INTERNATIONAL STANDARD

ISO 10517

Second edition
2009-07-15

Powered hand-held hedge trimmers — Safety

Taille-haies portatifs à moteur — Sécurité

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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 10517 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 13, *Powered lawn and garden equipment*.

This second edition cancels and replaces the first edition (ISO 10517:1993), which has been technically revised as follows. It has been harmonized with the revised requirements of EN 774. Noise and vibration requirements have been included as well as a table listing the significant hazards.

Introduction

Noise emission and vibration levels are primarily determined for

— manufacturers' declaration of levels,

— comparisons of the vibration level and noise emitted by hedge trimmers in the family concerned, and

— for purposes of noise control at the source at the design stage.

Powered hand-held hedge trimmers — Safety

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This International Standard specifies safety requirements and their verification for the design and construction of hand-held, integrally-driven petrol combustion engine hedge trimmers, hereafter referred to as "hedge trimmers", designed to be used by a single operator for trimming hedges and bushes while utilizing one or more linear reciprocating cutter blades.

It establishes methods for the elimination or reduction of hazards arising from the use of the trimmers. In addition, it specifies the type of information to be provided by the manufacturer on safe working practices.

This International Standard deals with all significant hazards, hazardous situations and events relevant to hand-held powered hedge trimmers when they are used as intended (see Clause 4).

This International Standard does not deal with low noise design. It is not applicable to hedge trimmers with an engine displacement over 80 cm^3, nor is it applicable to hedge trimmers manufactured before the date of its publication.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

ISO 3744:1994, *Acoustics — Determination of sound power levels of noise sources using sound pressure — Engineering method in an essentially free field over a reflecting plane*

ISO 3767-1:1998, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 3767-3:1995,*Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 3: Symbols for powered lawn and garden equipment*

ISO 3767-4:1993, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 4: Symbols for forestry machinery*

ISO 3864-1:2002, *Graphical symbols — Safety colours and safety signs — Part 1: Design principles for safety signs in workplaces and public areas*

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 5347-22:1997, *Methods for the calibration of vibration and shock pick-ups — Part 22: Accelerometer resonance testing — General methods*

ISO 7293:1997, *Forestry machinery — Portable chain saws — Engine performance and fuel consumption*

ISO 8041:2005, *Human response to vibration — Measuring instrumentation*

ISO 8893:1997, *Forestry machinery — Portable brush-cutters and grass-trimmers — Engine performance and fuel consumption*

ISO 11201:1995, *Acoustics — Noise emitted by machinery and equipment — Measurement of emission sound pressure levels at a work station and at other specified positions — Engineering method in an essentially free field over a reflecting plane*

EN 12096:1997, *Mechanical vibration — Declaration and verification of vibration emission values*

ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

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

IEC 60745-1:2006, *Hand-held motor operated electric tools — Safety — Part 1: General requirements*

IEC 60745-2-15:2006, *Hand-held motor-operated electric tools — Safety — Part 2-15: Particular requirements for hedge trimmers*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
petrol combustion engine hedge trimmer
machine fitted with reciprocating blades made of metal, intended to cut and form hedges, bushes and similar vegetation

3.2
cutting device
part of the assembly consisting of cutter blade and shear plate, or of the cutter blades together with any supporting part, which performs the cutting action and that can be single- or double-sided

See Figure 2.

3.3
cutter blade
part of the cutting device having blade teeth which cut by a shearing action either against other blade teeth or against a shear plate

See Figure 2.

3.4
blade tooth
part of the cutter blade which is sharpened to perform the shearing action

See Figure 2.

3.5
cutting length
effective cutting length of the cutting device measured from the inside edge of the first blade tooth or shear plate tooth to the inside edge of the last blade tooth or shear plate tooth

See Figure 3.

NOTE Where both blades move, the measurements are taken when the first and last teeth are furthest apart.

3.6
front handle
handle located at or towards the cutting device

See Figure 1.

3.7
rear handle
handle located furthest from the cutting device

See Figure 1.

3.8
throttle lock
device for temporarily setting the throttle in a partially open position to aid starting

3.9
throttle trigger
device for operating the throttle

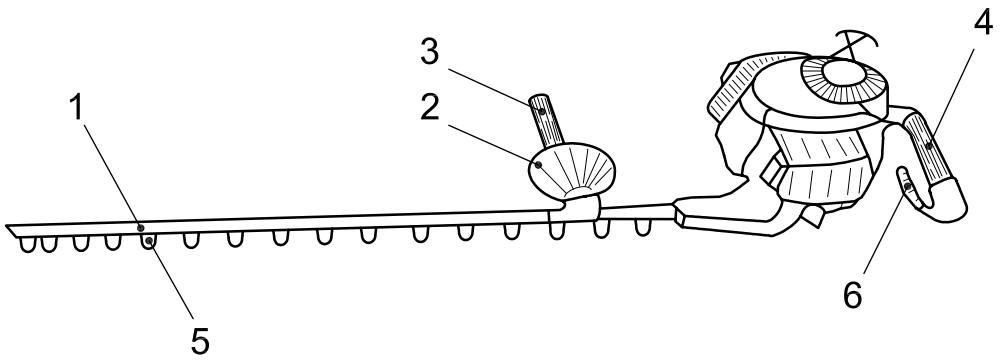
3.10
blade control
device activated by the operator's hand or finger for controlling the cutter blade movement

NOTE Depending on the application, this can require a single or a two-stage operation.

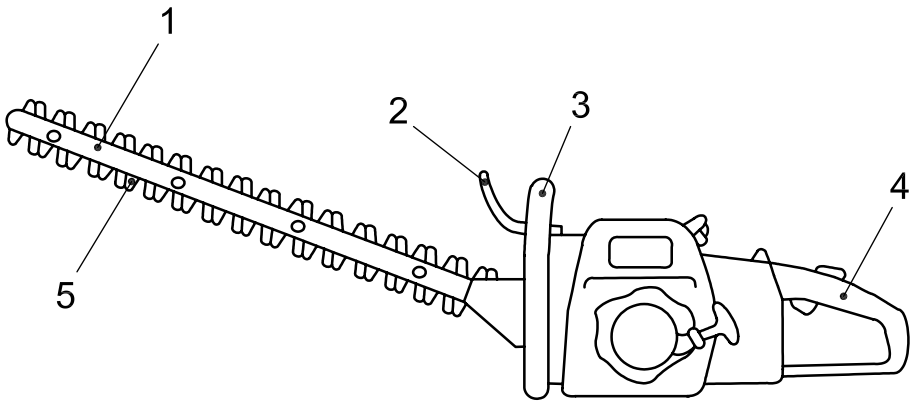
3.11
blunt extension
extending blunt part of the cutting device or an extending part of an unsharpened plate fitted to the cutting device to prevent contact with the moving cutter blade

3.12
maximum operating engine [motor] speed
highest engine [motor] speed obtainable with the cutting device engaged

3.13
adjustable handle
handle whose position can be modified either by movement or by rotation

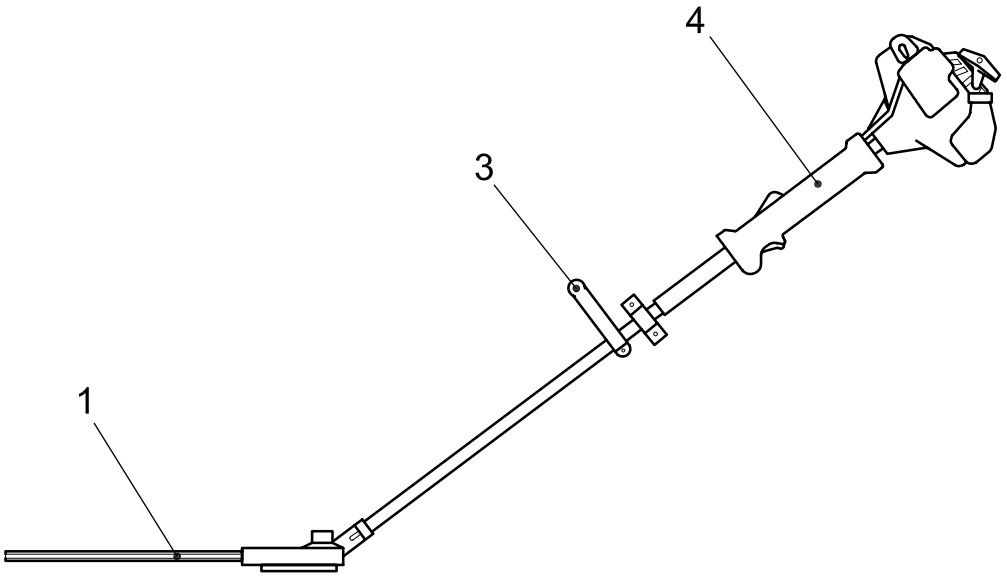


a) Petrol combustion engine hedge trimmer



b) Petrol combustion engine hedge trimmer

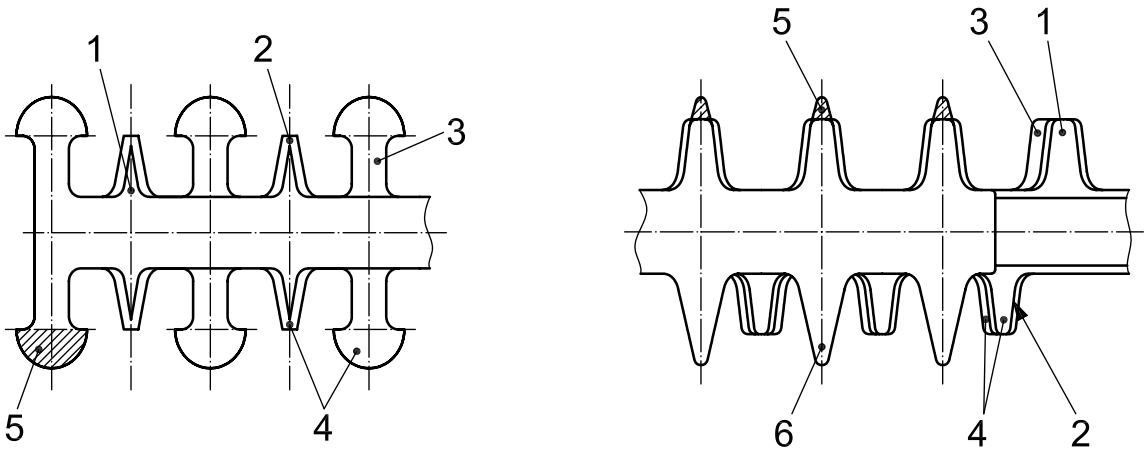
Figure 1 (*continued*)



c) Long-reach petrol combustion engine hedge trimmer

Key
1 cutting device
2 guard
3 front handle
4 rear handle
5 blade tooth
6 blade control

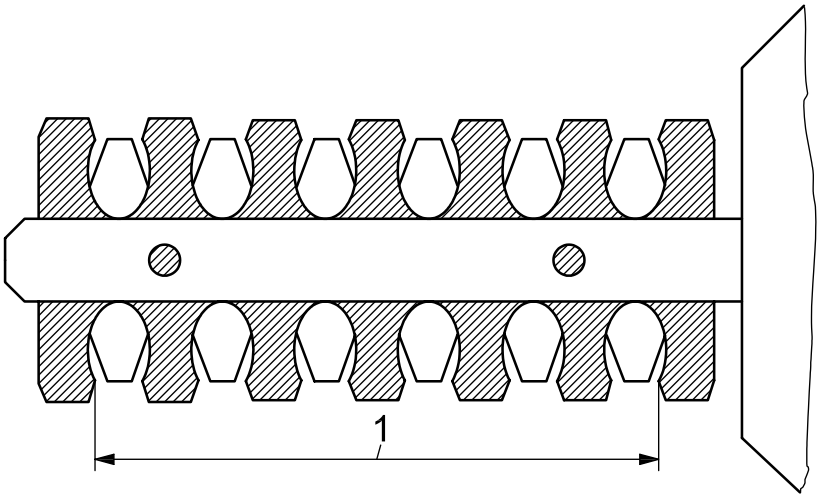
Figure 1 — Examples of types of hedge trimmer



a) **b)**

Key
1 cutting blade
2 blade tooth
3 shear plate
4 cutting device
5 blunt extension
6 unsharpened plate

Figure 2 — Cutting device



Key

1 cutting length

Figure 3 — Cutting length

4 List of significant hazards

This clause contains for defined danger zones all the significant hazards, hazardous situations and events, as far as they are dealt with in this International Standard, identified by risk assessment as significant for these types of hedge trimmer and which require specific action by the designer or manufacturer to eliminate or to reduce the risk (see Table 1). It is the responsibility of the manufacturer to check whether or not the safety requirements given by this International Standard apply to each significant hazard presented by the specific hedge trimmer and to confirm that the risk assessment is complete with particular attention to

— the intended use of the hedge trimmer including maintenance, setting and cleaning and its foreseeable misuse, and

— identification of all significant hazards associated with the hedge trimmer.

Table 1 — Significant hazards associated with powered hand-held hedge trimmers

Hazard		Location or event	Clause/subclause of this International Standard
1	**Mechanical hazards**		
	Due to:		
	a) shape	Holding and operating the hedge trimmer	5.2.1
	b) relative locations	Safe positioning in use	6.1; Annex A
1.2	Shearing hazard	Clearing processed material from cutting device	5.2.2, 5.2.3, 5.2.5, 6.1; Annex A
1.3	Cutting or severing hazard	Inadvertent contact with cutting device	5.2.2, 5.2.3, 5.2.4, 5.2.5, 5.2.6, 6.1; Annex A
1.4	Entanglement hazard	Loose clothing entering cutting device	6.1; Annex A
1.10	Ejection of parts (of machinery and processed materials/workpieces)	Processed material ejected from cutting device	6.1; Annex A
2	**Electrical hazards**		
2.1	Contact of persons with live parts (direct or indirect)	High voltage and ignition parts Damage to cables due to oil, fuel and abrasion	5.9.1, 5.9.2, 5.9.3
3	**Thermal hazards**		
3.1	Burns, scalds and other injuries, by possible contact of persons with objects or materials with an extremely high or low temperature, by flames or explosions and also by the radiation of heat sources	Contact with hot parts	5.6
4	**Hazards generated by noise**		
4.1	Hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	Hearing damage due to hedge trimmer and/or processing of material	5.11, 6.1, 6.2; Annexes A and D
5	**Hazards generated by vibration** (resulting in a variety of neurological and vascular disorders)	Hand/arm damage due to hedge trimmer and/or processing of material	5.10, 6.1, 6.2; Annexes A and C
7	**Hazards generated by materials and substances** processed, used or exhausted by machinery, including:		
7.1	Hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	Breathing in of engine exhaust fumes	5.8, 6.1; Annex A
7.2	Fire or explosion hazard	Refuelling	5.7, 6.1; Annex A
8	**Hazards generated by neglecting ergonomic principles in hedge trimmer design** (mismatch of machinery with human characteristics and abilities) caused, for example, by:		
8.1	Unhealthy postures or excessive efforts	Handling during use	6.1; Annex A
8.3	Neglected use of personal protection equipment	Protect against noise and vibration	5.10, 5.11, 6.1, 6.2; Annex A
8.6	Human error	Incorrect use, etc. Danger to bystanders	6.1; Annex A
8.7	Inadequate design, location of manual controls	Location of stop/start control	5.4.2, 5.4.3
		Identification of control(s)	5.4.1, 5.4.3

Table 1 (*continued*)

Hazard		Location or event	Clause/subclause of this International Standard
10	**Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders**, including:		
10.3	Failure, malfunction of control system (unexpected start-up, unexpected overrun)	Unexpected movement of cutting device Run-down of cutting device	5.2.3, 5.2.4, 5.2.5, 5.3
10.4	Errors of fitting	Fitting an incorrect blade or fitting blade incorrectly	5.2.7; 6.1; Annex A
11	**Hazards caused by (temporary) missing and/or incorrectly positioned safety-related measures/means**, for example:		
11.1	All kinds of guards	Protection against access to hazardous parts	5.2.2, 5.2.6, 5.5, 5.6, 5.9
11.3	Starting and stopping devices	Control of hedge trimmer	5.2, 5.3, 5.4
11.4	Safety signs and signals	User awareness of hazards	6.2, Annex B
11.5	All kinds of information or warning devices	User awareness and safe use	Clause 6; Annexes A and B
11.6	Energy supply disconnecting devices	Engine stop	5.4.3

5 Safety requirements and/or verification of safety measures

5.1 General

The hedge trimmer shall comply with the safety requirements and/or protective measures of this clause. In addition, the hedge trimmer shall be designed according to the principles of ISO 12100-1 and ISO 12100-2 for hazards relevant but not significant that are not dealt with by this International Standard (e.g. sharp edges other than the cutting device).

5.2 Handles and cutting device

5.2.1 Handles

The number of handles shall be in accordance with Table 2.

The handles shall be designed and constructed in such a way as to make starting and stopping straightforward and so that each one can be grasped (held) with one hand The gripping surface of handles shall be at least 100 mm long. On bail or closed handles (U-shaped handles) this dimension is related to the inner width of the gripping surface. On straight handles it is the complete length between the housing and the end of the handle.

The gripping length of a bail or closed handle shall comprise any length that is straight or curved at a radius of greater than 100 mm, together with any blend radius, but not more than 10 mm at either or both ends of the gripping surface.

There shall be a minimum radial clearance of 25 mm around the gripping length.

If a part containing the motor complies with the dimensions above, it may be considered as a handle.

If a straight handle is supported centrally (i.e. “T” type), the gripping length shall be calculated as follows:

a) for handles with a periphery (not including the support) of less than 80 mm, the gripping length is the sum of the two parts either side of the support;

b) for handles with a periphery (not including the support) of 80 mm or more, the gripping length is the complete length from end to end.

Where appropriate, the part of the handle containing the blade control actuator shall be counted as part of the handle gripping length. Finger grip or similar superimposed profiles shall not affect the method of calculating handle gripping length.

If handles are adjustable to different positions, it shall not be possible to fix them in a position which contravenes other provisions of this International Standard.

For handles with blade control which are adjustable without the use of a tool, it shall not be possible to alter the handle position when the cutting device is powered. When altering the position of a handle with blade control, the blade control shall be disabled such that the cutting device can not be powered until the handle is locked into one of its designated operating positions (e.g. the control is automatically disengaged from the throttle of the engine if the handle is not locked into one of the positions of use).

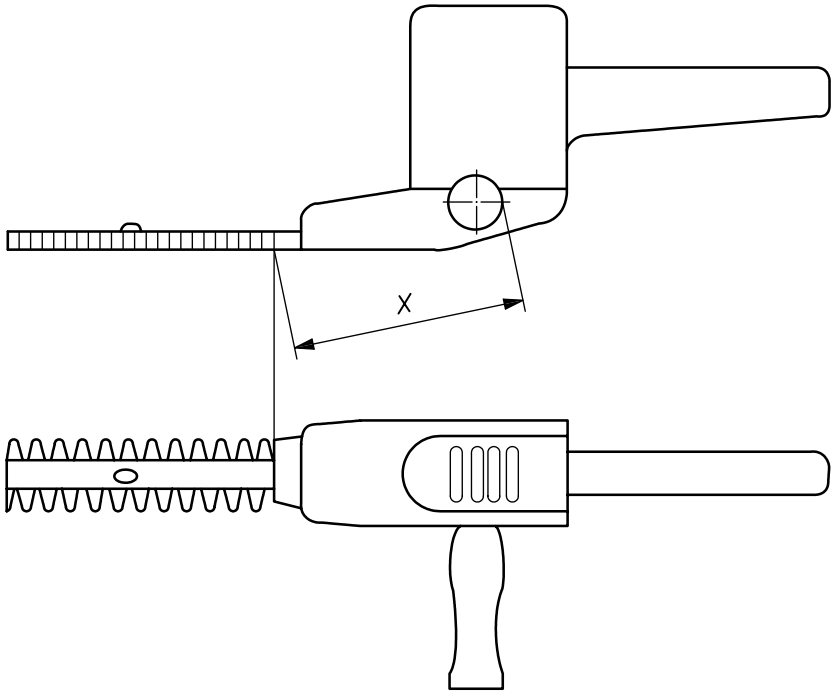
Compliance shall be checked by inspection and measurement.

5.2.2 Hand protection

From any handle it shall not be possible to touch the moving cutter blade with fingers spread out.

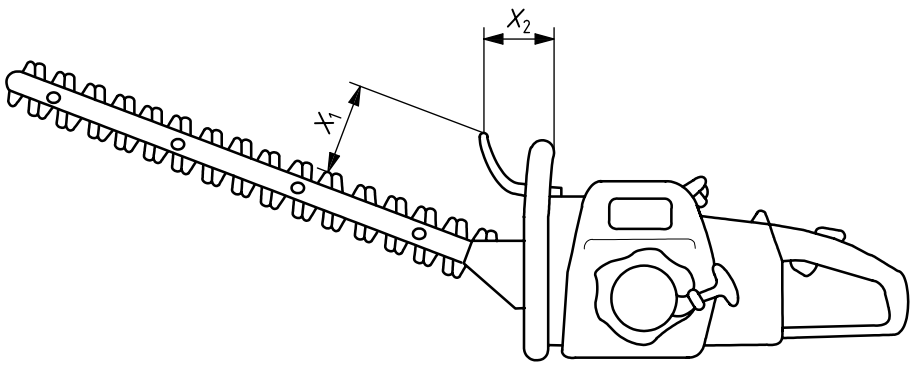
All handles shall be so located that the test distance from the cutter blade to the side furthest from the cutter blade of any handle is not less than 120 mm. The distance shall be measured along the shortest path from the side of the handle furthest from the cutter blade to the nearest cutting edge of the cutter blade [see Figure 4 a)]. If there is a guard, the distance shall be measured from the furthest side of the handle to the guard and from there to the nearest cutting edge of the cutter blade [see Figure 4 b)].

If the cutting device can be adjusted or altered for length, distance from handles or angle with respect to the handles, then this measurement shall be taken in the position in which any part of the cutting blade is nearest to the front handle. Positions where the cutting device will not operate are not included.



$X \geqslant 120$ mm

a)



$X_1 + X_2 \geqslant 120$ mm

b)

Figure 4 — Examples of measurement method for test distance for hand protection

5.2.3 Cutting device

To safeguard against contact with the cutter blade, hedge trimmers shall be constructed to meet the requirements of one of the categories given in Table 2.

Table 2 — Requirements

Category	1	2	3	4	5
Cutting length	$\leqslant$ 200 mm	$>$ 200 mm	$>$ 200 mm	$>$ 200 mm	No requirement
Holding moment (see 5.2.4)	No requirement	No requirement	No requirement	No requirement	$>$ 20 N·m
Minimum number of handles	1	2 and harness [a]	2 and harness [a]	2 and harness [a]	2 and harness [a]
Number of handles with blade control	1	1	2 [b]	2 [b]	1 (in rear)
Maximum stopping time	No requirement	No requirement	1 s [c]	1 s [c]	2 s
Cutting device	In accordance with Figure 5	In accordance with Figure 5	In accordance with Figure 5 or 6	In accordance with Figure 5 or 7	In accordance with Figure 5, 6 or 7
Stopping times for categories 4 and 5 will be reviewed with a view to reduction by 50 % at the next revision of this International Standard.					

[a] The harness shall only be required if the mass of the hedge trimmer is greater than 6 kg and the distance from the blade control to a moving cutting blade is greater than 1 000 mm.

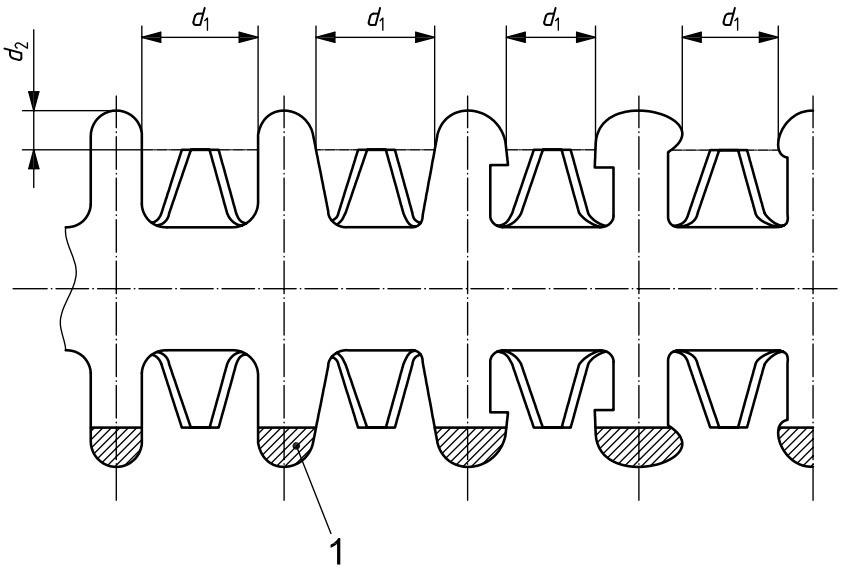
[b] If the distance from the blade control to a moving cutting blade is greater than 1 000 mm then only the rear handle is required to have a blade control.

[c] If the distance from the blade control to a moving cutting blade is greater than 1 000 mm then the stopping time may be 2 s.

Blunt extensions shall extend over the full length of the cutting device for blade configurations according to Figures 5 and 6. For cutting devices with blade configurations as shown in Figure 7, the blunt extensions shall reach a distance of at least 400 mm from any point of the rear face of the front handle [see Figures 8 a) and b)] or 1 000 mm from the rear of the control on the rear handle [see Figure 8 c)]. If the front handle is located part way along the cutting device, the blunt extensions shall start at the first blade tooth and continue until the 400 mm minimum distance beyond the rear of the front handle is reached.

Blunt extensions are not required for category 4 and 5 hedge trimmers with blade spacing in excess of that allowed by the dimension d_1 in Figures 5 and 6 if there are only two handles and the front handle is permanently fixed on the smooth side of a single-sided cutting device [e.g. Figures 1 a) and 9 a)].

Positions where the cutting device will not operate are not included.



Key

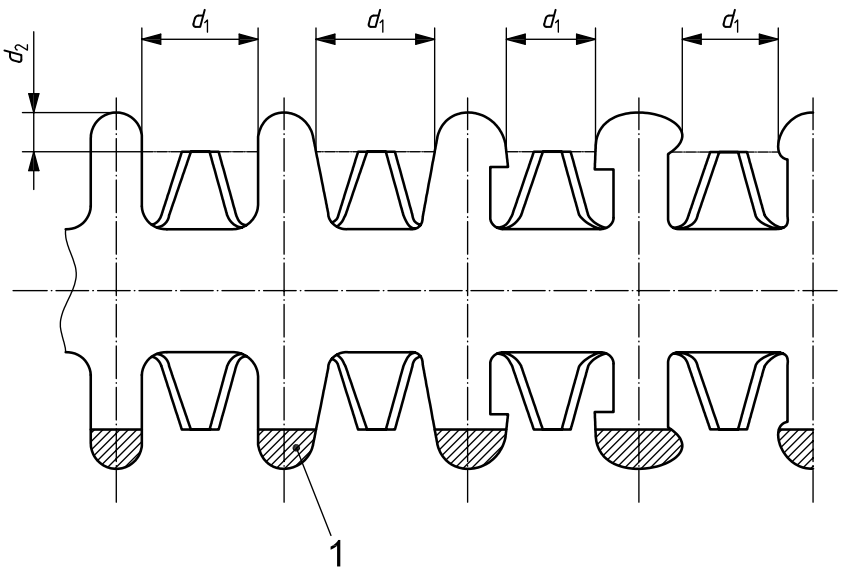
$d_1 \leqslant 8$ mm closest distance between adjacent blunt extensions measured outboard of the blade teeth

$d_2 \geqslant 8$ mm minimum depth of blunt extensions

1 extending depth of blunt part or unsharpened plate

NOTE See Table 2. Can be single- or double-sided.

Figure 5 — Cutting device configuration option for categories 1, 2, 3 and 5



Key

$d_1 \leqslant 12$ mm closest distance between adjacent blunt extension measured outboard of the blade teeth

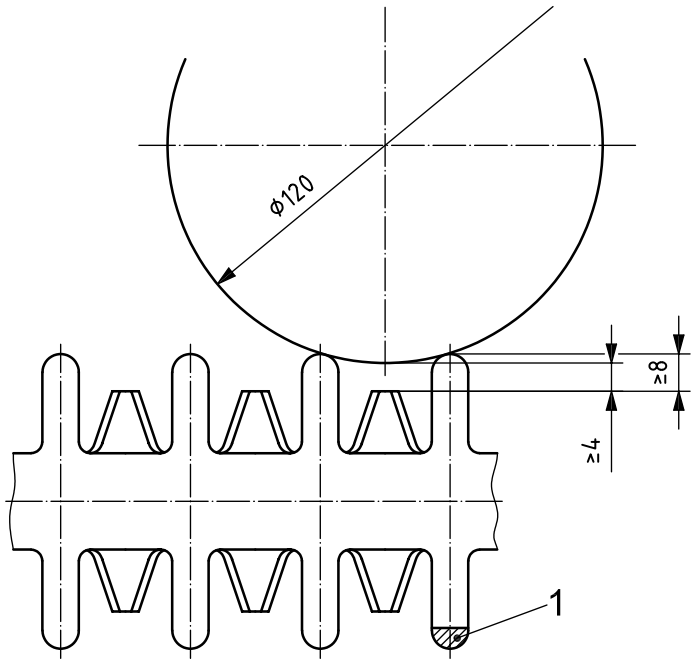
$d_2 \geqslant 8$ mm minimum depth of blunt extensions

1 extending depth of blunt part or unsharpened plate

NOTE See Table 2. Can be single- or double-sided.

Figure 6 — Cutting device configuration option for categories 3 and 5

Dimensions in millimetres



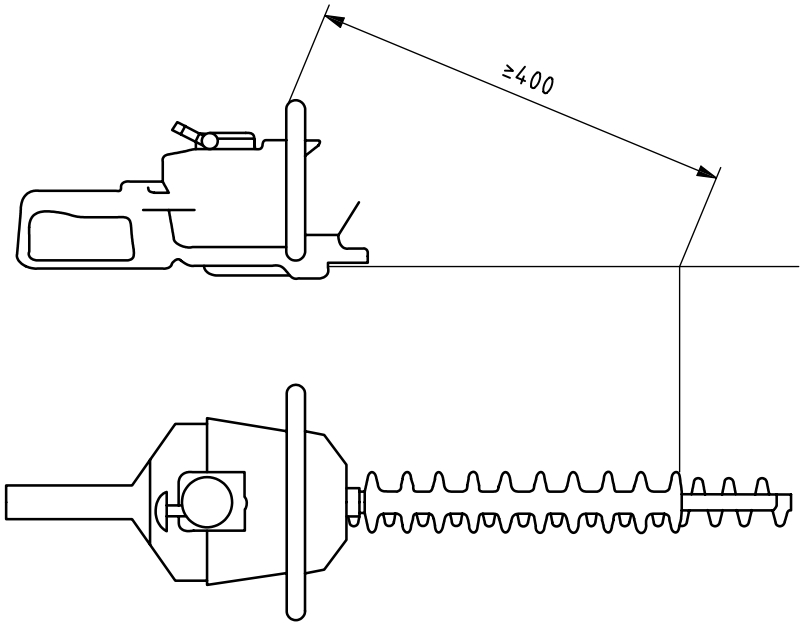
Key

1 extending depth of blunt part or unsharpened plate

NOTE See Table 2. Can be single- or double-sided.

Figure 7 — Cutting device configuration option for categories 4 and 5

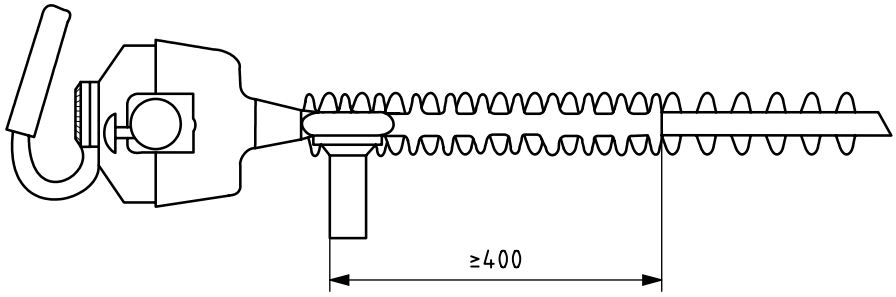
Dimensions in millimetres



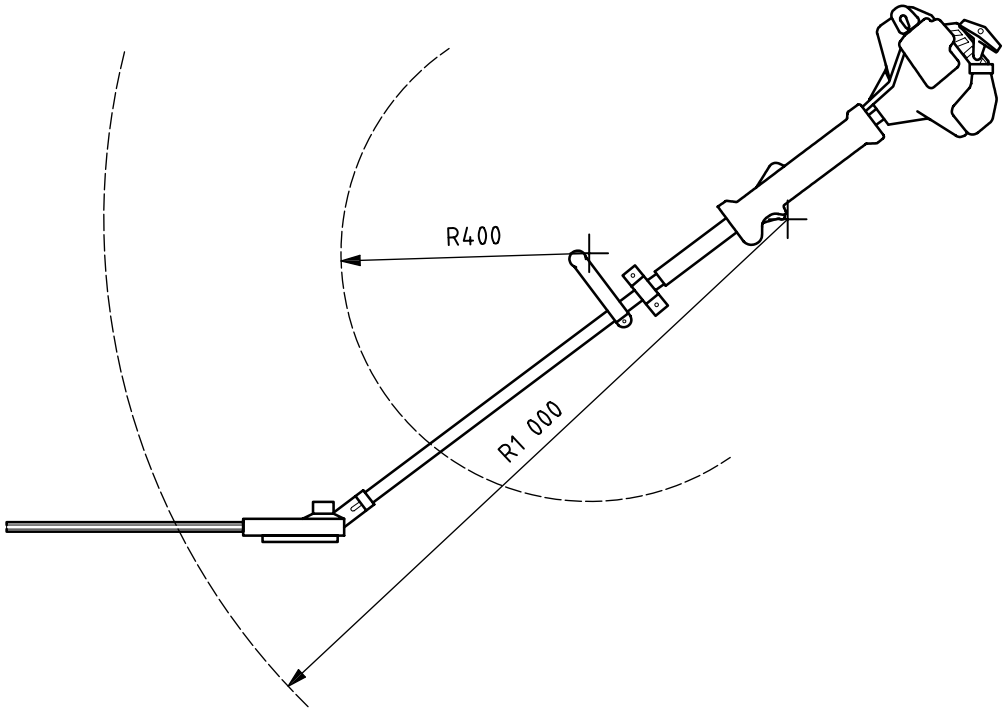
a)

Figure 8 (*continued*)

Dimensions in millimetres



b)



c)

Figure 8 — Example of measurement method for minimum length of blunt extension

5.2.4 Holding moment

The holding moment, M, as required for category 5 according to Table 2, shall be calculated as follows:

$$M = F \times L$$

where

F is the force in newtons;

L is the length in metres.

For a hedge trimmer with a lateral rear handle, the holding moment shall be calculated taking into account the dimensions and points of application shown in Figure 9 a).

For a hedge trimmer with a longitudinal rear handle, the holding moment shall be calculated taking into account the dimensions and points of application shown in Figure 9 b).

The holding moment for a machine with tanks shall be determined with them half full.

5.2.5 Blade stopping time

5.2.5.1 General

The cutting device stopping mechanism shall meet the stop time requirement given in Table 2.

Compliance shall be checked in accordance with 5.2.5.2 and 5.2.5.3.

5.2.5.2 Test method

The ambient test temperature shall be (20 ± 5) °C.

The hedge trimmer 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.

The means for operating the hedge trimmer during the test shall be such that the blade control is released abruptly from the full ON position and returns to the idle or OFF position by itself. A device to detect the moment of release of the blade control shall be provided.

The running speed during the test of ungoverned and governed hedge trimmers shall be 133 % of the speed corresponding to maximum power or the maximum speed, whichever is the lesser.

Tachometers shall have an accuracy of ± 2,5 % and the time-recording measurement system shall have a total accuracy of ± 25 ms.

Figure 10 presents a schematic representation of two cycles. Each cycle shall consist of the following sequence:

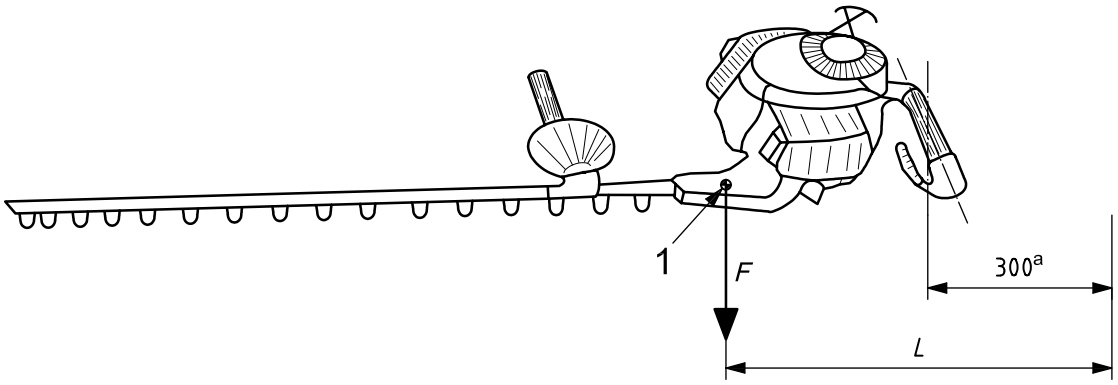
— accelerate the blade from rest to the maximum speed (time equal to t_s);

— hold it at this speed for a short time to ensure that it is stable (time equal to t_r);

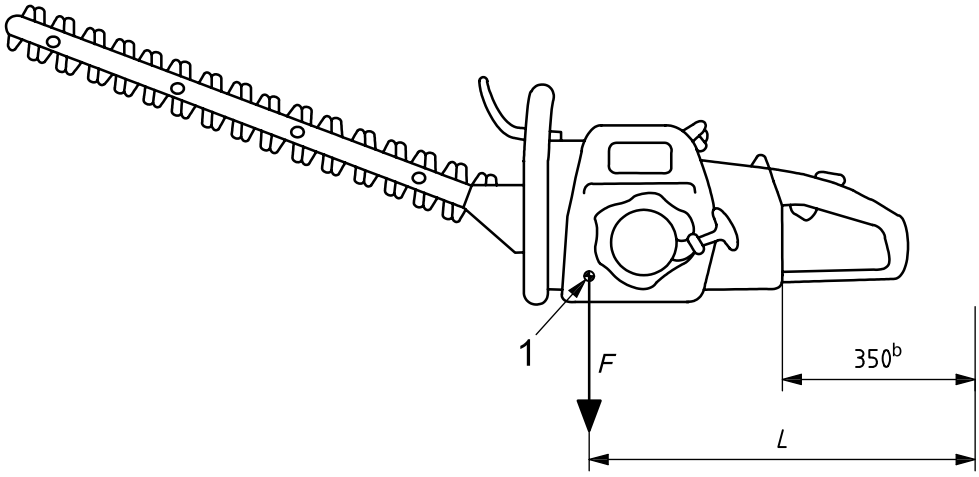
— release the blade control and allow the blade to come to rest (time equal to t_b);

— allow a short time at rest before commencing the next cycle (time equal to t_o).

Dimensions in millimetres



a)



b)

Key

1 centre of gravity

a 300 mm dimension is from the centre of the rear handle.

b 350 mm dimension is from the front of the rear handle.

Figure 9 — Calculation of holding moment

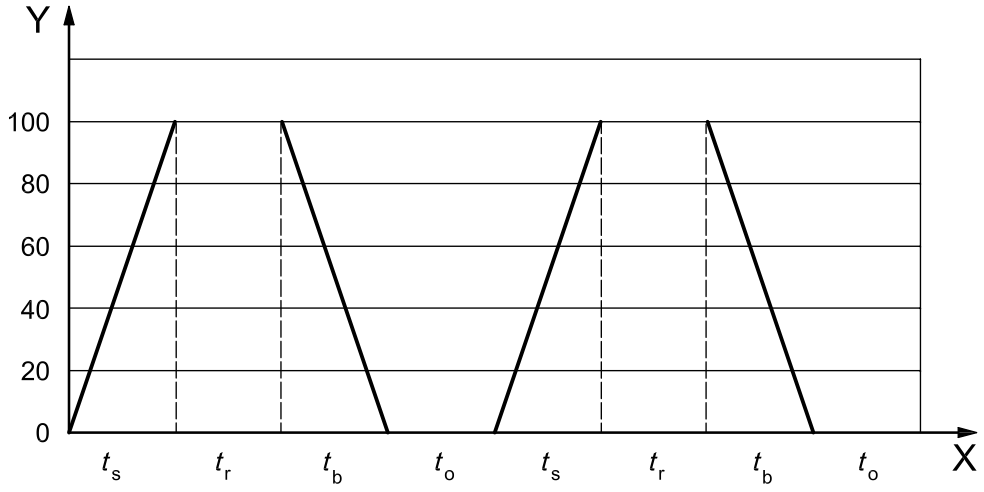


Figure 10 — Example of test cycles

If the total time for one cycle is t_c, then $t_c = t_s + t_r + t_b + t_o$. The test cycle times for "ON" ($t_s + t_r$) and "OFF" ($t_b + t_o$) shall be decided by the manufacturer but shall not exceed 100 s "ON" and 20 s "OFF".

The hedge trimmer shall be run in for 15 min prior to the test, in accordance with the manufacturer's instructions, with the cutting device, stopping mechanism, carburettor and ignition being adjusted and lubricated as appropriate, also in accordance with the manufacturer's instructions.

Ten ON/OFF operations of the blade control shall be carried out prior to the test, with the cutting device and stopping mechanism being adjusted in accordance with the manufacturer's instructions.

Stopping time is measured from the moment of release of the blade control until the cutter blade has reached the end of the last full stroke. Where there are two blade controls, half the test cycles and stop time measurements shall be carried out on each.

5.2.5.3 Operating mode

For hedge trimmers with an adjustable stopping mechanism, the test sequence shall consist of a total of 306 cycles; measurements of the stopping time of the cutting blades shall be made for the first six cycles of every 50 cycles of operation and the final six cycles of the test sequence. During the test, no adjustments shall be made.

For hedge trimmers with a non-adjustable stopping mechanism, the test sequence shall consist of a total of 2 506 cycles; measurement of the stopping time of the cutting blade shall be made for the first six cycles of every 500 cycles of operation and the final six cycles of the test sequence.

In both cases, the hedge trimmer shall be lubricated as appropriate.

No other stopping times shall be recorded.

5.2.5.4 Acceptance

Each of the measured stopping times shall comply with the requirements of Table 2.

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

The test sequence need not be continuous; however, any period or periods of operation shall only be stopped after any of the required sets of six measured cycles.

5.2.6 Cutting device transportation guard

A guard for the cutting device shall be provided. It shall be designed to cover the cutting device during transportation or when the hedge trimmer is stored.

The guard shall stay in its protective position when the hedge trimmer is held with the covered cutting device pointing vertically downwards.

5.2.7 Cutting device attachment

The cutting device attachment shall be designed so that it cannot be fitted incorrectly.

Compliance shall be checked by inspection and functional testing.

5.3 Starting and idling

Hedge trimmers shall be fitted with one or two blade controls (see Table 2) and be so designed that the hazards due to inadvertent starting are reduced to a minimum. This requirement shall be deemed to be met if either

a) the blade control, or one of the blade controls for categories 3 and 4 (see Table 2), requires two separate and dissimilar actions before the cutting device operates, or

b) the hedge trimmer has a blade control in each handle, neither of which requires two separate and dissimilar actions before the cutting device operates, and the blunt extensions, if required by 5.2.3, extend the full length of the cutting blade.

There shall be no arrangement to lock the blade control in the ON position and the cutting device shall stop when a blade control is released.

Starting the engine shall not be considered as one of these actions unless the engine stops when the control is released.

When starting the engine of hedge trimmers, the throttle trigger may be locked in a starting position (throttle lock). This position shall be unlocked automatically when the throttle trigger is operated.

On hedge trimmers, there shall be a means which separates the driving mechanism from the cutter blades. When the throttle lock is engaged for starting the engine, the cutting attachment may be engaged. When the engine is idling, the cutting device shall not have any cutting actions. If a centrifugal clutch is provided, it shall disconnect the power to the cutter blades when the engine is idling. The cutting device shall disengage at not less than 1,25 times the idling speed.

Compliance shall be checked by inspection.

5.4 Controls

5.4.1 Marking

All controls shall be duly marked, indicating the function, direction and/or method of operation as appropriate.

Detailed instructions on the operation of all controls shall be provided in an instruction handbook (see 6.1). Colours shall be in contrast to the background unless the symbols are cast, embossed or stamped, in which case colours are not required. Symbols according to ISO 3767-1 and ISO 3767-3 may be used as appropriate (see Annex B).

5.4.2 Blade control

With hand(s) on the handle(s), the controls shall be operable from all normal hand positions, without having to change the position of either hand.

Compliance shall be checked by inspection.

5.4.3 Engine stop

Hedge trimmers shall have a control for stopping the engine which can be operated without releasing the hold of either of the handles. The engine stopping device shall not depend on sustained manual pressure for its operation. The stop position shall be clearly marked. The control shall have a contrasting colour against its background.

Compliance shall be checked by inspection.

5.5 Power drive parts protection

All moving parts other than the cutting device shall be guarded to prevent the operator's contact with these components.

Compliance with the dimensions according to ISO 13857 shall be checked by verification.

5.6 Heat protection

5.6.1 General

Exposed components of the exhaust system having a surface temperature greater than 80 °C at an ambient temperature of 20 °C ± 3 °C shall be considered hot and shall be guarded so that they are not accessible to unintentional contact during normal use. These parts, which shall also include any exhaust guard that can be fitted to the hedge trimmer, are considered accessible if the area contactable by the test cone (see 5.6.2.3) is larger than 10 cm^2.

The temperature of handles and permanently held controls shall not exceed 43 °C when measured at an ambient temperature of 20 °C ± 3 °C. Other controls and surfaces contacted during normal operation shall not exceed 55 °C when measured at an ambient temperature of 20 °C ± 3 °C.

5.6.2 Test equipment, test conditions and test method

5.6.2.1 Temperature measuring equipment

The temperature measuring equipment for hot surfaces shall have an accuracy of ± 4 °C or better.

5.6.2.2 Test conditions

The test shall be conducted in the shade. The engine shall be operated at maximum no-load speed until the surface temperatures stabilise. The cutting device shall be lubricated as appropriate.

Identify the hot (see 5.6.1) surface area(s) on the exhaust system and guard. Temperatures shall be determined by correcting the observed temperature by the difference between 20 °C and the ambient temperature at the time of the test, i.e. temperature (°C) equals the observed temperature (°C) minus the ambient temperature (°C) plus 20 °C.

5.6.2.3 Test method

The cone (see Figure 11) shall be used with its axis in any direction and moved in any direction.

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

When moving the cone, determine if contact is made with the hot surface area(s) by the cone tip or conical surface of the cone. The cylindrical surface of the cone and the flat surface of the cone shall not be considered.

5.6.3 Test acceptance

The tip or conical surface of the cone shall not be able to make contact with any hot surface area greater than 10 cm^2.

Dimensions in millimetres

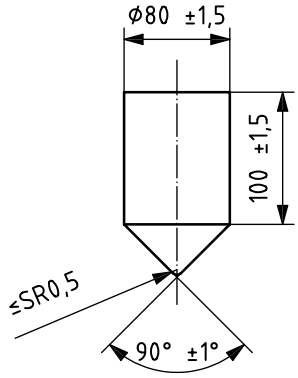


Figure 11 — Dimensions of cone

5.7 Fuel tank

The fuel cap shall have a retainer. The fuel tank opening shall be at least 20 mm in diameter and shall be located so that filling of the tank by means of a suitable funnel is not obstructed by other components.

The design of the fuel tank assembly shall be such that no leakage occurs while the hedge trimmer is at its normal operating temperature, in all working positions and while being transported. Seepage from any fuel tank venting system shall not constitute a leakage.

5.8 Engine exhaust

The engine exhaust shall not be directed towards the operator in the normal working position.

5.9 Electrical requirements of ignition system

5.9.1 General

Electrical cables shall be protected if located in potentially abrasive contact with metal surfaces and shall be resistant to lubricants and fuel, or protected from contact with them.

5.9.2 Ignition circuit

Ignition interruption or short-circuiting shall be provided and shall be fitted on the low voltage side.

All high voltage parts of the circuit, including spark plug terminals, shall be electrically protected such that the operator cannot make accidental contact with them.

5.9.3 Test method

The requirements shall be checked by inspection and using the finger probe as specified in IEC 60745-1.

5.9.4 Test acceptance

The finger probe shall not make contact with high voltage parts of the circuit, including spark plug terminals.

Inspection shall show that cables are protected against abrasion by metal surfaces and the cables are either resistant to, or there is no contact with, lubricants and fuel.

5.10 Vibration

5.10.1 Reduction by design and protective measures

The hedge trimmer shall be designed to generate a vibration level as low as practicable. The main sources causing vibration are

— oscillating forces from the motor,

— the cutting means,

— unbalanced moving parts,

— the impact in gears, bearings and other mechanisms, and

— the interaction between operator, hedge trimmer and the material being worked.

Besides the vibration reduction of the source, technical measures for isolating the vibration source from the handle, such as isolators and resonating masses, may be used when appropriate.

5.10.2 Reduction by information

Even after the possible technical measures for vibration reduction have been taken, when appropriate the instruction handbook shall include recommendations for

— the use of low-vibration operating modes and/or limited time of operation, and

— the wearing of personal protection equipment (PPE).

5.10.3 Vibration measurement

The measurement of hand-arm vibration shall be in accordance with Annex C.

5.11 Noise

5.11.1 Reduction by design and by information

It is recommended that special care be taken in the acoustical design of hedge trimmers, especially with regard to the exhaust system and the selection of the silencer. The main sources causing noise for combustion-engine-driven hedge trimmers are

— the air intake system,

— the engine cooling system,

— the engine exhaust system,

— the cutting system, and

— vibrating surfaces.

NOTE 1 ISO/TR 11688-1 gives general technical information on widely recognized technical rules and means to be applied in the design of machines of low noise emission.

NOTE 2 ISO 11691 and ISO 11820 can be useful when testing the silencer.

NOTE 3 ISO/TR 11688-2 gives useful information on noise generation mechanisms in machinery.

The instruction handbook shall recommend the use of low-noise operating modes and/or limited time of operation, and give instructions on the protective measures to be taken by the user, including, where appropriate, the type of ear protection to be provided.

5.11.2 Noise emission measurement

The sound power level and emission sound pressure level at the operator's position shall be measured in accordance with Annex D.

6 Information for use

6.1 Instructions for use

Each hedge trimmer shall be provided with an instruction book written in one of the official languages of the country of sale, giving detailed instructions on the operation of all controls, servicing and maintenance as appropriate to comply with ISO 12100-2:2003, Clause 6. The instructions shall include those operations that are meant to be performed by the user. The instructions shall be simple and clear such that they are suitable for unskilled users. They shall include the following:

— instructions for, and, where appropriate, illustrations of, the assembly and disassembly of the hedge trimmer, if the hedge trimmer is not supplied in a completely assembled form;

— instructions for, and, where appropriate, illustrations of, the use of the hedge trimmer, including detailed instructions on all controls~~;~~

— instructions for, and, where appropriate, illustrations of, adjustment and any necessary user maintenance of the hedge trimmer, including lubrication of the cutting device(s) and how to set the carburettor and ignition;

— instructions for, and, where appropriate, illustrations of, the designated operating position.

— instructions and, where appropriate, drawings giving detailed explanations of all controls;

— instructions for safe handling of fuel;

— instructions and, where appropriate, drawings for the recommended replacement or repair of parts, or servicing and the specifications of the spare parts to be used, when these affect the health and safety of operators;

— explanation of any pictograms that are used on the hedge trimmer and a repeat of all other information except for the serial number;

— the essential characteristics of tools which can be fitted to the machinery;

— the operating method to be followed in the event of accident and breakdown;

— where a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked;

— a warning that hedge trimmers are not intended for use by children;

— warnings concerning ways in which the machinery must not be used where experience has shown that these might occur.

The instruction handbook and the technical documentation describing the hedge trimmer shall

— give the declared noise emission values of the machine in accordance with D.2.4 and D.2.8.5;

— declare the values for A-weighted sound power level and A-weighted emission sound pressure levels at the operator position, determined in accordance with Annex D;

— include separately information about uncertainty for the values dealing with both measurement uncertainty and production uncertainty;

— declare the values for equivalent vibration total value to which the hand-arm system is subjected, determined in accordance with Annex C, if this total exceeds 2,5 m/s^2;

— state that the values for equivalent vibration total value to which the hand-arm system is subjected do not exceed 2,5 m/s^2, where this is the case;

Compliance shall be checked by inspection.

6.2 Marking

All hedge trimmers shall be legibly and indelibly marked with the following minimum information:

— designation of the hedge trimmer;

— the business name and full address of the manufacturer and, where applicable, his authorized representative;

— year of construction, that is, year in which the manufacturing process is completed;

— designation of series or type;

— serial number if any;

— clear identification of the function, direction and/or method of operation of controls, where appropriate.

The substance of the following warnings shall be marked on the hedge trimmer (in words or pictograms):

— "**Warning. Read the instruction handbook**";

— "**Wear ear protection**"

— "**Wear eye protection**".

If pictorials are used, they shall be explained in the instruction handbook. Pictograms shall follow those of ISO 11684. Examples of pictorials are given in Annex B.

6.3 Warnings

Markings giving warning information shall be located as close as practicable to the relevant hazard. Such markings shall be in one of the official languages of the country in which the hedge trimmer is to be sold, or appropriate pictograms/symbols in contrasting colours shall be used. If the marking is cast, embossed or stamped, colours are not required. The symbols used shall follow the conventions laid down in ISO 3767-1, ISO 3767-3, ISO 3767-4 and ISO 3864-1.

6.4 Durability of marking and warnings

6.4.1 Requirements

Markings provided for identification and directional or warning information shall

— have a durable bond with the base material surface,

— be water resistant and designed to be permanently legible,

— not curl at edges, and

— not become illegible due to spilled fuel or lubricant.

6.4.2 Verification

The marking shall be rubbed by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in hexane. The marking shall remain easily legible. It shall not be easily possible to remove any label nor shall any label show any sign of curling.

Annex A
(informative)

Safety instructions

A.1 General

This annex presents an example of safe operating practices for all the hedge trimmers covered by this International Standard. The instruction handbook should include, where appropriate, the substance of the following clauses. It should also include information concerning noise levels and any necessary warnings, together with the following messages:

IMPORTANT

Read carefully before use

Keep for future reference

A.2 Safe operating practices

A.2.1 Training

Provide the following instruction:

Become familiar with the owner's manual before attempting to operate the equipment.

A.2.2 Preparation

Provide the following instructions.

a) THIS HEDGE TRIMMER CAN CAUSE SERIOUS INJURIES. Read the instructions carefully for the correct handling, preparation, maintenance, starting and stopping of the hedge trimmer. Become familiar with all controls and the proper use of the hedge trimmer.

b) Never allow children to use the hedge trimmer.

c) Beware of overhead power lines.

d) Avoid operating while people, especially children, are nearby.

e) Dress properly! Do not wear loose clothing or jewellery, which can be caught in moving parts. Use of sturdy gloves, non-skid footwear and safety glasses is recommended.

f) Use extra care when handling fuels. They are flammable and the vapours are explosive. The following points should be observed.

   — Use only an approved container.

   — Never remove the fuel cap or add fuel with the power source running. Allow engine and exhaust components to cool down before refuelling.

   — Do not smoke.

— Never refuel indoors.

— Never store the hedge trimmer or fuel container inside where there is an open flame, such as near a water heater.

— If fuel is spilled, do not attempt to start the power source, but move the hedge trimmer away from the spillage before starting.

— Always replace and securely tighten the fuel cap after refuelling.

— If the fuel tank is drained, this should be done outdoors.

g) If the cutting mechanism strikes any foreign object or the hedge trimmer starts making any unusual noise or vibration, shut off the power source and allow the hedge trimmer to stop. Disconnect the spark plug wire from the spark plug and take the following steps:

— inspect for damage;

— check for, and tighten, any loose parts;

— have any damaged parts replaced or repaired with parts having equivalent specifications

h) Warn of the need for ear protection.

i) Warn of the need for eye protection.

j) Instruct in how to stop the hedge trimmer in an emergency.

A.2.3 Operation

Provide instructions for correct use and an indication that the hedge trimmer should not be used for any other purpose, as well as the following instructions.

a) Stop the engine before

— cleaning or when clearing a blockage,

— checking, carrying out maintenance or working on the hedge trimmer,

— adjusting the working position of the cutting device,

— leaving the hedge trimmer unattended.

b) Ensure that the hedge trimmer is correctly located in a designated working position before starting the engine.

c) While operating the hedge trimmer, always ensure that the operating position is safe and secure, especially when using steps or a ladder.

d) Do not operate the hedge trimmer with a damaged or excessively worn cutting device.

e) To reduce fire hazards, keep the engine and silencer free of debris, leaves and excessive lubricant.

f) Always ensure that all handles and guards are fitted when using the hedge trimmer. Never attempt to use an incomplete hedge trimmer or one fitted with an unauthorized modification.

g) Always use two hands to operate a hedge trimmer fitted with two handles.

h) Always be aware of your surroundings and stay alert for possible hazards of which you may not be aware due to the noise of the hedge trimmer.

A.2.4 Maintenance and storage

Provide the following instructions.

a) When the hedge trimmer is stopped for servicing, inspection or storage, shut off the power source, disconnect the spark plug wire from the spark plug and make sure all moving parts have come to a stop. Allow the hedge trimmer to cool before making any inspections, adjustments, etc.

b) Store the hedge trimmer where the fuel vapour will not reach an open flame or spark. Always allow the hedge trimmer to cool down before storing.

c) When transporting or storing the hedge trimmer, always fit the cutting device transport guard.

Annex B
(informative)

Symbols and pictograms

B.1 General

This annex presents the safety symbols and pictograms that can be used on the hedge trimmers covered by this International Standard.

The symbols used shall follow the conventions laid down in ISO 3767-1, ISO 3767-3, ISO 3767-4 and ISO 3864-1, while pictograms shall follow those of ISO 11684.

The symbol size may be modified to fit the hedge trimmer design. The pictograms and symbols presented do not represent an exhaustive list.

B.2 Pictograms

See Figures B.1 to B.4.

Figure B.1 — General warning sign — ISO 7010-W001

Figure B.2 — Before use, read instruction handbook — ISO 7010-M002

Figure B.3 — Wear ear protection — ISO 7010-M003

Figure B.4 — Wear eye protection — ISO 7010-M004

Annex C
(normative)

Vibration

C.1 General

This vibration test code specifies the information necessary to carry out efficiently and under standardized conditions the determination of the vibration emission characteristics of portable, hand-held petrol combustion engine hedge trimmers.

It is a test procedure for establishing the magnitude of vibration at the handles of the hedge trimmer. The results obtained can be used to compare different hedge trimmers or different models of the same type of hedge trimmer. Although the magnitudes measured are obtained in an artificial operation, they will give an indication of the values that would be found in a real work situation.

The determination of vibration characteristics is used for

— manufacturer's declarations,

— comparing the data between hedge trimmers in the family concerned,

— development work at the design stage,

— the estimation of the vibration risk taking into consideration the specific conditions (parameters).

NOTE Use of this vibration test code ensures reproducibility of the determination of the vibration characteristics. The operating modes are of interest for assessment of the vibration exposure, for example, over a typical working day. The work cycle chosen for this test code is based on the assumption that the hedge trimmer is commonly used in the full open throttle mode with interruptions of work in the idling mode.

C.2 Terms and definitions

For the purposes of this annex, the terms and definitions given in ISO 8041 and the following apply:

C.2.1
accelerometer
sensitive element intended to pick-up vibration and to convert it into electrical signals

NOTE A tri-axial accelerometer will permit measurements in the X, Y and Z axes simultaneously.

C.3 Quantities to be measured and quantities to be determined

Quantities to be measured are the weighted accelerations in three perpendicular directions, a_{hwx}, a_{hwy} and a_{hwz}.

Quantities to be determined are the equivalent vibration total value ($a_{hv,eq}$) for each handle.

NOTE Mathematically, a_{hv} is the root-sum of the squares of the three root-mean-square (r.m.s.) single-axis acceleration values of the frequency-weighted hand-transmitted vibration values (a_{hvx}, a_{hvy}, a_{hvz}).

C.4 Instrumentation

C.4.1 General

The vibration measurement system and frequency weighting for hand-arm vibration shall be in accordance with ISO 8041.

C.4.2 Accelerometer

The total mass of the vibration accelerometer giving the acceleration in the three directions at each measuring position shall be as low as possible and shall not in any case exceed 25 g, including the mounting but excluding the cable.

NOTE ISO 5349-2:2001, 6.5.1 gives useful information on the checking of the accelerometer and its mounting.

C.4.3 Fastening of accelerometer

The accelerometer shall be mounted firmly on the handle by means of a fastening device. Guidance is given in ISO 5348 and ISO 5349-2.

For measurement on handles with resilient covers (for example, a cushioned handle), it is permissible to use a suitable adaptor for the accelerometer. The adaptor shall consist of a suitably formed light, rigid plate with a suitable mounting arrangement for the accelerometer used. Care shall be taken that the mass, size and shape of the adaptor do not significantly influence the signal from the accelerometer in the frequency range of interest. For further guidance, see ISO 5349-2:2001, 6.1.4.2.

C.4.4 Calibration

The whole measuring chain, including the accelerometer, shall be checked before and after use and, when necessary to ensure accuracy during any sequence of measurements, in accordance with ISO 8041.The accelerometers shall be calibrated in accordance with ISO 5347-22.

C.4.5 Speed indicator

The rotational frequency of the engine shall be measured with an accuracy of $\pm$ 1,5 % of the reading. The indicator and its engagement with the hedge trimmer shall not affect operation during the test.

C.5 Measurement direction and location

C.5.1 Measurement direction

Measurements shall be made at each hand-grip, where the operator normally holds the hedge trimmer. Measurements shall be made in the three directions X, Y and Z. The accelerometers shall be positioned at the thumb side of the hand, at a maximum distance of 70 mm from the gripping length, without obstructing the normal grip.

C.5.2 Measurement location

The centre of gravity of the accelerometers shall be positioned at a maximum distance of 20 mm from the handle contour. One of the axes of the accelerometer shall be parallel to the axis of the handle.

Typical locations of the transducer assemblies and directions of measurement are shown in Figures C.2, C.3 and C.4.

C.6 Adjustment of hedge trimmer before test

Tests shall be carried out on a new, normal production hedge trimmer fitted with standard equipment. The hedge trimmer shall be run in and warmed up until stable conditions are reached before the test is commenced.

The cutting device(s) shall be lubricated as appropriate.

The carburettor and ignition shall be set as appropriate; measurements shall be made with full tanks.

The hedge trimmer shall be operated with the operator standing upright. The hedge trimmer shall be connected to the harness, if any, and held with both hands in a manner consistent with day-long use of the hedge trimmer. The hedge trimmer shall be held with the axis of the cutting device orientated as in the normal rest position on a horizontal surface.

During the test, the cutting means shall be driven. Contact between the hand and the transducer shall be avoided, as gripping forces on the handles could influence the measured vibration values.

C.6.1 General

The tests to obtain the required data for a given operating condition shall consist of

— a minimum of four measurements with a break to reach stable idling conditions between each measurement,

— at least four separate periods of vibration data totalling at least 20 s, and

— signal durations each of at least 2 s over which the engine speed is within $\pm$ 3,5 s^{-1}.

NOTE The operating modes given in C.7.2 and C.7.3 are of interest for assessment of user vibration exposure values — for example, over a typical working day. No cutting mode is given, since that mode is too diverse and cannot be performed under repeatable conditions.

C.6.2 Idling

The engine speed shall be adjusted so that the cutting equipment does not move.

C.6.3 Racing

Measurements shall be made with the blade attached at an engine speed of 133 % of the speed at maximum engine power determined in accordance with ISO 8893.

If the engine has a speed limiter set below that speed, the measurement shall be made at the maximum speed achievable. Tests shall be carried out at the maximum possible stable speed but they shall be carried out at a speed that is no more than 8 s^{-1} below the maximum speed determined by the speed governor. The engine speed shall be controlled with the throttle trigger.

A speed indicator shall be used to check the speed of the engine. It shall have an accuracy of $\pm$ 2,5 % of the reading. The indicator and its engagement with the hedge trimmer shall not affect the operation during the test.

C.7 Information

C.7.1 General

The information specified in C.7.2 to C.7.5, when applicable, shall be compiled and reported for all measurements made in accordance with this International Standard.

C.7.2 Hedge trimmer under test

Include the following information:

a) description of the hedge trimmer (including its engine displacement, type and serial number, and type of cutting attachment);

b) operating conditions, as listed in Table C.1.

C.7.3 Instrumentation

Include the following information:

a) equipment used for the measurements, including name, type, serial number and brand;

b) methods used to fasten the accelerometers;

c) method used to calibrate the instrumentation system;

d) date and place of the most recent calibration of the accelerometer calibrator.

C.7.4 Vibration and other data

Include the following information:

a) location of the accelerometer positions (a sketch may be included, if necessary);

b) measurement values and arithmetic mean values in accordance with Table C.1;

c) declared values;

d) remarks, if any;

e) air temperature;

f) the date and place of the measurements.

Table C.1 — Reporting vibration measurements and calculation of arithmetic mean of acceleration sum

Operation	Measured data and validity	Nominal engine speed s^{-1}	Front/left handle / Rear/right handle						
			Test No.						
			1	2	3	4	5	6	n
Idling (Id)	$a_{hv,Id}$ (m/s^2)								
	$\overline{a}_{hv,Id}$ (m/s^2)		—	—	—				
	s_{n-1} (m/s^2)		—	—	—				
	C_v (–)		—	—	—				
Racing (Ra)	$a_{hv,Ra}$ (m/s^2)								
	$\overline{a}_{hv,Ra}$ (m/s)		—	—	—				
	s_{n-1} (m/s^2)		—	—	—				
	C_v (–)		—	—	—				
The acceleration sum (a_{hv}) is measured and recorded, and the arithmetic mean ($\overline{a}_{hv}$) is calculated until the coefficient of variation (C_v) and the standard deviation (s_{n-1}) are less than 0,4.									
The calculation of $\overline{a}_{hv}$ is based on at least four measurements of a_{hv}.									
The value for the arithmetic mean ($\overline{a}_{hv,Id}$, $\overline{a}_{hv,Ra}$) is used to calculate the equivalent vibration total values ($a_{hv,eq}$).									

C.7.5 Equivalent total vibration values

The equivalent vibration value is based on a work cycle composed of idling and racing.

The equivalent vibration value ($a_{hv,eq}$) shall be determined as follows:

$$a_{hv,eq} = \left(\frac{1}{5} \times \overline{a}_{hv,Id}{}^2 + \frac{4}{5} \times \overline{a}_{hv,Ra}{}^2 \right)^{1/2}$$

C.8 Validity test

The validity is assured for every combination of handle and operating mode when either the coefficient of variation of the consecutive weighted values is less than 0,4 or the standard deviation is less than 0,4 m/s^2.

If the measured values for a combination of handle and operating mode give a value exceeding 0,4 for both coefficient of variation and standard deviation, only this combination shall be repeated until the criterion is met.

For the purposes of this annex, the coefficient of variation (C_v) of a test series is defined as the ratio between the standard deviation of a series of measurement values and the mean value of the series:

$$C_v = \frac{s_{n-1}}{\overline{x}}$$

where the standard deviation, s_{n-1}, is

$$s_{n-1} = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} \left(x_i - \overline{x} \right)^2}$$

and the mean value of the series, $\bar{x}$, is

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

where

x_i is the i-th value measured;

n is the number of measurement values.

C.9 Information to be measured and calculated

The measurements and calculations are generally done in the following sequence, as illustrated in Figure C.1.

a) Measure the weighted acceleration of each operating mode in the three directions for left and right handles ($a_{hwx,i}$, $a_{hwy,i}$ and $a_{hwz,i}$), where i is idling or racing.

b) Calculate the root sum of squares (r.s.s.) of accelerations of the three directions of an operating mode, e.g. $a_{hw,x}$, where x is idling or racing.

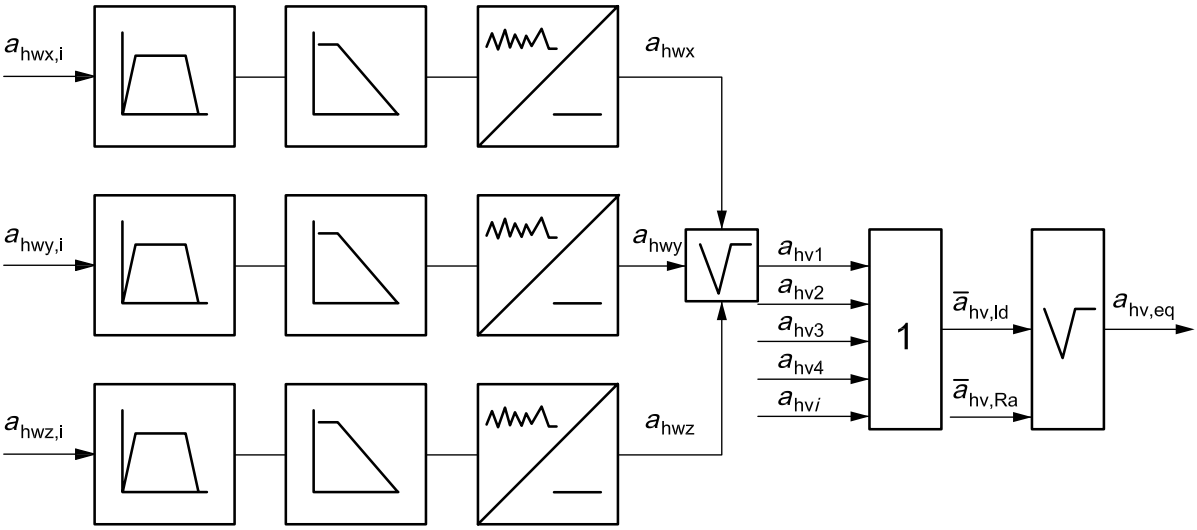
c) Repeat a) and b) three more times.

d) Calculate the arithmetic mean of the selected operating mode, e.g. $\bar{a}_{hv,x}$, where x is idling or racing;

e) Repeat a) to d) as many times as is necessary depending on the coefficient of variation and the standard deviation.

f) Repeat a) to e) for the other operating modes.

g) Calculate the equivalent total vibration value ($a_{hv,eq}$) for each handle, according to C.7.5.



Information is given in C.9.

Figure C.1 — Sequence of measuring and calculation of vibration data

C.10 Measurement uncertainties and declaration of vibration values

Vibration declaration is the responsibility of the manufacturer. If undertaken, it shall be done so that it is possible to verify the declared values.

The declaration shall include a reference to this vibration test code and to the basic standard used. Deviations, if any, from this test code and/or the basic standard shall also be indicated.

The vibration total value to which the hand-arm system is subjected for the work cycles (see C.7.5) shall be declared. The average vibration value for idling and racing (if applicable) shall be provided on request.

The uncertainties associated with the measurements shall be declared.

The methodology used for taking uncertainty into account should be based on the use of measured values and on measured values and uncertainties. The latter are the uncertainty associated with the measurement procedure (which is determined by the grade of accuracy of the measurement method used) and the production uncertainty (variation of vibration emission from one hedge trimmer to another of the same type made by the same manufacturer). If a measurement at 70 mm or 80 mm cannot be obtained, the transducer shall be placed as close as possible to this position, avoiding contact with the hand.

The method for the calculation of uncertainty shall be in accordance with EN 12096.

See Figures C.2 to C.4.

Dimensions in millimetres

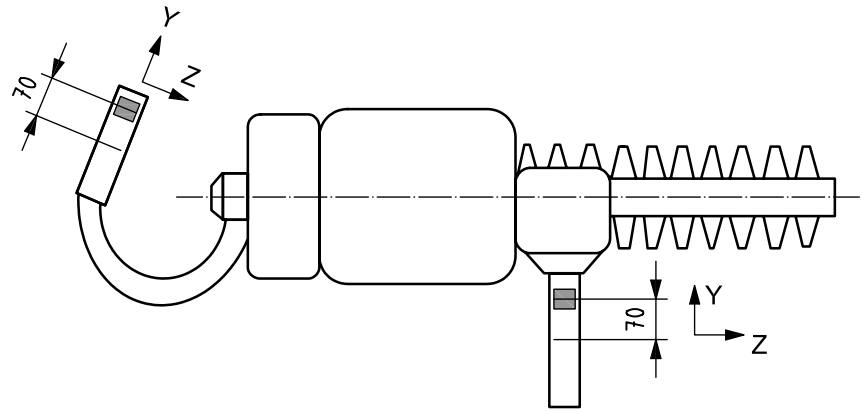


Figure C.2 — Example of transducer location/orientation (longitudinal rear handle)

Dimensions in millimetres

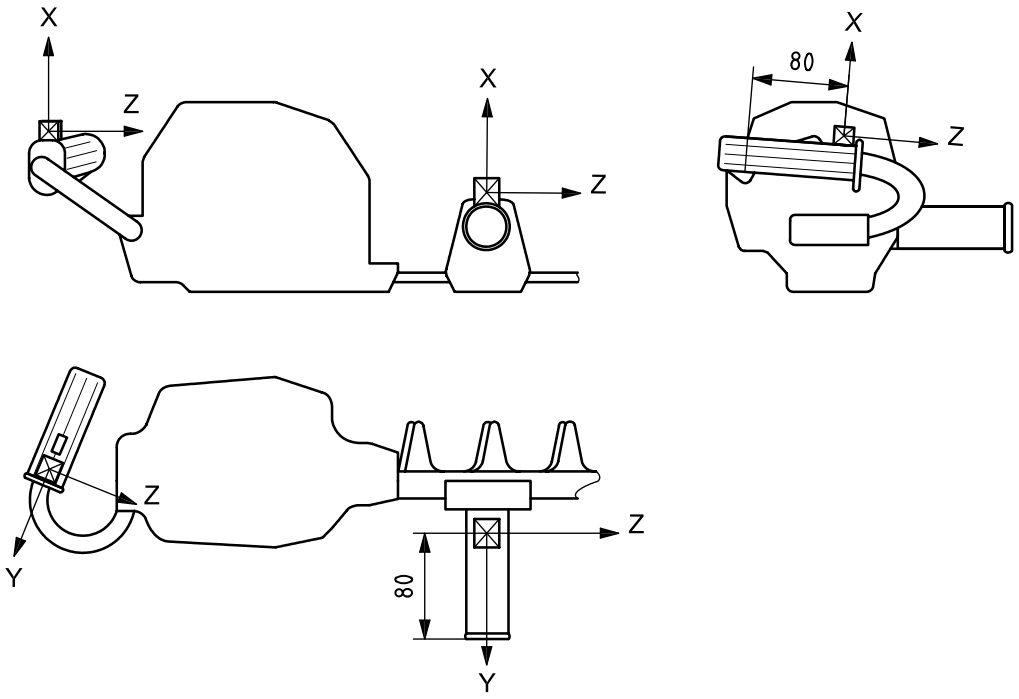


Figure C.3 — Example of transducer location/orientation (lateral rear handle)

Dimensions in millimetres

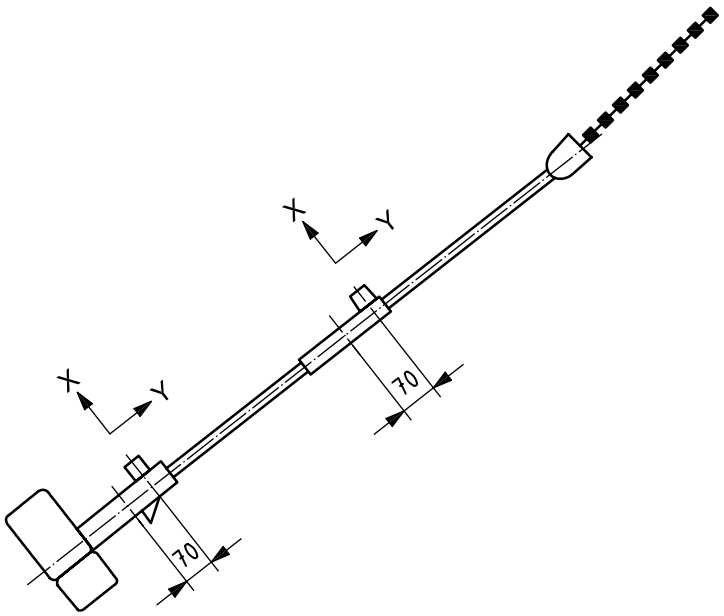


Figure C.4 — Example of transducer location/orientation (long-reach hedge trimmers)

Annex D
(normative)

Noise test code — Engineering method (grade 2)

D.1 General

This noise test code specifies the information necessary to carry out efficiently and under standardized conditions the determination of the noise emission characteristics of portable hand-held petrol combustion engine hedge trimmers.

Noise emission characteristics include the A-weighted emission sound pressure level at the operator position and the A-weighted sound power level. It is intended for product control as well as type tests.

The results obtained can be used to compare different hedge trimmers or different models of the same type of hedge trimmer. Although the noise emission values determined are obtained in an artificial operation, they are representative of noise emission in a real work situation.

D.2 Quantities to be measured and quantities to be determined

Quantities to be measured are defined in the relevant basic noise measurement standards, ISO 3744 and ISO 11201. These are time-averaged sound pressure levels (A-weighted and — if required — in frequency bands).

Quantities to be determined are sound power levels and emission sound pressure levels (A-weighted and — if required — in frequency bands).

D.2.1 A-weighted sound power level determination

For the determination of the A-weighted sound power level, ISO 3744 shall be used, subject to the following modifications or additions.

— The microphone array shall be six microphone positions as shown in Figure D.1 and specified in Table D.1.

NOTE 1 The six-microphone array is permitted because experimental data has shown that use of this array does not yield results that differ significantly from those obtained with the ten-microphone array specified in ISO 3744.

The measurement surface shall be a hemisphere with a radius, r, of 4 m. A smaller radius is permitted if it can be demonstrated that the results are within 0,5 dB of those obtained with a hemisphere of r = 4 m.

— The conditions for the particular type of hedge trimmer to be tested and its mounting and orientation shall be as defined in D.2.3 and D.2.6.1.

— 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 +10 °C to 30 °C and the wind speed shall be less than 5 m/s. A wind screen shall be used each time the wind speed exceeds 1 m/s.

— Measurements shall be made using instruments with the time-weighting characteristics “slow” or, preferably, using an integrating-averaging sound level meter, both as defined in IEC 61672-1.

— For measurements in the open air, the environmental correction, K_{2A}, shall be taken as zero.

— For measurements indoors, the value of K_{2A}, determined in accordance with ISO 3744:1994, Annex A, shall be 2 dB at maximum, in which case K_{2A} shall be taken as zero.

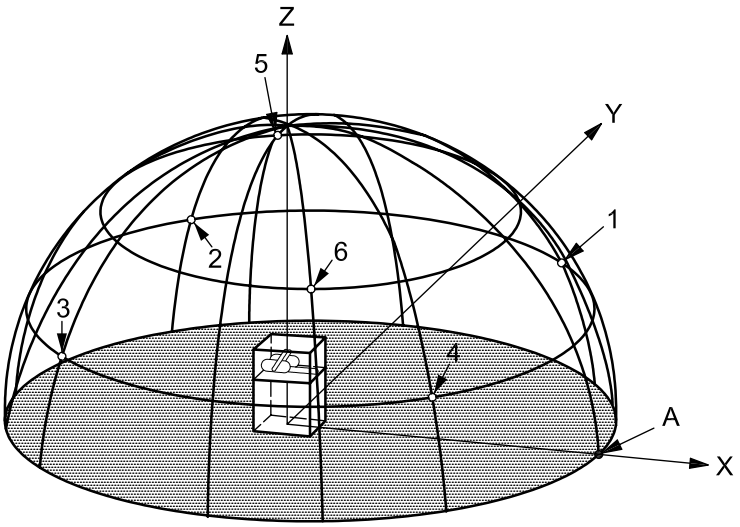


Figure D.1 — Microphone positions on the hemisphere (see Table D.1)

Table D.1 — Coordinates of microphone positions

Position No.	X	Y	Z
1	+0,7r	+0,7r	0,38r
2	−0,7r	+0,7r	0,38r
3	−0,7r	−0,7r	0,38r
4	−0,7r	−0,7r	0,38r
5	−0,27r	+0,65r	0,71r
6	+0,27r	−0,65r	0,71r

D.2.2 A-weighted emission sound pressure level measurement at operator position

D.2.2.1 General

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

— The surface shall comply with one of the conditions of D.2.2.2 or D.2.2.3. Reproducibility of results using natural grass or other organic material is likely to be worse than that required for grade 2 accuracy. In case of dispute, measurements shall be carried out in the open air and on the artificial surface (see D.2.2.2).

— 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 +10 °C to 30 °C, and the wind speed shall be less than 5 m/s. A wind screen shall be used each time the wind speed exceeds 1 m/s.

— Measurements shall be made using instruments with the time-weighting characteristics “slow” or, preferably, using an integrating-averaging sound level meter, both as defined in IEC 61672-1.

— The location of a particular type of hedge trimmer respective to the microphone array shall be in accordance with D.2.6.

D.2.2.2 Requirements for an artificial surface

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

Table D.2 — Absorption coefficient

Frequency Hz	Absorption coefficient	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 at the centre of the test environment on a hard, reflecting surface and shall have a size of at least 3,6 m × 3,6 m. The construction of the supporting structure shall be such that the requirements for the acoustic properties are met with the absorptive material in place. The structure shall support the test set-up to avoid compression of the absorbing material.

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

D.2.2.3 Requirements for grass-covered ground

The ground at the centre of the test site shall be flat and have good sound-absorbing properties. It shall be either forest ground or grass. Grass or other organic material shall have a height of 5 cm ± 2 cm.

D.2.3 Installation, mounting and operating conditions

Measurements shall be carried out on a new, normal production hedge trimmer fitted with standard equipment as provided by the manufacturer.

An engine speed indicator shall be used to check the speed of the engine. It shall have an accuracy of ± 1,0 % of the reading. The indicator and its engagement with the hedge trimmer shall not affect operation during the test.

D.2.4 Measurement uncertainties and declaration of noise emission values

When measuring the A-weighted sound pressure level at the operator position, tests shall be repeated to attain the required grade of accuracy and until the required number of consecutive A-weighted results needed for the 20 s readings are within a range of not more than 2 dB. The arithmetic average of these values shall be the measured A-weighted emission sound pressure level of the hedge trimmer.

Noise declaration is the responsibility of the manufacturer. Both the A-weighted sound power level and the A-weighted emission sound pressure level at the operator’s position shall be declared as a single-number declaration (see ISO 4871:1996, Annex A).

It shall be possible to verify the declared values according to ISO 4871. The noise declaration shall include a reference to this noise test code and to the basic standard used (ISO 3744 or ISO 11201). Deviations, if any, from this test code and/or the basic standards shall also be indicated.

The uncertainties associated with the measurements shall be taken into account when deciding on the declared noise emission values.

The methodology used for taking uncertainty into account should be based on the use of measured values and measurement uncertainty. 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 hedge trimmer to another of the same type made by the same manufacturer). One method for the calculation of uncertainty is given in ISO 4871.

D.2.5 Hedge trimmer conditions

Measurements shall be carried out on a hedge trimmer with the cutting attachment that comes with the machine. The engine shall be run in prior to the test. The hedge trimmer shall be warmed up until stable conditions are reached before the test is commenced.

The carburettor shall be set as appropriate.

The engine speed for all test modes shall be kept constant to within $\pm$ 2,0 s^{-1}. No alterations to the initial settings are permitted once measurements have commenced.

D.2.6 Mounting and orientation of the hedge trimmer

D.2.6.1 A-weighted sound power level measurement

During measurements, the cutting device of the hedge trimmer shall be directed above and in the direction of the positive X axis.

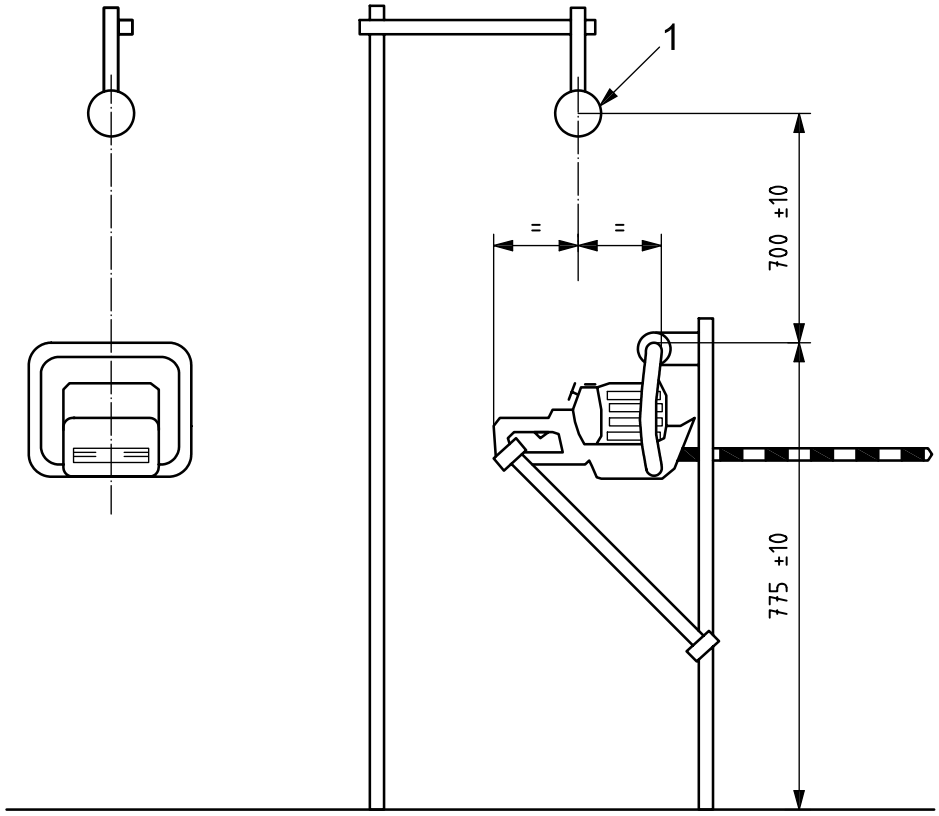
The hedge trimmer shall be mounted at the shaft as shown in Figures D.2 and D.3. The hedge trimmer shall be positioned with the front handle above the centre of the hemisphere, with the handle at a height of 775 mm $\pm$ 10 mm above the ground.

It is recommended that a flexible mounting system be provided in order to avoid unrealistic operating conditions and influences on the proper engine running conditions.

D.2.6.2 A-weighted emission sound pressure level measurement

The microphone shall be located as shown in Figures D.2 and D.3.

Dimensions in millimetres

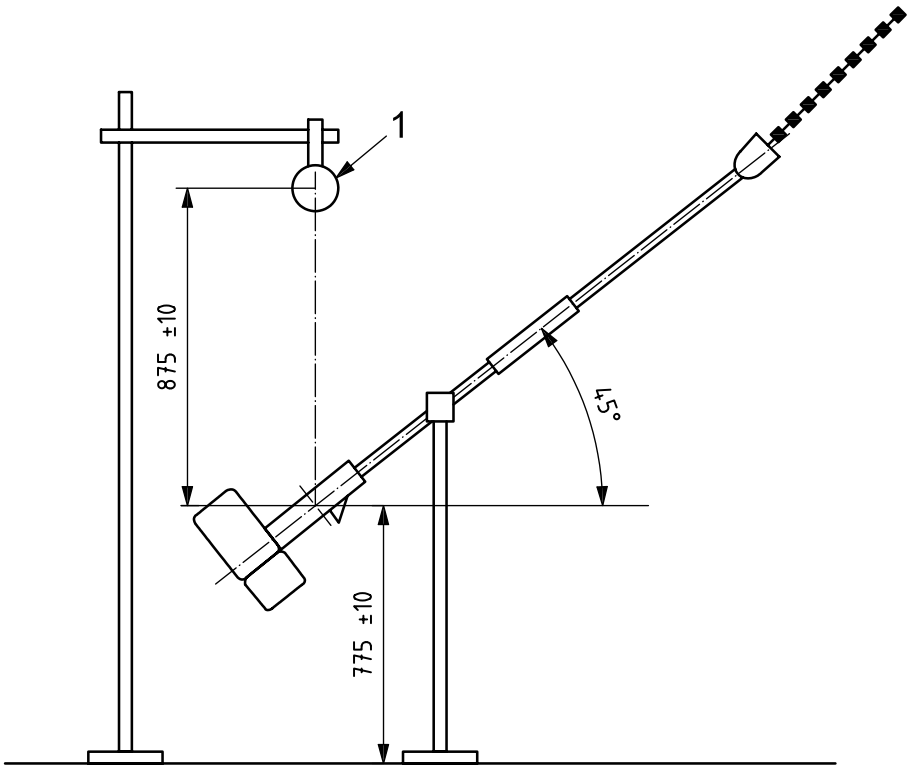


Key

1 microphone

Figure D.2 — Test set-up for hedge trimmers with integrated power source

Dimensions in millimetres



Key

1 microphone

Figure D.3 — Test set-up for long-reach hedge trimmers

D.2.7 Test procedure

Noise emission quantities shall be determined for a work cycle composed of two different operating conditions, idling and racing. Each cycle shall consist of

a) a minimum of four measurements with a short break and a significant change of speed between the measurements in order to allow stable conditions, with each measurement at idle separated by a short period of racing and vice versa,

b) at least four separate periods of noise data totalling at least 20 s, and

c) signal durations each of at least 2 s, over which the engine speed is within $\pm$ 3,5 s^{-1}

The collection of data for idling and racing need not be carried out in any fixed sequence.

The range of the values for each operating condition shall not be greater than 2 dB. If this range is exceeded, then the tests shall be repeated until four consecutive results fall within a range of 2 dB. The final value to be retained for each microphone position is the arithmetical mean of these four successive values satisfying the above criterion.

For all conditions specified below, the following procedure shall be followed when measuring both A-weighted sound power levels and A-weighted emission sound pressure levels.

When determining the A-weighted sound power level, this procedure shall be applied to the averaged sound pressure levels over the six microphone positions.

D.2.7.1 Idling

Measurements shall be made at the engine idling speed.

D.2.7.2 Racing

The measurements shall be made at an engine speed which is 133 % of the speed at maximum engine power as determined in accordance with ISO 7293.

If the engine has a speed limiter which is below that speed, the measurement shall be made at the maximum speed. If the engine does not run with a stable speed the test shall be carried out at the maximum possible stable speed but at least with a speed of no more than 8 s^{-1} below the governed speed. The speed of the engine shall be controlled by the throttle trigger.

D.2.8 Information to be recorded and reported

D.2.8.1 General

The information specified in D.2.8.2 to D.2.8.6, when applicable, shall be recorded and reported for all measurements made in accordance with the requirements of this International Standard.

D.2.8.2 Hedge trimmer under test

Include the following information:

a) engine displacement, type and serial number, and type and length of the cutting attachment;

b) operating conditions, as listed in Tables D.3 and D.5, during acoustical evaluation.

D.2.8.3 Acoustic environment

Include the following information:

a) if outdoors, a sketch showing the location of the hedge trimmer with respect to the surrounding terrain, including a physical description of the test environment (the nature of the ground plane shall be described);

b) if indoors, a description of the physical treatment of the walls, ceiling and floor, a sketch showing the location of the hedge trimmer and room contents.

D.2.8.4 Instrumentation

Include the following information:

a) equipment used for the measurements, including name, type, serial number and manufacturer;

b) method used to calibrate the instrumentation system;

c) date and place of the most recent calibration of the acoustical calibrator.

D.2.8.5 Acoustical and other data

Include the following information:

a) the A-weighted sound pressure levels of the background noise at the microphone positions;

b) measurement values and mean values in accordance with Tables D.3, D.4 and D.5;

c) remarks on the subjective impression of noise (audible discrete tones, impulsive character, spectral content, temporal characteristics, etc.);

d) air temperature and wind speed;

e) the date and place of the measurements.

Table D.3 — A-weighted emission sound pressure level (L_p) determination — Reporting measured sound pressure levels and mean sound pressure levels

Operating conditions	Engine speed s^{-1}	A-weighted measured sound pressure levels L'_{pA} dB Test No.					Arithmetic mean value $\overline{L'_{pA}}$ dB	Correction factor K_1	A-weighted emission sound pressure value L_{pA} dB
		1	2	3	4	n			
Idling									
Racing									

$L_{pA} = \overline{L'_{pA}} - K_1$

K_1 background noise correction according to ISO 11201.

Table D.4 — Table for reporting measurement results from sound power measurements

Test	Operating conditions	Engine speed s^{-1}	L'_{pA1} dB	L'_{pA2} dB	L'_{pA3} dB	L'_{pA4} dB	L'_{pA5} dB	L'_{pA6} dB	$\overline{L'_{pA}}$ dB
1	Idling								
	Racing								
2	Idling								
	Racing								
3	Idling								
	Racing								
4	Idling								
	Racing								
n	Idling								
	Racing								

Average sound pressure levels $\overline{L'_{pA,X}}$		
	Idling (Id)	$\overline{L'_{pA,Id}}$ = dB
	Racing (Ra)	$\overline{L'_{pA,Ra}}$ = dB

L'_{pA1} to L'_{pA6} are the measured time-averaged sound pressure levels at the corresponding microphone positions. $\overline{L'_{pA}}$ is the averaged sound pressure level as defined in ISO 3744:1994, Equation (4).

$\overline{L'_{pA,X}}$ is the arithmetic average of the values for $\overline{L'_{pA}}$ for the respective operating condition.

Individual values for L'_{pA} shall only be reported if available. The test procedure may include automatic averaging.

Table D.5 — Sound power data

Operating conditions	Average sound pressure level $\overline{L'_{pA,X}}$ dB	Correction factor K_1	Surface sound pressure level $\overline{L_{pAf}}$ dB	Surface level L_S dB	Sound power level L_{WA} dB
Idling	$\overline{L'_{pA,Id}}$ =				
Racing	$\overline{L'_{pA,Ra}}$ =				

$\overline{L'_{pA,X}}$ is the arithmetical average of the values for $\overline{L'_{pA}}$ given in Table D.4 for the respective operating condition:

$\overline{L_{pAf}} = \overline{L'_{pA,X}} - K_1$

where $\overline{L'_{pA,X}}$ is replaced by $\overline{L'_{pA,Id}}$ or $\overline{L'_{pA,Ra}}$ respectively, and K_1 is the background noise correction according to ISO 3744:1994, 8.3.

$L_{WA} = \overline{L_{pAf}} + L_S$

where

L_S = 10 lg $\frac{S}{S_0}$ in dB

with S_0 = 1 m^2 and where S is the surface of the hemisphere in m^2.

The environmental correction, K_{2A}, is assumed to be 0, see D.2.1.

D.2.8.6 Equivalent sound levels

In addition to the information reported according to D.2.8.5, the following data may also be reported.

The work cycle is composed of idling and racing.

The equivalent A-weighted emission sound pressure level ($L_{pA,eq}$) shall be determined as follows:

$$L_{pA,eq} = 10 \lg\left(\frac{1}{5} \times 10^{0,1 L_{pA,Id}} + \frac{4}{5} \times 10^{0,1 L_{pA,Ra}}\right) \quad \text{in dB}$$

The equivalent A-weighted sound power level ($L_{WA,eq}$) shall be determined as follows:

$$L_{WA,eq} = 10 \lg\left(\frac{1}{5} \times 10^{0,1 L_{WA,Id}} + \frac{4}{5} \times 10^{0,1 L_{WA,Ra}}\right) \quad \text{in dB}$$

Annex E
(informative)

Example of material and construction fulfilling the requirements for an artificial surface for the noise test code

E.1 Material

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

E.2 Construction

As is shown in Figure E.1, the artificial flooring of the measurement site is subdivided into nine joint planes, each of approximately 1,20 m × 1,20 m. The backing layer (1) of the construction as shown in Figure E.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 should be protected against moisture by applying a coat of plastic paint. The outsides of the flooring are bordered by a two-legged aluminium section (4) of a leg height of 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 hedge trimmer is placed during measurement, as well as at any other place on which the operator may stand, aluminium T-sections (3) with a leg length of 20 mm are mounted as spacers.

These sections also provide exact markings which facilitate the alignment of the hedge trimmer in the middle of the measurement site. The prepared boards are then covered with the mineral wool fibre material (2) cut to size.

The felt flooring of the joint planes that are neither stood on nor driven over (type A surface in Figure E.1) are covered with a simple wire mesh fastened to the edge strips and to the attachment points; for this purpose, the sections should be provided with holes. Thus, the material is adequately attached, but it remains possible to replace the mineral wool fibre material should it become soiled. As a wire mesh, a so-called aviary wire (5) 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.

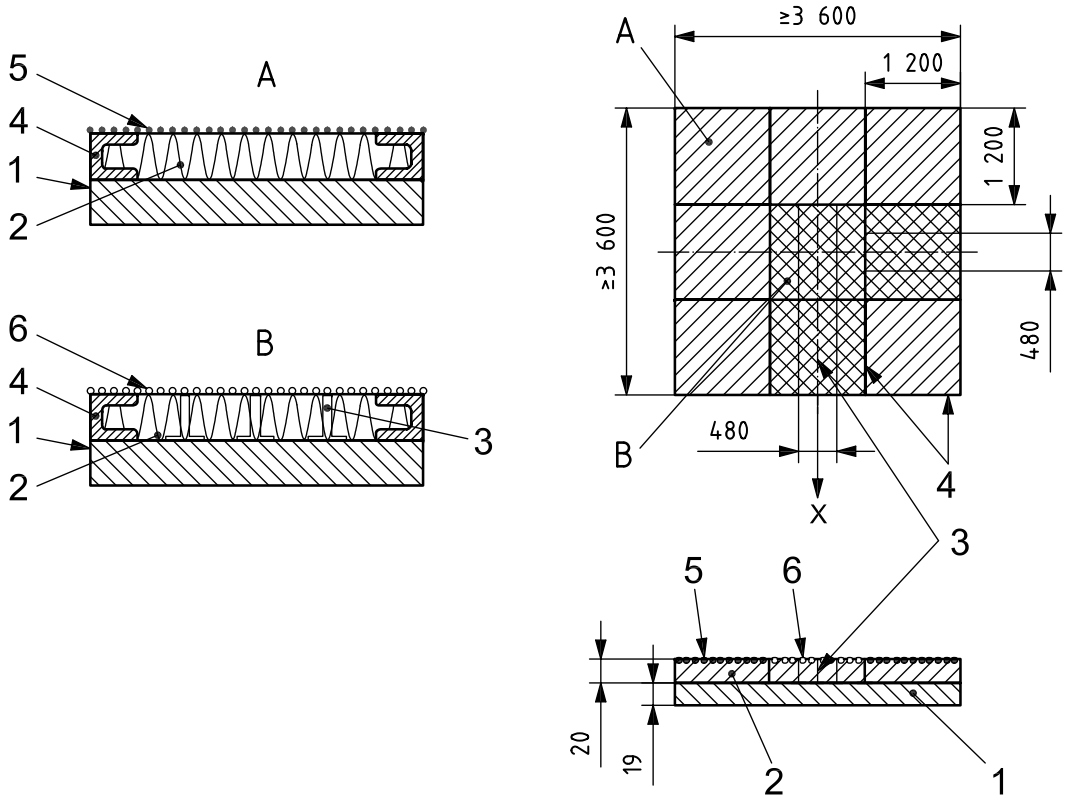
Protection by simple wire mesh is not, however, sufficient in the area subjected to traffic (type B surface in Figure E.1). For these surfaces, the use of wire grating of corrugated steel wire (6) with a diameter of 3,1 mm and a mesh width of 30 mm has proved to be suitable.

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 is the case with an asphalt or concrete site, for example.

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



Surface A is not suitable for carrying weight. Do not stand on it.

Surface B is suitable for carrying weight. May be stood on.

Key

1 backing layer of plastics-coated chipboard (nominally 19 mm thick)
2 mineral wool fibre layer (nominally 20 mm thick)
3 aluminium T-sections (nominally 3 mm thick × 20 mm high)
4 aluminium U-sections (nominally 3 mm thick × 20 mm high)
5 wire mesh (nominally 10 mm × 10 mm mesh made of 0,8 mm diameter steel wire)
6 wire grating (nominally 30 mm × 30 mm mesh made of 3,1 mm diameter steel wire)

NOTE Unless otherwise stated, all dimensions are approximate.

Figure E.1 — Sketch of measurement surface covered with an artificial surface
(not to scale)

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