INTERNATIONAL STANDARD

ISO 5395-1

Second edition
2013-09-01

Garden equipment — Safety requirements for combustion-engine-powered lawnmowers —

Part 1: Terminology and common tests

Matériel de jardinage — Exigences de sécurité pour les tondeuses à gazon à moteur à combustion interne —

Partie 1: Terminologie et essais communs

Reference number
ISO 5395-1:2013(E)

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Published in Switzerland

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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 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 5395-1 was prepared by the European Committee for Standarization (CEN) Technical Committee CEN/TC 144, *Tractors and machinery for agriculture and forestry* in collaboration with ISO Technical Committee TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 13, *Powered lawn and garden equipment*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition of ISO 5395-1, together with ISO 5395-2 and ISO 5395-3, cancels and replaces ISO 5395:1990, which has been technically revised. These three parts also incorporate the Amendment ISO 5395:1990/Amd.1:1992.

ISO 5395 consists of the following parts, under the general title *Garden equipment — Safety requirements for combustion-engine-powered lawnmowers*

— *Part 1: Terminology and common tests*

— *Part 2: Pedestrian-controlled lawnmowers*

— *Part 3: Ride-on lawnmowers with seated operator*

Introduction

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

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

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

Garden equipment — Safety requirements for combustion-engine-powered lawnmowers —

Part 1: Terminology and common tests

1 Scope

This part of ISO 5395 specifies terminology and common test methods used for verification of safety requirements for combustion engine powered rotary lawnmowers and cylinder lawnmowers including pedestrian-controlled (with or without sulky) and ride-on types (hereafter named "lawnmower"), and equipped with:

— metallic cutting means and/or;

— non-metallic cutting means with one or more cutting elements pivotally mounted on a generally circular drive unit, where these cutting elements rely on centrifugal force to achieve cutting, and have a kinetic energy for each single cutting element of 10 J or more.

This document does not apply to:

— robotic and remote-controlled lawnmowers, flail mowers, grassland mowers, sickle bar mowers, towed/semi-mounted grass cutting machines, and scrub-clearing machines;

— cutting-means assembly when used in combination with an agricultural tractor;

— electrically powered and battery-powered lawnmowers.

NOTE IEC 60335-1[1] together with IEC 60335-2-77[2] give requirements for pedestrian-controlled walk-behind electrically powered lawnmowers.

This document is not applicable to lawnmowers which are manufactured before the date of publication of this document.

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.

EN 1032:2003+A1:2008, *Mechanical vibration — Testing of mobile machinery in order to determine the vibration emission value*

IEC 61672-1:2002, *Electroacoustics — Sound level meters — Part 1: Specifications*

ISO 354:2003, *Acoustics — Measurement of sound absorption in a reverberation room*

ISO 683-9:1988, *Heat-treatable steels, alloy steels and free-cutting steels — Part 9: Wrought free-cutting steels*

ISO 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 4871, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 5008:2002, *Agricultural wheeled tractors and field machinery — Measurement of whole-body vibration of the operator*

ISO 5008:2002/Cor 1:2005, *Agricultural wheeled tractors and field machinery — Measurement of whole-body vibration of the operator — Technical Corrigendum 1*

ISO 5395-2:2013, *Garden equipment — Safety requirements for combustion-engine-powered lawnmowers — Part 2: Pedestrian-controlled lawnmowers*

ISO 5395-3:2013, *Garden equipment — Safety requirements for combustion-engine-powered lawnmowers — Part 3: Ride-on lawnmowers with seated operator*

ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

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

ISO 16063 (all parts), *Methods for the calibration of vibration and shock transducers*

ISO 20643:2005, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission*

ISO 20643:2005/Amd.1:2012, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission — Amendment 1: Accelerometer positions*

3 Terms and definitions

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

3.1
attachment
device designed for mounting only on a specific machine to perform a specific task related to mowing and not intended to be universally adaptable to other lawnmowers

3.2
brake steering
steering achieved by applying a decelerating force to the traction drive on one side of the lawnmower with the drive to the other side still applied

3.3
clutch steering
steering achieved by disconnecting the traction drive to one side of the lawnmower with the drive to the other side still fully engaged

3.4
cutting means
mechanism or part of the lawnmower that is designed to perform the cutting action

3.5
cutting-means assembly
cutting means together with the cutting-means enclosure, including cutting-means shaft(s) and guide wheels/slides

3.6
cutting-means control
device to disengage the cutting means from its drive and stop the cutting-means motion while keeping the engine running

3.7
cutting-means enclosure
part or assembly, including the discharge chute and guard for grass catcher opening, designed to prevent unintended contact with the cutting means

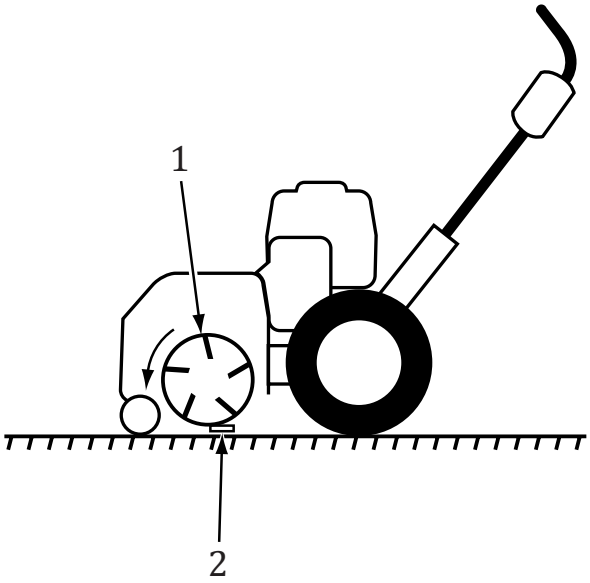
3.8
cutting-means tip circle
path determined by the outer-most point of the cutting-means cutting edge as it rotates about its axis

3.9
cutting-means stopping time
interval from the instant of release of the cutting-means operator-presence control or disengagement of the cutting-means control until the cutting means have stopped

3.10
cutting width
total distance across the cutting-means path at a right angle to the direction of travel

3.11
cylinder lawnmower
lawnmower with one or more cutting means, rotating about an axis parallel to a supporting surface, that provide a shearing action with a fixed cutter bar

Note 1 to entry: See example in Figure 1.



Key
1 cutting means
2 cutter bar

Figure 1 — Example of cylinder lawnmower cutting means

3.12
discharge chute
portion of the cutting-means enclosure, extending outward from the discharge opening, designed to control the ejection of material from the cutting means

3.13
discharge opening
opening in the cutting-means enclosure through which cut grass is ejected

3.14
flail mower
mower with a multiplicity of free-swinging cutting elements that rotate about a horizontal axis, which cuts the grass by impact and mulches it with the same tools

[SOURCE: ISO 17101-1:2012, definition 3.2]

3.15
grass catcher
part or combination of parts, intended to be used with the lawnmower, which provides a means for collecting grass clippings

[SOURCE: ISO 11094:1991, modified]

3.16
grassland mower
mower with a cutting means rotating about a vertical axis for cutting or mulching high grass, having a minimum cutting height of 50 mm, the cutting-means enclosure of which is not fully enclosed

3.17
hydrostatic bypass valve
device designed to allow a hydrostatically-driven lawnmower to be moved without the engine running

3.18
lever steer lawnmower
lawnmower in which steering, traction-drive engagement, and speed-control functions are combined and controlled by hand-operated lever(s), which can also control the braking function

3.19
maximum operating engine speed
highest engine speed that can be attained with the operator control and with the cutting means engaged

3.20
mulching lawnmower
rotary lawnmower which returns clippings to the lawn without a discharge opening

3.21
nominal power
power at the maximum operating engine speed

Note 1 to entry: The power is expressed in kilowatts (kW).

3.22
normal operation
use of the machine, by the operator, which is reasonably foreseeable and which is consistent with such activities as starting, cutting grass, stopping, fuelling, connecting to (or disconnecting from) a power source, emptying the grass catcher, driving and mounting or dismounting ride-on machines

3.23
normal use
normal operation, routine maintenance, servicing, cleaning, transporting, storage, attaching or removing attachments, and making routine adjustments

3.24
operator position
position of the operator holding the handles behind a pedestrian-controlled lawnmower or riding and holding the steering device on a ride-on lawnmower or pedestrian-controlled lawnmower equipped with a sulky

3.25
operator-presence control
OPC
device that automatically interrupts power to a drive when the operator's actuating force is removed

3.26
parking brake
device to prevent a stopped machine from moving

3.27
pedestrian-controlled lawnmower
lawnmower, with or without traction drive, designed to be controlled by the operator walking behind the machine or from an attached sulky

3.28
pivoting handle
handle which is foldable for storage or park position

3.29
lawnmower
lawn-cutting machine, powered by a combustion engine, where the cutting means operates in a plane approximately parallel to the ground and which uses the ground to determine the height of cut by means of wheels, air-cushion or skids, etc.

3.30
ride-on lawnmower
self-propelled lawnmower on which an operator rides

3.31
robotic lawnmower
unattended lawnmower that operates automatically

3.32
roll-over protective structure
ROPS
structure designed to minimize the likelihood of crushing injury to the operator resulting from accidental roll over of the machine with the operator in the normal operator position

3.33
rotary lawnmower
lawnmower in which one or more cutting means, cutting by impact, rotate about an axis perpendicular to the cutting plane

3.34
scrub-clearing machine
powered mower, with cutting means rotating about a vertical axis, designed for cutting scrub and woody vegetation, with no ground support forward of the cutting means and supported on either side by skids, not wheels

3.35
service brake system
means for decelerating and stopping a machine from its ground travel speed

3.36
sickle bar mower
powered mower that reciprocates a knife or knives to provide a shearing action with a stationary cutter bar or movable knife

3.37
stability
ability of a lawnmower to resist overturning as a result of static or dynamic forces arising in normal use, e.g. travelling on slopes

[SOURCE: ISO 5053:1987, modified]

3.38
stopping distance
distance travelled between the point of the first application of the service brake control and the point at which the machine motion stops

3.39
sulky
removable trailing platform with wheels, rollers or skids designed to carry an operator while controlling a self-propelled pedestrian-controlled lawnmower

3.40
swing-over handle
handle which allows two opposite operator positions without turning the machine

3.41
throw line
steepest line in a vertical plane, tangential to the periphery of the cutting cylinder in the direction of rotation, which does not intersect a guard or other components of a cylinder lawnmower

3.42
transport position
designated position of the cutting means during movement between work locations

3.43
zero-turn lawnmower
ride-on lawnmower that can pivot 360° about the midpoint between the drive wheels

4 Common test methods

4.1 If not otherwise specified within this document, the tests may be carried out in any order and on separate machines, cutting-means enclosures, and cutting-means components.

When the order in which tests should be carried out and the number of permitted machines are not defined in this part of ISO 5395, these conditions should be determined by agreement between the persons carrying out the tests and the manufacturer. Descriptions of a number of common test methods applicable to both pedestrian-controlled lawnmowers and ride-on lawnmowers are included in the annexes of this part of ISO 5395.

4.2 The following test methods are applicable to rotary lawnmowers only:

— cutting-means impact test as given in Annex B;

— foot protection test as given in Annex C;

— structural integrity test as given in Annex D;

— thrown object test as given in Annex E.

4.3 The following test methods are applicable to both rotary lawnmowers and cylinder lawnmowers:

— cutting-means stopping time and durability test as given in Annex A;

— noise test code as given in Annex F;

— whole-body vibration and hand-arm vibration at the handles as given in Annex G;

— determination of hot surfaces as given in Annex H.

Annex A
(normative)

Lawnmower cutting-means stopping time test

A.1 General

This annex specifies the method to measure the stopping time of cutting means.

A.2 Test object

The test shall be carried out on a lawnmower equipped with the cutting means to be tested. If the lawnmower has alternative cutting means available, it shall be tested with the cutting means which produces the longest stopping time.

A.3 Apparatus

A.3.1 Rotational speed indicator, with a rotating speed reading inaccuracy of ±2,5 %.

A.3.2 Time recording device.

A.3.2.1 Stopwatch, in cases where the results obtained are at least 0,3 s less than the allowed cutting-means stopping time.

A.3.2.2 Automatic time recording device, with an inaccuracy of ±2,5 % of the maximum allowed stopping time and including devices according to A.3.2.2.1 and A.3.2.2.2.

A.3.2.2.1 Device, for registering the moment of release of the cutting-means operator-presence control or operation of the control.

A.3.2.2.2 Device, for registering the movement of the cutting means with at least 36 inputs per revolution.

A.4 Test condition and lawnmower preparation

The ambient temperature shall be between 15 °C and 35 °C.

The lawnmower shall be mounted and instrumented in such a manner that the results of the test are not affected. If an external starting device is used, it shall not influence the results.

Prior to the test the lawnmower shall be assembled and adjusted according to the instruction handbook.

Knives of cylinder lawnmowers shall be lubricated. For cylinder lawnmowers, the rotating cutting cylinder(s) and/or the stationary cutting edge(s) shall be adjusted such that either:

— a sheet of Kraft paper, of nominal 80 g/m^2 construction, is cut at least along 50 % of the width of cut, or

— the gap between moving and stationary cutting means at standstill does not exceed 0,15 mm over the whole width of cut when checked with calibrated strip gauges.

The lawnmower shall be operated for 15 min. During this 15 min period, the cutting-means control shall be operated 10 times at maximum operating engine speed.

For cylinder lawnmowers, care shall be taken to avoid overheating the cutting means by operating continuously (without cutting grass) and therefore appropriate interruptions for cooling and lubrication can be introduced.

A.5 Cutting-means stopping time

Stopping time is measured from the moment of release of the OPC or disengagement of the cutting-means control to when the cutting means are deemed to have stopped, which for an automatic time recording device is the time at which the automatic time recording device received its last input.

An automatic time recording device shall be used when measurement by other means can result in a measured stopping time within 0,3 s of the maximum permitted stopping time.

A.6 Test procedure

The lawnmower shall be operated at maximum operating engine speed. The maximum operating engine speed shall be checked before testing. If the measured maximum operating engine speed is outside the value specified in the instruction handbook, the engine speed shall be adjusted in accordance with the manufacturer's instructions.

The means of operating the lawnmower during the test shall be such that the OPC or the cutting-means control is released abruptly from the full "on" position and it returns to the "idle" or "off" position by itself.

The lawnmower cutting means shall be subjected to 5 000 stop/start cycles. The 5 000 test cycles are not required to be continuous. The lawnmower shall be maintained and serviced in accordance with the manufacturer's instructions throughout the test. There shall be no maintenance or adjustment after 4 500 cycles have been completed.

For lawnmowers with an engine stop OPC and separate cutting-means control, only the separate cutting-means control (not the engine stop OPC) shall be tested 5 000 cycles according to this section.

Each cycle shall consist of the following sequence:

a) accelerate the cutting means from rest to the maximum operating engine speed;

b) hold it at this speed for a short time to ensure that it is stable;

c) disengage/release the cutting-means control;

d) allow a short time at rest before commencing the next cycle.

This test is not representative of normal operation and therefore the cycle times shall be set to avoid unnecessary wear or damage to the lawnmower.

The cutting-means stopping time shall be measured for each of the following:

— the first five cycles of the 5 000 cycle test sequence (not including the 10 preparatory operations); and

— each of the last five cycles prior to any brake maintenance or adjustment carried out during the test; and

— the last five cycles of the 5 000 test cycles.

No other cutting-means stopping times need to be recorded.

If the test sample fails to complete the full number of cycles but otherwise meets the requirements of this test, either the lawnmower can be repaired, if the brake mechanism is not affected, and the test continued, or, if the lawnmower cannot be repaired, one further sample can be tested which shall then comply fully with the requirements.

Annex B
(normative)

Rotary lawnmower cutting-means impact test

B.1 General

This annex specifies the test method to evaluate mechanical strength relating to the cutting-means assembly of rotary lawnmowers.

It is not required that the lawnmower be suitable for use after this test has been completed.

B.2 Test object

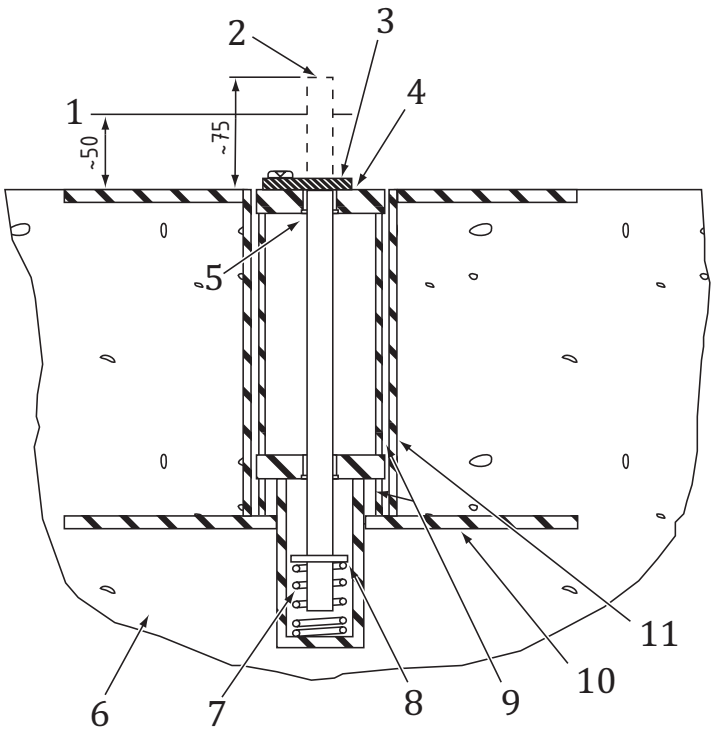
The test shall be carried out on a lawnmower equipped with cutting-means assembly that has not previously been subjected to an impact test. If there are alternative cutting means available for the same lawnmower, it shall be tested in all configurations.

B.3 Apparatus

B.3.1 Impact test fixture with a 25 mm ± 0,5 mm diameter steel rod, of Grade 1 according to ISO 683-9, or equivalent, which is retained under load for example by a spring and then capable of being released so it abruptly rises to about 75 mm above the supporting surface. An example of an impact test fixture is shown in Figure B.1. It shall be possible to adjust the height of the loaded rod, when it is in the retracted position, so that it is lower than the cutting means of the lawnmower to be tested.

B.3.2 Target panels configuration according to E.7.

Dimensions in millimetres



Key

1 cutting-means height
2 released steel rod position
3 remote control actuating lever (metal plate)
4 end fittings: 25 mm thick with diameter 27 mm hole, fitted to 100 mm standard pipe, identical parts both ends,
5 retracted steel rod position
6 concrete or an equivalent material
7 compression spring
8 pin or washer fixed to rod
9 removable cylinder assembly
10 reinforcement
11 standard pipe

Figure B.1 — Example of impact test fixture

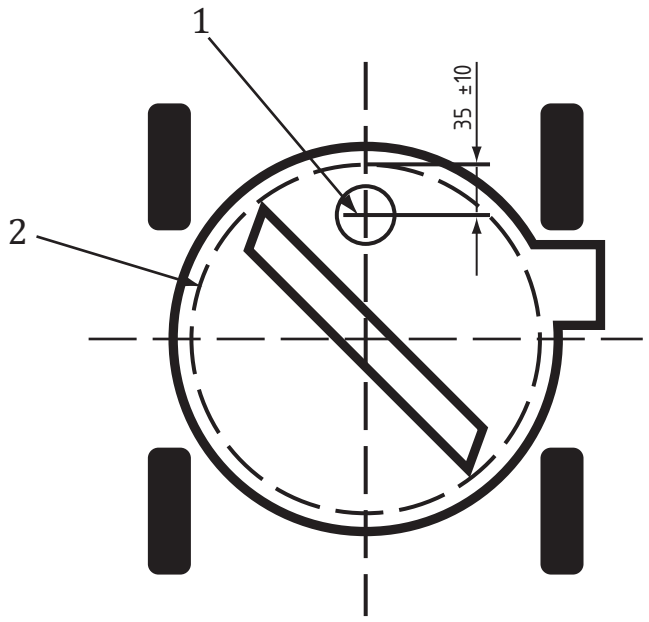
B.4 Impact test

The tests shall be done at an ambient temperature between 15 °C and 35 °C.

The cutting means of the test lawnmower shall be adjusted to the cutting height closest to 50 mm.

The lawnmower shall be positioned over the impact test fixture so that when the steel rod is released from its retracted position using the remote control it enters into the path of the rotating cutting means. The cutting means shall strike the test rod within 35 mm ± 10 mm of the cutting-means tip circle (see Figure B.2) at the front (12 o'clock ± 5° position).

Dimensions in millimetres



Key

1 injection point for steel rod at the front (12 o'clock ± 5° position)

2 cutting-means tip circle

Figure B.2 — Point of entry of steel rod into the path of rotating cutting means at the front (12 o'clock position)

The lawnmower shall be operated at maximum operating engine speed. The maximum operating engine speed shall be checked before testing. If the measured maximum operating engine speed is outside the value specified in the instruction handbook, the engine speed shall be adjusted in accordance with the manufacturer's instructions.

Target panels shall be arranged around the lawnmower as described in E.7.2.

With the lawnmower running at maximum operating engine speed, the rod shall be inserted once into the path of each cutting means. The test shall continue for a minimum of 3 s after the rod has been inserted. The rod shall be replaced after each test.

When necessary, pedestrian-controlled lawnmowers shall be elastically restrained to minimize horizontal movement during the test.

Where it is not possible to insert the rod in the specified position due to lawnmower design, the lawnmower shall be moved the minimum distance necessary to permit the rod to be inserted.

A new cutting-means assembly shall be used for each impact test, if not otherwise agreed between the persons carrying out the tests and the lawnmower manufacturer.

Inspect and record any damage and penetration of the target panels.

Annex C
(normative)

Rotary lawnmower foot protection test

C.1 General

This annex specifies the test method to evaluate the cutting-means enclosure related to the protection of the foot from contacting the cutting means of the rotary lawnmower.

C.2 Test object

The test shall be carried out on a lawnmower equipped with the cutting-means assembly to be tested. If there are alternative cutting-means assemblies available for the same lawnmower, it shall be tested in all configurations.

Components of lawnmowers, such as wheels and frames, shall be considered as part of the cutting-means enclosure for the purpose of this test.

C.3 Apparatus

C.3.1 Foot probe with dimensions according to Figure C.1. All portions of the foot probe which can come into contact with the cutting-means assembly shall be hard with a surface roughness equivalent to 400 grit sand paper. The surface on which the base of the foot probe is expected to slide shall be of a smooth, hard construction so as to not introduce friction to affect the probe movement forces.

Dimensions in millimetres

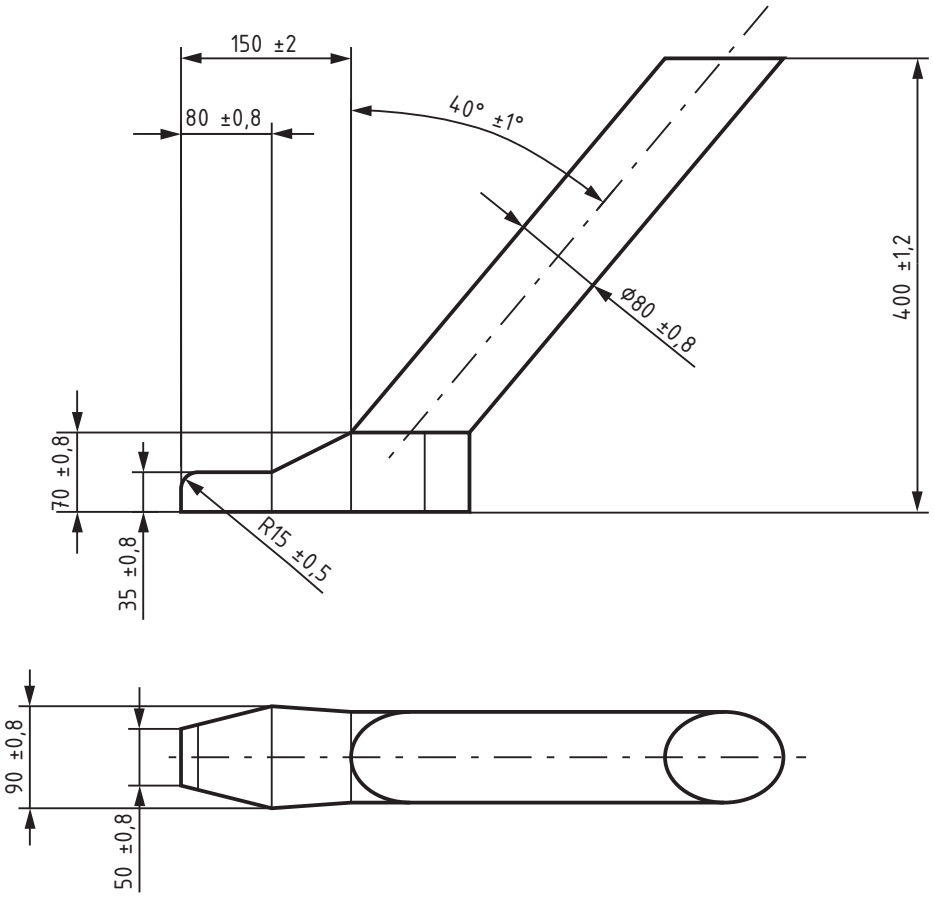


Figure C.1 — Foot probe

C.4 Test conditions and lawnmower preparation

The tests shall be done at an ambient temperature between 15 °C and 35 °C.

The lawnmower shall be placed on a smooth hard flat horizontal surface. Discharge chutes, guards and deflectors shall be in their operating position on the cutting-means enclosure and the lawnmower support members shall be in contact with the supporting surface.

The operating position of discharge chutes, guards and deflectors shall be determined when:

— the lawnmower is operated on the coconut matting of E.6, and

— the cutting means are engaged and operated at maximum operating engine speed, and

— the cutting means are adjusted to the lowest and highest cutting positions.

C.5 Verification

WARNING — — To avoid injury to test personnel, this test shall be conducted under static conditions, with the lawnmower and cutting means stationary.

Except for air-cushion lawnmowers, the tests shall be made at the highest and lowest cutting heights. If the cutting-means path height is different at different cutting-means speeds, the test shall be conducted so as to include the upper and lower extremes of the cutting-means height.

Air-cushion lawnmowers shall be supported in the highest height they can reach under their normal operating conditions.

The foot probe shall be inserted towards the cutting means on areas around the cutting-means enclosure as described in ISO 5395-2 and ISO 5395-3, respectively.

The probe movements shall conform to the following sequence:

a) the base of the probe shall be parallel and on or at any height above the lawnmower supporting surface. Testing above the supporting surface shall be performed in a manner consistent with testing performed on the supporting surface. This can require the use of shims or a similar device to transpose the plane of the supporting surface. The probe shall be moved horizontally; and

b) the probe shall be inclined forward and backward by up to 15°; and

c) except for the discharge chute and self-closing guard, the probe shall be applied until a horizontal force of 20 N maximum is reached, or until any portion of the cutting-means enclosure lifts from its original position. For a self-closing discharge chute and self-closing guard, the probe shall be applied until a horizontal force of 20 N maximum is reached.

No vertical force shall be applied to the foot probe, except as necessary to maintain the horizontal movement.

Any contact of the foot probe with the cutting-means path constitutes a failure and shall be recorded.

Annex D
(normative)

Rotary lawnmower structural integrity test

D.1 General

This annex specifies the test method to evaluate the structural integrity of the cutting-means enclosure of the rotary lawnmower.

D.2 Test object

The test shall be carried out on a lawnmower equipped with the cutting-means assemblies to be tested. If there are alternative cutting-means assemblies available for the same lawnmower, it shall be tested in all configurations, with and without attachments such as grass catchers or mulching parts.

D.3 Apparatus

D.3.1 Steel balls with 12,75 mm ± 0,25 mm diameter, and hardened to 45 HRC minimum (for example, balls used in ball-bearings). Balls shall not be chipped or damaged.

D.3.2 Structural integrity test fixture with a smooth hard flat horizontal steel surface at least 1,5 mm thick on a 19 mm thick plywood base, or on a single steel plate with a minimum thickness of 4 mm, extending at least 25 mm beyond the cutting-means enclosure (as shown in Figure D.1). There shall be an air inlet hole in the base plate at a position corresponding to the centre of each cutting means with diameter as specified in Table D.1.

Table D.1 — Through hole size for structural integrity test

Lawnmower type	**Cutting-means tip circle diameter** (CTCD)	**Air inlet hole diameter** (mm) ± 5 mm
Non-Mulching	All	0,3 x CTCD
Mulching	CTCD < 635 mm	CTCD - 127
Mulching	CTCD ≥ 635 mm	0,8 x CTCD

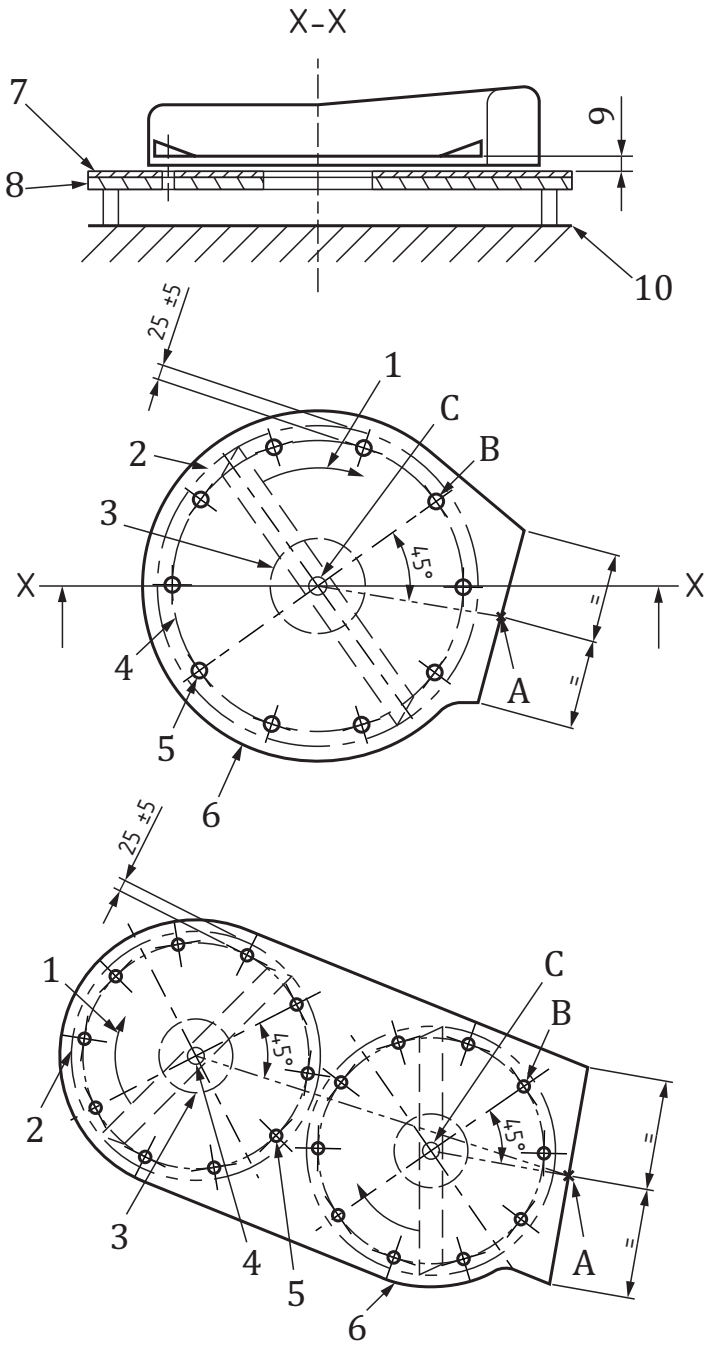
D.3.3 Injection means.

There shall be means to inject the balls with variable velocity. The range of velocity with which the balls are injected shall be such that each ball achieves a free rise height of 30 mm to 270 mm above the cutting plane of the cutting means.

There shall be 10 equally spaced injection points, 25 mm ± 5 mm inside the cutting-means tip circle. These injection points shall start from point “B”, which is on line “BC”, 45° from a line “AC” in a direction counter to the direction of cutting-means rotation. For lawnmowers with a discharge opening, “A” is the centre of the discharge chute exit and “C” is the centre of the cutting-means tip circle (see Figure D.1). For lawnmowers with no discharge opening (for example, mulching lawnmowers), the starting point “B” shall be at the 12 o’clock position with regard to the longitudinal axis.

The injection tubes shall not protrude above the steel plate.

Dimensions in millimetres



Key

A	centre of discharge chute exit	5	10 x Ø15 injection points equally spaced on each spindle
B	ball injection points	6	cutting-means enclosure
C	centre of cutting-means tip circle	7	steel plate
1	direction of rotation	8	plywood
2	cutting-means tip circle	9	cutting height
3	air inlet hole	10	hard level horizontal ground
4	injection hole centreline		

Figure D.1 — Structural integrity test fixture — Single and multiple cutting means examples

D.4 Test condition and lawnmower preparation

The tests shall be done at an ambient temperature between 15 °C and 35 °C.

The lawnmower shall be positioned on the steel plate with the cutting-means axis “C” over the centre of the air inlet hole described in D.3.2. Pedestrian-controlled lawnmowers shall be elastically restrained at the handle to ensure that the lawnmower does not have any permanent horizontal movement during the tests. Ride-on lawnmowers shall be restrained from moving horizontally.

The injection points shall be adjusted so their centres are 25 mm ± 5 mm inside the cutting-means tip circle.

The cutting means shall be set at the lowest adjustable cutting height, but not less than 30 mm. If the maximum cutting height is less than 30 mm then the lawnmower shall be tested when adjusted to its maximum cutting height.

The lawnmower shall be operated at maximum operating engine speed. The maximum operating engine speed shall be checked before testing. If the measured maximum operating engine speed is outside the value specified in the instruction handbook, the engine speed shall be adjusted in accordance with the manufacturer’s instructions.

D.5 Test procedure

Ten balls shall be injected into each of the 10 injection points. If preferred, instead of using 10 injection points, either the lawnmower can be rotated in 36° increments from injection point “B” to achieve the same effect. Or alternatively using only one injection point this injection point can be rotated in 36° increments from point B to achieve the same effect.

The test shall be conducted once for each combination of cutting-means assembly and cutting-means enclosure. The lawnmower shall be equipped with a new cutting-means assembly for each test if not otherwise agreed between the persons carrying out the tests and the lawnmower manufacturer.

Inspect and report any damage on the cutting-means enclosure.

In the event of a test failure, two additional lawnmowers of the same model and configuration can be tested in an attempt to demonstrate compliance. If so, both additional lawnmowers shall be tested, and if either of these fails, the lawnmower shall be considered not to be in compliance with the structural integrity requirement of this standard.

It is not required that the lawnmower be suitable for use after this structural integrity test is completed.

Annex E
(normative)

Rotary lawnmower thrown object test

E.1 General

This annex specifies the test method to evaluate the design of the rotary lawnmower cutting-means enclosure, guards and grass catchers to minimize the risk of thrown objects in normal use.

E.2 Test equipment

a) A base according to E.6.

b) Test enclosure according to E.7.

c) Steel balls of 6,35 mm ± 0,2 mm diameter, hardened to 45 HRC minimum (for example, balls used in ball-bearings). Balls shall not be chipped or damaged.

d) Ball injection system which has sufficient capacity to inject steel balls in accordance with E.4 d).

E.3 Lawnmower

The lawnmower shall be tested in all operational configurations, with and without attachments such as grass catchers or mulching parts.

Each test shall be carried out on a lawnmower equipped with a new cutting-means assembly if not otherwise agreed between the persons carrying out the tests and the lawnmower manufacturer.

For lawnmowers that have multiple vertical cutting-means positions within the cutting-means enclosure for cut height setting, the cutting means shall be positioned in the lowest recommended position within the cutting-means enclosure. The cutting height with the lawnmower standing on a hard level surface shall be adjusted to 30 mm or, if this is not possible, the next higher cutting height shall be used. Lawnmowers with a maximum cutting height setting of 30 mm or less shall be set at their maximum cutting height.

E.4 Preparation

a) The lawnmower shall be positioned on the test base (E.6) over the injection point so that it is located at the front (12 o'clock ± 5° position) and within 25 mm ± 5 mm of the cutting-means tip circle. See Figures E.5 to E.9.

   The lawnmower shall be restrained in such a manner that the specified position relative to the injection point is maintained throughout the test. For pedestrian-controlled lawnmowers, this can be achieved by elastically restraining the handle. Ride-on lawnmowers shall be restrained from moving horizontally. The fixing medium shall not obstruct the free passage of balls from under the cutting-means enclosure.

b) Locate target panels (E.7.2) around the lawnmower according to E.7.

c) Operate the lawnmower at the maximum operating engine speed. The maximum operating engine speed shall be checked before testing. If the measured maximum operating engine speed is outside

the value specified in the instruction handbook, the engine speed shall be adjusted in accordance with the manufacturer's instructions.

d) Adjust the ball injection system so that the rise height of the balls will be as low as possible and yet ensure that the cutting means impacts with the ball.

To establish the ball rise height, adjust the velocity with which the ball is injected so that the ball rises not less than 30 mm above the surface of the coconut matting and within an angle of 10° of the vertical axis. Inject the balls one at a time into the cutting-means path. Increase the velocity of the balls in small increments until each ball is contacted by the cutting means.

E.5 Test

The tests shall be done at an ambient temperature between 15 °C and 35 °C.

Each test shall be carried out on a lawnmower equipped with a new cutting-means assembly if not otherwise agreed between the persons carrying out the tests and the lawnmower manufacturer.

Start the test when the minimum ball injection velocity has been established.

A new cutting means shall be used after each 100 cutting means to ball contacts if not otherwise agreed between the persons carrying out the tests and the lawnmower manufacturer. Balls remaining within the test fixture or on the test surface shall be removed to minimize ricochet.

NOTE In the event of excessive target hits in a localized area, it may be necessary to repair or replace the target before continuing with the tests.

Continue and inject balls until 500 cutting means to ball contacts have been counted in each test.

Multi-spindle lawnmowers shall be tested for all spindles individually, and if one or more cutting-means assemblies can be raised while others are running, tests shall be carried out in the worst combination of cutting-means assemblies raised and lowered.

Count and record hits. Balls that hit and damage the centreline of the target area height line shall be scored with the target area below that line.

E.6 Base

The base shall be approximately 19 mm plywood covered with coconut matting rectangles firmly fixed to the plywood (see Figures E.1 to E.3). The coconut matting rectangles shall be a minimum of 500 mm on each side. The Figures show nails to attach the matting. Nails are an acceptable method of attaching, although nails are not required as the only means of attachment to the plywood. The nail pattern shown in Figure E.3 is a suggested pattern for 500 mm squares of matting. Any portion of coconut matting showing a worn area where there is evidence of 50 % or more reduction in the height or number of fibres shall be replaced.

The minimum base width shall be 1,5 m larger than the cutting width of the lawnmower, and 1,5 m longer than the distance between the forward edge of the leading cutting-means tip circle and the rear edge of the trailing cutting-means circle.

The coconut matting shall weigh approximately 7 000 g/m^2 and shall have approximately 20 mm high fibres with general vertical orientation embedded in a PVC base.

The injection tube outlet shall be fixed and flush with, or below, the upper surface of the coconut matting (see Figure E.2).

E.7 Test enclosure and target panels

E.7.1 General

The test enclosure shall be constructed generally as shown in Figures E.1 and E.4.

The walls shall consist of 8 fibreboard target panels as specified in E.7.2. Each target panel shall be 900 mm high and positioned perpendicular to the base of the test fixture so as to form an octagon. The target panels shall generally be located perpendicular to a radial line extending 750 mm ± 50 mm from the cutting-means tip circle of single spindle lawnmowers, or to the nearest cutting-means tip circle of multi-spindle lawnmowers, as shown in Figures E.5 to E.9. If a target interferes with a part of the lawnmower such as a grass catcher, a handle or a wheel, the minimum number of target panels necessary shall be moved back to avoid such interference.

There shall be no gaps between the target panels. Any target panel supports shall be the minimum necessary to provide the necessary support and shall be positioned so that they will not influence the results of the tests. In order to facilitate the counting of hits, the panel supports shall be designed to allow sliding in and out of at least one additional target panel.

The target shall be divided into elevation zones by horizontal lines as shown in Figure E.4.

For pedestrian-controlled machines only, there shall be an operator target area. Except for machines with a movable offset handle this area shall be 900 mm ± 4 mm wide and 2 000 mm ± 6 mm high and shall comprise the target panel directly behind the machine together with an additional panel above the test enclosure. The portion of the operator target area above the height of the target panels shall be a single sheet of 150 g/m^2 ± 25 g/m^2 Kraft paper located in the same vertical plane as the target panel that is located behind the rear of the machine.

If the machine has movable offset handles the width of the operator target area shall be 900 mm ± 4 mm plus the total possible amount of offset. The offset shall be measured from the handle centreline when the handle is placed in the extreme right position and to the handle centreline when it is placed in the extreme left position.

During any of the tests, in the event of excessive hits in a localized area, it may be necessary to repair or replace the target panel before continuing with the tests. Replace the target panels if hits from previous tests leave holes that cannot be covered by a 40 mm square gummed label. Not more than one thickness of gummed label (patch) shall be placed over any one area.

E.7.2 Target panel

E.7.2.1 Material

A single target panel shall be of any of the following (see Figure E.1), that meet the penetration tests of E.7.2.2:

— a single sheet of corrugated fibreboard;

— a single sheet of corrugated fibreboard with extra sheets of appropriate Kraft paper added in front of the target face;

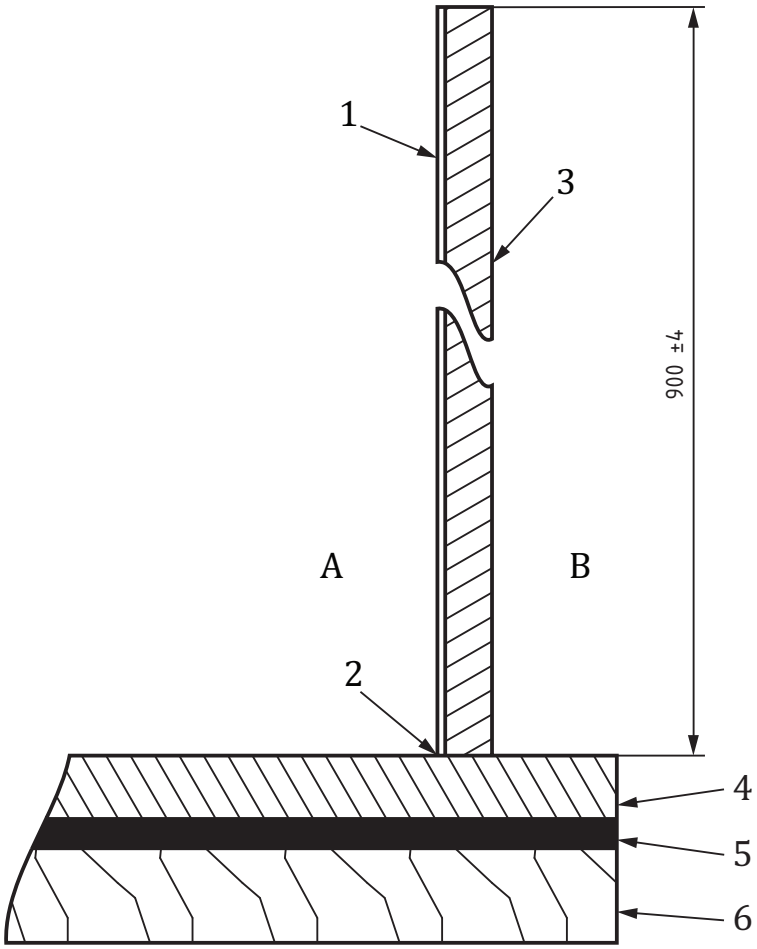
— If Kraft paper is used it shall be fixed to the fibreboard, i.e. “spot” glued, to ensure that the whole of the paper stays in close proximity to the surface of the fibreboard when it is in position in the test enclosure;

— two sheets of corrugated fibreboard stacked together.

The flutes of the corrugated fibreboard target panels shall be vertical.

The fibreboard construction shall have two or three liners and have one or two flutes.

Dimensions in millimetres



Key

A inside of test enclosure

B outside of test enclosure

1 Kraft paper, used as necessary and spot glued to the inside surface of the target panels to ensure close proximity over the whole area

2 target panel inside edges fit snugly to base surface to prevent balls from escaping from test enclosure

3 target panels made of a single sheet of single or double flute corrugated fibreboard of 9 mm maximum thickness with the flutes running vertically

4 coconut matting

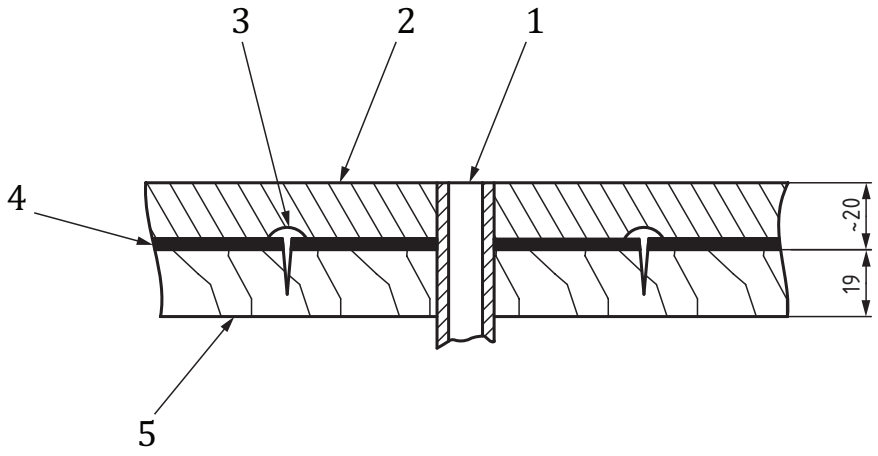
5 PVC base for coconut matting

6 plywood base

NOTE Dimensions are nominal unless otherwise stated.

Figure E.1 — Test enclosure, construction detail

Dimensions in millimetres, approximate



Key

1 top of injection tube level with or below surface of matting'
2 coconut matting
3 nail
4 PVC
5 plywood base

Figure E.2 — Base detail

Dimensions in millimetres, approximate

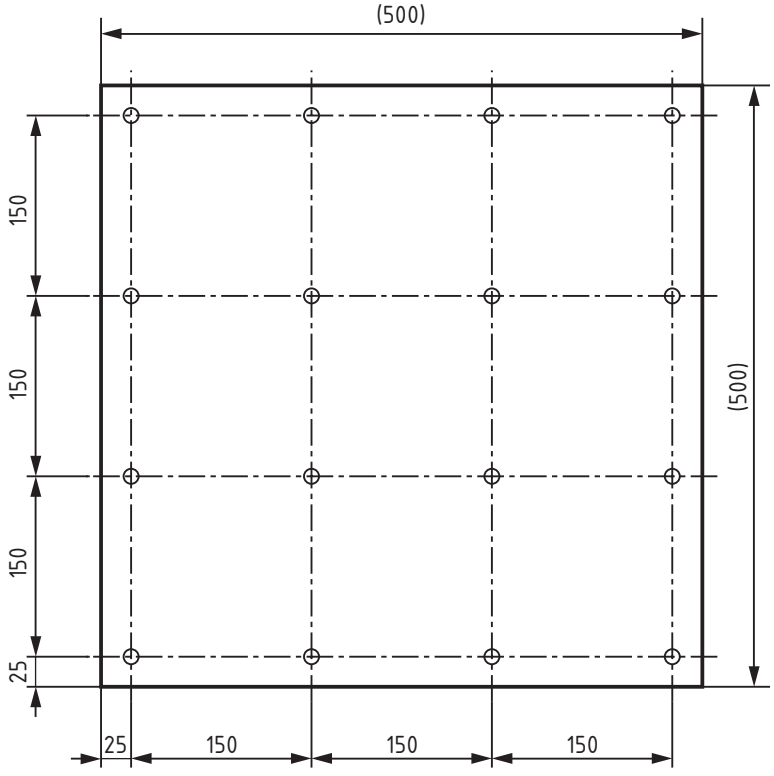
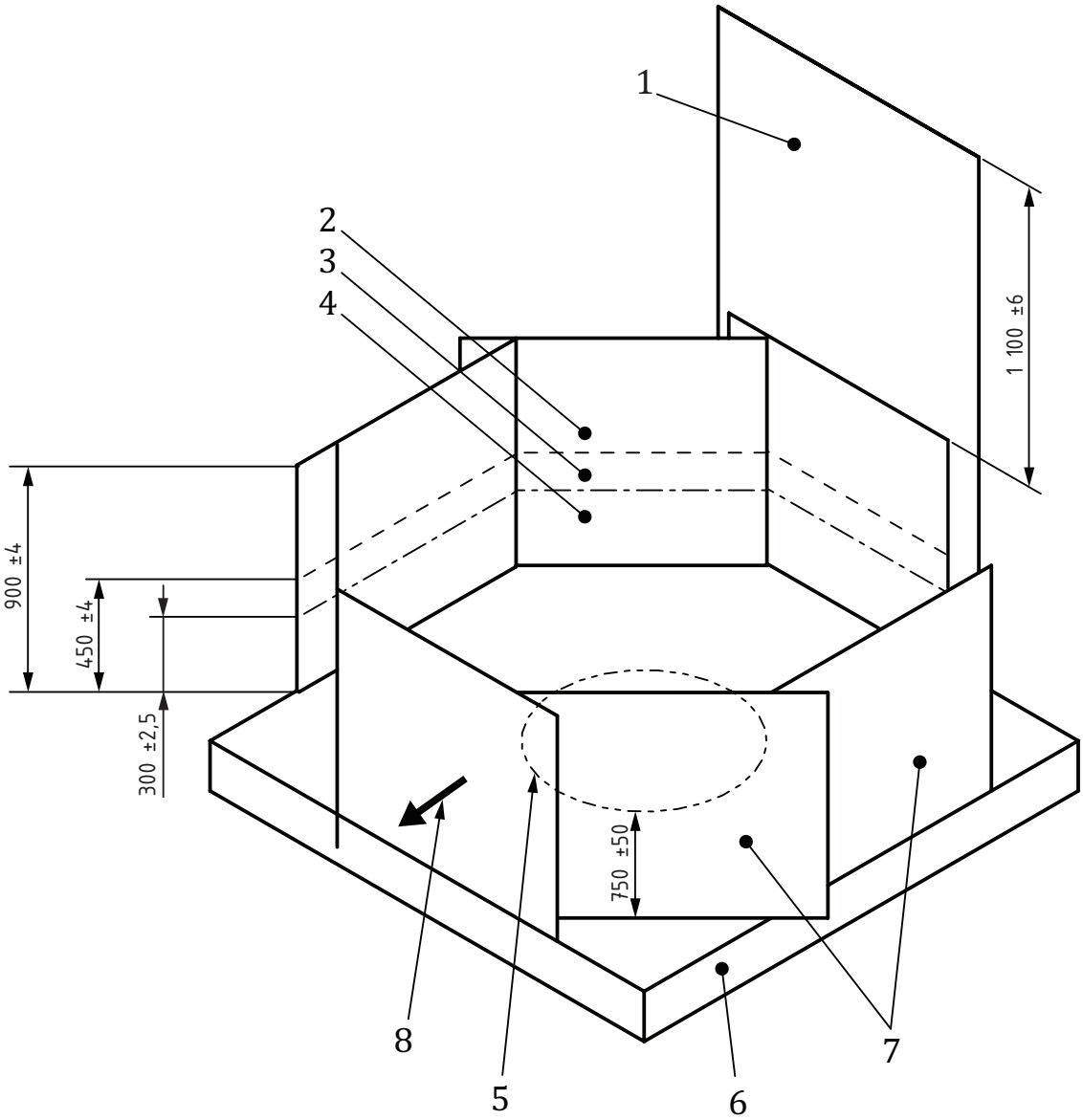


Figure E.3 — Example of base, nail plan

Dimensions in millimetres

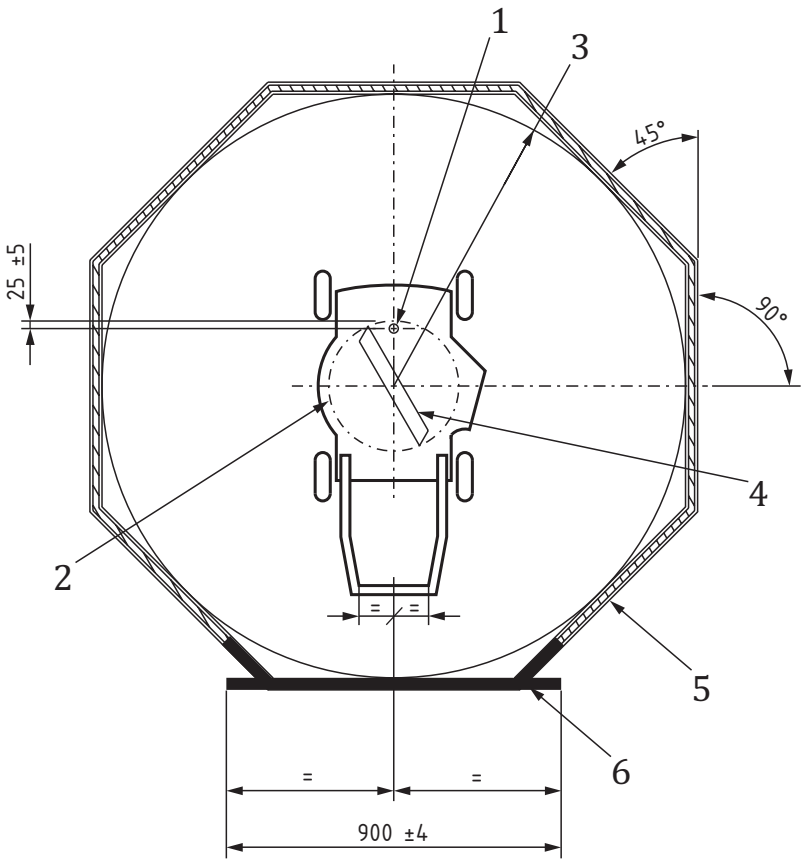


Key

1 top operator target area (single thickness Kraft paper target panel for pedestrian lawnmowers only)
2 top target area
3 middle target area
4 lower target area
5 cutting-means tip circle
6 base (see Figures E.2 and E.3)
7 eight corrugated fibreboard target panels with flutes vertical (see Figure E.1)
8 machine front

Figure E.4 — Test enclosure, general view

Dimensions in millimetres



Key

1 injection point

2 cutting-means tip circle

3 R = 750 + (BTC/2) mm ± 50 mm where BTC = cutting-means tip circle. If interference occurs between machine and target panels, move target panels to just clear.

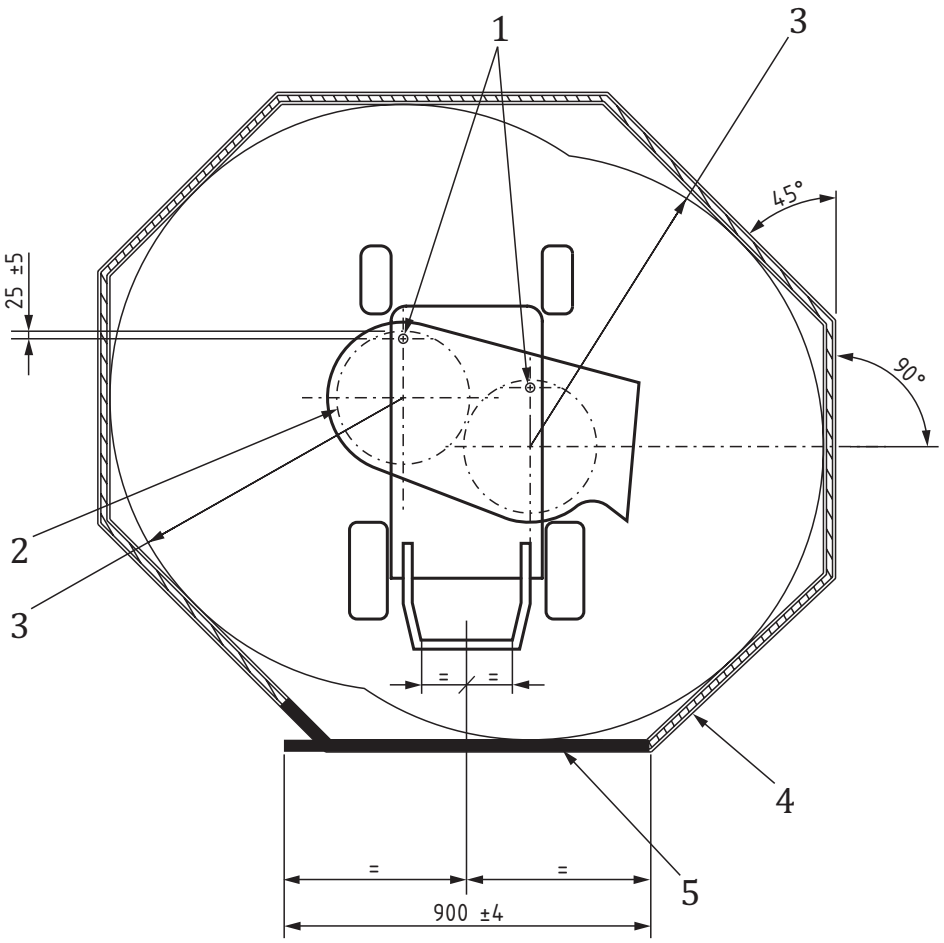
4 cutting means

5 lower operator target area 0 mm to 900 mm

6 upper operator target area 900 mm to 2 000 mm (Kraft paper)

Figure E.5 — Test enclosure, pedestrian-controlled single spindle

Dimensions in millimetres



Key

1 injection points (2)

2 cutting-means tip circle

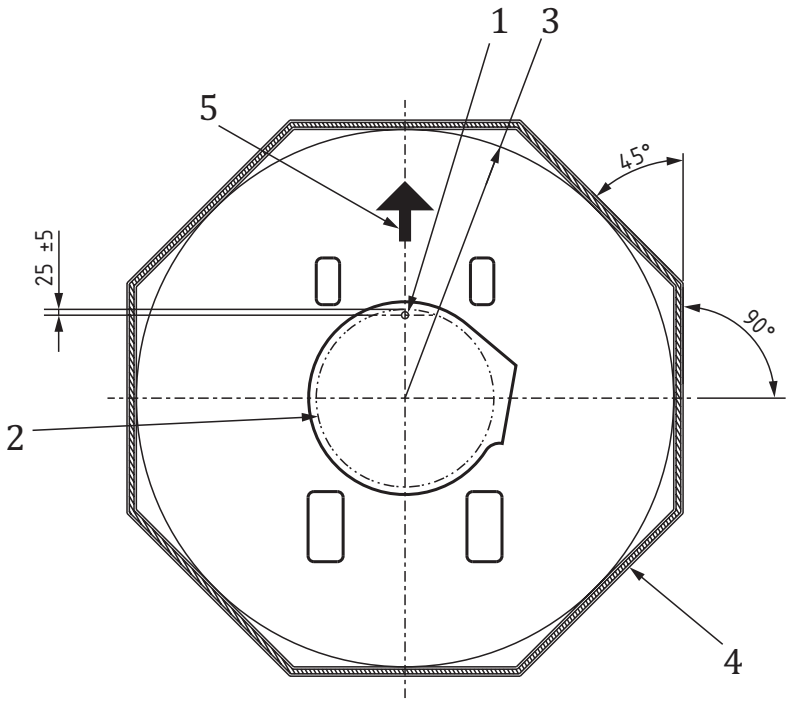
3 R = 750 + (BTC/2) mm ± 50 mm where BTC = cutting-means tip circle. If interference occurs between machine and target panels, move target panels to just clear.

4 eight target panels, 900 mm high

5 upper operator target area 900 mm to 2 000 mm (Kraft paper)

Figure E.6 — Test enclosure, pedestrian-controlled multiple spindle

Dimensions in millimetres



Key

1 injection point

2 cutting-means tip circle

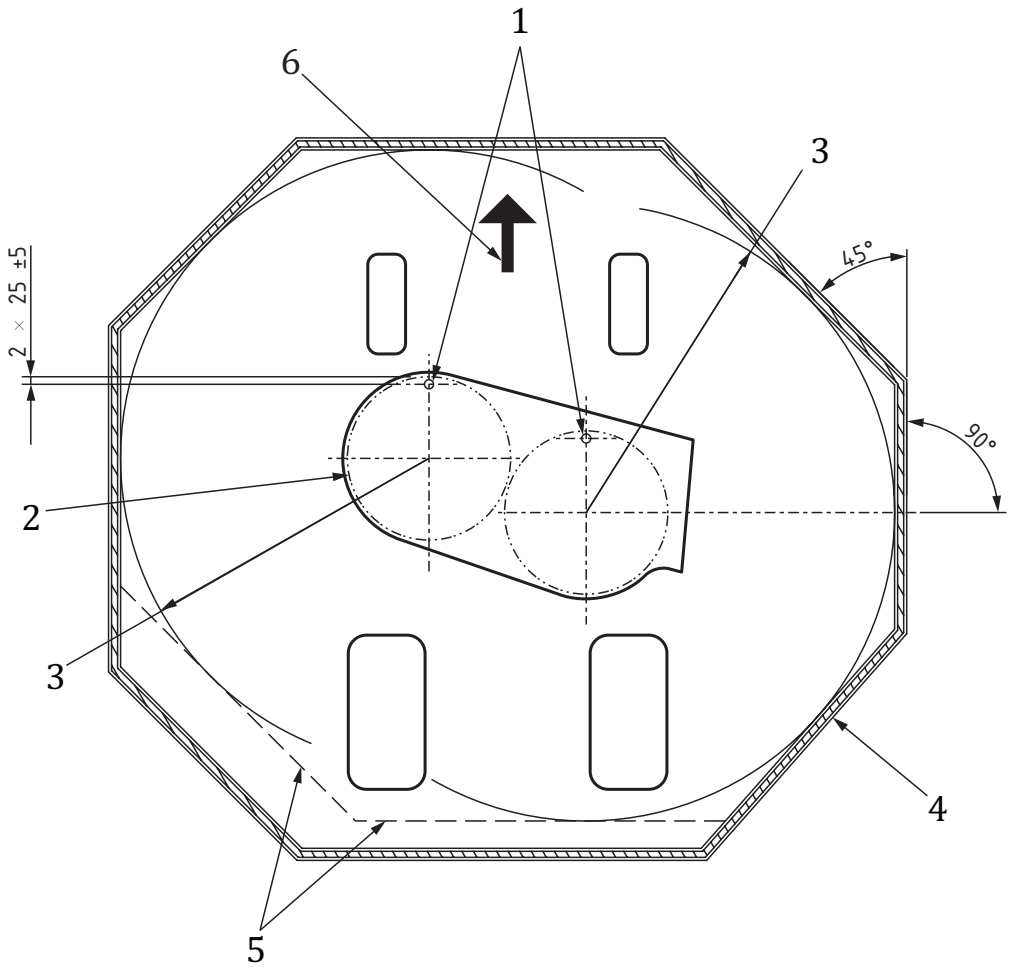
3 R = 750 + (BTC/2) mm ± 50 mm where BTC = cutting-means tip circle. If interference occurs between machine and target panels, move the target panels to just clear.

4 eight target panels, 900 mm high

5 front

Figure E.7 — Test enclosure, ride-on single spindle

Dimensions in millimetres



Key

1 injection points (2)

2 cutting-means tip circle

3 R = 750 + (BTC/2) mm ± 50 mm where BTC = cutting-means tip circle. If interference occurs between machine and target panels, move the target panels to just clear.

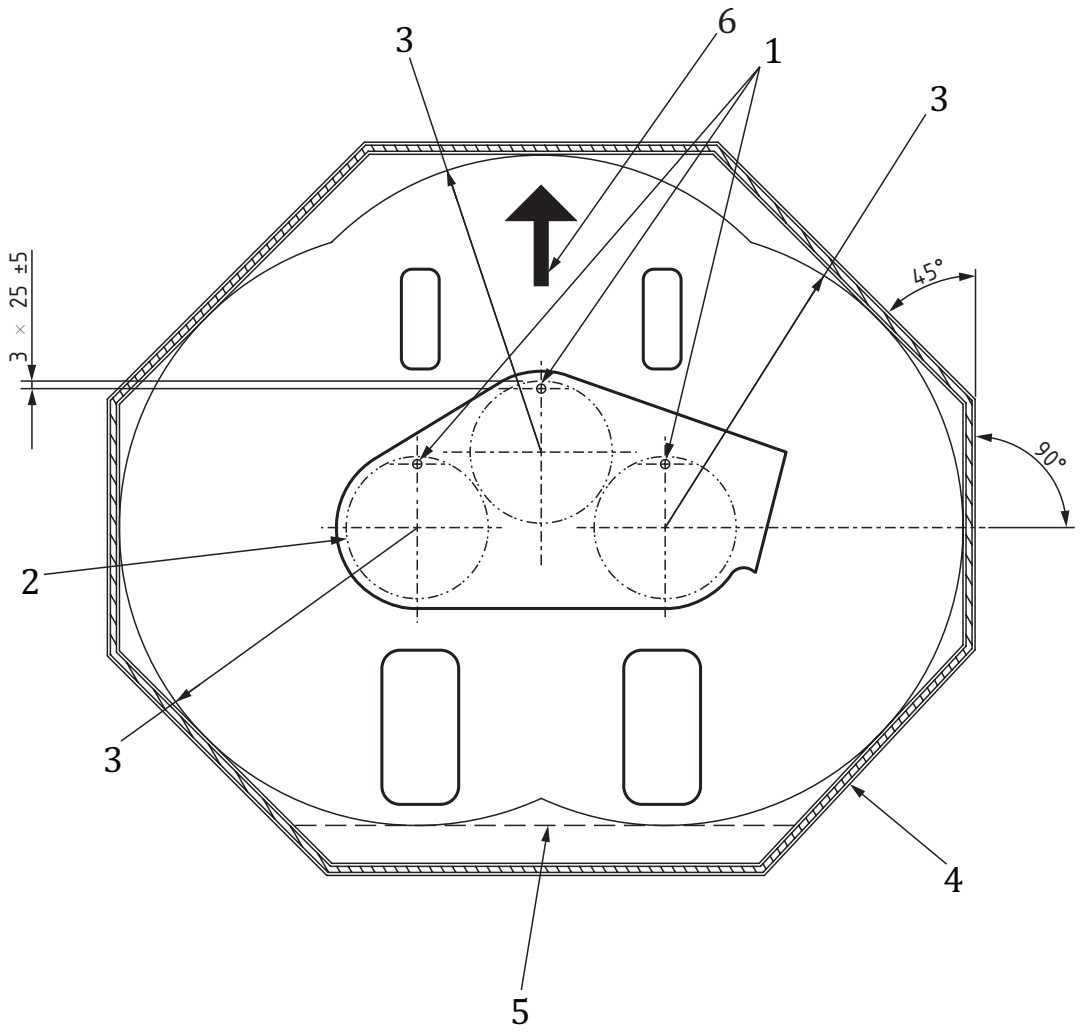
4 eight target panels, 900 mm high

5 clearance between target panels and machine

6 front

Figure E.8 — Test enclosure, ride-on two spindles

Dimensions in millimetres



Key

1 injection points (3)

2 cutting-means tip circle

3 R = 750 + (BTC/2) mm ± 50 mm where BTC = cutting-means tip circle. If interference occurs between machine and target panels, move target panels to just clear.

4 eight target panels, 900 mm high

5 clearance between target panels and machine

6 front

Figure E.9 — Test enclosure, ride-on multiple spindles

E.7.2.2 Corrugated fibreboard penetration test

E.7.2.2.1 Purpose

The purpose of these tests is to provide a means of selecting a uniform target panel material for thrown object tests on rotary lawnmowers.

E.7.2.2.2 Test fixture

The test fixture shall be in accordance with Figure E.10.

E.7.2.2.3 Fibreboard samples

Fibreboard shall be cut into squares of 150 mm per side.

E.7.2.2.4 Procedure

Immediately before the lawnmower tests, five samples of the fibreboard shall be tested and the acceptance criteria in E.7.2.2.5 shall be met.

Place a fibreboard square centrally on the bottom plate. The square can be secured at the edges by tape or adhesive. Cover with the steel top plate and make sure that the centre holes of the top and bottom plates are aligned and that the fibreboard is flattened by the top plate.

Raise the penetrator to the recommended height as shown in Figure E.10, and allow falling on to the fibreboard samples.

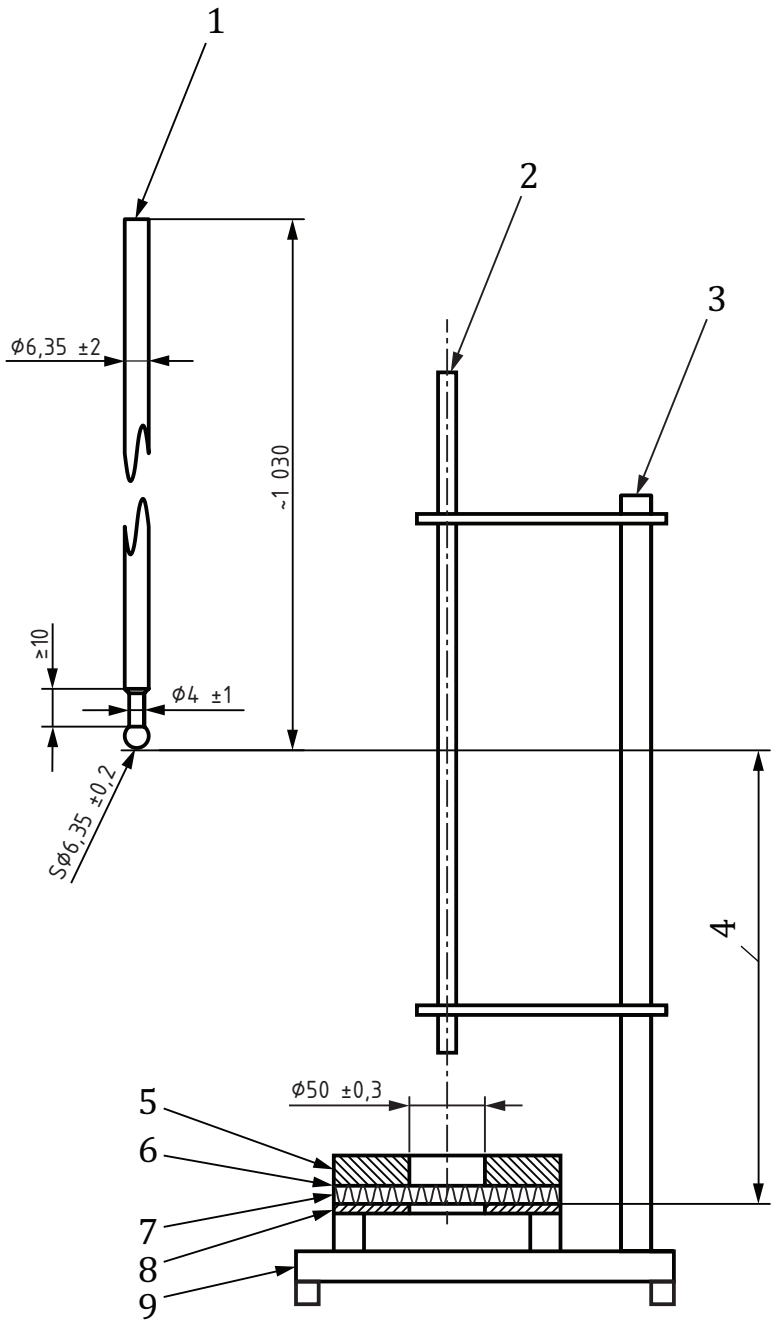
E.7.2.2.5 Acceptance criteria

The spherical end of the penetrator shall not penetrate completely through the test sample more than 2 out of 5 drops when dropped 300 mm.

The spherical end of the penetrator shall penetrate completely through the test sample in at least 4 out of 5 drops when dropped 400 mm.

If the penetrator penetrates the fibreboard more than the allowed number of times permitted by the acceptance criteria when dropped 300 mm, add sufficient sheets of Kraft paper to the target face of the fibreboard in order to meet penetration requirements.

Dimensions in millimetres; Tolerance ± 5 mm unless shown otherwise



Key

1 penetrator: mass 0,25 kg ± 0,005 kg
2 guide tube, vertical ± 2°
3 support
4 drop height
5 20 mm x 150 mm x 150 mm, steel top plate
6 add extra Kraft paper here
7 fibreboard sample
8 min 6,35 mm x 150 mm x 150 mm, steel bottom plate
9 base plate

Figure E.10 — Fixture for fibreboard penetration test

Annex F
(normative)

Noise test code (Grade 2)

F.1 General

This annex specifies a noise test code for determining efficiently and under standardized conditions, the noise emission characteristics of pedestrian-controlled and ride-on lawnmowers. Noise emission characteristics include the A-weighted emission sound pressure level at the operator position and the A-weighted sound power level.

Although the noise emission values determined are obtained in an artificial operation, they are representative of noise emission in a real work situation.

F.2 A-weighted sound power level determination

For the determination of sound power level, ISO 3744:2010 shall be used subject to the following modifications.

a) The reflecting surface shall be replaced by an artificial surface which complies with F.4 or by natural grass which complies with F.5. Reproducibility of results using natural grass is likely to be lower than that required for Grade 2 level of accuracy. In the case of dispute, measurements shall be carried out in the open air and on the artificial surface.

b) The measurement surface shall be a hemisphere with a radius, r, which depends on the width of cut of the machine under test and which shall be:

   r = 4 m for machines with a width of cut up to 1,2 m;

   r = 10 m for machines with a width of cut exceeding 1,2 m. A smaller radius is permitted if it is demonstrated that the results are within 0,5 dB compared with measurements with a hemisphere of r = 10m.

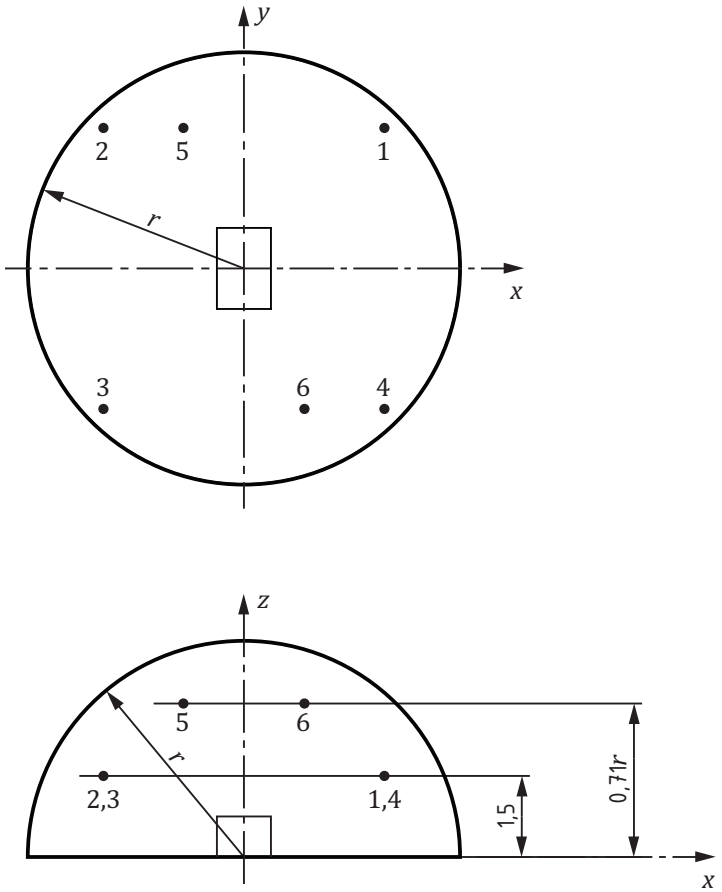
c) The microphone array shall be 6 microphone positions as defined in Figure F.1 and Table F.1.

d) Environmental conditions shall be within the limits specified for the measuring equipment. The ambient air temperature shall be between 5 °C and 30 °C and the wind speed shall be less than 8 m/s and preferably less than 5 m/s[2]. A microphone windbreak shall be used whenever the wind speed exceeds 1 m/s.

e) Measurements shall be made using an integrating-averaging sound level meter as defined in IEC 61672-1.

f) The value of K_{2A}, determined in accordance with ISO 3744:2010, Annex A, shall at maximum be 2 dB and shall be taken into account.

Dimensions in metres



Key

r radius of hemisphere

Figure F.1 — Microphone positions on the hemisphere (see Table F.1)

Table F.1 — Coordinates of microphone positions

Position No.	X/r	Y/r	Z
1	+0,65	+0,65	1,5 m
2	−0,65	+0,65	1,5 m
3	−0,65	−0,65	1,5 m
4	+0,65	−0,65	1,5 m
5	−0,28	+0,65	0,71r
6	+0,28	−0,65	0,71r

F.3 A-weighted emission sound pressure level measurement at the operator position

For the measurement of the A-weighted emission sound pressure level, ISO 11201:2010 shall be used subject to the following modifications:

a) The reflecting surface shall be replaced by an artificial surface according to F.4 or by a natural grass surface according to F.5. Reproducibility of results using natural grass is likely to be lower than that required for Grade 2 level of accuracy. In the case of dispute, measurements shall be carried out in the open air and on the artificial surface.

b) Environmental conditions shall be within the limits specified by the manufacturers of the measuring equipment. The ambient air temperature shall be in the range from 5 °C to 30 °C, and the wind speed shall be less than 8 m/s and preferably less than 5 m/s. A microphone windbreak shall be used whenever the wind speed exceeds 1 m/s.

c) Measurements shall be made using instruments with the time-weighting characteristics "slow", as defined in IEC 61672-1, or, preferably, using integrating-averaging sound level meters as defined in IEC 61672-1.

d) The operator or an equivalent dummy shall be 1,75 m ± 0,05 m tall and shall stand or sit upright and look straight ahead. The microphone shall be head mounted 200 mm ± 20 mm from the median plane of the head on the louder side and in line with the eyes. The microphone shall be aimed with its axis of maximally flat response (as specified by the manufacturer of the microphone) pointing forwards and at an angle of 45° downwards from the horizontal. If a helmet is used to mount the microphone the helmet shall be of a shape so that its outer edge is at least 30 mm closer to the head than the microphone.

F.4 Requirements for artificial surface

The artificial surface shall have absorption coefficients as given in Table F.2, measured in accordance with ISO 354.

Table F.2 — Absorption coefficients

Frequencies in Hz	Absorption Coefficients	Tolerance
125	0,1	± 0,1
250	0,3	± 0,1
500	0,5	± 0,1
1 000	0,7	± 0,1
2 000	0,8	± 0,1
4 000	0,9	± 0,1

The artificial surface shall be placed on a hard, reflecting surface and have a size of at least 3,6 m x 3,6 m placed at the centre of the test environment. The construction of the supporting structure shall be such that the requirements for the acoustic properties are also met with the absorptive material in place. The structure shall support the operator to avoid compression of the absorbing material.

NOTE See Annex I for an example of a material and construction which can be expected to fulfil these requirements.

F.5 Requirements for natural grass

The test environment shall be covered, at least for the horizontal projection of the measurement surface used, with high-quality natural grass. Before the measurements are taken, the grass shall be cut with a lawnmower to a height of cut as near as possible to 30 mm. The surface shall be clean of grass clippings and debris and shall be visibly free of moisture, frost, or snow.

F.6 Installation, mounting and operating conditions

Measurements shall be carried out on a new normal production machine featuring standard equipment. If a grass catcher is provided or available for the machine, it shall be fitted and empty.

Cutting means and knives of cylinder lawnmowers shall be lubricated. For cylinder lawnmowers, the rotating cutting cylinder(s) and/or the stationary cutting edge(s) shall be adjusted such that either:

— a sheet Kraft paper, of nominal 80 g/m^2 construction, is cut at least along 50 % of the width of cut; or

— the gap between moving and stationary cutting means at standstill does not exceed 0,15 mm over the whole width of cut when checked with calibrated strip gauges.

For cylinder lawnmowers, care shall be taken to avoid overheating the cutting means by operating continuously (without cutting grass) and therefore appropriate interruptions for cooling and lubrication can be introduced.

If the maximum height of cut of the machine is greater than 30 mm, the height of cut shall be adjusted to the lowest position provided, but not lower than 30 mm. If the maximum height of cut of the machine is less than 30 mm, the height of cut shall be adjusted to the highest position provided. The height of cut shall be adjusted with the machine resting on a hard, flat surface.

The engine shall be run-in and warmed up until stable conditions are reached before the test is commenced. The engine shall be set to the maximum operating engine speed and the cutting devices lubricated according to the instruction handbook. The maximum operating engine speed shall be checked before testing. If the measured maximum operating engine speed is outside the value specified in the instruction handbook, the engine speed shall be adjusted in accordance with the manufacturer's instructions.

During the test the cutting means shall be engaged and unloaded. The test shall be carried out at the maximum operating engine speed (see 3.19). An engine speed indicator shall be used to check the speed of the engine. It shall have an inaccuracy of ± 2,5 % of the reading. The indicator and its engagement with the lawnmower shall not affect the operation during the test.

For the sound power level determination, machines shall be measured by placing them on the surface in such a way that the projection of the geometrical centre of their main parts (excluding handle, grass catcher, etc.) coincides with the origin of the coordinate system of the microphone positions. If an artificial surface is used, it shall be placed so that its geometrical centre also coincides with the origin of the coordinate system of the microphone positions. The longitudinal axis of the machine shall be on the *x*-axis. The measurement shall be carried out without an operator.

For the sound pressure level determination, adjustable features (e.g. handle height, seat position) shall be set to suit the operator.

F.7 Measurement uncertainties and declaration of noise emission values

When measuring the emission sound pressure level at the operator position, tests shall be repeated to attain the required grade of accuracy, and until three consecutive A-weighted results give values within not more than 2 dBA. The arithmetic average of these shall be the measured A-weighted emission sound pressure level of the machine. The uncertainties associated with the measurements shall be taken into account when deciding on the declared noise emission values.

The methodology used for taking uncertainties into account should be based on the use of measured values and measurement uncertainties. The latter are the uncertainty associated to the measurement procedure (which is determined by the grade of accuracy of the measurement method used) and the production uncertainty (variation of noise emission from one machine to another of the same type made by the same manufacturer).

The declaration of noise emission values shall be made according to ISO 4871. Applying the dual number declaration is recommended.

F.8 Information to be recorded and reported

The information to be recorded and reported is that required by ISO 3744 and ISO 11201.

The instruction handbook and the technical documentation describing the machine shall give the declared noise emission values of the machinery:

— the A-weighted emission sound pressure level at the operator position;

— the A-weighted sound power level of the machinery;

— reference to the noise test code used for the tests;

— the uncertainties of the measurements.

Annex G
(normative)

Vibration test code — Whole-body vibration and hand-arm vibration

G.1 General

This annex specifies a vibration test code for determining, efficiently and under specified conditions the magnitude of vibration at the handles of pedestrian-controlled lawnmowers, including sulkies, steering controls of ride-on lawnmowers and whole-body vibrations for operators on sulkies and ride-on lawnmowers.

Although the magnitudes measured are obtained in an artificial operation, they nevertheless give an indication of the values to be found in a real work situation.

G.2 Quantities to be measured

The quantities to be measured are the frequency-weighted accelerations in the three perpendicular directions, $a_{hw}x$, $a_{hw}y$ and $a_{hw}z$.

G.3 Instrumentation

G.3.1 General

Tachometers shall have an inaccuracy of ± 2,5 %.

For specification of other instrumentation, see EN 1032:2003+A1:2008, Clause 4 for the hand-arm vibration measurement, and Clause 5 for the whole-body vibration measurement.

G.3.2 Fastening of transducer

G.3.2.1 Transducers for hand-arm vibration measurements

The transducer shall be fastened in accordance with ISO 20643:2005, 7.2.2. If a resilient coating is being used between the hand and the vibrating structure (for example, a cushioned handle or steering wheel), it is permissible to use a suitable mounting for the transducer (for example, a thin suitably formed metal sheet) placed between the hand and the surface of the resilient material. In either case, care shall be taken that the size, shape and mounting of the transducer or of the special transducer support does not significantly influence the transfer of vibration to the hand. Care shall also be taken when mounting the transducer that the transfer function is flat up to 1,5 kHz for all three directions.

The transducers used for hand-transmitted vibration measurements on the steering wheel shall be mounted firmly to the steering wheel, for example by using a threaded stud or clamp. The total mass of the accelerometers and mounting devices (stud or clamp) shall not be more than 50 g (and preferably not more than 30 g). The mounting device shall be selected to minimize the distance between the base surface of the accelerometers and the vibrating surface of the steering wheel and the distance shall not exceed 15 mm.

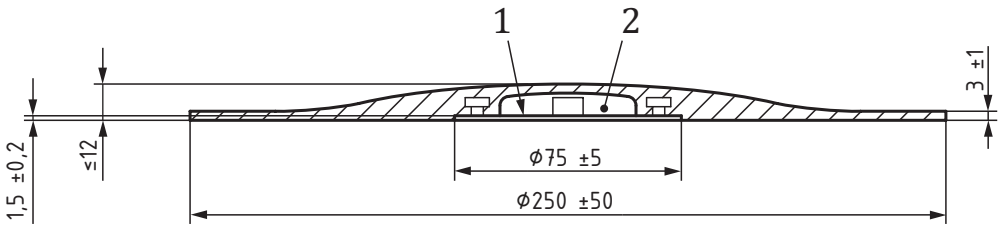
NOTE Tangling of signal carrying wires on the steering column can be eliminated by attaching the wires to a spoke on the steering wheel and trailing them to the centre of the wheel.

G.3.2.2 Transducers for whole-body vibration measurements

The transducer shall be fastened in accordance with EN 1032:2003+A1:2008, 6.2.

The transducers used for the measurement in the seat shall be mounted in a semi-rigid disc which is defined in ISO 5008 and described as follows (see Figure G.1).

Dimensions in millimetres



Key

1 thin metal disc for accelerometer mount and added centre rigidity

2 appropriate cavity for accelerometer(s)

Figure G.1 — Design of a semi-rigid mounting disc

The disc shall be as thin as possible and be of approximately 80 Shore-A to 90 Shore-A moulded rubber or plastic material.

NOTE For practical reasons, it is usually not possible to perfectly align the accelerometers in the disc with the directions of the basicentric coordinate system. In a tolerance range within ±15° of the appropriate directions, the accelerometers can be considered as aligned parallel to these directions.

The transducers used for the measurement at the feet of an operator shall be rigidly fixed on the working platform. If the working platform is covered by a resilient material, the transducers can be mounted in the middle of a rigid metal plate (about 300 mm x 400 mm).

G.3.3 Calibration

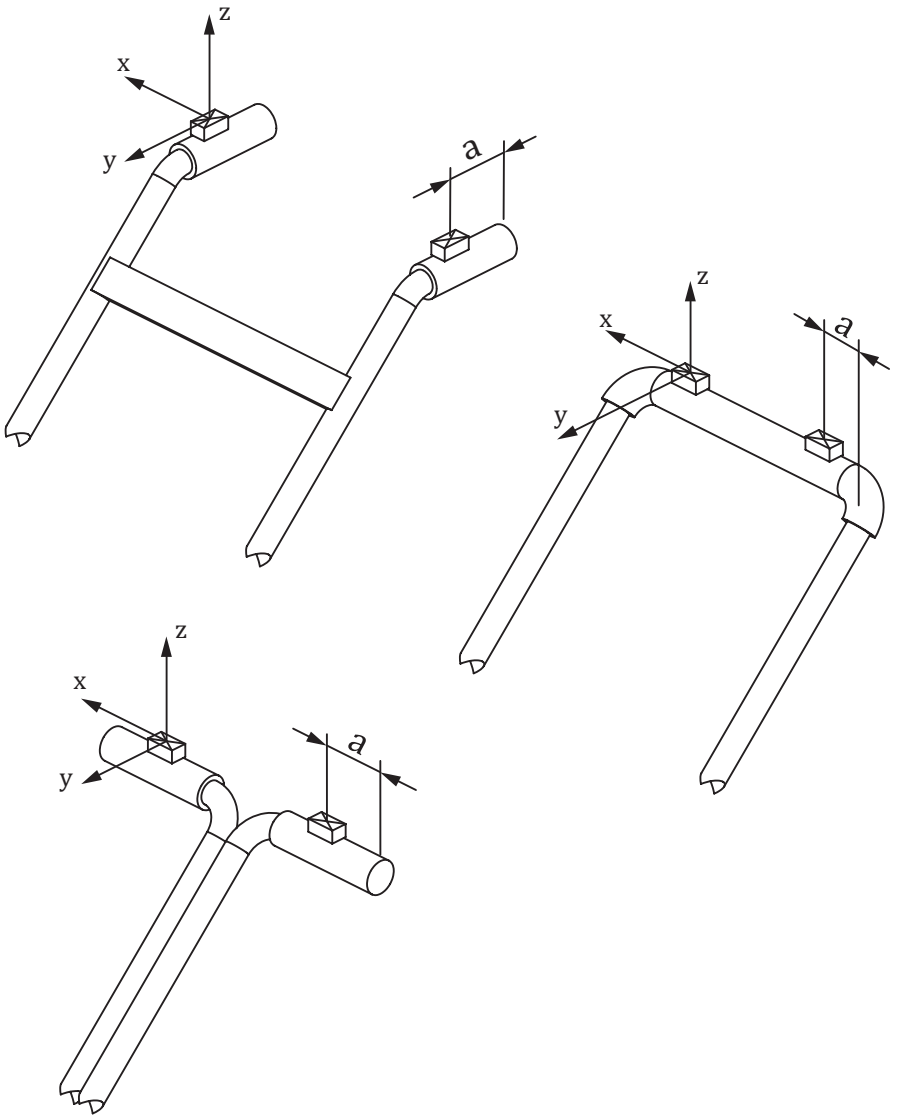
Calibration shall be in accordance with ISO 16063 for the hand-arm vibration and for the whole-body vibration.

G.3.4 Measurement direction

Measurements shall be made simultaneously for the three (3) directions x, y and z (see Figure G.2 for pedestrian-controlled lawnmowers and Figure G.3 for ride-on lawnmowers).

G.3.5 Measurement location

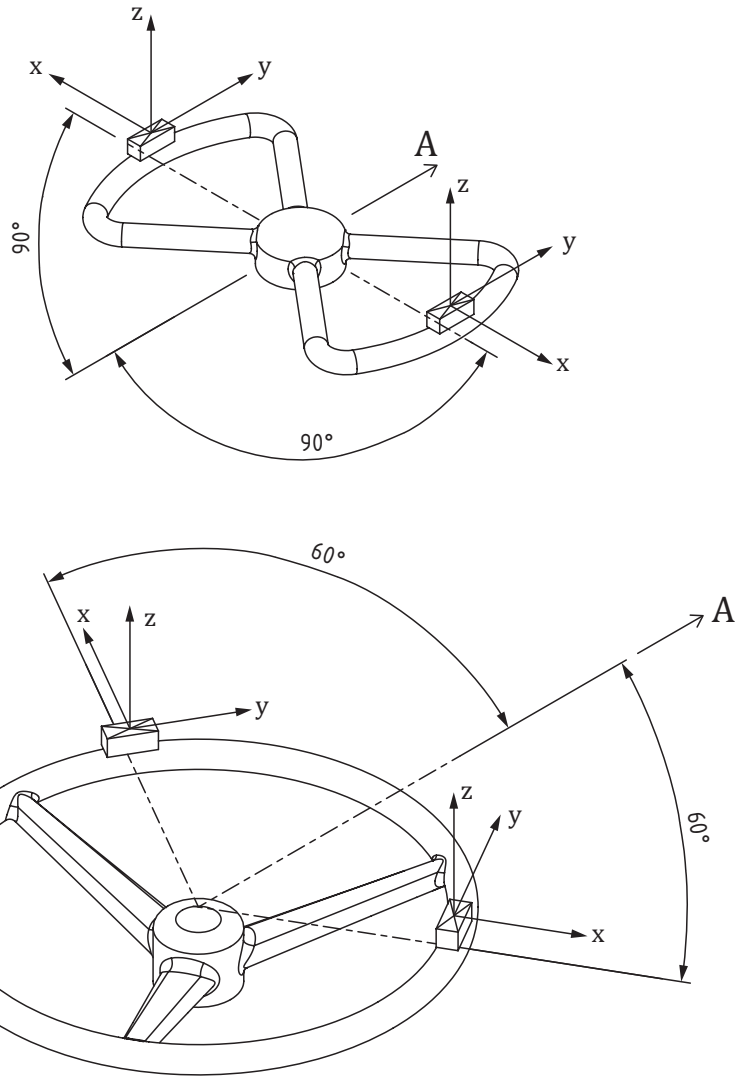
A maximum of two transducers shall be used for hand-arm vibration and one for whole-body vibration. The transducer(s) for the hand-arm vibration measurements shall be placed where an operator holds the steering control(s) according to Figure G.2 or Figure G.3. The transducer for the whole-body vibration measurement shall be placed according to EN 1032:2003+A1:2008, 6.2.



Key

a 100 mm

Figure G.2 — Examples of transducer location/orientation (pedestrian-controlled machines)



Key

A machine front

Figure G.3 — Examples of transducer location/orientation for hand-arm vibration (ride-on machines)

G.4 Measurement procedure

G.4.1 Determination of working procedure

Measurements shall be carried out on a new normal production machine featuring standard equipment provided by the manufacturer with the machine. The machine shall be maintained and serviced in accordance with the manufacturer's instructions.

The lawnmower shall be tested for all cutting means supplied with the lawnmower and including all other attachments supplied by the lawnmower manufacturer giving the highest vibration levels. The configuration of the lawnmower tested shall be recorded.

Knives of cylinder lawnmowers shall be lubricated. For cylinder lawnmowers, the rotating cutting cylinder(s) and/or the stationary cutting edge(s) shall be adjusted such that either:

— a sheet Kraft paper, of nominal 80 g/m^2 construction, is cut at least along 50 % of the width of cut, or

— the gap between moving and stationary cutting means at standstill does not exceed 0,15 mm over the whole width of cut when checked with calibrated strip gauges.

Before the test is commenced, run the engine for minimum 10 min with the cutting means engaged.

For cylinder lawnmowers, care shall be taken to avoid overheating the cutting means by operating continuously (without cutting grass) and therefore appropriate interruptions for cooling and lubrication can be introduced.

The hands of the operator shall be in the designated gripping area, close to the transducer positioned as indicated in Figures G.2 and G.3. The operator shall be in the normal operating position. Tyre pressures shall be in accordance with the manufacturers' specifications. When the machine is designed to be operated with a grass catcher, the measurement shall be carried out with this configuration. The grass catcher shall be empty. The fuel tank shall be full. The machine shall be tested with the cutting-means assembly, listed in the instruction handbook, giving the highest vibration values. Cutting means and knives of cylinder lawnmowers shall be adjusted as specified in F.6.

The measurements shall be carried out with an operator who shall be 1,75 m ± 0,05 m tall. For ride-on machines, the operator shall have a mass of 90 kg ± 5 kg.

NOTE 1 The vibration measurements are influenced by the operator. The operator should therefore be familiar with the normal operation of the machine (see 3.22).

Tests shall be made in conditions likely to be found on most days during intended use of the machine. Unlikely extreme conditions (e.g. heat, cold, rain, mud) for the type of machine shall be avoided. The measurements shall be made within the temperature range 5 °C to 35 °C. The conditions prevailing at the time of test shall be recorded.

NOTE 2 For testing of machines equipped with large pneumatic tyres, the temperature range may need to be more restricted.

G.4.2 Hand-arm vibration

G.4.2.1 General

Testing shall be carried out with the machine stationary and at the maximum operating engine speed with the cutting means engaged. The maximum operating engine speed shall be checked before testing. Any sealed adjustments shall not be moved when checking the maximum operating engine speed. If the measured maximum operating engine speed is outside the value specified in the instruction handbook, the engine speed shall be adjusted in accordance with the manufacturer's instructions. Measurements shall for sulkies and ride-on machines be carried out on a flat horizontal level hard surface (e.g. concrete, asphalt). Measurements for pedestrian-controlled lawnmowers shall be carried out on a surface in accordance with E.6.

G.4.2.2 Pedestrian-controlled machines

Adjustable handles of pedestrian-controlled machines shall be set to suit the operator. The cutting height shall be set to 30 mm or the next higher cutting position when set on a flat hard horizontal level surface. Machines with a maximum cutting height setting of 30 mm or less shall be set at their maximum height setting.

G.4.2.3 Sulkies and ride-on machines

If the operator position on the ride-on machine or sulky and the steering devices are adjustable they shall be set to suit the operator. The cutting height shall be set to 30 mm or the next higher cutting position when set on a flat hard horizontal level surface. Machines with a maximum cutting height setting of 30 mm or less shall be set at their maximum height setting.

G.4.3 Whole-body vibration

Whole-body vibration measurement shall be carried out with the machine travelling in a straight line at a speed closest to 6 km/h on a flat horizontal level surface. The height of cut shall be set at the lowest position and the cutting means engaged. Each reading shall be obtained from a signal time suitable for the test equipment being used. Duration of each measurement shall not be less than 8 s. If an equivalent level of accuracy can be achieved using a shorter duration than 8 s, this shall be justified when used.

G.5 Measurement procedure

Before starting the measurements, sufficient time for warming-up the machine, including the tyres, to reach normal operating conditions (at least 10 min) shall be allowed, during which the machine is travelling and the seat suspension (if fitted) is operating.

One test series shall be carried out with each type of equipment for which results of measurements are required (set of tyres, type of cabin and seat).

Measurements for determination of the vibration values shall be repeated for the selected operating mode to obtain one test series. When the operating condition is travelling, a test series shall consist of five runs on the test track.

For each transducer position, a series of three tests shall be carried out using one operator.

Measurement for the three directions shall be made simultaneously.

G.6 Determination of the measurement result

G.6.1 Hand–arm vibrations

The reported value for hand-transmitted vibration is the average value of five vibration total values, each of the five values taken from a valid test series, measured on the steering wheel/controls. If a single figure is quoted, it shall be the higher of the two.

G.6.2 Whole-body vibrations

The reported value for whole-body vibration is the highest (rms) value of the frequency-weighted accelerations, determined on three orthogonal axes (1,4awx, 1,4awy, awz), measured on the seat pan under the operator.

For whole-body vibration emission values, it shall be indicated whether the factor 1,4 for the x- and y-directions is included in the reported value.

G.7 Measurement uncertainties and declaration of vibration values

When measuring whole-body and hand-arm vibration levels, tests shall be repeated to attain the required grade of accuracy, until three consecutive results give values within not more than 0,2 m/s^2 for whole-body and 0,5 m/s^2 for hand-arm vibration. The arithmetic average of these shall be the measured vibration level of the machine. The uncertainties associated with the measurements shall be taken into account when deciding on the declared vibration values.

NOTE Guidelines for defining uncertainty factor K are given by EN 12096.[6]

G.8 Information to be recorded and reported

The instruction handbook and the technical documentation describing the machine shall give reference to the vibration test code used for the tests and give vibration values for hand-arm vibrations and whole body vibrations as specified in ISO 5395-2 and ISO 5395-3, respectively.

Annex H
(normative)

Determination of hot surfaces

H.1 General

This annex specifies a method to determine the accessibility of hot surfaces which can be unintentionally touched by an operator during normal operation.

NOTE Text adapted from EN 14930:2007.[7]

H.2 Temperature measuring equipment

The temperature measuring equipment for hot surfaces shall have an inaccuracy of ± 2 °C.

H.3 Determination of temperature of areas to be assessed

Measure the temperatures on the areas to be assessed under the following conditions:

— the test shall be conducted in the shade with a wind speed not exceeding 3 m/s and an ambient temperature at the time of the test of 20 °C ± 5 °C;

— the engine shall be operated at its maximum operating engine speed with the cutting means engaged until the surface temperatures stabilize;

— the measured surface temperatures shall be corrected by applying the formula:

— Corrected temperature (°C) = observed temperature (°C) – ambient temperature (°C) + 20 °C;

— mark the areas with corrected surface temperatures higher than the threshold values given in ISO 5395-2 and ISO 5395-3.

It is not necessary to test the accessibility of hot parts while they are hot. Allow the hot parts to cool before using the cone(s).

H.4 Determination of inadvertent accessibility of hot surfaces

H.4.1 For distance between the identified hot area and the nearest control in excess of 100 mm

Determine the inadvertent accessibility of the hot surfaces (see H.3) specified in ISO 5395-2 and ISO 5395-3, respectively, with cone A as shown in Figure H.1. The test cone shall be moved with the axis of the cone anywhere between 0° and 180° to the horizontal and with the nose or point of the cone in a downward-to-horizontal direction, towards the hot surfaces specified for testing.

H.4.2 For distance between the identified hot area and the nearest control less than or equal to 100 mm

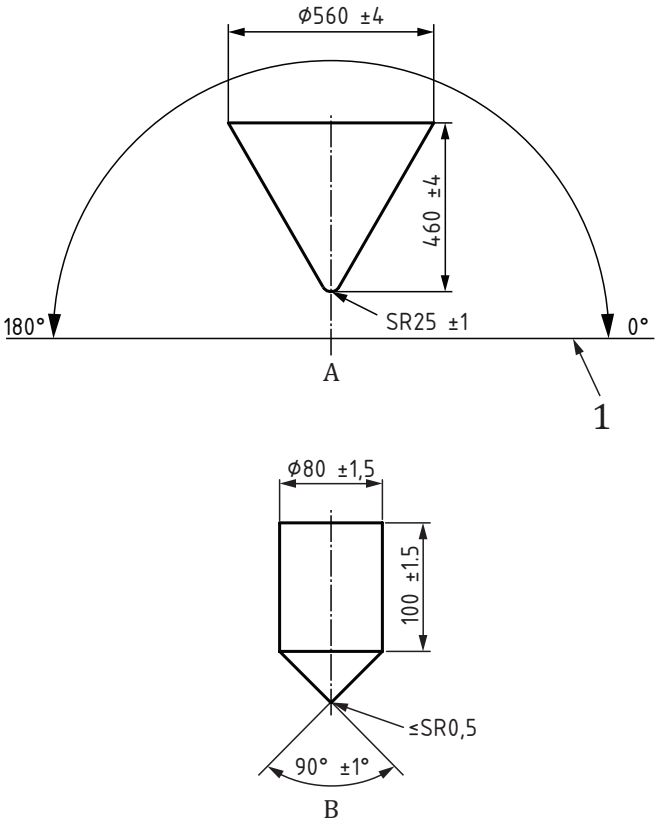
Determine the inadvertent accessibility of the hot surfaces (see H.3) specified in ISO 5395-2 and ISO 5395-3, respectively, with cone B as shown in Figure H.1. The test cone shall be moved in any direction towards the hot surfaces specified for testing.

Table H.1 summarizes the use of the cones. Mark and calculate the areas touchable with the selected test cone tip or conical surface.

Table H.1 — Methods for use of the test cones

Distance from nearest control (mm)	>100	≤100
Type of cone to be used	A	B
Orientation of cone	Point down or horizontal only	Any direction
Direction of movement of cone	Downwards or horizontal only	Any direction

Dimensions in millimetres



Key

1 horizontal plane

Figure H.1 — Test cones for the determination of hot parts accessibility

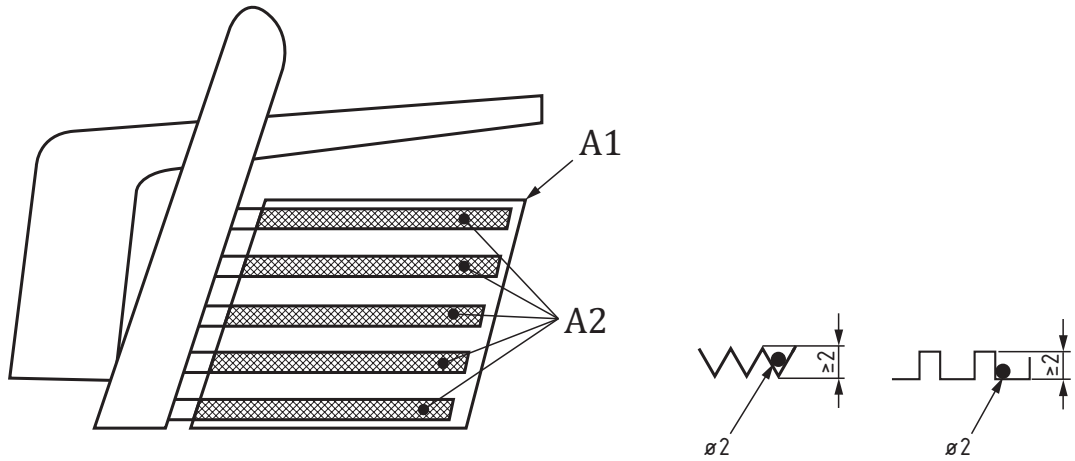
H.4.3 Recording of determined inadvertent accessible hot areas

Measure and record the inadvertent accessible hot area(s). If the area is interrupted the surface is defined by:

a) If a marked surface (with area A1) consists of multiple separate surfaces of which the sum of the areas (A2) exceeds 80 % of A1, then A1 shall be considered as one uninterrupted area (see Figure H.2).

b) Surfaces whose structure does not allow a ball with 2 mm diameter to penetrate more than 2 mm below highest parts of the structure shall be considered as part A1 (see Figure H.2).

c) If the marked surface (with area A1) includes holes of which the sum of the areas (A3) is less than 20 % of the area of marked surface (A1), then A1 shall be considered as one uninterrupted area (see Figure H.3).

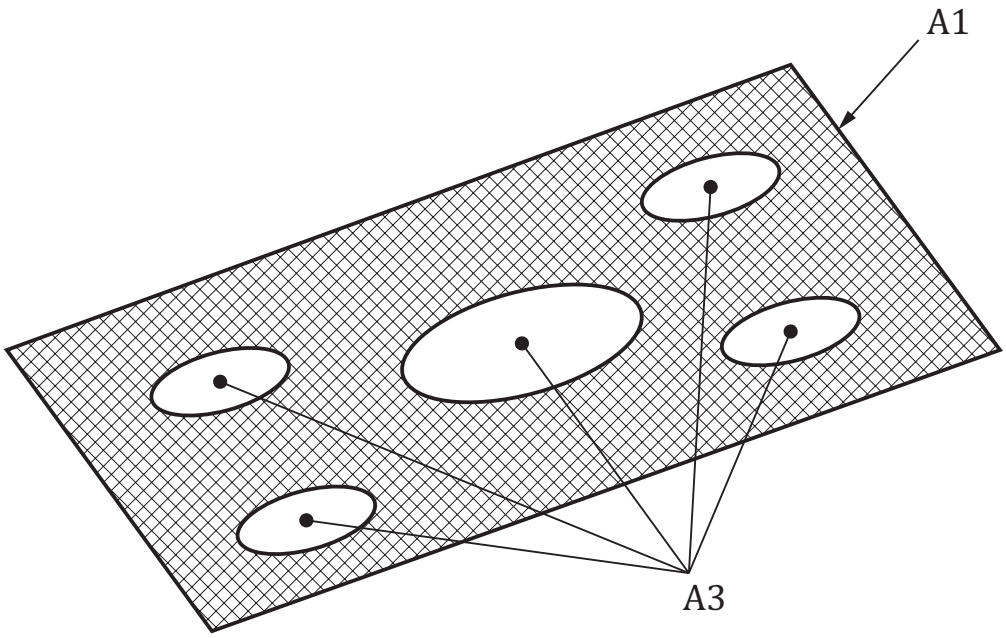


Key

A1 marked surface

A2 sum of area > 80 % of A_1

Figure H.2 — Example of a surface consisting of multiple separate surfaces



Key

A1 marked surface

A3 sum of area of the holes

Figure H.3 — Example of a surface with holes

Annex I
(informative)

Example of a material and construction fulfilling the requirements for an artificial surface

I.1 General

This annex describes an artificial surface which could be suitable to use in the noise test code.

I.2 Material

Mineral fibre, 20 mm thick, having an airflow resistance of 11 kN·s/m^4 and a density of 25 kg/m^3.

I.3 Construction

As is shown in Figure I.1, the artificial flooring of the measurement site is sub-divided into 9 joint planes, each of approximately 1,20 m x 1,20 m. The backing layer (a) of the construction as shown in Figure I.1 consists of chipboard, 19 mm thick, coated with a plastics material on both sides. Such boards are used, for example, for the construction of kitchen furniture. The cut edges of the chipboards shall be protected against moisture by applying a coat of plastic paint. The outsides of the flooring are bordered by a two-legged aluminium section (d), its leg height being 20 mm. Sections of this profile material are also screwed to the edges of the joint planes where they serve as spacers and attachment points.

On the middle joint plane on which the machine is placed during measurement as well as any other place on which the operator can get to stand on, aluminium T-sections (c) with a leg length of 20 mm are mounted as spacers. These sections also provide exact markings which facilitate the alignment of the machine in the middle of the measurement site. The prepared boards are then covered with the insulating felt material (b) cut to size.

The felt flooring of the joint planes which are neither stood on nor driven over (type A surface in Figure I.1) are covered with a simple wire mesh fastened to the edge strips and to the attachment points; for this purpose, the sections shall be provided with holes. Thus, the material is adequately attached, it shall remain possible to replace the felt material if it becomes soiled. As a wire mesh, a so-called aviary wire (e) with a mesh width of 10 mm and a wire diameter of 0,8 mm has proved to be suitable. This wire appears to protect the surface adequately without affecting the acoustic conditions.

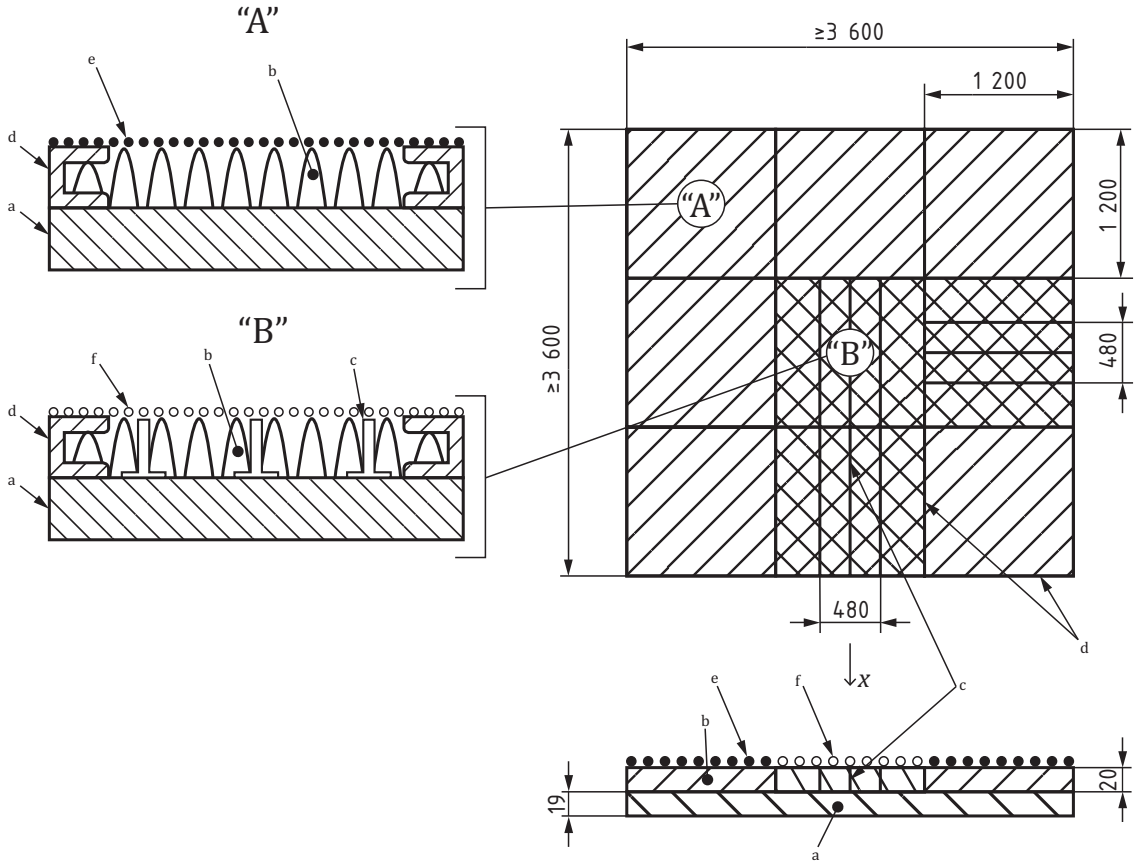
Protection by simple wire mesh is not, however, sufficient in the area subjected to traffic (type B surface in Figure I.1). For these surfaces, the use of wire grating of corrugated steel wire (f) with a diameter of 3,1 mm and a mesh width of 30 mm has proved to be suitable.

The construction of the measurement site as described above offers two advantages: it can be prepared without much time and effort, and all the materials are easily obtainable.

The fact that the microphone positions are not situated directly above the flooring of the measurement site allows the microphones to be easily mounted on stands, assuming that the ground is even and hard as, for example, an asphalt or concrete site.

When arranging the microphones, account has to be taken of the fact that the height of the microphones has to be determined in relation to the surface of the flooring of the measurement site. It shall, therefore, be 40 mm higher when measuring from the ground under the microphone.

Dimensions in millimetres, approximate



Key

"A" this surface is not suitable to carry weight. Do not stand on or drive over

"B" This surface is suitable to carry weight. Can be stood on or driven over

a backing layer of plastics coated chipboard (nominally 19 mm thick)

b mineral wool fibre layer (nominally 20 mm thick)

c aluminium T-sections (nominally 3 mm thick x 20 mm high)

d aluminium U-sections (nominally 3 mm thick x 20 mm high)

e wire mesh (nominally 10 mm x 10 mm mesh made of 0,8 mm diameter steel wire)

f wire grating (nominally 30 mm x 30 mm mesh made of 3,1 mm diameter steel wire)

Figure I.1 — Sketch of the measurement surface covered with an artificial surface

Bibliography

[1] IEC 60335-1, *Household and similar electrical appliances — Safety — Part 1: General requirements*

[2] IEC 60335-2-77, *Household and similar electrical appliances — Safety — Part 2-77: Particular requirements for pedestrian controlled mains-operated lawnmowers*

[3] ISO 5053:1987, *Powered industrial trucks — Terminology*

[4] ISO 11094:1991, *Acoustics — Test code for the measurement of airborne noise emitted by power lawn mowers, lawn tractors, lawn and garden tractors, professional mowers, and lawn and garden tractors with mowing attachments*

[5] ISO 17101-1:2012, *Agricultural machinery — Thrown-object test and acceptance criteria — Part 1: Rotary mowers*

[6] EN 12096, *Mechanical vibration — Declaration and verification of vibration emission values*

[7] EN 14930:2007, *Agriculture and forestry machinery and garden equipment — Pedestrian controlled and hand-held machines — Determination of accessibility of hot surfaces*

ICS 65.060.70

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