
**Hand-held non-electric power tools —
Safety requirements —**

Part 12:

Circular, oscillating and reciprocating saws

Machines portatives à moteur non électrique — Exigences de sécurité —

Partie 12: Scies circulaires, scies oscillantes et scies alternatives

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Published in Switzerland

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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 11148-12 was prepared by Technical Committee ISO/TC 118, *Compressors and pneumatic tools, machines and equipment*, Subcommittee SC 3, *Pneumatic tools and machines*.

ISO 11148 consists of the following parts, under the general title *Hand-held non-electric power tools — Safety requirements*:

- *Part 1: Assembly power tools for non-threaded mechanical fasteners*
- *Part 2: Cutting-off and crimping power tools*
- *Part 3: Drills and tappers*
- *Part 4: Non-rotary percussive power tools*
- *Part 5: Rotary percussive drills*
- *Part 6: Assembly power tools for threaded fasteners*
- *Part 7: Grinders*
- *Part 8: Sanders and polishers*
- *Part 9: Die grinders*
- *Part 10: Compression power tools*
- *Part 11: Nibblers and shears*
- *Part 12: Circular, oscillating and reciprocating saws*

A part 13, dealing with fastener driving tools, is under preparation.

Introduction

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

The machinery concerned and the extent to which hazards, hazardous situations and events are covered are defined in the Scope of this part of ISO 11148.

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

ISO 11148 consists of a number of independent parts for individual types of hand-held non-electric power tools.

Certain parts of ISO 11148 cover hand-held non-electric power tools driven by internal combustion engines powered by gaseous or liquid fuel. In these parts, the safety aspects relating to internal combustion engines are found in a normative annex.

The parts are type-C standards and refer to pertinent standards of type A and B where such standards are applicable.

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Hand-held non-electric power tools — Safety requirements —

Part 12:

Circular, oscillating and reciprocating saws

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1 Scope

This part of ISO 11148 specifies safety requirements for hand-held non-electric power tools (hereinafter “circular, oscillating and reciprocating saws”) intended for sawing. The circular, oscillating and reciprocating saws can be powered by compressed air, hydraulic fluid or internal combustion engines and are intended to be used by one operator and supported by the operator’s hand or hands, with or without a suspension, e.g. a balancer.

NOTE 1 At the time of publication, no circular, oscillating or reciprocating saws driven by internal combustion engines are known [other than circular saws with bonded abrasives and/or super abrasives (diamond) cut-off wheels]. Once these are identified, it is intended to amend this part of ISO 11148 to include such power tools.

This part of ISO 11148 is applicable to

- circular saws;
- circular knives;
- oscillating saws having a saw blade with a radius of 50 mm or less or a diamond cutting-off blade with a radius of 100 mm or less;
- oscillating knives (including windshield knives);
- reciprocating saws, including jig saws and power hack saws.

NOTE 2 For examples of circular, oscillating and reciprocating saws, see Annex B.

NOTE 3 For circular saws with bonded-abrasive and/or super-abrasive (diamond) cut-off wheels, see ISO 11148-7 and ISO 19432.

This part of ISO 11148 is not applicable to special requirements and modifications of circular, oscillating and reciprocating saws for the purpose of mounting them in fixtures.

This part of ISO 11148 deals with all significant hazards, hazardous situations or hazardous events relevant to circular, oscillating and reciprocating saws when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer, with the exception of the use of circular, oscillating and reciprocating saws in potentially explosive atmospheres.

NOTE 4 EN 13463-1 gives requirements for non-electrical equipment for potentially explosive atmospheres.

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 3857-3, *Compressors, pneumatic tools and machines — Vocabulary — Part 3: Pneumatic tools and machines*

ISO 5391, *Pneumatic tools and machines — Vocabulary*

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

ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces*

ISO 13732-3, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces*

ISO 15744, *Hand-held non-electric power tools — Noise measurement code — Engineering method (grade 2)*

ISO 17066, *Hydraulic tools — Vocabulary*

ISO 20643, *Mechanical vibration — Hand-held and hand-guided machinery — Principles for evaluation of vibration emission*

ISO 28927-8, *Hand-held portable power tools — Test method for evaluation of vibration emission — Part 8: Saws, polishing and filing machines with reciprocating action and small oscillating or rotating action*

EN 12096, *Mechanical vibration — Declaration and verification of vibration emission values*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3857-3, ISO 5391, ISO 12100 and ISO 17066 (for hydraulic tools) and the following apply.

3.1 General terms and definitions

3.1.1

hand-held power tool

machine operated by one or two hands and driven by rotary or linear motors powered by compressed air, hydraulic fluid, gaseous or liquid fuel, electricity or stored energy (e.g. by a spring) to do mechanical work and so designed that the motor and the mechanism form an assembly that can easily be brought to its place of operation

NOTE Hand-held power tools driven by compressed air or gas are called pneumatic tools (or air tools). Hand-held power tools driven by hydraulic liquid are called hydraulic tools.

3.1.2

inserted tool

tool inserted in the circular, oscillating or reciprocating saw to perform the intended work

3.1.3

service tool

tool for performing maintenance or service on the circular, oscillating or reciprocating saw

3.1.4

control device

device to start and stop the circular, oscillating or reciprocating saw or to change the direction of the rotation or to control the functional characteristics, such as speed and power

3.1.5

start-and-stop device

throttle

manually operated control on the circular, oscillating or reciprocating saw by which the energy supply to the motor can be turned on and off

3.1.6**hold-to-run start-and-stop device
constant pressure throttle**

start-and-stop device that automatically returns to the OFF position when force on the start-and-stop device actuator is released

3.1.7**lock-on start-and-stop device
constant pressure throttle with instant release lock**

hold-to-run start-and-stop device that can be locked in the ON position and which is designed so that it permits the circular, oscillating or reciprocating saw to be turned off by a single motion of the same finger or fingers used to turn it on

3.1.8**lock-off start-and-stop device
lock-off throttle**

start-and-stop device that automatically latches in the OFF position when the actuator is released and where two motions are required to energize the circular, oscillating or reciprocating saw

3.1.9**positive on-off start-and-stop device
positive on-off throttle**

start and stop device that remains in an ON position until it is manually changed

3.1.10**maximum operating pressure**

maximum pressure at which a circular, oscillating or reciprocating saw may be operated

3.1.11**whip hose**

air hose connecting the main air hose and an air tool for the purpose of providing more flexibility

3.1.12**rated air pressure**

air pressure, required at an air tool inlet port to assure rated performance of the tool, also considered the maximum pressure at which the tool may be operated

3.1.13 Rated speed**3.1.13.1****rated speed**

(pneumatic tool) speed of an air tool at no load and rated air pressure at the tool inlet port

NOTE The rated speed is expressed in revolutions per minute.

3.1.13.2**rated speed**

(hydraulic tool) nominal speed of a hydraulic tool at no load and rated flow at the tool inlet port

NOTE The rated speed is expressed in revolutions per minute.

3.1.14**maximum attainable speed**

maximum speed which the tool can achieve under the most adverse condition of possible maladjustment or malfunction of its speed control devices, when supplied with compressed air at the pressure marked on the circular, oscillating or reciprocating saw

3.1.15**suspension device**

device attached to the tool, whose primary purpose is to reduce the strain on the operator caused by the weight of the tool

NOTE The device can also have a secondary purpose of transmitting a reaction torque.

3.2 Definitions related to circular, oscillating and reciprocating saws

3.2.1

circular saw

rotary power tool equipped with a circular saw blade

3.2.2

panel saw

air tool for cutting ferrous or non-ferrous panelling, usually having an angle drive and blade speeds of 9,1 m/s (1 800 sfpm) or less

3.2.3

trim saw

air tool for cutting trim, composition board, plywood, plastic and thin non-ferrous materials usually at speeds of over 20,3 m/s (4 000 sfpm)

3.2.4

oscillating saw

power tool equipped with a circular or segment saw blade, which moves with an angular oscillating movement

3.2.5

reciprocating saw

power tool equipped with a straight saw blade, which moves with a reciprocating movement

EXAMPLE Jig saw or power hack saw.

3.2.6

knife

edge tool used as a cutting instrument, which has a pointed blade, a sharp edge and a handle

3.2.7

riving knife

metal part placed in the plane of the saw blade, which prevents the wood from tightening on to the rear part of the saw blade, thus preventing the backward movement of the tool or the jamming of the saw blade

3.2.8

circular knife

rotary power tool equipped with a circular knife

3.2.9

oscillating knife

power tool equipped with a knife, which moves with an angular oscillating movement

3.2.10

saw blade

blade of circular, segment or straight shape intended for cutting or cutting-off operations by chip removal by means of teeth with cutting edges

3.2.11

guide plate

part supporting the saw on the material being cut

See Figure 2.

3.2.12

shoe or backing plate

support for the reciprocating saw against the work while a cut is being made

4 Safety requirements and/or protective measures

4.1 General

The machine shall comply with the safety requirements and/or protective measures and be verified in accordance with Clause 5. In addition, the machine shall be designed in accordance with the principles of ISO 12100 for relevant, but not necessarily significant, hazards, which are not dealt with by this part of ISO 11148.

The measures adopted to comply with the requirements of this clause shall take account of the state-of-the-art.

It is recognized that optimizing the design with respect to some safety measures can result in a degradation of performance against other safety requirements. In such cases, it is required to strike a balance between the various requirements in order to achieve a circular, oscillating or reciprocating saw design that satisfies each requirement, so far as is reasonably practicable, and remains fit for purpose.

4.2 Mechanical safety

4.2.1 Surfaces, edges and corners

Accessible parts of circular, oscillating and reciprocating saws, except the inserted tool, shall not have sharp edges or angles or rough or abrasive surfaces; see ISO 12100:2010, 6.2.2.1.

4.2.2 Supporting surface and stability

Circular, oscillating and reciprocating saws shall be so designed that they can be laid aside and remain in a stable position on a plane surface.

4.2.3 Flanges

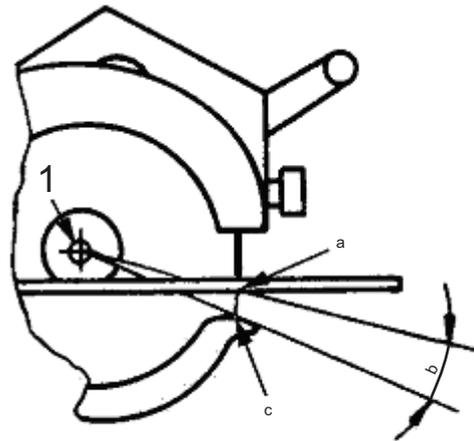
Flanges for circular saws, for clamping the saw blade to the working spindle shall be of equal size, and of a size not less than 0,3 times the rated diameter of the blade.

4.2.4 Hydraulic fluid ejection

Hydraulic systems of the circular, oscillating and reciprocating saws shall be enclosed so as to give protection against high-pressure fluid ejection.

4.2.5 Guide plate

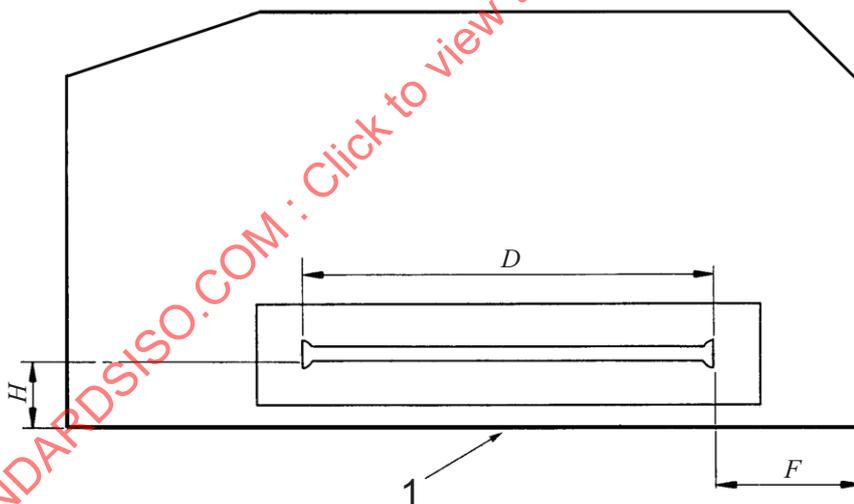
Circular saws shall have a guide plate of a size and shape to support the saw against the material being cut. The guide plate shall be securely fastened to the saw housing. If the blade exposure angle, α , below the guide plate (see Figure 1) exceeds 10° , the guide plate shall have an outboard section (see Figure 2). The outboard section shall enclose the full diameter of the saw blade and its outer edge shall not be less than 25 mm from the face of the blade, H in Figure 2. The distance between the periphery of the largest specified blade to the front edge of the base plate, F , shall be larger than 13 mm. The angle in Figure 1 shall be measured between the intersections of the blade tip circle with the underside of the base and each side of the lower guard.



Key

- 1 centre of blade
- a Blade periphery intersect point with the bottom plane of the base plate.
- b Blade exposure angle, α .
- c Blade periphery intersect point with the perpendicular projection on to the blade, of either side or the front tip of the movable guard, which yields the largest blade exposure angle, α_{max} .

Figure 1 — Blade exposure angle



Key

- 1 outboard section of the base plate
- D diameter of the blade
- F dimension from the periphery of the largest specified blade to the front edge of the base plate measured along the bottom surface of the base plate at maximum cutting depth; $F > 13$ mm
- H dimension from the outside edge of the base plate on the blade side, to the near surface of the thickest specified blade of a not inclined base plate; $H \geq 25$ mm

Figure 2 — Guide plate dimensions

Reciprocating saws shall be equipped with a shoe or backing plate, which supports the reciprocating saw against the work while a cut is being made.

4.2.6 Run-down time

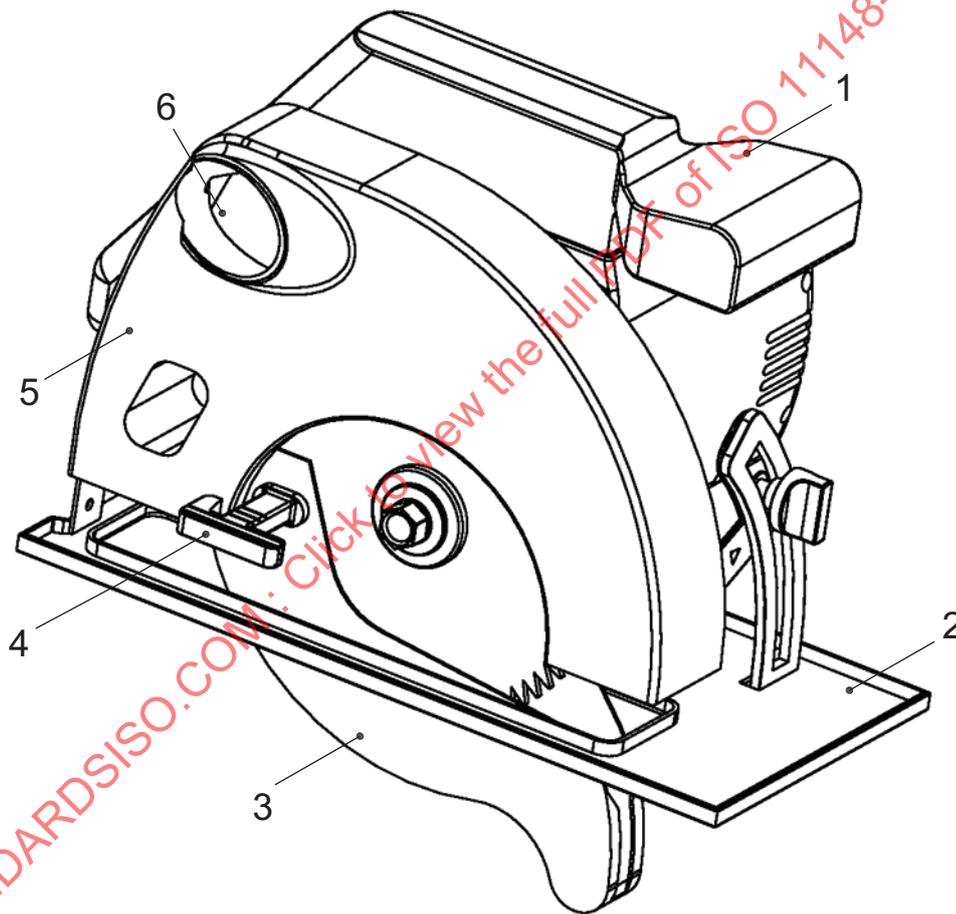
Circular saws shall have a run-down time after the stop command has been given of not more than 5 s.

4.2.7 Guards

4.2.7.1 Circular saws

Means shall be provided for affixing the safety guard(s) firmly to the saw.

Circular saws shall be provided with a guard above and below the guide plate to prevent unintentional contact of hands with the inserted saw blade. The guard shall be designed to keep the saw blade cutting edge substantially covered at all times, except that portion of the edge necessary to permit the blade to enter the work. It shall not be possible to remove the guard without the aid of a service tool.



Key

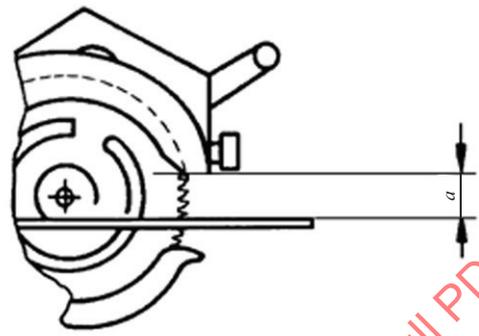
- 1 auxiliary handle
- 2 guide plate
- 3 movable lower guard
- 4 guard-retracting handle
- 5 fixed guard
- 6 dust shoot

Figure 3 — Circular saw with a movable lower guard

A saw with a movable lower guard, as illustrated in Figure 3, may include a guard-retracting handle. Such a handle shall be designed so that whenever manipulating the handle, the operator's fingers need not be in the area where teeth are exposed. The portion of the handle intended to be grasped shall be remote from the teeth or shall be separated from the teeth by a suitable guard, baffle or the like. The guard shall not be liable to jam in any position during normal operation.

The guard shall:

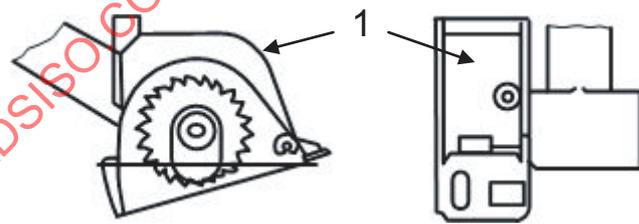
- a) except for panel saws and trim saws:
 - 1) have a distance, a (see Figure 4), from the upper guard to the base plate of less than 38 mm, with the blade set for a cut of maximum depth, and with the plane of the blade 90° from the plane of the base;
 - 2) have a blade exposure angle (see Figure 1) of less than 25°;



a Distance from the upper guard to the base plate.

Figure 4 — Distance from the upper guard to the base plate

NOTE The guards of panel saws and trim saws are illustrated in Figure 5.



Key

- 1 stationary guard

Figure 5 — Panel saw safety guard

- b) provide protection whenever the saw is at any other setting (i.e. depth and angle of cut) that its adjusting means permits;
- c) cover the blade teeth at least to the roots of the blade teeth; this requirement shall apply to resharpened as well as to new blades;
- d) provide protection such that a test probe (see Figure 6) of diameter 13 mm and length 50 mm, cannot touch the blade teeth whenever advanced toward the blade from the front of the saw, perpendicular to the blade,

parallel to the table and above the table. The saw is to be set for a 90° cut whenever the probe is applied. The probe is to be first centred on the blade and then offset 13 mm to the right and 13 mm to the left of the centre of the blade (see Figures 6 and 7);

Dimensions in millimetres

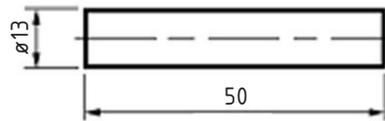
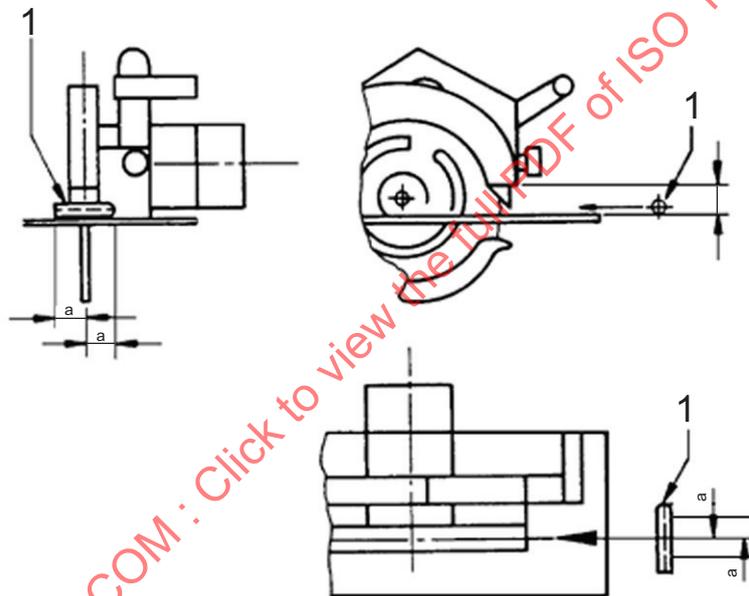


Figure 6 — Test probe



Key

- 1 test probe
- a Test probe off-set.

Figure 7 — Test probe advancement toward the saw blade

- e) protect the operator from the teeth at the front and above the base;

An opening provided for the ejection of dust in the fixed guard of a circular saw shall conform to at least one of the following.

- The opening shall be located beyond the outer circumference of the blade, including the teeth.
- A probe of 13 mm in diameter shall not contact the blade whenever inserted through the opening.

The lower guard shall:

- a) automatically retract to the closed position whenever the saw is not in use, regardless of the position of the saw or the setting (depth and angle of cut).
- b) Whenever released from its fully open position, the retractable guard shall move to its fully closed position in a time no greater than 0,3 s. The fully open position is determined with the saw in a normal cutting mode. Verification shall be carried out according to 5.4;
- c) have no provision for being locked in the opening position;
- d) be designed such that the saw blade can be removed without removing the safety guard from the saw;
- e) prevent the fitting of a saw blade with a diameter larger than that recommended by the manufacturer of the circular saw.

4.2.7.2 Oscillating saws

Oscillating saws do not require a guard.

4.2.7.3 Reciprocating saws

Reciprocating saws do not require a guard for the part of the saw blade which performs the sawing and is situated below the guide plate. The part of the saw blade which is situated above the guide plate shall be protected by a guard or the design shall be such that the risk of contact with the teeth of the blade and with moving parts of the mechanism is prevented.

4.2.8 Power tool construction

The circular, oscillating or reciprocating saw shall be so designed and constructed as to prevent the loosening or loss of components during expected use, including rough handling and occasional dropping, which can compromise its safety functions. Verification shall be carried out in accordance with 5.6.

4.2.9 Riving knife

Circular saws intended for cutting wood shall be provided with a riving knife. The riving knife shall not be thicker than the width of the cutting groove nor thinner than the saw blade body. For more detailed specifications, see IEC 60745-2-5.

4.2.10 Blade mounting device — Reciprocating saws

The blade mounting device shall be capable of holding the blade securely during operation and shall have the blade-holding mechanism so constructed as to minimize the likelihood of pinch points during intended use of the tool.

4.3 Thermal safety

Surface temperatures of parts of the circular, oscillating or reciprocating saw, which are held during use or that can be inadvertently touched, shall follow the provisions of ISO 13732-1 and ISO 13732-3.

Pneumatic tools shall be so designed to minimize the cooling effects of exhaust air on the handles and other gripping zones.

4.4 Noise reduction

The circular, oscillating or reciprocating saw shall be designed and constructed so that the emission of noise is reduced to the lowest level, taking account of technical progress and the availability of means of reducing noise, in particular at source. Principles for designing circular, oscillating and reciprocating saws with reduced noise emission are contained in ISO/TR 11688-1 and ISO/TR 11688-2.

The noise emission from using circular, oscillating and reciprocating saws has three main sources:

- the circular, oscillating or reciprocating saw itself;
- the inserted tool;
- the workpiece.

NOTE Generally the noise emitted due to the characteristics of the workpiece cannot be controlled directly by the manufacturer of the circular, oscillating or reciprocating saw.

Typical sources of noise emitted by the circular, oscillating or reciprocating saw itself are

- a) the motor and drive mechanism,
- b) the exhaust air or gases, and
- c) vibration or impact-induced noise.

Where the exhaust air or gases are the major contributor to the noise, means to reduce the noise, for example a silencer or equivalent means, shall be included in the design.

Alternatively, where practicable, the exhaust air or gases can be piped away from the operator in a hose.

Vibration-induced noise can often be reduced by vibration isolation and damping.

This list is not exhaustive; where alternative technical measures for noise reduction, with greater efficiency, are available, they should be used by the manufacturer.

4.5 Vibration

The circular, oscillating or reciprocating saw shall be designed and constructed so that the vibration is reduced to the lowest level at the handles and at any other parts of the tool in contact with the operator's hands, taking account of technical progress and the availability of means of reducing vibration, in particular at source. Principles for designing circular, oscillating and reciprocating saws with reduced vibration emission are contained in CR 1030-1.

Typical sources of vibration emitted by a circular, oscillating and reciprocating saws are

- unbalance of rotating parts,
- poorly designed motors and gears, and
- resonances in the structure of the machine, particularly the handles and their mounts.

The following design features have been found to be effective and should be considered by manufacturers whenever designing circular, oscillating and reciprocating saws:

- a) autobalancers;
- b) increasing inertia;
- c) isolated casing or handles.

This list is not exhaustive; where alternative technical measures for vibration reduction, with greater efficiency, are available, they should be used by the manufacturer.

4.6 Materials and substances processed, used or exhausted

4.6.1 Exhaust air or gas

Circular, oscillating and reciprocating saws driven with compressed air or gas shall be designed in such a way that exhaust air or gases are directed so as not to cause a hazard to the operator and so that any other effects, such as blowing the dust and reflected air or gas from the workpiece on to the operator, are minimized.

4.6.2 Dust and fumes

So far as is reasonably practicable, the circular, oscillating or reciprocating saw shall be designed to facilitate the collection and removal or suppression of airborne dust particles and fumes generated by the work process. The user instructions shall include sufficient information to enable adequate control of the risks from dust and fumes.

4.6.3 Lubricants

Where specifying lubricants, the manufacturer shall take environmental and occupational health aspects into account.

4.7 Ergonomics

4.7.1 Design of the handle

Gripping areas of the circular, oscillating and reciprocating saws shall be designed to provide convenient, effective means for the operator to exercise full control over the circular, oscillating or reciprocating saw.

Handles and other parts used for gripping the circular, oscillating or reciprocating saw shall be designed to ensure that the operator is able to grip the circular, oscillating or reciprocating saw correctly and to perform the expected work. Handles shall suit the functional anatomy of the hand and the dimensions of the hands of the operator population.

NOTE Further guidance on ergonomic design principles can be found in EN 614-1.

Circular, oscillating and reciprocating saws having a mass greater than 2 kg (including the inserted tool) shall be capable of being supported by two hands while being lifted or operated.

The grip shall be such that normal feed force and reaction torque can be transmitted in an ergonomic way from the hand of the operator to the circular, oscillating or reciprocating saw.

The strength of a removable handle and the nature of fixing it shall be appropriate to the intended principal use.

4.7.2 Suspension device

Provision should be made, where appropriate, to enable the attachment to the circular, oscillating or reciprocating saw of a suspension device in order to reduce, where practicable, the physical strain placed on the operator by the weight of the circular, oscillating or reciprocating saw. The fitting of a suspension device shall not introduce an additional hazard.

4.8 Controls

4.8.1 Start-and-stop device

Circular, oscillating and reciprocating saws shall be equipped with a single control device to start or stop them. It shall be adapted to the handle, or to the part of the circular, oscillating or reciprocating saw being gripped, so that it can be held comfortably in the run position, and so that the operator can activate it without releasing the grip on the handles.

Start-and-stop devices shall be so designed that the inserted tool ceases to be powered when the start-and-stop device is released. Without manual effort and whenever completely released, the device shall move to the stop position, i.e. shall be of the hold-to-run type.

Start-and-stop devices shall be in the stop position or immediately move to the stop position whenever the circular, oscillating or reciprocating saw is connected to the energy supply.

It shall not be possible to lock the start-and-stop device in the running position.

4.8.2 Unintentional start

The start-and-stop device shall be so designed, positioned or guarded that the risk of unintentional start is minimized. Verification shall be carried out according to 5.5.

Circular and reciprocating saws shall have lock-off start-and-stop devices.

4.8.3 Actuating forces

For circular, oscillating and reciprocating saws, which are intended to start frequently or are intended to be used for precision work, the actuating force shall be small.

For circular, oscillating and reciprocating saws, which are normally used in operations of long duration, the force to keep the start device in the run position shall be small.

NOTE For further information on trigger forces for control devices, see EN 894-3.

5 Verification

5.1 General conditions for tests

Tests according to this part of ISO 11148 are type tests.

5.2 Noise

The noise emission values shall be measured and declared in accordance with ISO 15744.

Compliance with 4.4 may be verified through the comparison of the noise-emission values with those for other machines of the same family, or with machines of similar size and performance characteristics.

5.3 Vibration

For reciprocating, oscillating and small circular saws, the vibration total value shall be measured and reported in accordance with ISO 28927-8. For circular saws intended for cutting wood, the vibration total value shall be measured and reported in accordance with ISO 20643. The vibration emission value, and its uncertainty, shall be declared in accordance with EN 12096.

NOTE Useful information about operating conditions during vibration tests on circular saws intended for cutting wood can be found in IEC 60745-2-5.

Compliance with 4.5 may be verified through the comparison of the vibration-emission values with those for other machines of the same family, or machines of similar size and performance characteristics.

5.4 Circular saw retractable lower guard

Compliance with 4.2.7.1 f) shall be verified by subjecting a single sample to each of the following tests. Closure time shall be measured without restoration of the guard in case of bending.

- a) Saw 25 cuts 2,4 m (8 ft.) long of 13 mm (1/2 inch) thick fir plywood, which has been stored indoors for 72 h prior to being sawed. Then, condition the saw for 24 h in air at a relative humidity of 90_{-0}^{+5} %, and a temperature of $32 + 2$ °C ($90 + 4$ °F). Following the conditioning, the closure time is to be measured.

NOTE A guard need not be conditioned as described in item a) above, if it is obvious that an accumulation of sawdust cannot affect the closure time of the guard.

- b) Set the saw for a 90° cut of maximum depth and oriented so that the lower guard strikes the floor with the table parallel to the floor. Then, drop the saw from a height of 1 m on to a concrete surface. Measure the closure time.
- c) Set the saw for a 90° cut of maximum depth and oriented in a hand-carrying position intended for the particular tool. Then, drop the saw from a height of 1 m on to a concrete surface. Measure the closure time.

5.5 Unintentional start

Compliance with 4.8.2 shall be established for all types of start/stop device using the following test.

The circular, oscillating or reciprocating saw shall be connected to the energy supply and placed and maintained in any possible position and pulled over the horizontal plane by its hose.

Operation of the start-and-stop device shall not occur.

Additionally, those circular, oscillating and reciprocating saws for which lock-off start-and-stop devices are required to start shall be checked to verify that the device is present and effective by visual inspection.

5.6 Power tool construction

Compliance with 4.2.8 shall be verified by dropping a sample circular, oscillating or reciprocating saw without inserted tool three times on to a concrete surface from a height of 1 m, without affecting its operational and safety functions. The sample shall be positioned so as to vary the point of impact.

5.7 Structure of verification of safety requirements

Table 1 — Structure of verification

Safety requirement	Visual check	Functional check	Measurement	Reference [to the subclause(s) of this part of ISO 11148 or other International Standard]
4.2.1 Surfaces, edges and corners	X			
4.2.2 Supporting surface and stability	X	X		
4.2.3 Flanges			X	
4.2.4 Hydraulic fluid ejection	X			
4.2.5 Guide plate			X	
4.2.6 Run-down time			X	
4.2.7 Guards			X	5.4
4.2.8 Power tool construction		X		5.6
4.2.9 Riving knife	X		X	
4.3 Thermal safety			X	ISO 13732-1 ISO 13732-3
4.4 Noise reduction			X	ISO 15744 5.2
4.5 Vibration			X	ISO 28927-8 ISO 20643 5.3
4.6.1 Exhaust air or gas		X		
4.6.2 Dust and fumes	X	X		
4.7.1 Design of the handle	X			
4.7.2 Suspension device	X	X		
4.8.1 Start-and-stop device		X		
4.8.2 Unintentional start	X	X		5.5
4.8.3 Actuating forces	X	X		

6 Information for use

6.1 Marking, signs and written warnings

Circular, oscillating and reciprocating saws shall be marked visibly, legibly and indelibly with the following information:

- name and full address of the manufacturer and, where applicable, his/her authorized representative;

NOTE 1 The address can be simplified if there is not really enough room on small machines, as long as the manufacturer (and, where applicable, his/her authorized representative) can always be identified so that mail is able to reach the company.

- designation of series or type;

NOTE 2 The designation of the tool can be achieved by a combination of letters and numbers.

- serial number or batch number;
- year of construction, that is the year in which the manufacturing process is completed;

- rated speed for circular saws and knives, expressed in revolutions per minute;
- rated saw blade diameter for circular saws and knives and rated saw blade radius for oscillating saws:
 - for pneumatic circular, oscillating and reciprocating saws:
 - the rated air pressure marked as (max.);
 - for hydraulic circular, oscillating and reciprocating saws:
 - the nominal pressure and flow;
 - the maximum allowable setting for the pressure relief valve.

The circular, oscillating and reciprocating saws shall be permanently marked with a graphical symbol, in accordance with Annex C, showing that the operator's instructions shall be read before work starts.

The direction of rotation for circular saws and knives shall be permanently marked in accordance with C.1.2.

6.2 Instruction handbook

6.2.1 General

For the information to be provided to the user, the content of Clause 6 together with ISO 12100:2010, 6.4.5.2 and 6.4.5.3 apply.

The information provided by the manufacturer is an important, but not exclusive, basis for safe use of the tool. It shall provide sufficient information for the end user to perform an initial risk assessment.

The hazards identified in 6.2.2.3 to 6.2.2.12 are foreseeable in the general use of hand-held circular, oscillating and reciprocating saws. The information provided with the tool shall state that the user or the user's employer shall assess the specific risks that can be present as a result of each use.

The instruction handbook shall contain information relating to at least the following:

- name and address of the manufacturer or supplier or any other agent responsible for placing the circular, oscillating or reciprocating saw on the market;
- designation of the series or type;
- operating instructions; see 6.3;
- information on noise emission; see 6.4.2;
- information on the vibration transmitted to the hands of the operator; see 6.4.3;
- maintenance instructions; see 6.5;
- explanations of any symbols marked on the circular, oscillating or reciprocating saw; see Annex C;
- information about residual risks and how to control them.

6.2.2 Operator's instructions

6.2.2.1 General

The instructions and warnings stated in 6.2.2 to 6.2.5 shall be given with all circular, oscillating and reciprocating saws unless the risk assessment shows that they are not relevant to a particular circular, oscillating and reciprocating saw. Words of equivalent meaning may be used.

6.2.2.2 Statement of use

The operator's instructions shall include a description of the correct use of the circular, oscillating or reciprocating saw and make reference to the appropriate inserted tools. The operator's instruction shall state that any other use is forbidden. Foreseeable misuse of the circular, oscillating or reciprocating saw, which experience has shown to occur, shall be warned against.

6.2.2.3 Allowance for user

The operator's instructions shall be written primarily for professional users. Where a tool can be used by non-professional users then additional information for use shall be provided.

6.2.2.4 General safety rules

- For multiple hazards, read and understand the safety instructions before installing, operating, repairing, maintaining, changing accessories on, or working near the circular, oscillating or reciprocating saw. Failure to do so can result in serious bodily injury.
- Only qualified and trained operators should install, adjust or use the circular, oscillating or reciprocating saw.
- Do not modify this circular, oscillating or reciprocating saw. Modifications can reduce the effectiveness of safety measures and increase the risks to the operator.
- Do not discard the safety instructions; give them to the operator.
- Do not use the circular, oscillating or reciprocating saw if it has been damaged.
- Tools shall be inspected periodically to verify that the ratings and markings required by this part of ISO 11148 are legibly marked on the tool. The employer/user shall contact the manufacturer to obtain replacement marking labels where necessary.

6.2.2.5 Projectile hazards

- Failure of the workpiece, or accessories, or even of the inserted tool itself, can generate high-velocity projectiles.
- Always wear impact-resistant eye protection during the operation of the circular, oscillating or reciprocating saw. The grade of protection required should be assessed for each use.
- Ensure that the workpiece is securely fixed.
- Ensure that sparks and metal cuttings are directed so as not to cause a hazard.
- Ensure that the saw blade or cutter is properly clamped.

6.2.2.6 Entanglement hazards

Choking, scalping and/or lacerations can occur if loose clothing, personal jewellery, neck wear, hair or gloves are not kept away from tools and accessories.

6.2.2.7 Operating hazards

- Avoid contact with the saw blade, knife or cutter to prevent the cutting of hands and other body parts.
- Guards shall be securely in place and in good functional condition.
- Damaged, bent or severely worn guards shall be replaced with the tool manufacturer's recommended guards.
- Make sure that retractable guards return rapidly to their fully-closed position whenever released from the open position.
- Retractable guards shall never be clamped or tied in an open position or otherwise disabled.

- Use of the tool may expose the operator's hand to hazards including cuts and abrasion and heat. Wear suitable gloves to protect hands.
- Operators and maintenance personnel shall be physically able to handle the bulk, weight and power of the tool.
- Hold the tool correctly: be ready to counteract normal or sudden movements and have both hands available.
- Maintain a balanced body position and secure footing.
- Avoid injury by cutting or severing: avoid contact with saw blade, cutter or knife whenever the energy supply is connected to the tool. Wear protective equipment, such as gloves, apron and helmet.
- Injury can be caused by uncontrolled movements of the tool: always ensure that all of the guide plate (if fitted) is held firmly against the workpiece.
- Cutting with these tools creates sharp edges; wear gloves to protect hands.
- Release the start-and-stop device in the case of an interruption of the energy supply.
- Use only lubricants recommended by the manufacturer.
- Personal protective safety glasses shall be used; suitable gloves and protective clothing are recommended.
- Be aware that there is a running-on of the rotary inserted tool after the start-and-stop device has been released.

6.2.2.8 Repetitive motions hazards

- Whenever using a circular, oscillating or reciprocating saw to perform work-related activities, the operator can experience discomfort in the hands, arms, shoulders, neck or other parts of the body.
- While using a circular, oscillating or reciprocating saw, the operator should adopt a comfortable posture while maintaining secure footing and avoiding awkward or off-balance postures. The operator should change posture during extended tasks; this can help avoid discomfort and fatigue.
- If the operator experiences symptoms, such as persistent or recurring discomfort, pain, throbbing, aching, tingling, numbness, burning sensation or stiffness, these warnings should not be ignored. The operator should tell the employer and consult a qualified health professional.

6.2.2.9 Accessory hazards

- Disconnect the circular, oscillating or reciprocating saw from the energy supply before fitting or changing the inserted tool or accessory.
- Only use sizes and types of accessories and consumables that are recommended by the circular, oscillating or reciprocating saw manufacturer; do not use other types or sizes of accessories or consumables.
- Avoid direct contact with the inserted tool during and after use as it can be hot or sharp.
- Inspect the saw blade before use. Do not use saw blades which may have been dropped or which are chipped, cracked or otherwise defective.

6.2.2.10 Workplace hazards

- Slips, trips and falls are major causes of workplace injury. Be aware of slippery surfaces caused by use of the tool and also of trip hazards caused by the air line or hydraulic hose.
- Proceed with care in unfamiliar surroundings. There can be hidden hazards, such as electricity or other utility lines.
- The circular, oscillating or reciprocating saw is not intended for use in potentially explosive atmospheres and is not insulated against coming into contact with electric power.

- Ensure that there are no electrical cables, gas pipes, etc., which can cause a hazard if damaged by use of the tool.

6.2.2.11 Dust and fume hazards

- Dusts and fumes generated when using circular, oscillating and reciprocating saws can cause ill health (for example cancer, birth defects, asthma and/or dermatitis); risk assessment and implementation of appropriate controls for these hazards are essential.
- Risk assessment should include dust created by the use of the tool and the potential for disturbing existing dust.
- Operate and maintain the circular, oscillating or reciprocating saw as recommended in the instruction handbook, in order to minimize dust or fume emissions.
- Direct the exhaust so as to minimize disturbance of dust in a dust-filled environment.
- Where dusts or fumes are created, the priority shall be to control them at the point of emission.
- All integral features or accessories for the collection, extraction or suppression of airborne dust or fumes should be correctly used and maintained in accordance with the manufacturer's instructions.
- Select, maintain and replace the consumable/inserted tool as recommended in the instruction handbook to prevent an unnecessary increase in dust or fumes.
- Warnings shall be given against the risk of explosion or fire due to the material being processed.
- Use respiratory protection in accordance with the employer's instructions and as required by occupational health and safety regulations.
- Working in certain materials creates emission of dust and fumes, causing potentially explosive environments.

6.2.2.12 Noise hazards

- Exposure to high noise levels can cause permanent, disabling hearing loss and other problems, such as tinnitus (ringing, buzzing, whistling or humming in the ears). Therefore, a risk assessment and implementation of appropriate controls for these hazards are essential.
- Appropriate controls to reduce the risk may include actions, such as damping materials to prevent workpieces from "ringing".
- Use hearing protection in accordance with the employer's instructions and as required by occupational health and safety regulations.
- Operate and maintain the circular, oscillating or reciprocating saw as recommended in the instruction handbook, to prevent an unnecessary increase in noise levels.
- Select, maintain and replace the consumable/inserted tool as recommended in the instruction handbook, to prevent an unnecessary increase in noise.
- If the circular, oscillating or reciprocating saw has a silencer, always ensure it is in place and in good working order whenever the tool is being operated.

6.2.2.13 Vibration hazards

The information for use shall draw attention to vibration hazards that have not been eliminated by design and construction and remain as residual vibration risk. It shall enable employers to identify the circumstances in which the operator is likely to be at risk from vibration exposure. If the vibration-emission value obtained using ISO 20643 or ISO 28927-8, as specified in 5.3, does not adequately represent the vibration emission in the intended uses (and foreseeable misuses) of the machine, additional information and/or warnings shall be supplied to enable the risks arising from vibration to be assessed and managed.

The following warnings (or equivalent) shall be given.

- Exposure to vibration can cause disabling damage to the nerves and blood supply of the hands and arms.
- Wear warm clothing when working in cold conditions and keep your hands warm and dry.
- If you experience numbness, tingling, pain or whitening of the skin in your fingers or hands, stop using the circular, oscillating or reciprocating saw, tell your employer and consult a physician.
- Operate and maintain the circular, oscillating or reciprocating saw as recommended in the instruction handbook to prevent an unnecessary increase in vibration levels.
- Select, maintain and replace the consumable/inserted tool as recommended in the instruction handbook, to prevent an unnecessary increase in vibration levels.
- Support the weight of the tool in a stand, tensioner or balancer, if possible.
- Hold the tool with a light, but safe, grip taking account of the required hand-reaction forces, because the risk from vibration is generally greater when the grip force is higher.
- Improper mounting of the saw blade can cause excessive vibration levels.

6.2.3 Additional safety instructions for saws with riving knife

- Use the appropriate riving knife for the blade being used. For the riving knife to work, it shall be thicker than the body of the blade, but thinner than the tooth set of the blade.
- Adjust the riving knife as described in the instruction manual. Incorrect spacing, positioning and alignment can make the riving knife ineffective in preventing kickback.
- Always use the riving knife except when plunge cutting. The riving knife shall be replaced after plunge cutting. Riving knife causes interference during plunge cutting and can create kickback.
- For the riving knife to work, it shall be engaged in the workpiece. The riving knife is ineffective in preventing kickback during short cuts.
- Do not operate the saw if the riving knife is bent. Even a light interference can slow the closing rate of a guard.

For saws with riving knife, the operating instructions shall contain the following.

- a) Instructions to ensure that the riving knife is adjusted so that the distance between the riving knife and the rim of the blade is not more than 5 mm, and the rim of the blade does not extend more than 5 mm beyond the lowest edge of the riving knife.
- b) Information on how to replace the riving knife of the hand-held saw by the blade guard support with riving knife function and its adjustment.
- c) Proper use and adjustment of the riving knife.

6.2.4 Additional safety instructions for pneumatic power tools

- Air under pressure can cause severe injury:
 - always shut off air supply, drain hose of air pressure and disconnect tool from air supply when not in use, before changing accessories or when making repairs;
 - never direct air at yourself or anyone else.
- Whipping hoses can cause severe injury. Always check for damaged or loose hoses and fittings.
- Do not use quick disconnect couplings at tool inlet for impact and impulse wrenches. Use hardened steel (or material with comparable shock resistance) threaded hose fittings.

- Whenever universal twist couplings (claw couplings) are used, lock pins shall be installed and whipcheck safety cables shall be used to safeguard against possible hose-to-tool and hose-to-hose connection failure.
- Do not exceed the maximum air pressure stated on the tool.
- Never carry an air tool by the hose.

6.2.5 Additional safety instructions for hydraulic power tools

- Do not exceed the maximum relief-valve setting stated on the tool.
- Carry out a daily check for damaged or worn hoses or hydraulic connections and replace if necessary.
- Use only clean oil and filling equipment.
- Power units require a free flow of air for cooling purposes and should, therefore, be sited in a well-ventilated area free from hazardous fumes.
- Ensure that couplings are clean and correctly engaged before operation.
- Do not inspect or clean the tool while the hydraulic power source is connected. Accidental engagement of the tool can cause serious injury.
- Do not install or remove the tool while the hydraulic power source is connected. Accidental engagement of the tool can cause serious injury.
- Be sure all hose connections are tight.
- Wipe all couplers clean before connecting. Failure to do so can result in damage to the quick couplers and cause overheating.

Instructions shall be given that only hydraulic fluid recommended by the manufacturer shall be used.

NOTE It is advisable to enquire of the manufacturer whether or not non-flammable fluids can be used.

6.2.6 Specific safety instructions

Warnings shall be given about any specific or unusual hazards associated with the use of the circular, oscillating or reciprocating saw. Such warnings shall indicate the nature of the hazard, the risk of injury and the avoidance action to take.

6.3 Operating instructions

The instructions shall include, where appropriate:

- instructions for setting-up or fixing the circular, oscillating or reciprocating saw in a stable position, as appropriate for circular, oscillating or reciprocating saws which can be mounted in a support;
- assembly instructions, including recommended guards, accessories and inserted tools;
- an illustrated description of functions;
- limitations on tool use by environmental conditions;
- instructions for setting and testing;
- general instructions for use, including changing inserted tools and limits on the size and type of workpiece.

6.4 Data

6.4.1 General

The instructions shall include the information on the data plate and the following:

- mass of the circular, oscillating or reciprocating saw;
- for hydraulic circular, oscillating and reciprocating saws:
 - specification of the coupling;
 - specification of hoses with regard to pressure and flow;
 - maximum inlet temperature of the inlet fluid.

6.4.2 Noise

6.4.2.1 Declaration of emission

The instructions shall include a noise emission declaration in accordance with ISO 15744.

6.4.2.2 Additional information

If the values for noise emissions obtained using the appropriate tests defined in 5.2 do not adequately represent the emissions during the intended uses of the machine, additional information and/or warnings shall be supplied to enable an assessment and the management of the associated risks.

NOTE Information on noise emission is intended to be provided in the sales literature.

6.4.3 Vibration

6.4.3.1 Declaration of emission

The instructions shall include the vibration-emission value and uncertainty as specified in 5.3 and the reference number of the test code in accordance with ISO 28927-8 or ISO 20643.

6.4.3.2 Additional information

If the vibration-emission values obtained using the appropriate tests defined in 5.3 do not adequately represent the emissions during the intended uses of the machine, additional information and/or warnings shall be supplied to enable an assessment and the management of the associated risks.

NOTE Information on vibration emission is intended to be provided in the sales literature.

6.5 Maintenance instructions

The maintenance instructions shall contain:

- instructions to keep circular, oscillating and reciprocating saws safe by regular preventative maintenance;
- information on when the regular preventative maintenance shall be carried out, for instance after a specified time of operation, a specified number of cycles/operations or a stated number of times per year;
- instructions for disposal so as not to expose personnel and the environment to hazards;
- a list of the service operations that the user should carry out;
- instructions for lubrication, if required;

- instructions to check the speed and make a simple check of the vibration level after each service;
- instructions to check the speed regularly;
- specifications of the spare parts to be used, whenever these affect the health and safety of operators.

Maintenance instructions shall also include precautions to be taken to avoid exposure to hazardous substances deposited (due to work processes) on the tool.

NOTE Skin exposure to hazardous dusts can cause severe dermatitis. If dust is generated or disturbed during the maintenance procedure, it can be inhaled.

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