Standard And Regulations

UL 1740 and ISO 10975

Team E

About UL

- Global safety science company founded as **Underwriters' Electrical Bureau** in 1894
- **UL Standards**
  - SustainAbility Standards
  - Standards for Electrical and Electronic Products
  - Life Safety Standards
  - Standards for Building Products
  - Standards for Industrial Control Equipment
  - Standards for Plastic Materials
  - Standards for Wire and Cable
  - UL Solutions of Canada

Underwriters Laboratories

Headquartered in Northbook, IL

UL 1740: Robots and Robotic Equipment

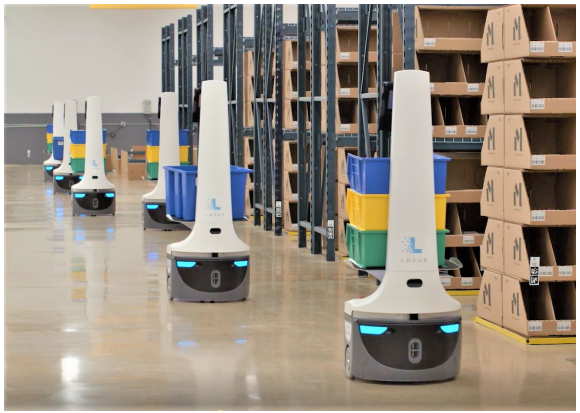
- It is a general standard that covers Robots and Robotic Equipment rated 600V or less.
- Applicable to both indoor and outdoor robots.
- Unique end-user applications that are not covered in this standard are also evaluated

Objectives:

1. To ensure persistent and dependable function of robots and robotic equipment
2. Protect humans from robots and robotic equipment

Application market

This standard applies to parts assembly, parts transfer, automated material handling, inspection, loading, die-casting, deburring, welding, paint spraying, automated storage & retrieval systems, and the like.



Application market

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Main Prescriptions

Construction

Protection against injury to person

Instructions

Performance

Markings

Application to Spraybot

1. Construction:

Enclosures - Part 7

a. “shall have mechanical strength and durability and be formed such that operating parts will be protected against damage and shall resist the abuses likely to be encountered during installations”

b. “shall protect persons against a risk of electric shock, and the material shall not create or contribute to a risk of fire, electric shock, or injury to persons”

c. “shall comply with the **Polymeric Enclosure Rigid Metallic Conduit Connection Test** in the standards for Enclosures for Electrical Equipment, UL 50

Application to Spraybot

1. **Construction:**

   Enclosures - Part 7

   a. An enclosure, a frame, guard, a handle, or the like, shall not be sufficiently **sharp constitute a risk of injury to a persons** in normal maintenance and use
   b. A **hinged or pivoted panel** or cover shall be positioned to minimize chance of injury under gravity or normal vibrations - **Sprayer**

Application to Spraybot

a. **Construction:**
   i. **Protection Against Corrosion**
      1. Iron and steel parts shall be protected against corrosion by an enameling, galvanizing,plating or other equivalent means
      2. Parts made of stainless steel aluminum magnesium need not be protected if they are small and do not carry a risk of shock and fire
      3. Enclosures exposed to corrosive elements such as salt spray shall comply with the enclosure performance requirements outlined in the standard for an **Enclosures for electrical equipment, UL50**.

Application to Spraybot

2. Protection Against Injury to Personnel

- **Robot Control - Standard**
  - Indicator light when robot is engaged
  - Emergency hardware stop on robot + E-stop on joystick
- **Conductors - Standard**
  - Correct wire gauge based on ampere ratings
  - Exposed contacts on external connectors must be safe
  - Strain relief cables, Interconnecting cables
  - Inadvertent connections shall not cause fire or shock risk
- **Battery and Battery Circuits - Standard**
  - Battery terminals shall be protected from short circuiting
  - Lithium batteries fall under UL 1642
  - Overcharge and undercharge protection

Application to Spraybot

3. Markings - In progress

a. **Standard:** Caution or warnings as applicable
   i. Marking on herbicide tank indicating corrosive materials
   ii. Marking on batteries and electrical components indicating high voltage and capacity
   iii. Real time warnings/alarms for battery faults provided to user through UI.

4. Instructions - TBD

a. **Standard:** Manufacturer's instructions, Routine maintenance, Identification of each component likely to be placed, Installation instructions
   i. Detailed documentation of all above components to be provided to Terry before final handover
   ii. Precisely, mechanical part drawings, electrical subsystem wiring diagrams, safety and operational instructions etc.

ISO 10975 - Tractors and machinery for agriculture: Safety Requirements

BS ISO 10975:2009

Tractors and machinery for agriculture.
Auto-guidance systems for operator-controlled tractors and self-propelled machines.
Safety requirements

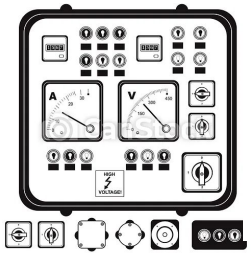
Objectives:

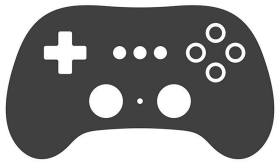
- To reduce operator fatigue, and to increase the accuracy and efficiency of field operations.
- To ensure the proper function and safety of such systems

Application Markets

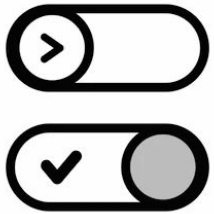
Farming machinery which is self-propelled with auto guidance systems which are either retrofitted or factory installed

Main Prescriptions





Requirements for controls and displays



Activation and deactivation of system

Audible and/or visual indicators to show the status of the system for operator.

Instructions Manual

Standards

Controls and Displays

- Shall comply with the requirements of ISO 15077.
- Should provide operator with adequate visibility of displays to operate the machine

Operator Presence System

- Should use a mechanical/electrical/electronic means used to detect if an operator is no longer in the operator station or an activity monitor

Instruction Manuals

- Should contain operator information
- Should direct to NOT activate auto-guidance on on a public roadway
- Should contain safety signals and/or signs

Standards

State of auto-guidance system

- Should be off at startup
- Should have an audible indicator
- When stationary, it shall not initiate steering commands
- Shall automatically change from the active state to enabled/disabled when:
  - insufficient data to determine vehicle position
  - whenever all signals (e.g. crop feeder data and satellite signals) are lost
  - Within a maximum of 10s after an indication that the operator is not present
  - If the steering wheel moves 30° or more

Application to Spraybot

Sprabot does not require an operator but the standard provides key insights to design farming robots

Modified standards that were employed in spraybot:

- System should be disabled at power-on
- System should auto-disable if there is insufficient sensor information - Hypervisor controls this
- Safety measures - redundant safety like collision monitor with obstacle avoidance based navigation
- Visual indicator of activity - Accurate system status on UI
- Operator assigns mission and is allowed to remotely intervene the system
- Robust software design with recovery behaviours etc.
- To be done - Add audio/visual alarms on UI incase of emergency

The presentation must address the following topics:

(1) what the standard is about;

(2) what products or markets the standard is applicable to;

(3) what the main prescriptions of the standard are;

(4) how the standard applies to the team's project. No standard can be shared by two teams in a year. Teams will be graded on the depth of the study as presented in class, and on the presentation itself, which must be interesting, engaging, and relevant.

Standards & Regulations Presentation Element	Weight
1a. Standard/Regulation #1 Description: What is it about?	0.5
1b. Standard/Regulation #1 Description: To which products/markets does it apply?	0.5
1c. Standard/Regulation #1 Description: What are its main prescriptions?	2
2. Standard/Regulation #1 Application: How does it apply to the team's project?	1
3a. Standard/Regulation #2 Description: What is it about?	0.5
3b. Standard/Regulation #2 Description: To which products/markets does it apply?	0.5
3c. Standard/Regulation #2 Description: What are its main prescriptions?	2
4. Standard/Regulation #2 Application: How does it apply to the team's project?	1
5a. Delivery: Length	0.5
5b. Delivery: Intelligibility, flow, demeanor, audience connection	0.5
5c. Delivery: Q & A	1
Total:	10

UL1740

ISO_10975_2009(en).PDF

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