UL 3300

Outline of Investigation for Service, Communication, Information, Education and Entertainment Robots

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Summary of Topics

This third issue of the Outline of Investigation for SCIEE Robots, UL 3300, dated January 12, 2021 corrects the title of UL 50E. This third issue replaces the second issue published January 11, 2021.

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INTRODUCTION

This Outline of Investigation describes safety requirements for Service, Communication, Information, Education and Entertainment (SCIEE) robots. The Outline of Investigation cites the supplemental requirements for robotic functionality which includes multidirectional mobility and manipulation.

The standard for Audio/video, information and communication technology equipment – Part 1: Safety requirements (UL 62368-1) provides the product safety requirements for multiple energy sources associated with SCIEE robots. It specifies mechanical energy source requirements based on application. It does not fully anticipate additional hazards from mechanical energy sources related to manipulators not contained within an enclosure or work cell used by an instructed or skilled person. Existing standards for robotics are well-developed for industrial applications and take into account the safety risk assessment framework of the industrial use environment. Other Standards address what ISO 13482 (Robots and robotic devices – Safety requirements for personal care robots) refers to as “inherently safe design.” For instance, household floor care robot standards rely upon the typical end product safety standard requirements, taking into account battery-operation and battery-charging.

The requirements of UL 3300 are specifically intended to address the safety of SCIEE robotic functions not anticipated by the requirements of UL 62368-1 for reduced risk of pain and injury. Mobility and/or uncontained manipulation introduce potential for hazard due to the speed and mass of the robot, use environment and other considerations. The dynamic nature of the robotic function requires the expanded assessment. Identification of the additional requirements is in accordance with UL 62368-1, subclause 4.1.2, “Constructions not specifically covered.”

Safeguarding persons from harmful energy sources resulting from operation of robots of various sizes and types, in structured and unstructured environments, and with or without supervision requires safety-related controls that enable the robot to respond to the use environment. It is not practical to prescribe the controls to be employed, so emphasis has to be placed on the operational challenges presented to the robot to determine control effectiveness. However, there is no current, complete library of operational challenges available to reference. Considering this, UL 3300 has simulated representative environmental conditions where some structure is to be expected and has placeholders where environmental conditions cannot be adequately represented at the time of publication.

Further development of this Outline of Investigation for SCIEE robotic applications will require preparation of safety cases that demonstrate the adequacy of safety-related controls for the anticipated operational design domains. UL 4600 Standard for the Evaluation of Autonomous Products provides an overall approach to developing safety cases.

UL 3300 specifies requirements for certain SCIEE robots while offering a framework for inclusion of additional robots once the safety case development work advances toward completion. Application of these requirements requires informed consideration of the particular robot operational design domain, applying additional operational challenges as considered necessary to fulfill the intent of the requirements. As this Outline of Investigation is applied, the experience gained will lead to updates of existing requirements and to recording of new requirements for those robots not fully addressed at this time.

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1 Scope

These requirements cover the safety of the robotic function of Service, Communication, Information, Education and Entertainment (SCIEE) robots.

These requirements supplement the safety requirements for the intended, non-robotic product function as described in the relevant identified standard(s) and, where applicable, cover robotics intended for indoor and outdoor use.

The scope includes service robots intended for commercial use applications where ongoing operation of the robot does not require instructed or skilled person intervention during operation.

Note 1: See UL 62368-1, “Principles of this product safety standard” in Clause 0 for an explanation of ordinary, instructed and skilled persons.

Note 2: Where an instructed person initiates / configures the robot (e.g. educational settings) is not considered to be intervention during operation.

These requirements do not apply to:

– Robots intended to treat, alleviate instability or move individuals in hospitals, care facilities or in the home.

– Robots operated exclusively for industrial purposes.

– Material-handling robots for use in restricted environments.

– Robots for on- or off-road transport of persons.

– Robots intended for use in a food establishment except where the robot serves as a conveyance to directly relinquish food to the consumer

Note: Food establishment is defined in the US FDA Food Code

– Robots for which safety of the robotic function is described in the relevant end-product safety standard.

Examples of such standards include:

– Commercial floor cleaning machines covered by ANSI/CSA C22.2 No. 336, Particular requirements for rechargeable battery-operated commercial robotic floor treatment machines with traction drives.

– Portable battery-operated automatic vacuums covered by UL 1017, Standard for Vacuum Cleaners, Blower Cleaners, and Household Floor Finishing Machines

– Robots identified as a toy by the manufacturer and intended for play only by children covered by the Standard for Electric Toys, UL 696 and/or ASTM F963, Standard Consumer Safety Specification for Toy Safety.

– Robots intended for use in hazardous locations

– Robots intended for use as personnel protective equipment

Note: Additional requirements may be necessary for robots

– with parts in contact with food or potable water

– with parts in contact with persons such that biocompatibility is a consideration.

– subject to occupational safety and health regulation

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– intended for use aboard aircraft, watercraft and road vehicles

– that perform as or are integrated in security or life safety systems

2 Normative References

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ASTM F963, Standard Consumer Safety Specification for Toy Safety

CAN/CSA C22.2 No. 62368-1, Audio/Video, information and communication technology equipment – Part 1: Safety requirements

ISO 13482, Robots and robotic devices – Safety requirements for personal care robots

UL 696, Standard for Electric Toys

UL/ULC 2271, Standard for Batteries for Use in Light Electric Vehicle (LEV) Applications

UL/ULC 2580, Standard for Batteries for Use in Electric Vehicles

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

UL 62368-1, Standard for Audio/Video, information and communication technology equipment – Part 1: Safety requirements

UL 50E, Standard for Enclosures for Electrical Equipment, Environmental Considerations

IEC 60529, Degrees of protection provided by enclosures (IP Code)

3 Terms, Definitions and Abbreviations

For the purposes of this document the following terms and definitions apply.

3.1 **DOCKING STATION** – An external accessory part of the robot to which the robot returns, or is returned by the user, to charge the robot's battery and/or communicate with a network.

Note to entry: A docking station is also known as a charging station, charger and / or variations on this.

3.2 **MANIPULATOR** – Machine in which the mechanism usually consists of series of segments, jointed or sliding relative to one another, for the purpose of grasping (by use of an end effector) and/or moving objects usually in several degrees of freedom.

[Source: ISO 8373:2012, subclause 2.1]

3.3 **MOBILITY** – Motion that results in relocation of the robot within its use environment.

3.4 **OPERATIONAL DESIGN DOMAIN** – The set of environments and situations the SCIEE robot is intended to operate within. This includes not only direct environmental conditions and geographic restrictions, but also a characterization of the set of objects, events, and other conditions that will occur within that environment.

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