



JOINT CANADA – UNITED
STATES NATIONAL STANDARD

ANSI/CAN/UL 3300:2025

STANDARD FOR SAFETY

Service, Communication, Information,
Education and Entertainment Robots –
SCIEE Robots

SCC FOREWORD

National Standard of Canada

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UL Standard for Safety for Service, Communication, Information, Education and Entertainment Robots – SCIEE Robots, ANSI/CAN/UL 3300

First Edition, Dated May 14, 2024

Summary of Topics

The revision of ANSI/CAN/UL 3300 dated April 16, 2025 includes the following changes in requirements:

- **Clarification of requirements regarding vulnerable persons:** [Section 5](#)
- **Clarification of temperature test conditions:** [5.2.5](#), [5.2.5.1](#), [5.2.5.2](#)
- **Clarification of normative reference to UL 62368-1:** [Section 5](#)
- **Clarification of which child dummy to use for Additional Evaluation of Compliance:** [7.6](#)
- **Clarification of appropriate test probe to use to determine accessibility:** [5.2.1](#), [7.3.2](#)
- **Correction of reference to “Labeling”:** [E.1.4](#)
- **Correction of reference to “Method of Covering Enclosures with Foil for Measurements and Tests”:** [7.2.6.3](#)
- **Correction of mandrel diameter used in the sharp edge test:** [7.2.12.3](#)
- **Editorial correction of reference to “Ageing Test on Motors”:** [Section 5](#)
- **Clarification of emergency stop:** [8.8](#)
- **Obstacle recognition related testing for artificial intelligence enabled robot:** [8.15](#) and [Bibliography](#)

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

The revised requirements are substantially in accordance with Proposal(s) on this subject dated November 8, 2024.

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ANSI/UL 3300-2025



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ANSI/CAN/UL 3300:2025

**Standard for Service, Communication, Information, Education and
Entertainment Robots – SCIEE Robots**

First Edition

May 14, 2024

This ANSI/CAN/UL Safety Standard consists of the First Edition including revisions through April 16, 2025.

The most recent designation of ANSI/UL 3300 as an American National Standard (ANSI) occurred on April 16, 2025. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page, Preface or SCC Foreword.

This Standard has been designated as a National Standard of Canada (NSC) on April 16, 2025.

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Preface

This is the First Edition of ANSI/CAN/UL 3300, Standard for Service, Communication, Information, Education and Entertainment Robots – SCIEE Robots.

ULSE is accredited by the American National Standards Institute (ANSI) and the Standards Council of Canada (SCC) as a Standards Development Organization (SDO).

This Standard has been developed in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization.

This ANSI/CAN/UL 3300 Standard is under continuous maintenance, whereby each revision is approved in compliance with the requirements of ANSI and SCC for accreditation of a Standards Development Organization. In the event that no revisions are issued for a period of four years from the date of publication, action to revise, reaffirm, or withdraw the standard shall be initiated.

Annex [A](#), Annex [B](#), Annex [C](#), and Annex [E](#), identified as Normative, form mandatory parts of this Standard.

Annex [D](#) and Annex [E](#), identified as Informative, are for information purposes only.

In Canada, there are two official languages, English and French. All safety warnings must be in French and English. Attention is drawn to the possibility that some Canadian authorities may require additional markings and/or installation instructions to be in both official languages.

This joint American National Standard and National Standard of Canada is based on, and now supersedes, the Third Issue of the Outline of Investigation of UL 3300.

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

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This Edition of the Standard has been formally approved by the Technical Committee (TC) on Service, Communication, Information, Entertainment And Education Robots, General Requirements, TC 3300.

This list represents the TC 3300 membership when the final text in this Standard was balloted. Since that time, changes in the membership may have occurred.

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This Standard is intended to be used for conformity assessment.

The intended primary application of this Standard is stated in its scope. It is important to note that it remains the responsibility of the user of the standard to judge its suitability for this particular application.

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1 Scope

This document establishes the safety requirements for Service, Communication, Information, Education and Entertainment (SCIEE) robots.

These requirements supplement the safety requirements for the intended, non-robotic function as described in the relevant identified standards CSA C22.2 No. 62368-1/UL 62368-1, Audio/Video, Information and Communication Technology Equipment; or CSA C22.2 No. 60335-1/UL 60335-1, Household and Similar Electrical Appliances, including the applicable Part 2. Mobility and/or uncontained manipulation introduce potential for hazard due to the speed and mass of the robot, use environment and other considerations described herein. Where applicable, these requirements cover robotics intended for use in indoor and outdoor locations.

The scope includes SCIEE robots intended for use by, or in close proximity to, the general consumer.

These requirements do not apply to:

- On- or off-road transport of persons;
- Use in industrial environments, including training simulators for industrial applications;
- Use in hazardous locations;
- Use as personnel protective equipment;
- Agricultural use;
- Use in food preparation;
- Use to treat, alleviate instability, or move individuals in hospitals, care facilities or in the home;
- Use as medical devices or in medical environments;
- Robotic functions that have no safety dependencies (i.e., non-safety-related functions, e.g., accuracy of AI query responses, efficacy of a security alarm); or
- Robotic functions described in the relevant end-product safety standard.

Examples of such standards include:

- Commercial floor cleaning machines covered by 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;
- Outdoor commercial drones – UL 3030, Standard for Unmanned Aerial Vehicles; and
- 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.

NOTE The requirements of UL 3300 can be applied to robots with multiple use cases, some of which are not specifically covered.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

AATCC 20, *Test Methods for Fiber Analysis: Qualitative*

AATCC 20A, *Test Methods for Fiber Analysis: Quantitative*

ASTM F963, *Standard Consumer Safety Specification for Toy Safety*

Code of Federal Regulations, 16 CFR Part 24, *Guides for Select Leather and Imitation Leather Products*

Code of Federal Regulations, 16 CFR Part 303.15, *Required label and method of affixing*

Code of Federal Regulations, 16 CFR Part 303.4, *English language requirements*

Code of Federal Regulations, 16 CFR Part 303.43, *Fiber Content tolerances*

Code of Federal Regulations, 16 CFR Part 423, *Care Labelling of Textile Wearing Apparel and Certain Piece Goods*

Code of Federal Regulations, 16 CFR Part 1500.49, *Technical requirements for determining a sharp metal or glass edge in toys and other articles intended for use by children under 8 years of age*

Code of Federal Regulations, 16 CFR Part 1610, *Standard for the Flammability of Clothing Textiles*

Code of Federal Regulations, 167 CFR Part 205.100, *National Organic Program*

CSA C22.2 No. 94.2:20, *Enclosures for electrical equipment, environmental considerations*

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

CSA C22.2 No. 60335-1, *Safety of household and similar appliances – Part 1: General requirements*

CSA C22.2 No. 60335-2-29, *Household and similar electrical appliances – Safety – Part 2-29: Particular requirements for battery chargers*

IEC 60068-2-6, *Environmental Testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14, *Environmental Testing – Part 2-14: Tests – Test N: Change of Temperature*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-6, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

IEC 61508, *Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems (all parts)*

IEC 62061, *Safety of Machinery – Functional Safety Of Safety-Related Control Systems*

IEC/TS 62998-1, *Safety of Machinery – Safety-Related Sensors Used For The Protection Of Persons*

ISO 12405-4, *Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 4: Performance testing*

ISO 13849, *Safety of machinery – Safety-related parts of control systems (all parts)*

ISO 13850, *Safety of machinery – Emergency stop function – Principles for design*

ISO TS 15066, *Robots and Robotic devices, Collaborative Robots*

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

UL 62, *Flexible Cords and Cables*

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

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

UL 2595, *General Requirements for Battery-Powered Appliances*

UL 5500, *Remote Software Updates*

UL 60335-1, *Household and Similar Electrical Appliances, Part 1: General Requirements*

UL 60335-2-29, *Household and Similar Electrical Appliances – Safety – Part 2-29: Particular Requirements For Battery Chargers*

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

UL 62368-1, *Audio/Video, Information and Communication Technology Equipment – Part 1: Safety Requirements*

15 USC 45, *Unfair methods of competition unlawful; prevention by Commission*

3 Terms, Definitions and Abbreviated Terms

3.1 Abbreviations

Abbreviations are summarized alphabetically in [Table 1](#).

Table 1
Abbreviations

ODD	Operational Design Domain
OTS	Off the Shelf
PL	Performance Level
SCIEE robot	Service, Communication, Information, Education and Entertainment Robot
SIL	Safety Integrity Level

3.2 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.3 Function terms

3.3.1

collision avoidance

safety function involving non-contact sensing (e.g., lidar) plus a predetermined action (e.g., stopping, braking, decelerating) to avoid impact with a person.

3.3.2

emergency stop

safety function which is intended to avert arising or reduce existing hazards to persons, damage to machinery or to work in progress, and be initiated by a single human action.

[SOURCE: ISO 12100]

3.3.3

fail-safe routine

routine intended to bring the robot, including its manipulator(s), end-effector(s), and/or payloads into a safe, controlled state in response to a condition that could compromise safety, such as detection of a hardware fault, loss of communications with the docking station, or excessive battery discharge.

3.3.4

non-robotic function

function of a robot that consists of energy sources that can be identified as electrical, mechanical, thermal, chemical and/or radiation which are needed for the normal operation and performance of the robot.

3.3.5

protective stop

type of interruption of operation that allows a cessation of motion for safeguarding purposes and which retains the program logic to facilitate a restart.

[SOURCE: ISO 8373]

3.3.6

robotic function

a degree of autonomy that enables mobility and motion, i.e., location, manipulation, or positioning.

[SOURCE: ISO 8383, modified definition of "robot"]

3.3.7

safety function

function whose failure can result in an immediate increase of risk(s).

EXAMPLE Safety-limited speed ([3.3.8](#)) and collision avoidance ([3.3.1](#)) are examples of safety functions.

Note 1 to entry: Safety functions are defined in [8.2](#), Safety functions, or by manufacturer risk assessment (see [8.1](#), Risk assessment).

[SOURCE: ISO 12100, modified]

3.3.8

safety-limited speed

safety function that limits the speed of the robot or any of its parts.

3.4 Hazard terms

3.4.1

critical edge

a level change that the robot cannot traverse safely during one or more of its operating modes.

EXAMPLE A robot can climb stairs but must be able to detect the stairs and then transition into a different walking mode to do it safely.

3.4.2

entrapment

hazard involving a robot trapping a person in a way so they cannot free themselves, either between parts of the robot (e.g., gripper end-effector) or against another object (e.g., wall, floor).

3.4.3

horizontal impact

hazard involving part of a robot contacting a person while the robot is moving horizontally on a travel surface.

3.4.4

vertical fall

hazard involving a robot falling (e.g., due to loss of balance, critical edge) with its velocity increased past its rated speed by gravity.

3.5 General terms

3.5.1

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

3.5.2

end-effector

device specifically designed for attachment to the manipulator to enable the robot to perform its task.

EXAMPLE Gripper

[SOURCE: ISO 8373]

3.5.3

leg (robotic)

mechanism of interconnected set of links and joints which is actuated to support and propel the mobile robot by making reciprocating motion and intermittent contact with the travel surface.

[SOURCE: ISO 8373, modified]

3.5.4

manipulator

mechanism usually consisting of a series of segments, jointed or sliding relative to one another, for the purpose of moving objects usually in several degrees of freedom.

[SOURCE: ISO 8373, modified]

3.5.5

mobility

motion that results in relocation of the robot within its use environment.

3.5.6

operational design domain (ODD)

the set of environments and use cases the 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.

3.5.7

outdoor location

location for robot where protection from the weather and other outdoor influences provided by a building or other structure is limited or non-existent.

3.5.8

payload

a rated physical load to be carried by a robot.

3.5.9

robot, legged

mobile robot that travels using one or more legs. See [3.5.3](#), leg (robotic).

[SOURCE: ISO 8373]

3.5.10

sensor unit

analog or digital device that detects the surrounding environment that produces a dynamic output for processing to represent a physical parameter or form necessary for control of the robotic function.

EXAMPLE The CCD (charge-coupled device) is the sensor unit part of a camera. The laser light and light detector together form the sensor unit of lidar.

Note 1 to entry: For passive detection, the receiver is the sensor unit; for active detection, the transmitter and receiver together are the sensor unit.

3.5.11

space

three dimensional volume.

[SOURCE: UL 1740]

3.5.12

space, maximum

space which can be swept by the moving parts of the robot as defined by the manufacturer plus the space which can be swept by the end-effector and the payload.

[SOURCE: UL 1740]

3.5.13

supervising operator

an instructed person who places a SCIEE robot into service, monitors its operation, and is capable of intervening to take control of the robotic function.

EXAMPLE Security robot monitored by local security patrol.

Note 1 to entry: An instructed person that configures and/or initiates robot use without monitoring the robot's real-time operation or without being able to intervene with the robot's operation is not considered to be a supervising operator.

3.5.14

vulnerable person

an individual at greater risk of harm from products or systems, due to age, level of literacy, physical or mental condition or limitations, or inability to access product safety information.

[SOURCE: ISO/IEC Guide 51]

4 General Requirements

Robots shall be constructed so that they function safely, causing no risk of harm to persons or surroundings, when stationary or mobile. This includes in normal use as represented by the robot specification, environmental use conditions, and reasonably foreseeable misuse. In general, this principle is fulfilled by individually considering the intended use, the energy sources, the robotic function, and any combination of the foregoing.

EXAMPLE A classroom telepresence robot (audio / video user interface) is considered the intended use. Autonomous mobility (not requiring human interaction) is considered to be the robotic function.

Requirements are specified in the relevant Clauses and, where referenced in those Clauses, in the relevant annexes.

Where compliance of materials, components or subassemblies is demonstrated by inspection, such compliance may additionally be determined by review of published data or test results.

Tests are conducted on the complete robot unless specifically stated. Where it is necessary to defeat a feature to assess a protective means, it shall be stated in the test procedure.

5 Non-robotic Function

SCIEE robots shall comply with CSA C22.2 No. 62368-1/UL 62368-1. Energy sources covered within CSA C22.2 No. 62368-1/UL 62368-1 are:

- General requirements: CSA C22.2 No. 62368-1/UL 62368-1 Clause 4;
- Electrically caused injury: CSA C22.2 No. 62368-1/UL 62368-1 Clause 5 (Risk of electric shock);
- Electrically caused fire: CSA C22.2 No. 62368-1/UL 62368-1 Clause 6 (Risk of fire);
- Injury caused by hazardous substances: CSA C22.2 No. 62368-1/UL 62368-1 Clause 7 (Chemical);
- Mechanically caused injury: CSA C22.2 No. 62368-1/UL 62368-1 Clause 8 (Mechanical sources from non-mobility, i.e., static operation), see note;
- Thermal burn injury: CSA C22.2 No. 62368-1/UL 62368-1 Clause 9; and
- Radiation: CSA C22.2 No. 62368-1/UL 62368-1 Clause 10.

NOTE 1 Mechanically caused injury based on mobility and robot motion are covered in UL 3300.

For applications within the scope of CSA C22.2 No. 60335-1/UL 60335-1 and the specific Part 2, the applicable requirements may be used as an alternative to CSA C22.2 No. 62368-1/UL 62368-1. When CSA C22.2 No. 60335-1/UL 60335-1 is selected, the additional requirements specified in Annex C are to be applied.

Robots with intended uses in addition to SCIEE shall comply with the relevant safety standard covering that intended use. When requirements differ between the standards, the most onerous requirement(s) shall be applied.

EXAMPLE If the relevant safety standard for an application specified a pollution degree 2, and another relevant standard specifies a pollution degree 3, this robot with multiple applications would be subject to the requirements for pollution degree 3.

Compliance is determined by inspection and tests.

5.1 Requirements for components

5.1.1 General

Components used in and with the robot are to meet the component requirements specified in CSA C22.2 No. 62368-1/UL 62368-1. Where cited in this Standard, the component requirements are modified or replaced.

5.1.2 Power supplies

Power supplies shall comply with Clause [9](#) of this Standard, Electric Power Sources.

5.1.3 Batteries

Batteries and cells shall comply with Clause [11](#) of this Standard, Batteries.

5.1.4 Toxicology

The following requirements from ASTM F963 are applicable to substances and materials that make up accessible surfaces:

- Hazardous materials, and
- Heavy elements.

5.1.5 Textiles

For robots covered in whole or part by textiles, the additional requirements in Annex [A](#), Textiles, are to be applied.

In addition to meeting the requirements in Annex [A](#), Textiles, the textile shall also meet the requirements for Code of Federal Regulations (CFR) 16, Part 1610, as defined in ASTM F963, Flammability testing procedure for fabrics.

For robot constructions where the textile provided is not intended to be separated from the robot body, the combination of the solid substrate and textile shall be subject to the flammability test in ASTM F963, Flammability testing procedure for solids and soft toys.

5.2 Accessibility

All accessibility requirements from the non-robotic standards shall be met except where modified or replaced as cited by this Standard.

5.2.1 Test probe

When applying the requirements in CSA C22.2 No. 62368-1/UL 62368-1, Determination of accessible parts, the jointed test probe for equipment likely to be accessible to children shall be used to assess access to mechanical energy sources and physical motion of the robot.

5.2.2 Size of parts

Accessible parts shall not be removable from the robot by a vulnerable person if they can fit entirely inside the small part cylinder of ASTM F963, Small parts cylinder.

Compliance is determined by inspection and review of data. When it is unclear if the construction prevents access to small parts and if data is not available, the following tests shall be conducted:

- The force test in CSA C22.2 No. 62368-1/UL 62368-1, Steady force test, 30 N;
- Torque test for removal of components, [7.2.13.1](#); and
- Tension test for removal of components, [7.2.13.2](#).

5.2.3 Environmental conditions

5.2.3.1 Outdoor locations or indoor wet locations

Robots intended for outdoor locations and/or indoor wet locations shall:

- be rated minimum 3R in accordance with CSA C22.2 No. 94.2/UL 50E or IPX4 in accordance with IEC 60529;
- not have accessible circuits or parts that exceed 15 V rms, 30 Vdc, or 21.2 Vpk; and
- comply with the Exposure to moisture test in [7.4.10](#).

5.2.4 Sharp edges

Robots shall not have sharp edges in any accessible areas of the completed construction. The Sharp edge test as described in [7.2.12](#) is to be conducted to assess access to any accessible sharp edges where the edge construction is questionable. Edges are considered potentially hazardous if they fail the sharp edge test described in Code of Federal Regulations (CFR) 16, Part 1500.49. Edges other than metal and glass are defined as potentially hazardous if they are sharp to the touch under casual handling conditions. The sub-assembly should not be considered unless the product is intended to be accessed as a sub-assembly e.g., an accessory part.

5.2.5 Maximum permitted temperatures

The temperature tests in CSA C22.2 No. 62368-1/UL 62368-1 shall be conducted as defined in [5.2.5.1](#) and [5.2.5.2](#).

5.2.5.1 Touch temperature test

During the Temperature tests defined in CSA C22.2 No. 62368-1/UL 62368-1, the surface temperature rise limits for accessible parts shall not exceed those specified under the Touch temperature test in [7.2.11](#).

5.2.5.2 Temperature test in recessed installation

If the robot specification includes the capability of charging the robot in a recessed location, the Temperature test, using maximum operating temperatures for materials, components and systems specified in CSA C22.2 No. 62368-1/UL 62368-1, shall be repeated while the robot is charging in a recessed location simulating the manufacturer's specification.

5.3 Abuse tests

In addition to the tests specified in CSA C22.2 No. 62368-1/UL 62368-1 for safeguards, the robot shall be subject to the following additional test.

5.3.1 Drop test

A robot that is intended to be carried shall be subject to the Drop test in [7.3.4](#).

6 Mobility

The requirements applicable to the robot are based on the application as specified in CSA C22.2 No. 62368-1/UL 62368-1. Additional requirements for the robotic function are covered in Clauses [6](#) – [12](#).

6.1 Indicators

Robots which require visible aids shall be provided with indicators designed to function with limited flicker which can trigger a reaction. Audible indicators shall be discernible by vulnerable persons but are not to exceed the specified limits. See Clause [10](#) and Annex [D](#), Indicators, of this Standard for additional requirements and guidance on indicators.

6.2 Robot stop control

Robots shall be provided with the means by which to cause a stop. The initiation means can be triggered internally or externally.

NOTE Safety-related stop functions are covered in Clause [8](#).

6.3 Manipulators

The requirements in this Clause apply to legged robots and robots that have one or more manipulator(s) and/or end-effector(s) that are accessible to persons.

NOTE 1 Manipulator subassemblies evaluated to UL 1740 may be used, provided overall operation and construction comply with this Standard.

NOTE 2 ICT (Information and Computer Technology) equipment having fully contained integral manipulators with end-effectors for data storage and access are addressed by CSA C22.2 No. 62368-1/UL 62368-1, Special categories of equipment containing moving parts, and are considered out of scope of this Clause.

6.3.1 Interconnecting cables

In addition to meeting suitable ratings for interconnecting cables in CSA C22.2 No. 62368-1/UL 62368-1, all cables used for safe manipulator operation (i.e., cables, either internal or external, that bridge between moving parts of the robot) regardless of energy source classification shall have sufficient mechanical strength for their application. Wiring connections to a continuously moving part, or a part for which the degree of movement is appreciable, shall be:

- UL 62 flexible cord/cable of a Type such as S, SJ, SJE, SJO, SEO, SJT, SJTO, SJEO, SO, ST, SE, or STO flexible cord; or
- UL 758 appliance wiring material of a suitable rated voltage, temperature, and flammability for the interconnected circuits, and provided with mechanical construction to support ongoing flexibility such as a supplemental jacket over the conductors.

Compliance is determined based on testing in accordance with the test in [7.5.1](#), Endurance test, and the appropriate requirements of CSA C22.2 No. 62368-1/UL 62368-1 or CSA C22.2 No. 60335-1/UL 60335-1.

6.3.2 Range of motion

Means shall be provided to limit the range of motion of robot manipulator(s) and/or end-effector(s). The means provided shall not themselves cause a risk of pain, injury, or entrapment to persons. If mechanical stops are used, they shall be subjected to the test in [7.5.2](#), Mechanical hardstop test. If safety function(s) are used, see Clause [8](#).

NOTE Means complying with UL 1740, Limiting robot motion, are considered to meet these requirements.

6.3.3 Gripper end-effectors

Robots with gripper end-effectors shall be provided with means to release the gripper in an emergency, i.e., if a person is entrapped by the gripper. The gripper release shall comply with the test in [7.5.4](#), Gripper release test, and if the gripper release is performed by a control system, the gripper release function shall comply with Clause [8](#).

6.3.4 Concurrent and/or divergent motion

Robots with manipulators that are permitted to move while the robot's mobile platform is moving, and/or robots with multiple manipulators that are permitted to move at the same time, whether coordinated or independently, shall maintain safe operation. Safety functions responsible for the robot maintaining safe operation during simultaneous movement, or that prevent simultaneous movement, shall comply with Clause [8](#).

7 Testing

7.1 Robot specifications

The intended use and operational limits of the robot shall be specified by the manufacturer, consisting of declaration of the parameters specified in [Table B.1](#) – [Table B.3](#) in Annex [B](#), Required Information for Robot Specification.

7.2 Tests for mobility safeguards

7.2.1 General

Robotic function safeguards shall be suitable for the robot specification such that they protect an operator and others in the use environment from hazards introduced by independent robot movement without human intervention. Such hazards include those arising from motion itself, the robot shape and size, sensor obfuscation, pre-programmed and learned decisions and actions, lack of situational awareness, and localization and navigation errors.

The performance of a robot shall be investigated by subjecting representative sample(s) of the robot to the robotic function tests described in this Clause, in addition to the tests in the referenced standards that cover non-robotic functions (i.e., CSA C22.2 No. 62368-1/UL 62368-1 or CSA C22.2 No. 60335-1/UL 60335-1).

During the robotic function tests described in this Clause, all functions that are not safety-related that could act prior to and/or interfere with safety functions shall be disabled or otherwise modified so that they do not influence the results of these tests.