
Agricultural tractors — Requirements for steering

Tracteurs agricoles — Exigences relatives à la conduite

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10998:2008](https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008)

<https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008>



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

ISO 10998:2008

<https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2008

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	1
3.1 General terms	1
3.2 Steering parameters	3
3.3 Types of steering equipment.....	4
3.4 Types of steering transmission.....	5
4 General provisions for testing.....	6
5 Requirements, test procedures and acceptance criteria.....	6
5.1 Predictable response of the tractor	6
5.2 Steering response behaviour	7
5.3 Actuating forces/reaction forces.....	7
5.4 Simulation of failures (increased steering forces)	8
5.5 Energy supply/reserve and warnings	10
5.6 Adjustment devices/care/maintenance	11
5.7 Strength/durability of components.....	11
5.8 Steering systems containing complex electronic control systems	12
Annex A (normative) Special requirements to be applied to the safety aspects of complex electronic tractor control systems.....	13
Bibliography	18

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 10998 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 4, *Tractors*.

This second edition cancels and replaces the first edition (ISO 10998:1995), which has been technically revised.

iTeh STANDARD PREVIEW
(standards.iteh.ai)
ISO 10998:2008
<https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008>

Agricultural tractors — Requirements for steering

1 Scope

This International Standard specifies performance and safety requirements for both normal and emergency steering modes of agricultural tractors. It is applicable to those tractors having a maximum design speed, measured in accordance with ISO 3965, not exceeding (60 ± 3) km/h.

It is not applicable to track-laying tractors equipped with steel tracks having a maximum design speed, measured in accordance with ISO 3965, not exceeding (15 ± 3) km/h.

2 Normative references

The following referenced documents are indispensable for the application 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 789-11:1996, *Agricultural tractors — Test procedures — Part 11: Steering capability of wheeled tractors*

ISO 3965:1990, *Agricultural wheeled tractors — Maximum speeds — Method of determination*

ISO 7000:2004, *Graphical symbols for use on equipment — Index and synopsis*

ISO 14982:1998, *Agricultural and forestry machinery — Electromagnetic compatibility — Test methods and acceptance criteria*

ISO 19879:2005, *Metallic tube connections for fluid power and general use — Test methods for hydraulic fluid power connections*

3 Terms and definitions

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

3.1 General terms

3.1.1

agricultural tractor

power-driven vehicle, either wheeled and having at least two-axes or tracklaying, whose function depends essentially on its tractive power, and which is specially designed to pull, push, carry or actuate certain implements, machines or trailers intended for use in agriculture or forestry

NOTE Such a tractor can be arranged to carry a load and/or attendants as specified in ISO 23205.

3.1.2

steering equipment

all components whose purpose is to determine the direction of movement of the tractor, comprising **steering control** (3.1.3), **steering transmission** (3.1.4), **steered wheels** (3.1.7) or tracks, and **energy supply** (3.1.8) if any

3.1.3

steering control

part of the steering equipment which controls steering operation

NOTE It may be operated with or without the direct intervention of the driver. For steering equipment in which the steering forces are provided solely or partly by the muscular effort of the driver, the steering control includes all parts from the driver interface up to the point where the steering effort is transformed by mechanical, hydraulic or electrical means.

3.1.4

steering transmission transmission

all parts of the steering equipment providing the means of transmitting the steering forces between the steering control and the steered wheels or tracks

NOTE 1 It includes all parts from the point where the steering control effort is transformed by mechanical, hydraulic or electrical means.

NOTE 2 The steering transmission is divided into two independent functions: The **control transmission** (3.1.4.1) and the **energy transmission** (3.1.4.2). Where the term "steering transmission" or "transmission" is used alone in this International Standard, it encompasses both control transmission and energy transmission. A distinction is drawn between mechanical, electrical and hydraulic transmission systems or combinations thereof, according to the means by which the signals and/or energy is transmitted.

3.1.4.1

control transmission

all components by means of which signals are transmitted for control of the steering equipment

3.1.4.2

energy transmission

all components by means of which the energy required for control/regulation of the steering function of the wheels is transmitted

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10998:2008](https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008)

<https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008>

3.1.5

autonomous steering system

system that incorporates a function within a complex electronic control system that causes the tractor to follow a defined path or to alter its path in response to signals initiated and transmitted from off-board the tractor

NOTE The driver will not necessarily be in primary control of the tractor.

3.1.6

advanced driver assistance steering system

system, additional to the main steering system, that provides assistance to the driver in steering the tractor, but where the driver remains at all times in primary control of the tractor

NOTE The advanced driver assistance steering system comprises the **automatically commanded steering function** (3.1.6.1) and/or **corrective steering function** (3.1.6.2).

3.1.6.1

automatically commanded steering function

function within a complex electronic control system where actuation of the steering system can result from automatic evaluation of signals initiated on-board the tractor, possibly in conjunction with passive infrastructure features, to generate continuous control action in order to assist the driver in following a particular path, in low speed manoeuvring or parking operations

3.1.6.2

corrective steering function

discontinuous control function within a complex electronic control system whereby, for a limited duration, changes to the steering angle of one or more wheels or tracks can result from the automatic evaluation of signals initiated on-board the tractor, in order to maintain the basic desired path of the tractor or to influence the tractor's dynamic behaviour

NOTE Systems that do not themselves positively actuate the steering system but that — possibly in conjunction with passive infrastructure features — simply warn the driver of a deviation from the ideal path of the tractor or of an unseen hazard by means of a tactile warning transmitted through the steering control, are also considered to be corrective steering.

3.1.7

steered wheels

wheels, the alignment of which may be altered directly or indirectly in relation to the longitudinal axis of the tractor in order to determine the direction of movement of the tractor

NOTE 1 The steered wheels include the axis around which they are rotated in order to determine the direction of movement of the tractor. Endless tracks of tracklaying tractors and all wheels of skid steered tractors are considered to be steered wheels for the purposes of this International Standard.

NOTE 2 In the case of tractors with **articulated steering equipment** (3.3.6.2), all wheels of the tractor are considered to be steered wheels for the purposes of this International Standard.

3.1.8

energy supply

parts of the steering equipment which provide energy, control energy, and where appropriate, process and store energy

NOTE The energy supply also includes any storage reservoirs for the operating medium and the return lines, but does not include the tractor engine (except for the purposes of 5.4.1.3), nor the drive between it and the energy source

3.1.8.1

energy source

part of the energy supply which provides the energy in the required form

EXAMPLE Hydraulic pump, air compressor, manual exertion.

3.1.8.2

energy reservoir

part of the energy supply in which the energy provided by the energy source is stored

EXAMPLE Pressurized fluid reservoir, tractor battery.

3.1.8.3

storage reservoir

part of the energy supply in which the operating medium is stored

EXAMPLE Fluid reservoir at or near atmospheric pressure.

3.1.9

maximum mass

maximum allowable tractor mass as stated by the manufacturer

3.1.10

continuous

without step changes in response to changing input

3.2 Steering parameters

3.2.1

steering control effort

force applied to the steering control in order to steer the tractor

3.2.2

steering time

period of time from the beginning of the movement of the steering control to the moment at which the steered wheels have reached a specific steering angle

3.2.3

steering angle

angle between the projection of a longitudinal axis of the tractor and the line of intersection of the wheel plane (being the central plane of the tyre, normal to the spin axis of the wheel) and the road surface

NOTE 1 It is not applicable to tracklaying and skid steered (wheeled) tractors.

NOTE 2 For tractors with articulated steering equipment, it is the total displacement angle between the front wheels and the rear wheels as they move about one or more vertical steering axes from their normal straight-ahead condition to a turned condition.

3.2.4

steering forces

all forces operating in the steering transmission

3.2.5

mean steering ratio

(tractors on which the steering control is a steering wheel) ratio of the angular displacement of the steering control of wheeled tractors to the mean of the swept steering angle of the steered wheels for a full lock-to-lock turn

3.2.6

turning circle

circle within which are located the projections onto the ground plane of all the points of the tractor, excluding devices which can be folded (e.g. mirrors), when the tractor is driven in a circle

3.2.7

nominal radius of steering wheel

length which, in the case of a steering wheel, is the shortest dimension from its centre of rotation to the outer edge of the rim

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO 10998:2008](https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008)

3.2.8

reaction forces

forces emerging at the wheels and transmitted directly or indirectly to the steering control

<https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032c1f724d8e/iso-10998-2008>

NOTE The reaction forces are in balance with the forces applied to the steering control in order to maintain the achieved and intended direction of movement of the tractor.

3.3 Types of steering equipment

3.3.1

main steering system

steering equipment of a tractor which is mainly responsible for determining the direction of travel

NOTE It can consist of either **manual steering equipment** (3.3.1.1), **power-assisted steering equipment** (3.3.1.2) or **full-power steering equipment** (3.3.1.3).

3.3.1.1

manual steering equipment

steering equipment in which the steering forces result solely from the muscular effort of the driver

3.3.1.2

power-assisted steering equipment

steering equipment in which the steering forces result from both the muscular effort of the driver and the energy supply (supplies)

NOTE Steering equipment in which steering forces result solely from one or more energy supplies when the equipment is intact, but in which steering forces can be provided by the muscular effort of the driver alone if there is a fault in the steering (integrated power system), is also considered to be power-assisted steering equipment.

3.3.1.3**full-power steering equipment**

steering equipment in which the steering forces are provided solely by one or more energy supplies and not by the muscular effort of the driver

3.3.2**self-tracking equipment**

(tractors having more than two axles) steering system designed to create a change of steering angle on one or more wheels only when acted upon by forces and/or moments applied through the tyre to road contact

3.3.3**auxiliary steering equipment**

steering equipment in which the rear wheels are steered in addition to the front wheels

NOTE The rear wheels can be steered in the same direction or in the opposite direction to the front wheels, and/or the steering angle of the front wheels and/or the rear wheels can be adjusted relative to the tractor's behaviour.

3.3.4**front-wheel steering equipment**

steering equipment in which only the wheels of the front axle(s) are steered

3.3.5**rear-wheel steering equipment**

steering equipment in which only the wheels of the rear axle(s) are steered

3.3.6**multi-wheel steering equipment**

steering equipment in which the wheels of one or more of each of the front and the rear axle(s) are steered

3.3.6.1**all-wheel steering equipment**

steering equipment in which all the wheels are steered

3.3.6.2**articulated steering equipment**

steering equipment in which the movement of chassis parts relative to each other is directly produced by the steering forces

3.3.6.3**compound steering equipment**

steering equipment that is a combination of front-axle steering and articulated steering

3.3.6.4**skid steering equipment**

steering equipment where the change of direction of the tractor is achieved by different rotational speeds of the wheels or endless tracks left and right of the longitudinal plane of the tractor

3.4 Types of steering transmission**3.4.1****purely mechanical steering transmission**

steering transmission in which the steering forces are transmitted entirely by mechanical means

3.4.2**purely hydraulic steering transmission**

steering mechanism in which the steering forces, somewhere in the transmission, are transmitted only by hydraulic means

3.4.3

purely electric steering transmission

steering transmission in which the steering forces, somewhere in the transmission, are transmitted only by electric means

3.4.4

hybrid steering transmission

steering transmission in which the steering forces are in part transmitted through one, and in part through another, of the means defined in 3.4.1, 3.4.2 and 3.4.3

4 General provisions for testing

4.1 The test shall be conducted on a level surface affording good adhesion (e. g. $\mu \geq 0,8$).

4.2 During the test(s), the tractor shall be loaded to its maximum mass and its maximum load on the steered axle(s).

In the case of axles fitted with auxiliary steering equipment, this test shall be repeated with the tractor loaded to its technically permissible maximum mass and the axle equipped with auxiliary steering equipment loaded to its maximum permissible mass.

4.3 Before the test begins, the tyre pressures shall be as prescribed by the manufacturer for the mass specified in paragraph 4.2 when the tractor is stationary.

4.4 In the case of any systems that uses electrical energy for part or all of the energy supply, all performance tests shall be carried out under conditions of actual or simulated electrical load of all essential systems or systems components that share the same energy supply. *Essential systems* shall comprise at least the lighting systems, windscreen wipers, engine management and braking systems.

<https://standards.iteh.ai/catalog/standards/sist/de2bd7ea-e30a-4fa6-83e3-032a1f724d8e/iso-10998-2008>

5 Requirements, test procedures and acceptance criteria

5.1 Predictable response of the tractor

5.1.1 Requirements

It shall be possible to travel along a straight section of road without abnormal steering correction by the driver and without abnormal vibration in the steering system at the maximum design speed of the tractor.

The direction of operation of the steering control shall correspond to the intended change of direction of the tractor and there shall be a continuous relationship between the steering control deflection and the steering angle.

NOTE These requirements do not apply to advanced driver assistance steering systems that incorporate an automatically commanded or corrective steering function, nor to auxiliary steering equipment.

5.1.2 Test procedure

Drive in a curve with a radius of 50 m and exit a tangent at a speed of 40 km/h or the maximum design speed if this is below 40 km/h.

5.1.3 Acceptance criteria

It shall be possible to leave the curve according to 5.1.2 without exciting an undamped resonance in the steering equipment.

5.2 Steering response behaviour

5.2.1 Requirements

The steering system shall ensure easy and safe handling of the tractor up to its maximum design speed.

For tractors having a maximum design speed greater than 40 km/h, there shall be a tendency to self-centre when tested in accordance with 5.2.2 with the intact steering equipment.

5.2.2 Test procedure

Drive the tractor in a circle at constant speed of at least 10 km/h with the steering control adjusted to a position approximately half way between straight ahead and full turn wheel lock, release the steering control and observe the behaviour of the tractor.

5.2.3 Acceptance criteria

When testing according to 5.2.2, the turning circle shall remain constant or become larger. If the turning circle becomes smaller, the steering system is unsuitable for speeds greater than 40 km/h.

5.3 Actuating forces/reaction forces

5.3.1 Requirements

The reaction forces shall reach a value suitable to give the driver a satisfactory feedback in order to perceive the respective conditions having impact on the driving mode of the tractor, thus making the behaviour of the tractor predictable for the driver.

The maximum permitted steering time and the maximum permitted steering control effort with intact steering equipment shall not exceed the values given in Table 1.

Table 1 — Permitted steering control effort with intact steering equipment

Maximum design speed km/h	Maximum steering control effort daN	Maximum steering time s
≤ 40	25	5
> 40	25	4