
**Agricultural machinery and
tractors — Auto-guidance systems
for operator-controlled tractors and
self-propelled machines — Safety
requirements**

*Tracteurs et matériels agricoles — Systèmes d'autoguidage pour
tracteurs commandés par opérateur et pour machines automotrices
— Exigences de sécurité*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This second edition cancels and replaces the first edition (ISO 10975:2009), which has been technically revised.

The main changes are as follows:

- requirements have been added for limits of operation in [4.3](#);
- conditions have been added to [4.4.7](#);
- installation instructions for retrofitted systems have been added in [5.3](#).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a type-C standard as stated in ISO 12100.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

- machine manufacturers (small, medium and large enterprises);
- health and safety bodies (regulators, accident prevention organisations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

- machine users/employers (small, medium and large enterprises);
- machine users/employees (e.g. trade unions, organizations for people with special needs);
- service providers, e.g. for maintenance (small, medium and large enterprises);
- consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

In addition, this document is intended for standardization bodies elaborating type-C standards. The requirements of this document can be supplemented or modified by a type-C standard.

For machines which are covered by the scope of a type-C standard and which have been designed and built according to the requirements of that standard, the requirements of that type-C standard take precedence.

The structure of safety standards in the field of machinery is as follows:

- Type-A standards (basis standards) give basic concepts, principles for design, and general aspects that can be applied to machinery;
- Type-B standards (generic safety standards) deal with one or more safety aspects or one or more types of safeguards that can be used across a wide range of machinery:
 - Type-B1 standards on particular safety aspects (e.g. safety distances, surface temperature, noise);
 - Type-B2 standards on safeguards (e.g. two-hands controls, interlocking devices, pressure sensitive devices, guards);
- Type-C standards (machinery safety standards) deal with detailed safety requirements for a particular machine or group of machines.

Auto-guidance systems are used in tractors and self-propelled agricultural machines to reduce operator fatigue and to increase the accuracy and efficiency of field operations. To ensure the proper function and safety of such systems, this document specifies requirements for controls and displays, activation and deactivation of the system, audible and/or visual indicators to show the status of the system and the information to be provided to the operator. According to the current practice, these requirements are applicable to factory installed systems and systems intended to be retrofitted.

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Agricultural machinery and tractors — Auto-guidance systems for operator-controlled tractors and self-propelled machines — Safety requirements

1 Scope

This document specifies safety requirements for auto-guidance systems used in agricultural tractors and self-propelled agricultural machines.

It is applicable to auto-guidance systems which are factory installed as an integral part of the tractor or self-propelled machine, as well as systems designed to be retrofitted to equipment after such equipment has left the control of the manufacturer.

It is not applicable to guidance systems used in tractors or self-propelled machines that do not require an on-board operator for primary control of the tractor or self-propelled machine.

This document does not specify requirements necessary to ensure the integrity of the complex electronic control system which can be an integral part of the auto-guidance system. Such requirements are dealt with in other International Standards which address complex electrical/electronic machine control systems.

This document is not applicable to tractors and self-propelled machines which were manufactured with an auto-guidance system, and to self-contained auto-guidance retrofit systems, which were individually placed on the market before the date of publication of this document.

NOTE Specific road traffic regulations can impose additional requirements for auto-guidance systems.

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.

ISO 3600, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Operator's manuals — Content and presentation*

ISO 4254-1, *Agricultural machinery — Safety — Part 1: General requirements*

ISO 10998, *Agricultural tractors — Requirements for steering*

ISO 11684, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Safety signs and hazard pictorials — General principles*

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 15077, *Tractors and self-propelled machinery for agriculture — Operator controls — Actuating forces, displacement, location and method of operation*

ISO/FDIS 18497-1:—¹⁾, *Agricultural machinery and tractors — Safety of partially automated, semi-autonomous and autonomous machinery — Part 1: Machine design principles and vocabulary*

ISO 26322-1, *Tractors for agriculture and forestry — Safety — Part 1: Standard tractors*

1) Under development. Stage at the date of publication: ISO/FDIS 18497-1:2023.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4254-1, ISO 10998, ISO 12100, ISO/FDIS 18497-1:—, ISO 26322-1 and the following apply.

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

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

3.1 activity monitor

type of *operator presence system* (3.4) whereby the *auto-guidance system* (3.2) receives feedback from the operator's station indicating that an operator is present at the operator station

EXAMPLE This can be accomplished by monitoring the manual manipulation of a control or combinations of controls over a given period of time (e.g. touchscreen display, control actuation)

3.2 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

Note 1 to entry: See definition of 'partially automated' in ISO/FDIS 18497-1:—, 3.2.

3.3 complex electronic control system

electronic control systems subject to a hierarchy of control in which a controlled function may be overridden by a higher level electronic control system/function

3.4 operator presence system OPS

system that detects if an operator is positioned in an operator station and automatically takes a control system action based on that determination

[SOURCE: ISO/TS 19014-5:2021, 3.16]

3.5 States

3.5.1 active state

condition where the system is switched on and providing dynamic steering commands to the tractor or self-propelled machine

3.5.2 enabled state

condition where the system is switched on and prepared to carry out steering of the tractor or self-propelled machine upon receipt of a valid command or *signal* (3.6)

3.5.3 disabled state

condition where the system is switched off or not prepared to carry out steering

3.6**signal**

information or data in the form of either electrical voltages or currents, digital messages by a direct connection or by a communication data network which is provided to a control system

EXAMPLE Satellite signals provided by a receiver by an RS232 connection or a network in conformity with ISO 11783 (all parts).

3.7**visual indicator**

signal (3.6) that is intended to be detected by the sense of sight

EXAMPLE A lamp, LED, display message or display symbol.

4 Safety requirements and/or measures**4.1 Controls and displays**

4.1.1 Location, marking and method of operation of controls shall comply with the requirements of ISO 15077.

4.1.2 A display, if provided, shall be constructed and positioned such that the operator has adequate visibility to operate the machine and view the work area and so as to not interfere with direct access to primary machine controls. The display may be mounted in such a way that it can be positioned in different locations, e.g. to account for adequate visibility for field operations as compared to operation on roadways.

4.1.3 In the case where the visual indicator is available as information on a display which utilizes more than one operator-selected screen or page, the indicator need not be present on each screen or page, but shall be present on at least one designated screen or page. The designated screen or page shall be identified in the operator's manual.

4.2 Operator presence system

An operator presence system shall be provided. This requirement is fulfilled through the use of electro-mechanical/electrical/electronic means used to detect if an operator is no longer in the operator station or an activity monitor or other technical solutions which are capable of detecting the presence of an operator in the operator station.

4.3 Limits of operation

The auto-guidance system shall be capable of limiting the maximum machine curvature to an appropriate curvature while the auto-guidance system is active. Reasons to limit the curvature include current machine speed, current terrain condition the machine is on, and current machine configuration as appropriate.

4.4 State requirements

4.4.1 At start-up, the auto-guidance system shall be in the disabled state.

4.4.2 Means such as contact switches, soft keys or other similar devices, accessible to the operator, shall be provided to change

- a) between the disabled and enabled states,
- b) from the enabled state to the active state, and

c) from the active state to the disabled state.

4.4.3 A visual indicator showing the current (disabled, enabled or active) state of the system shall be provided for the operator.

4.4.4 An audible indicator shall be provided for the operator which shall sound when the system enters or leaves the active state.

4.4.5 The system shall require a command from the operator to change from the disabled or enabled state to the active state.

4.4.6 When the tractor or self-propelled machine is stationary, there shall be no movement of steering components initiated by the auto-guidance system.

4.4.7 The system shall automatically change from the active state to either enabled or disabled state under any of the following conditions.

- a) The operator turns the steering wheel, which can be measured by either rate or range of motion (e.g. hydraulic pressure switch, steering angle device):
 - 1) if rate of motion is measured, the auto-guidance system shall change state if the steering wheel is moved at an angular speed of 50°/s or faster;
 - 2) if range of motion is measured, the auto-guidance system shall change state if the steering wheel moves 30° or more;
 - 3) for machines without a steering wheel, the auto-guidance system shall leave the active state when the operator manipulates the primary steering controls;
 - 4) for machines with a steering wheel, the steering effort required to leave the active state shall not exceed 250 N (as defined in ISO 10998).
- b) For systems that rely only on satellite signals (e.g. GNSS, RTK), whenever the satellite signal provides insufficient data to determine machine position or orientation to the desired level of accuracy.
- c) For systems that rely only on environmental sensors, whenever the sensor signal provides insufficient data to determine machine position or orientation to the desired level of accuracy.
- d) For systems that rely on multiple types of signals, whenever all signals (e.g. crop feeler data and satellite signals) provide insufficient data to determine machine position or orientation to the desired level of accuracy.
- e) Within a maximum of 10 s after an indication that the operator is not present or else is not active in the operator station.
- f) For systems that do not rely on a location device to determine operator presence (such as an activity monitor), within 30 s of the machine becoming stationary and remaining stationary.

5 Information for use

5.1 Operator's manual

5.1.1 An operator's manual complying with the requirements of ISO 3600 shall be provided with each system.

5.1.2 In particular, instructions shall be given that the operator shall disable (i.e. set to the disabled state) the auto-guidance system when the tractor or self-propelled machine is travelling on a public roadway.

5.2 Safety and instructional signs

5.2.1 Safety signs conforming to the requirements of ISO 11684 shall be appropriately displayed according to the manufacturers risk assessment.

5.2.2 Safety signs may be affixed to the equipment or displayed as electronic images, either momentarily or for the entire period of operation.

5.2.3 Instructional signs relating to equipment operation, servicing and care shall have an appearance, different from safety signs affixed to the equipment or displayed as electronic images.

5.3 Installation instructions for retrofitted systems

5.3.1 Installation instructions shall be provided for systems designed to be retrofitted to equipment after such equipment has left the control of the manufacturer.

5.3.2 Installation instructions shall contain requirements for ensuring that the system, when installed, complies with [Clause 4](#).