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Woodworking machines — Safety —

Part 1: Common requirements

Machines à bois — Sécurité —

Partie 1: Exigences communes

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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 39, *Machine tools*, Subcommittee SC 4, *Woodworking machines,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 142, *Woodworking machines - Safety,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition replaces the first edition (ISO 19085-1:2017), which has been technically revised.

The main technical changes compared to the previous edition are as follows:

— in the Scope, “intended for continuous production use” has been added, referring to machines;

— in Clause 3, definitions of “stationary” and “displaceable” machines have been deleted, as well as these terms throughout the document; subclause 5.1 was unified, as well as Annex C;

— in 4.3, the start via control power-on, used on integrated fed machines, has been added;

— Subclause 4.5 has been reordered and clarified;

— in 4.7.3, for software parametrization, reference to the relevant B-standard has been added;

— new Subclause 4.13 has been added (taken from some specific parts);

— Subclause 5.6 has been unified and simplified to better adapt to the different needs of specific parts of the ISO 19085 series;

— in 5.9.2.3, light alloy characteristics have been changed, to discern from the other class of guards;

— in 5.10, requirements on roller table have been added (taken from some specific parts);

— Subclause 6.2 has been updated and a new full noise test code has been added in Annex F.

A list of all parts in the ISO 19085 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The ISO 19085 series provides technical safety requirements for the design and construction of woodworking machinery. It concerns designers, manufacturers, suppliers and importers of the machines specified in the Scope. It also includes a list of items that the manufacturer need to give to the user.

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

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance etc.)

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e. g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate in the drafting process of this document.

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

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

The full set of requirements for a particular type of woodworking machine are those given in the part of the ISO 19085 series applicable to that type, together with the relevant requirements from this document, to the extent specified in the Scope of the applicable part of the ISO 19085 series.

For woodworking machines not covered by a specific applicable part, this document can be used as a guide. However, the designer then needs to perform a full risk assessment according to ISO 12100 and design the means for reducing the risks arising from relevant hazards.

As far as possible, in other parts of the ISO 19085 series, safety requirements have been treated by way of reference to the relevant clauses of this document, to avoid repetition and reduce their length. The other parts contain replacements and additions to the common requirements given in this document.

Woodworking machines — Safety —

Part 1: Common requirements

1 Scope

This document gives the safety requirements and measures to reduce risks arising during operation, adjustment, maintenance, transport, assembly, dismantling, disabling and scrapping, related to woodworking machines capable of continuous production use, hereinafter referred as "machines". These safety requirements and measures are those common to most of the machines, when they are used as intended and under the conditions foreseen by the manufacturer, reasonably foreseeable misuse has been considered too.

The machines are designed to process solid wood and material with similar physical characteristics to wood, with hand feed or integrated feed.

This document is intended to be used in conjunction with the other parts of the ISO 19085 series, applicable to specific machine types. The extent to which all significant hazards of a specific machine type are covered is indicated in the specific part of the ISO 19085 series relevant to that machine type. The hazards covered, at least partly, by the requirements of this document, are listed in Annex A.

It is not applicable to machines intended for use in potential explosive atmospheres or to machines manufactured prior to the date of its publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 3744:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Engineering methods for an essentially free field over a reflecting plane*

ISO 3746:2010, *Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Survey method using an enveloping measurement surface over a reflecting plane*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components*

ISO 4871:1996, *Acoustics — Declaration and verification of noise emission values of machinery and equipment*

ISO 11201:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions in an essentially free field over a reflecting plane with negligible environmental corrections*

ISO 11202:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying approximate environmental corrections*

ISO 11204:2010, *Acoustics — Noise emitted by machinery and equipment — Determination of emission sound pressure levels at a work station and at other specified positions applying accurate environmental corrections*

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

ISO 13849-1:2015, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13850:2015, *Safety of machinery — Emergency stop function — Principles for design*

ISO 13851:2019, *Safety of machinery — Two-hand control devices — Principles for design and selection*

ISO 13856-1:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 1: General principles for design and testing of pressure-sensitive mats and pressure-sensitive floors*

ISO 13856-2:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 2: General principles for design and testing of pressure-sensitive edges and pressure-sensitive bars*

ISO 13856-3:2013, *Safety of machinery — Pressure-sensitive protective devices — Part 3: General principles for design and testing of pressure-sensitive bumpers, plates, wires and similar devices*

ISO 14118:2017, *Safety of machinery — Prevention of unexpected start-up*

ISO 14119:2013, *Safety of machinery — Interlocking devices associated with guards — Principles for design and selection*

ISO 14120:2015, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

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

IEC 60204-1:2016, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60529:1989+A1:1999, *CSV, Degrees of protection provided by enclosures (IP Code)*

IEC 60825-1:2014, *Safety of laser products — Part 1: Equipment classification and requirements*

IEC 61310-1:2007, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals*

IEC 61439-1:2011, *Low-voltage switchgear and controlgear assemblies — Part 1: General rules*

IEC 61496-1:2012+Cor.1:2015, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests*

IEC 61496-2:2013, *Safety of machinery — Electro-sensitive protective equipment — Part 2: Particular requirements for equipment using active opto-electronic protective devices (AOPDs)*

IEC 61496-3:2018, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*

IEC 61800-5-2:2016, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements — Functional*

IEC 62477-1:2012+A1:2016, *Safety requirements for power electronic converter systems and equipment — Part 1: General*

EN 847-1:2017, *Tools for woodworking — Safety requirements — Part 1: Milling tools, circular saw blades*

EN 847-2:2017, *Tools for woodworking — Safety requirements — Part 2: Requirements for the shank of shank mounted milling tools/circular saw blades*

EN 847-3:2013, *Tools for woodworking — Safety requirements — Part 3: Clamping devices*

EN 1837:1999+A1:2009, *Safety of machinery — Integral lighting of machines*

EN 50370-1:2005, *Electromagnetic compatibility (EMC) — Product family standard for machine tools — Part 1: Emission*

EN 50370-2:2003, *Electromagnetic compatibility (EMC) — Product family standard for machine tools — Part 2: Immunity*

EN 50525-2-21:2011, *Electric cables — Low voltage energy cables of rated voltages up to and including 450/750 V (U0/U) — Part 2-21: Cables for general applications — Flexible cables with crosslinked elastomeric insulation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010, ISO 13849-1:2015 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
woodworking machine
machine designed to machine and/or process wood and *material with similar physical characteristics to wood* (3.2)

3.2
material with similar physical characteristics to wood
wood-based material such as chipboard, fibreboard and plywood, including when composed with plastic or light alloy laminates/edges/profiles, and solid wood composed with plastic or light alloy profiles or laminates or edges, as well as cork, bone, rigid rubber or plastics

Note 1 to entry: Examples for plastics are thermoplastic materials and thermoplastic resins, thermosetting resins, expanded plastic materials, polyurethane, phenol and polyvinylchloride (PVC).

3.3
easily machinable material
material, which, upon unexpected contact with a running tool, does not mechanically generate sparks and does not result in a damage of the tool

EXAMPLE Material with similar physical characteristics to wood or light alloy.

3.4
control power-on
control that does not directly start any movement, but, after activation, enables providing power to *machine actuators* (3.5)

3.5
drive
machine actuator
power mechanism used to effect motion on the machine

3.6
operational stop
stop for operational reasons without cutting off the energy supply to the actuators where the stop condition is monitored and maintained

3.7
run-up time
time elapsed from the actuation of the start control device until the spindle or machine part reaches the intended speed

3.8
run-down time
time elapsed from the actuation of the stop control device up to spindle or machine part standstill

3.9
normal processing mode
MODE 1
condition with all safeguards in place and functional, typically used for normal processing but not limited to it

3.10
feed
relative movement between workpiece and tools during machining

3.11
hand feed
manual feed
manual holding and/or guiding of the workpiece or machine element with incorporated tool during machining

Note 1 to entry: Hand feed includes the use of a hand-operated support on which the workpiece is placed manually or clamped and the use of a *demountable power feed unit* (3.13).

3.12
integrated feed
mechanical feed
powered *feed* (3.10) mechanism for the workpiece or tool which is integrated with the machine and where the workpiece or machine element with incorporated tool is held and guided mechanically during the machining operation

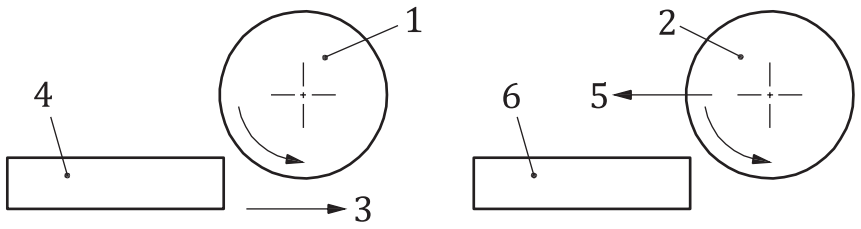
3.13
demountable power feed unit
adjustable powered *feed* (3.10) mechanism, which can be mounted onto the machine by the user

3.14
climb cutting
cutting where the projection of the movement of the cutting knife in direction of the *feed* (3.10) movement shows in the same direction as the relative movement of the workpiece against the tool

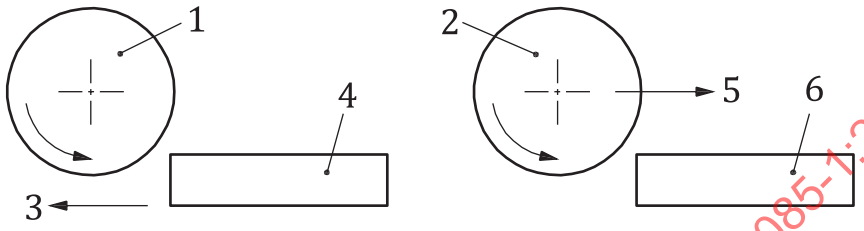
Note 1 to entry: See Figure 1 a).

3.15
cutting against the feed
cutting where the projection of the movement of the cutting knife in direction of the *feed* (3.10) movement shows in the opposite direction as the relative movement of the workpiece against the tool

Note 1 to entry: See Figure 1 b).



a) Climb cutting



b) Cutting against the feed

Key

1	tool, fixed axis	4	work-piece (moving)
2	tool, moving axis	5	feed direction (tool)
3	feed direction (work-piece)	6	work-piece (fixed)

Figure 1 — Climb cutting and cutting against the feed

3.16
boring tool
tool whose *feed* (3.10) movement during machining is only in direction of its axis of rotation

3.17
ejection
uncontrolled movement of the workpiece or parts of it or part of the tool from the machine during processing

3.18
kickback
particular form of *ejection* (3.17) describing the unexpected movement of the workpiece or parts of it opposite to the direction of the *feed* (3.10) during processing

3.19
anti-kickback device
device which either reduces the possibility of a *kickback* (3.18) or stops the movement of the workpiece or parts of it during the kickback

3.20
electro-sensitive protective equipment
ESPE
assembly of devices and/or components working together for protective tripping or presence-sensing purposes, and comprising at a minimum:

— a sensing device,

— controlling/monitoring devices,

— output signal switching devices

Note 1 to entry: Safety-related control systems associated with the ESPE or the ESPE itself can include a secondary switching device, muting functions, stopping performance monitor, start interlock, etc.

EXAMPLE Light beam (AOPD), laser scanner (AOPDDR), capacitive, active infrared, ultra-sonic and image monitoring equipment.

[SOURCE: ISO 13855:2010, 3.1.4, modified — The abbreviated term, examples and Note 1 to entry have been added.]

3.21
pressure-sensitive protective equipment
PSPE
assembly of devices and components triggered using the “mechanical activated trip” method to provide protection under hazardous situations

EXAMPLE Pressure-sensitive mats, bumpers, pressure-sensitive edges.

Note 1 to entry: PSPE generate a stopping signal by the use of different techniques, e.g. mechanical contacts, fibre-optic sensors, pneumatic sensors.

[SOURCE: ISO 13482:2014, 3.30, modified — In the example, "and bars" and "and floors" have been removed.]

3.22
teleservice
machine diagnosis (including trouble-shooting), software update and *telecontrol* (3.23) from a remote service site

3.23
telecontrol
control of the machine movements from a remote service site

4 Safety requirements and measures for controls

4.1 Safety and reliability of control systems

For the design and implementation of any safety function, either realized in electric, pneumatic, hydraulic or mechanic technology, the appropriate requirements of ISO 13849-1:2015 apply.

Machines safety functions are implemented and assured through safety-related parts of the control system (SRP/CS) that shall achieve a required performance level (PL_r). This requirement is given for each safety function in the relevant subclauses of Clause 4 and Clause 5.

Annex B summarizes PL_r for each safety function. However, the provisions of Clause 4 and Clause 5 remain the sole and complete normative set of requirements and explanations.

Specific parts of the ISO 19085 series can introduce further safety functions not considered in this document or a PL_r different from that given in this document for the same safety function, depending on the risk assessment according to ISO 12100:2010. For machines for which no specific part of the ISO 19085 series exists, and where the risk assessment results in a PL_r higher than that of this document, the higher PL_r applies.

Wherever a performance level (PL) is mentioned in the ISO 19085 series, the requirements for the performance level refer to ISO 13849-1:2015.

The safety-related embedded software (SRESW) of the SRP/CS shall be in accordance with ISO 13849-1:2015, 4.6.1 and 4.6.2.

The safety-related application software (SRASW) of the SRP/CS shall be in accordance with ISO 13849-1:2015, 4.6.1 and 4.6.3.

SRP/CS shall be validated according to ISO 13849-1:2015, Clause 8 (see also ISO 13849-2:2012).

The environmental conditions to which SRP/CS are exposed, e.g. dust, fumes and/or gases, shall be taken into account. The SRP/CS shall fulfil the environmental requirements of an existing related type-B safety standard. Otherwise, IEC 62477-1:2012+A1:2016 applies as it does for electromechanical components, too.

The SRP/CS shall fulfil the EMC requirements of an existing related type-B safety standard. Otherwise, the requirements of EN 50370-2:2003 apply (see also 7.9 for the EMC requirements on the complete machine).

Verification: By checking the relevant documentation, drawings and/or circuit diagrams, calculation, inspection of the machine and/or relevant functional testing of the machine. Verification that PL of safety functions and safeguards achieves PL_r shall be according to ISO 13849-1:2015, 4.7.

4.2 Control devices

All hand-operated control devices shall be positioned ≥600 mm and ≤1 800 mm above floor level. For electric control devices, see also IEC 60204-1:2016, 10.1.2.

NOTE Additional requirements regarding movable control panels, if any, are specified in the specific parts of the ISO 19085 series.

It shall be possible to actuate normal stop or emergency stop control devices from the same operator position as the start control devices.

Reset devices, if fitted, shall be situated outside the hazard zone in a position with good view to the hazard zone. It shall not be possible to actuate the reset control device from inside the hazard zone.

Verification: By checking the relevant drawings, inspection of the machine, measurement and relevant functional testing of the machine.

4.3 Start

4.3.1 Direct start

Before start of the machine, all relevant safeguards shall be in place and operational. This is achieved by the arrangements described in 4.6 and 5.6. Start shall only be possible by actuation of the start control device provided for that purpose. Unintended actuation shall be impeded, e.g. by a control device with shroud.

Start of powered feed (integrated or demountable) shall only be possible when the tool spindles involved in machining are running.

The SRP/CS for prevention of unexpected start shall achieve PL_r = c.

The SRP/CS for interlocking of start with safeguards shall achieve PL_r = c.

The SRP/CS for interlocking of power feed with tool rotation shall achieve PL_r = c.

For electrically operated machines, IEC 60204-1:2016, 7.5 and 9.2.3.2, apply.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.3.2 Start via control power-on

Control power-on activation shall only be possible if all relevant safeguards are in place and operational. This is achieved by the interlocking arrangement, including PL required, described in 4.6 and 5.6. The control power-on device shall be protected against unintended actuation, e.g. by shroud.

Cycle start shall only be possible after actuation of a control device provided for that purpose, and after control power-on activation.

The SRP/CS for prevention of unexpected control power-on shall achieve PL_r = c.

NOTE 1 The SRP/CS for unexpected control power-on include the input (e.g. push-button), the logic and the output (e.g. contactors).

The SRP/CS for interlocking of control power-on with safeguards shall achieve PL_r = c.

NOTE 2 The SRP/CS for interlocking of control power-on with safeguards include the input (safeguards signals), the logic and the output (e.g. contactors).

No PL is required for cycle start function.

Closure of interlocking movable guards or moving away from a triggered ESPE or PSPE shall not lead to an automatic start of dangerous movements. For each start, a deliberate action of the operator is required, i.e. safeguard reset.

NOTE 3 Dangerous movement means movement affecting the safety of the operator or other persons, not the integrity of the machine.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.4 Safe stops

4.4.1 General

The stop function shall be realized according to IEC 60204-1:2016, 9.2.2:

a) in stop category 0 for machine actuators with spring-actuated mechanical brakes or without brakes;

b) in stop category 1 or, for operational stop, in stop category 2 for machine actuators with any other type of brakes, e.g. electrical brakes.

NOTE Electrical braking also includes deceleration by a frequency inverter.

For machine actuators stopped in stop category 0, power shall be cut to these actuators except workpiece clamping (if fitted) unless STO according to IEC 61800-5-2:2016 is used.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.4.2 Normal stop

The machine shall be fitted with a stop control which, when activated, brings all dangerous movements safely to a stop.

If no emergency stop control is necessary, all normal stop control devices shall be push buttons which protrude from the control panel surface and have no shroud, and shall not be turn switches.

For normal stop of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2016, 4.2.3.2 [safe torque off (STO)], and IEC 61800-5-2:2016, 4.2.3.3 [safe stop 1 (SS1)], apply.

The SRP/CS for normal stop (braking function excluded) shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.4.3 Operational stop

For operational stops, the stopping sequence shall be as follows.

a) Stop the machine actuators in stop category 2 according to IEC 60204-1:2016, 9.2.2, and keep workpiece clamping effective (if fitted).

b) Keep the standstill condition monitored and maintained after stopping.

For operational stop of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2016, 4.2.3.4 [safe stop 2 (SS2)], and IEC 61800-5-2:2016, 4.2.4.2 [safe operating stop (SOS)], apply.

For measures against access to hazard zones during operational stop, see 5.5.

The SRP/CS for monitoring of the standstill condition shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.4.4 Emergency stop

Machines with more than one machine actuator or where provision is made for use with more than one machine actuator (e.g. with a socket for a demountable power feed) shall be fitted with an emergency stop control, which, when activated, shall bring all dangerous movements safely to a stop. Electrical emergency stop control systems shall comply with the requirements of IEC 60204-1:2016, 9.2.3.4.2 and 10.7.

If an emergency stop control is fitted, the requirements of ISO 13850:2015 apply and the control device shall be located in accordance with 4.2.

For emergency stop of PDS(SR), IEC 61800-5-2:2016, 4.2.3.2 [safe torque off (STO)], and IEC 61800-5-2:2016, 4.2.3.3 [safe stop 1 (SS1)], apply.

The SRP/CS for emergency stop (braking function excluded) shall achieve PL_r = c.

Verification: By checking relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.5 Braking function of tools

If tool drives are fitted with brakes, activation of a normal stop or an emergency stop shall cause an immediate activation of the brakes.

The SRP/CS for activation of the brakes shall achieve PL_r = c.

Where a spring-operated mechanical brake or any other type of brake not using electronic components is fitted, the last paragraph of IEC 60204-1:2016, 9.3.4, does not apply.

The braking process of electric brakes shall be performed either by direct current injection or by frequency inverter braking. Reverse current braking shall not be used.

Electric braking systems containing electronic components (excluding PDS/SR, power drive system, safety related) shall be designed in category 2 of ISO 13849-1:2015 (a higher category is allowed) with the exception that the test rate requirement in ISO 13849-1:2015, 4.5.4, is not applicable. The diagnostic coverage (DC_{avg}) shall be at least 60 %. For DC estimation, see ISO 13849-1:2015, Annex E. The SRP/CS for braking shall be tested, e.g. by measuring the braked run-down time. The feedback shall come from either the encoder fitted to the spindle motor or from the measurement of the residual current in the wires powering the motor. The test shall be:

a) independent from the basic control system for braking or an internal watchdog shall be provided in the control system for braking;

b) independent from the intention of the operator;

c) performed at each spindle stop (not limited to normal and emergency stops); and

d) followed by these consequences: latest after the third negative test result in succession, it shall not be possible to operate the machine; a negative test result shall be indicated (see also 7.1), unless the machine is stopped after the first negative test result.

For electric braking systems using only simple electronic parts like rectifiers, transistors, triacs, diodes, resistors, thyristors the PFH_d according to ISO 13849-1:2015 shall be less than $3{,}8 \times 10^{-6}$. For calculating the probability of occurrence of a dangerous failure for a simple electronic brake component with no fault detection (no DC) and no testing capability (category B and 1), the procedure described in ISO 13849-1:2015, Annex D, may be used.

The SRP/CS for electric braking systems shall achieve PL_r = b.

For braking function of PDS(SR) (power drive system, safety related), IEC 61800-5-2:2016, 4.2.3.3, on Safe Stop 1 (SS1), applies. The SRP/CS for SS1 of PDS(SR) shall achieve PL_r = c.

For brake release, see 5.4.3.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.6 Mode selection

If it is necessary to operate the machine with safeguards disabled, i.e. not in normal processing mode (MODE 1), e.g. for setting or adjustment, the machine shall be fitted with a mode selector.

NOTE Additional protective measures are defined in the specific parts.

IEC 60204-1:2016, 9.2.3.5, applies.

Mode selection shall be in accordance with the following requirements (see also ISO 12100:2010, 6.2.11.10):

a) the mode selected shall override all other controls or operating modes, except emergency stop;

b) the mode selector shall be lockable in any position, e.g. by a key-operated switch;

c) changing the mode shall not initiate any movement of the machine;

d) when changing modes, the machine shall be brought to a safe stop, except when changing from a mode with safeguards disabled to the normal processing mode.

The SRP/CS for mode selection shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.7 Tool speed changing

4.7.1 Speed changing by shifting the belts on the pulleys

On machines with varying speed by changing the belts positions on the pulleys, before starting tool drives:

— the selected tool speeds shall be indicated at the operator's position; or

— the belts positions with related tool speeds shall be visible from the operator's position without opening any guard.

The SRP/CS for speed indication, if fitted, shall achieve PL_r = b.

See also IEC 61310-1:2007.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.7.2 Speed changing by incremental speed change motor

On machines with an incremental speed change motor, e.g. a change pole motor, the selected speed shall be indicated at the selector device.

The SRP/CS for speed selection shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.7.3 Infinitely variable speed by frequency inverter

Machines equipped with an infinitely variable speed control (i.e. frequency inverter) for the tool drive shall have speed monitoring. The selected speed shall be indicated at the selector device, unless the speed is automatically selected by the control system.

The control for speed monitoring shall ensure that, as soon as the real speed exceeds the selected speed by more than 10 %, the drive is stopped automatically in stop category 0 according to IEC 60204-1:2016, 9.2.2.

NOTE A deviation of the selected speed can be caused, for example, by an error in the selected value converting system, the controlling system or the rotary pulse generator of the infinite variable speed control.

The SRP/CS for speed monitoring shall achieve PL_r = c.

For speed monitoring of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2016, 4.2.4.5 [safely-limited speed (SLS)], applies.

For software parametrization, ISO 13849-1:2015, 4.6.4, applies.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.8 Failure of any power supply

In case of any power supply interruption, no dangerous situation shall occur, e.g. by loss of workpiece clamping during machining, or by unintended movement of machine parts caused by gravity or other energies like pneumatic or hydraulic.

In case of the return of any interrupted power supply, the automatic start of any dangerous movements shall be prevented.

Parameters affecting safety functions of the machine shall not change in an uncontrolled way.

Non-return valves used to maintain workpiece clamping shall be fitted directly at the actuating cylinders.

For electric supply, IEC 60204-1:2016, 7.5, applies.

The requirements of ISO 14118:2017, Clause 6, apply.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.9 Manual reset control

The requirements of ISO 13849-1:2015, 5.2.2, apply.

The SRP/CS for manual reset shall achieve PL_r = c.

Manual reset may be achieved by control power-on circuit, where control-power on device fulfils the position requirements stated in 4.2 for manual reset devices.

If only one safeguard is triggered, safeguard local reset and process start may occur at the same time.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.10 Standstill detection and monitoring

Standstill detection may be used for deactivation of guard locking (see 5.5.2.3) or other applications like interlocking with machine part movements.

In case of operational stop only, the standstill condition shall constantly be monitored. If the standstill condition is not maintained, an emergency stop shall be initiated.

The SRP/CS for standstill detection and for monitoring shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.11 Machine moving parts speed monitoring

If a machine part movement is speed limited, the control for speed monitoring shall ensure that, as soon as the real speed exceeds the speed limit by more than 5 %, the drive is stopped automatically in stop category 0 according to IEC 60204-1:2016, 9.2.2.

For software requirements, ISO 13849-1:2015, 4.6, applies.

For limited speed monitoring of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2016, 4.2.3.4 (safely-limited speed, SLS), applies.

The SRP/CS for speed monitoring of moving parts (except tools) shall achieve PL_r = b.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.12 Time delay

If a time delay device is used to achieve a safe condition, the delay time shall at least be set to the maximum run-down time of the dangerous movements. Either the delay time shall be fix or the adjustment device shall be sealed.

The SRP/CS for the delay function shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

4.13 Teleservice

For machines with teleservice capability, the following requirements apply.

A secure connection line, e.g. VPN, shall be in place between the provider of the teleservice and customer.

During telecontrol, the connection line shall periodically be supervised to ensure it does not hang. Hanging communication lines shall be terminated on both ends, e.g. after a timeout of more than 1 min (no PL required).

The teleservice functions provided for diagnosis, software update and/or telecontrol shall be enabled from the machine side.

Indication that the teleservice mode is activated shall be provided at the machine (no PL required), e.g. by a message on the screen.

Any single machine shall be readily and clearly identifiable by the teleservice remote technician.

The emergency stop control function and all safety functions at the machine shall take precedence over any command issued from remote.

Any teleservice operation shall not activate control power-on, nor mode selection and shall neither suspend nor reset any safeguard or safety function.

When the telecontrol is activated, a warning shall appear on the control panel stating that the operator shall check that:

— all safeguards are in place and functional;

— the machine is in the normal processing mode (MODE 1); and

— they stay by the machine during all telecontrol operation, checking that nobody else is around the machine.

A confirmation of the above from the operator shall be required before starting the telecontrol function (no PL required).

After the teleservice operations are carried out, a message shall appear on the control panel stating that the teleservice is finished.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5 Safety requirements and measures for protection against mechanical hazards

5.1 Stability

Machines and auxiliary equipment shall be designed so that they are stable under foreseeable operating conditions and without risks of overturning, falling or unexpected movement [see also 7.3.1 g), s)].

Machines provided with an integrated device for moving, e.g. wheels and relevant supports, shall have the possibility to be made stable during working, e.g. by wheels brakes or retractable wheels supports, and shall pass the stability test in Annex C.

Verification: By checking the relevant drawings, inspection of the machine, and performing the test in Annex C.

5.2 Risk of break-up during operation

To reduce the probability of break-up during operation, the requirements of 5.3 apply. To reduce the effect of break-up during operation, the requirements of 5.9, 5.5.1 and 5.5.2 apply.

Unless the ejection of parts from the machines is prevented by enclosures, the design of workpiece feeding and guiding devices (e.g. feed rollers, fences and pushers) shall be such that their contact with the tool is prevented. If the possibility of contact between tools and parts of the machine cannot be excluded by design, any part of the machine that can come in contact with the tools shall be made of easily machinable material.

Verification: By checking the relevant drawings, inspection of the machine and relevant functional testing of the machine.

5.3 Tool and tool fixing design

5.3.1 General

The tool fixing shall be such that the tools do not become loose during start up, operation, run-down and braking, e.g. by using a positive connection between the spindle and the tool, or by using a positive connection between the front tool flange, if any, and the tool spindle.

Tools supplied by the machine manufacturer, if any, shall comply with the relevant standards.

NOTE Requirements for milling tools with cutting diameter over 16 mm, circular saw blades and milling tool holders are specified in EN 847-1:2017, EN 847-2:2017 and EN 847-3:2013.

Verification: By checking relevant drawings and inspection of the machine.

5.3.2 Spindle locking

When it is necessary to hold the spindle stationary for manual tool changing, a spindle holding/blocking device, e.g. a double spanner arrangement or an integral locking device, shall be provided.

Verification: By checking the relevant drawings, inspection of the machine and relevant functional testing of the machine.

5.3.3 Circular saw blade fixing device

For fixing of saw blades, flanges shall be provided.

Where two-parted flanges are provided, the clamping surface shall be at least 3 mm in width and recessed to the centre. The outer clamping diameter shall be equal for both parts within a tolerance of ±1 mm.

Verification: By checking the relevant drawings, measurement, inspection of the machine.

5.3.4 Flange dimension for circular saw blades

The outer clamping diameter of the flanges shall be at least $D/4$, where D is the diameter of the largest circular saw blade for which the machine is designed.

Verification: By checking the relevant drawings, measurement, inspection of the machine and relevant functional testing of the machine.

5.4 Braking

5.4.1 Braking of tools

An automatic brake shall be provided for tool spindles where the un-braked run-down time exceeds maximum run-down time fixed in 5.4.2.

The braked run-down time shall be less than maximum run-down time fixed in 5.4.2.

In case of failure of power supply, maximum run-down time fixed in 5.4.2 may be exceeded.

The braking torque shall not be applied directly to the tool itself or to its flanges, if any.

Verification: By checking the relevant drawings, measurement, inspection of the machine and relevant functional testing of the machine. For the determination of the run-up time, braked and un-braked run-down time, the machine shall pass the appropriate test given in Annex D.

5.4.2 Maximum run-down time

The maximum run-down time shall be 10 s.

NOTE Higher run-down time can be possible on specific machines and is indicated in the relevant specific part of the ISO 19085 series. For this reason, Subclause 5.6 considers also safeguards for machines with run-down time of more than 10 s.

Verification: by measurement and relevant functional testing of the machine.

5.4.3 Brake release

Where a control is provided to release the mechanical brake in order to enable rotation by hand, release of the brake shall only be effective when the tool has stopped rotating.

If time delay device is used, the requirements of 4.12 apply.

The actuator of the brake release shall be interlocked with the tool drive to prevent starting of the tool drive if the brake release function has not been reset.

The SRP/CS for the interlocking of the brake release with the tool drive shall achieve PL_r = c.

Verification: By checking the relevant drawings, inspection of the machine and relevant functional testing of the machine.

5.5 Safeguards

5.5.1 Fixed guards

Fixed guards shall be designed in accordance with ISO 14120:2015.

Fixed guards that are to be demounted by the user, e.g. for maintenance and cleaning purposes, shall be fitted with fixing elements remaining attached to the machine or to the guard when the guard is removed, e.g. un-losable screws [see also 7.3.1 x)].

Verification: By checking the relevant drawings and inspection of the machine.

5.5.2 Interlocking movable guards

5.5.2.1 General

Movable guards shall be designed in accordance with ISO 14120:2015 and shall be with interlocking or with interlocking and guard locking.

Measures against defeating of interlocking devices shall be taken according to ISO 14119:2013, Clause 7.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

NOTE For electrical components characteristics, the information from component manufacturer can be useful.

5.5.2.2 Movable guards with interlocking

Guard interlocking shall fulfil the principles of ISO 14119:2013, 4.2, with the exception that the access time may be shorter than the overall system stopping performance.

The SRP/CS for guard interlocking shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5.5.2.3 Movable guards with interlocking and guard locking

Guard interlocking with guard locking shall fulfil the principles of ISO 14119:2013, 4.3.

Guard interlocking with manually operated guard locking according to ISO 14119:2013, F.5, may be applied if the time necessary for the guard to be unlocked is greater than the time necessary for the hazardous movement to cease.

NOTE Usually, this is the case if the run-down time for the hazardous movements is less than 10 s.

The manual operated release of the guard locking should not take much longer than 10 s to avoid incentive for defeating.

The SRP/CS for the interlocking shall achieve PL_r = c.

The SRP/CS for the guard locking shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5.5.3 Hold-to-run control

Where hazardous movements are controlled by a hold-to-run according to IEC 60204-1:2016, 9.2.3.7, the following requirements apply.

a) The hazard zone shall be completely visible from the place of the operator.

b) For linear movements, the stopping distance or the distance moved before the moving parts reverse shall be short enough to prevent any shearing, crushing or impact hazard.

The SRP/CS for hold-to-run shall achieve PL_r = c.

As an exception, the SRP/CS for hold-to-run may achieve PL_r = b, if:

— an emergency stop device is fitted in the vicinity of the hold-to-run control device; or

— the maximum speed of the movement cannot exceed 10 mm/s.

NOTE Push buttons according to IEC 60947-5-1 are not sufficient since they only fulfil the requirement of category B, due to the potential failure not to open.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5.5.4 Two-hand control

Where hazardous movements are controlled by a two-hand control device according IEC 60204-1:2016, 9.2.3.8, it shall be minimum of type III A as defined in ISO 13851:2019 and according to the following requirements.

a) The hazard zone shall be completely visible from the place of the operator.

b) The push-buttons of the two-hand control device and their position shall be arranged in accordance with ISO 13851:2019.

The SRP/CS for two-hand control shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5.5.5 Electro-sensitive protective equipment (ESPE)

Electro-sensitive protective equipment (ESPE) shall be designed and arranged in compliance with:

a) IEC 61496-1:2012 and IEC 61496-2:2013 and as minimum type 2 as defined in IEC 61496-2:2013 for active opto-electronic protective devices (AOPD), also known as light curtains or light barriers;

b) IEC 61496-3:2018 and as minimum type 3 as defined in IEC 61496-2:2013 for laser scanners (AOPDDR).

The SRP/CS for the interlocking of dangerous movements with the ESPE shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5.5.6 Pressure-sensitive protective equipment (PSPE)

Pressure-sensitive protective equipment (PSPE) shall be designed and arranged in compliance with:

a) ISO 13856-1:2013 for pressure-sensitive mats;

b) ISO 13856-2:2013 for pressure-sensitive edges;

c) ISO 13856-3:2013 for pressure-sensitive bumpers and trip wires.

Specific parts of the ISO 19085 series give the requirements for other types of PSPE, e.g. trip plates and trip bars, where they are used.

The SRP/CS for the interlocking of dangerous movements with the PSPE shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5.5.7 Enabling control

The requirements of IEC 60204-1:2016, 9.2.3.9 and 10.9, apply and the control device shall be at least a two-position enabling switch.

The SRP/CS for enabling control shall achieve PL_r = c.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

5.6 Prevention of access to hazardous moving parts

Access to shearing and/or crushing zones caused by power-driven moving machine parts shall be prevented, e.g. by guards or protective devices according to 5.5.

Access to the tools shall be prevented by a combination of fixed guards (see 5.5.1) and interlocking movable guards (see 5.5.2) (see also ISO 12100:2010, 3.27). As an exception, for accessing tools, no interlocking movable guards are required, if all following conditions are met:

— run-down time of the tool is less than 10 s;

— access is required for tool change only;

— tool change is necessary less than once a week.

Movable guards for accessing tools require interlocking and guard locking. As an exception, only interlocking of the movable guards without guard locking may be provided for machines with manual feed and a run-down time of tools not higher than 10 s.

Where safeguarding of the part of the tools involved in machining is not possible by fixed or movable guards, access shall be prevented by one or any combination of the following means:

a) automatically adjustable guards;

b) manually adjustable guards;

c) impeding/deterring devices;

d) ESPE;

e) PSPE.

Access to hazardous movements of drives, e.g. for the tools or feed mechanism, shall be prevented by fixed guards, and, where access is required more than once a week, also by movable guards with interlocking. Movable guards shall be provided with interlocking and guard locking if the run-down time is higher than 10 s.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine, measurement and relevant functional testing of the machine.

5.7 Impact hazard

Where impact hazard due to contact between parts of the body (with the exception of forearm and hand) and moving machine parts or moving workpieces is not avoided by design of the machine or by the measures in 5.6, the speed of these movements shall not exceed 25 m/min, with speed monitoring according to 4.11.

No other hazards, e.g. hazards due to protruding screws or sharp edges, entanglement hazard, shearing or crushing, shall be present.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine, measurement and relevant functional testing of the machine.

5.8 Clamping devices

Where powered clamping is provided, crushing hazards shall be prevented by one of the following measures:

a) a two-hand control to control the clamping stroke (see 5.5.4);

b) reduction of the gap between clamp and workpiece to 6 mm or less by a manually adjustable device in combination with clamping stroke limitation to a maximum of 10 mm;

c) guarding of the clamp by a guard fixed to the clamping device to reduce the gap between workpiece and guard to less than 6 mm; the maximum extension of the clamp outside the guard shall not exceed 6 mm.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine, measurement and relevant functional testing of the machine.

5.9 Measures against ejection

5.9.1 General

Machines shall be fitted with means or devices to minimize the risk of ejection, including kickback if any, for example:

a) guards;

b) anti-kickback devices;

c) clamping devices for the workpieces (see 5.8).

NOTE The devices in b) and c) are not relevant to all machine types.

The specific parts of the ISO 19085 series address the risk of ejection, if any, due to climb cutting or cutting against the feed.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine, measurement and relevant functional testing of the machine.

5.9.2 Guards materials and characteristics

5.9.2.1 Choice of class of guards

Where guards are used as capturing devices to minimize the effect of ejection of machine parts or workpiece parts, they shall be designed according to 5.9.2.2 (class A guards) or 5.9.2.3 (class B guards) to withstand the estimated forces.

NOTE In specific parts of the ISO 19085 series, reference is made to the required class of guards.

Verification: By checking the relevant drawings and inspection of the machine.

5.9.2.2 Guards of class A

Guards of class A shall be manufactured from any of the following:

a) steel with at least an ultimate tensile strength of 350 N mm^{-2} and a wall thickness of 2 mm;

b) light alloy with at least:

   1) an ultimate tensile strength of 180 N mm^{-2} and a wall thickness of 5 mm;

   2) an ultimate tensile strength of 240 N mm^{-2} and a wall thickness of 4 mm;

   3) an ultimate tensile strength of 300 N mm^{-2} and a wall thickness of 3 mm;

c) polycarbonate with a wall thickness of at least 5 mm;

d) any material passing the impact test in Annex E, with the projectile specified in E.3.1 and E.3.2.

Verification: By checking the relevant drawings, inspection of the machine and for materials not listed in a) to c) by performing the impact test given in Annex E.

NOTE For the ultimate tensile strength, the value given by the provider is enough.

5.9.2.3 Guards of class B

Guards of class B shall be manufactured from any of the following:

a) steel with at least an ultimate tensile strength of 350 N mm^{-2} and a wall thickness of 1,5 mm;

b) light alloy with at least an ultimate tensile strength of 110 N mm^{-2} and a wall thickness of 2 mm;

c) polycarbonate with a wall thickness of at least 3 mm;

d) cast iron with at least an ultimate tensile strength of 200 N mm^{-2} and a wall thickness of 5 mm;

e) any material passing the impact test in Annex E, with the projectile specified in E.3.1 and E.3.3.

Verification: By checking the relevant drawings, inspection of the machine and for materials not listed in a) to d) by performing the impact test given in Annex E.

NOTE For the ultimate tensile strength, the value given by the provider is enough.

5.10 Workpiece supports and guides

Means for supporting and guiding the workpiece during machining shall be provided, e.g. tables, carriages, feed rollers, workpiece clamping devices, pressure devices, fences.

Wherever roller tables are used, and shearing/crushing hazards exist between an automatically fed workpiece and rollers (e.g. at the out-feed end of the machine), the gaps between the rollers shall be closed by infill plates. The gaps between the rollers and the infill plates and between the first roller and the end of the machine shall be ≤4 mm (see Figure 2). The infill plates between the rollers shall have a maximum depth below the top of the rollers of 8 mm (see Figure 2).

Dimensions in millimetres

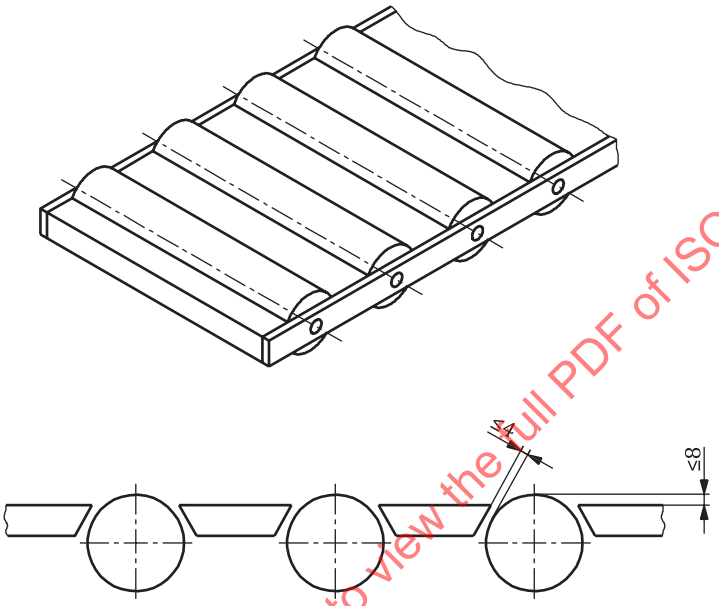


Figure 2 — Safeguarding of gaps between the rollers of roller tables

As an exception, infill plates are not required for roller tables with width not greater than 25 mm, roller diameter not greater than 30 mm, and the distance between two consecutive idle rollers of maximum 6 mm, which are known as profile supports (see Figure 3).

Dimensions in millimetres

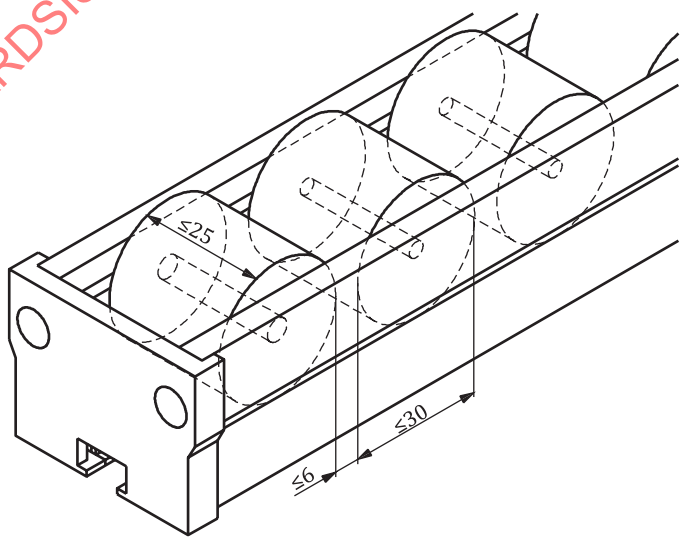


Figure 3 — Profile support design

Verification: By checking the relevant drawings, measurement and inspection of the machine.

6 Safety requirements and measures for protection against other hazards

6.1 Fire

To minimize fire hazards, the requirements of 6.3 and 6.4 shall be met (see also 7.3).

Verification: By checking the relevant drawings and inspection of the machine.

6.2 Noise

6.2.1 Noise reduction at the design stage

Machinery shall be designed and constructed in such a way that risks resulting from the emission of noise are reduced to the lowest level, taking account of technical progress and the availability of means for reducing noise, in particular at source.

When designing woodworking machinery, the information and technical measures to control noise at the source given in ISO/TR 11688-1:1995 shall be taken into account. The success of the applied noise reduction measures is assessed on the basis of the actual noise emission values in relation to other machines of the same type with comparable non-acoustical technical data.

ISO/TR 11688-2:1998 provides useful information about noise generation mechanisms in machinery.

The most relevant noise sources of woodworking machines are: tools, motors, machining process.

The following list of technical measures for noise reduction at the source gives only examples of technical measures at the design stage and is not meant to be complete:

a) choice of low-noise machine components;

b) reduction of vibrations through the static and dynamic balancing of rotating parts;

c) reduction of vibrations within the machine by reducing both the mass of the moving parts and their acceleration;

d) choice and design of low-noise transmission components, e.g. gears, pulleys, belts, bearings;

e) design of the machine structure to take into account vibration damping and by avoidance of structural resonance;

f) exhausts remote from operating positions;

g) choice and design of the mounts for the drives;

h) choice and design of cooling fans with optimum clearance and possible inclusion of overspeed limiters;

i) sound deadening and vibration damping of hydraulic circuits, pumps and drives;

j) choice and design of low rotational speed components.

Alternative measures with identical or higher effectiveness may be used.

The following list gives examples for noise reduction by protective devices:

1) encapsulation of machine parts;

2) machine enclosure;

3) partial enclosures;

4) screens;

5) mufflers/silencers.

Verification: By checking the relevant drawings, measurement and inspection of the machine.

6.2.2 Noise emission measurement and declaration

The measurement of noise emission is the way to determine the residual risk due to noise.

Annex F shall be applied for noise emission measurement and declaration.

Verification: By checking the relevant drawings, measurements and performing the test in Annex F.

6.3 Emission of chips and dust

Except for boring tools, that part of the tool which is not involved in machining shall be enclosed by a capture device (exhaust hood, enclosure of the area of dust generation), which shall have an extraction outlet. The opening of the capture device should face the projection.

Where the opening of the capture device cannot face the projection, the flow of chips and dust shall be guided efficiently to the opening of the capture device.

The opening of the capture device shall be large enough to capture the chips and dust projected.

NOTE 1 The size of the opening of the capture device depends on the emission pattern and the distance between the emission source and the opening of the capture device.

The capture device shall be designed in order to minimize pressure drop and material build up, e.g. by avoiding abrupt change of direction of extracted chips and dust, sharp angles and obstacles causing a risk for hanging of chips and dust.

The conveying of chips and dust between the capture device and the machine connection to the chips and dust extraction system (CADES), especially flexible connections of moving units, shall follow the requirements to minimize pressure drop and material build up.

To ensure that the chips and dust extracted from the point of origin are conveyed to the collection system, the design of the hoods, ducts and baffles should be based on a conveying velocity of extracted air in the duct of 20 m s^{-1} for dry chips and 28 m s^{-1} for wet chips (moisture content 18 % or above).

The pressure drop between the inlet of all capture devices and the connection to the CADES should not exceed 1 500 Pa (at air velocity in the ducts of 20 m s^{-1}).

Unintended access to the rotating tools through any dust extraction outlet shall be impeded, but the requirements of ISO 13857:2019 on fixed guards and distance guards do not apply here, due to their negative impact on the extraction of chips and dust.

NOTE 2 The risk of explosion usually does not exist on woodworking machines. If relevant, the risk is covered in a specific part of the ISO 19085 series.

Verification: By checking of drawings, inspection of the machine.

NOTE 3 For measurement of CADES performance, two standardized methods are useful: concentration method (see EN 1093-9) and index method (see EN 1093-11).

6.4 Electricity

With the exception of 6.3.3, the requirements of IEC 60204-1:2016 apply, unless stated otherwise in this document.

For the requirements regarding prevention of electric shock due to direct contact, IEC 60204-1:2016, 6.2, applies.

For the requirements regarding protection against short circuits, excluding the part of electric circuit between the machine main switch and the different circuit branches (also known as “feeder circuit”) and overloading, IEC 60204-1:2016, Clause 7, applies.

The machine manufacturer shall provide the protective bonding system of the machine up to the PE terminal and shall provide the user with information on how to complete the protection against electric shock due to indirect contact [see 7.3.1 v)].

The machine manufacturer shall provide the user with information on how to provide the protection against short circuiting of the part of electric circuit between the machine main switch and the different circuit branches [see 7.3.1 w)].

NOTE 1 The protection against short circuiting of the part of electric circuit between the machine main switch and the different circuit branches is not up to the machine manufacturer.

The degree of protection of all electric components outside of enclosures and the enclosures for electrical components themselves shall be at least IP 54 in accordance with the requirements of IEC 60529:1989+A1:1999+A2:2013 CSV, except for monitors, displays, mice of the HMI and label printers.

Electrical enclosures shall not be exposed to risk from the ejection of tools and workpieces. Live parts shall not be accessible in accordance with IEC 60204-1:2016, 6.2.2. Fire risk is not present where power circuits are protected against over current in accordance with IEC 60204-1:2016, 7.2.3.

The test 1 for the continuity of the protective bonding circuit applies in accordance with IEC 60204-1:2016, 18.2. The functional test applies in accordance with IEC 60204-1:2016, 18.6.

If a power supply cord is permanently fitted to the machine, it shall be of type H07 in accordance with the requirements of EN 50525-2-21:2011.

Machines with connection plug to three phases power supply shall be fitted with a phase changer.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant tests (IEC 60204-1:2016, 18.2, test 1, and functional test according to IEC 60204-1:2016, 18.6).

NOTE 2 For electrical components, characteristics information from the electrical components’ suppliers can be useful.

6.5 Ergonomics and handling

The machine and its control devices shall be designed according to ergonomic principles (see EN 1005-4) for work posture which is not fatiguing.

The positioning, labelling and illumination (if necessary) of control devices, and facilities for materials and tool set handling shall be in accordance with ergonomic principles (see EN 894-1, EN 894-2, EN 894-3 and EN 1005-1, EN 1005-2 and EN 1005-3).

Parts of the machine with a mass exceeding 25 kg and which are required to be lifted for normal use with a lifting device shall include the necessary attachments to accommodate the fitting of a lifting device or lugs positioned such as to avoid their overturn or fall or move in an uncontrolled way during transport, assembly, dismantling and scrapping.

Tanks containing hydraulic fluid, compressed air drainers and oilers shall be placed or oriented in such a way that the filler and drain pipes can be easily reached.

NOTE Further guidance is given in IEC 60204-1:2016, EN 614-1 and EN 614-2.

Verification: By checking the relevant drawings and/or circuit diagrams, measurements and inspection of the machine.

6.6 Lighting

Where lighting is required according to EN 1837:1999+A1:2009, it shall be provided in accordance with the requirements of IEC 60204-1:2016, 15.2 [see also 7.3.1 l)].

Verification: By checking the relevant drawings and/or circuit diagrams and inspection of the machine.

6.7 Pneumatics

For machines fitted with pneumatic equipment, the requirements of ISO 4414:2010 apply.

Verification: By checking the relevant drawings and/or circuit diagrams and inspection of the machine.

6.8 Hydraulics

For machines fitted with hydraulic equipment, the requirements of ISO 4413:2010 apply.

Verification: By checking the relevant drawings and/or circuit diagrams and inspection of the machine.

6.9 Electromagnetic compatibility

The machine shall have immunity to electromagnetic disturbances in accordance with EN 50370-2:2003. IEC 61439-1:2011 and EN 50370-1:2005 also apply.

NOTE Machines which incorporate CE-marked electrical components, and where such components and cabling are installed in accordance with their respective manufacturer's instructions, are generally considered to be protected against external electromagnetic disturbances.

Verification: By checking the relevant drawings and/or circuit diagrams and inspection of the machine.

6.10 Laser

If the machine is fitted with a laser to indicate the cutting lines, the laser shall be of category 2, 2M or a lower risk category in accordance with the requirements of IEC 60825-1:2014.

The laser shall be fitted to the machine so that warnings on the laser itself remain visible [see also 7.2.1 i)].

All provisions from the laser manufacturer associated to the installation and the use of the laser shall be fulfilled. The instruction for use of the laser shall be repeated in the instruction manual. Warning label and advice on use of eye protection, if any, shall be provided on the machine near the operator's position.

Verification: By checking the relevant drawings and inspection of the machine.

NOTE For the laser characteristics, a confirmation from the manufacturer of the laser can be useful

6.11 Static electricity

If the machine is fitted with flexible hoses for chips and dust extraction, the hoses shall be flame retardant. They shall also be antistatic or able to lead charge to earth potential via a metallic spiral. Both ends of this spiral shall be earthed.

Verification: By checking the relevant drawings and inspection of the machine.

6.12 Errors of fitting

Taking into account a residual gap between tool and its enclosure of 10 mm, it shall not be possible to fit a tool of greater diameter than the largest tool for which the machine is designed (see also 7.3).

Verification: By checking the relevant drawings and inspection of the machine.

6.13 Isolation

The requirements of ISO 12100:2010, 6.3.5.4, and of ISO 14118:2017, Clause 5, apply as well as the following.

The electric power supply to the machine shall be controlled by a supply disconnecting device which is in accordance with the requirements of IEC 60204-1:2016, 5.3.3.

If the machine is fitted with any braking system other than a mechanical brake, the electrical supply disconnecting device shall:

a) be equipped with a blocking device. It shall only be possible to switch off the electrical supply disconnecting device after manually overriding the blocking device;

b) not be situated on the same side of the machine as the stop controls; or

c) be situated at the same side of the machine control panel as the stop control devices at a horizontal distance of at least 1 200 mm from these control devices.

If pneumatic energy is also used for other purposes than clamping, it shall be possible to isolate the pneumatic supply by a manually operated lockable mechanical valve according to ISO 4414:2010, 5.2.8, first indent. The device shall include means permitting it only to be locked in the off position (e.g. by a padlock). Dumping pneumatic pressure shall not be by disconnection of a pipe.

For pneumatic systems without devices capable of storing pneumatic energy and without devices capable of making dangerous movements after being isolated from the pneumatic power supply, a quick action coupling (see ISO 4414:2010) without the means for locking is acceptable. In this case, the isolated machine (or part of machine) shall be easy enough to survey so that the disconnected coupling can be under the control of the person making an intervention on the machine at all times.

The machine shall have means to isolate hydraulic power (if provided). These means shall conform to ISO 4413:2010.

Where the machine has a hydraulic system that is powered by an integral electrically operated hydraulic pump, isolation of the hydraulic power is allowed by disconnecting the electrical supply. Where hydraulic energy is stored, e.g. in a reservoir or pipe, safe means for dumping of residual pressure shall be provided. Safe means can include a valve but does not include disconnection of any pipe.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine.

6.14 Maintenance

The basic principles of ISO 12100:2010, 6.2.15, shall be observed, and in addition, at least the information for maintenance listed in ISO 12100:2010, 6.4.5.1 e), shall be provided.

The machine shall be supplied with all special equipment and accessories for all maintenance operations intended to be carried out by the user.

The machine shall be designed so that maintenance and cleaning can be wherever possible undertaken when the machine is disconnected from all energy sources (see also 7.3).

The exterior of the machine shall be designed in order to ease the daily cleaning of chips and dust not extracted by chips and dust extraction systems. Where guards need to be opened for cleaning, such guards shall be in accordance with 5.5.2.

If dumping of residual pneumatic or hydraulic pressure allows movement of any machine component arising, then pressure shall be maintained in the system to prevent such movement, and dumping of the residual pneumatic or hydraulic pressure shall be by voluntary action on a separate control.

Verification: By checking of relevant drawings, inspection of the machine and relevant functional testing of the machine.

6.15 Relevant but not significant hazards

For relevant but not significant hazards, e.g. sharp edges of the machine frame, ISO 12100:2010 applies.

7 Information for use

7.1 Warning devices

The basic principles of ISO 12100:2010, 6.4.3, shall be observed as well as the following.

If the machine is equipped with an electrical braking system with electronic control system (excluding PDS/SR), the negative result of the periodical test required in 4.5 shall be indicated in close proximity to the stop control device for the corresponding spindle drive motor (e.g. by a yellow warning light).

Optical signals shall be clearly visible from the operators' places.

Verification: By checking of relevant drawings, inspection of the machine and relevant functional testing of the machine.

7.2 Marking

7.2.1 General

If graphical symbols related to the operation of actuators are used, they shall be in accordance with IEC 61310-1:2007, Table A.1.

The principles of ISO 12100:2010, 6.4.4, shall be observed as well as the following.

The following information shall be marked legibly and indelibly throughout the expected life of the machine, either directly on the machine (e.g. by engraving, etching) or by using labels or plates permanently fixed to the machine (e.g. by riveting or stickers):

a) name and address of the machine manufacturer and, where applicable, the business name and full address of the authorized representative;

b) designation of the machinery and designation of series or type;

c) year of construction; that is the year in which the manufacturing process is completed;

d) serial or identification machine number, if any;

e) rating information (mandatory for electro-technical products: voltage, frequency, nominal current, in accordance with IEC 60204-1:2016, 16.4);

f) if the machine is equipped with a pneumatic supply, a permanent warning label shall be placed in proximity to the electrical supply disconnection device, warning that the pneumatic supply is not isolated by isolation of the electrical supply;

g) on machines fitted with a hydraulic and/or pneumatic system, nominal pressure for the hydraulic and/or pneumatic circuits;

h) function of all isolators shall be marked in a position on the machine in close proximity to the relevant isolator;

i) if the machine is fitted with a laser, a warning label and advice on use of eye protection, if required, shall be provided on the machine near the operator's position;

j) other product marks, as necessary (for example, the CE mark in the EU).

If the machine is equipped with scales, the requirements of EN 894-2 shall apply.

If the machine is fitted with tools, tool marking shall conform to the requirements of EN 847-1:2017.

All written information presented on the machine, including warnings, shall be in the official language of the country in which the machine is to be used. Wherever possible, pictograms should be used.

Verification: By checking the relevant drawings and inspection of the machine.

7.2.2 Additional markings

The following additional information shall be marked legibly and indelibly throughout the expected life of the machine, either directly on the machine (e.g. by engraving, etching) or by using labels or plates permanently fixed to the machine (e.g. by riveting or stickers):

a) an arrow showing the direction of rotation for tool spindles having one direction of rotation and a double arrow for tool spindles which can rotate in both directions;

b) on machines where speed changing is achieved by changing the position of the drive belts on the drive pulleys, a diagram in min^{-1} adjacent to the pulleys or on a door giving access to the belt drive mechanism showing the relevant speed in min^{-1} selected for each combination of pulleys;

Verification: By checking the relevant drawings and inspection of the machine.

7.3 Instruction handbook

7.3.1 General

The principles of ISO 12100:2010, 6.4.5, shall be observed, and in addition, the instruction handbook shall include, where relevant:

a) a repetition of the markings, pictograms and other instructions on the machine as required in 7.1 and 7.2 and, if necessary, information about their meaning;

b) the description of the intended use of the machine, and description of foreseeable ways in which the machine shall not be used;

c) warnings regarding residual risks as:

   1) instructions on factors that influence exposure to noise, including:

      i) the choice of low-noise tools;

      ii) the correct speed selection;

      iii) the tools and machine maintenance;

      iv) the type of material being machined;

      v) the significance and use of any enclosure provided; and

      vi) the use of ear protection;

   2) information on factors that influence exposure to dust, including:

      i) the level of tool and machine maintenance;

      ii) the material being machined;

      iii) the importance of local extraction (capture at source);

      iv) the proper adjustment of hoods/baffles/chutes; and

v) the machine connection to an external chips and dust extraction system which ensures parameters given in instruction for use;

3) to indicate that in case of power supply failure, the tool may rotate for more than maximum run-down time (see 5.4.2);

d) instruction for safe use in accordance with ISO 12100:2010, 6.4.5.1 d), including:

1) the working area around the machine to be levelled and kept well-maintained, unobstructed and free from loose material, e.g. chips and off-cuts;

2) wearing suitable personal protective equipment when necessary. This can include:

i) ear protection to reduce the risk of induced hearing loss;

ii) respiratory protection to reduce the risk of inhalation of harmful dust;

iii) gloves for handling tools (tools should be carried in a holder wherever practicable); and

iv) eye protection;

3) reporting faults or defects in the machine, including guards or tools, as soon as they are discovered;

4) adopting safe procedures for cleaning, maintenance and remove chips and dust regularly to avoid the risk of fire;

5) following tool manufacturer's instructions for use, adjustment and repair of tools;

6) ensuring that the maximum rotational speed marked on the tools is not exceeded;

7) the type of tools and recommended speed for different materials that can be machined;

8) information how to change the tools;

9) recommendation on care to be taken when handling tools and on use of tool carriers wherever practicable;

10) not removing dust, chips, splinters or any other part of the workpiece from the cutting area while the machine is running;

11) not using the machine unless the guards and other safety devices necessary for machining are in position, in good working order and properly maintained;

12) information that operators shall be adequately trained in the use, adjustment, setting and operation of the machine, with special regard to guards and protective devices and how to carry out regular examination of them;

13) instruction on the correct use of safety appliances;

14) how to isolate the machine from all power sources;

15) instruction to minimize noise levels including also condition and maintenance of the tools and guards positioning;

16) instruction that the dust extraction equipment is to be switched on before commencing machining;

17) information that the machine when in operation can create sources of ignition;

e) warning that the machine is producing wood dust and therefore shall be connected, at installation, to an external chips and dust extraction system designed according to EN 12779:2015 or EN 16770:2018;

f) information regarding the chips and dust equipment to be fitted to the machine as follows:

   1) necessary airflow in $m^3\ h^{-1}$;

   2) pressure drop at each dust extraction connection outlet at the recommended air velocity;

   3) recommended conveying air velocity in the duct in $m\ s^{-1}$;

   4) cross section dimensions and details of each connection outlet;

g) where necessary, requirements for the need to fix machines to the floor and how this is to be done;

h) instruction for a safe transportation of machines, including at least the mass, the lifting points and lifting methods;

i) minimum and maximum workpiece sizes;

j) the range of tool dimensions, tool mass and tool momentum of inertia, which are suitable for the machine;

k) that only sharpened tools shall be used;

l) instruction that adequate general or localized lighting shall be provided;

m) information that whenever possible, maintenance shall be only done if the machine is isolated from all energy sources and unintended start is prevented;

n) if fitted with a hydraulic or a pneumatic system, the method for the safe dissipation of residual energy (see 6.8 and 6.9);

o) those safety devices which shall be tested, how frequently the tests shall be carried out and the test method. This shall include, if fitted, at least the following:

   1) emergency stops — by functional test;

   2) interlocking movable guards — by opening each guard in turn to stop the machine and by proving an inability to start the machine with each guard in the open position;

   3) interlocking movable guards with guard locking — by checking the impossibility to open each guard in turn until the machine is stopped and to start the machine as long as a guard is open;

   4) any ESPE and PSPE devices — by functional testing;

   5) the brakes — by functional testing to check that the spindles is/are braked within the specified time;

p) if fitted with mechanical brakes, the minimum number of braking cycles and the method of refurbishment (replacement);

q) the declaration of noise emission values according to F.8.

r) if fitted with a laser:

   1) statement that no exchange with a different class of laser is permitted, that no additional optical equipment shall be used and that repair shall only be carried out by the laser manufacturer or authorized persons;

   2) repetition of the laser manufacturer instructions for setting and use of the laser (where appropriate);

s) information on conditions necessary to ensure that throughout the foreseeable lifetime, the machine including its components cannot overturn or fall or move in an uncontrolled way during transport, assembly, dismantling, disabling and scrapping;

t) the operating method to be followed in the event of accident or breakdown; if a blockage is likely to occur, the operating method to be followed so as to enable the equipment to be safely unblocked;

u) the identification data of the spare parts to be changed by the user, when these affect the health and safety of operators (parts to be changed only by the manufacturer or personnel charged by the manufacturer are excluded);

v) information on how to complete protection against electric shock due to indirect contact in the machine, e.g. by a device for automatic disconnection of the power supply to be installed by the user in the line powering the machine (RCD);

w) information on how to provide protection against short circuits of the part of electric circuit between the machine main switch and the different circuit branches (also known as "feeder circuit") as far as relevant;

x) description of fixed guards which have to be removed by the user for maintenance and cleaning purposes. (guards to be dismounted only by the manufacturer or personnel charged by the manufacturer are excluded);

y) information for changing safety-related components with lifetime (mission time or $T10_d$ according to ISO 13849-1:2015, whichever the less) lower than 20 years;

z) where teleservice is provided, instruction that:

   1) the operator shall be present at the machine when telecontrol is activated.

   2) Before software update, the operator at the machine shall check that the machine is on, in normal stop condition and empty from workpieces and shall confirm it to the service technician in remote.

Verification: By checking the information given in the instruction handbook and relevant drawings.

7.3.2 Additional information

The following additional information shall be provided in the instruction handbook, where relevant:

a) instruction for safe use, which shall also include:

   1) when using milling tools with diameter ≥16 mm and circular saw blades, they shall conform to EN 847-1:2017 and EN 847-2:2017; tool holders shall conform to EN 847-3:2013;

   2) workpiece to be adequately supported during machining/feeding using, where necessary, additional support, e.g. for long workpieces;

b) instruction that where the noise enclosures (if provided) are not interlocked (see 5.6), they shall remain in the closed position to ensure the most efficient noise reduction;

c) instruction to stop the machine whilst unattended;

d) instruction that before manually changing any tool, the spindles shall be stopped until standstill of all tools and that unintended start shall be prevented.

Verification: By checking the information given in the instruction handbook and relevant drawings.

Annex A
(informative)

List of significant hazards

This annex contains those significant hazards, hazardous situations and events that are common to most woodworking machines, designed to process solid wood and material with similar physical characteristics to wood, with hand feed or integrated feed, to be taken into consideration during risk assessment. The extent to which all significant hazards are covered is indicated in the relevant specific parts of the ISO 19085 series. These hazards are listed in Table A.1, in correlation with the relevant clauses of this document, as a guide for the full risk analysis to be done when specific part of the ISO 19085 series does not exist.

Table A.1 — List of significant hazards

No.	Hazards, hazardous situations and hazardous events	ISO 12100:2010	Relevant subclause in this document
1	**Mechanical hazards** related to — machine parts or work-pieces due to		
	a) shape;	6.2.2.1, 6.2.2.2, 6.3	4.2, 5.3, 5.6, 5.10, 6.15, 7.2, 7.3
	b) relative location;		4.2, 4.3, 4.8, 5.6, 7.2
	c) mass and stability (potential energy of elements which may move under the effect of gravity);		4.8, 4.9
	d) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion);		4.3, 4.8, 5.6, 5.10
	e) mechanical strength;		5.2
	— accumulation of energy inside the machinery by:		
	f) gases under pressure;	6.2.10, 6.3.5.4	4.8, 6.7, 6.13
1.1	Crushing hazard		4.3, 4.4, 4.8, 5.4, 5.6, 5.10, 6.12, 6.13
1.2	Shearing hazard		4.3, 4.4, 5.4, 5.6, 5.10, 6.12, 6.13
1.3	Cutting or severing hazard		4.3, 4.4, 4.5, 4.8, 5.4, 5.6, 6.12, 6.13
1.4	Entanglement hazard		4.4, 4.5, 5.6, 6.12, 6.13
1.5	Drawing-in or trapping hazard		4.3, 4.4, 4.5, 5.4, 5.6, 6.12, 6.13
1.6	Impact hazard		4.3, 5.10, 6.12
1.9	High pressure fluid injection or ejection hazard	6.2.10	4.4, 6.7, 6.8, 6.13
2	**Electrical hazards** due to		
2.1	Contact of persons with live parts (direct contact)	6.2.9, 6.3.5.4	6.4, 6.13
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)	6.2.9	6.4, 6.13
2.4	Electrostatic phenomena	6.2.9	6.11
4	**Hazards generated by noise**, resulting in		

Table A.1 *(continued)*

No.	Hazards, hazardous situations and hazardous events	ISO 12100:2010	Relevant subclause in this document
4.1	Hearing loss (deafness), other physiological disorders (loss of balance, loss of awareness)	6.2.2.2, 6.3	6.2, 7.1, 7.3
4.2	Accidents due Interference with speech communication, acoustic signals		
6	**Hazards generated by radiation**		
6.5	Laser	6.3.4.5	6.10
7	**Hazards generated by materials and substances** (and their constituent elements) processed or used by the machinery		
7.1	Hazards from contact with or inhalation of harmful fluids and dusts	6.2.3 b), 6.2.4	6.3, 7.3
7.2	Fire	6.2.4	6.1
8	**Hazards generated by neglecting ergonomic principles** in machinery design		
8.1	Unhealthy postures or excessive effort	6.2.7, 6.2.8.2, 6.2.11.12, 6.3.5.5, 6.3.5.6	4.2, 6.5
8.2	Hand-arm or foot-leg anatomy	6.2.8.3	6.5
8.4	Local lighting	6.2.8.6	6.6, 7.3
8.5	Mental overload and underload, stress	6.2.8.5	7.3
8.6	Human error, human behaviour	6.2.8, 6.2.11.8, 6.2.11.10, 6.3.5.2, 6.4	7.3
8.7	Design, location or identification of manual controls	6.2.8.7, 6.2.11.8	4.2
8.8	Design or location of visual display units	6.2.8.8, 6.4.2	4.2
9	**Combination of hazards**	6.3.2.1	4.3, 4.5, 4.7, 4.8, 5.6, 6.12, 6.13
10	**Unexpected start-up**, unexpected overrun/overspeed (or any similar malfunction) from		
10.1	Failure/disorder of the control system	6.2.11, 6.3.5.4	4.1, 6.13
10.2	Restoration of energy supply after an interruption	6.2.11.4	4.8, 6.7
10.3	External influences on electrical equipment	6.2.11.11	4.1, 6.9
10.4	Other external influences (gravity)	6.2.12.2	5.10
10.5	Errors in the software	6.2.11.7	4.1
10.6	Errors made by the operator (due to mismatch of machinery with human characteristics and abilities; see 8.6)	6.2.8, 6.2.11.8, 6.2.11.10, 6.3.5.2	4.2, 6.5, 7.3
11	**Impossibility of stopping the machine in the best possible conditions**	6.2.11.1, 6.2.11.3, 6.3.5.2	4.4, 4.5, 6.13
12	**Variations in the rotational speed of tools**	6.2.2.2, 6.3.3	4.7
13	**Failure of the power supply**	6.2.11.1, 6.2.11.4	4.8
14	**Failure of the control circuit**	6.2.11, 6.3.5.4	4.1
15	**Errors of fitting**	6.2.7, 6.4.5	6.12
16	**Break-up during operation**	6.2.3	5.2, 5.9
17	**Falling or ejected objects or fluids**	6.2.3, 6.2.10	4.8, 7.3
18	**Loss of stability/overturning of machinery**	6.3.2.6	5.1

Annex B
(informative)

Performance level required

Table B.1 gives a quick-view summary of PL_r for each safety function. However, for full requirements, refer to Clauses 4 and 5.

Table B.1 — Safety functions and performance level required (PL_r)

Area	No.	Safety function	PL_r	Subclause in this document
Start	1	Prevention of unexpected start	c	4.3.1
	2	Interlocking of start with safeguards	c	4.3.1
	3	Interlocking of powered feed with tool rotation	c	4.3.1
	4	Prevention of unexpected control power-on	c	4.3.2
	5	Interlocking of control power-on with safeguards	c	4.3.2
Stop	6	Normal stop (braking function excluded)	c	4.4.2
	7	Monitoring of the standstill condition	c	4.4.3
	8	Emergency stop (braking function excluded)	c	4.4.4
Tool braking	9	Activation of the brakes	c	4.5
	10	Electric braking systems (excluding PDS/SR)	b	4.5
	11	SS1 of PDS(SR)	c	4.5
	12	Interlocking of brake release	c	5.4.3
Mode selection	13	Mode selection	c	4.6
Spindle speed	14	Speed indication	b	4.7.1
	15	Speed selection	c	4.7.2
	16	Speed monitoring	c	4.7.3
Controls	17	Manual reset	c	4.9
	18	Standstill detection and monitoring	c	4.10
	19	Speed monitoring of moving parts (except tools)	b	4.11
	20	Time delay	c	4.12
Safeguards	21	Interlocking of movable guards	c	5.5.2.2, 5.5.2.3
	22	Guard locking of movable guards	c	5.5.2.3
	23	Hold-to-run	b/c	5.5.3
	24	Two-hand control	c	5.5.4
	25	Interlocking of dangerous movements with ESPE	c	5.5.5
	26	Interlocking of dangerous movements with PSPE	c	5.5.6
	27	Enabling control	c	5.5.7

Annex C
(normative)

Stability test

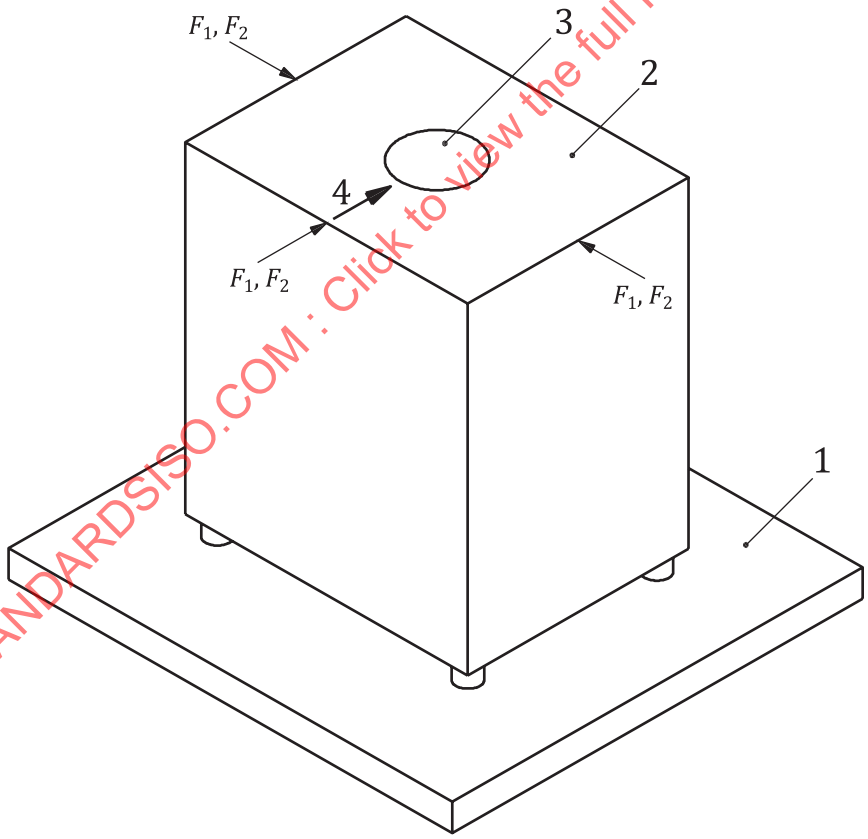
The machine fitted with a device for moving (e.g. wheels and relevant supports) shall be set in its working position on a chipboard fixed on the floor and the brakes for the wheels applied (where fitted) or the wheels retracted from the floor (if a device for retracting them is fitted).

Test 1: A horizontal force, F_1 = 100 N, shall be applied in the plane of workpiece support and in the direction of feed in line with the centre of the tool.

Test 2: a horizontal force, F_1 = 100 N, shall be applied in the plane of workpiece support and perpendicular to the direction of the feed in line with the centre of the tool, subsequently to both sides of the machine, one at a time.

During test 1 and test 2, the machine shall not move.

The tests shall be repeated with a horizontal force, F_2 = 300 N, applied as described above. The machine shall not tilt (see Figure C.1).



Key

1 chipboard
2 workpiece support
3 tool
4 feed direction

Figure C.1 — Test of stability during working, forces application

Annex D
(normative)

Test for braking function

D.1 Conditions for all tests

a) The spindle unit shall be set in accordance with the intended use of the machine (as stated in the instruction handbook, see 7.3).

b) When selecting the speed and the tools for the tests, conditions shall be chosen which create the greatest kinetic energy for which the machine is designed.

c) Before beginning the test, the spindle unit shall be run for at least 3 min at idle speed.

d) Verify that the actual spindle speed is within ±10 % of the intended speed.

D.2 Un-braked run-down time

The un-braked run-down time shall be measured as follows.

a) Start the tool spindle drive motor and run at the intended speed (no load) for 1 min.

b) Cut power to the spindle drive motor and measure the un-braked run-down time.

c) Repeat steps a) and b) twice more.

The un-braked run-down time is the average of the three measurements taken.

D.3 Braked run-down time

The braked run-down time shall be measured as follows.

a) Start the tool spindle drive motor and run at the intended speed (no load) for 1 min.

b) Initiate the stopping sequence and measure the braked run-down time.

c) Allow the spindle to rest for not more than $\left(\frac{P}{c}\right)^2$ min, where P is the motor power (rated input) in kW and factor c = 7,5 kW. The re-start interval shall not be less than 1 min.

d) Re-start the spindle drive motor and run at no-load for not more than $\left(\frac{P}{c}\right)^2$ min, where P is the motor power (rated input) in kW and factor c = 7,5 kW. The idle running time shall not be less than 1 min.

The test is repeated 9 more times.

The braked run-down time is the average of the 10 measurements taken. The standard deviation of the 10 measurements shall not exceed 10 % of this average, otherwise the test shall be repeated.

D.4 Run-up time

The run-up time shall be measured as follows.

a) Start the tool spindle drive motor and measure the run-up time (see 3.7).

b) Stop the tool spindle drive motor and allow the spindle to come to a complete stop.

The test is repeated 2 times.

The run-up time is the average of the 3 measurements taken.