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UL 2753

BATTERY OPERATED RIDE-ON LAWN MOWERS

Issue No. 2

February 7, 2018

Summary of Topics

This is the second issue of the Outline of Investigation for Battery Operated Ride-On Lawn Mowers, which covers rechargeable battery powered reel and rotary ride-on lawn mowers intended as consumer products for household use.

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INTRODUCTION

1 Scope

1.1 This Outline of Investigation covers rechargeable reel and rotary ride-on battery powered lawn mowers intended as consumer products for household use.

1.2 These requirements do not cover equipment for use in hazardous locations as defined in the National Electrical Code, NFPA 70.

1.3 This Outline of Investigation does not cover:

- a) Robotic Lawn Mowers that are unattended and operate automatically; or
- b) Battery-Operated Lawn Mowers which are covered under UL 1447.

1.4 Most requirements for battery operation and charging are incorporated by reference to UL 2595.

2 Units of Measurement

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

3 References

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

ANSI Standards

ANSI/NFPA 70
National Electrical Code

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

IEC Standards

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

UL Standards

UL 44
Thermoset-Insulated Wires and Cables

UL 62
Flexible Cords and Cables

UL 66
Fixture Wire

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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

248-1

Low-Voltage Fuses – Part 1: General Requirements

UL 248-5

Low-Voltage Fuses – Part 5: Class G Fuses

UL 275

Automotive Glass-Tube Fuses

UL 275A

Automotive Blade Type Fuses

UL 310

Electrical Quick-Connect Terminals

UL 458

Land Vehicles and Marine Crafts

UL 486A-UL 486B

Wiring Connectors

UL 486C

Splicing Wiring Connectors

UL 486E

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

UL 496

Lampholders

UL 510

Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

UL 635

Insulating Bushings

UL 746A

Polymeric Materials – Short Term Property Evaluations

UL 746B

Polymeric Materials – Long Term Property Evaluations

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UL 746C

Polymeric Materials – Use in Electrical Equipment Evaluations

UL 746D

Polymeric Materials – Fabricated Parts

UL 758

Appliance Wiring Material

UL 796

Printed-Wiring Boards

UL 810

Capacitors

UL 817

Cord Sets and Power Supply Cords

UL 840

Insulation Coordination Including Clearances and Creepage Distances for Electrical Equipment

UL 991

Tests for Safety-Related Controls Employing Solid State Devices

UL 1059

Terminal Blocks

UL 1077

Supplementary Protectors for Use in Electrical Equipment

UL 1283

Electromagnetic Interference Filters

UL 1412

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

UL 1434

Thermistor-Type Devices

UL 1441

Coated Electrical Sleeving

UL 1447

Electric Lawn Mowers

UL 1557

Electrically Isolated Semiconductor Devices

UL 1565

Positioning Devices

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UL 1741

Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources

UL 1977

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

UL 1998

Software in Programmable Components

UL 2459

Insulated Multi-Pole Splicing Wire Connectors

UL 2595

General Requirements for Battery-Operated Appliances

UL 4248-1

Fuseholders – Part 1: General Requirements

UL 4248-9

Fuseholders – Part 9: Class K

UL 60691

Thermal-Links – Requirements and Application Guide

UL 60730-1

Automatic Electrical Controls for Household and Similar Use; Part 1: General Requirements

UL 60730-2-6

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

4 Glossary

4.1 For the purpose of this Outline of Investigation the following definitions apply.

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

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

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

4.5 **ELECTRICAL ENCLOSURE** – A part of the equipment intended to reduce the risk of contact with electrical circuits.

4.6 **MECHANICAL ENCLOSURE** – A part of the equipment intended to reduce the risk of injury due to mechanical and other physical hazards.

4.7 **NORMAL LOAD** – Operation with drive wheels engaged, an operator with a minimum weight of 91 kg (200 lb) seated on the machine during the test, and with the deck adjusted in the highest cutting position. The test surface shall be a substantially level (not to exceed $\pm 1\%$ grade), dry, smooth, hard-surfaced area of concrete, asphalt (or other surface with equivalent coefficient of surface friction), that is free from loose material.

4.8 **ORDINARY TOOL** – A tool, such as a flat-blade or cross-head screwdriver, a nut driver, or pliers.

CONSTRUCTION

5 Components

5.1 General

5.1.1 In addition to complying with the requirements in this Outline of Investigation, rechargeable reel and rotary ride-on battery powered lawn mowers shall also comply with Consumer Turf Care Equipment – Walk-Behind Mowers and Ride-On Machines with Mowers – Safety Specifications, ANSI B71.1, applicable sections in Part I: General and Part III: Ride-on mowers, lever steer mowers, lawn tractors, and lawn and garden tractors.

5.1.2 A component of a product covered by this Outline of Investigation shall with each of the following:

- a) Comply with the requirements for that component as indicated in 5.2 – 5.13;
- 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) Additionally comply with the applicable requirements of this Outline of Investigation.

5.1.3 A component of a product covered by this Outline of Investigation 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 Outline of Investigation; or
- c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

5.1.4 A component that complies with a UL component standard other than those specified in 5.2 – 5.13 is acceptable if:

- a) The component also complies with the applicable component standard specified in 5.2 – 5.13; or
- b) The component standard:
 - 1) Is compatible with the ampacity and overcurrent protection requirements in National Electrical Code, NFPA 70, where appropriate;
 - 2) Considers long-term thermal properties of polymeric insulating materials in accordance with UL 746B; and
 - 3) Any use limitations of the other component UL standard is identified and appropriately accommodated in the end use application. For example, a component used in a household application, but intended for industrial use and complying with the relevant component standard may assume user expertise not common in household applications.

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

5.2 Connectors and terminals

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

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

5.2.2 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 5.2.7.

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

5.2.4 Splicing wire connectors shall comply with UL 486C.

5.2.5 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 5.2.8.

5.2.6 Equipment wiring terminals for use with all alloys of copper, aluminum, or copper-clad aluminum conductors, shall comply with UL 486E.

5.2.7 Terminal blocks shall comply with UL 1059, and if applicable, be suitably rated for field wiring.

5.2.8 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 Capacitors and filters

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

5.3.2 Electromagnetic interference filters with integral enclosures shall comply with UL 1283.

5.4 Controls

5.4.1 Electromechanical and electronic controls

5.4.1.1 A control, other than as specified in 5.4.2 – 5.4.5, shall comply with UL 60730-1, and/or the applicable Part 2 standard from the UL 60730 series.

5.4.2 Motor and speed controls

5.4.2.1 A control used to start, stop, regulate or control the speed of a motor shall comply with one of UL 60730-1.

5.4.3 Pressure controls

5.4.3.1 A pressure control shall comply with UL 60730-1 and UL 60730-2-6.

5.4.4 Temperature controls

5.4.4.1 A temperature control shall comply with UL 60730-1 and UL 60730-2-9.

5.4.4.2 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.

5.4.4.3 A thermal cutoff shall comply with UL 60691.

5.4.5 Timer controls

5.4.5.1 A timer control shall comply with UL 60730-1 and UL 60730-2-7.

5.5 Cords, cables, and internal wiring

5.5.1 A cord set or power supply cord shall comply with UL 817. See 11.4.2.

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

5.5.3 Internal wiring composed of insulated conductors shall comply with one UL 758, UL 44, UL 83, UL 66 or the applicable UL standard for other insulated conductor types specified in Wiring Methods and Materials of the National Electrical Code, NFPA 70.

Exception: Insulated conductors for specialty applications (e.g. data processing or communications) and located in a low-voltage circuit not involving the risk of fire or personal injury need not comply.

5.6 Gaskets, seals and tubing

5.6.1 Gaskets, o-rings, seals, and tubing the failure of which would increase the risk of fire, electric shock, injury to persons, or other hazards shall comply with UL 157. See 6.8.

Exception: Rubber or neoprene compounds relied upon for protection from rain are only required to comply with Accelerated Aging Test, Section 24

5.7 Inverters, converters and controllers

5.7.1 Inverters, converters and controllers with a nominal output of 24 Vdc or less shall comply with UL 458.

5.7.2 Inverters and converters with a nominal output of more than 24 Vdc shall comply with UL 1741.

5.8 Light sources and associated components

5.8.1 Lampholders and indicating lamps shall comply with UL 496.

5.9 Overcurrent protection

5.9.1 Fuses shall comply with UL 248-1; and the applicable UL 248 Part 2 (e.g. UL 248-5). Defined use fuses that comply with UL 248-1, UL 275, and another applicable UL standard for fuses are considered to fulfill this requirement. All fuses shall be found suitable for the intended application.

5.9.2 Fuseholders shall comply with UL 4248-1, and the applicable UL 4248 Part 2 (e.g. UL 4248-9).

5.9.3 Supplementary protectors shall comply with UL 1077.

5.9.4 Fusing resistors shall comply with UL 1412.

5.9.5 Overcurrent protection of the size necessary to reduce the likelihood of overheating of the smallest conductor in the circuit. A fuse shall comply with UL 248 series of standards, UL 275 and UL 275A and shall be found suitable for the intended application: