Standards & Regulations

Team D: GetAGrip.AI

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Get AGrip

Lessons Learned from Spring Semester

Standard	Title
ISO 10975:2009	Tractors and machinery for agriculture — Auto-guidance systems for operator-controlled tractors and self-propelled machines — Safety requirements
IEEE 829-2008	IEEE Standard for Software and System Test Documentation

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What is an Auto-Guidance System?

Group of **components used in conjunction with the main steering system** which **provides assistance** to the operator **in steering** the tractor or self-propelled machine, **but** in which the **operator remains at all times in primary control**.

Examples:
- GPS-Based Navigation Systems
- RTK Correction Systems
- Computer Vision Systems

Assistance Methods:
- Indicator Lights / Displays
- Audio Feedback
- Steering Control Systems

What is **ISO 10975:2009**?

What it Covers:

Safety Requirements for auto-guidance systems in operator-controlled tractors and self-propelled agricultural machines.

    a. **Addresses System Controls and Displays**: Specifies how these should be implemented to ensure safety and proper functioning.
    b. **Outlines Activation/Deactivation**: Details how systems should be turned on and off, with associated indicators for system status.
    c. **Operator Information**: Mandates the type of information that should be provided to the operator.
    d. **Retrofittable Systems Consideration**: Applicable to both factory-installed systems and those intended for aftermarket installation.

# What Does **ISO 10975:2009** Apply To?

Tractors and Self-Propelled Machines: Specifically aimed at agricultural vehicles that are guided by an operator.

- **Factory and Retrofit Installations**: Relevant for both types of system installations.
- **Not Retroactive for Older Systems**: Does not apply to systems manufactured or individually marketed before the publication of the standard.
- **Compliance Over Precedence**: If there is a conflict between this standard and machine-specific standards, the latter take precedence.
- **Road Traffic Regulations**: Notes that additional requirements may be imposed by specific road traffic regulations
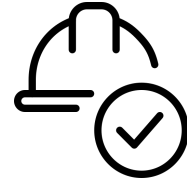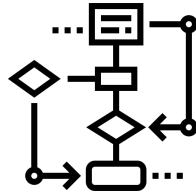
Main Prescriptions: **ISO 10975:2009**

Controls & Display
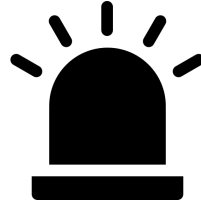
Operator Presence System

Safety & Instructional Signs

State Requirements

Instruction Manual

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Summary of Requirements

Controls and Displays:
- Displays should not obstruct the operator's view or access to primary controls and must be clearly visible.
- Information screens must include a designated page with necessary indicators as per the operator's manual.

Operator Presence System:
- The system must detect operator presence in the operator station using mechanical, electrical, electronic means, activity monitors, or other technical solutions.

State Indicators and Transition Requirements:
- Visual and audible indicators for system states (disabled, enabled, active) are required.
- The operator must issue a command to activate the system from disabled or enabled states.
- No steering movement should occur when the machine is stationary and under auto-guidance control.

Summary of Requirements (Cont.)

State Indicators and Transition Requirements (Cont.):
- The system should revert to enabled or disabled state if:
  - The steering wheel turns at 50°/s or moves 30° or more.
  - The operator manually operates primary steering controls.
  - Steering effort to deactivate exceeds 250 N (for vehicles with steering wheels).
- The system must deactivate within 10 seconds if the operator is absent or inactive.
- For GPS-dependent systems, deactivation occurs if satellite data is insufficient for vehicle positioning.
- For systems using multiple signals, deactivation occurs if all signals are lost (e.g., crop feeder data and satellite signals).

System Activation and Deactivation:
- At engine start-up, the auto-guidance system must be in a disabled state.
- Switches or similar devices must be provided for the operator to change system states.

How Does **ISO 10975:2009** Apply To Our Project?

Requirements Present on the Amiga

- **Emergency Stop**: Hierarchy of control in which functions can be overridden by higher level electronic control
- **Activity Monitor:** Indicates speed, battery level and other features that an operator can modify or control
- **Teleoperation Upon Start:** System is in teleoperation mode when switched on. Operator must manually change to autonomous mode.
- **Instruction Manual:** Clear explanation of device buttons, modes and usage

What is **IEEE 829-2008**?

IEEE Standard for Software and System Test Documentation

- Standard that specifies the form of a **set of documents used in software testing**
- Each stage of software testing potentially produces its own separate type of document
- The standard provides a **structured approach** to testing that allows for **consistency** in the creation and maintenance of test documentation in software

What is **IEEE 829-2008**?

What does it cover?

a. **Test Plan:** Document detailing approach to testing (objectives, resources, schedules, level of testing, etc.)
b. **Test Design Specifications:** Identifies associated tests for each feature
c. **Test Case Specification:** Specifies the input, predicted results, and set of execution conditions for a test item
d. **Test Item Transmittal Report:** Records the handover of the test item from the development team to the testing team
e. **Test Log:** Record of what occurred during a test
f. **Test Incident Report:** Any event occurring that requires investigation during testing is recorded here
g. **Test Summary Report:** Document that summarizes the results (including incidents, deviations from the plans, and overall effectiveness)

What Does **IEEE 829-2008** Apply To?

All software-based systems

- Includes firmware, microcode, and documentation
- Systems and software being developed, acquired, operated, maintained, and/or reused (legacy, modified, commercial-off-the-shelf (COTS), government-off-the-shelf (GOTS), or Non-Developmental Items (NDIs))

Spans numerous industries

- IT, healthcare, automotive, aerospace & defense, consumer electronics, finance, telecommunications, education & research
- Not limited to a specific market or product but is rather a universal standard that can be adopted by any entity involved in software and system testing to ensure quality and reliability

Main Prescriptions: **IEEE 829-2008**

Test Plan

Test Design
Specification

Test Case Specification

Test Procedure
Specification

Test Item Transmittal
Report

Test Log

Test Incident Report

Test Summary Report

How Can We Apply IEEE 829-2008?

Test Plan

- Define the objectives for testing the subsystem/system
- Clearly define which component is being tested
- Describe approaches of the plan and the anticipated outcome
- Set the success criteria for each test

Test Design Specification

- Specify the test design
- Reference the requirements and design documents
- Clearly state which conditions the test will be valid
  - Lighting conditions for perception subsystem
  - Pepper orientation for manipulation subsystem

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How Can We Apply IEEE 829-2008?

Test Case Specification

- Clearly state input
  - Image from which rostopic
- Specify expected output to tell if the robot has succeeded or failed
  - Detected 3 out of 4 peppers in one frame

Test Procedural Specification

- Clearly state procedure and set up
  - Location, used robot, used pepper
- Include procedures for recording rosbags
- Include procedures of handling unexpected situations

How Can We Apply **IEEE 829-2008**?

Test Item Transmittal
Report

- Document the versions of the code that was being tested and how that was handled after the test

Test Log

- Document chronological log of the testing activities, keeping track of edge cases

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How Can We Apply IEEE 829-2008?

Test Incident Report

- Document incidents where the robot's performance does not meet expectations
- For debugging

Test Summary Report

- Summarize outcomes, evaluate test and make action plans to improve what we saw