INTERNATIONAL STANDARD

ISO 4254-13

Second edition
2023-04

Agricultural machinery — Safety —

Part 13: Large rotary mowers

Matériel agricole — Sécurité —

Partie 13: Grandes faucheuses rotatives

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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.

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

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 7, *Equipment for harvesting and conservation*.

This second edition cancels and replaces the first edition (ISO 4254-13:2012), which has been technically revised.

The main changes are as follows:

— additional information has been added to the Scope regarding applicability;

— the Normative references have been updated;

— in Clause 3:

  — some terms and definitions have been modified, added or removed;

  — former Figure 1 has been removed and subsequent figures have been renumbered;

— blade test and performance requirements have been moved to ISO 5718-2;

— in Clause 4, subclauses 4.8, 4.9, 4.10 and 4.11 have been revised to reflect the strength and performance requirements in the standards concerned;

— in Clause 5:

  — title has been revised;

  — Figure 2 (former Figure 3) has been modified;

  — Figure 3 (former Figure 4) has been modified;

- 5.2.2.3 has been added to indicate a test condition;
- 5.3.1.4 has been modified to indicate new requirements for test equipment;
- 5.4.1.4 has been added to indicate new requirements for test equipment;
- 5.4.5 test acceptance criteria has been modified;
- 5.5.4 test acceptance criteria has been modified;
- subclause 5.7 and succeeding subclauses have been removed;
- subclause 5.8 and succeeding subclauses, including Table 1 and Figure 12, have been removed;
- 5.6.2.6 has been modified to correct an error in the sand particle size requirements for test equipment;

— the Bibliography has been updated.

A list of all parts of ISO 4254 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The structure of safety standards in the field of machinery is as follows:

— type-A standards (basis safety standards) giving basic concepts, principle for design, and general aspects that can be applied to machinery;

— type-B standards (generic safety standards) dealing with one safety aspect or one type of safeguards that can be used across a wide range of machinery;

  — type-B1 standards on particular safety aspects (for example, safety distances, surface temperature, noise);

  — type-B2 standards on safeguards (for example, two-hands controls, interlocking devices, pressure sensitive devices, guards);

— type-C standards (machinery safety standards) dealing with detailed safety requirements for a particular machine or group of machines.

This Standard is a type C standard as stated in ISO 12100.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

Significant hazards that are common to all agricultural machines (self-propelled ride-on, mounted, semi-mounted and trailed) are dealt with in ISO 4254-1.

Agricultural machinery — Safety —

Part 13:
Large rotary mowers

1 Scope

This document, when used together with ISO 4254-1, specifies the safety requirements and their verification for the design and construction of towed, semi-mounted, or mounted large rotary mowers with single or multiple cutting elements which have a cutting element tip circle of 1 000 mm or greater for any single cutting-element assembly, mounted on a propelling tractor or machine, intended for agricultural mowing equipment and designed for shredding crop residue, grass and small brush by impact. It describes methods for the elimination or reduction of hazards arising from the intended use and reasonably foreseeable misuse of these machines by one person (the operator) in the course of normal operation and service. In addition, it specifies the type of information on safe working practices to be provided by the manufacturer.

NOTE 1 When used outside of agriculture, additional requirements not specified in this document can be applicable.

This document is not applicable to:

— rotary disc mowers, rotary drum mowers, and flail mowers designed for forage crop harvesting as covered by ISO 4254-12;

— arm-type large rotary mowers;

— pedestrian-controlled motor mowers;

— lawn mowers covered by the ISO 5395 series.

When requirements of this document are different from those which are stated in ISO 4254-1, the requirements of this document take precedence over the provisions of ISO 4254-1 for machines that have been designed and built according to the provisions of this document.

This document is also not applicable to environmental hazards, road safety, electromagnetic compatibility, vibration and hazards related to moving parts for power transmission. It is also not applicable to hazards related to maintenance or repairs to be carried out by professional service personnel.

This document, taken together with ISO 4254-1, deals with all the significant hazards, hazardous situations and events relevant to large rotary mowers used as intended and under the conditions foreseen by the manufacturer. (A list of significant hazards is provided in Annex A.)

NOTE 2 Example illustrations of two mowers (a rigid-deck large rotary mower and a trail-type multi-section, foldable-wing large rotary mower) dealt with in this document are shown in Annex C, C.1.

NOTE 3 Example illustrations of mowers not dealt with in this document are shown in Annex C, C.2.

NOTE 4 ISO 14982 specifies test methods and acceptance criteria for evaluating the electromagnetic compatibility of all kinds of mobile agricultural machinery.

This document is not applicable to large rotary mowers which are manufactured before the date of publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 730, *Agricultural wheeled tractors — Rear-mounted three-point linkage — Categories 1N, 1, 2N, 2, 3N, 3, 4N and 4*

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

ISO 5673-1, *Agricultural tractors and machinery — Power take-off drive shafts and power-input connection — Part 1: General manufacturing and safety requirements*

ISO 5718-2, *Harvesting equipment – Requirements for cutting elements – Part 2: Blades for large rotary mowers (under development)*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4254-1, ISO 12100 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/.

3.1 Rotary mowers

3.1.1
large rotary mower
mower, which may include mulching, with single or multiple cutting-element assemblies which have a *cutting-element tip circle* (3.2.4) of 1 000 mm or greater powered by a propelling machine in which one or more functional components rotate(s) about a vertical axis to cut or shear crop residue, grass and small brush by impact

3.1.1.1
rigid-deck large rotary mower
large rotary mower (3.1.1) with single or multiple cutting-element assemblies on a common rigid deck

3.1.1.2
multi-section, foldable-wing large rotary mower
large rotary mower (3.1.1) with multiple cutting-element assemblies and with a single wing or multiple wings that are capable of following the terrain

Note 1 to entry: The wings are foldable for transport and to clear obstacles, but are intended to operate only with all sections in close proximity to the ground surface when mowing.

3.2 Cutting elements

3.2.1
cutting element
mower tool designed to cut or shear crop residue, grass and small brush by impact

Note 1 to entry: This can include mulching.

Note 2 to entry: Blades are common cutting-elements used on large rotary mowers.

3.2.2
cutting-element holder
rotating part of the mower to which the *cutting element* (3.2.1) is fastened

3.2.3
cutting-element assembly
rotating group of parts including *cutting element(s)* (3.2.1), *cutting-element holder* (3.2.2), cutting-element fasteners

3.2.4
cutting-element tip circle
maximum cutting diameter of the *cutting-element assembly* (3.2.3)

3.2.5
cutting-element enclosure
housing for the cutting-element assembly including the top deck, side deck, rigid or flexible guards designed to minimize thrown objects or inadvertent blade contact

3.3 Thrown-object testing

3.3.1
projectile impact
rupture of the front layer but not the back layer of the *target material* (3.3.3) by a *test projectile* (3.3.4)

3.3.2
projectile hit
rupture of all layers of the *target material* (3.3.3) by a *test projectile* (3.3.4)

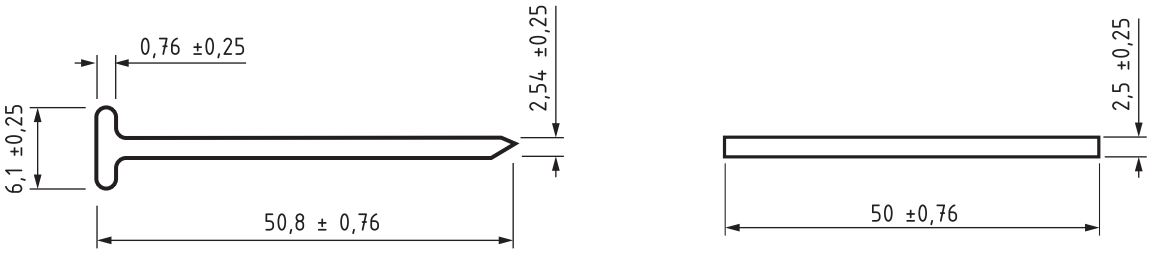
3.3.3
target material
material used for the thrown-object test

Note 1 to entry: See Annex D

3.3.4
test projectile
common steel nail or steel wire with the approximate dimensions shown in Figure 1

Note 1 to entry: The wire projectile should be capable of bending 180° with no cracks or breaks.

Dimensions in millimetres



a) Criteria for nail projectile **b) Criteria for wire projectile**

Figure 1 — Test projectile

3.3.5
target wall
arrangement of target material and supports

Note 1 to entry: See the cross-section in Figure 8 with configuration shown in Figures 6 and 7.

3.3.6
operator zone
space on the *target wall* (3.3.5) representing the area in which operator is seated on the propelling machine with hands on the steering controls and feet on controls or areas provided for foot placement while operating the mower

Note 1 to entry: For examples of target configurations, see Figures 6 and 7.

4 Safety requirements and/or protective/risk reduction measures

4.1 General

4.1.1 Machinery shall be in accordance with the safety requirements and/or protective/risk reduction measures of Clauses 4 and 5. Machinery shall meet the test requirements and acceptance criteria as specified in 5.3, 5.4 and 5.5. In addition, the machine shall be designed in accordance with the principles of ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

4.1.2 Unless otherwise specified in this document, the machine shall be in accordance with the requirements of ISO 4254-1 and with ISO 13857:2019, Tables 1, 3, 4 and 6.

4.1.3 The maximum tip speed for cutting elements shall not exceed 96,5 m/s.

4.2 Protection against thrown objects

The mower shall be designed to minimize thrown objects so that tests defined in 5.6 are satisfied.

Protective devices, for example, protective skirts, chains or rubber strips may be used.

4.3 Protection against inadvertent contact with the cutting elements

4.3.1 The mower shall be designed or guarded in such a way that any inadvertent contact with the cutting elements at the sides and on the top is prevented when the mower is operated according to the manufacturer's instructions in the operator's manual.

4.3.2 The mower shall be designed or guarded in such a way that any inadvertent contact with the cutting elements at the front (normally the intake) and at the rear (normally the exhaust) is minimized when the mower is operated according to the manufacturer's instructions in the operator's manual.

4.3.3 The top protection shall be achieved by a rigid guard or by the device used to prevent thrown-objects.

4.3.4 At the sides, at the front (intake area) and at the rear (exhaust area), there shall be protection by rigid or flexible guard; the device used to minimize projectiles; or a combination of these devices so when tested according to 5.2, there will be no contact between the foot-probe and the cutting element or the cutting-element assembly.

4.4 Rotating power component guarding and shielding

4.4.1 The mower shall be designed or guarded in such a way that any inadvertent contact with the rotating power component is minimized when the mower is operated according to the manufacturer's instructions in the operator's manual.

4.4.2 Drive shafts and their connecting points shall be guarded per ISO 5673-1. Other moving parts for power transmission shall be guarded against contact to comply with the safety distances of ISO 13857:2019, Tables 1, 3, 4 and 6.

4.5 Overrunning clutch or freewheel device

4.5.1 Mowers equipped with an overrunning clutch or a free-wheel device shall be guarded as described in 4.4.

4.5.2 Rotating elements that can be inadvertently contacted shall have evidence of rotation and a suitable safety sign to warn of the hazard.

4.5.3 There shall be instructions in the operator's manual stating to wait until all movement is stopped before servicing.

4.6 Attachment means for trailed mowers

Any trailed unit shall be designed in such a manner that there is a remaining downward load of 3 % of the total weight, or at least 500 N on the hitch point, in order to avoid an uncontrolled upward movement when it is disconnected.

4.7 Attachment means for mounted and semi-mounted mowers

Three-point hitch-mounted and semi-mounted mowers shall be attached to the propelling machine by means of one or a combination of the standardized attachment methods in accordance with ISO 730.

4.8 Cutting elements

Blades used as cutting elements shall meet the strength and performance requirements set forth in ISO 5718-2.

4.9 Impact of the cutting-element assemblies

The mower shall be tested to withstand a sudden impact to the cutting elements according to 5.3.

4.10 Unbalance

The mower shall be tested to withstand an unbalanced cutting-element assembly according to 5.4.

4.11 Structural integrity

4.11.1 There shall be no break-through of test rods through the cutting-element enclosure and there shall be no failure of other shielding when tested according to 5.5.

4.11.2 If the top and side decks are manufactured with a mild carbon steel material of 2,5 mm thickness or more, the requirements of 4.11.1 are satisfied and testing according to 5.5 is not required.

5 Verification of safety requirements and/or protective/risk reduction measures

5.1 Test conditions — General

5.1.1 Assembly

5.1.1.1 The mower shall be completely assembled and mounted on, or attached to, its propelling machine except for tests where mounting on a suitable test fixture is designated; or, where necessary, the mower unit may be tested while separated from the power unit and power be provided by some other means. However, the speeds shall be the same as those attained when on, or attached to, the propelling machine, and the fixed parts of the mower which extend into the trajectory area shall also be duplicated as nearly as practicable.

5.1.1.2 Adjustable guards shall be set in the most open position for the test.

5.1.2 Mower position

The mower shall rest on a horizontal surface that is level within 2°.

Means to restrain the mower in position during the test should be employed, if necessary. Resilient restraints (for example, chains) may be used.

5.1.3 Test speed

Except for static tests, the mower shall be operated at the highest operating speed recommended in the operator's manual.

5.1.4 Number of tests

All tests shall be run once for each cutting-element assembly of the mower, except where otherwise herein designated. A new mower can be used for each test, except for the structural integrity test and the thrown-object test.

5.2 Foot-probe test

5.2.1 Foot-probe test equipment

Foot-probe test equipment shall be constructed of a rigid material capable of not deflecting under 110 N ± 10 N in accordance with Figure 2.

Dimensions in millimetres

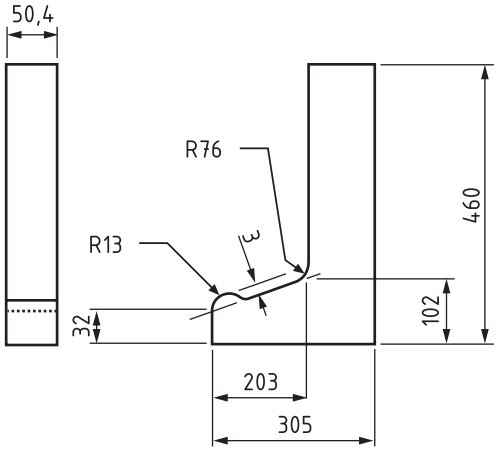
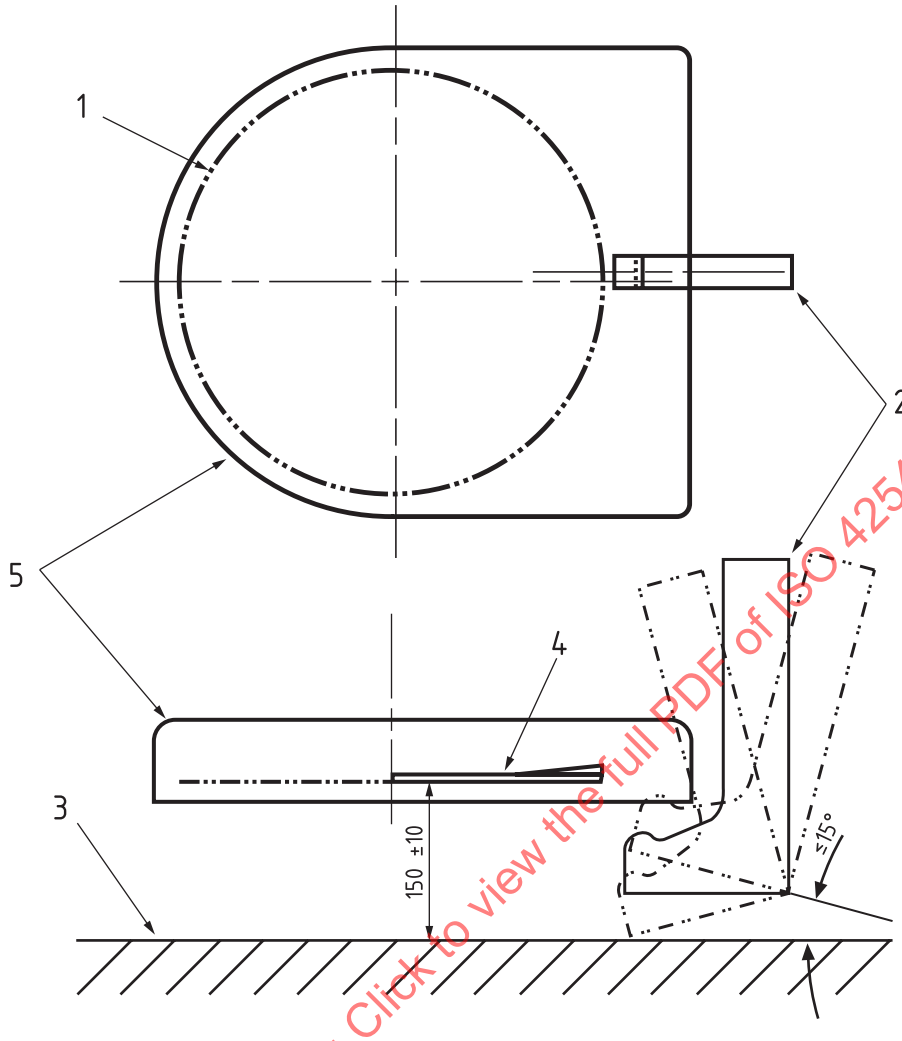


Figure 2 — Foot-probe test equipment

Dimensions in millimetres



Key

1 cutting-element tip circle
2 foot probe
3 ground level
4 cutting-element
5 cutting-element enclosure

Figure 3 — Foot-probe test

5.2.2 Test conditions

5.2.2.1 The test shall be conducted under static conditions with the mower positioned according to 5.1.2 and attached to a tractor.

5.2.2.2 The cutting-element shall be clamped to the cutting-element holder simulating the maximum cutting-tip diameter in the cutting plane.

5.2.2.3 The cutting-element shall be positioned at a height of 150 mm ± 10 mm from ground level.

5.2.2.4 Components of the mower or machine, or both, such as frames, etc., can be considered as part of the cutting-element enclosure for the purpose of this test.

5.2.3 Test procedure

5.2.3.1 The foot-probe shall be introduced with the lower part horizontally to the mower and be held with the upper part in a vertical plane and rotated horizontally and vertically a maximum of 15° to either side of the centreline while simultaneously being raised and lowered as shown in Figure 3.

5.2.3.2 The foot-probe shall be applied until the force toward the cutting-element of 110 N ± 10 N is reached, or until any portion of the cutting-element enclosure lifts from its original position, or until contact is made with the cutting-element, whichever occurs first. If the cutting-element height is different for different cutting-element speeds or cutting-element options, the test shall include the two cutting-element-height extremes.

5.2.4 Test acceptance

The requirement that there be no contact between the probe and the cutting element or cutting-element assemblies shall be verified by slow manual rotation of the cutting elements with all power off.

5.3 Impact test for cutting-element assemblies

5.3.1 Test equipment

5.3.1.1 The mower shall be completely encircled at the time of test by target walls that are resting on the floor. Testing can be performed on sand, soil or concrete.

5.3.1.2 The target wall shall be positioned in accordance with Figures 6, 7 and 8.

5.3.1.3 A protective barrier shall be provided to protect the operator.

5.3.1.4 The impact test rod shall be 51 mm ± 1 mm diameter, low-carbon steel with a tensile strength of at least 400 MPa.

5.3.1.5 The test fixture shall be constructed as shown in Figure 4.

5.3.2 Test conditions

5.3.2.1 The mower shall be adjusted for approximately 75 mm static height of cut or the cutting-element height setting closest to 75 mm.

5.3.2.2 The mower shall be set to run at a speed as specified in 5.1.3.

5.3.3 Test procedure

5.3.3.1 The mower shall be positioned over a fixture that holds the test rod stationary and dropped onto the test rod such that the cutting element makes positive contact with the rod.

NOTE Examples of the construction and configuration of this fixture are shown in Figures 4 and 5.

5.3.3.2 The mower shall be dropped fast enough so that mower speed is not materially reduced by glancing contact before solid contact is made.

NOTE Modifications to the mower's lift mechanism can be made to increase the mower's drop velocity.

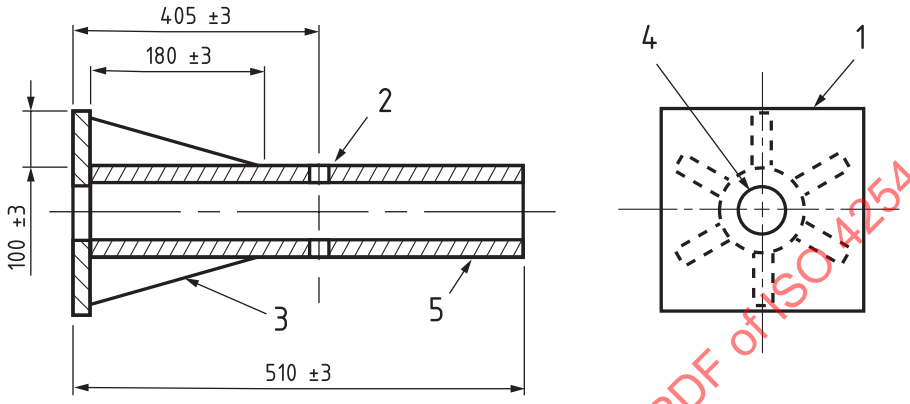
5.3.3.3 The mower shall be dropped onto the rod and allowed to continue for at least 2 s before disengaging the power or lifting the mower.

5.3.3.4 The test shall be conducted once in each of the two following manners.

a) The mower is positioned so that the contact between the cutting element and the rod is at a point as close to the cutting-element holder connection as possible. If the cutting element has a bent configuration such that it is raised close to the cutting-element holder, then the rod shall be elevated to ensure adequate cutting-element contact.

b) The mower is positioned so that the contact between the cutting element and centreline of the rod is approximately 25 mm from the outer tip of the cutting element.

Dimensions in millimetres

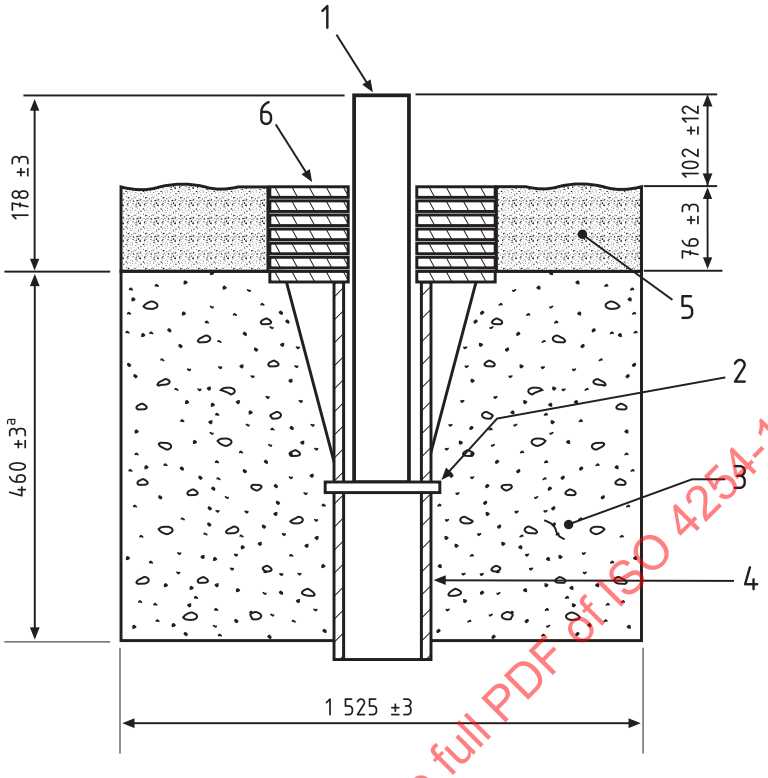


Key

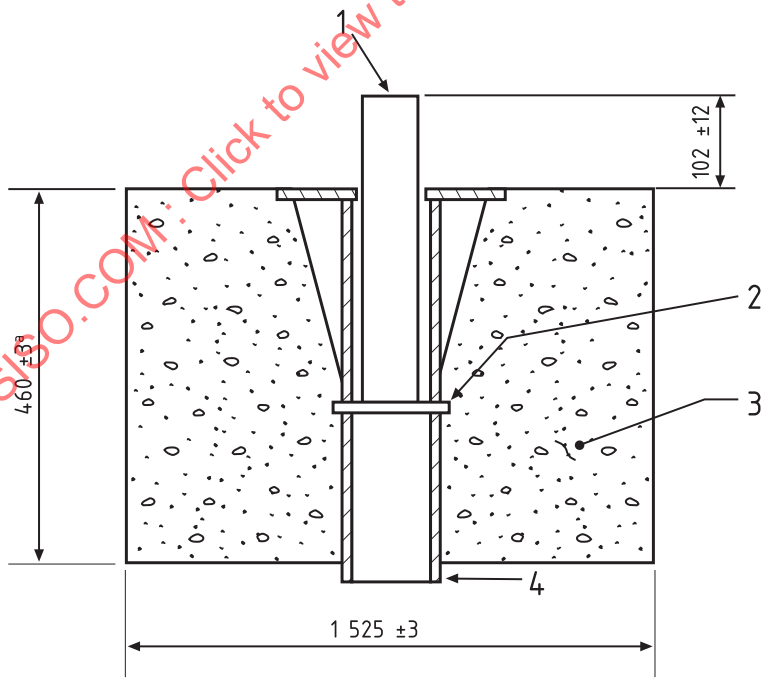
1 300 mm square x 12,7 mm steel plate
2 16 mm diameter thru-hole
3 10 mm steel gusset welded to pipe and plate (6 places)
4 54 mm ± 3 mm diameter hole
5 63 mm ASA schedule 80 steel pipe welded to plate

Figure 4 — Impact test rod fixture construction

Dimensions in millimetres



a) Example of impact test rod fixture configuration surrounded by sand



b) Example of impact test rod fixture configuration in concrete

Key

1 impact test rod
2 16 mm bolt or pin
3 1 525 mm diameter concrete cured for a minimum of 4 days
4 test fixture (see Figure 4)
5 sand (see 5.6.2.5 and 5.6.2.6 for details)

6 300 mm square x 12,7 mm steel plate with 54 mm diameter thru-hole (6)

[a] Nominal dimension.

Figure 5 — Examples of impact test rod fixture configurations

5.3.4 Test acceptance

The tests in 4.9 and 5.3 shall be completed without loss of any part of the mower or failure of any mower component, excluding portions of the cutting element with a mass of 30 g or less, in a manner that can be hazardous to the operator or bystanders. Any target projectile hits by any part of the mower or any part of the cutting elements weighing 30 g or more shall constitute failure. There shall be no projectile hits made in the target walls by any part of the mower or cutting elements.

5.4 Unbalance test for cutting-element assemblies

5.4.1 Test equipment

5.4.1.1 The mower shall be completely encircled at the time of test by target walls that are resting on the floor. Testing can be performed on sand, soil or concrete.

5.4.1.2 The target wall shall be positioned in accordance with Figures 6, 7 and 8.

5.4.1.3 A protective barrier shall be provided to protect the operator.

5.4.1.4 The cutting element shall be positioned statically at the start of the test at a height of 150 mm ± 25 mm from ground level.

5.4.2 Test conditions — Multi-piece cutting element assembly

For each cutting-element assembly, remove the cutting elements and fasteners from one end of the cutting-element holder assembly.

5.4.3 Test conditions — One-piece cutting element construction

For each cutting-element assembly, remove the bevelled or sharpened length of the cutting element on one end only.

5.4.4 Test procedure

The mower shall be run for 2 min before shutoff. For multi-spindle mowers, the test can be conducted on all spindles concurrently.

5.4.5 Test acceptance

The requirements of the test described above shall be satisfied if there is no loss of any part of the mower or failure of any mower component in a manner that can be hazardous to the operator or bystanders. There shall be no projectile hits made in the target walls by any part of the mower or cutting elements.

5.5 Structural integrity test

5.5.1 Test equipment

5.5.1.1 Target walls shall be positioned around the mower as specified in Figures 6, 7 and 8 and constructed with a material which meets the penetration test specification in Annex D.

5.5.1.2 Use low-carbon hot-finish test rods with the following dimensions.

— For mowers with cutting-element tip-circle diameter up to 1 220 mm, use test rods with the following dimensions: 9,5 mm diameter and 50,8 mm ± 3 mm long.

— For mowers with at least one cutting-elements tip-circle diameter over 1 220 mm, use test rods with the following dimensions: 12,7 mm diameter and 50,8 mm ± 3 mm long.

5.5.2 Test conditions

5.5.2.1 The cutting-element shall be positioned at a height of 305 mm ± 13 mm above the sand base.

5.5.2.2 When supports are necessary to position the mower such that the cutting element is 305 mm above the sand base, the supports shall consist of round steel bars or tubing no larger than 40 mm in diameter, and no more than six shall be used per frame unit. The supports shall be placed, as necessary, under wheels, side skids, or other structural components which normally rest on the ground if the mower were at the minimum cutting-element height. If additional supports are needed, they shall be located at least 150 mm outside the cutting-element enclosure.

NOTE The mower can also be supported from above.

5.5.3 Test procedure

5.5.3.1 The test shall consist of vertical downward introduction of test rods inserted into each of eight equally spaced holes for each cutting-element assembly in accordance with Figure 10.

5.5.3.2 The test rods shall be introduced through the tube and funnel arrangement as specified by Figure 10 or through a similar arrangement with air or mechanical assist.

5.5.3.3 A sufficient number of test rods shall be dropped into each of the eight positions so that a cutting element contacts at least 12 test rods per position.

WARNING — Test rods can puncture the target wall as noted in Figures 6, 7 and 8. Additional protection, such as straw bales or steel sheets, around the exterior of the target wall from the cutting-element line to the sand should be in place.

5.5.4 Test acceptance

The mower shall meet the requirements stated in 4.11.2.

5.6 Thrown object test

The thrown-object test shall be conducted only after the acceptance criteria of the structural integrity test are met, if required.

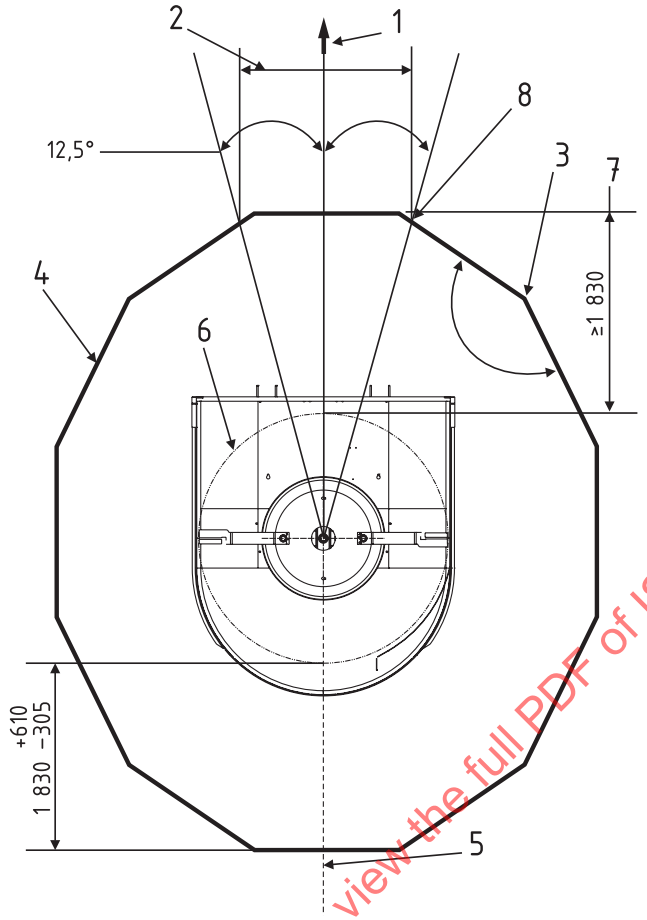
5.6.1 Operator zone

5.6.1.1 The operator-zone height shall be 610 mm above the cutting-element line to the top of the target wall.

5.6.1.2 The operator-zone width shall be defined by 25° included angle projected to the target wall and shall not exceed 2 000 mm.

5.6.1.3 For multiple spindle mowers, the operator-zone focal point shall be on a line, in the forward direction of travel, midway between the hitch pins, or on the centreline of the tongue hole.

Dimensions in millimetres

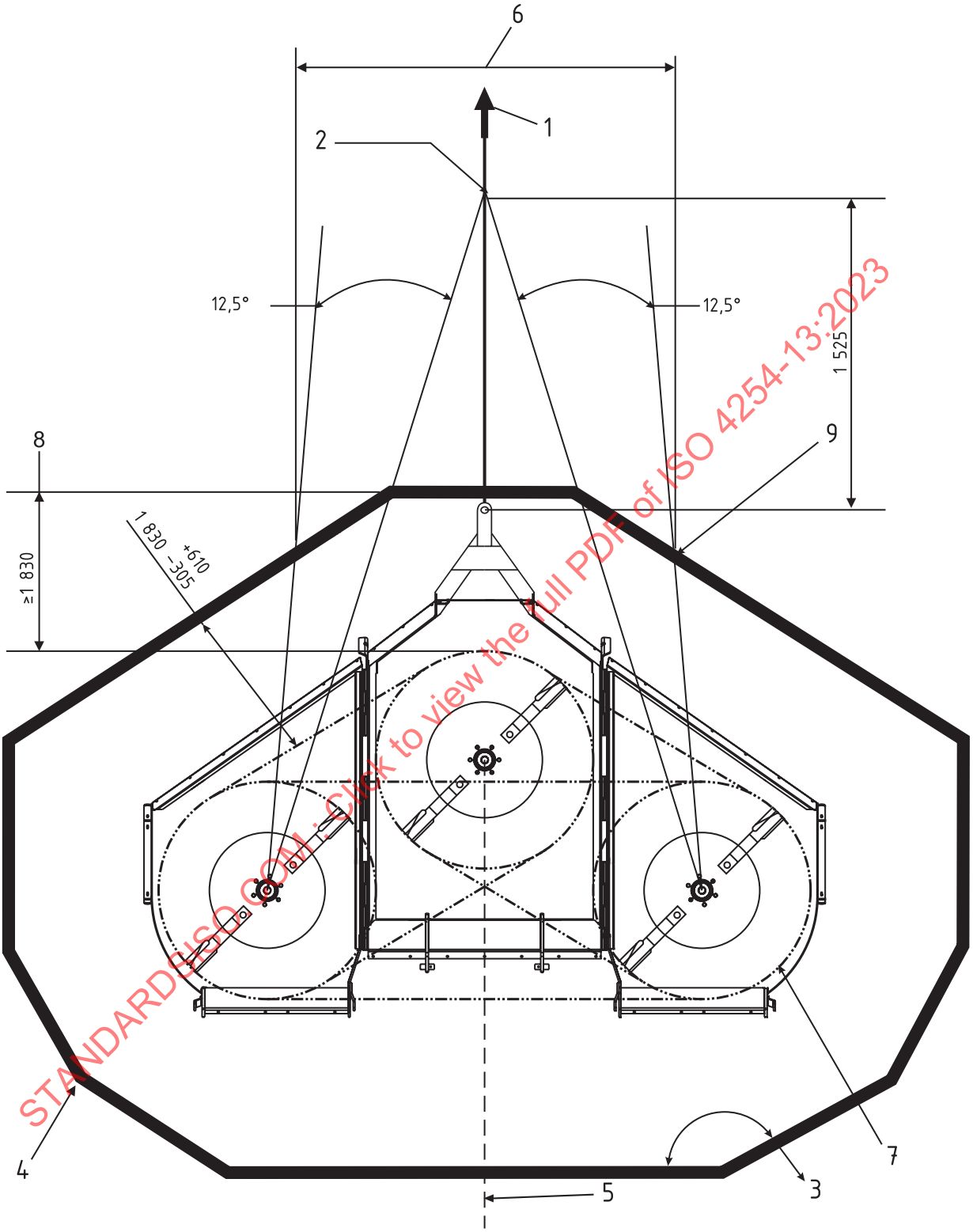


Key

1 direction of forward travel
2 width of the operator zone
3 125 degree (minimum) angle between optional flat panels
4 target wall
5 mower to be as centrally located as possible
6 cutting element tip circle
7 minimum wall distance from cutting-element tip circle in operator zone
8 intersection points of the projected lines and the wall

Figure 6 — Target wall configuration and operator zone for single spindle mower

Dimensions in millimetres



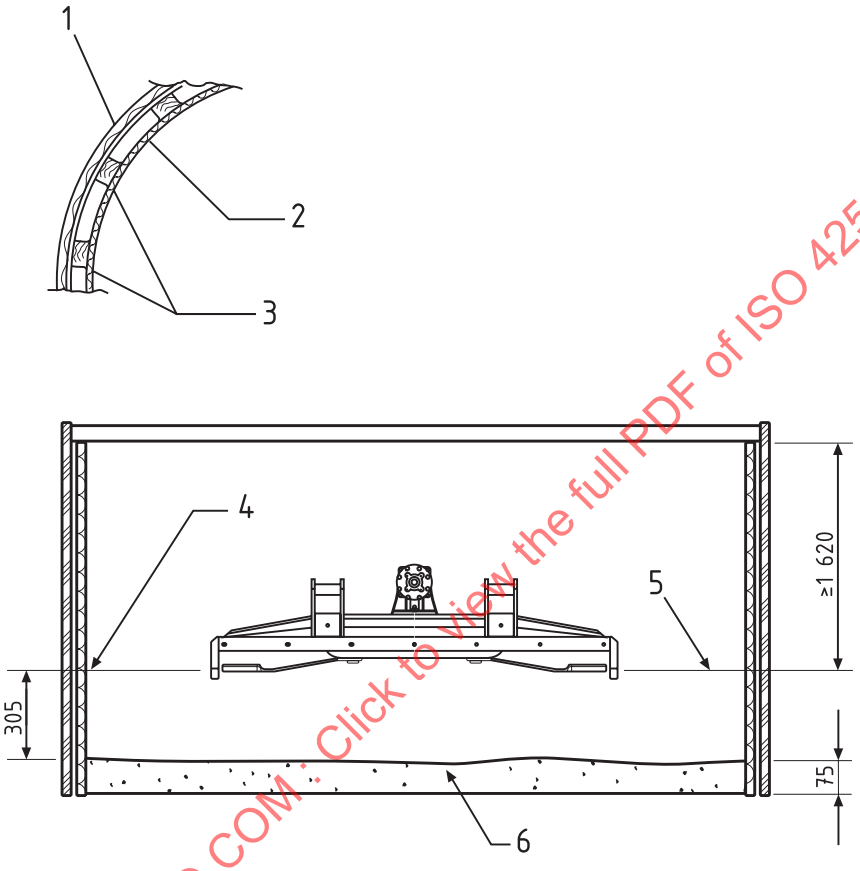
Key

1 direction of forward travel
2 operator zone focal point
3 125 degree (minimum) angle between optional flat panels
4 target wall
5 mower to be as centrally located as possible

6 width of operator zone
7 cutting element tip circle
8 minimum wall distance from cutting-element tip circle in operator zone
9 intersection points of the projected lines and the wall

Figure 7 — Target wall configuration and operator zone for multiple spindle mower

Dimensions in millimetres



Key
1 secondary wall
2 target material
3 target material supports
4 cutting element line drawn on target wall
5 horizontal plane of static cutting element(s)
6 sand base (see 5.6.2.5 and 5.6.2.6 for details)

Figure 8 — Target wall construction detail and cross-section of target wall configuration

5.6.2 Test equipment

5.6.2.1 Test shall be performed using test projectiles as described in 3.3.4 and shown in Figure 1.

5.6.2.2 Target walls shall be constructed as shown in Figure 8 and configured as shown in Figures 6 or Figure 7, as applicable.

If more than one panel is used in a corner, the panels should be approximately the same width.

5.6.2.3 For mowers mounted under a tractor, a 915 mm diameter vertical cylinder of target material shall be placed in the operator zone such that the back of the cylinder is 76 mm behind the back of the operator's seat, or 76 mm behind the rear position of an actual operator if there is no back support on the seat.

5.6.2.4 The target cylinder shall extend from the operator's normal foot position to a height of 1 m above the operator's seat.

5.6.2.5 The sand base shall be a minimum of 75 mm in depth.

5.6.2.6 Sand particle size shall not exceed 4,76 mm.

5.6.3 Test conditions

5.6.3.1 In the situation where introduction tube locations can be varied as necessary to clear structural components, these tube locations shall be positioned to direct the vector of impacted test projectiles toward the target wall rather than toward adjacent cutting elements or the sides of the mower.

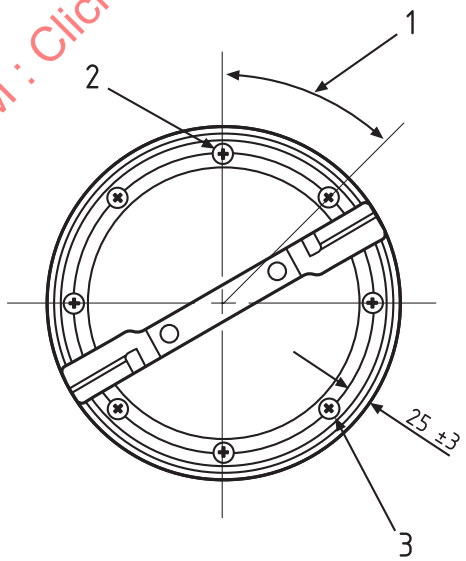
5.6.3.2 During tests, all holes shall be plugged with the introduction tube or by other means.

5.6.3.3 Provisions shall be made to protect the operator during the test.

5.6.3.4 If the mower is equipped with multiple-level cutting elements, the upper blade(s) shall be removed for the test.

5.6.3.5 Sand for the base as described in 5.6.2.6 shall be moistened to prevent blowing.

Dimensions in millimetres



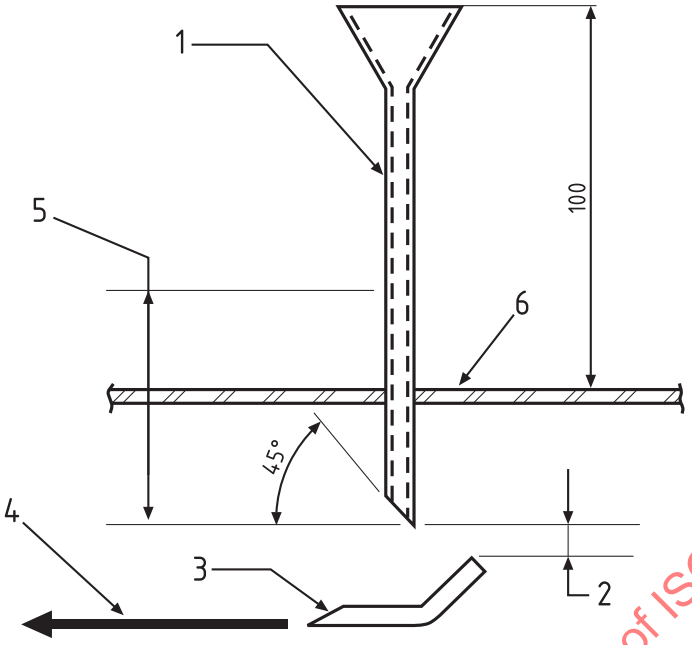
Key

1 45 degree basic between holes (see note)
2 primary hole located on line of travel
3 hole diameter to fit introduction tube

Note Each hole can be varied as necessary to clear structural components.

Figure 9 — Typical introduction tube location

Dimensions in millimetres



Key

1 introduction tube (32 mm maximum OD x 25 mm ± 3 mm ID)
2 57 mm ± 6 mm cutting element at normal operating position (see note)
3 mower cutting element
4 direction of cutting-element travel
5 vertical within 5° over 100 mm length
6 mower top protection

Note Measurement is taken with mower off and blade clamped to blade carrier in the running position.

Figure 10 — Introduction tube configuration

5.6.4 Test procedure

5.6.4.1 The test shall consist of vertical downward introduction of 150 test projectiles inserted into each of eight equally spaced holes for each cutting-element assembly in accordance with Figure 9.

5.6.4.2 The test projectiles shall be introduced through the tube and funnel arrangement as specified by Figure 10 or through a similar arrangement with air or mechanical assist.

5.6.4.3 The introduction shall be repeated three times for each hole (450 per hole) for a total of 3 600 per cutting-element assembly.

5.6.4.4 The drop velocity should remain relatively constant and be adjusted to ensure that between 5 % and 15 % of the test objects drop through the cutting element without making cutting element contact (in order to ensure that the entire length of the test object is exposed to the cutting element). Where a common hole is used between two cutting elements, the 5 % requirement of test projectiles dropping through the cutting element is waived, due to the impossibility of test projectiles passing through the cutting elements.

5.6.4.5 After each 150 test projectiles are introduced, the projectiles in a 610 mm diameter circle under the introduction hole shall be counted to verify that not more than 15 % of the test projectiles pass through the cutting element without making cutting element contact. On some mowers, it might

not be possible to prevent more than 15 % of the test projectiles from passing through the cutting-element height without contact. In this case, the 150 quantity shall be increased to ensure that at least 128 projectiles do make cutting-element contact in each test; however, the number of additional nails introduced shall remain consistent through the entire mower. This can be determined either by sound or by counting the pass-throughs.

5.6.5 Scoring

5.6.5.1 After every 150 projectiles have been introduced, record the number of test projectiles contacted by the cutting element and record the marks on the wall above the cutting-element line in the following groups:

a) projectile hits in the operator zone;

b) projectile impacts in the operator zone;

c) projectile impacts outside the operator zone;

d) projectile hits outside the operator zone.

5.6.5.2 Total the number of marks in each of these four categories to obtain their totals for the particular cutting-element assembly.

5.6.5.3 Divide each sum by the total number of cutting-element projectile contacts for that assembly and multiply by 100 to achieve a percentage.

NOTE Sample test reporting forms are shown in Annex B.

5.6.6 Test acceptance

5.6.6.1 For each cutting-element assembly, none of the composite individual cutting-element assembly scores shall exceed the following acceptance criteria:

a) 0 % projectile hits in the operator zone;

b) 0,20 % projectile impacts in the operator zone;

c) 10,00 %, calculated as the sum of projectile impacts and projectile hits outside the operator zone;

d) 3,50 % projectile hits outside the operator zone.

5.6.6.2 Failure of test criteria a) shall constitute a test hole failure.

— In the event of a failure of one test hole, the test can be repeated for that test hole.

— Two consecutive tests of that test hole with 0 % projectile hits in the operator zone shall be accomplished to meet the requirements of this test criterion.

— The number of impacts of the final successfully passed test shall be recorded for this hole.

— Failure to comply with the test acceptance of a) indicates the machine has failed the test.

5.6.6.3 Failure of any of the acceptance criteria b), c) or d) shall constitute failure of the test.

5.6.6.4 If the machine fails the test, it can be retested.

5.6.6.5 The scores of b), c) and d) criteria are then computed on the sum of the two tests.

5.6.6.6 If the scores from b), c) or d) still exceed the acceptance criteria, the machine has failed the test.

6 Information for use

6.1 Operator's manual

6.1.1 An operator's manual and a durable weather-resistant storage location for the instructions shall be provided on the equipment. Comprehensive instructions and information on all aspects of maintenance and the safe use of the machine, including suitable clothing and personal protective equipment (PPE) requirements and the need for training, shall be provided by the manufacturer in the operator's manual. Useful information for the drafting of the operator's manual is given in ISO 4254-1, ISO 3600 and ISO 12100:2010, 6.4.5.

6.1.2 The operator's manual and the technical documentation describing the machine prepared by the manufacturer for the information of potential users shall emphasize:

a) that all persons not involved with the mower operation shall be kept away;

b) the use of a PTO drive shaft assembly equipped with a guard in good condition;

c) the potential hazards involved when bringing a part of the mower into working or transport position;

d) that the mower shall not be operated without guard(s) in place;

e) that the engine and all movement shall be stopped before any blockage removal, servicing or adjusting;

f) that variation in field conditions (such as the type and the density of the material being cut) can result in blockages, and the action of the operator can take to remove blockages;

g) that the working elements (provided with the mower) be used and the instructions be followed for clearing blockages (including a reminder of the need to stop the engine);

h) the need to apply locking devices for the raised parts before carrying out maintenance or transporting the mower;

i) the need for support or blocking when working under a raised mower;

j) the hazards associated with PTO overspeeding;

k) the hazard caused by the working elements continuing to rotate for some time after the power source has been disconnected;

l) the need to check for damage of the protective structures, canvases, chains and/or rubber strips and to replace damaged parts as necessary;

m) that there is a hazard that worn or damaged cutting elements can be ejected, so detailed information on when and how to replace the cutting elements shall be given;

n) that no person be allowed to climb on or ride on the mower;

o) the correct way of storing the mower to ensure stability;

p) hazards associated with worn or damaged cutting-element attachment means, and detailed information on when and how to replace the cutting element attachment means;

q) the need to determine whether an overrunning clutch is appropriate for the application;

r) the need to use replacement cutting-elements; cutting-element attachment means, protective skirts, and wear parts, as recommended by the manufacturer;

s) the importance of the driveline being securely attached onto the PTO.

7 Marking and safety signs

7.1 Marking

All mowers shall be marked in accordance with ISO 4254-1.

In addition, safety signs or symbols shall be affixed, drawing attention to;

— hazards caused by cutting elements during working and due to their inertia after the power source has been disconnected;

— hazards caused by objects ejected from the protected zone of the mower;

— hazards caused by operation of the mower without guard(s) in place;

— hazards caused by bringing a part of the mower into the transport or working position;

— prohibiting persons from climbing on or riding on the mower.

7.2 Safety signs

7.2.1 Safety signs shall be appropriately displayed when necessary to alert the operator and others of the risk of personal injury during normal operations and servicing.

7.2.2 Safety signs shall conform to the requirements as specified in ISO 4254-1.

Annex A
(informative)

List of significant hazards

For the purposes of this document, Table A.1 gives the significant hazard(s), the significant hazardous situation(s) and event(s) covered by this document, that have been identified by risk assessment as being significant for this type of machine, and which require specific action to eliminate or to reduce the risk.

Table A.1 — List of significant hazards

N°	Hazard	Hazardous situation and event	Clause/ subclause of ISO 4254-1	Clause/subclause of this part of ISO 4254
1.1	Crushing hazard			4.1, 6.1, 7.1
1.2	Shearing hazard			4.1, 4.3, 6.1, 7.1
1.3	Cutting or severing hazard			4.1, 4.3, 6.1, 7.1
1.4	Entanglement hazard			4.1, 4.3, 4.4, 4.5, 6.1, 7.1
1.5	Drawing-in or trapping hazard			4.3, 4.4, 4.5, 6.1, 7.1
1.6	Impact hazard			4.2, 4.3, 5.5.3, 5.6
1.7	High pressure fluid injection hazard		4.13	
1.8	Ejection of parts			4.2, 4.3, 5.5.3, 5.6
2.1	Electrical hazards, caused by electrical contact (direct or indirect)		4.12	
2.2	Hazards due to batteries, fire, emissions of dust and gas, etc		5.3, 5.6	
3	Thermal hazards resulting in burns and scalds by a possible contact of persons, by flames or explosions and also by the radiation of heat sources		5.5	
4.1	Hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	Noise	4.3	
5.1	Unhealthy postures or excessive efforts		4.11, 4.17	
5.2	Human error			6.1, 7.1
6.1	Failure of energy supply (of energy and/or control circuits)	a) failure, malfunction of control system (unexpected start up, unexpected overrun);		6.1, 7.1
		b) starting and stopping devices	5.1.8	

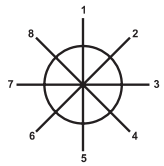
Table A.1 *(continued)*

N°	Hazard	Hazardous situation and event	Clause/ subclause of ISO 4254-1	Clause/subclause of this part of ISO 4254
6.2	Errors of fitting			6.1
6.3	Overturn, unexpected loss of machine stability			6.1
7.1	All kinds of guards			4.1, 4.3, 4.4, 4.5, 5.1, 5.6, 6.1
7.2	All kinds of safety related (protection) devices			4.1, 4.3, 4.4, 4.5, 5.1, 5.6
7.3	Safety signs			6.1
7.4	Essential equipment and accessories for safe adjusting and/or maintaining			6.1
8	Hazards due to sudden movement, instability, etc			4.1, 4.6, 4.7
9.1	Hazards to exposed persons due to uncontrolled movement			4.6, 4.7
9.2	Hazards due to break-up and/ or ejection of parts			4.2, 4.3, 4.4, 4.5, 5.1, 5.4, 5.5, 5.6
9.3	Loss of stability			6.1

Annex B
(informative)

Example of test recording forms

B.1 Large rotary mower thrown-object testing recording form



Machine Model: _____ Shielding Type (if used): _____

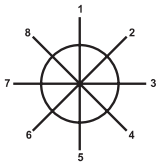
Serial No.: _____ Shielding Part No.: _____

Cutting Element Spindle (if multiple): _____ Conducted By: _____

Cutting Element Part No.: _____ Date: _____

NOTE % - Based on ratio of test object impacts or hits to number of objects struck by the cutting element.

Hole Position	Run No.	No. of Test Objects Dropped	No. of Test Objects Struck by Cutting Element	OUTSIDE OPERATOR ZONE				IN OPERATOR ZONE			
				Objec t Target Impacts		Object Target Hits		Object Target Impacts		Object Target Hits	
					% of Projectile Impacts		% of Projectile Hits		% of Projectile Impacts		% of Projectile Hits
		150 (min)	127 (min)	No.		No.		No.		No.	
1.	1.										
	2.										
	3.										
TOTAL #1											
2.	1.										
	2.										
	3.										
TOTAL #2											
3.	1.										
	2.										
	3.										
TOTAL #3											
4.	1.										
	2.										
	3.										
TOTAL #4	4.										
TOTAL OF ALL 8 HOLES											



Machine Model: _____ Shielding Type)if used): _____

Serial No.: _____ Shielding Part No.: _____

Cutting Element Spindle (if multiple): _____ Conducted By: _____

Cutting element Part No.: _____ Date: _____

NOTE % - Based on ratio of test object impacts or hits to number of objects struck by the cutting element.

Hole Position	Run No.	No. of Test Objects Dropped	No. of Test Objects Struck by Cutting Element	OUTSIDE OPERATOR ZONE				IN OPERATOR ZONE			
				Object Target Impacts		Object Target Hits		Object Target Impacts		Object Target Hits	
				No.	% of Projectile Impacts	No.	% of Projectile Hits	No.	% of Projectile Impacts	No.	% of Projectile Hits
		150 (min)	127 (min)								
5.	1.										
	2.										
	3.										
TOTAL #5											
6.	1.										
	2.										
	3.										
TOTAL #6											
7.	1.										
	2.										
	3.										
TOTAL #7											
8.	1.										
	2.										
	3.										
TOTAL #8	4.										
TOTAL OF ALL 8 HOLES											