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Agricultural and forestry machinery — Safety requirements and testing for portable, hand-held, powered brush-cutters and grass-trimmers —

Part 1: Machines fitted with an integral combustion engine

Matériel agricole et forestier — Exigences de sécurité et essais pour débroussailleuses et coupe-herbe portatifs à moteur —

Partie 1: Machines équipées d'un moteur à combustion interne intégré

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Contents

Page

Foreword

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

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 17, *Manually portable (hand-held) powered lawn and garden equipment and forest machinery*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 144, *Tractors and machinery for agriculture and forestry,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 11806-1:2011), which has been technically revised.

The main changes compared to the previous edition are as follows:

— Figure 3 has been revised to provide examples of handle distance;

— a force requirement in the throttle trigger lock-out performance test has been added;

— Figures 5a and 5b have been added to clarify throttle trigger lock-out performance test;

— fuel tank structural integrity test requirements have been added by including a new Annex D;

— fuel line strength and accessibility requirements have been added by including a new Annex E;

— Annex A, cutting attachment impact and spin test, has been revised for repeatability.

A list of all parts in the ISO 11806 series can be found on the ISO website.

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

Introduction

This document is a type-C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organisations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate at the drafting process of this document.

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

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

Agricultural and forestry machinery — Safety requirements and testing for portable, hand-held, powered brush-cutters and grass-trimmers —

Part 1: Machines fitted with an integral combustion engine

1 Scope

This document gives safety requirements and measures for their verification for the design and construction of portable hand-held, powered brush-cutters and grass-trimmers (hereafter called machines) having an integral combustion engine as their power unit and mechanical power transmission between the power source and the cutting attachment. Methods for the elimination or reduction of hazards arising from the use of these machines and the type of information on safe working practices to be provided by the manufacturer are specified.

This document deals with all significant hazards, hazardous situations and hazardous events relevant to these machines, as well as when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

This document is not applicable to machines equipped with metallic cutting attachments consisting of more than one piece, such as pivoting chains or flail blades.

NOTE See Annex C for a list of significant hazards.

This document is applicable to portable, hand-held, powered brush-cutters and grass-trimmers manufactured after its date of publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of 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 683-4:2016, *Heat-treatable steels, alloy steels and free-cutting steels — Part 4: Free-cutting steels*

ISO 3767-1:2016, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 3767-5:2016, *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 machines*

ISO 7112:2018, *Machinery for forestry — Portable brush-cutters and grass-trimmers — Vocabulary*

ISO 7113:1999, *Portable hand-held forestry machines — Cutting attachments for brush cutters — Single-piece metal blades*

ISO 7918:1995, *Forestry machinery — Portable brush-cutters and grass-trimmers — Cutting attachment guard dimensions*

ISO 8380:1993, *Forestry machinery — Portable brush-cutters and grass-trimmers — Cutting attachment guard strength*

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

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

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

ISO 22867:2021, *Forestry and gardening machinery — Vibration test code for portable hand-held machines with internal combustion engine — Vibration at the handles*

ISO 22868:2021, *Forestry and gardening machinery — Noise test code for portable hand-held machines with internal combustion engine — Engineering method (Grade 2 accuracy)*

IEC 61032:1997, *Protection of persons and equipment by enclosures — Probes for verification*

3 Terms and definitions

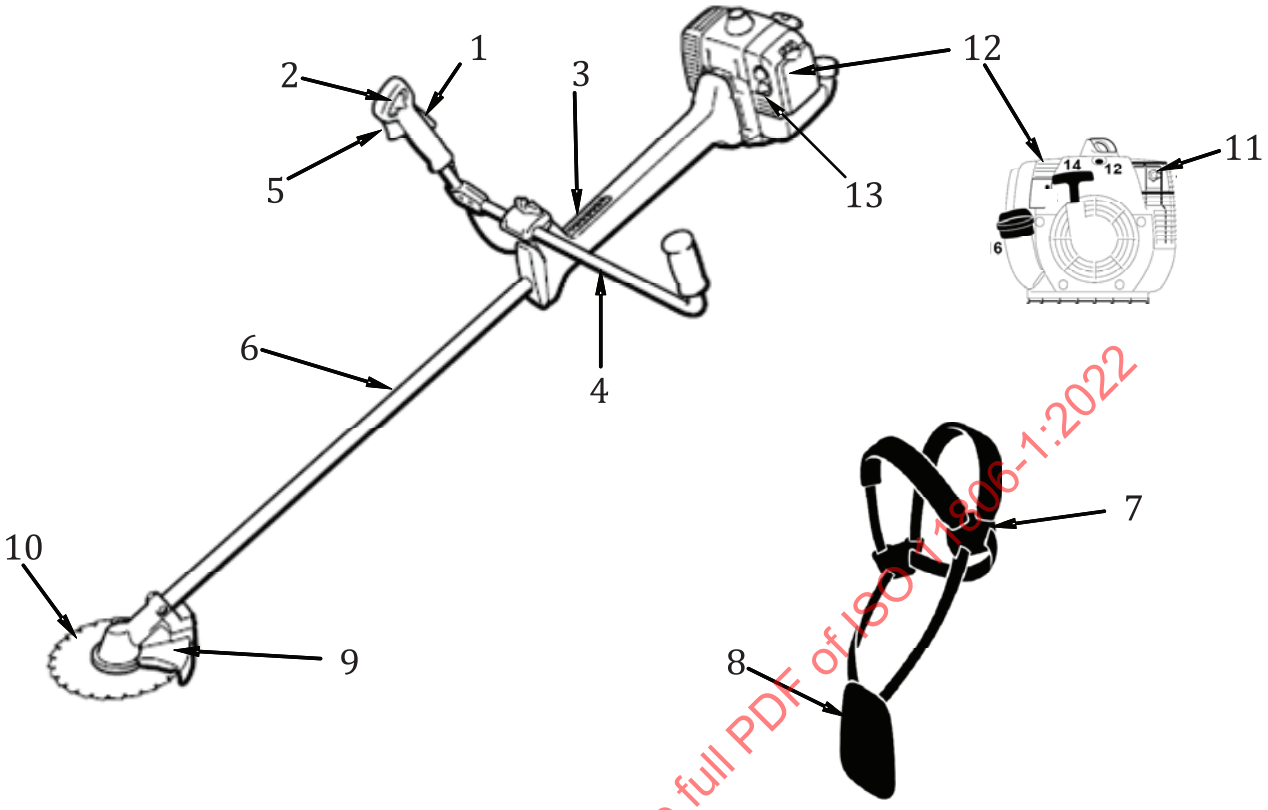
For the purposes of this document, the terms and definitions given in ISO 7112:2018, ISO 12100:2010 and the following apply.

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

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

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

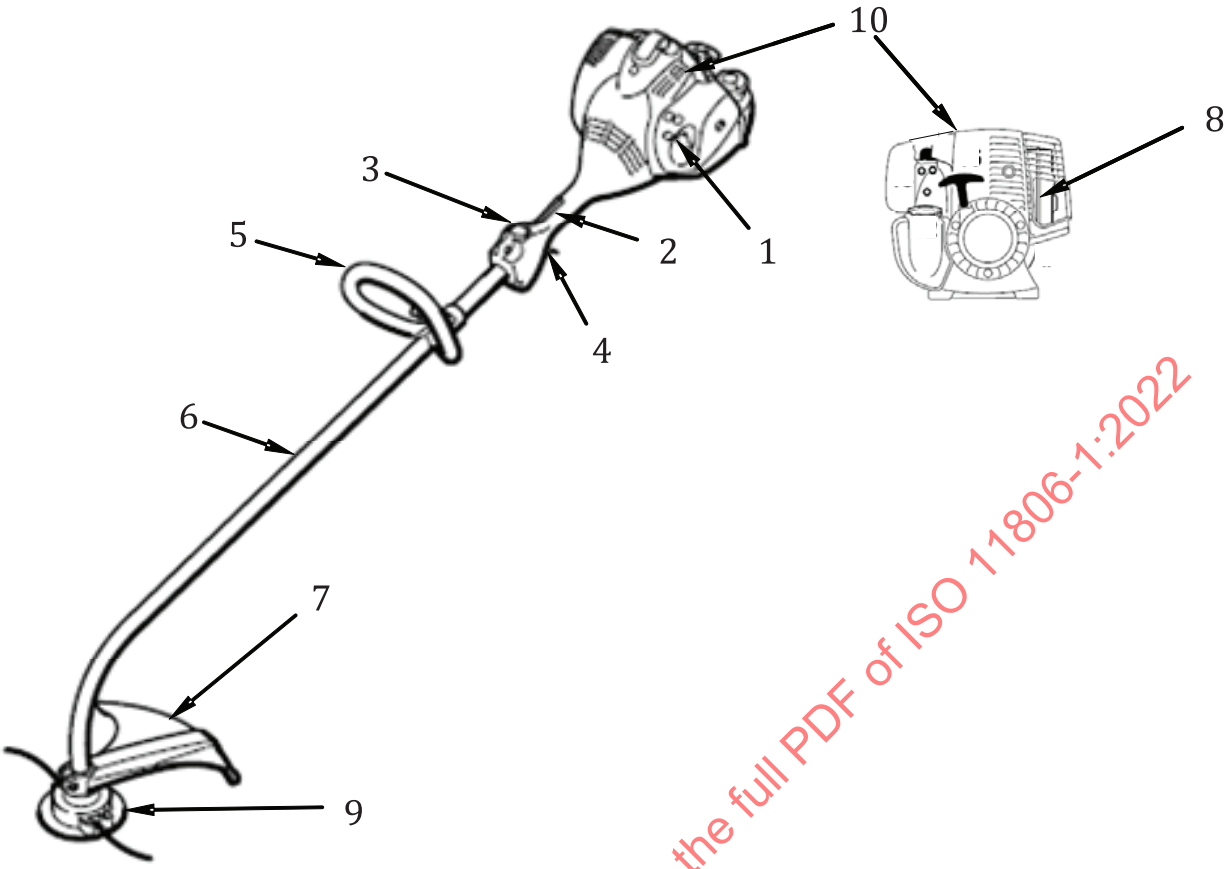
3.1
machine
complete brush-cutter, brush saw or grass-trimmer, including power unit, drive shaft tube, cutting attachment and guard, but excluding the harness



Key

1 throttle trigger lock-out
2 stop switch
3 suspension point
4 handle
5 throttle trigger
6 drive shaft tube
7 harness, quick-release mechanism
8 harness, hip pad
9 cutting attachment guard
10 cutting attachment, e.g. saw blade
11 muffler
12 power unit
13 choke

Figure 1 — Machine (brush-cutter) with integral combustion engine



Key

1 choke
2 rear handle
3 stop switch
4 throttle trigger
5 front handle
6 drive shaft tube
7 cutting attachment guard
8 muffler
9 cutting attachment, e.g. string trimmer head
10 power unit

Figure 2 — Machine (grass-trimmer) with integral combustion engine

4 Safety requirements and/or protective measures

4.1 General

Machines 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 12100:2010 for relevant but not significant hazards which are not dealt with by this document. The machine shall also be marked according to 5.2 and carry warnings according to 5.3.

The safe operation of a brush-cutter and a grass-trimmer depends on both the safety requirements given in this clause and the safe working conditions associated with the use of adequate personal

protection equipment (PPE), such as gloves, slip-resistant footwear, and leg, eye and hearing protection equipment, as well as safe working procedures (see 5.1).

The instructions to be provided with the machine shall conform with 5.1.

If a grass-trimmer can be converted to a brush-cutter, then the converted machine shall conform with the requirements for a brush-cutter and vice versa.

The overall safety of the separate cutting attachment shall be verified as a part of the complete machine.

Except where otherwise specified in this document, the safety distances specified in ISO 13857:2019, 4.2.4.1 and 4.2.4.3 shall be met.

If a special tool is required to replace a cutting attachment, it shall be supplied with the machine.

4.2 Handles

4.2.1 Requirements

The machine shall have a handle for each hand. These handles shall be designed such that:

— they can be fully gripped by an operator when wearing gloves;

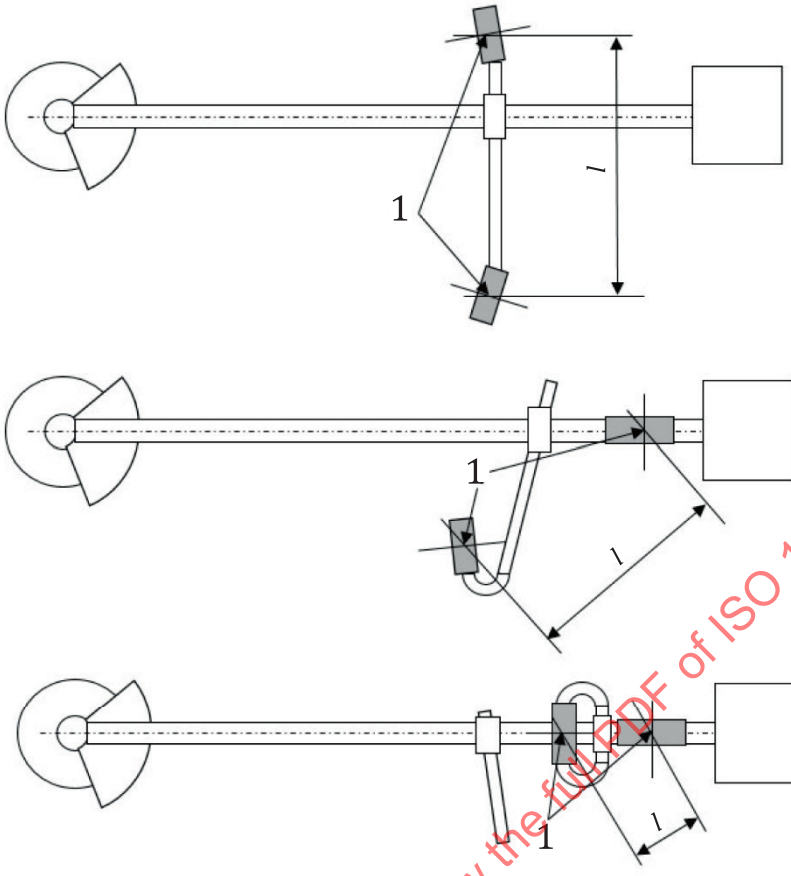
— they provide the necessary sureness of grip by their shaping and surface;

— they have a length of at least 100 mm;

— the distance *l* (see Figure 3) between the centre of the handles is at least 500 mm for those machines which can be equipped with metal saw blades, and at least 250 mm for all others;

— they are adjustable so that a suitable ergonomic working position can be achieved. An adjustment below the minimum distance *l* shall be prevented by design.

NOTE The position of the operator relative to the cutting attachment is defined by the suspension point (see 4.5 and 4.6) and the barrier (see 4.3).



Key

1 centre of gripping area

Figure 3 — Examples for handle distance *l*

4.2.2 Verification

The design, adjustment and dimensions shall be verified by inspection and measurements and function test.

4.3 Barrier and distance to cutting attachment for brush-cutters

4.3.1 Requirements

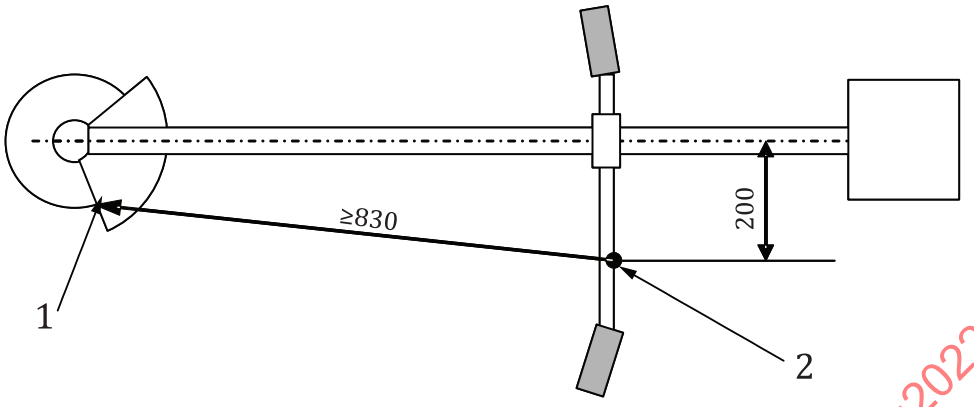
Brush-cutters shall be equipped with a barrier to prevent an unintentional contact with the cutting attachment during operation.

The barrier shall project at least 200 mm horizontally and perpendicularly from the centre-line of the drive shaft tube. This function can also be performed by the handle assembly. See Figure 4.

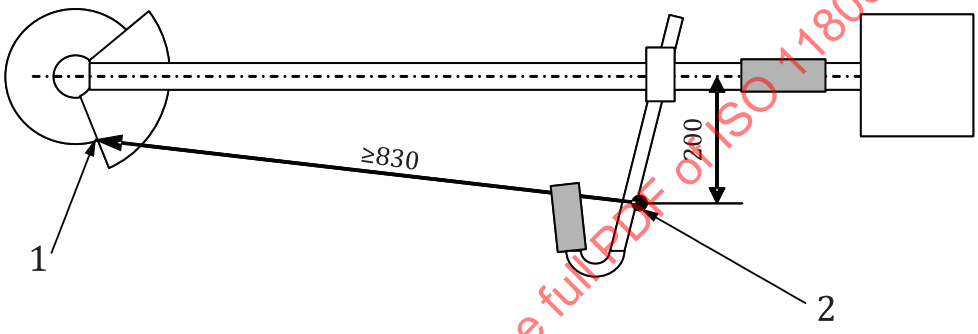
The minimum straight line distance from the rear of the barrier (2) at a width of 200 mm (2) to the nearest unguarded point of the cutting attachment (1) shall be at least 830 mm, where the unguarded point of the cutting attachment is the intersection between the plane perpendicular to the cutting path and the side-edge of the cutting attachment guard. See Figure 4.

Barriers that are to be removed as a part of maintenance procedures or assembled by the operator, described in the instructions, shall be fixed by systems that can be opened or removed only with tools. The fixing system for barriers which are independent from the handle assembly shall be permanently attached to the barrier and/or the machine when the barrier is removed.

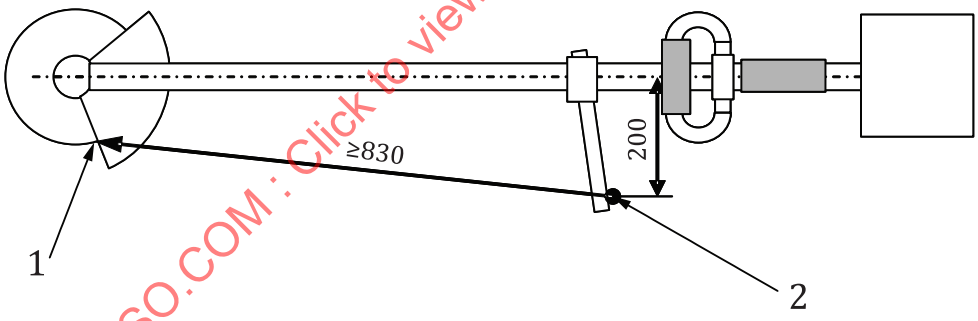
Dimensions in millimetres



a) Bicycle-type handle serving as a barrier



b) Front and rear handles with front handle serving as a barrier



c) Front and rear handle with separate barrier

Key

1 unguarded point of the cutting attachment

2 rear of the handle bar/barrier

Figure 4 — Example of machines with different handle configurations, barrier and distance to cutting attachment

4.3.2 Verification

The design, adjustment and dimensions shall be verified by inspection and measurements.

4.4 Harness

4.4.1 Requirements

A double shoulder harness shall be provided for all machines exceeding a dry weight of 7,5 kg and for all brush saws. The double shoulder harness shall be supplied with a hip pad.

Brush-cutters other than brush saws having a dry weight of 7,5 kg or less and grass-trimmers having a dry weight of 6 kg to 7,5 kg shall at least be provided with a single shoulder harness. For a grass-trimmer with a dry weight below 6 kg, no harness is required.

The harness shall be adjustable to the size of the operator.

Shoulder harnesses shall be:

— designed in a way for easy removal; or

— equipped with a quick release mechanism that ensures that the machine can be removed or released quickly from the operator.

A single shoulder harness is considered to be designed in a way for easy removal.

A double shoulder harness is considered to be designed in a way for easy removal, if the left and right shoulder straps are not connected to each other in front of the operator's body.

If straps to connect the left and right shoulder straps are provided, the double shoulder harness is also considered to be designed in a way for easy removal when the straps connecting the left and right shoulder straps can be released under the load of the machine by using one hand and have no more than two release points.

NOTE An example of a release point is a buckle that requires squeezing between the thumb and finger before releasing, such as a side release buckle.

A quick-release mechanism, if provided, shall be positioned either at the connection between the machine and the harness or between the harness and the operator. The quick-release mechanism shall only function by deliberate action of the operator.

It shall be possible to open the quick-release mechanism while under load using only one hand and it shall have no more than two release points.

4.4.2 Verification

The type of harness, its functionality and its adjustment shall be verified by inspection. The quick-release mechanism(s) shall be verified by a functional test carried out by a person wearing the harness and with a vertical load of three times the dry weight of the machine acting on the suspension point.

4.5 Balance

4.5.1 Requirements

4.5.1.1 All machines requiring a harness, except those described in 4.5.1.2, shall have the suspension point (see Figure 1, No. 3) adjustable so that the machine is balanced when it is suspended on this point.

Such a balanced machine, with the suspension point at a vertical distance of (775 ± 25) mm above the ground, shall have:

— for brush-cutters: a distance from the ground to the nearest point of the blade of (200 ± 100) mm;

— for grass-trimmers: a distance from the ground to the nearest point of the cutting attachment of (150 ± 150) mm.

The requirements shall be met with tanks that are half filled and with all configurations of the machine according to the manufacturer's instructions.

4.5.1.2 Machines suspended with a harness, and designed to be supported by the ground shall have the suspension point adjustable so that the ground contact force is not greater than 20 N, with tanks that are half filled and with all configurations of the machine according to the manufacturer's instructions.

4.5.2 Verification

The requirements of 4.5.1 shall be verified by inspection and measurement using the lightest and heaviest recommended cutting attachments.

4.6 Cutting attachment strength

4.6.1 Requirements

The cutting attachment, excluding flexible cutting lines, shall not break or crack when impacted once against a steel rod of diameter (25 ± 1) mm.

The same cutting attachment shall then not break or crack when operated at an over-speed.

An exception from this second requirement is made for a single-piece metal blade. Such blades shall instead meet the material requirements in ISO 7113:1999, Clause 5.

These requirements are applicable to all recommended cutting attachments.

4.6.2 Verification

Impact strength shall be verified by a test according to Annex A.

The final verification for cracks shall be done by visual inspection.

Single-piece metal blades shall be verified by testing in accordance with ISO 7113:1999, Clause 5.

4.7 Cutting attachment retention

4.7.1 Requirements

Metallic cutting attachments shall be secured to prevent relative motion between the cutting attachment and the retainer, or between the metallic cutting attachment and the shaft on which it is mounted.

The method for securing the metallic cutting attachment shall also prevent loosening of the cutting attachment during use.

These requirements are applicable to all metallic cutting attachments recommended in the instructions.

4.7.2 Verification

The method of attachment shall be verified by inspection and by using the following test procedure.

a) Install the cutting attachment in accordance with the instructions.

b) Lock the power transmission shaft.

c) Apply to the cutting attachment a rotational torque, M, in newton metres (N · m). See Formula (1):

$$M = 0{,}4 \times V \times k \quad (1)$$

where

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

k is the gear ratio (engine/cutting attachment rotational frequency).

Conduct the test five times in the direction opposite to normal rotation, then five times in the direction of normal operation.

4.8 Cutting attachment guards

4.8.1 Requirements

The guard dimensions shall be in accordance with ISO 7918:1995.

The guard location shall be in accordance with ISO 7918:1995, for all possible adjustments.

The guard strength shall be in accordance with ISO 8380:1993 for all guards, except for the test at -25 °C which does not apply to the guard of grass-trimmers.

Guard dimensions shall be in accordance with the specifications in ISO 7918:1995 before and after the tests specified in 4.8.2.

In a thrown objects test in accordance with Annex B, no more than three penetrations in the target zone are allowed. If more than three penetrations occur, the test shall be repeated five times with no more than three penetrations in each of these tests. No cracks or breakages of the guards are allowed.

Guards that are to be removed in connection with a change of cutting attachment or as part of maintenance procedures, described in the instructions, shall be fixed by systems that can be opened or removed only with tools. These guards-fixing systems shall remain attached to the guards or to the machinery when the guards are removed.

4.8.2 Verification

Guard dimensions, fixing system and locations shall be verified by inspection and measurements. Strength requirements shall be verified by testing in accordance with ISO 8380:1993. The thrown-objects requirement shall be verified by testing in accordance with Annex B.

4.9 Transport cover

4.9.1 Requirements

Machines with a metallic cutting attachment shall be provided with a transport cover, which shall be so designed that it remains attached to the cutting attachment during transport and storage.

4.9.2 Verification

The attachment of the transport cover to the cutting attachment shall be verified by inspection when holding the machine in any direction.

4.10 Length of flexible cutting lines

4.10.1 Requirements

Grass-trimmers with flexible cutting lines shall have a line-limiting device or other means of line-length control. The limiting device shall cut the flexible cutting lines to lengths compatible with the cutting attachment guard.

4.10.2 Verification

The means to limit or control the line length shall be verified by a functional test and inspection.

4.11 Engine starting device

4.11.1 Requirements

The engine starting device shall be a self-contained, battery-operated electric starter and/or a manual starter where the actuator is permanently attached to the machine.

Machines with a manual starter shall have a recoil device for the rope.

Two or more separate and dissimilar actions shall be required to activate the electrical starting device.

4.11.2 Verification

The means of starting the engine shall be verified by inspection and functional testing.

4.12 Engine stopping device

4.12.1 Requirements

The machine shall be fitted with an engine stopping device by means of 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 while the machine is held with both hands by an operator wearing gloves. The colour of the control shall clearly contrast with the background.

4.12.2 Verification

The correct functioning of the engine stopping device shall be verified by inspection while the machine is being operated. The location of the control shall also be verified by inspection.

4.13 Throttle control

4.13.1 Position

4.13.1.1 Requirements

The throttle trigger shall be positioned so that it can be pressed and released with a gloved hand while holding the handle to which the throttle trigger is mounted.

4.13.1.2 Verification

The position shall be verified by inspection and functional testing.

4.13.2 Operation

4.13.2.1 Requirements

The machine shall be provided with a throttle trigger that, when released, automatically reverts to the idling position. The throttle trigger, except for grass-trimmers with a cutting attachment where each filament or pivoting non-metallic blade has a kinetic energy of less than 10 J, shall be retained in the idling position by the automatic engagement of a throttle trigger lock-out.

NOTE When fitted to assist starting, a throttle control latch maintains an engine speed higher than the idling speed until the throttle trigger is activated and released.

For brush-cutters and grass-trimmers with a cutting attachment where each filament or pivoting non-metallic blade has a kinetic energy of 10 J or more, after the starting procedure has been finished, activation of the throttle trigger to increase the engine speed to a point where the cutting attachment 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 control latch and the engine returns to idling speed.

Except for grass-trimmers with a cutting attachment, where each filament or pivoting non-metallic blade has a kinetic energy of less than 10 J, unintentional movement of the cutting attachment shall be minimized by a throttle control linkage so designed that a force applied to the handle, with the throttle trigger lock-out engaged, will not increase the engine speed to a point where the clutch engages and cutting attachment movement begins. When a force is applied to the throttle trigger, while the throttle trigger lockout is engaged, engine speed shall not increase to a point where the clutch engages and cutting attachment movement begins.

For the calculation of kinetic energy, see 4.13.2.2.

4.13.2.2 Calculation of kinetic energy of filament and pivoting non-metallic blade

For the purposes of this document, the kinetic energy (E_k), in joules, of filament and pivoting non-metallic blades shall be calculated according to Formula (2):

$$E_k = 0{,}5m\left[\frac{\pi}{30}n\left(r-\frac{L}{2}\right)\right]^2 \quad (2)$$

where

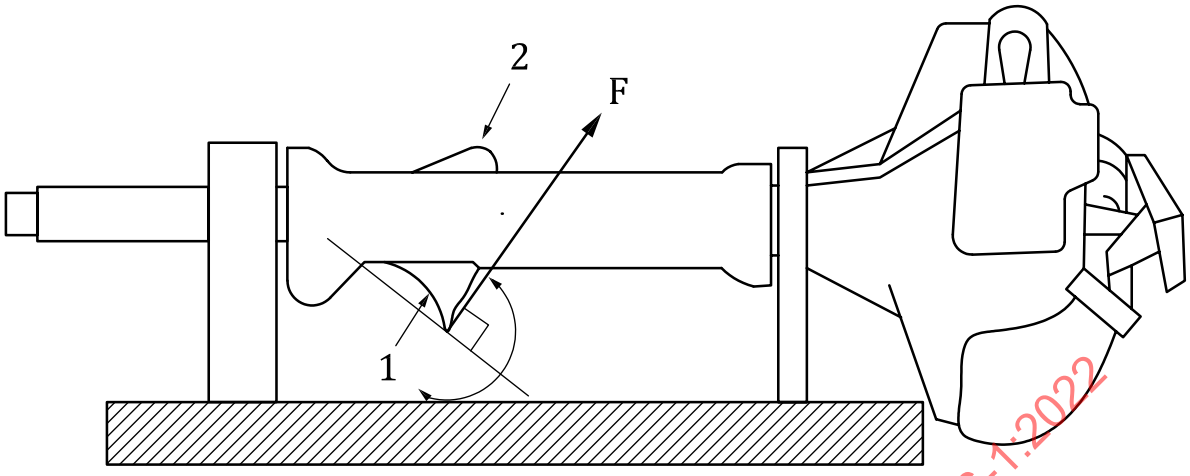
- L is the maximum free length of a filament or the length from the pivoting point to the outer tip for the pivoting non-metallic blade, in metres;
- m is the mass of length L, in kilograms;
- n is the maximum rotational speed with a cutting element (blade or filament) with length L, in revolutions per minute;
- r is the distance from the axis of rotation of the cutting head to the outer tip of the cutting element, in metres.

4.13.2.3 Verification

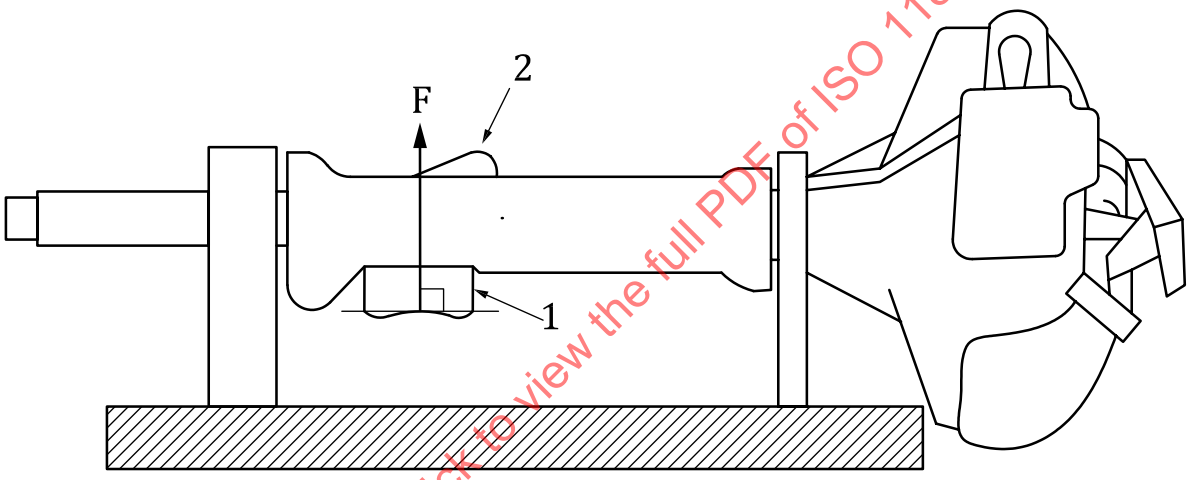
The function of the throttle trigger shall be verified by inspection while operating the machine.

The throttle-control linkage design shall be verified by applying a force in the most unfavourable direction on the handle with the throttle control, equal to three times the dry weight of the machine.

The throttle trigger lock-out function shall be verified by applying a force (F) equal to (50 ± 2) N or the dry weight of the machine, whichever is higher, on the throttle trigger with the throttle trigger lock-out engaged. During the test, the handle shall be fixed, without contacting the throttle trigger lock-out. The force (F) shall be applied gradually to the throttle trigger in the direction of travel and held for (5 ± 1) s. For pivoting throttle triggers, the force shall be applied at the point furthest from the pivot, and for linear operating throttle triggers, the force shall be applied at the midpoint of the throttle trigger. See Figures 5 a) and 5 b).



a) Pivoting throttle triggers



b) Linear operating throttle triggers

Key

1 throttle trigger
2 throttle trigger lock-out
F force

Figure 5 — Throttle trigger lock-out performance test

4.13.3 Throttle control latch

4.13.3.1 Requirements

If a throttle control latch is provided to aid starting and its engagement will result in a movement of the cutting attachment during starting, it shall be such that the throttle control latch has to be engaged manually and shall be automatically released when the throttle trigger is operated. In these cases, the activation device for setting the throttle control latch shall be located outside the gripping area of the handle and require at least two independent motions to engage the throttle control latch.

For finger-type throttle control, the gripping area is defined as extending from 25 mm in front of the rear part of the throttle trigger to 75 mm behind the rear part of the throttle trigger.

For thumb-type throttle control, the gripping area is defined as the distance from the rear part of the throttle trigger to the rearmost part of the handle.

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

4.13.3.2 Verification

The function of the throttle control latch shall be verified by inspection and measurements while operating the machine. The force to release the throttle control latch shall be applied within 1 s at a position (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).

4.14 Clutch

4.14.1 Requirements

All machines to which a blade can be attached shall have a clutch so designed that the cutting attachment does not move when the engine rotates at any speed less than 1,25 times the idling speed.

4.14.2 Verification

Correct operation of the clutch shall be verified by inspection with an engine speed setting 1,25 times the maximum idling speed specified in the instructions.

4.15 Tanks

4.15.1 General

4.15.1.1 Requirements

Fuel tank caps shall have a retainer.

The fuel tank opening shall be at least 20 mm in diameter and the oil tank opening, if existent, at least 15 mm in diameter. Each opening or cap shall be clearly marked to indicate the function of the tank, and if only the caps are marked, they shall not be interchangeable between tanks.

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

The filler openings shall be located so that the action of filling the tanks is not obstructed by other components. It shall be possible to use a funnel.

4.15.1.2 Verification

Cap retainers, opening dimensions and location shall be verified by measurement and inspection. Caps and fuel tank ventilation system performance shall be verified as follows.

Conduct the test without the influence of sunlight, with an ambient air speed of max. 3 m/s and at (20 ± 3) °C ambient temperature.

Fill the tank to the manufacturer's recommended fill level. Secure cap per the manufacturer's recommendations.

Prepare the machine for testing by cycling the engine for 5 s at idling speed and 5 s at racing speed, until the surface temperature stabilizes within 5 °C. Once the surface temperature has stabilized, shutdown the machine.

Immediately following the shutdown, inspect the caps and fuel tank ventilation system for leakage while holding the machine for 30 s in each of the six orthogonal directions.

4.15.2 Fuel tank structural integrity

4.15.2.1 Requirements

No visible tank leakage shall occur after testing the machine according to Annex D. Seepage from the fuel tank ventilation system is not regarded as leakage.

4.15.2.2 Verification

Inspect the machine for leakage while holding the machine for 30 s in each of the six orthogonal directions after testing the machine according to Annex D.

4.15.3 Fuel feed line strength and accessibility

4.15.3.1 Requirements

No fuel feed lines shall become damaged, detached or leak after testing the machine according to Annex E.

4.15.3.2 Verification

Verification is by visual inspection.

4.16 Protection against contact with parts of the machine under high voltage

4.16.1 Requirements

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

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

4.16.2 Verification

The location and insulation of the parts under high voltage shall be verified by inspection, using test probe B of IEC 61032:1997. The ignition interruption or short-circuiting shall be verified by inspection.

4.17 Protection against contact with hot parts

4.17.1 Requirements

The cylinder and parts in direct contact with the cylinder or the muffler shall be protected against unintentional contact during normal operation of the machine.

Such hot surfaces shall be considered accessible if the contactable area exceeds 10 cm^2 when probed by the test cone as shown in Figure 6.

The temperature for the accessible parts of the machine defined above, including guards or shields provided to prevent access to such hot surfaces, shall not be more than 80 °C for metallic surfaces or 94 °C for plastic surfaces.

4.17.2 Verification

Verification shall be by determining the accessibility of identified hot surfaces using the test cone shown in Figure 6 and as follows.

Conduct the temperature test in the shade and with a maximum wind speed of 3 m/s. Operate the engine by cycling for 5 s at idling speed and 5 s at racing speed until the surface temperatures stabilize.

Identify the hot surface area or areas. Determine temperatures using temperature-measuring equipment with an accuracy of ±2 °C.

If the test is conducted at an ambient temperature outside of the nominal (20 ± 3) °C, the recorded temperatures shall be corrected using Formula (3):

$$T_C = T_O - T_A + 20 \quad (3)$$

where

T_C is the corrected temperature, in degrees Celsius (°C);

T_O is the observed temperature, in degrees Celsius (°C);

T_A is the ambient temperature, in degrees Celsius (°C).

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

Apply the test cone shown in Figure 6 in any direction and with a maximum force of $(10^{\ 0}_{-1})$ N. When moving the cone, determine whether there is any contact between the hot surface area or areas and the cone's tip or the conical surface. Neither tip nor conical surface shall come into contact with any hot surface area greater than 10 cm^2.

Dimensions in millimetres

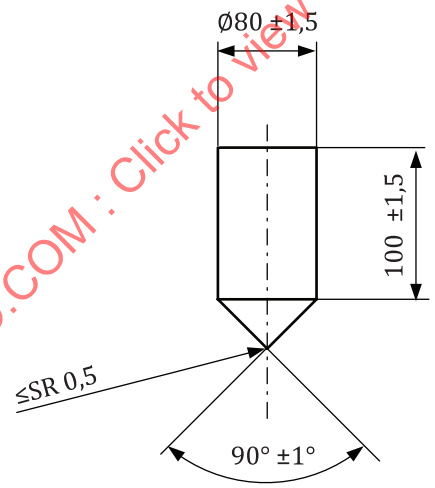


Figure 6 — Test cone

4.18 Exhaust gases

4.18.1 Requirement

The exhaust outlet shall be located such that it directs exhaust emissions away from the operator in normal working positions as described in the manufacturer's instructions.

4.18.2 Verification

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

4.19 Vibration

4.19.1 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 is 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, cutting means, unbalanced moving parts, impact in gear sprockets, bearings and other mechanisms, and the interaction between operator, machine and material being worked.

NOTE CR 1030-1 gives general technical information on widely recognized technical rules and means, and provides guidelines for the design of reduced hand-arm vibration machines.

4.19.2 Vibration measurement

The vibration shall be measured, and the equivalent vibration total value shall be calculated for each handle in accordance with ISO 22867:2021.

4.20 Noise

4.20.1 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 is assessed on the basis of the actual noise emission values. The main sources causing and influencing noise are the air intake system, engine cooling system, engine exhaust system, cutting system and vibrating surfaces.

ISO/TR 11688-1:1995 gives general technical information and guidance for the design of low-noise machines. Special care shall be taken in the acoustical design of brush-cutters and grass-trimmers.

NOTE ISO/TR 11688-2:1998 gives useful information on noise generation mechanisms in machinery and ISO 14163:1998 provides guidelines for noise control by silencers. ISO 11691:2020 and ISO 11820:1996 address the testing of the silencer.

4.20.2 Noise measurement

The equivalent A-weighted emission sound pressure level at the operator's position and the A-weighted sound power level shall be measured and calculated in accordance with ISO 22868:2021.

4.21 Electromagnetic immunity

4.21.1 Requirements

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

4.21.2 Verification

Electromagnetic immunity shall be verified by testing in accordance with ISO 14982:1998.

5 Information for use

5.1 Instructions

5.1.1 General

For the information to be provided to the user, the following applies, together with ISO 12100:2010, 6.4.

5.1.2 Technical data

The instructions shall give at least the following information for each model and/or shall mark where significant differences occur:

— machine mass (with empty tanks, without cutting attachment, cutting attachment guard and harness), in kg;

— cutting attachments (type, diameter for blades), in mm;

— maximum rotational frequency of the spindle, in min^{-1};

— engine idling speed range, in min^{-1};

— values for equivalent vibration total value (for each handle), determined in accordance with ISO 22867:2021, together with uncertainty of stated values, both in m/s^2;

— values for the equivalent A-weighted emission sound pressure level at the operator position, determined in accordance with ISO 22868:2021, together with the uncertainty of the stated values, both in dB;

— values for the equivalent A-weighted sound power level, determined in accordance with ISO 22868:2021 (if required), together with the uncertainty of the stated values, both in dB.

5.1.3 Other information

The instructions shall contain, in accordance with ISO 12100:2010, 6.4.5, comprehensive instructions and information on all aspects of operator/user maintenance, safe use of the machine, including type and use of PPE and the need for training in all operations. The instructions shall take into account the use of the machine by a first-time and/or inexperienced operator.

Extensive use should be made of pictograms and/or diagrams.

The importance of reading the instructions thoroughly before using the machine shall be stressed on the front page of the instructions.

The terms used in all documentation shall be in accordance with ISO 7112:2018.

The instructions shall at least cover information relating to the following:

a) transport, handling and storage of the machine, including:

   — instructions for securing the machine during transport to prevent loss of fuel, damage or injury;

   — cleaning and maintenance before storage, including the use of guards on cutting attachments with metal blades;

   — use of a transport cover for metal blades during transport and storage;

b) commissioning of the machine, including:

   — assembling instructions, initial adjustments and checks, including a description of the method to install or remove the cutting attachment including, for brush-cutters, a warning of sharp

edges and need to wear gloves, also including the initial assembly of the machine including the handle position and other attachments;

— for machines with a clutch, routines for checking that the cutting attachment stops turning when the engine idles;

— a list of recommended cutting attachments and appropriate guards and their location, including a warning of possible safety consequences from using other cutting attachments, such as metal multi-piece pivoting chains and flail blades;

— information regarding regular maintenance, pre-operating procedures and daily maintenance routines, as well as the consequences of improper maintenance;

— filling of fuel and oil, especially concerning fire precautions;

c) the machine itself, including:

— a description, identification and the nomenclature of principal parts including the safety devices and harness and the use of the quick-release mechanism (when provided), explanations of their functions and necessary PPE to be used, including correct clothing;

— an explanation of symbols and safety signs;

— regular maintenance tasks, pre-operational measures and daily maintenance techniques, including checking for loose fasteners, fuel leaks and damaged parts, such as cracks in the cutting attachment;

— application of the machine and how it is intended to be used, including prohibited uses; for brush- cutters, information shall also be given about the risks of kick-back and blade-thrust;

— declared values of the A-weighed emission sound pressure level at the operator's position and of the A-weighted sound power level, including a warning about the risks and measures to be taken to minimize those risks;

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

d) the use of the machine, including:

— a note alerting the user to the fact that national regulation can restrict the use of the machine;

— the need for daily inspection before use and after dropping or other impacts to identify any significant defects;

— instructions on general operation and common cutting tasks including warnings against unintended use;

— instructions on the use of PPE including recommendations for the appropriate type of hearing protection, eye protection and clothing;

— for brush-cutters, the clothing instructions shall include information to use slip-resistant foot protection, as well as protective clothing;

— a warning against the use of the machine when the operator is tired, ill or under the influence of alcohol or other drugs;

— hazards which could be encountered while using the machine and how to avoid them while performing typical tasks (e.g. removal of blockage);

— warning of risks for bystanders and the need to keep them at least 15 m away from the machine during its operation;

- starting and stopping techniques, with particular reference to safety;
- a warning about the emission of exhaust gases;
- information on correct working posture, the need for rest periods and changing working positions;
- advice to keep firm footing and balance during operation, including the need to use the harness provided;

e) maintenance instructions, including:

- a description of 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, for these machines the cutting attachment and the cutting attachment guard;
- drawings or diagrams to allow user maintenance and fault-finding;
- the provision of sufficient information to enable the user to maintain the safety system throughout the life of the product and an evaluation of the consequences of improper maintenance, use of non-conformant replacement components, or the removal or modification of safety components.

5.2 Marking

All machines shall be marked with the following minimum information:

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

The address may be simplified, provided the manufacturer (or, where applicable, his authorized representative) can be identified, but in any event the address on the plaque shall be sufficient for mail to reach the company.

— designation of series or type;

Allowing the technical identification of the product. This may be achieved by a combination of letters and/or numbers and may be combined with the designation of the machinery.

— 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 and can be combined with the designation of series or type.

NOTE An example of such a code is “A123-B”.

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

— serial number, if any;

— the maximum rotational frequency of the spindle, in min^{-1};

— the rotational direction for the cutting attachment on a component near the cutting attachment, when applicable.

In addition, the cutting attachment or its retainer for grass trimmers shall be marked with the following information:

— maximum rated rotational frequency, in min^{-1};

— rotational direction, when applicable;

— name or trademark of the manufacturer.

The machine shall also bear the following information:

— identification and method of operation, preferably according to ISO 3767-1:2016 and ISO 3767-5:2016, of the controls for engine starting and stopping devices, choke control, primer and heated handle switch (if provided);

— identification of carburettor and oil adjustments (if provided);

— identification of fuel and oil tank (if provided) openings and/or caps.

If symbols or pictorials are used, they shall be explained in the instructions, and, except if cast, embossed or stamped, shall be in contrast to their background. Embossed features shall be at least 0,3 mm in height above the surrounding surface. The information and/or instructions provided by the symbols shall be clearly legible when viewed 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, such as the effects of temperature, moisture, petrol, oil, abrasion and weathering exposure.

If labels are used, they shall be tested in accordance with 5.4.2, after which they shall undergo a visual inspection and be compared against an untested, new control specimen. No significant indications of indentation, separation, splitting, chalking, swelling, peeling, blistering, flaking, large scratches or cracking of the material, and/or no significant deterioration of print, shall be detected.

The labels shall also be tested in accordance with 5.4.3, after which the non-adhesion distance shall be a maximum of 1 mm from the specimen edge and the adhesive properties shall be at least 0,09 *w*, in newtons, where *w* is the test specimen width, in millimetres.

NOTE Labels tested and approved according to ANSI/UL 969:2018, supplemented by the gasoline, exposure test can be used and considered to fulfil the requirement of 5.4.

5.3 Warnings

All machines shall be marked with the following warnings using text or pictograms.

— Read the instructions and follow all warnings and safety instructions.

— Wear eye and hearing protection.

— Wear head protection, where there is a risk of falling objects.

— For brush-cutters, wear slip-resistant footwear and gloves.

— The distance between the machine and bystanders shall be at least 15 m.

— Do not use metal blades (if applicable).

— Beware of thrown objects.

— Beware of blade thrust (on brush-cutters).

If pictorials are used, they shall be explained in the instructions.

NOTE 1 Guidance for the design of pictorials is given in ISO 17080:2005 and ISO 11684:1995. Examples can also be found in ISO 7010:2019.

When pictorials 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 above the surrounding surface. The information and/or instructions provided by the symbols shall be clearly legible when viewed from a distance of not less than 500 mm.

The warnings shall be located in a readily visible position on the machine and shall resist the anticipated service conditions, such as the effects of temperature, moisture, fuel, oil, abrasion and weathering exposure.

If labels are used, they shall be tested in accordance with 5.4.2, after which they shall undergo a visual inspection and be compared against an untested, new, control specimen. No significant indications of indentation, separation, splitting, chalking, swelling, peeling, blistering, flaking, large scratches or cracking of the material, and/or no significant deterioration of print shall be detected.

The labels shall also be tested in accordance with 5.4.3, after which the non-adhesion distance shall be a maximum of 1 mm from the specimen edge and the adhesive properties shall be at least 0,09 *w*, in newtons, where *w* is the test specimen width, in millimetres.

NOTE 2 Labels tested and approved according to ANSI/UL 969:2018 supplemented by the gasoline exposure test can be used and are considered to fulfil the requirement of 5.4.

5.4 Test of labels

5.4.1 Preparation of test specimens and control specimens

5.4.1.1 General

New test specimens shall be prepared for each of the tests given in 5.4.2 and 5.4.3. New control specimens shall also be prepared for any test that involves a visual inspection.

5.4.1.2 Test panels

Test panels shall be made with a surface equal to that on which the label shall be mounted.

The test panels shall be carefully cleaned with an appropriate solvent, in order to remove all traces of adhesive, grease, oil and water, and then dried for at least 2 h.

5.4.1.3 Test specimens

The number of test specimens and control specimens prepared for each test shall be a minimum of three.

The test specimen/control specimen shall be the complete label, wherever possible, except where the physical limitations of the test equipment do not allow for testing of an entire sign or when the graphical content of the sign has no effect on the results of the test. The minimum dimensions of the test specimen shall be 13 mm width and 25 mm length.

The backing layer protecting the adhesive side shall be completely removed for the wipe resistance test (see 5.4.2) and for the adhesion test (see 5.4.3) to a length of at least 15 mm, but leaving the protected end long enough to be attached to the pulling machine. The specimens shall then be applied to the test panel symmetrically. The applied specimens shall be rolled over five times using a steel roller with a rubber coating, having a width at least 2 mm wider than the test specimen, and a diameter of 30 mm to 60 mm; the roller shall be applied with a force of (50 ± 2) N and a rolling speed of (200 ± 20) mm/s shall be maintained.

After being applied to the test panels, the test specimens shall be conditioned at a temperature of (23 ± 5) °C with a relative humidity of (50 ± 20) % for at least 24 h, prior to testing.

5.4.2 Wipe resistance test

Three test specimens shall be mounted on test panels in accordance with 5.4.1 and then immersed in the test liquid for (300 ± 3) s.

After removed it from the test liquid, wipe the test specimen with a force of (10 ± 1) N and 1 cycle/s, using an unbleached cotton cloth soaked in the test liquid for (30 ± 3) s. After the wiping test has been completed, a visual inspection of the test specimen shall be carried out.

The test liquids shall be

a) water, and

b) a mixture by volume of 50 % isooctane and 50 % toluene.

5.4.3 Adhesion test

Three test specimens shall be mounted on test panels in accordance with 5.4.1 and immersed in the test liquid (50 % isooctane and 50 % toluene) for (30 ± 1) min.

After removing the test specimen from the test liquid, inspect and measure any non-adhesion distances from the specimen edge.

Then, attach the test panel to a holder and the free end of the test specimens, still covered by a backing layer protecting the adhesive side, to a pulling machine. Apply a pulling force upwards at an angle of (90 ± 5)° to the test panel and at a speed of (60 ± 6) mm/min. Measure the tensile force required for this over a distance of at least 15 mm. The average value of the tensile force, expressed in newtons, shall be calculated and recorded. If the test distance of 15 mm is not achievable because the test specimens tear, the test specimens shall be reinforced with a second layer of the label being tested.

Annex A
(normative)

Cutting attachment impact and spin test

A.1 The machine shall be suspended freely in an operating position (see Figure A.1).

A.2 The test shall be conducted with a rotational cutting attachment speed corresponding to engine racing speed. For grass trimmers the rotational cutting attachment speed shall be determined with the line set to the manufacturer's maximum recommended length.

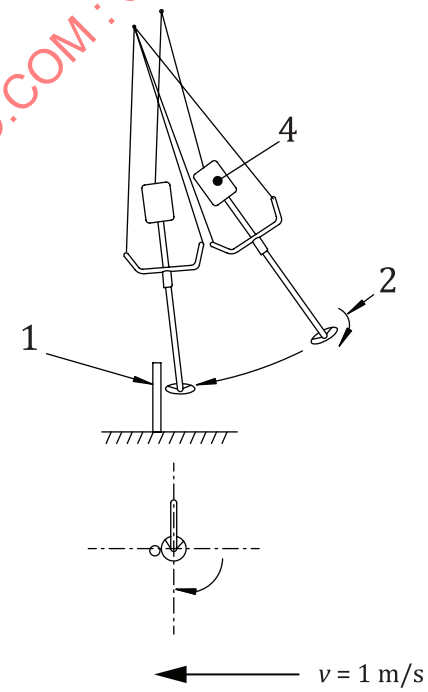
The impact test shall be conducted with one swing against a (25 ± 1) mm diameter steel rod of designation 9S20 in accordance with ISO 683-4:2016, Table 2. The steel rod shall be impacted horizontally by the cutting attachment at an approach speed (v) of (1 ± 0,1) ms^{-1}, as shown in Figure A.1.

For the impact test of flexible non-metallic line cutting attachments, the line shall be set at a length of (51 ± 13) mm from where the line exits the cutting attachment, and any supply reels shall be filled to the manufacturer's recommended maximum capacity.

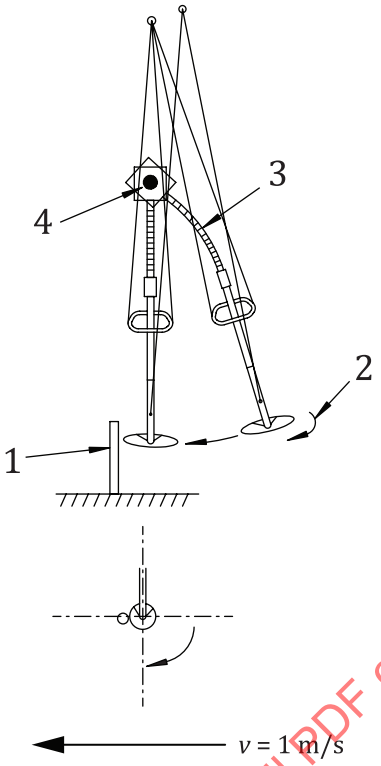
A.3 The engine shall be switched off immediately after the impact.

A.4 After the impact test of A.2, the line length of flexible cutting means using flexible lines, shall be set at (25 ± 12) mm extending from the cutting attachment and no other modifications shall be made to the cutting attachment. The cutting attachment shall then be spun for 5 min at 1,33 times the speed used in A.2. The attachment assembly shall be fastened to the test apparatus in the same manner as it would be on the machine.

NOTE Single-piece solid steel blades are exempt from the spin test.



a) Machine with integral combustion engine



b) Machine with backpack power unit

Key

1 steel rod
2 direction of rotation
3 flexible shaft
4 power unit

Figure A.1 — Impact test

If the blade rotates in the opposite direction, the cutting attachment shall impact the steel rod from the other side.

Annex B
(normative)

Thrown objects test

B.1 Test stand

B.1.1 The test shall be conducted on a test stand as shown in Figures B.1 and B.2.

B.1.2 The base shall be a flat board.

B.1.3 The base shall be covered with an artificial-grass mat with a maximum height of 15 mm and a fibre length of 6 mm to 8 mm.

B.1.4 The fibre shall not have any specific orientation.

NOTE For the insertion position of the test-piece injection tube, see Figure B.2.

B.2 Test conditions

B.2.1 The machine shall be mounted rigidly above the base, and oriented in such a way that the device which inserts the test pieces is at a distance (l) which is half the depth of the cutting teeth or 13 mm inside the outer path line of the cutting attachment, whichever is less (see Figures B.1 and B.2). The flexible lines of the grass-trimmer shall be adjusted to their maximum length.

B.2.2 The insertion of the test pieces shall be made in a vertical direction from below, at one of the two positions shown in Figure B.2, as follows:

— if the cutting attachment rotates counter-clockwise, position A shall be used; and

— if the cutting attachment rotates clockwise, position B shall be used.

B.2.3 The lower surface of the cutting elements shall be parallel to and (30 ± 3) mm above the top of the fibre surface (see Figure B.2). In cases where the cutting head (see Figure B.2) extends more than 30 mm below the cutting elements, a clearance of 1 mm to 5 mm between the cutting head and the fibre surface shall be maintained.

B.2.4 Adjust the velocity with which the test piece is inserted, so that the test piece rises a minimum of 20 mm and a maximum of 30 mm above the cutting element.

B.3 Penetration wall

B.3.1 At the operator's position, a wall with a minimum height of 2 000 mm above the top of the base shall be established.

B.3.2 The wall shall be made of kraft paper (mass per unit area 80 g/m^2).

B.3.3 The paper shall be flatly attached without folds on a framework whose minimum inside dimensions are shown in Figure B.1.

B.4 Test pieces

The test pieces shall be ceramic prisms with triangular sides and a prism height of (6,5 ± 0,8) mm (see Figure B.3). The mass of one prism shall be $(0,4^{+0,03}_{-0,04})$ g.

B.5 Procedure

B.5.1 At the selected test-piece insertion position (A or B), 25 test pieces shall be inserted vertically and individually from below, into the circular path of the rotating cutting attachment.

B.5.2 The engine shall be operated at racing speed.

B.5.3 The base of the test stand shall be cleaned after the insertion of five test pieces.

B.6 Inspection of the cutting attachment

B.6.1 If the blade is damaged during the test, it shall be replaced with a new blade.

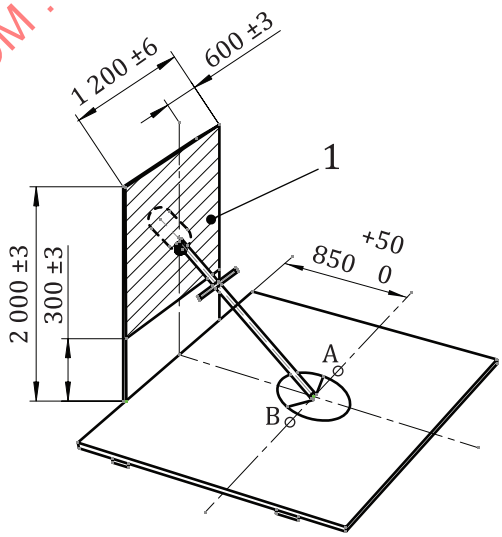
B.6.2 For grass-trimmers with a damaged line, pull out a fresh piece of line and cut it off to the original length.

B.7 Result

After the test, the penetration wall shall be examined to determine if there has been any penetration in the target zone.

Penetration is confirmed if a ball of 5 mm diameter can be pressed through the tear with a maximum force of 3 N.

Dimensions in millimetres



Key

1 target zone

A, B insertion position of the test pieces

NOTE See Figure B.2 for further information on insertion positions (A, B).

Figure B.1 — Machine position on test stand