INTERNATIONAL STANDARD

ISO 11681-2

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

Part 2: Chain-saws for tree service

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

Partie 2: Scies à chaîne pour l'élagage des arbres

Reference number
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Foreword

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

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

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 11681-2 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 17, *Manually portable forest machinery*.

This third edition cancels and replaces the second edition (ISO 11681-2:2006), which has been technically revised.

ISO 11681 consists of the following parts, under the general title *Machinery for forestry — Portable chain-saw safety requirements and testing*:

— *Part 1: Chain-saws for forest service*

— *Part 2: Chain-saws for tree service*

Introduction

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

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

At the time of publication of this edition, it was not state of the art to require that starting of the machine would be always possible without causing movement of the saw chain. Such a requirement will be considered for inclusion in the next revision of this International Standard.

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

Part 2: Chain-saws for tree service

1 Scope

This part of ISO 11681 gives safety requirements and measures for their verification for the design and construction for tree service of portable, combustion-engine, hand-held chain-saws having a maximum mass — without guide bar or saw chain and with tanks empty — of 4,3 kg, intended to be used, with the right hand on the rear handle and left hand on the front handle, by a trained operator for pruning and dismantling standing tree crowns, and by persons having read and understood the safety requirements provided in the instruction handbook, using the appropriate personal protective equipment (PPE). 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 part of ISO 11681 deals with all significant hazards, hazardous situations and hazardous events relevant to these machines when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

NOTE See Annex B for a list of significant hazards.

This part of ISO 11681 is applicable to chain-saws manufactured after its date of publication.

2 Normative references

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

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

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

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

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

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

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

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

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

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

ISO 10726, *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, *Forestry machinery — Portable chain-saws — Non-manually actuated chain brake performance*

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

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

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

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

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

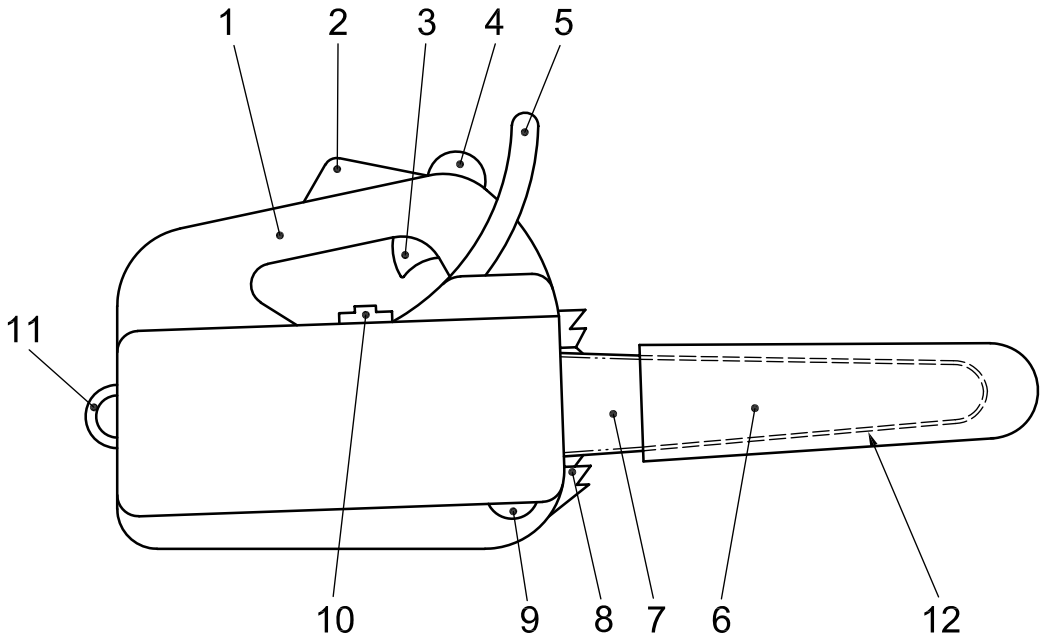
ISO 22868, *Forestry and gardening machinery — Noise test code for portable hand-held machines with internal combustion engine — Engineering method (Grade 2 accuracy)*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6531 and ISO 12100 and the following apply.

NOTE Figure 1 shows an example of a chain-saw within the scope of this part of ISO 11681.



Key

1	rear handle	7	guide bar
2	throttle trigger lock-out	8	spiked bumper
3	throttle trigger	9	chain catcher
4	front handle	10	stopping device
5	front hand guard	11	attachment point
6	guide-bar cover	12	saw chain

Figure 1 — Example of chain-saw

3.1
trained operator
person who has competence and knowledge in

— the use of, and particular hazards associated with using, a chain-saw (for tree service work) manufactured in accordance with the provisions of this part of ISO 11681, and

— the precautions to be taken to limit these hazards, including the wearing of the recommended personal protective equipment (PPE)

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 for relevant but not significant hazards which are not dealt with by this part of ISO 11681.

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, hearing and head protective equipment, as well as safe working procedures (see 5.1).

Except where otherwise specified in this part of ISO 11681, the safety distances specified in ISO 13857:2008, 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, and

— they conform to the dimensions and clearances given for tree-service chain-saws in ISO 7914 (see also 4.12.1).

The strength of both handles shall comply with ISO 7915.

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. 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. Its strength shall comply with ISO 6534.

4.3.1.2 Verification

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

4.3.2 Protection at rear handle

4.3.2.1 Requirements

A 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 broken chain.

This 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 handle (see Figure 2).

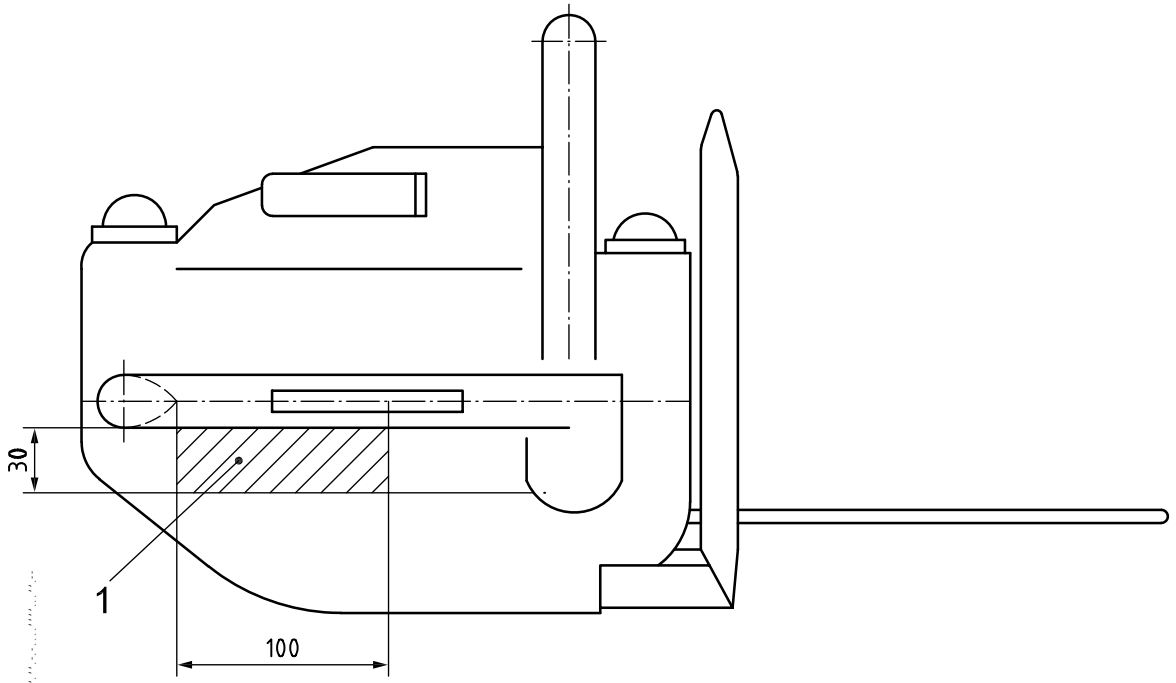
This requirement may also be fulfilled by parts of the machine.

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

4.3.2.2 Verification

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

Dimensions in millimetres



Key

1 minimum area covered or guarded to protect hand from broken saw chain

Figure 2 — Minimum dimensions of protection at rear handle

4.4 Balance and holding moment

4.4.1 Requirements

Chain-saws shall be longitudinally balanced to within ±25° between the centreline of the guide bar and the horizontal plane, and laterally balanced to within ±10° between the guide bar plane and the vertical plane.

The maximum holding moment shall not exceed 6 N·m.

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

4.4.2 Verification

The angles for longitudinal and lateral balance and the holding moment shall be verified by functional testing in accordance with ISO 8334.

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 50 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.

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 tree-service chain-saws given in ISO 13772.

4.5.2.2 Verification

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

4.5.3 Kickback and chain stop angles

4.5.3.1 Requirements

The computed kickback angle or the chain stop angle, whichever is the lesser, shall be determined for each guide bar and chain specified in the instruction handbook and shall not exceed 25°.

4.5.3.2 Verification

The computed kickback angle and chain stop angle shall be verified by functional testing in accordance with ISO 9518.

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. 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. Means for replacing the chain catcher shall be verified by inspection.

4.7 Spiked bumper

4.7.1 Requirements

The chain-saw shall have provision for mounting a spiked bumper (see Figure 1).

4.7.2 Verification

The provision for mounting a spiked bumper 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 either hand when the saw is held with one hand, and with the right hand when the saw is held with both hands, whether or not the operator is 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

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. 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

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.

NOTE When fitted to assist starting, a throttle lock will maintain 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.

Unintentional movement of the saw chain shall be minimized by a throttle-control 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 chain movement begins.

4.12.2.2 Verification

The functionality of the throttle trigger and throttle trigger lock-out shall be verified by inspection while operating the machine. The throttle control linkage design shall be verified by applying a force equal to three times the weight of the machine, without saw chain or guide bar and with tanks empty, in any direction on the rear handle.

4.12.3 Throttle lock

4.12.3.1 Requirements

If a throttle lock is provided to aid starting and its engagement will result in movement of the chain during starting, the throttle lock shall have to 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 lock shall be located outside the gripping area of the handle and it shall require at least two independent motions to engage the throttle lock.

The gripping area is defined as extending from 25 mm in front of, to 75 mm behind, the rear part of the throttle trigger.

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

4.12.3.2 Verification

The functionality of the throttle lock shall be verified by inspection while operating the machine. The specified force for releasing the throttle lock shall be applied within 1 s at a position 5 mm $\pm$ 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 spur sprocket shall be prevented. Covers for the spur 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 interlocked movable guard (detachable without the use of tools).

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

Interlocked movable guards shall have a safety-related control system which complies with at least ISO 13849-1:2006, 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.

4.14 Clutch

4.14.1 Requirements

The chain-saw's clutch shall be so designed that the chain 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 when the engine speed is increased from idling speed to 1,25 times the highest idling speed, in accordance with the instruction handbook.

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 60745-1:2006, Figure 1. The ignition interruption or short-circuiting shall be verified by inspection.

4.16 Protection against contact with hot parts

4.16.1 Requirements

Hot parts, with the exclusion of the guide-bar and saw chain, shall be protected against unintentional contact during normal operation of the chain-saw. Such hot parts shall be considered accessible if they can be reached by the test cone as shown in Figure 3. Neither tip nor conical surface shall come into contact with any hot surface area greater than 10 cm^2.

The temperature for these accessible parts of the machine, as given 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.

4.16.2 Verification

The protection against contact 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 °C ± 3 °C, the recorded temperatures shall be corrected using the formula:

$$T_C = T_O - T_A + 20\ °C$$

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 3 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.

Dimensions in millimetres

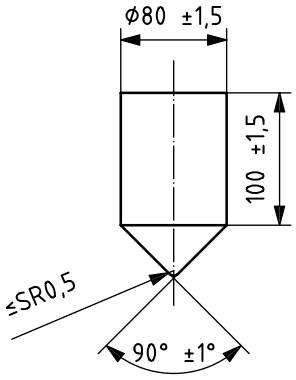


Figure 3 — Test cone

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 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 will 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.

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 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 once with the longest guide bar, as specified in the instruction handbook, at −25 °C ± 2 °C.

Before the drop test, install the guide bar, together with the associated saw chain, and half fill the fuel and oil tanks with a mixture by volume of 40 % glycol and 60 % 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 6531:2008, Figure A.1.

4.18 Exhaust gases

4.18.1 Requirements

The exhaust outlet shall be located so as to direct emissions away from the operator's face 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 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 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 chain tension.

4.20.2 Verification

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

4.21 Attachment device

4.21.1 Requirements

The chain-saw shall be equipped with an attachment device that enables the unit to be attached to a rope or tool strap, as appropriate. The diameter of the opening shall be at least 10 mm. The device shall be capable of carrying a mass of at least six times the total chain-saw weight, with full tanks, longest guide bar and saw chain.

The attachment device shall be located so that the saw will hang with the guide bar down.

4.21.2 Verification

The attachment device shall be verified by inspection and measurement.

4.22 Vibration

4.22.1 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 1 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.

NOTE 2 ISO/TR 22521 provides useful information about comparative data on vibration levels.

4.22.2 Vibration measurement

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

4.23 Noise

4.23.1 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.

ISO/TR 11688-1 gives general technical information and guidance for the design of low-noise machines.

Special care shall be taken in the acoustical design of chain-saws.

NOTE ISO/TR 11688-2 gives useful information on noise generation mechanisms in machinery and ISO 14163 provides guidelines for noise control by silencers. ISO 11691 and ISO 11820 address the testing of the silencer. Information about comparative data on the emission sound pressure levels of some portable hand-held forestry machinery can be found in ISO/TR 22520. See the Bibliography.

4.23.2 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.

4.24 Electromagnetic immunity

4.24.1 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.

4.24.2 Verification

The electromagnetic immunity shall be verified by testing in accordance with ISO 14982.

5 Information for use

5.1 Instruction handbook

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 instruction handbook shall give at least the following technical information for each chain-saw model.

a) **Mass**

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

b) **Volume**

1) Fuel tank, in cm^3.

2) Tank for chain lubricating oil, in cm^3.

c) **Cutting length**

Usable cutting lengths, in cm.

d) **Chain**

1) Maximum chain speed at 1,33 times the maximum engine power speed or maximum engine speed, whichever is the lesser, in m/s.

2) Specified pitch, in mm [inches].

3) Specified gauge (thickness of drive links), in mm [inches].

4) Type of chain and guide bar.

e) **Drive sprocket**

Specified number of teeth and specified pitch.

f) **Engine**

1) Engine displacement, in cm^3.

2) Maximum engine power in accordance with ISO 7293, in kW.

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

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

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

6) Values for equivalent vibration total value (for each handle), determined in accordance with ISO 22867, together with uncertainty of stated values, both in m/s^2.

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

5.1.3 Other information

The instruction handbook shall contain, in accordance with ISO 12100:2010, 6.4.5, comprehensive instructions and information on all aspects of operator/user maintenance, and the safe use of the chain-saw, including type and use of PPE, suitable clothing and the need for training in all manual chain-saw operations.

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

The importance of reading the instruction handbook thoroughly before using the chain-saw shall be stressed on the front of the instruction handbook.

A warning shall also be given that the chain-saw is of a special type designed especially for tree service. It shall be stated that the saw is only to be used by a trained operator using a carefully designed, safe work system, and it shall be emphasized that the chain-saw is only intended for tree service under these defined conditions. It shall also be stated that, generally, the chain-saw is intended to be used with two hands in the same way as a conventional chain-saw.

NOTE Annex A gives useful guidance on the use of the tree service chain-saw, including safe work system.

The terms used in all documentation shall be in accordance with ISO 6531.

The instruction handbook 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,
- 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 chain adjustments with the engine stopped, including regular checking of the chain brake,
- regular functional checks of the clutch (no 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 precautions;

c) the chain-saw itself, including

- a description, identification and the nomenclature of principal parts, including the safety devices of the 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 an octave band analysis to be supplied upon request to enable selection of the correct hearing protection,

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

d) the use of the chain-saw, 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 significant damage or defects,

— instructions regarding the starting procedure, including the instruction that starting shall always be done with the chain brake activated and an explanation of how to achieve this,

— 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 suitable for tree climbing, including mention 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 the means for users to protect themselves and, if appropriate, recommendations for limiting the duration of operation,

— instructions on the regular testing of the chain brake,

— 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,

— 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,

— information regarding the appropriate use of a spiked bumper, e.g. the advantage of using a spiked bumper when cutting thick branches,

— for the effects of vibration, instructions on the use of gloves,

— an instruction that the chain-saw, when held in both hands, is to be held with the right hand on the rear handle and the left hand on the front handle, and

— a description of how to use the saw, including the importance of the operator being trained in safe climbing techniques and in the use of all recommended additional safety equipment, such as harness, loops, straps, rope and carabiners, and other fall arrest systems for operator and saw (see Annex A for examples);

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,

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

— the procedure for sharpening the saw chain, with particular emphasis on the effects of kickback behaviour that may result if specifications are not followed, and

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

5.2 Marking

All chain-saws 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;

— designation of machinery;

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

— serial number, if any.

NOTE The designation of machinery allows the technical identification of the product. This can be achieved by a combination of letters and/or numbers and combined with the designation of the series or type.

The chain-saw shall also bear the following information:

— identification and method of operation — preferably according to ISO 3767-5 — of the controls for the engine stopping device, chain brake, manual oiler control, choke control, primer and heated handle switch (if provided);

— identification of carburettor and oil adjustments;

— identification of fuel and oil tank openings and/or caps.

If symbols are used, they shall be explained in the instruction handbook, 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, e.g. 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 $0{,}09w$, in newtons, where w is the test specimen width, in millimetres.

5.3 Warnings

All chain-saws shall be marked, using text or pictorials, with an indication that

— head, hand, arm, leg and foot, and eye and hearing protection is necessary (examples of pictorials can be found in ISO 17080:2005, Figures A.3.4 and A.3.5),

— protective clothing is necessary, e.g. for feet, legs, hands and forearms, and

— by a warning sign:

WARNING: THIS CHAIN-SAW IS FOR USE BY TRAINED TREE SERVICE OPERATORS ONLY. SEE INSTRUCTION HANDBOOK!

See also 5.4.4.

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

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

When symbols are used, they shall, except if they are cast, embossed or stamped, be in contrast to their background. Embossed features shall be at least 0,3 mm in height 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.

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 $0{,}09w$, in newtons, where w is the test specimen width, in millimetres.

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 and material equal to that on which the sign 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 sign 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 protective layer 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 N and a rolling speed of approximately 200 mm/s shall be maintained.

After being applied to the test panels, the test specimens shall be conditioned at a temperature of 23 °C ± 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 s ± 3 s.

After having removed it from the test liquid, wipe the test specimen with a force of 10 N and 1 cycle/s, using an unbleached cotton cloth soaked in the test liquid for 30 s ± 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 min ± 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 protective layer, to a pulling machine. Apply a pulling force upwards at an angle of 90° 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.

5.4.4 At point of sale

Visible information or labelling shall be provided for the point of sale of the chain-saw (e.g. hang tag and/or carton sticker), easily visible to the potential purchaser of the chain-saw and giving, as a minimum, the following information in the language of the country of sale:

WARNING: THIS CHAIN-SAW IS FOR USE BY TRAINED TREE SERVICE OPERATORS ONLY. SEE INSTRUCTION HANDBOOK!

Annex A
(informative)

Working with tree service chain-saws from rope and harness

A.1 Overview

This annex presents suitable working practices for reducing the risk of injury from the use of tree service chain-saws when working at height from a rope and harness. While it may form the basis of guidance and training literature, it should not be regarded as a substitute for formal training. The guidance given in this annex is only an example of best working practice.

NOTE National or other regulations, which could be more stringent, can apply.

Presented are

— general recommendations that should be followed before using a tree service chain-saw for work at height from a rope and harness,

— preparations for using a tree service chain-saw from a rope and harness, and

— how to use a tree service chain-saw for pruning and dismantling, including secure work positioning for two-handed use, starting the chain-saw, cutting with the chain-saw, restrictions on one-handed use and freeing a trapped saw.

This annex does not deal with techniques for controlling sections of branches and stems cut by the saw. Nor does it cover those aspects of safe use already dealt with in 5.1.

A.2 General recommendations

The operator of a tree service chain-saw working at height from a rope and harness should never work alone. A ground worker trained in appropriate emergency procedures should be present to assist.

The operator should be trained in general safe climbing and work positioning techniques and should be properly equipped with harness, ropes, strops, carabiners and other equipment for maintaining secure and safe working positions for both himself and the saw.

A.3 Preparing the saw for use

The chain-saw should be checked, fuelled, started and warmed up by the ground worker and then switched off before being sent up to the operator in the tree.

The chain-saw should be fitted with a suitable strop for attachment to the operator's harness (see Figure A.1).

a) Secure the strop around the attachment point on the rear of the saw.

b) Provide suitable carabiners to allow indirect (i.e. via the strop) and direct attachment (i.e. at the attachment point on the saw) of the saw to the operator's harness.

c) Ensure the saw is securely attached when sent up to the operator.

d) Ensure the saw is secured to the harness before disconnecting it from the means of ascent.

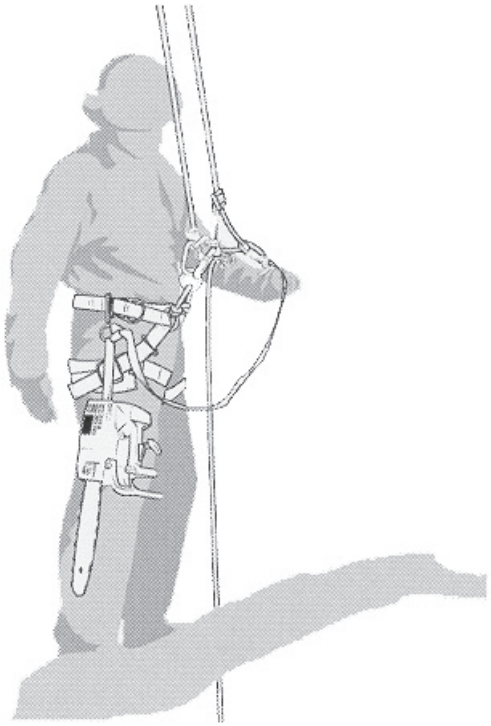


Figure A.1 — Example of attachment of tree service chain-saw to operator's harness

The ability to directly attach the saw to the harness reduces the risk of damage to equipment when moving around the tree. The saw should always be switched off when directly attached to the harness.

The saw should only be attached to the recommended attachment points on the harness. These may be at mid-point (front or rear) or at the sides. Wherever possible, the saw should be attached to the centre rear mid-point to keep it clear of climbing lines and to support its weight centrally down the operator's spine. See Figure A.2.

When moving the saw from any one attachment point to another, the operator should ensure that it is secured in the new position before releasing it from the previous attachment point.

Figure A.2 — Example of attachment of tree service chain-saw to centre rear mid-point on harness

A.4 Using the saw in the tree

An analysis of accidents with these saws during tree service operations shows the primary cause as being inappropriate one-handed use of the saw. In the vast majority of accidents, operators fail to adopt a secure work position that allows them to hold both handles of the saw, resulting in an increased risk of injury due to

— not having a firm grip on the saw if it kicks back,

— a lack of control of the saw, such that it is more likely to come into contact with climbing lines and the operator's body (particularly the left hand and arm), and

— loss of control owing to an insecure work position and resulting in contact with the saw (unexpected movement during operation of the saw).

A.4.1 Securing the work position for two-handed use

In order to allow the saw to be held with both hands, as a general rule, operators should aim for a secure work position in which the saw is operated at

— hip level, when cutting horizontal sections, and

— solar-plexus level, when cutting vertical sections.

Where the operator is working close into vertical stems with low lateral forces on the work position, secure footing could be all that is needed for maintaining a secure work position. However, as operators move away from the stem, they will need to take measures to remove or counteract increasing lateral forces by, for example, redirecting the main line via a supplementary anchor point or using an adjustable strop direct from the harness to a supplementary anchor point (see Figure A.3).

Figure A.3 — Example of redirection of main line via supplementary anchor point

Gaining a secure footing at the work position can be aided by the use of a temporary foot stirrup created from an endless sling (see Figure A.4).

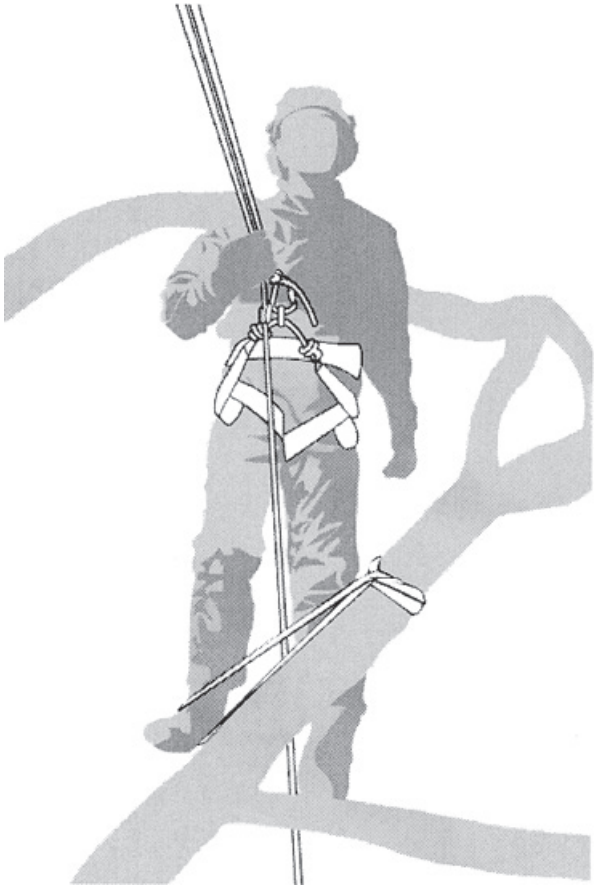


Figure A.4 — Example of temporary foot stirrup created from endless sling

A.4.2 Starting the saw in the tree

When starting the saw in the tree, the operator should

a) apply the chain brake before starting,

b) hold the saw on either the left or right side of the body when starting:

   1) on the left side, holding the saw with the left hand on the front handle and thrusting the saw away from the body while holding the pull starter cord in the right hand, or

   2) on the right side, holding the saw with the right hand on either handle and thrusting the saw away from the body while holding the pull starter cord in the left hand.

The chain brake should always be engaged before a running saw is lowered onto its strop.

The operator should always check that the saw has sufficient fuel before undertaking critical cuts.

A.4.3 One-handed use of the chain-saw

Operators should not use tree service chain-saws one-handed when the work position is unstable or in preference to a handsaw when cutting small diameter wood at the branch tips.

Tree service chain-saws should only be used one-handed where

a) operators cannot gain a work position enabling two-handed use,

b) they need to support their working position with one hand, and

c) the saw is being used at full stretch, at right angles to and out of line with the operator's body.

Operators should never

— cut with the kickback zone at the tip of the chain-saw guide bar,

— "hold and cut" sections, or

— attempt to catch falling sections.

A.4.4 Freeing a trapped saw

It the saw becomes trapped during cutting, operators should

a) switch off the saw and attach it securely to the tree inboard (i.e. towards the trunk side) of the cut or to a separate tool line,

b) pull the saw from the kerf while lifting the branch as necessary, and

c) if necessary, use a handsaw or second chain saw to release the trapped saw by cutting a minimum of 30 cm away from the trapped saw.

Whether a handsaw or a chain-saw is used to free a trapped saw, the release cuts should always be outboard (toward the tips of the branch), in order to prevent the saw being taken with the section and further complicating the situation.

Annex B
(informative)

List of significant hazards

This annex specifies the significant hazards, hazardous situations and significant hazardous events that have been identified as being significant for the chain-saws within the scope of this part of ISO 11681 and which require specific action by the designer or manufacturer to eliminate or reduce the risk.

Table B.1 — List of significant hazards associated with portable chain-saws for tree service

Ref. No.	Hazard		Subclause of this part of ISO 11681
	Origin (source)	Potential consequences	
1	**Mechanical hazards**		
	Rotary saw chain	Cutting or severing of upper and lower extremities	4.3, 4.5, 4.6, 4.9, 4.14
	Moving transmission parts	Entanglement, severing of upper extremities	4.13
	Thrown objects from saw chain	Injury from impact of ejected objects	4.8
	Break-up of saw chain	Injury from ejected parts of saw chain	4.3, 4.6, 4.19, 4.20, 5.1
	Engine control system malfunction or controls resulting in unexpected start-up with saw chain engaged, unexpected over-run/over-speed	Shearing, cutting, severing or entanglement of upper and lower extremities	4.2, 4.10, 4.11, 4.12, 4.14, 4.23, 5.1, 5.2
2	**Electrical hazards**		
	Live parts of electrical system (direct contact) or parts which have become under high voltage under faulty conditions (indirect contact)	Injuries from electric shock to the body	4.15
3	**Thermal hazards**		
	Hot engine parts, including parts which have become hot caused by heat radiation	Injury from burns and scalds from accidental contact	4.16
4	**Noise hazards**		
	Engine, transmission and cutting system, including resonance of fixed machine parts	Discomfort, partial hearing loss, deafness, loss of balance, loss of awareness, stress	4.23, 5.1, 5.3
5	**Vibration hazards**		
	Engine, handles	Discomfort, neurological, osteo-articular and vascular disorders	4.22, 5.1, 5.3
6	**Material/substance hazards**		
	Engine exhaust gases, gasoline	Respiration problems through inhalation of harmful gases and injuries to the skin from contact with harmful liquids	4.18, 5.1
7	**Ergonomic hazards**		
	Location and design of controls, handles, etc.	Discomfort, fatigue, injuries to locomotor apparatus, loss of control	4.2, 4.4, 4.7, 4.10, 4.11, 4.12, 5.1

Table B.1 (*continued*)

Ref. No.	Hazard		Subclause of this part of ISO 11681
	Origin (source)	Potential consequences	
8	**Combination of hazards**		
	Poor posture or excessive effort in combination with inadequate design or location of manual controls, including inadequate consideration of human hand–arm anatomy, related to handle design, machine balance and the use of spiked bumper.	Discomfort, fatigue, injuries to locomotor apparatus, loss of control	4.2, 4.4, 4.5, 4.7, 4.10, 4.11, 4.12, 4.22, 5.1, 5.3, Annex A
	Hot engine parts/electrical short-circuiting in combination with leaking gasoline tank/ gasoline spilling	Burns and scalds by resulting fire	4.16, 4.17, 5.1

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