INTERNATIONAL STANDARD

ISO 11789

First edition
1999-04-01

Powered edgers with rigid cutting means — Definitions, safety requirements and test procedures

Coupe-bordures à moteur avec organe de coupe rigide — Définitions, exigences de sécurité et modes opératoires d'essai

Reference number
ISO 11789:1999(E)

Contents

1 Scope 1
2 Normative references 1
3 Definitions 2
4 General construction 4
4.1 Handling (hand-held machine) 4
4.2 Power driven components 4
4.3 Heat protection 4
4.4 Protection from exhaust fumes 5
4.5 Guard attachment 5
4.6 Electrical requirements 5
4.7 Engine (motor) stopping 6
4.8 Controls 6
4.9 Identification of controls 6
4.10 Fuel tanks 6
5 Marking 7
5.1 Machine and blade identification 7
5.2 Warnings and symbols 7
5.3 Label requirements 7
6 Safety instructions 8
7 Enclosures and guards (cutting means) 8
7.1 Cutting means contact protection — Foot probe 8
7.2 Thrown object protection 8
7.3 Thrown objects protection test 9

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet iso@iso.ch

Printed in Switzerland

8 Structural integrity 9

8.1 Strength of cutting means 9

9 Sound levels 11

9.1 Test values 11

9.2 Test site 11

9.3 Unit conditions 11

9.4 Instrumentation 11

9.5 Microphone position (operator's ear) 12

9.6 Test procedure 12

10 Vibration 12

10.1 Test conditions 12

10.2 Test procedure 12

10.3 Unit operation 14

10.4 Mesurements 14

Annex A (normative) **Safety instructions for edgers** 31

Annex B (informative) **Symbols and/or safety hazard pictorials** 34

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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

International Standard ISO 11789 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 13, *Powered lawn and garden equipment*.

Annex A forms an integral part of this International Standard. Annex B is for information only.

Powered edgers with rigid cutting means — Definitions, safety requirements and test procedures

1 Scope

This International Standard specifies mechanical safety requirements and test methods applicable to walk-behind powered edgers that employ rigid cutting means with a blade tip circle not more than 305 mm in diameter, and where the plane of the blade tip circle is designed to operate at not more than 15° from the vertical.

This International Standard applies to hand-held portable and powered edgers employing a rigid cutting element with a blade tip circle not more than 305 mm in diameter.

This International Standard also includes test methods for noise and vibration.

This International Standard does not cover edgers with cutting means of non-metallic filament line or freely pivoting non-metallic cutters.

This International Standard does not cover accessories or attachments that alter the function of the machine.

The electrical aspects of electrically powered edgers are not covered by this International Standard. For the electrical requirements applicable to electrically driven machines, reference should be made to IEC 60335-1.

NOTE — For motion control requirements related to self-propelled machines, reference should be made to ISO 5395.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of the IEC and ISO maintain registers of currently valid International Standards.

ISO 3304:1985, *Plain end seamless precision steel tubes — Technical conditions for delivery.*

ISO 3305:1985, *Plain end welded precision steel tubes — Technical conditions for delivery.*

ISO 3306:1985, *Plain end as-welded and sized precision steel tubes — Technical conditions for delivery.*

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 3767-5:1992, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 5: Symbols for manual portable forestry machinery.*

ISO 3789-1:1982, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Location and method of operation of operator controls — Part 1: Common controls.*

ISO 3789-3:1989, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Location and method of operation of operator controls — Part 3: Controls for powered lawn and garden equipment.*

ISO 4200:1991, *Plain end steel tubes, welded and seamless — General tables of dimensions and masses per unit length.*

ISO 5347-0:1987, *Methods for the calibration of vibration and shock pick-ups — Part 0: Basic concepts.*

ISO 5348:1998, *Mechanical vibration and shock — Mechanical mounting of accelerometers.*

ISO 5349:1986, *Mechanical vibration — Guidelines for the measurement and the assessment of human exposure to hand-transmitted vibration.*

ISO 5395:1990, *Powered lawn-mowers, lawn tractors, lawn and garden tractors, professional mowers, and lawn and garden tractors with mowing attachments — Definitions, safety requirements and test procedures.*

ISO 11684:1995, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Safety signs and hazard pictorials — General principles.*

IEC 60335–1:1991, *Safety of household and similar electrical appliances — Part 1: General requirements.*

IEC 60651:1979, *Sound level meters.*

3 Definitions

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

NOTE — For different types of machines, see figures 1 and 2, showing a walk-behind and a hand-held edger.

3.1
blade
cutting means
mechanism used to provide the cutting action of an edger

3.2
blade retainer
mechanism which holds the blade to the driving member

3.3
blade guard
structure covering a portion of the blade arc

3.4
blade-tip circle
path described by the outermost point of the cutting means cutting edge as it rotates about its shaft axis

3.5
clutch
mechanism for connecting and disconnecting a driven member to and from a rotating source of power

3.6
debris deflector
additional guarding made of flexible material fitted to the unit as an extension of the guard to protect the operator from thrown debris

3.7
depth of cut
vertical location of the blade-tip circle relative to the surface level

NOTE — See figure 9.

3.8
edger
grass/soil trimming machine where the cutting means operates in a plane approximately perpendicular to the ground

NOTE — The cutting means is only adjustable within an angle of ± 15° from the vertical.

3.9
governor
device that limits the maximum speed of the engine

3.10
guiding handle
the front handle of a hand-held portable machine by which the operator supports the least percentage of machine weight

NOTE — See figure 2.

3.11
handle
structure that enables the operator to hold and control the unit during operation

3.12
hand-held
supported by hand, possibly assisted by wheel(s) or skids

3.13
maximum engine speed
engine speed at wide open throttle, using carburetor settings according to the manufacturer's recommendation or 133 % of the maximum power speed, whichever is less

3.14
maximum governed speed
maximum speed an engine is capable of attaining, equal to the greater of

— the value of the speed when limited by a governor (3.9) or other means, and

— the value declared by the manufacturer.

3.15
normal operation
use of the machine which is reasonably foreseeable, as seen by the ordinary user, and which is consistent with such activities as cutting grass, starting, stopping, fueling, or connecting to (or disconnecting from) a power source

3.16
operator control
control requiring operator actuation to perform specific functions

3.17
starter
mechanism that rotates the engine to start it

3.18
support handle
handle of a hand-held portable machine by which the operator supports the greatest percentage of the product weight

3.19
throttle
device that adjusts the volume of fuel and air mixture delivered to the combustion chamber of an internal combustion engine

3.20
unit
machine
complete edger

3.21
walk-behind
normally controlled by an operator walking behind a ground-supported unit

4 General construction

4.1 Handling (hand-held machine)

A hand-held edger shall be provided with two separate handles. The handles shall:

a) be fixed in position, except that the guiding handle may be adjustable;

b) be located so that the distance (D), measured in a horizontal plane, between the rearmost portion of the blade-tip circle and the foremost position (as defined by the manufacturer) of the guiding handle is at least 450 mm. See figure 3.

4.2 Power driven components

All power driven components except

— any part of a component functioning in contact with the soil;

— any axle of a ground wheel;

shall be guarded to prevent human contact with these parts during normal operation. The principles set out in ISO 5395:1990, annex A, shall be followed when developing a guarding system.

4.3 Heat protection

4.3.1 Requirements

A guard shall be provided to prevent accidental contact with any exposed engine exhaust components with a hot surface area greater than 10 cm^2 and with a temperature greater than 80 °C at (20 °C ± 3 °C) ambient temperature during normal operation of the machine. For purposes of this requirement, the guard is considered part of the exposed engine exhaust components.

4.3.2 Test equipment

The measuring equipment shall have an accuracy of ± 4 °C.

4.3.3 Test method

The test shall be conducted in the shade on a hard, flat and level surface. The engine shall be operated at its maximum engine or governed speed (whichever is appropriate) until the surface temperature stabilizes.

Temperatures shall be determined by correcting the observed temperature by the difference between the specified ambient and the test ambient temperature. Identify the hot surface area(s) on the engine exhaust system. When the distance between the identified hot area and the nearest control is in excess of 100 mm, cone A in figure 4 shall be used. For a distance less than 100 mm between the identified hot area and the nearest control, cone B in figure 4 shall be used.

Move cone A, with the axis of the cone anywhere between 0° and 180° to the horizontal with the nose or point of the cone in a downward to horizontal direction towards the hot surface. The cone shall not be moved upwards. When moving the cone, determine if contact is made with the hot surface area(s) with the cone tip or conical surface of the cone.

Move cone B in any direction.

4.3.4 Test acceptance

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

4.4 Protection from exhaust fumes

Engine exhaust shall not be directed toward the operator during normal operation.

4.5 Guard attachment

All guards required under 4.2, 4.3 and 7 shall be permanently attached to the machine and shall not be detachable without the use of tools, or the construction of the machine shall be such that it cannot be used without the guard in its guarding position.

4.6 Electrical requirements

For electrical requirements for electrically driven machines see IEC 60335-1.

4.6.1 Battery circuits

The requirements in 4.6.1.1, 4.6.1.2, 4.6.1.3 and 4.6.1.4 apply only to battery circuits of less than 42 V.

4.6.1.1 Electrical cables

Electrical cables shall be protected if located in potentially abrasive contact with the metal surfaces.

The wiring assembly shall, where possible, be grouped together, be properly supported, and be located so that no portion is in contact with the carburetor, metallic fuel lines, the exhaust system, moving parts or sharp edges. Any edges of metal members likely to be in contact with the cables shall be rounded or protected to prevent possible damage to the cables by cutting or abrasion.

4.6.1.2 Battery installation

The compartment for a vented storage battery shall have an opening to provide ventilation and drainage. When the battery is in the operating position, acid shall not leak onto parts that would be affected to the extent that a hazard would be created from corrosion.

4.6.1.3 Overload protection

All circuits, except starter motor and high-tension ignition circuits, shall be provided with overload protection devices in the ungrounded line near the battery terminal or starter cable. The overload protection may be located in either wire of a two-wire system. This requirement need not apply to battery-powered machines capable of passing the following test.

With the motor shaft locked to prevent rotation, connect it to its fully charged integral battery and leave it in that condition until the battery is discharged or failure of any component takes place. The machine shall not emit flames

or molten metal. Any internal explosion shall be contained so as not to cause any material to be ejected from the machine

4.6.1.4 Terminals and uninsulated electrical parts

Terminals and uninsulated electrical parts and two-wire non-grounded systems shall be protected against short-circuiting by the fuel can, or tools, during normal refuelling and lubrication servicing.

4.6.2 Ignition circuits

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

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

4.7 Engine (motor) stopping

4.7.1 The machine shall be fitted with a stopping device, which brings it to a final stop and does not depend on sustained manual effort for its operation. The device shall be so positioned that it can be operated while the machine is being held with both hands by the operator wearing protective gloves. The purpose and method of operation of the device shall be clearly and durably marked. The colour of the stop switch shall be in good contrast compared with its background.

4.8 Controls

Operator controls shall meet the requirements specified in ISO 3789-1 and ISO 3789-3.

4.8.1 Operator presence control requirements

A machine shall be provided with a device on the handle which will automatically stop blade rotation when the operator's hands are removed from a handle.

NOTE — On walk-behing machines, this may be accomplished by stopping the drive engine (motor) or by an intermediate blade clutch brake device. On hand-held machines, this may be accomplished be means of a centrifugal clutch and a continuous pressure throttle control system that will shut off the drive of the engine after the pressure is released.

4.8.2 Restarting requirement

For restarting blade rotation, the control shall require two separate actions. If these actions are to be carried out using the same hand, then they shall be totally distinct thereby preventing accidental starting.

4.9 Identification of controls

Controls, other than those the purpose of which is obvious, shall have the function direction and/or method of operation clearly identified by a durable label or mark.

Easily understood detailed instructions on the operation of all controls shall be provided in an operator's manual.

NOTE — International symbols may be used for control identification. Reference should be made to ISO 3767-1, ISO 3767-3 and ISO 3767-5.

4.10 Fuel tanks

4.10.1 Tank filler

The fuel tank filler opening shall be located so that it will not be obstructed by the edger components, as verified by the procedure described in 4.10.1.1. For hand-held edgers, the fuel tank filler opening shall have a minimum diameter of 20 mm.

4.10.1.1 Test method and acceptance criteria

The diameter of the fuel tank opening shall be checked by measurement. Accessibility shall be verified by using a test probe that is 100 mm long and 20^{0}_{-1} mm diameter. It shall be possible for the centre of one end of the probe to be aligned with the centre of the filler opening and for axis of the probe to be within 15° of the centreline of the filler opening.

5 Marking

5.1 Machine and blade identification

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

— name of the manufacturer;

— model number or type;

— serial number.

Each blade shall be marked to identify the part number and the manufacturer, importer or supplier.

5.2 Warnings and symbols

Every machine shall be prominently marked with the following warnings, hazards pictorials or appropriate symbols:

— WARNING;

— read operators manual;

— wear eye protection;

— wear ear protection (when appropriate);

— keep by-standers away;

— direction of edger blade rotation.

The symbols of hazard pictorials shall follow the conventions laid down in ISO 3767-1, ISO 3767-3 and ISO 3767-5 (for symbols) and ISO 11684 for hazard pictorials. This International Standard does not mandate the symbols or hazard pictorials to be used on the machine, but stresses that the accepted ISO conventions shall be used when developing the appropriate symbol or hazard pictorial.

All symbols and/or hazard pictorials shall be explained in the operators manual.

Annex B presents examples of symbols and hazard pictorials which can be used on edgers.

5.3 Label requirements

Labels provided for identification, directional and cautionary information, shall have a reasonable life for the anticipated machine operating environment and satisfy the following requirements:

a) the label shall have a durable bond with the base surface material;

b) the label shall be weather resistant and under normal cleaning procedures shall not fade, discolour, crack, or blister and shall remain legible;

c) the label shall not curl at the edges and legibility shall not be affected by spilled fuel or oil.

Marks or labels giving cautionary information shall be located close to the relevant hazard and if wording is used, it shall be in the language(s) of the country in which the product is sold.

5.3.1 Test method

The marking shall be rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with fuel.

5.3.2 Test acceptance

After the test, the marking shall be easily legible; it shall not be easily possible to remove any labels and they shall show no curling.

6 Safety instructions

The manufacturer shall supply with the machine pertinent instructions such as those presented in annex A.

7 Enclosures and guards (cutting means)

7.1 Cutting means contact protection — Foot probe

Walk-behind machines for which the distance D, as illustrated in figure 5, is less than 450 mm shall be provided with a blade guard supplemented by other parts of the machine as necessary. The foot contact probe test described in 7.1.1 is to be conducted with the machine placed on a smooth, level surface and be adjusted to the wheel height and blade height setting that will result in the most severe test condition.

7.1.1 Test method

The foot probe as illustrated in figure 6 shall be applied at any angle on the operator's side, and moved forward in a direction parallel to the plane of the blade. The sole of the foot probe shall be maintained parallel to the supporting surface during the test.

7.1.2 Test acceptance

The foot probe shall not make contact with the cutting means.

NOTE — Hand-held machines are not subject to the foot probe requirements but shall conform to 4.1 b).

7.2 Thrown object protection

7.2.1 Guard dimensions

Machines when positioned for edging shall be guarded (as a minimum) to the extent shown in figure 7 and shall fulfil the requirements of 7.3.

When other guards and/or machine structures provide guarding equivalent to this minimum requirement, they shall be considered as part of this requirement.

7.2.2 Guard strength

The guard or guarding that is described in 7.2.1 for the cutting means, and any mounting means provided for such guarding, shall withstand the ball-impact test described in 7.2.2.1 and shall fulfil the requirements of 7.3.

7.2.2.1 Test method

The ball-impact test shall be conducted using a 50 mm diameter smooth steel sphere with a mass of approximately 0,45 kg. If the component being tested can be struck from above, and is at an angle of less than 45° to the horizontal, the sphere shall be allowed to fall vertically from rest to strike the component. Otherwise, the sphere

shall be suspended by a cord and allowed to fall from rest as a pendulum to strike the component. In either case, the vertical travel of the sphere shall be 1 300 mm.

7.2.2.2 Test acceptance

The guards shall withstand the test of 7.2.2.1 without cracking or deforming such that the function of the guard is affected.

7.2.3 Debris deflector strength

Where a debris deflector of flexible material is fitted it shall pass the test as described in 7.2.3.1.

7.2.3.1 Test method

A force of 200 N (for walk-behind edgers) or the weight of the unit (for hand-held edgers) shall be applied for 10 s over the width of the deflector in a direction that produces the maximum stress on the deflector.

7.2.3.2 Test acceptance

After the test the debris deflector shall not crack or separate from the edger, nor shall it be permanently deformed such that any of the requirements of this International Standard would not be met.

7.3 Thrown objects protection test

Hand-held machines when positioned in accordance to 7.3.1 shall pass the line or sight test as described in 7.3.3.

Walk-behind machines when positioned in accordance to 7.3.2 shall pass the line of sight test as described in 7.3.3.

7.3.1 Hand-held edgers test setup

The edger shall be positioned on a flat and level surface as shown in figure 3. The height of (775 ± 25) mm shall be met at the lower contour of the rear support handle 50 mm upwards from were the gripping length starts.

The edger shall be adjusted to 50 % of its depth of cut as shown in figure 9.

A panel with an operator zone cutout as defined in figure 8 shall be positioned perpendicular to the test surface and blade tip circle at a distance of 850 mm rearwards from the rear edge of the cutting means.

Dimension x for the operator zone cut out is the distance between the cutting plane and the parallel plane containing the centreline of the support handle.

7.3.2 Walk-behind edgers test setup

The edgers wheels shall be positioned on a flat and level surface and adjusted to 0 % depth of cut.

A panel with an operator zone cut out as defined in figure 10 shall be positioned perpendicular to the test surface at a distance of 330 mm rearward of the rear most portion of the handle.

7.3.3 Test method and acceptance criteria

There shall be no line of sight contact with the leading edge of the edger blade when viewed from the operator position through the operator zone cut out as defined in 7.3.1 and 7.3.2. Construction/assembly gaps of 3 mm or less shall be ignored.

8 Structural integrity

8.1 Strength of cutting means

Walk-behind machines when positioned for edging shall pass the impact test as described in 8.1.1, 8.1.2 and 8.1.4.

Hand-held machines when positioned for edging shall pass the impact test as described in 8.1.1, 8.1.3 and 8.1.4.

CAUTION — These tests have some element of risk. Test personnel shall either be kept out of the test area or otherwise protected from the hazard of thrown objects.

8.1.1 Test equipment

An example of a suitable impact test fixture for walk-behind machines is shown in figure 11.

An example of a suitable impact test fixture for hand-held machines is shown in figure 11 a).

8.1.2 Test method — Walk-behind machines

The engine shall be operated at the maximum engine or governed speed (whichever is appropriate).

The edger shall be positioned over or horizontal to a 30 mm × 3 mm nominal welded or seamless steel tube that has been placed in the test fixture (an example of a test fixture is shown in figure 11). The blade of the test edger shall be adjusted to the cutting depth closest to 10 mm and shall be so positioned that when the tube is inserted into the path of the rotating blade, the blade will strike the exposed portion of the tube within 10 mm to 15 mm of the blade tip. A new piece of tube shall be used for each test.

The engine shall be switched off 1 s after impact.

Where it is not possible to insert the tube due to edger design, the edger shall be moved the minimum distance necessary to permit the tube to be inserted.

8.1.3 Test method — Hand-held machines

The engine shall be operated at the maximum engine or governed speed (whichever is appropriate).

The unit shall be suspended freely in the operating position and allowed to swing in an arc as shown in figure 11 a). The cutting element shall be impacted by a rigidly supported 25 mm diameter cold rolled steel rod as shown in figure 11 a).

The calculations shall be made such that the unit centre of gravity shall be at its lowest point at blade contact with the bar.

The engine shall be switched off 1 s after impact.

Determine the drop height from:

$$h = \frac{(r_1 / r_2)^2}{19{,}6}$$

where

h is the drop height, in metres;

r_1 and r_2 are as shown in figure 11 a), in metres.

8.1.4 Test acceptance

No complete blade, arm, or disc to which it is mounted shall become detached. Any breakage or cracking of the blade or blade retainer shall be considered as failure of the test. Breaking of the shearing device (if fitted) or chipping of the blade cutting edge are not considered test failures.

NOTE — The test does not require that the machine is suitable for use after the test.

9 Sound levels

If sound level measurements are required, they shall be determined by tests as defined in the following subclauses.

9.1 Test values

The values to be measured shall be A-weighted sound pressure levels, in decibels, determined with the frequency weighting “A” and “slow” response as defined in IEC 60651.

9.2 Test site

9.2.1 Measurement of noise in free field

The test area shall be a flat, open space covered with natural ground covering not exceeding 80 mm in height, and free of any large reflecting surfaces such as signboards or buildings for a minimum distance of 30 m from the unit and microphone.

The ambient sound level at the point of measurement (including wind effects) coming from sources other than the unit being tested shall be at least 10 dB(A) lower than sound level of the unit.

Measurements shall be made only when wind gusts are less than 5,4 m/s.

9.2.2 Measurement of sound in sound room (alternate method)

An anechoic or semi-anechoic chamber may be used for conducting a sound level test provided the test results do not vary more than ± 1 dB(A) from the free field test results. If the variation exceeds ± 1 dB(A), the correction between the sound room measurement and free field sound measurement shall be applied to the result obtained from the sound room.

Sound levels for distances exceeding the dimensions of the chamber, may be calculated from measurements taken in the chamber, provided that sufficient data is available to substantiate such calculations. Artificial grass is acceptable as floor covering in the chamber.

9.3 Unit conditions

9.3.1 Test conditions

The unit shall be evaluated with all the blades recommended by the manufacturer, and with an operator in the operating position.

The engine shall be tested warm with all adjustments made according to manufacturer's recommendations.

9.3.2 Handle adjustments

With the unit at minimum depth setting, position and hold the unit as shown in figure 12.

9.4 Instrumentation

9.4.1 Calibration

Before and after each series of measurements an acoustical calibrator with an accuracy of at least ± 0,5 dB(A) shall be applied to the microphone to check the calibration of the entire measuring system at one or more frequencies in the range from 200 Hz and 1 000 Hz.

The measuring equipment shall be allowed to reach a steady-state (stabilized) temperature before it is calibrated.

9.4.2 Engine speed indicator

An engine speed indicator shall be used to check the speed of the engine.

It shall have an accuracy of ± 3 % of measured value.

9.5 Microphone position (operator's ear)

9.5.1 Microphone position

The microphone centreline shall be located (200 ± 20) mm to the side of the centre plane of the operator's head. See figures 12 and 13.

The microphone shall be aimed vertically towards the ground.

NOTE — The operator may attach the microphone to a helmet.

9.5.2 Other influence

Not more than one person, other than the observer reading the meter and the operator, shall be within 15 m of the unit or microphone, and that person shall be directly behind the observer reading the meter, on a line through the microphone and the observer.

9.6 Test procedure

9.6.1 Operator's ear

Four measurements shall be taken at each of the operator's ears. The variation of four values shall not be greater than 3 dB(A). If this variation is exceeded, the test shall be repeated until four consecutive tests fall within a variation of 3 dB(A). The results of each of the four measurements and their arithmetic average shall be recorded.

The engine speed during the measurements shall be kept within ± 200 r/min.

9.6.2 Operating conditions

The test shall be conducted without edging. The test shall be conducted at output shaft maximum engine or governed speed (whichever is appropriate) ± 200 r/min.

10 Vibration

If vibration level measurements are required, they shall be determined by tests as defined in this clause.

10.1 Test conditions

The unit shall be evaluated with all the blades recommended by the manufacturer.

The engine shall be tested warm with all adjustments made according to the manufacturer's recommendations.

10.2 Test procedure

10.2.1 Instrumentation

10.2.1.1 Calibration

All vibration measuring equipment shall be calibrated. Calibration shall be made immediately before and after each test sequence.

10.2.1.2 Frequency response

The instrumentation for the measurement shall have a uniform response (± 2 dB) in terms of acceleration over the whole frequency range of 8 Hz to 1 500 Hz. At the reference frequency of 31,5 Hz, the tolerance range shall be ± 1 dB. The readings shall be taken using the “slow” response according to IEC 60651.

10.2.1.3 Fastening of transducer

The transducer and the mechanical filter, if used, shall be mounted firmly, for example by using adhesive, threaded stud or clamp. In all cases, the mounting shall be in accordance with the transducer manufacturer's instructions. For accelerometers, the mounting shall be in accordance with ISO 5348.

If the handle has a soft resilient cover, this shall be removed, or a clamp shall be tightened securely around it on which the transducer is mounted, or a special adapter may be used.

If the machinery has a resilient handle, the test report shall state the action taken, e.g. solid clamping, removal or use of adapter.

10.2.2 Hardware

The test instrumentation used shall meet the requirements described in 10.2.2.1 to 10.2.2.4.

10.2.2.1 Accelerometer(s)

For each test location, the weight of an accelerometer including mounting hardware but excluding the cables shall not exceed 25 g.

Each accelerometer shall meet the requirements outlined in ISO 5348.

The cross-axis sensitivity shall be no more than 10 % of the sensitivity in the axis to be measured.

Also, care shall be taken when mounting the accelerometer(s) that the transfer function is flat up to 1 500 Hz for all three directions.

10.2.2.2 Amplifier

The amplifying device and amplitude or level indicator employed shall meet the requirements outlined in ISO 5347-0.

10.2.2.3 Measurement

As an alternative to making direct measurements, a magnetic tape recorder, a graphic level recorder, or indication meter may be used.

An alternate measurement technique can be to use a sampling network to record the continuous measurements as a discrete time series, with appropriate anti-alias filtering.

Processing of measurements should be conducted using signal analyses provided that it meets the requirements outlined in ISO 5347-0.

10.2.2.4 Tachometer

A tachometer shall be used to measure the engine speed (in revolutions per minute) accurate to within ± 3 % of the measured value.

10.2.2.5 Filter

A frequency filter used to weigh the overall vibration level in each axis is defined in figure 14.

Table 1 gives the attenuation factors for 1/3 octave band center frequencies.

Other frequency spectral techniques, filter weighting frequencies that comply with table 1 guidelines are acceptable.

10.2.3 Accelerometer location and mounting

The accelerometer(s) shall be rigidly mounted such that the centre of gravity of the accelerometer(s) is less than 20 mm from the outside of the handle grips, and shall be located so as to permit a normal hand position.

The accelerometer(s) shall be located as close to the hand as is practical without contacting it.

Care shall be taken that the size, shape and mounting of the accelerometer or the accelerometer support do not significantly influence the transfer of vibration to the hand.

Preferred orientation of transducers is shown in figure 15.

The vibration level shall be measured and reported in the direction of the orthogonal coordinate system as shown in figure 15. Where this procedure cannot be followed, the positions of the accelerometer(s) relative to the hand coordinates shall be reported.

10.3 Unit operation

The unit shall be adjusted for best operation in accordance with the manufacturer's recommendations.

The engine speed shall be output shaft maximum speed without edging.

The unit shall be equipped with a new blade.

The fuel tank shall be at least half full.

The unit shall be operated with a normal grip in an upright position in accordance with the manufacturer's recommendations.

10.4 Mesurements

10.4.1 Measured quantity

The acceleration in the three orthogonal directions shall be measured and processed to form an overall vibration value for each handle, the Weighted Acceleration Sum (WAS). Schematically, the WAS is shown in figure 16. Mathematically, WAS is the sum of the root-mean-square (RMS) values of the weighted signals from each axis.

The WAS can be calculated from frequency spectra of 1/3 octave or 1/1 octave with the weighting factors for the center frequencies calculated from ISO 5349.

Alternately, the WAS can be calculated from higher resolution FFT Systems where weighting complies with the same standard.

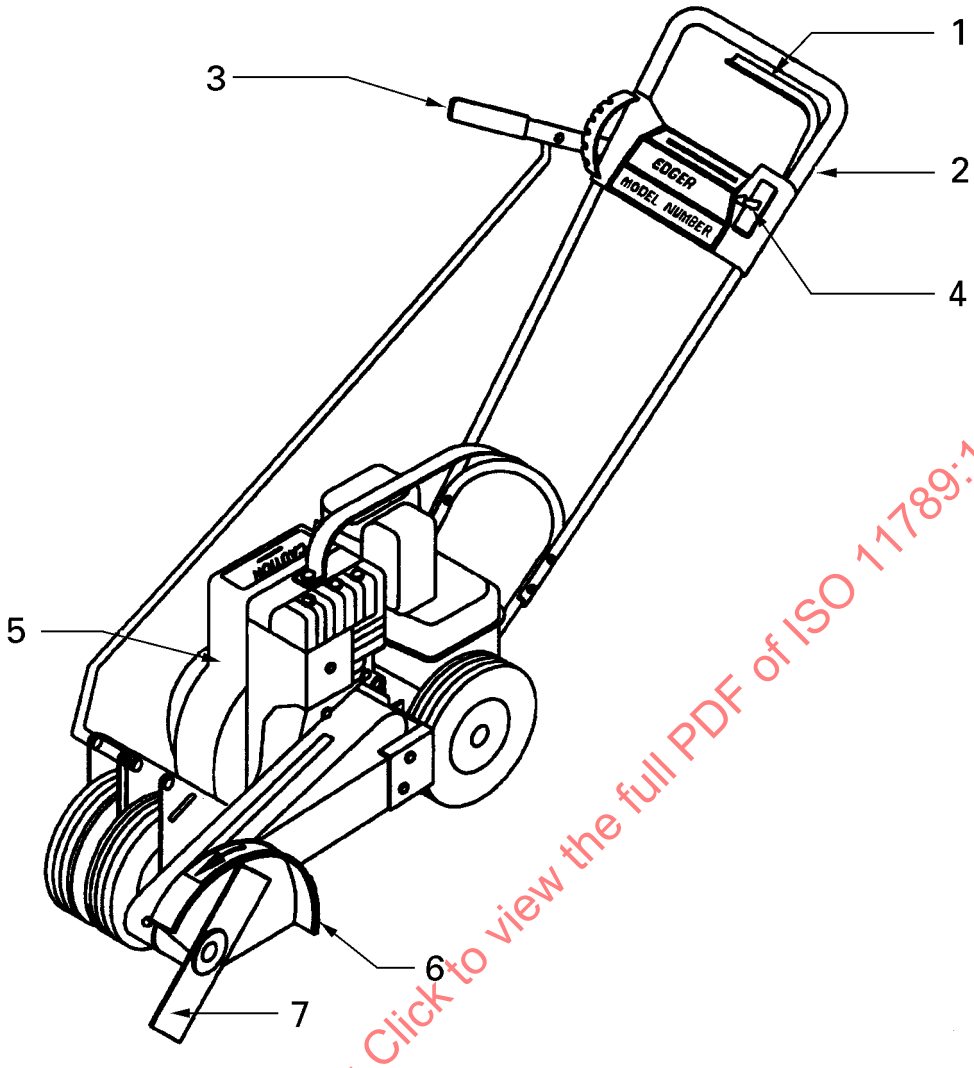
The three different acceleration directions may be measured at different times.

10.4.2 Results

The results reported shall be the arithmetic average obtained from a minimum of five sets.

Table 1 — Attenuation factors for 1/3 octave band centre frequencies

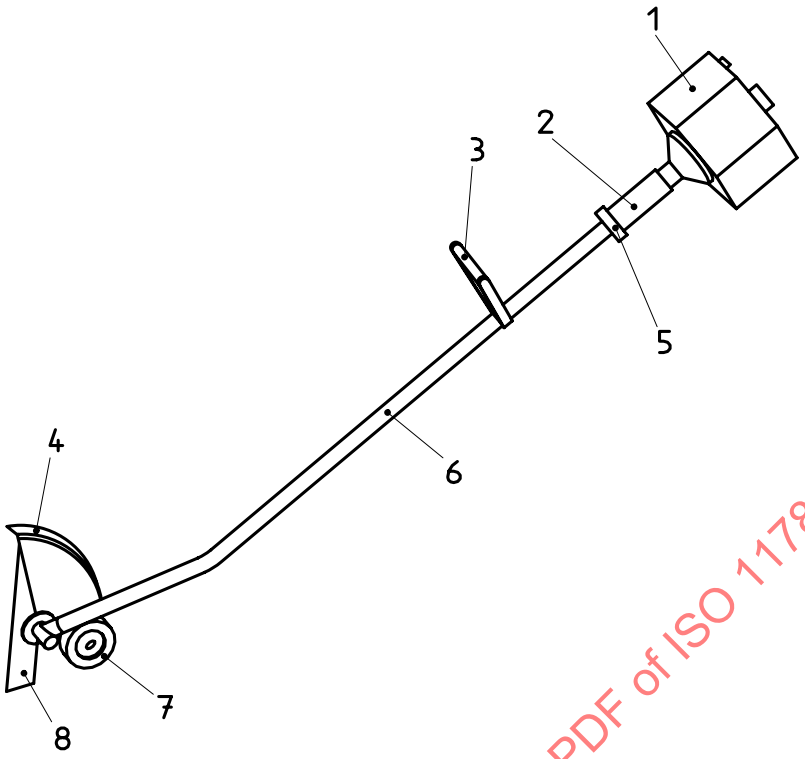
Central frequency 1/3 octave Hz	Linear gain	Gain dB
< 8	0	—
8	1	0
10	1	0
12,5	1	0
16	1	0
20	0,8	– 2
25	0,63	– 4
31,5	0,5	– 6
40	0,4	– 8
50	0,315	– 10
63	0,25	– 12
80	0,2	– 14
100	0,156	– 16
125	0,125	– 18
160	0,1	– 20
200	0,078	– 22
250	0,625	– 24
315	0,05	– 26
400	0,039	– 28
500	0,031 25	– 30
630	0,025	– 32
800	0,02	– 34
1 000	0,015 6	– 36
> 1 000	0	—



Key

1 Operator presence control
2 Handle
3 Cutting means depth adjustment
4 Throttle control
5 Engine motor
6 Guard
7 Cutting means

Figure 1 — Example of walk-behind edger with nomenclature

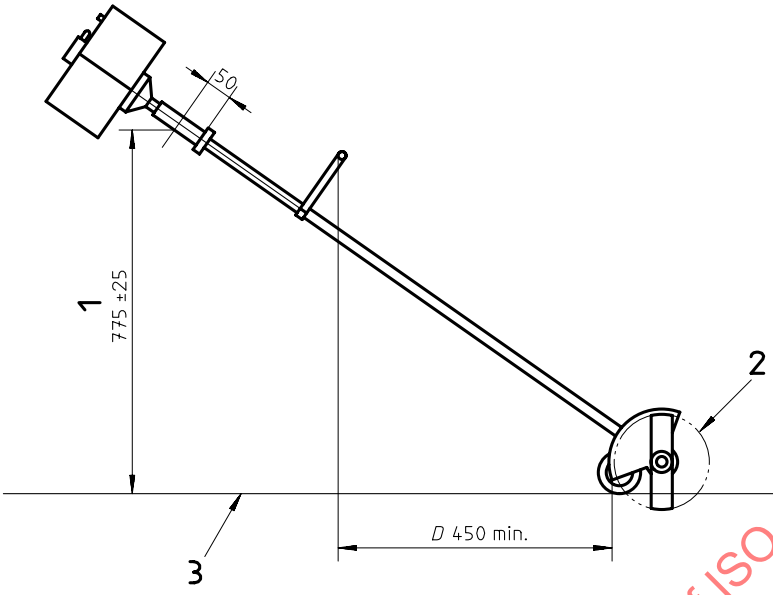


Key

1 Engine (motor)
2 Support handle
3 Guiding handle
4 Guard
5 Stop switch
6 Shaft housing
7 Support wheel (depth wheel)
8 Cutting means

Figure 2 — Example of hand-held edger with nomenclature

Dimensions in millimetres



Key

1 Support handle height
2 Blade-tip circle
3 Hard, flat and level test surface

Figure 3 — Hand-held edger, dimension D

Dimensions in millimetres

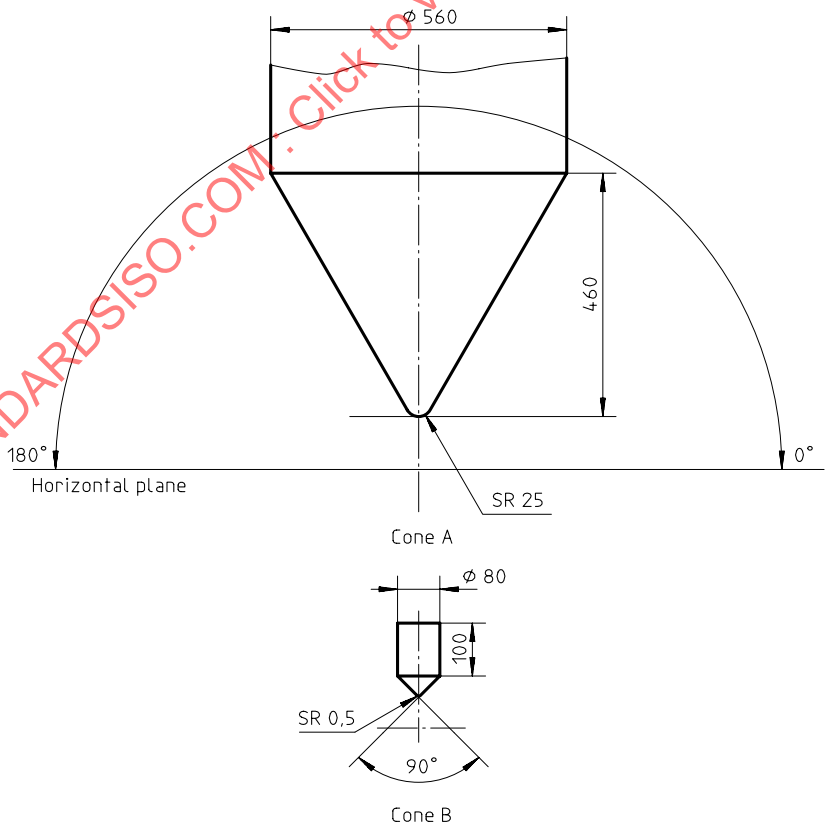


Figure 4 — Test cones

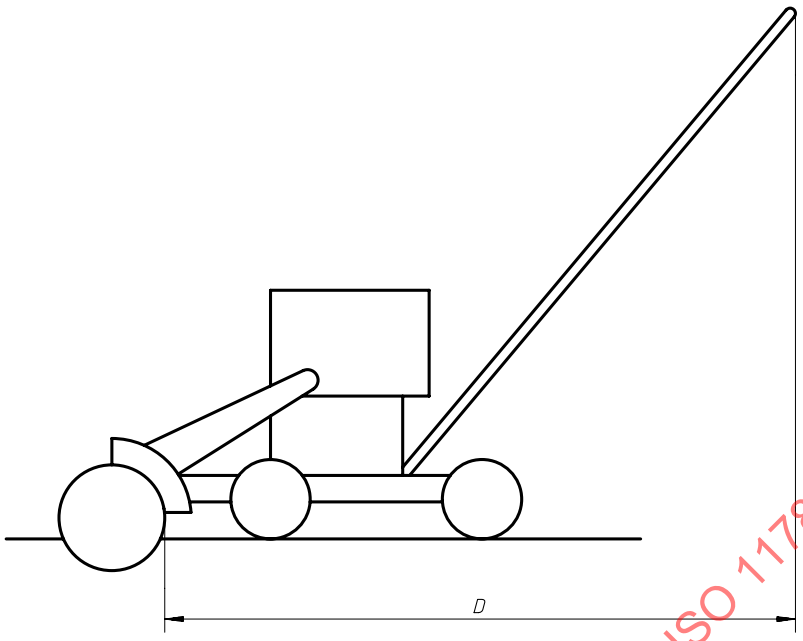


Figure 5 — Distance between rear of rotating cutting means and foremost working position of handle

Dimensions in millimetres

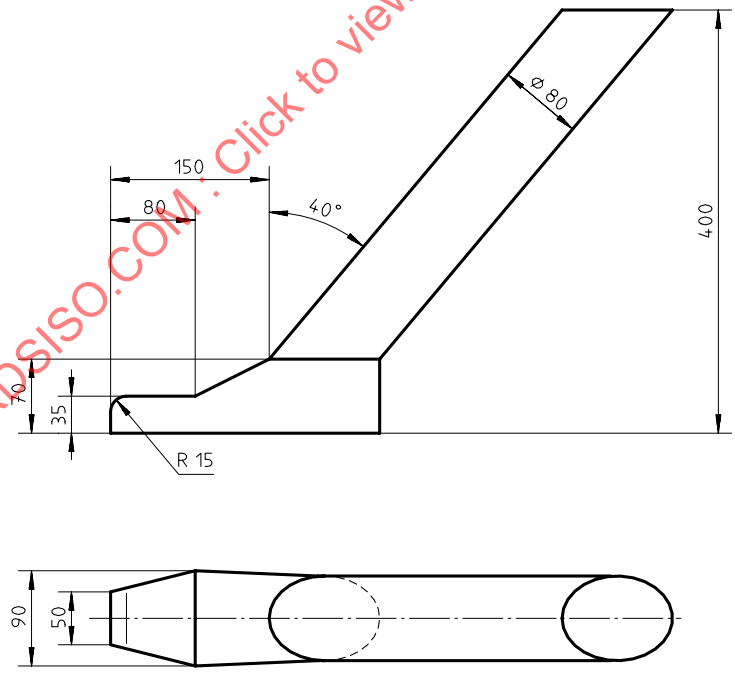
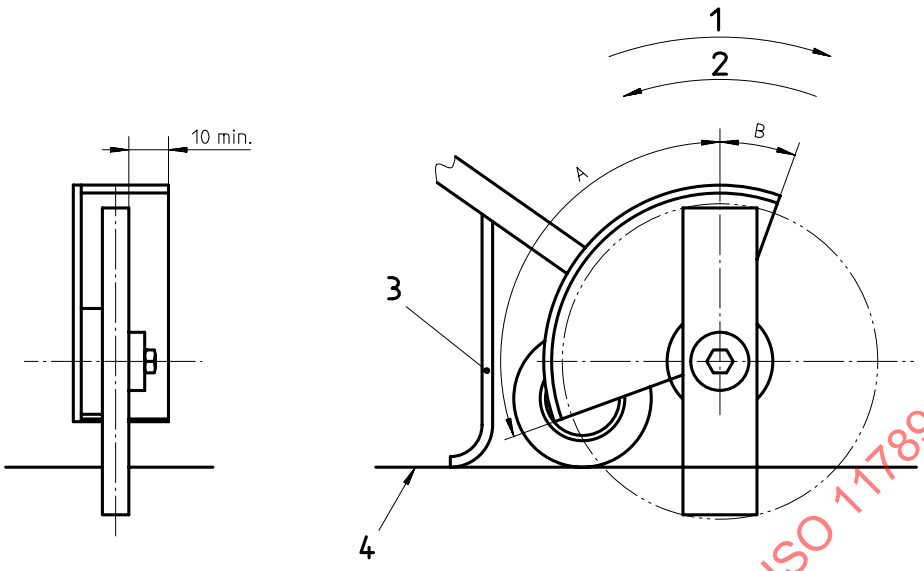


Figure 6 — Foot probe

Dimensions in millimetres



Key

1 Forward rotation
2 Reverse rotation
3 Debris deflector
4 Hard, flat and level test surface

For units with a forward rotating blade

A As required to meet clause 7. May be supplemented by support wheel, degris deflector or other components.

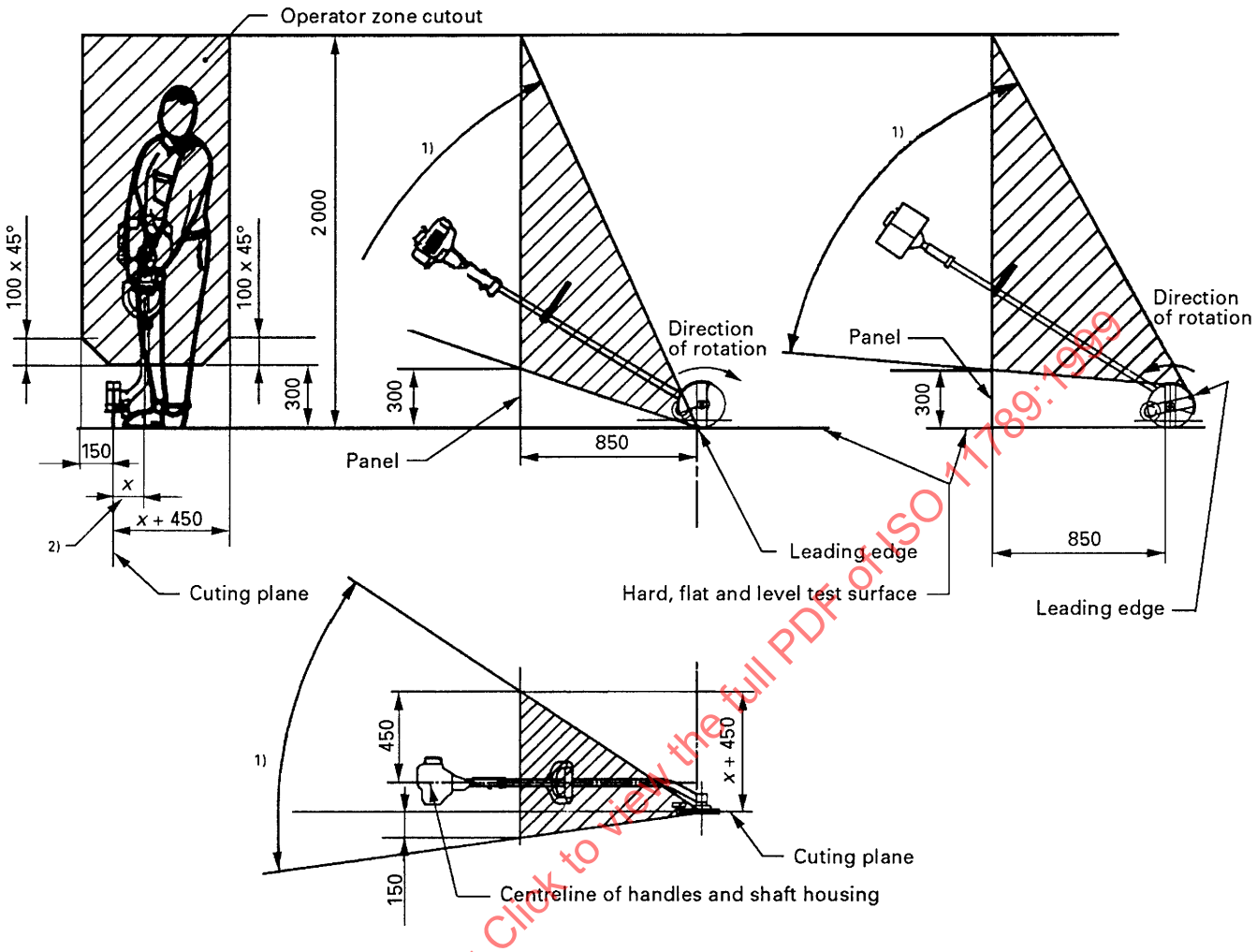
$B \geqslant 0°$

For units with a reverse rotating blade

$A \geq 0°$
$B \geq 110°$ } As required to meet clause 7

Figure 7 — Minimum guard dimensions

Dimensions in millimetres

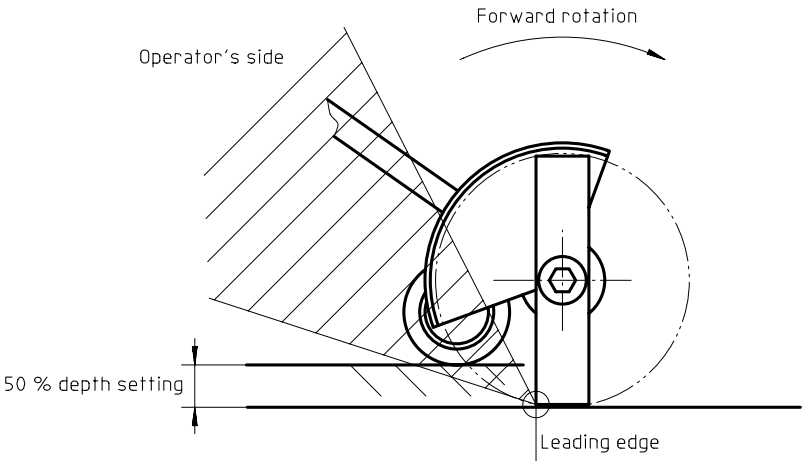


1) No sight to leading edge of blade.

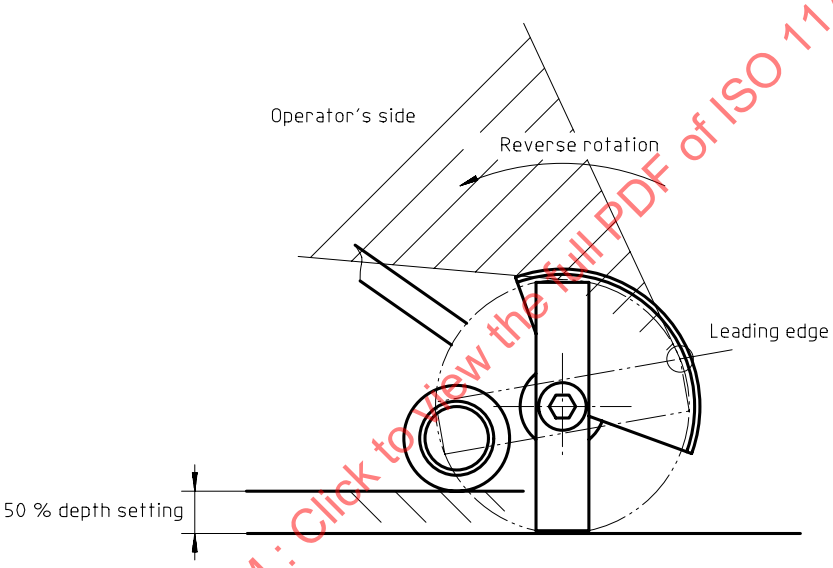
2) x may vary of different models.

NOTE — Tolerances for shown dimensions ± 5 mm.

Figure 8 — Operator thrown object protection test



a) Forward rotating blade



b) Reverse rotating blade

Figure 9 — 50 % depth setting for hand-held edger

Dimensions in millimetres

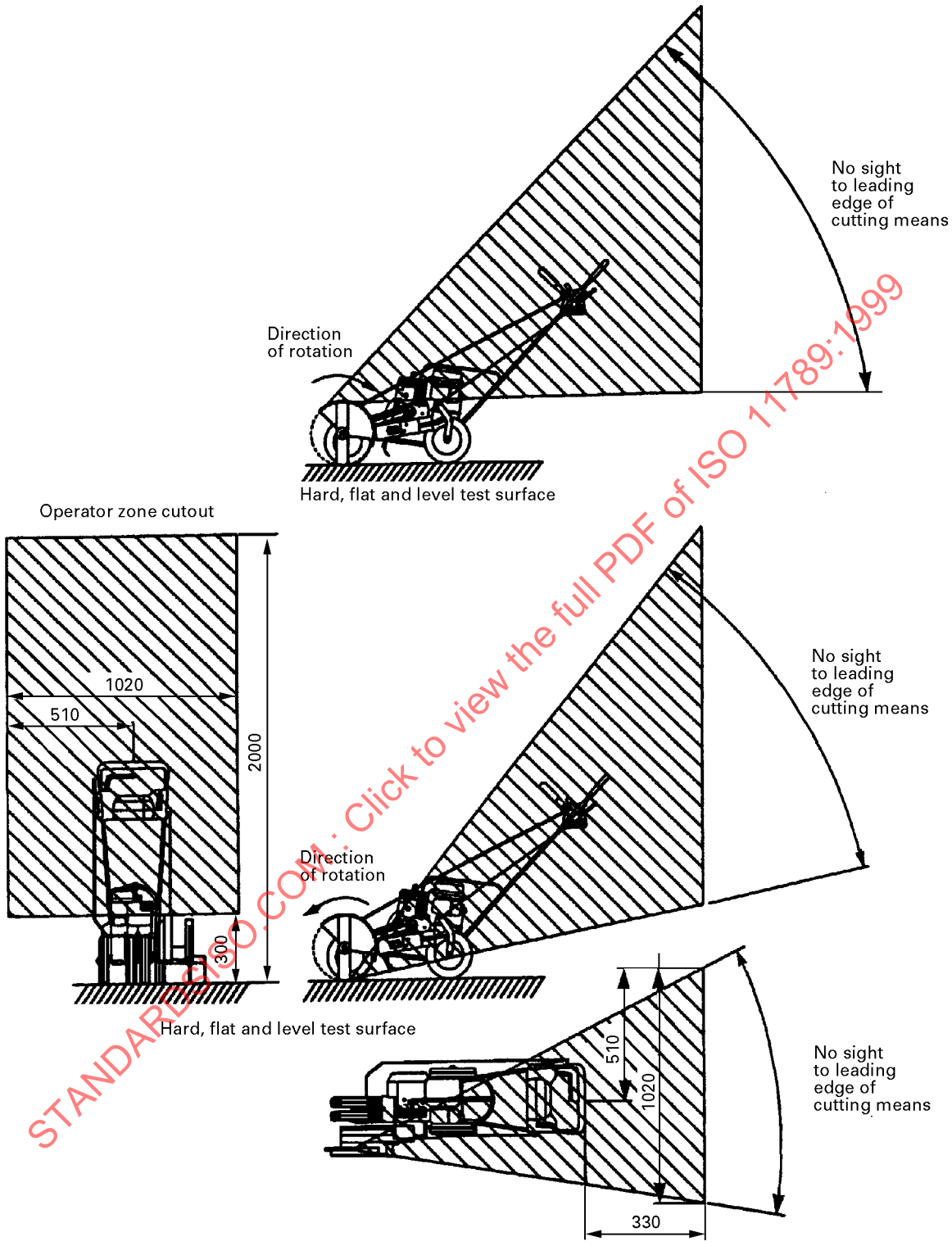


Figure 10 — Operator line of sight for walk-behind edger

Dimensions in millimetres

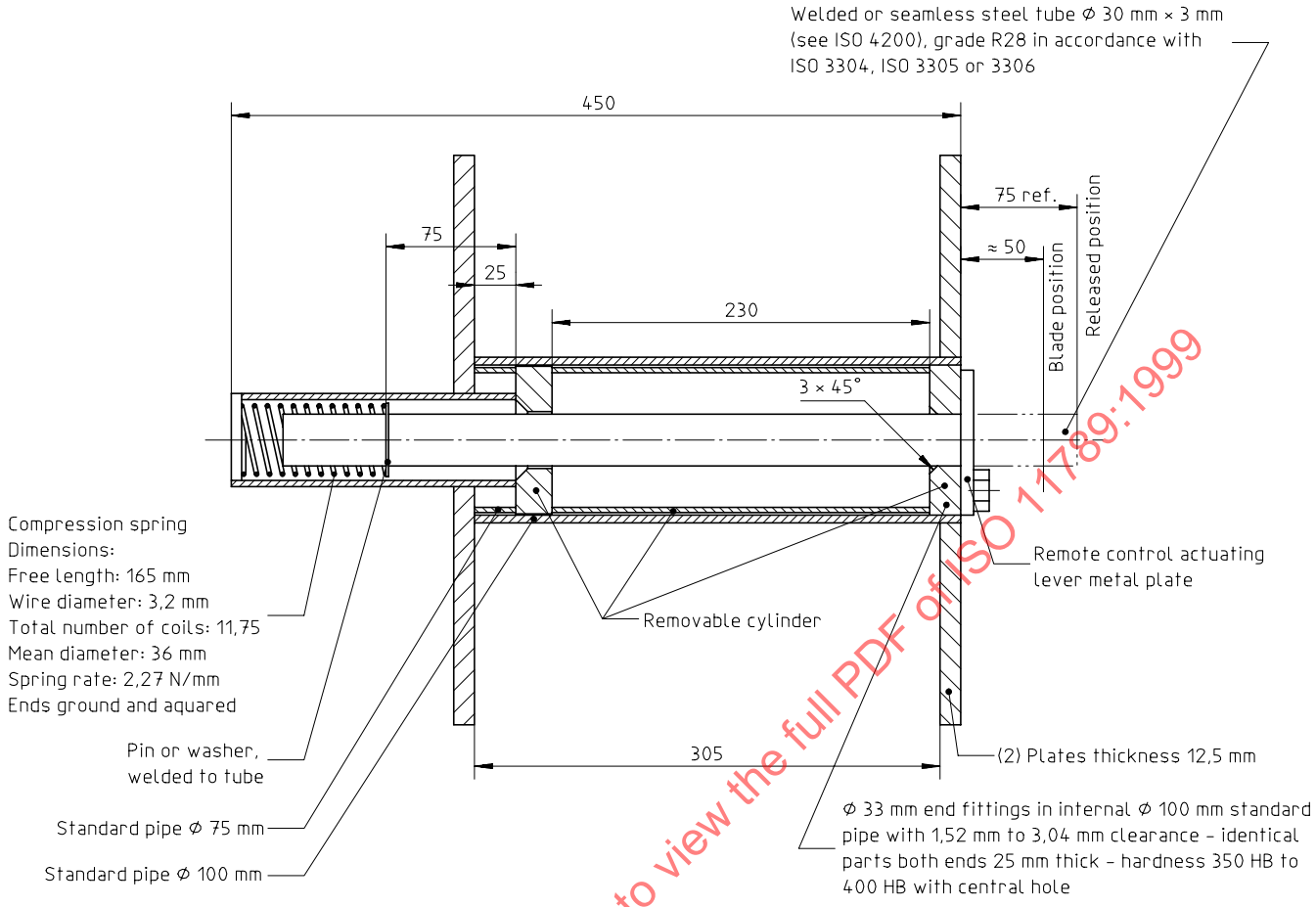


Figure 11 — Example of impact test fixture (ground supported)

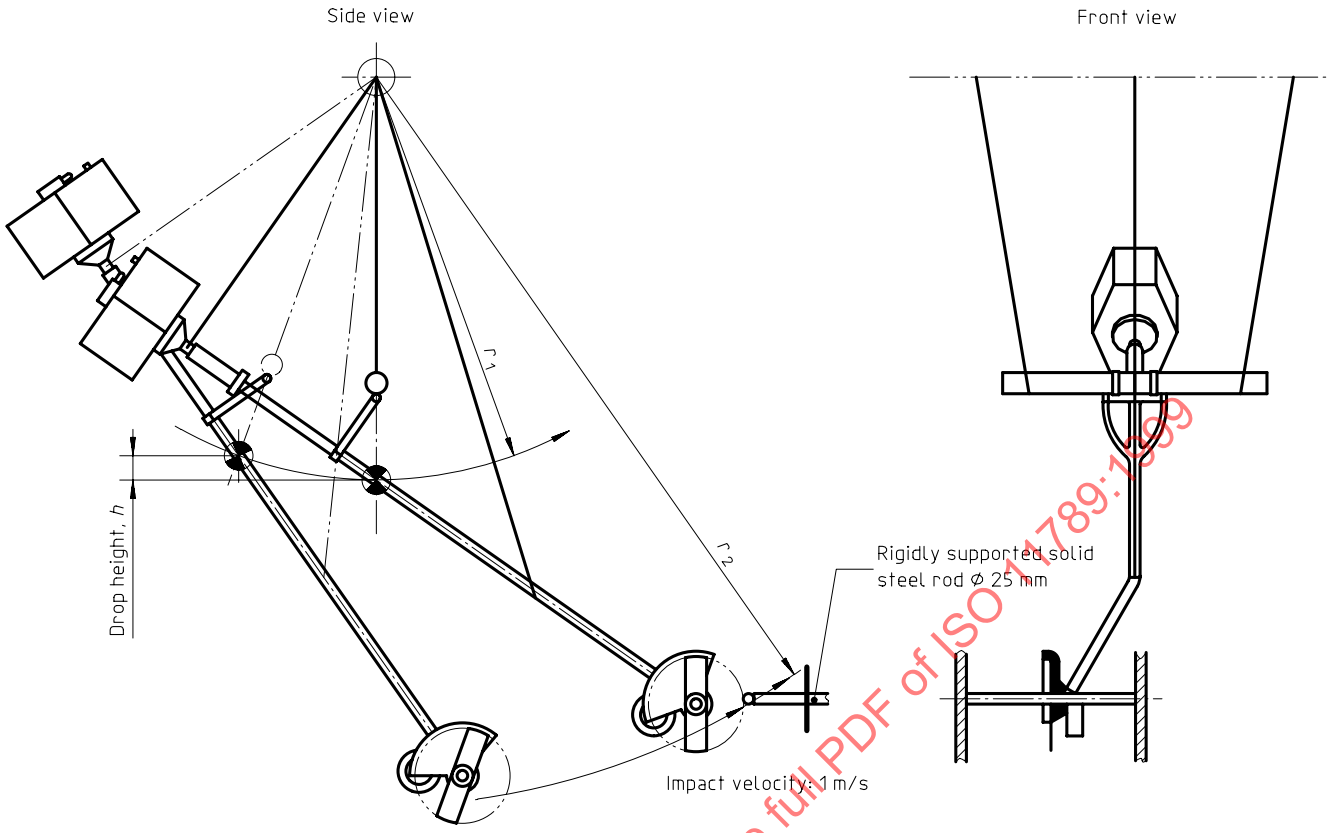
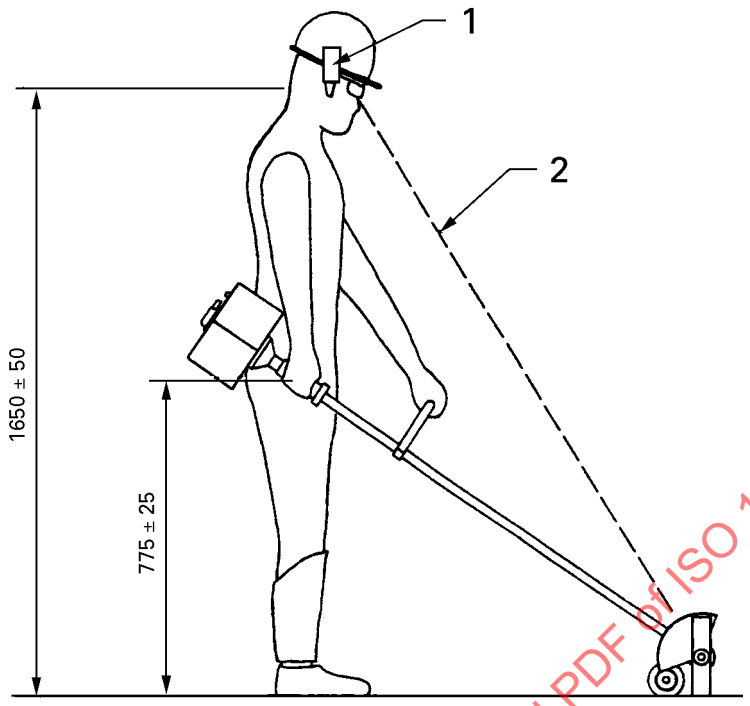


Figure 11 a) — Example of blade impact test — Hand-held edger

Dimensions in millimetres

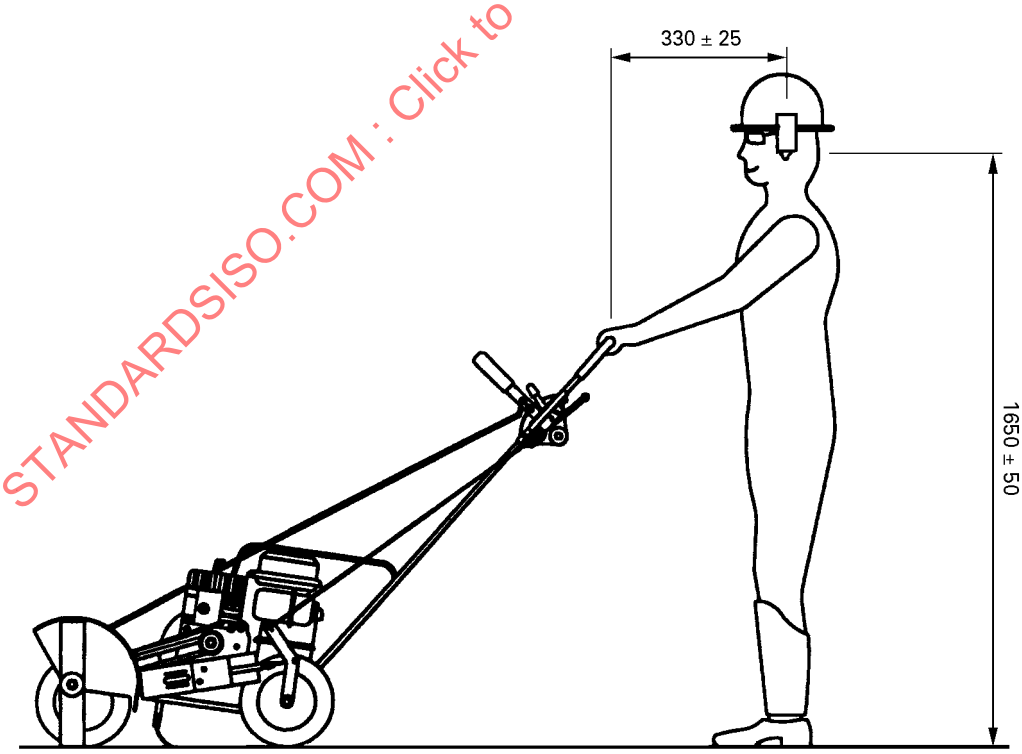


Key

1 Microphone

2 Operator view to blade

a) Hand-held edger



b) Walk-behind edger

Figure 12 — Sound test positioning

Dimensions in millimetres

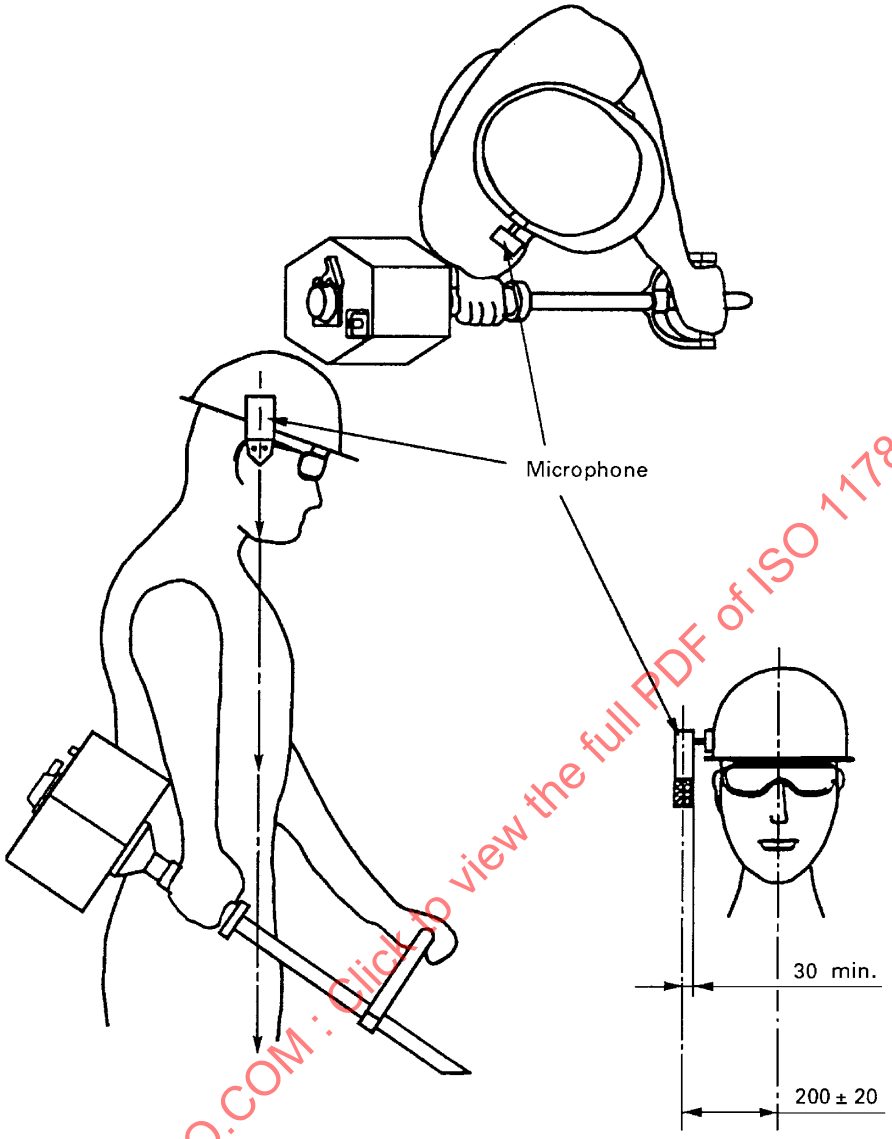


Figure 13 — Microphone location — Operator's ear

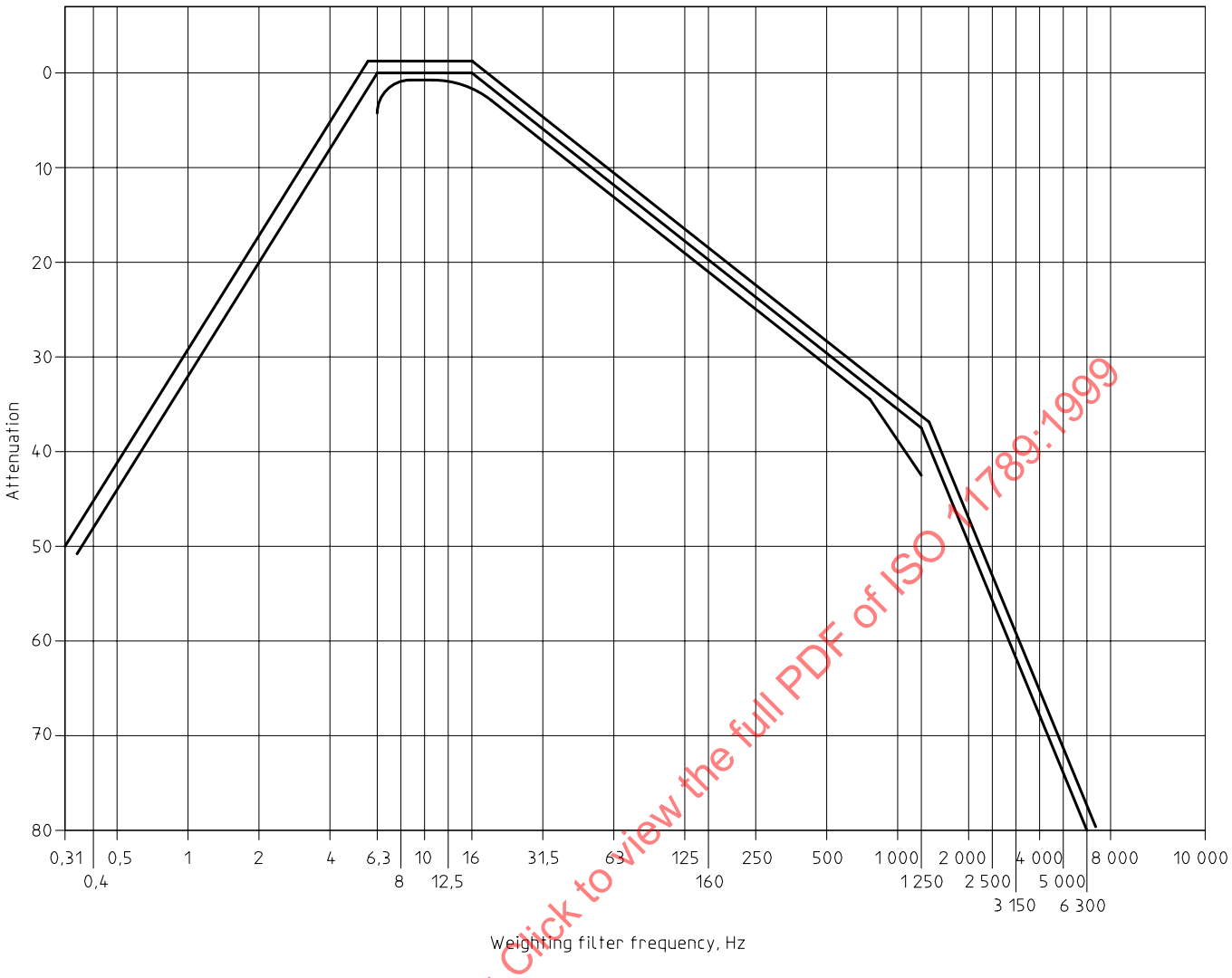


Figure 14 — Weighting filter frequency attenuation curve