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Machinery for forestry — Portable chain-saw safety requirements and testing —

Part 1: Chain-saws for forest service

Matériel forestier — Exigences de sécurité et essais des scies à chaîne portatives —

Partie 1: Scies à chaîne pour travaux forestiers

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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.

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 fourth edition cancels and replaces the third edition (ISO 11681-1:2011), which has been technically revised.

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

— the normative references in Clause 2 have been updated;

— requirements for kickback in 4.5.3.1 have been clarified;

— requirements and verification for throttle control system in 4.12 have been updated;

— a new subclause, 4.17.2.3 “Fuel feed lines strength and accessibility” has been added;

— 5.1.2 “Technical data”, has been updated;

— in 5.1.3, information on safe starting procedure has been added.

A list of all parts in the ISO 11681 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: players with regard to machinery safety:

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

— health and safety bodies (regulators, accident prevention organizations, 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.

Machinery for forestry — Portable chain-saw safety requirements and testing —

Part 1: Chain-saws for forest service

1 Scope

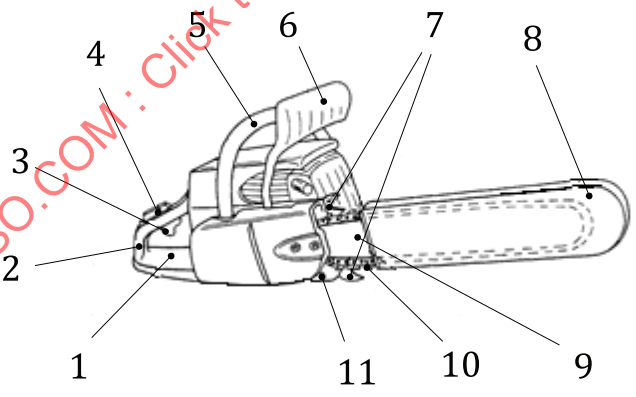
This document specifies safety requirements and measures for verification for the design, construction, transporting and commissioning of portable, combustion-engine, hand-held chain-saws. The chain-saws are intended to be used for forest work by only one operator, with the right hand on the rear handle and left hand on the front handle.

Dismantling and scrapping of the product is not covered by this document. 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, with the exception of kickback and balance for machines with an engine displacement of more than 80 cm^3, relevant to these machines when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Annex A).

This document is applicable to chain-saws manufactured after its date of publication.

NOTE Figure 1 shows an example of a chain-saw within the scope of this document.



Key

1	rear hand-guard	7	spiked bumper
2	rear handle	8	guide-bar cover
3	throttle trigger	9	guide-bar
4	throttle trigger lock-out	10	saw-chain
5	front handle	11	chain catcher
6	front hand-guard		

Figure 1 — Example of chain-saw

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 6531:2017, *Machinery for forestry — Portable chain-saws — Vocabulary*

ISO 6533:2020, *Forestry machinery — Portable chain-saw front hand-guard — Dimensions and clearances*

ISO 6534:2007, *Forestry machinery — Portable chain-saw hand-guards — Mechanical strength*

ISO 6534:2007/Amd 1:2012, *Forestry machinery — Portable chain-saw hand-guards — Mechanical strength — Amendment 1*

ISO 6535:2015, *Portable chain-saws — Chain brake performance*

ISO 7293:2021, *Forestry machinery — Portable chain saws — Engine performance and fuel consumption*

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

ISO 7914:2002/Amd 1:2012, *Forestry machinery — Portable chain-saws — Minimum handle clearance and sizes — Amendment 1*

ISO 7915:2021, *Forestry machinery — Portable chain-saws — Determination of handle strength*

ISO 8334:2007, *Forestry machinery — Portable chain-saws — Determination of balance and maximum holding moment*

ISO 9518:2018, *Forestry machinery — Portable chain-saws — Kickback test*

ISO 10726:2020, *Portable chain-saws — Chain catcher — Dimensions and mechanical strength*

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

ISO 13772:2018, *Forestry machinery — Portable chain-saws — Non-manually actuated chain brake performance*

ISO 13772:2018/Amd 1:2020, *Forestry machinery — Portable chain-saws — Non-manually actuated chain brake performance — Amendment 1*

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

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 6531:2017 and ISO 12100:2010 apply.

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

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

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

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 safe operation of a chain-saw also depends on the safe environment associated with the use of personal protective equipment (PPE), such as gloves, slip-resistant footwear, and leg, eye, foot, hearing and head protective equipment, as well as safe working procedures (see 5.1).

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.

4.2 Handles

4.2.1 Requirements

Chain-saws shall have a handle for each hand. These handles shall be designed such that:

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

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

— they conform to the dimensions and clearances given in ISO 7914:2002 (see also 4.12.1), and

— the strength of both handles complies with ISO 7915:2021.

Chain-saws having a system for isolating 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 (see 4.11), even in the case of failure of the vibration isolation system.

4.2.2 Verification

Dimensions shall be verified by measurement. Strength requirements shall be verified by testing in accordance with ISO 7915:2021. The possibility of stopping the chain-saw engine when a failure has occurred in the vibration isolation system shall be verified by inspection of the design and by functional testing.

4.3 Hand protection

4.3.1 Protection at front handle

4.3.1.1 Requirements

A hand-guard shall be fitted in the vicinity of the front handle to protect the operator's fingers and hand from injury through contact with the saw-chain.

The dimensions of this front hand-guard shall comply with ISO 6533:2020. Its strength shall comply with ISO 6534:2007.

4.3.1.2 Verification

Dimensions shall be verified by measurement. Strength requirements shall be verified by testing in accordance with ISO 6534:2007.

4.3.2 Protection at the rear handle

4.3.2.1 Requirements

A hand-guard shall be provided along the length of the right side of the bottom of the rear handle to protect the operator's hand from contact with a broken saw-chain.

This hand-guard shall extend from the right edge of the handle for at least 30 mm on the guide bar side (see Figure 2) and

— at least 100 mm lengthwise from the inner rear part of the saw body (see Figure 2), or

— at least three times the diameter of 25 mm behind the throttle trigger, as defined by three cylinders pressed together against the handle and the throttle trigger, whichever of these options is further back.

This requirement may also be fulfilled by parts of the machine.

The strength of the rear hand-guard shall comply with ISO 6534:2007.

4.3.2.2 Verification

Dimensions shall be verified by measurement. Strength requirements shall be verified by testing in accordance with ISO 6534:2007.

Dimensions in millimetres

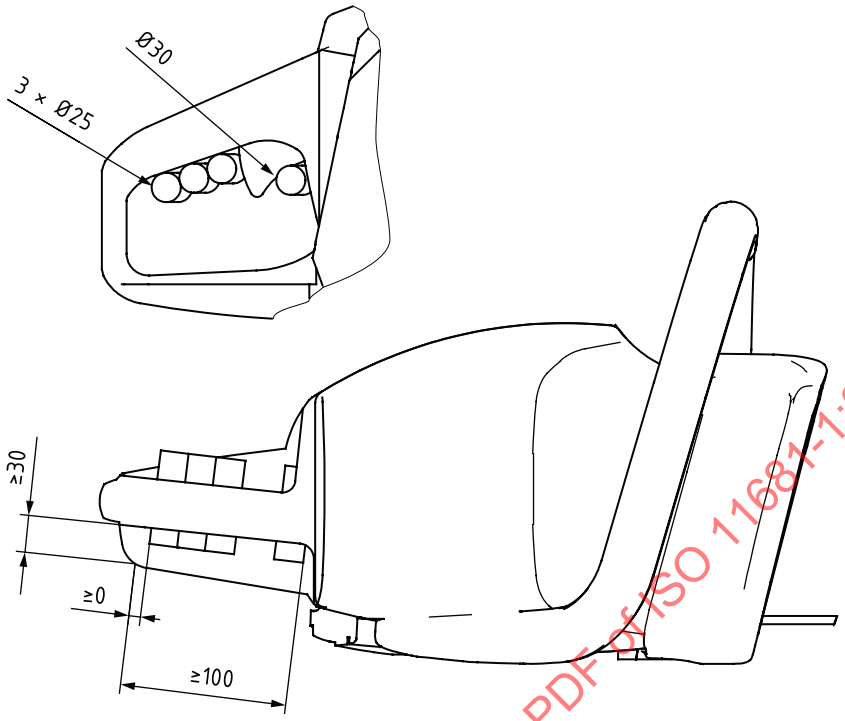


Figure 2 — Minimum dimensions of protection at the rear handle

4.4 Balance

4.4.1 Requirements

Chain-saws with an engine displacement of 80 cm^3 or less shall be longitudinally balanced to within ±30° between the centreline of the guide bar and the horizontal plane.

The limit shall be met by the shortest and longest applicable guide bars.

NOTE Sufficient information to allow the setting of a limit is not available for chain-saws with an engine displacement of more than 80 cm^3.

4.4.2 Verification

The angle for longitudinal balance shall be verified by functional testing in accordance with ISO 8334:2007.

4.5 Protection against injury by kickback

4.5.1 Chain brake

4.5.1.1 Requirements

The chain-saw shall be fitted with a chain brake that can be activated manually by means of the front hand-guard. The chain brake release force shall be between 20 N and 60 N and the direction of movement shall be away from the operator.

The average stopping time shall not exceed 0,12 s and the maximum stopping time shall not exceed 0,15 s.

4.5.1.2 Verification

The chain brake release force and stopping time shall be verified in accordance with ISO 6535:2015.

4.5.2 Non-manual chain brake

4.5.2.1 Requirements

There shall also be a non-manual chain brake system that operates the chain brake when kickback occurs. This system shall meet the requirements for forest chain-saws given in ISO 13772:2018.

4.5.2.2 Verification

The non-manually activated chain brake system shall be verified by functional testing in accordance with ISO 13772:2018.

4.5.3 Kickback and chain stop angles

4.5.3.1 Requirements

The following requirement is only applicable for chain-saws with an engine displacement of less than 80 cm^3 and a guide bar length not exceeding 63 cm. At least one of the calculated kickback parameters (CKA_{wob} or CKA_{wb} or CKA_{cs}) shall be less than 45°. This requirement shall be fulfilled for all guide bar and saw-chain combinations specified in the instructions. For definitions of the kickback parameters, see ISO 9518:2018.

NOTE Sufficient information to allow the setting of a limit is not available for chain-saws with an engine displacement of more than 80 cm^3.

4.5.3.2 Verification

CKA_{wob}, CKA_{wb} and CKA_{cs} shall be verified by functional testing in accordance with ISO 9518:2018.

4.6 Chain catcher

4.6.1 Requirements

The chain-saw shall be fitted with a chain catcher located, and with dimensions and strength, in accordance with ISO 10726:2020. The chain catcher shall be replaceable.

4.6.2 Verification

Dimensions shall be verified by measurement. Strength requirements shall be verified by testing in accordance with ISO 10726:2020. Means for replacing the chain catcher shall be verified by inspection.

4.7 Spiked bumper

4.7.1 Requirements

The chain-saw shall be equipped with a spiked bumper (see Figure 1) or shall have provision for mounting one.

4.7.2 Verification

The presence of a spiked bumper or the provision for mounting one shall be verified by inspection.

4.8 Chip discharge

4.8.1 Requirements

The chain-saw shall be so designed that wood particles are directed below the underside of the saw when it is in an upright (cross-cutting) position.

4.8.2 Verification

The direction of the discharge of wood particles shall be verified by inspection during cross-cutting operations.

4.9 Guide bar cover

4.9.1 Requirements

The chain-saw shall be provided with a guide bar cover (see Figure 1), so designed that it remains attached to the guide bar during transport and storage.

4.9.2 Verification

The attachment of the guide bar cover to the guide bar shall be verified by inspection when holding the chain-saw in any direction.

4.10 Engine starting device

4.10.1 Requirements

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

Chain-saws 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.

4.10.2 Verification

The means of starting the chain-saw shall be verified by inspection and functional testing.

4.11 Engine stopping device

4.11.1 Requirements

The chain-saw 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 using the right hand by an operator holding the saw with both hands and wearing protective gloves. The colour of the control shall clearly contrast with the background.

4.11.2 Verification

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

4.12 Throttle control system

4.12.1 Dimensions

4.12.1.1 Requirements

The throttle trigger shall be so positioned that it can be pressed and released with a gloved hand while the rear handle is held by meeting the dimensional requirements of ISO 7914:2002. See also 4.2.1.

4.12.1.2 Verification

The position and dimensions shall be verified by measurement.

4.12.2 Operation

4.12.2.1 Requirements

4.12.2.1.1 Throttle trigger/Throttle trigger lock-out

The chain-saw shall be provided with a throttle trigger that, when released, automatically reverts to the idling position. The throttle trigger shall be retained in the idling position by the automatic engagement of a throttle trigger lock-out.

When a force is applied to the throttle trigger, while the throttle trigger lock-out is engaged, engine speed shall not increase to a point where the clutch engages and continuous saw-chain movement begins.

NOTE When fitted to assist starting, a throttle control latch maintains an engine speed higher than idling speed until the throttle trigger is activated and released (see 4.12.3).

After the starting procedure has been completed, activation of the throttle trigger to increase the engine speed to a point at which the saw-chain will start to move shall only be possible with the throttle trigger lock-out disengaged.

The starting procedure is considered to have been completed when the operator disengages the throttle lock and the engine returns to idling speed.

4.12.2.1.2 Unintentional continuous movement of the saw-chain

Unintentional continuous movement of the saw-chain shall be prevented by a throttle-linkage so designed that when a force is applied to the rear handle while the throttle trigger lock-out is engaged, engine speed will not increase to a point where the clutch engages, and continuous saw-chain movement begins.

4.12.2.2 Verification

4.12.2.2.1 Throttle trigger/Throttle trigger lock-out

The throttle trigger and throttle trigger lock-out requirements shall be verified by inspection and the following test.

The throttle trigger lock-out function shall be verified by inspection and by applying a force equal to 50 N ± 5 N to the throttle trigger with the throttle trigger lock-out engaged. The force shall be applied gradually during approximately 1 s and then held for 5 s ± 1 s at a position 5 mm ± 1 mm in front of the rear part of the throttle trigger. The force shall be applied in the direction of the throttle trigger movement (parallel to the path of the trigger for a trigger with linear travel and perpendicular to the arc segment for a trigger designed to rotate around a fixed point).

During the test, the handle shall be fixed with means that do not in any way interfere the function of the throttle trigger lock-out.

4.12.2.2.2 Unintentional continuous movement of the saw-chain

Unintentional continuous movement of the saw-chain shall be verified by the following test.

The machine shall be equipped with guide bar and saw-chain and the fuel and oil tanks shall be at least half full. Initially start and warm up the engine to steady-state conditions by applying load (cutting or by using a brake as described in ISO 22868:2021). Stop the engine and fix the machine by the guide bar using a vice. Restart the engine at idling speed.

Let the engine speed stabilize for 10 s and set the engine to the highest idling speed recommended by the manufacturer in the instructions.

Apply a load corresponding to three times the mass of the machine as defined in 5.1.2 a) to the rear handle. When load is applied in the most unfavourable direction, no continuous movement of the saw-chain shall be observed.

Saw-chain movement is not considered continuous if the saw-chain movement includes interruptions in rotation.

4.12.3 Throttle control latch

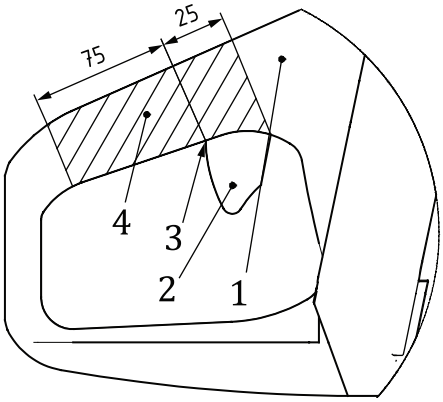
4.12.3.1 Requirements

If a throttle control latch is provided to aid starting and its engagement results in movement of the saw-chain during starting, the throttle control latch shall be engaged manually and shall be automatically released when the throttle trigger is operated. In such cases, the activation device used to set the throttle control latch shall be located outside the gripping area of the handle and it shall require at least two independent motions to engage the throttle control latch.

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 (see Figure 3).

The operational force on the throttle trigger for releasing the throttle control latch 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 3 — Gripping area

4.12.3.2 Verification

The functionality of the throttle control latch shall be verified by inspection and measurement while operating the machine. The specified force for releasing the throttle control latch shall be applied within 1 s at a position 5 mm ± 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).

4.13 Drive sprocket guard

4.13.1 Requirements

Unintended contact with the drive sprocket shall be prevented. Covers for the drive sprocket that are provided to meet this requirement, whose only function is to guard against unintentional contact, shall be either a fixed guard (detachable by means of tools) or an interlocking movable guard (detachable without the use of tools).

Fixed guards shall be fixed by systems that can be opened or removed only with tools and that have their fixing system permanently attached to the guard and/or machine when the guard is removed.

Interlocking movable guards shall have a safety-related control system which complies with at least ISO 13849-1:2015, Category 1.

4.13.2 Verification

The design of fixed guards shall be verified by inspection.

The functionality of interlocking movable guards shall be checked by inspection, functional testing and to the principles specified in ISO 13849-2:2012.

4.14 Clutch

4.14.1 Requirements

The chain-saw's clutch shall be so designed that the saw-chain does not move continuously when the engine rotates at any speed less than 1,25 times the idling speed. Saw-chain movement is not considered continuous if the saw-chain movement includes interruptions in rotation.

4.14.2 Verification

Correct operation of the clutch shall be verified by inspection when the engine speed is increased from idling speed to 1,25 times the highest idling speed, in accordance with the instructions.

4.15 Protection against contact with parts under high voltage

4.15.1 Requirements

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

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

4.15.2 Verification

The location and insulation of the parts under high voltage shall be verified by inspection, using a standard test finger, in accordance with IEC 61032:1997, Figure 2, Probe B. The ignition interruption or short-circuiting shall be verified by inspection.

4.16 Protection against contact with hot parts

4.16.1 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 chain-saw. This applies to:

— parts less than 120 mm from the front handle in accordance with Figure 4 and along a 100 mm distance to the left of reference point X_0, as defined in ISO 6533:2020,

— parts less than 80 mm from the front handle in accordance with Figure 5 and along a 100 mm distance upwards from reference point X_1, as defined in ISO 7914:2002, and

— the muffler, if it can come into contact with the projection of a straight line within 120 mm from the top of the front handle in accordance with Figure 6 and along a 100 mm distance to the left of reference point X_0, as defined in ISO 6533:2020.

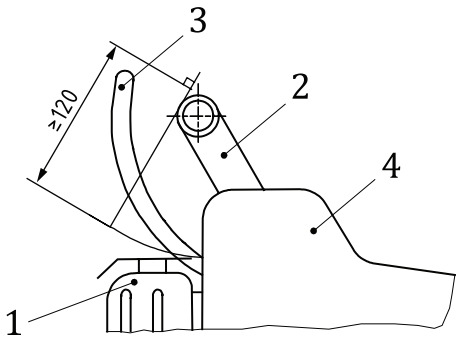
Maintenance and adjustment procedures as described in the instructions are considered intentional acts and excluded from the provision of this subclause.

Mufflers other than those mounted at the front of the chain-saw shall be provided with protection against contact so that the accessible area does not exceed 10 cm^2.

The temperature for these accessible parts of the machine, as listed above and 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.

NOTE For further information, see ISO 13732-1:2006, Annex E.

Dimensions in millimetres

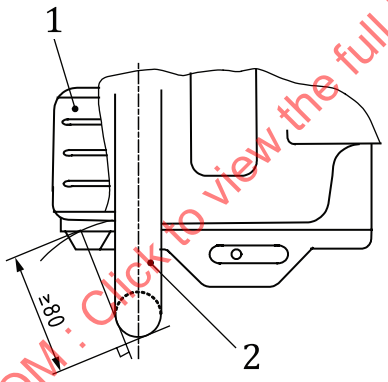


Key

1 muffler
2 front handle
3 front hand-guard
4 housing

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

Dimensions in millimetres

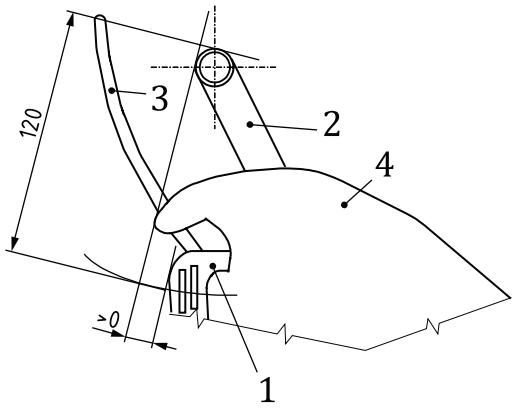


Key

1 muffler
2 front handle

Figure 5 — Required lateral distance between front handle and unprotected hot parts (plain view)

Dimensions in millimetres



Key

1 muffler
2 front handle
3 front hand-guard
4 housing

Figure 6 — Guarding against contact with hot part

4.16.2 Verification

The protection of the muffler or silencer shall be verified by measurement of the required distances. The protection of silencers other than those mounted at the front of chain-saws shall be verified by determining the area accessible, 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 (1):

$$T_C = T_O - T_A + 20 \quad (1)$$

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 7 in any direction and with a maximum force of $\left(10^{\ 0}_{-1}\right)$ N. When moving the cone, determine whether there is any contact between the hot surface area(s) 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. The cylindrical surface of the cone or the flat surface of the cone shall not be considered.

Dimensions in millimetres

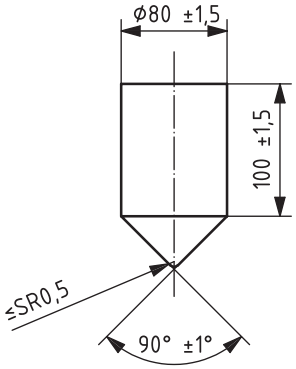


Figure 7 — Test cone

4.17 Fuel and oil systems

4.17.1 Requirements

The fuel cap shall have a retainer.

The fuel tank opening shall be at least 20 mm in diameter and the oil tank opening at least 19 mm in diameter. Each opening or cap shall be clearly marked to indicate the function of the tank; 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 chain-saw is at the normal operating temperature, with the chain-saw in all working positions and while being transported.

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

Tanks and fuel lines shall be integrated in the chain-saw so that they can withstand, without any visible leakage, the shock occurring when the complete chain-saw is impacted to the ground in accordance with 4.17.2.2.

Fuel feed lines accessible by the probe defined in Figure 8, shall not break, crack, leak or become detached from their fittings or connections when tested in accordance with 4.17.2.3.

4.17.2 Verification

4.17.2.1 General

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

4.17.2.2 Drop test

The chain-saw shall be impacted onto a concrete surface by dropping it twice (once with the longest guide bar and once with the shortest guide bar as specified in the instructions), at –25 °C ± 2 °C. If only one guide bar is specified in the instructions, that bar shall be used for both impacts.

Before the drop test, install one of the selected guide bars, together with the associated saw-chain, and half fill the fuel and oil tanks with a mixture by volume of 50 % glycol and 50 % water, then condition the chain-saw at the test temperature for at least 6 h.

Within 60 s of its emergence from the conditioning environment, drop the chain-saw onto a concrete surface. Do this with the chain-saw suspended by means of a string attached to the front handle so that the guide bar plane is vertical and the lowest point of the front handle where it is suspended is 775 mm ± 5 mm above the concrete surface.

Inspect for visible leakage while holding the chain-saw for 30 s ± 2 s in each of the positions b) to g) as specified in ISO 6531:2017, Figure A.1. Repeat the test with the second guide bar after reconditioning at –25 °C ± 2 °C for a minimum of 1 h.

4.17.2.3 Fuel feed lines strength and accessibility

Fuel feed line strength and accessibility shall be determined by the use of a 7 mm diameter × 200 mm length test probe made of PA6 Plastic material without glass reinforcement (Figure 8). The test probe shall be mounted to a force meter. All guards and covers shall be installed for the test and the test shall be conducted at a temperature of (20 ± 5) °C. The fuel feed lines and connections shall be preconditioned by completely filling the fuel tank and then running the engine for 5 min. Stop the engine and wait for 24 h prior to conducting the test.

The fuel feed lines and connections shall be tested by inserting the test probe into any opening which can be used to access the fuel feed lines. Fuel feed lines accessible with the tip of the test probe, shall be tested by applying an axial force of $\left(40^{+0}_{-2}\right)$N . The force shall be applied to accessible fuel feed lines that the probe contacts.

Compliance is checked by visual inspection. For chain-saws incorporating pressurized fuel feed lines visual inspection shall be performed when the chain-saw engine is running and then after the engine is stopped.

Dimensions in millimetres

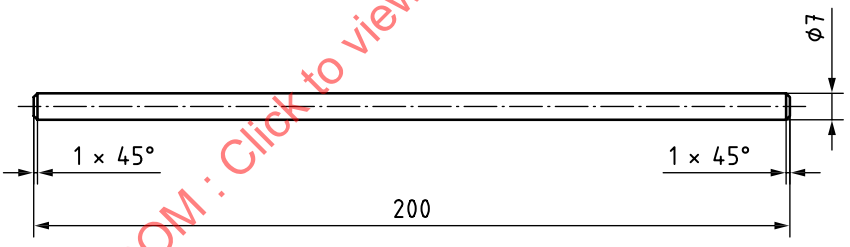


Figure 8 — Test probe for fuel feed line strength and accessibility

4.18 Exhaust gases

4.18.1 Requirements

The exhaust outlet shall be located so as to direct emissions away from the operator in normal working positions.

4.18.2 Verification

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

4.19 Chain lubrication

4.19.1 Requirements

The guide bar and saw-chain shall be automatically lubricated. If, additionally, a manual oiler is provided, it shall be located so that it can be operated by the right hand while holding the chain-saw.

4.19.2 Verification

The functionality of the saw-chain oiling system shall be verified by inspection while operating the machine. The location of a manual oiler, if provided, shall be verified by inspection.

4.20 Chain tensioning

4.20.1 Requirements

Chain-saws shall be provided with a means for adjusting the saw-chain tension.

4.20.2 Verification

The adjustment means shall be verified by inspection and functional testing.

4.21 Vibration

4.21.1 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.

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 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.

4.21.2 Vibration measurement

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

4.22 Noise

4.22.1 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 generally the air intake system, engine cooling system, engine exhaust system, cutting system and vibrating surfaces.

NOTE 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 chain-saws.

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.

4.22.2 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.

4.23 Electromagnetic immunity

4.23.1 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.

4.23.2 Verification

The 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 technical information for each chain-saw model.

a) Mass

Chain-saw without guide bar and saw-chain, empty tanks, in kg.

b) Cutting length

Usable cutting lengths, in cm or cm and inch.

c) Saw-chain speed

Saw-chain speed in m/s as measured at maximum engine power speed according to ISO 7293:2021.

d) Approved saw-chains and guide bars

Recommended saw-chains and guide bars approved to meet the requirements of this document.

e) Engine

Engine idling speed range, min^{-1}.

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

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

h) 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.

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, and the safe use of the chain-saw, including type and use of PPE, suitable clothing and the need for training in all manual chain-saw operations. The instructions shall take into account the use of a chain-saw 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 chain-saw shall be stressed on the front of the instructions.

The terms used in all documentation shall be in accordance with ISO 6531:2017. Alternative wording may be used provided it is explained according to ISO 6531:2017.

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

a) transport, handling and storage of the chain-saw, including
   - the use of a guide bar cover during transport and storage,
   - cleaning and maintenance before storage, and
   - instructions for securing the machine during transport to prevent loss of fuel, damage or injury.

b) commissioning of the chain-saw, including
   - assembly instructions, initial adjustments and checks, and including a description of the method to install the saw-chain and guide bar,
   - a list of recommended saw-chain and guide bar combinations, including a warning of possible consequences from using non-approved combinations, e.g. increased risk of kickback,
   - chain tensioning and sharpening techniques, including the use of gloves,
   - information regarding regular maintenance, pre-operating procedures and daily maintenance routines, as well as the consequences of improper maintenance,
   - guide bar and saw-chain adjustments with the engine stopped, including regular checking of the chain brake,
   - regular functional checks of the clutch (no saw-chain movement at idling speed) and information regarding the correct adjustment of the idling speed, and
   - filling of fuel and oil tanks, especially concerning fire precaution.

c) the chain-saw itself, including
   - a description, identification and the nomenclature of principal parts, including the safety devices of the chain-saw and an explanation of its function,
   - an explanation of symbols and safety signs,
   - the mounting of a spiked bumper,
   - information on specified replacement saw-chains and guide bars,
   - declared values of the A-weighted emission sound pressure level at the operator position and of the A-weighted sound power level, including a warning of the risks and the measures to be taken to minimize those risks, with a third octave band analysis to be supplied upon request to enable selection of the correct hearing protection,
   - equivalent vibration.

d) the use of the chain-saw, including

- a note alerting the user of possible national regulations which can restrict the use of the machine,
- the need for daily inspection before use and after dropping or other impacts to identify significant damage or defects,
- instructions regarding the safe starting procedure, which includes the instruction to always engage the chain brake before starting the engine and, when the engine has started, to immediately disengage the throttle control latch and ensure that the engine speed has returned to idle before disengaging the chain brake,
- instructions to only use the throttle control latch at starting procedure and a warning of using the machine with the throttle control latch engaged,
- operating instructions and instructions for common cutting tasks, as well as the need for adequate training, including prohibited operations and a warning against the use of the unit when tired, ill or under the influence of alcohol or other drugs,
- instructions for the selection and use of eye (visor or glasses), head, hand, leg and foot protection, including mentioning of the need to use slip-resistant foot protection,
- instructions regarding exposure to noise, and the 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 to seek medical attention if symptoms occur and, if appropriate, recommendations for limiting the duration of operation,
- instructions on the regular testing of the chain brake, with information about possible effects of normal use and maintenance on the kickback safety performance of the chain-saw,
- hazards which may be encountered while using the saw, such as blockage of the saw-chain, and how to avoid them while performing typical tasks,
- warning about the risk for bystanders and animals and the need to keep a safe distance during operation of the chain-saw,
- an explanation of the kickback safety features that the chain-saw incorporates, including a description of the chain brake function and the influence of saw-chain and guide bar type on kickback magnitude. The user shall also be informed about the possible effects of use and maintenance of the chain brake system and other components such as the saw-chain and guide bar on the kickback safety performance of the machine,
- an explanation of, and instructions in how to deal with, the phenomena of kickback, “skating” and “bouncing”, and dropping at the end of a cut,
- a warning about the emission of exhaust gases, lubrication oil mist and saw dust,
- an instruction that the chain-saw shall be held with the right hand on the rear handle and the left hand on the front handle, and
- information regarding the appropriate use of a spiked bumper, e.g. the advantage of using a spiked bumper when cutting trees and thick branches.

e) maintenance instructions, including

- servicing and replacement tasks for the user, including the need to keep the chain-saw in good working condition,
- specifications of the spare parts affecting the health and safety of the operator, particularly the saw-chain and guide bar,