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Machinery for forestry — General safety requirements

Matériel forestier — Exigences de sécurité générales

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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

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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 11850 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 15, *Machinery for forestry*.

This third edition cancels and replaces the second edition (ISO 11850:2003), which has been technically revised.

Introduction

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

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

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

Machinery for forestry — General safety requirements

1 Scope

This International Standard specifies general safety requirements for self-propelled forestry machines and machines configured as forestry machines. It deals with all significant hazards, hazardous situations and events common to fellers, bunchers, delimbers, forwarders, log loaders, skidders, processors, harvesters, mulchers and multi-function versions of these machine types, as defined in ISO 6814, when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

It does not deal with hazards specific to individual machines, such as those related to specific attachments, and therefore its use will not alone be sufficient to address all significant hazards for a majority of the machines it covers.

It does not deal with hazards related to chain shot, chain breakage on the upper side of the bar, lifting operation, remote control operation, the need for work lights or road safety. For vibration measurement, the test setup and work cycles are not dealt with; nor is the verification method for noise measurement addressed. It is not applicable to hazards related to maintenance or repairs carried out by professional service personnel.

The list of significant hazards dealt with is given in Annex A.

This International Standard is not applicable to machines manufactured before its date of publication.

2 Normative references

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

ISO 2631-1, *Mechanical vibration and shock — Evaluation of human exposure to whole-body vibration — Part 1: General requirements*

ISO 2860, *Earth-moving machinery — Minimum access dimensions*

ISO 2867:2011, *Earth-moving machinery — Access systems*

ISO 3411:2007, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope*

ISO 3450, *Earth-moving machinery — Wheeled or high-speed rubber-tracked machines — Performance requirements and test procedures for brake systems*

ISO 3457, *Earth-moving machinery — Guards — Definitions and requirements*

ISO 3600, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Operator's manuals — Content and presentation*

ISO 3767-1, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 3767-4, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Symbols for operator controls and other displays — Part 4: Symbols for forestry machinery*

ISO 3795, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 4413, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 5010, *Earth-moving machinery — Rubber-tyred machines — Steering requirements*

ISO 5349-2, *Mechanical vibration — Measurement and evaluation of human exposure to hand-transmitted vibration — Part 2: Practical guidance for measurement at the workplace*

ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls*

ISO 6683, *Earth-moving machinery — Seat belts and seat belt anchorages — Performance requirements and tests*

ISO 6405-1, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 6750, *Earth-moving machinery — Operator's manual — Content and format*

ISO 6814, *Machinery for forestry — Mobile and self-propelled machinery — Terms, definitions and classification*

ISO 8082-1, *Self-propelled machinery for forestry — Laboratory tests and performance requirements for roll-over protective structures — Part 1: General machines*

ISO 8082-2, *Self-propelled machinery for forestry — Laboratory tests and performance requirements for roll-over protective structures — Part 2: Machines having a rotating platform with cab and boom on the platform*

ISO 8083:2006, *Machinery for forestry — Falling-object protective structures (FOPS) — Laboratory tests and performance requirements*

ISO 8084:2003, *Machinery for forestry — Operator protective structures — Laboratory tests and performance requirements*

ISO 9533, *Earth-moving machinery — Machine-mounted audible travel alarms and forward horns — Test methods and performance criteria*

ISO 10263-4, *Earth-moving machinery — Operator enclosure environment — Part 4: Heating, ventilating and air conditioning (HVAC) test method and performance*

ISO 10263-5:2009, *Earth-moving machinery — Operator enclosure environment — Part 5: Windscreen defrosting system test method*

ISO 10265:2008, *Earth-moving machinery — Crawler machines — Performance requirements and test procedures for braking systems*

ISO 10532, *Earth-moving machinery — Machine-mounted retrieval device — Performance requirements*

ISO 10533, *Earth-moving machinery — Lift-arm support devices*

ISO 10570, *Earth-moving machinery — Articulated frame lock — Performance requirements*

ISO 11112, *Earth-moving machinery — Operator's seat — Dimensions and requirements*

ISO 11169, *Machinery for forestry — Wheeled special machines — Vocabulary, performance test methods and criteria for brake systems*

ISO 11512, *Machinery for forestry — Tracked special machines — Performance criteria for brake systems*

ISO 11837, *Machinery for forestry — Saw chain shot guarding systems — Test method and performance criteria*

ISO 11839, *Machinery for forestry — Glazing and panel materials used in operator enclosures for protection against thrown sawteeth — Test method and performance criteria*

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

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

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

ISO 14269-2, *Tractors and self-propelled machines for agriculture and forestry — Operator enclosure environment — Part 2: Heating, ventilation and air-conditioning test method and performance*

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

ISO 15818, *Earth-moving machinery — Lifting and tying-down attachment points — Performance requirements*

ISO 15998:2008, *Earth-moving machinery — Machine-control systems (MCS) using electronic components — Performance criteria and tests for functional safety*

ISO 19472:2006, *Machinery for forestry — Winches — Dimensions, performance and safety*

EN 779:2002, *Particulate air filters for general ventilation — Determination of the filtration performance*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100 and ISO 6814 apply.

4 Safety requirements and/or protective measures

4.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. The machine shall also be marked in accordance with 5.2 and carry safety signs in accordance with 5.3.

In addition, the machine shall be designed in accordance with the principles of ISO 12100 for relevant but not significant hazards which are not dealt with by this document.

The operator's manual to be provided with the machine shall comply with 5.1.

Verification of conformity shall be by inspection.

4.2 Safety distances, guards, shields

Unless otherwise specified in this International Standard, safety distances shall comply with the requirements of ISO 13857, with the exception of ISO 13857:2008, 4.2.4.2. Guards and shields, including thermal guards, shall be in accordance with ISO 3457, except that fasteners which retain fixed guards and shields in position shall be attached either to the guard or the machine.

Verification of conformity shall be by measurement.

4.3 Operator station

4.3.1 Operator space envelope

The design and arrangement of the operator station shall be such as to allow the operator to perform all normal operations at each operating position without equipment or working attachments infringing on the operator space envelope, as defined in ISO 3411:2007, Clause 5, or on the space required for the operation of controls, see 4.5.

Verification of conformity shall be by inspection and measurement.

4.3.2 Structures for operator protection

4.3.2.1 Falling object protective structure (FOPS)

All machines shall be equipped with a FOPS tested to the 11 600 J energy level specified in ISO 8083:2006, 4.3.

Verification of conformity shall be by testing in accordance with ISO 8083.

4.3.2.2 Roll-over protective structure (ROPS)

All applicable machines within the scope of ISO 8082-1 and ISO 8082-2 shall be equipped with a ROPS meeting the requirements of ISO 8082-1 or ISO 8082-2, as applicable.

Verification of conformity shall be by testing in accordance with ISO 8082-1 or ISO 8082-2, as appropriate.

4.3.2.3 Operator protective structure (OPS)

All applicable machines within the scope of ISO 8084 shall have an OPS in accordance with ISO 8084, including the constructional requirements of ISO 8084:2003, 5.2.

A device or devices intended to deflect saplings and branches by geometry, position and strength shall be installed on skidders ahead of or behind the operator's station, as appropriate.

The operator shall be protected from hazards caused by flying part(s) of failed saw chains or saw teeth by means of polycarbonate or equivalent glazing, or other appropriate guards or shields, or both.

All machines equipped with a circular saw head shall have operator protection in accordance with ISO 11839.

All machines equipped with a chain saw cutting system shall have a saw chain shot guarding system in accordance with ISO 11837.

For machines fitted with a front- or rear-mounted winch, the OPS protection shall cover at least any window opening on machines fitted with a cab and any opening as applicable for machines with a canopy.

Verification of conformity shall be carried out by checking for conformance with ISO 8084, ISO 11837 or ISO 11839, as appropriate.

4.3.2.4 Load bunk headboard

The load bunk of all tree and log transporting machines shall be equipped with a headboard capable of withstanding a force of 35 000 N applied at any point perpendicular to the face of the load bunk headboard structure. The structure shall provide protection of the cab with the machine in an inline position and the operator station in its load transport position. The test force shall be applied to the structure through a steel plate of diameter 200 mm or 200 mm × 200 mm square, with edges rounded to R 13. The plate shall be placed on as few bars of the headboard as possible. Permanent deformation shall be a maximum of 100 mm. A 100 mm diameter straight timber test piece shall not pass through the load bunk headboard when applied with a force of a maximum of 100 N.

The headboard shall be located between the load and the operator's station, and its height in the load transport position shall be greater than or equal to the height of the operator station. The headboard width shall be no less than the width across the inside of the stakes in their widest position, minus 50 mm max. at each side.

Verification of conformity shall be by inspection, test and measurement.

4.3.2.5 Fumes, spillage, hose guards and sharp edges

A person in the operator station shall be protected as follows.

a) Engine exhaust and harmful gases from heating systems shall be directed away from the operator's station, including any of its air intakes.

b) Fuel and other fluid fillers shall be located outside the operator's station. The design, sealing and location of these fillers shall be chosen to minimize the potential for spillage into the operator's station. Tanks shall have means for safely relieving internal pressure before opening or when being opened.

c) Battery location or locations shall be within easy access and shall minimize the potential of fumes and acid entering the operator's station, even in the event of the machine overturning. Batteries shall have provisions for easy handling.

d) Pressurized hoses, pipes and components shall be located or shielded so that in the event of rupture, the fluid cannot be discharged directly onto the operator in the operating position. This also applies to all operating positions for movable shields (e.g. doors or windows) designed to be open during machine operation.

e) Structural edges and corners of metallic or non-metallic materials of hardness sufficient to cause contusions or penetration of the human skin shall meet the following requirements:

   — external corners, such as those on cab or service doors, and pointed objects shall have a minimum radius of 4 mm;

   — grab-handles and edges/corners of handholds shall have a minimum radius of 5 mm.

Verification of conformity shall be by inspection and measurement.

4.3.2.6 Operator environment

If a closed cab is provided, the cab shall be equipped with heating and ventilation systems in accordance with ISO 14269-2 or ISO 10263-4.

The cab shall also be equipped with a filtration system with inlet air filter(s) of at least class F7 in accordance with EN 779:2002 or equivalent. The inlet air filter(s) shall be serviceable from inside the cab or from a service platform. If the intake air filter(s) are located before the fan, the system between the filter and fan shall be free from leakage.

Information on service, maintenance and filter replacement shall be included in the operator's manual.

Verification of conformity shall be by checking for conformance with ISO 14269-2 or ISO 10263-4 and with EN 779, as appropriate, and by inspection.

4.3.3 Seat

Machines shall be fitted with a seat in accordance with ISO 11112 that positions the operator for ergonomic and stable operation of the machine controls.

A minimum of 25 mm clearance between the seat and fixed objects that could cause pinching shall be maintained when adjusting the seat in the driving or working position or when rotating the seat between those positions. Adjusting the seat fore or aft, or both, shall be permissible while rotating it from the driving to the working position and vice versa.

The seat shall be adjustable without the use of tools.

Machines with a swivelling seat shall have primary controls that meet the requirements of 4.5.3 in all operating positions of the seat.

Verification of conformity shall be by inspection and measurement.

4.3.4 Seat belt

All machines shall be equipped with a seat belt system in accordance with ISO 6683. Seat belts shall have a device to keep them off the floor when not in use.

Verification of conformity shall be by inspection.

4.4 Access to operator's station and maintenance locations

Access to the operator's station and maintenance locations for daily service shall be as follows.

a) The access shall permit a person to achieve three points of support if the platform or work surface is elevated by more than 550 mm above the ground and shall be in accordance with ISO 2860 and ISO 2867. Foot placement surfaces shall be slip-resistant and the design of the steps shall be such that accumulation of debris, mud, snow, etc. is minimized.

   On tracked machines, an access step on the track frame may be inset up to 100 mm from the edge of the track shoe.

   On machines with articulated steering, a minimum clearance of 150 mm shall be available at the fully articulated steering position, as shown in Figure 1.

b) The access system shall minimize the possibility of controls being used as handholds.

c) The operator's station entry/exit opening dimensions shall be in accordance with ISO 2867. On machines with cabs or partial enclosures, a minimum of two openings on different surfaces shall be provided: a primary opening for the main access way and an alternative opening to serve as an emergency exit. These openings shall be in accordance with ISO 2867:2011, Table 1. If the two required openings are enclosed by doors, windows or screens, they shall be able to be opened from the inside and outside without tools. Locks can be used on these openings provided they can be unlocked or opened from the inside and there is a decal affixed to the openings advising the operator to unlock the openings during operation, if applicable.

d) Hinged doors and windows of the operator's station shall have a device for retaining them in the open and shut positions. The required OPS shall be maintained if the doors or windows are designed to remain open during machine operation. When use of the OPS requires that doors and windows be closed, a decal shall be used alerting the operator to this effect.

e) Service openings for daily service shall be in accordance with ISO 2867:2011, Table 1 (maintenance opening). If the size or weight of hinged doors, lids or hoods create a hazard, a device shall be provided to hold them open.

f) Machines with articulated frames shall be equipped with articulated frame locks in accordance with ISO 10570.

Verification of conformity shall be by inspection and measurement.

Dimensions in millimetres

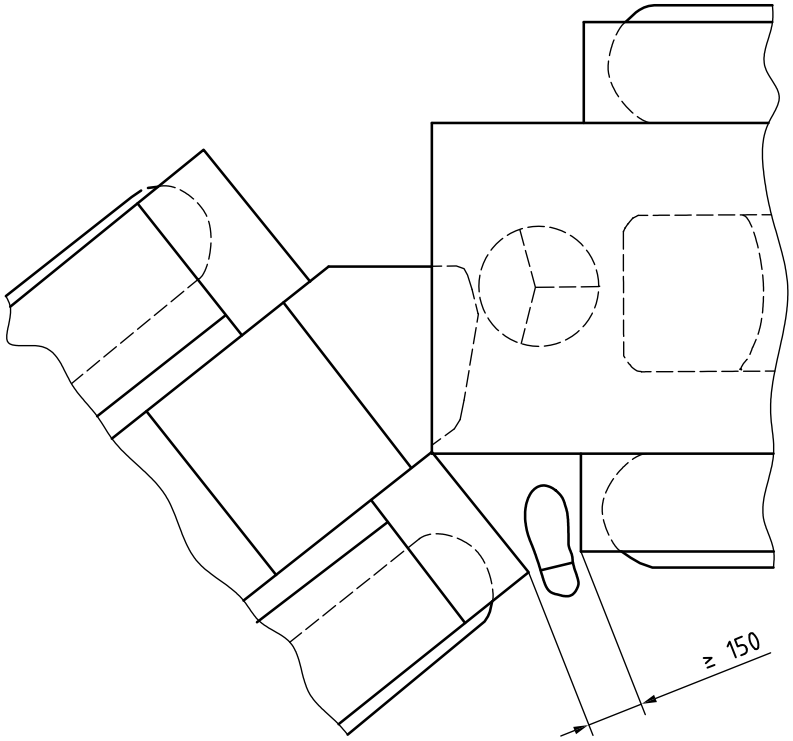

Figure 1 — Minimum clearance on machines with articulated steering

4.5 Controls

4.5.1 Starting

4.5.1.1 Unauthorized starting or movement of machines

Means shall be provided to render the starting control and parking release systems inoperative in order to deter unauthorized machine or working tool movement following machine shutdown. Locking devices such as key-type ignition switches, lockable master energy disconnect switches or provisions for padlocks satisfy this requirement. Lockable cabs can be used as protection for controls or systems located within the cab.

Verification of conformity shall be by inspection.

4.5.1.2 Transmission neutral start

In order to prevent unexpected machine movement during engine start-up, an interlock shall be provided which shall prevent the engine from being started unless

— the transmission is in neutral, or

— the transmission clutch is disengaged, or

— the combination direction and speed control is in neutral, or

— an equivalent system is provided.

No interlock is required if the transmission control returns to neutral when released.

Verification of conformity shall be by inspection and functional testing.

4.5.1.3 Bypass start protection

Starter-motor solenoid and relay electrical connections shall be shielded or blocked by obstacles to prevent accidental connection and discourage deliberate connection that circumvents neutral start interlock features without the use of tools.

Verification of conformity shall be by inspection.

4.5.2 Engine stop control

The engine stop control shall be clearly identified and, if separate from the ignition key, shall be of a colour contrasting to the background.

Verification of conformity shall be by inspection.

4.5.3 Other controls

The operator controls shall be selected, designed, constructed and arranged as follows.

a) The primary controls, i.e. controls used frequently or continuously by the operator, including machine controls, transmission, brakes, steering, engine speed and working tool controls, shall be located within the zones of comfort. Secondary controls, i.e. controls that are infrequently used by the operator, such as windscreen wipers, starter, heater and air conditioner, shall be within zones of reach in accordance with ISO 6682. Control arrangement and function shall consider space requirements for arctic clothing in accordance with ISO 2860 and ISO 3411 unless a heated operator enclosure is provided.

b) The required travel and actuation force of controls shall be consistent with the frequency of use and practical ergonomics needed to minimize operator fatigue or stress.

   NOTE See ISO 10968 and ISO 15077 for guidance.

c) Foot pedals shall be of appropriate size, shape and spacing and shall have a slip-resistant surface. In designs where there is an analogy between driving a forestry machine and a motor vehicle (i.e. with the clutch on the left, the brake in the centre and the accelerator on the right), pedals shall be similarly located to avoid the risk of confusion.

d) Equipment controls shall automatically return to their neutral position when the operator releases the control. This does not apply to travel or other controls where a detent is necessary for a specific operational requirement.

e) Controls which cause movement of the machine or equipment shall be arranged, protected or provided with neutral-position locks to minimize accidental activation when the operator enters or leaves the machine.

f) For machines with more than one working position, the operator shall be able to move from one position to the other without hazard from accidental contact with a control.

Verification of conformity shall be by inspection, measurement and functional testing.

4.5.4 Warning alarm

Machines shall be equipped with an operator-controlled alarm horn and back-up alarm in accordance with ISO 9533.

Verification of conformity shall be by inspection.

4.5.5 Safety and reliability of electronic control systems

The safety and reliability of control systems using electronic components classified as safety functions (SRP/CS), in accordance with risk assessment, shall meet the requirements of ISO 13849-1 when tested in accordance with ISO 15998:2008, Clause 7.

Verification of conformity shall be by inspection and by testing in accordance with ISO 15998.

4.5.6 Emergency attachment lowering

If the prime mover (i.e. engine) is stopped, it shall be possible to

— lower the equipment/attachment to the ground/frame,

— see the equipment/attachment lowering from the operator actuating position of the lowering control, and

— release the residual pressure in each hydraulic and pneumatic circuit, which can otherwise cause a hazardous movement risk.

The means of lowering the equipment/attachment and the device to release the residual pressure may be located outside the operator's station as long as it is located outside the danger zone.

Verification of conformity shall be by inspection.

4.6 Visibility

Provisions shall be made for good visibility to the operating and driving directions and work area(s) of the machine under all working and operating conditions. To ensure good visibility, aids such as mirrors or CCTV devices shall be used when necessary. Means of cleaning the windscreen (e.g. by the use of windscreen wipers and washers) shall be provided. If wipers are used on polycarbonate glazing, the glazing surface shall be hard-coated.

For machines with an enclosed operator's station, a windscreen defrosting system shall be provided. The windscreen defrosting system shall be tested in accordance with ISO 10263-5. The windscreen areas to be defrosted shall be at least as defined for excavators in ISO 10263-5:2009, Table 1. The minimum percentage of defrosted area after 1 h shall be in accordance with ISO 10263-5:2009, Table 2.

Glare from sunshine or artificial lighting shall be minimized by adjustable shielding or by location.

Rainwater draining from the roof shall be directed away from the windows.

Verification of conformity shall be by inspection and by checking for conformance with ISO 10263-5.

4.7 Lighting

4.7.1 Instrument and monitor lights

Instrument and monitor lighting shall be provided to permit machine operation in the dark. The arrangement or design of the instrument panel and monitor lights shall be such that glare and reflection for the operator are minimized.

Verification of conformity shall be by inspection.

4.7.2 Operator station and maintenance lighting

An interior light shall be installed in enclosed cabs.

When internal parts of the machine require inspection, adjustments or maintenance, an electrical outlet shall be provided to allow the connection of a portable lamp.

Verification of conformity shall be by inspection.

4.8 Braking systems

The braking systems of wheeled machines shall be in accordance with ISO 11169. The braking systems of those wheeled machines not within the scope of ISO 11169 but covered by the present document shall be in accordance with ISO 3450.

The braking systems of tracked machines shall be in accordance with ISO 11512.

The braking systems of those tracked machines not within the scope of ISO 11512 but covered by the present document shall have a minimum slope capability of 25° in accordance with ISO 10265 for the service and parking brakes.

Verification of conformity shall be by inspection and by checking for conformance with ISO 11169 or ISO 3450 for wheeled machines and ISO 11512 or ISO 10265 for tracked machines.

4.9 Steering systems

The steering of wheeled machines shall be in accordance with ISO 5010; wheeled machines with a maximum travel speed >30 km/h shall be provided with the emergency steering specified in ISO 5010.

Verification of conformity shall be by inspection and by checking for conformance with ISO 5010.

4.10 Retrieval, tie-down and machine-lifting devices

Both the front and rear of the machine shall be equipped with a retrieval device or devices; constructional parts can serve as such devices. Such retrieval devices and constructional devices shall comply with the strength requirements of ISO 10532.

The machine shall be equipped with tie-down points/locations for transporting machines on trucks, trailers, etc., which shall meet the strength requirements of ISO 15818.

The machine shall be equipped with lifting points/locations for attaching a machine to a crane or hoist, which shall meet the strength requirements of ISO 15818.

Verification of conformity shall be by inspection and measurement and by checking for conformance with ISO 10532 and ISO 15818.

4.11 Stability

All machines with working equipment and/or attachments and optional equipment shall be designed and constructed so that stability is provided under normal operating conditions, including maintenance, assembling, dismantling and transportation, as specified by the manufacturer in the operator's manual.

Devices intended to increase the stability in the working mode or modes (e.g. outriggers, locking of the oscillation joint or pendulum axle) shall be fitted with locking devices, e.g. a check valve keeping them in position in case of hose failure or oil leakage.

Verification of conformity shall be by inspection.

4.12 Automatic processing systems

On machines with automatic processing systems, e.g. a programmable sequence of functions, provisions shall be made for automatically stopping or neutralizing the power transmission — i.e. to booms, harvesting (felling, delimbing, slashing) or other equipment — when the operator leaves the operator station. No single electrical failure or power-loss in the automatic processing system shall create a hazard. After restoring power or fixing the failure, the automatic system shall not restart without reactivation of the automatic processor system control.

An audible or visual device shall be provided to alert the operator prior to leaving the operator station if the automatic processing systems are not neutralized and if the parking brake has not been set prior to or at the time the operator leaves the operator station.

Machine control systems, including processing systems, shall comply with ISO 13849-1.

Verification of conformity shall be by inspection and by checking for conformance with ISO 15998.

4.13 Electromagnetic compatibility

Electromagnetic compatibility of the machines shall be in accordance with ISO 14982 or ISO 13766.

Verification of conformity shall be by checking for conformance with ISO 14982 or ISO 13766, as appropriate.

4.14 Fire risks

Machines shall be constructed to reduce possible fire risks. This can be accomplished, for example, by minimizing debris accumulation, providing cleanouts, guarding fuel lines, arranging fuel fillers to avoid fuel spillage, and by proper routing, clamping, overload protecting of electric wires and hydraulic lines.

For the protection of the operator, machines shall have provision for holding a portable fire extinguisher of a mass of at least 2 kg, suitable for fuel, oil and wood product fires. The extinguisher shall be attached in a position easily accessible to the operator from the operator's station.

NOTE Local regulations governing fire extinguishers may exist.

It shall be possible to electrically isolate the battery by means of either a circuit-breaker or disconnect switch accessible from outside the machine or by a battery relay activated by the ignition switch. Such disconnection shall not affect low current, constantly powered circuit(s) provided for electronic requirements such as the fire suppression system or memory-related systems.

Low-current, constantly powered circuit(s) shall be provided (i.e. fuses) for fire prevention.

The burning rate of the operator station materials shall not exceed 100 mm/min.

Verification of conformity shall be by inspection and by checking the burning rate in accordance with ISO 3795.

4.15 Noise

4.15.1 Noise reduction by design at source and by protective measures

Noise reduction shall be an integral part of the design process, thus specifically taking into account measures at source. The success of the applied noise reduction measures are assessed on the basis of the measured noise.

The main sources causing and influencing noise are generally the air intake system, engine cooling system, engine exhaust system, cutting system, and vibrating surfaces.

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

Special care shall be taken in the acoustical design of the machine.

NOTE 2 ISO/TR 11688-2 gives useful information on noise generation mechanisms in machinery, ISO 14163 gives guidelines for noise control by silencers, and ISO 11691 and ISO 11820 can be used for testing silencers.

4.15.2 Verification

The equivalent A-weighted emission sound pressure level at the operator's position and the A-weighted sound power level shall be measured and calculated.

NOTE The noise test code is under development and when available is intended to be included in a future edition of this International Standard.

4.16 Vibration

4.16.1 Vibration reduction by design at source and by protective measures

Vibration reduction shall be an integral part of the design process, thus specifically taking into account measures at source. The success of the applied vibration reduction measures are assessed on the basis of the measured vibration. The main sources causing and influencing vibration are the power source, travelling function, loader, harvesting equipment cutting saw and the encapsulation of the machine's vibrating components.

Vibration reduction measures by design include

— selecting low vibration components, e.g. engine,

— selecting proper materials,

— selecting proper thickness and coating of surfaces,

— selection of the cutting saw configuration,

— proper maintenance of the cutting saw,

— selection of engine/exhaust mountings, and

— selecting a low-noise exhaust system.

4.16.2 Verification

The vibration shall be measured and the equivalent vibration total value for hand–arm vibrations and highest root mean square value of weighted acceleration for the whole-body vibration calculated. Hand–arm vibration measurements shall be made in accordance with ISO 5349-2 and whole-body vibration measurements in accordance with ISO 2631-1.

4.17 Storage places

There shall be a storage compartment or compartments or fastening places for accessories (e.g. personal protective equipment, tools, radiophone, operator's manual, lunch box) such that they are held in place during machine operations.

A first-aid kit shall be fitted inside the operator station.

Verification of conformity shall be by inspection.

4.18 Maintenance

It shall be possible to perform routine lubrication and maintenance with the engine stopped.

If parts of the machine, including the cab or machinery house, must be raised for routine maintenance, a mechanical support device or devices in accordance with ISO 10533 shall be provided.

Special tools required for scheduled maintenance carried out by the operator shall be provided. Storage for these tools shall be provided. Provisions shall be made for draining machine fluids without spillage onto the ground as well as for avoiding contact with such fluids by service personnel.

In the event of a system failure causing parts of the machine to remain supported by a fluid pressure, it shall be possible to lower those parts to the ground or to a secure position in a controlled manner.

Verification of conformity shall be by inspection.

4.19 Winches

Winches used in forestry applications shall be in accordance with ISO 19472:2006, Clauses 6 and 7. See also 4.3.2.3.

Verification of conformity shall be by inspection and by checking conformance with ISO 19472.

4.20 Hydraulic systems

Hydraulic systems shall comply with the safety requirements of ISO 4413.

5 Information for use

5.1 Operator's manual

All machines shall be equipped with an operator's manual in accordance with ISO 12100:2010, 6.4.5, and with ISO 3600 or ISO 6750 provisions for safe use and maintenance of the machine.

In particular, the following points, where applicable, shall be emphasized:

a) intended use(s) of the machine;

b) commissioning of the machine;

c) any relevant training requirements;

d) information regarding the personal protective equipment (PPE) required;

e) location and method of opening the alternative openings/emergency exits;

f) precautions to be taken with moving parts of the working process;

g) description and function of all controls and explanation of symbols and text used;

h) purpose of the safety signs attached to the machine;

i) overhead electric line warning;

j) warning to stay clear of the articulation area while the engine is running;

k) warning to stay clear of raised machine elements;

l) recommended use of low-noise operating modes, and/or limited time operation;

m) information about stable operation of the machine in all operating conditions including maintenance, assembly, dismantling and transportation;

n) warning to keep safety guards and shields in place while the engine is running and to keep all OPS in place and in operational condition;

o) general requirements for routine lubrication, maintenance and use of special tools;

p) safe methods for filling and draining tanks and reservoirs;

q) information on the correct methods of use, points for retrieval, tie-down, lifting and allowed loading of those points;

r) hazards associated with batteries and location of the circuit breaker;

s) fire-prevention practices[1)];

t) procedures to be followed when adjustments are to be made with the machine running;

u) use of devices for maintaining machine elements in the raised position during service and maintenance;

v) information for depressurizing and identifying suspended machine elements and stored energy sources which are not depressurized or released by the normal shutdown procedure or in the event of a system failure;

w) information concerning the replacement of hydraulic hoses;

x) information on appropriate spare parts to be used, when these affect the health and safety of operators;

y) information concerning the cab filtration system, the type of replacement filters, methods for service and maintenance of the cab filtration system for proper performance;

z) information about the importance of keeping the operator station clean and maintaining the cab environmental systems;

aa) information on the equivalent A-weighted emission sound pressure level at the operator's position(s), together with the uncertainty of stated values, and including a warning of the noise level and any recommendation for the use of hearing ear protection where this exceeds regional noise level regulations and if required by such regulations — or, if this level does not exceed the regional noise level regulations, an indication of this fact, if so required;

bb) information on the equivalent A-weighted sound power level, together with the uncertainty of stated values, where this level at any operator's position(s) exceeds regional noise level regulations, if required by such regulations;

1) Local regulations governing fire extinguishers may exist.

cc) information about the equivalent vibration total value, together with the uncertainty of stated values, of the machine to which the hand-arms are subjected, where this exceeds regional regulations and if required by such regulations — or, if this level does not exceed the regional vibration regulations, an indication of this fact, if so required[2)];

dd) information about highest root mean square value of weighted acceleration, together with the uncertainty of stated value, to which the body is subjected where this exceeds regional regulations and if required by such regulations or, if this level does not exceed the regulations, an indications of this fact, if so required;

ee) instructions for installing optional working lights and the precautions to be observed, if applicable.

Information on noise emission should also be given in the sales literature.

5.2 Marking

The following markings specific to forestry machinery shall be provided:

— retrieval devices;

— tie-down points/locations;

— lifting points/locations;

— fire extinguisher deployment holes, if applicable;

— first aid storage place;

— a prominent sign located at the alternative opening, if lockable, to remind the operator to unlock it before operating the machine.

NOTE 1 National or regional regulations could require special markings and language requirements for fire extinguishers and fire suppression systems.

NOTE 2 National and regional provisions for additional mandatory markings can also exist.

Seat belts shall bear a permanent and legibly marked label containing the following information:

— statement of compliance with ISO 6683;

— the year of manufacture;

— seat belt model number;

— name of manufacturer or importer/distributor.

Control functions shall be clearly and permanently identified unless obvious (e.g. a steering wheel or brake pedal). Symbols in accordance with ISO 3767-1 or ISO 6405-1 and with ISO 3767-4 shall be used. Words may be used to complement such symbols or in cases where appropriate symbols have not been standardized.

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

If symbols are used, they shall be explained in the operator's manual.

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2) Experience has shown that the magnitude of hand–arm vibration on the steering wheel or control levers of purpose-built forestry machines with a (seated) ride-on operator is in general significantly below 2,5 m/s^2, in which case it is sufficient to mention that the acceleration is below this limit.

5.3 Safety signs

All machines shall be marked with the following safety signs, as appropriate, by means of text or pictograms, indicating the need to

a) read the operator's manual,

b) install mechanical support before getting under raised machine elements,

c) stay clear of articulation area while the engine is running,

d) stay clear of raised machine elements,

e) keep guards and shields in place while the engine is running,

f) stay clear of overhead electric lines on machines which lift a load or raise a machine element higher than 5 m (this warning being located at the operator's station),

g) keep bystanders clear of the working machine (addressed to the operator),

h) keep clear from working machine (addressed to the bystander),

i) use the seat belts, and

j) if the machine is fitted with a cab, to keep the doors and windows closed when the machine is operational.

NOTE 1 The above messages are intended to define the context of the message and are not the actual message text.

If pictorials are used, they shall be explained in the operator's manual.

NOTE 2 Guidance for the design of pictorials is given in ISO 11684 and ISO 9244.

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

Annex A
(informative)

List of significant hazards

The table below lists significant hazards, hazardous situations and events, as far as they are dealt with in this document, identified by risk assessment as significant for this type of machinery and which require an action to eliminate or reduce the risk.

Ref. No.	Hazard	Hazardous situation/event	Subclause of this International Standard
1	Crushing	Falling of raised machine elements	4.3, 4.4, 4.18, 5.1, 5.3
2	Shearing	Shearing by machine elements	4.2, 4.4, 5.1, 5.3
3	Cutting or severing	Injury from sharp edges	4.3, 5.1, 5.3
4	Entanglement	Moving parts	4.2, 4.18, 5.1, 5.3
5	Stabbing or puncture	Impact from thrown objects	4.3, 5.1, 5.3
6	High-pressure fluid ejection	Hydraulic injection	4.3, 5.1, 5.3
7	Electrical	Fire or electric shock	4.14, 5.1, 5.3
8	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high temperature	Contact with hot parts or sprayed with hot fluids	4.14, 5.1, 5.3
9	Hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness), accidents due to interference with auditory warning signals and speech communication	Hearing damage due to the working machine	4.15, 5.1
11	Contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts	Inhalation of exhaust or spillage of fluids	4.3, 4.18, 5.1
12	Unhealthy postures or excessive effort	Injury from long-term use	4.3
13	Inadequate design, location or identification of manual controls	Loss of control	4.5, 5.1, 5.2
14	Unexpected start-up, unexpected over-run/over-speed (or any similar malfunction), movement without all parts in safe position	Engine start with gear engaged	4.5, 4.11, 5.1
15	Impossibility of stopping the machine in the best possible conditions	Collision with stationary object	4.8
16	Break-up during operation	Breakage of working tools	4.3, 5.1
17	Falling or ejected objects	Impact of thrown objects	4.3, 5.3
18	Loss of stability/overturning of machinery	Loss of control or roll-over when working on steep slopes	4.3, 4.11
19	Slip, trip and fall of persons (related to machinery)	Operator slips when mounting or dismounting	4.4, 5.1, 5.3

Bibliography

[1] ISO 9244, *Earth-moving machinery — Machine safety labels — General principles*

[2] ISO 10968, *Earth-moving machinery — Operator's controls*

[3] ISO 11684, *Tractors, machinery for agriculture and forestry, powered lawn and garden equipment — Safety signs and hazard pictorials — General principles*

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

[5] ISO/TR 11688-2, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 2: Introduction to the physics of low-noise design*

[6] ISO 11691, *Acoustics — Measurement of insertion loss of ducted silencers without flow — Laboratory survey method*

[7] ISO 11820, *Acoustics — Measurements on silencers* in situ

[8] ISO 13766, *Earth-moving machinery — Electromagnetic compatibility*

[9] ISO 14163, *Acoustics — Guidelines for noise control by silencers*

[10] ISO 15077, *Tractors and self-propelled machinery for agriculture and forestry — Operator controls — Actuating forces, displacement, location and method of operation*

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