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Woodworking machines — Safety —

Part 1: Common requirements

Machines à bois — Sécurité —

Partie 1: Exigences communes

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Contents

Page

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 on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 39, *Machine tools*, Subcommittee SC 4, *Woodworking machines*.

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

Introduction

The ISO 19085 series of International Standards 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 informative items that the manufacturer will need to give to the user.

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

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

When requirements of this type-C standard are different from those which are stated in type-A or 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 ISO 19085 applicable to that type, together with the relevant requirements from this document, to the extent specified in the Scope of the applicable part of ISO 19085.

For woodworking machines not covered by an applicable part, this document can be used as a guide. However, the designer will then need 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 parts of ISO 19085 other than this document, safety requirements have been treated by way of reference to the relevant sections 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.

NOTE Requirements for tools are given in EN 847-1:2013 and EN 847-2:2013.

Woodworking machines — Safety —

Part 1: Common requirements

1 Scope

This document gives the safety requirements and measures to reduce risks related to woodworking machines arising during operation, adjustment, maintenance, transport, assembly, dismantling, disabling and scrapping and which are common to machines used in the woodworking industry. It is applicable to woodworking, stationary and displaceable machines when they are used as intended and under the conditions foreseen by the manufacturer.

NOTE 1 For relevant but not significant hazards, e.g. sharp edges of the machine frame, see ISO 12100:2010.

It is intended to be used in conjunction with the other parts of ISO 19085, applicable to specific machine types.

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

NOTE 2 Machines for capturing and extracting dust are covered by EN 12779 and EN 16770.

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 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 7960:1995, *Airborne noise emitted by machine tools — Operating conditions for woodworking machines*

ISO 9614-1:1993, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 1: Measurement at discrete points*

ISO 9614-2:1996, *Acoustics — Determination of sound power levels of noise sources using sound intensity — Part 2: Measurement by scanning*

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 13851:2002, *Safety of machinery — Two-hand control devices — Functional aspects and design principles*

ISO 13855:2010, *Safety of machinery — Positioning of safeguards with respect to the approach speeds of parts of the human body*

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 14118:2000, *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 60204-1:2005, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60529:2013, *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, *Safety of machinery — Electro-sensitive protective equipment — Part 1: General requirements and tests. Corrected by Cor. 1:2015.*

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 61496-3:2008, *Safety of machinery — Electro-sensitive protective equipment — Part 3: Particular requirements for Active Opto-electronic Protective Devices responsive to Diffuse Reflection (AOPDDR)*

IEC 61800-5-2:2007, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements — Functional*

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

EN 847-1:2013, *Tools for woodworking — Safety requirements — Part 1: Milling tools, circular saw blades*

EN 847-2:2013, *Tools for woodworking — Safety requirements — Part 2: Requirements for the shank of shank mounted milling tools*

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

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 http://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
material with similar physical characteristics to wood
wood-based material such as chipboard, fibreboard and plywood, including when covered with plastic or light alloy laminates/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, will not mechanically generate sparks and will not result in a damage of the tool

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

3.4
stationary machine
machine designed to be located on or fixed to the floor or other parts of the structure of the premises

3.5
displaceable machine
machine, stationary during use and equipped with a device, e.g. wheels, which allows it to be moved between locations

3.6
drive
machine actuator
power mechanism used to effect motion on the machine

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
automatic machine
machine, which, after initiation of start by the operator, is capable of running and/or autonomously repeating machining cycles, whereby the work-piece may be manually loaded and/or unloaded

3.10
cutting area
area where the tools can be involved in the cutting process

3.11
non-cutting area
area where the tools are not involved in the cutting process

3.12
feed
relative movement between work-piece and tools during machining

3.13
hand feed
manual feed
manual holding and/or guiding of the work-piece 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 work-piece is placed manually or clamped and the use of a *demountable power feed unit* (3.15).

3.14
integrated feed
mechanical feed
feed (3.12) mechanism for the work-piece or tool which is integrated with the machine and where the work-piece or machine element with incorporated tool is held and controlled mechanically during the machining operation

3.15
demountable power feed unit
power *feed* (3.12) mechanism, which is mounted on the machine so that it can be moved from its working position to a rest position and vice versa without the use of a spanner or similar additional device

3.16
climb cutting
cutting where the projection of the movement of the cutting knife in direction of the *feed* (3.12) movement shows in the same direction as the relative movement of the work-piece against the tool

Note 1 to entry: See Figure 1 a).

3.17
cutting against the feed
cutting where the projection of the movement of the cutting knife in direction of the *feed* (3.12) movement shows in the opposite direction as the relative movement of the work-piece against the tool

Note 1 to entry: See Figure 1 b).

3.18
boring tool
tool whose *feed* (3.12) movement during machining is only in direction of its axis of rotation

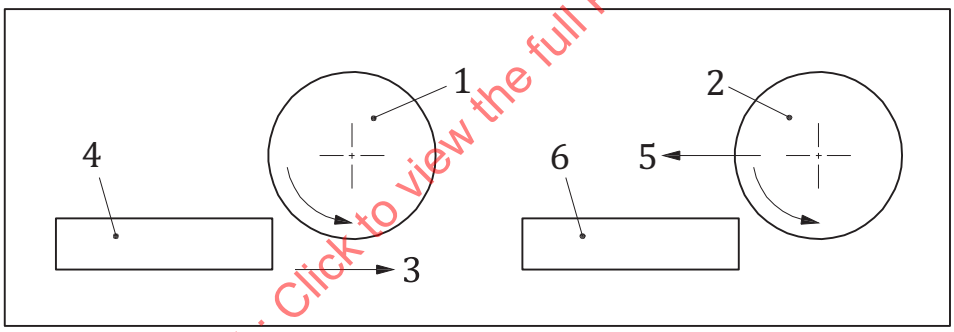
3.19
scoring
pre-cutting of a surface with a tool

3.20
scoring saw blade
saw blade mounted in front of the main saw blade which is used for *scoring* (3.19)

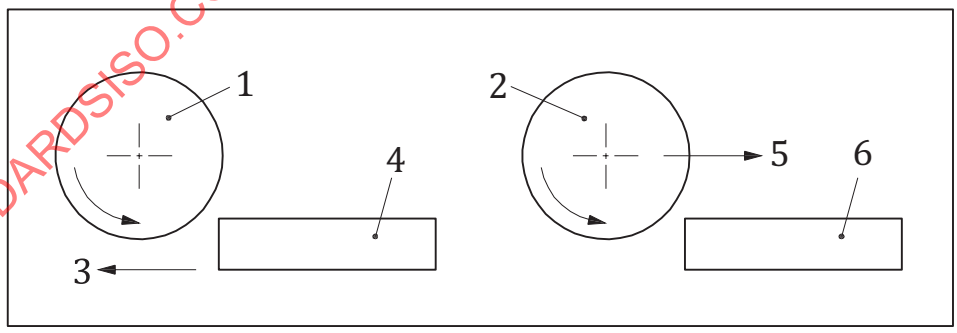
3.21
sanding wheel
tool where the active part is made of coated abrasive

3.22
grinding wheel
tool where the active part is made of bounded abrasive

3.23
ejection
uncontrolled movement of the work-piece or parts of it or part of the tool from the machine during processing



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

3.24
kickback
particular form of *ejection* (3.23) describing the unexpected movement of the work-piece or parts of it opposite to the direction of *feed* (3.12) during processing

3.25
anti-kickback device
device which either reduces the possibility of *kickback* (3.24) or arrests the motion during kickback of the work-piece or parts of it

3.26
operational stop
stop for operational reasons without cutting off the energy supply to the actuators where the stop condition is monitored and maintained

3.27
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

[SOURCE: ISO 13855:2010, 3.1.4, modified — The abbreviation and Notes to entry have been added.]

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

Note 2 to entry: Examples are light beam (AOPD), laser scanner (AOPDDR), capacitive, active infrared, ultra-sonic and image monitoring equipment.

3.28
pressure-sensitive protective equipment
PSPE
assembly of devices and components triggered using the “mechanical activated trip” method to provide protection under hazardous situations

Note 1 to entry: Examples of PSPE are pressure-sensitive mats and floors, bumpers, pressure-sensitive edges and bars.

Note 2 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]

4 List of significant hazards

This clause contains the correlation between hazards, their origin and potential consequences common to woodworking machines, as defined in the Scope and the relevant clauses of this document, 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 ISO 19085.

These hazards are listed in Table 1 as a guide for the full risk analysis to be performed when an applicable part of ISO 19085 does not exist.

Table 1 — List of significant hazards

No.	Type or group	Examples of hazards		ISO 12100:2010	Relevant section of ISO 19085-1:2017
		Origin[a]	Potential consequences[b]		
1	**Mechanical hazards**	Acceleration, deceleration (kinetic energy)	Being thrown	6.2.2.1	5.1
			Crushing	6.2.2.2	6.1
		Angular parts	Cutting or severing	6.2.10	6.2
		Approach of a moving element to a fixed part	Drawing-in or trapping	6.3	6.3
			Entanglement	6.3.5.4	6.4
		Cutting parts	Friction or abrasion		6.5
		Elastic elements	Impact		6.6
		Falling objects	Injection		6.7
		Gravity (stored energy)	Shearing		6.8
		Height from the ground	Stabbing or puncture		6.9
		High pressure			6.10
		Machinery mobility			7.8
		Moving elements			7.12
		Rotating elements			7.7
		Rough, slippery surface			7.13
		Stability			7.14
		Vacuum			
2	**Electrical hazards**	Arc	Burn	6.2.9	7.4
		Electromagnetic phenomena	Chemical effects	6.3.5.4	7.11
			Effects on medical implants		7.13
		Electrostatic phenomena			
		Live parts	Electrocution		
		Not enough distance to live parts under high voltage	Falling, being thrown		
			Fire		
		Overload	Projection of molten particles		
		Parts which have become live under fault conditions			
			Shock		
		Short-circuit			
		Thermal radiation			
3	**Thermal hazards**	Fire	Burn		7.1
		Flame	Dehydration		7.3
		Objects or materials with a high or low temperature	Discomfort		7.4
			Injuries by the radiation of heat sources		
		Radiation from heat sources			
			Scald		

[a] One origin of hazards can have several potential consequences.

[b] For each type or group of hazard, some potential consequences can be related with several origins of hazards.

Table 1 *(continued)*

No.	Type or group	Examples of hazards		ISO 12100:2010	Relevant section of ISO 19085-1:2017
		Origin[a]	Potential consequences[b]		
4	**Noise hazards**	Exhausting system	Discomfort	6.2.2.2	5.4.2
		Gas leaking at high speed	Loss of balance	6.2.3 c)	8.3
		Manufacturing process (stamping, cutting, etc.)	Permanent hearing loss	6.2.4 c)	
			Stress	6.2.8 c)	
		Moving parts	Tinnitus	6.3.1	
		Scraping surfaces	Tiredness	6.3.2.1 b)	
		Unbalanced rotating parts	Accidents (e.g. mechanical, electrical) as a consequence of an interference with speech communication or with acoustic signals	6.3.2.5.1	
		Whistling pneumatics		6.3.3.2.1	
		Worn parts		6.3.4.2	
		Rotating tools		6.4.3	
				6.4.5.1 b) and c)	
5	**Radiation hazards**	Ionising radiation source	Burn		7.10
		Low frequency electromagnetic radiation	Damage to eyes and skin		
		Optical radiation (infrared, visible and ultraviolet), including laser	Effects on reproductive capability		
		Radio frequency electromagnetic radiation	Genetic mutation		
			Headache, insomnia, etc.		
6	**Material/ substance hazards**	Aerosol	Breathing difficulties, suffocation	6.2.3	7.3
		Biological and microbiological (viral or bacterial) agent		6.2.4	7.8
			Cancer		
			Corrosion		
		Dust	Effects on reproductive capability		
		Fibre			
		Flammable	Fire		
		Fluid	Infection		
		Fume	Mutation		
		Oxidiser	Poisoning		
			Sensitisation		

[a] One origin of hazards can have several potential consequences.

[b] For each type or group of hazard, some potential consequences can be related with several origins of hazards.

Table 1 *(continued)*

No.	Type or group	Examples of hazards		ISO 12100:2010	Relevant section of ISO 19085-1:2017
		Origin[a]	Potential consequences[b]		
7	**Ergonomic hazards**	Access	Discomfort	6.2.7	5.2
		Design or location of indicators and visual displays units	Fatigue	6.2.8	7.5
			Musculoskeletal disorder	6.2.11.8	7.6
		Design, location or identification of control devices	Stress	6.2.11.12	7.14
			Any other (e.g. mechanical, electrical) as a consequence of human error	6.3.5.5	8.3
		Effort		6.3.5.6	
		Flicker, dazzling, shadow, stroboscopic effect			
		Local lighting			
		Mental overload/underload			
		Posture			
		Repetitive activity			
		Visibility			
8	**Hazards associated with environment in which the machine is used**	Dust	Burn	6.2.11	7.9
		Electromagnetic disturbance	Slight disease	6.2.11.4	
			Slipping, falling	6.2.11.7	
		Lightning	Suffocation	6.2.11.11	
		Moisture	Any other as a consequence of the effect caused by the sources of the hazards on the machine or parts of the machine	6.2.11.8	
		Pollution		6.2.11.10	
		Temperature		6.3.5.2	
		Water		6.3.5.4	
		Wind		6.4	

[a] One origin of hazards can have several potential consequences.

[b] For each type or group of hazard, some potential consequences can be related with several origins of hazards.

5 Safety requirements and measures for controls

5.1 Safety and reliability of control systems

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

Machine safety functions are implemented and assured through safety-related parts of the control system (SRP/CS) that achieve a required performance level (PL_r). This requirement is given for each safety function in the relevant subclauses of Clause 5 and Clause 6.

Table A.1 summarizes PL_r for each safety function; however, the provisions of Clause 5 and Clause 6 remain the sole and complete normative set of requirements and explanations.

Other specific parts of ISO 19085 may 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 ISO 19085 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 is mentioned in ISO 19085, the requirements for the performance level refer to ISO 13849-1:2015.

For SRP/CS as part of a safety component or protective device for which there is an existing related type-B safety standard, all requirements of that standard apply.

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 62477-1:2016 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.

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

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.

5.2 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 60204-1:2005, 10.1.2

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

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

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

5.3 Start

Before start or restart of the machine, all relevant safeguards shall be in place and operational. This is achieved by the arrangements described in 6.6.1. Start or restart 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 shall only be possible when the tool spindles involved in machining are running.

The SRP/CS for prevention of unexpected start/restart and for interlocking arrangements shall achieve PL_r = c.

For electrically operated machines, see IEC 60204-1:2005, 7.5 and 9.2.5.2.

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

5.4 Safe stops

5.4.1 General

The stop function shall be realized according to IEC 60204-1:2005, 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 stop category 2 for operational stop only, 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 work-piece clamping (if fitted) unless STO according to IEC 61800-5-2:2007 is used.

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

5.4.2 Normal stop

The machine shall be fitted with a stop control which, when activated, brings all machine actuators and any demountable power feed unit safely to a stop.

If no emergency stop control is necessary, all normal stop control devices shall protrude and have no shroud.

For normal stop of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2007, 4.2.2.2 [safe torque off (STO)] and IEC 61800-5-2:2007, 4.2.2.3 [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.

5.4.3 Operational stop

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

a) Stop the machine actuators in stop category 2 according to IEC 60204-1:2005, 9.2.2 and keep work-piece clamping effective (if fitted).

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

For operational stop of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2007, 4.2.2.4 [“safe stop 2” (SS2)] and IEC 61800-5-2:2007, 4.2.3.1 [“safe operating stop” (SOS)] apply.

For measures against access to danger zones in operational stop condition, see 6.5.

The SRP/CS for monitoring of the stand-still 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.

5.4.4 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. Electrical emergency stop control systems shall comply with the requirements of IEC 60204-1:2005, 9.2.5.4.2 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 5.2.

For emergency stop of PDS(SR), IEC 61800-5-2:2007, 4.2.2.2 [safe torque off (STO)] and IEC 61800-5-2:2007, 4.2.2.3 [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.

5.5 Braking function of tool spindles

The SRP/CS for the braking function 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 60204-1:2005, 9.3.4 does not apply.

As an exception, where electric braking systems containing electronic components are used, the control system for braking shall achieve PL_r = b and be designed in category 2 of ISO 13849-1:2015 with the exception that the test rate requirement in ISO 13849-1:2015, 4.5.4 is not applicable. The SRP/CS for braking shall be tested periodically, e.g. by monitoring 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

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

b) be independent from the intention of the operator, and

c) be performed at each spindle stop.

Where the test result is negative, more than three times in succession, it shall not be possible to operate the machine. A negative test result shall be indicated (see also 8.1).

The diagnostic coverage (DC_{avg}) shall be at least 60 %.

See ISO 13849-1:2015, Annex E for DC estimation.

As an exception, a simple electronic brake (using simple electronic parts like rectifiers, transistors, triacs, diodes, resistors, thyristors) shall achieve PL_r = b and the PFHd according to ISO 13849-1:2015 shall be less than $3{,}8 \times 10^{-6}$.

NOTE Complex electronic components like microprocessors or PLCs cannot be considered, as well tried under the scope of ISO 13849-1 and, therefore, do not fulfil the requirements of category 1 of ISO 13849-1.

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 1), the procedure described in ISO 13849-1:2015, Annex D can be used.

For brake release, see 6.4.3.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant functional testing of the machine. For the determination of un-braked run-down time and braked run-down time, if relevant, the appropriate tests given in Annex B apply.

5.6 Mode selection

If it is necessary to operate the machine with reduced safety measures, e.g. for setting or adjustment, the machine shall be fitted with a mode selector.

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 control 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 normal or operational stop except when changing from a mode with lower safety measures (e.g. setting) into a mode with higher safety measures.

The SRP/CS for mode selection shall achieve PL_r = c. See also 8.3 and IEC 60204-1:2005, 9.2.3.

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

5.7 Spindle speed changing

5.7.1 Spindle speed changing by changing 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.

5.7.2 Spindle 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. Speed selection shall be designed to 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.

5.7.3 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. Where the speed is automatically selected by the control system, the selected speed need not to be indicated.

The control for speed monitoring shall ensure that, as soon as the real speed exceeds the selected speed by more than 10 %, the drive shall be stopped automatically in stop category 0 according to IEC 60204-1:2005, 9.2.2.

NOTE A deviation of the selected speed may be caused by, e.g. 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 61800-5-2:2007, 4.2.3.4 [safely-limited speed (SLS)] applies.

The requirements of ISO 13849-1:2015, 4.6 apply on the development of the safety-related software.

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

5.8 Failure of any power supply

In case of any power supply interruption, no dangerous situation shall occur, e. g. by loss of work-piece clamping during machining.

In case of the return of any interrupted power supply, the automatic restart of any dangerous movements shall be prevented (for PL_r on restart, see 5.3).

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

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

For electric supply, see IEC 60204-1:2005, 7.5.

The requirements of ISO 14118:2000, Clause 6 apply.

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

5.9 Manual reset control

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

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

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

5.10 Enabling control

The requirements of IEC 60204-1:2005, 9.2.6.3 and 10.9 apply.

The SRP/CS for enabling 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.

5.11 Machine moving parts speed monitoring

The control for speed monitoring shall ensure that, as soon as the real speed exceeds the speed limit, the drive shall be stopped automatically in stop category 0 according to IEC 60204-1:2005, 9.2.2.

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

For speed monitoring of PDS(SR) (power drive system, safety-related), IEC 61800-5-2:2007, 4.2.3.4 [safely-limited speed (SLS)] applies.

The SRP/CS for speed monitoring of moving parts (excepting tools) 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.

5.12 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 times 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.

6 Safety requirements and measures for protection against mechanical hazards

6.1 Stability

6.1.1 Stationary machines

It shall be possible to fix stationary machines to a suitable stable structure, e.g. floor. Facilities for fixing are, e.g. fixing holes in the machine frame [also see 8.3.1 g)]. If the intended use of the machine includes the use without fixation to a suitable structure, the test in Annex C shall be passed.

Verification: By checking the relevant drawings, inspection of the machine, and performing the test in Annex C, for machines that do not require fixation.

6.1.2 Displaceable machines

Displaceable machines shall have the facility to make them stable during machining (e.g. by providing brakes for the wheels or a device to retract the wheels from the floor). Machines provided with wheels shall have adequate stability during transportation. Displaceable machines shall pass the tests in Annex C.

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

6.2 Risk of break-up during operation

To reduce the probability of break-up during operation, the requirements of 6.3 apply. To reduce the effect of break-up during operation, the requirements of 6.9, 6.5.1 and 6.5.2 apply.

Unless the ejection of parts from the machines is prevented by enclosures, the design of work-piece 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.

6.3 Tool holder and tool design

6.3.1 General

The tool fixing device 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 and tool holders 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 847-1:2013, EN 847-2:2013 and EN 847-3:2013.

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

6.3.2 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 bar inserted through the spindle, shall be provided.

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

6.3.3 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.

6.3.4 Flange dimension for circular saws 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.

6.4 Braking

6.4.1 Braking of tool spindles

An automatic brake shall be provided for tool spindles where the un-braked run-down time exceeds maximum run-down time fixed in 6.4.2.

The braked run-down time shall be less than maximum run-down time fixed in 6.4.2.

In case of failure of power supply, maximum run-down time fixed in 6.4.2 may be exceeded.

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

Electrical brakes and their function shall be performed either by direct current injection or by frequency inverter braking. Reverse current braking shall not be used.

Verification: By checking the relevant drawings, 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, see the appropriate test given in Annex B.

6.4.2 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 are indicated in the relevant specific part of this series. For this reason, 6.6.2 and 6.6.3 consider also safeguards for machines with run-down time of more than 10 s.

6.4.3 Brake release

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

If time delay device is used, 5.12 applies.

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

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

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

6.5 Safeguards

6.5.1 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 8.3.1 v).

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

6.5.2 Interlocking movable guards

6.5.2.1 General

Movable guards shall be designed in accordance with ISO 14120:2015 and shall be interlocked without guard locking or interlocked with guard locking.

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.

6.5.2.2 Movable guards with interlocking *without* guard locking

Guard interlocking without guard locking shall fulfil the principles of ISO 14119:2013, 4.2.

The SRP/CS for guard interlocking without 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.

6.5.2.3 Movable guards with interlocking *with* 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 guard interlocking with 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.

6.5.3 Hold-to-run control

Where hazardous movements are controlled by a hold-to-run according to IEC 60204-1:2005, 9.2.6.1, the following requirements apply.

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

b) The stopping distance or the distance moved before the moving parts reverse shall be short enough to prevent any hazard.

The SRP/CS for hold-to-run 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.

6.5.4 Two-hand control

Where hazardous movements are controlled by a two-hand control device according IEC 60204-1:2005, 9.2.6.2, it shall be minimum of type III A as defined in ISO 13851:2002 and according the following requirements.

a) The danger 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 13851:2002.

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.

6.5.5 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 61496-3:2008 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.

6.5.6 Pressure-sensitive protective equipment (PSPE)

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

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

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

c) ISO 13856-3:2013 for pressure-sensitive bumpers, plates, wires and similar devices.

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.

6.6 Prevention of access to moving parts

6.6.1 General

Access to hazardous moving parts shall be prevented by one or more of the following safeguards (see 6.5):

a) guards (see 6.5.1 and 6.5.2);

b) ESPE (see 6.5.5);

c) PSPE (see 6.5.6).

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

6.6.2 Guarding of tools

Access to the tools shall be prevented by a combination of fixed guards (see 6.5.1) and interlocking movable guards (see 6.5.2).

Movable guards with interlocking and guard locking are required if the run-down time of dangerous movements is higher than 10 s.

Movable guards on automatic machines require interlocking with guard locking regardless of the run-down time of dangerous movements.

As an exception, no interlocking movable guards are required, when 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.

In this case, access to the tool shall be prevented by fixed guards and/or adjustable guards.

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 the rotating tools from any dust extraction outlet shall be prevented by fixed guards and/or distance guards according to the requirements of ISO 13857.

See also ISO 12100:2010, 3.27.

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

6.6.3 Guarding of drives

Access to the drives, e.g. for the tools or the feed mechanism, shall be prevented by a combination of fixed guards (see 6.5.1) and interlocking movable guards (see 6.5.2).

Movable guards with interlocking and guard locking are required if the run-down time of dangerous movements is higher than 10 s.

As an exception, no interlocking movable guards are required if the run-down times of dangerous movements are less than 10 s and access to the guarded area is necessary less than once a week. In this case, fixed guards only may prevent access to the drive.

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

6.6.4 Guarding of shearing and/or crushing zones

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 6.5.

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

6.7 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 work-pieces is not avoided by design of the machine or by the measures in 6.6, the speed of these movements shall not exceed 25 m/min (speed monitoring according to 5.11).

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.

6.8 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 6.5.4);

b) two-stage clamping with a maximum clamping force at the clamping device of 50 N for the first stage, followed by full clamping force actuated by a manual control;

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

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

The SRP/CS for prevention of unexpected activation of second stage clamping force in b) shall achieve PL_r = c.

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

6.9 Measures against ejection

6.9.1 General

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

a) guards;

b) anti-kickback devices;

c) anti-splinter devices;

d) clamping devices for the work-pieces (see 6.8).

For requirements against ejection of tool parts, see 6.2, 6.5.1, 6.5.2.

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

6.9.2 Guards materials and characteristics

6.9.2.1 Choice of class of guards

Where guards are used as capturing devices to minimize the effect of ejection of machine parts or work-piece parts, they shall be designed according to 6.9.2.2 (class A guards) or 6.9.2.3 (class B guards) to withstand the estimated forces.

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

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

6.9.2.2 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 D, with the projectile specified in D.3.1 and D.3.2.

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

NOTE For the ultimate tensile strength, a confirmation from the manufacturer of the material can be useful.

6.9.2.3 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:

   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 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 D, with the projectile specified in D.3.1 and D.3.3.

Verification: By checking the relevant drawings, tensile strength measurement, inspection of the machine and for materials not listed in a) to e) by performing the impact test given in Annex D.

NOTE For the ultimate tensile strength, a confirmation from the manufacturer of the material can be useful.

6.10 Work-piece supports and guides

Means for support and guiding of the work-piece during machining shall be provided, e.g. tables, carriages, feed rollers, work-piece clamping devices, pressure devices, fences.

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

7 Safety requirements and measures for protection against other hazards

7.1 Fire

To minimize fire hazards, the requirements of 7.3 and 7.4 shall be met (see also 8.3).

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

7.2 Noise

7.2.1 Noise reduction at the design stage

When designing machinery, the information and technical measures to control noise at source given in ISO/TR 11688-1:1995 shall be taken into account. The most relevant noise sources are the rotating tools.

NOTE ISO/TR 11688-2:1998 gives useful information on noise generation mechanisms in machinery.

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

7.2.2 Noise emission measurement

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

Operating conditions for noise measurement shall comply with ISO 7960:1995, the relevant Annex of which is additionally specified in this document. For machines where no specific Annex in ISO 7960:1995 exists, the requirements of Annex E apply.

Mounting and operating conditions of the machine shall be identical for the determination of emission sound pressure levels at the work station and sound power levels.

Emission sound power levels shall be measured according to the enveloping surface measuring method in ISO 3746:2010 with the following modifications.

a) The environmental indicator K_{2A} shall be equal to or less than 4 dB.

b) The difference between the background sound pressure level and the machine sound pressure level at each measuring point shall be equal to or greater than 6 dB. The correction formula for this difference is given in ISO 3746:2010, 8.3.3, Formula (12).

c) Only the parallelepiped measurement surface shall be used. This parallelepiped measurement surface shall be located at 1 m from the reference surface.

d) Where the distance from the machine to an auxiliary unit is less than 2 m, the auxiliary unit shall be included in the reference surface.

e) The accuracy of the test method shall be better than 3 dB.

f) The number of microphone positions shall be 9, in accordance with Annex E.

Alternatively, where the facilities exist and the measurement method applies to the machine type, emission sound power levels may also be measured according to a method with higher precision, e.g. ISO 3743-1:2010, ISO 3743-2:1994, ISO 3744:2010 and ISO 3745:2012 without the preceding modifications.

For determination of sound power level by sound intensity method, use ISO 9614-1:1993 and ISO 9614-2:1996 (subject to agreement between the supplier and the purchaser).

Emission sound pressure level at the workstation shall be measured according to ISO 11202:2010 with the following modifications.

a) The environmental indicator, K_{2A}, and local environmental factor, K_{3A}, shall be equal to or less than 4 dB.

b) The difference between the background emission sound pressure level and the workstation sound pressure level shall be equal to or greater than 6 dB according to ISO 11202:2010, 6.4.1, accuracy grade 2 (Engineering).

c) The correction of the local environmental factor, K_{3A}, shall be calculated in accordance with ISO 11204:2010, A.2 with the reference restricted to ISO 3746:2010 instead of the method given in ISO 11202:2010, Annex A, or in accordance with ISO 3743-1:2010, ISO 3743-2:1994, ISO 3744:2010 or ISO 3745:2012 where one of these International Standards has been used as the measuring method.

Depending on which grade of measurement is used for the determination of the sound power level (engineering, survey, etc.), the corresponding grade of measurement shall be used to determine the sound pressure level at the operator's position, e.g. for ISO 3746:2010 (survey grade) of sound power, use ISO 11202:2010 for sound pressure. For ISO 3744:2010 (engineering grade) of sound power, use ISO 11201:2010 for sound pressure.

The declaration of noise emission shall be in accordance with 8.3.1 o).

Verification: By checking the relevant documents.

7.3 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.

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

NOTE 2 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 CADES (Chips And Dust Extraction System), 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}).

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).

7.4 Electricity

7.4.1 General

With the exception of 6.3.3, the requirements of IEC 60204-1:2005 apply, unless stated otherwise in this document.

See IEC 60204-1:2005, 6.2 for the requirements regarding prevention of electric shock due to direct contact, and IEC 60204-1:2005, Clause 7 for the requirements regarding protection against short circuits (excluded the part of electric circuit between the machine main switch and the different circuit branches) and overloading.

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 protection against electric shock due to indirect contact [see 8.3.1 t)].

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 8.3.1 u)].

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 EN 60529 and IEC 60529:2013.

Electrical enclosures shall not be exposed to risk from the ejection of tools and work-pieces. Live parts shall not be accessible in accordance with IEC 60204-1:2005, 6.2.2. Fire risk is not present where power circuits are protected against over current in accordance with IEC 60204-1:2005, 7.2.3.

In accordance with IEC 60204-1:2005, 18.2, the test 1 for the continuity of the protective bonding circuit and with IEC 60204-1:2005, 18.6, the functional test apply.

Verification: By checking the relevant drawings and/or circuit diagrams, inspection of the machine and relevant tests (IEC 60204-1:2005, 18.2, test 1 and functional test according to IEC 60204-1:2005, 18.6).

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

7.4.2 Displaceable machines

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

Displaceable machines with connection to three phases shall be fitted with a phase changer.

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

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

7.5 Ergonomics and handling

The machine and its controls 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).

Where necessary on the machine, work stations and the zones in which control devices, guards and protective devices are located shall be illuminated sufficiently to ensure that all work equipment and materials can be properly seen, and that eye strain is also avoided (see EN 1837).

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 60204–1:2005, EN 614–1 and EN 614–2.

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

7.6 Lighting

Where lighting is required as determined by reference to EN 1837, it shall be provided in accordance with the requirements of IEC 60204-1:2005, 15.2 [see also 8.3.1 k)].

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

7.7 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.

7.8 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.

7.9 Electromagnetic compatibility

The machine shall have sufficient immunity to electromagnetic disturbances to enable it to operate correctly in accordance with IEC 61439-1:2011, EN 50370-1:2005 and EN 50370-2:2003.

NOTE Machines which incorporate CE-marked electrical components, and where such components and cabling are installed in accordance with their respective manufacturers 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.

7.10 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 8.3 p).

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

7.11 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.

7.12 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 8.3.

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

7.13 Isolation

The requirements of ISO 12100:2010, 6.3.5.4 and of ISO 14118:2000, Clause 5 apply and in addition, 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 60204-1:2005, 5.3.2.

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; or

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

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 at all times under the control of the person making an intervention on the machine.

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.

7.14 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 8.3).

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 6.5.2.

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.

8 Information for use

8.1 Warning devices

The basic principles of ISO 12100:2010, 6.4.3 shall be observed and in addition, the following.

If the machine is equipped with an electrical brake with electronic control system, the negative result of the periodical test required in 5.5 shall be indicated (e.g. by a yellow warning light positioned in close proximity to the installed location of the stop control device for the corresponding spindle drive motor).

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.

8.2 Marking

8.2.1 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 and in addition, 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 60204-1:2005, 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.

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 847-1:2013.

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.

8.2.2 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, with 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.

8.3 Instruction handbook

8.3.1 General

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

a) The repetition of the markings, pictograms and other instructions on the machine as required in 8.1 and 8.2 and, if necessary, information about their meaning.

b) The intended use of the machine including reasonable foreseeable misuse (examples may be provided in the part of ISO 19085 specific for the machine concerned).

c) Warnings regarding residual risks:

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

      i) the correct choice of 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) an indication that in case of power supply failure, the tool may rotate for more than maximum run-down time (see 6.4.2).

d) Instructions for safe use in accordance with ISO 12100:2010, 6.4.5.1 d). This includes the following:

1) the working floor 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 of suitable personal protective equipment when necessary according to the relevant local legislation, which may 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 of 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 manufacturers' instructions for use, adjustment and repair of tools;

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

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

8) information on how to change the tools;

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

10) not removing any splinters or other part of the work-piece 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) how to isolate the machine from all power sources;

14) instructions for minimizing noise levels including also conditioning and maintenance of the tools and guards positioning;

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

16) 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 to an external chips and dust extraction system at installation.

External chips and dust extraction equipment with fixed installations are dealt within EN 12779.

f) Information regarding the chips and dust equipment 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 stationary machines to the floor and how this is to be done.

h) Minimum and maximum work-piece sizes.

i) The range of tool dimensions which are suitable for the machine.

j) That only sharpened tools shall be used.

k) Instruction that adequate general or localized lighting shall be provided.

l) Information that whenever possible, maintenance shall be only done if the machine is isolated from all energy sources and involuntary restart is prevented.

m) If fitted with a hydraulic or a pneumatic system, the method for the safe dissipation of residual energy (see 7.8 and 7.9).

n) 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.

o) A declaration regarding airborne noise emissions from the machinery, either the actual value or a value established on the basis of measurements made on similar machinery, measured in accordance with the methods given in 7.2.2):

   1) A-weighted emission sound pressure levels at workstations;

   2) A-weighted sound power level emitted by the machinery.

   The declaration shall be accompanied by a statement of the measuring method used and the operating conditions applied during the test and values for associated uncertainty, K, using the dual-number form of declaration in accordance with ISO 4871 as follows:

   4 dB when using ISO 3746:2010 and ISO 11202;

   2 dB when using ISO 3743-1 or ISO 3743-2 or ISO 3744;

   1 dB when using ISO 3745.

   For example, for a sound power level:

   — L_{WA} = XX dB (measured value);

— associated uncertainty K = 4 dB;

— measurement made in accordance with ISO 3746.

If the accuracy of the declared emission values is to be checked, measurements shall be made using the same method and the same operating conditions as those declared.

The noise declaration shall be accompanied by the following statement.

"The figures quoted are emission levels and are not necessarily safe working levels. Whilst there is a correlation between the emission and exposure levels, this cannot be used reliably to determine whether or not further precautions are required. Factors that influence the actual level of exposure of the workforce include the characteristics of the work room and the other sources of noise, etc., i.e. the number of machines and other adjacent processes. Also, the permissible exposure level can vary from country to country. This information, however, will enable the user of the machine to make a better evaluation of the hazard and risk."

Information on noise emission shall also be provided in the sales literature providing performance data of the machine.

p) If fitted with a laser:

1) a 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).

q) 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.

r) 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.

s) 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).

t) Information on how to provide 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).

u) 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 as far as relevant.

v) 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).

w) Information for changing safety-related components with lifetime (T10d according ISO 13849-1) lower than 20 years.

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

8.3.2 Additional information

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

a) instruction for safe use shall also include:

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

   2) work-piece to be adequately supported during machining/feeding using, where necessary, additional support, e.g. for long work-pieces;

b) that where the noise enclosures (if provided) are not interlocked (see 6.6), the noise enclosures shall remain in the closed position as long as possible to ensure the most efficient noise reduction;

c) to stop the machine whilst unattended;

d) information that before manually changing any tool, the spindles shall be stopped, to wait for standstill of all tools and that the unexpected start-up shall be prevented.

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

Annex A
(informative)

Performance level required

This annex gives a quick-view summary of the performance level required (PL_r) for each safety function (see Table A.1). However, for full requirements and detailed explanations, refer to Clauses 5 and 6.

Table A.1 — Safety functions and their PL_r

Area	No.	Safety function/devices	PL_r	Subclause of ISO 19085-1:2017
Start	1	Prevention of unexpected start/restart	c	5.3, 5.8
	2	Interlocking of start with safeguards	c	5.3
	3	Interlocking of powered feed with tool spindle rotation	c	5.3
Stop	4	Normal stop (braking function excluded)	c	5.4.2
	5	Monitoring of the stand-still condition	c	5.4.3
	6	Emergency stop (braking function excluded)	c	5.4.4
Braking	7	Braking function	b/c	5.5
	8	Interlocking of brake release	c	6.4.3
Mode selection	9	Mode selection	c	5.6
Spindle speed	10	Speed indication	b	5.7.1
	11	Incremental speed changing	c	5.7.2
	12	Infinitely variable speed monitoring	c	5.7.3
Controls	13	Manual reset	c	5.9
	14	Enabling	c	5.10
	15	Machine moving parts speed monitoring	c	5.11
	16	Time delay	c	5.12
Safeguards	17	Hold-to-run	c	6.5.3
	18	Two-hand control	c	6.5.4
	19	Interlocking with ESPE	c	6.5.5
	20	Interlocking with PSPE	c	6.5.6
	21	Interlocking of movable guards	c	6.5.2.2
	22	Interlocking with guard locking of movable guards	c	6.5.2.3
Clamping	23	Prevention of unexpected activation of second stage clamping force	c	6.8

Annex B
(normative)

Test for braking function

B.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 8.3).

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.

B.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.

B.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 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.

B.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.

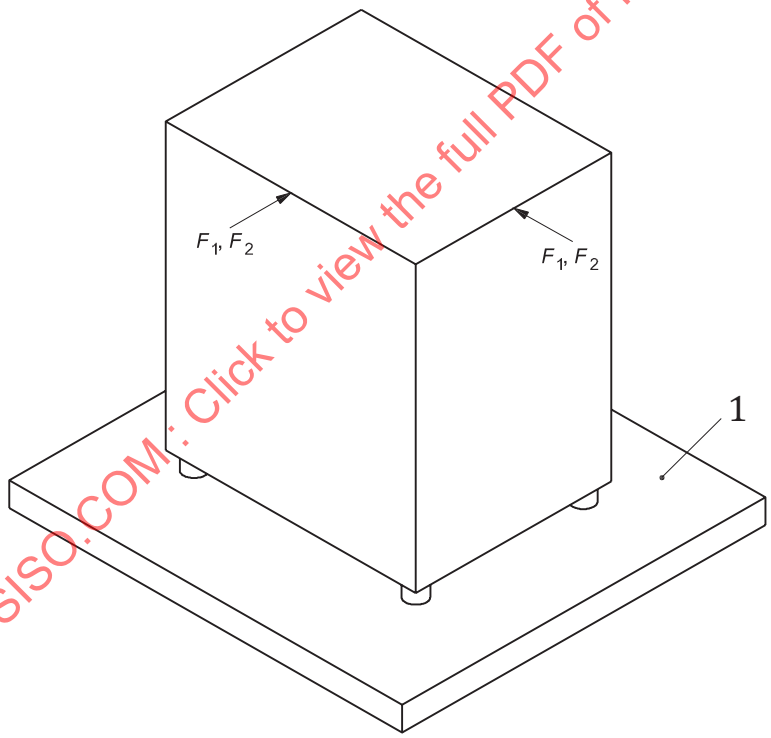
Annex C
(normative)

Stability test for displaceable machines

C.1 Test of stability during machining

The machine 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). A horizontal force, F_1 = 100 N, shall be applied in the plane of work-piece support and in the direction of feed in line with the machine tool. Subsequently, a horizontal force, F_1 = 100 N, is applied in the same plane but in perpendicular direction in the middle of the machine. Under both conditions, the machine shall not move.

The test is repeated with a horizontal force, F_2 = 300 N. The machine shall not tilt.



Key
1 chipboard

Figure C.1 — Stability test for displaceable machines

C.2 Test of stability during transportation

The machine is held in its normal transportation position on a plane inclined at an angle of 10° to the horizontal, the cable or cord wrapped up and stored.

While the machine is rotated slowly through 360°, it shall not tip over.