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Tractors for agriculture and forestry — Roll-over protective structures (ROPS) — Static test method and acceptance conditions

Tracteurs agricoles et forestiers — Structures de protection contre le retournement (ROPS) — Méthode d'essai statique et conditions d'acceptation

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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

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Contents

Page

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 5700 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 2, *Common tests*.

This fourth edition cancels and replaces the third edition (ISO 5700:1989), which has been technically revised. It also incorporates the Amendment ISO 5700:1989/Amd.1:1998.

Introduction

Testing of roll-over protective structures (ROPS) for wheeled tractors for agriculture and forestry aims at minimizing the likelihood of driver injury resulting from accidental overturning during normal operation (e.g. field work) of the tractor. The strength of the ROPS is tested by applying static loads and a static crushing test to simulate actual loads which can be imposed on the cab or frame when the tractor overturns either to the rear or to the side without free fall. The tests allow observations to be made on the strength of the structure and the attachment brackets to the tractor and also of the tractor parts that could be affected by the load imposed on the structure.

Provision is made to cover both tractors with the conventional forward facing driver's position only, as well as those with a reversible driver's position, which is in agreement with the relevant OECD test code practice. For tractors with a reversible driver's position, a clearance zone is defined to be the combined clearance zones for the two driving positions. The point of application of the side loading is determined as the mid-point between the seat index points measured in the two positions.

It is recognized that there may be designs of tractors — for example, lawn-mowers, narrow vineyard tractors, low profile tractors used in low buildings with limited overhead clearance, orchards, etc., stilt tractors and certain forestry machines such as forwarders — for which this International Standard is not appropriate.

NOTE For narrow-track wheeled tractors, see ISO 12003-1[5] and ISO 12003-2[6].

Tractors for agriculture and forestry — Roll-over protective structures (ROPS) — Static test method and acceptance conditions

1 Scope

This International Standard specifies a static test method and the acceptance conditions for roll-over protective structures (cab or frame) of wheeled tractors for agriculture and forestry.

It is applicable to tractors having at least two axles for wheels mounted with pneumatic tyres, or having tracks instead of wheels, with an unballasted tractor mass of not less than 800 kg and a minimum track width of the rear wheels greater than 1 150 mm.

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 630, *Structural steels — Plates, wide flats, bars, sections and profiles*

ISO 5353:1995, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*

ASTM A370, *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

3 Terms and definitions

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

3.1
roll-over protective structure
ROPS
framework protecting drivers of agricultural and forestry tractors that minimizes the likelihood of driver injury resulting from accidental overturning during normal operation

NOTE The ROPS is characterized by the provision of space for a clearance zone, 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 tractor that might come into contact with flat ground and that is capable of supporting the tractor in that position if the tractor overturns.

3.2
tractor mass
mass of the unladen tractor in working order with tanks and radiators full, roll-over protective structure with cladding, and any track equipment or additional front-wheel drive components required for normal use

NOTE Not included are the operator, optional ballast weights, additional wheel equipment, special equipment and loads.

3.3
reference mass
m_t
mass, not less than the tractor mass, selected by the manufacturer for calculation of the energy inputs to be used in the tests

3.4
horizontal loading test
application of a horizontal load to the rear, front and side of the roll-over protective structure

3.5
crushing test
application of a vertical load through a beam placed laterally across the uppermost members of the roll-over protective structure

3.6
longitudinal median plane
longitudinal plane of symmetry
zero Y plane
vertical plane Y passing through the mid-points of AB, perpendicular to AB, A and B being such that

— for each wheel, the vertical plane passing through its axis cuts the mid-plane of the wheel following a straight line Δ which meets the supporting surface of the vehicle at one point, and

— A and B are two points thus defined which correspond to two wheels, both of which are either steering or powered wheels, situated respectively at the two ends of the same real or imaginary axle

See Figure 1.

NOTE 1 The mid-plane of the dual wheels being equidistant from the inner edge of one wheel and the outer edge of the other, the straight line Δ is, in this particular case, the intersection of the mid-plane of the dual wheels and the vertical plane passing through the axis of the axle pin.

NOTE 2 Adapted from ISO 612:1978[1], Clause 5.

3.7
reference plane
vertical plane generally longitudinal to the tractor and passing through the seat index point and the steering-wheel centre.

NOTE Normally, this plane coincides with the longitudinal median plane of the tractor.

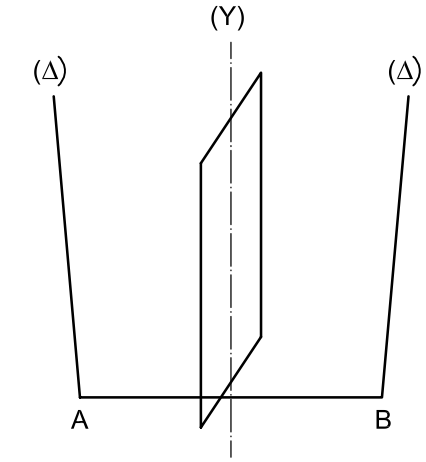


Figure 1 — Longitudinal median plane

4 Symbols and abbreviated terms

For the purposes of this document, the symbols given in Table 1 are used.

Table 1 — Symbols

Symbol	Description	Unit
a_h	Half of the horizontal seat adjustment	mm
a_v	Half of the vertical seat adjustment	mm
D	Deflection of the ROPS for the calculated basic energy required at the point of, and in line with, the load application	mm
E_{il1}	Energy input to be absorbed during first longitudinal loading	J
E_{il2}	Energy input to be absorbed during second longitudinal loading	J
E_{is}	Energy input to be absorbed during side loading	J
F	Static load force for the basic energy required	N
F_{max}	Maximum static load force occurring during loading (excluding overload)	N
F_f	Applied force at front in the crushing test	N
F_r	Applied force at rear in the crushing test	N
m_t	Reference mass	kg
W	Width of the ROPS	mm

5 Apparatus

5.1 Horizontal loading tests

5.1.1 Material, equipment and attachment means to ensure that the tractor chassis is firmly fixed to the ground (and supported) independently of the tyres.

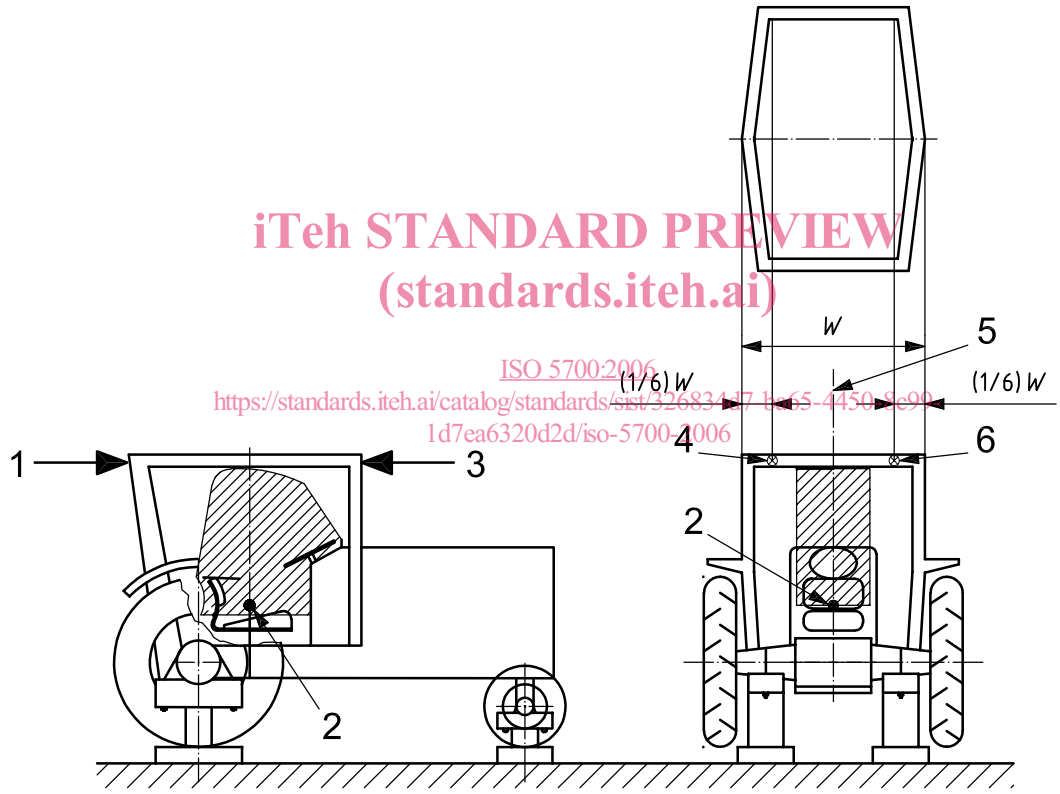
5.1.2 Means to apply a horizontal force to the roll-over protective structure, such as are shown in Figures 2 and 3, complying with the requirements of 5.1.2.1 to 5.1.2.4.

5.1.2.1 It shall be ensured that the load can be uniformly distributed normal to the direction of loading and along a beam of length between 250 mm and 700 mm, in an exact multiple of 50 mm.

5.1.2.2 The edges of the beam in contact with the roll-over protective structure shall be curved with a maximum radius of 50 mm.

5.1.2.3 Universal joints, or the equivalent, shall be incorporated to ensure that the loading device does not constrain the structure in rotation or translation in any direction other than the loading direction.

5.1.2.4 Where the roll-over protective structure's length, covered by the appropriate load-applying beam, does not constitute a straight line normal to the load application direction, the space shall be packed so as to distribute the load over this length.

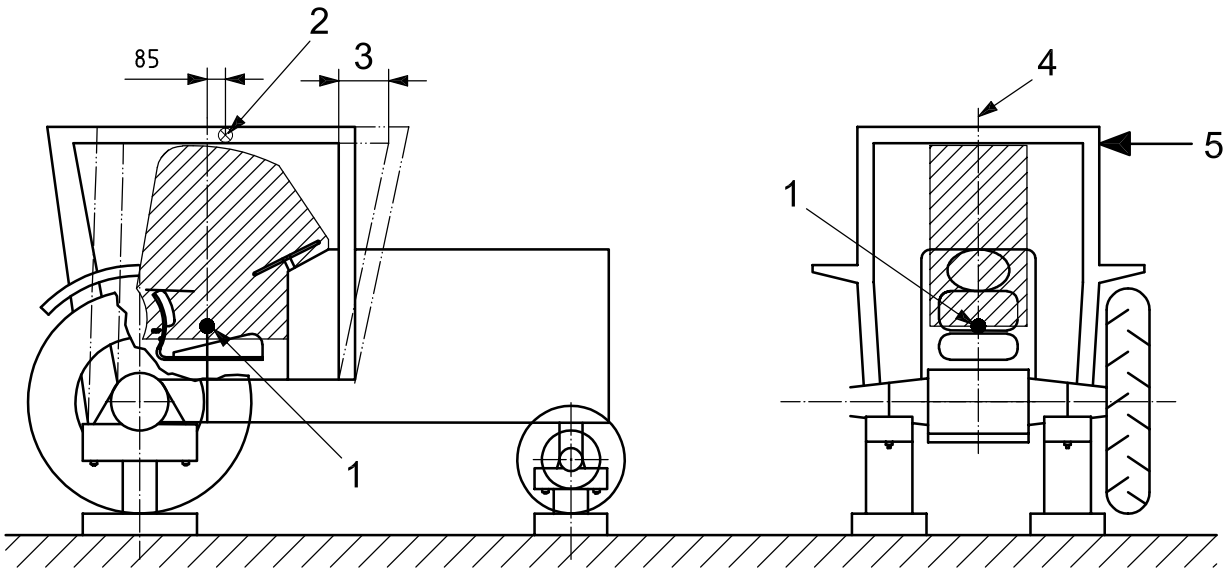


Key

1 rear load
2 seat index point (SIP)
3 front load
4 point of second longitudinal load application, front or rear
5 SIP, longitudinal centre-plane
6 point of longitudinal load application, rear or front

Figure 2 — Front and rear load application

Dimensions in millimetres



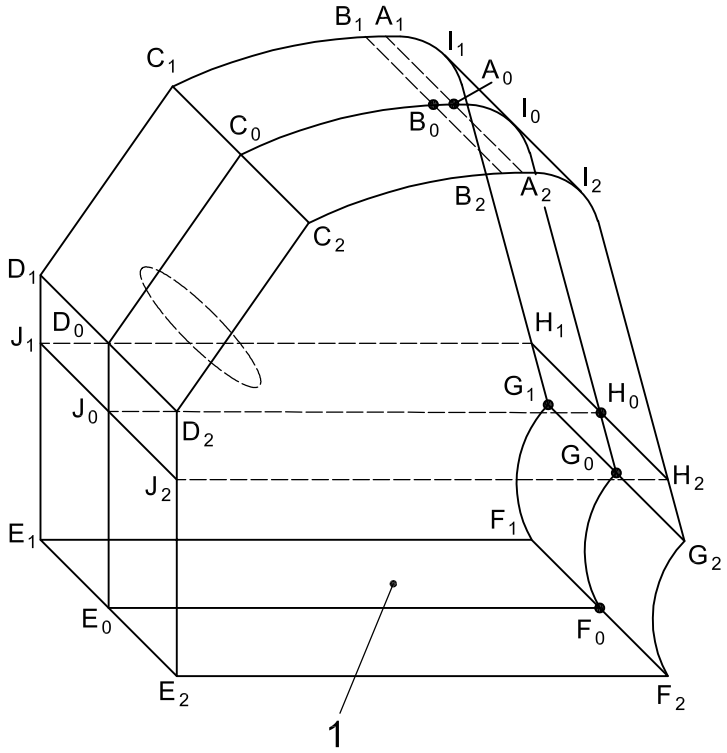
Key

1 seat index point (SIP)
2 point of side load application (see 7.2.3)
3 deflection due to rear longitudinal loading
4 SIP, longitudinal centre-plane
5 load

Figure 3 — Side load application

5.1.3 Equipment for measuring force and deflection along the direction of application of the force and relative to the tractor chassis. To ensure accuracy, measurements shall be taken as continuous recordings. The measuring devices shall be located so as to record the force and deflection at the point of, and along the line of, loading.

5.1.4 Means to prove that the clearance zone has not been entered during the test. A measuring rig based on the clearance zone as shown in Figure 4 may be used.



Key

1 seat index point (SIP)

Dimensions	mm	Remarks
A_1A_0, B_1B_0	100	Minimum
A_1A_2, B_1B_2, C_1C_2	500	
D_1D_2, E_1E_2	500	Minimum or equal to the steering-wheel radius plus 40 mm, whichever is greater
F_1F_2, G_1G_2, H_1H_2, I_1I_2, J_1J_2	500	
E_1E_0, E_2E_0	250	Minimum or equal to the steering-wheel radius plus 40 mm, whichever is greater
J_0E_0	300	
F_0G_0	---	Depending on the tractor
I_0G_0	---	
C_0D_0	---	
E_0F_0	---	

NOTE For other dimensions, see Figure 6 a) and b).

Figure 4 — Clearance zone measuring rig