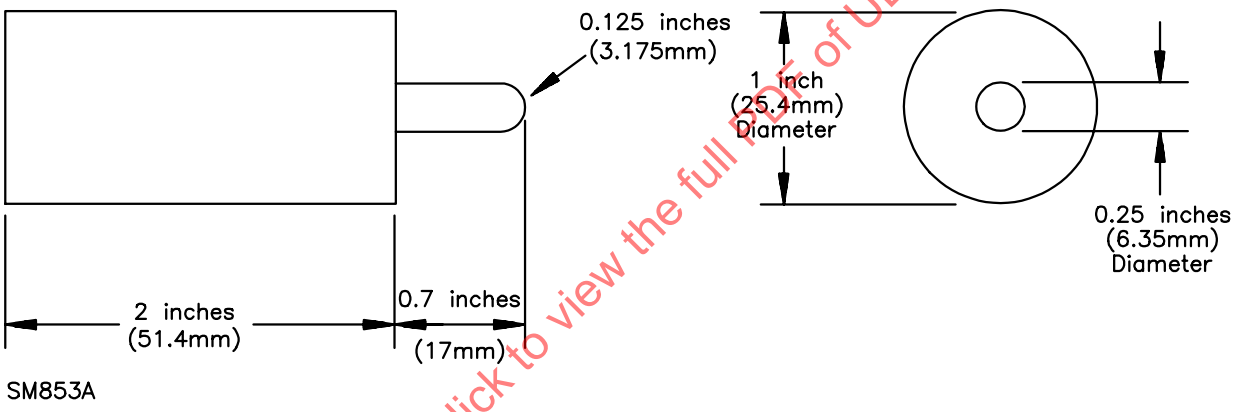
introduces a risk of fire or electric shock. Thermoplastic materials may be employed if investigated and found to have physical strength and rigidity, resistance to heat, resistance to flame propagation, dielectric strength, and other properties suitable for the application. All these properties shall be considered with respect to the effects of thermal aging.

15.3 A molded part shall have 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 occurs during normal use, unless the cap has the strength necessary to withstand the abuses to which it is subjected.

15.4 A brush cap of a lawn mower is to withstand an impact of 1 foot-pound (1.36 J) without cracking, breaking, or exposing live parts. The impact is to be applied through the hardened steel rod shown in Figure 15.1, with a diameter of 1/4 inch (6.4 mm), held in contact with the brush cap by any convenient means.

Figure 15.1

Impact rod



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16 Motors

16.1 A motor shall be acceptable for the particular application, and shall be capable of handling the maximum normal load of the lawn mower as described in 28.4 – 28.6, without introducing risks of fire, electric shock, or injury to persons.

16.2 A motor winding shall resist the absorption of moisture.

16.3 With reference to the requirement in 16.2, 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 shall be impregnated or otherwise treated to resist moisture absorption.

16.4 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.

17 Switches and Controls

17.1 A switch or other control device shall be provided in a lawn mower to control the motor. The switch or other control device shall have a voltage and current rating not less than the corresponding values of the load that it controls.

17.2 A lawn mower shall not employ a through-cord switch.

17.3 A single-pole switch in a lawn mower employing a polarized attachment plug shall be connected in the conductor not intended to be grounded.

17.4 A device that automatically starts a lawn mower, 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 does not result in a risk of injury to persons.

17.5 All operator controls shall be operable from the location assumed by an operator when operating the product. This is not intended to apply to a fixed adjustment, such as the adjustment of wheel-height on a lawn mower.

17.6 An electric lawn mower shall be provided with a momentary-contact switch or a dead-man control for disengaging the propelling drive and the blades so that the lawn mower cannot propel itself when it is unattended and so that the blades will not operate unless the operator actuates the control. No means for locking the switch in the "on" position shall be provided.

17.7 A switch shall be located or protected so that it is unlikely to be subjected to unintentional operation during intended use.

17.8 A switch shall be located or guarded so that a lawn mower cannot be energized by:

a) Placing the lawn mower in any at-rest position against a flat or contoured surface that is encountered in use; or

b) Actuating the switch by irregular surfaces across which the lawn mower is moved.

17.9 A switch shall operate by finger pressure with the lawn mower held in the intended manner.

18 Controls – End Product Test Parameters

18.1 General

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

18.1.2 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.

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18.2 Auxiliary controls

18.2.1 Auxiliary controls shall not introduce a risk of electric shock, fire, or personal injury hazard.

18.2.2 Auxiliary controls shall comply with the requirements of this end product Standard.

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

18.3 Operating controls (regulating controls)

18.3.1 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using 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 IEC 61000-4-5;

d) For the applicable overvoltage category, see Table 18.1;

e) For the applicable material group, see Table 18.2; and

f) For the applicable pollution degree, see Table 18.3.

18.3.2 The following test parameters shall be among the items considered when judging the acceptability of an operating control investigated using other than UL 60730-1:

a) Control action Types 1 or 2;

b) Unless otherwise specified in UL 1447, 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 18.1;

d) For the applicable material group, see Table 18.2; and

e) For the applicable pollution degree, see Table 18.3.

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Table 18.1
Overvoltage categories

Appliance	Overvoltage category
Intended for fixed wiring connection	III
Portable and stationary cord-connected	II
Control located in low-voltage circuit	I
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 18.2
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 UL 746A.	

Table 18.3
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

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18.4 Protective controls (limiting controls)

18.4.1 An electronic control that performs a protective function shall comply with the requirements in Controls, Section 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 electric shock, fire, or injury to persons.

18.4.2 The following test parameters shall be among the items considered when judging the acceptability of an electronic protective control investigated using 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 50°F (10°C) and the maximum ambient temperature determined by conducting the Temperature Test, Section 30;

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 in Section 30, 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 30; and

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

18.4.3 The test parameters and conditions used in the investigation of the circuit covered by 5.6.1.5, shall be as specified in 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 32°F (0°C) and 158°F (70°C);

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 77°F (25°C) 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 140°F (60°C), or 50°F (10°C) 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); and

j) If software is relied upon as part of the protective electronic control, it shall be evaluated as software Class 1 in accordance with UL 1998.

18.4.4 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.

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18.5 Controls using a temperature sensing device

18.5.1 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 specified in UL 991 or 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.

19 Lampholders

19.1 A lampholder shall be designed or installed so that uninsulated live parts other than the lamp contacts are not exposed to contact by persons removing or replacing lamps in normal service.

19.2 The screw shell of a lampholder shall be connected to the conductor of the flexible cord intended to be grounded, whether or not it is actually grounded.

20 Capacitors

20.1 A capacitor provided as a part of a capacitor motor, and a capacitor connected across the line, such as a capacitor for radio-interference suppression, shall be housed within a suitable enclosure or container that protects the plates against mechanical damage and that reduces the risk of the emission of flame or molten material resulting from breakdown or malfunction of the capacitor. The enclosure shall be made of metal providing strength and protection not less than that of sheet steel having a thickness of 0.020 inch (0.51 mm).

Exception No. 1: The enclosure of a capacitor may be made of sheet steel having a lesser thickness or of a material other than metal if the capacitor is mounted in an enclosure that:

a) Houses other parts of the lawn mower; and

b) Is acceptable for the enclosure of live parts.

Exception No. 2: The individual enclosure of an electrolytic capacitor with means for venting shall provide protection against mechanical damage only, and the requirement for minimum enclosure thickness does not apply. The individual enclosure of an electrolytic capacitor not provided with means for venting and with an opening (gap) more than 1/16-inch (1.6 mm) wide need not comply with the requirement for enclosure thickness if it complies with the test requirements specified in Section 42, Capacitor Test.

20.2 The voltage rating of a capacitor other than a motor-starting capacitor shall not be less than the maximum steady-state potential to which the capacitor is subjected during operation of the lawn mower.

21 Printed-Wiring Boards

21.1 A printed-wiring board included as part of the circuitry of a lawn mower shall comply with requirements in UL 796. The printed-wiring board shall have a flammability rating of V-1 or better as determined by an evaluation to UL 94.

Exception: A printed-wiring board positioned inside an enclosure or compartment having a 5V rating in accordance with UL 94 is not prohibited from having a flame rating of HB.

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22 Spacings

22.1 The spacing between uninsulated live parts of opposite polarity and between an uninsulated live part and a dead metal part that is exposed to contact by persons or that is grounded shall not be less than the value specified in Table 22.1, 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 lawn mower, such as a snap switch, are 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.

22.2 In applying Table 22.1, to a lawn mower incorporating two or more motors of different sizes, the spacings inside each motor shall be judged on the basis of the size of that motor, and the spacings elsewhere in the lawn mower shall be judged on the basis of the size of the largest motor in the lawn mower.

22.3 If an isolated dead metal part is interposed between or in close proximity to (a), (b), or (c), then the spacing between the isolated dead metal part and (a), (b), or (c) shall be at least 3/64 inch (1.2 mm):

a) Live parts of opposite polarity; or

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 sum of the spacing between the isolated dead metal part and each of the other two parts shall not be less than that specified in Table 22.1. See Figure 22.1.

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Table 22.1
Minimum acceptable spacings

Potential involved volts	Parts involved	Minimum spacings, inch (mm)							
		Motor diameter[a] 7 inches (180 mm) or less				Motor diameter[a] more than 7 inches (180 mm)			
		Over surface		Through air		Over surface		Through air	
0 – 125	Between commutator bars or collector rings of a motor and the motor shaft and laminations	3/32	(2.4)	3/32	(2.4)	3/16[b]	(4.8)	1/8[b]	(3.2)
	Elsewhere in the appliance	3/32	(2.4)	3/32	(2.4)	1/4[b,c]	(6.4)	1/8[b,c]	(3.2)
126 – 250	Between the commutator or collector rings of a motor	3/32	(2.4)	3/32	(2.4)	3/16[b]	(4.8)	3/16[b]	(4.8)

Table 22.1 Continued on Next Page

Table 22.1 Continued

Potential involved volts	Parts involved	Minimum spacings, inch (mm)							
		Motor diameter[a] 7 inches (180 mm) or less				Motor diameter[a] more than 7 inches (180 mm)			
		Over surface		Through air		Over surface		Through air	
	Elsewhere in the appliance	3/32	(2.4)	3/32	(2.4)	1/4[b,c]	(6.4)	1/4[b,c]	(6.4)

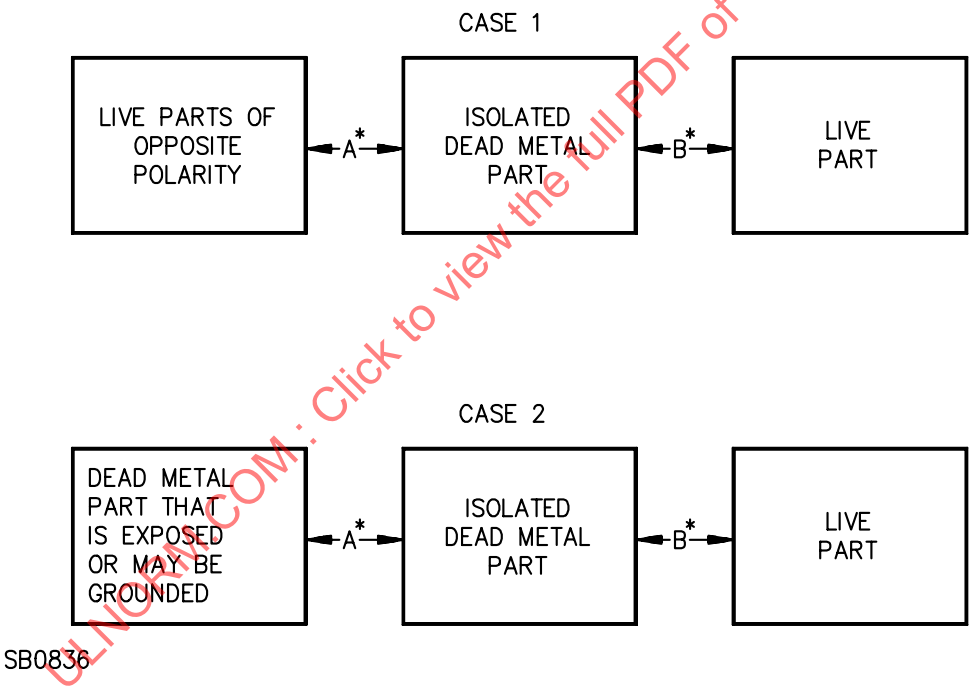
[a] This is the diameter, measured in the plane of the laminations, of the circle circumscribing the stator frame, excluding lugs, fins, boxes, and the like, used solely for motor mounting, cooling, assembly, or connection.

[b] Spacings not less than 3/32 inch (2.4 mm) are acceptable throughout a universal motor.

[c] Film-coated wire is considered to be an uninsulated live part. However, a spacing not less than 3/32-inch (2.4 mm) (over surface and through air) between film-coated wire, that is rigidly supported and held in place on a coil, and a dead metal part is acceptable in a lawn mower.

Figure 22.1

Spacings for isolated dead metal parts



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*Spacing A and spacing B shall each be at least 3/64 inch (1.2 mm); and spacing A plus spacing B shall not be less than indicated in Table 22.1.

22.4 Primary-circuit spacings apply in all secondary circuits supplied by a transformer winding of 200 volt-amperes or a higher capacity – maximum available power – at a potential greater than 100 volts. The spacings in all other secondary circuits are to be judged on the basis of the dielectric voltage-withstand test described in 31.1.

22.5 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-inch (0.8 mm) thick, and shall be located or be of such material so that it is not adversely affected by arcing.

Exception: Vulcanized fiber not less than 1/64-inch (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.

22.6 An insulating liner or barrier of a material other than that mentioned in 22.5, may be used if, upon investigation, the material is found to be acceptable for the particular application.

22.7 The spacings between an enclosure of polymeric material classified HB and:

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

b) An arcing part, such as a commutator, unenclosed switch contacts, and similar parts, shall not be less than 1/2 inch (12.7 mm) except as indicated in 46.7.1.

The spacing specified is to be measured from the source of the arc.

23 Grounding

23.1 The flexible cord of a lawn mower shall include an equipment-grounding conductor.

23.2 An equipment-grounding conductor of a flexible cord:

a) Shall be green with or without one or more yellow stripes;

b) Shall be connected to the grounding member of an suitable attachment plug of the grounding type; and

c) Shall be conductively connected to:

1) All exposed dead metal parts of the lawn mower; 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.

23.3 The screw mentioned in 23.2(c), shall be of corrosion-resistant metal or shall be acceptably protected against corrosion. A lock washer or other suitable means shall be employed to prevent the screw from being loosened by vibration. This screw shall have a slotted, hexagonal, green-colored head.

23.4 With reference to the requirement in 23.2(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.

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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-inch (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.

PERFORMANCE

24 General

24.1 The performance of a lawn mower shall be investigated by subjecting the requisite number of samples to all the applicable tests as described in Sections 25 – 42. Insofar as practicable, the tests shall be conducted in the order in which they are presented. Samples employed for leakage-current tests shall be tested for leakage prior to employing the samples for other tests.

25 Leakage Current Test

25.1 The leakage current of a lawn mower rated for a nominal 120-volt supply when tested in accordance with 25.2 – 25.6, shall not be more than 0.5 milliampere.

25.2 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 considered suitable for protection against shock as defined in 7.1 – 7.6. Surfaces are considered to be simultaneously accessible if they can be 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 not considered to involve a risk of electric shock.

25.3 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 centimeters in contact with the surface. If the surface is less than 10 by 20 centimeters, 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 lawn mower.

25.4 The measurement circuit for leakage current is to be as illustrated in Figure 25.1. 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 ohms resistive shunted by a capacitance of 0.15 microfarad.

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 kilohertz, 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-ohm resistor shunted by a 0.15 microfarad capacitor to 1500 ohms. At an indication of 0.5 milliampere the measurement is to have an error of not more than 5 percent at 60 hertz.

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

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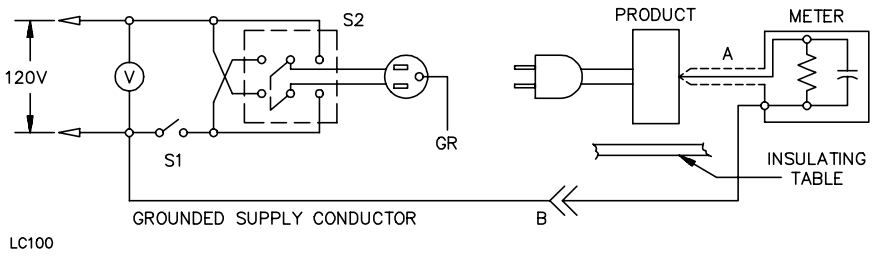
Figure 25.1

Leakage current measurement circuit



NOTE:

A – PROBE WITH SHIELDED LEAD.

B – SEPARATED AND USED AS CLIP WHEN MEASURING CURRENTS FROM ONE PART OF DEVICE TO ANOTHER.

25.5 A sample of the lawn mower 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 volts. The test sequence with reference to the measuring circuit – Figure 25.1 – is to be as follows:

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

b) Switch S1 is then to be closed energizing the lawn mower, and within 5 seconds the leakage current is to be measured using both positions of switch S2 and with the lawn mower 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.

25.6 Normally, the complete leakage current test program described in 25.5, is to be conducted without interruption for other tests. With the concurrence of those concerned, the leakage current test may be interrupted for the purpose of conducting other nondestructive tests.

26 Starting Current Test

26.1 A lawn mower shall be capable of starting and operating normally on a circuit protected by an ordinary – not time-delay– fuse having the same current rating of either 15 or 20 amperes as the attachment plug of the lawn mower.

Exception: A time-delay fuse may be used for the test provided the lawn mower is marked in accordance with Fuses, Section 52.

26.2 In a test to determine whether a lawn mower complies with the requirement in 26.1, the lawn mower is to be connected to a supply of rated voltage using a 100-foot (30.5 m) long cord set, as described in 33.2.2, and started three times, with the lawn mower 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,

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and the motor is to be allowed to come to rest between successive starts. The results are unacceptable if the fuse opens, or if a thermal protector provided as part of the lawn mower trips.

27 Continuity of Ground Connection Test

27.1 The grounding blade of the attachment plug and the dead metal parts of a lawn mower specified in 23.2(c), shall be electrically conductively connected.

27.2 The resistance between the point of connection of the equipment-grounding means at or within the lawn mower and any other point in the grounding circuit of the lawn mower shall not be more than 0.1 ohm.

27.3 Compliance with the requirement in 27.2, is to be determined by a resistance measuring instrument. If unacceptable results are observed, an alternating current of 20 amperes or more from a power supply of 12 volts 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.

28 Input Test

28.1 The current input to a lawn mower shall not be more than 120 percent of the rated value when the lawn mower is operated under the condition of normal load resulting in maximum input as described in 28.4 – 28.6 and Input Test, Section 60.1, while connected to a supply circuit of rated voltage and rated frequency.

28.2 If the rating is given in terms of a range of voltages, rated voltage is considered to be the highest value of the range – but not less than 120 volts or 240 volts.

28.3 A 100-foot-long (30.5 m) cord set, as described in 33.2.2, is to be used when the input test is conducted.

28.4 Maximum normal load is considered to be the load that approximates as closely as possible the most severe conditions of normal use. It is not a deliberate overload except as the conditions of actual use are likely to be somewhat more severe than the maximum load conditions that are recommended by the manufacturer of the lawn mower. Test loads that have been found to be close approximations of the most severe conditions of normal use are described in 28.6 and Input Test, Section 60, for some common forms of lawn mowers. However, lawn mowers having features not contemplated in these test procedures may be tested as necessary to meet the intent of these requirements. These features would include the attachments provided for use with the lawn mower.

28.5 Combination lawn mowers are to be tested individually for each function.

28.6 For reel lawn mowers, the input test is to be conducted with the lawn mower moving wet, thick grass, the average height of which is 3 inches (75 mm), and 1 inch (25.4 mm) of this height is to be cut during the input test.

29 Impact Test

29.1 The ball-impact test is to be conducted with a smooth steel sphere having a diameter of 2 inches (51 mm) and weighing 1.18 pounds (0.535 kg). When the component being tested can be struck from above, the sphere is to be allowed to fall vertically from rest to strike the component. For surfaces other than the top of the enclosure, the steel sphere is to be suspended by a cord and allowed to fall as a pendulum through the distance required to cause it to strike the surface. In either case, the vertical travel of the sphere is to be 51 inches (1.30 m).

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29.2 If the component is made of nonmetallic material, the ball-impact test is to be performed on the sample or samples in the as-received condition. The test is then to be repeated on a different sample or samples that have been conditioned 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 during the Temperature Test, Section 30, but not less than 70°C (158°F). The conditioned samples are to be tested after they have returned to room temperature.

29.3 Upon removal from the oven mentioned in 29.2 and before being subjected to the ball-impact test, no sample shall show checking, cracking, or other deleterious effects from the oven conditioning, nor shall any sample show distortion sufficient to impede the intended use of the lawn mower.

29.4 If the component is nonmetallic, a lawn mower that has an accessory that adapts the lawn mower for use at low temperatures, such as a lawn mower with a snow moving accessory, shall also be subjected to the ball-impact test immediately after being conditioned at minus 20°C (minus 4°F) for 7 hours.

29.5 Deformation of a guard during the ball-impact test is acceptable if:

a) Operation of the lawn mower or performance of the guard is not affected; or

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

29.6 A functional component, including a cutting tool or portion of the drive system, need not comply with the requirement for the ball-impact test if the lawn mower is not capable of its intended operation after the test.

30 Temperature Test

30.1 A lawn mower, when tested under the conditions described in 30.3 and 30.7, shall not attain a temperature at any point sufficiently high to constitute a risk of fire or to adversely affect any materials employed in the lawn mower, or to show a temperature rise greater than those specified in Table 30.2. An overcurrent protective device shall not open the circuit during the test.

30.2 During the temperature test, the temperature on a surface of a lawn mower that may be contacted by the user, other than a cutting or functional edge, shall not be more than the value specified in Table 30.1. If the test is conducted at a room temperature of other than 25°C (77°F), the results are to be corrected to that temperature.

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Table 30.1
Maximum temperatures of surfaces exposed to user contact

Location	Metal		Nonmetallic	
	°C	(°F)	°C	(°F)
A handle or knob that is grasped for lifting, carrying, or holding	50	(122)	60	(140)
A handle or knob that is contacted but does not involve lifting, carrying, or holding; and other surfaces subject to contact in the intended use of the product	60	(140)	85	(185)

30.3 For the temperature test, a lawn mower is to be loaded by an eddy-current brake, dynamometer, or the like as follows:

a) A single-speed lawn mower with a universal motor is to be operated and loaded to rated current.

b) A lawn mower with an induction motor is to be operated at rated voltage and loaded to obtain rated current. The input wattage is to be measured. If the lawn mower is intended for use on a nominal 120-V or a 240-V supply, the load is to be increased until the initial wattage is obtained at 120 or 240 V.

c) A variable-speed lawn mower with a universal motor, and discrete speed setting, is to be operated while loaded to rated current at highest and lowest speed settings and may be operated at intermediate speed settings.

d) An infinitely variable-speed lawn mower with a universal motor, without feedback, is to be operated as follows:

1) At the maximum-speed setting, while loaded to rated current.

2) At the no-load speed setting equal to 25 percent of the no-load maximum speed and then loaded to obtain 25 percent of the maximum speed obtained with rated current.

e) An infinitely variable-speed lawn mower with feedback is to be operated as follows:

1) At the maximum-speed setting while loaded to obtain rated current.

2) At a no load speed setting equal to 25 percent of the maximum no load speed and then loaded to obtain rated current.

Exception: If a lawn mower with feedback employs circuits to limit the current at low speed, so that rated current cannot be obtained at 25 percent of no load speed, then the load is to be adjusted to result in the maximum current obtainable at 25 percent of the maximum no load speed.

30.4 With reference to feedback as mentioned in 30.3 (d) and (e), a lawn mower is considered to have feedback if the rated current is exceeded when making the adjustment described in 30.3 (d) and (e)(2).

30.5 All values for temperature rises in Table 30.2, are based on an assumed ambient temperature of 25°C (77°F). Tests are to be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

30.6 A 100-foot-long (30.5 m) cord set, as described in 33.2.2, is to be used when the temperature test is conducted.

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

30.8 To determine whether a lawn mower complies with the requirements of 30.1, it is to be connected to a voltage supply as described in 30.7, and operated continuously until constant temperatures have been reached.

30.9 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.

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30.10 Temperatures are to be measured by thermocouples except when the resistance method is to be used as provided in 30.13. 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 laboratory practice. The thermocouple wire is to conform to the requirements given in the Tolerances on Initial Values of EMF versus Temperature tables in ANSI/ASTM E230/E230M.

Table 30.2
Maximum acceptable temperature rises

Materials and component		Degrees	
		°C	(°F)
1.	Varnished-cloth insulation	60	(108)
2.	Fuses	65	(117)
3.	Fiber employed as electrical insulation	65	(117)
4.	Wood and other combustible material	65	(117)
5.	Phenolic composition employed as electrical insulation or as a part the deterioration of which results in a risk of fire, electric shock, or injury to persons.	125[a]	(225)[a]
6.	Rubber or thermoplastic-insulated wires and cords	34[a,b]	(63)[a,b]
7.	Capacitor		
	Electrolytic	40[c]	(72)[c]
	Other type	65[d]	(117)[d]
8.	Class 105 insulation systems on windings of a transformer		
	Thermocouple method[e]	65	(117)
	Resistance method[e]	75	(134)
9.	Class 105 insulation systems on windings of a relay, a solenoid, etc.		
	Thermocouple method[e]	65	(117)
	Resistance method[e]	85	(153)
10.	Class 130 insulation systems on windings of a relay, a solenoid, etc.		
	Thermocouple method[e]	85	(153)
11.	Class A insulation systems on coil windings of an a-c motor having a diameter of more than 7 inches (178 mm), of a d-c motor, and of a universal motor:[e,f]		
	A. In a open motor		
	Thermocouple method	65	(117)
	Resistance method	75	(134)
	B. In a totally enclosed motor		
	Thermocouple method	70	(126)
	Resistance method	80	(144)
12.	Class A insulation systems on coil windings of an a-c motor having a diameter of 7 inches 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	75	(135)

Table 30.2 Continued on Next Page

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Table 30.2 Continued

Materials and component	Degrees °C	Degrees (°F)
B. In a totally enclosed motor		
Thermocouple or resistance method	80	(144)
13. Class B insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 inches, of a d-c motor and of a universal motor:[e,f]		
A. In an open motor		
Thermocouple method	85	(153)
Resistance method	95	(171)
B. In a totally enclosed motor		
Thermocouple method	90	(162)
Resistance method	100	(180)
14. Class B insulation systems on coil windings of an a-c motor having a diameter of 7 inches 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	95	(171)
B. In a totally enclosed motor		
Thermocouple or resistance method	100	(180)
15. Class E insulation systems on coil windings and core laminations		
Thermocouple method	80	(144)
Resistance method	90	(162)

[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 Class-A-insulated flexible cord entering a motor and subjected to a temperature rise of more than 35°C (63°F), comply with the requirement when braid intended for the temperature is employed on the conductor of other than a flexible cord. However, this does not apply to thermoplastic-insulated wires or cords.

[c] For an electrolytic capacitor that is physically integral with or attached to a motor, a temperature rise on insulating material integral with the capacitor enclosure of more than 65°C (117°F) meets the intent of the requirement.

[d] For a capacitor that operates at a temperature rise of more than 65°C (117°F), its marked temperature limit is to be taken into consideration.

[e] See 30.13.

[f] See note (a) to Table 22.1.

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30.11 A thermocouple junction and adjacent thermocouple lead wire are to be securely held in thermal contact with the surface being measured. In most cases, adequate 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.

30.12 Whenever referee temperature measurements are necessary in connection with the heating of electrical equipment, thermocouples consisting of 30 AWG (0.05 mm^2) iron and constantan wires and a temperature indicating instrument are to be used.

30.13 The temperature of a coil or winding is to be measured by means of thermocouples mounted on the outside of the coil wrap. When the coil is inaccessible for mounting thermocouples – for instance, when the coil is immersed in sealing compound or when the coil wrap includes thermal insulation such as

asbestos, or more than 1/32 inch (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 entries 12 and 14 in Table 30.2, the thermocouple is to be mounted on the integrally applied insulation of the conductor.

30.14 When 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:

$$t = \frac{R_2}{R_1} \times (K + t_1) - (K + t_2)$$

in which:

t is temperature rise in °C;

R_2 is resistance of the coil at the end of the test in ohms;

R_1 is resistance of the coil at the beginning of the test in ohms;

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

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

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

31 Dielectric Voltage-Withstand Test

31.1 A lawn mower shall withstand without breakdown for 1 minute the application of a 60-hertz essentially sinusoidal potential of 1000 volts plus twice rated voltage, other than as specified in 31.2, between live parts and dead metal parts, with the lawn mower at the temperature reached during the temperature test.

31.2 For a lawn mower employing an induction motor rated less than 1/2 horsepower (373 W output) and 250 volts or less, the test potential for the motor – but not for the remainder of the lawn mower – is to be 1000 volts.

31.3 In applying 31.2, to a motor not rated in horsepower, use is to be made of the appropriate table of ANSI/NFPA 70, which specifies 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 lawn mower is marked for use on alternating current only; otherwise, the table applying to direct-current motors is to be used.

31.4 To determine whether a lawn mower complies with the requirements in 31.1, the lawn mower is to be tested by means of a suitable 500-volt-ampere 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.

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32 Resistance to Moisture Tests

32.1 High humidity

32.1.1 A lawn mower employing insulating material likely to be adversely affected by moisture under conditions of normal 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 lawn mower rated for a nominal 120-volt supply shall comply with the requirements in 25.1, in a repeated leakage current test. The test is to be discontinued when leakage current stabilizes.

b) A lawn mower other than that specified in (a) shall have an insulation resistance of not less than 50,000 ohms between live parts and interconnected dead metal parts.

c) Other than as noted in 32.1.2, a lawn mower shall be subjected to a dielectric voltage-withstand test as described in 31.1, with the lawn mower still in the humidity chamber or room, at the specified humidity and temperature.

32.1.2 If it is necessary to remove the lawn mower from the chamber or room for the test in 32.1.1(c), it is to be tested within 1 minute after removal.

32.2 Water spray

32.2.1 After exposure to water spray as described in 32.2.2 and 32.2.3, a lawn mower:

a) Rated for a nominal 120 volt supply shall comply with the requirement in 25.1, in a repeated leakage-current test, except that the test shall be discontinued when leakage current stabilizes.

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

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

1) In accordance with 31.1, for a grounded lawn mower.

2) Twenty-five hundred volts for a double-insulated lawn mower rated a nominal 120 volts.

3) Thirty-five hundred volts plus twice the rated voltage of the lawn mower for a double-insulated lawn mower other than as specified in (c)(2).

32.2.2 A lawn mower, supported in a normal operating position, is to be subjected for 1 hour to a downward spray of water onto the top and sides, applied to the lawn mower at an angle of 45 degrees to the vertical, and in the direction or directions most likely to cause water to enter. The lawn mower is not to be operating when being subjected to this exposure, but is to be operated for 5 seconds after the spray is removed before being subjected to the tests in 32.2.1.

32.2.3 The water spray test apparatus is to consist of three spray heads mounted in a spray head pipe rack as shown in Figure 32.1. Spray heads are to be constructed in accordance with Figure 32.2. The water pressure for all tests is to be maintained at 5 pounds psi (34.5 kPa) at each spray head. The distance between the center nozzle and the lawn mower is to be approximately 5 feet (1.52 m). The spray is to be directed at an angle of 45 degrees to the vertical toward the louvers or other openings nearest current-carrying parts.

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32.2.4 Before the test is started, the resistivity of the water is to be 3500 ohm-centimeters ±5 percent when measured at 25°C (77°F). At the conclusion of the test, the resistivity of the water shall not be less than 3200 ohm-centimeters nor more than 3800 ohm-centimeters when measured at 25°C (77°F).

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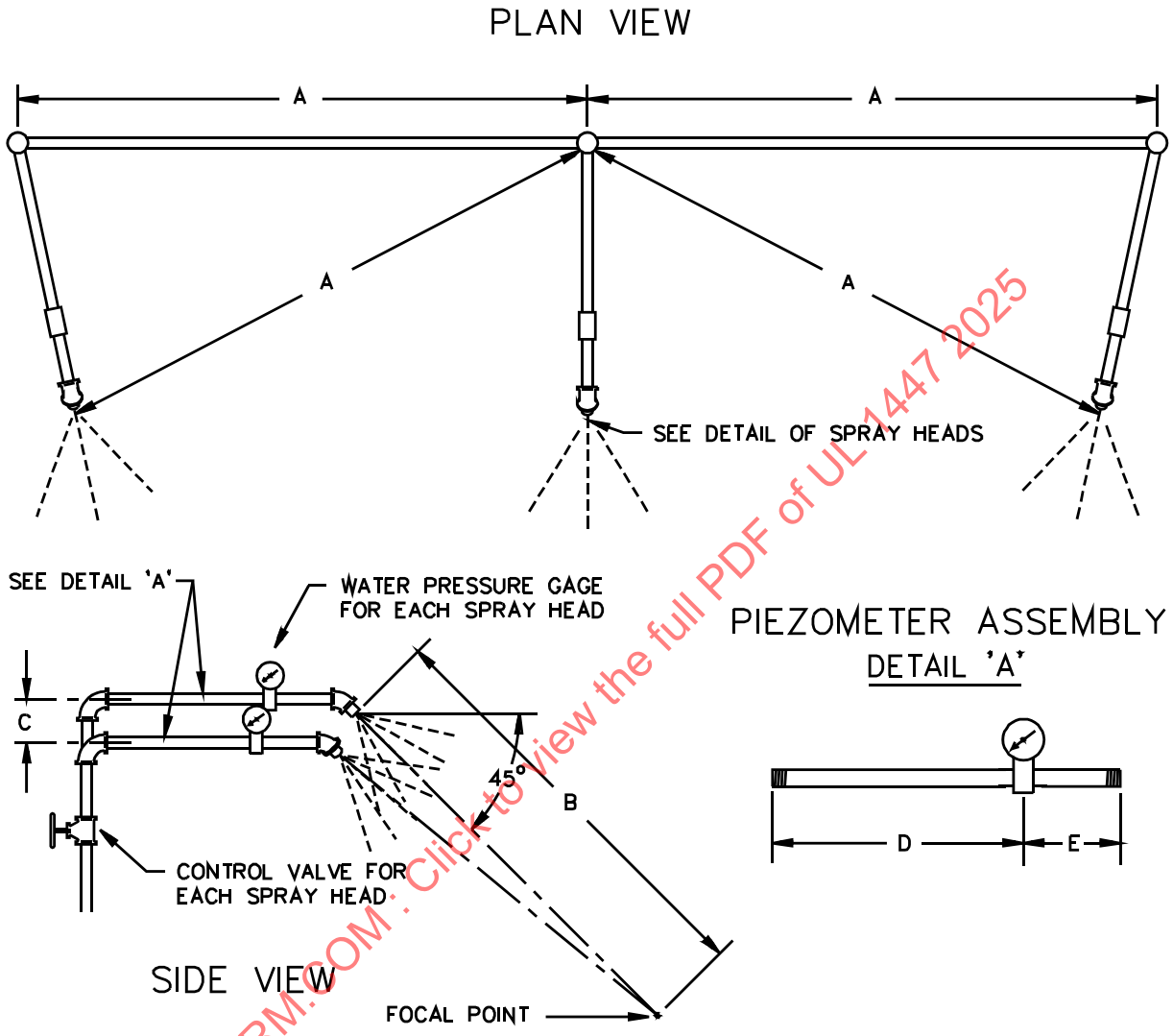
Figure 32.1

Rain test spray head pipe rack



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

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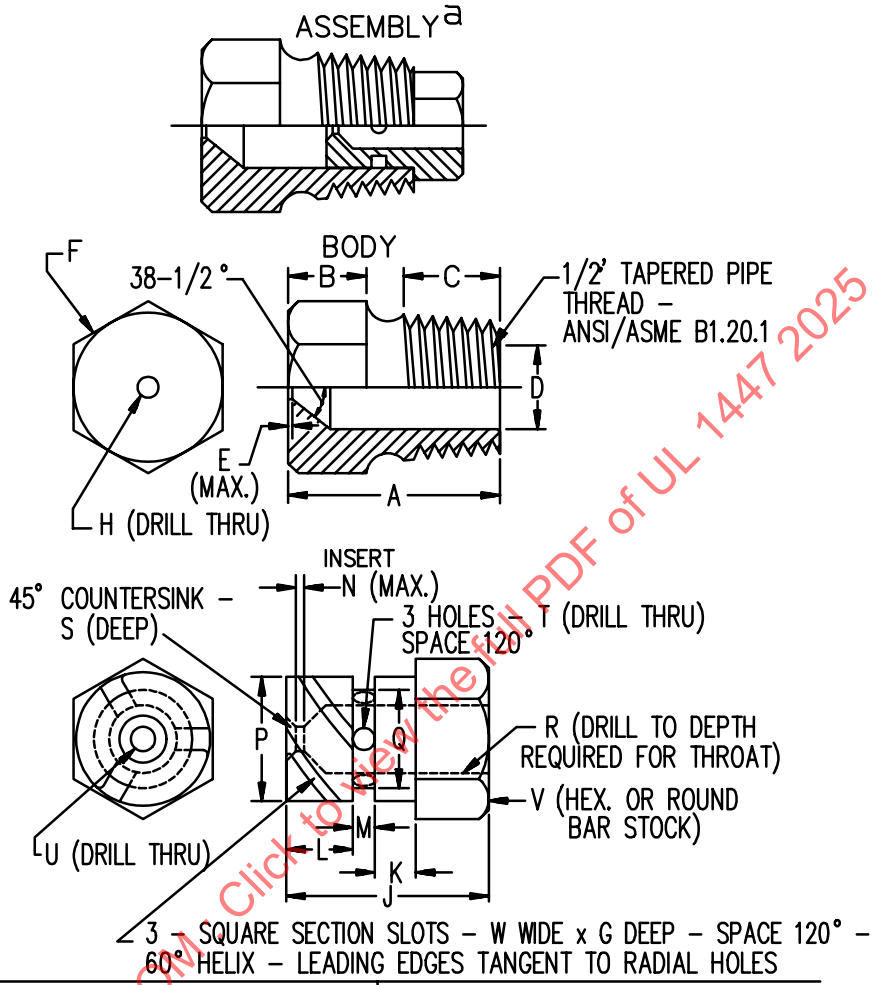
Figure 32.2

Rain test 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.

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33 Operation Tests

33.1 Blade stopping time after long term cycling

33.1.1 After 6000 cycles of operation, rotation of the blades shall cease within 5 seconds after the power is shut off. Mechanical means for braking the rotation shall show no evidence of malfunction.

33.1.2 To determine whether a mower complies with the requirements in 33.1.1, one sample is to be tested. Each cycle is to consist of 45 seconds on at maximum operating speed and 15 seconds off.

33.2 Peripheral speed

33.2.1 With the mower at maximum operating speed, the peripheral speed of any blade shall not exceed 19,000 feet (5791 m) per minute.

33.2.2 With reference to the requirement in 33.2.1, a 100-foot-long (30.5 m) cord set is to be used when the starting current is measured. If the manufacturer supplies a 100-foot cord set, that cord set is to be used. If a cord set of the required length is not supplied by the manufacturer, the following is to be used:

a) A 100-foot-long cord set having 16 AWG (1.3 mm^2) conductors if a 15 ampere attachment plug is provided on the lawn mower; or

b) A 100-foot-long cord set having 10 AWG (5.3 mm^2) conductors if a 20 ampere attachment plug is provided on the lawn mower.

33.3 Direction

33.3.1 The only direction of powered travel for a self-propelled mower shall be in the direction away from the handle.

33.3.2 Unless the direction of travel is governed by the position of the handle, a swing-over handle shall not be provided on a self-propelled mower.

33.4 Operation indicator

33.4.1 If the operation of a mower is so quiet that rotation of the blade or blades is not evident to the operator, an audible or visible indicator of blade rotation shall be provided on the mower.

33.5 Sound level

33.5.1 The sound level from a lawn mower shall not exceed 92 decibels on the "A" scale (dBA) with the microphone located 10 inches (254 mm) to the right and left of the position assumed by the operator when operating the product and 66 inches (1.68 m) above the ground.

33.5.2 Measurements of sound level are to be made with instrumentation conforming with IEC 61672-1 and IEC 61672-2.

33.5.3 The sound level test procedure is to be performed in accordance with the following:

a) An operator is to be at the lawn mower control when readings are taken;

b) The microphone is to be mounted independent of the equipment and operator; and

c) The sound-level meter is to be set on slow response (see 33.5.2).

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33.5.4 The test site is to be a flat open space free from any large reflecting surfaces, such as sign boards, buildings, or hillsides located within 100 feet (30.5 m) of the equipment being tested. The surface of the test area is to be grass, approximately 2 inches (51 mm) high. Equivalent laboratory conditions may be used.

33.5.5 The following operating conditions are to be established for the sound level test:

a) Ambient sound level, including wind, is to be at least 10 decibels below that of the equipment being tested;

b) Cutting height of the mower is to be adjusted for 2 inches (51 mm); and

c) The mower is to be operated at maximum speed in revolutions per minute in all modes of operation, but in a stationary position. Self-propelled lawn mowers may be blocked in position with clearance provided for the drive wheels.

34 Abnormal Operation Test

34.1 If a lawn mower employs a semiconductor or one or more semiconductor junctions, a capacitor, or a combination of both, no risk of fire, electric shock, or injury to persons shall result when either any semiconductor junction or capacitor is short or open-circuited.

34.2 To determine whether a lawn mower complies with the requirements in 34.1, the lawn mower is to be connected to a grounded supply of rated frequency and maximum rated voltage and is to operate at no load with the short- or open-circuited condition introduced. Only one abnormal condition is to be simulated at a time.

34.3 If the lawn mower is provided with a momentary-contact switch having no provision for being locked on and if there is indication of malfunction of the lawn mower, such as emission of smoke, inability of the lawn mower 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 lawn mower are to be connected to ground through a 3-ampere fuse. The results are unacceptable if the fuse opens during the test.

34.4 During the tests described in 34.2, the lawn mower 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 lawn mower could be properly connected. Opening of the fuse before a risk of fire, electric shock, or injury to persons results is an acceptable conclusion of a test.

35 Handle Durability Test

35.1 If the insulating material used for handles, as specified in 6.4.1, overlies dead metal:

a) The material shall not show holes, cracks, distortion, or other evidence of unacceptable deterioration after being conditioned as described in 35.2; and

b) The material shall not break, crack, rupture, or show other adverse effects after the lawn mower has been subjected to the impacts described in 35.3. The impact test is to be conducted on the samples that have been conditioned as described in 35.2.

35.2 The conditioning specified in 35.1, is to consist of keeping the lawn mower 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 normal operation, but at not less than 70°C (158°F).

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35.3 With reference to 35.1(b), each handle of a lawn mower is to be subjected to two impacts of 5 foot-pounds (6.8 J) as specified in 29.1. In the tests, two different handle assembly samples are not prohibited from being used, one for each impact.

36 Attachment Plug Test

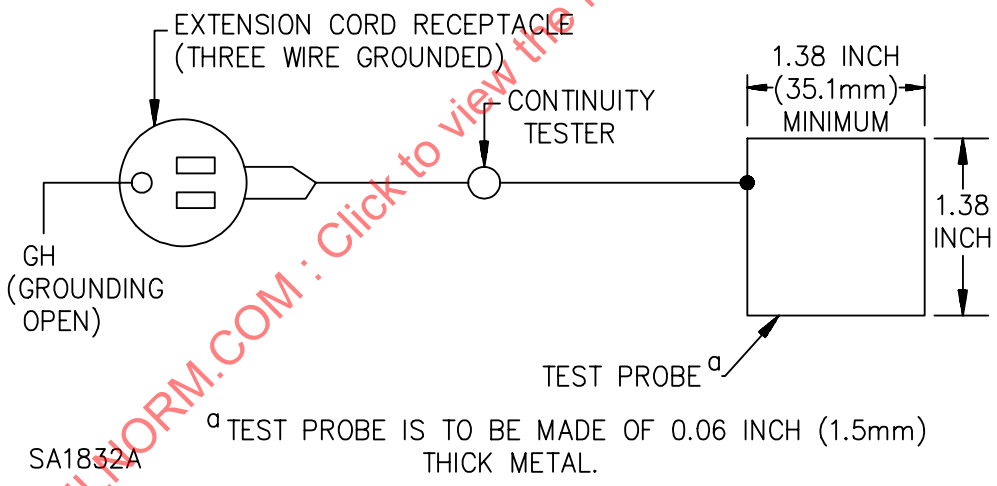
36.1 When tested as described in 36.2, the test probe shall not contact any blade of the lawn mower attachment plug while the plug is conductivity connected to the extension-cord connector.

Exception: The probe may contact the grounding blade of a 3-conductor grounding plug.

36.2 To determine whether an attachment plug complies with the requirement in 36.1, the plug is to be inserted in the extension-cord connector of the test assembly illustrated in Figure 36.1, as far as possible. The plug is then to be withdrawn not more than the 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 pounds (18 N) or less, until the probe contacts one blade of the plug. While the probe is in contact with the plug 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 then to be repeated for the other blade of the attachment plug.

Figure 36.1

Plug blade shielding gage



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37 Strain Relief Test

37.1 Pull

37.1.1 When tested as described in 37.1.2, the strain-relief means provided on the power supply cord shall withstand for 1 minute, without displacement, a pull of 35 pounds (156 N) applied to the cord, with the connections within the lawn mower disconnected.

37.1.2 A 35-pound (15.9 kg) weight is to be suspended from the power supply cord and supported by the lawn mower so that the strain-relief means will be stressed from any angle that the construction of the lawn mower 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.

37.2 Torque

37.2.1 A power supply cord shall withstand for 1 minute 50 ounce-inches (0.353 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 12.5.3, a product shall be tested in accordance with 38.2, without occurrence of any of the conditions specified in 12.5.3 (a) – (d).

38.2 The supply cord is to be held 1 inch (25.4 mm) from the point where the cord 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 bushing is to then 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 pounds-force (26.7 N). The supply cord within the product is to be manipulated to determine compliance with 12.5.3.

39 Cord Flexing Test

39.1 A power supply cord shall withstand 20,000 cycles of flexing at the cord entrance to the product. Flexing shall be performed at a rate not exceeding 10 cycles per minute, unless agreeable to those concerned.

39.2 Three samples are to be tested. Each sample is to be mounted so that the cord entrance point of the product is at the center of rotation. A 1-pound (0.45-kg) weight is to be attached to the cord between 3 feet and 5 feet (0.91m and 1.52 m) from the cord entry point. Any additional cord beyond 5 feet is to be removed. Guides are to be provided 3 feet from the cord entry point to minimize bouncing or side-to-side motion of the cord. The weight is to be located so as not to interfere with the guides. When a short cord is employed, the additional length is to be obtained by using an attached cord set that the manufacturer makes available. If a cord retaining device is provided with the lawn mower, the device is to be removed for this test. See Figure 39.1.

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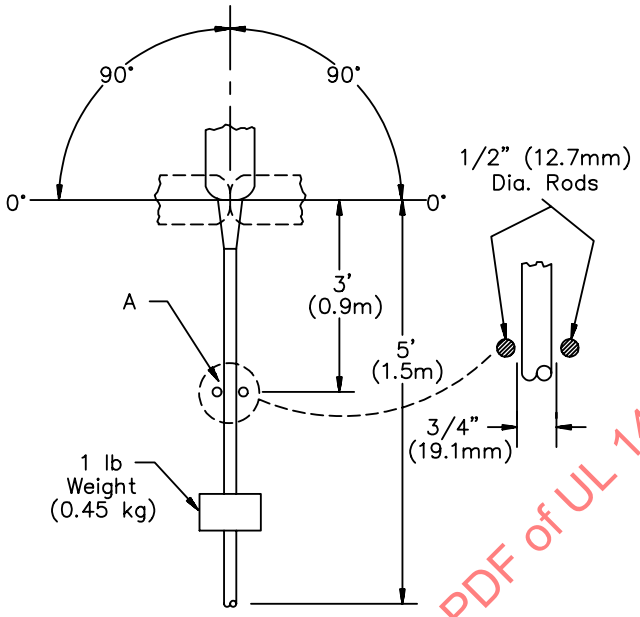
Figure 39.1

Cord flexing



A – Portions of the cord damaged by contact with the guides or attachment of the weight may be removed prior to the electrical tests.

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39.3 Starting with the cord in a vertical position and the cord entrance pointing downward, each cycle is to consist of rotating the entrance point 90 degrees to the horizontal position, rotating back 180 degrees to the opposite horizontal position, and then back to the vertical position, for a total rotation of 360 degrees. Rotation is to be smooth with no sudden starts or stops.

39.4 After flexing:

a) Each current-carrying conductor shall be capable of carrying its rated ampacity (for the size conductor) as given in ANSI/NFPA 70 for 2 minutes without interruption. A grounding conductor, when provided, shall be capable of carrying twice its rated ampacity for 2 minutes without interruption.

b) Following the test specified in (a), there shall be no dielectric breakdown when a potential of 1000 V plus twice the rated voltage of the product is applied for 1 minute between the individual conductors of the cord with the internal connections to the product severed and insulated, and between live parts and accessible metal parts.

c) There shall be no breakage of a cord jacket or individual conductor insulation. No strands shall be exposed through conductor insulation.

40 Pressure Pad Test

40.1 To determine if the pressure pad tests described in 40.2 and 40.3, are needed, a sample of the lawn mower is to be operated at no load for a period of 1 hour with the pad specified in 9.1.14, removed from the lawn mower. At the conclusion of the test, the lawn mower is to be carefully examined for evidence of a

risk of fire or electric shock. If there is such evidence, the tests described in 40.2, and, if applicable, 40.3, shall be conducted.

40.2 To determine compliance with 9.1.14, three samples of a soft rubber, neoprene, or polyvinyl chloride pressure pad, after conditioning in a full-draft, air-circulating oven maintained at a temperature of 20°C (36°F) more than the normal operating temperature for 168 hours, shall not undergo any change in dimension that will result in inability of the pad to hold down or maintain permanent position of an electrical part.

40.3 If a pressure pad is likely to be exposed to grease, three samples of the pad mentioned in 9.1.14, are to be conditioned for 18 hours in oil at a temperature of 20°C (36°F) more than the normal operating temperature. The oil to be used is IRM 902. The pads shall not undergo any change in dimension that will result in inability of the pad to hold down or maintain permanent position of an electrical part.

41 Switch and Control Tests

41.1 General

41.1.1 Switching contacts in an isolated secondary circuit that is limited to 100 volt-amperes or less:

a) Need not be investigated to determine whether it is suitable for the particular application; and

b) Need not be subjected to the tests in this section.

41.2 Locked rotor test

41.2.1 A switch or other device that controls the motor of a lawn mower shall perform acceptably when subjected to an overload test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the lawn mower. There shall not be any electrical or mechanical breakdown of the switch or undue pitting or burning of the contacts.

Exception No. 1: A reversing switch is to be tested as described in 41.3.1 and 41.3.2.

Exception No. 2: A speed changing switch is to be tested as described in 41.3.3 and 41.3.4.

Exception No. 3: This requirement does not apply to a switch that controls an induction motor and that has a horsepower rating no less than the controlled motor horsepower rating.

Exception No. 4: This requirement does not apply to a switch that is interlocked so that it will never have to break the locked rotor current.

41.2.2 For tests described in 41.2.3 – 41.3.4, the lawn mower is to be connected to a grounded power-supply circuit of rated frequency and maximum rated voltage. See 30.7. During the tests, exposed dead metal parts of the lawn mower are to be connected to ground through a 3-ampere plug fuse, so that any single-pole, current-rupturing device will be located in the ungrounded conductor of the supply circuit. If the lawn mower is intended for use on direct current, or on direct current as well as on alternating current, the exposed dead metal parts of the lawn mower are to be connected so as to be positive with respect to any single-pole, current-rupturing control device. Test results are not acceptable if the fuse in the grounding connection opens during any of the tests.

41.2.3 For the overload test described in 41.2.1, the rotor of the motor is to be locked in position, and the switch or control is to be operated at a rate of not more than 10 cycles per minute and is to be left in the "on" position as briefly as possible.

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

41.3 Reversing switch test

41.3.1 A switch or other device used for reversing the motor of a lawn mower, unless rated for the application, shall perform acceptably when subjected to a test consisting of 25 cycles of operation as described in 41.3.2. There shall not be any:

a) Electrical or mechanical breakdown of the device;

b) Undue pitting or burning of the contacts; or

c) Emission of molten metal or flame from the enclosure of the lawn mower.

41.3.2 For the test specified in 41.3.1, each cycle of operation is to consist of:

a) Throwing the switch to the position in which the motor of the lawn mower rotates in one direction, allowing it to attain full operating speed in that direction;

b) Then, 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 motor to attain normal speed in that direction; and

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

41.3.3 A switch or other device for changing the speed of the motor of a lawn mower, other than an on-off switch, unless rated for the application, shall perform acceptably when subjected to a test consisting of 50 cycles of operation as described in 41.3.4. There shall not be any:

a) Electrical or mechanical breakdown of the device;

b) Undue pitting or burning of the contacts; or

c) Emission of molten metal or flame from the enclosure of the lawn mower.

41.3.4 For the test specified in 41.3.3, each cycle of operation is to consist of operating the lawn mower 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.

42 Capacitor Test

42.1 An electrolytic capacitor not provided with means for venting and with an opening (gap) more than 1/16-inch (1.6 mm) wide that does not comply with the requirement for enclosure thickness in 20.1, shall not ignite the cotton or emit molten metal when it is tested as described in 42.2.

42.2 Three samples of the capacitor, mounted in the usual manner and with cotton placed around openings in the enclosure are to be subjected to such overvoltage as to cause breakdown or malfunction.

43 Accelerated Aging Test

43.1 A rubber or neoprene compound forming a part that is depended upon for protection from rain shall have physical properties as specified in Table 43.1, before and after accelerated aging.

43.2 The test procedure for determining whether a part complies with the requirement in 43.1, depends upon the material of which it is composed, its size and shape, the application in the lawn mower, and other

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factors. The test procedure may include visual inspection for cracks, deformation, and the like, after accelerated aging, as well as comparison of hardness, tensile strength, and elongation before and after accelerated aging.

43.3 With reference to 43.1 and 43.2, a part made of rubber or neoprene, tested to compare its tensile strength and elongation before and after accelerated aging, is acceptable if these properties are found to be not less than the minimum values specified in Table 43.1, corresponding to the temperature of the component during the temperature test.

Table 43.1
Accelerated aging test

Temperature on component during temperature test		Accelerated aging procedures	Minimum acceptable percent of unaged value for samples	
°C	(°F)		Tensile strength	Elongation
60 or less	(140 or less)	Air oven aging for 70 hours at 100 ±2°C (212 ±3.6°F)	60	60
61 – 75	(142 – 167)	Air oven aging for 7 days at 100 ±2°C (212 ±3.6°F)	50	50
76 – 90	(169 – 194)	Air oven aging for 7 days at 121.0 ±1.0°C (249.8 ±1.8°F)	50	50
91 – 105	(196 – 221)	Air oven aging for 7 days at 136.0 ±1.0°C (276.8 ±1.8°F)	50	50
All of the above[a]		Immersion for 168 hours in boiling solution of commercial dishwashing detergent – 25 grams per liter of water	50	50

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

44 Permanency of Marking Tests

44.1 General

44.1.1 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. Ordinary usage, handling, storage, and the like, of the lawn mower shall be considered in determining the permanence of a marking.

44.1.2 To determine if a pressure-sensitive label secured by adhesion is adequate for the intended use, representative samples are to be subjected to the tests described in 44.1.3 – 44.4.1. Samples of the label are to be applied to test surfaces employed in the intended application.

44.1.3 The adhesion of the pressure-sensitive labels is considered to be acceptable if immediately following removal from each test medium, and after being exposed for 24 hours to room temperature following removal from each test medium:

a) Each sample demonstrates good adhesion and edges are not curled;

b) The label resists defacement or removal as demonstrated by scraping across the test panel with a flat metal blade 1/32-inch (0.8 mm) thick, held at a right angle to the test panel; and

c) The printing is legible and is not defaced by rubbing with thumb or finger pressure.

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44.2 Oven aging test

44.2.1 Three samples of the test panels are to be placed for 240 hours in an air oven maintained at the temperature indicated in Table 44.1.

Table 44.1
Oven aging test temperatures

Maximum temperature – as measured during normal temperature test – of surface to which label is applied		Test temperature	
°C	(°F)	°C	(°F)
60	(140) or less	87	(189)
61 – 80	(142 – 176)	105	(221)
81 – 100	(178 – 212)	121	(250)
101 – 125	(214 – 257)	150	(302)
126 – 150	(259 – 302)	180	(346)

44.3 Immersion test

44.3.1 Six samples of the mounted label are to be placed for 24 hours in a controlled atmosphere maintained at 23 ±2°C (73 ±4°F) with a 50 ±5 percent relative humidity. Three samples are then immersed in water and three samples are immersed in oil at a temperature of 21 ±2°C (70 ±4°F) for 48 hours in each case.

44.4 Standard atmosphere test

44.4.1 Three samples of the mounted label are to be placed for 72 hours in a controlled atmosphere maintained at 23±2°C (73 ±4°F) with a 50 ±5 percent relative humidity.

45 Polymeric Materials Other Than HB

45.1 Mold stress evaluation

45.1.1 When tested under the conditions described in 45.1.2, the enclosure material shall comply with all of 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 in 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 or distortion shall be limited to the extent that the lawn mower complies with the strain-relief requirements in Section 37, Strain Relief Test.

45.1.2 Three samples of the complete lawn mower 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 during the Temperature Test, Section 30, but not less than 70°C (158°F). Immediately following this, the sample is to be examined with reference to the requirement in 45.1.1(a). After cooling to

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room temperature, the sample is to be examined with reference to 45.1.1 (b) – (d), and tested with reference to 45.1.1(e).

45.1.3 The oven conditioning described in 45.1.2, may cause the enclosure to distort to the extent that it is in a throwaway condition. These results are acceptable provided the performance is evaluated several times during the oven conditioning to ensure that intermediate stages of distortion do not constitute a risk of fire, electric shock, or injury to persons.

45.1.4 Crazing of the polymeric material is considered to be acceptable with regard to the requirements in 45.1.1.

45.2 Resistance to impact test

45.2.1 A lawn mower shall withstand the impact described in 45.2.3 without:

a) Making live parts accessible to contact; or

b) Producing any other condition that would increase the risk of shock of the lawn mower.

45.2.2 With reference to 45.2.1(b), cracking of the enclosure is not to affect the function of any safety or constructional feature, such as a thermostat, an overload-protective device, or strain relief. Cracking of the enclosure is not acceptable if a dust or moisture-tight enclosure is required.

45.2.3 A lawn mower is to be subjected to three impacts of 5 foot-pounds (6.8 J) as specified in 29.1, on any surface that is exposed to a blow during normal use.

45.3 Abnormal operation tests

45.3.1 When a lawn mower is connected to the circuit described in 34.2, and tested in accordance with 45.3.2, there shall not be:

a) Ignition of the enclosure material;

b) Exposure of live parts; or

c) Emission of flame or molten metal, or glowing or flaming of the combustible material upon which the lawn mower is placed.

Exception: Any emission of flame or molten metal or glowing or flaming of the combustible supporting surface that may result from such emission is acceptable if it occurs through an opening provided as a part of the design and construction of the enclosure – not an opening that occurs as a result of this test.

45.3.2 The lawn mower is to be operated under the condition of abnormal operation, such as stalled-rotor operation, operation with current-carrying parts short-circuited, or the like. During the test, the lawn mower is to rest on white tissue paper on a softwood surface and is to operate continuously until the ultimate results have been determined. In most cases, continuous operation will be necessary until constant temperatures are reached.

45.3.3 With reference to the requirement in 45.3.1, warping, shrinkage, expansion, or cracking of the material of the enclosure is acceptable.

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45.4 Flame resistance test

45.4.1 When tested in accordance with 45.4.2 – 45.4.4, the enclosure shall not support combustion for more than 1 minute after two 30-second applications of a test flame, with an interval of 1 minute between applications of the flame, and shall not be completely destroyed as a result of this test.

45.4.2 Three samples of the enclosure are to be placed in an oven for 7 days maintained at a temperature not less than 10°C (18°F) higher than the maximum temperature of the material measured during the Temperature Test, Section 30, but not less than 70°C (158°F). After cooling to room temperature, the samples are to be tested in accordance with 45.4.3 and 45.4.4.

Exception: This conditioning does not apply if:

a) It has been determined previously by means of a long-time thermal aging program that the flame-retardant properties of the enclosure material are not adversely affected by aging; and

b) The aging program included specimens at least as thin as the wall of the enclosure.

45.4.3 Three sections of the enclosure of the lawn mower that are most likely to be ignited are to be selected. Sections adjacent to coil windings, splices, open switches, or other arcing or sparking parts are considered as those most likely to be ignited. Using a separate sample in each case, each section is to be subjected to the flame test described in 45.4.4. During the test, the lawn mower is to be supported in its intended operating position in a draft-free location; the nonpolymeric portions of the enclosure in contact with or fastened to the polymeric portions are not to be removed; and, insofar as possible, the internal mechanism of the lawn mower is to be in place.

45.4.4 The flame of a Bunsen burner is to be adjusted to have a 3/4-inch (19.1-mm) yellow flame with no blue cone. Two 30-second applications of the tip of the flame are to be made to each section of the enclosure selected as indicated in 45.4.3, with a 1-minute interval between the applications.

45.4.5 A flame-retardant coating shall not be depended upon for acceptable results for the flammability requirements in 45.4.1 – 45.4.4.

46 Polymeric Materials Classified HB

46.1 General

46.1.1 A polymeric enclosure made of a material that is rated HB in accordance with 46.5.1, is not required to be subjected to the tests in Section 45, Polymeric Materials Other Than HB, and 46.2.1 – 46.4.5; or 46.6.1 – 46.7.5, when:

a) All live parts within the enclosure are acceptably 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 does 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.

46.1.2 With reference to 46.1.1(b), a component having integral leads shall be subjected to strain-relief tests unless such tests are a part of its regular test procedure.

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46.1.3 A polymeric enclosure of material that complies with the rate-of-burning requirement in Flame Test, Section 46.5, need not be subjected to the test required by 45.4.1, if all live parts within the enclosure are insulated or provided with internal enclosures independent of the outer polymeric enclosure.

46.2 Mold-stress evaluation

46.2.1 After being conditioned and evaluated as described in 45.1.1 – 45.1.4, and when operated at no load and at rated voltage, a lawn mower shall not have an input current more than 150 percent of the current measured during the input test conducted in accordance with 28.2 – 28.6.

46.3 Resistance to impact test

46.3.1 A lawn mower shall be subjected to the impact tests described in 45.2.3, and evaluated in accordance with 45.2.1 and 45.2.2.

46.4 Overload test

46.4.1 The no-load current input of a lawn mower that has completed the overload test described in 46.4.3, without burning out electrically shall not be more than 150 percent of the current measured during the input test on a previously unconditioned lawn mower in accordance with 28.1.

Exception: This requirement does not apply to a lawn mower tested in accordance with 46.4.5.

46.4.2 The enclosure of a lawn mower that burns out electrically during the overload test described in 46.4.3 or 46.4.5, shall not support flame for more than 1 minute.

46.4.3 A lawn mower is to be operated at no load for 1/2 hour and then at full load for 1/2 hour. The load is then to be increased every 15 minutes by 10 percent of the then-existing current until the current input equals approximately 150 percent of rated current or the lawn mower burns out.

46.4.4 During the overload test specified in 46.4.3, any overload-protective device provided with the lawn mower is to be short-circuited.

46.4.5 A lawn mower that has completed the overload test described in 46.4.3, without burning out, and has a no-load current input more than the value specified in 46.4.1, is to be operated until burnout occurs by continuing the overload conditioning.

46.5 Flame test

46.5.1 A polymeric material shall comply with the requirements for the horizontal burning test for classifying materials HB in UL 94.

46.6 Resistance to hot-wire ignition test

46.6.1 The polymeric material shall resist ignition for 7 seconds or longer when tested in accordance with 46.6.2 and 46.6.3.

Exception: A polymeric material is not required to be tested in accordance with 46.6.2 and 46.6.3, when the electrically live parts are spaced 1/32 inch (0.8 mm) or more from the surface of the polymeric material.

46.6.2 Each of three samples of the material, each 5-inches (127 mm) long, 1/2-inch (12.7 mm) wide, and having a thickness not more than the minimum thickness of the enclosure at any point, is to be

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wrapped with five turns of resistance wire, as described in 46.6.3, with a spacing of 1/4-inch (6.4 mm) between turns.

46.6.3 The wire is to be 24 AWG (0.21 mm^2), iron-free, 20 percent chromium and 80 percent nickel, conforming to 1.61 ohms per foot (5.28 ohms per meter) and 865 feet per pound (581 m/kg). The wire is to be approximately 10-inches (254 mm) long, and is to carry such current as to dissipate 65 watts. The measurement of time is to begin when the current begins to flow.

46.7 High-current arc ignition test

46.7.1 The spacing specified in 22.7(b), may be not less than 1/32 inch (0.8 mm) if the polymeric material does not ignite with 60 or fewer arcs when tested in accordance with 46.7.2 – 46.7.5.

46.7.2 Three samples of the polymeric material, each 5-inches (127 mm) long, 1/2-inch (12.7 mm) wide, and having a thickness not more than the minimum enclosure thickness, are to be tested.

46.7.3 The test is to be conducted using a pair of electrodes and a variable-inductive impedance load connected in series with a high-capacity alternating-current source. The stationary electrode is to be a 8 AWG (8.4 mm^2) solid copper conductor having a horizontal chisel point. The movable electrode is to be a 1/8-inch (3.2-mm) diameter stainless-steel rod having a pyramidal point. The major axis of each electrode is to be 45 degrees from the horizontal, and the major axes of both electrodes are to be in the same vertical plane. With the electrodes short-circuited, the variable-inductance impedance is to be adjusted until the current is 32.7 amperes at 240 volts alternating current, with a 50 percent power factor.

46.7.4 The sample is to be supported horizontally in air on a test stand. The movable electrode is to be provided with an insulated handle so that, with the circuit energized, it can be manually moved to contact the fixed electrode and then to break the electrical circuit. The electrodes are to be supported at a distance above the sample equal to the distance from the arc source to the enclosure in the lawn mower.

46.7.5 The movable electrode is to be moved in a horizontal direction to make and break electrical contact with the fixed electrode at a rate of 40 contacts per minute.

MANUFACTURING AND PRODUCTION TESTS

47 Production-Line Dielectric Voltage Withstand Test

47.1 Other than double-insulated mowers

47.1.1 A lawn mower shall withstand without breakdown for 1 minute the application of a 60-hertz essentially sinusoidal potential of 1000 volts plus twice rated voltage, other than as specified in 54.2, between live parts and dead metal parts. As an alternative to the test time of 1 minute, the test time may be reduced to 1 second if the potential is increased to 120 percent of the specified voltage.

47.1.2 For a lawn mower employing an induction motor rated less than 1/2 horsepower (373 W output) and 250 volts or less, the test potential for the motor – but not for the remainder of the lawn mower – is to be 1000 volts.

47.1.3 In applying 47.1.2, to a motor not rated in horsepower, use is to be made of the appropriate table of ANSI/NFPA 70, which specifies 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 lawn mower is marked for use on alternating current only; otherwise, the table applying to direct-current motors is to be used.

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47.1.4 The test equipment is to include an indication of breakdown that is audible or visible or both. In the event of breakdown, manual reset of an external switch is to be required, or an automatic reject of the unit under test is to result. The lawn mower is to be tested by means of a 500-volt-ampere 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.

Exception No. 1: A 500 volt-ampere or larger capacity transformer need not be used for the production-line dielectric tests if the transformer is provided with a voltmeter to measure the applied potential directly.

Exception No. 2: Test equipment other than that described may be used if found to accomplish the intended factory control.

Table 47.1
Production-line dielectric voltage withstand test potential for double-insulated lawn mowers

Points between which potential is to be applied		Test potential, volts
1.	Live parts and dead metal parts insulated from each other by basic insulation[a]	1000
2.	Accessible dead metal parts or, for a lawn mower with an outer enclosure of insulating material, metal foil wrapped tightly around the enclosure and inaccessible metal parts including metal foil in contact with the insulating barriers provided to accomplish compliance with the requirements in 73.6[a,b]	1500
3.	Live parts and accessible dead metal parts or, for a lawn mower with an outer enclosure of insulating material, metal foil wrapped tightly around the enclosure[a,b]	2500

[a] If necessary because of the inaccessibility of parts, tests in accordance with (1) and (2) may be conducted on subassemblies of the lawn mower, and in this case, the test described in (3) is to be conducted. If the tests in accordance with (1) and (2) are conducted on the completely assembled lawn mower, the test described in (3) may be omitted if there is no reinforced insulation.

[b] Those parts of the tests described in (2) and (3) that include application of metal foil to outer enclosures of insulating material may be waived provided that the manufacturer has an acceptable control program. To determine whether the material complies with the required physical and electrical properties, this program is to include the following:

1. Investigation of the dielectric properties of the materials. This investigation may be waived if the material has been investigated and found to be acceptable for the particular application.

2. Periodic physical property tests on molded parts.

3. Visual inspection of each molded part to determine that material is free from cracks and metal particles.

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47.2 Double-insulated mowers

47.2.1 Each finished double-insulated lawn mower shall withstand for 1 second without breakdown the application of a 60-hertz essentially sinusoidal test potential as specified in Table 47.1.

48 Production-Line Continuity of Ground Test

48.1 Each finished lawn mower shall comply with the requirement in 23.2(c), for continuity of the grounding connection.

RATING

49 General

49.1 A lawn mower shall be rated in volts, amperes, and frequency. The frequency shall be expressed in one of the following terms: hertz, Hz, cycles-per-second, cps, cycles/second, or c/s. If the lawn mower is intended for use on a direct-current circuit, such designation shall also be included in the rating.

Exception: In place of an ampere rating, a lawn mower may be rated in watts if the full-load power factor is 0.80 or more, or if the rating of the lawn mower is 50 watts or less.

MARKINGS

50 General

50.1 All required markings on a lawn mower shall be permanent as specified in Section 44, Permanency of Marking Tests. The markings shall also be legible, readily visible, and located on a part of the lawn mower that cannot be removed without impairing the operation of the lawn mower.

51 Identification and Rating

51.1 A product shall be legibly and permanently marked with:

a) The manufacturer's name, trade name, or trademark or other descriptive marking by which the organization responsible for the product may be identified when the manufacturer's identification is provided in a traceable code, the product shall be identified by the brand or trademark owned by a private labeler.

b) A distinctive ("catalog" or "model") number or the equivalent;

c) The electrical rating; and

d) The date or other dating period of manufacture not exceeding any three consecutive months. When the date of manufacture is abbreviated or is in a nationally accepted conventional code or in a code affirmed by the manufacturer, the code shall not repeat in less than 10 years, and shall not require reference to the production records of the manufacturer to determine when the product was manufactured.

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51.2 For a lawn mower employing a single motor as its only electric-energy-consuming component, the electrical rating given on the motor nameplate need not be shown elsewhere on the lawn mower if this nameplate is readily visible after the motor has been installed in the lawn mower.

51.3 If a lawn mower employs a dual-voltage motor and if the motor nameplate is employed to give the electrical rating of the lawn mower as indicated in 51.2, the lawn mower shall be additionally marked to indicate the particular voltage for which it is connected when shipped from the factory. If the lawn mower employs an attachment plug, instructions shall be provided to indicate the type of plug that should be used if the lawn mower is re-wired for the alternate voltage.

51.4 An accessory or the package containing it shall be marked with a catalog designation or the equivalent.

51.5 If a manufacturer produces or assembles lawn mowers at more than one factory, each finished lawn mower shall have a distinctive marking, which may be in code, by which it can be identified as the product of a particular factory.

52 Fuses

52.1 If a lawn mower will not start and attain normal running speed when connected to a circuit protected by an ordinary– not a time-delay – fuse as described in 26.1, the lawn mower shall be plainly marked with the following or the equivalent: "If connected to a circuit protected by fuses, use time-delay fuses with this lawn mower. "

53 Switches and Controls

53.1 A switch, other than a momentary contact switch – one that requires continuous pressure to hold it in the "on" position – that controls the motor of a lawn mower shall have a marked "off" position if the lawn mower, when energized, has moving parts that introduces a risk of injury to persons.

53.2 All positions of an operating control on a lawn mower shall be clearly identified by a marking.

Exception: This requirement does not apply to a momentary-contact operating control that cannot be locked "on".

54 Cautionary Markings

54.1 A required cautionary marking shall be of a color that contrasts with its background and shall be visible from the operator's position or from the position in which a specific risk of fire, electric shock, or injury to persons would be encountered.

54.2 In a cautionary marking, the words "CAUTION," "WARNING," or "DANGER " shall be in letters not less than 3/32-inch (2.4 mm) high.

54.3 If complete guarding of a moving part capable of causing injury to persons would defeat the intended function of the lawn mower, cautionary markings shall be provided to instruct the user how to reduce the risk of injury unless the risk is apparent to the user.

54.4 If the intended operation of a lawn mower contemplates cleaning or servicing by the user, such as the replacement of a pilot lamp, and if such cleaning or servicing would expose an otherwise enclosed or guarded live part to unintentional contact, the lawn mower shall be marked to indicate that such servicing or cleaning is to be done with the lawn mower disconnected from the supply circuit to reduce the risk of electric shock.

54.5 A lawn mower shall be provided with the warning label illustrated in Figure 54.1. The location of the label shall be as follows:

a) For a rotary mower, on the blade housing as close as possible to any discharge opening, or, if there is no discharge opening, in a position that is visible to the operator in the intended operating position.

b) For a reel-type mower, as close to the center of the cutting width of the blade as possible.

54.6 The dimensions of the label illustrated in Figure 54.1 shall be at least the values shown in the figure, and the lettering and symbol shall retain the same size relation to each other and to the label as shown in the figure.

54.7 A lawn mower shall be plainly marked with the word "WARNING " and the following or its equivalent "Risk of Electric Shock. Do not expose to water – replace damaged cord immediately."

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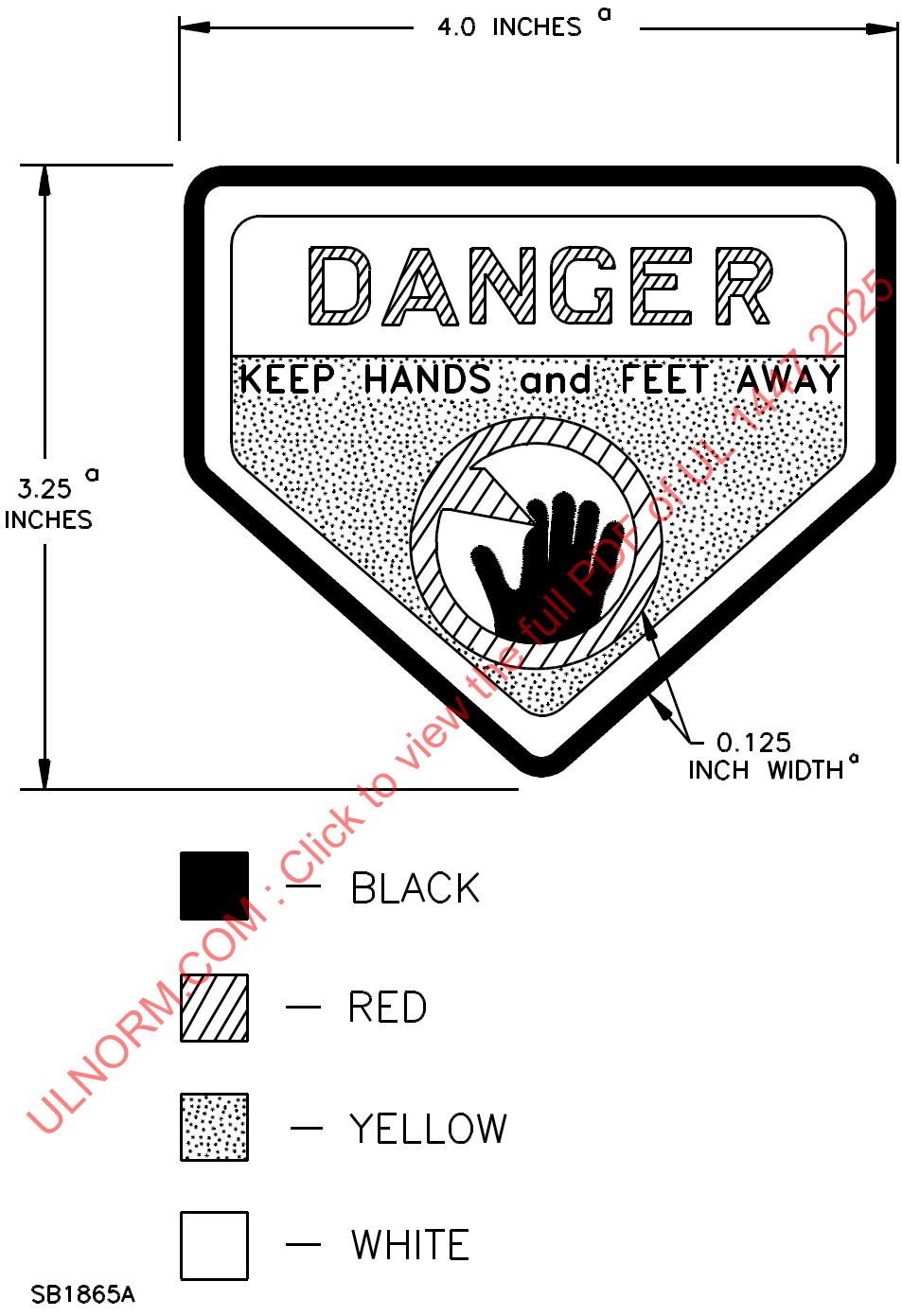
Figure 54.1

Warning label



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[a] SI values for the dimensions in this figure are:

Inches	(Millimeters)
4.0	(101)
3.25	(82.5)
0.125	(3.2)

54.8 If a lawn mower is shipped from the factory with a required guard detached, the lawn mower shall be legibly and permanently marked with the word "WARNING" and the following or its equivalent "Risk of Injury. Do not operate without guards in place."

54.9 Unless a battery-charger has been tested in accordance with 32.2.1 – 32.2.3, it shall be marked "Use indoors only."

54.10 If a lawn mower is provided with a catcher assembly that provides some or all of the guarding required by 57.1, the catcher assembly shall be permanently marked with the word, "WARNING," and the following or its equivalent, "To reduce the risk of injury, inspect catcher assembly frequently and replace with recommended replacement if there are signs of wear or deterioration." For the purposes of this requirement, a woven fabric with ink printing or a separate ink printed patch sewn to the catcher assembly is considered permanent.

54.11 A lawn mower that has been only subjected to the Thrown Objects Test of ANSI B71.1, with the catcher assembly in place, shall be marked with the word, "WARNING," and the following or its equivalent, "To reduce the risk of injury, do not operate lawn mower unless catcher assembly is attached. " This marking shall be readily visible from the operator's position. This marking may be located so it is readily visible to the operator upon removal of catcher assembly.

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INSTRUCTIONS

55 Instruction Manual

55.1 General

55.1.1 An instruction manual shall be provided with a lawn mower.

55.1.2 The instruction manual shall specifically warn the user against each risk of fire, electric shock, or injury to persons and state the precautions that should be taken to guard against those risks.

55.1.3 A lawn mower that has been only subjected to the Thrown Object Test of ANSI B71.1, with the catcher assembly in place, shall contain a warning statement in the instruction manual to indicate that risk of injury could occur if the lawn mower is operated without the catcher assembly attached.

55.1.4 The safety instruction shall be separated in format from the other instructions, and shall appear before the operating instructions in the instruction manual. The instructions shall be legible, and shall contrast with the background.

55.1.5 A lawn mower provided with a catcher assembly that provides some or all of the guarding required by 57.1, shall contain a warning notice in the instruction manual as to the durability of the catcher assembly. This notice shall state that under normal usage, the catcher assembly is subject to deterioration and wear and should, therefore, be frequently checked for replacement. It shall also state that any replacement assembly should be checked for compliance with the original manufacturer's recommendations or specifications.

55.1.6 The instruction manual shall include the following specific identifications and warning information applicable to accessories and attachments:

a) A statement specifying only those accessories and attachments that have been found to be acceptable for use with the lawn mower;

b) A warning to the user that the use of any other accessory or attachment might increase the risk of injury;

c) Instructions to the user in the safe use of the accessory or attachment; and

d) A statement indicating that devices for retaining extension cords are available.

55.1.7 When the double insulation symbol (a square within a square) is used as the only marking to identify a unit as being double insulated, the symbol shall be defined in the instruction manual (See Section 84, Details).

55.1.8 The instruction manual shall include the name and address (city, state, and zip code) of the manufacturer or brand-name distributor.

55.2 Safety instructions

55.2.1 The instruction manual shall include a safety instruction Section A or Section B, whichever is appropriate, and the applicable items of Section C of the following warning instructions, or the equivalent. The phrases "Read All Instructions" and "SAVE THESE INSTRUCTIONS" shall appear and shall be the first and last items, respectively. The phrase "Read All Instructions" shall be preceded by the statement "WARNING: When using electric lawn mowers, basic safety precautions should always be followed to reduce the risk of fire, electric shock, and personal injury, including the following:" Equivalent wordings in equally definitive terminology are not prohibited from being used when they meet the intent of the instruction, except for the signal word. The instructions shall be legible, and shall contrast with the background.

a) FOR ALL GROUNDED LAWN MOWERS

1) Grounding Instructions

This lawn mower should be grounded while in use to reduce the risk of injury to the operator from electric shock. The lawn mower is equipped with an approved three-conductor cord and three-prong grounding-type plug to fit the proper grounding-type receptacle. The green or green and yellow conductor in the cord is the grounding wire. Never connect the green or green and yellow wire to a live terminal. If your unit is for use on less than 150 volts, it has a plug as shown in sketch A in Figure 55.1. If it is for use on 150 to 250 volts, it has a plug as shown in sketch D.

An adapter, sketches B and C, is available for connecting plugs as shown in sketch A to two-prong receptacles. The green-colored rigid ear, lug, or the like, must be connected to a permanent ground, such as a properly grounded outlet box. No adapter is available for the plug shown in sketch D.

2) Extension Cords

Use only three-wire outdoor extension cords that have three-prong grounding-type plugs and three-pole receptacles that accept the lawn mower's plug.

b) FOR ALL DOUBLE-INSULATED LAWN MOWERS

1) Replacement Parts

When servicing use only identical replacement parts.

2) Polarized Appliance Connections

To reduce the risk of electric shock, this appliance has a polarized plug (one blade is wider than the other) and will require the use of a polarized extension cord. The appliance plug will fit into a polarized extension cord only one way. If the plug does not fit fully into the extension cord, reverse the plug. If the plug still does not fit, obtain a correct polarized

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extension cord. A polarized extension cord will require the use of a polarized wall outlet. This plug will fit into the polarized wall outlet only one way. If the plug does not fit fully into the wall outlet, reverse the plug. If the plug still does not fit, contact a qualified electrician to install the proper wall outlet. Do not change the equipment plug, extension cord receptacle, or extension cord plug in any way.

c) FOR ALL LAWN MOWERS

1) Avoid Dangerous Environment – Don't use lawn mowers in damp or wet locations.

2) Don't Use In Rain.

3) Keep Children Away – All visitors should be kept a safe distance from work area.

4) Dress Properly – Do not wear loose clothing or jewelry. They can be caught in moving parts. Use of rubber gloves and footwear is recommended when working outdoors.

5) Use Safety Glasses – Always use face or dust mask if operation is dusty.

6) Use Right Appliance – Do not use lawn mower for any job except that for which it is intended.

7) Ground Fault Circuit Interrupter (GFCI) protection should be provided on the circuit(s) or outlet(s) to be used for the lawn mower. Receptacles are available having built-in GFCI protection and may be used for this measure of safety.

Exception: This instruction does not apply to a battery-power lawn mower.

8) Warning – To prevent electric shock use only with an extension cord suitable for outdoor use, such as SW, SOW, STW, STOW, SJW, SJOW, SJTW, or SJTOW.

Exception: This instruction does not apply to a battery-powered lawn mower.

9) Extension Cord – Make sure your extension cord set is in good condition. When using an extension cord, be sure to use one heavy enough to carry the current your product will draw. For lengths less than ____ feet, No. ___ AWG extension cord should be used. An undersized cord will cause a drop in line voltage resulting in loss of power and overheating.(NOTE: Table 55.1, shows the correct size to use depending on cord length and nameplate ampere rating. If in doubt, use the next heavier gage. The smaller the gage number the heavier the cord.) To reduce the likelihood of disconnection of lawn mower cord from the cord set during operating:

i) Make a knot as shown in Figure 55.2, or

ii) Use one of the plug-receptacle retaining straps or connectors described in this manual.

Exception: This instruction does not apply to a battery-powered lawn mower.

10) Don't Abuse Cord – Never pull lawn mower by cord or yank it to disconnect from receptacle. Keep cord from heat, oil, and sharp edges.

Exception: This instruction does not apply to a cordless battery-powered lawn mower.

11) Don't Force Lawn Mower – It will do the job better and safer at the rate for which it was designed.

12) Don't Overreach – Keep proper footing and balance at all times.

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13) Stay Alert – Watch what you are doing. Use common sense. Do not operate lawn mower when you are tired.

14) Disconnect Lawn Mower – Disconnect the lawn mower from the power supply when not in use, before servicing, when changing accessories such as blades, and the like.

Exception: This instruction does not apply to a battery-powered lawn mower.

15) Store Idle Lawn Mower Indoors – When not in use, lawn mower should be stored in an indoor dry and locked-up place – out of reach of children.

16) Maintain Lawn Mower With Care – Keep cutting edges sharp and clean for best and safest performance.

Follow instructions for lubricating and changing accessories.

Inspect lawn mower cord periodically and if damaged, have it repaired by an authorized service facility. Inspect extension cords periodically and replace if damaged. Keep handles dry, clean, and free from oil and grease.

Exception: The statement, "Inspect extension cords periodically and replace if damaged." may be omitted for a battery-powered lawn mower.

17) Keep guards in place and in working order.

18) Keep blades sharp.

19) Keep hands and feet away from cutting area.

20) Objects struck by the lawn mower blade can cause severe injuries to persons. The lawn should always be carefully examined and cleared of all objects prior to each mowing.

21) If lawn mower strikes a foreign object, follow these steps:

i) Stop lawn mower. Release the switch.

ii) Unplug power cord.

iii) Inspect for damage.

iv) Repair any damage before restarting and operating the lawn mower.

22) Use identical replacement blades only.

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Figure 55.1

Grounding motors

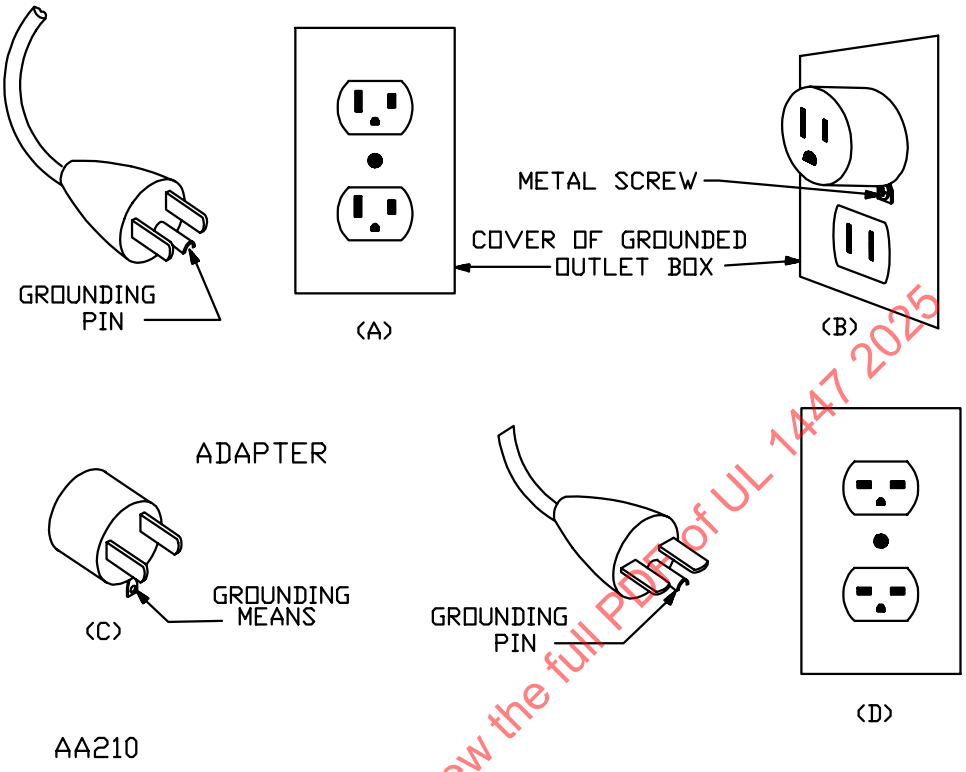

Table 55.1
Minimum gauge for extension cords

		Volts	Total length of cord in feet			
		120V	25	50	100	150
		240V	50	100	200	300
Ampere rating more than	**Ampere rating not more than**		**AWG**			
0	6		18	16	16	14
6	10		18	16	14	12
10	12		16	16	14	12
12	16		14	12	Not Recommended	

NOTE – Only the applicable parts of the Table need to be included. For instance, a 120-volt product need not include the 240-volt heading.

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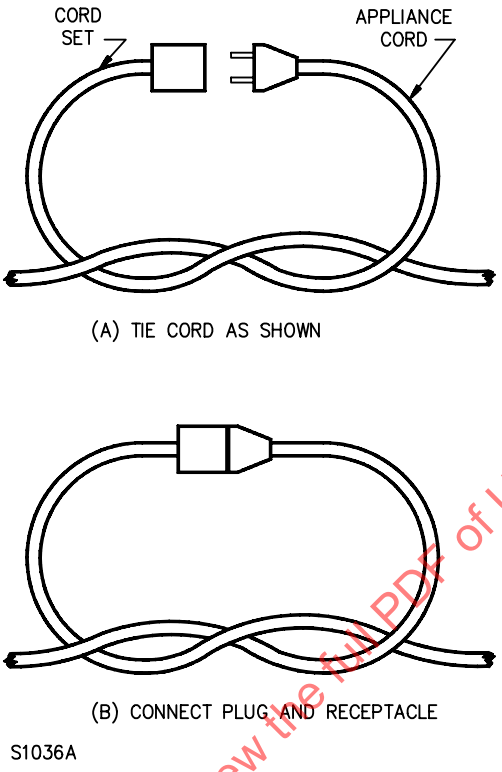
Figure 55.2

Method of securing cord set



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PART 2 – ROTARY LAWN MOWERS

GENERAL

56 Scope

56.1 These requirements cover rotary lawn mowers. These requirements are intended to add to, or modify, the requirements in Sections 2 – 31.

CONSTRUCTION

57 Mechanical Assembly

57.1 Each discharge opening of a rotary lawn mower shall be so located or guarded that grass clippings and debris do not discharge directly into the operator zone.

58 Switches and Controls

58.1 When moving in the normal direction of travel, the blade or blades of a walk-behind rotary mower shall come to a complete stop within 3 seconds after release of the blade control. See 63.1.

58.2 A walk-behind rotary mower shall be provided with a means that must be manually actuated before the blade or blades can be restarted. The means shall be either a control that is separate from the blade control, or it shall be incorporated into the blade control as a double action device that requires two separate actions to restart the blade or blades. See 63.1.

58.3 A walk-behind rotary motor having a blade that begins rotating when the motor is energized shall have its normal starting means located within the operating control zone. See 4.20 and 4.21.

PERFORMANCE

59 General

59.1 The tests described in 61.1 – 62.2, are to be conducted with:

a) The blade or blades assembled in the intended manner on a complete mower;

b) The mower resting on a horizontal surface and secured in place, if necessary, with resilient restraints; and

c) The motor operating at the manufacturer's recommended maximum governed speed. The tests are to be conducted once for each blade of a mower, but a new mower may be used for the tests of each blade of a multi-blade mower.

60 Input Test

60.1 For rotary lawn mowers, the input test is to be conducted with the lawn mower operating without load.

61 Impact Test

61.1 No part of the mower shall fracture, break, loosen, or deform in a manner that introduces a risk of injury to the operator or to bystanders as a result of the test described in 61.2.

61.2 The mower is to be positioned and operated over the test fixture illustrated in Figure 61.1. The test fixture is to be secured so that no movement of the fixture frame occurs during an impact. The mower blade is to be adjusted to the cutting height closest to 2 inches (51 mm) and positioned so that, when the rod is inserted into the blade housing, the portion of the rotating blade within 2 inches of the tip will strike the exposed portion of the rod.

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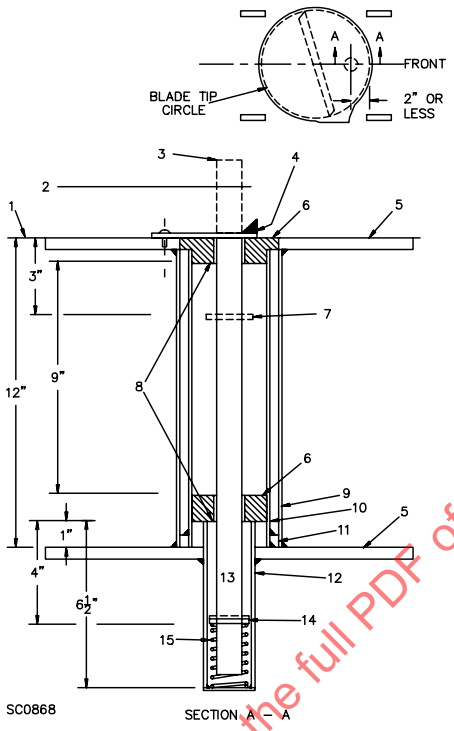
Figure 61.1

Typical sudden-impact test fixture



1. Floor Level
2. Blade height
3. Release position of rod
4. Remote control release
5. 1/2-inch (12.7-mm) plate
6. 1 inch (25.4 mm) thick hardened steel bushing, 1-1/8-inch (28.6-mm) diameter hole in center
7. Pin
8. Chamfer
9. 4-inch (102-mm) pipe
10. 3-inch (76-mm) pipe
11. Spacer
12. 2-inch (51-mm) pipe
13. 1-inch (25.4-mm) diameter SAE 1117 steel rod
14. Pin and washer
15. Compression spring

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62 Out-of-Balance Test

62.1 No part of the mower shall fracture, break, loosen, or deform in a manner that introduces a risk of injury to the operator or a bystander as a result of the test described in 62.2.

62.2 A blade is to be made unbalanced by removing or adding material at one end of the blade, and the mower is then to be operated in the unbalanced condition for 1 hour or until it ceases to function. The magnitude of unbalance, (U) in ounce-inches is to be calculated from the equation:

$$U = \frac{L^3}{1855}$$

in which L is the diameter of the blade-tip circle in inches.

For the SI system of units, the equation is:

$$U = \frac{L^3}{4.3}$$

in which U is in newton-meters and L is in meters.

63 Blade Stopping Time

63.1 To determine compliance of a mower blade control with 58.1, the following test is to be conducted:

a) The blade of the mower is to be operated for 6 minutes at the manufacturer's recommended maximum governed speed.

b) The blade control is to be released immediately after completing the 6 minutes of operation.

c) The time elapsed between release of the blade control and a complete stop in motion of the blade is to be measured.

64 Torque Test

64.1 When subjected to the torque test described in 64.2, the blade or blade-support restraining means shall not fracture, break, loosen, or deform in a manner that introduces a risk of injury to the operator or bystanders, and the initial fastener torque shall not have decreased more than 10 percent.

64.2 With the blade-drive restraining means tightened to the torque value specified by the manufacturer and with the blade shaft locked against rotation, torque is to be applied to the mower blade or, in the case of pivoted blades, to the blade-support member in the direction of normal rotation until the blade or blade-support member turns relative to the shaft, or until a torque of 50 pound-feet (68 N·m) is reached. If the blade turns relative to the shaft, it is to be turned for 15 revolutions, or until the torque applied reaches the 50-pound-foot limit. The blade is also to be turned in the opposite direction 15 revolutions or until the torque applied reaches the 50 pound-foot limit.

65 Structural Integrity Test

65.1 A catcher assembly and a guard shall be constructed of materials that will withstand the impact described in 65.2, without introducing a risk of injury to the operator or to bystanders.

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65.2 A 1/2-inch (12.7-mm) diameter steel ball is to strike the guard or catcher assembly at a velocity equal to the maximum blade-tip speed that can be obtained with the mower operating at the maximum governed speed specified by the manufacturer. The ball is to contact the material at an angle closest to the perpendicular that can be created by normal trajectory lines from the blade-tip circle to the guard or catcher assembly.

65.3 The shield of a mower that is provided to comply with the requirements of the foot contact test described in Section 66, Foot Contact Test, shall not permanently fracture, break, loosen, or deform as a result of the test described in 65.4.

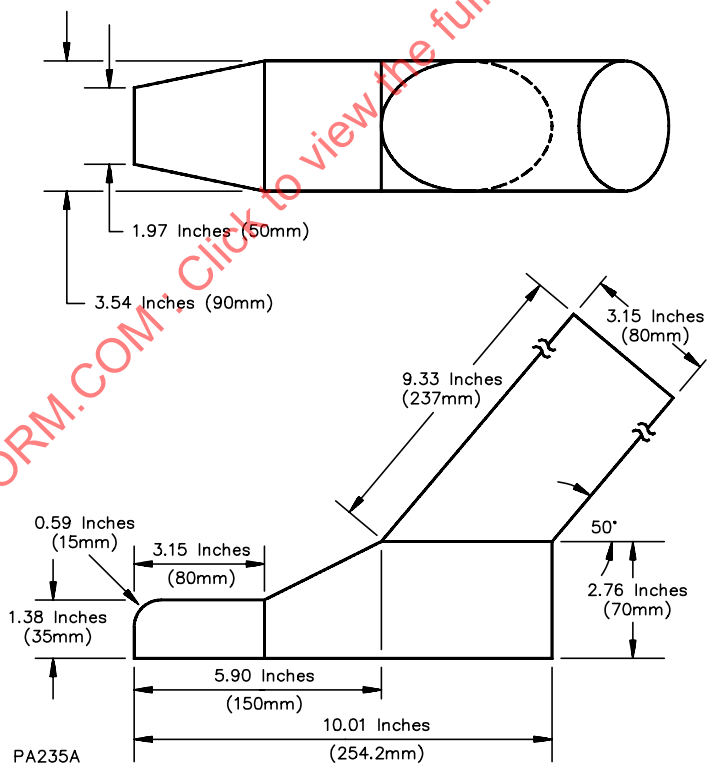
65.4 A 50-pound (222 N) static tensile force is to be applied to the shield for 10 seconds in a direction that is considered most likely to cause malfunction. For the test, the shield is to be attached to the mower in the manner in which it is intended to be used.

66 Foot Contact Test

66.1 When tested as described in 66.2 and 66.3, the foot probe illustrated in Figure 66.1 shall not contact the blade or the blade-tip circle of the mower.

Figure 66.1

Foot probe



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66.2 The foot-contact test is to be conducted under the following conditions:

a) The mower is to be placed on a smooth, level surface;

b) Pneumatic tires are to be inflated to the cold pressures recommended by the mower manufacturer;