INTERNATIONAL STANDARD

ISO 11681-1

Second edition
2004-02-01

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

Reference number
ISO 11681-1:2004(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a world-wide 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 11681-1 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 17, *Manually portable forest machinery*.

This second edition cancels and replaces the first edition (ISO 11681-1:1996), 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: Tree service chain-saws*

Introduction

This document is a type C standard as defined in ISO 12100-2.

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

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

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

Part 1:
Chain-saws for forest service

1 Scope

This part of ISO 11681 deals with the significant hazards and specifies safety requirements and their verification for design and construction of portable combustion-engine, hand-held chain-saws, designed only for use by one operator and intended for forest work.

It describes methods for the elimination or reduction of hazards arising from their use. In addition it specifies the type of information on safe working practices to be provided by the manufacturer.

It deals with all significant hazards. It does not cover the hazard from kickback for machines with an engine displacement over 80 cm^3. The environmental aspects, except for noise, have not been considered.

Chain-saws covered by this part of ISO 11681 are designed for use by persons having read and understood the safety requirements in the instruction handbook and using the appropriate personal protective equipment (PPE). The chain-saws covered are designed only to be operated with the right hand on the rear handle and the left hand on the front handle.

This part of ISO 11681 is not applicable to chain-saws which are manufactured before the date of publication of this document.

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 6531:1999, *Machinery for forestry — Portable chain-saws — Vocabulary*

ISO 6533:2001, *Forestry machinery — Portable chain-saw front hand-guard — Dimensions and clearances*

ISO 6534:1992, *Portable chain-saws — Hand guards — Mechanical strength*

ISO 6535:1991, *Portable chain-saws — Chain brake performance*

ISO 7293:1997, *Forestry machinery — Portable chain-saws — Engine performance and fuel consumption*

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

ISO 7915:1991, *Forestry machinery — Portable chain-saws — Determination of handle strength*

ISO 8334:1985, *Forestry machinery — Portable chain-saws — Determination of balance*

ISO 9518:1998, *Forestry machinery — Portable chain-saws — Kickback test*

ISO 10726:1992, *Portable chain-saws — Chain catcher — Dimensions and mechanical strength*

ISO/TR 11688-1:1995, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning*

ISO 13772:1997, *Forestry machinery — Portable chain-saws — Non-manually actuated chain brake performance*

ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*

ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles*

ISO 22867:—[1)], *Portable hand-held forestry machines with internal combustion engine — Vibration test code — Measurement of vibration at the handles*

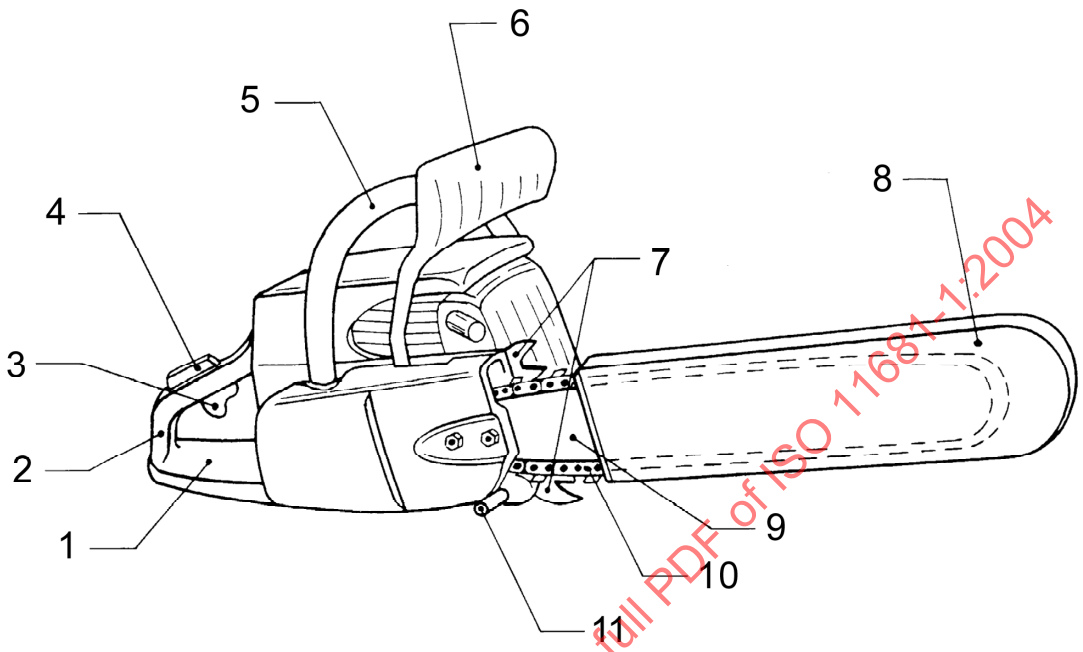
ISO 22868:—[1)], *Noise test code for portable hand-held forestry machines with an internal combustion engine — Determination of A-weighted emission sound pressure levels at the operator's position, and the sound power level — Engineering method (grade 2)*

IEC 60335-1, *Household and similar electrical appliances — Safety — Part 1: General requirements*

1) To be published.

3 Terms and definitions

For the purposes of this document, the terms definitions given in ISO 6531 and ISO 12100-1 apply. Figure 1 provides an example of a chain-saw.



Key

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

Figure 1 — Example of chain-saw

4 List of significant hazards

This clause specifies the significant hazards, hazardous situations and events in as far as they are dealt with in this part of ISO 11681 (see Table 1), identified by risk assessment as significant for this type of machinery, and which require action to eliminate or reduce the risk.

Table 1 — Significant hazards, hazardous situations and events covered by this part of ISO 11681

	Hazard	Subclause
1	Mechanical hazards created by cutting and impact, related to the saw chain.	5.3; 5.5; 5.6; 5.9; 5.19
2	Electrical hazards, created by contact with parts under high voltage (direct contact) or parts which have become under high voltage under faulty conditions (indirect contact).	5.12
3	Thermal hazards resulting in burns, scalds and other injuries, created by possible contact of persons with objects or materials with high temperature including the radiation of heat sources.	5.15
4	Noise hazards, resulting in hearing losses (deafness) and other physiological disorders (e.g. loss of balance, loss of awareness).	5.21; 6.2; 6.4
5	Vibration hazards (resulting in peripheral circulatory and nervous functional disturbances in the hand-arm system, such as the white finger disease).	5.20; 6.2; 6.4
6	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts related to exhaust gases.	5.16
7	Fire or explosion hazards related to fuel spillage.	5.18; 6.2
8	Hazards from neglect of ergonomic principles in machine design, such as hazards from unhealthy postures or excessive efforts and inadequate consideration of human hand-arm anatomy, related to handle design, machine balance and the use of spiked bumper.	5.2; 5.4; 5.7; 5.10; 6.2
9	Hazards from unexpected start-up, unexpected overrun/over-speed from failure/disorder of the control system related to failure in the handles and position of the controls.	5.2; 5.10; 5.11; 5.13
10	Hazards from impossibility of stopping the machine in the best possible conditions related to the handle strength and position of the engine stopping device.	5.2; 5.11
11	Hazards from failure of the control system related to handle strength, position of controls and marking.	5.2; 5.10; 5.11; 5.13; 6.3
12	Hazards from break-up (chain) during operation related to saw chain.	5.2; 5.3; 5.6; 5.17
13	Hazards from ejection of objects or fluids related to chip discharge and fuel spillage.	5.8; 5.18

5 Safety requirements and verification

5.1 General

The safe running of chain-saws depends on both the safety requirements as given in this clause and the safe working conditions associated with the use of adequate personal protection equipment (PPE) such as gloves, leg protection, boots, and eye, ear and head protection equipment.

Chain-saws shall comply with the safety requirements and/or protective measures of this clause. Chain-saws shall also be marked according to 6.3 and carry warnings according to 6.4. In addition, the machine shall be designed according to the principles of ISO 12100-2 for hazards relevant but not significant, which are not dealt with by this document.

5.2 Handles

5.2.1 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 when wearing protective gloves,

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

— they conform to the dimensions and clearances given in ISO 7914.

The strength of both handles shall at least comply with ISO 7915.

Chain-saws having a system for isolating the machine vibration from the handles shall be designed so that the operator has the possibility of stopping the engine in a controlled manner with the engine stopping device (see 5.11), even in case of failure of the vibration isolation system.

5.2.2 Verification

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

5.3 Hand protection

5.3.1 Protection at the front handle

5.3.1.1 Requirements

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

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

5.3.1.2 Verification

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

5.3.2 Protection at the rear handle

5.3.2.1 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 a broken saw-chain.

This guard shall extend from the right edge of the handle for at least 30 mm at the guide bar side and at least 100 mm lengthwise (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.

5.3.2.2 Verification

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

Dimensions in millimetres

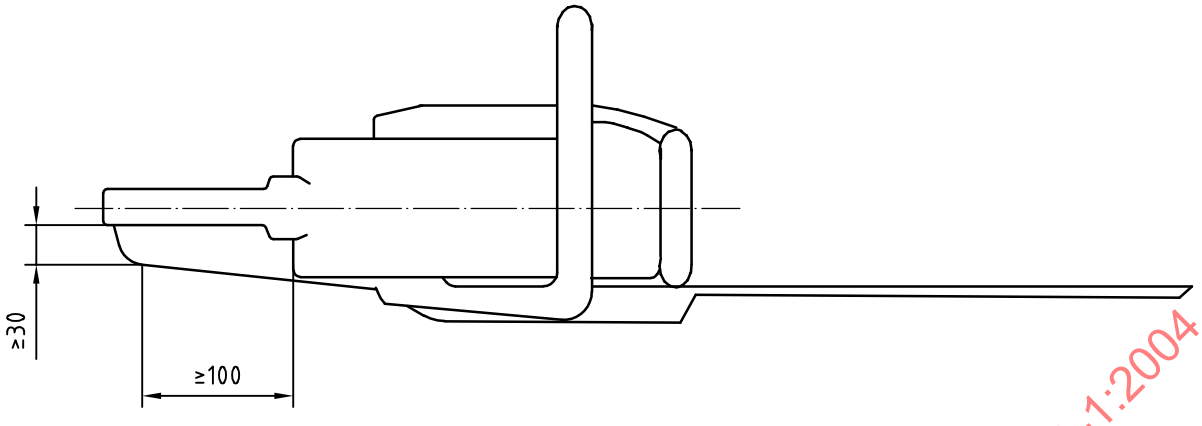


Figure 2 — Minimum dimensions of protection at the rear handle

5.4 Balance

5.4.1 Requirements

There shall be means to evenly balance the chain-saw when fitted with the guide bars as recommended in the instruction handbook. The maximum angle between the centreline of the guide bar and the horizontal plane shall not exceed ± 30°.

5.4.2 Verification

The possibility to balance the chain-saw shall be verified by functional testing in accordance with ISO 8334.

5.5 Protection against injury by kickback

5.5.1 Chain brake

5.5.1.1 Requirements

The chain-saw shall be fitted with a chain brake. It shall be possible to activate the chain brake manually by means of the front-hand guard. The chain brake release force shall be between 20 N and 60 N.

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

5.5.1.2 Verification

The chain brake release force shall be verified by functional testing in accordance with ISO 6535. The braking time shall be verified by functional testing in accordance with ISO 6535.

5.5.2 Non-manual chain brake system

5.5.2.1 Requirements

There shall also be a non-manual chain brake system, which operates the chain brake when kickback occurs. This system shall meet the requirements given in ISO 13772.

5.5.2.2 Verification

The non-manually activated chain brake system shall be verified by functional tests according to ISO 13772.

5.5.3 Kickback and chain stop angles

5.5.3.1 Requirements

The computed kickback angle and chain stop angle shall be determined for each cutting attachment specified and shall not exceed 45° for saws with combustion engine displacement up to 80 cm^3.

NOTE Sufficient information to set a limit is not available for saws over 80 cm^3.

5.5.3.2 Verification

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

5.6 Chain catcher

5.6.1 Requirements

The chain-saw shall be fitted with a chain catcher located and with dimensions and strength as described in ISO 10726.

5.6.2 Verification

Dimensions shall be verified by measurement. Strength requirements shall be verified by functional testing as described in ISO 10726.

5.7 Spiked bumper

5.7.1 Requirements

The chain-saw shall be equipped with a spiked bumper (see Figure 1) or with provision to mount a spiked bumper.

5.7.2 Verification

The presence of a spiked bumper or the provision to mount a spiked bumper shall be verified by inspection.

5.8 Chip discharge

5.8.1 Requirements

The chain-saw shall be designed so that wood particles are directed below the underside of the saw when it is in an upright (cross cutting) position. See also 6.4.

5.8.2 Verification

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

5.9 Guide-bar cover

5.9.1 Requirements

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

5.9.2 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.

5.10 Throttle trigger

5.10.1 Dimensions

5.10.1.1 Requirements

The throttle trigger shall be positioned so that it can be pressed and released with a gloved hand while holding the rear handle by fulfilling the dimensional requirements according to ISO 7914.

5.10.1.2 Verification

The dimensions shall be verified by measurement.

5.10.2 Unintentional movement

5.10.2.1 Requirements

Unintentional movement of the saw chain shall be minimized by

— a throttle trigger that, when released, automatically reverts to the idling position and is retained in that position by the automatic engagement of a throttle trigger lock-out unless the lock-out is already released, and

— a throttle control linkage so designed that a force applied on the rear handle will not increase the engine speed to a point where the clutch engages and chain movement begins.

5.10.2.2 Verification

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

5.10.3 Throttle lock

5.10.3.1 Requirements

If a throttle lock is provided for cold starting, it shall be such that the lock has to be engaged manually and is automatically released when the throttle trigger is operated.

5.10.3.2 Verification

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

5.11 Engine stopping device

5.11.1 Requirements

The machine shall be fitted with an engine stopping device by which the engine can be brought to a final stop and which does not depend on sustained manual effort for its operation. The control for this device shall be so positioned that it can be operated by the operator's right hand while holding the saw, wearing protective gloves. The purpose and method of operation of the device shall be clearly and durably marked (see 6.3).

The colour of the control shall clearly contrast with the background.

5.11.2 Verification

The function of the engine stopping device shall be verified by inspection while operating the machine. The control location shall be verified by inspection.

5.12 Protection against contact with parts under high voltage

5.12.1 Requirements

All high voltage parts of the circuit, including spark plug terminals, shall be located and/or insulated so that the operator can not make accidental contact with them.

5.12.2 Verification

The location and insulation of the parts under high voltage shall be verified by inspection and using a finger probe as specified in IEC 60335-1.

5.13 Clutch

5.13.1 Requirements

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

5.13.2 Verification

The function of the clutch shall be verified by running the engine with any speed up to, but not including, 1,25 times the idling speed specified in the instruction handbook.

5.14 Carburettor adjustment

5.14.1 Requirements

The carburettor adjustment shall be clearly and indelibly marked. The markings used shall be illustrated and explained in the instruction handbook (see 6.2).

NOTE Examples of suitable symbols are given in ISO 3767-5 [1].

5.14.2 Verification

The markings shall be verified by inspection.

5.15 Protection against contact with hot parts

5.15.1 Requirements

The silencer, the cylinder, or other parts that could come into direct contact with the cylinder, shall be protected so that they are not accessible to unintentional contact during normal operation of the machine. This applies to parts which are less than 120 mm away from the far side of the front handle above the machine (see Figure 3) and less than 80 mm from the far side of the front handle at the sides of the machine (see Figure 4). It also applies to the area of the silencer which can be contacted by the extension of a straight line between the outer side of the front handle above the machine and the outer edge of the housing over the silencer (see dimension > 0 in Figure 5).

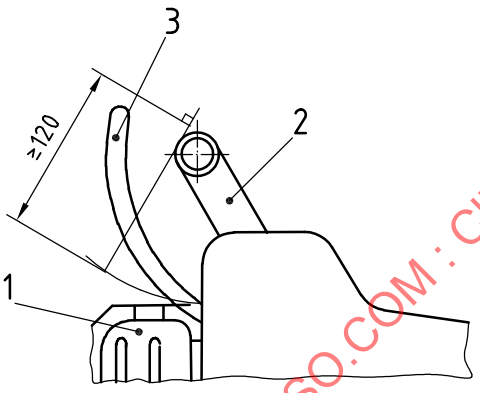
Silencers other than those mounted at the front of saws shall be provided with a guard as protection against contact so that the accessible area does not exceed 10 cm^2. The temperature for the accessible parts of the machine as defined above, as well as the guard for the cylinder, shall not cause a hazard to the operator.

NOTE For further information, see EN 563:1994 [9], and especially Annex C to that document.

5.15.2 Verification

The guarding of the cylinder or silencer shall be verified by measurement of required distances. Guards for silencers other than those mounted at the front of saws shall be verified by determining the area accessible by applying the test cone as specified in Figure 6 with minimum force.

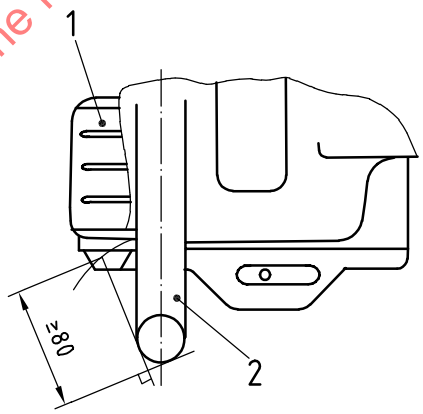
Dimensions in millimetres



Key

1 silencer
2 front handle
3 front hand-guard

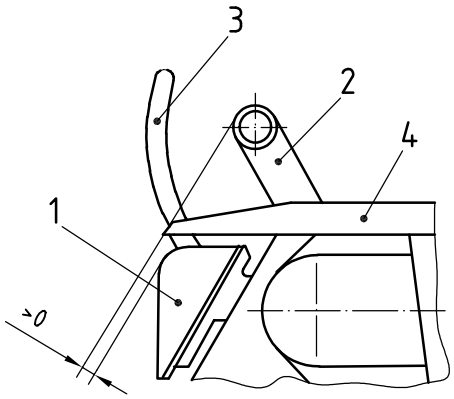
Figure 3 — Required distance between front handle and unprotected hot parts



Key

1 silencer
2 front handle

Figure 4 — Required lateral distance between front handle and unprotected hot parts (plain view)



Key

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

Figure 5 — Guarding against contact with hot parts

Dimensions in millimetres

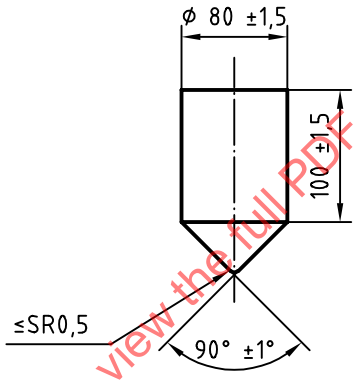


Figure 6 — Test cone

5.16 Exhaust gases

5.16.1 Requirements

The exhaust outlet shall be located to direct emissions away from the operator's face in normal working positions.

5.16.2 Verification

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

5.17 Chain lubrication

5.17.1 Requirements

The cutting attachment shall be automatically lubricated. If, additionally, a manual oiler is provided, it shall be located so it can be operated by right hand while holding the saw.

5.17.2 Verification

The function of the saw chain oiling system shall be verified by inspection when operating the machine. The location of a manual oilier, if provided, shall be verified by inspection.

5.18 Tank openings

5.18.1 Requirements

The fuel cap shall have a retainer.

The fuel tank opening shall be at least 20 mm diameter and the oil tank opening at least 19 mm diameter. Each opening or cap shall be clearly marked. If only the caps are marked, they shall not be interchangeable. See also 6.3.

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

The filler openings shall be so located that the filling of the tanks with a suitable funnel is not obstructed by other components.

5.18.2 Verification

The fuel cap retainer and opening dimensions 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.

5.19 Chain tensioning

5.19.1 Requirements

Chain-saws shall be provided with means for adjustment of chain tension.

5.19.2 Verification

The adjustment means shall be verified by inspection.

5.20 Vibration

5.20.1 Reduction by design and protective measures

The machine shall be designed to generate vibration levels as low as practicable. The main sources causing and influencing vibration are the dynamic forces from engine, cutting means, unbalanced moving parts, impact in gear sprockets, bearings and other mechanisms and the interaction between operator, machine and material being worked.

NOTE 1 CR 1030-1[10] gives general technical information on widely recognized technical rules and means and can be used as a guideline for the design of reduced hand-arm vibration machines.

NOTE 2 ISO/TR 22521[8] provides useful information about comparative data on vibration levels.

5.20.2 Reduction by information

Information on residual risks, after technical measures to control vibration emission at the design stage have been implemented, shall be given in the instruction handbook, see 6.2.

5.20.3 Vibration measurement

The weighted acceleration sum shall be measured and calculated in accordance with ISO 22867.

5.21 Noise

5.21.1 Reduction at source by design and by protective measures

The machine shall generate noise levels as low as practicable. The main sources causing and influencing noise are air intake system, engine cooling system, engine exhaust system, cutting system, vibrating surfaces and the interaction between operator and machine.

ISO/TR 11688-1 gives general technical information on widely recognized technical rules and means to be followed in the design of low-noise machines. Special care shall be taken in the acoustical design of chain-saws.

NOTE 1 ISO/TR 11688-2 [3] gives useful information on noise generation mechanisms in machinery and ISO 14163 [6] gives guidelines for noise control by silencers. ISO 11691 [4] and ISO 11820 [5] can be used for the testing of the silencer.

NOTE 2 Information about comparative data on emission sound pressure levels can be found in ISO/TR 22520 [7].

5.21.2 Reduction by information

Information on residual risks, after technical measures to control noise emission at the design stage have been implemented, shall be given in the instruction handbook (see 6.2).

5.21.3 Noise measurement

The emission sound pressure levels and sound power levels shall be determined in accordance with ISO 22868.

6 Information for use

6.1 Technical data

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

Mass

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

Volume

Fuel tank ..... cm^3

Tank for chain lubricating oil ..... cm^3

Cutting length

The usable cutting lengths ..... cm

Chain

Specified pitch ..... mm (inches)

Specified gauge (thickness of drive links) ..... mm (inches)

Type of chain and guide bar

Drive sprocket

Specified number of teeth and specified pitch

Engine

Engine displacement ..... cm^3

Maximum engine power (in accordance with ISO 7293) ..... kW

Recommended maximum speed with cutting attachment ..... min^{-1}

Recommended speed at idling ..... min^{-1}

Specific fuel consumption at maximum engine power (on request) ..... g/kWh

A-weighted sound power level and A-weighted emission sound pressure level at the operator position according to ISO 22868 ..... dB (A)

Vibration emission levels (according to ISO 22867) ..... m/s^2

6.2 Instruction handbook

The instruction handbook shall contain comprehensive instructions and information on all aspects of operator/user maintenance and the safe use of the chain-saw, including type and use of personal protective equipment (PPE), suitable clothing and the need for training in all manual chain-saw operations. The instructions shall take into account use of a chain-saw by a first-time and/or inexperienced operator. ISO 12100-2 gives guidance on the content of the information for use.