SLOVENSKI STANDARD
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Kolesni traktorji za kmetijstvo in gozdarstvo - Zaščitna struktura - Metode dinamičnega preskušanja in pogoji sprejemljivosti

Wheeled tractors for agriculture and forestry -- Protective structures -- Dynamic test method and acceptance conditions

Tracteurs agricoles et forestiers à roues -- Structures de protection -- Méthode d'essais dynamiques et conditions d'acceptation

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INTERNATIONAL STANDARD

ISO 3463

Third edition
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Wheeled tractors for agriculture and forestry — Protective structures — Dynamic test method and acceptance conditions

Tracteurs agricoles et forestiers à roues — Structure de protection — Méthode d'essais dynamiques et conditions d'acceptation

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3463 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry.*

This third edition cancels and replaces the second edition (ISO 3463 : 1984), of which it constitutes a technical revision (see the Introduction).

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Wheeled tractors for agriculture and forestry — Protective structures — Dynamic test method and acceptance conditions

0 Introduction

0.1 In the revision of this International Standard to adopt "Seat Index Point" (SIP) in place of "Seat Reference Point" (SRP), the mean seat position is used in accordance with ISO 5353. The seating position is therefore moved to the mean horizontal from the rearmost position used in previous editions. Half the minimum horizontal adjustment as stated in ISO 4253 is the adjustment figure used.

To adopt the seat index point (SIP) in place of seat reference point (SRP), the relationship of SIP 90 mm above and 140 mm in front of the SRP has been used. This relationship should be used when converting from SRP to SIP or vice versa.

The 1980 edition of ISO 3462, *Tractors and machinery for agriculture and forestry — Seat reference point — Method of determination* used a relationship of SIP 97 mm above and 130 mm in front of the seat reference point. In a practical comparison, however, it was found that the 90 mm vertical and the 140 mm horizontal relationship gave the most accurate conversion.

Variation from the 1980 edition of ISO 3462 is due to

a) seat cushions not being horizontal in practice;

b) seat cushion angle to backrest not being 90°;

c) curvature on the backrest placing the SIP device slightly forward of the SRP device.

0.2 Testing of protective structures for wheeled tractors for agriculture and forestry aims at minimizing the likelihood of driver injury resulting from accidental overturning during normal operation of the tractor.

The strength of the protective structure is tested by simulating such loads as are 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 may be affected by the load imposed on the structure.

Annex A gives requirements for providing resistance to brittle fracture at reduced operating temperature.

1 Scope and field of application

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

It applies to tractors having at least two axles for pneumatic-tyred wheels, with or without track attachments, and with a basic mass of 800 to 6 000 kg.

The minimum track width of rear wheels should generally be greater than 1 150 mm. It is recognized that there may be designs of tractors, for example, lawn mowers, narrow vineyard or 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.

2 References

ISO 612, *Road vehicles — Dimensions of motor vehicles and towed vehicles — Terms and definitions.*

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

ISO 4253, *Agricultural tractors — Operator's seating accommodation — Dimensions.*

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

3 Definitions

For the purposes of this International Standard, the following definitions apply.

3.1 protective structure : Cab or frame for the protection of drivers of wheeled tractors for agriculture or forestry by minimizing the likelihood of driver injury resulting from accidental overturning during normal operation.

NOTE — The protective structure is characterized by providing space for the clearance zone either inside the envelope of the structure or within a space bounded by a series of straight lines from the outer edge of the structure to any part of the tractor that might come into contact with flat ground and 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, protective structure with cladding, and any track equipment or additional front-wheel drive components required for normal use. The operator, optional ballast weights, additional wheel equipment, special equipment and loads are not included.

3.3 reference mass : Mass, not less than the tractor mass (see 3.2), selected by the manufacturer for calculation of the energy inputs to be used in the tests.

3.4 impact test : Application of a dynamic load produced by a block acting as a pendulum.

3.5 crushing test : Application of a vertical load through a beam placed laterally across the uppermost members of the protective structure.

3.6 longitudinal median plane (of a vehicle) : See ISO 612.

3.7 vertical reference plane (of a vehicle) : Vertical plane generally longitudinal to the tractor and passing through the seat index point and the steering-wheel centre.

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

4 Symbols

The following symbols are used in this International Standard :

m = tractor mass, as defined in 3.2, in kilograms

m_t = reference mass, as defined in 3.3, in kilograms

F = static load force, in newtons

E = energy input to be absorbed during test, in joules

H = the lift height of the pendulum block centre of gravity, in millimetres

L = reference wheelbase, which shall be not less than the maximum wheelbase, in millimetres

I = reference moment of inertia about the rear axle excluding the rear wheels, which shall be not less than the maximum moment of inertia, in kilogram metres squared.

5 Apparatus

5.1 Clearance zone framework

Means to prove that the clearance zone has not been entered during the test : a measuring rig complying with figures 1, 2a) and 2b) can be used.

5.2 Impact tests

5.2.1 Device to strike a blow against the protective structure, a pendulum block with a mass of 2 000 kg.

The pendulum block mass does not include the mass of the chains. The maximum chain mass shall be 100 kg.

The dimensions of the block, which shall be suspended from two chains from pivot points 6 m or more above ground level, shall be as shown in figure 3.

The pendulum block centre of gravity shall coincide with its geometric centre.

5.2.2 Means to lash the tractor to the ground. The tractor shall be lashed, by means of steel wire ropes incorporating tensioning devices, to ground rails preferably spaced approximately 600 mm apart throughout the area immediately below the pivot points and extending for approximately 9 m along the pendulum block axis and approximately 1,8 m to either side. Details of the means are given in figures 4, 5 and 6.

The wire rope shall be round, stranded with fibre core, construction 6 × 19 according to ISO 2408, using wire of tensile strength 1 770 N/mm^2.

The nominal diameter shall be as specified in table 1.

Table 1 — Nominal diameter of lashing ropes

Tractor mass, m kg	Rope diameter mm
m < 5 000	13
m ⩾ 5 000	16

5.2.3 Softwood beam, of cross-section 150 mm × 150 mm, to restrain the rear wheels when striking from the front and rear, and to clamp against the side of the front and rear wheels when striking from the side, as shown in figures 4, 5 and 6.

5.2.4 Wooden prop, to restrain the opposite rear wheel when striking from the side as shown in figure 6. Its length shall be 20 to 25 times its thickness and its width 2 to 3 times its thickness.

5.2.5 Device to measure elastic deflection, such as that shown in figure 7, in a horizontal plane that coincides with the upper limiting surface of the clearance zone.

5.3 Crushing tests

5.3.1 Means to apply downward force on the protective structure, such as that shown in figure 8, including a stiff beam with a width of 250 mm.

5.3.2 Equipment to measure total vertical force applied.

6 Preparation of tractor and protective structure

6.1 The protective structure shall be to production specifications and shall be fitted to the appropriate tractor model chassis in accordance with the manufacturer's declared attachment method.

6.2 A track width setting for the rear wheels shall be chosen such that, as far as possible, the protective structure is not supported by tyres during the test.

6.3 Cross-ply tyres should preferably be used.

6.4 The gear lever shall be in neutral and the hand-brake off.

6.5 All detachable windows, panels and removable non-structural fittings shall be removed so that they do not contribute to the strength of the protective structure.

In cases where it is possible to fix doors and windows open, or remove them during work, they shall either be removed or fixed open for the test, so that they do not add to the strength of the protective structure. It shall be noted whether, in this position, they would create a hazard for the driver in the event of overturning.

6.6 Impact tests

6.6.1 General

The position of the block and its supporting chains shall be selected so that the impact point will be at the upper edge of the protective structure and in line with the travel arc of the block centre of gravity.

The tractor shall be positioned and held securely in the area beneath the pivots so as to be struck appropriately.

The lashing attachment points shall be approximately 2 m behind the rear axle and 1,5 m in front of the front axle.

The tractor tyres shall be inflated according to the different types of tractor (no water ballast being used), and the lashing tightened to give deflections appropriate to the tractor type and tyre as shown in table 2.

6.6.2 Front and rear impact tests

The lashings shall be one on each side of both axles giving a resultant force in the plane in which the block centre of gravity will swing.

After the lashings have been tightened for the front and rear blows, a beam (see 5.2.3) shall be clamped against the appropriate wheels on the side opposite the pendulum and driven tight against them (see figures 4 and 5).

Table 2 — Impact tests — Deflection

Tractor type	Tyre pressure kPa	Tyre pressure (bar)	Deflection mm
Four-wheel drive with front and rear wheels of the same size :			
Front	100	(1)	25
Rear	100	(1)	25
Four-wheel drive with front wheels smaller than rear wheels :			
Front	150	(1,5)	20
Rear	100	(1)	25
Two-wheel drive :			
Front	200	(2)	15
Rear	100	(1)	25

6.6.3 Side impact test

The lashing shall be on the side of the axles adjacent to the blow.

A beam (see 5.2.3) shall be clamped against the side of the front and rear wheels opposite the pendulum and driven hard against the tyres. After lashing, a beam (see 5.2.4) shall be placed as a prop against the rear wheel rim and secured to the floor so that it is held tight against the rim during the impact, as shown in figure 6. The beam length shall be chosen so that when in position against the rim it is at an angle of 30 ± 3° to the horizontal.

6.7 Crushing tests

When in position for the crushing test, the tractor shall be supported under the axles so that the load applied is not carried on the wheels.

7 Procedure

7.1 Sequence of tests

7.1.1 For tractors with less than 50 % of the tractor mass on the front wheels, the following sequence shall be used (the sub-clause numbers are those in which the tests are described) :

a) impact from the rear (see 7.2.1 and 7.2.2);

b) crushing at the rear (see 7.4.1);

c) impact from the front (see 7.2.1 and 7.2.3);

d) impact from the side (see 7.3);

e) crushing at the front (see 7.4.2).

7.1.2 For tractors with 50 % or more of the tractor mass on the front wheels, the following sequence shall be used (the sub-clause numbers are those in which the tests are described) :

a) impact from the front (see 7.2.1 and 7.2.3);

b) impact from the side (see 7.3);

c) crushing at the rear (see 7.4.1);

d) crushing at the front (see 7.4.2).

7.1.3 No repairs or straightening of any member shall be carried out between tests.

7.1.4 If a protruding member would present an inadequate area for the pendulum block, a steel plate of appropriate thickness and depth and about 300 mm in length shall be fastened to the member such that the strength of the protective structure is not affected.

7.1.5 The energy input to be absorbed by the protective structure during the test shall be reported; it is calculated, in joules, by the formula :

$$E = 19{,}6\ H$$

7.2 Impact from rear and front

7.2.1 Positioning of tractor

For the impact tests to the rear and front, the tractor shall be positioned so that the supporting chains and the pendulum block face are at an angle of 20° to the vertical when striking the protective structure. If the angle of the protective structure member at the contact point at maximum deflection during impact is greater than 20° to the vertical, the block angle shall be further adjusted by any convenient means so that the striking face and the protective structure member are parallel at the impact point and maximum deflection, the supporting chains being at 20° to the vertical when the block strikes the protective structure.

Where the angle is greater than 20°, the adjustment of the pendulum block striking face shall be based on estimated maximum deformation.

7.2.2 Impact from rear

The rear impact is not required on tractors having 50 % or more of the tractor mass on the front wheels.

The rear blow shall be struck in a vertical plane parallel to the longitudinal median plane on the corner opposite to that on which the side impact (see 7.3) is made and at two-thirds of the distance from the tractor median plane to the vertical plane touching the outside extremity of the protective structure top. However, if a curve in the back of the protective structure starts at less than two-thirds of the distance from the centre, the impact shall be at the beginning of that curve, i.e. at the point where this curve is tangential to a line at right angles to the tractor median plane.

The height of the pendulum block lift shall be calculated from either of the following formulae. The choice of formula is at the manufacturer's discretion.

Alternative 1 : H (mm) $= 2{,}165 \times 10^{-8}\ m_t\ L^2$

Alternative 2 : H (mm) $= 5{,}74 \times 10^{-2}\ I$

7.2.3 Impact from front

The general requirements for this test are similar to those for the impact from the rear. The blow shall be struck as close to the protective structure top corner as is practicable on the same side as that on which the side impact is made (see 7.3). "As close to the corner as practicable" means 80 mm maximum from a vertical plane parallel to the tractor longitudinal median plane touching the outside extremity of the protective structure top. However, if a curve in the front of the protective structure starts at a distance further than 80 mm inside this vertical plane, the impact shall be struck at the beginning of the curve, i.e. at the point where this curve is tangential to a line at right angles to the median plane of the tractor.

The pendulum block lift shall be calculated from the following formulae :

— $H = 25 + 0{,}07\ m_t$, where m_t = 800 to 2 000 kg

— $H = 125 + 0{,}02\ m_t$, where m_t = 2 000 to 6 000 kg

7.3 Impact from either side

7.3.1 Positioning of tractor

For the side impact test the impact direction shall be horizontal.

The tractor shall be positioned so that the supporting chains and the pendulum block striking face are vertical when striking the protective structure. If the protective structure member angle at the contact point is not vertical, the pendulum block striking face and the protective structure members shall be set parallel at the impact point at maximum deflection by one additional support. The supporting chains shall remain vertical at the impact point.

In the case of non-vertical structure members, the adjustment of the pendulum block striking face shall be based on estimated maximum deformation.

7.3.2 Impact from side

If it is certain that any particular member will take the initial impact when the tractor overturns sideways, the impact shall be struck against this member. Otherwise, the impact shall be struck against the highest side member and in the vertical plane perpendicular to the longitudinal median plane (see clause 9) and 60 mm forward of the seat index point. In case of an offset seat and/or non-symmetrical strength of the protective structure, the side blow shall be on the side more likely to enter the clearance zone.

The lift height of the pendulum block shall be calculated from the following formulae :

- $H = 25 + 0{,}2\ m_t$, where m_t = 800 to 2 000 kg
- $H = 125 + 0{,}15\ m_t$, where m_t = 2 000 to 6 000 kg

7.4 Crushing tests

7.4.1 Crushing at rear

The beam shall be positioned across the rear uppermost structural members and the resultant crushing forces shall be located in the vertical reference plane. The force F shall be applied, where $F = 20\ m_t$, in newtons. This force shall be maintained for at least 5 s after the cessation of any visually detectable movement of the protective structure.

Where the rear part of the protective structure roof will not sustain the full crushing force, the force shall be applied until the roof is deflected to coincide with the plane joining the protective structure upper part with that part of the tractor rear capable of supporting the vehicle mass when overturned. The force shall then be removed and the tractor or loading force repositioned so that the beam is over that point of the protective structure which would then support the tractor front when completely overturned and the full force applied.

7.4.2 Crushing at front

The beam shall be positioned across the front uppermost structural members and the resultant crushing forces shall be located in the vertical reference plane. The force F shall be applied where $F = 20\ m_t$, in newtons. This force shall be maintained for at least 5 s after the cessation of any visually detectable movement of the protective structure.

Where the front part of the protective structure roof will not sustain the full crushing force, the force shall be applied until the roof is deflected to coincide with the plane joining the protective structure upper part with that part of the tractor front capable of supporting the vehicle mass when overturned. The force shall then be removed and the tractor or loading force repositioned so that the beam is over that part of the protective structure which would then support the tractor rear when completely overturned and the full force applied (see figure 9).

8 Seat index point

The seat index point (SIP) shall be determined, in accordance with ISO 5353.

For a suspended seat, the seat shall be set to the suspension travel mid-point, unless this is contradictory to clearly stated instructions by the seat manufacturer. Where special instructions for the seat setting exist, these shall be observed.

9 Clearance zone

9.1 The clearance zone is illustrated in figures 1, 2a) and 2b). Referring to the figures, the zone is defined in relation to the vertical reference plane (see 3.7). This reference plane shall be assumed to move horizontally with the seat and steering-wheel during impacts but to remain perpendicular to the tractor or the protective structure floor.

9.2 The clearance zone specified in 9.3 a) to j) assumes a seat adjustment of ± 75 mm horizontally and ± 30 mm vertically from the seat mid-position. Where the seat adjustment exceeds these values, the clearance zones shall be modified in accordance with 9.2.1 and 9.2.2.

9.2.1 If the horizontal seat adjustment provided exceeds ± 75 mm from the mid-position, then any dimensions forward from the SIP shall be reduced, and dimensions to the rear from the SIP increased, on the basis :

[Total adjustment to the rear of the seat mid-position minus 75 mm]

9.2.2 If the vertical seat adjustment provided exceeds ± 30 mm, then any dimensions above the SIP shall be increased and dimensions below the SIP reduced on the basis :

[Total adjustment above the seat mid-position minus 30 mm]

9.3 The clearance zone (see figures 1 and 2) is defined as in a) to j) when the tractor is standing on its wheels on a horizontal surface with, where applicable, the steering-wheel adjusted to the mid-position for seated driving.

a) a horizontal plane — $A_1B_1B_2A_2$ — 840 mm[1)] above the SIP with line B_1B_2 located 65 mm[1)] behind the SIP;

b) an inclined plane — $G_1G_2I_2I_1$ — perpendicular to the vertical reference plane and including the rearmost point of the seat backrest extended rearwards by 75 mm[1)] and upwards by 30 mm[1)], the extension of which passes through a point 840 mm[1)] above the SIP, 215 mm[1)] behind the SIP;

c) a cylindrical surface — $A_1A_2I_2I_1$ — perpendicular to the vertical reference plane, with a radius of 120 mm tangential to the planes defined in a) and b);

d) a cylindrical surface — $B_1C_1C_2B_2$ — perpendicular to the vertical reference plane, having a radius of 900 mm and centre 65 mm behind and 60 mm below the SIP (see figures 1 and 2), with the line C_1C_2 located 400 mm forward of B_1B_2;

e) an inclined plane — $C_1D_1D_2C_2$ — perpendicular to the vertical reference plane, joining the surface defined in d) at its forward edge and passing 40 mm from the steering-wheel rim;

1) See 9.2.