INTERNATIONAL STANDARD

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Agricultural and forestry tractors — Narrow-track wheeled tractors —

Part 1: Front-mounted roll-over protective structures

Tracteurs agricoles et forestiers — Tracteurs à roues à voie étroite —
Partie 1: Structures de protection contre le retournement montées à l'avant

Reference number
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 part of ISO 12003 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12003-1 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 3, *Safety and comfort of the operator*.

ISO 12003 consists of the following parts, under the general title *Agriculture and forestry tractors — Narrow-track wheeled tractors:*

— *Part 1: Front-mounted roll-over protective structures*

— *Part 2 : Rear-mounted roll-over protective structures*

Annexes A to E form a normative part of this part of ISO 12003.

Introduction

The testing of protective structures on tractors is aimed at minimizing the frequency and severity of driver injury resulting from tractors' accidental overturning during normal operation.

This part of ISO 12003 enables the strength of a tractor's front-mounted roll-over protective structure (ROPS) to be tested by the application of dynamic and static loads that simulate the actual loads which can be imposed on the cab or frame when the tractor overturns either to the rear or side without free fall. Observations can be made on the strength of the structure, the brackets attaching it to the tractor and those tractor parts that could be affected by the load imposed on the structure.

This part of ISO 12003 largely conforms with existing test codes. It does adopt, however, the seat index point (SIP) instead of the seat reference point (SRP). Moreover, for the definition of the minimum required clearance zone for the driver, the clearance datum point (CDP) is introduced, taking into consideration both the interrelation of the position of the SIP and SRP, as specified in ISO 3462, and the actual horizontal and vertical adjustment of the seat installed on the tractor.

Whether or not the lateral stability and non-continuous rolling test procedures given in annex E are necessary and should be included in future editions will be decided at the next revision of this part of ISO 12003.

Agricultural and forestry tractors — Narrow-track wheeled tractors —

Part 1: Front-mounted roll-over protective structures

1 Scope

This part of ISO 12003 specifies procedures for both the static and dynamic testing of roll-over protective structures (ROPS) front-mounted on narrow-track wheeled agricultural and forestry tractors. It defines the clearance zone and acceptance conditions for rigid or tiltable front, two-post ROPS, including any associated rear fixtures, and is applicable to tractors so equipped having the following characteristics:

— a ground clearance of not more than 600 mm beneath the lowest points of the front- and rear-axle housings (not considering lower points on the axle differential);

— a fixed or adjustable minimum track width of one of the two axles of less than 1 150 mm when fitted with the widest specified tyres and with the overall width of the other axle being less than that of the first axle;

— a mass greater than 600 kg but less than 3 000 kg, unladen, including the ROPS and tyres of the largest size recommended by the manufacturer.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 12003. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 12003 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 148, *Steel — Charpy impact test (V-notch)*

ISO 2408, *Steel wire ropes for general purposes — Characteristics*

ISO 3462, *Tractors and machinery for agriculture and forestry — Seat reference point — Method of determination*

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

ISO 12003-2, *Agricultural and forestry tractors — Narrow-track wheeled tractors — Part 2: Rear-mounted roll-over protective structures*

ASAE[1)] S 313.3:1999, *Soil cone penetrometer*

1) American Society of Agricultural Engineers.

3 Terms, definitions and symbols

For the purposes of this part of ISO 12003, the terms and definitions given in ISO 5353, and the following terms, definitions and symbols apply. The symbols and units given in Table 1 are applicable throughout this part of ISO 12003.

3.1
roll-over protective structure
ROPS
framework protecting drivers of wheeled 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; it is capable of supporting the tractor in the overturned position.

3.1.1
front-mounted ROPS
two-post roll-over protective structure mounted on the tractor in front of the driver and with a reduced clearance zone

cf. rear-mounted ROPS (see ISO 12003-2)

3.2
rear fixture
component such as rear tyre (measured at its smallest specified diameter), mudguard or other rigid tractor components, or all these, or a supplementary fixture of requisite width, height and strength installed behind the driver's seat which completes the front-mounted ROPS's clearance zone for the purposes of strength testing

See Figure 1.

3.3
tractor mass
m
mass of the unladen tractor in working order with tanks and radiator full, front-mounted ROPS and any equipment required for normal use

NOTE The operator, optional ballast weights, additional wheel equipment, and special equipment and loads are not included.

3.4
reference mass
m_t
mass, not less than the tractor mass, selected by the manufacturer for calculation of loading energies and forces to be applied in the tests

3.5
horizontal loading test
application of a horizontal static or dynamic load to the rear, front and sides of the front-mounted ROPS

3.6
crushing test procedure
application of a vertical static load through a beam placed laterally across the uppermost members of the front-mounted ROPS

3.7
reference plane
vertical plane, longitudinal to the tractor, passing through the seat index point (SIP) and the steering-wheel centre

NOTE Normally, for narrow-track tractors, this coincides with the median plane.

3.8
rear-fixture test procedure
test procedure, carried out prior to a dynamic or static strength test of the front-mounted ROPS, which considers the smallest tyres specified by the tractor manufacturer

3.9
clearance datum point
CDP
datum point determined from the SIP, necessary for establishing the clearance zone

See clause 8.

3.10
reference line
line passing through the CDP and the first point on the steering-wheel, which it intersects when brought from vertical towards the horizontal

3.11
wheelbase
horizontal distance between the two vertical planes passing through the rotational centre lines of the wheels, where one plane is for the front wheels and the other for the rear wheels

Table 1 — Symbols

Symbol	Description	Unit
a_h	Half the horizontal seat adjustment	mm
a_v	Half the vertical seat adjustment	mm
B	Minimum overall width of the tractor	mm
B_b	Maximum outer width of the front-mounted ROPS	mm
D	Deflection of the front-mounted ROPS at the point of, and in line with the load application (static test)	mm
D'	Deflection of calculated energy required	mm
E_i	Strain energy absorbed. Area under F-D curve	J
E_{il}	Energy input to be absorbed during longitudinal loading	J
E_{is}	Energy input to be absorbed during side loading	J
F	Static load force	N
F_i	Force applied to rear fixture	N
F'	Loading force for the calculated energy required	N
F_{max}	Maximum static load force occurring during loading with the exception of the overload	N
F_v	Vertical crushing force	N
h	Falling height of the pendulum block	mm
I	Moment of inertia about rear axle, whatever the mass of the rear wheels may be	$kg \cdot m^2$
L	Tractor reference wheelbase	mm
m	Tractor mass (see 3.3)	kg
m_t	Reference mass (see 3.4)	kg
NOTE	See annex E for characteristic tractor data symbols used in the calculation of non-continuous rolling.	

4 Conditioning of tractor and ROPS for pilot test

The front-mounted ROPS under test shall be in accordance with production specifications and shall be fitted in its protective position to the appropriate tractor model chosen in accordance with the manufacturer's declared attachment method.

The tractor under test shall be fitted with tyres having the greatest diameter indicated by the manufacturer and the smallest width for tyres of that diameter. The tyres shall not be liquid-ballasted and shall be inflated to the pressure recommended for field work.

The rear wheels shall be set to the narrowest possible track width, and the front wheels to the same track width. If two front track width settings could differ equally from the narrowest rear track width setting, then the wider of these two front track width settings shall be selected.

All the tractor's tanks shall be filled or replaced by equivalent masses in the corresponding position.

See annex E for the lateral stability and non-continuous rolling tests.

5 Test apparatus and equipment

5.1 Dynamic testing

5.1.1 Pendulum block

A pendulum block shall be suspended by two chains or wire ropes from pivot points not less than 6 m above the ground. Means shall be provided for adjusting independently the suspended height of the block and the angle between the block and the supporting chains or wire ropes.

The mass shall be 2 000 kg ± 20 kg, excluding the mass of the chains or wire ropes, which themselves shall not exceed 100 kg. The length of the sides of the impact face shall be 680 mm ± 20 mm. The block shall be filled such that the position of its centre of gravity is constant and coincides with the geometrical centre of the parallelepiped.

The parallelepiped shall be connected to the system which pulls it backwards by an instantaneous release mechanism designed and located so as to enable the pendulum block to be released without causing any significant oscillation of the parallelepiped.

5.1.2 Pendulum supports

The pendulum pivot points shall be rigidly fixed so that their displacement in any direction does not exceed 1 % of the height of fall.

5.1.3 Lashings

Anchoring rails with the requisite track width and covering the necessary area for lashing the tractor in all required tests shall be rigidly attached to a non-yielding base beneath the pendulum.

The tractor shall be lashed to the rails by means of wire rope of round-strand, fibre-core and 6 × 19 construction, in accordance with ISO 2408, and having a nominal diameter of 13 mm. The metal strands shall have an ultimate tensile strength of at least 1 770 MPa.

The central pivot of an articulated tractor shall be supported and lashed down as appropriate for all test procedures. For the side impact test procedure, the pivot shall also be propped from the side opposite the impact. The front and rear wheels are not required to be in line if this is more convenient for attaching appropriate wire ropes.

5.1.4 Wheel prop and beam

A softwood beam of 150 mm square shall be used as a prop for the wheels during the impact tests. During the lateral impact test, a softwood beam shall be clamped to the floor to brace the rim of the wheel opposite the side of impact.

5.1.5 Props and lashings for articulated tractors

Additional props and lashings shall be used for articulated tractors, the purpose of which is to ensure that the section of the tractor on which the front-mounted ROPS is fitted is as rigid as that of a rigid tractor.

5.1.6 Tyre pressures and deflection

The tractor tyres shall not be liquid-ballasted and shall be inflated to the pressures prescribed by the tractor manufacturer for field work. The lashings shall be tensioned in each particular case such that the tyres undergo a deflection equal to 12 % of the tyre wall height (distance between the ground and the lowest point of the rim) before tensioning.

5.1.7 Measuring apparatus

The following measuring apparatus shall be used:

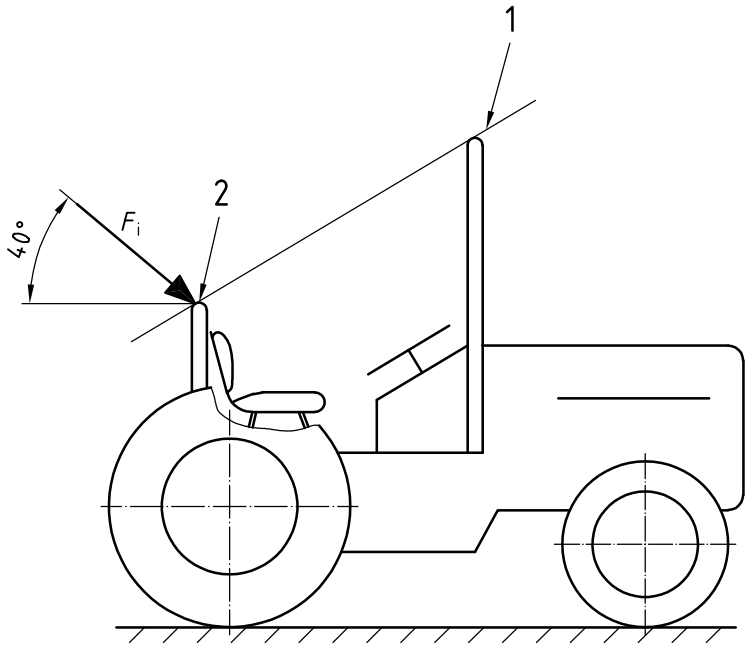
— a device for measuring the elastic deflection (the difference between the maximum momentary deflection and the permanent deflection);

— a device for checking that the front-mounted ROPS has not entered the clearance zone, and that this zone has remained within the protection given by the ROPS, during testing.

5.2 Static testing

5.2.1 Rig for static testing of rear fixture

This rig shall be such that it is possible to apply a load from the rear to the uppermost part of the fixture in the median plane of the tractor and under an angle of inclination of 40° above, and downwards from, the horizontal (see Figure 1). Provision shall be made for uniform distribution of the load to the fixture via a pad capable of following the deflection of the fixture.



Key

1 Simulated ground line

2 Supplementary (rear) fixture

Figure 1 — Test force direction

5.2.2 Rig for static testing of front-mounted ROPS

5.2.2.1 General

This rig shall enable horizontal thrust or loading to be applied to the front-mounted ROPS. Provision shall be made for the load to be uniformly distributed normal to the direction of loading and along a beam having a length of one of the exact multiples of 50 mm between 250 mm and 700 mm. The stiff beam shall have a vertical face dimension of 150 mm. The edges of the beam in contact with the front-mounted ROPS shall be curved, with a maximum radius of 50 mm.

The pad shall be capable of being adjusted to any angle in relation to the load direction, in order that it can follow the angular variations of the front-mounted ROPS's load-bearing surface as it deflects.

The direction of the force (deviation from horizontal and from vertical) shall be

— at the start of the test, under zero load, ± 2°, and

— during testing, under load, 10° above and 20° below the horizontal.

These variations shall be kept to a minimum.

The deflection rate shall be slow (< 5 mm·s^{-1}) so that the load can at all times be considered “static”.

5.2.2.2 Apparatus for measuring energy absorbed by front-mounted ROPS

The force vs deflection curve shall be plotted continuously in order to determine the energy absorbed by the front-mounted ROPS. Measurement of the force and deflection at the point where the load is applied to the front-mounted ROPS is not required; however, force and deflection shall be measured simultaneously and co-linearly.

The point of origin of deflection measurements shall be selected so that only the energy absorbed by the front-mounted ROPS or the deflection of certain parts of the tractor, or both, are measured. The energy absorbed by deflection or slipping of the anchoring or both shall not be included.

5.2.2.3 Means of anchoring tractor

Anchoring rails with the requisite track width and covering the necessary area for anchoring the tractor for all required tests shall be rigidly attached to a non-yielding base near the testing rig.

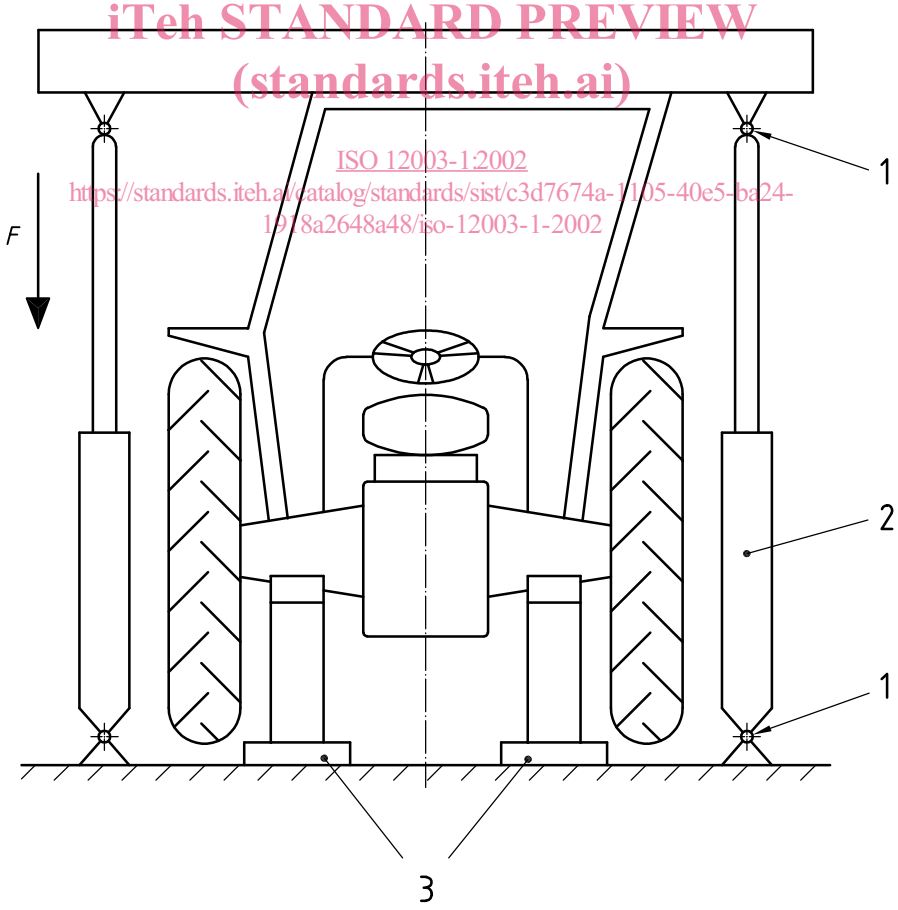
The tractor or assembly (the front-mounted ROPS and parts of the tractor to which it is attached) shall be anchored to the rails by any suitable means (plates, wedges, wire ropes, jacks, etc.) so that it cannot move during the tests. This requirement shall be checked during the test by means of the usual devices for measuring length. If the tractor or assembly moves, the entire test procedure shall be repeated, unless the system for measuring the deflections used in plotting the force vs deflection curve is connected to the tractor or assembly.

5.2.3 Crushing rig

This rig shall be capable of exerting a downward force on the front-mounted ROPS through a rigid beam approximately 250 mm wide, connected to the load-applying mechanism by means of universal joints. Suitable axle stands shall be provided so that the tractor tyres do not bear the crushing force. See Figure 2.

5.2.4 Other measuring apparatus

A device for checking that the front-mounted ROPS has not entered the clearance zone, and that this zone has remained within the front-mounted ROPS protection during testing, shall be used.



Key

1 Universal pin joints
2 Hydraulic cylinder
3 Supports

Figure 2 — Crushing rig — Example