INTERNATIONAL STANDARD

ISO 11681-2

First edition
1998-04-01

Machinery for forestry — Portable chain-saws — Safety requirements and testing —

Part 2:
Chain-saws for tree service

Matériel forestier — Scies à chaîne portatives — Exigences de sécurité et essais —

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

Reference number
ISO 11681-2:1998(E)

Content

International Organization for Standardization
Case postale 56 • CH-1211 Genève 20 • Switzerland
Internet central@iso.ch
X.400 c=ch; a=400net; p=iso; o=isocs; s=central

Printed in Switzerland

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.

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.

International Standard 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*.

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

— Part 1: Chain-saws for normal forestry work

— Part 2: Chain-saws for tree service.

Annexes A , B and C form an integral part of this part of ISO 11681.

Introduction

This part of ISO 11681 has been prepared for a special type of chain-saws used by trained persons for tree service work up in trees.

This part of ISO 11681 differs from ISO 11681-1[1)] as follows:

— clause 1: the tree service chain-saws are limited in size by a maximum engine displacement of 40 cm^3;

— clause 3: definitions for tree service chain-saw, attachment point and vibration isolation system have been added;

— subclause 4.1: the required handle dimensions have been altered;

— subclause 4.3: a requirement for maximum allowed holding moment has been added;

— subclause 4.4: requirements have been added that the non-manual chain brake system meet the requirement in ISO 13772 and that the allowed kickback angle be reduced to 30°;

— subclause 4.6: a permanently fixed spiked bumper is excluded;

— subclauses 4.9 and 4.10: the achievable values for noise and vibration have been deleted and replaced by a note concerning the need for a future development of "state of the art" values;

— subclause 4.12: the requirement has been modified to be valid for an engine-stopping device (instead of an ignition switch);

— subclause 4.13: the requirement for protection from contact with parts under high voltage has been enlarged to include a requirement for an ignition interruption or short-circuiting device on the low voltage side and a method to verify, by inspection and use of a finger probe, the protection of the operator from unintentional contact with parts under high voltage;

— subclause 4.16: the requirement for protection from hot parts has been enlarged to all parts of the machine and a reference to EN 563 has been added;

— subclause 4.18: the requirement has been clarified to be valid when holding the saw in both handles (normal operating position);

— subclause 4.21: a requirement for an attachment point has been added

— subclause 6.2: additional information is required;

— subclause 6.3: new safety warnings have been added;

— subclause 6.4: new markings on the saw are required.

Machinery is to comply as appropriate with ISO/TR 12100 for hazards which are not covered by this part of ISO 11681.

1) Equivalent to EN 608:1994.

Machinery for forestry — Portable chain-saws — Safety requirements and testing —

Part 2:
Chain-saws for tree service

1 Scope

This part of ISO 11681 specifies safety requirements and their verification for the design and construction of portable combustion-engined, hand-held chain-saws for tree service, designed for use by one operator (see figure 1).

It is applicable to chain-saws with a maximum engine displacement of 40 cm^3. These chain-saws are only intended to be used for tree service operation by an operator working up in trees.

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 does not, however, give any technical requirement to reduce noise and vibration hazards. Indeed, the different means available to reduce these hazards are a matter for the technical aids to which the manufacturer may resort, through specialized books or specific bodies.

The list of significant hazards which require action to reduce the risk is given in annex A.

The environmental aspects are not covered.

This part of ISO 11681 is primarily applicable to machines which are manufactured after the date publication.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 11681. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 11681 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7182:1984, *Acoustics — Measurement at the operator's position of airborne noise emitted by chain-saws*.[2)]

ISO 3767-5:1992, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 5: Symbols for manual portable forestry machinery*.

ISO 3864:1984, *Safety colours and safety signs*.

ISO 6531:—[3)], *Machinery for forestry — Portable hand-held chain-saws — Vocabulary*.

ISO 6533:1993, *Forestry machinery — Portable chain-saw front hand-guard — Dimensions*.

[2)] Equivalent to EN 27182:1991.

[3)] To be published. (Revision of ISO 6531:1982)

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 7505:1986, *Forestry machinery — Chain saws — Measurement of hand-transmitted vibration*.

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

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

ISO 9207:1995, *Manually portable chain-saws with internal combustion engine — Determination of sound power levels — Engineering method (grade 2).*

ISO 9518:—[4], *Forestry machinery — Portable chain-saws — Kickback test*.

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

ISO/TR 12100-1:1992, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology*.[5]

ISO/TR 12100-2:1992, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles and specifications*.[6]

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

IEC 60335-1:1991, *Safety of household and similar electrical appliances — Part 1: General requirements*.

EN 563:1994, *Safety of machinery — Temperatures of touchable surfaces — Ergonomics data to establish temperature limit values for hot surfaces*.

3 Definitions

For the purposes of this part of ISO 11681, the definitions given in ISO 6531 and the following apply.

3.1 chain-saw for tree service
chain-saw with a limited engine displacement, specially designed for use by trained tree service workers only when working up in trees

3.2 attachment point
suspension point located behind or within the rear handle, which allows for the attachment of a safety strap, carabiner or rope, as appropriate

3.3 vibration isolation system
set of components (for example elastic buffers, springs) designed to reduce the transmission of vibrations generated by the engine and the cutting attachments, to the hands of the operator

NOTE — Certain commonly used terms relating to chain-saws for tree service are given in figure 1.

[4] To be published. (Revision of ISO 9518:1992)

[5] Equivalent to EN 292-1:1991.

[6] Equivalent to EN 292-2:1991.

Key

1 Rear handle
2 Throttle trigger lockout
3 Throttle trigger
4 Front handle
5 Front handle guard
6 Guide-bar cover
7 Guide-bar
8 Spiked bumper
9 Chain catcher
10 Stopping device
11 Attachment point

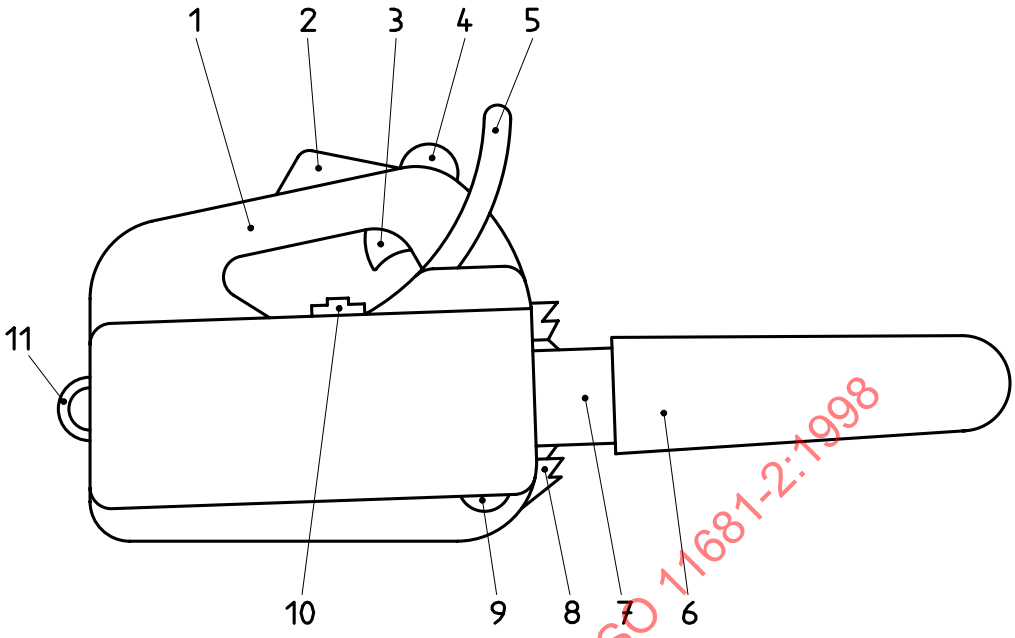

Figure 1 — Chain-saw for tree service

4 Safety requirements

The safe running of chain-saws depends on both the safety requirements as described in this clause and the safe environment associated with the use of personal protection equipment such as gloves, leg protection, boots, as well as eye and ear protection equipment. For protective clothing see EN 381[7].

4.1 Handles

Chain-saws shall have a handle for each hand. These handles shall be designed so that they can be fully gripped by an operator when wearing protective gloves, provide the necessary sureness of grip by their shaping and surface and conform to the dimensions and clearances given in annex B.

The strength of both handles shall comply with ISO 7915.

The operator shall be able to stop the chain-saw with the stopping device (see 4.12) even in case of failure in the vibration isolation system.

4.2 Hand protection

4.2.1 Protection at the front handle

A guard shall be fitted in the vicinity of the front handle (see figure 1), 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.

---

[7] EN 381 (all parts), *Protective clothing for users of hand-held chainsaws.*

4.2.2 Protection at the rear handle

Hand protection shall be provided along the length of the right side of the bottom of the rear handle. This protection 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 protection can also be provided by parts of the saw.

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

Dimensions in millimetres

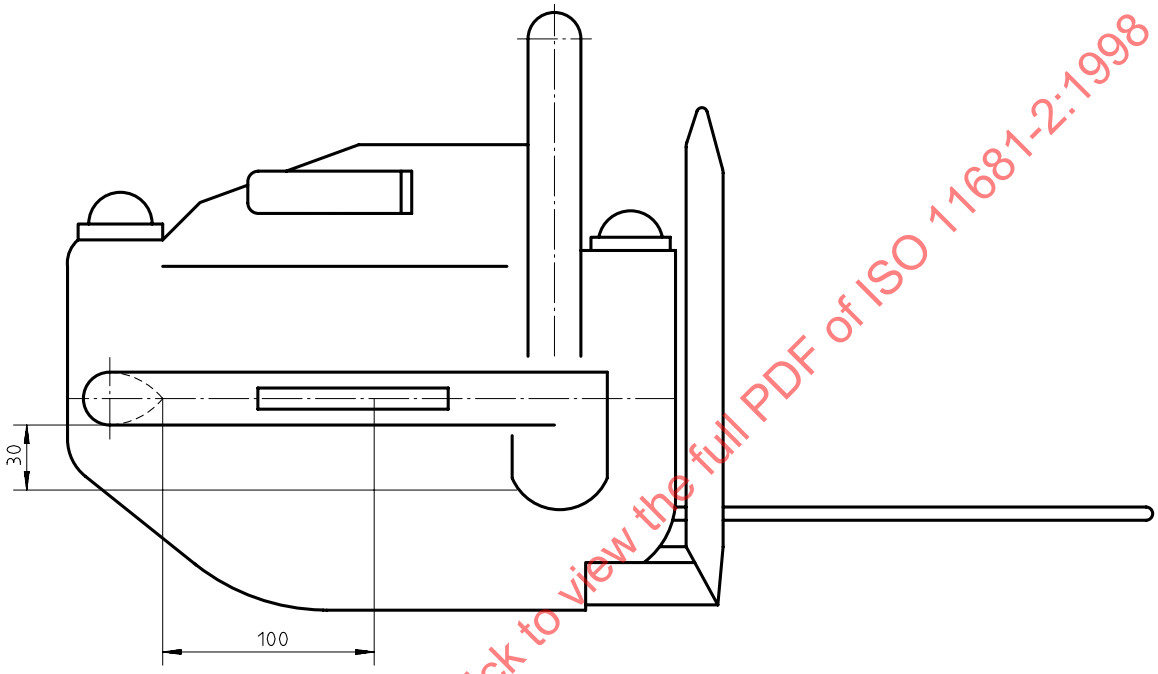

Figure 2 — Minimum dimensions of protection at the rear handle

4.3 Balance

The chain-saw shall be balanced when fitted with the manufacturer's recommended guide-bars. The balance shall be tested in accordance with ISO 8334. The maximum angle of the guide-bar shall not exceed 30° above and below the horizontal plane.

The holding moment to hold the chain-saw in a sideways position shall be 7 Nm maximum when determined in accordance with annex C.

4.4 Protection against injury by kickback

4.4.1 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.

There shall also be a non-manual chain brake activation system which activates the chain brake when kickback occurs. This system shall comply with ISO 13772.

The computed kickback angle and chain stop angle shall be determined with cutting attachments recommended by the manufacturer and in accordance with ISO 9518.

The computed kickback angle or chain stop angle, whichever is less, shall not exceed 30°.

4.4.2 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.

Measurements of release force and braking times shall be carried out in accordance with ISO 6535.

4.5 Chain catcher

The chain-saw shall be fitted with a chain catcher that conforms to the dimensions and strength requirements of ISO 10726.

4.6 Spiked bumper

The chain-saw shall have provision to mount a spiked bumper.

4.7 Chip discharge

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

4.8 Guide-bar cover

The chain-saw shall be provided with a guide-bar cover for safe transport (see figure 1).

4.9 Noise emission

The time-averaged emission sound pressure levels at the operator's ear shall be measured in accordance with ISO 7182.

NOTE 1— The sound power levels are for information purposes and will appear in the instruction handbook (see 6.2).

The sound power levels from the chain-saw shall be measured in accordance with ISO 9207.

NOTE 2— It is the intention of ISO/TC 23/SC 17 to collect noise and vibration values, for each machine type, in accordance with relevant measurement standards. These values will be used to define the "state of the art" levels based on principles to be established by SC 17. The interaction of noise and vibration on the machine characteristics will be assessed. The relationship between "state of the art" values and exposure limits will also be considered. For interim noise and vibration values, reference is made to ISO 11681-1.

4.10 Vibration

The weighted acceleration sum shall be measured and calculated in accordance with ISO 7505.

NOTE — It is the intention of ISO/TC 23/SC 17 to collect noise and vibration values, for each machine type, in accordance with relevant measurement standards. These values will be used to define the "state of the art" levels based on principles to be established by SC 17. The interaction of noise and vibration on the machine characteristics will be assessed. The relationship between "state of the art" values and exposure limits will also be considered. For interim noise and vibration values, reference is made to ISO 11681-1.

4.11 Throttle trigger

A chain-saw shall be provided with 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.

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

The throttle control linkage shall be so designed that a force equal to three times the weight of the chain-saw unit (without cutting attachment and with empty tanks), applied on the rear handle in any direction, shall not increase the engine speed to a point where the clutch engages and chain movement begins.

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

4.12 Engine-stopping device

The machine shall be fitted with an engine-stopping device by which the engine can be brought to a final stop and 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 right hand while the saw is being held by an operator wearing protective gloves. The purpose and method of operation of the device shall be clearly and durably marked.

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

4.13 Protection against contact with parts under high voltage

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

All high voltage parts of the circuit, including spark plug terminals, shall be electrically protected in such a manner that the operator cannot make accidental contact with them. The requirement shall be checked by inspection and using a finger probe as specified in figure 1 in IEC 60335-1:1991.

4.14 Clutch

The clutch shall be so designed that the chain does not run when the engine rotates up to 1,25 times the idling speed.

4.15 Carburettor adjustment

The elements of carburettor adjustment shall be clearly and indelibly marked, for example by symbols as given in ISO 3767-5. The markings used shall be illustrated and explained in the instruction handbook.

4.16 Protection against contact with hot parts

Hot parts with the exclusion of the guide-bar and saw chain, shall be guarded so that they are not accessible by unintentional contact during normal operation of the saw. Such hot parts shall be considered accessible if they can be reached by the test cone as shown in figure 3.

The temperature of the accessible parts of the machine shall not cause a hazard to the operator; see EN 563:1994, and especially its annex C.

Dimensions in millimetres

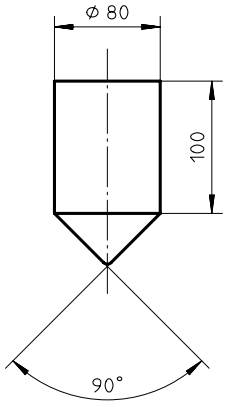

Figure 3 — Test cone

4.17 Exhaust gases

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

4.18 Chain lubrication

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

4.19 Tank openings

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 15 mm diameter. Each opening or cap shall be clearly marked. If only the caps are marked, they shall not be interchangeable.

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

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

4.20 Chain tensioning

Chain-saws shall be provided with the means of adjustment to provide chain tension according to the manufacturer's recommendation.

4.21 Attachment point

Tree service chain-saws shall be equipped with an attachment device which allows the unit to be secured 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 three times the total chain-saw weight, with full tanks, longest guide-bar and with a chain.

5 Verification of safety requirements

The compliance with safety requirements shall be verified according to table 1.

Table 1 — Safety requirements and testing method

Subclause	Safety requirements	Testing method			
		Inspection[1]	Function test[2]	Measurement[3]	Reference
4.1	Handles	×	×	×	annex B of this part of ISO 11681, ISO 7915
4.2.1	Protection at the front handle	×		×	ISO 6533, ISO 6534
4.2.2	Protection at the rear handle	×		×	ISO 6534
4.3	Balance	×		×	ISO 8334
	Holding moment			×	annex C of this part of ISO 11681
4.4.1	Protection against injury by kickback (chain brake), kickback angle or chain stop angle		×	×	ISO 9518, ISO 13772
4.4.2	Protection against injury by kickback (chain brake), release force, braking time		×	×	ISO 6535
4.5	Chain catcher	×		×	ISO 10726
4.6	Spiked bumper	×			
4.7	Chip discharge	×	×		
4.8	Guide-bar cover	×			
4.9	Noise emission			×	ISO 7182, ISO 9207
4.10	Vibration			×	ISO 7505
4.11	Throttle trigger	×	×		
4.12	Engine-stopping device	×	×		
4.13	Protection against contact with parts under high voltage	×	×	×	
4.14	Clutch		×	×	
4.15	Carburettor adjustment	×			
4.16	Protection against contact with hot parts		×	×	
4.17	Exhaust gases	×	×		
4.18	Chain lubrication		×		
4.19	Tank openings	×	×	×	
4.20	Chain tensioning	×	×		
4.21	Attachment point	×		×	

1) Consists of verifying that the machine has the relevant part.

2) Consists of verifying that the machine or component operates normally.

3) Consists of determining a value by using some form of device or instrument.

6 Information for use

6.1 General

Every chain-saw shall be supplied with information about the use for which it is designed or has been tested and about any conditions necessary to ensure that it will be safe and without risk to health at all times when it is being adjusted, used, cleaned or maintained.

6.2 Technical data

6.2.1 The following technical information shall be made available to the user for each chain-saw model.

Mass

Saw without guide-bar and chain, empty tanks: ..... kg

Volume

Fuel tank: ..... cm^3

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

Cutting length

All specified usable cutting lengths of guide-bar, specified by the manufacturer: ..... cm

Chain

Specified pitch: .....mm (in)

Specified gauge (thickness of drive links): .....mm (in)

Type of chain and guide-bar: .....

Sprocket

Specified number of teeth: .....

Engine

Engine displacement: ..... cm^3

Maximum shaft brake power (in accordance with ISO 7293): .....kW

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

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

Fuel consumption (in accordance with ISO 7293)

Fuel consumption at maximum engine power (on request): ..... kg/h

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

Maximum chain speed

Chain speed at 1,33 times the maximum power speed or maximum speed, whichever is less: ..... m/s

Chain brake (in accordance with ISO 6535)

Mean braking time at racing speed (on request): . ..... s

Vibrations (in accordance with ISO 7505): ..... m/s²

6.2.2 Data from the following calculations shall also be made available.

Sound pressure level (in accordance with ISO 7182)

$$L_{p_{A,av}} = 10 \lg \left[\frac{1}{3} \left(10^{0,1 L_{p_{A,Id}}} + 10^{0,1 L_{p_{A,Fl}}} + 10^{0,1 L_{p_{A,R}}} \right) \right]$$

where

$L_{p_{A,Id}}$ is the A-weighted time-averaged emission sound pressure level at idling, in decibels;

$L_{p_{A,Fl}}$ is the A-weighted time-averaged emission sound pressure level at full load, in decibels;

$L_{p_{A,R}}$ is the A-weighted time-averaged emission sound pressure level at racing, in decibels;

$L_{p_{A,av}}$ is the mean of the three or two previous quantities.

Octave band analysis (on request).

Sound power level (in accordance with ISO 9207)

$$L_{W_{A,av}} = 10 \lg \left[\frac{1}{3} \left(10^{0,1 L_{W_{A,Id}}} + 10^{0,1 L_{W_{A,Fl}}} + 10^{0,1 L_{W_{A,R}}} \right) \right]$$

where

$L_{W_{A,Id}}$ is the A-weighted sound power level at idling, in decibels;

$L_{W_{A,Fl}}$ is the A-weighted sound power level at full load, in decibels;

$L_{W_{A,R}}$ is the A-weighted sound power level at racing, in decibels;

$L_{W_{A,av}}$ is the mean of the three or two previous quantities.

6.3 Instruction handbook

Comprehensive instructions and information on all aspects of operator/user maintenance and the safe use for the chain-saw, including clothing and personal protective equipment requirements and the need for training in all manual chain-saw operations, especially for work in trees, shall be provided in the instruction handbook. They shall comply with ISO/TR 12100-2:1992, 5.5.

NOTE — Extensive use should be made of photographs 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.

An explanation shall also be given that this is a special type of chain-saw, designed especially for tree service. It shall be stated that the saw can be used one-handed by a trained operator using a carefully designed, safe work system, and it shall be emphasised that the chain-saw is only intended for tree work under these defined conditions. It shall also be stated that for all other operations the chain-saw is intended to be used with two hands in the same way as a conventional chain-saw.

Terms used in all documentation shall be in accordance with ISO 6531.

The instruction handbook shall at least cover information relating to:

a) transport, handling and storage of the chain-saw, such as

- the use of guide-bar cover during transport and storage;
- cleaning and maintenance before storage;

b) commissioning of the chain-saw, such as

- assembling instructions, initial adjustments and checks;
- filling of fuel and oil, especially concerning fire precautions;
- explanation of symbols and safety signs;

c) the chain-saw itself, such as

- description, identification and nomenclature of principal parts including the safety devices of the saw, and explanations of their functions;
- information regarding appropriate use of a spiked bumper (for example the advantage of using a spiked bumper when cutting thick branches);
- regular maintenance tasks, pre-operating measures (including routines for checking that the saw chain stops moving when the engine idles and that the chain brake works properly) and checking for lose parts, fuel leaks and damaged parts such as cracks in the front handle guard and chain catcher;
- application of the chain-saw and how it is intended to be used, including starting and stopping techniques with particular reference to safety;
- guide-bar and chain adjustments with the engine stopped;
- chain tensioning and sharpening techniques;
- data about sound pressure and power levels and vibration levels (see 6.2), including warning about the risks and measures to be taken to minimise those risks. Upon request, an octave band analysis shall be supplied to enable the selection of correct hearing protection;

d) the use of the chain-saw, such as

- operating instructions and instruction for common cutting tasks, including the use of PPE and the need for adequate training, and warning against the use of the unit while being tired, ill or under influence of alcohol or other drugs;
- PPE instructions shall include recommendations for the type of hearing protectors, eye protectors, head protectors. Clothing instructions shall include recommendations to use foot protection suitable for tree climbing, as well as appropriate protective clothing (see EN 381);
- hazards which may be encountered while using the saw and how to avoid them while doing typical tasks, including a warning that one-handed operation of the saw is dangerous;
- explanation of "skating" and "bouncing" phenomena, and of the greater risk of kickbacks and dropping at the end of a cut;

— the importance that the operator be trained in safe climbing techniques and in the use of all recommended additional safety equipment such as harness, loops, straps, rope and carabinas and other fall arrest systems for himself and the saw;

— warning about the emission of exhaust gases, lubrication oil mist and saw dust, explanation of white finger risks and means for self-protection;

e) maintenance instructions, such as

— servicing and replacement tasks for the user;

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

— explanation that the chain and guide-bar affect kickback behaviour of the chain-saw and the importance of respecting cutting attachment specifications (6.2);

— consequences of improper maintenance and removal of safety devices.

6.4 Marking

All chain-saws shall be marked legibly and indelibly with the following minimum information:

— name and address of the manufacturer;

— year of construction;

— designation of series or type;

— serial number, if any.

In addition, the chain-saws shall bear the following additional information:

— identification of the on/off control, oiler control, fuel and/or oil caps, choke control, primer control, heated handle switch (if provided);

— a symbol indicating that eye and hearing protection is necessary;

— a prominent mark "WARNING: THIS SAW IS FOR TRAINED TREE SERVICE OPERATORS ONLY — SEE INSTRUCTION HANDBOOK!";

— an instruction that two-handed operation is strongly recommended whenever possible.

NOTE — This text may be replaced by a pictorial.

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

All controls should be marked with an appropriate symbol, if available, in accordance with ISO 3767-5. Symbols relating to safety should be in accordance with the shape and colour requirements of ISO 3864.

Annex A
(normative)

List of hazards

Table A.1 gives the list of hazards based on ISO/TR 12100-1:1992 and annex A of ISO/TR 12100-2:1992.

The meaning of the statements given in the last column (solution given by this part of ISO 11681) of this table is:

— "not relevant": the hazard is not significant for the machine;

— "dealt with": the hazard is significant. The measures given in the clauses indicated provide guidance for dealing with the hazard in accordance with the principles of safety integration of ISO/TR 12100, i.e.

  — elimination or reduction of the risk by design, as far as possible;

  — protection measures;

  — information on the residual risks.

— "not dealt with": the hazard is significant for the machine but has not been taken into account during the preparation of this part of ISO 11681.

Table A.1 — List of hazards

Hazards		Solutions given by this part of ISO 11681
A.1	**Mechanical hazards** [caused for example by shape, relative location, mass and stability (potential energy of elements), mass and velocity (kinetic energy of elements), inadequacy of the mechanical strength, accumulation of potential energy by elastic elements (springs), liquids or gases under pressure, or vacuum of the machine parts or workpieces]	
A.1.1	Crushing hazard	not relevant
A.1.2	Shearing hazard	not relevant
A.1.3	Cutting or severing hazard	4.2, 4.4, 4.5, 4.8, 4.20
A.1.4	Entanglement hazard	not relevant
A.1.5	Drawing-in or trapping hazard	not relevant
A.1.6	Impact hazard	4.4
A.1.7	Stabbing or puncture hazard	not relevant
A.1.8	Friction or abrasion hazard	not relevant
A.1.9	High pressure fluid injection hazard	not relevant
A.1.10	Ejection of parts (of machinery and processed material / workpieces)	4.2.2, 4.5, 4.7, 4.20
A.1.11	Loss of stability (of machine and machine parts)	not relevant
A.1.12	Slip, trip and fall hazards in relationship with machinery (because of their mechanical nature)	4.21, 6.3
A.2	**Electrical hazards**	
A.2.1	Electrical contact (direct or indirect)	4.13
A.2.2	Electrostatic phenomena	not relevant
A.2.3	Thermal radiation or other phenomena such as ejection of molten particles, and chemical effects from short-circuits, overloads etc.	not relevant
A.2.4	External influences on electrical equipment	not relevant

Table A.1 (*continued*)

Hazards		Solutions given by this part of ISO 11681
A.3	**Thermal hazards**	
A.3.1	Burns and scalds, by a possible contact of persons, by flames or explosions and also by the radiation of heat sources	4.16
A.3.2	Health-damaging effects by hot or cold work environment	6.3
A.4	**Hazards generated by noise**	
A.4.1	Hearing losses (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	4.9, 6.3, 6.4
A.4.2	Interference with speech communication, acoustic signals, etc.	not dealt with
A.5	**Hazards generated by vibration**	
A.5.1	Neurological and vascular disorders	4.10
A.6	**Hazards generated by radiation**	
A.6.1	Radiation generated by electrical arcs	not relevant
A.6.2	Radiation generated by lasers	not relevant
A.6.3	Radiation generated by ionizing radiation sources	not relevant
A.6.4	Radiation generated by machines making use of high-frequency electromagnetic fields	not relevant
A.7	**Hazards generated by materials and substances processed, used or exhausted by machinery**	
A.7.1	Hazards resulting from contact with or inhalation of harmful fluids, gases, mists, fumes and dusts	4.17
A.7.2	Fire or explosion hazard	4.19
A.7.3	Biological and microbiological (viral or bacterial) hazards	not relevant
A.8	**Hazards generated by neglecting ergonomic principles in machine design (mismatch of machinery with human characteristics and abilities)**	
A.8.1	Unhealthy postures or excessive efforts	4.1, 4.3, 4.6
A.8.2	Inadequate consideration of human hand-arm or foot-leg anatomy	4.1
A.8.3	Neglected use of personal protection equipment	4.4, 4.9, 4.10, 6.3
A.8.4	Inadequate area lighting	not relevant
A.8.5	Mental overload or underload, stress, etc.	not relevant
A.8.6	Human error	4.11, 6.3, 6.4
A.9	**Hazard combinations**	
A.9.1	Hazard combinations	not relevant
A.10	**Hazards caused by failure of energy supply, breaking down of machinery parts and other functional disorders**	
A.10.1	Failure of energy supply (of energy and/or control circuits)	not relevant
A.10.2	Unexpected ejection of machine parts or fluids	4.2.2, 4.5, 4.20
A.10.3	Failure, malfunction of control system (unexpected start-up , unexpected overrun)	4.1, 4.11, 4.14
A.10.4	Errors of fitting	6.3
A.10.5	Overturn, unexpected loss of machine stability	not relevant
A.11	**Hazards caused by (temporary) missing and/or incorrect positioned safety related measures/means**	
A.11.1	All kinds of guards	not relevant
A.11.2	All kinds of safety-related (protection) devices	not dealt with
A.11.3	Starting and stopping devices	not relevant
A.11.4	Safety signs and signals	6.3
A.11.5	All kinds of information or warning devices	6.3
A.11.6	Energy supply disconnecting devices	not relevant
A.11.7	Emergency devices	6.3

Table A.1 (*concluded*)

Hazards		Solutions given by this part of ISO 11681
A.11.8	Feeding/removal means of workpieces	not relevant
A.11.9	Essential equipment and accessories for safe adjusting and/or maintaining	6.3
A.11.10	equipment evacuating gases, etc.	not relevant

Annex B
(normative)

Minimum handle clearance and sizes

Because of the special function of tree service chain-saws, the handle dimensions shall conform to the requirements given in table B.1 and figures B.1 to B.3.

Table B.1 — Clearance dimensions

Handle	Description	Dimension (see figures)	Figure	Minimum size mm
Front	Finger clearance in the handle grip area	A	B.1	35
	Handle grip area	—	B.2	—
	Clearance between the front of the saw body and the handle at the top measured 60 mm to the left of the guide-bar	B	B.1	40
	Clearance between the front of the chain-saw body and the handle measured at the centre of the guide-bar	C	B.1	25
Front and rear	Perimeter of the cross-section of the handle	—	—	65
Rear	Finger clearance of the released throttle trigger [1)]	E	B.3, B.1	30
	Clearance in the handle grip area and below the released throttle trigger [1)]	F	B.1	25
	Clearance behind the released throttle trigger at which F shall be met	G	B.1	75

1) The dimension shall be gauged free from play, i.e. with enough force applied to the trigger for it to contact the throttle lock-out.