INTERNATIONAL STANDARD

**ISO 16231-1**

First edition
2013-05-01

# Self-propelled agricultural machinery — Assessment of stability —

## Part 1: Principles

*Machines agricoles automotrices — Évaluation de la stabilité —*

*Partie 1: Principes*



Reference number
ISO 16231-1:2013(E)



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Published in Switzerland

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# Foreword

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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 documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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The committee responsible for this document is ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 3, *Safety and comfort*.



ISO 16231 consists of the following parts, under the general title *Self-propelled agricultural machinery — Assessment of stability*:



— *Part 1: Principles*

The following part is under preparation:

— *Part 2: Calculations and test procedures*

 

# Introduction

Self-propelled agricultural machinery with a ride-on operator (driver) can expose the operator to the hazard of rolling or tipping over during the intended operation. A risk assessment should determine whether this hazard applies to a particular machine and, when appropriate, the protective measures to be used in order to avoid or minimize this hazard for the ride-on operator. For many machines, this risk assessment will be reflected in the requirements of a machine-specific standard.

The risk assessment should consider the operating conditions in which the machine is intended to be used, the physical properties of the machine and the required skills to operate the machine as well as any other parameter which can have an impact on the risk for rollover or tip-over.

# Self-propelled agricultural machinery — Assessment of stability —

# Part 1: Principles

## 1 Scope

This part of ISO 16231 specifies principles for the assessment of stability with respect to the design and construction of self-propelled ride-on machines used in agriculture and the hazard of rolling over or tipping over, or both, when the machine is used as intended and under the conditions foreseeable by the manufacturer. In addition, it specifies the type of information on safe working practices (including residual risks) to be provided by the manufacturer.

This part of ISO 16231 is not applicable to:

— machines with an unladen mass lower than 400 kg;

— machines covered by other machine specific standards dealing with the protection against rollover and tip-over (e.g. agricultural tractors, forestry tractors);

— hazards associated with road transport operations;

— free fall events;

— rollover as a result of impact collisions.



This part of ISO 16231 is not applicable to machines manufactured before the date of its publication.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3776-1:2006, *Tractors and machinery for agriculture — Seat belts — Part 1: Anchorage location requirements*

ISO 3776-2:2013, *Tractors and machinery for agriculture — Seat belts — Part 2: Anchorage strength requirements*

ISO 3776-3:2009, *Tractors and machinery for agriculture — Seat belts — Part 3: Requirements for assemblies*

ISO 4254-1:2013, *Agricultural machinery — Safety — Part 1: General requirements*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions of ISO 4254-1:2013 and the following apply.

**3.1**
**automatic protective system**
**APS**
any automatic system, controlling functions of the machine or engaging devices, without intervention from the operator, to minimize the likelihood of overturning or tip-over

Note 1 to entry: For example, this means systems which bring the machine to a safe mode, when the allowed slope or stability limits would be exceeded, by reducing for instance speed or height or changing the inclination of the machine. It includes any automatic deployable structures.

**3.2**
**roll-over protective structure**
**ROPS**
framework that minimizes the likelihood of driver injury resulting from accidental overturning

Note 1 to entry: The ROPS is characterized by the provision of space for a deflection limiting volume, either inside the envelope of the structure or within a space bounded by a series of straight lines from the outer edges of the structure to any part of the machine that might come into contact with flat ground and that is capable of supporting the machine in that position if the machine overturns.

**3.3**
**self-protective structure**
**SPS**
structural components of the machine, with sufficient strength to provide a deflection limiting volume, if the machine overturns



**3.4**
**self-protective devices**
**SPD**
mounted attachment(s) or other device(s) fitted to the base machine which prevent the machine from rollover or tip-over, or both by for example its mass, shape, position



**3.5**
**slope**
grade
inclination of the land surface from the horizontal; percentage (%) slope = tan (degrees slope) · 100; degree slope = $\tan^{-1}$ ((%) slope / 100)

**3.6**
**static overturning angle**
**SOA**
<for each direction> angle of tilt on which the vertical projection of the centre of gravity (COG) falls beyond the area of stability

**3.7**
**required static stability angle**
**RSSA**
<for each machine/application, and for each direction> required calculated slope on which the machine is stable

**3.8**
**rollover**
loss of machine stability characterized by a clockwise or counter clockwise rotation of more than 90 degrees around either both the longitudinal of lateral axis of the machine

**3.9**
**tip-over**
loss of machine stability characterized by a clockwise or counter clockwise rotation of no more than 90 degrees around either both the longitudinal of lateral axis of the machine

**3.10**
**safety factor**
**SF**
factor intended to take into account the dynamic effects on the stability and the punctual variations of the ground conditions (e.g. holes or bumps)

# 4 Principles

## 4.1 Risk assessment

A risk assessment shall be carried out to determine whether there is a significant risk of rollover or tip-over. The risk assessment shall consider the following aspects:

— intended use of the machine (see Clause 6), e.g.

  — operations to be carried out;

  — typical operating and ground conditions (e.g. slope);

— physical properties of the machine (e.g. masses, dimensions) under operating conditions;

— machine limits;

— operator (e.g. education, training, experience, ability).



## 4.2 Protective measures

If the risk assessment shows that there is a need to reduce the risk of rollover or tip-over, or both, for the type of machine under consideration, the machine shall be



a) designed so that its Static Overturning Angle (SOA) is equal or greater than the Required Static Stability Angle (RSSA) which shall include a suitable safety factor; or

b) equipped with Self-Protective Device (SPD); or

c) equipped with an Automatic Protective System (APS); or

d) provided with means to afford an appropriate deflection limiting volume in case of rollover and/or tip-over, or both. Examples for such means are

  1) Self-Protective Structure, or

  2) additional structure such as a Roll-Over Protective Structure.

If the protective measure applied relies on the provision of a deflection limiting volume, the machine shall be equipped with an operator restraint system, e.g. seat belt and seat-belt anchorages in accordance with ISO 3776 (Parts 1 to 3).

## 4.3 Information for use

Appropriate information for use and operation of the machine shall be provided in the operator's manual (see Clause 6).

# 5 Verification of safety requirements and/or protective measures

The specified procedures given in Table 1 shall be applied for the relevant directions (e.g. forward, rearward, to the sides).