UL 82

STANDARD FOR SAFETY

Electric Gardening Appliances

UL Standard for Safety for Electric Gardening Appliances, UL 82

Ninth Edition, Dated August 31, 2017

Summary of Topics

This revision of ANSI/UL 82 dated May 14, 2021 is issued to clarify the application of test requirements to battery powered gardening appliances with respect to accessible parts and the mold stress test; SA2.2

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated January 15, 2021 and March 12, 2021.

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UL 82

Standard for Electric Gardening Appliances

First Edition – March, 1973
Second Edition – February, 1974
Third Edition – May, 1977
Fourth Edition – January, 1986
Fifth Edition – December, 1991
Sixth Edition – June, 1994
Seventh Edition – June, 2008
Eighth Edition – August, 2011

Ninth Edition

August 31, 2017

This ANSI/UL Standard for Safety consists of the Ninth Edition including revisions through May 14, 2021.

The most recent designation of ANSI/UL 82 as an American National Standard (ANSI) occurred on May 7, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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

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PART 1 – ALL GARDENING APPLIANCES

INTRODUCTION

1 Scope

1.1 These requirements cover cord-connected, electrically-operated gardening appliances, such as cultivators, edger-trimmers, and the like, rated 250 volts or less for use in accordance the National Electrical Code, ANSI/NFPA 70.

1.2 These requirements also cover battery-operated gardening appliances covered in Battery Powered Gardening Appliances, Supplement SA of this Standard.

1.3 These requirements do not cover sprayers, foggers, or equipment for use in hazardous locations as defined in the National Electrical Code, ANSI/NFPA 70.

1.4 These requirements do not cover electrically operated walk-behind lawn mowers . These appliances are covered under UL 1447.

1.5 These requirements do not cover battery operated ride-on lawn mowers. These appliances are covered under UL 2753.

1.6 These requirements do not cover electrically operated hedge trimmers. These appliances are covered under UL 60745-2-15.

1.7 These requirements do not cover electrically operated log splitters.

2 Units of Measurements

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

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

3 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 B175.3
Internal Combustion Engine-Powered Hand-Held Grass Trimmers and Brushcutters – Safety and Environmental Requirements

ASTM Standards

ASTM E230/E23-0M
Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

ASTM D257
Test Methods for DC Resistance or Conductance of Insulating Materials

IEC Standards

IEC 61000-4-5
Electromagnetic Compatibility (EMC) – Part 4-5: Testing and Measurement Techniques – Surge Immunity Test

ISO Standards

ISO 11684
Tractors, Machinery for Agriculture and Forestry, Powered Lawn and Garden Equipment – Safety Signs and Hazard Pictorials – General Principles

ISO 7010
Graphical Symbols – Safety Colours And Safety Signs – Registered Safety Signs

NFPA Standards

ANSI/NFPA 70
National Electrical Code

UL Standards

UL 20
General-Use Snap Switches

UL 44
Thermoset-Insulated Wires and Cables

UL 62
Flexible Cords and Cables

UL 66
Fixture Wire

UL 83
Thermoplastic-Insulated Wires and Cables

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

UL 157
Gaskets and Seals

UL 224
Extruded Insulating Tubing

UL 244A
Solid-State Controls for Appliances

UL 248-1
Low-Voltage Fuses – Part 1: General Requirements

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

UL 310
Electrical Quick-Connect Terminals

UL 355
Cord Reels

UL 486A-486B
Wiring Connectors

UL 486C
Splicing Wiring Connectors

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

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

UL 489A
Circuit Breakers For Use in Communications Equipment

UL 496
Lampholders

UL 498
Attachment Plugs and Receptacles

UL 507
Electric Fans

UL 508
Industrial Control Equipment

UL 510
Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

UL 514A
Metallic Outlet Boxes

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

UL 514D
Cover Plates for Flush-Mounted Wiring Devices

UL 635
Insulating Bushings

UL 746A
Polymeric Materials – Short Term Property Evaluations

UL 746B
Polymeric Materials – Long Term Property Evaluations

UL 746C
Polymeric Materials – Use in Electrical Equipment Evaluations

UL 746D
Polymeric Materials – Fabricated Parts

UL 758
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

UL 969
Marking and Labeling Systems

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

UL 1004-1
Rotating Electrical Machines – General Requirements

UL 1004-2
Impedance Protected Motors

UL 1004-3
Thermally Protected Motors

UL 1004-7
Electronically Protected Motors

UL 1012
Power Units Other Than Class 2

UL 1029
High-Intensity Discharge Lamp Ballasts

UL 1053
Ground-Fault Sensing and Relaying Equipment

UL 1059
Terminal Blocks

UL 1077
Supplementary Protectors for Use in Electrical Equipment,

UL 1283
Electromagnetic Interference Filters

UL 1310
Class 2 Power Units

UL 1411
Transformers and Motor Transformers for Use in Audio-, Radio-, and Television-Type Appliances,

UL 1412
Fusing Resistors and Temperature-Limited Resistors for Radio- and Television-Type Appliances

UL 1434
Thermistor-Type Device

UL 1439
Tests for Sharpness of Edges on Equipment

UL 1441
Coated Electrical Sleeving

UL 1446
Systems of Insulating Materials – General

UL 1447
Electric Lawn Mowers

UL 1557
Electrically Isolated Semiconductor Devices

UL 1565
Positioning Devices

UL 1642
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UL 1699
Arc-Fault Circuit-Interrupters

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

UL 1998
Software in Programmable Components

UL 2111
Overheating Protection for Motors

UL 2459
Insulated Multi-Pole Splicing Wire Connectors

UL 2595
General Requirements for Battery-Powered Appliances

UL 2753
Outline of Investigation for Battery Operated Ride-On Lawn Mowers

UL 4248-1
Fuseholders – Part 1: General Requirements

UL 4248-9
Fuseholders – Part 9: Class K

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

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

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

UL 8750
Light Emitting Diode (LED) Equipment for Use In Lighting Products

UL 60691
Thermal-Links – Requirements and Application Guide

UL 60730-1
Automatic Electrical Controls – Part 1: General Requirements

UL 60730-2-2
Automatic Electrical Controls for Household and Similar Use; Part 2 Particular Requirements for Thermal Motor Protectors

UL 60730-2-6
Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Automatic Electrical Pressure Sensing Controls Including Mechanical Requirements

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

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

UL 60745-2-13
Hand-Held Motor-Operated Electric Tools – Safety – Part 2-13: Particular Requirements for Chain Saws

UL 60745-2-15
Hand-Held Motor-Operated Electric Tools – Safety – Part 2-15: Particular Requirements for Hedge Trimmers

UL 61058-1
Switches for Appliances – Part 1: General Requirements

UL 61800-5-1
Adjustable Speed Electrical Power Drive Systems – Part 5-1: Safety Requirements – Electrical, Thermal, and Energy

4 Glossary

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

4.2 ACCESSIBLE PART – A part so located that it can be contacted by a person, either directly or by means of a probe or tool, or that is not recessed the required distance behind an opening. See Accessibility of Moving Parts, Section 9.

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

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

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

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

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

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

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

4.8 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.

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

4.10 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.

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

4.12 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”.

4.13 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.

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

4.15 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.

4.16 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.

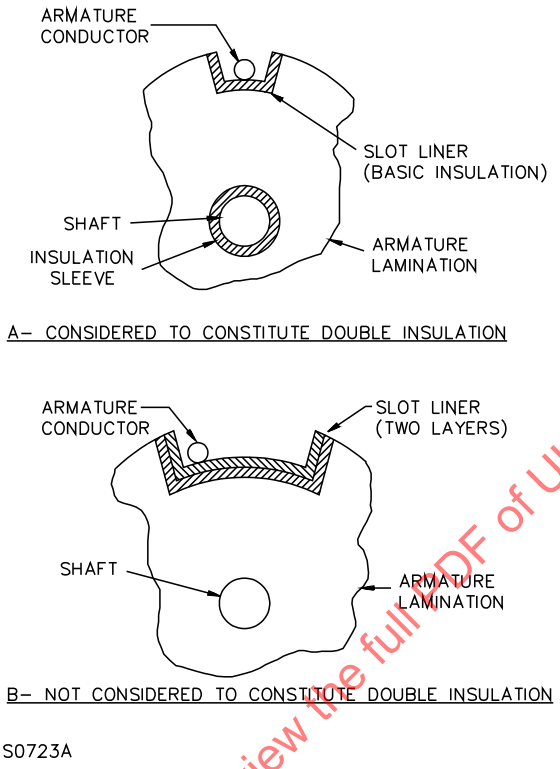
4.17 CUTTER AREA – The area through which the cutting means moves and in which a foreign object may be struck by the cutting means.

4.18 DEAD-MAN CONTROL – A control intended to automatically interrupt power when the actuating force supplied by the operator is removed.

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

Figure 4.1

Example of double insulation



4.20 ENCLOSURE – That portion of an appliance that:

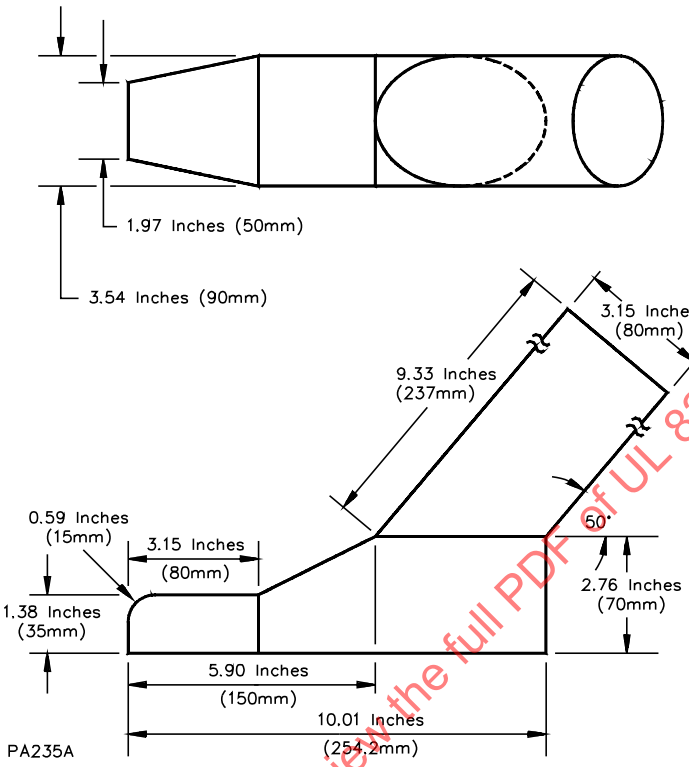
a) Renders all or any part that may otherwise present a risk of electric shock or injury to persons inaccessible; or

b) Prevents propagation of flame initiated by electrical disturbances occurring within the appliance.

4.21 FOOT PROBE – A simulated human foot. See Figure 4.2, for dimensional details.

Figure 4.2

Foot probe



4.22 GROUND-SUPPORTED APPLIANCE – An appliance that, during normal operation, is supported entirely or in part by the ground.

4.23 GUARD – A part of an assembly provided for shielding parts that may present a risk of fire, electric shock, or injury to persons.

4.24 HAND-SUPPORTED APPLIANCE – An appliance that, during normal operation, must be completely supported by the user.

4.25 LEAKAGE CURRENT – All current or currents, including capacitively-coupled currents, that may be conveyed between exposed conductive surfaces of an appliance and ground or other exposed conductive surfaces of the appliance.

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

4.27 OPERATOR CONTROL – Any device necessary for operating an appliance including a drive-engaging control, a movable-guide control, a drive-speed changing control, and a deflector control.

4.28 POLE PRUNER – hand supported pole-mounted appliance fitted with a saw chain cutting attachment mounted on a pole for pruning branches and having a bar not greater than 10.24 inch (260 mm).

4.29 PRUNERS – A hand-supported gardening appliance intended for one hand use and used primarily to cut off small twigs and branches of trees and shrubs.

4.30 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.

4.31 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.

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 Sections 5.2 – 5.23;

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

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

d) 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 evaluated 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 Sections 5.2 – 5.23, is acceptable if:

a) The component also complies with the applicable component standard specified in Sections 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 standards are identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and that complies 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 in the applicable UL standard that cover devices that provide those functions.

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

5.1.3 A component not anticipated by the requirements in this Standard, not specifically covered by the component standards specified in Sections 5.2 – 5.23, and that involves a risk of electric shock, fire, or personal injury, shall be additionally evaluated in accordance with the applicable UL standard, and shall comply with 5.1.1 (b) – (d).

5.1.4 With regard to a component being additionally evaluated, 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 the requirements in this standard.

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 5.2.9.

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

Exception No. 2: A fabricated pin terminal assembly is not required to comply with UL 498, if it complies with Live Parts, Section 14; Electric Insulation, Section 16; and Spacings, Section 22.

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 in (2.8 mm), 0.125 in (3.2 mm), 0.187 in (4.8 mm), 0.205 in (5.2 mm), and 0.205 in (6.3 mm), intended for internal wiring connections in appliances, or for the field termination of conductors to appliance, shall comply with UL 310.

Exception: Other sizes of quick-connect terminals shall be evaluated 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 5.2.9.

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 is not required to comply with UL 1059 if the part complies with the requirements in Live Parts, Section 14; Electrical Insulation, Section 16; and Spacings, Section 22, of this end product Standard. This exception does not apply to protective conductor terminal blocks.

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

5.3 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 the 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 in this Standard.

5.5 Capacitors and filters

5.5.1 The component requirements for a capacitor are not specified. A capacitor that complies with UL 810, is considered to comply with the requirements in 20.1.

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

5.6 Controls

5.6.1 General

5.6.1.1 Auxiliary controls shall be evaluated using the applicable requirements in this end product Standard and the requirements in Controls – End Product Test Parameters, Section 25.

5.6.1.2 Operating (regulating) controls shall be evaluated using the applicable component standard requirements specified in 5.6.2 – 5.6.7, and if applicable, the requirements in Controls – End Product Test Parameters, Section 25, 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 and UL 1998, or UL 60730-1, or both.

5.6.1.4 Protective (limiting) controls shall be evaluated using the applicable component standard requirements specified in Sections 5.6.2 – 5.6.7, and if applicable, the parameters in Controls – End Product Test Parameters, Section 25, 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 UL 991 or UL 60730-1 (except for the Controls Using Software requirements in Annex H), or both

5.6.1.6 Protective controls that rely upon software as a protective component shall comply with UL 991 and UL 1998, or UL 60730-1, or both.

5.6.1.7 An electronic, non-protective control that is simple in design need only be subjected to the applicable requirements in this end product Standard. A control that does not include an integrated circuit or microprocessor, but does consist of a discrete switching device, capacitors, transistors, or resistors, is considered simple in design. See Abnormal Operation Tests, Section 35.

5.6.2 Electromechanical and electronic controls

5.6.2.1 A control, other than as specified in Sections 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, or 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 60730-1 and UL 60730-2-6.

5.6.6 Temperature controls

5.6.6.1 A temperature control shall comply with UL 244A, UL 873, UL 61800-5-1, 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 comply with this requirement when preassembled in a cord set or power supply cord that complies with UL 817.

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

Exception No. 1: Insulated conductors is not required to comply with UL 758, if they comply with UL 44, UL 83 or UL 66 or if they comply with the applicable UL standard for other insulated conductor types specified in Wiring Methods and Materials, of the ANSI/NFPA 70.

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

5.8 Cord reels

5.8.1 A cord reel shall comply with special use cord reel requirements in 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 personal injury 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 ANSI/NFPA 70 requires a GFCI.

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

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

5.13.2 Lighting ballasts shall comply with UL 935 or 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.

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 comply with this requirement.

Exception No. 2: Individual LED light sources mounted on printed-wiring boards and intended for indicating purposes is not required to comply with UL 8750, but shall comply with the applicable requirements in this end product Standard.

5.14 Marking and labeling systems

5.14.1 A marking and labeling system shall comply with UL 969.

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 in 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 in this end product Standard.

5.15.1.5 Low voltage component fans that comply with UL 507, are considered to comply with the requirements in Motors, Section 17.

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:

Table 5.1
Superseded requirements

UL 1004-1 exempted requirements	Superseded by UL 82 requirements
Current and Horsepower Relation, Section 6	31.3
Cord-Connected Motors, Section 15	Supply Connections, Section 13
Factory Wiring Terminals and Leads, Section 17	Internal Wiring – Electrical Connections, Section 15
Electrical Insulation, Section 22	Electrical Insulation, Section 16
Non-Metallic Functional Parts, Section 28	Frames and Enclosures, Sections 6 Polymeric Enclosures, Section 7 Polymeric Materials Not Classed HB, Section 44 Polymeric Materials Classed HB, Section 45 High Current Arc Ignition Test, Section 46
Solid-State Controls, 7.2	Controls, Section 5.6
Non-metallic enclosure thermal aging, 9.1.4	Motors and Motor Overload Protection, 5.15
Motor enclosure, 9.2 – 9.4	Frames and Enclosures, Section 6
Grounding, Section 10 and Grounding Identification, Section 11	Grounding, Section 23
Ventilation Openings, Section 12: only applicable where the openings are on surfaces considered to be the appliance enclosure.	Frames and Enclosures, Section 6
Accessibility of Uninsulated Live Parts, Film-Coated Wire, and Moving Parts, Section 13	Accessibility of Live Parts, Section 10
Protection Against Corrosion, Section 14	Protection Against Corrosion, Section 12
Available fault current ratings for motor start and running capacitors, 26.6: not applicable for cord and plug connected appliances.	Capacitors, Section 20
Switch, Section 27 is not applicable to centrifugal starting switches	Switch and Control Test, Section 42
With the exception of Resilient Elastomer Mounting Test, Section 36 and Electrolytic Capacitor Tests, Section 41, the performance tests of UL 1004-1 are not applicable	All applicable performance tests
Only the following marking requirements specified in 44.1 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	52.2

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, Section 12;

b) Internal Wiring – Electrical Connections, Section 15;

c) Electrical Insulation, Section 16;

d) Motors, Section 17;

e) Capacitors, Section 20;

f) Spacings, Section 22; and

g) Grounding, Section 23.

5.16 Motor overload protection

5.16.1 Thermal protection devices integral with the motor shall comply with UL 2111, UL 1004-3, or UL 60730-1 and UL 60730-2-2, in conjunction with UL 1004-3 (to evaluate the motor-protector combination).

5.16.2 Impedance protection shall comply with UL 2111 or UL 1004-2.

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

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

a) The UL 991. When the protective electronic circuit is relying upon software as a protective component, it shall comply with the requirements in the 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) The 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.

5.17 Overcurrent protection

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

5.17.2 Fuseholders shall comply with UL 4248-1, and the applicable part standard (e.g. UL 4248-9).

5.17.3 Circuit breakers shall comply with UL 489.

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

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

5.17.5 Supplementary protectors shall comply with UL 1077.

5.17.6 Fusing resistors shall comply with UL 1412.

5.18 Polymeric materials

5.18.1 Polymeric enclosure materials or a polymeric device which provides mechanical support or electrical insulation or separation whose deterioration would reduce spacings between uninsulated live parts or could result in a risk of fire, electric shock, or risk of injury to persons shall comply with UL 746A, UL 746B, UL 746C, unless superseded by the requirements in this Standard. Polymeric materials molded or fabricated by a source other than the manufacturer, shall be identified according to UL 746D.

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

5.19 Power supplies

5.19.1 A Class 2 power supply shall comply with UL 1310.

5.19.2 A non-Class 2 power supply shall comply with UL 1012.

5.20 Semiconductors and small electrical and electronic components

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

5.20.2 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.

5.20.3 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.

5.20.4 Where an electronic component is determined to be a critical component during the testing Abnormal Operation Test, Section 35, the circuit shall comply with UL 991, including its Follow-Up Program; and as applicable, UL 1998 for controls that rely upon software as a protective component, UL 60730-1, or both. See Protective Controls (Limiting Controls), Section 25.4 for the test parameters to be used.

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

5.20.6 A critical component may also be identified using a Failure-Mode and Effect Analysis (FMEA) in accordance with the Failure-Mode and Effect Analysis (FMEA), requirements in UL 991.

5.20.7 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.

5.21 Supplemental insulation, insulating bushings, and assembly aids

5.21.1 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.

5.21.2 Wire positioning devices required to comply with the requirements in this Standard shall comply with UL 1565.

5.21.3 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, Section 13.3, Push-Back Relief Test, Paragraph 13.3.3, Mold Stress Relief Test, Section 44.1) shall be conducted.

5.22 Switches

5.22.1 Switches shall comply with UL 20, UL 773A, or UL 61058-1, 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) is not required to comply with this requirement.

5.22.2 Clock-operated switches, and time switches, including timers, shall comply with UL 917 or UL 60730-1 and UL 60730-2-7.

5.22.3 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.

5.23 Transformers

5.23.1 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.

5.23.2 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, electric shock, or injury to persons is not required to comply with this requirement.

6 Frames and Enclosures

6.1 General

6.1.1 The frame and enclosure of an appliance shall have the strength and rigidity necessary to resist the abuses to which it is likely to be subjected during normal service without total or partial collapse resulting in a risk of fire, electric shock, or injury to persons due to reduction of spacings, loosening or displacement of parts, and other serious defects.

6.1.2 Among the factors taken into consideration when judging the acceptability of a frame or enclosure 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. A material that will be exposed to oil, acids, solvents, reagents, cleaning agents, or ozone as part of the use or application of the appliance shall not be adversely affected by these environments, as determined by tests.

6.2 Metallic enclosures

6.2.1 The thickness of cast- and sheet-metal portions of an enclosure shall not be less than the applicable value specified in Table 6.1.

Exception: The specifications in Table 6.1, do not apply to an enclosure determined to be acceptable when evaluated under the considerations specified in 6.1.2.

Table 6.1
Thickness of metal enclosure

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

6.2.2 The material used as the enclosure shall be acceptable 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 evaluated with respect to aging to determine whether it is acceptable for the purpose. See 7.1.

7 Polymeric Enclosures

7.1 An enclosure formed of polymeric material shall either:

a) Comply with the requirements for Polymeric Materials Not Classed HB, Section 44; or

b) Be classed HB in accordance with UL 94, and comply with the requirements for Polymeric Materials Classed HB, Section 45, and if applicable, with the requirements for High Current Arc Ignition Test, Section 46.

Exception No. 1: An enclosure formed of polymeric material classed HB or less flammable is acceptable without further test provided the appliance complies with all of the following:

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

b) All leads connecting components inside the enclosure are mechanically secured so that displacement of any component resulting from degradation of the polymeric material will not cause a stress on the junction between a lead and a terminal of the component. A component having integral leads is to be subjected to strain relief tests if such tests are not otherwise a part of the required test procedure for the component; and

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

Exception No. 2: An enclosure formed of polymeric material classed HB that complies with all of the requirements for Polymeric Materials not Classed HB, Section 44, except those for the flame resistance test described in 44.4.1 – 44.4.4, is acceptable provided all live parts within the enclosure are acceptably insulated or have acceptable internal enclosures independent of the outer polymeric enclosure.

Exception No. 3: An enclosure formed of material classed V-2 or less flammable is not required to be subjected to the flame resistance test described in 44.4.1 – 44.4.4, if the thickness of the enclosure is not less than the minimum thickness for which the material was classed.

8 Handles

8.1 An appliance shall have a handle or handles that permit grasping the appliance with both hands.

Exception: An appliance that is manipulated with one hand, such as grass shears and pruners, may have only one handle.

8.2 Other than as noted in 8.4, the handles or surfaces most likely to be grasped by the user during the normal operation of an appliance shall be made of or covered with an insulating material that complies with the requirements in 8.5, the Handle Tests, Section 36, and the Dielectric Voltage Withstand Test, Section 80 and entry 2 of Table 80.1.

8.3 With reference to 8.2, 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.

8.4 The outer surfaces of a handle or other area likely to be grasped during normal operation shall not be of electrically conductive material, unless:

a) Insulation that complies with Dielectric Voltage Withstand Test, Section 80 and entry 2 of Table 80.1, 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 that complies with Dielectric Voltage Withstand Test, Section 80 and entry 2 of Table 80.1.

8.5 The insulating material specified in 8.2, shall be of a type and thickness that make it acceptable as the sole insulation between a live part and a dead metal part. If it overlies and is in intimate contact with dead metal, the insulating material shall not be less than 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 determined to be acceptable when evaluated in accordance with 6.1.2.

9 Accessibility of Moving Parts

9.1 Specific tests, markings, guards, and the like, are detailed for some appliances, but such detailed requirements apply to more or less common constructions and specific features. Other appliances not contemplated herein are to be given appropriate consideration regarding compliance with these detailed requirements.

9.2 There are risks of injury to persons inherent in some appliances that, if completely eliminated, would defeat the utility of the appliance. The requirements in this section are intended to reduce the risks, while retaining the normal function of such an appliance.

9.3 If various functional attachments are available for use with a basic appliance, each attachment is to be considered individually.

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

9.5 A moving part shall be guarded or enclosed to reduce the likelihood of injury to persons.

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

a) Degree of exposure necessary to perform its intended function;

b) Sharpness of the part;

c) The likelihood of unintentional contact with the part;

d) The speed of the part; and

e) The likelihood that a part of the body could be endangered, or that clothing could be entangled, resulting in a risk of injury to persons.

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

a) Removability without the use of a tool;

b) Removability for servicing and likelihood of replacement;

c) Strength and rigidity;

d) Completeness; and

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

9.8 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 cutting edges or a discharge chute of an appliance.

9.9 The unobstructed distance from the opening to the moving part specified in 9.8, shall not be less than 8D minus 1.5 inches (38 mm), in which D is the minor dimension of the opening in inches (mm).

Exception: A fan is considered to be acceptably guarded if the blade cannot be contacted with the probe illustrated in Figure 10.2.

9.10 An enclosure or guard over a rotating part and a discharge guide or deflector shall be sufficiently complete and shall have such strength as to:

a) Contain and deflect a part that, because of breakage or other reasons, may become loose or separated from the rotating part; and

b) Retain a foreign object that may be struck and propelled by the rotating part.

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

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

10 Accessibility of Live Parts

10.1 General

10.1.1 Electrical parts of an appliance shall be located or enclosed to reduce the likelihood of unintentional contact with uninsulated live parts. Insulated brush caps do not require additional enclosure.

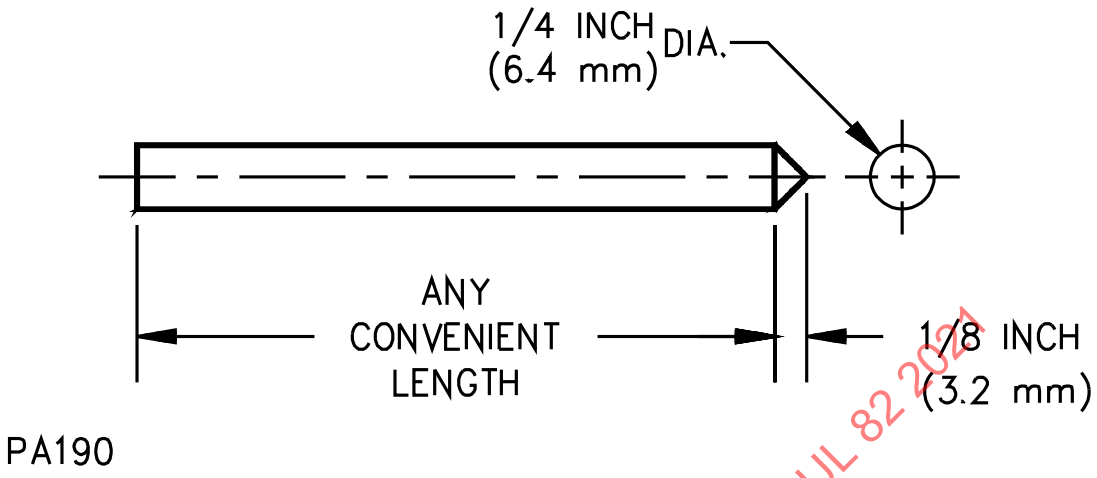
10.1.2 An opening anywhere in the enclosure of a hand-supported appliance, or in the handle portion, the area likely to be handled in guiding during normal operation, of an appliance that normally rests on the ground and is guided by the handle is acceptable if the probe of Figure 10.1, when inserted 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 10.1

Probe for hand-supported enclosure



10.1.3 With reference to the requirement in 10.1.1, and except as indicated in 10.1.2, an opening is capable of being used when:

a) A probe as illustrated in Figure 10.2, 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 10.3, cannot be made to touch any uninsulated live part when inserted through the opening in any possible direction using no appreciable force.

Figure 10.2

IEC articulate probe

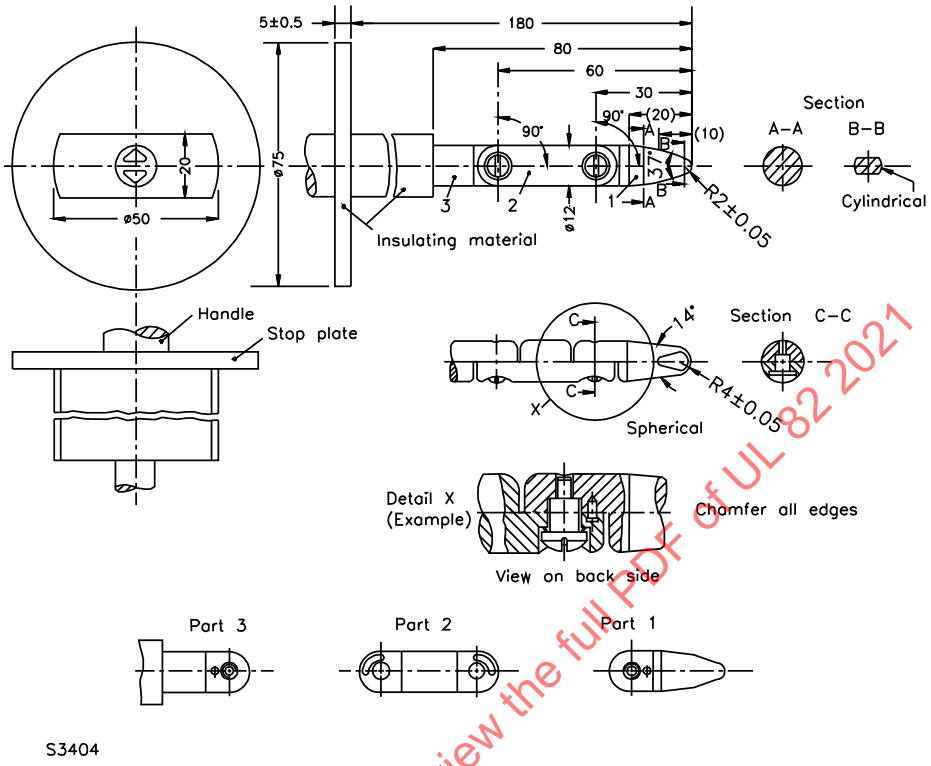
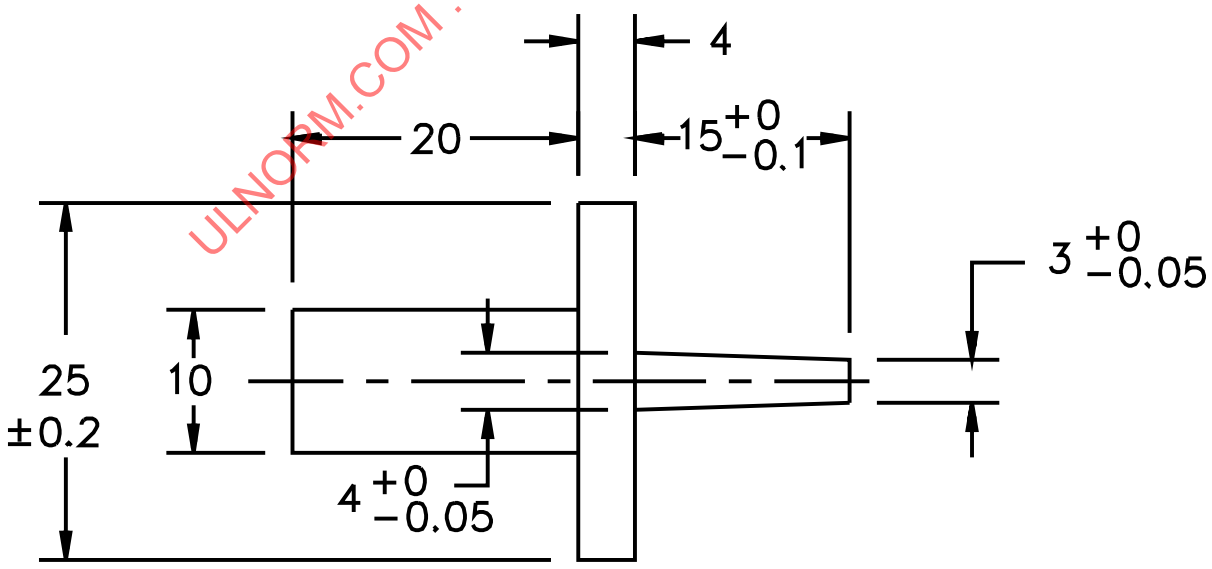


Figure 10.3

IEC test pin



10.1.4 The opening illustrated in Figure 10.4, is acceptable if, within the enclosure, there is no uninsulated live part or film-coated wire:

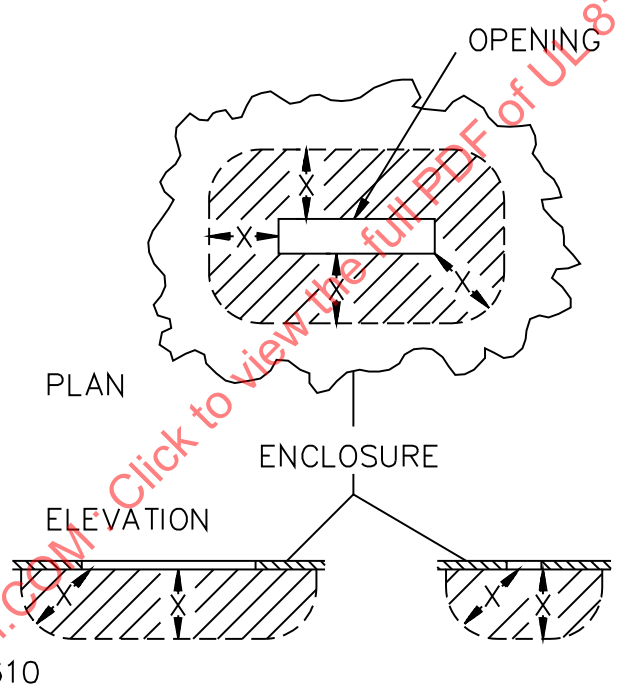
a) Less than X distance from the perimeter of the opening; and

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

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

Figure 10.4

Opening in enclosure



Proportions exaggerated for clarity

10.1.5 During the examination of an appliance to determine compliance with the requirements in 10.1.1, a part of the outer enclosure that may be removed without the use of a tool by the user of the appliance, 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 reduces the risk of electric shock unless marked in accordance with 53.5.

10.1.6 A latch or fastener that is intended to be opened by use of a coin or the like is considered to be capable of being opened without the use of a tool.

10.2 Assembly screws

10.2.1 An assembly screw in the 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 shall:

a) Not be accessible to the probes illustrated in Figure 10.2 and Figure 10.3, when inserted; or

b) Be recessed at least 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.

11 Mechanical Assembly

11.1 General

11.1.1 An appliance shall be assembled so that it will not introduce a risk of fire, electric shock, or injury to persons due to vibration during normal operation.

11.1.2 Except as noted in 11.1.3 and 11.1.4, 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.

11.1.3 A switch is not required to be prevented from turning if all four of the following conditions are met:

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

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

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

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

11.1.4 A lampholder of the type in which the lamp cannot be replaced, such as a neon pilot or an indicator light in which the lamp is sealed in a nonremovable jewel, is not required to be prevented from turning if rotation cannot reduce spacings below the minimum acceptable values.

11.1.5 With reference to the requirement in 11.1.2, a properly applied lock washer is acceptable as the means of preventing a small stem-mounted switch or other device having a single-hole mounting means from turning.

11.1.6 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.

11.1.7 The requirement in 11.1.6, also applies to an adhesive used to secure a conductive part that may, if loosened or dislodged:

a) Energize an accessible dead metal part;

b) Make a live part accessible;

c) Reduce spacings below the minimum acceptable values; or

d) Short-circuit live parts.

11.1.8 A gardening appliance 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.

11.1.9 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.

11.1.10 Compliance with the requirements in 11.1.8, may 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.

11.1.11 Routing as specified in 11.1.8, is acceptable if the construction is such that, after the wire has been put into the intended position prior to reassembling the gardening appliance, 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.

11.1.12 A gardening appliance 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 appliance shall be subjected to the test specified in 41.2. If the pressure pad is exposed to grease, it is also to be tested in accordance with 41.3.

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 41.1.

11.2 Appliances shipped partially disassembled

11.2.1 Except as noted in 11.2.2, an appliance shall be completely assembled before being shipped from the factory.

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

a) All parts for assembly that are necessary for the operation of the appliance are provided in one 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 the field are made by plug and receptacle connections only and do not require rearrangement of components or wiring; and

e) The appliance is marked in accordance with 53.7, if a required guard is shipped from the factory detached.

12 Protection Against Corrosion

12.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating, or other equivalent means if the corrosion of such unprotected parts are likely to result in a risk of fire, electric shock, or injury to persons.

Exception No. 1: Surfaces of sheet steel and cast-iron parts within an enclosure are not required to be protected against corrosion if the oxidation of iron or steel due to the exposure of the metal to air and moisture is not likely to be appreciable. The thickness of the metal and the temperature are also factors.

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

12.2 If the leakage of a liquid from inside of a container provided as a part of an appliance may result in a risk of fire, electric shock, or injury to persons, the container shall be of a material that is resistant to corrosion by the liquid it is intended to hold.

13 Supply Connections

13.1 Power supply cord

13.1.1 An appliance shall be provided with a power supply cord that cannot be damaged or impaired by any cutting edges, blades, belts, or rotating parts of the appliance.

Exception: An appliance may employ a motor attachment plug for connecting an extension cord.

13.1.2 A power supply cord shall not be less than 8 inches (203 mm) nor more than 18 inches (457 mm) long.

13.1.3 An appliance intended for use with an extension cord shall not be provided with terminal pins that will accommodate a standard flatiron or appliance plug.

13.1.4 A flexible power supply cord provided with an appliance shall be:

a) Type SW-A, SOW-A, STW-A, STOW-A, SJW-A, SJOW-A, SJTW-A, or SJTOW-A; or

b) Type SW, SOW, STW, STOW, SJW, SJOW, SJTW, or SJTOW.

13.1.5 The flexible cord used in a cord set provided with, or made available for use with, an appliance shall be one of the types specified in 13.1.4.

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

13.2 Attachment plug

13.2.1 An attachment plug shall be rated for use at a current not less than the rated current, and at the rated voltage of the appliance. If the appliance is acceptable for being adapted for use on two or more different values of voltage by field-alteration of internal connections, the attachment plug provided with the appliance shall be rated for the voltage for which the appliance is connected when shipped from the factory. See 52.6.

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

13.2.3 A three- to two-wire grounding adapter shall not be provided with an appliance.

13.2.4 An attachment plug may be of the locking type.

13.2.5 A ground-supported appliance shall be constructed so that the cord connector of the extension cord will not touch the ground when the handle is in a normal operating position.

13.2.6 An attachment plug on the supply cord of an appliance shall be constructed so that, when inserted in the connector of an extension cord, the blades will not be energized until they are inaccessible to contact by persons. See Attachment Plug Test, Section 38.

13.3 Strain relief

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

13.3.2 A metal strain-relief clamp or band without auxiliary protection is acceptable with a power supply cord unless it is evaluat3ed that the clamp may damage the cord insulation.

13.3.3 Means shall be provided so that the flexible cord cannot be pushed into the appliance through the cord-entry hole if such displacement is likely to subject the cord to mechanical damage or to exposure to a temperature higher than that for which the cord is rated, or is likely to reduce spacings, such as from a live part to a metal strain-relief clamp, below the minimum acceptable values.

13.4 Bushings

13.4.1 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 determined 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.

14 Live Parts

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

14.2 Stainless steel or plated iron or steel is capable of being used for a current-carrying part that is:

a) Within a motor or associated governor; or

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

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

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

15 Internal Wiring – Electrical Connections

15.1 General

15.1.1 The wiring and connections between parts of an appliance shall be acceptably protected or enclosed.

Exception: A length of flexible cord may be employed for external connections if flexibility is necessary in the application. See 15.1.2 and 15.1.4.

15.1.2 A flexible cord used for external interconnection as specified in the exception to 15.1.1, shall be one of the types of cord specified in 13.1.4, or the equivalent, and shall be provided with bushings and strain relief in accordance with 13.3.1 – 13.4.1, and Strain Relief and Torque Tests, Section 39, unless the construction is such that the cord will be protected from stress and motion.

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

15.1.4 With reference to exposure of internal wiring through openings in the enclosure of an appliance, the protection of the wiring required in 15.1.1, is considered to exist if, when evaluated as if it were film-coated wire, the wiring would be acceptable in accordance with 10.1.2 and 10.1.3. No wiring is to be located where it is likely to be contacted by the user.

15.1.5 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 appliance.

15.1.6 Wiring inside an appliance that might otherwise be subjected to mechanical damage shall be in armored cable, conduit, or electrical metallic tubing, or shall otherwise be protected.

15.1.7 Wiring shall be protected from sharp edges including screw threads, burrs, fins, moving parts, and the like that may cause abrasion of the insulation on conductors.

15.1.8 A screw (including the blunt-end type) used in the assembly of a 2-piece tube handle shall not terminate in the wireway. A through screw used to assemble a 2-piece tube handle shall not have threads exposed in the wireway.

Exception: A screw or screw threads may be exposed in the wireway if the wires in the wireway are enclosed in sleeving that has been evaluated and determined to be acceptable for the application.

15.1.9 Insulated internal wiring shall be acceptable for the application when considered with respect to:

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

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

c) Exposure to moisture; and

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

15.1.10 Thermoplastic-insulated wire and neoprene-insulated wire employed for internal wiring shall be standard building wire or acceptable appliance wiring material (see 15.1.9) and shall comply with Table 15.1.

Table 15.1
Characteristics of internal wiring

Insulation	Nominal thickness of insulation,		Braid or jacket required	Nominal thickness of braid or jacket,	
	inch	(mm)		inch	(mm)
Thermoplastic	1/32	(0.8)	No	–	–
Neoprene	1/64	(0.4)	Yes	1/64	(0.4)
Rubber	1/32[a]	(0.8)	Yes[a]	1/64[a]	(0.4)

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

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

15.2 Splices and connections

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

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

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

15.2.4 The insulation on a splice shall be at least 1/32 inch (0.8 mm) thick. 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- and moisture-resistant characteristics, and the like. Thermoplastic tape wrapped over a sharp edge is not acceptable.

15.2.5 The means of connecting stranded internal wiring shall be such that loose strands of wire cannot contact live parts of opposite polarity and dead metal parts.

15.2.6 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 acceptable for the combination of metals involved at the connection point.

15.2.7 With reference to 15.2.6, a wire-binding screw, a pressure wire connector, and the like, used as a terminating device shall be acceptable for use with aluminum under the conditions involved – for example, temperature, heat cycling, and vibration.

16 Electrical Insulation

16.1 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 acceptable for the application, that will not be adversely affected by the temperatures to which they will be subjected under conditions of actual use.

16.2 Ordinary vulcanized fiber may be used for insulating bushings, washers, separators, and barriers, but not as the sole support for uninsulated live parts if shrinkage, current leakage, or warpage may introduce a risk of fire or electric shock. Thermoplastic materials may be employed if evaluated and determined to have the necessary physical strength and rigidity, resistance to heat, resistance to flame propogation, dielectric strength, and other properties acceptable for the application. All these properties are to be considered with respect to the effects of thermal aging.

16.3 A molded part shall have the necessary 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 may occur during normal use unless the part has the strength necessary to withstand the abuses to which it is likely to be subjected. See Brush Cap Test, Section 37.

17 Motors

17.1 General

17.1.1 A motor shall be acceptable for the application, and shall be constructed to handle the maximum normal load of the appliance as described in 30.4 and 30.5, without introducing a risk of fire, electric shock, or injury to persons.

17.1.2 A motor winding shall resist the absorption of moisture.

17.1.3 With reference to the requirement in 17.1.2, fiber slot liners, cloth coil wrap, and similar moisture-absorptive materials shall be impregnated or otherwise treated to resist moisture absorption. Film-coated wire is not required to be additionally treated to prevent absorption of moisture.

17.1.4 An overcurrent-protective device shall not open the circuit during normal operation of the appliance.

17.1.5 A brush-holder assembly shall be constructed so that when a brush is worn out – no longer capable of performing its function – the brush, spring, and other parts of the assembly are retained to the degree necessary not to cause:

a) Accessible dead metal parts to become energized; and

b) Live parts to become accessible.

17.2 Overtemperature protection

17.2.1 The motor of a shredder or shredder-bagger shall be provided with a manually reset locked-rotor overtemperature-protective device or equivalent protection.

17.2.2 A motor employing a protective device that complies with the requirements for locked-rotor protection specified in Motor Overload Protection, Section 5.16, is considered to comply with 17.2.1.

18 Switches and Controls

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

18.2 A switch shall be located or protected so that it is not likely to be operated unintentionally during intended use of the appliance.

18.3 A switch shall be located or guarded so that an appliance cannot be energized by:

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

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

18.4 All switches shall operate readily by finger pressure with the appliance held in the intended manner.

18.5 An appliance shall not employ a through-cord switch.

18.6 A single-pole switch in an appliance employing a polarized attachment plug shall be connected in the conductor not intended to be grounded.

18.7 All operator controls shall be readily operable from the location intended to be assumed by the operator.

18.8 A self-propelled appliance and an appliance that, because of its function, tends to be self-propelled (for example, a cultivator) shall be provided with a momentary-contact switch or a dead-man control for disengaging the propelling drive to prevent movement of the appliance when it is unattended. No means for locking the switch in the "on" position shall be provided.

18.9 A reversing switch shall not be provided on an appliance that, because of its function, tends to be self-propelled.

Exception: On a cultivator, a momentary contact reversing switch that cannot be locked on may be provided for an auxiliary function not intended to be continuous if the function, the location, and the operation of the switch make it unlikely that the product will be operated in the reverse direction for a time longer than is necessary to perform the intended auxiliary function.

19 Lampholders

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

19.2 The screw shell of each lampholder shall be connected to:

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

b) The same conductor of the flexible cord in the absence of a conductor intended to be 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 elimination – shall be housed within an enclosure or container such that, should breakdown of the capacitor occur, the plates will not be subject to mechanical damage and there will be no emission of flame or molten material. The construction shall comply with one of the following:

a) The capacitor container shall be of sheet steel not less than 0.020 inch (0.51 mm) thick or shall be constructed to afford equivalent protection;

b) A capacitor having a sheet-steel container less than 0.020 inch (0.51 mm) thick or of other acceptable material shall be mounted in an enclosure that houses other parts of the appliance and that is acceptable for the enclosure of live parts;

c) The individual enclosure of an electrolytic capacitor with means for venting shall reduce the likelihood of mechanical damage only, and no minimum enclosure thickness is specified; or

d) The individual enclosure of an electrolytic capacitor not provided with means for venting and with an opening more than 1/16 inch (1.6 mm) wide between the capacitor enclosure and the motor shall comply with the requirements in Capacitor Overvoltage Test, Section 35.2, and no minimum enclosure thickness is specified.

20.2 The voltage rating of a capacitor other than a motor-starting capacitor shall be at least the maximum steady-state potential to which the capacitor is subjected during operation of the appliance.

21 Printed-Wiring Boards

21.1 A printed-wiring board included as part of the circuitry of a gardening appliance 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 may have a flame rating of HB.

22 Spacings

22.1 The spacing between uninsulated live parts of opposite polarity and between uninsulated live parts and a dead metal part that is exposed to contact by persons or that is grounded shall not be less than the applicable 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: This requirement does not apply to the inherent spacings of a component of the appliance, such as a snap switch. Such spacings are evaluated on the basis of the requirements for such components.

Exception No. 2: This requirement does not apply to the commutator, the brush assembly, or the jumpers that short-circuit the brushes of a repulsion, repulsion-induction, or repulsion-start induction motor. 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.

Table 22.1
Minimum acceptable spacings

Potential involved, volts	Part involved	Minimum spacings, inch (mm)							
		Motor diameter 7 inches (178 mm) or less[a]				Motor diameter more than 7 inches (178 mm)[a,b]			
		Over surface		Through air		Over surface		Through air	
		Inches	(mm)	Inches	(mm)	Inches	(mm)	Inches	(mm)
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	(4.8)	1/8	(3.2)
	Elsewhere in the appliance	3/32	(2.4)	3/32	(2.4)	1/4[c]	(6.4)	1/8[c]	(3.2)
126 – 250	Between commutator or collector rings of a motor	3/32	(2.4)	3/32	(2.4)	3/16	(4.8)	3/16	(4.8)
	Elsewhere in the appliance	3/32	(2.4)	3/32	(2.4)	1/4[c]	(6.4)	1/4[c]	(6.4)

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

[b] Spacings 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, rigidly supported and held in place on a coil and a dead metal part is acceptable in an appliance.

22.2 In applying Table 22.1 to an appliance incorporating two or more motors of different sizes, the spacings inside each motor are evaluated on the basis of the size of that motor, and the spacings elsewhere in the appliance are evaluated on the basis of the size of the largest motor in the appliance.

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

a) Live parts of opposite polarity;

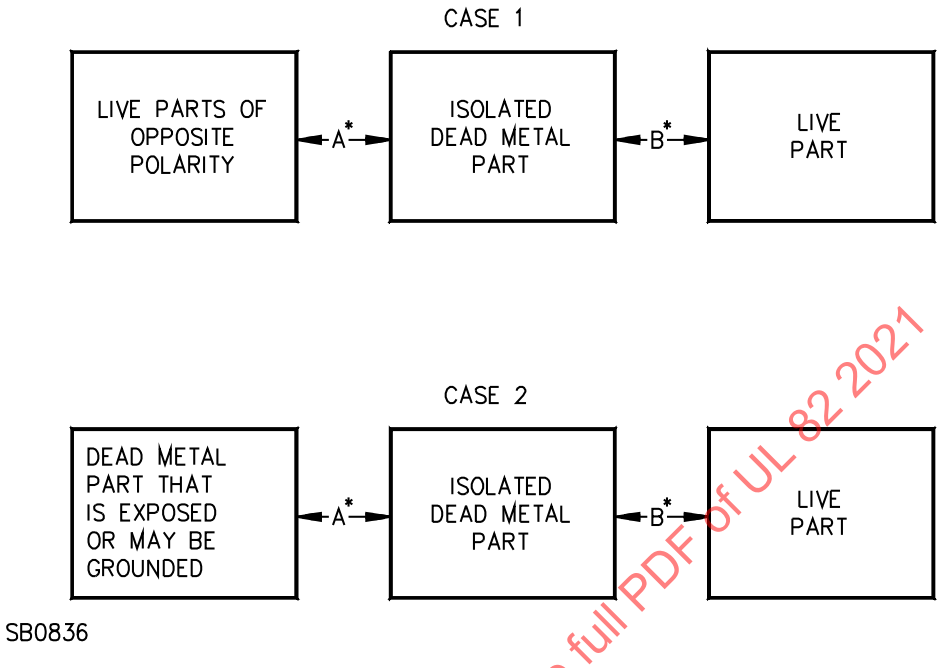
b) A live part and an exposed dead metal part; or

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

the spacing may be no less than 3/64 inch (1.2 mm) between the isolated dead metal part and any one of the other parts previously specified, provided the sum of the spacing between the isolated dead metal part and each of the other two parts is not less than the applicable value specified in Table 22.1. See Figure 22.1.

Figure 22.1

Spacings for isolated dead metal parts



Spacing A and spacing B shall be at least 3/64 inch (1.2 mm); and spacing A plus spacing B shall be no less than the applicable value specified in Table 22.1.

22.4 Primary-circuit spacings apply to all secondary circuits supplied by a transformer winding having a maximum available volt-amperes of 200 or more at a potential greater than 100 volts. The spacings in all other secondary circuits are to be evaluated on the basis of the dielectric voltage withstand test specified 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 be no less than 1/32 inch (0.8 mm) thick, and shall be located or be of such material that it will not be 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 specified in 22.5, may be used if, upon investigation, the material is determined to be acceptable for the application.

22.7 The spacings between an enclosure of polymeric material classed HB in accordance with UL 94, and:

a) A nonarcing bare live part, such as a bus bar, a connecting strap, a terminal, or the like, shall be no less than 1/32 inch (0.8 mm).

b) An arcing part, such as a commutator, unenclosed switch contacts, and the like, shall be no less than 1/2 inch (12.7 mm).

Exception: The spacing may be smaller than 1/2 inch (12.7 mm) but no less than 1/32 inch (0.8 mm) provided the material complies with the requirement in High Current Arc Ignition Test, Section 46.

22.8 The spacing specified in 22.7(b), is to be measured from the source of the arc.

23 Grounding

23.1 The flexible cord of an appliance shall include an equipment-grounding conductor.

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

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

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

c) Conductively connected to:

1) All exposed dead metal parts of the appliance; 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 specified in 23.2(c), shall be of corrosion-resistant metal or shall be protected against corrosion. A lock washer or other acceptable means shall be used 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.

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 secured in place such that it will not loosen due to impact shock or vibration.

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.

24 Rotating Parts

24.1 A rotating member shall be formed and constructed of materials of a strength that will reduce the likelihood of its release or loosening in a manner likely to cause a risk of injury to persons.

24.2 Except as noted in 24.3, 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 appliance shall not loosen a retaining means during normal operation tests conducted on the appliance.

24.3 Unless secured as specified in 24.2, a removable rotating part that is not intended to be removed by the user shall be secured by a keyed nut, a jam nut, a nut locked in place with a pin, or other positive means.

25 Controls – End Product Test Parameters

25.1 General

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

25.1.2 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.

25.2 Auxiliary controls

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

25.2.2 Auxiliary controls shall comply with the requirements in this end product Standard.

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

25.3 Operating controls (regulating controls)

25.3.1 The following test parameters shall be among the items considered when determining the acceptability of an operating control evaluated 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 25.1;

e) For the applicable Material Group, see Table 25.2; and

f) For the applicable Pollution Degree, see Table 25.3.

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

a) Control action Types 1 or 2;

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

c) For the applicable Opervoltage Category, see Table 25.1;

d) For the applicable Material Group, see Table 25.2; and

e) For the applicable Pollution Degree, see Table 25.3.

Table 25.1
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 25.2
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 25.3
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

25.4 Protective controls (limiting controls)

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

25.4.2 The following test parameters shall be among the items considered when determining the acceptability of an electronic protective control evaluated 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 32;

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 32.0 ±3.6°F (0 ±2°C) and 104 ±3.6°F (40.0 ±2°C). For protective devices intended for outdoor use, the test shall be conducted at ambient temperatures of -31.0 ±3.6°F (-35.0 ±2°C) and 104 ±3.6°F (40.0 ±2°C). If the maximum ambient temperature of the control is determined to exceed the specified upper limit of the ambient temperature by conducting the Temperature Test, Section 32, 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 32; and

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

25.4.3 The test parameters and conditions used in the investigation of the circuit covered by 5.6.1.4, 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 complies with 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 18°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.

25.4.4 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.

25.5 Controls using a temperature sensing device

25.5.1 A temperature sensing positive temperature coefficient (PTC) or negative temperature coefficient (NTC) thermistor, that performs the same function as an operating or protective control, shall be tested using the following number of cycles when testing a sensing device in accordance with the Endurance Test as specified in UL 991 or UL 60730-1:

a) For a device employed as an 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.

PERFORMANCE

26 General

26.1 The performance of an appliance shall be evaluated by subjecting the requisite number of samples to all the applicable tests as described in 27.1 – 43.3. Insofar as practicable, the tests shall be conducted in the order in which they are presented. Samples employed for leakage-current tests are to be tested for leakage prior to employing the samples for other tests.

26.2 An alternate magnet wire coating used in an appliance motor subject to the Overload Test, Section 83, and the Armature Investigation, Section 84 shall be:

a) An evaluated magnet wire of the same:

1) ANSI grade designation;

2) Generic material type and construction with the same temperature rating as the original magnet wire tested; or

b) Tested as indicated by the Overload Test, Sections 83 and the Armature Investigation, Section 84.

Exception: Only a single sample of a gardening appliance employing an alternate magnet wire coating is to be tested if the test results are equivalent to the test results of the original construction tested. Equivalency is based upon the test duration, the enclosure temperature, and the leakage current being slightly higher, the same, or less and acceptable dielectric voltage withstand test results.

27 Leakage Current Test

27.1 An appliance rated for a nominal 120-volt supply, shall be subject to the test specified in 27.2 – 27.7. As a result of the test, the leakage current shall not be more than 0.5 milliamperes.

27.2 All exposed conductive surfaces are to be tested for leakage currents. The leakage currents from these surfaces are to be measured to the grounded supply conductor individually as well as collectively where simultaneously accessible. Parts are considered to be exposed surfaces unless guarded by an enclosure considered acceptable for reducing the risk of electric shock as defined in 10.1.1 – 10.1.6. Surfaces are considered to be simultaneously accessible if they can be readily contacted by one or both hands of a person at the same time. These measurements do not apply to terminals operating at voltages that are considered not to present a risk of electric shock.

27.3 If a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil with an area of 10 by 20 centimeters (3.9 by 7.9 inches) in contact with the surface. If the surface is less than 10 by 20 centimeters (3.9 by 7.9 inches), 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 appliance.

27.4 The measurement circuit for leakage current is to be as illustrated in Figure 27.1. The measurement instrument is defined in (a) – (c). 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 is not required to have all the attributes of the defined instrument.

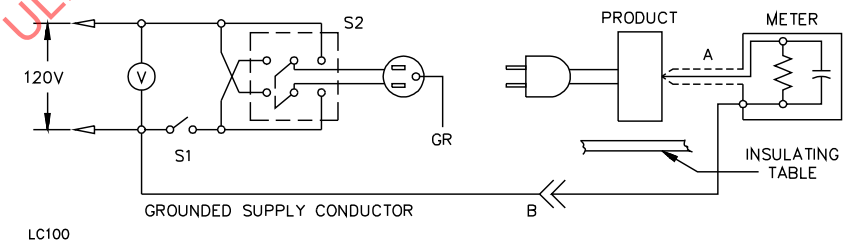
a) The meter is to have an input impedance of 1500 ohms resistive shunted by a capacitance of 0.15 microfarad.

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.

Figure 27.1

Leakage current measurement circuit



Note:

A – Probe with shielded lead.

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

27.5 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.

27.6 A sample of the appliance 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 27.1 – is to be as follows:

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

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

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

27.7 Normally, the complete leakage current test program described in 27.6, 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.

28 Starting Current Test

28.1 An appliance shall be subjected to the test specified in 28.2 and 28.3. As a result of the test, the appliance shall start and operate normally on a circuit protected by an ordinary – not time-delay – fuse having a current rating corresponding to the current rating of the attachment plug of the appliance in accordance with Table 28.1.

Exception: This requirement does not apply to an appliance that:

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

b) Is marked in accordance with 57.7.

Table 28.1
Rating of test fuse

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

28.2 In a test to determine whether an appliance complies with the requirement in 28.1, the appliance is to be connected to a supply of rated voltage using a 100-foot (30.5 m) cord set, as described in 28.3, and started three times, with the appliance at room temperature at the beginning of the test. Each start of the motor is to be made under conditions representing the beginning of normal operation, and the motor is to be allowed to come to rest between successive starts. The results are unacceptable if the fuse opens, or if a thermal protector provided as part of the appliance trips.

28.3 With reference to the requirement in 28.2, a 100-foot (30.5 m) cord set is to be used when the starting current is measured. If the manufacturer supplies a 100-foot (30.5 m) 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 appliance; 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 appliance.

29 Continuity of Ground Connection Test

29.1 The grounding blade of the attachment plug and the dead metal parts of an appliance specified in 23.2(c), shall be electrically connected.

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

29.3 Compliance with the requirement in 29.2, may be determined by any convenient method. However, if unacceptable results are obtained, 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.

30 Input Test

30.1 The current input to an appliance shall not be more than 120 percent of the rated value when the appliance is operated under the condition of normal load resulting in maximum input as described in 30.4, 30.5, 56.2, 58.2, 60.3, and 62.1.2, while connected to a supply circuit of rated voltage and rated frequency.

30.2 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.

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

30.4 In testing an appliance, normal load resulting in maximum input 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 loading conditions that are recommended by the manufacturer of the appliance. Test loads that have been determined to be close approximations of the most severe conditions of normal use are described in 56.2, 58.2, 60.3, and 62.1.2, for some common forms of appliances. However, appliances 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 appliance.

30.5 Combination appliances are to be tested individually for each function.

31 Dielectric Voltage Withstand Test

31.1 Other than as specified in 31.2, an appliance shall withstand for 1 minute without breakdown the application of a 60-hertz essentially sinusoidal potential of 1000 volts plus twice rated voltage between live parts and dead metal parts, with the appliance at the temperature reached during the Temperature Test, Section 32.

31.2 For an appliance 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 appliance – is to be 1000 volts. See 31.3.

31.3 In applying 31.2 to a motor not rated in horsepower, the appropriate table in ANSI/NFPA 70 that specifies the relationships between horsepower and full-load currents for motors is to be used. For a universal motor, the table applying to a single-phase, alternating-current motor is to be used if the appliance 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 an appliance complies with the requirements in 31.1, the appliance 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: A 500-volt-ampere or larger capacity transformer is not required to be used if the transformer is provided with a voltmeter to directly measure the applied output potential.

32 Temperature Test

32.1 An appliance shall be subjected to the test specified in 32.3. As a result of the test, the appliance shall not:

a) Attain a temperature at any point sufficiently high to cause a risk of fire or damage any materials employed in the appliance; or

b) Exceed the temperature rises specified in Table 32.1.

Table 32.1
Maximum acceptable temperature rises

Materials and components	°C	(°F)
A. MOTORS		
1. Class A insulation on coil windings of an a-c motor having a frame diameter of 7 inches (178 mm) or less, not including a universal motor, and on a vibrator coil [a,b]		
(a) In an open motor and on a vibrator coil:		
Thermocouple or resistance method	75	(135)
(b) In a totally enclosed motor:		
Thermocouple or resistance method	80	(144)
2. Class A insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 inches (178 mm), of a d-c motor, and of a universal motor[a,b]		
(a) In an open motor:		
Thermocouple method	65	(117)
Resistance method	75	(135)
(b) In a totally enclosed motor:		
Thermocouple method	70	(126)
Resistance method	80	(144)
3. Class B insulation systems on coil windings of an a-c motor having a frame diameter of 7 inches (178 mm) or less, not including a universal motor, and on a vibrator coil[a,b]		
(a) In an open motor and on vibrator coils:		
Thermocouple or resistance method	95	(171)

Table 32.1 Continued on Next Page

Table 32.1 Continued

Materials and components	°C	(°F)
(b) In a totally enclosed motor:		
Thermocouple or resistance method	100	(180)
4. Class B insulation systems on coil windings of an a-c motor having a frame diameter of more than 7 inches (178 mm), of a d-c motor, and of a universal motor[a,b]		
(a) In an open motor:		
Thermocouple method	85	(153)
Resistance method	95	(171)
(b) In a totally enclosed motor:		
Thermocouple method	90	(162)
Resistance method	100	(180)
5. Class E insulation systems on coil windings and core laminations		
Thermocouple method	80	(144)
Resistance method	90	(162)
B. COMPONENTS		
1. Capacitors:		
(a) Electrolytic[c]	40	(72)
(b) Other types[d]	65	(117)
2. Fuses	65	(117)
3. Relay, solenoid, and coils (except motor coil windings and transformers) with		
(a) Class 105 insulated systems[a]		
Thermocouple method	65	(117)
Resistance method	85	(153)
(b) Class 130 insulated systems[a]		
Thermocouple method	85	(153)
4. Transformers		
(a) Class 105 insulation systems[a]		
Thermocouple method	65	(117)
Resistance method	75	(135)
C. CONDUCTORS		
1. Rubber- or thermoplastic-insulated wires and cords[e,f]	35	(63)
D. ELECTRICAL INSULATION – GENERAL		
1. Fiber employed as electrical insulation	65	(117)
2. Phenolic composition employed as electrical insulation or as a part the deterioration of which could result in a risk of fire or electric shock[e]	125	(225)
3. Varnished cloth insulation	60	(108)
4. Wood or other combustible materials	65	(117)

[a] See 32.12.

[b] See note a to Table 22.1.

[c] For an electrolytic capacitor that is physically integral with or attached to a motor, the maximum acceptable temperature rise on insulating material integral with the capacitor enclosure may be not more than 65°C (117°F).

[d] A capacitor that operates at a temperature rise of more than 65°C (117°F) may be evaluated on the basis of its temperature limit.

Table 32.1 Continued on Next Page

Table 32.1 Continued

Materials and components	°C	(°F)
[e] These limitations do not apply to compounds and components that have been evaluated and determined acceptable for use at higher temperatures.		
[f] A rubber-insulated conductor within a Class-A-insulated motor, a rubber-insulated motor lead, and a rubber-insulated conductor of a flexible cord entering a motor may be subjected to a higher temperature if the conductor is provided with sleeving or a braid that has been evaluated and determined acceptable for use at the higher temperature. This does not apply to thermoplastic-insulated wires or cords.		

32.2 During the temperature test, the temperature of a surface that may be contacted by the user, other than a cutting or functional edge, shall not be more than the value specified in Table 32.2. 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.

Table 32.2
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 subjected to contact in normal use	60	(140)	85	(185)

32.3 For the temperature test, a garden appliance is to be loaded by an eddy-current brake, dynamometer, or the like as follows:

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

b) An appliance 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 appliance 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 appliance 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 appliance 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 appliance 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 an appliance 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.

32.4 With reference to feedback as specified in 32.3 (d) and (e), an appliance is considered to have feedback if the rated current is exceeded when making the adjustment described in (d) and (e)(2).

32.5 All values for temperature rises in Table 32.1, are based on an assumed ambient temperature of 25°C (77°F). Tests may be conducted at any ambient temperature within the range of 10 – 40°C (50 – 104°F).

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

32.7 The appliance is to be operated continuously until constant temperature has been reached while connected to a voltage supply as follows. 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 appliance has a nominal voltage rating of 115 or 230 volts. For an appliance having a voltage rating other than those just indicated, the voltage of the power supply circuit is to equal the maximum rated voltage of the appliance. If the appliance has a single frequency rating, the test is to be made at that frequency. An appliance rated a-c/d-c, d-c 60-hertz, or d-c 25 – 60 hertz is to be tested on direct current or 60-hertz alternating current, whichever results in higher temperatures. An appliance rated 25 – 60 or 50 – 60 hertz is to be tested on 60-hertz alternating current.

32.8 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 minutes, indicate no change.

32.9 Temperatures are to be measured by thermocouples except when the resistance method is to be used as specified in 32.12. 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 accepted laboratory practice. The thermocouple wire is to comply with the requirements given in the Tolerances on Initial Values of EMF versus Temperature tables in the, ANSI/ASTM E230/E230M.

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

32.11 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.

32.12 Ordinarily, the temperature of a coil or winding is to be measured by means of thermocouples mounted on the outside of the coil wrap. If the coil is inaccessible for mounting thermocouples (for example, a coil immersed in sealing compound), or if the coil wrap includes thermal insulation, or more than 1/32 inch (0.79 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 (17.8 mm) or less (see Table 32.1), the thermocouple is to be mounted on the integrally applied insulation of the conductor.

32.13 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:

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

in which:

Δ t is the temperature rise in °C;

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

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

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

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

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

33 Humidity Conditioning Test

33.1 An appliance using 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). As a result of the conditioning:

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

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

c) An appliance shall be subjected to a dielectric voltage withstand test as described in 31.1; if possible, the test is to be conducted with the appliance still in the humidity chamber or room at the specified humidity and temperature. If it is necessary to remove the appliance from the chamber or room, it is to be tested within 1 minute of removal.

Exception: A battery charger that is not provided as an integral part of an appliance is not required to comply with these requirements.

34 Water Spray Test

34.1 A shredder, shredder-bagger, pruner, or grass shears shall be subjected to the test specified in 34.2 – 34.4. As a result of the test, the following conditions shall be met:

a) Rated for a nominal 120 volt supply shall comply with the requirement in 27.1, in a repeated leakage current test, except that the test is to 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. The dielectric test potential shall be:

1) In accordance with 31.1, for a grounded appliance.

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

3) Thirty-five hundred volts plus twice the rated voltage of the appliance for a double-insulated appliance rated other than a nominal 120 volts.

34.2 Grass shears are to be mounted so that the blade is tilted downward at a 30 degree angle. Pruners are to be mounted so that the blade is tilted upward at a 30 degree angle. A spray of water is to be directed onto the blade and the portion of the motor case nearest the blade for 4 hours. This spray is not to strike the enclosure on the side of the motor away from the blade. The appliance is to be operating during and 5 seconds after the spray is removed before being subjected to the tests required by 34.1.

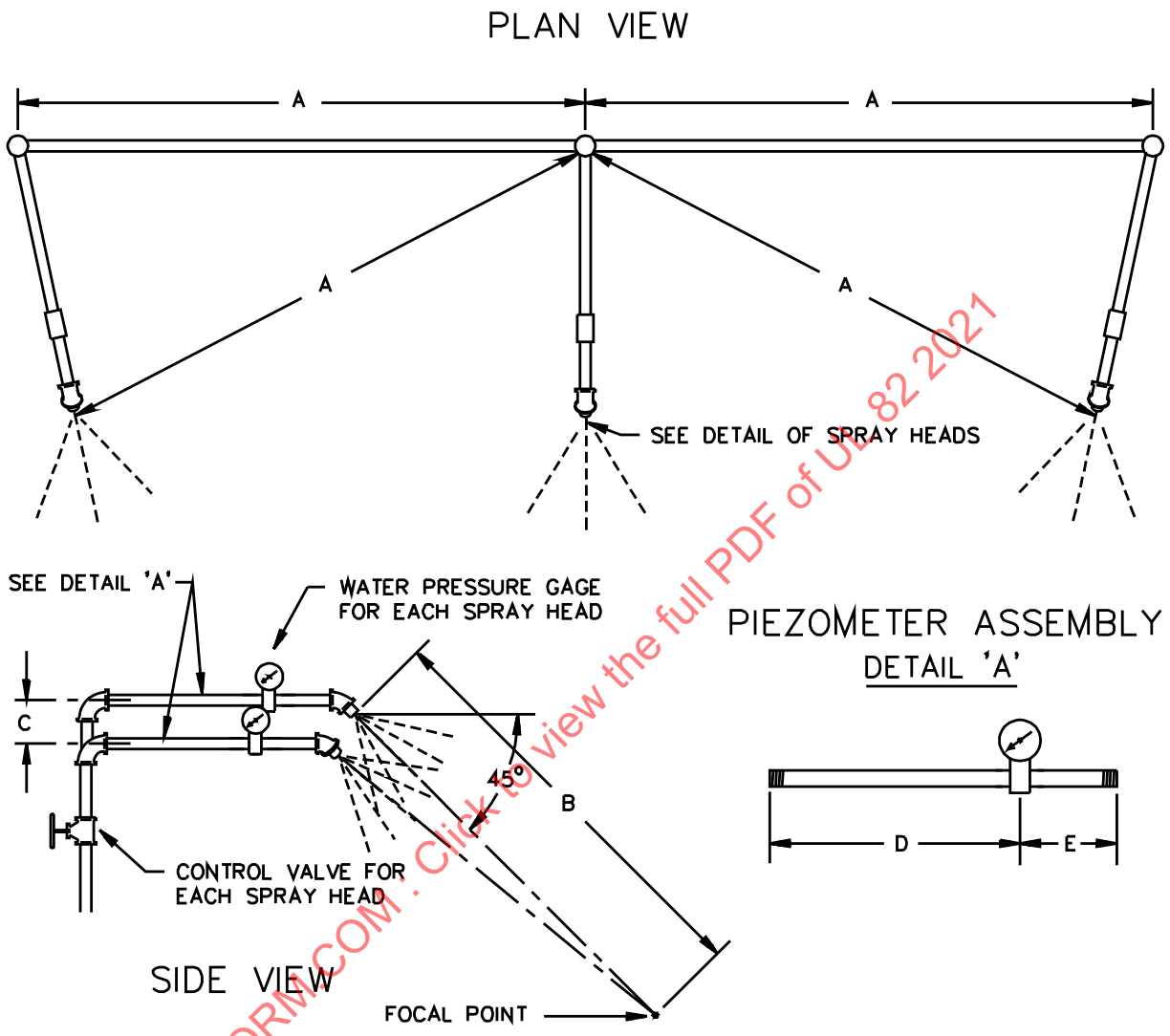
34.3 A shredder or shredder-bagger, supported in the normal operating position, is to be subjected for 1 hour to a downward spray of water onto the top and sides, applied to the appliance at an angle of 45 degrees from the vertical and in the direction most likely to cause water to enter. The appliance is not to be operated during exposure to the water spray, but is to be operated for 5 seconds without load before being subjected to the tests required by 34.1.

34.4 The water spray test apparatus is to consist of three spray heads mounted in a water supply pipe rack as illustrated in Figure 34.1. Spray heads are to be constructed in accordance with the details specified in Figure 34.2. The water pressure for all tests is to be maintained at 5 psi (34 kPa) at each spray head. The distance between the center nozzle and the appliance is to be approximately 5 feet (1.5 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.

34.5 Before the test is started, the resistivity of the water is to be 3500 ohm-centimeters ±6 percent when measured at 25°C (77°F). At the conclusion of the test, the resistivity of the water is not to be less than 3200 ohm-centimeters nor more than 3800 ohm-centimeters when measured at 25°C (77°F).

Figure 34.1

Rain-test spray-head piping

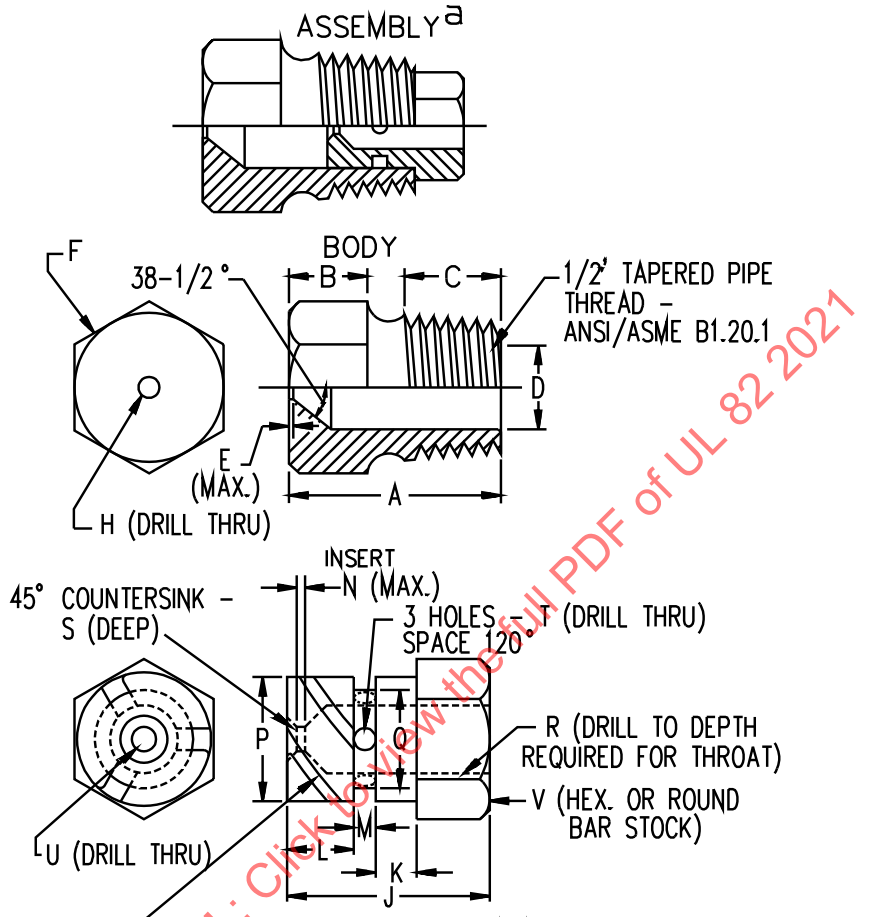


Item	mm	inch
A	710	28
B	1400	55
C	55	2–1/4
D	230	9
E	75	3

RT101F

Figure 34.2

Rain-test spray head



Item	inch	mm	Item	inch	mm
A	1 7/32	31.0	N	1/32	0.80
B	7/16	11.0	P	.575	14.61
C	9/16	14.0		.576	14.63
D	.578	14.68	Q	.453	11.51
	.580	14.73		.454	11.53
E	1/64	0.40	R	1/4	6.35
F	c	c	S	1/32	0.80
G	.06	1.52	T	(No. 35) [b]	2.80
H	(No.9) [b]	5.0	U	(No. 40) [b]	2.50
J	23/32	18.3	V	5/8	16.0
K	5/32	3.97	W	0.06	1.52
L	1/4	6.35			
M	3/32	2.38			

[a] Nylon Rain-Test Spray Heads are available from Underwriters Laboratories

[b] ANSI B94.11M Drill Size

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

RT100E

35 Abnormal Operation Tests

35.1 Component short- and open-circuit test

35.1.1 An appliance having a semiconductor of one or more semiconductor junctions, a capacitor, or a combination of both shall be subjected to the tests specified in 35.1.2 – 35.1.4, As a result of the test, the semiconductor shall not involve a risk of fire, electric shock, or injury to persons when either the semiconductor junction or the capacitor is short- or open-circuited.

35.1.2 The appliance is to be connected to a grounded supply of rated frequency and maximum rated voltage operating at no load with the short- or open-circuited condition introduced. Only one abnormal condition is to be simulated at a time.

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

35.1.4 During the tests described in 35.1.2, the appliance is to be connected in series with a nontime-delay fuse of the maximum current rating that can be accommodated by the fuse-holder of the branch circuit to which the appliance 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.

35.2 Capacitor overvoltage test

35.2.1 In a test to determine if a capacitor as described in 20.1(d), is acceptable, several 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. If the cotton ignites upon breakdown of the capacitor, the results are unacceptable.

36 Handle Tests

36.1 If the insulating material used for a handle, as specified in 8.2, overlies dead metal, the material shall be conditioned as specified in 36.2 – 36.4. As a result of the test, the material shall not:

a) Show holes, cracks, distortion, or other evidence of unacceptable deterioration after being conditioned as described in 36.2; and

b) Break, crack, rupture, or show other adverse effects after the appliance has been subjected to the impacts described in 36.3. The impact test is to be conducted on the samples that have been conditioned as described in 36.2.

36.2 For the conditioning specified in 36.1, the appliance is to be kept for 7 hours in an air-circulating oven at a temperature that is 10° C (18° F) higher than the temperature attained by the handle under conditions of normal operation, but at not less than 70°C (158°F).

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

36.4 The impact specified in 36.3, is to be applied by dropping a steel sphere, 2 inches (51 mm) in diameter and weighing 1.18 pounds (0.54 kg), through a vertical distance of 51 inches (1.29 m).

37 Brush Cap Test

37.1 A brush cap of a hand-supported appliance shall be subjected to the test specified in 37.2. As a result of the test, the brush cap shall withstand the test without cracking or breaking.

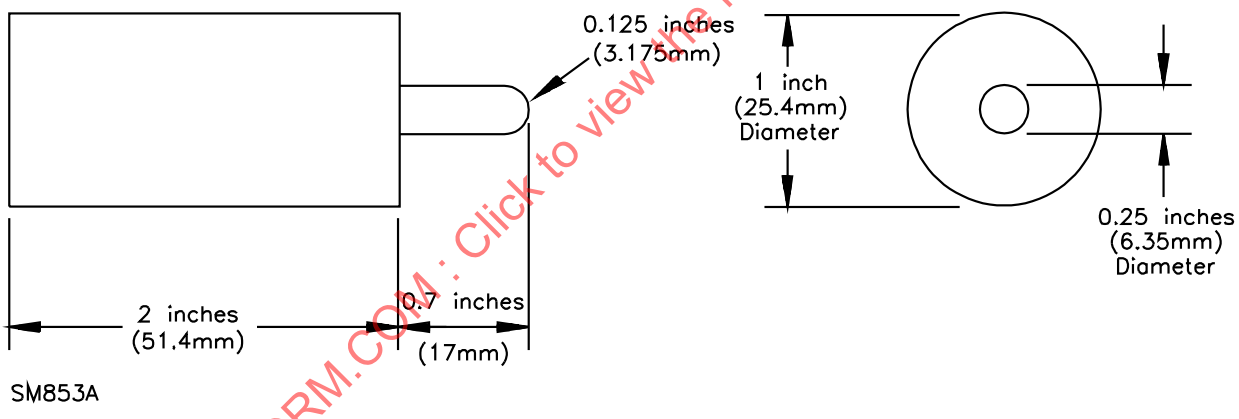
37.2 The appliance is to be dropped through a distance of 3 feet (0.91 m) to strike a concrete surface, except that if the brush cap is located so that it cannot strike the surface when the test is being conducted, it is to be subjected to an impact of 1 foot-pound (1.36 J).

37.3 A brush cap of a ground-supported appliance shall be subjected to the test specified in 37.4. As a result of the test, the brush cap shall withstand the test without cracking, breaking, or exposing live parts.

37.4 An impact of 1 foot-pound (1.36 J) is to be applied to the brush cap through the hardened steel rod shown in Figure 37.1 with a diameter of 1/4 inch (6.4 mm), held in contact with the brush cap by any convenient means.

Figure 37.1

Impact rod



38 Attachment Plug Test

38.1 An attachment plug provided with an appliance shall be tested as spcified in 38.2 and 38.3. As a result of the test, the test probe shall not contact any blade of the attachment plug while the plug is conductively connected to the connector of the extension cord.

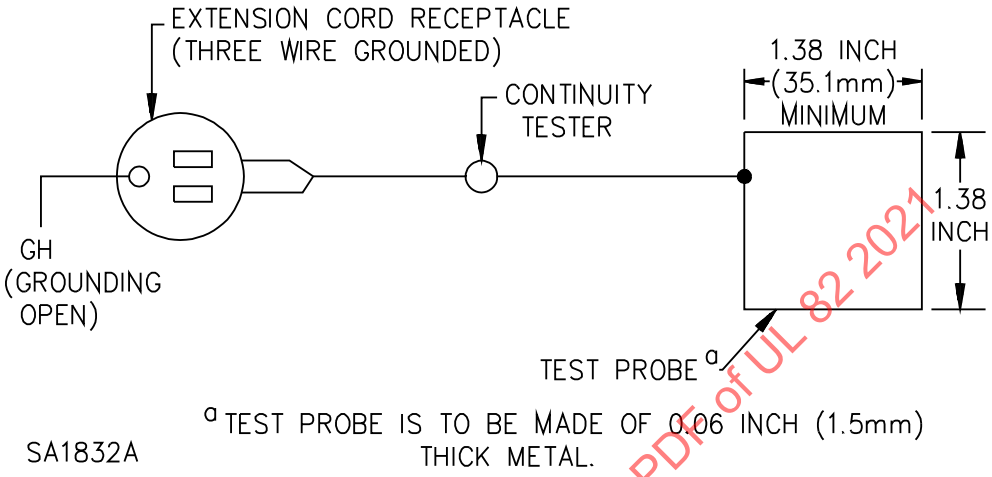
Exception: The probe may contact the grounding blade of a 3-conductor grounding plug.

38.2 The receptacle used in the test shall comply with the requirements in UL 498, or the equivalent. The receptacle is to be connected to the extension cord of the test assembly illustrated in Figure 38.1. The plug is to be inserted in the receptacle as far as possible. The plug is then to be withdrawn not more than the distance that is necessary to permit the test probe to be inserted between the plug body and the extension cord receptacle. 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 blade, the electrical continuity is to be

determined by an ohmmeter or similar instrument between the contacts of the extension cord receptacle and the test probe. The test is then to be repeated for the other blade of the attachment plug.

Figure 38.1

Test assembly for accessibility of attachment-plug blades



38.3 The test probe specified in 38.2, is to be made of 0.06-inch (1.5-mm) thick metal that is 1.38 inches (35 mm) wide, and not less than 1.38 inches long.

39 Strain Relief And Torque Tests

39.1 The strain-relief means provided on the power supply cord shall be subjected to the test specified in 39.2 and 39.3. As a result of the test, relief means shall withstand for 1 minute, without displacement, a pull of 35 pounds (156 N) applied to the cord, with the connections within the appliance disconnected. The strain relief is not acceptable if, at the point of disconnection of the conductors, there is such movement of the cord as to indicate that stress would have resulted on the connections.

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

39.3 A power supply cord shall withstand for 1 minute a torque of 50 ounce-inches (0.353 N·m) applied 1 inch (25.4 mm) from the strain relief without damage to the cord and without transmitting the torque to the terminations.

40 Cord Flexing Test

40.1 A power supply cord shall be subjected to the test specified in 40.2 – 40.5. As a result of the test, the cord shall withstand 20,000 cycles of flexing at the cord entrance to the product.

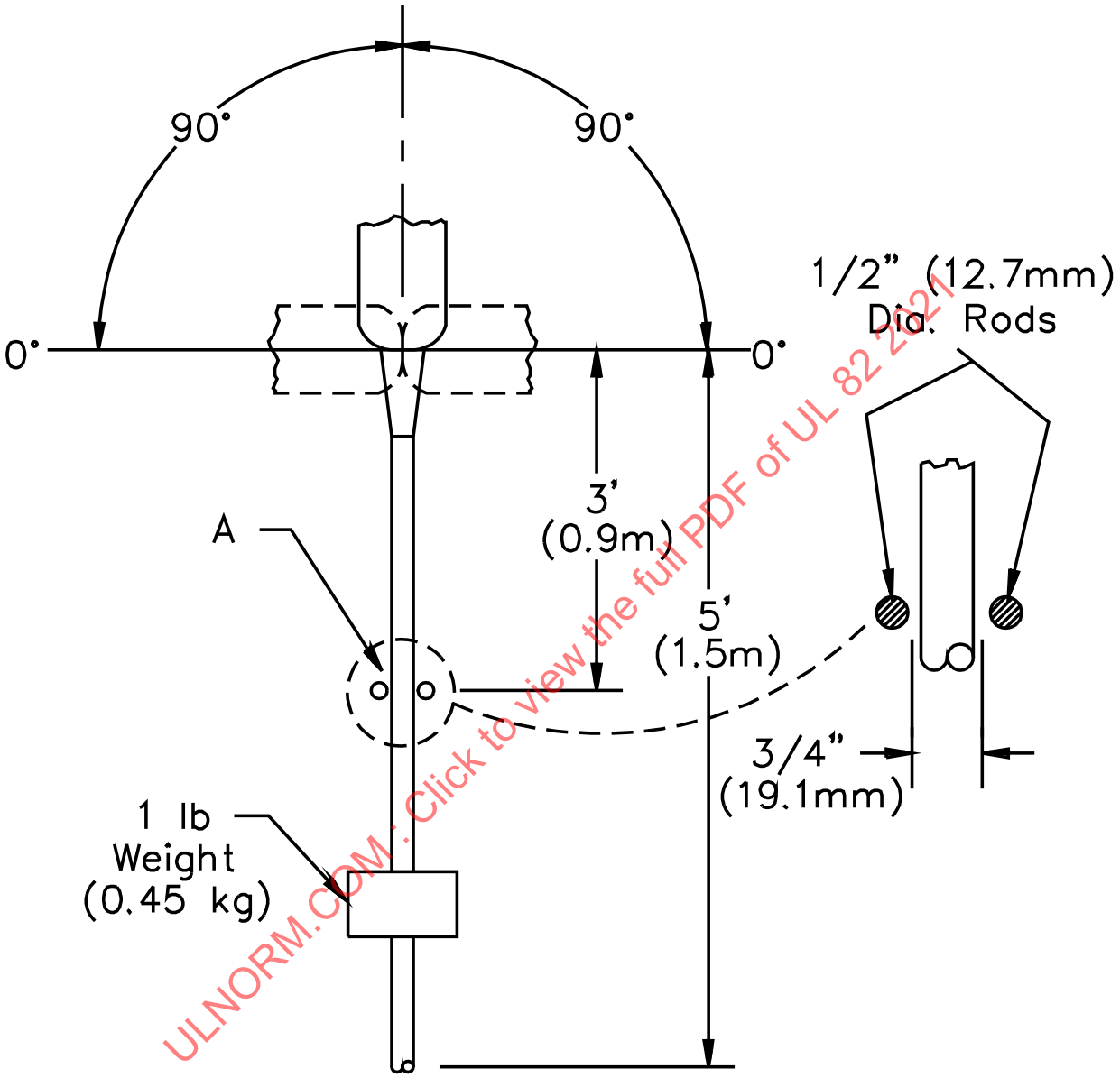
40.2 Flexing is to be performed at a rate not exceeding 10 cycles per minute, unless agreeable to those concerned.

40.3 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 (0.40-kg) weight is to be attached to the cord between 3 feet (0.91 m) and 5 feet (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 appliance, the device is to be removed for this test. See Figure 40.1 .

Figure 40.1

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.

S2864

Inch	1/2	3/4	**ft**	3	5	**lb**	1
(mm)	(12.7)	(19.1)	**(m)**	(0.91)	(1.52)	**kg**	(.40)

40.4 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.

40.5 After flexing:

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

b) Following the test specified in (a), there is to 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.

41 Pressure Pad Test

41.1 To determine if the pressure pad tests described in 41.2 and 41.3, are needed, a sample of the gardening appliance is to be operated at no load for a period of 1 hour with the pad specified in 11.1.12, removed from the appliance. At the conclusion of the test, the appliance is to be carefully examined for evidence of a risk of fire or electric shock. If there is such evidence, the tests described in 41.2, and, if applicable, 41.3, are to be conducted.

41.2 To determine compliance with 11.1.12, 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 the inability of the pad to hold down or maintain permanent position of an electrical part.

41.3 If a pressure pad is likely to be exposed to grease, three samples of the pad specified in 11.1.12, 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 the inability of the pad to hold down or maintain permanent position of an electrical part.

42 Switch and Control Tests

42.1 General

42.1.1 A switch or other device that controls the motor of an appliance shall perform acceptably when subjected to a test consisting of 50 cycles of operation, making and breaking the locked-rotor current of the appliance. There shall not be any electrical or mechanical breakdown of the device or undue pitting or burning of the contacts. In addition, the results are not acceptable if the fuse in the grounding connection provided in accordance with 42.1.2, opens during any of the tests.

Exception No. 1: A speed changing switch that has been previously evaluated and determined to be acceptable or has been tested in accordance with 42.3.1, is not required to be subjected to this test.

Exception No. 2: A reversing switch that has been previously evaluated and determined to be acceptable or has been tested in accordance with 42.2.1, is not required to be subjected to this test.

Exception No. 3: A switch that controls an induction motor and has an acceptable horsepower rating is not required to be subjected to this test.

Exception No. 4: A switch that is interlocked so that it will never have to break the locked-rotor current is not required to be subjected to this test.

Exception No. 5: A switch in an isolated secondary circuit limited to 100 volt-amperes or less is not required to be subjected to this test (see 42.3.3).

42.1.2 For the tests described in 42.1.3 – 42.3.2, the appliance is to be connected to a grounded power supply circuit of rated frequency and maximum rated voltage. See 32.7. During the tests, exposed dead metal parts of the appliance 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 appliance is intended for use on direct current, or on direct current as well as on alternating current, the exposed dead metal parts of the appliance are to be connected so as to be positive with respect to any single-pole, current-rupturing control device.

42.1.3 For the test described in 42.1.1, the rotor of the motor is to be locked in position, and the device is to be operated at a rate of not more than 10 cycles per minute; and the device is to be left in the on position as briefly as possible (a faster rate of operation may be employed if agreeable to those concerned).

42.2 Reversing switch

42.2.1 A switch or other device used for reversing the motor of an appliance, unless acceptable for the application, shall be subjected to a test consisting of 25 cycles of operation as described in 42.2.2. 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 appliance.

42.2.2 For the test specified in 42.2.1, each cycle of operation is to consist of:

a) Throwing the switch to the position in which the motor of the appliance 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.

42.3 Speed changing switch

42.3.1 A switch or other device for changing the speed of the motor of an appliance, other than an "on-off" switch, unless acceptable for the application, shall be subjected to 50 cycles of operation as described in 42.1.2 and 42.3.2. 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 appliance.

42.3.2 For the test specified in 42.3.1, each cycle of operation is to consist of operating the appliance 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.

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

a) Is not required to be evaluated to determine whether it is acceptable for the application; and

b) Is not required to be subjected to the tests in 42.1.1 – 42.3.2.

43 Accelerated Aging Test

43.1 A rubber or neoprene compound forming a part that is depended upon to protect the appliance from moisture shall be subjected to the test specified in 43.2 and 43.3. As a result of the tests, the part shall have physical properties as specified in Table 43.1, after aging.

Table 43.1
Accelerated aging test

Temperature on component during temperature test		Accelerated aging procedure	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 168 hours at 121.0 ±1.0°C (249.8 ±1.8°F)	50	50
91 – 105	(196 – 221)	Air oven aging for 168 hours at 136.0 ±1.0°C (276.8 ±1.8°F)	50	50

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 mode of application in the appliance, and other factors. The test procedure may include visual inspection for cracks, deformation, and the like after the accelerated aging, as well as comparison of hardness, tensile strength, and elongation before and after the 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 the accelerated aging, is acceptable if these properties are determined to be not less than the applicable values specified in Table 43.1.

44 Polymeric Materials Not Classed HB

44.1 Mold stress relief test

44.1.1 An appliance with a polymeric enclosure not classed HB shall be subjected to the test specified in 44.1.2 – 44.1.4. After testing, 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;

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 for protection 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 appliance complies with the Strain Relief and Torque Tests, Section 39.

44.1.2 Three samples of the complete appliance 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 as measured under normal operating conditions, but not less than 70° C (158° F). Immediately following this conditioning, the sample is to be examined with reference to the requirements in 44.1.1(a). After cooling to room temperature, the sample is to be examined with reference to 44.1.1 (b), (c), and (d), and tested as specified in 44.1.1(e).

44.1.3 The oven conditioning described in 44.1.2, may cause the enclosure to distort to the extent that it is in a throw-away condition provided the performance of the appliance, as examined several times during the oven conditioning, is such that intermediate stages of distortion do not introduce a risk of fire, electric shock, or injury to persons.

44.1.4 Crazing of the polymeric material is not considered to be unacceptable with regard to the requirements in 44.1.1.

44.2 Resistance to impact test – appliance

44.2.1 An appliance shall be subjected to the test specified in 44.2.2 – 44.2.5. As a result of the test, the appliance shall withstand the impact specified in 44.2.3 – 44.2.5, without:

a) Making live parts accessible to contact; or

b) Producing any other condition that would introduce a risk of electric shock.

44.2.2 With reference to 44.2.1 (b), cracking of the enclosure shall not affect the function of any protective or constructional feature, such as a thermostat, an overload-protective device, or a strain relief. Cracking of the enclosure is not acceptable if a dust- or moisture-tight enclosure is required.

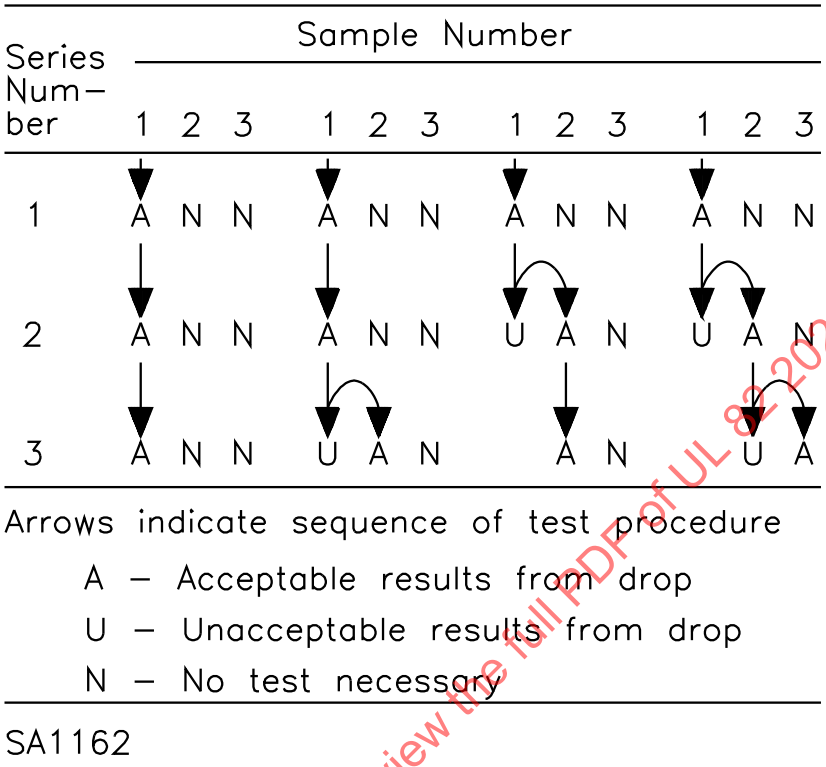
44.2.3 A ground-supported appliance is to be subjected to three impacts of 5 foot-pounds (6.8 J), as described in 44.3.2, on any surface that is exposed to a blow during normal use. For surfaces other than the top of an enclosure, the steel sphere used for the impact is to be suspended by a cord and allowed to fall as a pendulum through the distance required to cause it to strike the surface with the specified impact.

44.2.4 Each of three samples of a hand-supported appliance is to be subjected to the impact that results from its being dropped three times through a distance of 3 feet (0.91 m) to strike a concrete surface in the positions most likely to produce adverse results.

44.2.5 With reference to 44.2.4, the tests on a hand-supported appliance are to be conducted so that each sample strikes the surface in a position different from those of the other two samples. Three individual samples may be employed for the tests, or if the manufacturer so elects, fewer samples may be used in accordance with Figure 44.1. The overall performance is acceptable upon completion of any one of the procedures represented in Figure 44.1. If any sample does not comply with the test criteria on its first drop in any of three positions, the results of the test are unacceptable.

Figure 44.1

Procedure for impact test on a hand-supported appliance



44.3 Resistance to impact – component

44.3.1 A moving part as specified in 9.11, of a ground-supported appliance that is exposed to impact shall withstand the ball-impact test described in 44.3.2, and a component of a hand-supported appliance shall withstand the drop test specified in 44.3.3:

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

b) Without being affected to the extent that a part that may present a risk of injury to persons would be exposed to unintentional contact; and

c) Without affecting the intended mechanical performance of the appliance.

44.3.2 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 (0.45 kg). If the component being tested can be struck from above, the sphere is to be allowed to fall vertically from rest to strike the component. Otherwise, the sphere is to be suspended by a cord and is to be allowed to fall from rest as a pendulum to strike the component. In either case, the vertical travel of the sphere is to be 51 inches (1.29 m).

44.3.3 For the drop test, each of three samples of the complete appliance is to be dropped three times from a height of 3 feet (0.91 m) onto a concrete surface in such manner as to test the component most severely.

44.3.4 With reference to 44.3.3, the tests on a hand-supported appliance are to be conducted so that a sample strikes the surface in a different position for each drop. Three individual samples may be employed for the tests, or if the manufacturer so elects, fewer samples may be used in accordance with Figure 44.1. The overall performance is acceptable upon completion of any one of the procedures represented in the

figure. If any sample does not comply with the test criteria on its first drop in any position, the results of the test are unacceptable.

44.3.5 If the component is made of nonmetallic material, the ball-impact test or the drop test is to be performed on the sample or samples in the as-received condition. The test is then to be repeated on a 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 under normal operating conditions, but not less than 70°C (158°F). The conditioned samples are not to be tested until they have returned to room temperature.

44.3.6 After the conditioning described in 44.3.5, and before being subjected to the ball-impact test or the drop test, no sample shall show checking, cracking, or other deleterious effects, nor shall any sample show distortion that would introduce a risk of fire, electric shock, or injury to persons.

44.3.7 If the component is nonmetallic, samples of an appliance that has an accessory that may adapt the appliance for use at low temperatures are also to be subjected to the ball-impact test or drop test immediately after being conditioned at minus 20°C (minus 4°F) for 7 hours.

44.3.8 Deformation of a guard during the ball-impact or drop test is acceptable if:

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

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

44.3.9 A functional component, including a cutting tool or portion of the drive system, is not required to comply with the requirement for the drop or ball-impact test if it is obvious that the appliance would not be capable of normal operation after the test.

44.4 Abnormal operation test

44.4.1 An appliance shall be subjected to the test specified in 44.4.2 and 44.4.3. As a result of the test, 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 appliance 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.

44.4.2 For the test, the appliance is to be connected to the circuit specified in 35.1.2.

44.4.3 The appliance is to be operated under the condition of abnormal operation, such as stalled-rotor operation, operation without liquids, operation with current-carrying parts short-circuited, and the like. During the test, the appliance 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.

44.4.4 With reference to the requirement in 44.4.1, warping, shrinkage, expansion, or cracking of the material of the enclosure is acceptable.

44.5 Flame resistance test

44.5.1 An enclosure shall be subject to the test specified in 44.5.2 – 44.5.6. As a result of the test, 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.

44.5.2 Except as noted in 44.5.3, three samples of the enclosure are to be placed, for 7 days, in an oven maintained at a temperature not less than 10° C (18° F) higher than the maximum temperature of the material measured under normal operating conditions, but not less than 70° C (158° F). After cooling to room temperature, the samples are to be tested in accordance with 44.5.4 – 44.5.6.

44.5.3 The test described in 44.5.4 – 44.5.6, is to be conducted on unconditioned samples of the enclosure 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 of a thickness equal to or less than the minimum wall thickness of the enclosure.

44.5.4 Three sections of the enclosure of the appliance that are most likely to be ignited are to be selected. Using a separate sample in each case, each section is to be subjected to the flame test described in 44.5.5. During the test, the appliance is to be supported in its normal 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 appliance is to be in place.

44.5.5 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 specified in 44.5.4, with a 1-minute interval between the applications.

44.5.6 With reference to 44.5.4, the sections adjacent to coil windings, splices, open switches, or other arcing or sparking parts are considered to be those most likely to be ignited.

44.5.7 Flame-retardant coatings or paints are not to be depended upon for compliance with the flammability requirements in 44.5.1 – 44.5.6.

45 Polymeric Materials Classed HB

45.1 Mold-stress evaluation and input test

45.1.1 An appliance is to be conditioned and tested in accordance with 44.1.1 – 44.1.4. Following the test, each sample is to be operated at no load and rated voltage. As a result of the test, no sample shall have an input current of more than 145 percent of the current measured during the input test conducted in accordance with 30.1.

45.2 Resistance to impact test

45.2.1 An appliance is to be subjected to the applicable impact tests specified in 44.2.3 – 44.2.5, and shall comply with the requirements in 44.2.1 and 44.2.2.

45.3 Overload test

45.3.1 An appliance shall be subjected to the test specified in 45.3.2 – 45.3.4, as applicable. As a result of the test:

a) Except as noted in 45.3.4, the no-load current input of an appliance that has completed the overload test specified in 45.3.2, without burning out electrically shall not be more than 145 percent of the current measured during the input test on a previously unconditioned appliance in accordance with 30.1.

b) The enclosure of an appliance that burns out electrically during the overload test described in 45.3.2 or 45.3.4, shall not support flame for more than 1 minute.

45.3.2 An appliance 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 145 percent of rated current or the appliance burns out.

45.3.3 During the overload test specified in 45.3.2, any overload-protective device provided with the appliance is to be short-circuited.

45.3.4 An appliance is to be operated until burnout occurs by continuing the overload conditioning, if the appliance:

a) Has completed the overload test described in 45.3.3, without burning out; and

b) Has a no-load current input more than the value specified in 45.3.1.

45.4 Physical properties of enclosure material tests

45.4.1 An appliance shall be subjected to the test specified in 45.4.2 – 45.4.4. As a result of the test, the polymeric material shall resist ignition for 7 seconds or longer.

45.4.2 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 wrapped with five turns of resistance wire, with a spacing of 1/4 inch (6.35 mm) between turns.

45.4.3 The wire is to be 24 AWG (0.21 mm^2), iron-free, 20 percent chromium and 80 percent nickel, running 1.61 ohms per foot (5.25 ohm/m) and 865 feet per pound (581 m/kg). The wire is to be approximately 10 inches (254 mm) long and is to carry the current necessary for it to dissipate 65 watts. The measurement of the time is to begin when the current begins to flow.

45.4.4 The resistance per unit volume (volume resistivity) of the polymeric material shall not be:

a) Less than 45 megohm-centimeters in the as-received condition; and

b) Less than 10 megohm-centimeters after exposure for 96 hours to moist air having a relative humidity of 85 ±5 percent at a temperature of 32 ±2°C (90 ±4°F).

45.4.5 The volume resistivity is to be determined in accordance with ASTM D257.

46 High Current Arc Ignition Test

46.1 To determine compliance with the exception to 22.7(b), a polymeric material shall be subjected to the test specified in 46.2 – 46.5. As a result of the test, the material shall not ignite.

46.2 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.

46.3 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 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.

46.4 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 appliance.

46.5 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. The polymeric material is not acceptable unless each sample resists ignition during 60 arcs.

47 Permanence of Marking Tests

47.1 General

47.1.1 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. A pressure-sensitive label secured by adhesive shall be subjected to the tests specified in 47.2.1 – 47.4.1. As a result of the tests, the adhesion of a pressure-sensitive label or a label secured by cement or adhesive 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.

47.1.2 Ordinary usage, handling, storage, and the like of the appliance will be considered in determining the permanence of a marking.

47.2 Oven aging test

47.2.1 Three samples of the label, applied to test surfaces as in the intended application, are to be conditioned for 240 hours in an air oven maintained at the temperature specified in Table 47.1.

Table 47.1
Oven aging test temperatures

Maximum temperature – as measured during temperature test – of surface to which label is applied,		Test temperature	
°C	(°F)	°C	(°F)
60 or less	(140)	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	(356)

47.3 Immersion test

47.3.1 Six samples of the label, applied to test surfaces as in the intended application, are to be conditioned 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.

47.4 Standard atmosphere test

47.4.1 Three samples of the label, applied to test surfaces as in the intended application, are to be conditioned for 72 hours in a controlled atmosphere maintained at 23 ±2°C (73 ±4°F) with a 50 ±5 percent relative humidity.

MANUFACTURING AND PRODUCTION TESTS

48 General

48.1 Each finished appliance is to be subjected to the Production Line Dielectric Voltage Withstand Test, Section 49, and the Production Line Grounding Continuity Test, Section 50, with acceptable results before it leaves the factory.

49 Production Line Dielectric Voltage Withstand Test

49.1 Each appliance shall withstand, without electrical breakdown, as a routine production line test, the application of a 60-hertz essentially sinusoidal test potential between live parts and dead metal parts. Except as noted in 49.2, the production line test is to be in accordance with Condition A or Condition B of Table 49.1.

Table 49.1
Production-line test conditions

Appliance description	Condition A		Condition B	
	Potential, volts	Time, seconds	Potential, volts	Time, seconds
Having a universal motor or a motor rated 1/2 horsepower (373 W output) or less	1000	60	1200	1
Having a motor rated more than 1/2 horsepower	1000+2V[a]	60	1200+2.4V[a]	1

[a] Maximum marked voltage but not less than 120 volts if the maximum marked voltage is within the range 105 – 120 volts, and not less than 240 volts if the maximum marked voltage is within the range 210 – 240 volts.

49.2 Each finished double-insulated appliance shall withstand for 1 second without breakdown the application of a 60 hertz essentially sinusoidal test potential as specified in Table 49.2.

Table 49.2
Production line dielectric voltage withstand test potential for double-insulated appliances

Points between which potential is to be applied		Test potential, volts
A.	Live parts and dead metal parts insulated from each other by basic insulation[a]	1000
B.	Accessible dead metal parts or, for an appliance 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 72.7[a,b]	1500
C.	Live parts and accessible dead metal parts or, for an appliance with an outer enclosure of insulating material, metal foil wrapped tightly around the enclosure[a,b,c]	2500

[a] If necessary because of the inaccessibility of parts, tests in accordance with (A) and (B) may be conducted on subassemblies of the appliance and in this case, the test described in (C) shall be conducted. If the tests in accordance with (A) and (B) are conducted on the completely assembled appliances, the test described in (C) may be omitted if there is no reinforced insulation.

[b] Those parts of the tests described in (B) and (C) that include application of metal foil to outer enclosures of insulating is not required to be conducted if the manufacturer has an acceptable control program. To determine that 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 material. This investigation may be waived if the material has been evaluated and determined to be acceptable for the application;

2) Periodic physical property tests on molded parts; and

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

[c] The test of (C) is not required for small accessible metal parts, such as assembly screws, that are:

1) Isolated by an outer enclosure of insulating material that is subject to the control program indicated in note b; and

2) Are located so that they are remote from live parts and from inaccessible metal parts separated from live parts by basic insulation only. The remoteness is to include consideration of possible displacement of parts as the results of improper assembly.

49.3 A 500 volt-ampere or larger capacity transformer is not required to be used for the tests required in 49.1 and 49.2, if the transformer is provided with a voltmeter to measure the applied potential directly. The test equipment is to include an indication of breakdown that is audible or visual, 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.

49.4 Test equipment other than that described in 49.3, may be used if determined to accomplish the intended factory control.

50 Production Line Grounding Continuity Test

50.1 Each product that has a power supply cord having a grounding conductor is to be tested, as a routine production line test, to determine that grounding continuity exists between the grounding blade of the attachment plug and accessible dead metal parts of the product that are likely to become energized.

50.2 Only a single test need be conducted if the accessible metal selected is conductively connected by design to all other accessible metal.

50.3 Any acceptable indicating device, such as an ohmmeter, a battery-and-buzzer combination, or the like, may be used to determine whether a product complies with the requirement in 50.1.

RATING

51 General

51.1 An appliance shall be rated in volts, in frequency – expressed in one of the following terms: hertz, Hz, cycles-per-second, cps, cycles/second, or c/s – and in amperes. If the appliance 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, an appliance may be rated in watts if the full-load power factor is 0.80 or more, or if the rating of the appliance is 50 watts or less.

MARKING

52 General

52.1 All required markings shall be permanent (see Permanence of Marking Tests, Section 47), legible, readily visible, and shall be located on a part of the appliance that cannot be removed without impairing the operation of the appliance.

52.2 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;

Exception: The manufacturer's identification may be in a traceable code if the product is 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.

Exception: The date of manufacture may be abbreviated; or may be in a nationally accepted conventional code or in a code affirmed by the manufacturer, if the code does not repeat in less than 10 years, and does not require reference to the production records of the manufacturer to determine when the product was manufactured.

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

52.4 If a manufacturer produces or assembles appliances at more than one factory, each finished appliance shall have a distinctive marking by which it may be identified as the product of a particular factory.

52.5 For an appliance employing a single motor as its only electric-energy-consuming component, the electrical rating given on the motor nameplate is not required to be shown elsewhere on the appliance if this nameplate is readily visible after the motor has been installed in the appliance.

52.6 If an appliance employs a dual-voltage motor and if the motor nameplate is employed to indicate the electrical rating of the appliance in accordance with 52.5, the appliance shall be additionally marked to indicate the particular voltage for which it is connected when shipped from the factory. If the appliance employs an attachment plug, instructions shall be provided to indicate the type of plug that should be used if the appliance is reconnected for the alternate voltage.

52.7 If an appliance 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 28.1, the appliance shall be plainly marked with the following or the equivalent, "If connected to a circuit protected by fuses, use time-delay fuses with this appliance."

52.8 A switch, other than a momentary contact switch – one that requires constant pressure to hold it in the "on" position – that controls the motor of an appliance shall have a marked "off" position if the appliance, when energized, has moving parts that are likely to cause injury to persons.

52.9 The function of a reversing switch of a cultivator as described in the exception to 18.9, shall be marked on the appliance adjacent to the switch.

52.10 A trimmer using a flexible nonmetallic cutting line or that is provided with the gauge described in 57.6.1 and 57.6.2, shall be marked with the size and type of the cutting line specified by the manufacturer.

Exception: If the construction of the appliance is such that a cutting line that is larger than that specified by the manufacturer cannot be used with the appliance, the specification of the cutting line size and type may be given in the instruction manual.

52.11 A pole pruner shall be marked with the direction of rotation of the saw chain on the cutting attachment.

53 Cautionary

53.1 A required warning 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.

53.2 In a warning marking, the word "WARNING" shall be in letters not less than 3/32 inch (2.4 mm) high.

53.3 Under certain conditions where complete guarding of a moving part would defeat the utility of the appliance, cautionary markings shall be provided to instruct the user as to the steps to take to reduce a risk of injury to persons.

53.4 An edger, edger-trimmer, or a trimmer employing a nonmetallic cutting line not provided with a guard shall be plainly marked with the word "WARNING" and the following or the equivalent "Risk of Eye Injury. Use Safety Glasses or Similar Eye Protection."

53.5 If the construction of an appliance contemplates cleaning or servicing by the user, such as the replacement of pilot lamps, and if such cleaning or servicing would involve the exposure of a normally enclosed or protected live part to unintentional contact, the appliance shall be marked to indicate that such servicing or cleaning is to be done with the appliance disconnected from the supply circuit to reduce the risk of electric shock.

53.6 An appliance shall be plainly marked with the word "WARNING" and the following or the equivalent, "To reduce the risk of electric shock, do not expose to water– replace damaged cord immediately."

53.7 If an appliance is shipped from the factory with a required guard detached, the appliance shall be legibly and permanently marked with the word "WARNING" and the following or the equivalent, "To reduce the risk of injury to persons, do not operate without guards in place."

53.8 A pole pruner shall be plainly marked with the following or the equivalent,

a) “WARNING: Wear head and eye protection. Or the safety signs M014 of ISO 7010 and M004 of ISO 7010. A combination of personal protective equipment safety signs may be used.

b) “DANGER – Keep sufficient distance away from electrical power lines.” or the equivalent or alternatively the safety sign C.2.30 of ISO 11684.

54 Instruction Manual

54.1 General

54.1.1 An instruction manual shall be provided with an appliance.

54.1.2 The instruction manual shall specifically warn the user of any reasonably foreseeable risk of fire, electric shock, or injury to persons and state the precautions that should be taken to reduce such risk.

54.1.3 Specific identifications and warning information applicable to accessories and attachments shall be included in the instruction manual in accordance with 54.1.4.

54.1.4 The instruction manual shall include all of the following:

a) A statement specifying only those accessories and attachments that have been determined to be acceptable for use with the appliance, and:

1) A warning to the user that the use of any other accessory or attachment may increase the risk of injury; and

2) Instructions to the user for the intended use of the accessory or attachment, if necessary.

b) For a cultivator as described in the exception to 18.9, a statement to specify the function, and directions for the operation, of a reversing switch.

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

d) Instructions and cautionary statements for cleaning, user-maintenance (such as lubrication, adjustment, and the like), operations recommended by the manufacturer, and a warning to the user that any other servicing should be performed by an authorized service representative.

e) Instructions regarding the use of eye protection and advising the user that safety glasses or the like are available.

f) For trimmers employing a flexible nonmetallic cutting line:

1) Instructions and cautionary statements regarding line replacement with respect to use of proper type and size of line. The cautionary statements shall warn the user against using heavier lines than recommended by the manufacturer and against using line materials of other types – for example, metal wire, rope, and the like. It shall also make reference to the line gauge, if provided on the unit, and instruct the user how to apply the gauge to replacement lines and how to maintain the gauge;

2) Instructions regarding proper use of the trimmer and cautionary statements regarding the use of the appliance for edging operations; and

3) Cautionary statements regarding the use of proper clothing and footwear during operation to reduce the risk of injury that may be caused by flying debris.

g) 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 Details, Section 85).

h) For pole pruners:

1) “WARNING – Do not operate near electrical power lines. The unit has not been designed to provide protection from electric shock in the event of contact with overhead electric lines, Consult local regulations for safe distances from overhead electric power lines and ensure that the operating position is safe and secure before operating the saw chain pole pruner.”

2) Description and identification of the principal parts of the saw chain pole pruner including the safety devices and harness, and the use of the quick release mechanism.

3) Instruction for adjusting the proper tension of the saw chain, lubricating, maintenance and for transportation and storage.

4) Advice on correct working posture, maintaining firm footing and balance during operation including the safe usage of the harness, the quick release mechanism, and the need for rest periods and changing working position.

5) Advice of the need for head, and eye protection and the necessary personal protective equipment (PPE) to be used, including correct clothing.

6) Advice of the risk for bystanders, especially for children, and the need to keep them at a safe distance during operation of the saw chain pole pruner.

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

54.2 Important safety instructions

54.2.1 The instruction manual shall include an important safety instruction section which shall include the applicable items of 54.2.2.

54.2.2 The following applicable important safety instructions shall be separated in format from the other instructions, and shall appear before the operating instructions in the instruction manual. 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 gardening appliances, 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 may be used when they comply with 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 APPLIANCES

1) Grounding Instructions

This appliance should be grounded while in use to reduce the risk of electric shock to the operator. The appliance is equipped with a 3-conductor cord and 3-prong grounding plug to fit the proper grounding 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 illustrated in sketch A in Figure 54.1. If it is for use on 150 to 250 volts, it has a plug as illustrated in sketch D.

An adapter, sketches B and C, is available for connecting plugs as illustrated in sketch A to 2-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 illustrated in sketch D.

2) Extension Cords

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

b) FOR ALL DOUBLE-INSULATED APPLIANCES

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 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 APPLIANCES

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

2) Don't Use In Rain.

3) Keep Children Away – All visitors should be kept at a 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 substantial footwear is recommended when working outdoors. Wear protective hair covering to contain long hair.

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

6) Use Right Appliance – Do not use appliance 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 gardening appliance. Receptacles are available having built-in GFCI protection and may be used for this measure of safety.

Exception: This warning does not apply to a battery-operated appliance.

8) Warning – To reduce the risk of electric shock, use only with an extension cord intended for outdoor use, such as an extension cord of cord type SW-A, SOW-A, STW-A, STOW-A, SJW-A, SJOW-A, SJTW-A. or SJTOW-A.

Exception No. 1: This warning does not apply to a battery-operated appliance.

Exception No. 2: Types SW, SOW, STW, STOW, SJW, SJOW, SJTW, and SJTOW are alternative designations to Types SW-A, SOW-A, STW-A, STOW-A, SJW-A, SJOW-A, SJTW-A, and SJTOW-A, respectfully.

9) Extension Cord – Make sure your extension cord is in good condition. When using an extension cord, be sure to use one heavy enough to carry the current your product will draw. An undersized extension cord will cause a drop in line voltage resulting in loss of power and overheating. Table 54.1, 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 risk of disconnection of appliance cord from the extension cord during operating:

i) Make a knot as shown in Figure 54.2; or

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

10) Avoid Unintentional Starting – Don't carry plugged-in appliance with finger on switch. Be sure switch is off when plugging in.

11) Don't Abuse Cord – Never carry appliance by cord or yank it to disconnect from receptacle. Keep cord from heat, oil, and sharp edges.

Exception: This statement does not apply to a cordless battery-operated gardening appliance.

12) Don't grasp the exposed cutting blades or cutting edges when picking up or holding the appliance.(For grass shears and similar appliances only.)

13) Don't Force Appliance – It will do the job better and with less likelihood of a risk of injury at the rate for which it was designed.

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

15) Stay Alert – Watch what you are doing. Use common sense. Do not operate appliance when you are tired.

16) Disconnect Appliance – Disconnect the appliance from the power supply when not in use, before servicing, when changing accessories such as blades, and the like.

Exception: This warning does not apply to a battery-operated appliance.

17) Store Idle Appliances Indoors – When not in use, appliances should be stored indoors in dry, and high or locked-up place – out of reach of children.

18) Maintain Appliance With Care – Keep cutting edge sharp and clean for best performance and to reduce the risk of injury. Follow instructions for lubricating and changing accessories. Inspect appliance 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.

19) Check Damaged Parts – Before further use of the appliance, a guard or other part that is damaged should be carefully checked to determine that it will operate properly and perform its intended function. Check for alignment of moving parts, binding of moving parts, breakage of parts, mounting, and any other condition that may affect its operation. A guard or other part that is damaged should be properly repaired or replaced by an authorized service center unless indicated elsewhere in this manual.

d) EDGER-TRIMMERS

1) Keep guards in place and in working order.

2) Keep blades sharp.

3) Keep hands and feet away from cutting area.

e) CULTIVATORS, GRASS SHEARS, PRUNERS

Keep hands away from blades.

f) POLE PRUNERS

1) Keep all parts of the body away from the saw chain. Do not remove cut material or hold material to be cut when blades are moving. Make sure the switch is off when clearing jammed material. Saw chain continues to move after the switch is turned off. A moment of inattention while operating the extended-reach pruner may result in serious personal injury.

2) Carry the extended-reach pruner by the handle with the saw chain stopped. When transporting or storing the extended-reach pruner, always fit the saw chain device cover. Proper handling of the extended-reach pruner will reduce possible personal injury from the saw chain.

3) Hold the extended-reach pruner by insulated gripping surfaces only, because the saw chain may contact hidden wiring or its own cord. A saw chain contacting a "live" wire may make exposed metal parts of the extended-reach pruner "live" and could give the operator an electric shock.

Exception: "or its own cord" maybe omitted for battery-operated appliances.

4) Keep cable away from cutting area. During operation the cable may be hidden in shrubs and can be accidentally cut by the saw chain.

Exception: This warning does not apply to a battery-operated appliance.

5) Do not use the extended-reach pruner in bad weather conditions, especially when there is a risk of lightning. This decreases the risk of being struck by lightning.

6) To reduce the risk of electrocution, never use near any electrical power lines. Contact with or use near power lines may cause serious injury or electric shock resulting in death.

7) Always use two hands when operating the extended-reach pruner. Hold the extended-reach pruner with both hands to avoid loss of control.

8) Always use head protection when operating the extended-reach pruner overhead. Falling debris can result in serious personal injury.

NOTE For all markings above, alternate wording for "extended-reach" is possible, e.g. “pole” or “long reach”.

Figure 54.1

Grounding methods

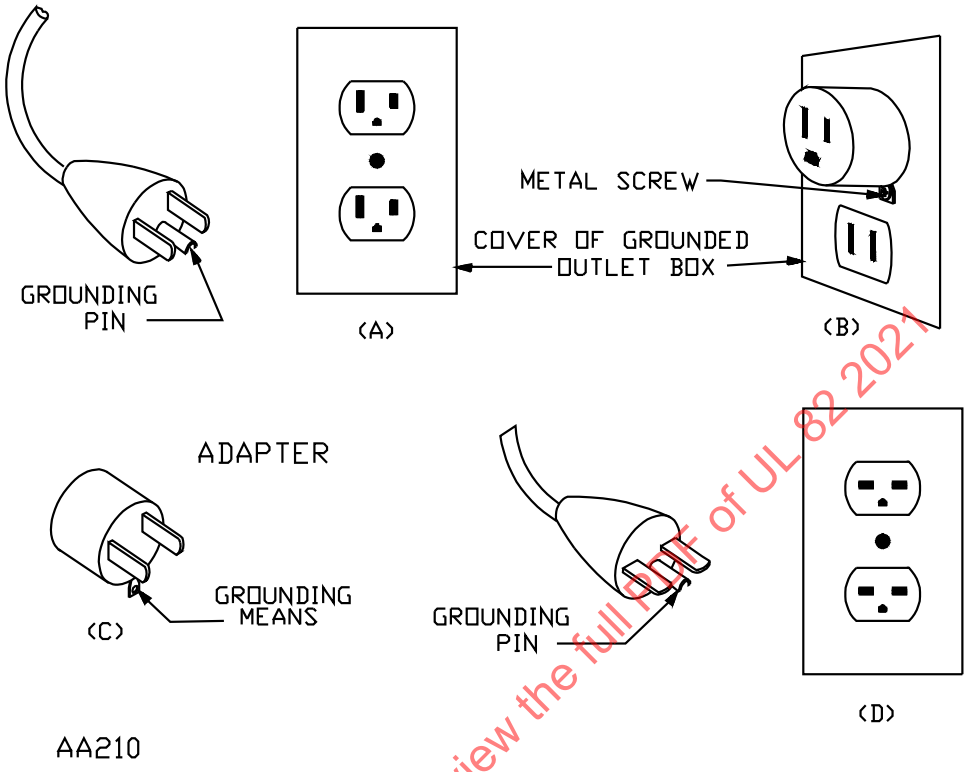


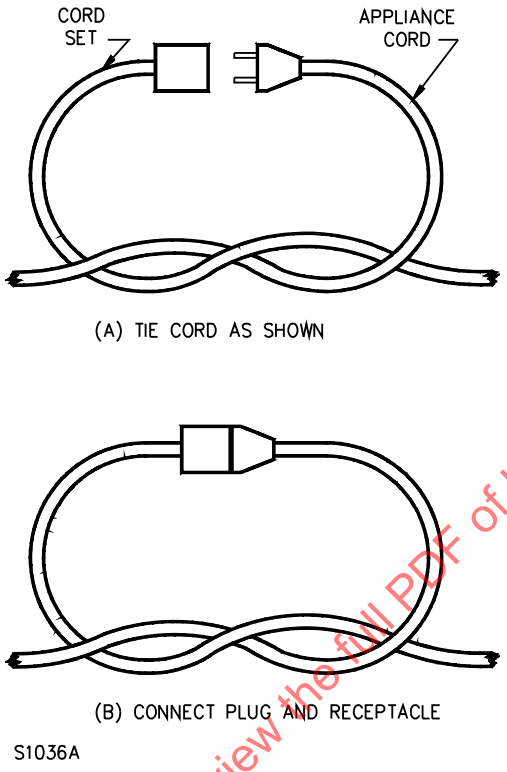
Table 54.1
Minimum gauge for extension cords

Volts	Total length of cord in feet			
120V	25	50	100	150
240V	50	100	200	300
Ampere Rating				
More than 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 is not required to include the 240-volt heading.

Figure 54.2

Method of securing extension cord



PART 2 – SPECIFIC APPLIANCES

GRASS SHEARS

55 Construction

55.1 Grass shears shall be sufficiently in balance when held by the handles to reduce the likelihood that the operator will attempt to hold it other than by the handles.

55.2 Grass shears shall be equipped with a momentary contact "on-off" switch.

55.3 The switch specified in 55.2, may have a means for locking in the "on" position if:

a) The lock-on mechanism is located or constructed so as to require a distinct, intentional movement to actuate it;

b) Unlocking can be accomplished with a single motion of that part of the switch that turns the grass shears on;

c) The movement required to unlock the switch is a natural action. For example, conventional grass shears with a switch that releases the means for locking the shears on when added pressure is applied to the actuator of the switch is acceptable; and

d) The means for locking and unlocking the switch complies with the requirements in (a) – (c) when the grass shears are being operated by either hand.

55.4 The unobstructed distance between any portion of the handles intended to be grasped and the cutting blades shall be at least 5 inches (127 mm). The handles shall be positioned so that at least 5 inches will be maintained in normal movements that are needed to approach and grasp the handles.

55.5 The power supply cord shall exit the enclosure at a point farthest from the cutting edges and in a direction away from the cutting edges.

55.6 If the handles can be adjusted to various positions, the balance and the relationship between the handles and the cutting blade are to be evaluated with the handles in all the possible positions.

56 Performance

56.1 Grass shears shall comply with the tests specified in Sections 26 – 47, modified as indicated in 56.2.

56.2 The input test is to be conducted with the appliance operating continuously, without load on the cutting member.

LAWN TRIMMERS, EDGERS, AND EDGER-TRIMMERS

57 Construction

57.1 General

57.1.1 The edging and trimming functions of an edger-trimmer shall be evaluated independently for compliance with edger and trimmer requirements.

57.2 Guarding

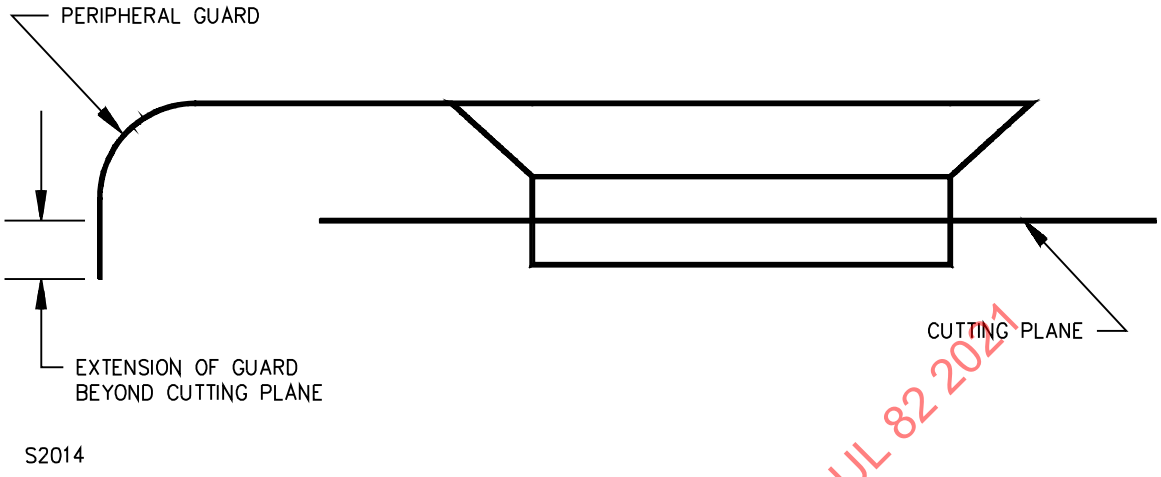
57.2.1 The cutting means of an edger or trimmer shall be provided with not less than 135 degrees of peripheral guarding. The guarding shall comply with the requirements in 57.2.2 and 57.2.3, and shall not include any openings in the top or rear sections facing the operator's side. Total guarding for the cutting means shall be such that the foot probe illustrated in Figure 4.2, applied as described in 57.2.5, cannot be made to contact the cutting means.

Exception: A trimmer as specified in 57.2.4, is not required to be provided with a guard.

57.2.2 For an appliance with a rigid cutting member, the guard required in 57.2.1, shall extend at least 1/4 inch (6.4 mm) beyond the cutting plane, measured perpendicularly, while the edger or trimmer is operating at no load. See Figure 57.1.

Figure 57.1

Extension of peripheral guard



57.2.3 For a grass trimmer, the 135-degree guard specified in 57.2.1, shall extend at least:

a) 45 degrees from the axis of the handle on the side where the cutting member is moving away from the operator; and

b) 75 degrees from the axis of the handle on the side where the cutting member is moving toward the operator. The vertex of the angle is the axis of the cutting member's spindle. The end of the guard is at the intercept of the radial extension of the cutting edge.

Exception No. 1: For a ground-supported grass trimmer, the angle may be less than 45 degrees on the side where the cutting member is moving away from the operator if the appliance complies with the foot-probe test described in 57.2.1 and 57.2.5.

Exception No. 2: For a trimmer having a 4 inch (102 mm) cutting swath or less and a cutting-member tip speed not more than 16,000 feet (4877 m) per minute, the angle may be less than 75 degrees on the side where the cutting member is moving toward the operator if the appliance complies with the foot-probe test described in 57.2.1 and 57.2.5.

57.2.4 The requirement in 57.2.1, does not apply to a trimmer employing a nonmetallic line for cutting if all of the following requirements are met:

a) The line is not larger than 0.090 inch (2.3 mm) in diameter and does not employ a center core or outer covering of another material;

b) The part of the trimmer that directs thrown objects away from the operator is clearly and visibly marked, identified, or defined by the configuration of any guards, shrouds, or enclosures;

c) The trimmer is marked in accordance with 53.4; and

d) The tip speed, as determined by the measurement of one trimmer, does not exceed 32,000 feet (9754 m) per minute when connected to the rated voltage for which the trimmer is marked.

Exception: A "spiral" shaped line with smooth round edges and having an equivalent mass per unit length as a 0.090 in (2.3 mm) diameter line is considered to be equivalent.

57.2.5 The foot probe specified in 57.2.1, is to be applied from any angle on the operator's side, in a direction parallel to the plane of the blade.

57.3 Knife blade

57.3.1 The cutting edge of a knife blade employed as a line limiter on a flexible-nonmetallic-line trimmer shall be packaged so that it is not likely to cause injury to a person removing the appliance from its shipping container.

Exception No. 1: The cutting edge of a knife blade employed as a line limiter on a flexible-nonmetallic-line trimmer is not required to be provided with packaging protection if the cutting edge is not sufficiently sharp to constitute a risk of injury to persons when evaluated in accordance with UL 1439.

Exception No. 2: Packaging protection is not required if exposure or location of the knife blade is such that determination of a risk of injury to persons cannot be evaluated by application of the tool described in UL 1439.

57.3.2 The knife blade employed as a line limiter for a flexible-nonmetallic-line trimmer shall be mechanically secured by screws, rivets, eyelets, or other means determined acceptable for the purpose.

57.4 Cutting blade position

57.4.1 The blade guard for an edger or an edger-trimmer shall extend far enough forward over the cutting blade that, when the appliance is in an edging position, a line tangent to the front or forward tip of the cutting circle and perpendicular to the supporting surface of the appliance will intercept the blade guard.

57.4.2 An edger-trimmer shall not employ a blade of which the plane of operation can be revolved more than 110 degrees from its horizontal trimming position.

57.5 Switches

57.5.1 A trimmer, edger, or edger-trimmer shall be provided with a momentary-contact switch that cannot be locked in the "on" position.

57.5.2 The switch specified in 57.5.1, shall be located or protected so that it will not be subject to unintentional operation during any user adjustment or maintenance such as cleaning, replacing, or adjusting line, with the appliance held in any position required for such operations.

57.5.3 A trimmer employing a flexible nonmetallic line for cutting shall be provided with precut lines or a built-in knife, cutter, or other mechanism that, upon operation of the appliance, automatically cuts or shortens the line to the proper length, or automatically provides a cutting line of proper length.

57.6 Gauges

57.6.1 A trimmer employing a flexible nonmetallic line for cutting shall be provided with a gauge that the user can utilize to determine whether a replacement line is of the size specified by the manufacturer. If the shape of the line is not circular, the gauge shall also indicate the proper shape of a replacement line. See 52.10.

Exception No. 1: A gauge is not required to be supplied with a trimmer that is provided with precut line segments for replacement purposes.

Exception No. 2: A gauge is not required to be supplied if the flexible nonmetallic line needed for replacement purposes is provided in bulk form.

57.6.2 The gauge shall be easy to use, of a go, no-go type – specifying the maximum line dimensions – and shall be located on or attached to the trimmer so that it is not damaged or otherwise rendered ineffective as a result of normal operation of the appliance.

57.7 Support

57.7.1 An edger or an edger-trimmer in the edging position shall be provided with a ground-supporting means to support the appliance during normal use.

Exception: Appliances that complies with 57.2.4, is not required to be provided with ground-supporting means.

57.8 Rotating members

57.8.1 A rotating member of an adjustable line trimmer (impact-feed type), the malfunction of which may create a risk of injury to persons, shall be constructed of material and in such a manner such that it complies with the Rotating Members Test – Adjustable Line Trimmers, Section 57.2.

57.9 Rotating Members Test – Adjustable Line Trimmers

57.9.1 A rotating member as specified in 57.8.1 shall be subjected to the tests specified in 57.9.2 – 57.9.6, as applicable. As a result of the test, the rotating member of the line trimmer shall not:

a) Bend, break, or have other malfunction of parts; or

b) Have parts releasing or loosening.

57.9.2 Two samples of an adjustable line trimmer hub and spool assembly shall be subjected to the Mold Stress Relief Test, Section 44.1. Following the test, either test method 1 in 57.9.3 and 57.9.4, or test method 2 in 57.9.5 and 57.9.6, shall be conducted.

57.9.3 In test method 1, each hub and spool assembly is to be subjected to three drops from a height of 24 inches (610 mm) onto a concrete floor, followed by operation as specified in 57.9.4. The three drops are to be conducted with the assembly mounted as intended on the trimmer and with the following orientation:

a) One sample is to be dropped three times with the spool drive shaft perpendicular to the impact surface.

b) The other sample is to be dropped three times with the trimmer tipped forward so that the hub drive shaft is inclined approximately 30 degrees to the front or forward position.

Exception: The same sample may be used for both conditions.

57.9.4 Each hub and spool assembly that has been dropped as specified in 57.9.3, is to be mounted as intended on the trimmer or on an equivalent test apparatus such as a precision mandrel attached to a driving means. The assembly is to be operated under the maximum unbalanced condition at 150 percent of the maximum no-load speed (measured without string) for 15 minutes. The maximum unbalanced condition is considered to be the hub and full spool with the line extended to its maximum recommended cutting length. The hub and spool assembly shall remain intact while mounted as intended on the trimmer or equivalent test apparatus during the entire period of operation.

57.9.5 In test method 2, a hub and spool assembly is to be subjected to 50 drops from a height of 24 inches (610 mm) onto a concrete floor, followed by operation as specified in 57.9.6. The drops are to be conducted with the assembly mounted as intended on the trimmer and with the following orientation:

a) One sample is to be dropped 50 times with the spool drive shaft perpendicular to the impact surface.

b) The other sample is to be dropped 50 times with the trimmer tipped forward so that the hub drive shaft is inclined approximately 30 degrees to the front or forward position.

Exception: The same sample may be used for both conditions.

57.9.6 Each hub and spool assembly that has been dropped as specified in 57.9.5, is to be mounted as intended on the trimmer. The assembly is to be operated under the maximum unbalanced condition at 106 percent of the rated voltage for 15 minutes. The maximum unbalanced condition is considered to be the hub and full spool with the line extended to its maximum recommended cutting length. The hub and spool assembly shall remain intact while mounted as intended on the trimmer or equivalent test apparatus during the entire period of operation.

58 Performance

58.1 Lawn trimmers, edgers, and edger-trimmers shall comply with the tests indicated in Sections 26 – 47, modified as indicated in 58.2.

58.2 The input test is to be conducted with the appliance operating continuously, without load on the cutting member.

CULTIVATORS

59 Construction

59.1 The direction of rotation of the cultivator blades shall tend to cause the cultivator to propel itself away from, rather than toward, the operator.

Exception: A cultivator may be of a type that can propel itself toward the operator if provided with a guard that prevents the blades from contacting the probe illustrated in Figure 4.2, when tested as described in 60.2.

60 Performance

60.1 Cultivators shall comply with tests indicated in Sections 26 – 47, modified as indicated in 60.2 and 60.3.

60.2 With reference to the exception to 59.1, the test is to be conducted with the cultivator operating in earth in the normal manner. The cultivator is to be directed in a rearward direction toward the probe illustrated in Figure 4.2. The angle made by the probe with respect to the direction of motion of the cultivator, the angle made by the handle of the cultivator with respect to the ground, and other variables, such as pressure applied and type and condition of earth are to be such as to result in the greatest likelihood of contact of the probe with the blades.

60.3 The input test is to be conducted with the appliance cultivating dry 60 – 80 mesh sand.

SHREDDERS, SHREDDER-BAGGERS, OR CHIPPERS

61 Construction

61.1 A garden shredder shall comply with the requirements in 61.2 – 61.4.

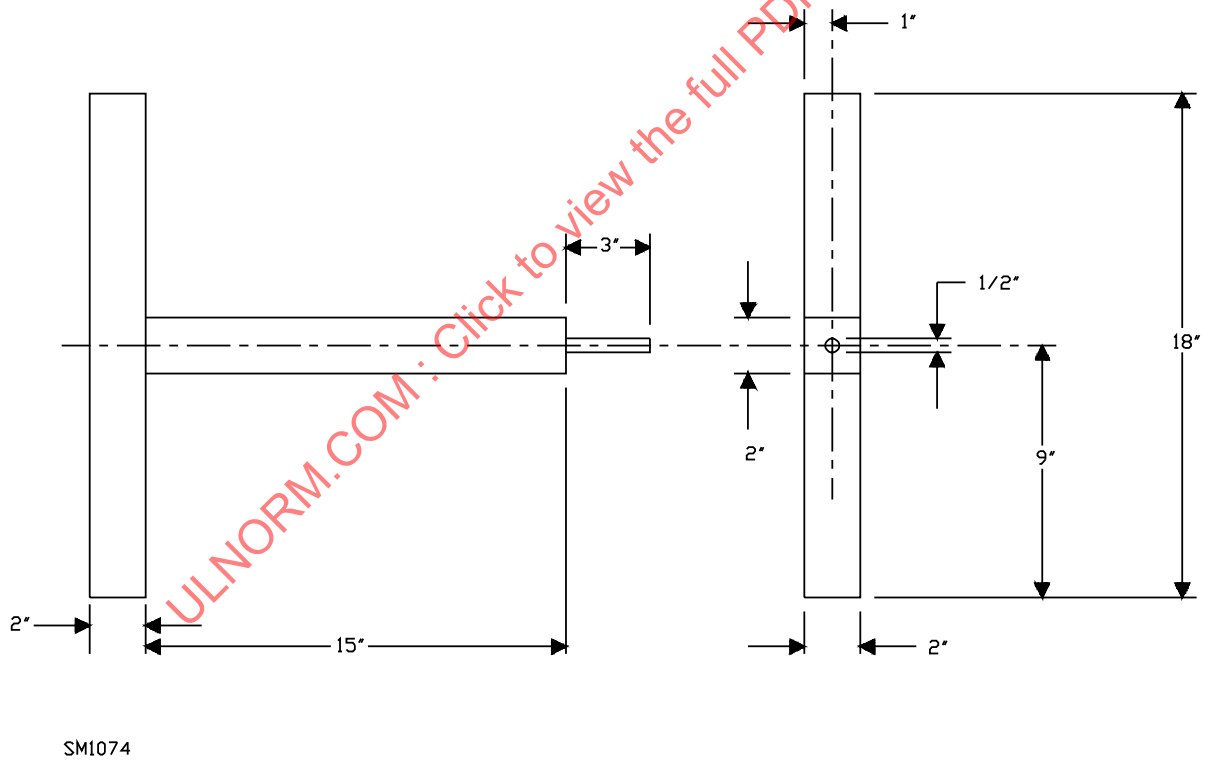
Exception: A garden shredder employing a monofilament line as the sole cutting means and that complies with 57.2.4, is not required to comply with the requirements in 61.2 – 61.4.

61.2 An infeed or discharge opening shall be so constructed and guarded as to prevent the probe shown in Figure 61.1, from contacting any cutting or shredding edge. The probe is to be applied in any possible direction or orientation with a force of 30 N (6.7 pounds-force).

Exception: The 30 N force is not required to be applied against a bag or other flexible catcher device that completely covers a discharge opening.

Figure 61.1

Arm probe



61.3 Any guard or obstruction protecting an infeed or discharge opening shall:

a) Be permanently attached to the machine, require the use of tools for removal or displacement, or be interlocked such that the machine is inoperable when it is not in place; and

b) If displaceable, be constructed such that it will return to its obstructing position upon the removal of any related attachment without any operator assistance, and be securely attached by a hinge or similar means.

61.4 A shredder, shredder-bagger, or chipper in which the unobstructed distance from any opening to a cutting edge is less than 8D minus 1.5 inches (38 mm), where D is the minor dimension of the opening, shall be provided with a pusher that complies with the following:

a) The pusher shall be so shaped or constructed that it cannot contact any cutting edges when used in the intended manner;

b) Provision shall be made for attachment of the pusher to the machine by a permanent means which is unlikely to be accidentally or casually removed; and

c) The minimum length of the pusher shall be equal to the distance from the infeed opening to the cutting edge, or 2 feet (0.6 m), whichever is less.

61.5 A shredder, shredder-bagger, or chipper shall be subjected to the Structural Integrity Test, Section 62.2, the Thrown Object Test, Section 62.3, the Throwback Test Section 62.4, and the Balance Test Section 62.5.

Exception No. 1: A shredder, shredder-bagger, or chipper using a monofilament line as the sole cutting member is not required to be subjected to the tests in Sections 62.2 – 62.4.

Exception No. 2: A shredder, shredder-bagger, or chipper having a discharge opening which is directed at an angle of 80 or more degrees below the horizontal is not required to be subjected to the Thrown Object Test, Section 62.3.

62 Performance

62.1 General

62.1.1 Shredders or shredder-baggers shall comply with the tests indicated in Sections 26 – 47, modified as indicated in 62.1.2.

62.1.2 The input test is to be conducted by measuring the average load obtained over 5 minutes while chipping and shredding materials according to the manufacturer's instructions.

62.2 Structural integrity test

62.2.1 A shredder, shredder-bagger, or chipper shall be subjected to the test specified in 62.2.2. As a result of the test, no part of the appliance shall fracture, break, loosen, or deform in a manner that may introduce a risk of injury to the operator or to bystanders as a result of the test, nor shall any part of the appliance or the test bar be ejected from any location on the appliance other than the discharge chute.

62.2.2 An appliance as specified in 62.2.1 is to be mounted according to the manufacturer's instructions and, if necessary, is to be secured in place. It is to be operated at the maximum speed available with an input voltage of 120 volts at 60 hertz. A steel bar of sufficient size and shape is to be inserted into each infeed opening in order to cause a sudden stop of the rotor during each insertion of the steel bar.

Exception: A shredder, shredder-bagger, or chipper is not required to be subjected to this test if it complies with Exception No. 1 of 61.5.

62.3 Thrown object test

62.3.1 A shredder, shredder-bagger, or chipper shall be subject to the tests specified in 62.3.2 – 62.3.5. As a result of the test, no more than 15 nails or nail fragments shall penetrate the surface of the corrugated paper in the area between 2 and 4 feet (0.6 and 1.2 m) above floor level (see Figure 62.1), and none shall

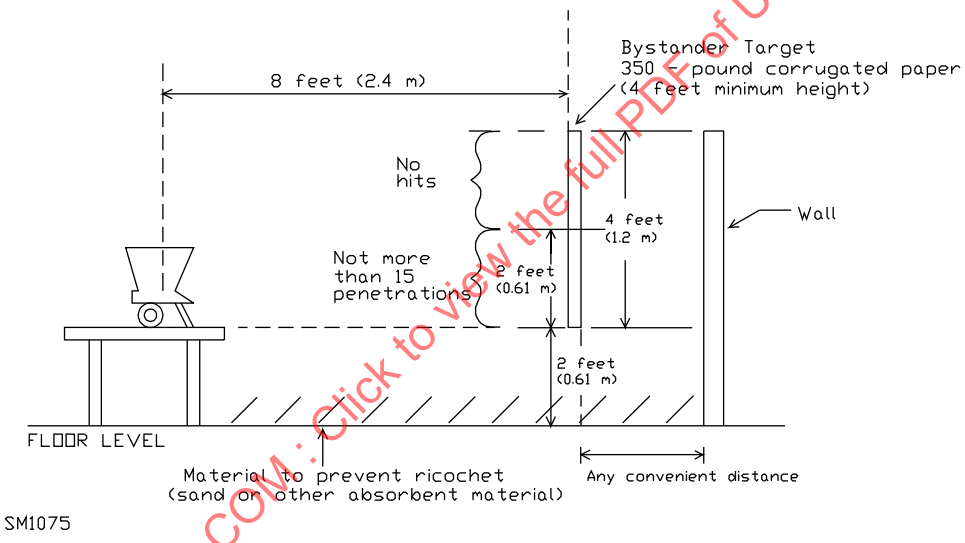
penetrate the surface above that 4-foot level. If the surface of the corrugated paper has more penetrations, the unit is to be tested two more times. The results will be considered acceptable if both additional tests comply with the test requirements in 62.3.2 – 62.3.5.

62.3.2 An appliance as specified in 62.3.1 is to be placed on an elevated platform 2 feet (610 mm) above the test chamber floor as illustrated in Figure 62.1. A wall constructed of 350-pound corrugated paper 4 feet (1.2 m) in height is to be placed 8 feet (2.4 m) from the discharge opening as shown in Figure 62.1, and is to surround the unit. The chamber floor between the appliance and the wall is to be covered with sand or other absorbent material. The means used to construct or support the corrugated paper wall is not to interfere with the penetration of the surface by a projectile.

Exception: A shredder, shredder-bagger, or chipper is not required to be subjected to this test if it complies with Exception No. 1 or Exception No. 2 of 61.5.

Figure 62.1

Thrown object test



NOTES:

1) The wall is not to be used for reinforcement of the corrugated paper.

2) The corrugated paper is to surround the unit.

62.3.3 Any bag or catcher which forms all or part of the guarding as specified in 61.2, and 62.3.5 is to be attached according to the manufacturer's instructions if:

a) The bag or catcher is shipped and sold as a part of the appliance; and

b) Both the catcher and the appliance are marked according to 52.2(a).

62.3.4 The shredder, shredder-bagger, or chipper is to be operated at the maximum speed obtainable with an input of 120 volts at 60 hertz. One hundred (100) six-penny steel nails are to be introduced into each feed intake opening at a feed rate as specified by the manufacturer's instructions or, if no feed rate is specified, as fast as possible.

62.3.5 A bag or catcher as specified in 62.3.3, shall not become detached from the machine during the test.

62.4 Throwback test

62.4.1 A shredder, shredder-bagger, or chipper shall be subject to the test specified in 62.4.2. As a result of the test, no particles shall exit any opening with sufficient force to penetrate a piece of 350-pound corrugated paper within 6 inches (152 mm) of the machine, nor shall any particle attain a vertical height of greater than 6 feet (1.8 m) from the supporting surface.

62.4.2 An appliance as specified in 62.4.1 is to be surrounded by the corrugated paper. The appliance is to be operated at a maximum attainable speed with an input of 120 volts at 60 hertz. All infeed and exit guards and obstructions are to be positioned according to the manufacturer's instructions. Ninety dowels which are 3/8 inch (95 mm) in diameter and 5 inches (127 mm) long are to be fed into any infeed opening at random, no more than three at a time, and at a feed rate as specified by the manufacturer's instructions or, if no feed rate is specified, as fast as possible.

Exception: A shredder, shredder-bagger, or chipper is not required to be subjected to this test if it complies with Exception No. 1 of 61.5.

62.5 Balance test

62.5.1 A shredder, shredder-bagger, or chipper shall be subjected to the test specified in 62.5.2 and 62.5.3. All bags and guards are to be included during the test. As a result of the test, the appliance shall not become physically unstable or unbalanced under conditions of normal use.

62.5.2 An appliance as specified in 62.5.1, shall not become unbalanced when:

a) The unit is tilted at an angle of 10 degrees from its normal upright position; and

b) A force equal to 20 percent of the weight of the unit, but not more than 250 N (56.2 pounds-force), is applied in any direction and at the location most likely to cause tipping.

62.5.3 The balance test is to be performed once with and once without any bags which can be removed without the use of tools. The tests shall also be performed with the bag full and the bag empty.

PRUNERS

63 Construction

63.1 Pruners shall be constructed to allow grasping and operation by a single hand. The grasping area shall prevent inadvertent contact of the user's hand holding the pruner with the cutting blade. See 63.4.

63.2 Pruners shall be equipped with a momentary contact on-off switch that shall not be capable of being locked in the “on” position.

63.3 The blades shall stop or return to the full retracted position when the switch trigger is released. A blade release mechanism shall be provided for a system that does not fully retract the blades when the switch trigger is released.

63.4 The unobstructed shortest path between the nearest root of the cutting blade and:

a) The rear of the switch trigger;

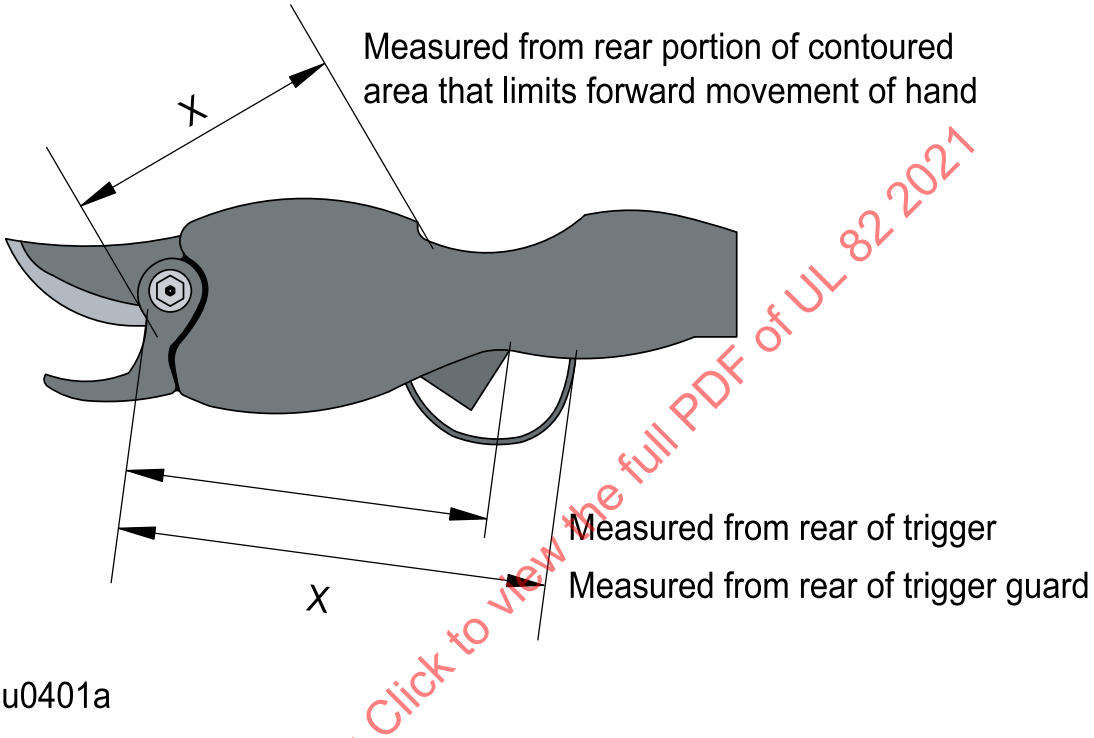
b) The rear of the switch guard; or

c) The rear portion of any contoured area that limits the forward movement of the hand,

shall be at least 5 inches (127 mm). The handle shall be positioned so that the required distance will be maintained in normal movements that are needed to approach and grasp the handle. The distances shall be measured along the shortest path from points (a), (b), or (c) to the nearest root of the cutting blade. See Figure 63.1.

Figure 63.1

Examples of measurement for finger protection [a]



[a] The illustration shows the blades in the full retract position.

Key: X = ≥5 in (127 mm)

63.5 The power supply cord shall exit the enclosure at a point farthest from the cutting edges and in a direction away from the cutting edges.

64 Performance

64.1 Pruners shall comply with the tests indicated in Sections 26 – 47, modified as indicated in 64.2.

64.2 The input test is to be conducted with the appliance operating continuously, without load on the cutting member.

POLE PRUNERS

65 Construction

65.1 A cutting attachment capable of being operated as a standalone chain saw or reassembled into a chain saw as specified in the manufacturer's instruction manual, shall comply with the requirements in UL 60745-2-13.

65.2 To prevent the operator from contacting the saw chain while operating the pole pruner, the minimum distance between the activating switch and the saw chain shall be 39.37 in. (1,000 mm). The distance shall be measured with the pole adjusted to the minimum distance between the cutting attachment and the activating switch. If the pole consists of sections that can be removed, the minimum number of pole sections required to operate the device shall be used to measure the distance.

65.3 Pole pruners shall be equipped with a momentary contact on-off switch that shall not be capable of being locked in the "on" position.

65.4 The power supply cord shall exit the enclosure at a point farthest from the cutting edges and in a direction away from the cutting edges.

65.5 The activating switch shall be equipped with a device that automatically locks it in the “off” position when the actuator is released.

65.6 To provide safe control, the pole pruner shall be fitted with at least two handles. The handles shall be designed such that each handle can be grasped with one hand. If the handle nearest the cutting device is an integral part of the shaft, it shall be suitably shaped to be grasped securely with a perimeter between 2.56 inch (65 mm) and 6.30 inch (160 mm). The gripping surface of the front handle shall be at least 3.94 inch (100 mm) long. For bail or closed handles (U-shaped handles) this dimension is related to the inner width of the gripping surface. On straight handles it is the complete length between the housing and the end of the handle. There shall be a minimum radial clearance of 0.98 inch (25 mm) around the gripping length.

65.7 If the shaft is used as a handle, the entire shaft length can be considered as the handle as long as it is electrically isolated from the cutting device.

65.8 Pole pruners having a mass of more than 13.2 lb (6 Kg) shall be provided with a harness to be worn by the operator for support and balance during cutting operations. Any harness, whether required or not, shall be adjustable to the size of the operator and equipped with a quick-release mechanism to enable a rapid emergency release of the machine from the harness or the harness from the operator.

65.9 A protective cover shall be provided with the machine to cover the saw chain in order to prevent injuries during transportation and storage. The cover shall not become detached with the saw chain of the appliance in a vertical downwards position.

65.10 The saw chain cutting attachment shall be constructed so that it can be adjusted to obtain the tension recommended by the manufacturer.

65.11 A pole pruner with a saw chain speed of 5 m/s and above shall be provided with a means for lubricating the saw chain. If the pole pruner is equipped with a manual saw chain oiler control, it shall be located so that it can be operated while both handgrips are held by the hands of the operator.

66 Performance

66.1 Pole pruners shall comply with the tests indicated in Sections 26 – 47, modified as indicated in 66.2.

66.2 The input test is to consist of cross-cutting a soft pine beam, the thickness of which is not less than 150 percent of the width of the saw blade and the width of which is 75 percent of the length of the saw blade (the length of the saw blade is considered to be the effective length of the blade on which the chain rides, and the width of the saw blade is considered to be the width of the blade plus twice the thickness of the chain).