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Building construction machinery and equipment — Portable, hand-held, internal combustion engine driven cut-off machines — Safety requirements

Machines et matériels pour la construction des bâtiments — Tronçonneuses à disque, portatives, à moteur à combustion interne — Exigences de 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 19432 was prepared by Technical Committee ISO/TC 195, *Building construction machinery and equipment*.

This second edition cancels and replaces the first edition (ISO 19432:2006), which has been technically revised, primarily concerning:

— additional requirement for starting device (4.4);

— throttle trigger (4.6);

— unintentional movement (4.6.2);

— throttle lock (4.6.3);

— additional requirements for tank strength (4.10);

— additional requirements for transmission cover (4.12);

— clarification of the parts to be recognized as hot parts, including temperature limits (4.13.1);

— additional requirement for electromagnetic immunity;

— added requirement for declaration of uncertainties to noise and vibration values (5.1.1, B.8 and C.10);

— modifications in required markings (5.2) and warnings (5.3) including durability requirements for labels;

— modified calculation of values for equivalent sound power, sound pressure and hand vibration (Annexes B and C);

— stricter specification for accelerometer mounting (C.4.3) and position (C.5);

— inclusion of a simulated feeding force to the vibration test procedure (C.8);

— definition of machine positions (Annex D);

— additional information on reproducibility for noise and vibration measurements (Annex E);

— a new informative Annex F covering a list of significant hazards.

Introduction

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

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

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

Building construction machinery and equipment — Portable, hand-held, internal combustion engine driven cut-off machines — Safety requirements

1 Scope

This International Standard specifies safety requirements, and measures for their verification, for the design and construction of portable, hand-held, internal combustion engine-driven, cut-off machines, intended to be used by a single operator in the cutting of construction materials, such as asphalt, concrete, stone and metal. It is applicable only to those machines designed purposely for use with a rotating, bonded-abrasive and/or super-abrasive (diamond) cut-off wheel having a maximum outer diameter of 430 mm, centre-mounted on, and driven by, a spindle shaft, where the top of the wheel rotates away from the operator (see Figure 1).

This International Standard deals with all significant hazards, hazardous situations or hazardous events significant to these machines when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer. (See Annex F for a list of significant hazards.)

This International Standard specifies methods for the elimination or reduction of hazards arising from their use, as well as the type of information on safe working practices to be provided with the machines.

Cut-off wheel specifications are not considered in this International Standard; for such specifications, see, for example, ISO 603-7[1], ISO 13942[12] and ISO 22917[15].

This International Standard is not applicable to machines 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 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

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

ISO 5349-2:2001, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 2: Practical guidance for measurement at the workplace*

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

ISO 7914:2002, *Forestry machinery — Portable chain-saws — Minimum handle clearance and sizes*

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

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

ISO/TR 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning*

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

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

ISO 14982:1998, *Agricultural and forestry machinery— Electromagnetic compatibility — Test methods and acceptance criteria*

ISO 16063-1, *Methods for the calibration of vibration and shock transducers — Part 1: Basic concepts*

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

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

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

3 Terms and definitions

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

3.1
cut-off wheel
wheel composed of abrasive particles bonded together by an appropriate binder and incorporating, if necessary, some appropriate form of reinforcement, or made of metal or other materials of similar properties and having diamond, CBN particles or other suitable abrasive particles bonded to its rim

3.2
arbor hole
centre hole of the cut-off wheel used for mounting the cut-off wheel on the machine spindle

3.3
blotter
washers made from some compressible material (e.g. paper, card or similar), attached to each side of the cut-off wheel, the function of which is to smooth imperfections in the cut-off wheel and allow a limited degree of slip when the wheel stalls in use

3.4
choke
device for enriching the fuel air mixture in the carburettor, to aid starting

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

3.6
cut-off wheel guard
partial enclosure intended to deflect cutting debris, as well as pieces of the cut-off wheel in the event that the wheel is broken in operation

3.7
engine-stopping device
device by which the stopping of the engine is initiated

3.8
flange contact surface
area between the inner and outer circumference on the flange, which forms the contact surface between the flange and the cut-off wheel

3.9
flange assembly
device provided to clamp and drive the cut-off wheel

3.10
handle
device designed to facilitate safe and easy control of the machine

3.10.1
front handle
handle located at or towards the front of the engine housing

3.10.2
rear handle
handle located at or towards the rear of the engine housing

3.11
idle speed
speed at which the engine runs with no load and throttle trigger released and the cut-off wheel does not rotate

3.12
reactive movement
sudden and unexpected motion of the machine, which can occur when the rotating cut-off wheel contacts a foreign object during cutting or because of pinching

3.13
maximum depth of cut
t
distance to which the cut-off wheel can enter the work-piece, as measured from the outer diameter of the wheel to the outside diameter of the flange

3.14
maximum cut-off wheel speed
maximum permitted speed of a new cut-off wheel marked on the cut-off wheel

3.15
maximum spindle speed
maximum speed at which the spindle rotates with a fully open throttle and no load

3.16
muffler
device for reducing engine exhaust noise and directing the exhaust gases

3.17
rated speed
engine speed at which maximum power occurs

3.18
spindle
shaft of the cut-off machine, which supports, retains and drives the cut-off wheel in connection with the flanges

3.19
throttle trigger
device for controlling the engine speed

3.20
throttle lock
device for setting the throttle in a partially open position, to aid starting

3.21
throttle trigger lock-out
device that prevents the unintentional operation of the throttle trigger until manually released

3.22
throttle control linkage
mechanism which transmits motion from the throttle trigger to the throttle control valve

3.23
transmission cover
device between the engine and the cutting equipment designed to prevent unintentional contact with the transmission

4 Safety requirements and verification

4.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of ISO 12100 for relevant but not significant hazards which are not dealt with by this International Standard.

The safe running of cut-off machines depends on both the safety requirements according to this clause and the safe working conditions associated with the use of adequate personal protection equipment (PPE), such as gloves, leg protection, boots, eye, hearing and head protection equipment, and safe working procedures (see 5.1).

Cut-off machines shall also be marked according to 5.2 and carry warnings according to 5.3.

The instruction handbook to be provided with the machines shall comply with 5.1.

For protection from contact with moving parts, except the cut-off wheel, any opening shall have a safety distance to the moving part that meets the requirements of ISO 13857:2008, 4.2.4.1 and 4.2.4.3.

When the machine is placed in its normal resting position (see Figure 1) on a flat horizontal surface, the cut-off wheel or the guard shall not touch the horizontal plane and the machine shall remain stable.

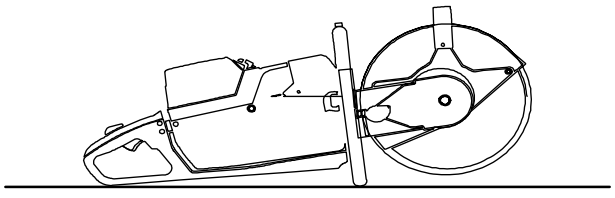


Figure 1 — Example of cut-off machine placed in a normal position on a flat surface

A method of verification is established for each requirement.

SAFETY PRECAUTIONS — Some of the tests specified in this International Standard involve processes that could lead to a hazardous situation. Any person performing tests in accordance with this International Standard should be appropriately trained in the type of work to be carried out. All national regulatory conditions and health and safety requirements must be followed.

4.2 Handles

4.2.1 Requirements

Cut-off machines shall have a handle for each hand. These handles shall be designed so that they

— can be fully gripped by an operator when wearing protective gloves,

— provide the necessary sureness of grip by their shaping and surface, and

— conform to the dimensions and clearances, except distances B and C, given in ISO 7914:2002, Table 1, for tree work service.

Cut-off machines with a system to isolate the machine vibration from the handles shall be designed so that the operator is able to stop the engine in a controlled manner with the engine-stopping device, even in the event of partial or full failure of the vibration isolators.

4.2.2 Verification

Dimensions shall be verified by measurements. The ability to control the machine if a failure occurs in the vibration isolators shall be verified by inspection of the design and function test.

4.3 Spindle speed

4.3.1 Requirement

Engine speed shall be limited so that it is not possible to accelerate the engine so that the maximum spindle speed (see 5.1) is exceeded.

4.3.2 Verification

The spindle speed shall be measured at the spindle with fully open throttle and no load. The maximum allowed inaccuracy is 5 r/min.

NOTE Simple calculations using the engine speed and the transmission ratio cannot be permitted due to the potential for slippage in the energy transmission from the engine to the shaft.

4.4 Engine-starting device

4.4.1 Requirements

The engine-starting device shall be an electric starter or a manual starter. The actuator for the manual starter shall be permanently attached to the machine.

The cut-off machine with a manual starter shall have a recoil device for the rope.

To activate the electrical starting device, two or more separate and dissimilar actions shall be required. This also applies to manual starting devices with stored energy.

4.4.2 Verification

The means to start the cut-off machine shall be verified by inspection and a functional test.

4.5 Engine-stopping device

4.5.1 Requirements

The machine shall be fitted with an engine-stopping device by which the engine can be brought to a final stop and which does not depend on sustained manual effort for its operation. The control for this device shall be so positioned that it can be operated by the operator's hand while holding the rear handle and wearing protective gloves.

The colour of the control shall contrast clearly with the background of the engine-stopping device.

4.5.2 Verification

The function of the engine-stopping device shall be verified by inspection while the machine is being operated. The control location and colour shall be verified by inspection.

4.6 Throttle control system

4.6.1 Dimensions

4.6.1.1 Requirements

The throttle trigger shall be positioned so that it can be pressed and released with a gloved hand while holding the rear handle by fulfilling the dimensional requirements for clearance around and behind the throttle trigger, as shown in ISO 7914:2002, Figures 3 and 4.

4.6.1.2 Verification

The dimensions shall be verified by measurement.

4.6.2 Operation

4.6.2.1 Requirements

The cut-off machine shall be provided with a throttle trigger that, when released, automatically reverts to the idling position unless a throttle lock to aid starting is engaged (see 4.6.3). The throttle trigger shall be retained in the idling position by the automatic engagement of a throttle trigger lock-out.

After the starting procedure has finished, activation of the throttle trigger, to increase the engine speed to a point where the cut-off wheel starts to move, shall only be possible after the throttle trigger lock-out has been disengaged.

The starting procedure is finished when the operator disengages the throttle lock and the engine returns to idling speed.

Unintentional movement of the cut-off wheel shall be minimized by a throttle control linkage, so designed that a force applied to the rear handle with the throttle trigger lock-out engaged will not increase the engine speed to a point where the clutch engages and cut-off wheel movement begins.

4.6.2.2 Verification

The function of the throttle trigger and throttle trigger lock-out shall be verified by inspection while operating the machine. The throttle control linkage design shall be verified by applying a force in any direction related to the plane of the cut-off wheel, on the centre of the rear handle grip and with the machine body secured. The force shall be equal to three times the weight of the cut-off machine unit with empty tanks, without accessories and without the cut-off wheel.

4.6.3 Throttle lock

4.6.3.1 Requirement

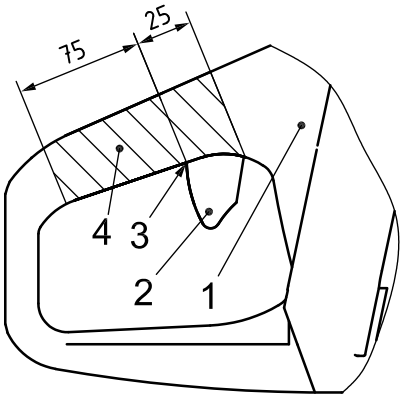
If a throttle lock is provided to aid starting and its engagement will result in a movement of the cut-off wheel during starting, it shall be such that it has to be engaged manually and shall be automatically released when the throttle trigger is operated. Releasing the throttle lock, both with and without operation of the throttle trigger lock-out, is acceptable.

To prevent risk from unintentional operation, the throttle lock shall be located outside the gripping area of the handle and require at least two independent motions to engage the throttle lock.

The gripping area of the handle is defined to extend from 25 mm in front of the rear part of the throttle trigger to 75 mm behind the rear part of the throttle trigger (see Figure 2).

The operational force on the throttle trigger for releasing the throttle lock shall not exceed 25 N.

Dimensions in millimetres



Key

1 rear handle
2 throttle trigger
3 intersection between rear handle and throttle trigger
4 gripping area

Figure 2 — Handle gripping area

4.6.3.2 Verification

The function of the throttle lock shall be verified by inspection and measurement. The force to release the throttle lock shall be applied within 1 s and measured (5 ± 1) mm in front of the rear part of the throttle trigger and in the direction of the trigger movement (perpendicular to the rotation radius of the trigger).

4.7 Clutch

4.7.1 Requirements

The cut-off machine shall have a clutch so designed that the cut-off wheel does not move when the engine rotates at any speed less than 1,25 times the idling speed.

4.7.2 Verification

The function of the clutch shall be verified by running the engine with any speed up to 1,25 times the idling speed. If a range is specified in the instruction handbook, the verification shall be done based on the highest idling speed.

4.8 Exhaust gases

4.8.1 Requirements

The exhaust outlet shall be designed so that the exhaust gases are directed away from the operator when the machine is held in a typical cutting position, as shown in Figure 3.

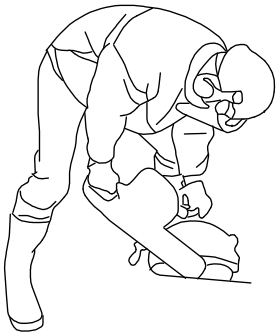


Figure 3 — Example of cut-off machine held in typical cutting position

4.8.2 Verification

The location and direction of the exhaust outlet shall be verified by inspection.

4.9 Cutting-debris discharge

4.9.1 Requirements

The cut-off machine shall be designed so that the main stream of cutting debris from the cut-off wheel is directed away from the operator's face or upper body when holding the machine in a typical cutting position, as shown in Figure 3. (See also 4.13.1.)

See 5.1 for required information about instructions for the wheel guard.

4.9.2 Verification

The direction of the cutting debris shall be verified by inspection.

4.10 Fuel and oil system

4.10.1 Requirements

The fuel tank cap and, if provided, the oil tank cap shall have a retainer to prevent the cap from being lost.

The fuel tank opening shall be at least 20 mm in diameter.

The design of the cap shall be such that no leakage occurs while the machine is at the normal operating temperature, in all working positions and while being transported.

The fuel tank and, if provided, oil tank filler opening shall be so located that the filling of the tank is not obstructed by other machine components. It shall be possible to use a funnel.

Tanks and fuel lines shall be integrated in the cut-off saw so that they withstand, without any visible leakage, the shock that occurs when the complete cut-off machine is impacted onto the ground in accordance with 4.10.2.2.

4.10.2 Verification

4.10.2.1 General

The fuel cap retainer, opening dimensions and the possibility of using a funnel shall be verified by inspection and measurement. The tightness of the caps shall be verified by inspection while turning the cut-off machine in any direction. Seepage from fuel tank ventilation systems is not regarded as leakage.

4.10.2.2 Drop test

The cut-off machine shall be impacted onto a concrete surface by dropping it twice, once with the largest diameter cut-off wheel, as specified in the instruction handbook, and once without the cut-off wheel, at (-5 ± 2) °C.

Before the drop test, install the cut-off wheel and fill the fuel tank and oil tank half full with a mixture of 50 % glycol and 50 % water (by volume) and condition the cut-off machine at the test temperature for at least 6 h.

Within 60 s of coming out from the conditioning environment, the cut-off machine shall be dropped onto a concrete surface.

The drop shall be done with the cut-off machine suspended by means of a string attached to the front handle so that the cut-off wheel plane is vertical and the lowest point of the front handle where it is suspended is 775 mm $\pm$ 5 mm above the concrete surface.

Repeat the test without the cut-off wheel after reconditioning at (-5 ± 2) °C for a minimum of 1 h.

Inspect for visible leakage while holding the machine for (30 ± 2) s in each of the positions a) to f) specified in Figure D.1.

4.11 Protection against contact with parts under high voltage

4.11.1 Requirements

All high-voltage parts of the circuit, including spark-plug terminals, shall be located, insulated or guarded so that the operator cannot make unintentional contact with them.

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

4.11.2 Verification

The location and insulation of the parts under high voltage shall be verified by inspection and using a standard test finger, in accordance with IEC 60745-1:2006, Figure 1. The ignition interruption or short-circuiting shall be verified by inspection.

4.12 Transmission cover(s)

4.12.1 Requirements

The moving transmission shall be covered to prevent contact during operation.

Covers whose only function is to guard from unintentional contact shall be fixed guards (detachable by means of tools).

Fixed guards shall have their fixing system permanently attached to the guard and/or the machine when the guard is removed.

4.12.2 Verification

The design of fixed guards shall be verified by inspection.

4.13 Protection against contact with hot parts

4.13.1 Requirements

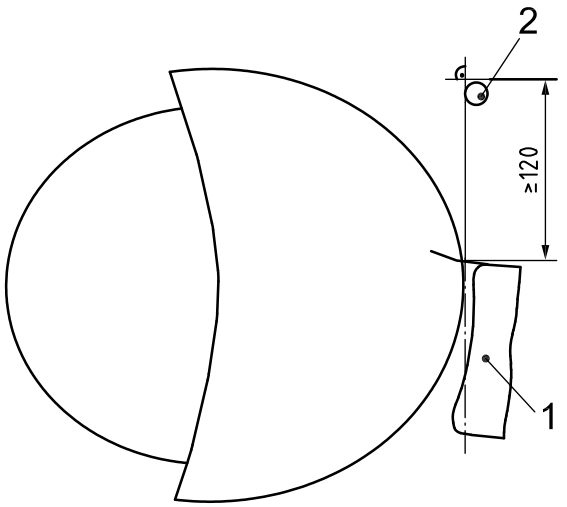
The cylinder or parts in direct contact with the cylinder or muffler shall be protected to avoid unintentional contact during normal operation of the machine. This applies to parts which are less than 120 mm away from the far side of the front handle above the machine (see Figure 4) and less than 80 mm from the far side of the front handle at the sides of the machine (see Figure 5).

It also applies to the area of the muffler which can be contacted by a tangential line between the outer side of the front handle above the machine and the outer edge of the housing over the muffler, with a length of 120 mm from the front handle (dimension ≥0 in Figure 6).

The protection shall ensure that the area contactable by the cone, as described in 4.13.2, does not exceed 10 cm^2. The temperature for the parts of the machine as defined above, as well as the protection for the cylinder, shall not be more than 80 °C for metallic surfaces or 94 °C for plastic surfaces.

NOTE For further information, see Annex E of ISO 13732-1:2006[9].

Dimensions in millimetres

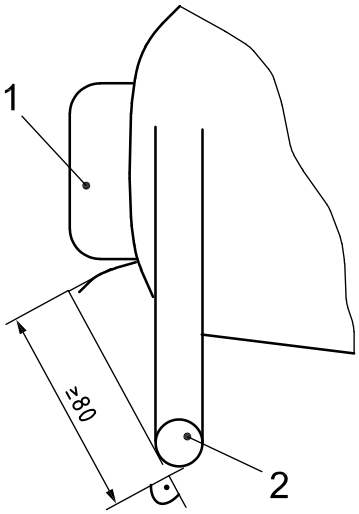


Key

1 muffler

2 front handle

Figure 4 — Required distance between front handle and unprotected hot part



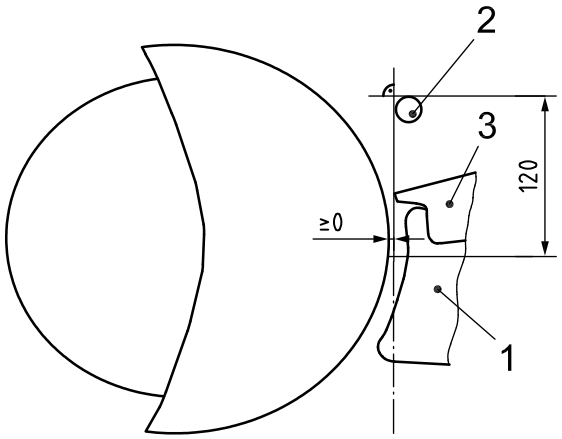
Key

1 muffler

2 front handle

Figure 5 — Required lateral distance between front handle and unprotected hot parts — Plan view

Dimensions in millimetres



Key

1 muffler

2 front handle

3 housing

Figure 6 — Protection against contact with hot parts

4.13.2 Verification

The protection of the cylinder or muffler shall be verified by measuring the required distances. Protection for the muffler shall be verified by determining the contactable area, by applying the test cone as shown in Figure 7 with a force of $(10\ ^{0}_{-1})$ N in any direction.

Dimensions in millimetres

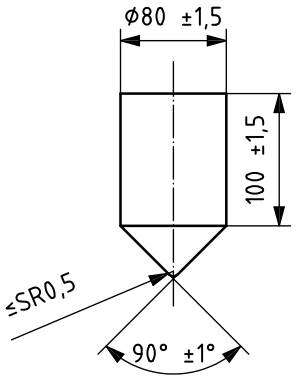
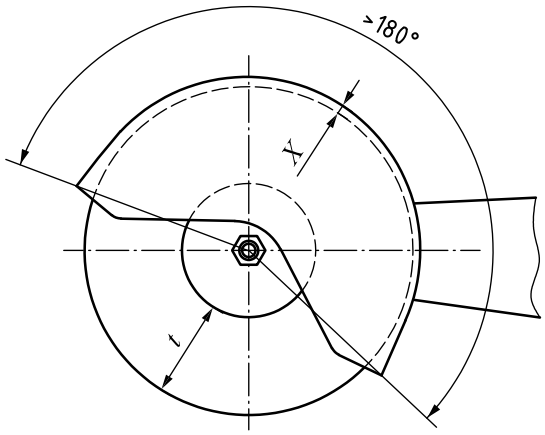


Figure 7 — Test cone

4.14 Cut-off wheel guard

4.14.1 Requirements

The machine shall have a cut-off wheel guard that requires the use of a tool for attachment or removal. The cut-off wheel guard shall cover continuously at least 180° of the circumference of the intended wheels (see Figure 8). The guard shall remain in its position during normal operation.



Key

t maximum depth of cut

X radial clearance

Figure 8 — Cut-off wheel guard dimensions and maximum depth of cut

If the guard is designed to rotate around the wheel centre, tools shall not be required to perform the adjustment.

The radial clearance (see Figure 8) between the guard and a cut-off wheel with the maximum outer diameter (see 5.1) shall not be more than 15 mm, to avoid the possibility of mounting an oversized cut-off wheel. The radial clearance does not need to be respected along the whole periphery of the guard.

The strength of the cut-off wheel guard shall comply with Annex A and remain functionally intact after the tests. Minor deformations and superficial damage are accepted. Any fixing devices, such as screws, shall remain intact.

The design of the machine shall incorporate a provision for dust reduction resulting from the cutting process which allows the operator to attach the provision to, for example, water or a vacuum to enable its operation.

4.14.2 Verification

The attachment of the guard and the enclosure of the wheel shall be verified by inspection and measurement and a functional test. The strength requirements shall be verified by functional testing in accordance with Annex A. The provisions to reduce the emission of dust shall be verified by inspection and a functional test.

4.15 Flange locking device

4.15.1 Requirements

The flanges shall have positive locking to the spindle to prevent flange rotation on the spindle. The fastening of the flanges and the cut-off wheel to the spindle shall not be loosened by rotational forces or torque from the spindle. When applying a torque, M, as specified in 4.15.2, there shall be no movement between the cut-off wheel and the flanges and the spindle.

4.15.2 Verification

The locking of the flanges to the spindle shall be verified by inspection and the following tests.

a) Attach the cut-off wheel and flanges to the spindle with the specified wheel-fastener tightening torque (see 5.1.2).

b) Lock the spindle and apply to the cut-off wheel a rotational torque M, in newton metres (N·m), calculated as follows:

$$M = 0{,}4 \times V \times k$$

where

V is the engine displacement in cubic centimetres (cm^3);

k is the gear ratio (engine/spindle speed).

c) Repeat the test five times in the normal rotational direction, then five times in the opposite direction of rotation. Observe for any movement.

4.16 Flange assembly

4.16.1 Requirements

The machine shall be equipped with two flanges (see Figure 9) made of steel or another material having comparable physical properties and which complies with the dimensions given in Table 1 for all types of cut-off wheels and Table 2 for superabrasive (diamond) cut-off wheels only. Both flanges shall have the same outer diameter and the same contact surface.

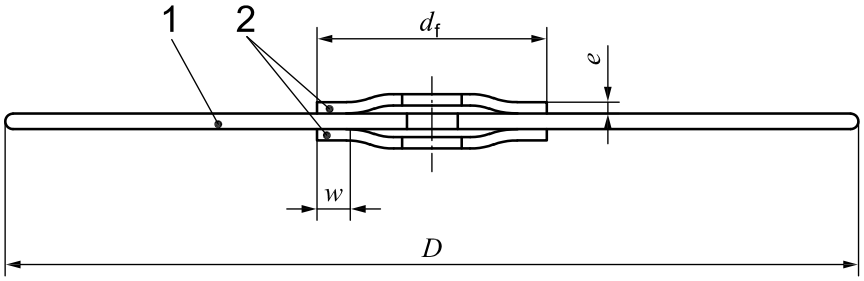
Flanges according to Table 1 shall always be provided with the machine. Optionally, flanges with dimensions according to Table 2 may be provided and shall be marked “For superabrasive cut-off wheels only.”.

Flanges will be considered suitable if they are mounted as shown in Figure 9, and loaded with the specified wheel-fastener tightening torque. The contact surface, w, of the flange shall be flat after the loading.

See also 5.1.2 for required information on the correct combination of flanges and cut-off wheel.

4.16.2 Verification

The dimensions and radial width of the flanges shall be verified by measurement. After applying the specified wheel-fastener tightening torque, the flatness of the flanges and the contact with the cut-off wheel shall be verified by inspection and gauging with a 0,05 mm thick gauge. It shall not be possible to insert the gauge at any point around the flange circumference between the flange contact surface and the surface of the cut-off wheel. Blotters shall not be used during the test.



Key

1 cut-off wheel

2 flange

Figure 9 — Cut-off wheel and flange dimensions

Table 1 — Cut-off wheel and flange dimensions — Abrasive and superabrasive wheels

Dimensions in millimetres

Cut-off wheel	Flange assembly		
Nominal outer diameter D	Minimum outside diameter d_f	Minimum radial width of contact surface w	Minimum recess e
≤ 250	63,5	7,9	1,5
> 250; ≤ 300	75	13	1,5
> 300; ≤ 350	87,5	15	1,5
> 350; ≤ 400	100	17	1,5

Table 2 — Cut-off wheel and flange dimensions — Superabrasive wheels only

Dimensions in millimetres

Cut-off wheel	Flange assembly		
Nominal outer diameter D	Minimum outside diameter d_f	Minimum radial width of contact surface w	Minimum recess e
≤ 250	37,5	6	1,5
> 250; ≤ 300	45	7,2	1,5
> 300; ≤ 350	52,5	8,4	1,5
> 350; ≤ 400	60	9,6	1,5

4.17 Spindle diameter

The nominal diameter for the spindle shall be equal to the arbor hole diameter of the cut-off wheel as specified in the instruction handbook, with a tolerance of 0 mm to −0,06 mm.

4.18 Special tools

4.18.1 Requirements

If special tools are needed for mounting and removal of the cut-off wheel and for adjusting the idle speed, they shall be provided with the machine.

4.18.2 Verification

This requirement shall be verified by inspection.

4.19 Noise

4.19.1 Reduction by design at source and by protective measures

Noise reduction shall be an integral part of the design process, thus specifically taking into account measures at source. The success of the applied noise reduction measures are assessed on the basis of the actual noise emission values. The main sources causing and influencing noise are generally the air intake system, engine cooling system, engine exhaust system, cutting system, and vibrating surfaces.

ISO/TR 11688-1 gives general technical information and guidance for the design of low-noise machines. Special care shall be taken in the acoustical design of cut-off machines.

NOTE 1 ISO/TR 11688-2[6] gives useful information on noise generation mechanisms in machinery and ISO 14163[13] gives guidelines for noise control by mufflers. ISO 11691[7] and ISO 11820[8] can be used for the testing of the muffler.

NOTE 2 Annex E provides useful information about round-robin data on emission sound pressure levels.

4.19.2 Noise measurement

The A-weighted emission sound pressure level at the operator's position and the A-weighted sound power levels shall be measured and calculated in accordance with Annex B.

4.20 Vibration

4.20.1 Reduction by design at source and by protective measures

Vibration reduction shall be an integral part of the design process, thus specifically taking into account measures at source. The success of the applied vibration-reduction measures are assessed on the basis of the actual-vibration total values for each handle. The main sources causing and influencing vibration are generally the dynamic forces from engine, cut-off wheel, unbalanced moving parts, impact in gear sprockets, bearings and other mechanisms and the interaction between operator, machine and material being worked.

Besides measures to reduce vibration at source, technical measures such as isolators and resonating masses shall be used to isolate, when appropriate, the vibration source from the handles.

NOTE 1 CR 1030-1[17] gives general technical information on widely recognized technical rules and means and can be used as a guideline for the design of reduced hand-arm-vibration machines.

NOTE 2 Annex E provides useful information about round-robin data on vibration levels.

4.20.2 Vibration measurement

The vibration shall be measured and the equivalent-vibration total value shall be calculated for each handle in accordance with Annex C.

NOTE The equivalent-vibration total value, $a_{hv,eq}$, can be used to determine the daily vibration exposure according to ISO 5349-1[3] and ISO 5349-2, taking into account the local conditions of use for the time of exposure and type of work to be executed.

4.21 Electromagnetic immunity

4.21.1 Requirements

All electronic components used in the systems to control the machine shall meet the acceptance criteria of ISO 14982:1998, 6.3 and 6.6, concerning electromagnetic immunity of the machine.

4.21.2 Verification

The electromagnetic immunity shall be verified by testing as specified in ISO 14982.

5 Information for use

5.1 Instruction handbook

5.1.1 General

For information to be provided to the user, the content of this clause, together with ISO 12100:2010, 6.4, apply.

5.1.2 Technical data

The instruction handbook shall give the following technical information for each operating condition.

a) Mass

— Dry weight of machine without cut-off wheel and accessories and with empty tank, in kilograms (kg).

b) Volume

— Fuel tank, in litres (l).

c) Cut-off wheel

— Maximum outer diameter, in millimetres (mm).

— Arbor hole diameter, in millimetres (mm).

— Minimum flange outside diameter, d_f, in millimetres (mm).

— Wheel-fastener tightening torque, in newton metres (N·m).

— Maximum cut-off wheel speed, per minute (min^{-1}).

Wheel-type limitation, including correct combination of flanges and cut-off wheel, as well as tightening torque (if applicable).

d) Spindle

— Spindle diameter, in millimetres (mm).

— Maximum spindle speed, per minute (min^{-1}).

e) Engine

— Engine displacement, in cubic centimetres (cm^3).

— Rated engine power at rated engine speed (in accordance with ISO 7293), in kilowatts (kW).

— Idle speed (id), per minute (min^{-1}).

— Rated engine speed (in accordance with ISO 7293), per minute (min^{-1}).

f) Noise and vibration

— Values for A-weighted emission sound pressure level and its uncertainty at the operator position, determined in accordance with Annex B, in decibels (dB).

NOTE An octave band analysis can be supplied to enable the selection of correct hearing protection.

— Values for A-weighted sound power level, including its uncertainty, determined in accordance with Annex B, in decibels (dB).

— Values for equivalent-vibration total value and its uncertainty for each handle, determined in accordance with Annex C, in metres per second squared (m/s^2).

The values given in the instruction handbook shall be given together with a reference to this International Standard.

Sales literature describing the machinery should not contradict the instructions as regards health and safety aspects. Sales literature describing the performance characteristics of machinery should contain the same information on noise emission and vibration values as that contained in the instruction handbook.

5.1.3 Other information

The instruction handbook shall contain, in accordance with ISO 12100:2010, 6.4.5, comprehensive instructions and information on all aspects of operator/user maintenance and the safe use of the cut-off machine, including type and use of personal protective equipment (PPE), suitable clothing and the need for training in all manual machine operations. The instructions shall take into account the use of a machine by a first-time and/or inexperienced operator.

The importance of reading the instruction handbook thoroughly before using the cut-off machine shall be stressed on the front of the instruction handbook.

The instruction handbook shall at least cover information relating to the following.

a) Transport, handling and storage of the cut-off machine, including

— the use of cut-off wheel cover during transport and storage, and

— recommendations for storage of the machine, including cleaning and maintenance.

b) Commissioning of the cut-off machine, including

— assembly instructions, initial adjustments and checks,

— information regarding starting and stopping, with particular reference to safety,

— information regarding pre-operating measures and daily maintenance techniques, including instructions for adjustment of idling speed and, if a special tool is needed, a description of this tool,

— information about the importance of only using cut-off wheels designed for use on hand-held cut-off machines and a warning of the possible consequences of using a cut-off wheel not intended for hand-held cut-off machines,

— selection and mounting of the correct cut-off wheel for the type of work to be carried out,

— information regarding correct positioning and fixing of the cut-off wheel guard, including use of blotters, choice of flanges and tightening torque, and if a special tool is needed, this has also to be described, and

— fuelling and refuelling, especially concerning fire precautions and the risk of smoking during refuelling procedures, and that of fuel spillage and fire ignition by sparks when cutting metal.

c) Information regarding the cut-off machine, including

— description, identification and nomenclature of principal parts, including the safety devices of the machine, and an explanation of its function,

— explanation of symbols and warnings,

— information regarding specified replacement cut-off wheels and advice to use only those wheels designated for use on the cut-off machine, and stating that it is prohibited to use any other type of cutting attachment designated for use, i.e. the cut-off wheel shall have an allowed rotational speed that is at least equal to the maximum spindle speed indicated on the machine,

— information on spindle diameter and the use of adjustment rings,

— declared values of the A-weighted emission sound pressure level at the operator's position and of the A-weighted sound power level, including warning about the risks and measures to be taken to minimize those risks; an octave band analysis shall be supplied upon request to enable the selection of correct hearing protection, and

— equivalent vibration, including warning about the risks and measures to be taken to minimize those risks (including an explanation of white-finger risks and means for the users to protect themselves);

d) Use of the cut-off machine, including the following:

— operating instructions and instructions for common cutting tasks, including adjustment of the cut-off wheel guard and advice to use the machine only with both hands, having a firm grip on both handles, prohibited operations and warning against the use of the unit while tired, ill or under the influence of alcohol or other drugs;

— advice to organize the work to be undertaken, paying special attention to surveying the site in order to note any hazards, such as electrical cables and flammable substances, to the use of warning signs, and to safe working distance from other persons;

— instructions to inspect the cut-off wheel for cracks, distortion of shape or unbalance and to reject any such cut-off wheel that does not meet this requirement;

— a warning not to leave the engine running while unattended, e.g. on the ground, and not to carry the machine when the engine is running;

— instructions for the use of PPE, which shall include recommendations for the appropriate type of equipment to be used;

— a warning that the machine shall not be used where flammable substances and gases are present, emphasizing the need for sufficient ventilation;

— a warning that the machine produces exhaust fumes, which include hydrocarbons and benzene, when running emphasizing the need for sufficient ventilation, not only if used indoors but also when working in trenches, hollows or other confined locations;

— instructions regarding exposure to noise, selection and use of hearing protection, including recommendations for limiting the duration of operation, if appropriate;

— instructions regarding exposure to vibration with an explanation of white-finger risks and means for users to protect themselves and, if appropriate, recommendations for limiting the duration of operation;

— a warning about hazards which may be encountered, such as reactive movement (i.e. climbing, pulling, pinching and especially rotational reactions), while using the machine and how to avoid them;

— instructions on the need to control the dust emission at the source;

— warning not to cut asbestos materials.

e) Maintenance instructions, including

— instructions on servicing and replacement tasks for the user, including the need to keep the machine in good working condition,

— specifications of the spare parts to be used, when these affect the health and safety of operators,

— drawings or diagrams to allow user maintenance and fault-finding tasks, and

— provision of sufficient information to enable the user to maintain the safety system throughout the life of the product with an explanation of the consequences of improper maintenance, use of non-conforming replacement components, or the removal or modification of safety components.

5.2 Markings

All cut-off machines shall be marked with the following information as a minimum:

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

The address can be simplified as long as the manufacturer (and, where applicable, his authorized representative) can be identified. In any event, the address on the plaque must be sufficient for mail to reach the company.

— designation of series or type;

— designation of machinery;

The designation of machinery is to allow the technical identification of the product and this can be achieved by a combination of letters and/or numbers. In this case, the explicit designation shall be given in the instruction handbook:

— serial number, if any;

— direction of rotation of the spindle for the cut-off wheel;

— year of construction, i.e. the year in which the manufacturing process is completed.

In addition, the machine shall bear the following additional information:

— identification and method of operation, preferably according to ISO 3767-5[2], of the choke control, fuel cap and heated handle switch (if provided);

— identification of carburettor adjustments;

— maximum spindle speed.

If symbols are used, they shall be explained in the instruction handbook.

When symbols are used, they shall, except if they are cast, embossed or stamped, be in contrast to their background. Embossed features shall be at least 0,3 mm in height. The information and/or instructions provided by the symbols shall be clearly legible when viewed by the naked eye from a distance of not less than 500 mm.

The markings shall be located in a readily visible position and shall resist the anticipated service conditions, e.g. the effects of temperature, moisture, petrol, oil, abrasion and weathering exposure.

5.3 Warnings

All cut-off machines shall be marked with the following warnings:

— a sign indicating “WARNING: SEE INSTRUCTION HANDBOOK”;

— a symbol indicating that head, eye and hearing protection, and also dust protection, are necessary;

— a warning for reactive movement while using the machine;

— a warning for sparks (fire risk), inhalation of exhaust gases;

— a statement that the use of a damaged cut-off wheel is prohibited, as well as the use of a saw blade.

All text can be replaced by pictorials.

NOTE Guidelines for the design of pictorials are also given in ISO 11684[5].

If symbols or pictorials are used, they shall be explained in the instruction handbook.

The warnings shall be located in a readily visible position on the cut-off machine and shall resist the anticipated service conditions, e.g. the effects of temperature, moisture, petrol, oil, abrasion and weathering exposure.

When symbols are used, they shall, except if they are cast, embossed or stamped, be in contrast to their background. Embossed features shall be at least 0,3 mm in height. The information and/or instructions provided by the symbols shall be clearly legible when viewed by the naked eye from a distance of not less than 500 mm.

Annex A
(normative)

Strength test of cut-off wheel guard

A.1 General

This test shall be used to analyse the strength of the guard. It is not intended to examine the protection of the operator in case of a wheel failure.

The test shall be performed inside a fully protected enclosure that can contain all of the cut-off wheel fragments and other debris.

This test creates flying debris and wheel fragments, and should only be carried out in a properly constructed and equipped test facility.

A.2 Principle

In this test of the cut-off wheel guard, a non-reinforced wheel of the maximum size and thickness possible for appropriate mounting on the machine and running at the maximum spindle speed is burst. The fragments of the broken wheel hit the guard and transfer kinetic energies to the outer edge and the inner surface of the guard. In a subsequent examination, it is revealed whether or not the guard is significantly damaged.

A.3 Test setup

The test shall be performed inside a fully protected enclosure able to contain all of the cut-off wheel fragments and other debris. In this enclosure, the cut-off machine shall be suspended horizontally on ropes affixed to the front and rear handle, as shown in Figure A.1. If necessary, the cut-off machine may be stabilized in the lateral direction with two ropes fixed to a rod on the front handle.

As an alternative to the use of ropes, the test may be carried out with the cut-off machine mounted on a base.

The projectile used in this test shall have sufficient energy to burst the cut-off wheel (i.e. a steel ball or pin).

A.4 Test object

Measurements shall be carried out on a new machine, featuring standard equipment, and with the tank(s) at least half full.

A.5 Preparation

Adjust the guard so that the open exposure of the wheel is at an angle of 45° to the horizontal.

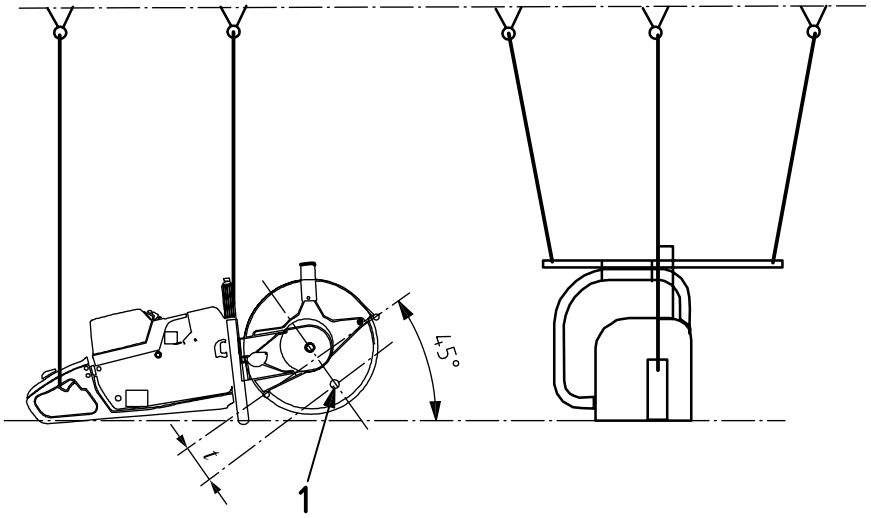
A.6 Test procedure

The cut-off machine with a non-reinforced wheel of the maximum size and thickness possible for appropriate mounting on the machine and running at the maximum spindle speed shall be burst, while the machine is hanging horizontally on ropes affixed to the front and rear handles (see Figure A.1). The burst shall be caused by a projectile fired at the wheel or by another suitable method. The projectile shall hit the wheel at a distance

($t \pm 12$) mm from the outer diameter, where t is $0{,}25 \times D$. The test shall be carried out until three separate wheel bursts are accomplished using the same guard.

A.7 Test result

After three consecutive tests, the guard shall be inspected. It shall have maintained its structural integrity such that the guard can furthermore be used for all applicable operations.



Key

1 impact point

Figure A.1 — Test setup for cut-off wheel — Burst test

Annex B
(normative)

Noise test code — Engineering method (grade 2 of accuracy)

B.1 General

The noise test code specified in this annex gives the information necessary for determining, efficiently and under standardized conditions, the noise emission characteristics of portable, hand-held, internal combustion engine-driven cut-off machines.

Noise emission characteristics include the A-weighted emission sound pressure level at the operator's position and the A-weighted sound power level.

The determination of these quantities is necessary for

— manufacturers, to declare the noise emitted,

— comparing the noise emitted by machines in the family concerned, and

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

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

NOTE These quantities can also be used for the calculation of the daily exposure level and for the estimation of environmental noise.

The use of this noise test code enables reproducibility of the determination of the noise emission characteristics within specified limits determined by the grade of accuracy of the basic noise measurement method used. Noise measurement methods allowed by this annex are engineering methods (grade 2).

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

Quantities to be measured are defined in 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.

B.3 A-weighted sound power level determination

B.3.1 For the determination of the A-weighted sound power level, ISO 3744 shall be used, subject to the modifications or additions given in B.3.2 to B.3.5.

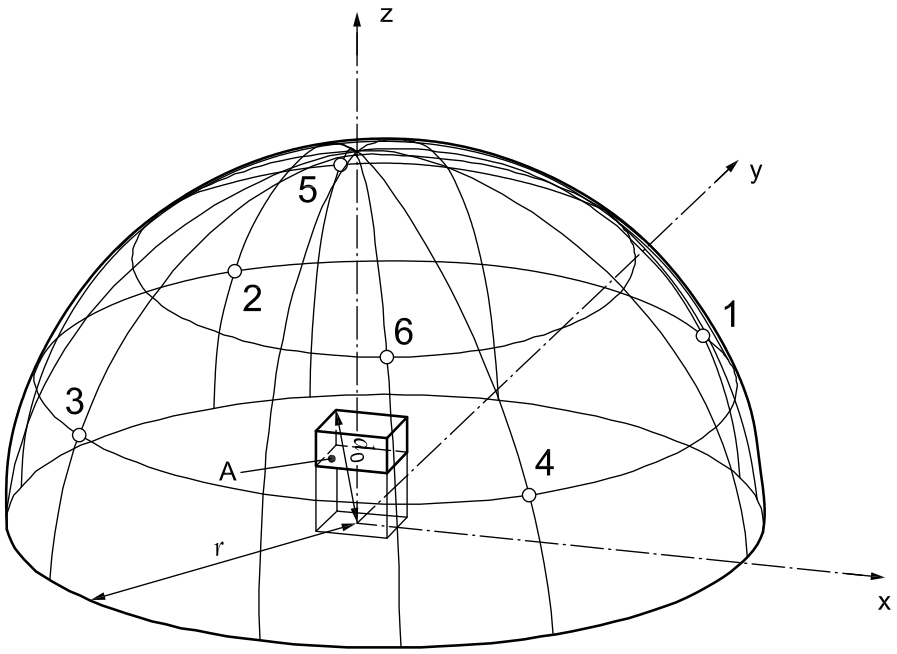
B.3.2 The microphone array shall be six microphone positions in accordance with Figure B.1 and Table B.1.

NOTE 1 The 6-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 10-microphone array specified in ISO 3744.

The measurement surface shall be a hemisphere with a radius, r, of 4 m. Dimension d_0 is determined by the reference box and its defined location above ground (see Figure B.1). A smaller radius is permitted if it is

demonstrated that the results are within 0,5 dB, compared with measurements with a hemisphere of $r = 4$ m. If a smaller radius, r, is used, it shall not be less than $2d_0$, where d_0 is defined by the reference box enclosing the machine.

NOTE 2 The smaller radius might be necessary in an anechoic room where a radius of 4 m cannot be provided.



Key

A reference box

d_0 characteristic source dimension

r hemisphere radius $\geq 2d_0$

Figure B.1 — Microphone positions on the hemisphere

Table B.1 — Coordinates of microphone positions

Position No.	X	Y	Z
1	+0,65r	+0,65r	0,38r
2	−0,65r	+0,65r	0,38r
3	−0,65r	−0,65r	0,38r
4	+0,65r	−0,65r	0,38r
5	−0,28r	+0,65r	0,71r
6	+0,28r	−0,65r	0,71r

B.3.3 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 microphone windscreen shall be used each time the wind speed exceeds 1 m/s.

The value of the environmental correction K_{2A}, determined in accordance with ISO 3744:2010, Annex A, shall be a maximum of 2 dB.

B.3.4 Measurements shall preferably be made using an integrating-averaging sound level meter as defined in IEC 61672-1.

B.3.5 The positive x-axis of the machine shall coincide with the positive x-axis of the hemisphere with the front handle vertically above the centre of the hemisphere (see Figure B.1).

The machine shall be mounted in the test stand in accordance with B.5.1.

B.4 A-weighted emission sound pressure level measurement at the operator position

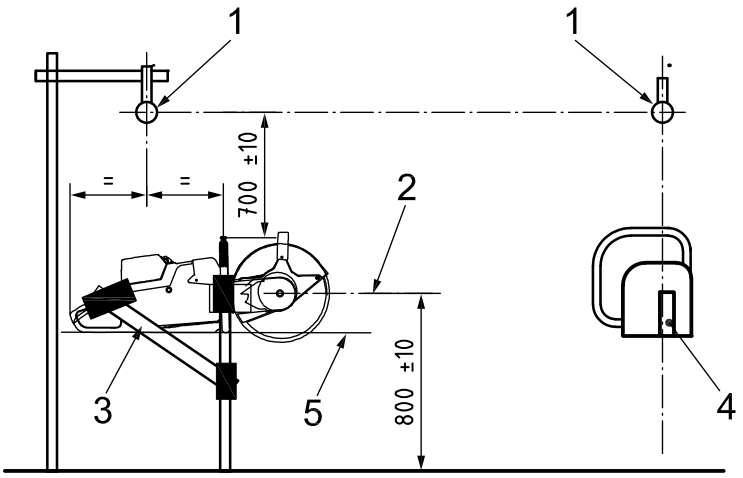
B.4.1 For the measurement of the A-weighted emission sound pressure level, ISO 11201:2010, accuracy grade 2, shall be applied, subject to the modifications and additions given in B.4.2 to B.4.4.

B.4.2 Environmental conditions shall be within the limits specified for 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 microphone windscreen shall be used each time the wind speed exceeds 1 m/s.

B.4.3 Measurements shall preferably be made using an integrating-averaging sound level meter, as defined in IEC 61672-1.

B.4.4 The location of the microphone relative to the machinery shall be (700 ± 10) mm above the top of the front handle and vertically above the centre line between the outer edge of the rear and front handles. The microphone shall be in the plane of the cut-off wheel (see Figure B.2).

Dimensions in millimetres



Key

1 position of the microphone (for operator's position)
2 spindle centre
3 test fixture
4 rear handle
5 horizontal plane through the support points of the cut-off machine

Figure B.2 — Test setup for sound pressure measurement

B.5 Mounting and operating conditions

B.5.1 Mounting

The machine shall be mounted on a test stand, as shown in Figure B.2, oriented with its supporting points in a horizontal plane (see Figure B.1) (800 ± 10) mm above the ground. A fixture should be used which holds the

machine in the intended position and which does not cause any reflections. A flexible mount is recommended to avoid any structural resonance.

B.5.2 Operating conditions

Measurements shall be carried out on a new, normal-production machine fitted with standard equipment. The engine and the machine shall be run-in prior to the test in accordance with the manufacturer's instructions. The engine shall be at a normal stable operating temperature before the test is started.

The carburettor shall be set as marked on the machine (see 5.2).

The engine speed for all test conditions shall be kept constant to within $\pm 3{,}5\ s^{-1}$.

An engine speed indicator shall be used to check the speed of the engine. It shall have a measurement uncertainty of ±1,0 % of the reading. The indicator and its engagement with the machine shall not affect the operation during the test.

No alterations to the initial settings are permitted once measurements have commenced.

B.6 Test procedure

B.6.1 General

A-weighted emission sound pressure levels shall be determined for two different operating conditions: idling (B.6.2) and at full load (B.6.3), and an A-weighted sound power level shall be determined for the full-load operating condition (B.6.3).

Perform the test as follows.

a) Carry out a minimum of four measurements with a significant change of speed between the measurements in order to allow the engine to stabilize. Each measurement at idle shall be separated by a short period of running the engine in the range of full-load speed, and the measurement at full-load speed shall be separated by a short period of idling.

b) Obtain at least four separate periods of noise data totalling at least 20 s.

c) Maintain each signal duration used for at least 2 s over which the engine speed shall be within ±3,5 r/s.

The collection of data for the two different operating conditions does not need to be carried out in any fixed sequence.

The range of all values noted for each operating condition shall not be greater than 2 dB. If this range is exceeded, repeat the tests 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 the four successive values satisfying this requirement.

For all the conditions according to B.6.2 and B.6.3, this procedure shall be followed when measuring the A-weighted emission sound pressure levels. When determining the A-weighted sound power level, this procedure shall be applied to the sound pressure levels averaged over the six microphone positions (L'_{pA}).

B.6.2 Idling

Take the measurements with a fully released throttle trigger. The idling speed shall be adjusted in accordance with the machine manufacturer's instructions. The cut-off wheel shall not move.

B.6.3 Full load

Take the measurements during a simulated cutting with the throttle fully open. The engine speed shall be kept at the maximum engine power speed, determined in accordance with ISO 7293, by adjustment of the load applied by the loading device (i.e. water brake) on the spindle.

NOTE An example of a water brake application is to be found in ISO 22868[14].

The loading device attached to the spindle shall be capable of absorbing the energy of the machine. If a water brake is used, the speed of the engine shall be controlled by the water flow inside of the water brake. The weight, shape or design of the loading device shall be such that there is no influence on the noise readings.

B.7 Information to be recorded and reported

The following information, when applicable, shall be recorded and reported for all measurements made in accordance with the requirements of this annex.

a) Machine under test

1) Description of the machine (including its engine displacement, manufacturer, type and serial number, and size and type of cut-off wheel);

2) Operating conditions, according to Tables B.3 and B.4, during noise testing.

b) Acoustic environment

1) Description of the test environment:

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

— if indoors, a description of the physical treatment of walls, ceiling and floor, with a sketch showing the location of machine and room contents.

2) Value of K_{2A}.

c) Instrumentation

1) Equipment used for the measurements, including name, type, serial number and manufacturer.

2) Method used to calibrate the instrumentation system.

3) Date and place of the most recent calibration of the acoustical calibrator.

d) Acoustical data

1) A-weighted sound pressure levels of the background noise at the microphone positions.

2) Emission sound pressure levels (see Table B.2):

— A-weighted emission sound pressure level at operator position at full load,

— A-weighted emission sound pressure level at operator position at idle,

— A-weighted emission sound pressure level at operator position calculated for a work cycle composed of 1/7 idling and 6/7 full-load operating conditions.

3) A-weighted sound power level (see Tables B.3 and B.4).

The A-weighted emission sound pressure level at the operator position for the work cycle, $L_{p\mathrm{A,wc}}$, in decibels (dB), shall be determined using the equation:

$$L_{p\mathrm{A,wc}} = 10\lg\left(\frac{1}{7}10^{0,1L_{p\mathrm{A,Id}}} + \frac{6}{7}10^{0,1L_{p\mathrm{A,Fl}}}\right)$$

where

$L_{p\mathrm{A,Id}}$ is the A-weighted emission sound pressure level at the operator position for idling;

$L_{p\mathrm{A,Fl}}$ is the A-weighted emission sound pressure level at the operator position for full load.

The A-weighted sound power level shall be determined as the sound power level for the full-load operating condition, $L_{W\mathrm{A,Fl}}$.

e) Air temperature and wind speed

f) Date and place of measurements

Table B.2 — A-weighted emission sound pressure level determination — Recording and reporting measured values, mean values and emission values

Operating conditions	Engine speed s^{-1}	Measured A-weighted sound pressure levels $L'_{p\mathrm{A}}$ dB					Arithmetic mean value $\overline{L'_{p\mathrm{A},X}}$ dB	Correction factor $K_{1\mathrm{A}}$	A-weighted emission sound pressure level $L_{p\mathrm{A},X}$ dB
		Test no.							
		1	2	3	4	n			
Idling (Id)									
Full load (Fl)									

NOTE The emission sound pressure level for the respective operating conditions X is calculated from

$$L_{p\mathrm{A},X} = \overline{L'_{p\mathrm{A},X}} - K_{1\mathrm{A}}$$

where $K_{1\mathrm{A}}$ is the background noise correction, according to ISO 11201

and X is the operating condition for idling (Id) or full load (Fl).

Table B.3 — A-weighted sound power level determination — Recording and reporting measured A-weighted sound pressure levels

Test	Operating condition	Engine speed r/s	L'_{pA1} dB	L'_{pA2} dB	L'_{pA3} dB	L'_{pA4} dB	L'_{pA5} dB	L'_{pA6} dB	$\overline{L'_{pA}}$ dB
1	Full load (FI)								
2	Full load (FI)								
3	Full load (FI)								
4	Full load (FI)								
n	Full load (FI)								
Average sound pressure level $\overline{L'_{pAX}}$	Full load (FI) $\overline{L'}_{pAFI} =$ 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 according to ISO 3744:2010, Equation (4).

$\overline{L'_{pAX}}$ is the arithmetic average of the values for $\overline{L'_{pA}}$ for the full-load operating condition.

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

Table B.4 — A-weighted sound power level determination — Recording and reporting sound power data

Operating condition	Average sound pressure level $\overline{L'}_{pA,FI}$ dB	Correction factor K_{1A} dB	Surface sound pressure level $\overline{L}_{pA,FI}$ dB	Surface level L_S dB	Sound power level L_{WAFI} dB
Full load (FI)					
Environmental correction $K_{2A} =$ dB					

$\overline{L'}_{pAFI}$ is the arithmetic average of the values for $\overline{L'_{pA}}$ given for the full-load operating condition.

The surface sound pressure level $\overline{L}_{pA,FI}$ for the full-load operating condition is calculated from:

$$\overline{L}_{pA,FI} = \overline{L'}_{pA,FI} - K_{1A} - K_{2A}$$

where

K_{1A} is the background noise correction according to ISO 3744:2010, 8.3;

K_{2A} is the environmental correction (see B.3.3).

The sound power level $L_{WA,FI}$ for the full-load operating condition is calculated from:

$$L_{WA,FI} = \overline{L_{pA,FI}} + L_S$$

where $L_S = 10 \lg \frac{S}{S_0}$ is expressed in decibels, with $S_0 = 1$ m^2 and where S is the surface of the hemisphere, expressed in square metres.

B.8 Declaration of noise emission levels

The noise declaration shall provide:

— the dual-number value of the A-weighted emission sound pressure level at the operator position as defined in ISO 4871, i.e. values of A-weighted emission sound pressure level and associated uncertainty given separately, for full load and optionally for idling, and work cycle as defined in B.7 e),

— the single-number value of the A-weighted sound power level as defined in ISO 4871, i.e. the value of the sound power level plus the value of the associated uncertainty, for full load.

The noise declaration shall include a reference to this noise test code and to the basic standard used, i.e. ISO 3744 and/or ISO 11201. Deviations, if any, from this test code and/or the basic standards shall also be indicated.

NOTE 1 The uncertainty to be associated with the declared noise level(s) is based on the total standard deviation σ_t which is composed of the standard deviation of reproducibility σ_R and the standard deviation of production σ_p. Results from round-robin tests carried out in 2007 and 2008 concerning σ_R are given in Annex E. The determination of σ_p must be done by the manufacturer, based on his experience of the production variation.

NOTE 2 Methods for the determination of uncertainty and the verification of declared values are given in ISO 3744, ISO 11201 and ISO 4871.

Annex C
(normative)

Measurement of vibration values at the handles

C.1 General

The vibration test code specified in this annex gives the information necessary for determining efficiently and under standardized conditions the vibration emission characteristics of portable, hand-held, internal combustion engine-powered cut-off machines.

It presents a test procedure for establishing the magnitude of vibration at the handles of the machine and is suitable for product control as well as type tests.

It is intended that the results obtained be used to compare different machines or different operating conditions of the same type of machine.

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

C.2 Terms and definitions

For the purpose of this annex, the terms and definitions given in ISO 20643 apply.

C.3 Vibration parameters to be measured and determined

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

Quantities to be determined are total-vibration values, a_{hv}, and 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 (RMS) single-axis acceleration values of the frequency-weighted hand-transmitted vibration values (a_{hwx}, a_{hwy}, a_{hwz}).

C.4 Instrumentation

C.4.1 General

The vibration measurement system and frequency weighting for hand-arm 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, according to ISO 5349-2:2001, 6.1.5.

NOTE The sensitive element intended to pick up the vibration and to convert it into electrical signals is an accelerometer. A tri-axial accelerometer will permit measurements in the x, y and z axes simultaneously.

C.4.3 Fastening of accelerometer

The accelerometer shall be glued onto the handle according to ISO 5349-2:2001, 6.1.4.

For measurement on handles with resilient covers (e.g. a cushioned handle), the resilient material shall be removed from the area where the accelerometer shall be glued.

C.4.4 Calibration

The whole measuring chain, including the accelerometer, shall be checked before and after use, as well as whenever necessary, to ensure accuracy during any sequence of measurements, in accordance with ISO 8041. The accelerometers shall be calibrated in accordance with ISO 16063-1.

C.4.5 Speed indicator

The rotational frequency of the engine shall be measured with an accuracy of ±1,0 % of the reading. The speed indicator and its engagement with the machine shall not affect the operation during the test.

C.5 Measurement direction and location

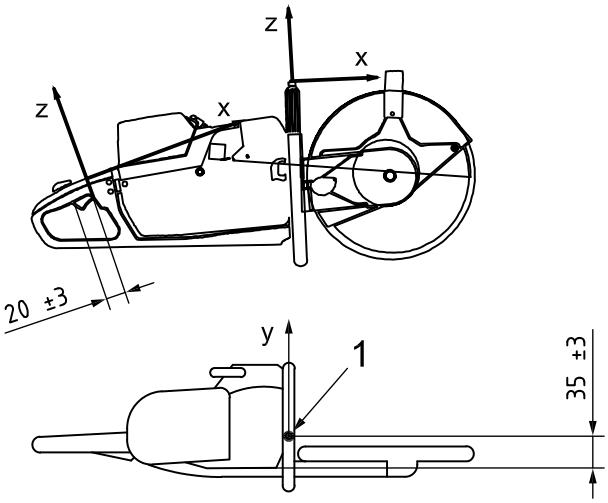
Measurements shall be made at each hand-grip, where the operator normally holds the machine. Measurements shall be made in the three directions x, y and z.

The position of the accelerometer shall be as near as possible to the hand without obstructing the normal grip.

For the front handle, the accelerometer shall be mounted 35 mm ± 3 mm to the right of the point of lateral balance on the front handle with feed force, and with the cut-off wheel centre-mounted (see Figure C.1). If this dimension cannot be obtained, the accelerometer shall be placed at the right end of that portion of the handle intended to be grasped.

For the rear handle, the accelerometer shall be 20 mm ± 3 mm in front of the throttle-trigger rear end (see Figure C.1). If this cannot be obtained, it shall be placed as close as possible to the hand holding the handle, between the thumb and index finger.

Dimensions in millimetres



Key

1 lateral balance point

Figure C.1 — Position of accelerometers

C.6 Operating conditions, testing and presentation of results

Measurements shall be carried out on a new machine, featuring standard equipment and with the tank(s) at least half full. The cut-off wheel used shall be a superabrasive wheel with the maximum diameter and an unbalance of 250 g · mm to 260 g · mm.

The engine shall be run-in prior to the test. Instructions for the run-in of the engine shall be given in the instruction handbook. The engine shall be at operating temperature before the test is commenced.

The engine speed for all test conditions shall be kept constant to within ±3,5 r/s.

No alterations to the initial settings are permitted once measurements have commenced.

The test procedure in C.8 shall be followed. The measured vibration of the machine can be influenced by the tester who operates the machine, who must therefore be skilled and able to operate the machine properly.

NOTE Be aware that gripping forces on the handles can influence the measured vibration values.

The measurement shall be continued until the validity required by C.7 is fulfilled.

The total vibration for each handle shall be calculated in accordance with C.9.

C.7 Validity test

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

If the measured values for a combination of handle and operating condition gives a value exceeding 0,2 for the coefficient of variation and 0,4 for the standard deviation, only the non-complying combination shall be repeated until the criterion above is met.

For the purposes of this International Standard, 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:

$$C_{\mathrm{V}} = \frac{s_{n-1}}{\overline{x}}$$

where the standard deviation 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 is $\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$

where

x_i is the ith value measured;

n is the number of measurement values.

C.8 Test procedure

C.8.1 General

The tests shall be carried out in the operating conditions for idling (C.8.2) and racing (C.8.3). The machine shall be held by the operator standing upright and with the machine in a normal horizontal operating manner with the machine horizontal and the cut-off wheel vertical.

A test 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 must be obtained totalling at least 20 s;

— each signal duration used must be at least 2 s over which the engine speed is within ±3,5 r/s.

The collection of data for the two operating conditions does not need to be carried out in any fixed sequence.

C.8.2 Idling

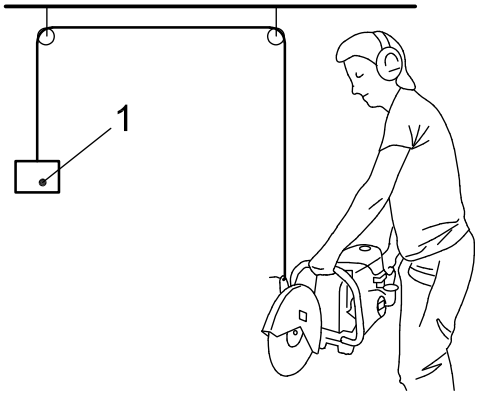
Measurements shall be made at the engine idling speed. The idling speed shall be specified in the instruction handbook.

C.8.3 Racing

Measurements shall be made with no load and at the engine speed for maximum engine power, as determined in accordance with ISO 7293. The engine speed shall be controlled with the throttle trigger.

The test at racing shall be carried out with an artificial feed force which is obtained by applying an upward force of 60 N on the cut-off wheel guard in the vertical plane through the cut-off wheel and through the centre of the spindle.

The force can be applied using a weight as shown in Figure C.2 or, alternatively, a dynamometer can be attached. The application of force shall be achieved with minimum adaptation to the machine.



Key

1 mass of 10 kg, representing the feed force

Figure C.2 — Working position of operator and application of force

C.9 Information to be measured, calculated and reported

The measurements and calculations are generally carried out in the following sequence and as shown in Figure C.3.

a) Measure the weighted acceleration of an operating condition in the three directions for front and rear handles, a_{hwxj}, a_{hwyj}, and a_{hwzj}, where j is the operating condition idling (Id) or racing (Ra).

b) Calculate the root sum of squares of accelerations, $a_{hv,j}$, of the three directions x, y and z for the operating condition selected.

c) Repeat a) and b) at least three times.

d) Calculate the arithmetic mean of the operating condition, e.g. $a_{hv,j}$.

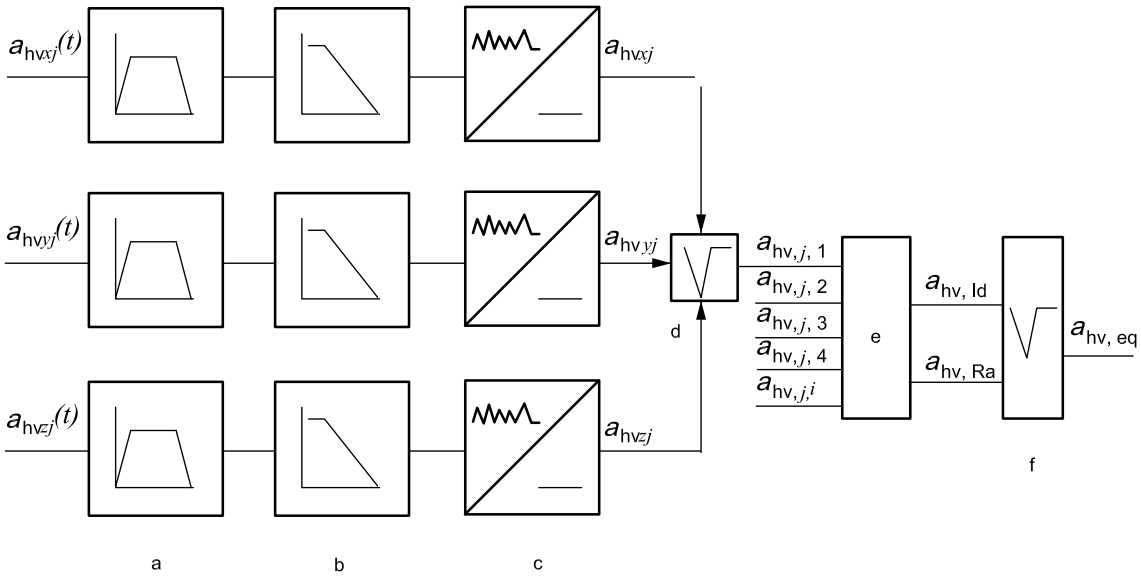
e) Repeat a) to d) as many times as necessary, depending on the coefficient of variation (C_v) and the standard deviation (s_{n-1}) (see C.7).

f) Perform a) to e) for the other operating condition.

g) Calculate the equivalent-vibration total value, $a_{hv,eq}$, for each handle according to C.12.

h) Determine the declared value.

Information to be reported is given in C.11.



a Pass band.

b Weighting filter.

c Root-mean-square (r.m.s.).

d See Note to C.4.2.

e Average value for each operating condition.

f See C.12.

Figure C.3 — Sequence of measuring and calculation of vibration data

C.10 Declaration and verification of vibration values

The declaration shall include a reference to this International Standard. Deviations, if any, shall be indicated.

Calculated equivalent-vibration total values shall be used for the declaration of the vibration emission values.

The average vibration value for applicable operating conditions (idling and full load) shall be provided by the manufacturer on request.

The uncertainty to be associated with the declared vibration emission value(s) is based on total standard deviation σ_t which is composed of the standard deviation of reproducibility σ_R and the standard deviation of production σ_p. Guidelines for σ_R are given in Annex E. The determination of σ_p must be done by the manufacturer, based on his experience of the production variation.

NOTE One method for the calculation of uncertainty is given in EN 12096[16].

C.11 Information to be reported

The following information, when applicable, shall be compiled and reported for all measurements made in accordance with the requirements of this annex.

a) Machine under test:

   1) description of the machine, including its engine displacement, manufacturer, type and serial number, type and dimension of cut-off wheel;

   2) operating conditions in accordance with C.1.

b) Instrumentation:

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

   2) methods used to fasten the accelerometers;

   3) method used to calibrate the instrumentation system;

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

c) Vibration and other data:

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

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

   3) declared values;

   4) remarks, if any;

   5) air temperature;

   6) date and place of measurements.

Table C.1 — Table for reporting the determined-vibration total values and calculation of their arithmetic mean

Operating condition	Calculated data and validity criteria	Nominal engine speed	Front handle/rear handle				
			Test No.				
		s^{-1}	1	2	3	4	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^2)		—	—	—		
	s_{n-1} (m/s^2)		—	—	—		
	C_v		—	—	—		
The total-vibration values a_{hv} are determined and recorded, and their arithmetic mean $\overline{a}_{hv}$ is calculated until the coefficient of variation C_v is less than 0,2 or the standard deviation s_{n-1} is less than 0,4.							
The calculation of arithmetic mean $\overline{a}_{hv}$ is based on at least four determinations of the total vibration value a_{hv}.							
The values for the arithmetic mean ($\overline{a}_{hv,Id}$ and $\overline{a}_{hv,Ra}$) are used to calculate the equivalent-vibration total values $a_{hv,eq}$.							

C.12 Equivalent-vibration total values

The equivalent-vibration total values are determined by means of work cycles. The work cycles are composed of components of 1/7 idling and 6/7 racing operating conditions.

The equivalent-vibration total value $a_{hv,eq}$, in metres per second squared (m/s^2), shall be determined using the following equation:

$$\overline{a_{hv,eq}} = \left[\frac{1}{7} \left(\overline{a_{hv,Id}} \right)^2 + \frac{6}{7} \left(\overline{a_{hv,Ra}} \right)^2 \right]^{1/2}$$

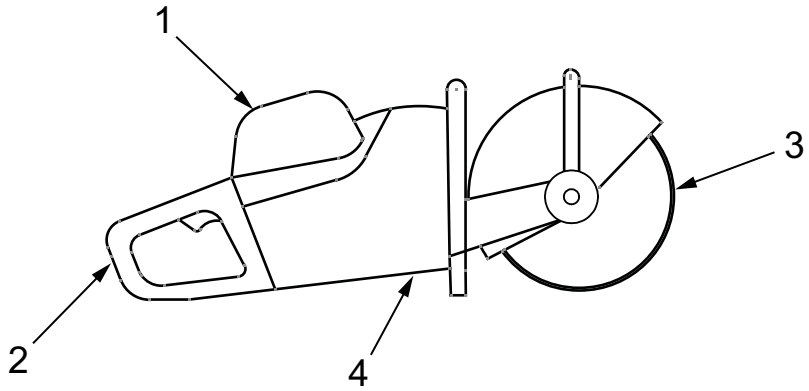
where

$\overline{a_{hv,Id}}$ is the average vibration level for idling operating conditions (C.8.2);

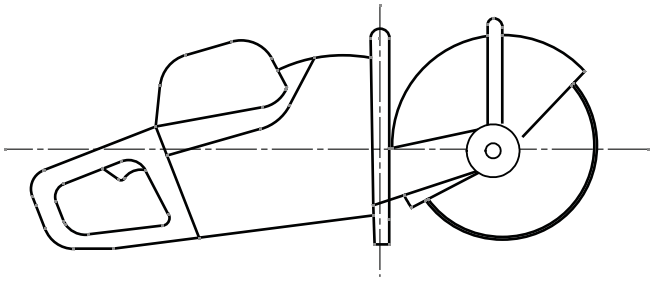
$\overline{a_{hv,Ra}}$ is the average vibration level for racing operating conditions (C.8.3).

Annex D
(normative)

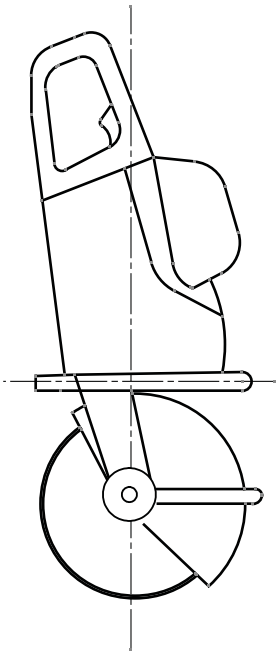
Cut-off machine positions



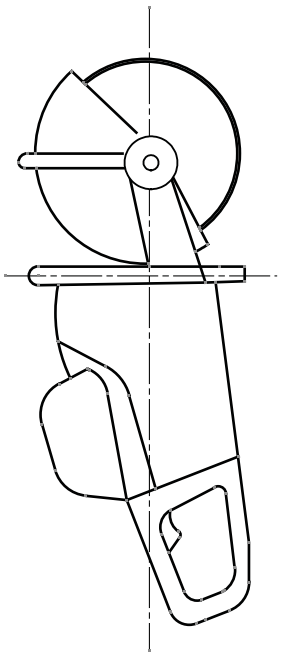
a) Right-hand-side view



b) Upright

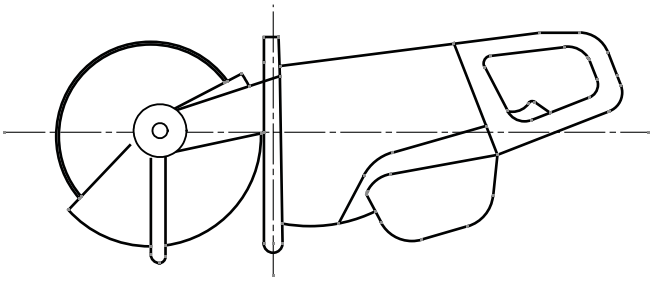


c) Cut-off wheel down

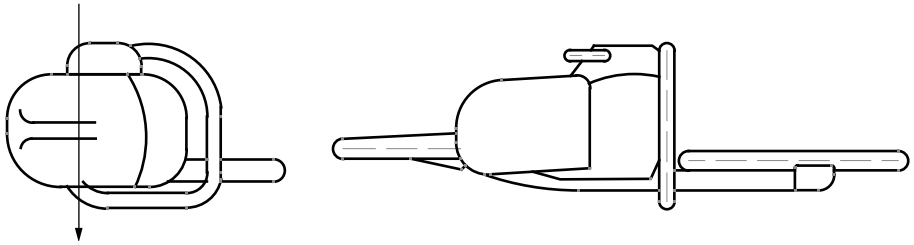


d) Cut-off wheel up

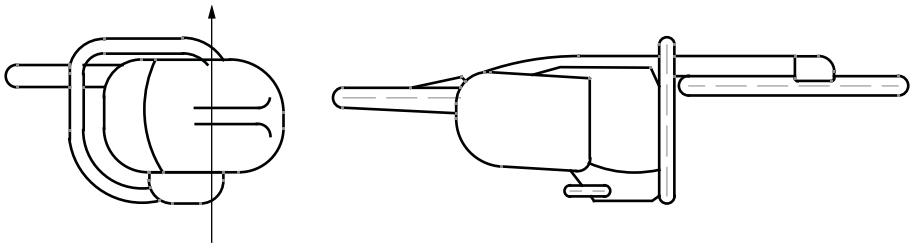
Figure D.1 (*continued*)



e) Upside down



f) Right-hand-side down



g) Right-hand-side up

Key

1 top
2 rear
3 front
4 bottom

Figure D.1 — Cut-off machine positions

Annex E
(informative)

Summary of results from round-robin tests (2007 and 2008) on one cut-off machine

This annex summarizes, in Tables E.1 and E.2, the results in the form of average values ($\bar{x}$) and calculated standard deviation (σ_R) from these values. The tests were done during 2007 and 2008 at eight different laboratories.

Table E.1 — Average values ($\bar{x}$) and calculated standard deviation (σ_R) from A-weighted emission sound pressure levels at the operator position and A-weighted sound power determination at eight test laboratories

Cut-off machine	A-weighted emission sound pressure		A-weighted sound power	
	$\bar{x}$	σ_R	$\bar{x}$	σ_R
Idling	81,5	0,8	91,4	0,8
Full load	101,7	0,6	111,1	0,7
Calculated from 1/7 idling + 6/7 full load	101	0,7		

Table E.2 — Average values ($\bar{x}$) and calculated standard deviation (σ_R) from vibration levels measured at eight test laboratories

Cut-off machine	Front handle		Rear handle	
	$\bar{x}$	σ_R	$\bar{x}$	σ_R
Idling	8,2	2,5	7,4	1,2
Racing	5,8	0,8	3,2	0,3
Calculated from 1/7 idling + 6/7 full load	6,2	1	4,1	0,4

Annex F
(informative)

List of significant hazards

Table F.1 specifies 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 the type of machinery covered by this International Standard.

Table F.1 — List of significant hazards associated with portable hand-held cut-off machines

Ref. No.	Hazard		Subclause of this International Standard
	Origin (source)	Potential consequences	
1	**Mechanical hazards**		
	Rotating cut-off wheel	Cutting or severing of upper and lower extremities	4.3, 4.5, 4.6, 4.7, 4.9, 4.15, 4.16, 4.17, 4.18
	Moving transmission parts	Entanglement, severing of upper extremities	4.12
	Thrown objects from cut-off wheel	Injury from impact of ejected objects	4.8, 4.9, 4.15
	Break-up of cut-off wheel	Injury from ejected fragments of the cut-off wheel	4.6, 4.14, 4.15, 4.16, 4.20, 4.21, 5.1
	Engine control system malfunction or controls resulting in unexpected start-up with cut-off wheel engaged, unexpected over-run/over-speed	Shearing, cutting, severing or entanglement of upper and lower extremities	4.2, 4.5, 4.6, 4.7, 4.10, 4.11, 4.12, 4.18, 4.21, 5.1, 5.2
2	**Electrical hazards**		
	Live parts of electrical system (direct contact) or parts which have come under high voltage under faulty conditions (indirect contact)	Injuries from electric shock to the body	4.16
3	**Thermal hazards**		
	Hot engine parts including parts which have become hot because of heat radiation	Injury from burns and scalds from accidental contact	4.13, 5.1
4	**Noise hazards**		
	Engine, transmission and cutting system, including resonance of fixed machine parts	Discomfort, partial hearing loss, deafness, loss of balance, loss of awareness, stress, interference with speech communication and warning signals	4.19, 5.1, 5.3
5	**Vibration hazards**		
	Engine, handles	Discomfort, neurological, osteo-articular and vascular disorders	4.20, 5.1, 5.3
6	**Material/substance hazards**		
	Engine exhaust gases, gasoline	Respiration problems through inhalation of harmful gases and injuries to the skin from contact with harmful liquids	4.8, 5.1
	Dust emission from cutting process	Respiration problems through inhalation of harmful dust	4.14, 5.1
7	**Ergonomic hazards**		
	Location and design of controls, handles, etc.	Discomfort, fatigue, injuries to locomotor apparatus, loss of control	4.2, 4.4, 4.5, 4.6, 4.7, 4.10, 4.11, 4.12, 5.1, 5.2

Table F.1 (*continued*)

Ref. No.	Hazard		Subclause of this International Standard
	Origin (source)	Potential consequences	
8	**Combination of hazards**		
	Poor postures or excessive effort in combination with inadequate design or location of manual controls, including inadequate consideration of human hand-arm anatomy, related to handle design, machine balance and the use of spiked bumper.	Discomfort, fatigue, injuries to locomotor apparatus, loss of control	4.2, 4.4, 4.5, 4.6, 4.7, 4.10, 4.11, 4.12, 5.1, 5.2
	Hot engine parts/electrical short-circuiting in combination with leaking gasoline tank/ gasoline spilling	Burns and scalds caused by resulting fire	4.10, 4.11, 4.13, 5.1

Bibliography

[1] ISO 603-7:1999, *Bonded abrasive products — Dimensions — Part 7: Grinding wheels for manually guided grinding*

[2] 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*

[3] ISO 5349-1:2001, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 1: General requirements*

[4] ISO 6531:2008, *Machinery for forestry — Portable chain-saws — Vocabulary*

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

[6] ISO/TR 11688-2:1998, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design*

[7] ISO 11691:1995, *Acoustics — Measurement of insertion loss of ducted silencers without flow — Laboratory survey method*

[8] ISO 11820:1996, *Acoustics — Measurements on silencers in situ*

[9] ISO 13732-1:2006, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

[10] ISO 13849-1:2006, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

[11] ISO 13849-2:2003, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

[12] ISO 13942:2000, *Bonded abrasive products — Limit deviations and run-out tolerances*

[13] ISO 14163:1998, *Acoustics — Guidelines for noise control by silencers*

[14] ISO 22868:2005, *Forestry machinery — Noise test code for portable hand-held machines with internal combustion engine — Engineering method (Grade 2 accuracy)*

[15] ISO 22917:2004, *Superabrasives— Limit deviations and run-out tolerances for grinding wheels with diamond or cubic boron nitride*

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

[17] CR 1030-1:1995, *Hand-arm vibration — Guidelines for vibration hazards reduction — Part 1: Engineering methods by design of machinery* (CEN Report)

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