
**Tractors for agriculture and
forestry — Falling object protective
structures — Test procedures and
performance requirements**

*Tracteurs agricoles et forestiers — Structures de protection contre les
chutes d'objets — Modes opératoires d'essai et exigences de performance*

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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 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

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

The committee responsible for this document is ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 2, *Common tests*.

This first edition of ISO 27850 has been developed to establish technical harmonization with OECD Code 10:July 2012.

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Introduction

The falling-object protective structure (FOPS) testing procedure considered in this International Standard refers to the tractor used in its traditional agricultural tasks. However, it is reasonable to consider that a specific use of the tractor, such as dedicated forestry applications, for which the tractor has to be properly equipped, would need FOPS testing at higher levels of energy, for which other test methods are appropriate.

This International Standard specifies technical performance requirements, associated test procedures, and performance test report information. Technical harmonization with OECD Code 10 is ensured by the Maintenance Agency operating as specified in [Annex C](#).

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Tractors for agriculture and forestry — Falling object protective structures — Test procedures and performance requirements

1 Scope

This International Standard sets forth the test procedures and performance requirements for a falling-object protective structure, in the event such a structure is installed on an agricultural or forestry tractor.

This International Standard is applicable to agricultural and forestry tractors having at least two axles for pneumatic tyred wheels or having tracks instead of wheels.

This International Standard does not apply to forestry machinery as defined in ISO 6814.

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 3164:1995, *Earth-moving machinery — Laboratory evaluations of protective structures — Specifications for deflection-limiting volume*

ISO 3463:2006, *Tractors for agriculture and forestry — Roll-over protective structures (ROPS) — Dynamic test method and acceptance conditions*

ISO 3471:2008, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements*

ISO 5700:2013, *Tractors for agriculture and forestry — Roll-over protective structures (ROPS) — Static test method and acceptance conditions*

ISO 12003-1:2008, *Agricultural and forestry tractors — Roll-over protective structures on narrow-track wheeled tractors — Part 1: Front-mounted ROPS*

ISO 12003-2:2008, *Agricultural and forestry tractors — Roll-over protective structures on narrow-track wheeled tractors — Part 2: Rear-mounted ROPS*

ASTM A370:1979, *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

agricultural tractor

self-propelled agricultural vehicle having at least two axles, or a track-laying agricultural vehicle, and having a maximum design speed of not less than 6 km/h, particularly designed to pull, push, carry, and operate implements used for agricultural work (including forestry work), which may be provided with a detachable loading platform

Note 1 to entry: It may be equipped with one or more seats.

3.2
falling-object protective structure
FOPS

assembly providing reasonable overhead protection to an operator in driving position from falling objects

3.3
roll-over protective structure
ROPS

framework (safety cab or frame) protecting operators of agricultural and forestry tractors that avoids or limits risk to the operator resulting from accidental overturning during normal operation

Note 1 to entry: 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.

3.4
safety zone

zone of protection provided for the tractor operator

Note 1 to entry: The safety zone is determined by the ROPS International Standard that has been chosen. For tractors equipped with ROPS tested in accordance with ISO 3463, ISO 5700, ISO 12003-1, or ISO 12003-2, the safety zone is the clearance zone specified in each of these International Standards. For tractors equipped with ROPS tested in accordance with ISO 3471, the safety zone is the deflection limiting volume (DLV) according to ISO 3164.

4 Permissible measurement tolerances

- a) Distance $\pm 5\%$ of maximum deflection or ± 1 mm
- b) Mass $\pm 0,5\%$

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5 Procedure

5.1 Preparation of tractor and FOPS for testing

5.1.1 Whether the FOPS is manufactured by the tractor manufacturer or by an independent party, the test shall only be valid for the model of tractor on which the test is carried out. The FOPS shall be retested for each model of tractor to which it is to be fitted. However, the testing station may certify that the strength tests are also valid for tractor models derived from the original model by modifications to the engine, transmission, and steering and front suspension (see [Clause 9](#)). On the other hand, more than one FOPS may be tested for any one model of tractor.

5.1.2 The protective structure submitted for test shall include at least all components which transfer loading from the impact location of the drop test object to the safety zone. The protective structure submitted for test shall be either (i) rigidly attached to the test bench at its normal mounting locations (see [Figure 1](#)), or (ii) attached to the tractor chassis in the normal manner, by means of any brackets, mountings, or suspension components used in normal production and other parts of the tractor that may be affected by loads imposed by the protective structure [see [Figures 2a](#)] and [2b](#)]. The vehicle chassis shall be mounted rigidly to the test bay floor.

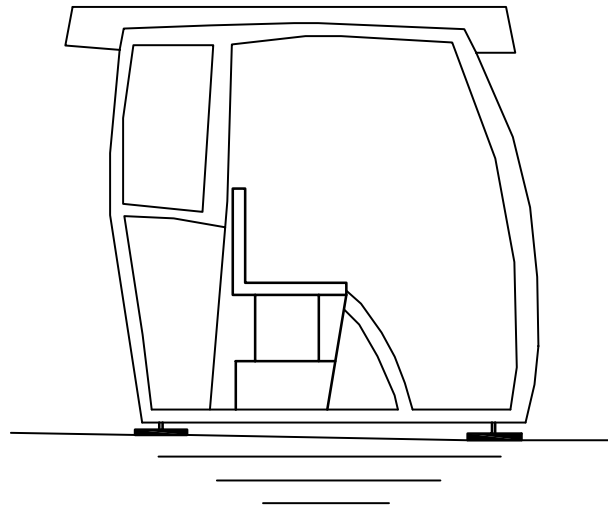
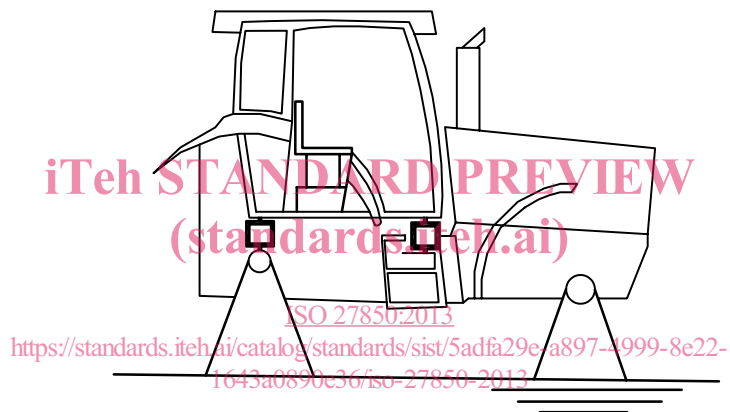
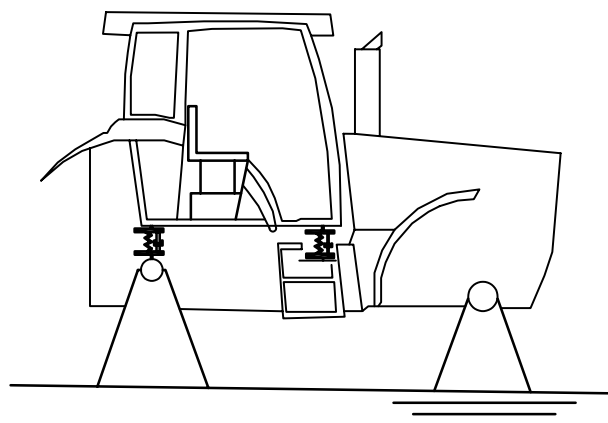


Figure 1 — Minimum test configuration



a) By mountings/attachments



b) By suspension components

Figure 2 — FOPS test configurations when attached to the vehicle chassis

5.1.3 A FOPS might be designed solely to protect the operator in the event of an object falling onto the tractor, but weather protection for the operator, of a more or less temporary nature, might also be fitted

on the structure. The operator will usually remove this in warm weather. In addition, there are FOPS whose cladding is permanent and for which warm-weather ventilation is provided by windows or flaps.

5.1.3.1 Since the cladding can add strength to the FOPS and removable cladding could be absent when an incident occurs, all parts that are intended to be removable by the operator shall be removed for the purpose of the test. Doors, roof hatch, and windows that can be opened shall either be removed or fixed in the open position for the test, so that they do not add to the strength of the FOPS. It shall be noted whether, in this position, they would create a hazard for the operator in the event of an object falling. In the case of FOPS with a roof hatch that can be opened and is a member of the protective structure, the test shall be carried out in both the open and closed position.

5.1.3.2 Throughout this International Standard, reference is made to the testing of the FOPS. This shall be understood to include cladding which cannot be removed during normal operation of the tractor. A description of any temporary cladding supplied shall be included in the specifications.

5.1.3.3 All glass or similar brittle material shall be removed prior to testing. Tractor and ROPS components which might sustain needless damage during the test and which do not affect the strength of the FOPS or its dimensions may be removed prior to testing if the manufacturer so wishes.

5.1.3.4 No repairs or adjustments shall be carried out during the test. Several identical samples can be provided by the manufacturer if several drop tests are required.

5.1.4 Should the same structure be used for FOPS and ROPS evaluations, the FOPS test shall precede the ROPS test (according to ISO 3463, ISO 5700, ISO 12003-1, ISO 12003-2, or ISO 3471). The removal of impact dents or replacement of the FOPS cover is permitted.

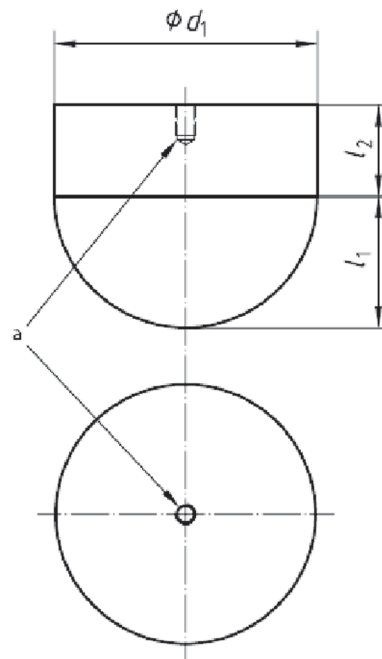
5.2 Apparatus and procedure

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5.2.1 Apparatus

5.2.1.1 The drop object shall be a solid steel or ductile iron sphere as shown in [Figure 3](#), the impact surface of which shall have properties against deformation during testing. The drop object shall have a typical mass of 45 kg and a spherical contact surface diameter of between 200 mm and 250 mm.

**Key**

- d_1 200 mm to 250 mm
 l_1 approximately 102 mm
 l_2 approximately 109 mm

a May be drilled and tapped for lifting eye.

NOTE Actual values of dimensions are given here as examples.
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Figure 3 — Example of test object

5.2.1.2 Means of raising the drop object to the required height.

5.2.1.3 Means of releasing the drop object so that it drops without restraint.

5.2.1.4 Surface of such firmness that it is not penetrated by the machine or test bed under the loading of the drop test.

5.2.1.5 Means of determining whether the FOPS enters the safety zone during the drop test. This may be either of the following:

- a safety zone template, placed upright, made of material which will indicate any penetration by the FOPS, in which case grease or other suitable material may be applied on the lower surface of the FOPS cover to indicate such penetration;
- a dynamic instrumentation system of sufficient frequency response to indicate the expected deflection of the FOPS with respect to the safety zone.

The top area of the safety zone is defined by: the points, I1, A1, B1, C1, C2, B2, A2, I2, of the clearance zone for ISO 3463 and ISO 5700; the plane described in 10.2 d) and e) for ISO 12003-1:2008; the surface defined by points H1, A1, B1, C1, C2, B2, A2, H2 for ISO 12003-2, and the top of the DLV for ISO 3471.

In the event the tractor has a reversible driver's position (reversible seat and steering wheel), the safety zone shall be the combined envelope of the two DLVs defined by the two different positions of the steering wheel and the seat.